

Minor Property

Preliminary Drainage Report

Presented to: City of Marysville



Minor Property

Preliminary Drainage Report

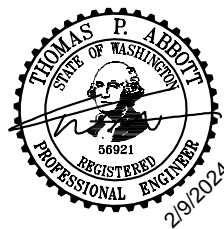
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Approved by
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Job No: 23-0011

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SECTION 1: PROJECT OVERVIEW

The proposed Minor project is approximately a 3.94-acre site. The project is a single-family Residential development on parcel #00590700017600 and addressed at 8512 E Sunnyside School Road, Marysville WA, 98270. The project proposes to construct 29 new single-family lots along with associated private and public utilities proposed to serve project development. The site will gain access from the adjacent Cornelius/Lacey project to the west. No frontage improvements along E Sunnyside School Rd will be required. See the Vicinity Map in Appendix 1 for visual representation of the subject property.

Existing Site

The parcel #00590700017600 is currently occupied by one single family home with associated outbuildings taking access from E Sunnyside School Rd. The central portion of the site containing the existing home consists of impervious surfaces associated with the buildings and paved driveways, while the rest of the site contains lawn and landscape. Existing topography generally descends to the north/northeast along moderate slopes, towards conveyance ditches along E Sunnyside School Rd. The project parcel is currently zoned WR-R-6-18 in the City of Marysville.

The proposed development currently straddles two stormwater threshold discharge basins (TDAs) since site runoff from developed surfaces splits to either the Northwest or southeast upon reaching the E Sunnyside School Rd conveyance system, prior to reaching the ¼ mile boundary downstream of the project site.

A Geotechnical Report has been prepared by Terra Associates on January 25, 2024 on the site. The report indicates “relatively high soil fines content, evidence of shallow perched groundwater, and the underlying presence of dense to very dense, cemented, till and till-like soils.” As a result, Terra does not recommend using infiltration for stormwater control onsite.

Proposed Development

The proposed single-family project will construct 29 new single-family lots and will gain access from the adjacent Cornelius/Lacey project to the west upon its completion. Frontage improvements along E Sunnyside School Rd will not be required.

Proposed Drainage System

This project is designed to comply with the 2019 Department of Ecology Stormwater Manual for Western Washington (2019 DOE SWMMWW). Stormwater will be mitigated via two detention vaults located along the northwestern and eastern portions of the site. Prior to vault intake, Perfilter cartridge filtration units will be used to treat stormwater runoff to meet basic water quality treatment requirements. The proposed detention vault systems will each discharge to their respective existing frontage conveyance ditches in E Sunnyside School Rd, thus maintaining the site's two natural discharge flow paths.

Onsite development will create 2.42 AC of new impervious surfaces which will be collected by either of the two detention vaults for mitigation and stormwater quality treatment. These areas are considered to be within the two Onsite Basins for stormwater modeling, which are referred to as Onsite Basin 1 and Onsite Basin 2 respectively. Upstream run-on from the property to the south will be collected and contribute to the Onsite Basin 2. Runoff from surfaces unable to be collected due to vertical constraints, approximately 0.16 AC, will be considered to bypass detention and be within the Bypass Basin(s).

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 ponds. See Section 2.0 for discussion of how SWPPP Elements are addressed.

Minimum Requirements

Per the 2019 DOE Manual, Minimum Requirements 1-9 apply to the proposed development.

Minimum Requirement #1: Preparation of Stormwater Site Plans

This report along with the preliminary plans 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 will be specified in the Construction Plans and the CSWPP.

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

Flow from the site will preserve its natural drainage patterns to the north towards E Sunnyside School Rd frontage. Runoff then flows either towards King Creek to the west of the site, or to Stevens Creek to the southeast of the site.

Minimum Requirement #5: On-Site Stormwater Management

The project proposes BMP T5.13 soils to be underlain within all pervious areas that are disturbed by development. Generally, all other infiltration-related BMPs are infeasible due to "relatively high soil fines content, evidence of shallow perched groundwater, and the underlying presence of dense to very dense, cemented, till and till-like soils" per Geotechnical analysis. Generally, other dispersion related BMPs are considered infeasible due to the absence of adequate flow path lengths. Please see Section 4.5 for additional discussion of Onsite Stormwater Management and Low Impact Development BMP feasibility.

Minimum Requirement #6: Runoff Treatment

Proposed new pollution generating impervious surfaces (PGIS) will exceed the 5,000 SF threshold and thus basic water quality treatment will be provided via water quality treatment structures that will treat stormwater runoff discharging from the stormwater detention vaults. Two Perfilter cartridge filtration units are proposed for this purpose. See Section 4.0 for additional discussion regarding proposed stormwater management and water quality treatment measures.

Minimum Requirement #7: Flow Control

The project will exceed the 10,000 SF new plus replaced impervious threshold within each TDA, thus is required to provide flow control. Two concrete detention vaults will be installed in the northwestern and eastern portions of the project site, accessible via access Tracts. The vaults will discharge via point discharges at historic, mitigated rates towards existing flow paths along E Sunnyside School Rd frontage. Please see Section 4.0 for additional flow control modeling and parameters for detention sizing.

Minimum Requirement #8: Wetlands Protection

There are no critical wetland areas, streams, or associated buffers on/within close proximity to the project site.

Minimum Requirement #9: Operation and Maintenance

See Operations and Maintenance in Section 6 of this report.

SECTION 2: TEMPORARY EROSION AND SEDIMENT CONTROL DESIGN

SWPPP Design Elements

A Construction Stormwater Pollution Prevention Plan (SWPPP) will be provided prior to construction. The SWPPP report is modeled under the guidelines of 1.3.4.2 MR2 of the DOE Manual. 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 construction plans (to be submitted at a later date) 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 (to be submitted at a later date) for locations and details.

Element #3 – Control Flow Rates

Detention of construction period runoff will be provided by means of sediment ponds on the site. See sheets ER-01 and ER-02 of the construction plans (to be submitted at a later date) 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 construction plans (to be submitted at a later date) 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 construction plans (to be submitted at a later date) 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 construction plans (to be submitted at a later date) 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 construction plans (to be submitted at a later date) for locations and details.

Element #9 – Control Pollutants

Pollutants shall be controlled as specified in Volume IV of the 2019 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 construction plans (to be submitted at a later date) for notes.

Element #11 – Maintain BMPs

Maintenance of the BMPs is specified within the Construction Sequence and Grading and Erosion Control Notes. See sheets ER-01 and ER-02 of the construction plans (to be submitted at a later date) for the Construction Sequence and notes.

Element #12: Manage the Project

The Grading and Erosion Control Notes specify seasonal work limitations. Maintenance of the BMPs is specified within the Construction Sequence and Grading and Erosion Control Notes. See sheets ER-01 and ER-02 of the construction plans (to be submitted at a later date) 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.

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 split between two TDAs. One is in the King Creek subbasin, within the Ebey Slough watershed. The other is in the Stevens Creek Subbasin, which is tributary to Lake Stevens followed by the Snohomish River.

Floodplain / Floodway (FEMA) maps

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

Critical Areas Map

There are no critical wetland areas, streams, or associated buffers on/within close proximity 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 Tokul gravelly medial loam (0 to 8 percent slopes) which is classified as Hydrologic Soil Group B. Per geotechnical analysis, site soils do not exhibit acceptable infiltration rates, which is consistent with NRCS soil mapping data.

Wetland Inventory Maps

There are no critical wetland areas, streams, or associated buffers on/within close proximity to the project site.

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 King creek and Stevens Creek which the project is tributary to. Please refer to Appendix 3 for copies of applicable 303(d) listings.

Water Quality Problems

King creek has a category 5 listing in the DOE Water Quality Assessment Review tools for temperature, while Stevens Creek does not have any listings. The development however will improve water quality tributary to the creek via basic treatment device(s).

Stormwater Compliance Plans

Not applicable to the proposed project.

Task 3. Field Inspection/Downstream Analysis

On November 27th, 2023, a Downstream Analysis was performed at the site. The weather consisted of 46°F and clear skies. The following observations were verified during the visit.

The subject property areas consist primarily of flat to moderately sloped lawn areas surrounding the existing home, associated outbuildings, and driveways that are located in the central/southern portion of the site. There are some areas of upstream sheet flow from the property to the south due to existing topography.

Two flow paths have been identified leaving the east and west sides of the parcel that do not converge within one quarter mile of the site. As a result, the site is located within two threshold discharge areas (TDAs). Both flow paths are formed where runoff travels north towards E Sunnyside School Rd on either the west or east side of the TDA basin split (Image 1).

TDA #1 / Flowpath 1 – Overland flows traveling northwest are collected by an existing roadside ditch along E Sunnyside School Rd (Images 2 & 3). The ditch carries runoff to an existing pond/wetland area (Image 4) located on the neighboring property to the west. Overflow from the pond/wetland travels back to E Sunnyside School Rd (Image 5), crossing under the road to the north side (Image 6). Flow becomes more concentrated as it continues along the north side of E Sunnyside School Rd towards the intersection with 83rd Ave NE. Flow converges at a pipe crossing west under 83rd Ave NE (Image 9) The pipe outlets on the west side of 83rd Ave NE (Image 10), where King Creek continues beyond the quarter mile boundary.

TDA #2 / Flowpath 2 – Overland flows traveling northeast are collected by an existing roadside ditch along E Sunnyside School Rd (Images 11 & 12). The roadside ditch continues east along E Sunnyside School Rd to the eastern property corner (Image 13). E Sunnyside School Road begins to turn southeast beyond the property and the ditch continues under several driveway-culvert crossings (Image 14) until it reaches Densmore Rd. The flow crosses under Densmore Rd (Image 15) and continues southeast beyond the quarter mile buffer (Image 16), eventually joining Stevens Creek.

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 the quarter mile buffer of analysis.

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.

SECTION 4: DETENTION AND WATER QUALITY TREATMENT DESIGN

4.1 Predeveloped Site Hydrology

The pre-developed and developed conditions were modeled in WWHM for the purpose of matching historic, forested condition flow rates and durations. Based on the site location, the WWHM used the Everett Gage with a Precipitation Scale factor of 1.200. For visual representation of the listed basins, see Figure 4.0, "Predeveloped Hydrology Map".

Onsite Basin 1:

The predeveloped condition applied to the Onsite Basin 1 results in a forested land cover condition. This basin is tributary to TDA 1 and the values modeled in WWHM are as follows:

Table 1: Predeveloped Conditions: Onsite Basin 1

Onsite Basin 1	
<u>Ground Cover</u>	<u>Area (acre)</u>
Forest, mod	0.90
Forest, steep	0.18
Total	1.08

Onsite Basin 2:

The predeveloped condition applied to the Onsite Basin 2 results in a forested land cover condition. This basin is tributary to TDA 2 and the values modeled in WWHM are as follows:

Table 2: Predeveloped Conditions: Onsite Basin 2

Onsite Basin 2	
<u>Ground Cover</u>	<u>Area (acre)</u>
Forest, mod	2.00
Forest, steep	0.77
Total	2.77

Upstream Basin:

The predeveloped condition applied to the Upstream Basin results in existing land cover condition. In the developed condition, this basin will be collected alongside Onsite Basin 2. The values as modeled in WWHM are as follows:

Table 3: Predeveloped Conditions: Upstream Basin

Upstream Basin	
<u>Ground Cover</u>	<u>Area (acre)</u>
Forest, mod	0.80
Lawn, mod	0.20
Rooftops	0.12
Driveways, flat	0.23
Total	1.35

4.2 Developed Site Hydrology

In the developed condition, the proposed residential project will construct 29 single-family lots. Emergency and standard access drives along with associated private and public utilities are proposed to serve project development.

In compliance with the City of Marysville Design & Development Standards and the 2019 DOE Manual, all runoff from onsite developed/disturbed surfaces will be collected, treated, and discharged directly to existing/historic flow paths or will bypass detention and be mitigated within the proposed flow control system. Lots were modeled to have 65% impervious coverage.

Onsite Basin 1:

The developed Onsite Basin is 1.01 acres and includes the majority of the developed site within its TDA 1 boundaries. In the developed condition, the Onsite Basin has been modeled using WWHM with the following areas and ground cover designations:

Table 4: Developed Conditions: Onsite Basin 1

Onsite Basin 1	
<u>Ground Cover</u>	<u>Area (acre)</u>
Pasture, flat	0.41
Roads, flat	0.08
Rooftops	0.33
Driveways, flat	0.16
Sidewalks, flat	0.03
Total	1.01

Bypass Basin 1:

Bypass Basin 1 is 0.07 acres and is comprised of sloped landscape area adjacent to the detention vault/within Tract 999 that cannot be topographically collected into the detention system. Bypass Basin 1 was modeled using WWHM with the following areas and ground cover designations:

Table 5: Developed Conditions: Bypass Basin 1

Bypass Basin 1	
<u>Ground Cover</u>	<u>Area (acre)</u>
Pasture, mod	0.07
Total	0.07

Onsite Basin 2:

The developed Onsite Basin is 2.68 acres and includes the majority of the developed site within its TDA 2 boundaries. In the developed condition, the Onsite Basin has been modeled using WWHM with the following areas and ground cover designations:

Table 6: Developed Conditions: Onsite Basin 2

Onsite Basin 2	
<u>Ground Cover</u>	<u>Area (acre)</u>
Pasture, flat	0.85
Roads, flat	0.29
Rooftops	1.00
Driveways, flat	0.45
Sidewalks, flat	0.09
Total	2.68

Bypass Basin 2:

Bypass Basin 2 is 0.09 acres and is comprised of sloped landscape area adjacent to the detention vault/within Tract 998 and Lot 29 that cannot be topographically collected into the detention system. Bypass Basin 2 was modeled using WWHM with the following areas and ground cover designations:

Table 7: Developed Conditions: Bypass Basin 2

Bypass Basin 2	
<u>Ground Cover</u>	<u>Area (acre)</u>
Pasture, mod	0.09
Total	0.09

Upstream Basin:

The developed condition applied to the Upstream Basin results in existing land cover condition. In the developed condition, this basin will be collected alongside Onsite Basin 2. The values as modeled in WWHM are as follows:

Table 8: Predeveloped Conditions: Upstream Basin

Upstream Basin	
<u>Ground Cover</u>	<u>Area (acre)</u>
Forest, mod	0.80
Lawn, mod	0.20
Rooftops	0.12
Driveways, flat	0.23
Total	1.35

4.3 Detention Facility Design

The proposed detention vault facility used for mitigating developed condition flows was designed in compliance with the 2019 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 Facilities

The proposed cast in place concrete detention vault facilities detains, and releases collected storm water runoff from the two Onsite Basins. The facilities are located within Tract 999 (Vault 1) and Tract 998 (Vault 2). Flows from the Onsite Basin are collected and conveyed to the detention vault via a proposed network of catch basins and storm water conveyance pipes.

Detailed WWHM output is provided in Appendix 4. A summary of the detailed statistics and inputs used for modeling the system in WWHM2012 can be found below.

Table 9.1: Detention Vault 1 Design Summary

Detention Vault 1	
Live Storage Bottom Area (modeled)	2,392 SF
Live Storage Bottom Area (provided)	2,392 SF
Number of Cells	1
Cell Dimensions	23' x 104'
Begin Live Storage Elevation	343.00'
Riser Height	6.00'
Volume (modeled)	14,352 CF
Volume (provided)	14,352 CF
Top of Riser Elevation	349.00'
Top Outside of Vault Elevation	350.50'

See table below for the flow rates and water surface elevations by storm event for detention vault 1.

Table 10.1: Flow Rates and Water Surface Elevations by Storm Event

Storm Event	Predeveloped Rate (cfs)	Mitigated Rates (cfs)
2-Year	0.0429	0.0237
10-Year	0.0895	0.0382
50-Year	0.1459	0.0549
100-Year	0.1747	0.0633

The table below is design summary for Detention Vault 2.

Table 9.2: Detention Vault 2 Design Summary

Detention Vault 2	
Live Storage Bottom Area (modeled)	5,152 SF
Live Storage Bottom Area (provided)	5,152 SF
Number of Cells	2
Cell Dimensions	(23' x 148') & (23' x 76')
Begin Live Storage Elevation	337.00'
Riser Height	6.50'
Volume (modeled)	33,488 CF
Volume (provided)	33,982 CF
Top of Riser Elevation	403.50'
Top Outside of Vault Elevation	405.00'

See table below for the flow rates and water surface elevations by storm event for the detention vault 2.

