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Brodie Plat

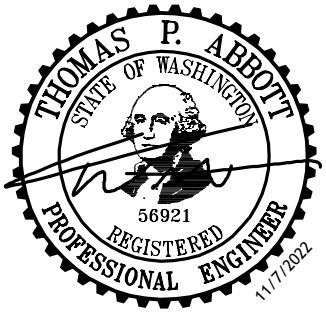
Construction Drainage Report

Prepared for

City of Marysville
80 Columbia Ave
Marysville, WA 98270

Prepared by
Ryan Ferguson, EIT

Reviewed by
Tom Abbott, PE



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

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TABLE OF CONTENTS

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 Modular Wetland 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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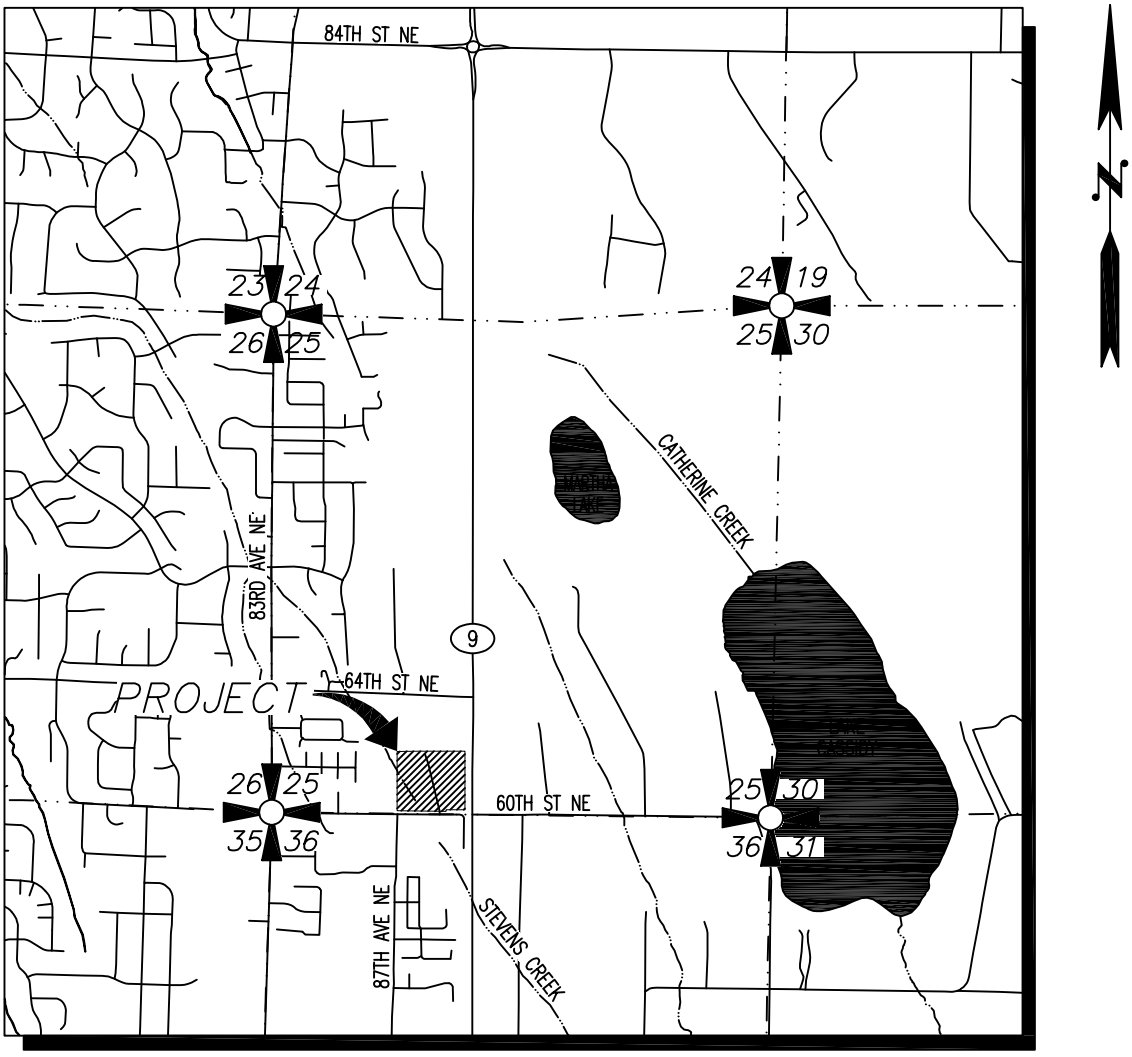

VICINITY MAP

SCALE: 1"=2000'

Drawing: P:\Civil\2022\C22-177 Brodie Plat\Drawings\Exhibits\C22177-EX-VM.dwg Plotted: Oct 26, 2022 - 12:12pm

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Kent Woodinville Olympia

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BRODIE PLAT

VICINITY MAP

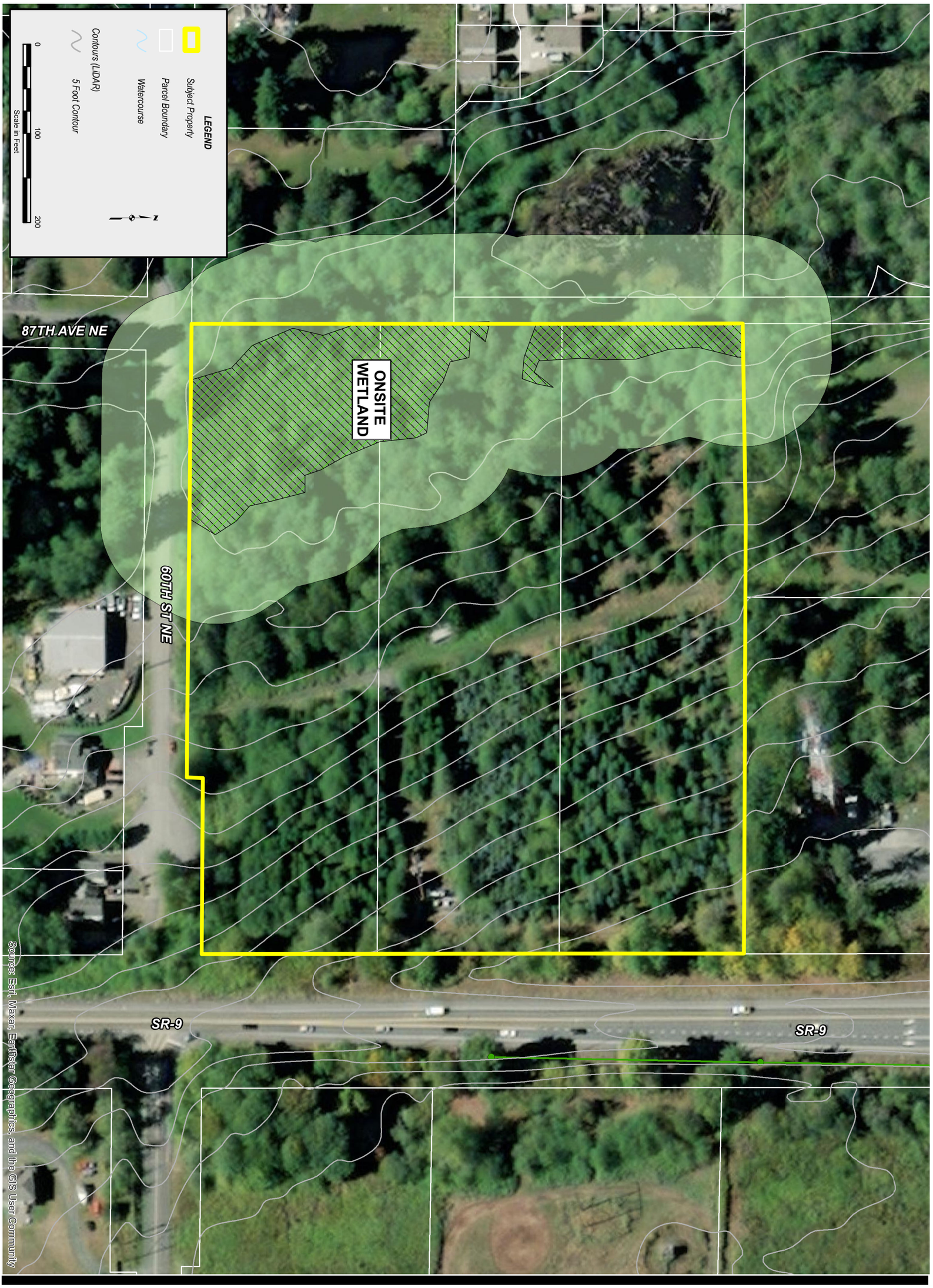

FIGURE: 2.0

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

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EXISTING CONDITIONS MAP

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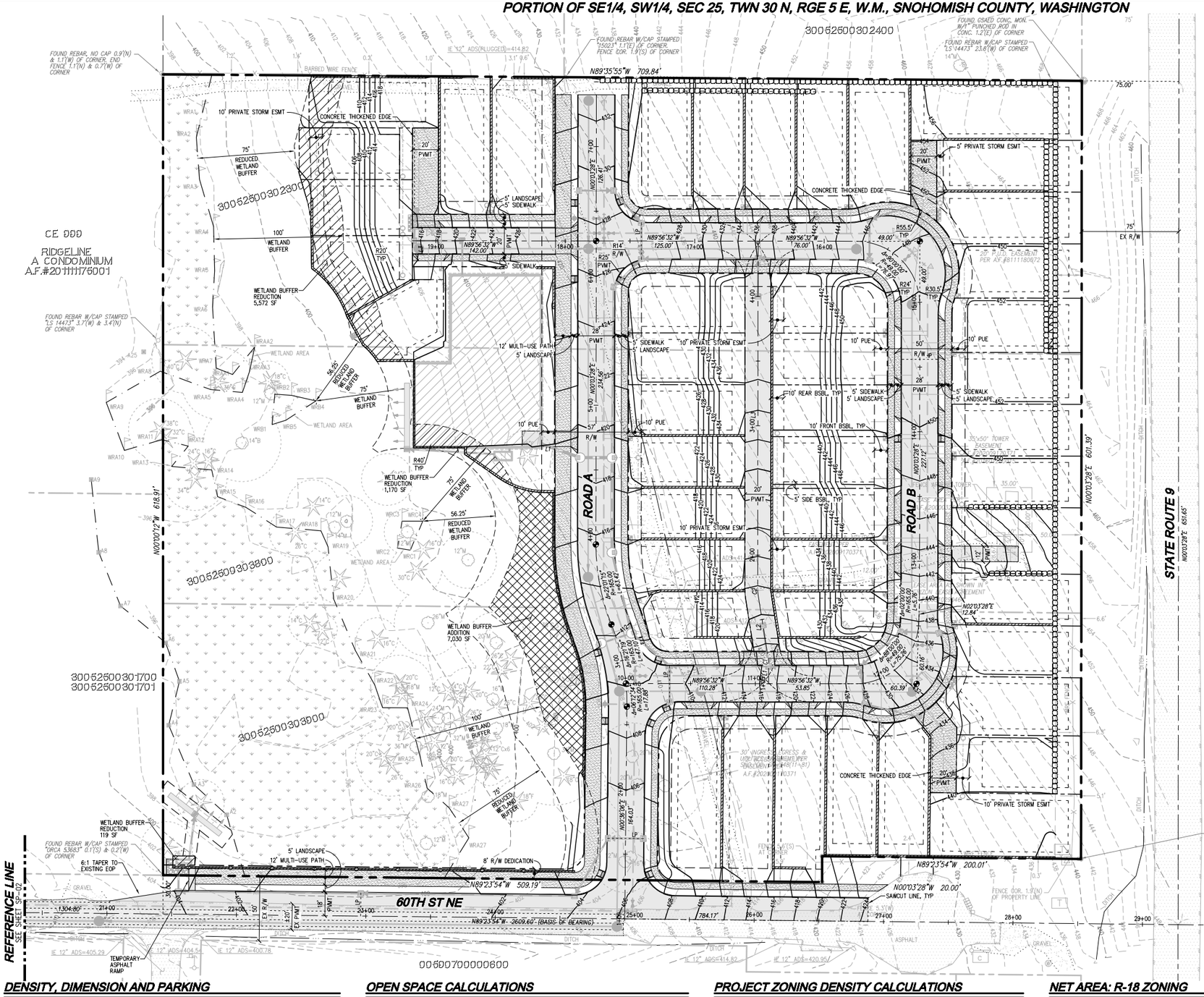
SOURCE INFORMATION

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

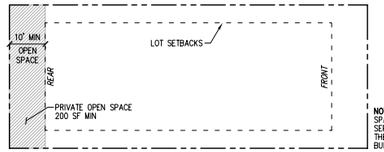


REFERENCE LINE SEE SHEET SP-02

SCALE: 1" = 40'
40' 0 40' 80'

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
	FALL PROTECTION 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	14.64'	N00°03'28"E
L2	49.95'	N89°56'32"W
L3	268.64'	N00°03'28"E

CURVE TABLE

Curve #	Length	Radius	Delta
C1	4.71'	30.00'	09°00'00"
C2	4.71'	30.00'	09°00'00"

LOT SIZE SUMMARY

LOTS PROPOSED: 44
AVERAGE LOT SIZE: 4,145 SF
SMALLEST LOT SIZE: 3,500 SF (LOT 27, 28 AND 29)
LARGEST LOT SIZE: 6,195 SF (LOT 1)

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: 6,862 SF
WETLAND BUFFER ADDITION: 7,030 SF
NET: 168 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	

IMPERVIOUS AREA

IMPERVIOUS AREA PROPOSED: 199,940 SF (4.59 AC)
SITE PERCENTAGE AS IMPERVIOUS: 45.9%

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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811 or 1-800-424-5555
Utilities Underground Location Center

REVISIONS

NO.	DATE	DESCRIPTION	BY

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BRODIE PLAT

PRELIMINARY SITE PLAN

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

JOB NUMBER:	C22-177
DRAWING NAME:	C22177P-SP-PL
DESIGNER:	TPA
DRAFTING BY:	DPN
DATE:	6-28-22
SCALE:	1"=40'
JURISDICTION:	CITY OF MARYSVILLE

SP-01

SHEET 4 OF 14

Drawing: P:\Civil\2022\C22-177 Brodie Plat\Drawings\Preliminary\C22177P-SP-PL.dwg Plotted: Oct 19, 2022 - 1:03pm

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. 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 64th 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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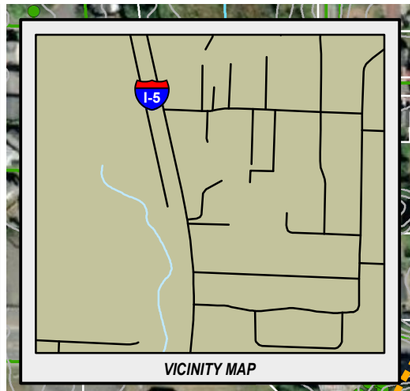

VICINITY MAP

64TH ST NE

SR-9

DOWNSTREAM FLOWPATH

PROJECT SITE

83RD AVE NE

QUARTER MILE
BOUNDARY OF ANALYSIS

60TH ST NE

87TH AVE NE

IMAGES 1, 2, & 3

LEGEND

- Subject Property
- Parcel Boundary
- Watercourse
- Downstream Flowpath

Contours (LiDAR)

- 5 Foot Contour

0 300 600

Scale in Feet

N

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

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

DOWNSTREAM ANALYSIS MAP

NAD 1983 HARN
STATEPLANE WASHINGTON
NORTH FIPS 4601 FEET

REVISION:
JOB NUMBER: C22-177

DESIGNER: TABBOTT
DRAWING BY: RFERGUSON
DATE: 10/26/2022
SCALE: AS SHOWN
JURISDICTION: MARYSVILLE

FIGURE:

3.0

Downstream 20221025.mxd | MOD: 10/26/2022 | rferguson

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	1.31
Forest, steep	5.77
Total	**7.08**

4.2 Developed Site Hydrology

In the developed condition, the project will develop 44 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 6.43 acres comprised of a 44 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	2.43
Roads, flat	1.26
Driveway, flat	0.40
Sidewalks, flat	0.46
Pasture, flat	1.88
Total	**6.43**

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Bypass Basin:
The developed Bypass Basin is 0.65 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	0.20
Total	**0.65**

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.

