Serenity Trails

Preliminary Drainage Report

Presented to: City of Marysville

Serenity Trails

Drainage Report

Prepared for
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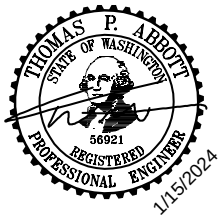

January 2024 ***Job No: 23-0012***

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SECTION 1: PROJECT OVERVIEW

The proposed Serenity Trails project is approximately a 2.07-acre site. The project is a single-family residential development on parcel #00590700028500 and addressed at 3208 83rd Ave NE Marysville, WA 98270. The project proposes to construct 14 new single-family lots along with associated private and public utilities proposed to serve development. The site will gain access from 83rd Ave NE right-of-way to the west. Frontage improvements along 83rd Ave NE consisting of sidewalk improvements to City standards are proposed. See the Vicinity Map in Appendix 1 for visual representation of the subject property.

Existing Site

The parcel #00590700028500 is currently undeveloped, containing a mixture of tree growth and tall grass coverage. There is a small parcel #00590700028503 owned by Verizon taking up the majority of property frontage along 83rd Ave NE. A gravel access driveway serves the Verizon lot and also takes up the small panhandle of the subject property. Existing topography generally descends to the west along flat slopes towards 83rd Ave NE. The project parcel is currently zoned WR-R-6-18 in the City of Marysville.

The proposed development is located within a single threshold discharge area (TDA) since site runoff from developed surfaces travels west and converges downstream within the quarter mile boundary of analysis.

A preliminary Geotechnical Engineering Design Study has been prepared by Earth Solutions Northwest on the site just north of the proposed project site. The City of Marysville is allowing the use of this geotechnical report due to the proximity of the projects to one another. Please reference the geotechnical report for detailed soils information. The geotechnical report indicates that slopes are gentle with slopes from east to west across the site. Infiltration is noted as being infeasible due to the presence of till soils onsite.

Proposed Development

The proposed single-family project will construct 14 new single-family lots and will gain access from 83rd Ave NE. Full build-out of existing half-street ROW associated with adjacent developments to the north and south of the project are proposed. Frontage improvements along 83rd Ave NE consisting of sidewalk improvements to City standards are also proposed.

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 a detention pond with vertical cast in place walls located along the western portion of the site. Prior to discharge, a Perkfilter cartridge filtration unit will be used to treat stormwater runoff to meet basic water quality treatment requirements. The proposed detention pond and water quality treatment systems will discharge to the existing city conveyance system within 83rd Ave NE right-of-way.

Onsite development will create 1.20 AC of new impervious surfaces. Onsite runoff will be collected by the open detention pond for mitigation and then will flow through a Perkfilter downstream of detention for water quality treatment. These developed areas are considered to be within the Onsite Basin for stormwater modeling. A portion of ROW improvements associated with the development adjacent to the south of the project will bypass detention and has been modeled as such in the Bypass Basin. See Section 4.0 for additional modeling details.

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 pattern to the west towards 83rd Ave NE frontage. Runoff then flows south along 83rd Ave in existing conveyance systems towards Soper Hill Rd, which are tributary to unnamed streams that join Hulbert Creek.

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 the nature of till soils underlying the site. 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 a water quality treatment structure that treats stormwater runoff discharging from the detention system. 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 and is required to provide flow control. An open detention pond with vertical cast-in-place concrete walls will be installed in the western portion of the project site. The detention system will discharge to the existing city conveyance system in 83rd Ave ROW at mitigated rates. 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. A wetland recon letter indicating such has been included with project submittal items.

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 I.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.

Element #2 – Establish Construction Access
Stabilized construction accesses will be installed as shown on the plans.

Element #3 – Control Flow Rates
Detention of construction period runoff will be provided by means of sediment ponds on the site.

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.

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.

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.

Element #8 – Stabilize Channels and Outlets
Temporary channels, shall be stabilized with check dams.

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.

Element #10 – Control De-Watering
There will be no de-watering as a part of this project.

Element #11 – Maintain BMPs
Maintenance of the BMPs is specified within the Construction Sequence and Grading and Erosion Control 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.

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 located within a single TDA. Site runoff winds through unnamed streams that join Hulbert Creek which eventually outfalls into Ebey Slough.

Floodplain / Floodway (FEMA) maps
Per FEMA Floodplain map #53061C0738F 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 are not feasible for infiltration BMPs, 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 did not contain any listings for Hulbert Creek which the project is tributary to. Please refer to Appendix 3 for copies of applicable 303(d) listings.

Water Quality Problems
Hulbert Creek has no category 5 listings in the DOE Water Quality Assessment Review tools. 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 46ºF and clear skies. The following observations were verified during the visit.

The subject property area is currently undeveloped and consists primarily of flat to moderately sloped grass areas, with some tree coverage in the eastern half. There are assumed to be some areas of upstream sheet flow from the property to the east due to existing topography.

One general flow path has been identified leaving the west side of the parcel, and all flow converges within one quarter mile of the site. As a result, the site is located within a single threshold discharge area (TDA).

Site flow generally travels overland to the west (Image 1) until reaching 83rd Ave NE and continuing south (Image 2). A series of catch basins and drainage ditches along the east side of 83rd Ave NE carry flow south for approximately a quarter mile (Images 3-6). The conveyance system then turns west under 83rd Ave (Image 7) and outlets to a vegetated area near the intersection with Soper Hill Rd (Image 8). Flow is directed south again and crosses under Soper Hill Rd (Image 9) into a wetland area (Image 10) that continues southwest beyond the quarter mile boundary of analysis. Flow ultimately joins Hulbert Creek well beyond the quarter mile boundary.

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 peak flow determination for direct discharge. Based on the site location, the WWHM used the Seatac Gage with a Precipitation Scale factor of 1.20. For visual representation of the listed basins, see the Predeveloped Hydrology Map.

Onsite Basin:

The predeveloped condition for the Onsite Basin is the historic forested condition. The values as modeled in WWHM are as follows:

Table 1: Predeveloped Conditions: Onsite Basin

Onsite Basin	
Ground Cover	Area (acre)
Forest, mod	1.95
Total	**1.95**

4.2 Developed Site Hydrology

In the developed condition, the project proposes to construct 14 new single-family lots along with associated private and public utilities proposed to serve development. Minimal frontage improvements along 83rd Ave NE are proposed as well.

In compliance with 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. Please note that all pervious surfaces have been modeled as pasture, as they will be noted in the construction plans to be underlain with BMP T5.13 soils.

Onsite Basin:

The developed Onsite Basin includes the developed site within its boundaries. The maximum lot impervious value per zoning code was utilized in determine proposed site impervious coverage. In 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, flat	0.60
Roads, flat	0.23
Sidewalk, flat	0.06
Driveway, flat	0.27
Pasture, flat	0.65
Pond	0.08
Total	**1.89**

Bypass Basin:
The Bypass Basin is comprised of adjacent project ROW to the south of the project that provides access to lots 11-14. These ROW improvements are not collected to the onsite detention system, but are rather allowed to drain to the existing drainage infrastructure associated with the remaining portion of the adjacent half-street ROW. 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)
Road, flat	0.02
Sidewalk, flat	0.02
Pasture, flat	0.02
Total	**0.06**

4.3 Detention Facility Design

The proposed detention pond system used for mitigating developed condition flows was designed in compliance with the 2019 DOE requirements to model hydrologic conditions and detention with the following evaluation parameters:

> *"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 Pond Facility
The proposed detention pond facility detains, and releases collected storm water runoff from the Onsite Basin. The facility is located at the westerly portion of the site. Flows from the Onsite Basin are collected and conveyed to the detention pond via a proposed network of catch basins and storm water conveyance pipes. Detailed WWHM output is provided in Appendix 4. A summary of the detailed statistics and inputs used for modeling the system in WWHM2012 can be found below.

Table 4: Detention Pond Design Summary

Detention Pond	
Live Storage Bottom Area (modeled)	3,380 SF
Live Storage Dimensions (modeled)	26'x130'
Live Storage Bottom Area (provided)	3,640 SF
Live Storage Dimensions (provided)	26'x140'
Begin Live Storage Elevation	335.00
Riser Height	7.50
Volume (modeled)	25,350 CF
Volume (provided)	27,300 CF
Top of Riser Elevation	342.50

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

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	0.0721	0.0507	338.60
10-Year	0.1496	0.0787	339.72
50-Year	0.2429	0.1089	340.40
100-Year	0.2905	0.1236	340.93

4.4 Water Quality Treatment

Perkfilter
Water quality treatment for the Onsite Basin is accomplished through a Perkfilter structure located downstream of the detention pond system. A summary of design criteria is provided below:

Table 6: Perkfilter Design Summary

48" Ø Perkfilter Manhole	
Tributary Area	*1.89 AC*
Tributary PGIS Area	*0.50 AC*
Water Quality Flow Rate (2 yr mitigated peak)	0.0507 cfs
WQ Treatment Capacity	0.0750 cfs
Number of Cartridges	2
Cartridge Height	12"+18"
Internal Drop	3.5'
Peak Flow Rate	0.1236 cfs
Peak Flow Storm Event	100-year

4.5 Onsite Stormwater Management

The project does not 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: Feasible**

Roofs:

1. *Downspout Full Infiltration per BMP T5.10A or Downspout Full Dispersion per BMP T5.30*
    - Infiltration is not feasible on site due to the lack of infiltratable soils 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 locations 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 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**

3. *Downspout Dispersion per BMP T5.10B.*
    - Due to site specific constraints including building location as well as the proximity of slopes and walls to the developed site improvements, there is inadequate flow path length 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 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 per the Geotechnical Engineer, 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 location as well as the proximity of slopes and walls to the developed site improvements, there is inadequate flow path length to disperse on site.
        i. **Conclusion: Infeasible**

SECTION 5: CONVEYANCE DESIGN

The stormwater conveyance system is comprised of a network of open/closed grate catch basins, buried pipe, a detention pond and a Perkfilter water quality unit. 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, a detention pond, and a perkfilter water quality treatment structure. These facilities will require periodic maintenance and inspection. Inspection and maintenance procedures are contained on the following pages.