Table 10.2: Flow Rates and Water Surface Elevations by Storm Event

Storm Event	Predeveloped Rate (cfs)	Mitigated Rates (cfs)
2-Year	0.3216	0.1575
10-Year	0.6210	0.2467
50-Year	0.9733	0.3471
100-Year	1.1519	0.3969

4.4 Water Quality Treatment

Perkfilter 1 - West

Water Quality Treatment for the Onsite Basin 1 is accomplished through a Perkfilter structure located upstream of the detention vault A. A summary of design criteria is provided below:

Table 11: Perkfilter 1 Design Summary

48" Ø Perkfilter Manhole	
Tributary Area	1.08 AC
Tributary Impervious Area	0.60 AC
Water Quality Flow Rate	0.062 cfs
2-yr unmitigated peak	0.33 cfs
Number of Cartridges	2
Cartridge Height	12"+18"
Internal Drop	2.3'
Peak Flow Rate	1.23 cfs
Peak Flow Storm Event	100-year

Perkfilter 2 - East

Water Quality Treatment for the Onsite Basin 2 is accomplished through a Perkfilter structure located upstream of the detention vault B. A summary of design criteria is provided below:

Table 12: Perkfilter 2 Design Summary

Perkfilter Vault – 6'x8'	
Tributary Area	4.41 AC
Tributary Impervious Area	2.24 AC
Water Quality Flow Rate	0.233 cfs
2-yr unmitigated peak	1.27 cfs
Number of Cartridges	9
Cartridge Height	12"+18"
Internal Drop	2.3'
Peak Flow Rate	4.48 cfs
Peak Flow Storm Event	100-year

4.5 Onsite Stormwater Management

The project does not meet the LID performance standard and minimum requirements 1-9 are required for the project but choose to implement List #2 to evaluate low impact design. The following BMP's below are assessed for implementation:

Lawn and Landscaped Areas:

1. *Post-Construction Soil Quality and Depth*
 - BMP T5.13 soils will be applied to all permeable and landscaped areas in developed condition.
 - i. **Conclusion: Infeasible**

Roofs:

1. *Downspout Full Infiltration per BMP T5.10A or Downspout Full Dispersion per BMP T5.30*
 - Infiltration is not feasible on site, which has been confirmed by testing found in the geotechnical report and thus BMP T5.10A is infeasible. Due to site specific constraints including building and fire lane location as well as the proximity of slopes and walls to the developed site improvements, there is inadequate flow path to disperse on site per BMP T5.30.
 - i. **Conclusion: Infeasible**
2. *Bioretention*
 - Due to spatial constraints provided by the development footprint and infiltration infeasibility confirmed by testing in the geotechnical report, a bioretention facility cannot be designed to provide the required horizontally projected surface area.
 - i. **Conclusion: Infeasible**
3. *Downspout Dispersion per BMP T5.10B.*
 - Due to site specific constraints including building and fire lane location as well as the proximity of slopes and walls to the developed site improvements, there is inadequate flow path to disperse on site.
 - i. **Conclusion: Infeasible**
4. *Perforated Stub-Out Connections per BMP T5.10C.*
 - No stub-out connections will be implemented in the design as soils are not suitable for infiltration as well as the site's proximity to steep slopes.
 - i. **Conclusion: Infeasible**

Other Hard Surfaces:

1. *Full Dispersion per BMP T5.30*
 - Due to site specific constraints including building and fire lane location as well as the proximity of slopes and walls to the developed site improvements, there is inadequate flow path to disperse on site.
 - i. **Conclusion: Infeasible**
2. *BMP T5.15 Permeable Pavement*
 - Infiltration is not feasible on site which has been confirmed by testing found in the geotechnical report.
 - i. **Conclusion: Infeasible**
3. *Bioretention*
 - Due to spatial constraints provide by the development footprint and infiltration infeasibility as confirmed by testing in the geotechnical report, a bioretention facility cannot be designed to provide the required horizontally projected surface area.
 - i. **Conclusion: Infeasible**
4. *Sheet Flow Dispersion or Concentrated Flow Dispersion in accordance with BMP T5.12 or BMP T5.11*
 - Due to site specific constraints including building and fire lane location as well as the proximity of slopes and walls to the developed site improvements, there is inadequate flow path to disperse on site.
 - i. **Conclusion: Infeasible**

SECTION 5: CONVEYANCE DESIGN

The proposed storm drainage system consists of buried pipes, catch basins, detention vaults, and perfilter water quality treatment structures. Catch basins have been located such that each section of storm drainage pipe may adequately convey associated tributary area flows.

A fully prepared conveyance capacity analysis of the proposed pipes onsite will be prepared at a future submittal.

SECTION 6: OPERATIONS AND MAINTENANCE MANUAL

The proposed storm drainage system consists of buried pipes, catch basins, detention vaults, and perfilter water quality treatment structures. These facilities will require periodic maintenance and inspection. Inspection and maintenance procedures are contained on the following pages.

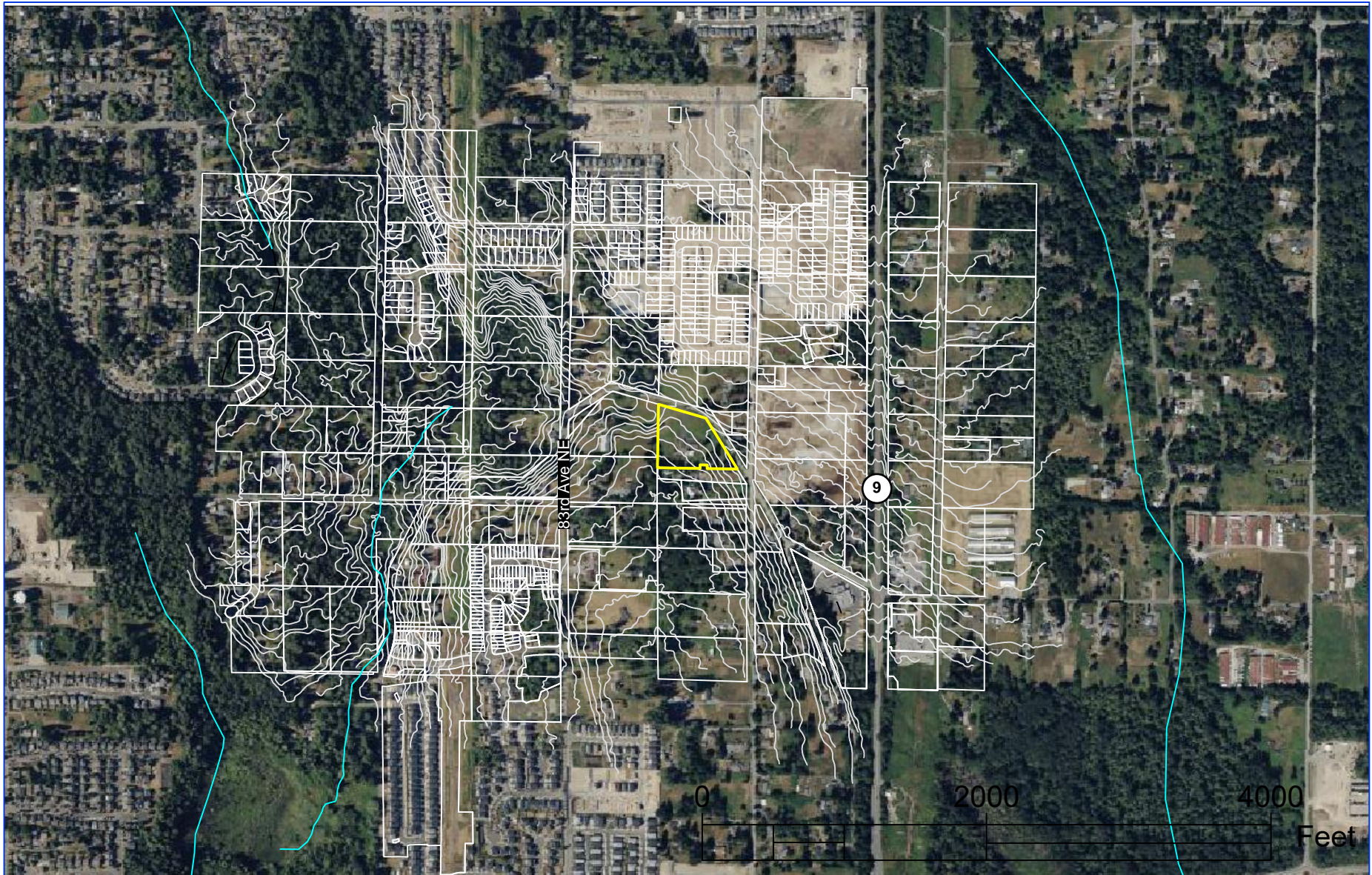
SECTION 7: SPECIAL REPORTS AND STUDIES

The following studies were conducted in preparation of this Report:

- Geotechnical Report, Terra Associates Inc, January 25, 2024

Appendix 1: Project Overview

1. Vicinity Map
2. Existing Conditions Map
3. Proposed Development Map



SOUTH LAKE RIDGE, LLC

MINOR PROPERTY

VICINITY MAP

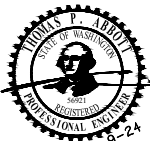


Solid Ground Engineering

8105 166th Ave NE
Redmond, WA 98052

JOB NUMBER:	23-0011	DATE:	2-7-24
JURISDICTION:	Marysville	DRAWN BY:	CJD

SW 1/4, SW 1/4, SEC. 36, T. 30N, R5E, W.M. SNOHOMISH COUNTY, WASHINGTON



ENGINEER'S STAMP

REVISIONS

DESCRIPTION

DATE

#



EXISTING CONDITIONS MAP

SOUTH LAKE RIDGE, LLC.
MINOR PROPERTY
8512 E. SUNNYSIDE SCHOOL RD

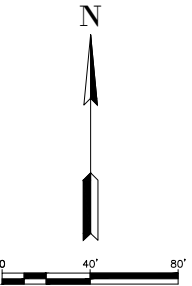
DRAWN BY: AJP
CHECKED BY: TPA
DATE: 2-9-24
JURISDICTION: CITY OF MARYVILLE
JOB NUMBER: 23-0011

EC-01
2 OF 7

N 89°34'45" W 5288.2' (BASIS OF BEARING)
EAST-WEST CENTER OF SECTION LINE

LEGEND AND ABBREVIATIONS

Table with columns: EXISTING SYMBOLS, DESCRIPTION, ABBREVIATIONS. Includes symbols for rebar, corner monuments, section ties, invert/culvert, water valve, fire hydrant, etc.



SURVEY INFORMATION
EQUIPMENT & PROCEDURES

METHOD OF SURVEY: SURVEY PERFORMED BY FIELD TRAVERSE AND REAL TIME KINEMATIC GPS POSITIONING UTILIZING THE HIGN SMARTNET NETWORK
INSTRUMENTATION: LEICA TS16 ROBOTIC ELECTRONIC TOTAL STATION, LEICA IVA GNSS G508 RECEIVER...

LEGAL DESCRIPTION

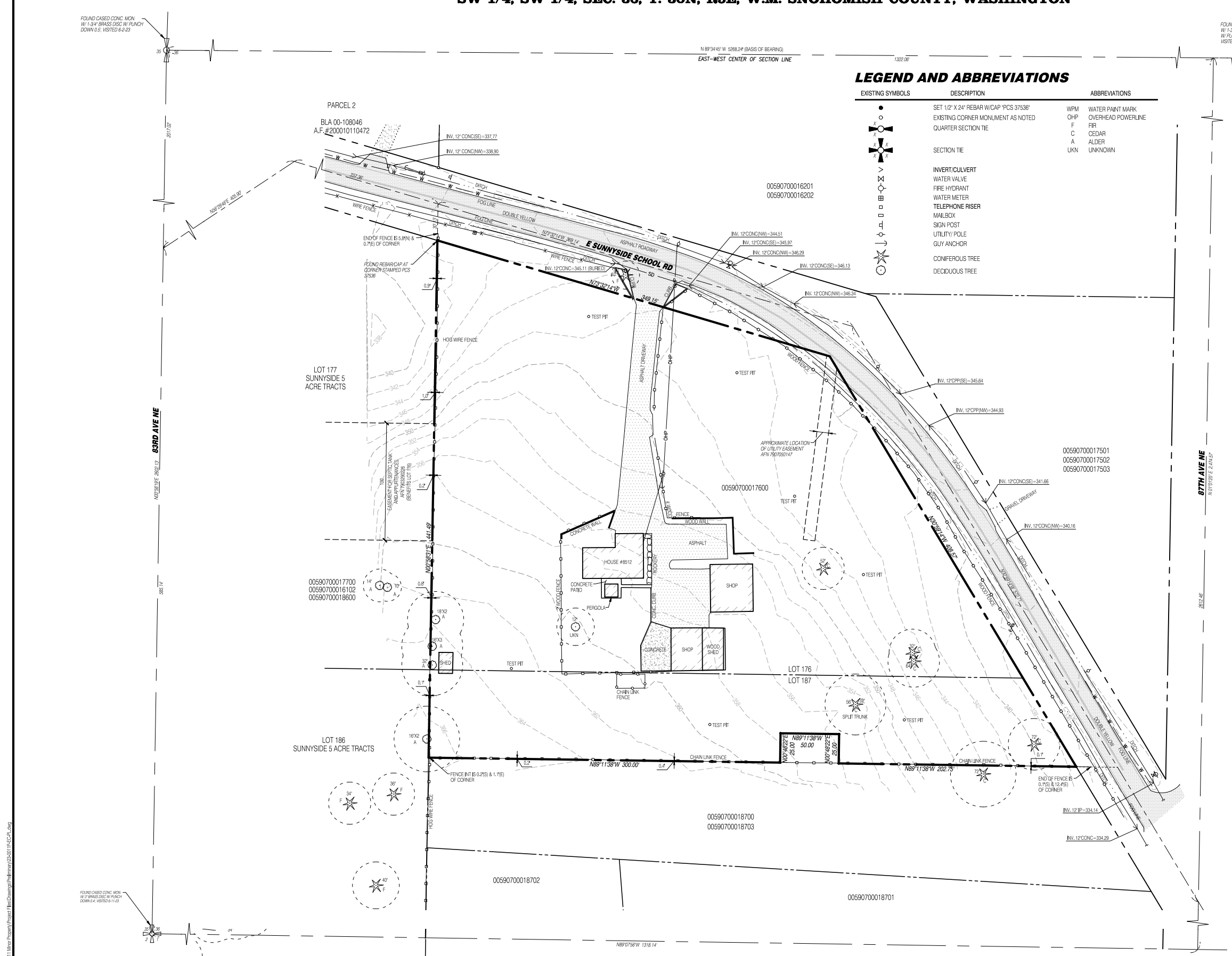
LOT 176, SUNNYSIDE FIVE ACRE TRACTS, ACCORDING TO THE PLAT THEREOF, RECORDED IN VOLUME 7 OF PLATS, PAGE 19, RECORDS OF SNOHOMISH COUNTY, WASHINGTON.
EXCEPT THE SOUTH 25.00 FEET OF THE NORTH 75.00 FEET OF THE EAST 50.00 FEET OF THE WEST 350.00 AS MEASURED ALONG THE WEST LINE OF SAID LOT 187.

VERTICAL DATUM

NAVD 88 (NAVD88 -3.67' - NGVD29)
FOUND CASED CONC. MON. WITH 3" BRASS DISC & PUNCH AT THE SOUTHWEST CORNER OF SECTION 36

SURVEY REFERENCES

- (R1) PLAT OF SUNNYSIDE FIVE ACRE TRACTS - VOL. 7, PG. 19
(R2) SNO. CO. BOUNDARY LINE ADJUSTMENT - AFN 200010110472
(R3) RECORD OF SURVEY - AFN 9701095004
(R4) SNO. CO. SHORT PLAT NO. SP332(B-77) - AFN 7711150288



DRAINFIELD NOTE
NO KNOWN DRAINFIELD RECORDS ARE AVAILABLE FOR THE PROJECT SITE. IF DRAINFIELDS ARE ENCOUNTERED DURING CONSTRUCTION, SEPTIC TANK SHALL BE PUMPED AND DRAINFIELD SHALL BE REMOVED...

WELL NOTE
NO KNOWN WELL RECORDS ARE AVAILABLE FOR THE PROJECT SITE. IF WELLS ARE ENCOUNTERED DURING CONSTRUCTION, THEY SHALL BE DECOMMISSIONED BASED ON WADCO STANDARDS.

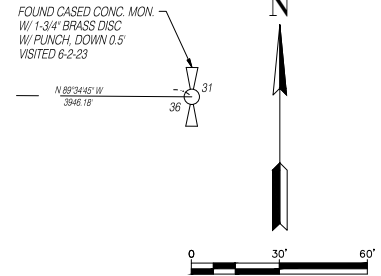
UTILITY NOTE
THE CONTRACTOR SHALL VERIFY THE LOCATION OF ALL EXISTING UTILITIES PRIOR TO ANY CONSTRUCTION. AGENCIES INVOLVED SHALL BE NOTIFIED WITHIN A REASONABLE TIME PRIOR TO THE START OF CONSTRUCTION.