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Table 4: Detention Vault Design Summary

Detention Vault	
Live Storage Bottom Area (modeled)	*10,140 SF*
Live Storage Bottom Area (provided)	*10,244 SF*
Number of Cells	*7*
Cell Dimensions	*(2 x 13' x 64'), (5 x 13' x 132')*
Begin Live Storage Elevation	401.00
Riser Height	8.00'
Volume (modeled)	81,120 CF
Volume (provided)	81,536 CF
Top of Riser Elevation	409.00
Top Outside of Vault Elevation	410.50

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

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	0.3515	0.3518	405.91
10-Year	0.7600	0.5763	408.01
50-Year	1.3064	0.8307	409.02
100-Year	1.6045	0.9574	409.05

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4.4 Water Quality Treatment

Perkfilter

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 Design Summary

Ø Perkfilter Vault	
Tributary Area	*6.43 AC*
Tributary PGIS Area	*1.66 AC*
Water Quality Flow Rate (2 yr mitigated peak)	0.1780 cfs
WQ Treatment Capacity	0.1900 cfs
Number of Cartridges	7
Cartridge Height	12″
Internal Drop	1.7′
Peak Flow Rate	0.9574 cfs
Peak Flow Storm Event	100-year

Modular Wetland

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

Table 7: Modular Wetland Design Summary

Modular Wetland	
Tributary Area	*0.65 AC*
Tributary PGIS Area	*0.28 AC*
Water Quality Flow Rate (91% of total volume)	0.0840 cfs
WQ Treatment Capacity	0.103 cfs
Number of Cartridges	N/A
Cartridge Height	N/A
Internal Drop	0.5′
Peak Flow Rate	0.6465 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 Detail
4. Modular Wetland Detail
5. WWHM2012 Output – Detention Vault
6. WWHM2012 Output – Perkfilter - Onsite Basin
7. WWHM2012 Output – Modular Wetland - Frontage Bypass

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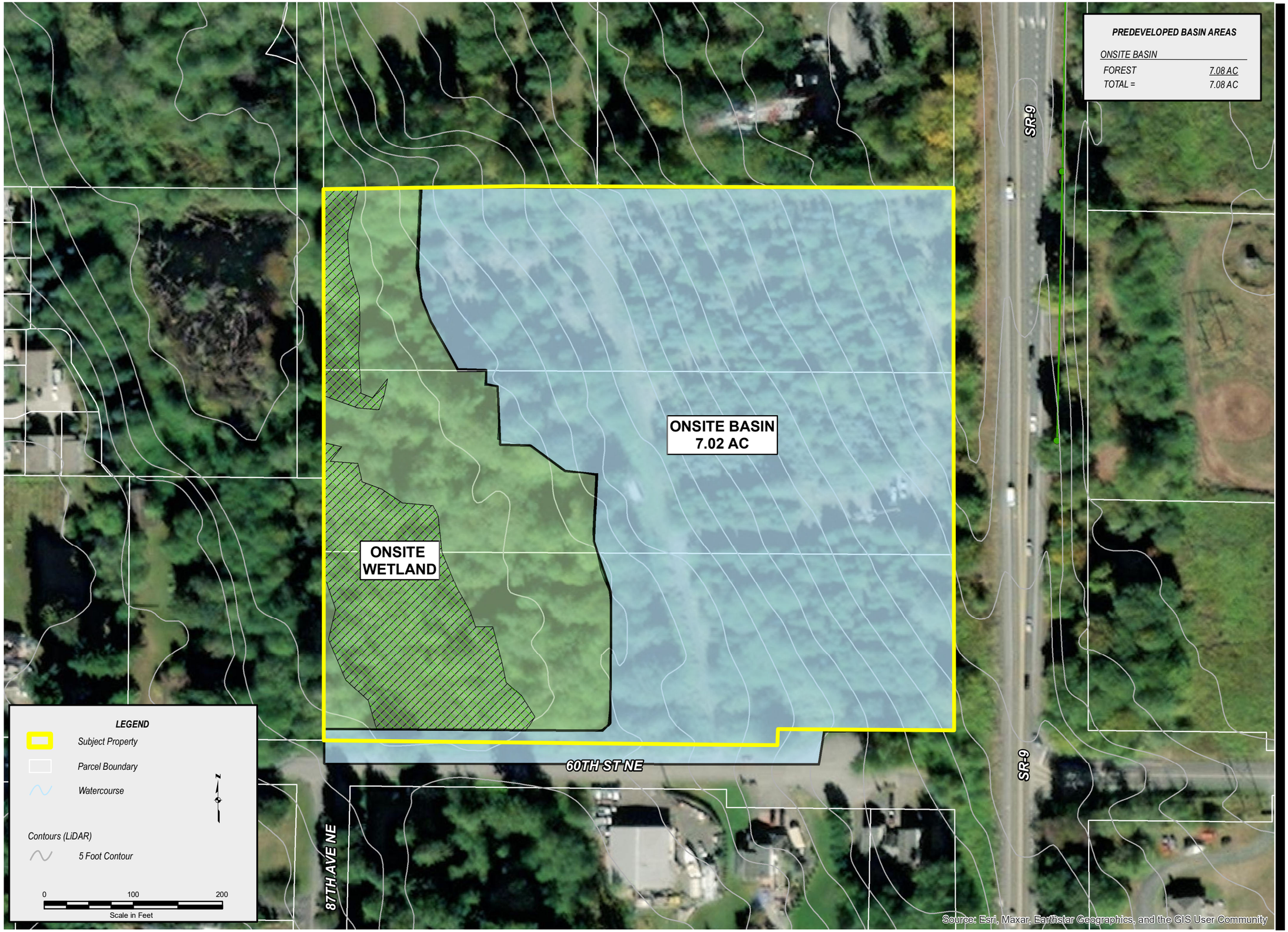

PREDEVELOPED BASIN AREAS

ONSITE BASIN	
FOREST	7.08 AC
TOTAL =	7.08 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

PREDEVELOPED HYDROLOGY MAP MAP

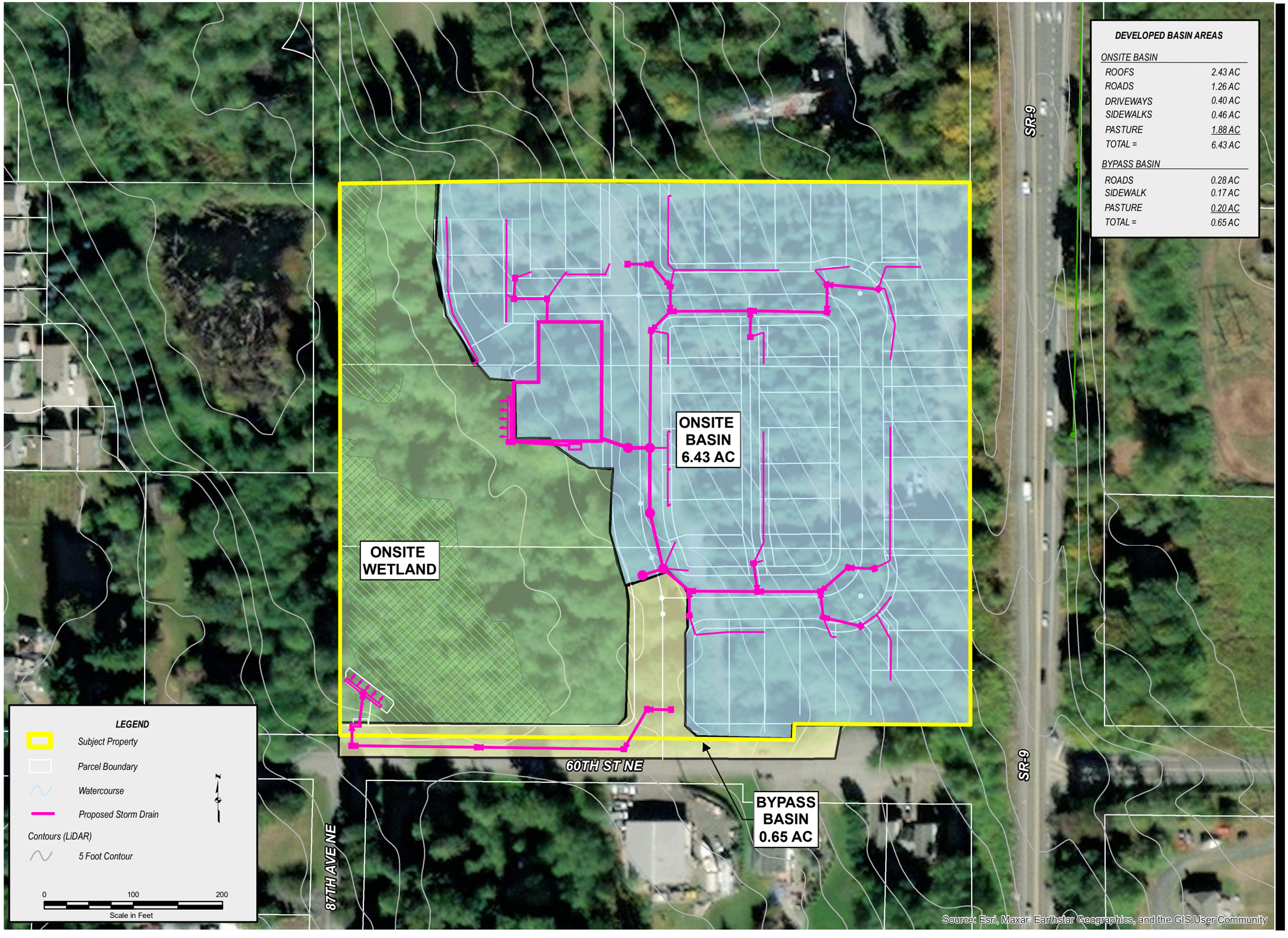
NAD 1983 HARN
STATEPLANE WASHINGTON
NORTH FIPS 4601 FEET

REVISION:
JOB NUMBER: C22-177

DESIGNER: TABBOTT
DRAWING BY: RFERGUSON
DATE: 10/26/2022
SCALE: AS SHOWN
JURISDICTION: MARYSVILLE

FIGURE:
4.0

Predeveloped Hydrology Map.mxd | MOD: 10/26/2022 | rferguson



DEVELOPED BASIN AREAS

ONSITE BASIN	
ROOFS	2.43 AC
ROADS	1.26 AC
DRIVEWAYS	0.40 AC
SIDEWALKS	0.46 AC
PASTURE	1.88 AC
TOTAL =	6.43 AC
BYPASS BASIN	
ROADS	0.28 AC
SIDEWALK	0.17 AC
PASTURE	0.20 AC
TOTAL =	0.65 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

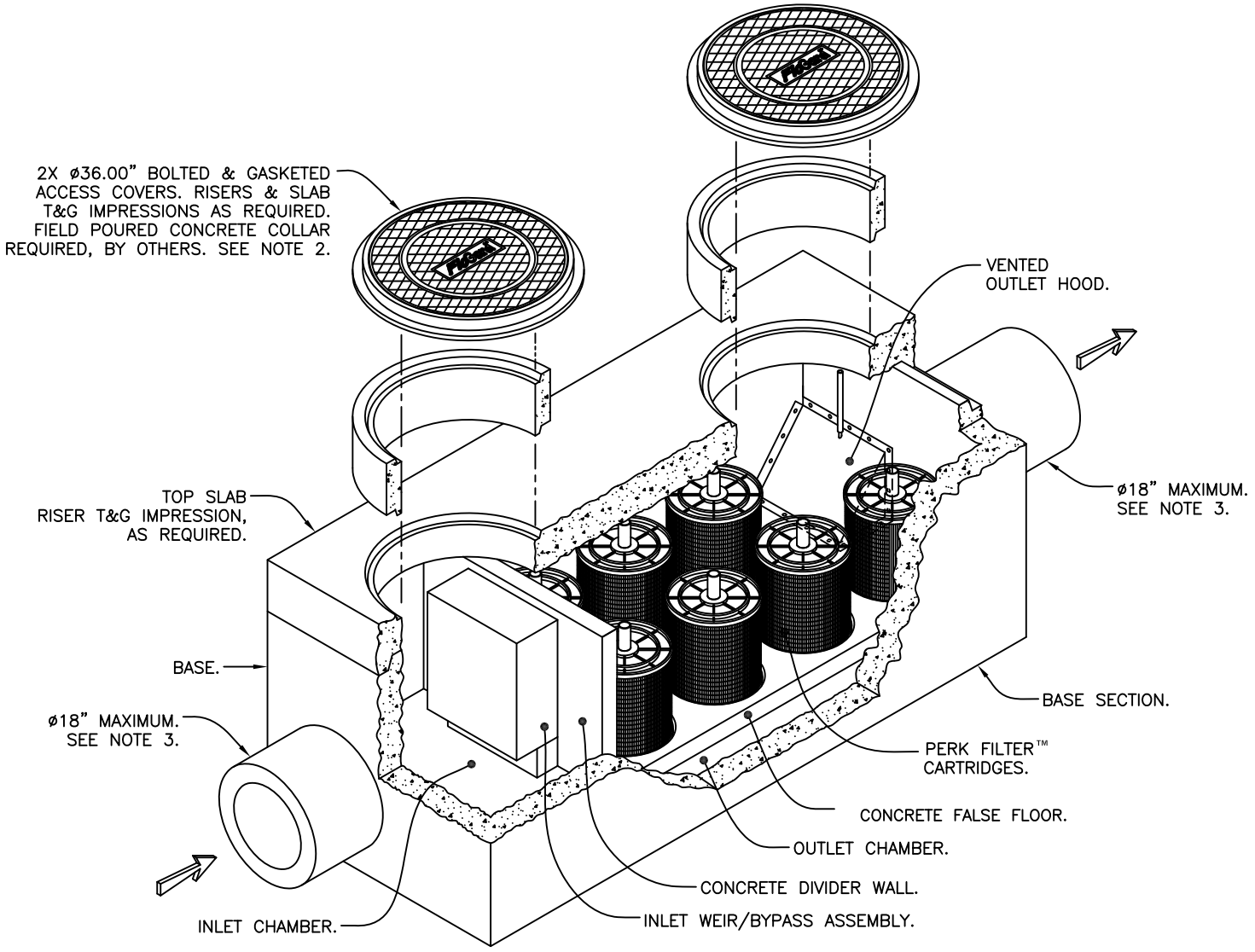
REVISION:
JOB NUMBER: C22-177

DESIGNER: TABBOTT
DRAWING BY: RFERGUSON
DATE: 10/26/2022
SCALE: AS SHOWN
JURISDICTION: MARYSVILLE

FIGURE:
5.0

Developed Hydrology Map 20221026.mxd | MOD: 10/26/2022 | rferguson

PF-V-4-0001



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 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.