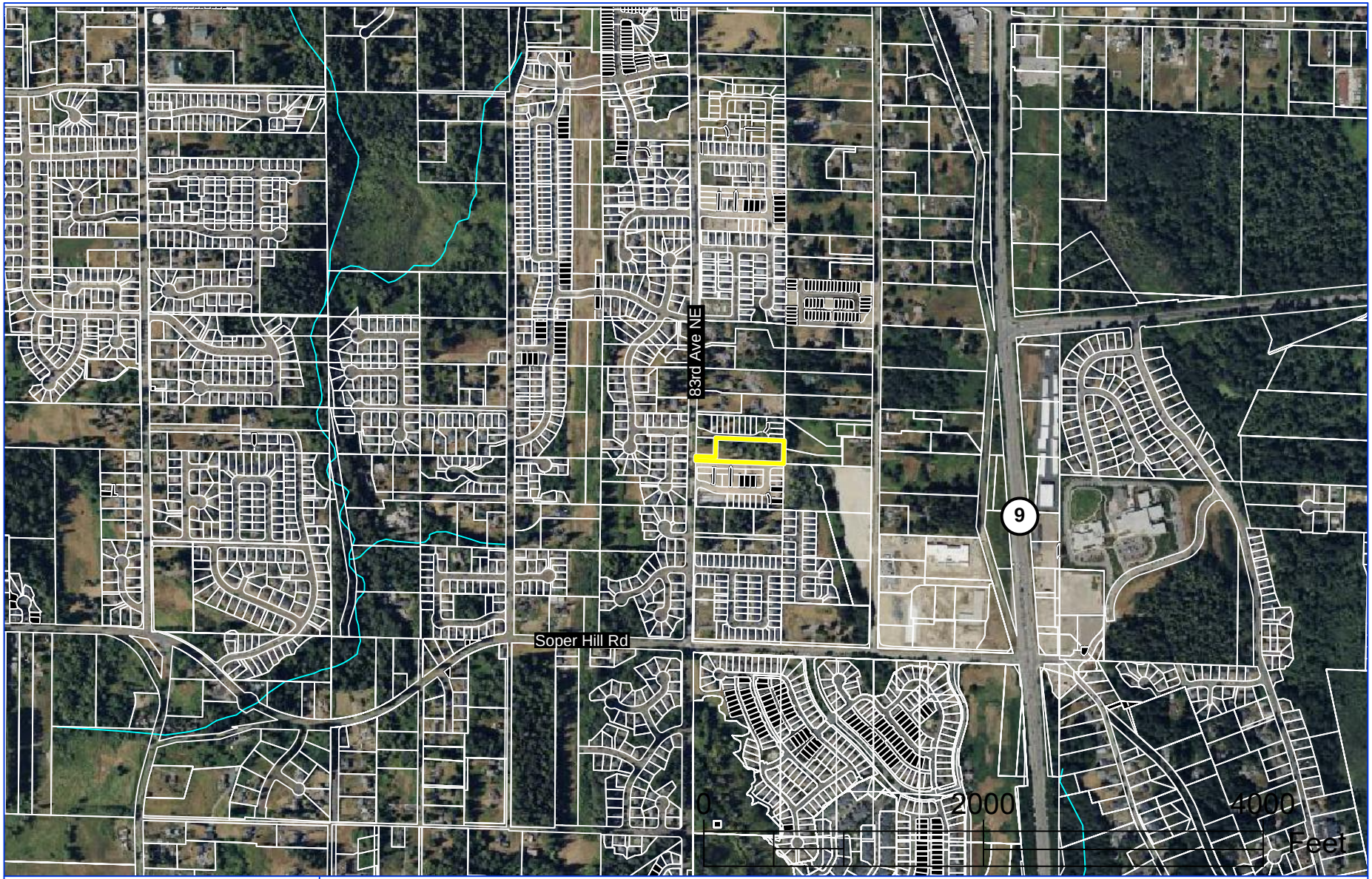
SECTION 7: SPECIAL REPORTS AND STUDIES

The following studies were conducted in preparation of this Report:

- Geotechnical Engineering Study – Jensen Property, Earth Solutions NW, May 2021
- Critical Areas Recon Letter, Kvam Aquatic Sciences, LLC, October 2023

Appendix 1: Project Overview

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



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8105 166th Ave NE
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KEYSTONE LAND, LLC

SERENITY TRAILS

VICINITY MAP

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JURISDICTION:	Marysville	DRAWN BY:	CJD

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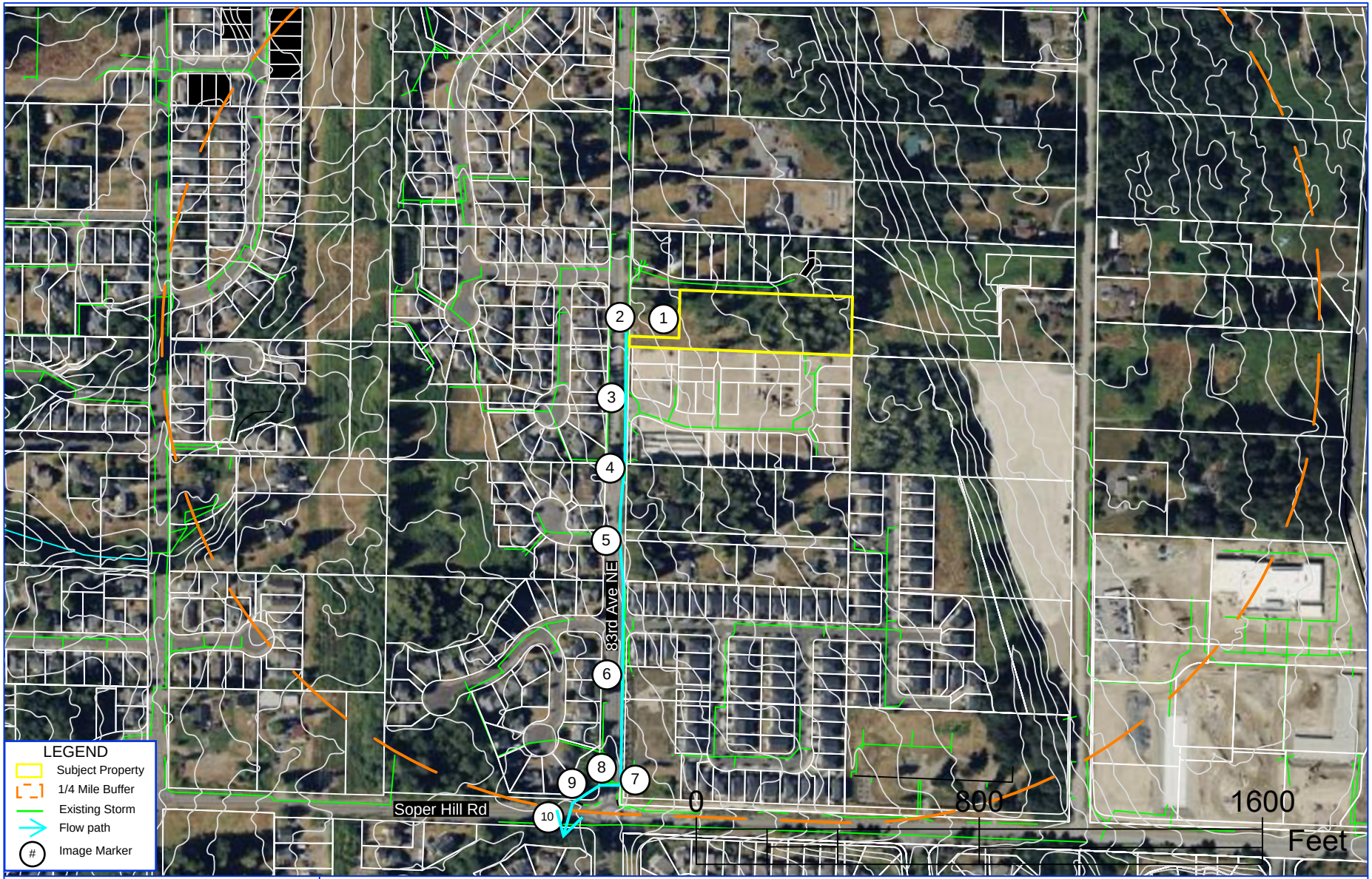
Appendix 2: Temporary Erosion and Sediment Control Design

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

Appendix 3: Downstream Analysis

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



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DOWNSTREAM ANALYSIS MAP

JOB NUMBER:	23-0012	DATE:	1-15-24
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Downstream Analysis Photographs

Image 1: Facing east towards the property from 83rd Ave NE frontage, flow travels west

Image 2: Facing south along 83rd Ave NE frontage where runoff collects roadside

Image 3: runoff that continues as overland flow along 83rd Ave collects in existing storm system, conveys south

Image 4: storm conveyance system continues south along 83rd Ave

Image 5: Closed conveyance pipe outlets into grass swale along 83rd Ave

Image 6: storm conveyance system continues again via pipe south along 83rd Ave

Image 7: Conveyance system crosses west under 83rd Ave prior to Soper Hill Rd intersection

