4332 86TH AVENUE SE
MERCER ISLAND, WASHINGTON 98040

STORM DRAINAGE REPORT

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HOMES

PREPARED FOR:
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WE PROJECT 25-0018.01

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Table of Contents

APPENDICES

SECTION 1: PROJECT OVERVIEW

The project site is located at 4332 86th Avenue SE, Mercer Island, Washington 98040 (King County Tax Parcel Number 3622500045). More generally, the site is located within the SW ¼ of the NW ¼ of Section 18, Township 24 North, Range 5 East, W.M. Please see Figure 1: Vicinity Map below.

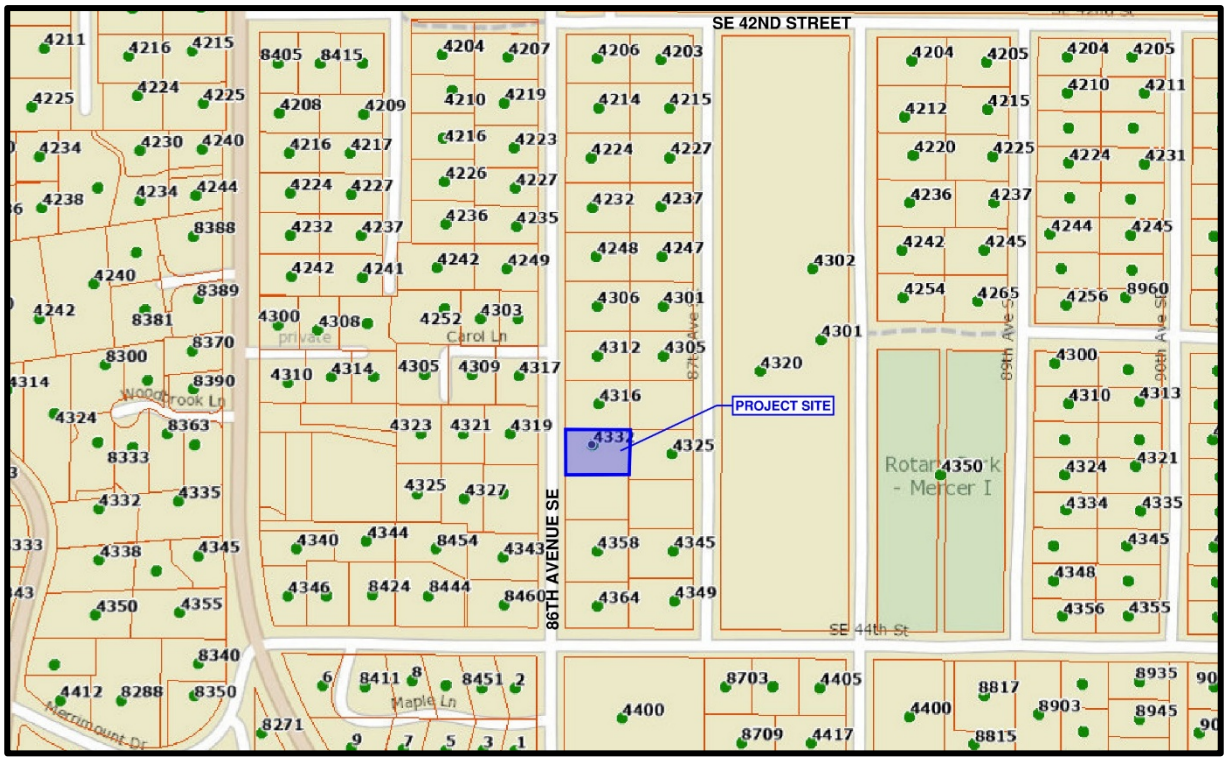

Figure 1: Vicinity Map
Not to Scale

The project site consists of a single parcel encompassing approximately 0.30-acre. The site contains an existing single-family residential dwelling, walkways, two (2) small outbuildings, a paved driveway, landscaping, and utility services. Access to the site is provided via 86th Avenue SE. The project site is bound by residential dwellings to the north and east, by a vacant parcel zoned for residential land use to the south, and by 86th Avenue SE to the west. 86th Avenue SE is a crowned two-lane paved roadway with a roadside drainage swale along the eastern edge, and limited pavement markings. There is an existing speed hump located south of the existing driveway, and drainage culverts extend below existing driveways in the vicinity of the project site to convey runoff north down the existing roadside swale.