Media Filtration

PerkFilter™

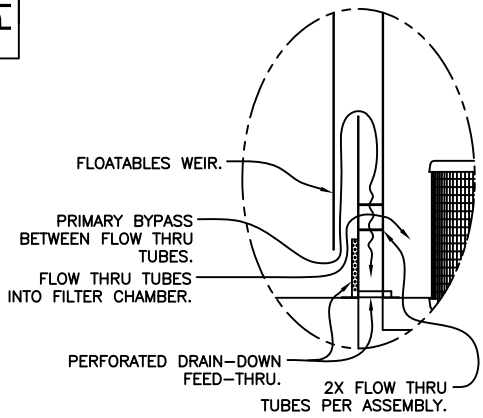
4' Wide Concrete Vault

Three to Eight Cartridges / Stacks

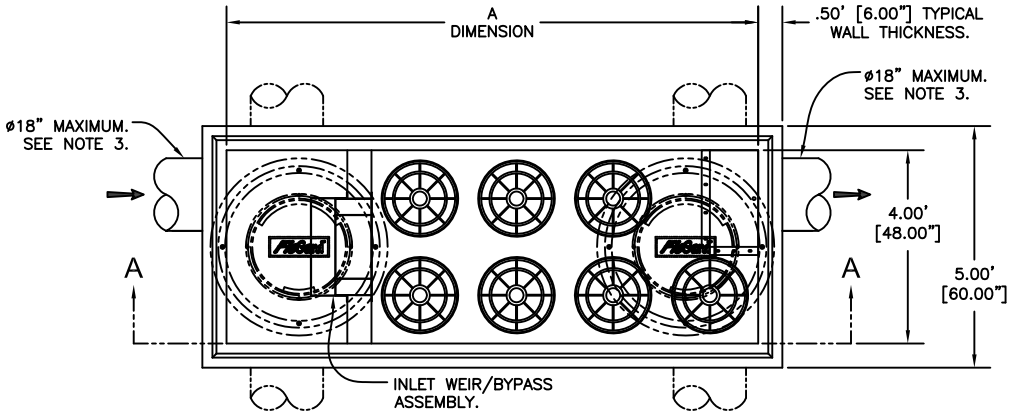
Oldcastle Infrastructure™
A CRH COMPANY

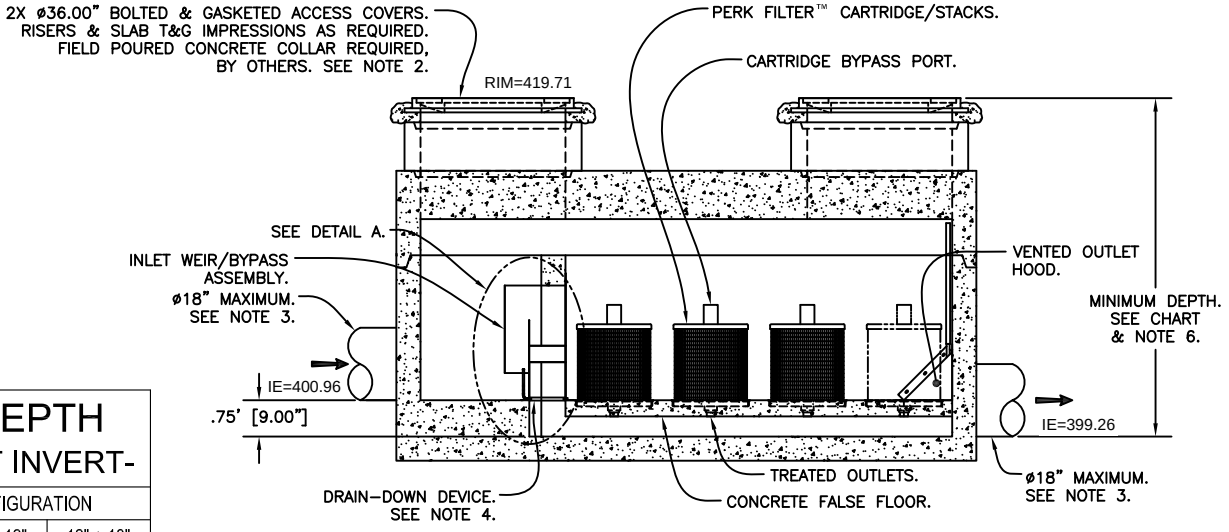
DRAWING NO.	REV	DATE	
PF-V-4-0001	F	CJS 6/17/20	SHEET 1 OF 2

PF-V-4-0001



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'

4' 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)
3	8	36 / 0.08	2.9	54 / 0.12	4.3	72 / 0.16	5.0	90 / 0.20	6.7
4	8	48 / 0.11	2.9	72 / 0.16	4.4	96 / 0.21	5.0	120 / 0.27	6.8
5	12	60 / 0.13	2.9	90 / 0.20	4.4	120 / 0.27	5.1	150 / 0.33	6.8
6	12	72 / 0.16	3.0	108 / 0.24	4.5	144 / 0.32	5.1	180 / 0.40	6.9
7	12	84 / 0.19	3.0	126 / 0.28	4.5	168 / 0.37	5.2	210 / 0.47	7.0
8	12	96 / 0.21	3.0	144 / 0.32	4.5	192 / 0.43	5.2	240 / 0.53	7.0
MAXIMUM HEAD LOSS		1.7 FT		2.3 FT		2.9 FT		3.5 FT	

Media Filtration

PerkFilter™

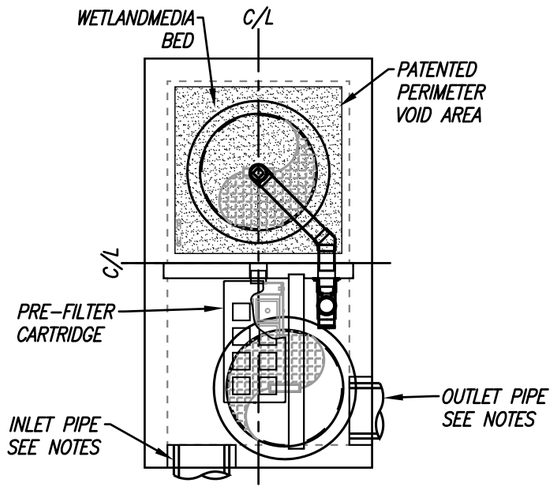
4' Wide Concrete Vault

Three to Eight Cartridges / Stacks

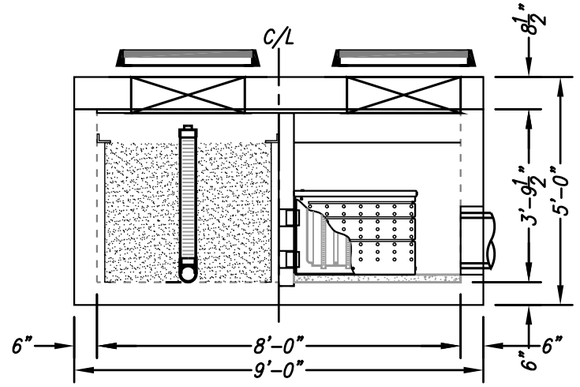
Oldcastle Infrastructure™
A CRH COMPANY

DRAWING NO.	REV	DATE	
PF-V-4-0001	F	CJS 6/17/20	SHEET 2 OF 2

SITE SPECIFIC DATA			
PROJECT NUMBER		----	
PROJECT NAME		BRODIE PLAT	
PROJECT LOCATION		EVERETT, WA	
TREATMENT REQUIRED			
VOLUME BASED (CF)		FLOW BASED (CFS)	
		0.0840	
PEAK BYPASS REQUIRED (CFS) – IF APPLICABLE			0.6465
PIPE DATA	I.E.	MATERIAL	DIAMETER
INLET PIPE	397.24	DI	12"
OUTLET PIPE	396.74	PVC	12"
	PRETREATMENT	BIOFILTRATION	DISCHARGE
RIM ELEVATION	401.92	401.92	401.92
SURFACE LOAD	HS-20	HS-20	HS-20
FRAME & COVER	ø30"	ø30"	N/A
WETLANDMEDIA VOLUME (CY)			1.56
ORIFICE SIZE (DIA. INCHES)			5 EA ø0.82"
NOTES:			



PLAN VIEW



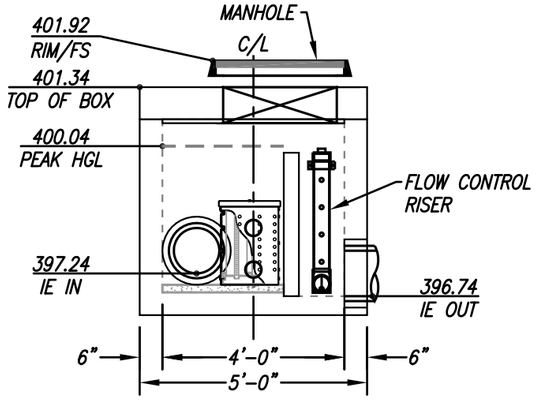
LEFT END VIEW

INSTALLATION NOTES

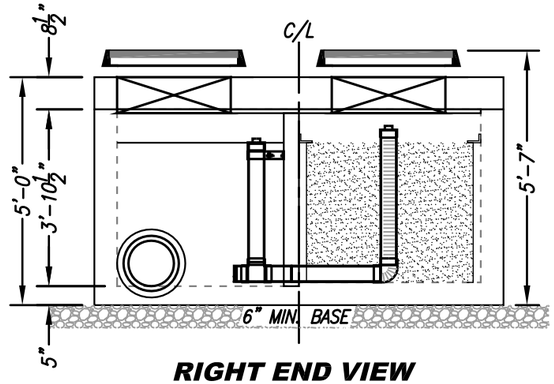
1. CONTRACTOR TO PROVIDE ALL LABOR, EQUIPMENT, MATERIALS AND INCIDENTALS REQUIRED TO OFFLOAD AND INSTALL THE SYSTEM AND APPURTENANCES IN ACCORDANCE WITH THIS DRAWING AND THE MANUFACTURERS' SPECIFICATIONS, UNLESS OTHERWISE STATED IN MANUFACTURER'S CONTRACT.
2. UNIT MUST BE INSTALLED ON LEVEL BASE. MANUFACTURER RECOMMENDS A MINIMUM 6" LEVEL ROCK BASE UNLESS SPECIFIED BY THE PROJECT ENGINEER. CONTRACTOR IS RESPONSIBLE FOR VERIFYING PROJECT ENGINEER'S RECOMMENDED BASE SPECIFICATIONS.
4. CONTRACTOR TO SUPPLY AND INSTALL ALL EXTERNAL CONNECTING PIPES. ALL PIPES MUST BE FLUSH WITH INSIDE SURFACE OF CONCRETE (PIPES CANNOT INTRUDE BEYOND FLUSH). INVERT OF OUTFLOW PIPE MUST BE FLUSH WITH DISCHARGE CHAMBER FLOOR. ALL PIPES SHALL BE SEALED WATERTIGHT PER MANUFACTURER'S STANDARD CONNECTION DETAIL.
5. CONTRACTOR RESPONSIBLE FOR INSTALLATION OF ALL PIPES, RISERS, MANHOLES, AND HATCHES. CONTRACTOR TO GROUT ALL MANHOLES AND HATCHES TO MATCH FINISHED SURFACE UNLESS SPECIFIED OTHERWISE.
6. VEGETATION SUPPLIED AND INSTALLED BY OTHERS. ALL UNITS WITH VEGETATION MUST HAVE DRIP OR SPRAY IRRIGATION SUPPLIED AND INSTALLED BY OTHERS.
7. CONTRACTOR RESPONSIBLE FOR CONTACTING BIO CLEAN FOR ACTIVATION OF UNIT. MANUFACTURER'S WARRANTY IS VOID WITHOUT PROPER ACTIVATION BY A BIO CLEAN REPRESENTATIVE.

GENERAL NOTES

1. MANUFACTURER TO PROVIDE ALL MATERIALS UNLESS OTHERWISE NOTED.
2. ALL DIMENSIONS, ELEVATIONS, SPECIFICATIONS AND CAPACITIES ARE SUBJECT TO CHANGE. FOR PROJECT SPECIFIC DRAWINGS DETAILING EXACT DIMENSIONS, WEIGHTS AND ACCESSORIES PLEASE CONTACT BIO CLEAN.



ELEVATION VIEW



RIGHT END VIEW

INTERNAL BYPASS DISCLOSURE:

THE DESIGN AND CAPACITY OF THE PEAK CONVEYANCE METHOD TO BE REVIEWED AND APPROVED BY THE ENGINEER OF RECORD. HGL(S) AT PEAK FLOW SHALL BE ASSESSED TO ENSURE NO UPSTREAM FLOODING. PEAK HGL AND BYPASS CAPACITY SHOWN ON DRAWING ARE USED FOR GUIDANCE ONLY.