SURVEY DISCLAIMER
THE TOPOGRAPHIC SURVEY WAS PERFORMED BY PACIFIC COAST SURVEYS. SOLID GROUND ENGINEERING ASSUMES NO LIABILITY AS TO THE ACCURACY AND COMPLETENESS OF THIS DATA. ANY DISCREPANCIES FOUND BETWEEN WHAT IS SHOWN ON THE PLANS AND WHAT IS NOTED IN THE FIELD SHOULD BE BROUGHT IMMEDIATELY TO THE ATTENTION OF THE ENGINEER.



Vertical text on the left margin: C:\Users\... \Public\Projects\... \811\Drawings\... \23-0011\EC-01.dwg

SW 1/4, SW 1/4, SEC. 36, T. 30N, R5E, W.M. SNOHOMISH COUNTY, WASHINGTON



LEGEND

SYMBOLS	DESCRIPTION
(Symbol: Small circle with dot)	REMOVABLE BOLLARD
(Symbol: Dashed line)	'FIRE LANE NO PARKING' SIGN
(Symbol: Solid line)	LOCK n LOAD RETAINING WALL (UNLESS OTHERWISE NOT)
(Symbol: Dotted line)	ASPHALT PAVEMENT
(Symbol: Horizontal dashed line)	ASPHALT GRIND AND OVERLAY
(Symbol: Vertical dashed line)	CONCRETE PAVEMENT
(Symbol: Dashed line with triangles)	FALL PROTECTION FENCING

PROJECT INFORMATION

TAX PARCELS:	00590700017600, 00590700018700, 00590700018703
SITE ADDRESS:	8512 E. SUNNYSIDE SCHOOL RD
PROPOSED ZONING:	WR R-4-18 3.88 AC
PROPOSED LAND USE:	DETACHED SINGLE FAMILY HOMES
FUTURE LAND USE (PER COMP PLAN):	URBAN LOW RESIDENTIAL
PROPOSED LOTS:	29 LOTS
BUILDING SETBACKS:	20' GARAGE 5' SIDE / 11' WHEN ADJACENT TO R/W 10' REAR CITY OF MARYSVILLE CITY OF MARYSVILLE SNOHOMISH COUNTY PUD CASCADE NATURAL GAS FRONTIER COMCAST LAKE STEVENS SCHOOL DISTRICT NO. 5 MARYSVILLE FIRE DISTRICT RFA
WATER:	
SEWER:	
POWER:	
GAS:	
TELEPHONE:	
CABLE:	
SCHOOL DISTRICT:	
FIRE DISTRICT:	

DENSITY CALCULATIONS

ZONE (DENSITY):	WR R-4-18
GROSS AREA:	169,001 SF (3.88 AC)
FLAT 20% DEDUCTION:	33,800 SF (0.78 AC)
NET AREA:	135,201 SF (3.10 AC)
BASE DENSITY:	3.10 x 6 = 18.60 = 19 LOTS
MAX DENSITY:	3.10 x 18 = 55.8 = 56 LOTS
LOTS PROPOSED:	29 LOTS
ROI CREDITS NECESSARY:	10 UNITS

OPEN SPACE CALCULATIONS

REQUIRED OPEN SPACE:	15% NET AREA = 15% x 135,201 = 20,280 SF
PROVIDED OPEN SPACE (TRACT 999, 998):	20,813 SF
REQUIRED ACTIVE OPEN SPACE:	35% x OPEN SPACE = 35% x 20,280 = 7,098 SF
PROVIDED ACTIVE OPEN SPACE (TRACT 998):	11,959 SF

SOIL TYPE AND VEGETATIVE COVER

SOILS:	TILL SOILS
VEGETATIVE COVER:	PRIMARILY LAWN

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.

SURVEY DISCLAIMER

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SAFETY IS IN YOUR HANDS. EVERY DIG. EVERY TIME.



ENGINEER'S STAMP

REVISIONS	DESCRIPTION	DATE

PRELIMINARY PLAT MAP

SOUTH LAKE RIDGE, LLC.
MINOR PROPERTY
8512 E. SUNNYSIDE SCHOOL RD

DRAWN BY:	AJP
CHECKED BY:	TPA
DATE:	2-9-24
JURISDICTION:	CITY OF MARYSVILLE
JOB NUMBER:	23-0011

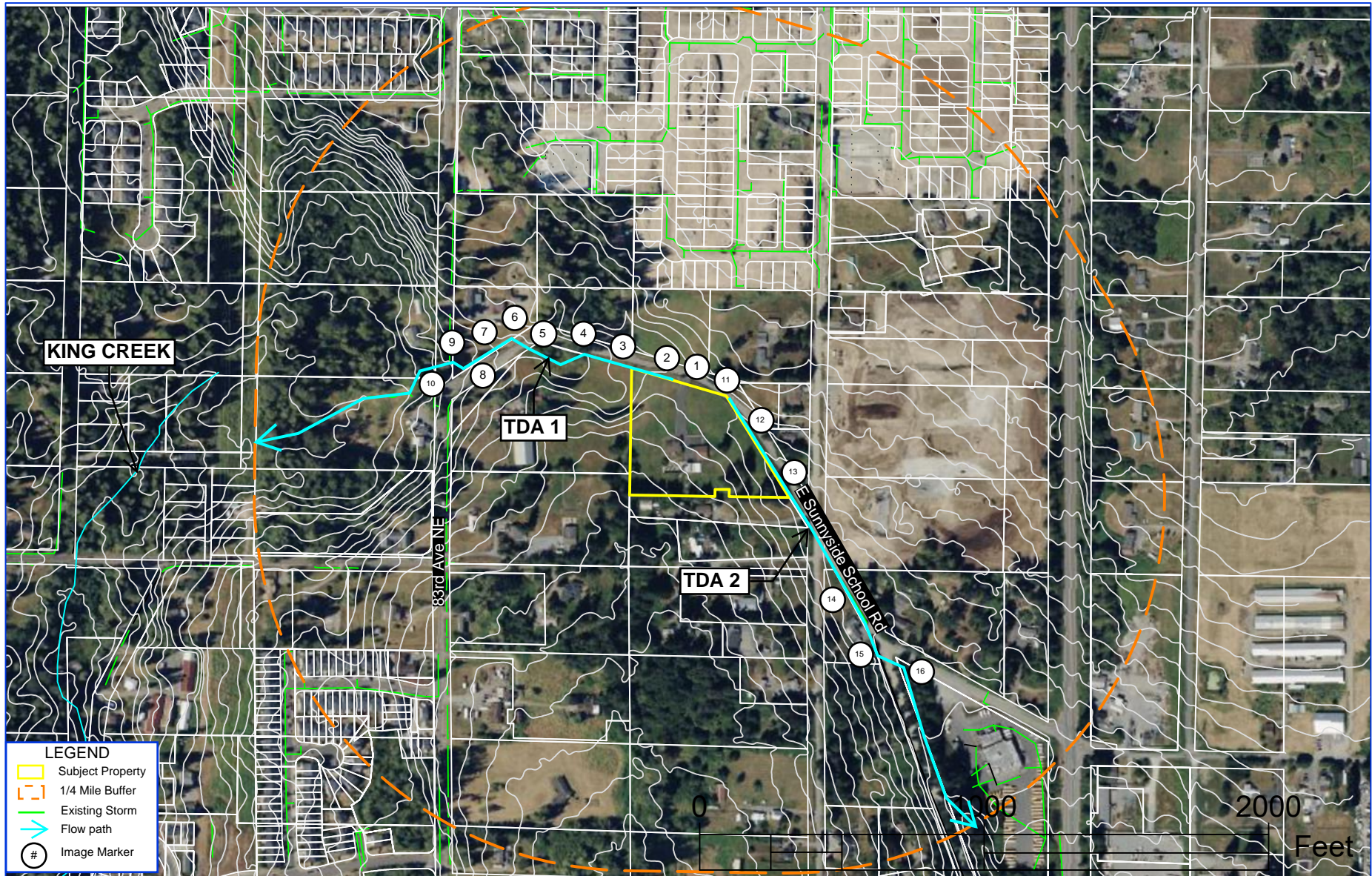
PP-01
3 OF 7

Appendix 2: Temporary Erosion and Sediment Control Design

1. TESC Plans (to be provided at a later submittal date)

Appendix 3: Downstream Analysis

1. Downstream Analysis Map
2. Downstream Analysis Site Visit Pictures
3. USDA Soils Map & Description



- LEGEND**
- Subject Property
 - 1/4 Mile Buffer
 - Existing Storm
 - Flow path
 - # Image Marker

SOUTH LAKE RIDGE, LLC

MINOR PROPERTY

DOWNSTREAM ANALYSIS MAP

SGE
Solid Ground Engineering
 8105 166th Ave NE
 Redmond, WA 98052

JOB NUMBER:	23-0011	DATE:	2-7-24
JURISDICTION:	Marysville	DRAWN BY:	CJD

C:\Users\CooerDanby\Documents\CAD-GIS\Map\Minor_Marysville\Minor_Downstream_Ma.dwg

Downstream Analysis Photographs



Image 1: Middle of existing driveway along E Sunnyside School Rd where TDA #1 & #2 split west or east

TDA #1 – Flowpath 1



Image 2: Facing west along E Sunnyside School Rd where Flowpath 1 continues in a roadside ditch



Image 3: Northwest property corner where runoff sheet flows west down existing slopes



Image 4: Property west of project site along E Sunnyside School Rd where runoff enters existing pond/wetland



Image 5: west of existing pond/wetland where overflow runoff continues back to cross under E Sunnyside School Rd



Image 6: north side of E Sunnyside School Rd where channelized flow continues west



Image 7: north side of E Sunnyside School Rd where channelized flow continues west



Image 8: Intersection of E Sunnyside School Rd and 83rd Ave NE



Image 9: Intersection of E Sunnyside School Rd and 83rd Ave NE where flow crosses west under 83rd via culvert



Image 10: Culvert outlet west of 83rd where King Creek continues to quarter mile boundary

TDA #2 – Flowpath 2



Image 11: Facing east along E Sunnyside School Rd where Flowpath 2 continues in a roadside ditch



Image 12: Facing southeast along E Sunnyside School Rd where Flowpath 2 continues in a roadside ditch



Image 13: east property corner along E Sunnyside School Rd where Flowpath 2 continues



Image 14: along E Sunnyside School Rd where Flowpath 2 continues



Image 15: near intersection of E Sunnyside School Rd and Densmore Rd, flow crosses east under Densmore Rd

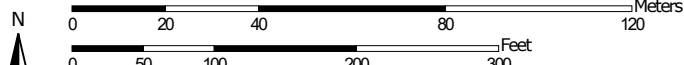


Image 16: east side of Densmore Rd, flow continues southeast beyond quarter mile boundary

Soil Map—Snohomish County Area, Washington



Map Scale: 1:1,620 if printed on A portrait (8.5" x 11") sheet.



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



Natural Resources
Conservation Service

Web Soil Survey
National Cooperative Soil Survey

11/17/2023
Page 1 of 3

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 25, Aug 29, 2023

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

Date(s) aerial images were photographed: Aug 14, 2022—Sep 1, 2022

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
72	Tokul gravelly medial loam, 0 to 8 percent slopes	6.0	100.0%
Totals for Area of Interest		6.0	100.0%

Snohomish County Area, Washington

72—Tokul gravelly medial loam, 0 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2t61k

Elevation: 160 to 1,150 feet

Mean annual precipitation: 45 to 70 inches

Mean annual air temperature: 46 to 52 degrees F

Frost-free period: 140 to 200 days

Farmland classification: All areas are prime farmland

Map Unit Composition

Tokul and similar soils: 85 percent

Minor components: 15 percent

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

Description of Tokul

Setting

Landform: Hillslopes, till plains

Landform position (two-dimensional): Toeslope

Landform position (three-dimensional): Side slope, tread

Down-slope shape: Convex

Across-slope shape: Convex

Parent material: Volcanic ash mixed with loess over glacial till

Typical profile

O_i - 0 to 1 inches: slightly decomposed plant material

O_a - 1 to 2 inches: highly decomposed plant material

A - 2 to 6 inches: gravelly medial loam

B_{s1} - 6 to 9 inches: gravelly medial loam

B_{s2} - 9 to 17 inches: gravelly medial loam

B_{s3} - 17 to 24 inches: gravelly medial loam

BC - 24 to 33 inches: gravelly medial fine sandy loam

2B_{sm} - 33 to 62 inches: cemented material

Properties and qualities

Slope: 0 to 8 percent

Depth to restrictive feature: 20 to 39 inches to densic material; 20 to 39 inches to cemented horizon

Drainage class: Moderately well drained

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

Depth to water table: About 18 to 36 inches

Frequency of flooding: None

Frequency of ponding: None

Available water supply, 0 to 60 inches: Moderate (about 8.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 3s

Hydrologic Soil Group: B

Ecological site: F002XA005WA - Puget Lowlands Moist Forest

Forage suitability group: Limited Depth Soils (G002XN302WA),
Limited Depth Soils (G002XF303WA)

Other vegetative classification: Limited Depth Soils
(G002XN302WA), Limited Depth Soils (G002XF303WA)

Hydric soil rating: No

Minor Components

Pastik

Percent of map unit: 5 percent

Landform: Terraces

Landform position (three-dimensional): Tread

Down-slope shape: Linear

Across-slope shape: Linear

Hydric soil rating: No

Barneston

Percent of map unit: 5 percent

Landform: Moraines, eskers, kames

Landform position (two-dimensional): Summit, shoulder

Landform position (three-dimensional): Interfluve, crest

Down-slope shape: Convex

Across-slope shape: Convex

Hydric soil rating: No

Norma

Percent of map unit: 3 percent

Landform: Drainageways, depressions

Landform position (three-dimensional): Dip

Down-slope shape: Linear, concave

Across-slope shape: Concave

Hydric soil rating: Yes

Mckenna

Percent of map unit: 2 percent

Landform: Drainageways, depressions

Landform position (three-dimensional): Dip

Down-slope shape: Linear, concave

Across-slope shape: Concave

Hydric soil rating: Yes

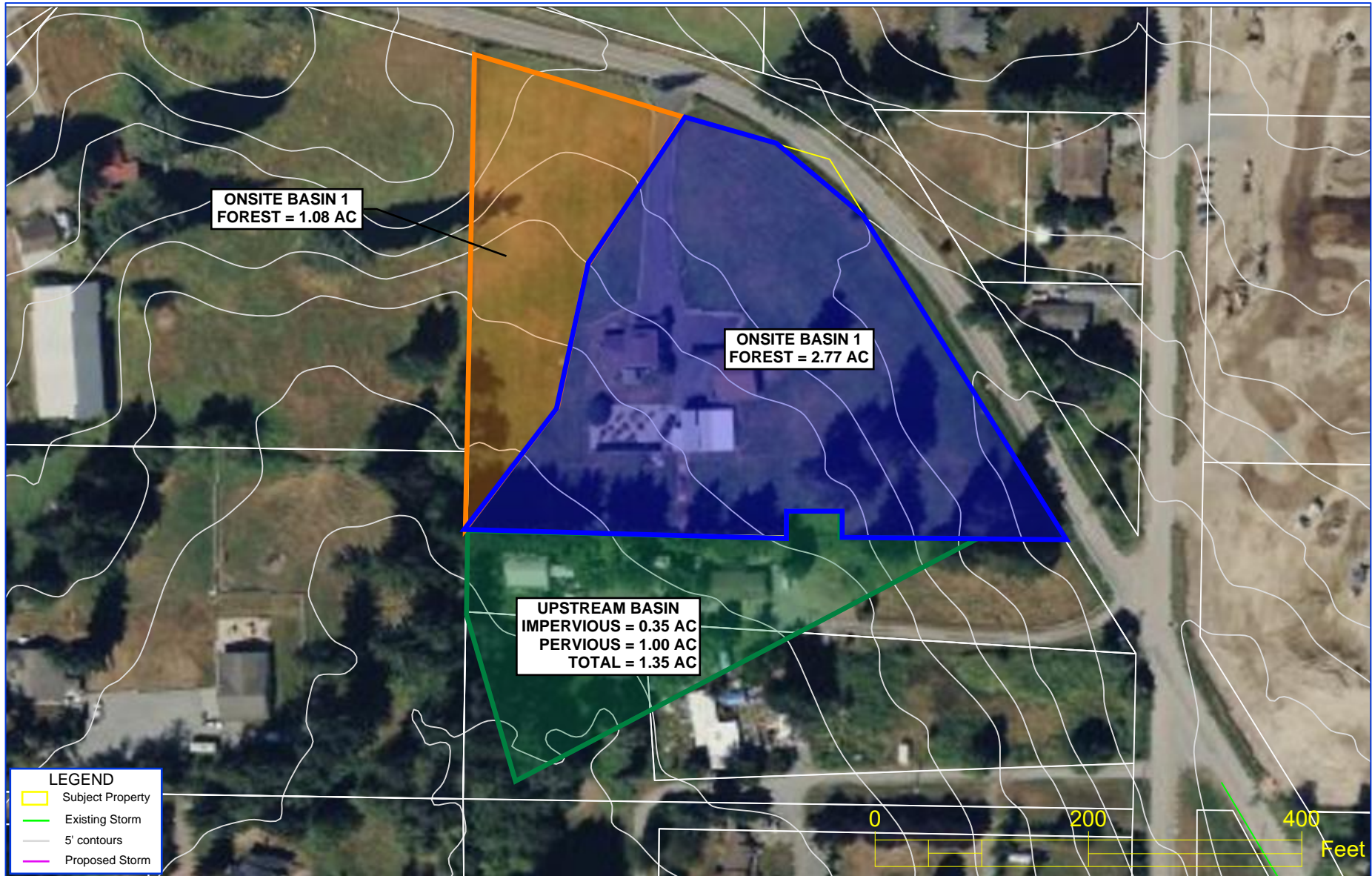
Data Source Information

Soil Survey Area: Snohomish County Area, Washington

Survey Area Data: Version 25, Aug 29, 2023

Appendix 4: Detention and Water Quality Design Analysis

1. Predeveloped Hydrology Map
2. Developed Hydrology Map
3. WWHM2012 Output – Detention Vault A
4. WWHM2012 Output – Detention Vault B
 5. Perfilter 1 Detail
 6. Perfilter 2 Detail
7. Water Quality Design Data Sheet