Image 8: Storm systems outlets to vegetated area at 83rd Ave – Soper Hill intersection

Image 9: Flow continues to culvert crossing south under Soper Hill Rd

Image 10: Culvert outlets to wetland area on south side of Soper Hill Rd, continues beyond quarter mile boundary

Map Scale: 1:1,090 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 15 30 60 90

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 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

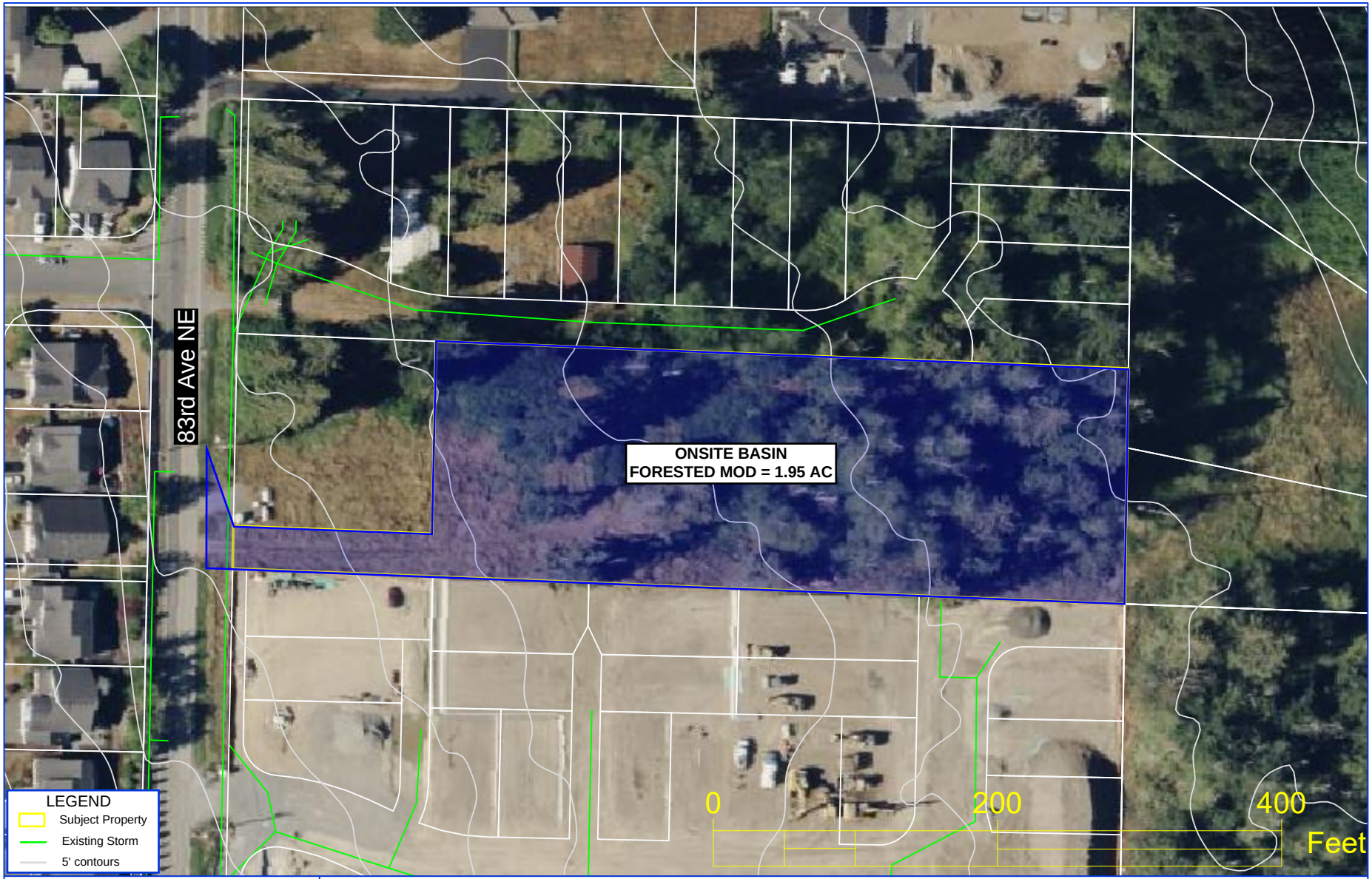
The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

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	2.9	100.0%
Totals for Area of Interest		**2.9**	**100.0%**

Appendix 4: Detention and Water Quality Design Analysis

1. Predeveloped Hydrology Map
2. Developed Hydrology Map
3. Perkfilter Detail
4. WWHM2012 Output – Detention System



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PREDEVELOPED HYDROLOGY MAP

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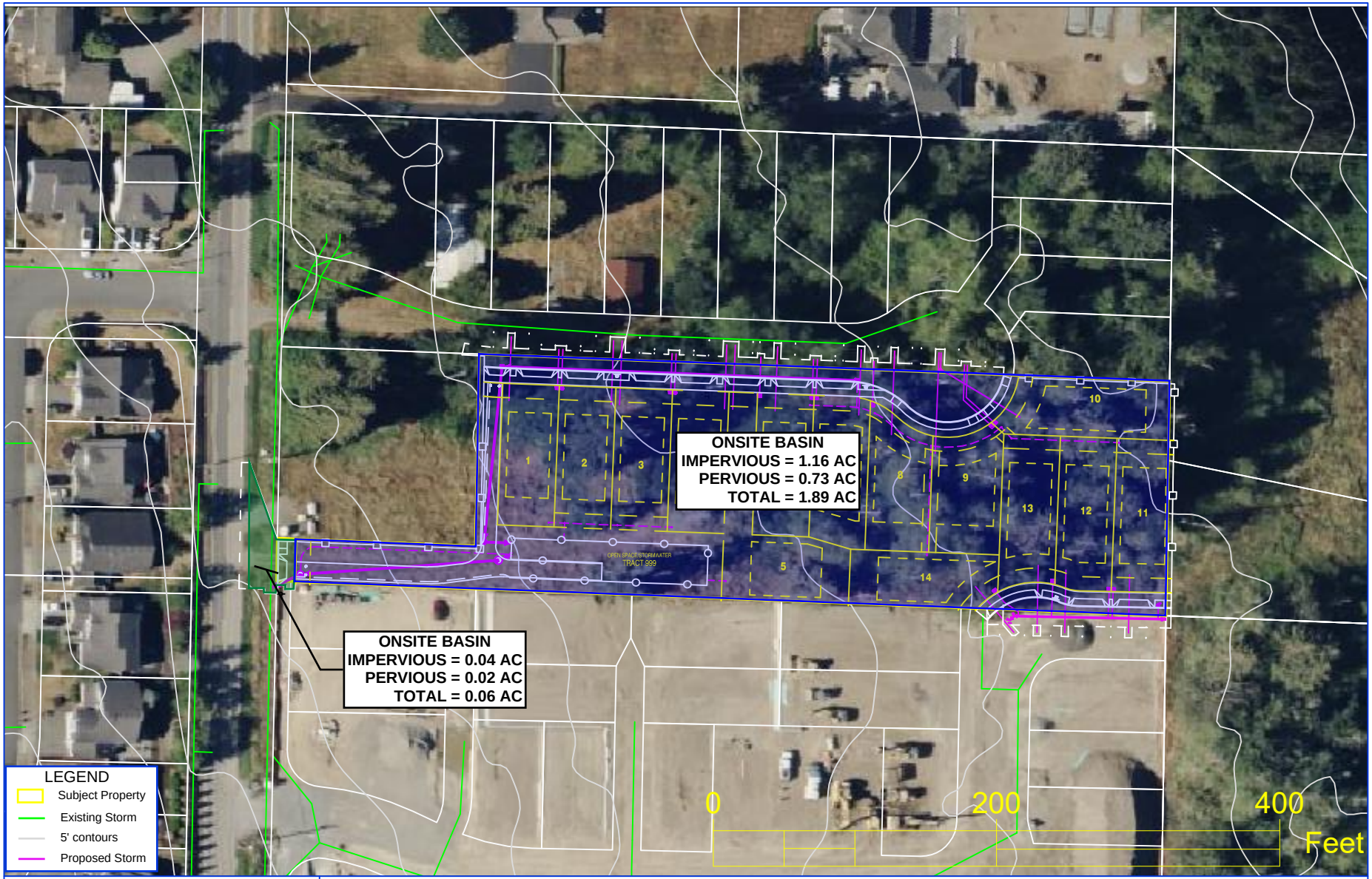

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DEVELOPED HYDROLOGY MAP

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JURISDICTION:	Marysville	DRAWN BY:	CJD

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SITE SPECIFIC DATA	
Structure ID	-
Treatment Flow Rate (gpm/cfs)	-
Peak Flow Rate (cfs)	-
Cartridge Quantity	-
Rim Elevation	-