The site consists of a single drainage basin which is part of the Cedar River / Lake Washington drainage basin. The site has mild to moderate slopes with the southeastern corner of the site creating a high point that slopes down to the northwest. The existing residence has a pitched roof that directs stormwater to an existing roof drain gutter system

which discharges to the ground surface via downspouts and splash blocks. Stormwater runoff flows via overland flow across hard surfaces, and through landscape / lawn areas surrounding the residence prior to discharging to the 86th Avenue SE right-of-way and onto the neighboring residential parcel to the north. Runoff that flows onto the adjacent parcel to the north continues to flow via overland flow across the property to the northwest prior discharging to the roadside swale along the east side of 86th Avenue SE. Runoff collected in the swale is channelized and directed north via the swale and through existing culverts. Runoff continues north via the drainage swale until it reaches the property located at 4214 86th Avenue SE where the swale is collected in an existing public tight-line storm system and the swale is terminated. Runoff continues north until it reaches the 4206 86th Avenue SE property where the existing drainage network alignment turns to direct runoff west beneath 86th Avenue SE. Runoff continues north via the existing public tight-line drainage system to SE 42nd Street. The drainage network alignment then turns and continues west along SE 42nd Street, crosses 85th Avenue SE, and reaches the quarter-mile (1/4)-mile downstream location. Please reference the Existing Conditions exhibits included in Section 4 which illustrate the existing drainage basin, land use characteristics, and Analysis Point (AP) used in the storm drainage calculations prepared for the project.

The project site has 35% or more of existing impervious coverage, so the proposed development is classified as a redevelopment project and shall evaluate the Redevelopment Minimum Requirements and Flow Chart. Please see Figure 2: Flow Chart for Determining Minimum Requirements for New Development Projects provided in Section 2.

Proposed improvements include the demolition of the existing structure and hardscape surfaces within the parcel boundary to allow for the construction of a new single-family residential dwelling, driveway, concrete walkways/patios, landscaping, and utility improvements required to support the development. The project will result in 2,000 square feet (SF) or more of new plus replaced hard surface area. Therefore, the project is required to satisfy Minimum Requirements #1 through #5 as outlined in the 2019 Washington Department of Ecology Stormwater Management Manual for Western Washington (DOE Manual). Please reference the Developed Conditions exhibits included in Section 4 which illustrate the proposed drainage basin, land use characteristics, and AP. The project is not a road related project; however, the proposed improvements do result in greater than 5,000 SF of new plus replaced hard surface area AND the value of the proposed improvements are anticipated to exceed 50% of the assessed value of the existing site improvements. Therefore, all Minimum Requirements apply to the new and replaced hard surfaces and converted vegetation areas. Please see Figure 3: Flow Chart for Determining Minimum Requirements for Redevelopment Projects provided in Section 2.

SECTION 2: CONDITIONS AND REQUIREMENTS

The project proposes greater than 5,000 square feet of new plus replaced impervious area and the value of the proposed improvements are anticipated to exceed 50% of the assessed value of the existing site improvements. Therefore, all Minimum Requirements apply to the new and replaced hard surfaces and converted vegetation areas. The project has been designed to comply with these requirements. Compliance and/or applicability of each minimum requirement are summarized below.

Minimum Requirement #1: Preparation of Stormwater Site Plans
Stormwater site plans have been prepared in conjunction with the proposed improvements and are provided under separate cover.

Minimum Requirement #2: Construction Stormwater Pollution Prevention (SWPP)
The proposed development will result in greater than 2,000 square feet (SF) of new plus replaced hard surface area and will disturb greater than 7,000 SF of land area. Therefore, a Construction SWPP Plan (CSWPPP) shall be required. Please reference Appendix D of this report for the CSWPPP.