Solid Ground Engineering

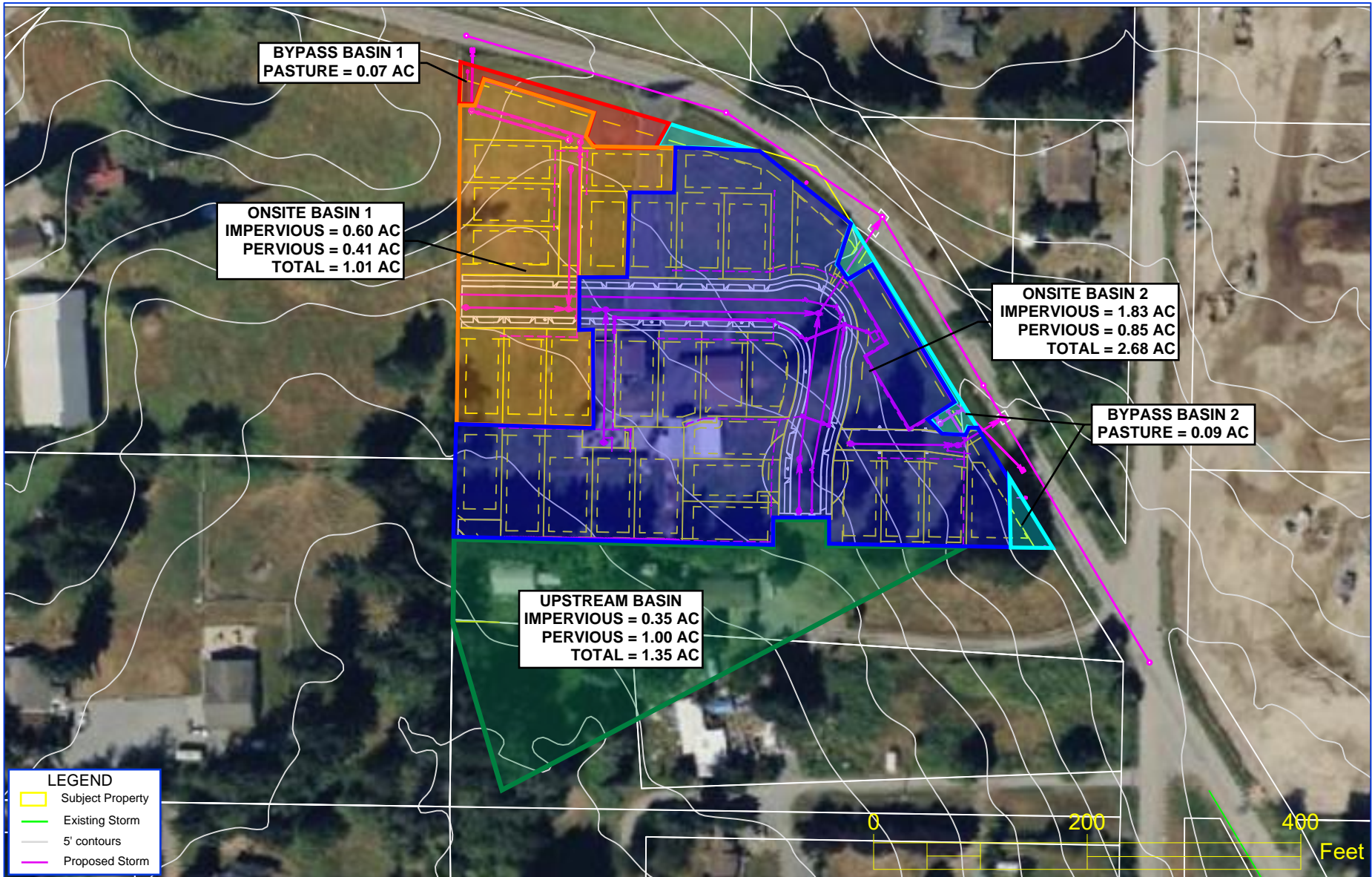
8105 166th Ave NE
Redmond, WA 98052

SOUTH LAKE RIDGE, LLC

MINOR PROPERTY

PREDEVELOPED HYDROLOGY MAP

JOB NUMBER:	23-0011	DATE:	2-7-24
JURISDICTION:	Marysville	DRAWN BY:	CJD



SOUTH LAKE RIDGE, LLC

MINOR PROPERTY

DEVELOPED HYDROLOGY MAP



Solid Ground Engineering

8105 166th Ave NE
Redmond, WA 98052

JOB NUMBER:	23-0011	DATE:	2-7-24
JURISDICTION:	Marysville	DRAWN BY:	CJD

6 OF 6

**WWHM2012
PROJECT REPORT**

Project Name: Minor West Vault
Site Name:
Site Address:
City :
Report Date: 2/7/2024
Gage : Everett
Data Start : 1948/10/01
Data End : 2009/09/30
Precip Scale: 1.20
Version Date: 2023/01/27
Version : 4.2.19

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

High Flow Threshold for POC 1: 50 year

PREDEVELOPED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

<u>Pervious Land Use</u>	<u>acre</u>
C, Forest, Mod	.9
C, Forest, Steep	.18
Pervious Total	1.08
<u>Impervious Land Use</u>	<u>acre</u>
Impervious Total	0
Basin Total	1.08

Element Flows To:

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

MITIGATED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

<u>Pervious Land Use</u>	<u>acre</u>
C, Pasture, Flat	.41
Pervious Total	0.41
<u>Impervious Land Use</u>	<u>acre</u>
ROADS FLAT	0.08
ROOF TOPS FLAT	0.33
DRIVEWAYS FLAT	0.16
SIDEWALKS FLAT	0.03
Impervious Total	0.6
Basin Total	1.01

Element Flows To:

Surface	Interflow	Groundwater
Vault 1	Vault 1	

Name : Vault 1
Width : 104 ft.
Length : 23 ft.
Depth: 7 ft.
Discharge Structure
Riser Height: 6 ft.
Riser Diameter: 12 in.
Orifice 1 Diameter: 0.71875 in. Elevation: 0 ft.
Orifice 2 Diameter: 1.1875 in. Elevation: 4.3 ft.
Orifice 3 Diameter: 0.6875 in. Elevation: 5.1 ft.

Element Flows To:
Outlet 1 Outlet 2

Vault Hydraulic Table

<u>Stage(feet)</u>	<u>Area(ac.)</u>	<u>Volume(ac-ft.)</u>	<u>Discharge(cfs)</u>	<u>Infilt(cfs)</u>
0.0000	0.054	0.000	0.000	0.000
0.0778	0.054	0.004	0.003	0.000
0.1556	0.054	0.008	0.005	0.000
0.2333	0.054	0.012	0.006	0.000
0.3111	0.054	0.017	0.007	0.000
0.3889	0.054	0.021	0.008	0.000
0.4667	0.054	0.025	0.009	0.000
0.5444	0.054	0.029	0.010	0.000
0.6222	0.054	0.034	0.011	0.000
0.7000	0.054	0.038	0.011	0.000
0.7778	0.054	0.042	0.012	0.000
0.8556	0.054	0.047	0.013	0.000

0.9333	0.054	0.051	0.013	0.000
1.0111	0.054	0.055	0.014	0.000
1.0889	0.054	0.059	0.014	0.000
1.1667	0.054	0.064	0.015	0.000
1.2444	0.054	0.068	0.015	0.000
1.3222	0.054	0.072	0.016	0.000
1.4000	0.054	0.076	0.016	0.000
1.4778	0.054	0.081	0.017	0.000
1.5556	0.054	0.085	0.017	0.000
1.6333	0.054	0.089	0.017	0.000
1.7111	0.054	0.094	0.018	0.000
1.7889	0.054	0.098	0.018	0.000
1.8667	0.054	0.102	0.019	0.000
1.9444	0.054	0.106	0.019	0.000
2.0222	0.054	0.111	0.019	0.000
2.1000	0.054	0.115	0.020	0.000
2.1778	0.054	0.119	0.020	0.000
2.2556	0.054	0.123	0.021	0.000
2.3333	0.054	0.128	0.021	0.000
2.4111	0.054	0.132	0.021	0.000
2.4889	0.054	0.136	0.022	0.000
2.5667	0.054	0.140	0.022	0.000
2.6444	0.054	0.145	0.022	0.000
2.7222	0.054	0.149	0.023	0.000
2.8000	0.054	0.153	0.023	0.000
2.8778	0.054	0.158	0.023	0.000
2.9556	0.054	0.162	0.024	0.000
3.0333	0.054	0.166	0.024	0.000
3.1111	0.054	0.170	0.024	0.000
3.1889	0.054	0.175	0.025	0.000
3.2667	0.054	0.179	0.025	0.000
3.3444	0.054	0.183	0.025	0.000
3.4222	0.054	0.187	0.025	0.000
3.5000	0.054	0.192	0.026	0.000
3.5778	0.054	0.196	0.026	0.000
3.6556	0.054	0.200	0.026	0.000
3.7333	0.054	0.205	0.027	0.000
3.8111	0.054	0.209	0.027	0.000
3.8889	0.054	0.213	0.027	0.000
3.9667	0.054	0.217	0.027	0.000
4.0444	0.054	0.222	0.028	0.000
4.1222	0.054	0.226	0.028	0.000
4.2000	0.054	0.230	0.028	0.000
4.2778	0.054	0.234	0.029	0.000
4.3556	0.054	0.239	0.038	0.000
4.4333	0.054	0.243	0.043	0.000
4.5111	0.054	0.247	0.047	0.000
4.5889	0.054	0.252	0.050	0.000
4.6667	0.054	0.256	0.053	0.000
4.7444	0.054	0.260	0.056	0.000
4.8222	0.054	0.264	0.058	0.000
4.9000	0.054	0.269	0.060	0.000
4.9778	0.054	0.273	0.062	0.000
5.0556	0.054	0.277	0.064	0.000
5.1333	0.054	0.281	0.069	0.000
5.2111	0.054	0.286	0.072	0.000
5.2889	0.054	0.290	0.075	0.000

5.3667	0.054	0.294	0.078	0.000
5.4444	0.054	0.299	0.081	0.000
5.5222	0.054	0.303	0.083	0.000
5.6000	0.054	0.307	0.085	0.000
5.6778	0.054	0.311	0.088	0.000
5.7556	0.054	0.316	0.090	0.000
5.8333	0.054	0.320	0.092	0.000
5.9111	0.054	0.324	0.094	0.000
5.9889	0.054	0.328	0.096	0.000
6.0667	0.054	0.333	0.280	0.000
6.1444	0.054	0.337	0.672	0.000
6.2222	0.054	0.341	1.147	0.000
6.3000	0.054	0.346	1.613	0.000
6.3778	0.054	0.350	1.984	0.000
6.4556	0.054	0.354	2.221	0.000
6.5333	0.054	0.358	2.408	0.000
6.6111	0.054	0.363	2.572	0.000
6.6889	0.054	0.367	2.725	0.000
6.7667	0.054	0.371	2.870	0.000
6.8444	0.054	0.375	3.009	0.000
6.9222	0.054	0.380	3.140	0.000
7.0000	0.054	0.384	3.267	0.000
7.0778	0.054	0.388	3.388	0.000
7.1556	0.000	0.000	3.506	0.000

Name : Basin 2

Bypass: Yes

GroundWater: No

<u>Pervious Land Use</u>	<u>acre</u>
C, Pasture, Mod	.07
Pervious Total	0.07
<u>Impervious Land Use</u>	<u>acre</u>
Impervious Total	0
Basin Total	0.07

Element Flows To:

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

ANALYSIS RESULTS

Stream Protection Duration

Predeveloped Landuse Totals for POC #1
Total Pervious Area:1.08
Total Impervious Area:0

Mitigated Landuse Totals for POC #1
Total Pervious Area:0.48
Total Impervious Area:0.6

Flow Frequency Return Periods for Predeveloped. POC #1

<u>Return Period</u>	<u>Flow(cfs)</u>
2 year	0.042903
5 year	0.068847
10 year	0.089544
25 year	0.119954
50 year	0.145867
100 year	0.174716

Flow Frequency Return Periods for Mitigated. POC #1

<u>Return Period</u>	<u>Flow(cfs)</u>
2 year	0.023736
5 year	0.03191
10 year	0.038225
25 year	0.047304
50 year	0.054917
100 year	0.063305

Stream Protection Duration

Annual Peaks for Predeveloped and Mitigated. POC #1

<u>Year</u>	<u>Predeveloped</u>	<u>Mitigated</u>
1949	0.047	0.021
1950	0.049	0.023
1951	0.040	0.020
1952	0.034	0.018
1953	0.028	0.018
1954	0.167	0.029
1955	0.052	0.026
1956	0.045	0.028
1957	0.061	0.027
1958	0.077	0.025
1959	0.041	0.024
1960	0.041	0.025
1961	0.107	0.044
1962	0.042	0.021
1963	0.070	0.022
1964	0.053	0.019
1965	0.033	0.024
1966	0.020	0.019
1967	0.041	0.021
1968	0.050	0.026
1969	0.153	0.037
1970	0.028	0.020
1971	0.052	0.027

1972	0.033	0.022
1973	0.031	0.022
1974	0.086	0.022
1975	0.034	0.019
1976	0.034	0.022
1977	0.025	0.019
1978	0.029	0.019
1979	0.094	0.024
1980	0.044	0.019
1981	0.029	0.020
1982	0.038	0.027
1983	0.077	0.023
1984	0.037	0.028
1985	0.050	0.026
1986	0.113	0.066
1987	0.051	0.032
1988	0.027	0.025
1989	0.034	0.016
1990	0.035	0.026
1991	0.037	0.024
1992	0.028	0.024
1993	0.028	0.018
1994	0.026	0.023
1995	0.037	0.028
1996	0.073	0.027
1997	0.140	0.101
1998	0.024	0.019
1999	0.030	0.024
2000	0.027	0.027
2001	0.010	0.015
2002	0.035	0.024
2003	0.027	0.022
2004	0.046	0.029
2005	0.032	0.024
2006	0.107	0.031
2007	0.081	0.026
2008	0.096	0.069
2009	0.028	0.022

Stream Protection Duration

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.1667	0.1010
2	0.1533	0.0688
3	0.1399	0.0665
4	0.1132	0.0443
5	0.1074	0.0369
6	0.1072	0.0316
7	0.0961	0.0312
8	0.0939	0.0292
9	0.0857	0.0291
10	0.0807	0.0284
11	0.0769	0.0277
12	0.0768	0.0277
13	0.0725	0.0273
14	0.0696	0.0273

15	0.0613	0.0272
16	0.0534	0.0267
17	0.0519	0.0266
18	0.0517	0.0261
19	0.0508	0.0259
20	0.0505	0.0258
21	0.0501	0.0257
22	0.0493	0.0256
23	0.0469	0.0247
24	0.0456	0.0247
25	0.0446	0.0245
26	0.0441	0.0245
27	0.0416	0.0244
28	0.0410	0.0241
29	0.0410	0.0240
30	0.0409	0.0237
31	0.0400	0.0236
32	0.0377	0.0236
33	0.0375	0.0235
34	0.0373	0.0233
35	0.0368	0.0228
36	0.0353	0.0228
37	0.0348	0.0224
38	0.0341	0.0224
39	0.0340	0.0223
40	0.0336	0.0222
41	0.0336	0.0220
42	0.0330	0.0218
43	0.0330	0.0216
44	0.0322	0.0214
45	0.0314	0.0211
46	0.0305	0.0211
47	0.0293	0.0203
48	0.0287	0.0202
49	0.0285	0.0196
50	0.0280	0.0193
51	0.0278	0.0193
52	0.0278	0.0191
53	0.0276	0.0190
54	0.0273	0.0190
55	0.0269	0.0187
56	0.0265	0.0185
57	0.0257	0.0183
58	0.0245	0.0177
59	0.0240	0.0176
60	0.0204	0.0159
61	0.0095	0.0154

Stream Protection Duration

POC #1

The Facility PASSED

The Facility PASSED.

