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Brodie Plat

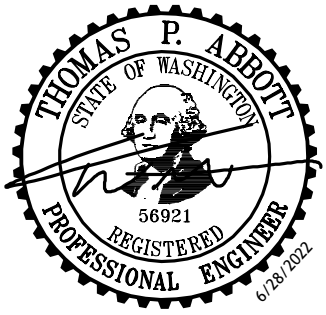
Preliminary Drainage Report

Prepared for

City of Marysville
80 Columbia Ave
Marysville, WA 98270

Prepared by
Nathaniel Martin, EIT

Reviewed by
Tom Abbott, PE



June 2022 ***Job No: C22-177***

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APPENDICES

SECTION 1: PROJECT OVERVIEW

The proposed Brodie Plat project is comprised of parcel numbers 30052500302300, 30052500303800, and 30052500303900, and proposes the construction of 45 single family lots with associated utilities, ROW, and open spaces on a 10.02-acre site. There are frontage improvements proposed on the site along 60th St NE, and access to the site will be from 60th St NE. The site is located within the SW ¼ of the SW ¼ of Section 25, Township 30 N, Range 05 E, W.M. The project address is 8719 60th St NE Marysville, WA 98270. See the Vicinity Map in Appendix 1 for visual representation of the subject property.

Existing Site

The parcel 30052500303800 is currently occupied by a cellular tower in the east and a cargo shipping storage container in the center of the parcel. The shipping container on site will be removed, and the cell tower will remain in Tract 996 with access from the public ROW. The site is bordered to the west by R18 (Multi-Family Medium) zoned land, to the north by Recreation zoned land, and to the south by R6.5 (Single Family High) zoned land. The project parcels are currently zoned Recreation and a rezone to R-18 zoning is proposed for the project site. Existing ground cover is a combination of trees, grass, and gravel.

The proposed development will exist within the bounds of the Onsite Basin and the frontage along 60th St NE. In the existing condition, the site discharges to the onsite wetland and conveyances north and west offsite. See Predeveloped and Developed Hydrology Maps in Appendix 4 for a visual representation of these basins. The project site includes a stream area and wetlands areas that are along the westerly portion of the site. Buffer averaging is proposed.

Site soils are classified as about 27% Norma loam and about 73% Tokul gravelly medial loam (where about 25% is at 0 to 8 percent slopes, about 39% is at 8 to 15 percent slopes, and about 9% is at 15 to 30 percent slopes). See the Soils Map in Appendix 3 for visual layout of soil type areas of the subject property. According to the Marysville topographic map, the existing site slopes are generally sloping from northeast to southwest. Due to till soils present onsite, the Geotechnical Engineer does not recommend infiltration for LID BMPs to be used onsite.

Proposed Development

The proposed Brodie Plat project will develop associated utilities, driveways, ROW, landscaping, and open spaces. Stormwater will be mitigated via a detention and water quality treatment system and bypass basin. Onsite development will disturb 6.46 acres of area that will be collected to the detention vault for mitigation and stormwater quality treatment, while frontage improvements will impact an additional 0.56 acres within the 60th Ave dedicated ROW a portion of onsite ROW that cannot be collected to the detention vault but will be treated for stormwater quality treatment.

Proposed Drainage System

This project is subject to the requirements of the 2014 Stormwater Management Manual for Western Washington (DOE Manual). In compliance with 2014 DOE Manual, all runoff from developed/disturbed surfaces must be collected, treated, and released to natural drainage courses unless it is dispersed or infiltrated.

Proposed pollution generating impervious surfaces (PGIS) will exceed the 5,000 SF threshold and thus basic water quality treatment will be provided via a water quality treatment structure that treats stormwater runoff from roadways and driveways.

The disturbed area of the development is contained within the Onsite Basin and the Bypass Basin. The Onsite Basin consists of onsite developed roof, landscape, sidewalk, pavement and driveway. This project is required to meet flow control requirements which are achieved by a detention vault in the

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northwestern portion of the site. Developed condition stormwater associated with the Onsite Basin will be collected within the detention vault and released directly into Grace Creek, which is located directly south of and parallel to Allen Creek, after treatment in the proposed Perkfilter. Developed condition stormwater associated with the Bypass Basin will be treated by a Perkfilter and dispersed. See Section 4.0 for additional discussion regarding proposed stormwater management and water quality treatment measures.

Erosion/Sedimentation Control
Erosion control measures that will be utilized during construction will include a combination of silt fence, storm drain inlet protection, interceptor swales, and sediment pond. See Section 2.0 for discussion of how SWPPP Elements are addressed.

Minimum Requirements
Per the 2014 DOE, Minimum Requirements 1-9 apply to the proposed development.

Minimum Requirement #1: Preparation of Stormwater Site Plans
A report along with the construction plans, to be submitted at a later date, satisfies the minimum requirement.

Minimum Requirement #2: Construction Stormwater Pollution Prevention
See Section 2 of this Report for the SWPPP BMP Elements, and the SWPPP (submitted as a separate document) for a complete discussion of erosion control BMP's and their use specific to the site.

Minimum Requirement #3: Source of Pollution
Permanent source control BMPs are not applicable for the subject site since the associated activities for the new residence do not fall within the types of facilities listed within Volume IV of the DOE Manual (Residential developments are not required to implement source control BMP's). BMPs for erosion and sedimentation control are specified in the Construction Plans and the SWPPP.

Minimum Requirement #4: Preservation of Natural Drainage Systems and Outfalls
Flow from the site will preserve its natural drainage pattern from the northeast to the southwest. Runoff flows towards Grace Creek, which then eventually discharges into Lake Stevens.

Minimum Requirement #5: On-Site Stormwater Management
The project will exceed the 10,000 SF PGHS threshold and is required to provide an Onsite Stormwater BMP. A detention vault will be installed in the northwestern end of the site and will discharge at a historic, mitigated rate that will be dispersed into native vegetation in Tract 999.

Minimum Requirement #6: Runoff Treatment
As the project will exceed the 5,000 SF threshold of PGHS, the project is required to provide "basic" and "phosphorus" water quality treatment per the 2014 DOE manual. Phosphorus treatment is required as discharge is into a stream. A Perkfilter water quality treatment unit will be installed downstream of the detention vault to meet this requirement and a second Perkfilter unit will be installed along the 60th St NE frontage. Runoff from public ROW facilities will not be treated by the proposed on-site Perkfilter, which will be privately owned and maintained.

Minimum Requirement #7: Flow Control
A detention vault is proposed at the northwestern end of the site to control flows and release at historic, mitigated rates. Please see Section 4.0 for additional flow control modeling and parameters for detention sizing.

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Minimum Requirement #8: Wetlands Protection

Wetlands exist onsite and have been given 100' buffers. Buffer averaging is proposed. The dispersion facility discharges from the Bypass Basin and the detention vault outfall are proposed within the outer 25% of the revised buffer line. Please see sheet RD-01 of the plan set for location information. Wetland areas will not be disturbed during site construction and will be protected with silt fencing and other BMPs throughout construction.

Minimum Requirement #9: Operation and Maintenance

See Operations and Maintenance in Section 6 of this report.

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Appendix 1: Project Overview

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

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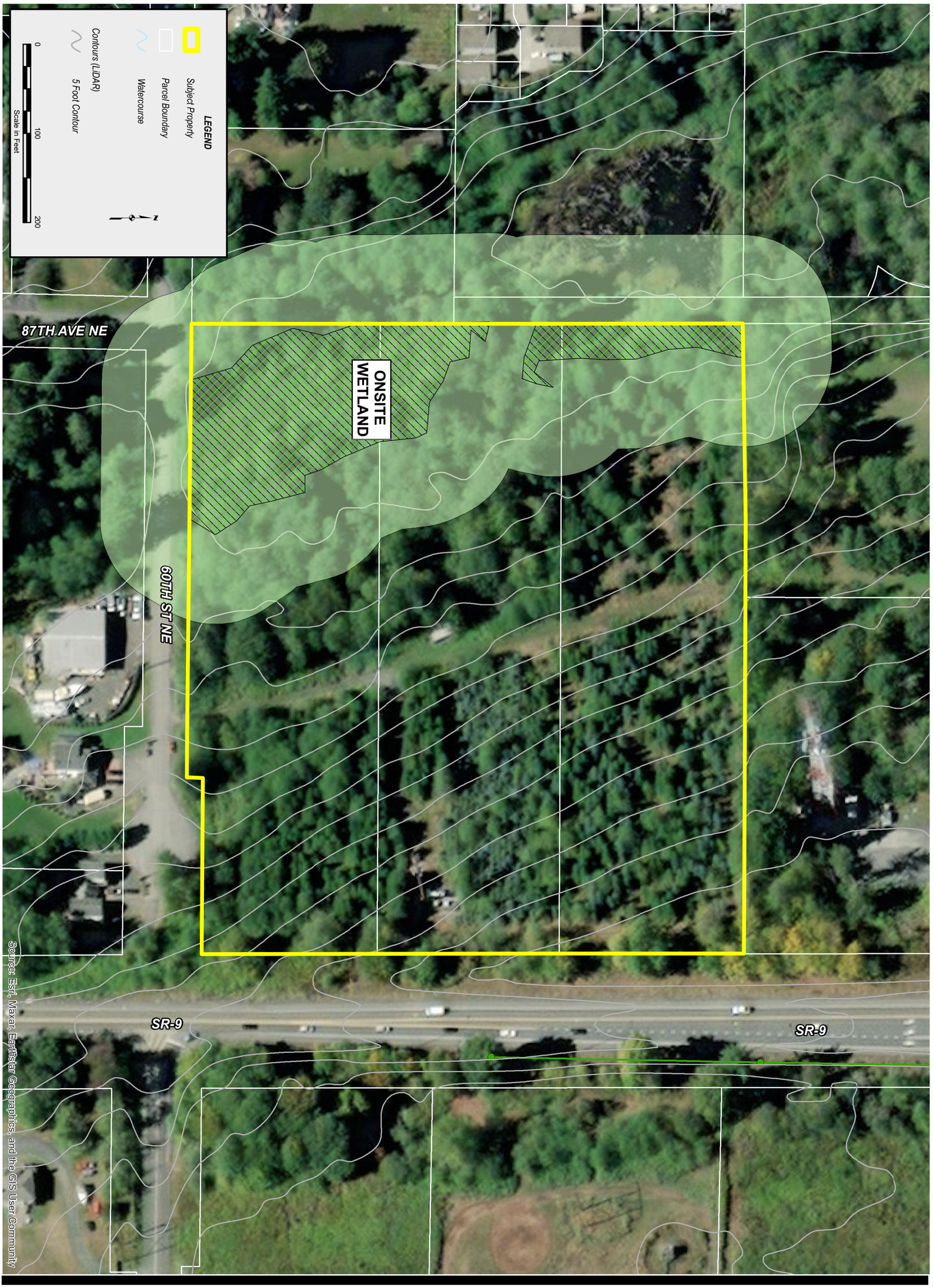