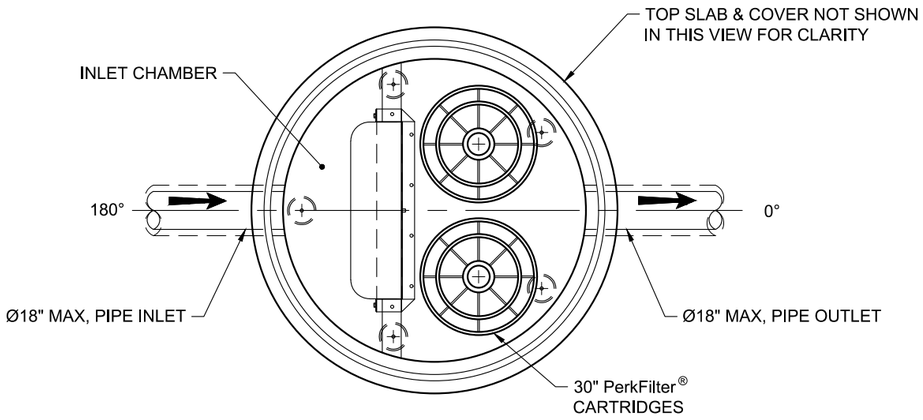
Pipe Data	Pipe Location	Pipe Size	Pipe Type	Invert Elevation
Inlet	-	-	-	-
Outlet	-	-	-	-

Notes:
-

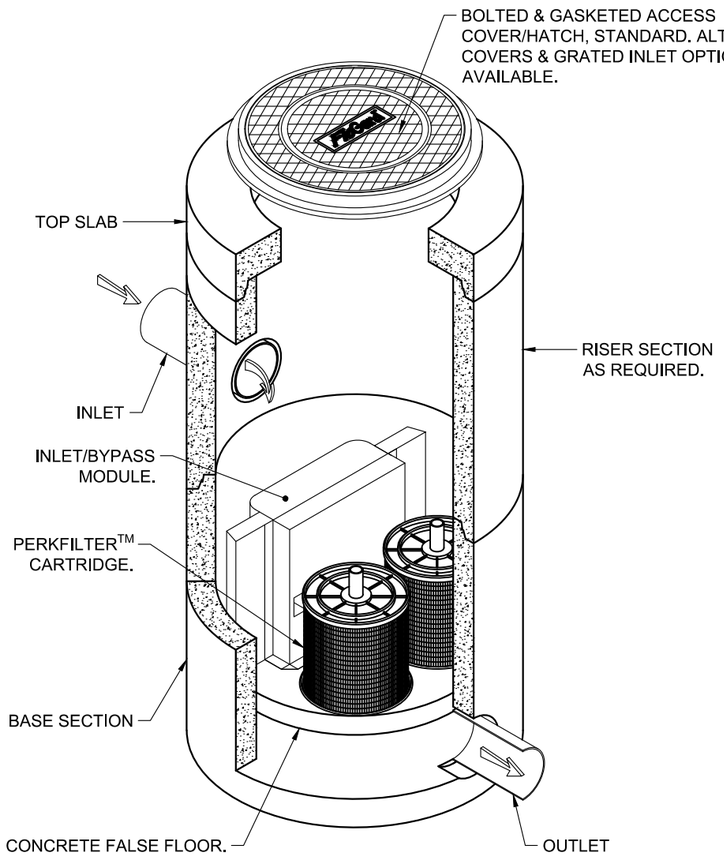
PERFORMANCE SPECIFICATIONS	
Peak Treatment Capacities: [1]	
Max. Cartridge Quantity	2
NJDEP 80% Removal, 75 micron	68 gpm / 0.151 cfs
WA Ecology GULD - Basic & Phosphorus	34 gpm / 0.075 cfs
Max. Bypass Capacity	3.62 cfs

1. Contact Oldcastle for alternative treatment and peak flow capacities.

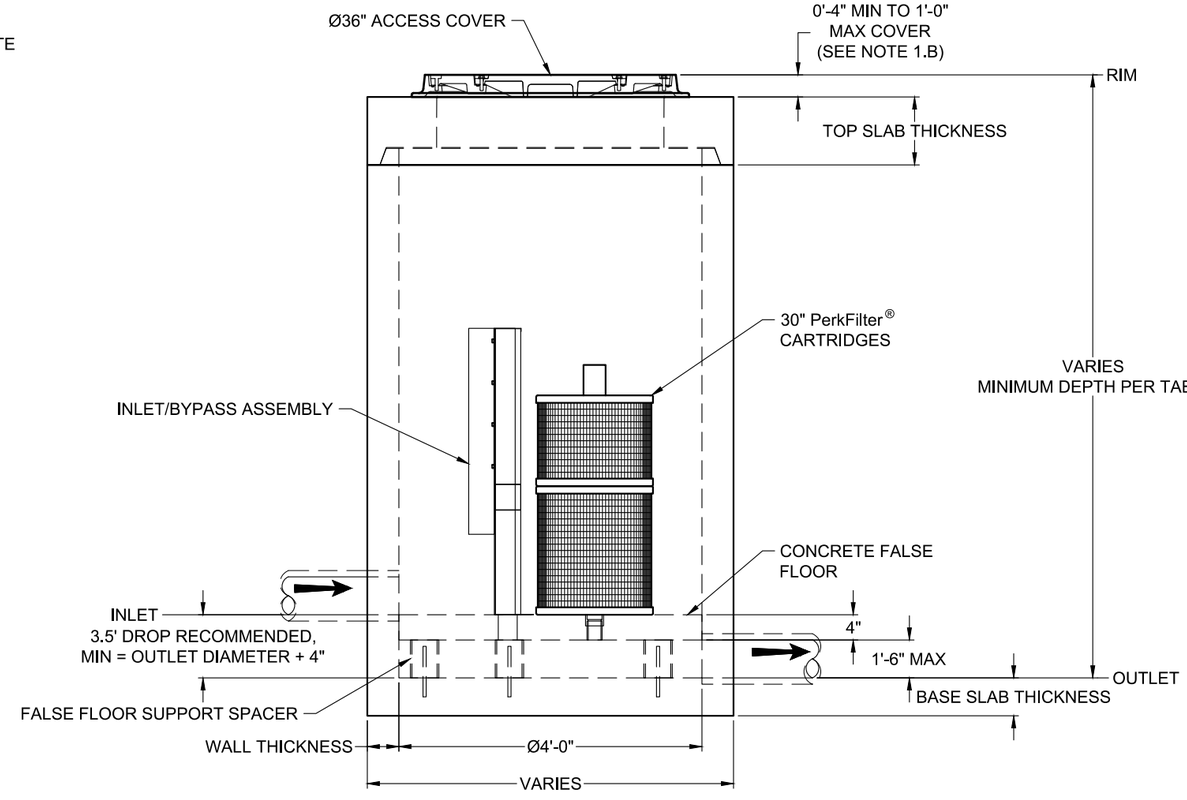
MINIMUM DEPTH	
Outlet Pipe Size	Minimum Rim to Outlet Depth
Ø6"	5.67'
Ø8"	5.92'
Ø10"	6.17'
Ø12"	6.42'
Ø15"	6.67'
Ø18"	6.92'



PLAN VIEW



ISOMETRIC VIEW



ELEVATION VIEW

NOTES:

1. DESIGN LOADINGS:
   A. AASHTO HS-20-44 (WITH IMPACT)
   B. DESIGN SOIL COVER: 1'-0" MAXIMUM
   C. ASSUMED WATER TABLE: BELOW INVERT.
   D. LATERAL EARTH PRESSURE: 45 PCF (DRAINED)
   E. LATERAL LIVE LOAD SURCHARGE: 80 PSF (APPLIED TO 8'-0" BELOW GRADE)
   F. NO LATERAL SURCHARGE FROM ADJACENT BUILDINGS, WALLS, PIERS, OR FOUNDATIONS.
2. CONCRETE 28-DAY MINIMUM COMPRESSIVE STRENGTH: 5,000 PSI MINIMUM.
3. REINFORCING: REBAR, ASTM A615/A706, GRADE 60
4. CEMENT: ASTM C150
5. REQUIRED ALLOWABLE SOIL BEARING CAPACITY: 2,500 PSF
6. REFERENCE STANDARD:
   A. ASTM C 478
   B. ASTM C 497
7. 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.
8. 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.
9. CONTRACTOR RESPONSIBLE TO VERIFY ALL SIZES, LOCATIONS, AND ELEVATIONS OF OPENINGS.
10. CONTRACTOR RESPONSIBLE TO ENSURE ADEQUATE BEARING SURFACE IS PROVIDED (I.E. COMPACTED AND LEVEL PER PROJECT SPECIFICATIONS).
11. 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.
12. FOR SITE SPECIFIC DRAWINGS WITH DETAILED STRUCTURE DIMENSIONS AND WEIGHTS, PLEASE CONTACT OLDCASTLE INFRASTRUCTURE.
13. MAXIMUM PICK WEIGHTS:
   A. TOP SLAB: XX,XXX LBS
   B. RISER: XX,XXX LBS
   C. BASE: XX,XXX LBS*
   (* COMBINED WEIGHT OF BASE INCLUDES FALSE FLOOR, AND PRODUCT INTERNALS.)
14. INTERNALS SHALL CONSIST OF CARTRIDGES, INLET/BYPASS ASSEMBLIES, FALSE FLOOR AND FALSE FLOOR SUPPORT SPACERS.