Minimum Requirement #3: Source Control of Pollution
Per the DOE Manual, all known, available and reasonable Source Control Best Management Practices (BMPs) shall be applied to all projects. The proposed development includes the construction of a single-family residential dwelling that will not contain pollutants such as petroleum products or hazardous substances and is not classified as a high-use site. Source Control BMPs proposed as part of the development include the preservation of natural vegetation, cover of storage areas such as soil stockpiles, and establishing vegetative coverage on disturbed areas to minimize the potential for off-site sedimentation during construction activities. Temporary Erosion and Sediment Control (TESC) measures shall also be implemented as demonstrated on the Stormwater Site Plans.

Minimum Requirement #4: Preservation of Natural Discharge Systems and Outfalls
The project has been designed to discharge from the site at the existing discharge location in accordance with this requirement. The stormwater discharge from the proposed development shall not create a significant adverse impact to downstream receiving waters and downgradient properties. Please reference Section 3 of this report for discussion on the off-site areas and downstream analysis, and Section 4 of this report for the stormwater analysis for the project.

Minimum Requirement #5: On-Site Stormwater Management

Per the DOE Manual, projects shall employ On-site Stormwater Management BMPs based on the appropriate project thresholds. Projects that trigger Minimum Requirements #1-9 shall, for each surface (lawn and landscaped areas, roofs, and other hard surfaces), consider the BMPs in the order listed in List #3 for that type of surface. The project shall use the first BMP that is considered feasible. Please reference Figure 4: Flow Chart for Determining MR #5 Requirements. Note that the project is flow control exempt per Minimum Requirement #7 as evaluated by the DOE Manual; however, the City of Mercer Island requires that the project construct a storm water detention facility in accordance with the City of Mercer Island On-Site Detention Design Requirements. Therefore, the project does propose an on-site detention facility, which does influence some conclusions drawn pertaining to BMPs application for the project. Please reference Appendix C for the annotated On-Site Detention Design Requirements documents in support of the proposed development. The project has evaluated BMP feasibility for each surface as discussed below.

Lawn and landscaped areas:

1. Post-Construction Soil Quality and Depth in accordance with BMP T5.13 in Chapter 11 of Volume V of the DOE Manual.

   The project shall utilize amended soils in vegetated areas in accordance with BMP T5.13.

Roofs:

1. Downspout Full Infiltration systems in accordance with BMP T5.10A in Section Chapter 4 of Volume V of the DOE Manual.

   A Geotechnical Engineering Evaluation was completed by Nelson Geotechnical Associates, Inc. (NGA) dated June 24, 2024. Two (2) small-scale pilot infiltration tests (PITs) were performed at the site to evaluate infiltration potential. Based on the results of both of the small PITs and the relatively silty compact nature of the native glacial till soils that underlie the site, it was concluded by NGA that soils are not conducive for stormwater infiltration systems. Based on NGA's conclusions, infiltration systems were determined to be infeasible for the project. Please reference the Geotechnical Engineering Evaluation prepared by NGA included in Appendix A of this report.

2. Downspout Dispersion Systems in accordance with BMP T5.10B in Chapter 4 of Volume V of the DOE Manual.

The project site is bound by existing single-family residences to the north and east, by a vacant parcel zoned for residential use to the south, and by 86th Avenue SE to the west. There are no viable 25-foot-long flow paths through native vegetation to disperse all impervious areas. Additionally, it is assumed that runoff from the roof shall be directed to the proposed on-site detention facility based on the City of Mercer Island requirement to construct a stormwater detention facility. Therefore, Full Dispersion was determined to not be feasible for the project.

3. Perforated Stub-out Connections in accordance with BMP T5.10C in Chapter 4 of Volume V of the DOE Manual.

   NGA concluded that infiltration should be considered infeasible. Based on NGA's conclusions and the City of Mercer Island On-Site Detention requirements, Perforated Stub-out Connections were determined to be infeasible.