FIGURE: 2.0

NAD 1983 HARN
STATEPLANE WASHINGTON
NORTH FIPS 4601 FEET

REVISION:
JOB NUMBER: C22-177

DESIGNER: TABBOTT
DRAWING BY: TABBOTT
DATE: 6/27/2022
SCALE: AS SHOWN
JURISDICTION: MARYSVILLE

LAND PRO GROUP

BRODIE PLAT

EXISTING CONDITIONS MAP

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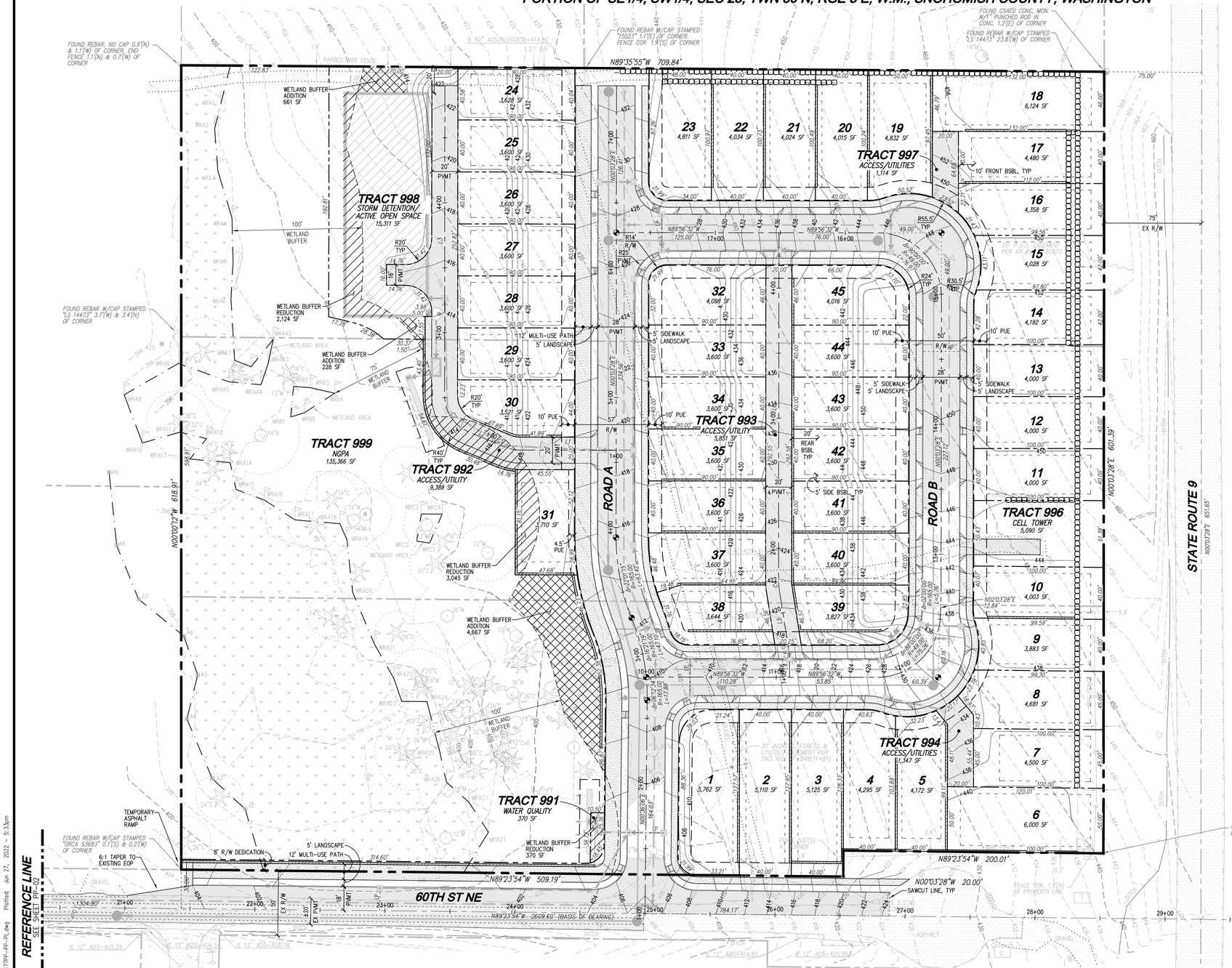
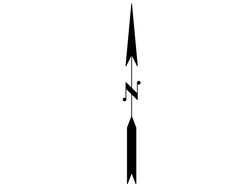
SOURCE INFORMATION

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

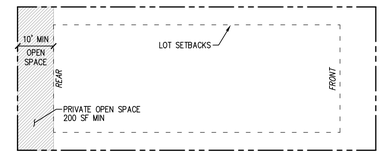
PORTION OF SE1/4, SW1/4, SEC 25, TWN 30 N, RGE 5 E, W.M., SNOHOMISH COUNTY, WASHINGTON





LEGEND

SYMBOL	DESCRIPTION
	TYPE 1 CATCH BASIN, GRATED LID
	TYPE 1 CATCH BASIN, SOLID LID
	TYPE 2 CATCH BASIN, GRATED LID
	TYPE 2 CATCH BASIN, SOLID LID
	STORM PIPE
	CLEANOUT
	DRAIN LINE
	6" PVC FRENCH DRAIN
	SEWER MANHOLE
	SEWER PIPE
	WATER PIPE
	NGPA FENCING
	SIGN ("NO PARKING" UNLESS OTHERWISE NOTED)
	STREET LIGHT
	FULL DEPTH ASPHALT
	2" GRIND AND OVERLAY
	RIP-RAP PAD
	SURVEY MONUMENT



NOTE: PRIVATE OPEN SPACE IS NOT TO BE SEPARATED FROM THE PROPOSED BUILDING BY WALLS.

TYPICAL PRIVATE OPEN SPACE DETAIL

SCALE: 1"=20'

ALLEY CENTERLINE TABLES

LINE TABLE

Line #	Length	Direction
L1	73.89'	N89°56'32"W
L2	20.12'	N67°13'59"W
L3	238.69'	N00°03'28"E
L4	14.64'	N00°03'28"E
L5	49.95'	N08°56'32"W
L6	268.64'	N00°03'28"E

CURVE TABLE

Curve #	Length	Radius	Delta
C4	4.71'	30.00'	09°00'00"
C3	4.71'	30.00'	09°00'00"
C1	11.89'	30.00'	22°42'33"
C2	35.23'	30.00'	67°17'27"

LOT SIZE SUMMARY

LOTS PROPOSED:	45
AVERAGE LOT SIZE:	4,113 SF
SMALLEST LOT SIZE:	3,521 SF (LOT 30)
LARGEST LOT SIZE:	6,421 SF (LOT 19)

ACCESS CALCULATION (PER MMC 22G.080.070(4))

LOTS TO ACCESS FROM AUTOCOURTS:	14 (25–38)
PRD REQUIREMENT FOR NON-STANDARD ACCESS:	25%
PROPOSED NON-STANDARD ACCESS:	14 LOTS/45 TOTAL LOTS=31.1%

WETLAND BUFFER AVERAGING CALCULATIONS

WETLAND BUFFER REDUCTION:	5,539 SF
WETLAND BUFFER ADDITION:	5,556 SF
NET:	17 SF

DENSITY, DIMENSION AND PARKING

Requirement	Allowable under PRD Regulation	Proposed
Density: Dwelling unit/acre	As allowed per the underlying zone	18 DU/AC
Maximum density:	As allowed per the underlying zone or modified through the residential density incentives in Chapter 22C.090 MMC	4.5 DU/AC
Minimum street setback:	10 feet	10 feet
Minimum side yard setback:	5 feet (if no lot line between homes, 10 feet separation required)	5 feet
Minimum rear yard setback:	10 feet (if no lot line between homes, 20 feet separation required)	10 feet
Base height:	As allowed per the underlying zone	30 feet max
Maximum building coverage:	No maximum building coverage	TBD
Maximum impervious surface:	70 percent	70%
Minimum lot area:	3,500 square feet	3,521 SF
Minimum lot width:	30 feet	40 feet
Minimum driveway length:	20 feet	20 feet
Minimum parking:	3 stalls per detached single-family dwelling	135 total•

OPEN SPACE CALCULATIONS

	AC (unless otherwise noted)	SF (unless otherwise noted)
Gross Project Site Area•	10.01	435,992
Net Project Area (NPA)•	6.58	286,707
Req. Open Space (15% NPA)	0.99	43,006
Req. Open Space (65% Critical Area/Buffer Portion)	0.64	27,954
Req. Open Space (35% Active Open Space Portion)	0.35	15,052
Active Open Space Provided (Tract 998)	0.35	15,311
Critical Areas Open Space Provided (Tract 999)	0.64	27,954
Total Open Space Provided	0.99	43,265

PROJECT ZONING DENSITY CALCULATIONS

	DU (unless otherwise noted)	SF (unless otherwise noted)
Gross Project Site Area (AC)•	10.01	435,992
Net Project Area (NPA) (AC)•	6.58	286,707
Base Density	118.47	
Max Density (with Bonus Density) = 120% x Base Density	137.00	
Dwelling Units Proposed	45	
Density Proposed (DU/AC)	4.50	
Bonus Density Required	0	

NET AREA: R-18 ZONING

	AC (unless otherwise noted)	SF (unless otherwise noted)
Gross Parcel Area	10.01	435,992
ROW Dedication	1.77	76,974
Tract 992, 993, 994, 997 (Access and/or Alley Tracts)	0.41	17,701
Wetland Area	1.25	54,610
Total Removal for NPA	3.43	149,285
Net Project Area (NPA)	6.58	286,707
Net Project Density (NPA x 18 DU/AC)	118.47	

UTILITY NOTE

THE CONTRACTOR SHALL VERIFY THE LOCATION OF ALL EXISTING UTILITIES PRIOR TO ANY CONSTRUCTION. AGENCIES INVOLVED SHALL BE NOTIFIED WITHIN A REASONABLE TIME PRIOR TO THE START OF CONSTRUCTION.

DISCLAIMER

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Call 2 Business Days Before You Dig
811 or 1-800-424-5555
Utilities Underground Location Center

REVISIONS

NO.	DATE	DESCRIPTION	BY

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Kent | Olympia
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LAND PRO GROUP, INC.

BRODIE PLAT

PRELIMINARY SITE PLAN

THOMAS P. ABBOTT — STATE OF WASHINGTON — 56921 — REGISTERED PROFESSIONAL ENGINEER

JOB NUMBER:	C22-177
DRAWING NAME:	C22177PP-PP-PL
DESIGNER:	TPA
DRAFTING BY:	DPN
DATE:	
SCALE:	1"=40'
JURISDICTION:	CITY OF MARYSVILLE

PP-01

SHEET 4 OF 5

Drawing: P:\Civil\2022\C22-177 Brodie Plat\Drawings\Preliminary Plat\C22177PP-PP-PL.dwg Plotted: Jun 27, 2022 - 5:33pm

SECTION 2: TEMPORARY EROSION AND SEDIMENT CONTROL DESIGN

SWPPP Design Elements

A Stormwater Pollution Prevention Plan (SWPPP) will be provided prior to construction. The SWPPP report is modeled under the guidelines of Volume II, Section 3 of the 2014 Stormwater Management Manual for Western Washington. Construction SWPPP Elements #1 through #13 are addressed below.

Element #1 – Mark Clearing Limits

All clearing limits will be delineated with high visibility plastic fence and/or silt fence. See sheets ER-01 of the preliminary plans for locations and details.

Element #2 – Establish Construction Access

Stabilized construction accesses will be installed as shown on the preliminary plans. 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 sediment pond located at the northern portion 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, 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

Exposed soils will be stabilized as specified in the Grading and Erosion Control Notes with temporary and permanent seeding, mulching, and plastic covering. See sheet ER-02 of the preliminary plans for notes.