Oldcastle Infrastructure™
A CRH COMPANY

Ph: 800.579.8819 | www.oldcastleinfrastructure.com/stormwater

PerkFilter® Manhole (STANDARD)

Ø48" with 30" Cartridges

CUSTOMER
-

PROJECT NAME
-

SHEET NAME	REVISION	SHEET
Specifier Drawing PFMH-48-30	-	1 OF 1
	REV DATE -	

Media Filtration

WWHM2012

PROJECT REPORT

General Model Information

WWHM2012 Project Name: Prelim Vault Sizing
Site Name:
Site Address:
City:

Report Date:	12/29/2023
Gage:	Everett
Data Start:	1948/10/01
Data End:	2009/09/30
Timestep:	15 Minute
Precip Scale:	1.200
Version Date:	2023/01/27
Version:	4.2.19

POC Thresholds

Low Flow Threshold for POC1:	50 Percent of the 2 Year
High Flow Threshold for POC1:	50 Year

Landuse Basin Data

Predeveloped Land Use

Onsite Basin

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Forest, Mod	1.95
Pervious Total	1.95
Impervious Land Use	acre
Impervious Total	0
Basin Total	1.95

Mitigated Land Use

Onsite Basin

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
C, Pasture, Flat	0.65
Pervious Total	0.65

Impervious Land Use	acre
ROADS FLAT	0.23
ROOF TOPS FLAT	0.6
DRIVEWAYS FLAT	0.27
SIDEWALKS FLAT	0.06
POND	0.08
Impervious Total	1.24
Basin Total	1.89

Bypass Basin

Bypass:	Yes
GroundWater:	No

Pervious Land Use	acre
C, Pasture, Flat	0.02
Pervious Total	0.02

Impervious Land Use	acre
ROADS FLAT	0.02
SIDEWALKS FLAT	0.02
Impervious Total	0.04
Basin Total	0.06

Routing Elements
Predeveloped Routing

Mitigated Routing

Trapezoidal Pond 1

Bottom Length: 130.00 ft.
Bottom Width: 26.00 ft.
Depth: 9 ft.
Volume at riser head: 0.8100 acre-feet.
Side slope 1: 1 To 1
Side slope 2: 1 To 1
Side slope 3: 1 To 1
Side slope 4: 1 To 1
Discharge Structure
Riser Height: 7.5 ft.
Riser Diameter: 12 in.
Orifice 1 Diameter: 0.875 in. Elevation:0 ft.
Orifice 2 Diameter: 1.000 in. Elevation:3.35 ft.
Orifice 3 Diameter: 1.000 in. Elevation:4.75 ft.
Element Flows To:
Outlet 1 Outlet 2

Pond Hydraulic Table

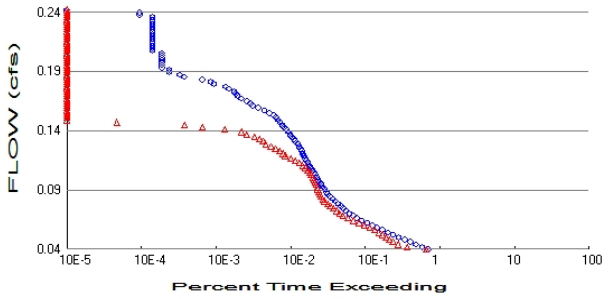
Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.077	0.000	0.000	0.000
0.1000	0.078	0.007	0.006	0.000
0.2000	0.079	0.015	0.009	0.000
0.3000	0.079	0.023	0.011	0.000
0.4000	0.080	0.031	0.013	0.000
0.5000	0.081	0.039	0.014	0.000
0.6000	0.081	0.047	0.016	0.000
0.7000	0.082	0.056	0.017	0.000
0.8000	0.083	0.064	0.018	0.000
0.9000	0.084	0.072	0.019	0.000
1.0000	0.084	0.081	0.020	0.000
1.1000	0.085	0.089	0.021	0.000
1.2000	0.086	0.098	0.022	0.000
1.3000	0.087	0.107	0.023	0.000
1.4000	0.087	0.115	0.024	0.000
1.5000	0.088	0.124	0.025	0.000
1.6000	0.089	0.133	0.026	0.000
1.7000	0.090	0.142	0.027	0.000
1.8000	0.090	0.151	0.027	0.000
1.9000	0.091	0.160	0.028	0.000
2.0000	0.092	0.169	0.029	0.000
2.1000	0.093	0.179	0.030	0.000
2.2000	0.093	0.188	0.030	0.000
2.3000	0.094	0.197	0.031	0.000
2.4000	0.095	0.207	0.032	0.000
2.5000	0.096	0.216	0.032	0.000
2.6000	0.096	0.226	0.033	0.000
2.7000	0.097	0.236	0.034	0.000
2.8000	0.098	0.246	0.034	0.000
2.9000	0.099	0.255	0.035	0.000
3.0000	0.099	0.265	0.036	0.000
3.1000	0.100	0.275	0.036	0.000
3.2000	0.101	0.286	0.037	0.000

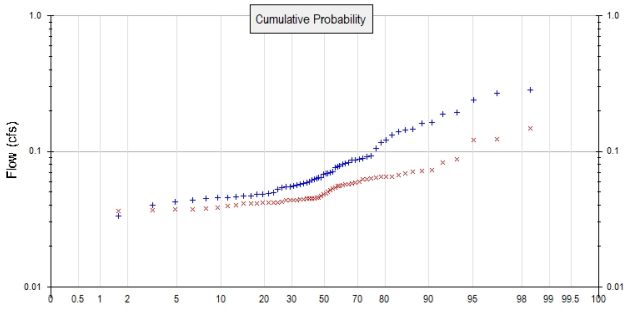
3.3000	0.102	0.296	0.037	0.000
3.4000	0.103	0.306	0.044	0.000
3.5000	0.103	0.316	0.049	0.000
3.6000	0.104	0.327	0.053	0.000
3.7000	0.105	0.337	0.056	0.000
3.8000	0.106	0.348	0.058	0.000
3.9000	0.106	0.358	0.061	0.000
4.0000	0.107	0.369	0.063	0.000
4.1000	0.108	0.380	0.065	0.000
4.2000	0.109	0.391	0.067	0.000
4.3000	0.110	0.402	0.069	0.000
4.4000	0.110	0.413	0.071	0.000
4.5000	0.111	0.424	0.073	0.000
4.6000	0.112	0.435	0.074	0.000
4.7000	0.113	0.447	0.076	0.000
4.8000	0.114	0.458	0.084	0.000
4.9000	0.114	0.469	0.090	0.000
5.0000	0.115	0.481	0.094	0.000
5.1000	0.116	0.492	0.098	0.000
5.2000	0.117	0.504	0.102	0.000
5.3000	0.118	0.516	0.105	0.000
5.4000	0.118	0.528	0.109	0.000
5.5000	0.119	0.540	0.112	0.000
5.6000	0.120	0.552	0.114	0.000
5.7000	0.121	0.564	0.117	0.000
5.8000	0.122	0.576	0.120	0.000
5.9000	0.123	0.588	0.122	0.000
6.0000	0.123	0.601	0.125	0.000
6.1000	0.124	0.613	0.127	0.000
6.2000	0.125	0.626	0.130	0.000
6.3000	0.126	0.638	0.132	0.000
6.4000	0.127	0.651	0.134	0.000
6.5000	0.128	0.664	0.137	0.000
6.6000	0.128	0.676	0.139	0.000
6.7000	0.129	0.689	0.141	0.000
6.8000	0.130	0.702	0.143	0.000
6.9000	0.131	0.716	0.145	0.000
7.0000	0.132	0.729	0.147	0.000
7.1000	0.133	0.742	0.149	0.000
7.2000	0.133	0.755	0.151	0.000
7.3000	0.134	0.769	0.153	0.000
7.4000	0.135	0.782	0.155	0.000
7.5000	0.136	0.796	0.157	0.000
7.6000	0.137	0.810	0.492	0.000
7.7000	0.138	0.823	1.068	0.000
7.8000	0.139	0.837	1.672	0.000
7.9000	0.139	0.851	2.124	0.000
8.0000	0.140	0.865	2.369	0.000
8.1000	0.141	0.879	2.607	0.000
8.2000	0.142	0.894	2.804	0.000
8.3000	0.143	0.908	2.988	0.000
8.4000	0.144	0.922	3.161	0.000
8.5000	0.145	0.937	3.324	0.000
8.6000	0.146	0.951	3.479	0.000
8.7000	0.146	0.966	3.628	0.000
8.8000	0.147	0.981	3.770	0.000
8.9000	0.148	0.995	3.907	0.000
9.0000	0.149	1.010	4.040	0.000

9.1000	0.150	1.025	4.168	0.000

Analysis Results

POC 1





\+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 1.95
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 0.67
Total Impervious Area: 1.28

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.072084
5 year	0.115273
10 year	0.14964
25 year	0.20003
50 year	0.242892
100 year	0.290548

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0.050737
5 year	0.066757
10 year	0.078692
25 year	0.095345
50 year	0.108943
100 year	0.123609

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1949	0.080	0.042
1950	0.081	0.048
1951	0.069	0.039
1952	0.056	0.044
1953	0.045	0.041
1954	0.285	0.055
1955	0.086	0.057
1956	0.076	0.064
1957	0.105	0.056
1958	0.091	0.069

1959	0.071	0.046
1960	0.069	0.049
1961	0.143	0.088
1962	0.069	0.045
1963	0.117	0.050
1964	0.092	0.037
1965	0.057	0.042
1966	0.033	0.037
1967	0.068	0.063
1968	0.082	0.053
1969	0.267	0.072
1970	0.047	0.038
1971	0.089	0.065
1972	0.055	0.060
1973	0.054	0.044
1974	0.146	0.052
1975	0.056	0.042
1976	0.059	0.045
1977	0.042	0.043
1978	0.049	0.041
1979	0.163	0.058
1980	0.076	0.041
1981	0.048	0.037
1982	0.062	0.062
1983	0.132	0.043
1984	0.064	0.072
1985	0.086	0.059
1986	0.193	0.122
1987	0.087	0.083
1988	0.045	0.056
1989	0.058	0.038
1990	0.061	0.057
1991	0.063	0.045
1992	0.048	0.044
1993	0.046	0.036
1994	0.044	0.047
1995	0.064	0.065
1996	0.121	0.062
1997	0.239	0.147
1998	0.040	0.045
1999	0.052	0.042
2000	0.045	0.067
2001	0.016	0.036
2002	0.059	0.044
2003	0.047	0.040
2004	0.078	0.070
2005	0.055	0.044
2006	0.188	0.065
2007	0.139	0.054
2008	0.161	0.121
2009	0.049	0.045