TREATMENT FLOW (CFS)	0.103
OPERATING HEAD (FT)	3.0
PRETREATMENT LOADING RATE (GPM/SF)	1.8
WETLAND MEDIA LOADING RATE (GPM/SF)	1.0

Bio Clean
A Forterra Company

MWS-L-4-8-3'-10"-V-UG
STORMWATER BIOFILTRATION SYSTEM
STANDARD DETAIL

9/30/22ASEPOLAR

WWHM2012
PROJECT REPORT

Project Name: Brodie Vault
Site Name:
Site Address:
City :
Report Date: 9/23/2022
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 : Onsite Basin
Bypass: No

GroundWater: No

Pervious Land Use	acre
C, Forest, Mod	1.31
C, Forest, Steep	5.77
Pervious Total	7.08

Impervious Land Use	acre
Impervious Total	0
Basin Total	7.08

Element Flows To:

Surface	Interflow	Groundwater

MITIGATED LAND USE

Name : Onsite Basin
Bypass: No

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GroundWater: No

Pervious Land Use	acre
C, Pasture, Flat	1.88
Pervious Total	**1.88**

Impervious Land Use	acre
ROADS FLAT	1.26
ROOF TOPS FLAT	2.43
DRIVEWAYS FLAT	0.4
SIDEWALKS FLAT	0.46
Impervious Total	**4.55**
Basin Total	**6.43**

Element Flows To:

Surface	Interflow	Groundwater
Vault 1	Vault 1	

Name : Vault 1
Width : 60 ft.
Length : 169 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: 1.78125 in. **Elevation:** 0 ft.
Orifice 2 Diameter: 1.75 in. **Elevation:** 3.9 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	0.232	0.000	0.000	0.000
0.1000	0.232	0.023	0.027	0.000
0.2000	0.232	0.046	0.038	0.000
0.3000	0.232	0.069	0.047	0.000
0.4000	0.232	0.093	0.054	0.000
0.5000	0.232	0.116	0.060	0.000

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0.6000	0.232	0.139	0.066	0.000
0.7000	0.232	0.162	0.072	0.000
0.8000	0.232	0.186	0.077	0.000
0.9000	0.232	0.209	0.081	0.000
1.0000	0.232	0.232	0.086	0.000
1.1000	0.232	0.256	0.090	0.000
1.2000	0.232	0.279	0.094	0.000
1.3000	0.232	0.302	0.098	0.000
1.4000	0.232	0.325	0.101	0.000
1.5000	0.232	0.349	0.105	0.000
1.6000	0.232	0.372	0.108	0.000
1.7000	0.232	0.395	0.112	0.000
1.8000	0.232	0.419	0.115	0.000
1.9000	0.232	0.442	0.118	0.000
2.0000	0.232	0.465	0.121	0.000
2.1000	0.232	0.488	0.124	0.000
2.2000	0.232	0.512	0.127	0.000
2.3000	0.232	0.535	0.130	0.000
2.4000	0.232	0.558	0.133	0.000
2.5000	0.232	0.582	0.136	0.000
2.6000	0.232	0.605	0.138	0.000
2.7000	0.232	0.628	0.141	0.000
2.8000	0.232	0.651	0.144	0.000
2.9000	0.232	0.675	0.146	0.000
3.0000	0.232	0.698	0.149	0.000
3.1000	0.232	0.721	0.151	0.000
3.2000	0.232	0.744	0.154	0.000
3.3000	0.232	0.768	0.156	0.000
3.4000	0.232	0.791	0.158	0.000
3.5000	0.232	0.814	0.161	0.000
3.6000	0.232	0.838	0.163	0.000
3.7000	0.232	0.861	0.165	0.000
3.8000	0.232	0.884	0.167	0.000
3.9000	0.232	0.907	0.170	0.000
4.0000	0.232	0.931	0.198	0.000
4.1000	0.232	0.954	0.211	0.000
4.2000	0.232	0.977	0.222	0.000
4.3000	0.232	1.001	0.231	0.000
4.4000	0.232	1.024	0.239	0.000
4.5000	0.232	1.047	0.281	0.000
4.6000	0.232	1.070	0.302	0.000
4.7000	0.232	1.094	0.320	0.000
4.8000	0.232	1.117	0.336	0.000
4.9000	0.232	1.140	0.350	0.000
5.0000	0.232	1.163	0.363	0.000
5.1000	0.232	1.187	0.376	0.000
5.2000	0.232	1.210	0.388	0.000
5.3000	0.232	1.233	0.399	0.000
5.4000	0.232	1.257	0.410	0.000
5.5000	0.232	1.280	0.420	0.000
5.6000	0.232	1.303	0.431	0.000
5.7000	0.232	1.326	0.440	0.000
5.8000	0.232	1.350	0.450	0.000
5.9000	0.232	1.373	0.459	0.000
6.0000	0.232	1.396	0.468	0.000

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6.1000	0.232	1.420	0.478	0.000
6.2000	0.232	1.443	0.488	0.000
6.3000	0.232	1.466	0.499	0.000
6.4000	0.232	1.489	0.510	0.000
6.5000	0.232	1.513	0.521	0.000
6.6000	0.232	1.536	0.532	0.000
6.7000	0.232	1.559	0.543	0.000
6.8000	0.232	1.582	0.554	0.000
6.9000	0.232	1.606	0.565	0.000
7.0000	0.232	1.629	0.575	0.000
7.1000	0.232	1.652	0.587	0.000
7.2000	0.232	1.676	0.598	0.000
7.3000	0.232	1.699	0.610	0.000
7.4000	0.232	1.722	0.621	0.000
7.5000	0.232	1.745	0.649	0.000
7.6000	0.232	1.769	0.662	0.000
7.7000	0.232	1.792	0.676	0.000
7.8000	0.232	1.815	0.689	0.000
7.9000	0.232	1.839	0.703	0.000
8.0000	0.232	1.862	0.717	0.000
8.1000	0.232	1.885	1.225	0.000
8.2000	0.232	1.908	2.134	0.000
8.3000	0.232	1.932	3.237	0.000
8.4000	0.232	1.955	4.374	0.000
8.5000	0.232	1.978	5.387	0.000
8.6000	0.232	2.001	6.155	0.000
8.7000	0.232	2.025	6.653	0.000
8.8000	0.232	2.048	7.105	0.000
8.9000	0.232	2.071	7.495	0.000
9.0000	0.232	2.095	7.864	0.000
9.1000	0.232	2.118	8.216	0.000
9.2000	0.000	0.000	8.552	0.000

Name : Bypass
Bypass: Yes

GroundWater: No

Pervious Land Use	**acre**
C, Pasture, Flat	**.2**
Pervious Total	**0.2**

Impervious Land Use	**acre**
ROADS FLAT	**0.28**
SIDEWALKS FLAT	**0.17**
Impervious Total	**0.45**
Basin Total	**0.65**

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

ANALYSIS RESULTS

Stream Protection Duration

Predeveloped Landuse Totals for POC #1
Total Pervious Area:7.08
Total Impervious Area:0

Mitigated Landuse Totals for POC #1
Total Pervious Area:2.08
Total Impervious Area:5

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.351495
5 year	0.573062
10 year	0.759995
25 year	1.048689
50 year	1.306358
100 year	1.604527

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0.351669
5 year	0.477441
10 year	0.573469
25 year	0.710235
50 year	0.823984
100 year	0.948491

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

Year	Predeveloped	Mitigated
1949	0.381	0.341
1950	0.429	0.383
1951	0.307	0.340
1952	0.286	0.309
1953	0.252	0.366
1954	1.316	0.491
1955	0.437	0.353
1956	0.362	0.279
1957	0.487	0.384

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1958	1.176	0.651
1959	0.318	0.315
1960	0.341	0.323
1961	1.429	0.858
1962	0.355	0.342
1963	0.583	0.419
1964	0.412	0.247
1965	0.256	0.250
1966	0.181	0.253
1967	0.358	0.568
1968	0.443	0.361
1969	1.147	0.631
1970	0.228	0.277
1971	0.410	0.331
1972	0.288	0.470
1973	0.247	0.357
1974	0.688	0.438
1975	0.303	0.351
1976	0.257	0.319
1977	0.224	0.285
1978	0.243	0.262
1979	0.704	0.459
1980	0.332	0.273
1981	0.240	0.269
1982	0.328	0.392
1983	0.596	0.326
1984	0.296	0.361
1985	0.405	0.411
1986	0.905	0.740
1987	0.397	0.489
1988	0.239	0.292
1989	0.300	0.307
1990	0.273	0.280
1991	0.292	0.281
1992	0.244	0.309
1993	0.242	0.261
1994	0.209	0.281
1995	0.295	0.323
1996	0.622	0.372
1997	1.108	1.210
1998	0.206	0.382
1999	0.241	0.242
2000	0.210	0.551
2001	0.090	0.265
2002	0.276	0.238
2003	0.218	0.276
2004	0.356	0.540
2005	0.265	0.274
2006	0.780	0.436
2007	0.622	0.388
2008	0.805	0.723
2009	0.246	0.300

Stream Protection Duration

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Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	1.4294	1.2101
2	1.3157	0.8578
3	1.1762	0.7403
4	1.1469	0.7234
5	1.1075	0.6511
6	0.9049	0.6310
7	0.8048	0.5680
8	0.7796	0.5514
9	0.7044	0.5400
10	0.6884	0.4909
11	0.6225	0.4887
12	0.6220	0.4696
13	0.5961	0.4587
14	0.5834	0.4381
15	0.4872	0.4359
16	0.4427	0.4195
17	0.4368	0.4105
18	0.4292	0.3918
19	0.4116	0.3879
20	0.4097	0.3842
21	0.4053	0.3834
22	0.3969	0.3818
23	0.3809	0.3725
24	0.3618	0.3657
25	0.3577	0.3612
26	0.3564	0.3605
27	0.3550	0.3572
28	0.3414	0.3530
29	0.3322	0.3513
30	0.3280	0.3420
31	0.3180	0.3413
32	0.3074	0.3399
33	0.3033	0.3312
34	0.2995	0.3258
35	0.2958	0.3228
36	0.2955	0.3226
37	0.2918	0.3194
38	0.2884	0.3150
39	0.2864	0.3093
40	0.2761	0.3092
41	0.2727	0.3071
42	0.2647	0.2998
43	0.2567	0.2920
44	0.2556	0.2847
45	0.2521	0.2810
46	0.2472	0.2808
47	0.2456	0.2805
48	0.2444	0.2793
49	0.2429	0.2765
50	0.2420	0.2762
51	0.2406	0.2737
52	0.2397	0.2729
53	0.2387	0.2693

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54	0.2277	0.2648
55	0.2240	0.2620
56	0.2179	0.2608
57	0.2101	0.2533
58	0.2088	0.2497
59	0.2059	0.2466
60	0.1814	0.2417
61	0.0900	0.2384

Stream Protection Duration
POC #1
The Facility PASSED

The Facility PASSED.

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.1757	11691	10401	88	Pass
0.1872	9432	7420	78	Pass
0.1986	7732	5777	74	Pass
0.2100	6192	4483	72	Pass
0.2214	5058	3604	71	Pass
0.2328	4139	2943	71	Pass
0.2443	3320	2342	70	Pass
0.2557	2763	1918	69	Pass
0.2671	2295	1562	68	Pass
0.2785	1939	1380	71	Pass
0.2900	1672	1243	74	Pass
0.3014	1444	1132	78	Pass
0.3128	1243	1047	84	Pass
0.3242	1071	949	88	Pass
0.3356	943	876	92	Pass
0.3471	846	807	95	Pass
0.3585	759	731	96	Pass
0.3699	693	681	98	Pass
0.3813	636	630	99	Pass
0.3927	593	587	98	Pass
0.4042	546	549	100	Pass
0.4156	517	523	101	Pass
0.4270	490	488	99	Pass
0.4384	462	446	96	Pass
0.4498	444	426	95	Pass
0.4613	424	391	92	Pass
0.4727	396	366	92	Pass
0.4841	358	343	95	Pass
0.4955	341	323	94	Pass
0.5069	325	304	93	Pass
0.5184	311	285	91	Pass
0.5298	296	268	90	Pass
0.5412	283	251	88	Pass
0.5526	274	234	85	Pass
0.5640	263	212	80	Pass
0.5755	253	200	79	Pass
0.5869	245	185	75	Pass
0.5983	236	170	72	Pass

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0.6097	226	153	67	Pass
0.6211	210	141	67	Pass
0.6326	201	127	63	Pass
0.6440	185	115	62	Pass
0.6554	173	97	56	Pass
0.6668	162	88	54	Pass
0.6782	157	76	48	Pass
0.6897	145	62	42	Pass
0.7011	130	53	40	Pass
0.7125	119	47	39	Pass
0.7239	109	43	39	Pass
0.7353	94	37	39	Pass
0.7468	80	33	41	Pass
0.7582	72	29	40	Pass
0.7696	62	26	41	Pass
0.7810	53	19	35	Pass
0.7924	39	18	46	Pass
0.8039	27	16	59	Pass
0.8153	22	15	68	Pass
0.8267	18	13	72	Pass
0.8381	15	11	73	Pass
0.8495	10	11	110	Pass
0.8610	10	8	80	Pass
0.8724	9	8	88	Pass
0.8838	9	8	88	Pass
0.8952	8	7	87	Pass
0.9066	7	7	100	Pass
0.9181	7	7	100	Pass
0.9295	7	7	100	Pass
0.9409	7	7	100	Pass
0.9523	7	6	85	Pass
0.9637	7	5	71	Pass
0.9752	7	5	71	Pass
0.9866	6	5	83	Pass
0.9980	6	5	83	Pass
1.0094	6	5	83	Pass
1.0209	6	5	83	Pass
1.0323	5	5	100	Pass
1.0437	5	5	100	Pass
1.0551	5	5	100	Pass
1.0665	5	3	60	Pass
1.0780	5	3	60	Pass
1.0894	5	3	60	Pass
1.1008	5	3	60	Pass
1.1122	4	3	75	Pass
1.1236	4	3	75	Pass
1.1351	4	3	75	Pass
1.1465	4	3	75	Pass
1.1579	3	3	100	Pass
1.1693	3	1	33	Pass
1.1807	2	1	50	Pass
1.1922	2	1	50	Pass
1.2036	2	1	50	Pass
1.2150	2	0	0	Pass
1.2264	2	0	0	Pass

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1.2378	2	0	0	Pass
1.2493	2	0	0	Pass
1.2607	2	0	0	Pass
1.2721	2	0	0	Pass
1.2835	2	0	0	Pass
1.2949	2	0	0	Pass
1.3064	2	0	0	Pass

Water Quality BMP Flow and Volume for POC #1
On-line facility volume: 0.058 **acre-feet**
On-line facility target flow: 0.084 **cfs.**
Adjusted for 15 min: 0.084 **cfs.**
Off-line facility target flow: 0.0476 **cfs.**
Adjusted for 15 min: 0.0476 **cfs.**

LID Report

LID Technique	Used for Water Quality Treatment?	Total Volume Needs Treatment (ac-ft)	Volume Through Facility (ac-ft)	Infiltration Volume (ac-ft.)	Cumulative Volume Infiltration Credit	Percent Volume Infiltrated	Comment Water Quality Treated
Vault 1 POC	N	931.21			N	0.00	
Total Volume Infiltrated		931.21	0.00	0.00		0.00	0.00
	0%	No Treat. Credit					

Compliance with LID Standard 8
Duration Analysis Result = Passed

Perlnd and Implnd Changes

No changes have been made.