Element #6 – Protect Slopes

Slopes are minor on the subject site. Slopes shall be protected 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 check dams. See sheets ER-01 and ER-02 of the preliminary plans for locations and details.

Element #9 – Control Pollutants

Pollutants shall be controlled as specified in Volume IV of the 2014 DOE Manual—Source Control BMPs to address potential sources of pollution which may exacerbate possible soil/groundwater contamination identified onsite.

Element #10 – Control De-Watering

There will be no de-watering as a part of this project. See sheet ER-02 of the preliminary 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 preliminary plans for the Construction Sequence and notes.

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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 preliminary plans for the Construction Sequence and notes.

Element #13: Protect on-site stormwater management BMPs

On-site stormwater management BMPs used for runoff from roofs and other hard surfaces are not feasible due to soil conditions and proposed project density.

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SECTION 3: DOWNSTREAM ANALYSIS

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. The limits of the downstream analysis extend roughly 0.25 miles beyond the subject property's natural discharge location.

Task 2. Resource Review

All of 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 Allen Creek subbasin, within the Snohomish watershed. Discharge from the proposed development will discharge into Grace Creek, a tributary of Allen Creek, which eventually discharges into Ebey Slough.

Floodplain / Floodway (FEMA) maps

Per FEMA Floodplain map #53061C0736F the subject property is not within a floodplain.

Critical Areas Map

No critical areas have been identified on, or immediately adjacent to, the project site.

Drainage Complaints

No relevant issues were identified near the proposed site.

Road Drainage Problems

No issues were identified near the proposed site.

Soil Survey

Site soils are classified as Norma loam (0 to 3 percent slopes) which is classified as a Hydrologic Soil Group B/D type soil and Tokul gravelly medial loam (0 to 30 percent slopes) which is classified as a Hydrologic Soil Group B type soil.

Wetland Inventory Maps

Wetlands are identified to be on, or immediately adjacent to, the project site. Reference the critical areas report submitted with this report for additional information regarding the wetland areas onsite.

Migrating River Studies

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

Section 303d List of Polluted Waters

Washington State Department of Ecology's Water Quality Assessment for Washington contains listings for the Grace Creek upstream and downstream of the project. Please refer to Appendix 3 for copies of applicable 303(d) listings.

Water Quality Problems

Grace Creek has no listings in the DOE Water Quality Assessment Review tools. However, because Grace Creek is connected and parallel to Allen Creek, which is listed as a category 4A due to bacteria concerns, it can be assumed that Grace Creek has the same or a similar category listing. No water quality problems were identified which would be exacerbated by the proposed development.

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Stormwater Compliance Plans
Not applicable to the proposed project.

Task 3. Field Inspection/Downstream Analysis
On June 27th, 2022, a Downstream Analysis was performed at the site. The weather consisted of 84 ºF and sunny skies. The following observations were verified during the visit.

The subject property areas consist primarily of lawn and forested area. There is a partially developed area in the existing condition with a gravel road leading to a cellular tower in the eastern portion of the site and a steel shipping container in the mid-western portion.

A flow path has been identified flowing from the northeast to the southwest within the threshold discharge area. Runoff flows along 60th St NE to the west for approximately 700 ft to a low point in the road near the intersection of 60th St NE and 87th Ave NE (image 1). Runoff travels north and east where flow is conveyed into Grace Creek, a tributary of Allen Creek. Flow continues north and west underneath 64yth St NE. The combined flow then continues north and west past the ¼-mile boundary of this analysis. See Figure 3.0, "Downstream Analysis Map" in Appendix 3 for a visual representation of current discharge.

A small amount of upstream flow occurs from the west along 60th St NE and upgradient vegetated area to the west (see image 2). This area drains similarly to the wetland low points and conveys north and west. None of this upstream area will be collected or captured by project improvements.

Task 4. Drainage System Description and Problem Descriptions
Based on the information available and all the resources available including visual inspection of the downstream flow path to the ¼-mile boundary, there is no evidence of existing or anticipated downstream drainage problems. All flows are adequately carried through natural channels to Ebey Slough.

Task 5. Mitigation of Existing or Potential Drainage Problems
No evidence of existing or potential problems with downstream drainage conveyance infrastructure was found. Mitigation is not required.

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Appendix 3: Resource Review

1. Figure 3.0 - Downstream Analysis Map
2. Downstream Analysis Photographs
3. USDA Soils Map & Description

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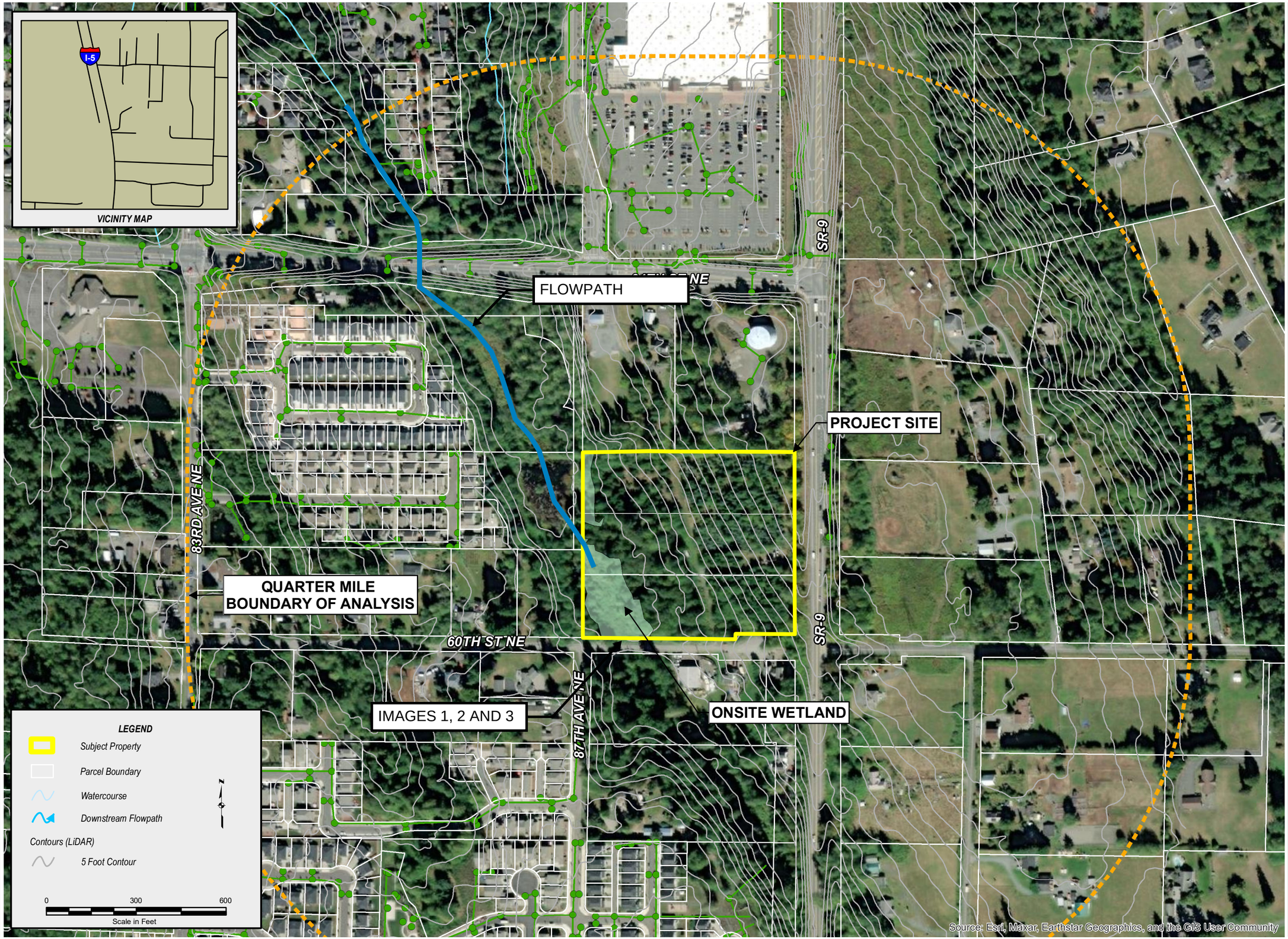

SOURCE INFORMATION

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

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LAND PRO GROUP

BRODIE PLAT

DOWNSTREAM ANALYSIS MAP

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STATEPLANE WASHINGTON
NORTH FIPS 4601 FEET

REVISION:
JOB NUMBER: C22-177

DESIGNER: TABBOTT
DRAWING BY: TABBOTT
DATE: 6/27/2022
SCALE: AS SHOWN
JURISDICTION: MARYSVILLE

FIGURE:
3.0

Downstream Analysis Map.mxd | MOD: 6/27/2022 | tabbott

Downstream Analysis Photographs

Image 1: Low point along 60th St NE. Site runoff drains to this point and flows north and east.

Image 2: Upstream area that flows along 60th St NE to the low point and onto the site wetland area.

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Image 3: Flow travels north and west as wetland flow from this point.

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Soil Map—Snohomish County Area, Washington
(Brodie Plat)

Map Scale: 1:1,660 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 20 40 80 120

Feet
0 50 100 200 300

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

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- 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 23, Aug 31, 2021

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

Date(s) aerial images were photographed: 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	2.6	25.5%
72	Tokul gravelly medial loam, 0 to 8 percent slopes	3.1	30.7%
73	Tokul gravelly medial loam, 8 to 15 percent slopes	3.5	34.6%
74	Tokul gravelly medial loam, 15 to 30 percent slopes	0.9	9.3%
Totals for Area of Interest		**10.1**	**100.0%**

SECTION 4: DETENTION AND WATER QUALITY TREATMENT DESIGN

4.1 Pre-Developed Hydrology/Land Cover

The pre-developed and developed conditions were modeled in WWHM for the purpose of peak flow determination for direct discharge. Based on the site location, the WWHM used the Everett Gage and a Precipitation Scale factor of 1.2.

Onsite Basin:

The predeveloped condition applied to the Onsite and Bypass Basins, modeled as a combined single basin. It does not include the wetland buffer area onsite that will not be disturbed for development. For visual representation of the listed basins, see Figure 4.0, "Predeveloped Hydrology Map". The values as modeled in WWHM are as follows:

Table 1: Predeveloped Conditions: Onsite Basin

Onsite Basin	
Ground Cover	Area (acre)
Forest, mod	1.25
Forest, steep	5.77
Total	**7.02**

4.2 Developed Site Hydrology

In the developed condition, the project will develop 45 single-family lots and associated driveways and utilities. Frontage improvements, including pavement widening and construction of pedestrian facilities, will be constructed along 60th St NE.

In compliance with the 2014 DOE Manual, all runoff from onsite developed/disturbed surfaces will be collected, treated, and discharged directly to existing/historic flow paths.