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.2852	0.1470
2	0.2668	0.1223
3	0.2392	0.1208

4	0.1929	0.0880
5	0.1882	0.0830
6	0.1633	0.0723
7	0.1614	0.0720
8	0.1458	0.0702
9	0.1430	0.0690
10	0.1390	0.0672
11	0.1324	0.0652
12	0.1206	0.0650
13	0.1167	0.0649
14	0.1047	0.0638
15	0.0920	0.0632
16	0.0910	0.0624
17	0.0888	0.0621
18	0.0872	0.0598
19	0.0864	0.0587
20	0.0859	0.0583
21	0.0825	0.0572
22	0.0814	0.0569
23	0.0802	0.0561
24	0.0783	0.0556
25	0.0765	0.0554
26	0.0755	0.0541
27	0.0711	0.0531
28	0.0692	0.0516
29	0.0689	0.0504
30	0.0689	0.0485
31	0.0676	0.0484
32	0.0643	0.0471
33	0.0639	0.0457
34	0.0629	0.0453
35	0.0624	0.0451
36	0.0611	0.0449
37	0.0595	0.0447
38	0.0586	0.0447
39	0.0580	0.0443
40	0.0569	0.0442
41	0.0561	0.0439
42	0.0558	0.0436
43	0.0548	0.0436
44	0.0545	0.0435
45	0.0540	0.0426
46	0.0521	0.0419
47	0.0493	0.0417
48	0.0491	0.0417
49	0.0481	0.0415
50	0.0479	0.0415
51	0.0471	0.0414
52	0.0466	0.0411
53	0.0459	0.0402
54	0.0455	0.0393
55	0.0453	0.0383
56	0.0452	0.0378
57	0.0436	0.0374
58	0.0423	0.0371
59	0.0399	0.0367
60	0.0334	0.0363
61	0.0157	0.0358

Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0360	14765	13984	94	Pass
0.0381	12350	7803	63	Pass
0.0402	10217	5876	57	Pass
0.0423	8551	4992	58	Pass
0.0444	7131	4487	62	Pass
0.0465	5959	4051	67	Pass
0.0486	5009	3632	72	Pass
0.0507	4259	3249	76	Pass
0.0528	3591	2864	79	Pass
0.0548	3071	2449	79	Pass
0.0569	2633	2073	78	Pass
0.0590	2254	1788	79	Pass
0.0611	1917	1479	77	Pass
0.0632	1644	1239	75	Pass
0.0653	1467	1072	73	Pass
0.0674	1304	971	74	Pass
0.0695	1178	877	74	Pass
0.0716	1077	797	74	Pass
0.0737	1001	727	72	Pass
0.0757	920	669	72	Pass
0.0778	837	610	72	Pass
0.0799	782	579	74	Pass
0.0820	718	545	75	Pass
0.0841	672	524	77	Pass
0.0862	635	510	80	Pass
0.0883	610	495	81	Pass
0.0904	582	482	82	Pass
0.0925	551	467	84	Pass
0.0945	518	452	87	Pass
0.0966	498	437	87	Pass
0.0987	480	420	87	Pass
0.1008	455	403	88	Pass
0.1029	436	387	88	Pass
0.1050	416	364	87	Pass
0.1071	397	334	84	Pass
0.1092	382	310	81	Pass
0.1113	363	279	76	Pass
0.1133	348	246	70	Pass
0.1154	336	214	63	Pass
0.1175	323	183	56	Pass
0.1196	312	169	54	Pass
0.1217	299	152	50	Pass
0.1238	288	134	46	Pass
0.1259	277	116	41	Pass
0.1280	265	99	37	Pass
0.1301	245	91	37	Pass
0.1322	236	81	34	Pass
0.1342	222	70	31	Pass
0.1363	210	55	26	Pass
0.1384	197	47	23	Pass
0.1405	187	28	14	Pass
0.1426	174	14	8	Pass
0.1447	164	8	4	Pass

0.1468	153	1	0	Pass
0.1489	146	0	0	Pass
0.1510	135	0	0	Pass
0.1530	126	0	0	Pass
0.1551	111	0	0	Pass
0.1572	94	0	0	Pass
0.1593	79	0	0	Pass
0.1614	66	0	0	Pass
0.1635	61	0	0	Pass
0.1656	55	0	0	Pass
0.1677	46	0	0	Pass
0.1698	41	0	0	Pass
0.1719	39	0	0	Pass
0.1739	37	0	0	Pass
0.1760	32	0	0	Pass
0.1781	29	0	0	Pass
0.1802	20	0	0	Pass
0.1823	18	0	0	Pass
0.1844	14	0	0	Pass
0.1865	8	0	0	Pass
0.1886	7	0	0	Pass
0.1907	5	0	0	Pass
0.1927	5	0	0	Pass
0.1948	4	0	0	Pass
0.1969	4	0	0	Pass
0.1990	4	0	0	Pass
0.2011	4	0	0	Pass
0.2032	4	0	0	Pass
0.2053	4	0	0	Pass
0.2074	4	0	0	Pass
0.2095	3	0	0	Pass
0.2116	3	0	0	Pass
0.2136	3	0	0	Pass
0.2157	3	0	0	Pass
0.2178	3	0	0	Pass
0.2199	3	0	0	Pass
0.2220	3	0	0	Pass
0.2241	3	0	0	Pass
0.2262	3	0	0	Pass
0.2283	3	0	0	Pass
0.2304	3	0	0	Pass
0.2324	3	0	0	Pass
0.2345	3	0	0	Pass
0.2366	3	0	0	Pass
0.2387	3	0	0	Pass
0.2408	2	0	0	Pass
0.2429	2	0	0	Pass

Water Quality

Water Quality BMP Flow and Volume for POC #1

On-line facility volume:	0 acre-feet
On-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.
Off-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.

LID Report

LID Technique	Used for Treatment ?	Total Volume Needs Treatment (ac-ft)	Volume Through Facility (ac-ft)	Infiltration Volume (ac-ft)	Cumulative Volume Infiltration Credit	Percent Volume Infiltrated	Water Quality	Percent Water Quality Treated	Comment
Trapezoidal Pond 1 POC	☐	263.25			☐	0.00			
Total Volume Infiltrated		263.25	0.00	0.00		0.00	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Failed

Model Default Modifications

Total of 0 changes have been made.

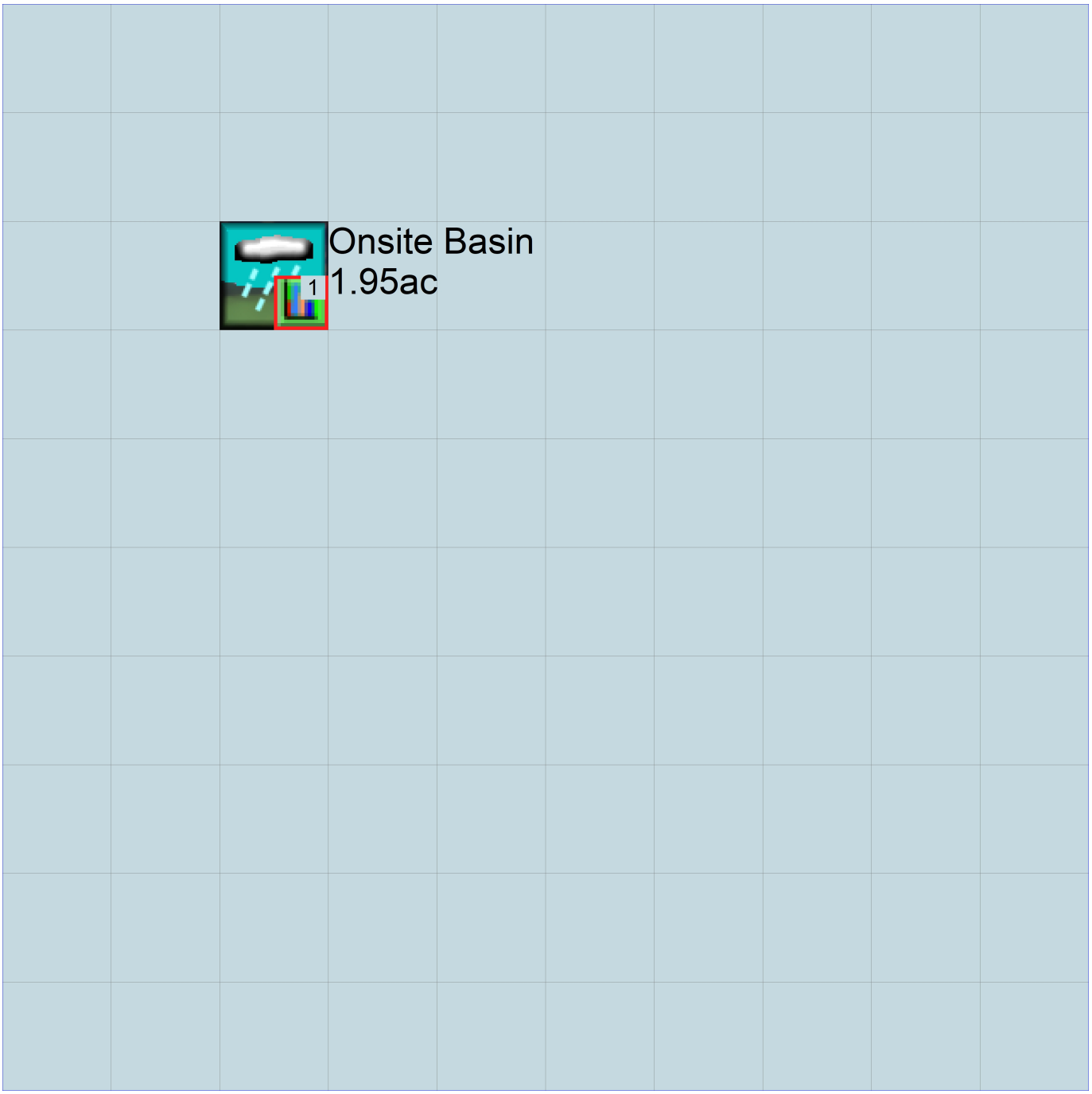
PERLND Changes

No PERLND changes have been made.