Other Hard Surfaces:

1. Sheet Flow Dispersion in accordance with BMP T5.12, or Concentrated Flow Dispersion in accordance with BMP T5.11 in Chapter 3 of Volume V of the DOE Manual.

   The project shall implement Sheet Flow Dispersion for the walkway areas to the maximum extent feasible. The project does not propose to concentrate flows, so Concentrated Flow Dispersion was determined to be not applicable for the project.

Minimum Requirement #6: Runoff Treatment

The development proposes a total of 1,183 square feet of pollution generating hard surfaces (PGHS) which consists of the proposed driveway and the asphalt restoration in 86th Avenue SE. Per the DOE Manual, projects in which the total of PGHS is 5,000 square feet or more OR projects in which the total of pollution generating pervious surfaces (PGPS) – not including permeable pavements – is ¾ of an acre or more, and from which there will be a surface discharge in a natural or man-made conveyance system from the site are required to construct stormwater treatment facilities. Therefore, the proposed PGHS area does not meet the thresholds requiring water quality treatment facilities.

Minimum Requirement #7: Flow Control

Per the DOE Manual, projects are required to achieve the standard flow control requirements if (a) the project has a total effective impervious surface of 10,000 square feet or more in a TDA, or (b) the project converts ¾-acre or more of vegetation to lawn or landscape, or convert 2.5-acres or more of native vegetation to pasture in a TDA, and there is a surface discharge in a natural or man-made conveyance system from the site,

or (c) projects that cause a 0.15 cubic feet per second (CFS) increase in the 100-year flow frequency from a TDA as estimated using an approved continuous simulation model and 15-minute time steps. The project analyzed the stormwater flow rates for the 100-year storm event using the Western Washington Hydrology Model (WWHM) with 15-minute time steps. To be conservative, the pre-development condition was modeled as a forested area. Based on the results of the WWHM analysis (see Appendix B) and the proposed improvements, the project does not meet the thresholds for any of the above conditions and is therefore not required to achieve the standard flow control requirement. As noted previously, the City of Mercer Island requires the project to construct an on-site detention facility, and an on-site detention tank is proposed and sized in accordance with the City's design requirements. Please reference Section 4 of this report for additional discussion on this minimum requirement.

Minimum Requirement #8: Wetlands Protection

There are no existing wetland areas in the vicinity of the project site, and the proposed development does not satisfy the thresholds for Minimum Requirements #6 and #7. Therefore, this minimum requirement is not applicable for the proposed development.

Minimum Requirement #9: Operation and Maintenance

Please reference Appendix E for operations and maintenance information.