Onsite Basin:

The developed Onsite Basin is 6.46 acres comprised of a 45 single family lots, open spaces, and ROW. A 70% impervious lot coverage assumption per lot was used. In the developed condition, the Onsite Basin has been modeled using WWHM with the following areas and ground cover designations:

Table 2: Developed Conditions: Onsite Basin

Onsite Basin	
Ground Cover	Area (acre)
Roof tops	2.03
Roads, flat	1.27
Driveway, flat	0.43
Sidewalks, flat	0.44
Pasture, flat	2.29
Total	**6.46**

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Bypass Basin:

The developed Bypass Basin is 0.56 acres and is comprised of proposed frontage improvements along 60th St NE, including pavement widening, planters, and pedestrian accesses along with some onsite ROW area. The Bypass Basin cannot be collected due to topographical constraints. The Bypass Basin was modeled using WWHM with the following areas and ground cover designations:

Table 3: Developed Conditions: Bypass Basin

Bypass Basin	
Ground Cover	Area (acre)
Roads, flat	0.28
Sidewalk, flat	0.17
Pasture, Flat	0.11
Total	**0.56**

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4.3 Detention Facility Design

The proposed detention vault facility used for mitigating developed condition flows was designed in compliance with 2014 DOE 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 Facility

The proposed detention facility detains, and releases collected storm water runoff from the Onsite Basin. The facility is located within Tract 998 in the northwestern corner of the site. Flows from the Onsite Basin are collected and conveyed to the detention vault via a proposed network of catch basins and storm water conveyance pipes. Detailed WWHM output is provided in Appendix 4. A summary of the detailed statistics and inputs used for modeling the system in WWHM2012 can be found below.

Table 4: Detention Vault Design Summary

Detention Vault	
Live Storage Bottom Area (modeled)	*10,200 SF*
Live Storage Bottom Area (provided)	*10,200 SF*
Number of Cells	*3*
Cell Dimensions	*170'x20'*
Begin Live Storage Elevation	400.00
Riser Height	8.00'
Volume (modeled)	81,600 CF
Volume (provided)	81,600 CF
Top of Riser Elevation	408.00
Top Outside of Vault Elevation	409.50

See table below for the flow rates and water surface elevations by storm event for the detention vault.

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Table 5: Flow Rates and Water Surface Elevations by Storm Event

Storm Event	Predeveloped Rate (cfs)	Mitigated Rates (cfs)	Water Surface Elevation (ft)
2-Year	0.3493	0.3506	405.84
10-Year	0.7553	0.5658	407.24
50-Year	1.2984	0.8068	407.94
100-Year	1.5948	0.9260	407.97

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4.4 Water Quality Treatment

Perkfilter-1

Water Quality Treatment for the Onsite Basin is accomplished through a Perkfilter structure located downstream of the detention vault. A summary of design criteria is provided below:

Table 6: Perkfilter-1 Design Summary

Perkfilter-1	
Tributary Area	*6.46 AC*
Tributary PGIS Area	*1.70 AC*
Water Quality Flow Rate (2 yr mitigated peak)	0.3506 cfs
Number of Cartridges	14
Cartridge Height	12″
Internal Drop	1.7′
Peak Flow Rate	0.9260 cfs
Peak Flow Storm Event	100-year

Perkfilter-2

Water Quality Treatment for the Bypass Basin is accomplished through a Perkfilter structure located in Tract 991. The perkfilter treats all stormwater that cannot be collected by the detention vault prior to discharge. A summary of design criteria is provided below:

Table 7: Perkfilter-2 Design Summary

Perkfilter-2	
Tributary Area	*0.56 AC*
Tributary PGIS Area	*0.28 AC*
Water Quality Flow Rate	0.0482 cfs
Number of Cartridges	3
Cartridge Height	18″
Internal Drop	2.3′
Peak Flow Rate	0.6283 cfs
Peak Flow Storm Event	100-year

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Appendix 4: Detention and Water Quality Design Analysis

1. Figure 4.0: Predeveloped Hydrology Map
2. Figure 5.0: Developed Hydrology Map
3. Perkfilter Details
4. WWHM2012 Output – Detention Vault
5. WWHM2012 Output – Perkfilter-2 Modeling (Bypass Basin)

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PREDEVELOPED BASIN AREAS

ONSITE BASIN	
FOREST	7.02 AC
TOTAL =	7.02 AC

SOURCE INFORMATION

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

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BRODIE PLAT

PREDEVELOPED HYDROLOGY MAP MAP

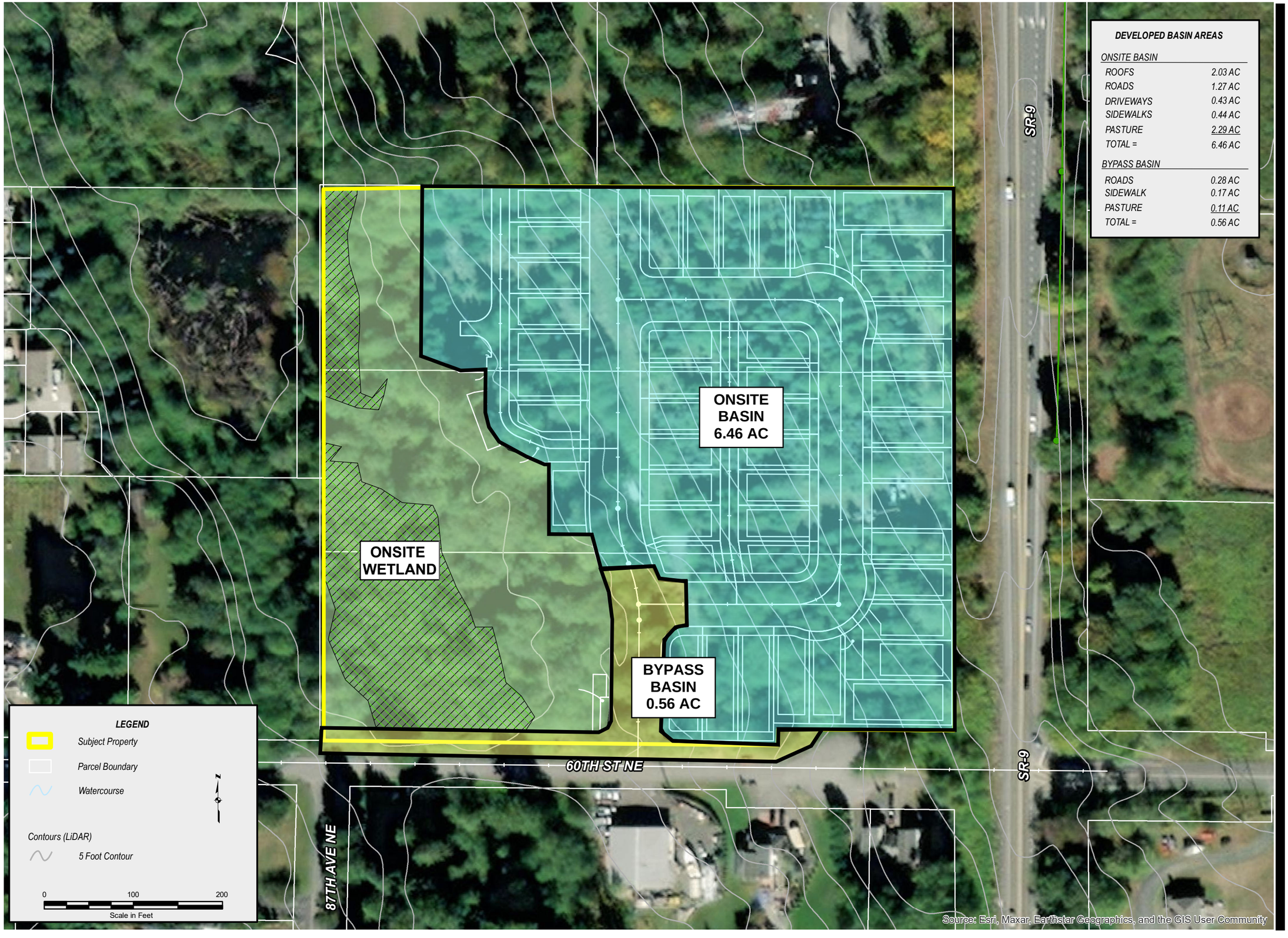
NAD 1983 HARN
STATEPLANE WASHINGTON
NORTH FIPS 4601 FEET

REVISION:
JOB NUMBER: C22-177

DESIGNER: TABBOTT
DRAWING BY: TABBOTT
DATE: 6/27/2022
SCALE: AS SHOWN
JURISDICTION: MARYSVILLE

FIGURE:
4.0

Predeveloped Hydrology Map.mxd | MOD: 6/27/2022 | tabbott



DEVELOPED BASIN AREAS

ONSITE BASIN	
ROOFS	2.03 AC
ROADS	1.27 AC
DRIVEWAYS	0.43 AC
SIDEWALKS	0.44 AC
PASTURE	2.29 AC
TOTAL =	6.46 AC
BYPASS BASIN	
ROADS	0.28 AC
SIDEWALK	0.17 AC
PASTURE	0.11 AC
TOTAL =	0.56 AC

SOURCE INFORMATION

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

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LAND PRO GROUP

BRODIE PLAT

DEVELOPED HYDROLOGY MAP

NAD 1983 HARN
STATEPLANE WASHINGTON
NORTH FIPS 4601 FEET

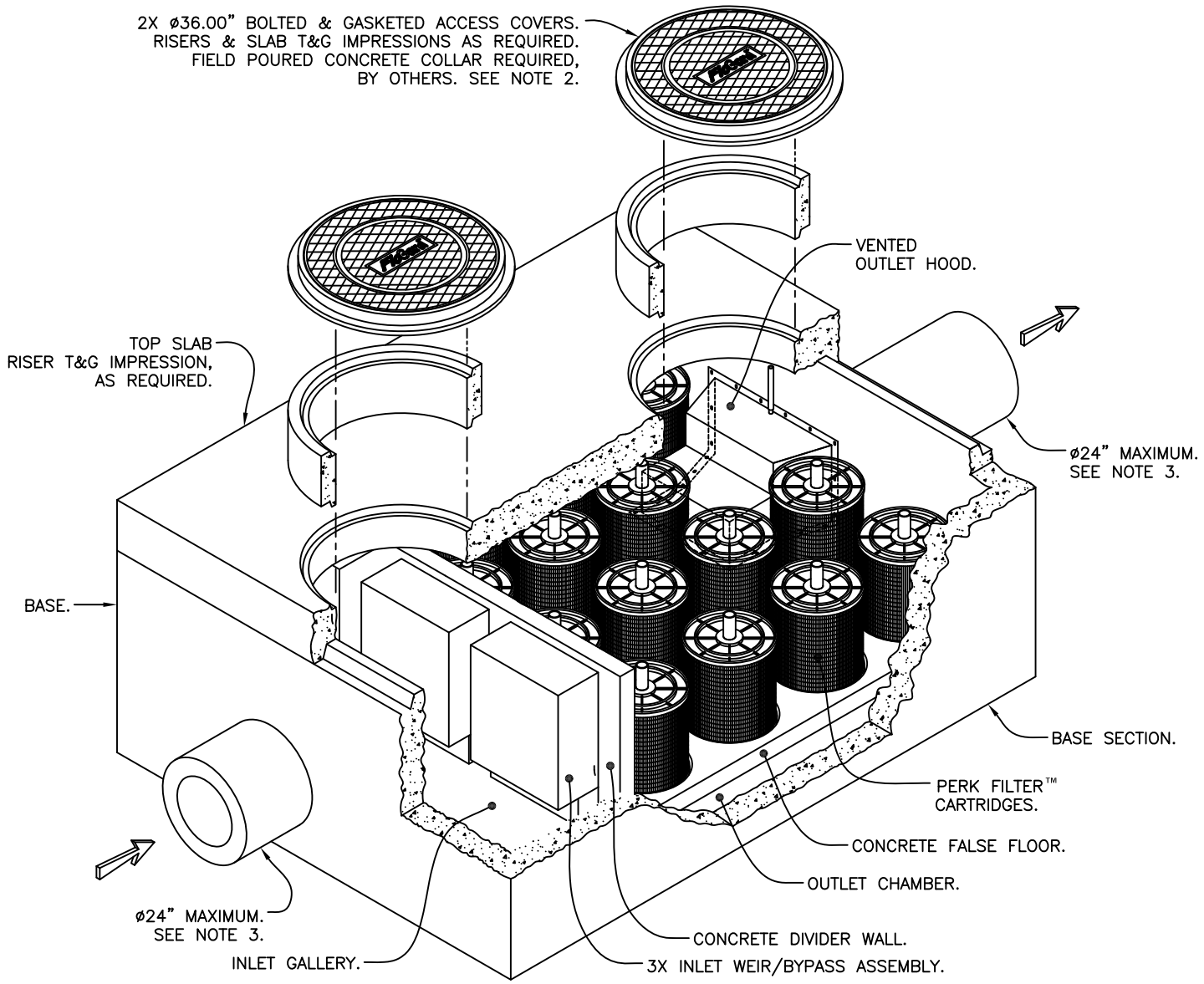
REVISION:
JOB NUMBER: C22-177

DESIGNER: TABBOTT
DRAWING BY: TABBOTT
DATE: 6/28/2022
SCALE: AS SHOWN
JURISDICTION: MARYSVILLE

FIGURE:
5.0

Developed Hydrology Map.mxd | MOD: 6/28/2022 | tabbott

PF-V-8-0001



Notes:

1. Precast concrete structure shall be manufactured in accordance with ASTM Designation C857 and C858.
2. Filter system shall be supplied with traffic rated (H20) bolted & gasketed Ø36" circular access covers with risers as required. Shallow applications may require configurations with (H20) bolted & gasketed square/rectangular access hatches. Field poured concrete collars required, by others.
3. Inlet & outlet pipe(s) (Ø 24" maximum) may enter device on all three sides of the inlet & outlet chambers respectively.
4. Inlet chamber shall be supplied with a drain-down device designed to remove standing water between storm events.
5. For depths less than specified minimums contact Oldcastle® Stormwater Solutions for engineering assistance.

Media Filtration

PerkFilter™

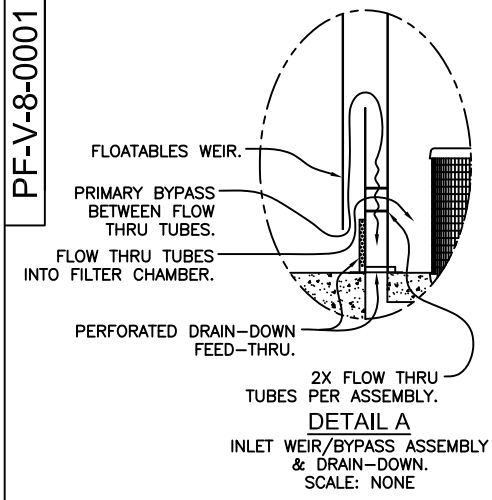
8' Wide Concrete Vault

Sixteen to Thirty Four Cartridges / Stacks

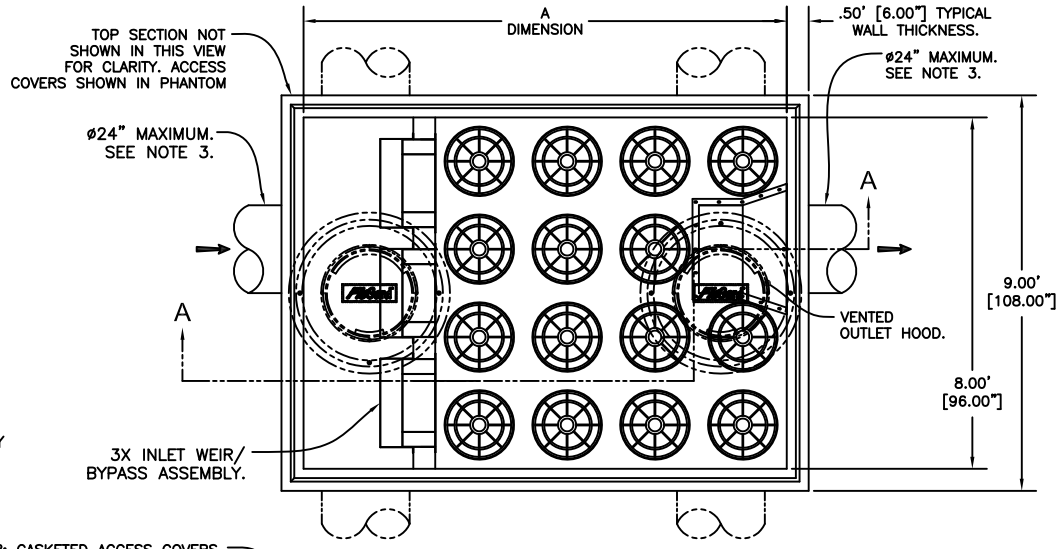
Oldcastle Infrastructure™
A CRH COMPANY

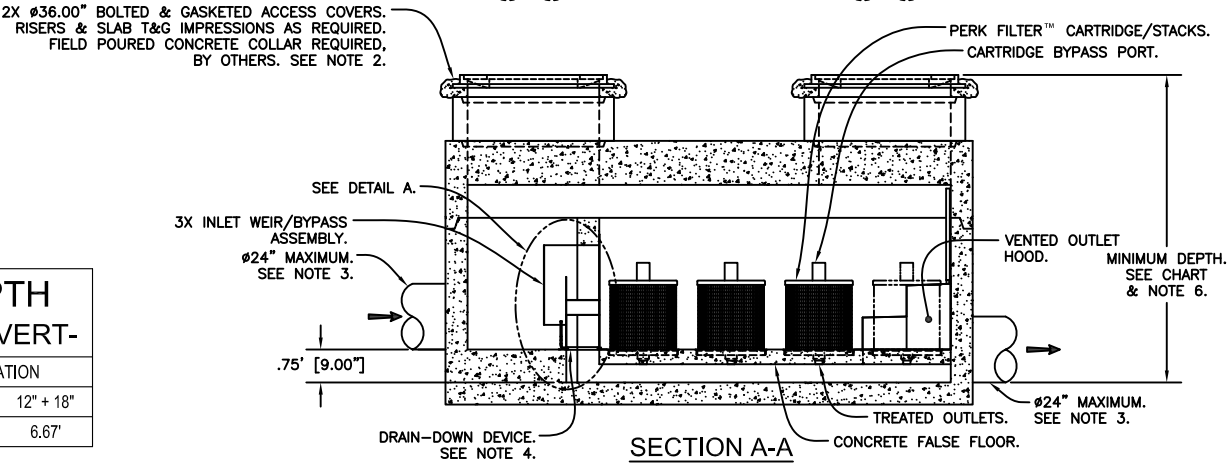
DRAWING NO.	REV	DATE	
PF-V-8-0001	F	MJT 6/17/20	SHEET 1 OF 2

PF-V-8-0001



DETAIL A
INLET WEIR/BYPASS ASSEMBLY & DRAIN–DOWN.
SCALE: NONE





SECTION A-A

MINIMUM DEPTH
-RIM TO OUTLET INVERT-

CARTRIDGE STACK CONFIGURATION			
12"	18"	12" + 12"	12" + 18"
4.25'	5.00'	5.92'	6.67'

8' VAULT
TREATMENT FLOW RATES, TOTAL FLOW CAPACITIES & MAXIMUM HEAD LOSS

CARTRIDGE STACK QUANTITY	A DIMENSION -LENGTH- (ID - FT)	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)
14	12	168 / 0.37	8.8	252 / 0.56	13.0	336 / 0.75	14.9	420 / 0.94	19.9
15	12	180 / 0.40	8.8	270 / 0.60	13.1	360 / 0.80	15.0	450 / 1.00	19.9
16	12	192 / 0.43	8.8	288 / 0.64	13.1	384 / 0.86	15.0	480 / 1.07	20.0
17	12	204 / 0.45	8.9	306 / 0.68	13.2	408 / 0.91	15.1	510 / 1.14	20.1
18	12	216 / 0.48	8.9	324 / 0.72	13.2	432 / 0.96	15.1	540 / 1.20	20.1
19	16	228 / 0.51	8.9	342 / 0.76	13.2	456 / 1.02	15.2	570 / 1.27	20.2
20	16	240 / 0.53	8.9	360 / 0.80	13.3	480 / 1.07	15.2	600 / 1.34	20.3
21	16	252 / 0.56	9.0	378 / 0.84	13.3	504 / 1.12	15.3	630 / 1.40	20.3
22	16	264 / 0.59	9.0	396 / 0.88	13.4	528 / 1.18	15.3	660 / 1.47	20.4
23	16	276 / 0.61	9.0	414 / 0.92	13.4	552 / 1.23	15.4	690 / 1.54	20.5
24	16	288 / 0.64	9.0	432 / 0.96	13.4	576 / 1.28	15.4	720 / 1.60	20.5
25	16	300 / 0.67	9.1	450 / 1.00	13.5	600 / 1.34	15.5	750 / 1.67	20.6
26	16	312 / 0.70	9.1	468/ 1.04	13.5	624 / 1.39	15.5	780 / 1.74	20.7
27	16	324 / 0.72	9.1	486 / 1.08	13.6	648 / 1.44	15.6	810 / 1.80	20.7
28	16	336 / 0.75	9.2	504 / 1.12	13.6	672 / 1.50	15.6	840 / 1.87	20.8
29	20	348 / 0.78	9.2	522 / 1.16	13.6	696 / 1.55	15.7	870 / 1.94	20.9
30	20	360 / 0.80	9.2	540 / 1.20	13.7	720 / 1.60	15.7	900 / 2.01	20.9
31	20	372 / 0.83	9.2	558 / 1.24	13.7	744 / 1.66	15.8	930 / 2.07	21.0
32	20	384 / 0.86	9.3	576 / 1.28	13.8	768 / 1.71	15.8	960 / 2.14	21.1
33	20	396 / 0.88	9.3	594 / 1.32	13.8	792 / 1.76	15.9	990 / 2.21	21.1
34	20	408 / 0.91	9.3	612 / 1.36	13.8	816 / 1.82	15.9	1020 / 2.27	21.2
MAXIMUM HEAD LOSS		1.7 FT		2.3 FT		2.9 FT		3.5 FT	