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WWHM2012
PROJECT REPORT

Project Name: Brodie – Onsite Perkfilter
Site Name:
Site Address:
City :
Report Date: 9/23/2022
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 : Onsite Basin
Bypass: No

GroundWater: No

Pervious Land Use	acre
C, Forest, Mod	1.31
C, Forest, Steep	5.77
Pervious Total	7.08

Impervious Land Use	acre
Impervious Total	0
Basin Total	7.08

Element Flows To:

Surface	Interflow	Groundwater

MITIGATED LAND USE

Name : Onsite Basin
Bypass: No

GroundWater: No

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Pervious Land Use	acre
C, Pasture, Flat	1.88
Pervious Total	1.88

Impervious Land Use	acre
ROADS FLAT	1.26
ROOF TOPS FLAT	2.43
DRIVEWAYS FLAT	0.4
SIDEWALKS FLAT	0.46
Impervious Total	4.55
Basin Total	6.43

Element Flows To:

Surface	Interflow	Groundwater
Vault 1	Vault 1	

Name : Vault 1
Width : 60 ft.
Length : 169 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: 1.78125 in. **Elevation:** 0 ft.
Orifice 2 Diameter: 1.75 in. **Elevation:** 3.9 ft.
Orifice 3 Diameter: 2 in. **Elevation:** 4.4 ft.

Element Flows To:

Outlet 1	Outlet 2

ANALYSIS RESULTS

Stream Protection Duration

Predeveloped Landuse Totals for POC #1
Total Pervious Area:7.08
Total Impervious Area:0

Mitigated Landuse Totals for POC #1
Total Pervious Area:1.88
Total Impervious Area:4.55

Flow Frequency Return Periods for Predeveloped. POC #1

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Return Period	Flow(cfs)
2 year	0.351495
5 year	0.573062
10 year	0.759995
25 year	1.048689
50 year	1.306358
100 year	1.604527

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0.177970
5 year	0.265189
10 year	0.338276
25 year	0.450831
50 year	0.551274
100 year	0.667685

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WWHM2012
PROJECT REPORT

Project Name: Brodie – Frontage Modular Wetland
Site Name:
Site Address:
City :
Report Date: 9/23/2022
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 : Frontage Bypass Basin
Bypass: No

GroundWater: No

Pervious Land Use	acre
C, Pasture, Flat	.2
Pervious Total	0.2

Impervious Land Use	acre
ROADS FLAT	0.28
SIDEWALKS FLAT	0.17
Impervious Total	0.45
Basin Total	0.65

Element Flows To:

Surface	Interflow	Groundwater

MITIGATED LAND USE

Name : Frontage Bypass Basin
Bypass: No

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GroundWater: No

Pervious Land Use	acre
C, Pasture, Flat	.2
Pervious Total	0.2

Impervious Land Use	acre
ROADS FLAT	0.28
SIDEWALKS FLAT	0.17
Impervious Total	0.45
Basin Total	0.65

Element Flows To:
Surface Interflow Groundwater

ANALYSIS RESULTS

Stream Protection Duration

Predeveloped Landuse Totals for POC #1
Total Pervious Area:0.2
Total Impervious Area:0.45

Mitigated Landuse Totals for POC #1
Total Pervious Area:0.2
Total Impervious Area:0.45

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.246242
5 year	0.335987
10 year	0.402043
25 year	0.493371
50 year	0.567328
100 year	0.646543

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0.246242
5 year	0.335987
10 year	0.402043
25 year	0.493371
50 year	0.567328
100 year	0.646543

Water Quality BMP Flow and Volume for POC #1
On-line facility volume: 0.058 acre-feet
On-line facility target flow: 0.084 cfs.

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Adjusted for 15 min: 0.084 **cfs.**
Off-line facility target flow: 0.0476 **cfs.**
Adjusted for 15 min: 0.0476 **cfs.**

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SECTION 5: CONVEYANCE DESIGN

The stormwater conveyance system is comprised of a network of open/closed grate catch basins, buried pipe, a concrete detention vault and a Perkfilter water quality vault, and the discharge to the existing wetland. Catch basins have been located such that each section of storm drainage pipe may adequately convey associated tributary area flows. All storm pipe located within the proposed private road was sized at the minimum diameter in accordance with the conveyance analysis.

The conveyance system was designed for the 100-year, 24-hour storm event, using the Rational Method with Everett IDF Tables. The Uniform Flow Method (Manning's Equation) was utilized to ensure that during the 100-year, 24-hour storm event, no catch basin structures would be overtopping. Conveyance analysis for the drainage system was completed using StormShed3G. See Appendix 5 for full StormShed output data as well as a visual representation of contributing conveyance basins.

The following catch basin summary table demonstrates that no catch basin structures overtop for the detention tributary drainage lines in the 100-year design storm event:

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Storm Drain Conveyance Analysis				
CB #	**Rim**	**HGL**	**Distance to Overtopping (ft)**	**Pipe Dia (in)**
CB4	420.93	412.54	8.39	**12**
CB5	415.05	412.95	2.10	**12**
CB6	416.28	413.54	2.74	**12**
CB7	418.73	409.05	9.68	**24**
CB8	418.74	409.25	9.49	**18**
CB9	415.05	409.33	5.72	**18**
CB10	411.41	409.44	1.97	**18**
CB11	411.65	409.44	2.21	**12**
CB12	409.53	409.40	0.13	**18**
CB13	409.45	409.42	0.03	**12**
CB14	416.82	413.64	3.18	**12**
CB15	419.23	415.54	3.69	**12**
CB16	427.67	424.39	3.28	**12**
CB17	436.13	433.19	2.94	**12**
CB18	437.05	433.40	3.65	**12**
CB19	427.27	424.11	3.16	**12**
CB20	432.00	427.38	4.62	**12**
CB21	425.31	422.34	2.97	**12**
CB22	426.57	423.58	2.99	**12**
CB23	426.90	423.46	3.44	**12**
CB24	429.04	425.79	3.25	**12**
CB25	429.06	425.79	3.27	**12**
CB26	436.06	432.58	3.48	**12**
CB27	436.89	433.78	3.11	**12**
CB28	446.50	443.43	3.07	**12**
CB29	445.88	443.50	2.38	**12**
CB30	447.32	443.87	3.45	**12**
CB32	401.92	397.64	4.28	**12**
CB33	403.88	398.78	5.10	**12**
CB34	400.26	399.11	1.15	**12**
CB35	403.87	402.55	1.32	**12**
CB36	404.93	403.80	1.13	**12**
CB37	405.42	403.81	1.61	**12**

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Vault Discharge Line

A conveyance capacity calculation was performed using Manning's Equation on the shallowest pipe slope (CB-2 to CB-1) within the detention discharge line to verify pipe capacity in the 100-year unmitigated storm event. A summary evaluation of pipe capacity, offered below, demonstrates compliance in an overtopping condition where the full 100-year peak flow is conveyed through the discharge line. The calculations associated with this evaluation can be found in Appendix 5.

CB-2 to CB-1:

100-Year Peak Flow Rate:	6.508 cfs (WWHM2012 - 701 Series)
Pipe Diameter:	18"
Minimum Slope:	1.00%
Pipe Flow Depth:	100%
Pipe Flow Capacity:	8.26 cfs
Evaluation:	System Adequate

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Appendix 5: Conveyance Analysis

1. StormShed3G Output Data
2. Manning's Analysis: Vault Discharge

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Appended on: Wednesday, October 12, 2022 10:17:34 AM

ROUTEHYD [] THRU [Brodie] USING [100 yr] AND [Everett] NOTZERO RELATIVE RATIONAL

Rational Method analysis

Reach ID	Area (ac)	TC (min)	i (in/hr)	Flow (cfs)	Full Q (cfs)	Full ratio	nDepth (ft)	Size	nVel (ft/s)	fVel (ft/s)	CArea
SD40	0.07	0.00	3.9213	0.2196	6.8262	0.0322	0.1229	12 in Diam	3.9712	8.6914	B37
SD39	0.19	0.1175	35.3149	5.05	3.6128	1.3978	1.00	12 in Diam	6.4299	4.60	B36
SD38	0.56	5.00	3.9213	1.4548	7.429	0.1958	0.3001	12 in Diam	7.3381	9.4589	B35
SD37	0.82	5.3748	3.7587	2.1688	3.636	0.5965	0.5564	12 in Diam	4.83	4.6295	B34
SD36	0.84	5.8613	3.5726	2.1257	3.7271	0.5703	0.5411	12 in Diam	4.9011	4.7455	B33
SD34	0.84	5.9395	3.545	2.1093	15.6003	0.1352	0.2483	12 in Diam	13.8691	19.8629	

HGL Analysis

From Node	To Node	HG El (ft)	App (ft)	Bend (ft)	Junct Loss (ft)	Adjusted HG El (ft)	Max El (ft)
							394.1606
No approach losses at node CB33 because inverts and/or crowns are offset.							
CB32	CB31	397.6346	------	0.0030	------	397.6375	401.9200
CB33	CB32	398.3026	------	0.4735	------	398.7762	403.8800
CB34	CB33	399.1672	0.0533	0.0002	------	399.1142	400.2600
CB35	CB34	402.2091	------	0.3362	------	402.5453	403.8700
CB36	CB35	403.8040	0.0012	0.0006	------	403.8034	404.9300
CB37	CB36	403.8054	------	------	------	403.8054	405.4200

Conduit Notes

Reach	HW Depth (ft)	HW/D ratio	Q (cfs)	TW Depth (ft)	Dc (ft)	Dn (ft)	Comment
SD34	0.8946	0.8946	2.11	0.6206	0.6206	0.2483	SuperCrit flow, Inlet end controls
SD36	0.9426	0.9426	2.13	0.6230	0.6230	0.5411	SuperCrit flow, Inlet end controls

SD37	1.8073	1.8073	2.17	1.4162	0.6293	0.5564	Outlet Control
SD38	0.7291	0.7291	1.45	1.0542	0.5111	0.3001	SuperCrit flow, Inlet end controls
SD39	2.3240	2.3240	5.05	1.0653	0.9195	>D	Outlet Control
SD40	2.0754	2.0754	0.22	2.0734	0.1922	0.1229	Outlet Control

Reach ID	Area (ac)	TC (min)	i (in/hr)	Flow (cfs)	Full Q (cfs)	Full ratio	nDepth (ft)	Size	nVel (ft/s)	fVel (ft/s)	CArea
SD20	0.52	11.5264	2.4037	0.7716	7.4182	0.104	0.2172	12 in Diam	6.1316	9.4452	B18
SD19	1.04	11.6079	2.3938	1.7546	24.3236	0.0721	0.1818	12 in Diam	17.9935	30.9697	B17
SD22	0.47	11.5264	2.4037	0.6129	14.4022	0.0426	0.1408	12 in Diam	9.0969	18.3375	B20
SD21	0.74	11.6051	2.3941	1.075	6.4243	0.1673	0.2763	12 in Diam	6.0837	8.1797	B19
SD18	1.81	11.6846	2.3846	2.8662	20.1719	0.1421	0.2543	12 in Diam	18.2246	25.6836	B16
SD17	0.11	0.00	3.9213	0.3882	15.5608	0.0249	0.1091	12 in Diam	8.3573	19.8127	B15
SD16	1.98	11.7495	2.3768	3.1873	16.6968	0.1909	0.2962	12 in Diam	16.3749	21.259	B14
SD15	0.46	13.2516	2.215	0.6379	5.1601	0.1236	0.2375	12 in Diam	4.4663	6.5701	B13
SD14	2.52	13.3561	2.2049	3.7196	15.2138	0.2445	0.5048	18 in Diam	7.1204	8.6092	B12
SD13	0.11	0.00	3.9213	0.3333	15.1259	0.022	0.1026	12 in Diam	7.8496	19.2589	B11
SD12	2.73	13.445	2.1963	4.0895	20.036	0.2041	0.4598	18 in Diam	8.9016	11.3381	B10
SD11	2.77	13.5649	2.1849	4.1317	15.2138	0.2716	0.534	18 in Diam	7.3239	8.6092	B9
SD27	0.07	0.00	3.9213	0.1921	5.1601	0.0372	0.1317	12 in Diam	3.1424	6.5701	B25
SD26	0.14	0.1432	31.4515	3.0822	12.7654	0.2415	0.3341	12 in Diam	13.4048	16.2535	B24
SD25	0.64	11.0851	2.4593	1.1239	5.1601	0.2178	0.3172	12 in Diam	5.2501	6.5701	B23
SD32	0.73	11.5264	2.4037	1.1922	8.2562	0.1444	0.2562	12 in Diam	7.4996	10.5121	B30
SD31	0.87	11.6064	2.394	1.422	5.1601	0.2756	0.3588	12 in Diam	5.6107	6.5701	B29
SD30	1.10	11.6984	2.3829	1.8253	17.9792	0.1015	0.2148	12 in Diam	14.7389	22.8918	B28

SD29	0.03	0.00	3.9213	0.1059	13.3663	0.0079	0.063	12 in Diam	5.121	17.0185	B27
SD28	1.18	11.7957	2.3714	1.9706	16.5768	0.1189	0.2333	12 in Diam	14.1523	21.1062	B26
SD24	1.87	11.9017	2.359	3.128	11.1215	0.2813	0.3628	12 in Diam	12.1594	14.1603	B22
SD23	2.07	11.9442	2.3541	3.4793	19.726	0.1764	0.2839	12 in Diam	18.9549	25.1159	B21
SD10	5.24	13.731	2.1694	7.9833	32.7648	0.2437	0.6717	24 in Diam	8.6192	10.4293	B8
SD9	5.39	13.7813	2.1647	8.2282	32.7648	0.2511	0.6831	24 in Diam	8.6823	10.4293	B7