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

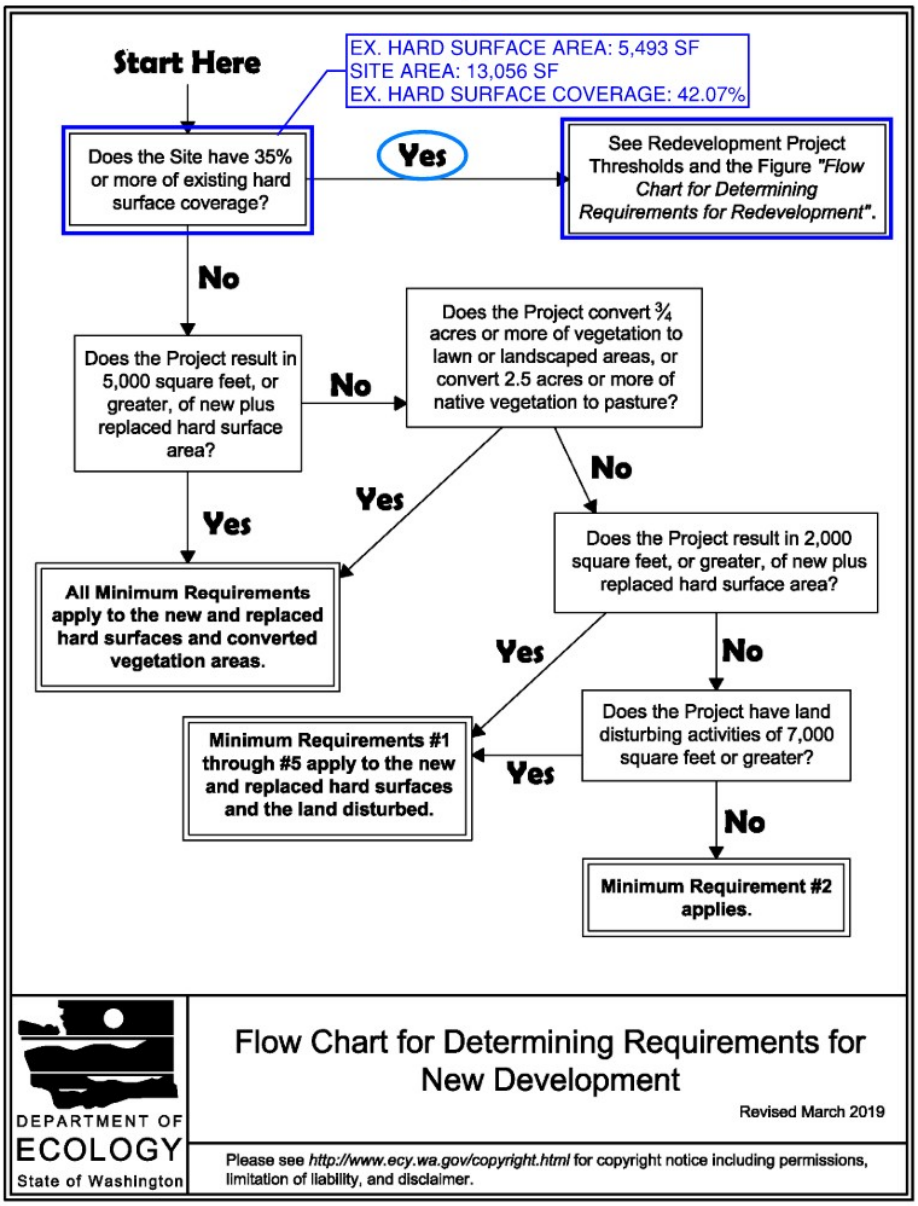

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Figure 2: Flow Chart for Determining Minimum Requirements for New Development Projects