Media Filtration

PerkFilter™

8' Wide Concrete Vault

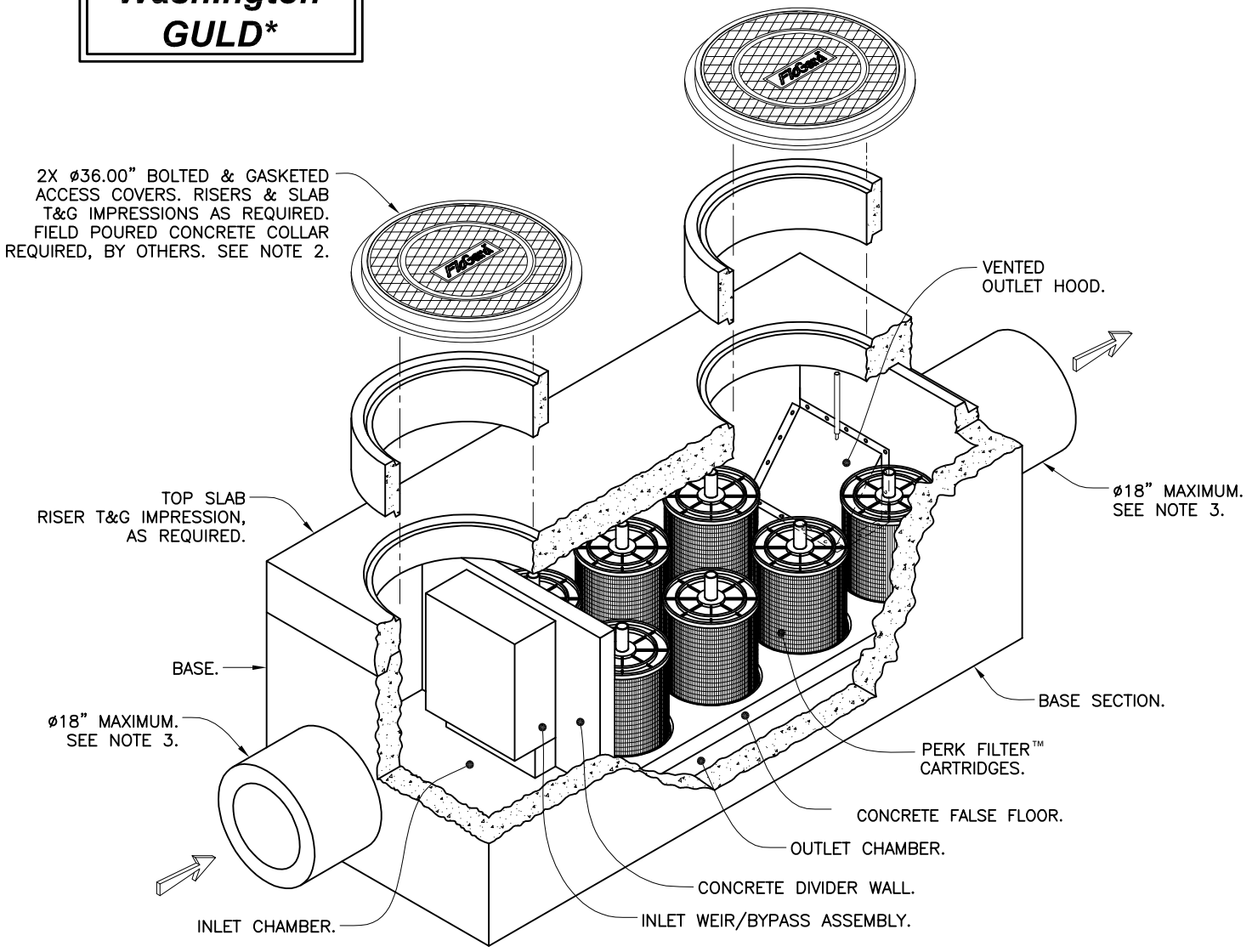
Sixteen to Thirty Four Cartridges / Stacks

Oldcastle Infrastructure™
A CRH COMPANY

DRAWING NO.	REV	DATE	
PF-V-8-0001	F	MJT 6/17/20	SHEET 2 OF 2

PF-V-4-WA-0001

Washington GULD*



Notes:

1. Precast concrete structure shall be manufactured in accordance with ASTM Designation C857 and C858.
2. Filter system shall be supplied with traffic rated (H20) bolted & gasketed Ø36" circular access covers with risers as required. Shallow applications may require configurations with (H20) bolted & gasketed square/rectangular access hatches. Field poured concrete collars required, by others.
3. Inlet & outlet pipe(s) (Ø 18" maximum) may enter device on all three sides of the inlet & outlet chambers respectively.
4. Inlet chamber shall be supplied with a drain-down device designed to remove standing water between storm events.
5. 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™

4' Wide Concrete Vault

Washington State GULD

Three to Seven Cartridges / Stacks

Oldcastle® Stormwater Solutions

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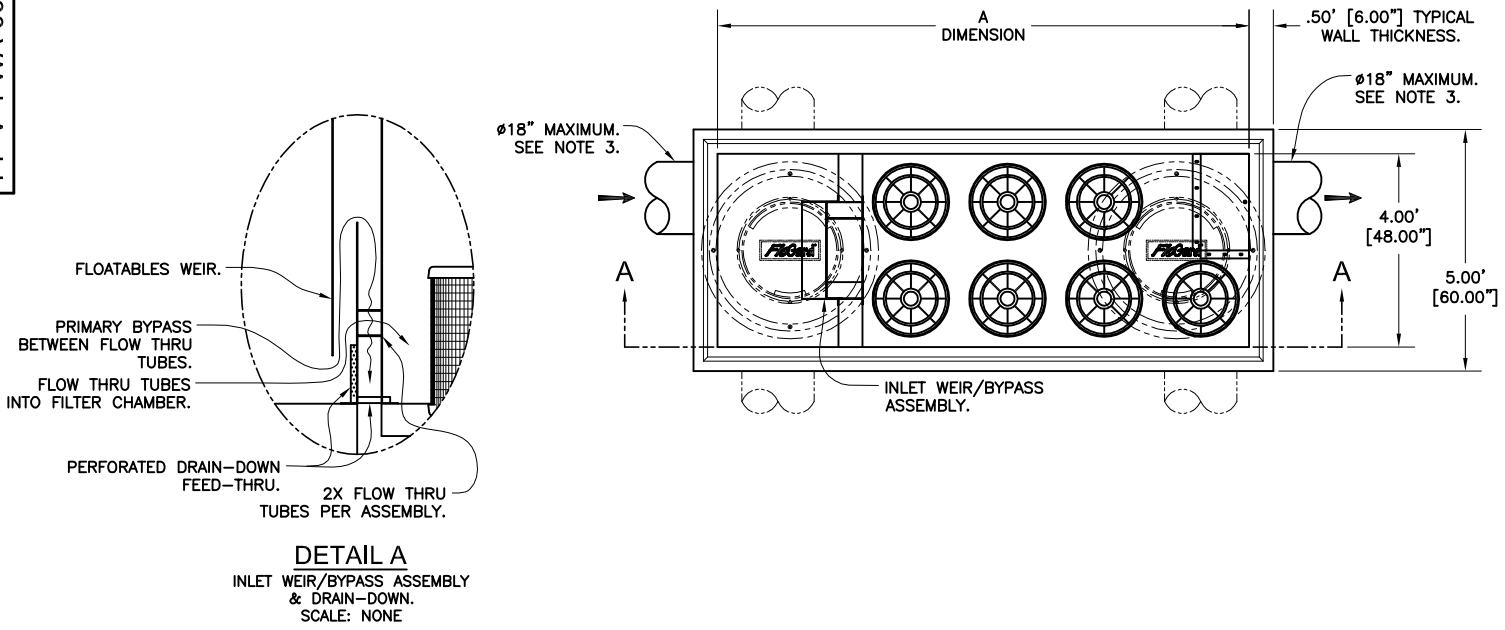
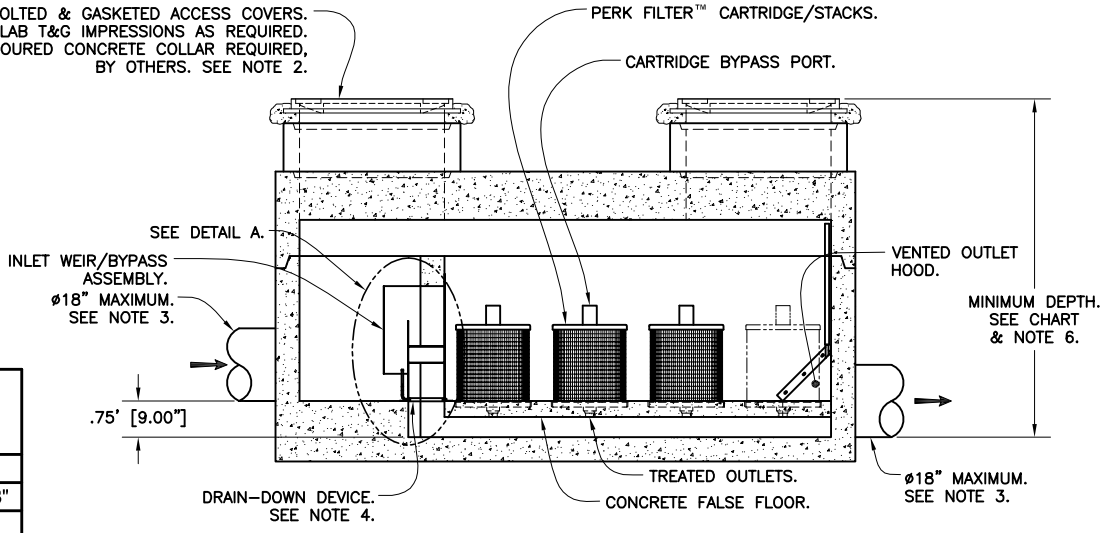
DRAWING NO.	REV	ECO	DATE	
PF-V-4-WA-0001	D	ECO-0122 JPR 10/3/14	JPR 3/2/11	SHEET 1 OF 2

PF-V-4-WA-0001



DETAIL A
INLET WEIR/BYPASS ASSEMBLY
& DRAIN–DOWN.
SCALE: NONE



SECTION A-A

Washington GULD*

MINIMUM DEPTH - RIM TO OUTLET INVERT -			
CARTRIDGE STACK CONFIGURATION			
12"	18"	12" + 12"	12" + 18"
4.25' [51.00"]	5.00' [60.00"]	5.92' [71.00"]	6.67' [80.00"]

4' VAULT
TREATMENT FLOW RATES, TOTAL FLOW CAPACITIES & MAXIMUM HEAD LOSS

CARTRIDGE STACK QUANTITY	A DIMENSION - LENGTH - (ID-FEET)	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)
3	7	20.4 / 0.045	2.9	30.6 / 0.068	4.3	40.8 / 0.091	5.0	51.0 / 0.114	6.7
4	9	27.2 / 0.061	2.9	40.8 / 0.091	4.4	54.4 / 0.121	5.0	68.0 / 0.152	6.8
5	9	34.0 / 0.076	2.9	51.0 / 0.114	4.4	68.0 / 0.152	5.1	85.0 / 0.190	6.8
6	11	40.8 / 0.091	3.0	61.2 / 0.136	4.5	81.6 / 0.182	5.1	102.0 / 0.227	6.9
7	11	47.6 / 0.106	3.0	71.4 / 0.159	4.5	95.2 / 0.212	5.2	119.0 / 0.265	7.0
MAXIMUM HEAD LOSS		1.7 FEET		2.3 FEET		2.9 FEET		3.5 FEET	

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

Media Filtration

Perk Filter™

4' Wide Concrete Vault

Washington State GULD

Three to Seven Cartridges / Stacks

Oldcastle® Stormwater Solutions

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DRAWING NO.	REV	ECO	DATE	
PF-V-4-WA-0001	D	ECO–0122 JPR 10/3/14	JPR 3/2/11	SHEET 2 OF 2

WWHM2012
PROJECT REPORT

Project Name: Updated Preliminary Sizing_20220622
Site Name:
Site Address:
City :
Report Date: 6/22/2022
Gage : Everett
Data Start : 1948/10/01
Data End : 2009/09/30
Precip Scale: 1.20
Version Date: 2018/10/10
Version : 4.2.16

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
Bypass: No

GroundWater: No

Pervious Land Use	acre
C, Forest, Mod	1.25
C, Forest, Steep	5.77
Pervious Total	7.02

Impervious Land Use	acre
Impervious Total	0
Basin Total	7.02

Element Flows To:

Surface	Interflow	Groundwater

MITIGATED LAND USE

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Name : Bypass Basin
Bypass: Yes

GroundWater: No

Pervious Land Use	acre
C, Pasture, Flat	.11
Pervious Total	**0.11**

Impervious Land Use	acre
ROADS FLAT	0.28
SIDEWALKS FLAT	0.17
Impervious Total	**0.45**
Basin Total	**0.56**

Element Flows To:

Surface	Interflow	Groundwater

Name : Onsite Basin
Bypass: No

GroundWater: No

Pervious Land Use	acre
C, Pasture, Flat	1.87
Pervious Total	**1.87**

Impervious Land Use	acre
ROADS FLAT	1.27
ROOF TOPS FLAT	2.45
DRIVEWAYS FLAT	0.43
SIDEWALKS FLAT	0.44
Impervious Total	**4.59**
Basin Total	**6.46**

Element Flows To:

Surface	Interflow	Groundwater
Vault 1	Vault 1	

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Name : Vault 1
Width : 60 ft.
Length : 170 ft.
Depth: 9 ft.
Discharge Structure
Riser Height: 8 ft.
Riser Diameter: 18 in.
Notch Type: Rectangular
Notch Width: 0.010 ft.
Notch Height: 2.000 ft.
Orifice 1 Diameter: 1.8125 in. **Elevation:** 0 ft.
Orifice 2 Diameter: 1.75 in. **Elevation:** 3.95 ft.
Orifice 3 Diameter: 2 in. **Elevation:** 4.4 ft.