IMPLND Changes

No IMPLND changes have been made.

Appendix
Predeveloped Schematic



Mitigated Schematic

Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1948 10 01        END    2009 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM         26   Prelim Vault Sizing.wdm
MESSU       25   PrePrelim Vault Sizing.MES
            27   PrePrelim Vault Sizing.L61
            28   PrePrelim Vault Sizing.L62
            30   POCPrelim Vault Sizing1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      11
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title---------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Onsite Basin              MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                        User  t-series Engl Metr ***
                                    in  out           ***
   11     C, Forest, Mod          1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************ Active Sections ******************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   11         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   11         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO
```

```
  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   11         0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   11              0       4.5      0.08       400       0.1       0.5     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   11             0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                              ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   11          0.2       0.5      0.35         6       0.5       0.7
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
               ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS       IFWS       LZS       AGWS       GWVS
   11             0         0         0          0       2.5          1          0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name-------->  Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                  in  out           ***
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************ Active Sections ******************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
  END IWAT-STATE1
```

```
END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Onsite Basin***
PERLND  11                        1.95     COPY   501     12
PERLND  11                        1.95     COPY   501     13

******Routing******
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                 ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG            ***
                                        in  out                              ***
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                      ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *        *  *  *  *  *        ***
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                         ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1.2            PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1.2            IMPLND   1 999 EXTNL  PREC
```

```
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    501 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13


END MASS-LINK

END RUN
```

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1948 10 01        END    2009 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                    UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM         26   Prelim Vault Sizing.wdm
MESSU       25   MitPrelim Vault Sizing.MES
            27   MitPrelim Vault Sizing.L61
            28   MitPrelim Vault Sizing.L62
            30   POCPrelim Vault Sizing1.dat
END FILES

OPN SEQUENCE
    INGRP               INDELT 00:15
      PERLND      13
      IMPLND       1
      IMPLND       4
      IMPLND       5
      IMPLND       8
      IMPLND      14
      RCHRES       1
      COPY         1
      COPY       501
      COPY       601
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title---------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Trapezoidal Pond  1         MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  601         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                          in  out           ***
   13     C, Pasture, Flat        1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************ Active Sections ******************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
```

```
 13         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags **************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   13         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   13         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   13              0       4.5      0.06       400      0.05       0.5     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   13              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                                  ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   13           0.15       0.4       0.3         6       0.5       0.4
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
               ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS       IFWS       LZS       AGWS      GWVS
   13              0         0         0         0       2.5          1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                  in  out           ***
    1      ROADS/FLAT             1    1    1   27    0
    4      ROOF TOPS/FLAT         1    1    1   27    0
    5      DRIVEWAYS/FLAT         1    1    1   27    0
    8      SIDEWALKS/FLAT         1    1    1   27    0
   14      POND                   1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections ******************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    1         0    0    1    0    0    0
    4         0    0    1    0    0    0
    5         0    0    1    0    0    0
    8         0    0    1    0    0    0
   14         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    1         0    0    4    0    0    4    1    9
    4         0    0    4    0    0    0    1    9
    5         0    0    4    0    0    0    1    9
```

```
    8         0    0    4    0    0    0    1    9
   14         0    0    4    0    0    0    1    9
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -   # CSNO RTOP  VRS  VNN RTLI     ***
    1         0    0    0    0    0
    4         0    0    0    0    0
    5         0    0    0    0    0
    8         0    0    0    0    0
   14         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -   # ***  LSUR     SLSUR      NSUR     RETSC
    1            400      0.01       0.1       0.1
    4            400      0.01       0.1       0.1
    5            400      0.01       0.1       0.1
    8            400      0.01       0.1       0.1
   14            400      0.01       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -   # ***PETMAX    PETMIN
    1              0         0
    4              0         0
    5              0         0
    8              0         0
   14              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -   # ***  RETS      SURS
    1              0         0
    4              0         0
    5              0         0
    8              0         0
   14              0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                <--Area-->     <-Target->   MBLK    ***
<Name>   #                <-factor->     <Name>   #   Tbl#    ***
Onsite Basin***
PERLND  13                     0.65     RCHRES   1      2
PERLND  13                     0.65     RCHRES   1      3
IMPLND   1                     0.23     RCHRES   1      5
IMPLND   4                      0.6     RCHRES   1      5
IMPLND   5                     0.27     RCHRES   1      5
IMPLND   8                     0.06     RCHRES   1      5
IMPLND  14                     0.08     RCHRES   1      5
Bypass Basin***
PERLND  13                     0.02     COPY   501     12
PERLND  13                     0.02     COPY   601     12
PERLND  13                     0.02     COPY   501     13
PERLND  13                     0.02     COPY   601     13
IMPLND   1                     0.02     COPY   501     15
IMPLND   1                     0.02     COPY   601     15
IMPLND   8                     0.02     COPY   501     15
IMPLND   8                     0.02     COPY   601     15

******Routing******
PERLND  13                     0.65     COPY     1     12
IMPLND   1                     0.23     COPY     1     15
```

```
IMPLND   4                          0.6     COPY     1     15
IMPLND   5                         0.27     COPY     1     15
IMPLND   8                         0.06     COPY     1     15
IMPLND  14                         0.08     COPY     1     15
PERLND  13                         0.65     COPY     1     13
RCHRES   1                            1     COPY   501     16
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG           ***
                                        in  out                             ***
    1     Trapezoidal Pond-008    1    1    1    1   28    0    1
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************ Active Sections ******************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
    1         1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ****************** PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
    1         4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                    ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
           FG FG FG FG  possible  exit  *** possible  exit      possible  exit
            *  *  *  *    *  *  *  *  *       *  *  *  *  *        ***
    1        0  1  0  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><--------><------>***
    1               1      0.02       0.0       0.0       0.5       0.0
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                       ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
    1            0         4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
  FTABLE      1
   91    4
     Depth      Area    Volume  Outflow1 Velocity  Travel Time***
      (ft)   (acres) (acre-ft)   (cfs)   (ft/sec)    (Minutes)***
  0.000000  0.077594  0.000000  0.000000
```