Flow(cfs) Predev Mit Percentage Pass/Fail

0.0215 13490 12726 94 Pass

0.0227	11214	8650	77	Pass
0.0240	9263	5698	61	Pass
0.0252	7679	3690	48	Pass
0.0265	6352	2154	33	Pass
0.0277	5268	1273	24	Pass
0.0290	4470	948	21	Pass
0.0302	3769	770	20	Pass
0.0315	3140	590	18	Pass
0.0328	2674	531	19	Pass
0.0340	2314	506	21	Pass
0.0353	1990	495	24	Pass
0.0365	1713	487	28	Pass
0.0378	1497	480	32	Pass
0.0390	1332	473	35	Pass
0.0403	1171	468	39	Pass
0.0416	1036	462	44	Pass
0.0428	953	454	47	Pass
0.0441	887	442	49	Pass
0.0453	813	429	52	Pass
0.0466	754	418	55	Pass
0.0478	703	403	57	Pass
0.0491	651	379	58	Pass
0.0504	609	369	60	Pass
0.0516	586	353	60	Pass
0.0529	565	342	60	Pass
0.0541	540	332	61	Pass
0.0554	511	322	63	Pass
0.0566	478	311	65	Pass
0.0579	454	299	65	Pass
0.0592	430	286	66	Pass
0.0604	405	274	67	Pass
0.0617	384	256	66	Pass
0.0629	366	240	65	Pass
0.0642	353	222	62	Pass
0.0654	340	200	58	Pass
0.0667	327	170	51	Pass
0.0680	315	152	48	Pass
0.0692	307	121	39	Pass
0.0705	298	119	39	Pass
0.0717	285	117	41	Pass
0.0730	274	114	41	Pass
0.0742	260	112	43	Pass
0.0755	247	96	38	Pass
0.0767	233	93	39	Pass
0.0780	218	90	41	Pass
0.0793	211	81	38	Pass
0.0805	197	77	39	Pass
0.0818	180	74	41	Pass
0.0830	172	70	40	Pass
0.0843	164	68	41	Pass
0.0855	155	64	41	Pass
0.0868	144	60	41	Pass
0.0881	137	57	41	Pass
0.0893	130	53	40	Pass
0.0906	120	50	41	Pass
0.0918	101	47	46	Pass
0.0931	84	42	50	Pass

0.0943	73	37	50	Pass
0.0956	55	28	50	Pass
0.0969	49	25	51	Pass
0.0981	43	21	48	Pass
0.0994	39	17	43	Pass
0.1006	38	5	13	Pass
0.1019	34	0	0	Pass
0.1031	29	0	0	Pass
0.1044	22	0	0	Pass
0.1057	19	0	0	Pass
0.1069	16	0	0	Pass
0.1082	8	0	0	Pass
0.1094	7	0	0	Pass
0.1107	6	0	0	Pass
0.1119	5	0	0	Pass
0.1132	5	0	0	Pass
0.1144	4	0	0	Pass
0.1157	4	0	0	Pass
0.1170	4	0	0	Pass
0.1182	4	0	0	Pass
0.1195	4	0	0	Pass
0.1207	4	0	0	Pass
0.1220	4	0	0	Pass
0.1232	3	0	0	Pass
0.1245	3	0	0	Pass
0.1258	3	0	0	Pass
0.1270	3	0	0	Pass
0.1283	3	0	0	Pass
0.1295	3	0	0	Pass
0.1308	3	0	0	Pass
0.1320	3	0	0	Pass
0.1333	3	0	0	Pass
0.1346	3	0	0	Pass
0.1358	3	0	0	Pass
0.1371	3	0	0	Pass
0.1383	3	0	0	Pass
0.1396	3	0	0	Pass
0.1408	2	0	0	Pass
0.1421	2	0	0	Pass
0.1434	2	0	0	Pass
0.1446	2	0	0	Pass
0.1459	2	0	0	Pass

Water Quality BMP Flow and Volume for POC #1
On-line facility volume: 0.0833 acre-feet
On-line facility target flow: 0.1103 cfs.
Adjusted for 15 min: 0.1103 cfs.
Off-line facility target flow: 0.0623 cfs.
Adjusted for 15 min: 0.0623 cfs.

LID Report

LID Technique	Used for	Total Volume	Volume	Infiltration	Cumulative
Percent	Water Quality	Percent	Comment		

Volume	Treatment? Water Quality	Needs Treatment	Through Facility	Volume (ac-ft.)	Volume Infiltration Credit
Infiltrated	Treated	(ac-ft)	(ac-ft)		
Vault 1 POC	N	133.91			N
0.00					
Total Volume Infiltrated		133.91	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: Minor East Vault
Site Name:
Site Address:
City :
Report Date: 2/7/2024
Gage : Everett
Data Start : 1948/10/01
Data End : 2009/09/30
Precip Scale: 1.20
Version Date: 2023/01/27
Version : 4.2.19

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

High Flow Threshold for POC 1: 50 year

PREDEVELOPED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

<u>Pervious Land Use</u>	<u>acre</u>
C, Forest, Mod	2
C, Forest, Steep	.77
Pervious Total	2.77
<u>Impervious Land Use</u>	<u>acre</u>
Impervious Total	0
Basin Total	2.77

Element Flows To:

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

Name : Upstream
Bypass: No

GroundWater: No

<u>Pervious Land Use</u>	<u>acre</u>
--------------------------	-------------

C, Lawn, Mod	.2
C, Forest, Mod	.8
Pervious Total	1
<u>Impervious Land Use</u>	<u>acre</u>
ROOF TOPS FLAT	0.12
DRIVEWAYS FLAT	0.23
Impervious Total	0.35
Basin Total	1.35

Element Flows To:		
Surface	Interflow	Groundwater

MITIGATED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

<u>Pervious Land Use</u>	<u>acre</u>
C, Pasture, Flat	.85
Pervious Total	0.85
<u>Impervious Land Use</u>	<u>acre</u>
ROADS FLAT	0.29
ROOF TOPS FLAT	1
DRIVEWAYS FLAT	0.45
SIDEWALKS FLAT	0.09
Impervious Total	1.83
Basin Total	2.68

Element Flows To:		
Surface	Interflow	Groundwater
Vault 1	Vault 1	

Name : Vault 1
Width : 112 ft.
Length : 46 ft.
Depth: 7.5 ft.

Discharge Structure

Riser Height: 6.5 ft.

Riser Diameter: 18 in.

Notch Type: Rectangular

Notch Width: 0.040 ft.

Notch Height: 1.000 ft.

Orifice 1 Diameter: 1.9375 in. **Elevation:** 0 ft.

Orifice 2 Diameter: 1.625 in. **Elevation:** 3 ft.

Orifice 3 Diameter: 4 in. **Elevation:** 6.1 ft.

Element Flows To:

Outlet 1

Outlet 2

Vault Hydraulic Table

<u>Stage(feet)</u>	<u>Area(ac.)</u>	<u>Volume(ac-ft.)</u>	<u>Discharge(cfs)</u>	<u>Infilt(cfs)</u>
0.0000	0.118	0.000	0.000	0.000
0.0833	0.118	0.009	0.029	0.000
0.1667	0.118	0.019	0.041	0.000
0.2500	0.118	0.029	0.050	0.000
0.3333	0.118	0.039	0.058	0.000
0.4167	0.118	0.049	0.065	0.000
0.5000	0.118	0.059	0.072	0.000
0.5833	0.118	0.069	0.077	0.000
0.6667	0.118	0.078	0.083	0.000
0.7500	0.118	0.088	0.088	0.000
0.8333	0.118	0.098	0.093	0.000
0.9167	0.118	0.108	0.097	0.000
1.0000	0.118	0.118	0.101	0.000
1.0833	0.118	0.128	0.106	0.000
1.1667	0.118	0.138	0.110	0.000
1.2500	0.118	0.147	0.113	0.000
1.3333	0.118	0.157	0.117	0.000
1.4167	0.118	0.167	0.121	0.000
1.5000	0.118	0.177	0.124	0.000
1.5833	0.118	0.187	0.128	0.000
1.6667	0.118	0.197	0.131	0.000
1.7500	0.118	0.207	0.134	0.000
1.8333	0.118	0.216	0.137	0.000
1.9167	0.118	0.226	0.141	0.000
2.0000	0.118	0.236	0.144	0.000
2.0833	0.118	0.246	0.147	0.000
2.1667	0.118	0.256	0.149	0.000
2.2500	0.118	0.266	0.152	0.000
2.3333	0.118	0.276	0.155	0.000
2.4167	0.118	0.285	0.158	0.000
2.5000	0.118	0.295	0.161	0.000
2.5833	0.118	0.305	0.163	0.000
2.6667	0.118	0.315	0.166	0.000
2.7500	0.118	0.325	0.168	0.000
2.8333	0.118	0.335	0.171	0.000
2.9167	0.118	0.345	0.174	0.000
3.0000	0.118	0.354	0.176	0.000
3.0833	0.118	0.364	0.199	0.000

3.1667	0.118	0.374	0.210	0.000
3.2500	0.118	0.384	0.219	0.000
3.3333	0.118	0.394	0.227	0.000
3.4167	0.118	0.404	0.234	0.000
3.5000	0.118	0.414	0.241	0.000
3.5833	0.118	0.423	0.247	0.000
3.6667	0.118	0.433	0.253	0.000
3.7500	0.118	0.443	0.259	0.000
3.8333	0.118	0.453	0.264	0.000
3.9167	0.118	0.463	0.270	0.000
4.0000	0.118	0.473	0.275	0.000
4.0833	0.118	0.483	0.280	0.000
4.1667	0.118	0.492	0.285	0.000
4.2500	0.118	0.502	0.290	0.000
4.3333	0.118	0.512	0.294	0.000
4.4167	0.118	0.522	0.299	0.000
4.5000	0.118	0.532	0.303	0.000
4.5833	0.118	0.542	0.308	0.000
4.6667	0.118	0.551	0.312	0.000
4.7500	0.118	0.561	0.316	0.000
4.8333	0.118	0.571	0.321	0.000
4.9167	0.118	0.581	0.325	0.000
5.0000	0.118	0.591	0.329	0.000
5.0833	0.118	0.601	0.333	0.000
5.1667	0.118	0.611	0.337	0.000
5.2500	0.118	0.620	0.340	0.000
5.3333	0.118	0.630	0.344	0.000
5.4167	0.118	0.640	0.348	0.000
5.5000	0.118	0.650	0.352	0.000
5.5833	0.118	0.660	0.359	0.000
5.6667	0.118	0.670	0.368	0.000
5.7500	0.118	0.680	0.378	0.000
5.8333	0.118	0.689	0.390	0.000
5.9167	0.118	0.699	0.403	0.000
6.0000	0.118	0.709	0.416	0.000
6.0833	0.118	0.719	0.429	0.000
6.1667	0.118	0.729	0.555	0.000
6.2500	0.118	0.739	0.625	0.000
6.3333	0.118	0.749	0.681	0.000
6.4167	0.118	0.758	0.730	0.000
6.5000	0.118	0.768	0.774	0.000
6.5833	0.118	0.778	1.187	0.000
6.6667	0.118	0.788	1.907	0.000
6.7500	0.118	0.798	2.798	0.000
6.8333	0.118	0.808	3.767	0.000
6.9167	0.118	0.818	4.721	0.000
7.0000	0.118	0.827	5.570	0.000
7.0833	0.118	0.837	6.247	0.000
7.1667	0.118	0.847	6.728	0.000
7.2500	0.118	0.857	7.065	0.000
7.3333	0.118	0.867	7.483	0.000
7.4167	0.118	0.877	7.817	0.000
7.5000	0.118	0.887	8.138	0.000
7.5833	0.118	0.896	8.445	0.000
7.6667	0.000	0.000	8.741	0.000

Name : Basin 2
Bypass: Yes

GroundWater: No

<u>Pervious Land Use</u>	<u>acre</u>
C, Pasture, Mod	.09
Pervious Total	0.09
<u>Impervious Land Use</u>	<u>acre</u>
Impervious Total	0
Basin Total	0.09

Element Flows To:		
Surface	Interflow	Groundwater

Name : Upstream
Bypass: No

GroundWater: No

<u>Pervious Land Use</u>	<u>acre</u>
C, Lawn, Mod	.2
C, Forest, Mod	.8
Pervious Total	1
<u>Impervious Land Use</u>	<u>acre</u>
ROOF TOPS FLAT	0.12
DRIVEWAYS FLAT	0.23
Impervious Total	0.35
Basin Total	1.35

Element Flows To:		
Surface	Interflow	Groundwater
Vault 1	Vault 1	

ANALYSIS RESULTS

Stream Protection Duration

Predeveloped Landuse Totals for POC #1

Total Pervious Area:3.77

Total Impervious Area:0.35

Mitigated Landuse Totals for POC #1

Total Pervious Area:1.94

Total Impervious Area:2.18

Flow Frequency Return Periods for Predeveloped. POC #1

<u>Return Period</u>	<u>Flow(cfs)</u>
2 year	0.3216
5 year	0.489468
10 year	0.621004
25 year	0.811994
50 year	0.973321
100 year	1.151877

Flow Frequency Return Periods for Mitigated. POC #1

<u>Return Period</u>	<u>Flow(cfs)</u>
2 year	0.157509
5 year	0.208144
10 year	0.246746
25 year	0.301602
50 year	0.347126
100 year	0.396863

Stream Protection Duration

Annual Peaks for Predeveloped and Mitigated. POC #1

<u>Year</u>	<u>Predeveloped</u>	<u>Mitigated</u>
1949	0.412	0.148
1950	0.443	0.155
1951	0.268	0.147
1952	0.309	0.125
1953	0.365	0.119
1954	0.936	0.153
1955	0.412	0.168
1956	0.247	0.170
1957	0.412	0.204
1958	0.851	0.155
1959	0.280	0.155
1960	0.358	0.171
1961	1.066	0.168
1962	0.317	0.152
1963	0.541	0.152
1964	0.308	0.147
1965	0.167	0.150
1966	0.182	0.120
1967	0.375	0.156
1968	0.344	0.224
1969	1.032	0.139

1970	0.228	0.130
1971	0.372	0.154
1972	0.399	0.157
1973	0.323	0.135
1974	0.529	0.137
1975	0.374	0.129
1976	0.203	0.161
1977	0.187	0.140
1978	0.217	0.118
1979	0.615	0.182
1980	0.304	0.140
1981	0.227	0.145
1982	0.229	0.238
1983	0.418	0.148
1984	0.267	0.170
1985	0.343	0.177
1986	0.673	0.356
1987	0.296	0.249
1988	0.276	0.155
1989	0.336	0.110
1990	0.226	0.156
1991	0.206	0.162
1992	0.304	0.134
1993	0.227	0.135
1994	0.171	0.151
1995	0.198	0.166
1996	0.446	0.223
1997	0.755	0.642
1998	0.341	0.131
1999	0.204	0.151
2000	0.453	0.159
2001	0.136	0.112
2002	0.177	0.154
2003	0.173	0.140
2004	0.398	0.247
2005	0.202	0.155
2006	0.602	0.259
2007	0.507	0.151
2008	0.436	0.432
2009	0.228	0.143

Stream Protection Duration

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	1.0661	0.6419
2	1.0323	0.4324
3	0.9355	0.3561
4	0.8509	0.2591
5	0.7550	0.2486
6	0.6734	0.2474
7	0.6154	0.2384
8	0.6022	0.2237
9	0.5411	0.2226
10	0.5293	0.2038
11	0.5072	0.1824
12	0.4530	0.1772

13	0.4465	0.1708
14	0.4427	0.1698
15	0.4358	0.1697
16	0.4180	0.1677
17	0.4124	0.1677
18	0.4123	0.1662
19	0.4123	0.1621
20	0.3990	0.1605
21	0.3981	0.1593
22	0.3750	0.1575
23	0.3736	0.1565
24	0.3721	0.1559
25	0.3648	0.1554
26	0.3577	0.1553
27	0.3440	0.1552
28	0.3432	0.1550
29	0.3410	0.1547
30	0.3360	0.1544
31	0.3228	0.1539
32	0.3172	0.1534
33	0.3091	0.1523
34	0.3082	0.1523
35	0.3044	0.1512
36	0.3040	0.1511
37	0.2959	0.1510
38	0.2798	0.1502
39	0.2757	0.1481
40	0.2681	0.1479
41	0.2673	0.1473
42	0.2471	0.1469
43	0.2287	0.1447
44	0.2284	0.1430
45	0.2282	0.1403
46	0.2270	0.1401
47	0.2268	0.1399
48	0.2265	0.1389
49	0.2172	0.1369
50	0.2063	0.1355
51	0.2039	0.1353
52	0.2032	0.1344
53	0.2023	0.1310
54	0.1976	0.1296
55	0.1870	0.1292
56	0.1819	0.1247
57	0.1769	0.1200
58	0.1733	0.1186
59	0.1709	0.1184
60	0.1668	0.1118
61	0.1359	0.1102

Stream Protection Duration

POC #1

The Facility PASSED

The Facility PASSED.