Element Flows To:
Outlet 1 **Outlet 2**

Vault Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.234	0.000	0.000	0.000
0.1000	0.234	0.023	0.028	0.000
0.2000	0.234	0.046	0.039	0.000
0.3000	0.234	0.070	0.048	0.000
0.4000	0.234	0.093	0.056	0.000
0.5000	0.234	0.117	0.063	0.000
0.6000	0.234	0.140	0.069	0.000
0.7000	0.234	0.163	0.074	0.000
0.8000	0.234	0.187	0.079	0.000
0.9000	0.234	0.210	0.084	0.000
1.0000	0.234	0.234	0.089	0.000
1.1000	0.234	0.257	0.093	0.000
1.2000	0.234	0.281	0.097	0.000
1.3000	0.234	0.304	0.101	0.000
1.4000	0.234	0.327	0.105	0.000
1.5000	0.234	0.351	0.109	0.000
1.6000	0.234	0.374	0.112	0.000
1.7000	0.234	0.398	0.116	0.000
1.8000	0.234	0.421	0.119	0.000
1.9000	0.234	0.444	0.122	0.000
2.0000	0.234	0.468	0.126	0.000
2.1000	0.234	0.491	0.129	0.000
2.2000	0.234	0.515	0.132	0.000
2.3000	0.234	0.538	0.135	0.000
2.4000	0.234	0.562	0.138	0.000
2.5000	0.234	0.585	0.141	0.000
2.6000	0.234	0.608	0.143	0.000
2.7000	0.234	0.632	0.146	0.000
2.8000	0.234	0.655	0.149	0.000
2.9000	0.234	0.679	0.151	0.000
3.0000	0.234	0.702	0.154	0.000
3.1000	0.234	0.725	0.157	0.000

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3.2000	0.234	0.749	0.159	0.000
3.3000	0.234	0.772	0.161	0.000
3.4000	0.234	0.796	0.164	0.000
3.5000	0.234	0.819	0.166	0.000
3.6000	0.234	0.843	0.169	0.000
3.7000	0.234	0.866	0.171	0.000
3.8000	0.234	0.889	0.173	0.000
3.9000	0.234	0.913	0.176	0.000
4.0000	0.234	0.936	0.196	0.000
4.1000	0.234	0.960	0.212	0.000
4.2000	0.234	0.983	0.224	0.000
4.3000	0.234	1.006	0.234	0.000
4.4000	0.234	1.030	0.242	0.000
4.5000	0.234	1.053	0.285	0.000
4.6000	0.234	1.077	0.306	0.000
4.7000	0.234	1.100	0.324	0.000
4.8000	0.234	1.124	0.340	0.000
4.9000	0.234	1.147	0.355	0.000
5.0000	0.234	1.170	0.368	0.000
5.1000	0.234	1.194	0.381	0.000
5.2000	0.234	1.217	0.393	0.000
5.3000	0.234	1.241	0.404	0.000
5.4000	0.234	1.264	0.415	0.000
5.5000	0.234	1.287	0.426	0.000
5.6000	0.234	1.311	0.436	0.000
5.7000	0.234	1.334	0.446	0.000
5.8000	0.234	1.358	0.456	0.000
5.9000	0.234	1.381	0.465	0.000
6.0000	0.234	1.405	0.474	0.000
6.1000	0.234	1.428	0.484	0.000
6.2000	0.234	1.451	0.495	0.000
6.3000	0.234	1.475	0.505	0.000
6.4000	0.234	1.498	0.516	0.000
6.5000	0.234	1.522	0.527	0.000
6.6000	0.234	1.545	0.538	0.000
6.7000	0.234	1.568	0.550	0.000
6.8000	0.234	1.592	0.560	0.000
6.9000	0.234	1.615	0.571	0.000
7.0000	0.234	1.639	0.582	0.000
7.1000	0.234	1.662	0.594	0.000
7.2000	0.234	1.686	0.605	0.000
7.3000	0.234	1.709	0.617	0.000
7.4000	0.234	1.732	0.629	0.000
7.5000	0.234	1.756	0.656	0.000
7.6000	0.234	1.779	0.669	0.000
7.7000	0.234	1.803	0.683	0.000
7.8000	0.234	1.826	0.697	0.000
7.9000	0.234	1.849	0.710	0.000
8.0000	0.234	1.873	0.724	0.000
8.1000	0.234	1.896	1.233	0.000
8.2000	0.234	1.920	2.142	0.000
8.3000	0.234	1.943	3.245	0.000
8.4000	0.234	1.966	4.382	0.000
8.5000	0.234	1.990	5.395	0.000
8.6000	0.234	2.013	6.163	0.000

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8.7000	0.234	2.037	6.661	0.000
8.8000	0.234	2.060	7.113	0.000
8.9000	0.234	2.084	7.503	0.000
9.0000	0.234	2.107	7.873	0.000
9.1000	0.234	2.130	8.224	0.000
9.2000	0.000	0.000	8.561	0.000

ANALYSIS RESULTS

Stream Protection Duration

Predeveloped Landuse Totals for POC #1
Total Pervious Area:7.02
Total Impervious Area:0

Mitigated Landuse Totals for POC #1
Total Pervious Area:1.98
Total Impervious Area:5.04

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.349321
5 year	0.569536
10 year	0.755334
25 year	1.042281
50 year	1.298394
100 year	1.594767

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0.350572
5 year	0.472894
10 year	0.565817
25 year	0.697604
50 year	0.806799
100 year	0.925958

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

Year	Predeveloped	Mitigated
1949	0.378	0.335
1950	0.427	0.380
1951	0.305	0.342
1952	0.285	0.307
1953	0.251	0.365
1954	1.307	0.476
1955	0.434	0.349

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1956	0.359	0.280
1957	0.484	0.382
1958	1.173	0.640
1959	0.316	0.319
1960	0.339	0.324
1961	1.425	0.822
1962	0.353	0.344
1963	0.580	0.413
1964	0.409	0.248
1965	0.254	0.251
1966	0.180	0.254
1967	0.356	0.572
1968	0.440	0.362
1969	1.139	0.608
1970	0.226	0.277
1971	0.407	0.329
1972	0.287	0.469
1973	0.245	0.356
1974	0.684	0.440
1975	0.302	0.349
1976	0.255	0.321
1977	0.223	0.287
1978	0.241	0.262
1979	0.699	0.456
1980	0.330	0.270
1981	0.238	0.271
1982	0.326	0.388
1983	0.592	0.323
1984	0.294	0.349
1985	0.403	0.413
1986	0.899	0.733
1987	0.394	0.484
1988	0.237	0.292
1989	0.298	0.305
1990	0.271	0.281
1991	0.290	0.283
1992	0.243	0.311
1993	0.241	0.264
1994	0.207	0.282
1995	0.294	0.315
1996	0.618	0.371
1997	1.100	1.173
1998	0.205	0.381
1999	0.239	0.243
2000	0.209	0.553
2001	0.090	0.268
2002	0.274	0.240
2003	0.216	0.278
2004	0.354	0.543
2005	0.263	0.275
2006	0.774	0.430
2007	0.618	0.383
2008	0.800	0.721
2009	0.244	0.299

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

Rank	Predeveloped	Mitigated
1	1.4250	1.1733
2	1.3069	0.8215
3	1.1733	0.7333
4	1.1387	0.7210
5	1.1001	0.6397
6	0.8990	0.6083
7	0.7999	0.5717
8	0.7738	0.5527
9	0.6993	0.5427
10	0.6839	0.4843
11	0.6183	0.4758
12	0.6182	0.4686
13	0.5921	0.4557
14	0.5798	0.4403
15	0.4840	0.4304
16	0.4401	0.4134
17	0.4342	0.4126
18	0.4267	0.3884
19	0.4088	0.3831
20	0.4070	0.3821
21	0.4026	0.3810
22	0.3942	0.3803
23	0.3784	0.3709
24	0.3595	0.3646
25	0.3556	0.3622
26	0.3540	0.3558
27	0.3528	0.3495
28	0.3393	0.3491
29	0.3298	0.3487
30	0.3261	0.3444
31	0.3162	0.3415
32	0.3053	0.3355
33	0.3016	0.3293
34	0.2978	0.3239
35	0.2939	0.3227
36	0.2935	0.3212
37	0.2899	0.3186
38	0.2867	0.3153
39	0.2846	0.3113
40	0.2743	0.3075
41	0.2709	0.3052
42	0.2631	0.2991
43	0.2550	0.2919
44	0.2538	0.2872
45	0.2508	0.2828
46	0.2455	0.2820
47	0.2443	0.2813
48	0.2430	0.2799
49	0.2414	0.2784
50	0.2406	0.2769
51	0.2390	0.2752

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52	0.2383	0.2705
53	0.2374	0.2696
54	0.2262	0.2680
55	0.2228	0.2637
56	0.2165	0.2622
57	0.2087	0.2544
58	0.2075	0.2512
59	0.2047	0.2482
60	0.1803	0.2425
61	0.0896	0.2395

Stream Protection Duration
POC #1
The Facility PASSED

The Facility PASSED.