HGL Analysis

From Node	To Node	HG El (ft)	App (ft)	Bend (ft)	Junct Loss (ft)	Adjusted HG El (ft)	Max El (ft)
							409.00
CB7	VAULT IN 2	409.1455	0.1003	0.0015	------	409.0467	418.7300
CB8	CB7	409.1824	0.0849	0.1145	0.0418	409.2539	418.7400
CB9	CB8	409.4096	0.0832	0.0019	------	409.3283	415.0500
CB10	CB9	409.4743	0.0688	0.0299	0.0050	409.4404	411.4100
CB12	CB10	409.5457	0.2557	0.0729	0.0392	409.4021	409.5300
CB14	CB12	413.6142	------	0.0012	0.0221	413.6375	416.8200
CB16	CB14	424.3357	------	0.0229	0.0303	424.3889	427.6700
CB17	CB16	433.0012	------	0.1860	------	433.1872	436.1300
CB18	CB17	433.3996	------	------	------	433.3996	437.0500
CB19	CB16	424.4369	1.2850	0.9608	------	424.1127	427.2700
CB20	CB19	427.3799	------	------	------	427.3799	432.0000
CB15	CB14	415.5353	------	------	------	415.5353	419.2300
CB13	CB12	409.4186	------	------	------	409.4186	409.4500
CB11	CB10	409.4449	------	------	------	409.4449	411.6500
CB21	CB8	422.2453	------	0.0961	------	422.3414	425.3100
CB22	CB21	423.5033	------	0.0366	0.0362	423.5761	426.5700
CB23	CB22	423.6275	0.2391	0.0750	------	423.4634	426.9000
CB24	CB23	425.7908	------	0.0004	------	425.7912	429.0400
CB25	CB24	425.7927	------	------	------	425.7927	429.0600
CB26	CB22	432.4066	------	0.0111	0.1608	432.5785	436.0600
CB28	CB26	442.7932	------	0.6321	------	443.4253	446.5000

CB29	CB28	443.5099	0.0358	0.0298	------	443.5039	445.8800
CB30	CB29	443.8726	------	------	------	443.8726	447.3200
CB27	CB26	433.7848	------	------	------	433.7848	436.8900

Conduit Notes

Reach	HW Depth (ft)	HW/D ratio	Q (cfs)	TW Depth (ft)	Dc (ft)	Dn (ft)	Comment
SD9	8.1455	4.0727	8.23	8.0000	1.0221	0.6831	Outlet Control
SD10	7.9024	3.9512	7.98	7.7667	1.0060	0.6717	Outlet Control
SD11	7.3696	4.9130	4.13	7.2139	0.7788	0.5340	Outlet Control
SD12	6.7043	4.4696	4.09	6.5583	0.7746	0.4598	Outlet Control
SD14	5.6657	3.7771	3.72	5.5604	0.7370	0.5048	Outlet Control
SD16	1.2942	1.2942	3.19	5.1421	0.7650	0.2962	SuperCrit flow, Inlet end controls
SD18	1.1657	1.1657	2.87	1.3175	0.7264	0.2543	SuperCrit flow, Inlet end controls
SD19	0.7212	0.7212	1.75	1.2189	0.5638	0.1818	SuperCrit flow, Inlet end controls
SD20	0.4996	0.4996	0.77	0.9072	0.3670	0.2172	SuperCrit flow, Inlet end controls
SD21	1.2664	1.2664	1.07	1.2189	0.4361	0.2763	Outlet Control
SD22	0.4099	0.4099	0.61	0.4927	0.3257	0.1408	SuperCrit flow, Inlet end controls
SD17	0.3053	0.3053	0.39	1.3175	0.2575	0.1091	SuperCrit flow, Inlet end controls
SD15	5.1586	5.1586	0.64	5.1421	0.3326	0.2375	Outlet Control
SD13	5.5649	5.5649	0.33	5.5604	0.2380	0.1026	Outlet Control
SD23	1.4153	1.4153	3.48	7.7139	0.7973	0.2839	SuperCrit flow, Inlet end controls
SD24	1.2333	1.2333	3.13	1.5114	0.7581	0.3628	SuperCrit flow, Inlet end controls
SD25	1.3575	1.3575	1.12	1.3061	0.4464	0.3172	Outlet Control
SD26	1.2208	1.2208	3.08	0.9134	0.7527	0.3341	SuperCrit flow, Inlet end controls
SD27	1.2227	1.2227	0.19	1.2212	0.1799	0.1317	Outlet Control
SD28	0.8466	0.8466	1.97	1.3061	0.5990	0.2333	SuperCrit flow, Inlet end controls
SD30	0.7932	0.7932	1.83	1.0185	0.5756	0.2148	SuperCrit flow, Inlet end controls
SD31	1.5099	1.5099	1.42	1.4253	0.5050	0.3588	Outlet Control

SD32	0.6426	0.6426	1.19	1.1939	0.4603	0.2562	SuperCrit flow, Inlet end controls
SD29	0.1448	0.1448	0.11	1.0185	0.1320	0.0630	SuperCrit flow, Inlet end controls

Reach ID	Area (ac)	TC (min)	i (in/hr)	Flow (cfs)	Full Q (cfs)	Full ratio	nDepth (ft)	Size	nVel (ft/s)	fVel (ft/s)	CArea
SD8	0.27	5.00	3.9213	0.8431	11.6874	0.0721	0.1818	12 in Diam	8.6458	14.8809	B6
SD7	0.47	5.0463	3.9002	1.4587	11.2306	0.1299	0.2433	12 in Diam	9.8723	14.2992	B5
SD6	0.69	11.5264	2.4037	1.2235	16.0524	0.0762	0.1865	12 in Diam	12.0937	20.4385	B4

HGL Analysis

From Node	To Node	HG El (ft)	App (ft)	Bend (ft)	Junct Loss (ft)	Adjusted HG El (ft)	Max El (ft)
							409.00
CB4	VAULT IN 1	410.6172	------	1.9255	------	412.5426	420.9300
CB5	CB4	412.6373	1.1607	1.4768	------	412.9533	415.0500
CB6	CB5	413.5404	------	------	------	413.5404	416.2800

Conduit Notes

Reach	HW Depth (ft)	HW/D ratio	Q (cfs)	TW Depth (ft)	Dc (ft)	Dn (ft)	Comment
SD6	0.6172	0.6172	1.22	2.0000	0.4666	0.1865	SuperCrit flow, Inlet end controls
SD7	2.6373	2.6373	1.46	2.5426	0.5118	0.2433	Outlet Control
SD8	0.5104	0.5104	0.84	1.1533	0.3844	0.1818	SuperCrit flow, Inlet end controls

Node and Reach invert report

Licensed to: Debug License

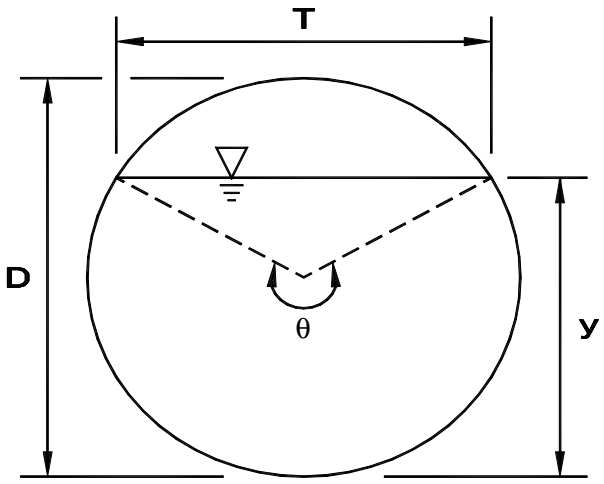
Node and Reach invert report

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

Project Name: Brodie Plat
Description: Vault Outfall Conveyance

Project No.: C22-177
Date: 10/12/2022
Calc. By: RKF

Pipe Diameter (D) =	18	in
Pipe Slope (S) =	1.00	%
Flow Depth (y) =	1.00	ft
Flowrate (Q) =	**8.26**	**cfs**
Mannings Coeff. (n) =	0.013	
Theta Angle (θ) =	3.82	rad
Wetted Area (A) =	1.25	ft^2
Wet. Perimeter (P) =	2.87	ft
Hydraulic Radius (R) =	0.44	ft
Top Width (T) =	1.41	ft
Flow Velocity =	6.60	fps



Formulas:

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

If y ≤ r : $\theta = 2a\cos(\frac{r-y}{r})$ 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): $T = \sin\left(\theta/2\right)d$

SECTION 6: OPERATIONS AND MAINTENANCE MANUAL

The proposed storm drainage system consists of buried pipes, catch basins, a detention vault, and a perkfilter water quality treatment structure and a modular wetland water quality treatment structure. 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.

Oldcastle Infrastructure™
A CRH COMPANY

PERKFILTER™

Inspection and Maintenance Guide

Water

PerkFilter™ Media Filtration System

Description

The PerkFilter is a stormwater treatment device used to remove pollutants from urban runoff. Impervious surfaces and other urban and suburban landscapes generate a variety of contaminants that can enter stormwater and pollute downstream receiving waters. The PerkFilter is a media-filled cartridge filtration device designed to capture and retain sediment, gross solids, metals, nutrients, hydrocarbons, and trash and debris. As with any stormwater treatment system, the PerkFilter requires periodic maintenance to sustain optimum system performance.

Function

The PerkFilter is a water quality treatment system consisting of three chambers: an inlet chamber, a filter cartridge treatment chamber, and an outlet chamber (Figure 1). Stormwater runoff enters the inlet chamber through an inlet pipe, curb opening, or grated inlet. Gross solids are settled out, and floating trash and debris are trapped in the inlet chamber. Pretreated flow is then directed to the treatment chamber through an opening in the baffle wall between the inlet chamber and treatment chamber. The treatment chamber contains media-filled filter cartridges (Figure 2) that use physical and chemical processes to remove pollutants. During a storm event, runoff pools in the treatment chamber before passing radially through the cylindrical cartridges from the outside surface, through the media for treatment, and into the center of the cartridge. At the center of the cartridge is a center tube assembly designed to distribute the hydraulic load evenly across the surface of the filter cartridge and control the treatment flow rate. The center tube assembly discharges treated flow through the false floor and into the outlet chamber. A draindown feature built into each cartridge allows the treatment chamber to dewater between storm events.

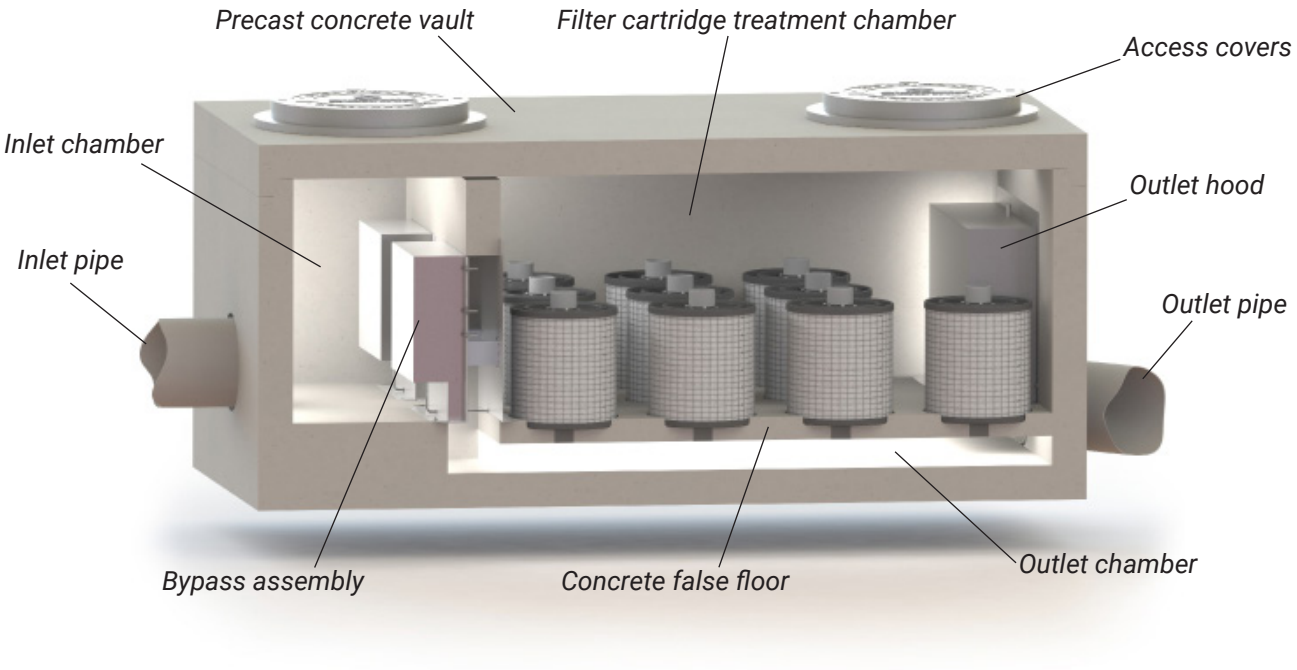


Figure 1. Schematic of the PerkFilter system.

All PerkFilter systems include a high-flow bypass assembly to divert flow exceeding the treatment capacity of the filter cartridges around the treatment chamber. The bypass assembly routes peak flow from the inlet chamber directly to the outlet chamber, bypassing the treatment chamber to prevent sediment and other captured pollutants from being scoured and re-entrained by high flow. Treated flow and bypass flow merge in the outlet chamber for discharge by a single outlet pipe.

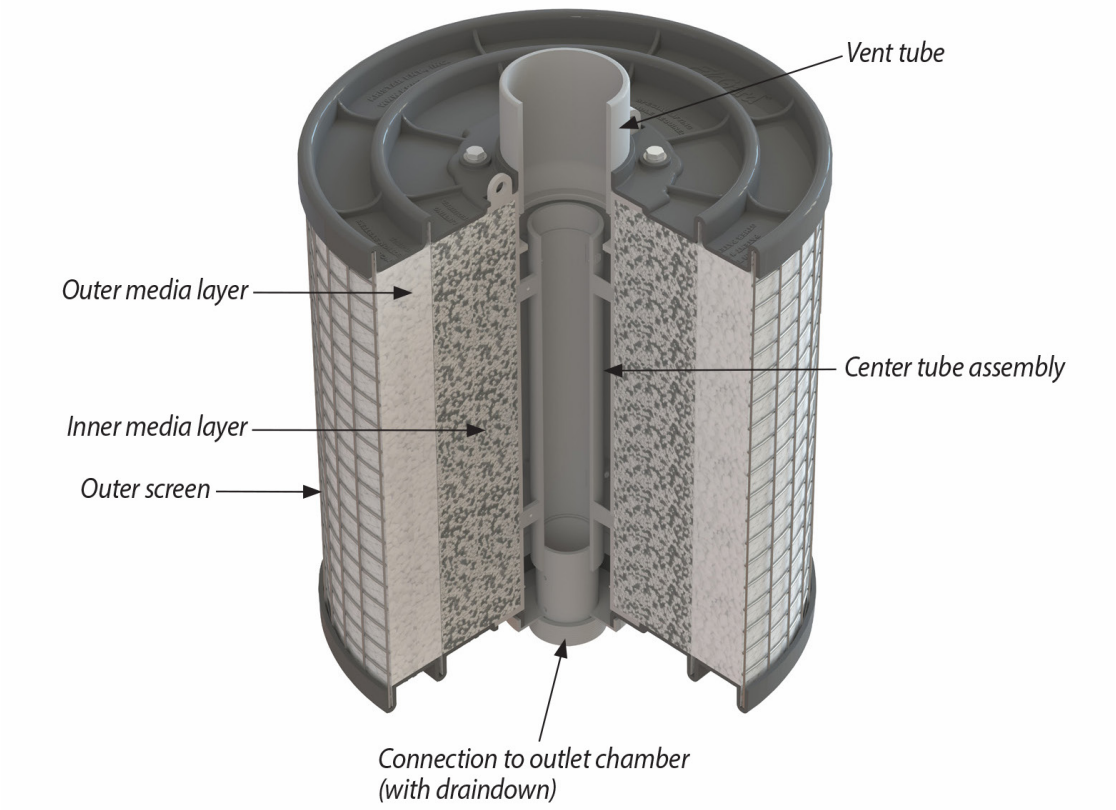


Figure 2. Schematic of PerkFilter cartridge.