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.1608	2329	2113	90	Pass
0.1690	1894	1403	74	Pass
0.1772	1583	1050	66	Pass
0.1854	1356	876	64	Pass
0.1936	1201	835	69	Pass
0.2018	1048	798	76	Pass
0.2100	914	734	80	Pass
0.2183	829	679	81	Pass
0.2265	737	615	83	Pass
0.2347	660	574	86	Pass
0.2429	600	510	85	Pass
0.2511	554	461	83	Pass
0.2593	519	428	82	Pass
0.2675	484	405	83	Pass
0.2757	446	383	85	Pass
0.2839	416	349	83	Pass
0.2921	377	327	86	Pass
0.3003	352	305	86	Pass
0.3085	329	281	85	Pass
0.3167	305	256	83	Pass
0.3249	276	230	83	Pass
0.3332	247	205	82	Pass
0.3414	219	181	82	Pass
0.3496	190	154	81	Pass
0.3578	173	122	70	Pass
0.3660	150	112	74	Pass
0.3742	134	86	64	Pass
0.3824	114	70	61	Pass
0.3906	102	59	57	Pass
0.3988	91	53	58	Pass
0.4070	82	47	57	Pass
0.4152	69	38	55	Pass
0.4234	55	32	58	Pass
0.4316	51	20	39	Pass
0.4398	46	17	36	Pass
0.4481	40	16	40	Pass
0.4563	38	16	42	Pass
0.4645	33	15	45	Pass
0.4727	31	14	45	Pass
0.4809	27	14	51	Pass
0.4891	22	12	54	Pass
0.4973	22	12	54	Pass
0.5055	20	11	55	Pass
0.5137	17	11	64	Pass
0.5219	17	10	58	Pass
0.5301	16	10	62	Pass
0.5383	15	10	66	Pass
0.5465	13	10	76	Pass
0.5547	13	10	76	Pass
0.5630	13	9	69	Pass
0.5712	11	8	72	Pass
0.5794	11	8	72	Pass
0.5876	11	8	72	Pass
0.5958	11	7	63	Pass
0.6040	10	6	60	Pass
0.6122	10	6	60	Pass

0.6204	9	5	55	Pass
0.6286	8	4	50	Pass
0.6368	8	2	25	Pass
0.6450	8	0	0	Pass
0.6532	8	0	0	Pass
0.6614	8	0	0	Pass
0.6697	8	0	0	Pass
0.6779	6	0	0	Pass
0.6861	6	0	0	Pass
0.6943	6	0	0	Pass
0.7025	6	0	0	Pass
0.7107	6	0	0	Pass
0.7189	6	0	0	Pass
0.7271	6	0	0	Pass
0.7353	6	0	0	Pass
0.7435	6	0	0	Pass
0.7517	6	0	0	Pass
0.7599	5	0	0	Pass
0.7681	5	0	0	Pass
0.7763	5	0	0	Pass
0.7846	5	0	0	Pass
0.7928	5	0	0	Pass
0.8010	5	0	0	Pass
0.8092	5	0	0	Pass
0.8174	5	0	0	Pass
0.8256	5	0	0	Pass
0.8338	5	0	0	Pass
0.8420	5	0	0	Pass
0.8502	5	0	0	Pass
0.8584	4	0	0	Pass
0.8666	4	0	0	Pass
0.8748	4	0	0	Pass
0.8830	4	0	0	Pass
0.8912	4	0	0	Pass
0.8995	4	0	0	Pass
0.9077	4	0	0	Pass
0.9159	4	0	0	Pass
0.9241	4	0	0	Pass
0.9323	4	0	0	Pass
0.9405	3	0	0	Pass
0.9487	3	0	0	Pass
0.9569	3	0	0	Pass
0.9651	3	0	0	Pass
0.9733	3	0	0	Pass

Water Quality BMP Flow and Volume for POC #1
On-line facility volume: 0.313 acre-feet
On-line facility target flow: 0.4129 cfs.
Adjusted for 15 min: 0.4129 cfs.
Off-line facility target flow: 0.2332 cfs.
Adjusted for 15 min: 0.2332 cfs.

LID Technique	Used for	Total Volume	Volume	Infiltration	Cumulative
Percent	Water Quality	Percent	Through	Volume	Volume
Volume	Treatment?	Needs	Facility	(ac-ft.)	Infiltration
Infiltrated	Water Quality	Treatment	(ac-ft)		Credit
	Treated	(ac-ft)	(ac-ft)		
Vault 1 POC	N	506.04			N
0.00					
Total Volume Infiltrated		506.04	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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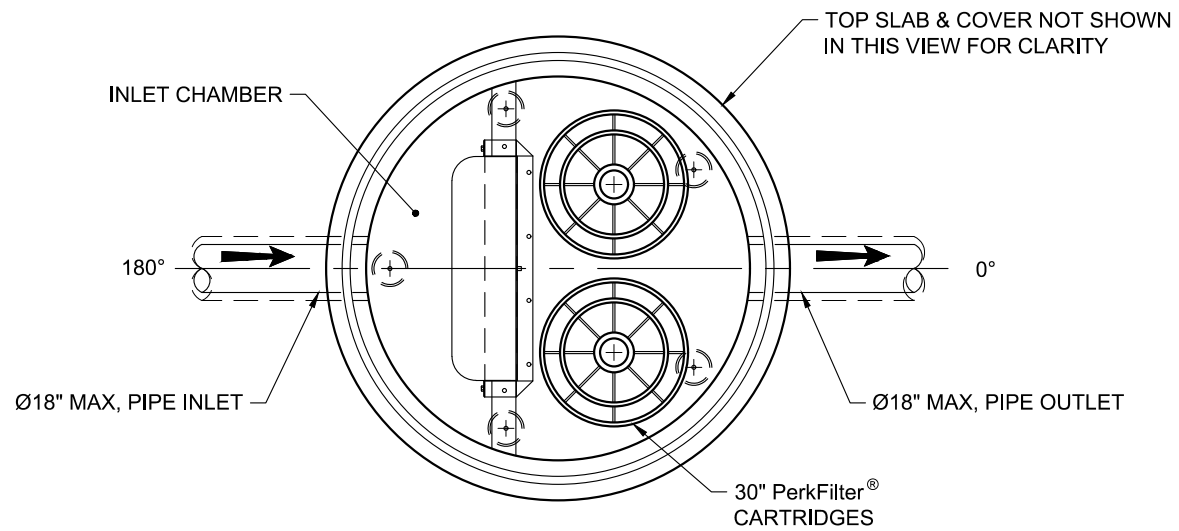
SITE SPECIFIC DATA					MINIMUM DEPTH	
Structure ID	-	Outlet Pipe Size	Ø6"	Minimum Rim to Outlet Depth	5.67'	
Treatment Flow Rate (gpm/cfs)	-	Ø8"		5.92'		
Peak Flow Rate (cfs)	-	Ø10"		6.17'		
Cartridge Quantity	-	Ø12"		6.42'		
Rim Elevation	-	Ø15"		6.67'		
		Ø18"		6.92'		

Pipe Data	Pipe Location	Pipe Size	Pipe Type	Invert Elevation
Inlet	-	-	-	-
Outlet	-	-	-	-

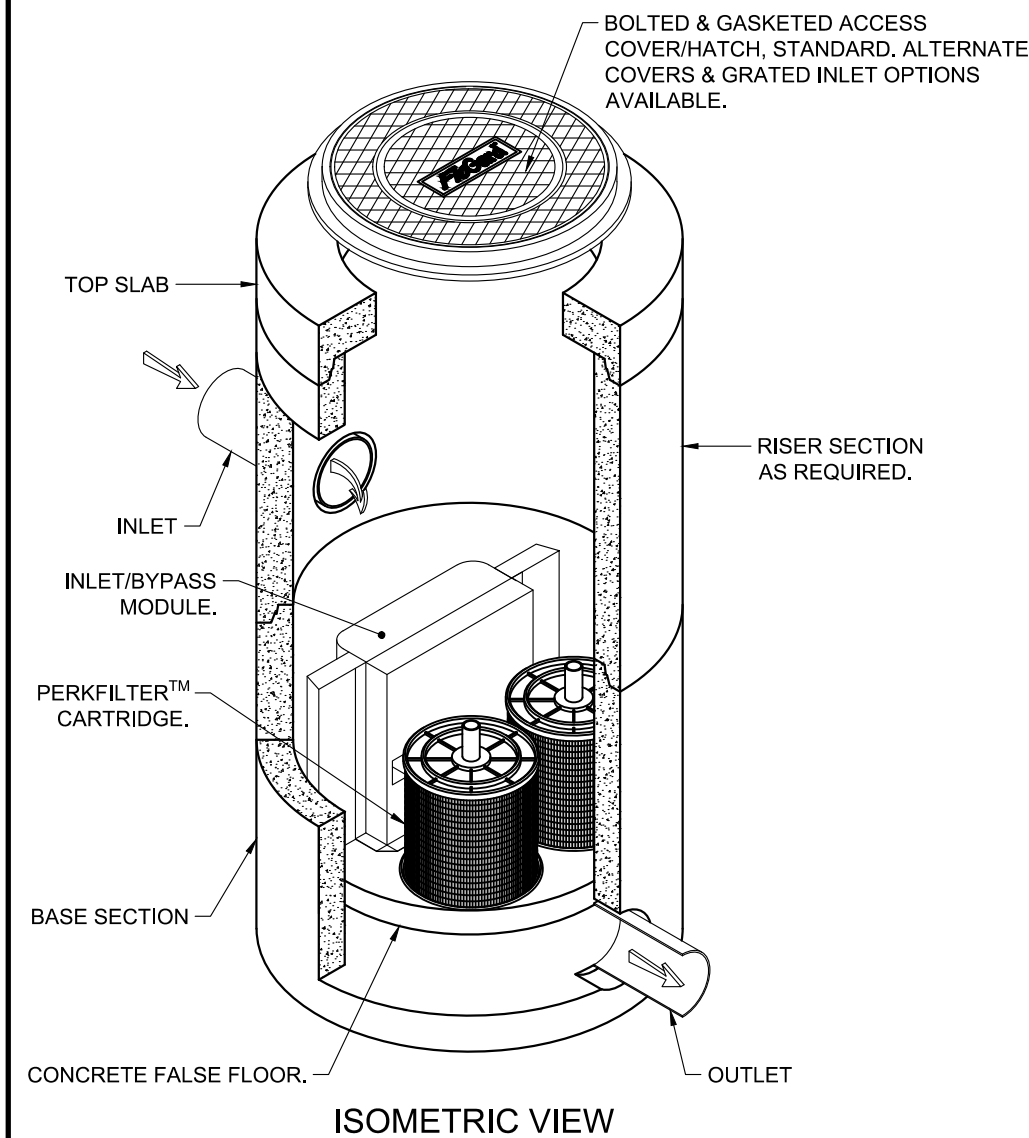
Notes:
-

PERFORMANCE SPECIFICATIONS	
Peak Treatment Capacities: ¹	
Max. Cartridge Quantity	2
NJDEP 80% Removal, 75 micron	68 gpm / 0.151 cfs
WA Ecology GULD - Basic & Phosphorus	34 gpm / 0.075 cfs
Max. Bypass Capacity	3.62 cfs

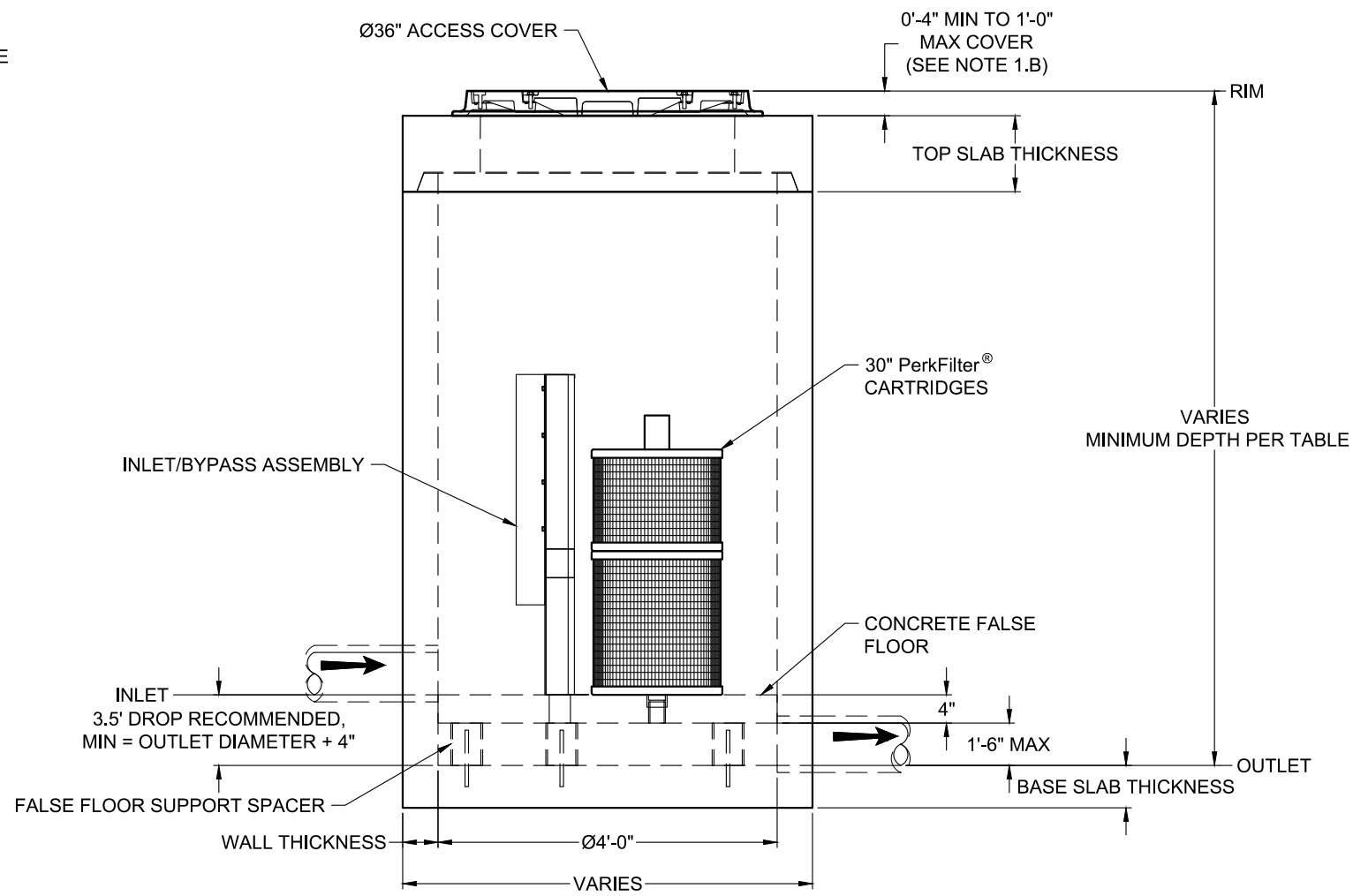
¹ Contact Oldcastle for alternative treatment and peak flow capacities.