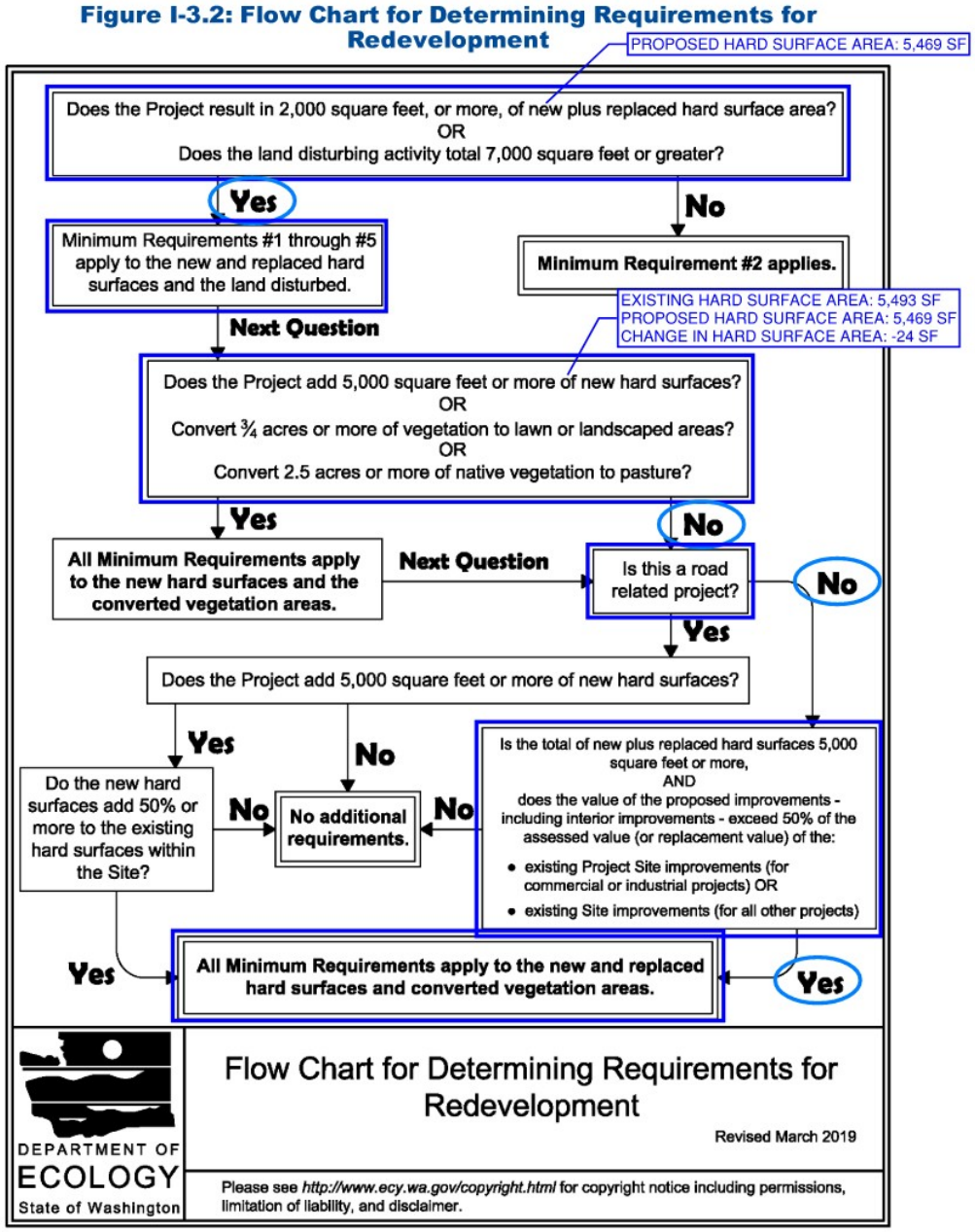

Figure 3: Flow Chart for Determining Minimum Requirements for Redevelopment Projects