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.1747	11650	11738	100	Pass
0.1860	9396	7828	83	Pass
0.1974	7704	5985	77	Pass
0.2087	6256	4616	73	Pass
0.2201	5005	3617	72	Pass
0.2314	4096	2928	71	Pass
0.2428	3335	2342	70	Pass
0.2541	2742	1862	67	Pass
0.2655	2301	1555	67	Pass
0.2768	1943	1369	70	Pass
0.2882	1653	1222	73	Pass
0.2995	1445	1122	77	Pass
0.3109	1240	1023	82	Pass
0.3222	1069	935	87	Pass
0.3336	940	857	91	Pass
0.3449	853	802	94	Pass
0.3563	757	724	95	Pass
0.3676	692	675	97	Pass
0.3790	638	628	98	Pass
0.3903	591	578	97	Pass
0.4017	546	545	99	Pass
0.4130	514	519	100	Pass
0.4244	490	480	97	Pass
0.4357	463	445	96	Pass
0.4471	443	419	94	Pass
0.4584	425	391	92	Pass
0.4698	395	365	92	Pass
0.4811	357	342	95	Pass
0.4925	341	324	95	Pass
0.5038	324	304	93	Pass
0.5152	309	284	91	Pass
0.5265	296	267	90	Pass
0.5379	284	253	89	Pass
0.5492	274	236	86	Pass
0.5606	263	213	80	Pass
0.5719	253	202	79	Pass

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0.5833	245	185	75	Pass
0.5946	236	170	72	Pass
0.6060	226	155	68	Pass
0.6173	210	141	67	Pass
0.6287	202	128	63	Pass
0.6400	183	114	62	Pass
0.6514	170	98	57	Pass
0.6627	162	88	54	Pass
0.6741	156	75	48	Pass
0.6854	144	64	44	Pass
0.6968	131	55	41	Pass
0.7082	117	47	40	Pass
0.7195	109	43	39	Pass
0.7309	95	38	40	Pass
0.7422	80	33	41	Pass
0.7536	72	30	41	Pass
0.7649	62	26	41	Pass
0.7763	53	19	35	Pass
0.7876	39	18	46	Pass
0.7990	27	16	59	Pass
0.8103	22	15	68	Pass
0.8217	18	13	72	Pass
0.8330	15	10	66	Pass
0.8444	10	10	100	Pass
0.8557	9	8	88	Pass
0.8671	9	8	88	Pass
0.8784	9	7	77	Pass
0.8898	8	7	87	Pass
0.9011	7	6	85	Pass
0.9125	7	6	85	Pass
0.9238	7	6	85	Pass
0.9352	7	5	71	Pass
0.9465	7	5	71	Pass
0.9579	7	5	71	Pass
0.9692	7	5	71	Pass
0.9806	6	4	66	Pass
0.9919	6	4	66	Pass
1.0033	6	4	66	Pass
1.0146	6	4	66	Pass
1.0260	5	4	80	Pass
1.0373	5	4	80	Pass
1.0487	5	3	60	Pass
1.0600	5	3	60	Pass
1.0714	5	3	60	Pass
1.0827	5	3	60	Pass
1.0941	5	3	60	Pass
1.1054	4	3	75	Pass
1.1168	4	2	50	Pass
1.1281	4	2	50	Pass
1.1395	3	1	33	Pass
1.1508	3	1	33	Pass
1.1622	3	1	33	Pass
1.1735	3	1	33	Pass
1.1849	2	0	0	Pass
1.1962	2	0	0	Pass

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1.2076	2	0	0	Pass
1.2189	2	0	0	Pass
1.2303	2	0	0	Pass
1.2416	2	0	0	Pass
1.2530	2	0	0	Pass
1.2643	2	0	0	Pass
1.2757	2	0	0	Pass
1.2870	2	0	0	Pass
1.2984	2	0	0	Pass

Water Quality BMP Flow and Volume for POC #1
On-line facility volume: 0 **acre-feet**
On-line facility target flow: 0 **cfs.**
Adjusted for 15 min: 0 **cfs.**
Off-line facility target flow: 0 **cfs.**
Adjusted for 15 min: 0 **cfs.**

LID Report

LID Technique	Used for Water Quality Treatment?	Percent Water Quality Treated	Total Volume Needs Treatment (ac-ft)	Volume Through Facility (ac-ft)	Infiltration Volume (ac-ft.)	Cumulative Volume Infiltration Credit	Percent Volume Infiltrated	Comment
Vault 1 POC	N		937.54			N	0.00	
Total Volume Infiltrated			937.54	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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WWHM2012
PROJECT REPORT

Project Name: Perkfilter-2
Site Name:
Site Address:
City :
Report Date: 6/28/2022
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 : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	acre
C, Forest, Flat	.56
Pervious Total	0.56

Impervious Land Use	acre
Impervious Total	0
Basin Total	0.56

Element Flows To:

Surface	Interflow	Groundwater

MITIGATED LAND USE

Name : Basin 1
Bypass: No

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GroundWater: No

Pervious Land Use	acre
C, Pasture, Flat	.11
Pervious Total	0.11

Impervious Land Use	acre
ROADS FLAT	0.28
SIDEWALKS FLAT	0.17
Impervious Total	0.45
Basin Total	0.56

Element Flows To:
Surface Interflow Groundwater

ANALYSIS RESULTS

Stream Protection Duration

Predeveloped Landuse Totals for POC #1
Total Pervious Area:0.56
Total Impervious Area:0

Mitigated Landuse Totals for POC #1
Total Pervious Area:0.11
Total Impervious Area:0.45

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.018816
5 year	0.028865
10 year	0.036614
25 year	0.047702
50 year	0.056936
100 year	0.067035

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0.243123
5 year	0.330041

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SECTION 5: CONVEYANCE DESIGN

Conveyance analysis and design will be included in the construction drainage report to be submitted at a later date.

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SECTION 6: OPERATIONS AND MAINTENANCE MANUAL

The proposed storm drainage system consists of buried pipes, catch basins, a detention vault, and two Perkfilter catch basin structures. These facilities will require periodic maintenance and inspection. Inspection and maintenance procedures are contained on the following pages.

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NO. 5 – CATCH BASINS AND MANHOLES

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Structure	Sediment	Sediment exceeds 60% of the depth from the bottom of the catch basin to the invert of the lowest pipe into or out of the catch basin or is within 6 inches of the invert of the lowest pipe into or out of the catch basin.	Sump of catch basin contains no sediment.
	Trash and debris	Trash or debris of more than ½ cubic foot which is located immediately in front of the catch basin opening or is blocking capacity of the catch basin by more than 10%.	No Trash or debris blocking or potentially blocking entrance to catch basin.
		Trash or debris in the catch basin that exceeds $^1/_3$ the depth from the bottom of basin to invert the lowest pipe into or out of the basin.	No trash or debris in the catch basin.
		Dead animals or vegetation that could generate odors that could cause complaints or dangerous gases (e.g., methane).	No dead animals or vegetation present within catch basin.
		Deposits of garbage exceeding 1 cubic foot in volume.	No condition present which would attract or support the breeding of insects or rodents.
	Damage to frame and/or top slab	Corner of frame extends more than ¾ inch past curb face into the street (If applicable).	Frame is even with curb.
		Top slab has holes larger than 2 square inches or cracks wider than ¼ inch.	Top slab is free of holes and cracks.
		Frame not sitting flush on top slab, i.e., separation of more than ¾ inch of the frame from the top slab.	Frame is sitting flush on top slab.
	Cracks in walls or bottom	Cracks wider than ½ inch and longer than 3 feet, any evidence of soil particles entering catch basin through cracks, or maintenance person judges that catch basin is unsound.	Catch basin is sealed and is structurally sound.
		Cracks wider than ½ 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.	No cracks more than $^1/_4$ inch wide at the joint of inlet/outlet pipe.
	Settlement/ misalignment	Catch basin has settled more than 1 inch or has rotated more than 2 inches out of alignment.	Basin replaced or repaired to design standards.
	Damaged pipe joints	Cracks wider than ½-inch at the joint of the inlet/outlet pipes or any evidence of soil entering the catch basin at the joint of the inlet/outlet pipes.	No cracks more than ¼-inch wide at the joint of inlet/outlet pipes.
	Contaminants and pollution	Any evidence of contaminants or pollution such as oil, gasoline, concrete slurries or paint.	Materials removed and disposed of according to applicable regulations. Source control BMPs implemented if appropriate. No contaminants present other than a surface oil film.
Inlet/Outlet Pipe	Sediment accumulation	Sediment filling 20% or more of the pipe.	Inlet/outlet pipes clear of sediment.
	Trash and debris	Trash and debris accumulated in inlet/outlet pipes (includes floatables and non-floatables).	No trash or debris in pipes.
	Damaged	Cracks wider than ½-inch at the joint of the inlet/outlet pipes or any evidence of soil entering at the joints of the inlet/outlet pipes.	No cracks more than ¼-inch wide at the joint of the inlet/outlet pipe.

NO. 5 – CATCH BASINS AND MANHOLES

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Metal Grates (Catch Basins)	Unsafe grate opening	Grate with opening wider than $^{7}/_{8}$ inch.	Grate opening meets design standards.
	Trash and debris	Trash and debris that is blocking more than 20% of grate surface.	Grate free of trash and debris. footnote to guidelines for disposal
	Damaged or missing	Grate missing or broken member(s) of the grate. **Any open structure requires urgent maintenance**.	Grate is in place and meets design standards.
Manhole Cover/Lid	Cover/lid not in place	Cover/lid is missing or only partially in place. **Any open structure requires urgent maintenance**.	Cover/lid protects opening to structure.
	Locking mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts cannot be seated. Self-locking cover/lid does not work.	Mechanism opens with proper tools.
	Cover/lid difficult to Remove	One maintenance person cannot remove cover/lid after applying 80 lbs. of lift.	Cover/lid can be removed and reinstalled by one maintenance person.

NO. 6 – CONVEYANCE PIPES AND DITCHES

Maintenance Component	Defect or Problem	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
Pipes	Sediment & debris accumulation	Accumulated sediment or debris that exceeds 20% of the diameter of the pipe.	Water flows freely through pipes.
	Vegetation/roots	Vegetation/roots that reduce free movement of water through pipes.	Water flows freely through pipes.
	Contaminants and pollution	Any evidence of contaminants or pollution such as oil, gasoline, concrete slurries or paint.	Materials removed and disposed of according to applicable regulations. Source control BMPs implemented if appropriate. No contaminants present other than a surface oil film.
	Damage to protective coating or corrosion	Protective coating is damaged; rust or corrosion is weakening the structural integrity of any part of pipe.	Pipe repaired or replaced.
	Damaged	Any dent that decreases the cross section area of pipe by more than 20% or is determined to have weakened structural integrity of the pipe.	Pipe repaired or replaced.
Ditches	Trash and debris	Trash and debris exceeds 1 cubic foot per 1,000 square feet of ditch and slopes.	Trash and debris cleared from ditches.
	Sediment accumulation	Accumulated sediment that exceeds 20% of the design depth.	Ditch cleaned/flushed of all sediment and debris so that it matches design.
	Noxious weeds	Any noxious or nuisance vegetation which may constitute a hazard to County personnel or the public.	Noxious and nuisance vegetation removed according to applicable regulations. No danger of noxious vegetation where County personnel or the public might normally be.
	Contaminants and pollution	Any evidence of contaminants or pollution such as oil, gasoline, concrete slurries or paint.	Materials removed and disposed of according to applicable regulations. Source control BMPs implemented if appropriate. No contaminants present other than a surface oil film.
	Vegetation	Vegetation that reduces free movement of water through ditches.	Water flows freely through ditches.
	Erosion damage to slopes	Any erosion observed on a ditch slope.	Slopes are not eroding.
	Rock lining out of place or missing (If Applicable)	One layer or less of rock exists above native soil area 5 square feet or more, any exposed native soil.	Replace rocks to design standards.

SECTION 7: SPECIAL REPORTS AND STUDIES

The following studies were conducted in preparation of this Report:

- Wetland Report, Wetland Resources, June, 2022
- Geotechnical Investigation, Cobalt Geosciences, June 2022

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