PLAN VIEW



ISOMETRIC VIEW



ELEVATION VIEW

NOTES:

- DESIGN LOADINGS:
 - AASHTO HS-20-44 (WITH IMPACT)
 - DESIGN SOIL COVER: 1'-0" MAXIMUM
 - ASSUMED WATER TABLE: BELOW INVERT.
 - LATERAL EARTH PRESSURE: 45 PCF (DRAINED)
 - LATERAL LIVE LOAD SURCHARGE: 80 PSF (APPLIED TO 8'-0" BELOW GRADE)
 - NO LATERAL SURCHARGE FROM ADJACENT BUILDINGS, WALLS, PIERS, OR FOUNDATIONS.
- CONCRETE 28-DAY MINIMUM COMPRESSIVE STRENGTH: 5,000 PSI MINIMUM.
- REINFORCING: REBAR, ASTM A615/A706, GRADE 60
- CEMENT: ASTM C150
- REQUIRED ALLOWABLE SOIL BEARING CAPACITY: 2,500 PSF
- REFERENCE STANDARD:
 - ASTM C 478
 - ASTM C 497
- THIS STRUCTURE IS DESIGNED TO THE PARAMETERS NOTED HEREIN. ENGINEER-OF-RECORD SHALL VERIFY THAT NOTED PARAMETERS MEET OR EXCEED PROJECT REQUIREMENTS. IF DESIGN PARAMETERS ARE INCORRECT, REVIEWING ENGINEER/AUTHORITY SHALL NOTIFY OLDCASTLE INFRASTRUCTURE UPON REVIEW OF THIS SUBMITTAL.
- OVERSIZED HOLES TO ACCOMMODATE SPECIFIC PIPE TYPE MUST BE CONCENTRIC TO PIPE ID. AFTER PIPES ARE INSTALLED, ALL ANNULAR SPACES SHALL BE FILLED WITH A MINIMUM OF 3,000 PSI CONCRETE FOR FULL THICKNESS OF PRECAST WALLS. PIPES ARE TO BE FLUSH WITH THE INSIDE SURFACE OF THE CONCRETE STRUCTURE.
- CONTRACTOR RESPONSIBLE TO VERIFY ALL SIZES, LOCATIONS, AND ELEVATIONS OF OPENINGS.
- CONTRACTOR RESPONSIBLE TO ENSURE ADEQUATE BEARING SURFACE IS PROVIDED (I.E. COMPACTED AND LEVEL PER PROJECT SPECIFICATIONS).
- SECTION HEIGHTS, SLAB/WALL THICKNESSES, AND KEYWAYS ARE SUBJECT TO CHANGE AS REQUIRED FOR SITE REQUIREMENTS AND/OR DUE TO PRODUCT AVAILABILITY AND PRODUCTION FACILITY CONSTRAINTS.
- FOR SITE SPECIFIC DRAWINGS WITH DETAILED STRUCTURE DIMENSIONS AND WEIGHTS, PLEASE CONTACT OLDCASTLE INFRASTRUCTURE.
- MAXIMUM PICK WEIGHTS:
 - TOP SLAB: XX,XXX LBS
 - RISER: XX,XXX LBS
 - BASE: XX,XXX LBS* (* COMBINED WEIGHT OF BASE INCLUDES FALSE FLOOR, AND PRODUCT INTERNALS.)
- INTERNALS SHALL CONSIST OF CARTRIDGES, INLET/BYPASS ASSEMBLIES, FALSE FLOOR AND FALSE FLOOR SUPPORT SPACERS.



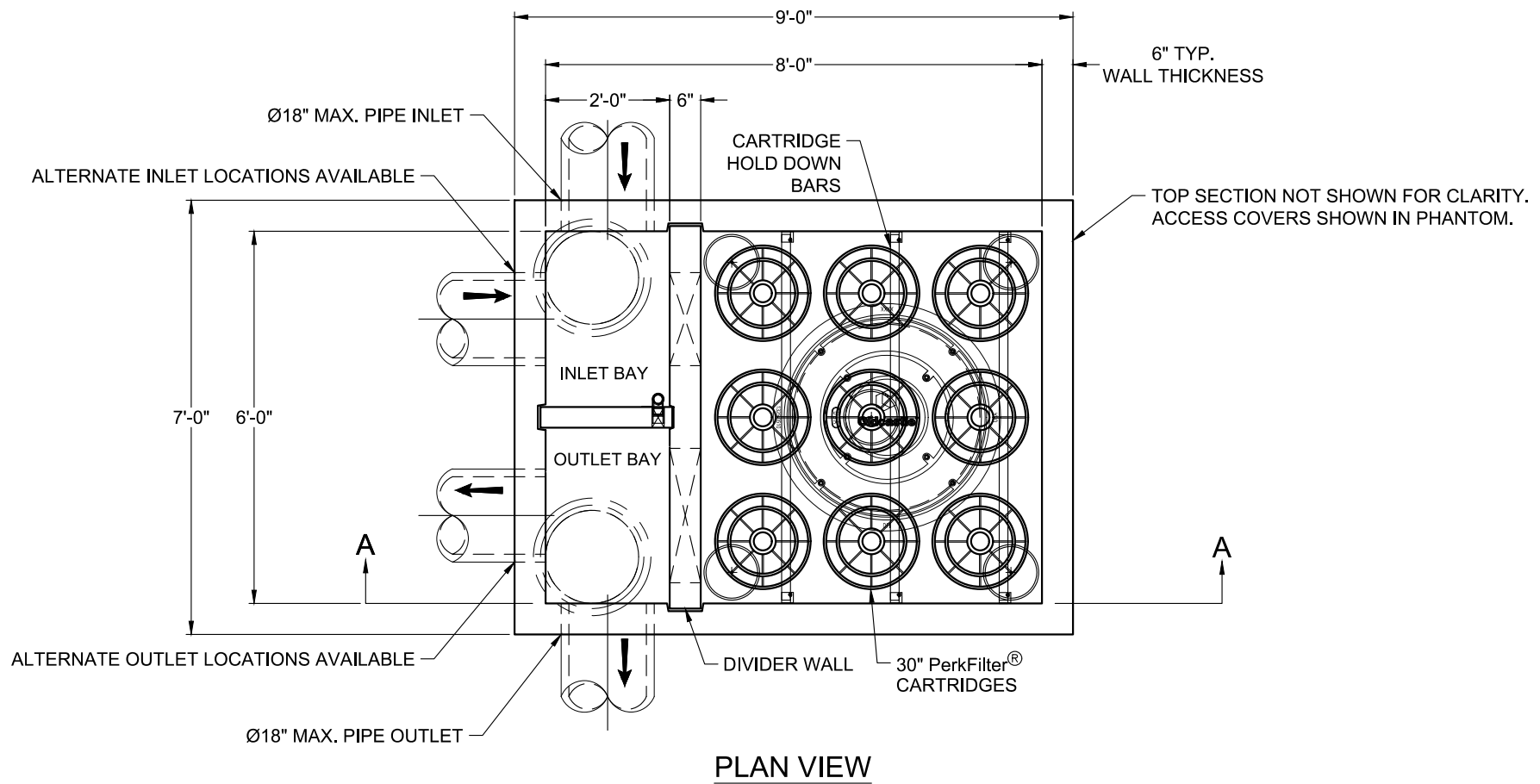
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PerkFilter® Manhole (STANDARD)
 Ø48" with 30" Cartridges

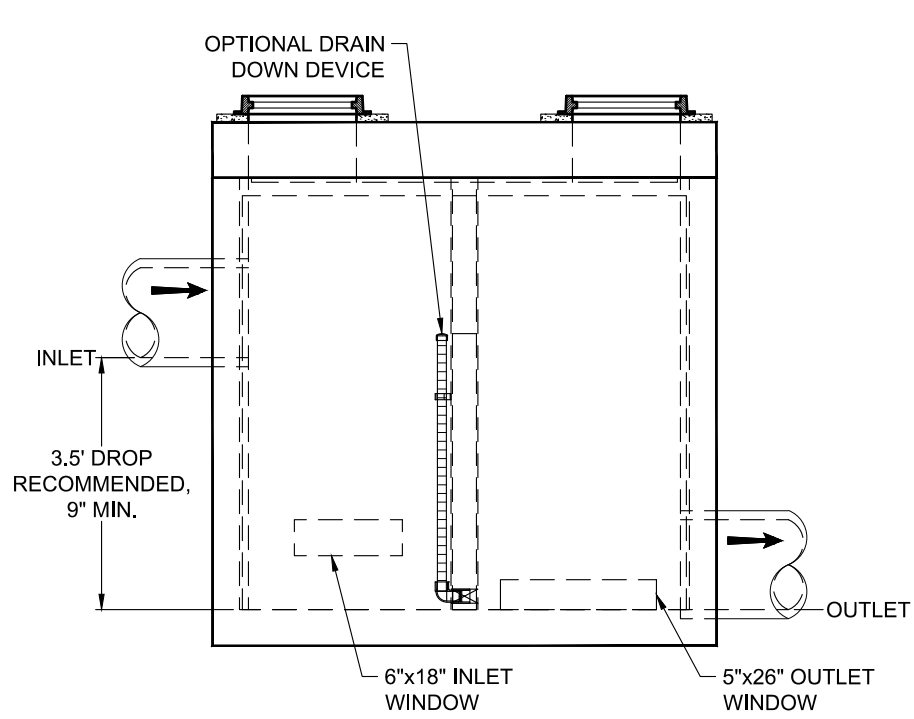
CUSTOMER	-
PROJECT NAME	-
SHEET NAME	Specifer Drawing PFMH-48-30
REVISION	-
REV DATE	-
SHEET	1 OF 1



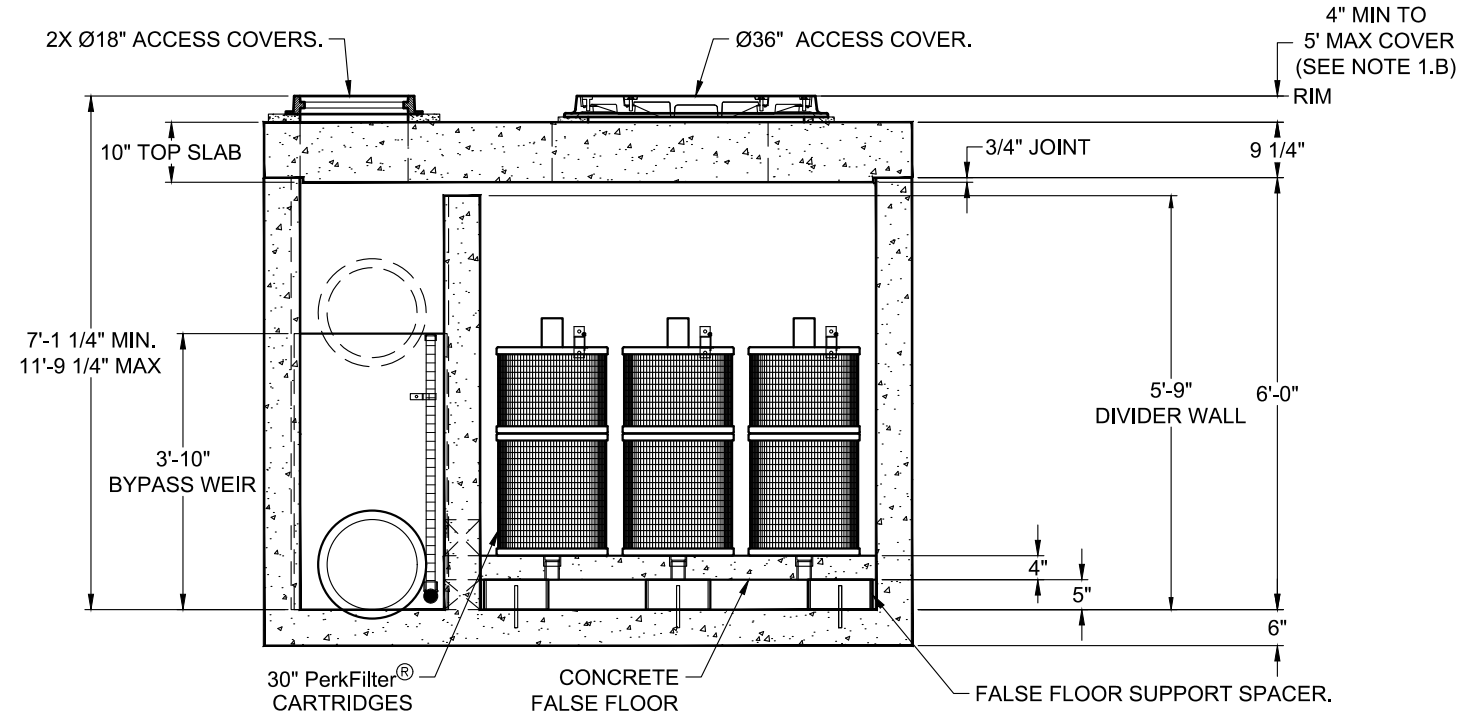
SITE SPECIFIC DATA				
Structure ID	-			
Treatment Flow Rate (gpm/cfs)	-			
Peak Flow Rate (cfs)	-			
Rim Elevation	-			
Pipe Data	Pipe Location	Pipe Size	Pipe Type	Invert Elevation
Inlet 1	-	-	-	-
Inlet 2	-	-	-	-
Outlet	-	-	-	-
Notes: -				
PERFORMANCE SPECIFICATIONS				
Peak Treatment Capacities: ¹				
Max. Cartridge Quantity	9			
NJDEP 80% Removal, 75 micron	0.602 cfs			
WA Ecology GULD - Basic & Phosphorus	0.341 cfs			
Max. Bypass Capacity	18.3 cfs			
¹ Contact Oldcastle for alternative treatment and peak flow capacities.				



PLAN VIEW



LEFT END VIEW



SECTION A-A

- NOTES:**
- DESIGN LOADINGS:
 - AASHTO HS-20-44 (WITH IMPACT)
 - DESIGN SOIL COVER: 5'-0" MAXIMUM
 - ASSUMED WATER TABLE: BELOW BASE OF PRECAST (ENGINEER-OF-RECORD TO CONFIRM SITE WATER TABLE ELEVATION)
 - LATERAL EARTH PRESSURE: 45 PCF (DRAINED)
 - LATERAL LIVE LOAD SURCHARGE: 80 PSF (APPLIED TO 8'-0" BELOW GRADE)
 - NO LATERAL SURCHARGE FROM ADJACENT BUILDINGS, WALLS, PIERS, OR FOUNDATIONS.
 - CONCRETE 28-DAY MINIMUM COMPRESSIVE STRENGTH: 5,000 PSI MINIMUM.
 - REINFORCING: REBAR, ASTM A615/A706, GRADE 60
 - CEMENT: ASTM C150
 - REQUIRED ALLOWABLE SOIL BEARING CAPACITY: 2,500 PSF
 - REFERENCE STANDARD:
 - ASTM C890
 - ASTM C913
 - ACI 318-14
 - THIS STRUCTURE IS DESIGNED TO THE PARAMETERS NOTED HEREIN. ENGINEER-OF-RECORD SHALL VERIFY THAT NOTED PARAMETERS MEET OR EXCEED PROJECT REQUIREMENTS. IF DESIGN PARAMETERS ARE INCORRECT, REVIEWING ENGINEER/AUTHORITY SHALL NOTIFY OLDCASTLE INFRASTRUCTURE UPON REVIEW OF THIS SUBMITTAL.
 - OVERSIZED HOLES TO ACCOMMODATE SPECIFIC PIPE TYPE MUST BE CONCENTRIC TO PIPE ID. AFTER PIPES ARE INSTALLED, ALL ANNULAR SPACES SHALL BE FILLED WITH A MINIMUM OF 3,000 PSI CONCRETE FOR FULL THICKNESS OF PRECAST WALLS. PIPES ARE TO BE FLUSH WITH THE INSIDE SURFACE OF THE CONCRETE STRUCTURE.
 - CONTRACTOR RESPONSIBLE TO VERIFY ALL SIZES, LOCATIONS, AND ELEVATIONS OF OPENINGS.
 - CONTRACTOR RESPONSIBLE TO ENSURE ADEQUATE BEARING SURFACE IS PROVIDED (I.E. COMPACTED AND LEVEL PER PROJECT SPECIFICATIONS).
 - SECTION HEIGHTS, SLAB/WALL THICKNESSES, AND KEYWAYS ARE SUBJECT TO CHANGE AS REQUIRED FOR SITE REQUIREMENTS AND/OR DUE TO PRODUCT AVAILABILITY AND PRODUCTION FACILITY CONSTRAINTS.
 - FOR SITE SPECIFIC DRAWINGS WITH DETAILED STRUCTURE DIMENSIONS AND WEIGHTS, PLEASE CONTACT OLDCASTLE INFRASTRUCTURE.
 - MAXIMUM PICK WEIGHTS:
 - TOP: XX,XXX LBS
 - BASE: XX,XXX LBS*
 (* COMBINED WEIGHT OF BASE INCLUDES DIVIDER WALLS, FALSE FLOOR, AND PRODUCT INTERNALS.)
 - INTERNALS SHALL CONSIST OF CARTRIDGES, WEIR WALL, FALSE FLOOR, FALSE FLOOR SUPPORT SPACERS, AND DIVIDER WALL.