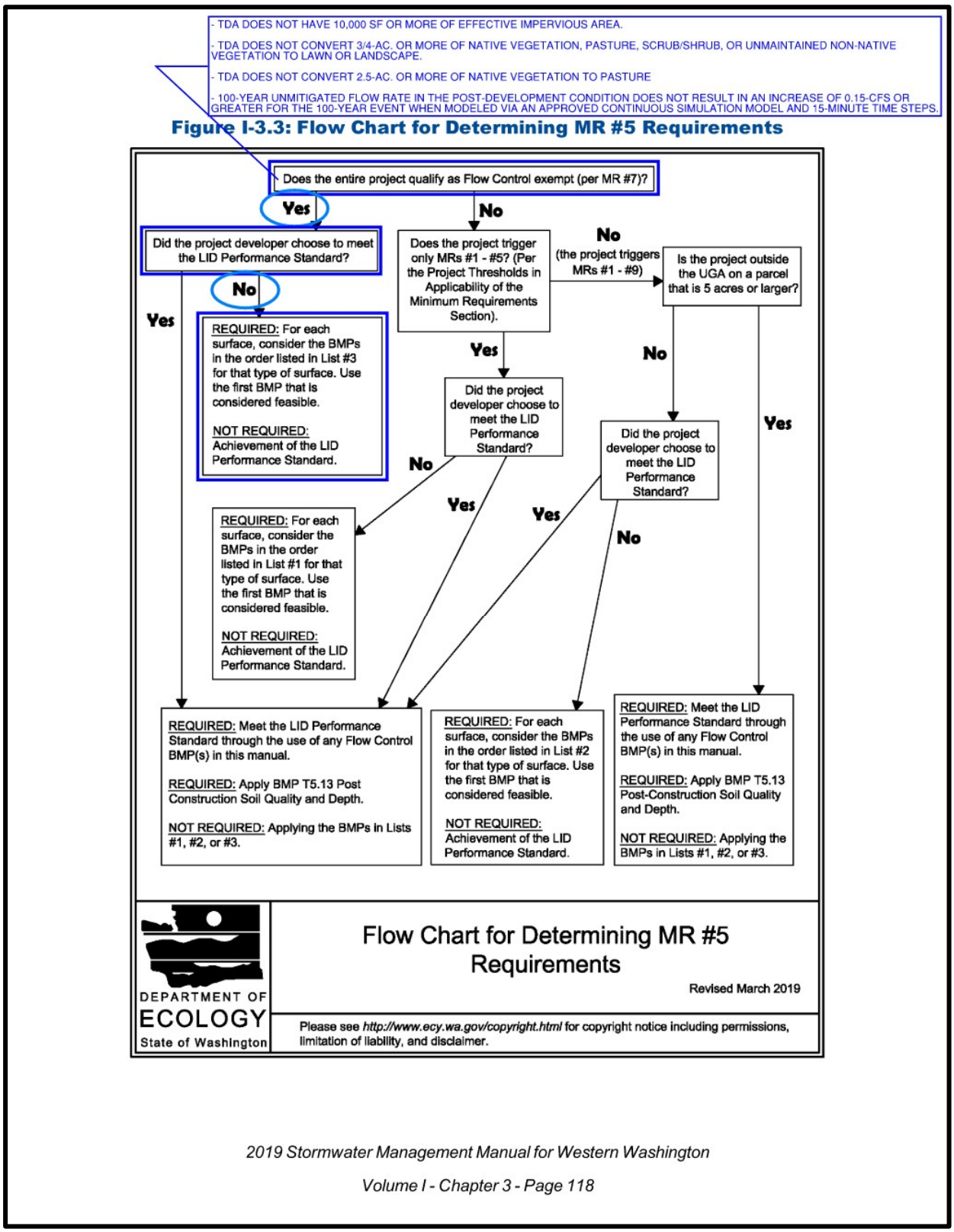

Figure 4: Flow Chart for Determining MR #5 Requirements

SECTION 3: OFFSITE ANALYSIS

The project site is bound to the north and east by existing single-family homes, to the south by a vacant parcel zoned for residential use, and to the west by 86th Avenue SE. The vacant parcel to the south, and the vegetated areas of the residential properties located to the east and southeast of the project site direct runoff onto the eastern portion of the subject property via overland flow. The limits of the off-site drainage area anticipated to discharge onto the project site were determined by a combination of an in-field pedestrian reconnaissance of the project site and a review of online topographic data that was readily available. The Off-Site Basin has been included in the storm drainage analysis prepared in support of the proposed development.

The residential property to the north is located downgradient of the project site. 86th Avenue SE is a crowned two-lane paved roadway with a roadside drainage swale along the eastern edge, and limited pavement markings. 86th Avenue SE is located downstream of the project site, and no stormwater runoff from the 86th Avenue SE right-of-way flows onto the project site.

There is an existing 12-inch diameter culvert that extends beneath the existing driveway serving the project site. The roadside drainage swale is well vegetated, approximately three (3) feet deep with steep side slopes, and a running slope of approximately 2.70% along the project's frontage. Runoff collected in the swale is channelized and directed north via the swale and through existing culverts. Runoff continues north via the drainage swale until it reaches the property located at 4214 86th Avenue SE where the swale is collected in an existing public tight-line storm system and the swale is terminated. Runoff continues north until it reaches the 4206 86th Avenue SE property where the existing drainage network alignment turns to directs runoff west beneath 86th Avenue SE. Runoff continues north via the existing public tight-line drainage system to SE 42nd Street. The drainage network alignment then continues west along SE 42nd Street, crosses 85th Avenue SE, and reaches the quarter-mile (1/4)-mile downstream location. No known drainage concerns exist along the downstream drainage path.