Configuration

The PerkFilter structure may consist of a vault, manhole, or catch basin configuration. Catch basin units may be fabricated from concrete or steel. Internal components including the PerkFilter cartridges are manufactured from durable plastic and stainless steel components and hardware. All cartridges are 18 inches in diameter and are available in two heights: 12-inch and 18-inch. Cartridges may be used alone or may be stacked (Figure 3) to provide 24-inch and 30-inch combinations. The capacity of each cartridge or cartridge combination is dictated by the allowable operating rate of the media and the outer surface area of the cartridge. Thus, taller cartridges have greater treatment capacity than shorter cartridges, but they also require more hydraulic drop across the system. Cartridges may be filled with various media depending on the target pollutants and desired treatment rate, among other factors.

Access to an installed PerkFilter system is typically provided by ductile iron castings or hatch covers. The location and number of access appurtenances is dependent on the size and configuration of the system.

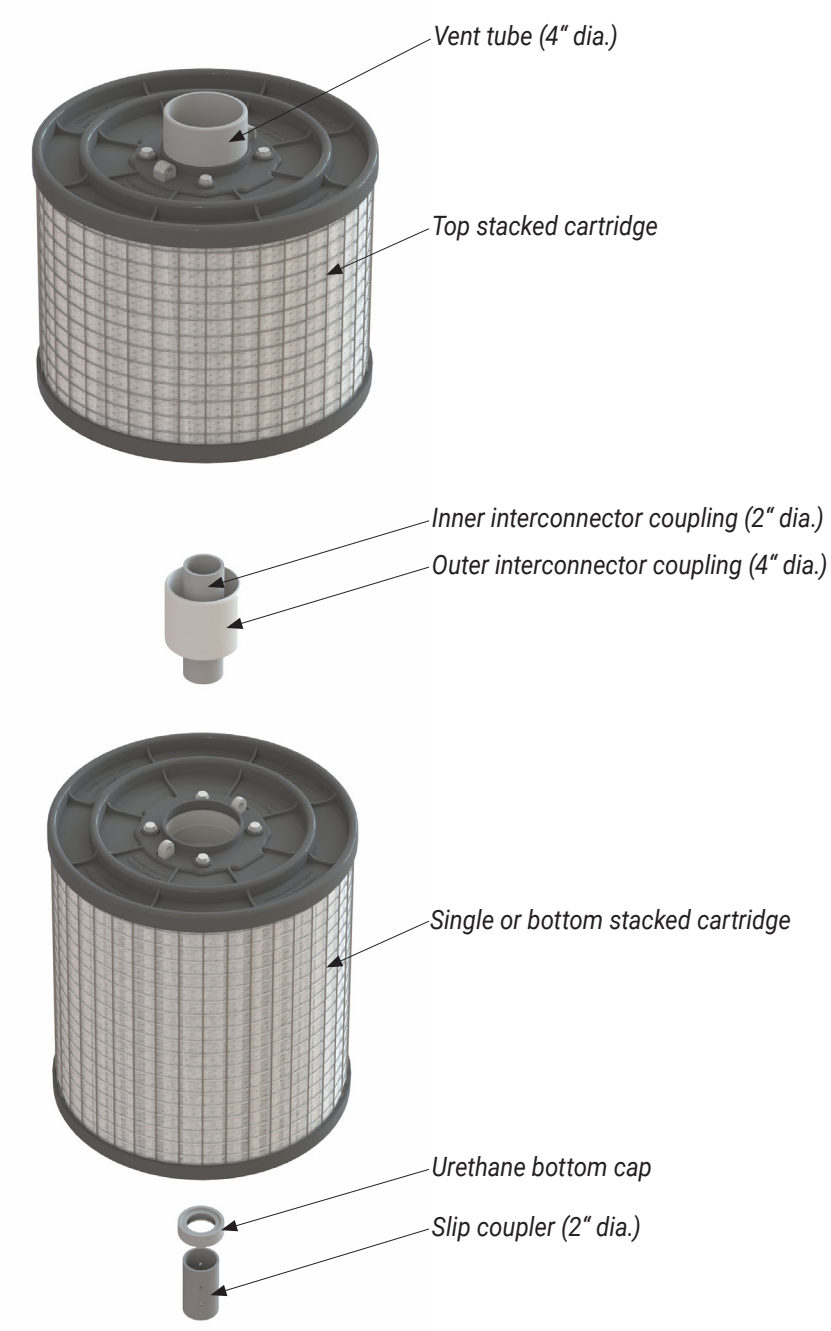


Figure 3. Schematic of stacked cartridges and connector components.

Maintenance Overview

State and local regulations require all stormwater management systems to be inspected on a periodic basis and maintained as necessary to ensure performance and protect downstream receiving waters. Maintenance prevents excessive pollutant buildup that can limit system performance by reducing the operating capacity and increasing the potential for scouring of pollutants during periods of high flow.

Inspection and Maintenance Frequency

The PerkFilter should be inspected on a periodic basis, typically twice per year, and maintained as required. Initially, inspections of a new system should be conducted more frequently to help establish an appropriate site-specific inspection frequency. The maintenance frequency will be driven by the amount of runoff and pollutant loading encountered by a given system. In most cases, the optimum maintenance interval will be one to three years. Inspection and maintenance activities should be performed only during dry weather periods.

Inspection Equipment

The following equipment is helpful when conducting PerkFilter inspections:

- Recording device (pen and paper form, voice recorder, iPad, etc.)
- Suitable clothing (appropriate footwear, gloves, hardhat, safety glasses, etc.)
- Traffic control equipment (cones, barricades, signage, flagging, etc.)
- Socket and wrench for bolt-down access covers
- Manhole hook or pry bar
- Flashlight
- Tape measure
- Measuring stick or sludge sampler
- Long-handled net (optional)

Inspection Procedures

PerkFilter inspections are visual and may be conducted from the ground surface without entering the unit. To complete an inspection, safety measures including traffic control should be deployed before the access covers are removed. Once the covers have been removed, the following items should be checked and recorded (see form provided at the end of this document) to determine whether maintenance is required:

- Inspect the internal components and note whether there are any broken or missing parts. In the unlikely event that internal parts are broken or missing, contact Oldcastle Infrastructure at (800) 579-8819 to determine appropriate corrective action.
- Note whether the inlet pipe is blocked or obstructed. The outlet pipe is covered by a removable outlet hood and cannot be observed without entering the unit.
- Observe, quantify and record the accumulation of floating trash and debris in the inlet chamber. The significance of accumulated floating trash and debris is a matter of judgment. A long-handled net may be used to retrieve the bulk of trash and debris at the time of inspection if full maintenance due to accumulation of floating oils or settled sediment is not yet warranted.

- Observe, quantify and record the accumulation of oils in the inlet chamber. The significance of accumulated floating oils is a matter of judgment. However, if there is evidence of an oil or fuel spill, immediate maintenance by appropriate certified personnel is warranted.
- Observe, quantify and record the average accumulation of sediment in the inlet chamber and treatment chamber. A calibrated dipstick, tape measure, or sludge sampler may be used to determine the amount of accumulated sediment in each chamber. The depth of sediment may be determined by calculating the difference between the measurement from the rim of the PerkFilter to the top of the accumulated sediment, and the measurement from the rim of the PerkFilter to the bottom of the PerkFilter structure. Finding the top of the accumulated sediment below standing water takes some practice and a light touch, but increased resistance as the measuring device is lowered toward the bottom of the unit indicates the top of the accumulated sediment.
- Finally, observe, quantify and record the amount of standing water in the treatment chamber around the cartridges. If standing water is present, do not include the depth of sediment that may have settled out below the standing water in the measurement.

Maintenance Triggers

Maintenance should be scheduled if any of the following conditions are identified during the inspection:

- Internal components are broken or missing.
- Inlet piping is obstructed.
- The accumulation of floating trash and debris that cannot be retrieved with a net and/or oil in the inlet chamber is significant.
- There is more than 6” of accumulated sediment in the inlet chamber.
- There is more than 4” of accumulated sediment in the treatment chamber.
- There is more than 4” of standing water in the treatment chamber more than 24 hours after end of rain event.
- A hazardous material release (e.g. automotive fluids) is observed or reported.
- The system has not been maintained for 3 years (wet climates) to 5 years (dry climates).

Maintenance Equipment

The following equipment is helpful when conducting PerkFilter maintenance:

- Suitable clothing (appropriate footwear, gloves, hardhat, safety glasses, etc.)
- Traffic control equipment (cones, barricades, signage, flagging, etc.)
- Socket and wrench for bolt-down access covers
- Manhole hook or pry bar
- Confined space entry equipment, if needed
- Flashlight
- Tape measure
- 9/16” socket and wrench to remove hold-down struts and filter cartridge tops
- Replacement filter cartridges
- Vacuum truck with water supply and water jet

Contact Oldcastle Infrastructure at (800) 579-8819 for replacement filter cartridges. A lead time of four weeks is recommended.

Maintenance Procedures

Maintenance should be conducted during dry weather when no flow is entering the system. Confined space entry is necessary to maintain vault and manhole PerkFilter configurations. Only personnel that are OSHA Confined Space Entry trained and certified may enter underground structures. Confined space entry is not required for catch basin PerkFilter configurations. Once safety measures such as traffic control are deployed, the access covers may be removed and the following activities may be conducted to complete maintenance:

- Remove floating trash, debris and oils from the water surface in the inlet chamber using the extension nozzle on the end of the boom hose of the vacuum truck. Continue using the vacuum truck to completely dewater the inlet chamber and evacuate all accumulated sediment from the inlet chamber. Some jetting may be required to fully remove sediment. The inlet chamber does not need to be refilled with water after maintenance is complete. The system will fill with water when the next storm event occurs.
- Remove the hold-down strut from each row of filter cartridges and then remove the top of each cartridge (the top is held on by four 9/16" bolts) and use the vacuum truck to evacuate the spent media. When empty, the spent cartridges may be easily lifted off their slip couplers and removed from the vault. The couplers may be left inserted into couplings cast into the false floor to prevent sediment and debris from being washed into the outlet chamber during washdown.
- Once all the spent cartridges have been removed from the structure, the vacuum truck may be used to evacuate all accumulated sediment from the treatment chamber. Some jetting may be required to fully remove sediment. Take care not to wash sediment and debris through the openings in the false floor and into the outlet chamber. All material removed from the PerkFilter during maintenance including the spent media must be disposed of in accordance with local, state, and/or federal regulations. In most cases, the material may be handled in the same manner as disposal of material removed from sumped catch basins or manholes.
- Place a fresh cartridge in each cartridge position using the existing slip couplers and urethane bottom caps. If the vault is equipped with stacked cartridges, the existing outer and inner interconnector couplers must be used between the stacked cartridges to provide hydraulic connection. Transfer the existing vent tubes from the spent cartridges to the fresh cartridges. Finally, refit the struts to hold the fresh cartridges in place.
- Securely replace access covers, as appropriate.
- Make arrangements to return the empty spent cartridges to Oldcastle Infrastructure.

PerkFilter
Inspection and Maintenance Log

Location_____

Structure Configuration and Size:

Inspection Date_____

☐ Vault _____feet x _____feet
☐ Manhole _____feet diameter
☐ Catch Basin _____feet x _____feet

Number and Height of Cartridge Stacks:

Count____each ☐12" ☐ 18" ☐ 24" ☐ 30"

Media Type:

☐ ZPC ☐ Perlite ☐ Other_____

Condition of Internal Components ☐ Good ☐ Damaged ☐ Missing	Notes:
Inlet or Outlet Blockage or Obstruction ☐ Yes ☐ No	Notes:
Floating Trash and Debris ☐ Significant ☐ Not Significant	Notes:
Floating Oils ☐ Significant ☐ Not Significant ☐ Spill	Notes:
Sediment Depth in Inlet Chamber ☐ Inches of Sediment:_____	Notes:
Sediment Depth in Treatment Chamber ☐ Inches of Sediment:_____	Notes:
Standing Water in Treatment Chamber ☐ Inches of Standing Water:_____	Notes:

Maintenance Required

☐ **Yes - Schedule Maintenance** ☐ **No - Inspect Again in _____ Months**

PERKFILTER™

OUR MARKETS

BUILDING STRUCTURES

COMMUNICATIONS

WATER

ENERGY

TRANSPORTATION

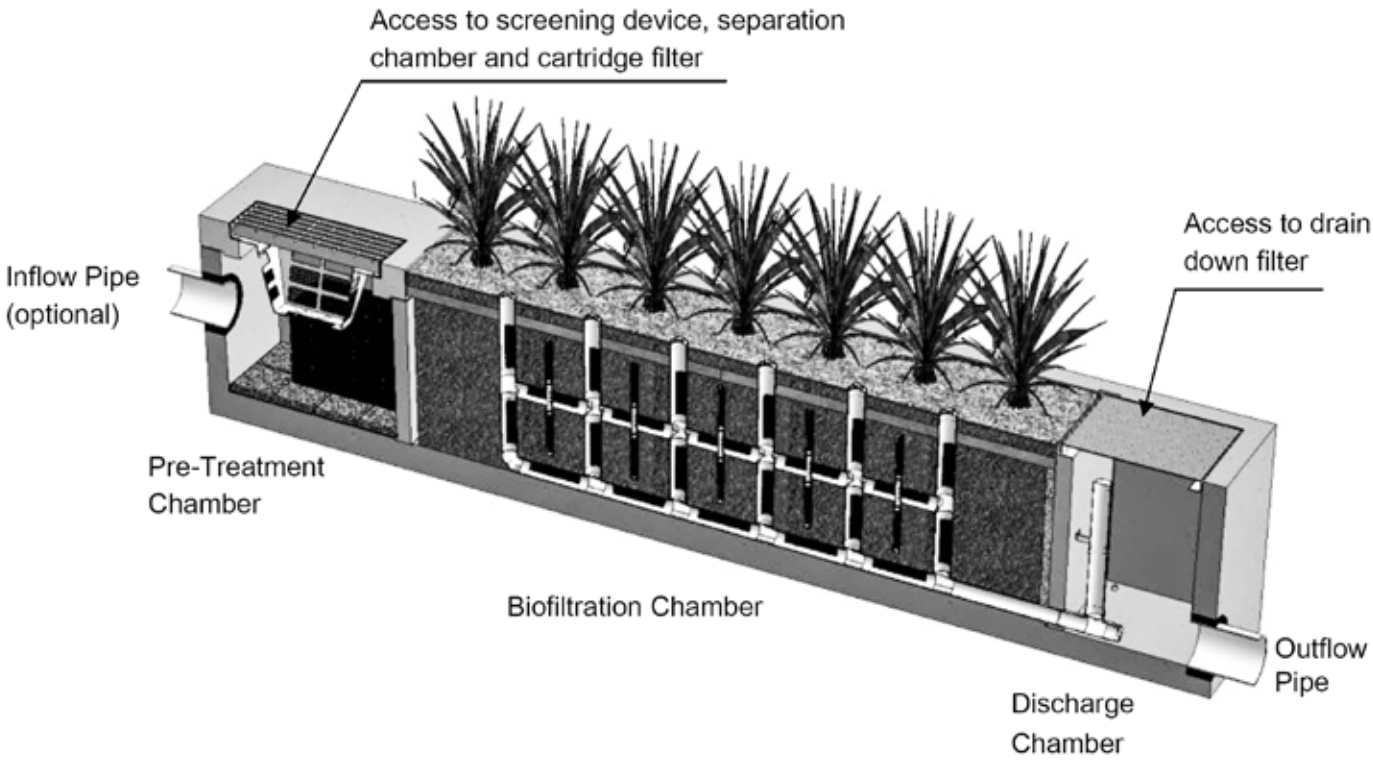
CONTECH®
ENGINEERED SOLUTIONS

Modular Wetlands® Linear
Operation & Maintenance Manual

MODULAR WETLANDS®

Maintenance Summary

- Remove Trash from Screening Device – average maintenance interval is 6 to 12 months.
  - *(5 minute average service time).*
- Remove Sediment from Separation Chamber – average maintenance interval is 12 to 24 months.
  - *(10 minute average service time).*
- Replace Cartridge Filter Media – average maintenance interval 12 to 24 months.
  - *(10-15 minute per cartridge average service time).*
- Replace Drain Down Filter Media – average maintenance interval is 12 to 24 months.
  - *(5 minute average service time).*
- Trim Vegetation – average maintenance interval is 6 to 12 months.
  - *(Service time varies).*



System Diagram

Maintenance Procedures

Screening Device

1. Remove grate or manhole cover to gain access to the screening device in the Pre- Treatment Chamber. Vault type units do not have screening device. Maintenance can be performed without entry.
2. Remove all pollutants collected by the screening device. Removal can be done manually or with the use of a vacuum truck.
3. Screening device can easily be removed from the Pre-Treatment Chamber to gain access to separation chamber and media filters below. Replace grate or manhole cover when completed.

Separation Chamber

1. Perform maintenance procedures of screening device listed above before maintaining the separation chamber.
2. With a pressure washer, spray down pollutants accumulated on walls and cartridge filters.
3. Vacuum out Separation Chamber and remove all accumulated pollutants. Replace screening device, grate or manhole cover when completed.

Cartridge Filters

1. Perform maintenance procedures on screening device and separation chamber before maintaining cartridge filters.
2. Enter separation chamber.
3. Unscrew the two bolts holding the lid on each cartridge filter and remove lid.
4. Remove each of 4 to 8 media cages holding the media in place.
5. Spray down the cartridge filter to remove any accumulated pollutants.
6. Vacuum out old media and accumulated pollutants.
7. Reinstall media cages and fill with new media from manufacturer or outside supplier. Manufacturer will provide specification of media and sources to purchase.
8. Replace the lid and tighten down bolts. Replace screening device, grate or manhole cover when completed.

Drain Down Filter

1. Remove hatch or manhole cover over discharge chamber and enter chamber. Entry into chambers may require confined space training based on state and local regulations.
2. Unlock and lift drain down filter housing and remove old media block. Replace with new media block. Lower drain down filter housing and lock into place.
3. Exit chamber and replace hatch or manhole cover.

Maintenance Notes

1. Following maintenance and/or inspection, it is recommended the maintenance operator prepare a maintenance/ inspection record. The record should include any maintenance activities performed, amount and description of debris collected, and condition of the system and its various filter mechanisms.
2. The owner should keep maintenance/inspection record(s) for a minimum of five years from the date of maintenance. These records should be made available to the governing municipality for inspection upon request at any time.
3. Transport all debris, trash, organics and sediments to approved facility for disposal in accordance with local and state requirements.
4. Entry into chambers may require confined space training based on state and local regulations.
5. No fertilizer shall be used in the Biofiltration Chamber.
6. Irrigation should be provided as recommended by manufacturer and/or landscape architect. Amount of irrigation required is dependent on plant species. Some plants may require irrigation.

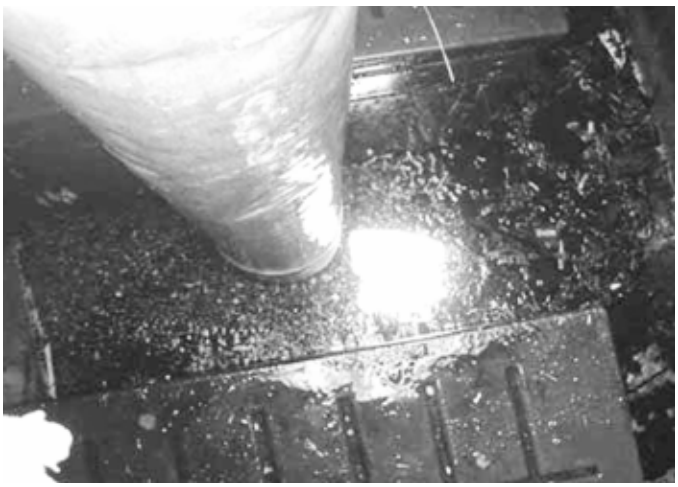
Maintenance Procedure Illustration

Screening Device

The screening device is located directly under the manhole or grate over the Pre-Treatment Chamber. It's mounted directly underneath for easy access and cleaning. Device can be cleaned by hand or with a vacuum truck.

Separation Chamber

The separation chamber is located directly beneath the screening device. It can be quickly cleaned using a vacuum truck or by hand. A pressure washer is useful to assist in the cleaning process.



Cartridge Filters

The cartridge filters are located in the Pre-Treatment chamber connected to the wall adjacent to the biofiltration chamber. The cartridges have removable tops to access the individual media filters. Once the cartridge is open media can be easily removed and replaced by hand or a vacuum truck.

Drain Down Filter

The drain down filter is located in the Discharge Chamber. The drain filter unlocks from the wall mount and hinges up. Remove filter block and replace with new block.

Trim Vegetation

Vegetation should be maintained in the same manner as surrounding vegetation and trimmed as needed. No fertilizer shall be used on the plants. Irrigation per the recommendation of the manufacturer and or landscape architect. Different types of vegetation requires different amounts of irrigation.

CONTECH® ENGINEERED SOLUTIONS

Inspection Report
Modular Wetlands Linear

Project Name _____

Project Address _____
(city) (Zip Code)

Owner / Management Company _____

Contact _____ Phone ( ) –

For Office Use Only
(Reviewed By)
(Date)
Office personnel to complete section to the left.

Inspector Name _____ Date ____/____/____ Time _____ AM / PM

Type of Inspection ☐ Routine ☐ Follow Up ☐ Complaint ☐ Storm Storm Event in Last 72-hours? ☐ No ☐ Yes

Weather Condition _____ Additional Notes _____

Inspection Checklist

Modular Wetland System Type (Curb, Grate or UG Vault): _____ Size (22', 14' or etc.): _____

Structural Integrity:	**Yes**	**No**	**Comments**
Damage to pre-treatment access cover (manhole cover/grate) or cannot be opened using normal lifting pressure?			
Damage to discharge chamber access cover (manhole cover/grate) or cannot be opened using normal lifting pressure?			
Does the MWS unit show signs of structural deterioration (cracks in the wall, damage to frame)?			
Is the inlet/outlet pipe or drain down pipe damaged or otherwise not functioning properly?			
Working Condition:			
Is there evidence of illicit discharge or excessive oil, grease, or other automobile fluids entering and clogging the unit?			
Is there standing water in inappropriate areas after a dry period?			
Is the filter insert (if applicable) at capacity and/or is there an accumulation of debris/trash on the shelf system?			
Does the depth of sediment/trash/debris suggest a blockage of the inflow pipe, bypass or cartridge filter? If yes, specify which one in the comments section. Note depth of accumulation in in pre-treatment chamber.			Depth:
Does the cartridge filter media need replacement in pre-treatment chamber and/or discharge chamber?			Chamber:
Any signs of improper functioning in the discharge chamber? Note issues in comments section.			
Other Inspection Items:			
Is there an accumulation of sediment/trash/debris in the wetland media (if applicable)?			
Is it evident that the plants are alive and healthy (if applicable)? Please note Plant Information below.			
Is there a septic or foul odor coming from inside the system?			

Waste:	**Yes**	**No**
Sediment / Silt / Clay		
Trash / Bags / Bottles		
Green Waste / Leaves / Foliage		

Recommended Maintenance	
No Cleaning Needed	
Schedule Maintenance as Planned	
Needs Immediate Maintenance	

Plant Information	
Damage to Plants	
Plant Replacement	
Plant Trimming	

Additional Notes: _____

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Cleaning and Maintenance Report
Modular Wetlands Linear

Project Name _____

Project Address _____
(city) (Zip Code)

Owner / Management Company _____

Contact _____ Phone ( ) –

Inspector Name _____ Date ____/____/____ Time _____ AM / PM

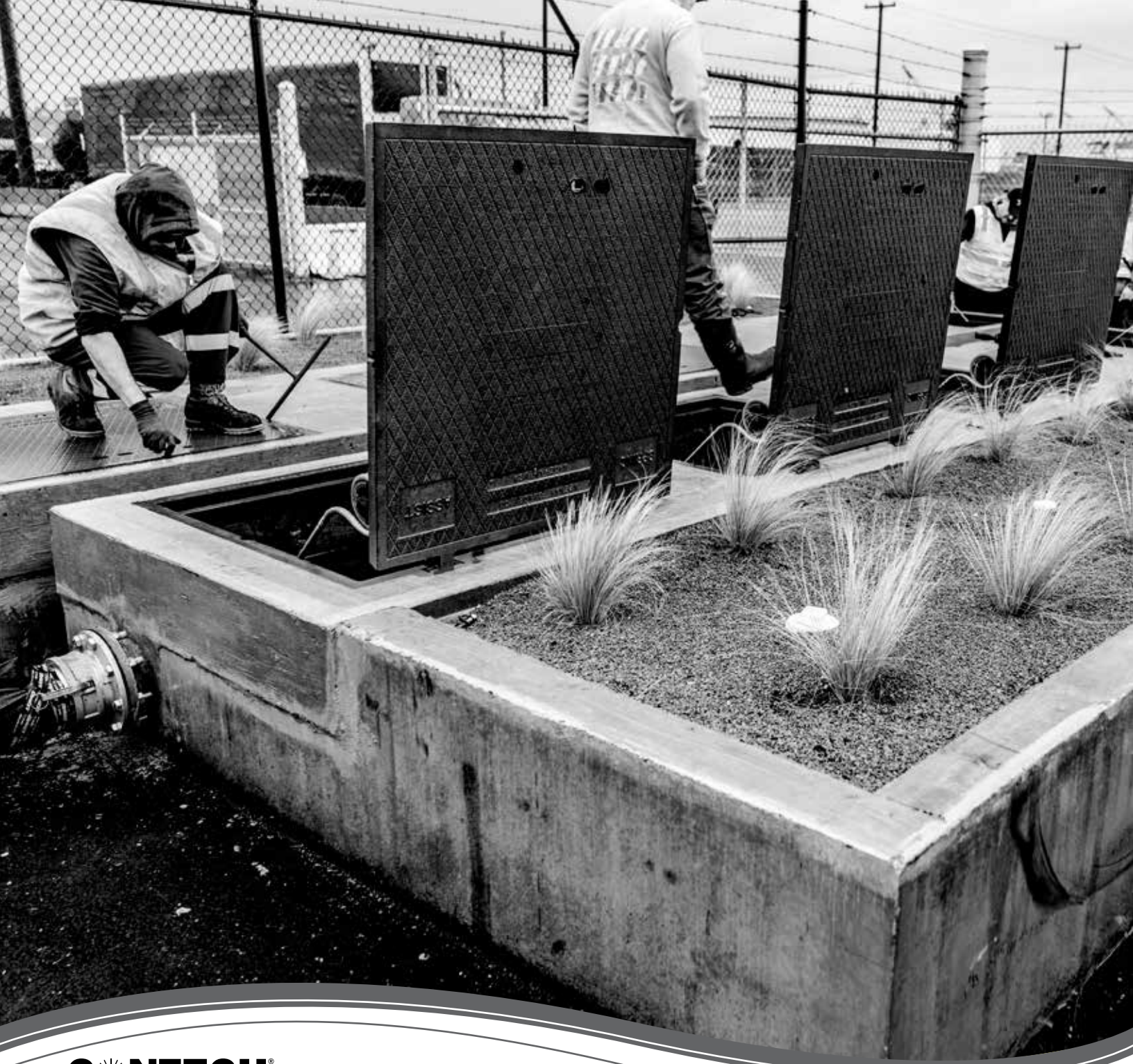
For Office Use Only
(Reviewed By)
(Date)
Office personnel to complete section to the left.

Type of Inspection ☐ Routine ☐ Follow Up ☐ Complaint ☐ Storm Storm Event in Last 72-hours? ☐ No ☐ Yes

Weather Condition _____ Additional Notes _____

Site Map #	GPS Coordinates of Insert	Manufacturer / Description / Sizing	Trash Accumulation	Foliage Accumulation	Sediment Accumulation	Total Debris Accumulation	Condition of Media 25/50/75/100 (will be changed @ 75%)	Operational Per Manufactures' Specifications (If not, why?)
	Lat: Long:	MWS Catch Basins						
		MWS Sedimentation Basin						
		Media Filter Condition						
		Plant Condition						
		Drain Down Media Condition						
		Discharge Chamber Condition						
		Drain Down Pipe Condition						
		Inlet and Outlet Pipe Condition						

Comments:



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SUPPORT

DRAWINGS AND SPECIFICATIONS ARE AVAILABLE AT WWW.CONTECHES.COM

Modular Wetlands Maintenance Guide 08/22

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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