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PerkFilter® Vault (STANDARD)		
6'x8' With 30" Cartridges		
CUSTOMER	-	
PROJECT NAME	-	
SHEET NAME	REVISION	SHEET
Specifier Drawing	-	1 OF 1
PFV-68-30	REV DATE	





PROJECT INFORMATION			
Contact Name:		Company:	
Email:		Phone:	
Date:	<input type="checkbox"/> Rush Request	<input type="checkbox"/> Site Plan Attached	
Project Name:			
Location:		Regulatory Jurisdiction:	
Type of Site:	<input type="checkbox"/> Residential	<input type="checkbox"/> Commercial	<input type="checkbox"/> Mixed Use <input type="checkbox"/> Industrial <input type="checkbox"/> Other
Treatment Technology:	<input type="checkbox"/> Bioretention/Biofiltration	<input type="checkbox"/> Media Filtration	<input type="checkbox"/> Hydrodynamic Separation

DESIGN SPECIFICATIONS

Sizing Methodology:

Water Quality Flow
 Water Quality Volume
 Downstream of Detention

Site Information:

Structure ID	Drainage Area ○ sf ○ acres	Percent Impervious (%)	Runoff Coefficient	WQ Flow Rate or Volume	Peak Flow Rate
				○ cfs/cf ○ gpm/gal	○ cfs ○ gpm

Additional Information (if available):

Water Quality		Water Quality	
On-Line BMP	Off-Line BMP	On-Line BMP	Off-Line BMP
24 hour Volume (ac-ft) <input type="text" value="0.0833"/>		24 hour Volume (ac-ft) <input type="text" value="0.3130"/>	
Standard Flow Rate (cfs) <input type="text" value="0.1103"/>	Standard Flow Rate (cfs) <input type="text" value="0.0623"/>	Standard Flow Rate (cfs) <input type="text" value="0.4129"/>	Standard Flow Rate (cfs) <input type="text" value="0.2332"/>

Note Special Conditions:

Shallow Application
 High Groundwater
 Limited Drop (PerkFilter Only) _____

Notes:

Appendix 5: Conveyance Analysis

Nothing is necessary for this appendix at this time

Appendix 6: Operations and Maintenance Manual

1. Operations and Maintenance Manual

Table V-A.2: Maintenance Standards - Infiltration (continued)

Maintenance Component	Defect	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed
		(A percolation test pit or test of facility indicates facility is only working at 90% of its designed capabilities. Test every 2 to 5 years. If two inches or more sediment is present, remove).	
Filter Bags (if applicable)	Filled with Sediment and Debris	Sediment and debris fill bag more than 1/2 full.	Filter bag is replaced or system is redesigned.
Rock Filters	Sediment and Debris	By visual inspection, little or no water flows through filter during heavy rain storms.	Gravel in rock filter is replaced.
Side Slopes of Pond	Erosion	See Table V-A.1: Maintenance Standards - Detention Ponds	See Table V-A.1: Maintenance Standards - Detention Ponds
Emergency Overflow Spillway and Berms over 4 feet in height.	Tree Growth	See Table V-A.1: Maintenance Standards - Detention Ponds	See Table V-A.1: Maintenance Standards - Detention Ponds
	Piping	See Table V-A.1: Maintenance Standards - Detention Ponds	See Table V-A.1: Maintenance Standards - Detention Ponds
Emergency Overflow Spillway	Rock Missing	See Table V-A.1: Maintenance Standards - Detention Ponds	See Table V-A.1: Maintenance Standards - Detention Ponds
	Erosion	See Table V-A.1: Maintenance Standards - Detention Ponds	See Table V-A.1: Maintenance Standards - Detention Ponds
Pre-settling Ponds and Vaults	Facility or sump filled with Sediment and/or debris	6" or designed sediment trap depth of sediment.	Sediment is removed.

Table V-A.3: Maintenance Standards - Closed Detention Systems (Tanks/Vaults)

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
Storage Area	Plugged Air Vents	One-half of the cross section of a vent is blocked at any point or the vent is damaged.	Vents open and functioning.
	Debris and Sediment	Accumulated sediment depth exceeds 10% of the diameter of the storage area for 1/2 length of storage vault or any point depth exceeds 15% of diameter. (Example: 72-inch storage tank would require cleaning when sediment reaches depth of 7 inches for more than 1/2 length of tank.)	All sediment and debris removed from storage area.
	Joints Between Tank/Pipe Section	Any openings or voids allowing material to be transported into facility. (Will require engineering analysis to determine structural stability).	All joint between tank/pipe sections are sealed.
	Tank Pipe Bent Out of Shape	Any part of tank/pipe is bent out of shape more than 10% of its design shape. (Review required by engineer to determine structural stability).	Tank/pipe repaired or replaced to design.
	Vault Structure Includes Cracks in Wall, Bottom, Damage to Frame and/or Top Slab	Cracks wider than 1/2-inch and any evidence of soil particles entering the structure through the cracks, or maintenance/inspection personnel determines that the vault is not structurally sound. Cracks wider than 1/2-inch at the joint of any inlet/outlet pipe or any evidence of soil particles entering the vault through the walls.	Vault replaced or repaired to design specifications and is structurally sound. No cracks more than 1/4-inch wide at the joint of the inlet/outlet pipe.

Table V-A.3: Maintenance Standards - Closed Detention Systems (Tanks/Vaults) (continued)

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
Manhole	Cover Not in Place	Cover is missing or only partially in place. Any open manhole requires maintenance.	Manhole is closed.
	Locking Mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than 1/2 inch of thread (may not apply to self-locking lids).	Mechanism opens with proper tools.
	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure. Intent is to keep cover from sealing off access to maintenance.	Cover can be removed and reinstalled by one maintenance person.
	Ladder Rungs Unsafe	Ladder is unsafe due to missing rungs, misalignment, not securely attached to structure wall, rust, or cracks.	Ladder meets design standards. Allows maintenance person safe access.
Catch Basins	See Table V-A.5: Maintenance Standards - Catch Basins	See Table V-A.5: Maintenance Standards - Catch Basins	See Table V-A.5: Maintenance Standards - Catch Basins

Table V-A.4: Maintenance Standards - Control Structure/Flow Restrictor

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Trash and Debris (Includes Sediment)	Material exceeds 25% of sump depth or 1 foot below orifice plate.	Control structure orifice is not blocked. All trash and debris removed.
	Structural Damage	Structure is not securely attached to manhole wall. Structure is not in upright position (allow up to 10% from plumb). Connections to outlet pipe are not watertight and show signs of rust. Any holes - other than designed holes - in the structure.	Structure securely attached to wall and outlet pipe. Structure in correct position. Connections to outlet pipe are water tight; structure repaired or replaced and works as designed. Structure has no holes other than designed holes.
Cleanout Gate	Damaged or Missing	Cleanout gate is not watertight or is missing. Gate cannot be moved up and down by one maintenance person. Chain/rod leading to gate is missing or damaged. Gate is rusted over 50% of its surface area.	Gate is watertight and works as designed. Gate moves up and down easily and is watertight. Chain is in place and works as designed. Gate is repaired or replaced to meet design standards.
Orifice Plate	Damaged or Missing	Control device is not working properly due to missing, out of place, or bent orifice plate.	Plate is in place and works as designed.
	Obstructions	Any trash, debris, sediment, or vegetation blocking the plate.	Plate is free of all obstructions and works as designed.
Overflow Pipe	Obstructions	Any trash or debris blocking (or having the potential of blocking) the overflow pipe.	Pipe is free of all obstructions and works as designed.
Manhole	See Table V-A.3: Maintenance Standards - Closed Detention Systems (Tanks/Vaults)	See Table V-A.3: Maintenance Standards - Closed Detention Systems (Tanks/Vaults)	See Table V-A.3: Maintenance Standards - Closed Detention Systems (Tanks/Vaults)
Catch Basin	See Table V-A.5: Maintenance Standards - Catch Basins	See Table V-A.5: Maintenance Standards - Catch Basins	See Table V-A.5: Maintenance Standards - Catch Basins

Table V-A.5: Maintenance Standards - Catch Basins

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is performed
General	Trash & Debris	Trash or debris which is located immediately in front of the catch basin opening or is blocking inletting capacity of the basin by more than 10%. Trash or debris (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of six inches clearance from the debris surface to the invert of the lowest pipe. Trash or debris in any inlet or outlet pipe blocking more than 1/3 of its height. Dead animals or vegetation that could generate odors that could cause complaints or dangerous gases (e.g., methane).	No Trash or debris located immediately in front of catch basin or on grate opening. No trash or debris in the catch basin. Inlet and outlet pipes free of trash or debris. No dead animals or vegetation present within the catch basin.
	Sediment	Sediment (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of 6 inches clearance from the sediment surface to the invert of the lowest pipe.	No sediment in the catch basin
	Structure Damage to Frame and/or Top Slab	Top slab has holes larger than 2 square inches or cracks wider than 1/4 inch. (Intent is to make sure no material is running into basin). Frame not sitting flush on top slab, i.e., separation of more than 3/4 inch of the frame from the top slab. Frame not securely attached	Top slab is free of holes and cracks. Frame is sitting flush on the riser rings or top slab and firmly attached.
	Fractures or Cracks in Basin Walls/ Bottom	Maintenance person judges that structure is unsound. Grout fillet has separated or cracked wider than 1/2 inch and longer than 1 foot at the joint of any inlet/outlet pipe or any evidence of soil particles entering catch basin through cracks.	Basin replaced or repaired to design standards. Pipe is regouted and secure at basin wall.
	Settlement/ Mis-alignment	If failure of basin has created a safety, function, or design problem.	Basin replaced or repaired to design standards.
	Vegetation	Vegetation growing across and blocking more than 10% of the basin opening. Vegetation growing in inlet/outlet pipe joints that is more than six inches tall and less than six inches apart.	No vegetation blocking opening to basin. No vegetation or root growth present.
	Contamination and Pollution	See Table V-A.1: Maintenance Standards - Detention Ponds	No pollution present.
Catch Basin Cover	Cover Not in Place	Cover is missing or only partially in place. Any open catch basin requires maintenance.	Cover/grate is in place, meets design standards, and is secured
	Locking Mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than 1/2 inch of thread.	Mechanism opens with proper tools.
	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure. (Intent is keep cover from sealing off access to maintenance.)	Cover can be removed by one maintenance person.
Ladder	Ladder Rungs Unsafe	Ladder is unsafe due to missing rungs, not securely attached to basin wall, misalignment, rust, cracks, or sharp edges.	Ladder meets design standards and allows maintenance person safe access.
Metal Grates (If Applicable)	Grate opening Unsafe	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 inletting capacity.	Grate free of trash and debris.
	Damaged or Missing.	Grate missing or broken member(s) of the grate.	Grate is in place, meets the design standards, and is installed and aligned with the flow path.

Table V-A.13: Maintenance Standards - Sand Filters (Above Ground/Open) (continued)

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
	Flow Spreader	Flow spreader uneven or clogged so that flows are not uniformly distributed across sand filter.	Spreader leveled and cleaned so that flows are spread evenly over sand filter.
	Damaged Pipes	Any part of the piping that is crushed or deformed more than 20% or any other failure to the piping.	Pipe repaired or replaced.

Table V-A.14: Maintenance Standards - Sand Filters (Below Ground/Enclosed)

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Below Ground Vault.	Sediment Accumulation on Sand Media Section	Sediment depth exceeds 1/2-inch.	No sediment deposits on sand filter section that which would impede permeability of the filter section.
	Sediment Accumulation in Pre-Settling Portion of Vault	Sediment accumulation in vault bottom exceeds the depth of the sediment zone plus 6-inches.	No sediment deposits in first chamber of vault.
	Trash/Debris Accumulation	Trash and debris accumulated in vault, or pipe inlet/outlet, floatables and non-floatables.	Trash and debris removed from vault and inlet/outlet piping.
	Sediment in Drain Pipes/Cleanouts	When drain pipes, cleanouts become full with sediment and/or debris.	Sediment and debris removed.
	Short Circuiting	When seepage/flow occurs along the vault walls and corners. Sand eroding near inflow area.	Sand filter media section re-laid and compacted along perimeter of vault to form a semi-seal. Erosion protection added to dissipate force of incoming flow and curtail erosion.
	Damaged Pipes	Inlet or outlet piping damaged or broken and in need of repair.	Pipe repaired and/or replaced.
	Access Cover Damaged/Not Working	Cover cannot be opened, corrosion/deformation of cover. Maintenance person cannot remove cover using normal lifting pressure.	Cover repaired to proper working specifications or replaced.
	Ventilation	Ventilation area blocked or plugged	Blocking material removed or cleared from ventilation area. A specified % of the vault surface area must provide ventilation to the vault interior (see design specifications).
	Vault Structure Damaged; Includes Cracks in Walls, Bottom, Damage to Frame and/or Top Slab.	Cracks wider than 1/2-inch or evidence of soil particles entering the structure through the cracks, or maintenance/inspection personnel determine that the vault is not structurally sound. Cracks wider than 1/2-inch at the joint of any inlet/outlet pipe or evidence of soil particles entering through the cracks.	Vault replaced or repairs made so that vault meets design specifications and is structurally sound. Vault repaired so that no cracks exist wider than 1/4-inch at the joint of the inlet/outlet pipe.
	Baffles/Internal walls	Baffles or walls corroding, cracking, warping and/or showing signs of failure as determined by maintenance/inspection person.	Baffles repaired or replaced to specifications.
Access Ladder Damaged	Ladder is corroded or deteriorated, not functioning properly, not securely attached to structure wall, missing rungs, cracks, and misaligned.	Ladder replaced or repaired to specifications, and is safe to use as determined by inspection personnel.	

Table V-A.15: Maintenance Standards - Manufactured Media Filters

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Below Ground	Sediment Accumulation on Media.	Sediment depth exceeds 0.25-inches.	No sediment deposits which would impede permeability of the

Table V-A.15: Maintenance Standards - Manufactured Media Filters (continued)

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Vault			compost media.
	Sediment Accumulation in Vault	Sediment depth exceeds 6-inches in first chamber.	No sediment deposits in vault bottom of first chamber.
	Trash/Debris Accumulation	Trash and debris accumulated on compost filter bed.	Trash and debris removed from the compost filter bed.
	Sediment in Drain Pipes/Clean-Outs	When drain pipes, clean-outs, become full with sediment and/or debris.	Sediment and debris removed.
	Damaged Pipes	Any part of the pipes that are crushed or damaged due to corrosion and/or settlement.	Pipe repaired and/or replaced.
	Access Cover Damaged/Not Working	Cover cannot be opened; one person cannot open the cover using normal lifting pressure, corrosion/deformation of cover.	Cover repaired to proper working specifications or replaced.
	Vault Structure Includes Cracks in Wall, Bottom, Damage to Frame and/or Top Slab	Cracks wider than 1/2-inch or evidence of soil particles entering the structure through the cracks, or maintenance/inspection personnel determine that the vault is not structurally sound. Cracks wider than 1/2-inch at the joint of any inlet/outlet pipe or evidence of soil particles entering through the cracks.	Vault replaced or repairs made so that vault meets design specifications and is structurally sound. Vault repaired so that no cracks exist wider than 1/4-inch at the joint of the inlet/outlet pipe.
	Baffles	Baffles corroding, cracking warping, and/or showing signs of failure as determined by maintenance/inspection person.	Baffles repaired or replaced to specifications.
Access Ladder Damaged	Ladder is corroded or deteriorated, not functioning properly, not securely attached to structure wall, missing rungs, cracks, and misaligned.	Ladder replaced or repaired and meets specifications, and is safe to use as determined by inspection personnel.	
Below Ground Cartridge Type	Media	Drawdown of water through the media takes longer than 1 hour, and/or overflow occurs frequently.	Media cartridges replaced.
	Short Circuiting	Flows do not properly enter filter cartridges.	Filter cartridges replaced.

Appendix 7: Special Reports and Studies

1. Geotechnical Report, Terra Associates Inc, January 25, 2024