0.100000	0.078311	0.007795	0.006570
0.200000	0.079030	0.015662	0.009292
0.300000	0.079751	0.023601	0.011380
0.400000	0.080474	0.031613	0.013140
0.500000	0.081198	0.039696	0.014691
0.600000	0.081925	0.047852	0.016093
0.700000	0.082653	0.056081	0.017383
0.800000	0.083383	0.064383	0.018583
0.900000	0.084115	0.072758	0.019710
1.000000	0.084848	0.081206	0.020777
1.100000	0.085584	0.089728	0.021791
1.200000	0.086321	0.098323	0.022760
1.300000	0.087061	0.106992	0.023689
1.400000	0.087802	0.115735	0.024583
1.500000	0.088545	0.124553	0.025446
1.600000	0.089289	0.133444	0.026281
1.700000	0.090036	0.142411	0.027089
1.800000	0.090784	0.151452	0.027875
1.900000	0.091534	0.160567	0.028639
2.000000	0.092287	0.169758	0.029383
2.100000	0.093040	0.179025	0.030108
2.200000	0.093796	0.188367	0.030817
2.300000	0.094554	0.197784	0.031509
2.400000	0.095313	0.207278	0.032187
2.500000	0.096074	0.216847	0.032851
2.600000	0.096837	0.226492	0.033501
2.700000	0.097602	0.236214	0.034139
2.800000	0.098369	0.246013	0.034766
2.900000	0.099138	0.255888	0.035381
3.000000	0.099908	0.265841	0.035986
3.100000	0.100680	0.275870	0.036581
3.200000	0.101455	0.285977	0.037166
3.300000	0.102230	0.296161	0.037743
3.400000	0.103008	0.306423	0.044378
3.500000	0.103788	0.316763	0.049380
3.600000	0.104569	0.327181	0.052989
3.700000	0.105353	0.337677	0.056019
3.800000	0.106138	0.348251	0.058705
3.900000	0.106925	0.358904	0.061156
4.000000	0.107713	0.369636	0.063432
4.100000	0.108504	0.380447	0.065571
4.200000	0.109297	0.391337	0.067598
4.300000	0.110091	0.402307	0.069533
4.400000	0.110887	0.413356	0.071388
4.500000	0.111685	0.424484	0.073175
4.600000	0.112485	0.435693	0.074901
4.700000	0.113287	0.446981	0.076573
4.800000	0.114090	0.458350	0.084264
4.900000	0.114895	0.469799	0.090286
5.000000	0.115702	0.481329	0.094884
5.100000	0.116511	0.492940	0.098873
5.200000	0.117322	0.504632	0.102492
5.300000	0.118135	0.516404	0.105851
5.400000	0.118949	0.528259	0.109013
5.500000	0.119766	0.540194	0.112017
5.600000	0.120584	0.552212	0.114891
5.700000	0.121404	0.564311	0.117653
5.800000	0.122226	0.576493	0.120319
5.900000	0.123050	0.588757	0.122901
6.000000	0.123875	0.601103	0.125407
6.100000	0.124702	0.613532	0.127846
6.200000	0.125532	0.626043	0.130223
6.300000	0.126363	0.638638	0.132543
6.400000	0.127196	0.651316	0.134811
6.500000	0.128030	0.664077	0.137032
6.600000	0.128867	0.676922	0.139208
6.700000	0.129705	0.689851	0.141342
6.800000	0.130545	0.702863	0.143437
6.900000	0.131388	0.715960	0.145496
7.000000	0.132231	0.729141	0.147520

```
  7.100000  0.133077  0.742406  0.149511
  7.200000  0.133925  0.755756  0.151472
  7.300000  0.134774  0.769191  0.153403
  7.400000  0.135625  0.782711  0.155306
  7.500000  0.136478  0.796317  0.157182
  7.600000  0.137333  0.810007  0.492554
  7.700000  0.138190  0.823783  1.068536
  7.800000  0.139049  0.837645  1.672335
  7.900000  0.139909  0.851593  2.124479
  8.000000  0.140771  0.865627  2.369539
  8.100000  0.141635  0.879748  2.607636
  8.200000  0.142501  0.893954  2.804832
  8.300000  0.143369  0.908248  2.988477
  8.400000  0.144239  0.922628  3.161045
  8.500000  0.145110  0.937096  3.324337
  8.600000  0.145983  0.951650  3.479713
  8.700000  0.146859  0.966293  3.628230
  8.800000  0.147736  0.981022  3.770727
  8.900000  0.148614  0.995840  3.907887
  9.000000  0.149495  1.010745  4.040270
  END FTABLE  1
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1.2             PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1.2             IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.76            PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76            IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY     1 OUTPUT MEAN   1 1     48.4      WDM    701 FLOW     ENGL      REPL
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    801 FLOW     ENGL      REPL
COPY   601 OUTPUT MEAN   1 1     48.4      WDM    901 FLOW     ENGL      REPL
RCHRES   1 HYDR   RO     1 1       1       WDM   1002 FLOW     ENGL      REPL
RCHRES   1 HYDR   STAGE  1 1       1       WDM   1003 STAG     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>           <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK        2
PERLND     PWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    2

  MASS-LINK        3
PERLND     PWATER IFWO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    3

  MASS-LINK        5
IMPLND     IWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    5

  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13

  MASS-LINK       15
IMPLND     IWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   15
```

```
  MASS-LINK       16
RCHRES     ROFLOW                          COPY           INPUT  MEAN
  END MASS-LINK   16

END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

Mitigated HSPF Message File

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Appendix 5: Conveyance Analysis

Nothing is necessary for this appendix at this time

Appendix 6: Operations and Maintenance Manual

1. Operations and Maintenance Manual

Appendix V-A: BMP Maintenance Tables

Ecology intends the facility-specific maintenance standards contained in this section to be conditions for determining if maintenance actions are required as identified through inspection. Recognizing that Permittees have limited maintenance funds and time, Ecology does not require that a Permittee perform all these maintenance activities on all their stormwater BMPs. We leave the determination of importance of each maintenance activity and its priority within the stormwater program to the Permittee. We do expect, however, that sufficient maintenance will occur to ensure that the BMPs continue to operate as designed to protect ground and surface waters.

Ecology doesn't intend that these measures identify the facility's required condition at all times between inspections. In other words, exceedance of these conditions at any time between inspections and/or maintenance does not automatically constitute a violation of these standards. However, based upon inspection observations, the Permittee shall adjust inspection and maintenance schedules to minimize the length of time that a facility is in a condition that requires a maintenance action.

Table V-A.1: Maintenance Standards - Detention Ponds

Maintenance Component	Defect	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed
General	Trash & Debris	Any trash and debris which exceed 1 cubic feet per 1,000 square feet. In general, there should be no visual evidence of dumping. If less than threshold all trash and debris will be removed as part of next scheduled maintenance.	Trash and debris cleared from site
	Poisonous Vegetation and noxious weeds	Any poisonous or nuisance vegetation which may constitute a hazard to maintenance personnel or the public. Any evidence of noxious weeds as defined by State or local regulations. (Apply requirements of adopted IPM policies for the use of herbicides).	No danger of poisonous vegetation where maintenance personnel or the public might normally be. (Coordinate with local health department) Complete eradication of noxious weeds may not be possible. Compliance with State or local eradication policies required
	Contaminants and Pollution	Any evidence of oil, gasoline, contaminants or other pollutants (Coordinate removal/cleanup with local water quality response agency).	No contaminants or pollutants present.
	Rodent Holes	Any evidence of rodent holes if facility is acting as a dam or berm, or any evidence of water piping through dam or berm via rodent holes.	Rodents destroyed and dam or berm repaired. (Coordinate with local health department; coordinate with Ecology Dam Safety Office if pond exceeds 10 acre-feet.)
	Beaver Dams	Dam results in change or function of the facility.	Facility is returned to design function. (Coordinate trapping of beavers and removal of dams with appropriate permitting agencies)
	Insects	When insects such as wasps and hornets interfere with maintenance activities.	Insects destroyed or removed from site. Apply insecticides in compliance with adopted IPM policies
	Tree Growth and Hazard Trees	Tree growth does not allow maintenance and inspection access or interferes with maintenance activity (i.e., slope mowing, silt removal, vactoring, or equipment movements). If trees are not interfering with access or maintenance, do not remove If dead, diseased, or dying trees are identified (Use a certified Arborist to determine health of tree or removal requirements)	Trees do not hinder maintenance activities. Harvested trees should be recycled into mulch or other beneficial uses (e.g., alders for firewood). Remove hazard Trees
Side Slopes of Pond	Erosion	Eroded damage over 2 inches deep where cause of damage is still present or where there is potential for continued erosion. Any erosion observed on a compacted berm embankment.	Slopes should be stabilized using appropriate erosion control measure(s); e.g.,rock reinforcement, planting of grass, compaction. If erosion is occurring on compacted berms a licensed engineer in the state of Washington should be consulted to resolve source of erosion.
Storage Area	Sediment	Accumulated sediment that exceeds 10% of the designed pond depth unless otherwise specified or affects inletting or outletting condition of the facility.	Sediment cleaned out to designed pond shape and depth; pond reseeded if necessary to control erosion.

Table V-A.1: Maintenance Standards - Detention Ponds (continued)

Maintenance Component	Defect	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed
	Liner (if Applicable)	Liner is visible and has more than three 1/4-inch holes in it.	Liner repaired or replaced. Liner is fully covered.
Ponds Berms (Dikes)	Settlements	Any part of berm which has settled 4 inches lower than the design elevation If settlement is apparent, measure berm to determine amount of settlement Settling can be an indication of more severe problems with the berm or outlet works. A licensed engineer in the state of Washington should be consulted to determine the source of the settlement.	Dike is built back to the design elevation.
	Piping	Discernable water flow through pond berm. Ongoing erosion with potential for erosion to continue. (Recommend a Goethechnical engineer be called in to inspect and evaluate condition and recommend repair of condition.	Piping eliminated. Erosion potential resolved.
Emergency Overflow/ Spillway and Berms over 4 feet in height	Tree Growth	Tree growth on emergency spillways creates blockage problems and may cause failure of the berm due to uncontrolled overtopping. Tree growth on berms over 4 feet in height may lead to piping through the berm which could lead to failure of the berm.	Trees should be removed. If root system is small (base less than 4 inches) the root system may be left in place. Otherwise the roots should be removed and the berm restored. A licensed engineer in the state of Washington should be consulted for proper berm/spillway restoration.
	Piping	Discernable water flow through pond berm. Ongoing erosion with potential for erosion to continue. (Recommend a Geotechnical engineer be called in to inspect and evaluate condition and recommend repair of condition.	Piping eliminated. Erosion potential resolved.
Emergency Overflow/Spillway	Emergency Overflow/Spillway	Only one layer of rock exists above native soil in area five square feet or larger, or any exposure of native soil at the top of out flow path of spillway. (Rip-rap on inside slopes need not be replaced.)	Rocks and pad depth are restored to design standards.
	Erosion	See "Side Slopes of Pond"	

Table V-A.2: Maintenance Standards - Infiltration

Maintenance Component	Defect	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed
General	Trash & Debris	See Table V-A.1: Maintenance Standards - Detention Ponds	See Table V-A.1: Maintenance Standards - Detention Ponds
	Poisonous/Noxious Vegetation	See Table V-A.1: Maintenance Standards - Detention Ponds	See Table V-A.1: Maintenance Standards - Detention Ponds
	Contaminants and Pollution	See Table V-A.1: Maintenance Standards - Detention Ponds	See Table V-A.1: Maintenance Standards - Detention Ponds
	Rodent Holes	See Table V-A.1: Maintenance Standards - Detention Ponds	See Table V-A.1: Maintenance Standards - Detention Ponds
Storage Area	Sediment	Water ponding in infiltration pond after rainfall ceases and appropriate time allowed for infiltration. Treatment basins should infiltrate Water Quality Design Storm Volume within 48 hours, and empty within 24 hours after cessation of most rain events.	Sediment is removed and/or facility is cleaned so that infiltration system works according to design.

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 regrouted and secure at basin wall.
	Settlement/ Misalignment	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. N/A