SECTION 4: FLOW CONTROL AND WATER QUALITY FACILITY ANALYSIS AND DESIGN

The drainage analysis was conducted using the Western Washington Hydrology Model software program (WWHM2012), which is recognized as an approved hydrologic model for projects in King County. The project was modeled using a 15-minute timestep in accordance with the DOE Manual. The Seatac rainfall region with a scale factor of 1.000 were utilized as part of the analysis.

Existing Conditions

The existing conditions consists of two (2) basins that combine to make a single Threshold Discharge Areas (TDAs) that are evaluated as part of the storm drainage analysis. The basins are defined as the Off-Site Basin and the Basin. The Off-Site Basin encompasses 0.41-acre of area that consists of the vegetated yard areas of the adjacent residential properties to the east and southeast as well as the vacant property to the south that is zoned for residential use. There are no impervious areas that are part of the Off-Site Basin. Runoff from the Off-Site Basin flows onto the eastern portion of the project site via overland flow.

The Basin encompasses 0.33-acre of surface area which includes the entire project site as well as the portion of the 86th Avenue SE right-of-way that is anticipated to be disturbed as part of the proposed improvements. Land use at the project site includes 0.14-acre of impervious area comprised of the existing single-family residence, concrete driveway, concrete patio, pathways, and the impervious portion of 86th Avenue SE that is proposed to be disturbed by the project. The remaining 0.19-acre is comprised of the yard areas, which consists of lawn and landscaped spaces surrounding the existing residence and the vegetated portion of the 86th Avenue SE right-of-way, please reference the Existing Conditions Land Use Exhibit. The existing residence has a roof gutter system which collects runoff from the roof and discharges it to the existing ground surface via splash blocks. Runoff from the project site flows from the southeastern portion of the property via overland flow across hard surfaces and through landscape / lawn areas surrounding the residence prior to discharging to the 86th Avenue SE right-of-way and onto the neighboring residential parcel to the north. The AP has been demonstrated in the flow line of the existing roadside drainage swale north of the outfall for the driveway culvert proposed as part of the project.

To be conservative, the existing land use for both basins has been analyzed assuming a forested condition. Please reference Appendix B of this report for the WWHM2012 analysis. A summary of the land use characteristics used in the WWHM2012 analysis are provided in Table 1: Existing Conditions Land Use. A summary of the stormwater runoff rates in the existing condition are summarized in Table 2: Existing Conditions Runoff Rates.

TPN:3622500040
MARGARET K MAYES
4316 86TH AVENUE SE
MERCER ISLAND, WA 98040

TPN:3622500085
ALICE T BRIDGFORTH

TPN:3622500080
ALICE T BRIDGFORTH
4325 87TH AVENUE SE
MERCER ISLAND, WA 98040

869.44'

86TH AVENUE SE

96.00'

CULV 12" CONC N.
IE = 346.73

BASIN
0.33 AC. (14,374 SF)

FFE=358.3'

1-STORY WOOD
FRAMED HOUSE

ANALYSIS POINT

CULV 12" CPP S.
IE = 349.80

CONFIRMED
N. END CPP,
S. END CONC

SD

LOT 9
TPN:3622500045
EB #5 LLC
4332 86TH AVENUE SE
MERCER ISLAND, WA 98040

OFF-SITE BASIN
0.41 AC. (18,014 SF)

SHED

GAZEBO

CULV 12" CONC N.
IE = 351.68

TPN:3622500075
ALICE T BRIDGFORTH

LOT 10
TPN:3622500046
EB #5 LLC

96.00'

GRAPHIC SCALE
15 0 15 30
(1" = 30')

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10/27/2025 BY GARRETT WINE

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57306
REGISTERED
PROFESSIONAL ENGINEER

4332 86TH AVENUE SE
MERCER ISLAND, WASHINGTON 98040
EXISTING CONDITIONS
BASIN EXHIBIT

PROJECT:	25-0018.01
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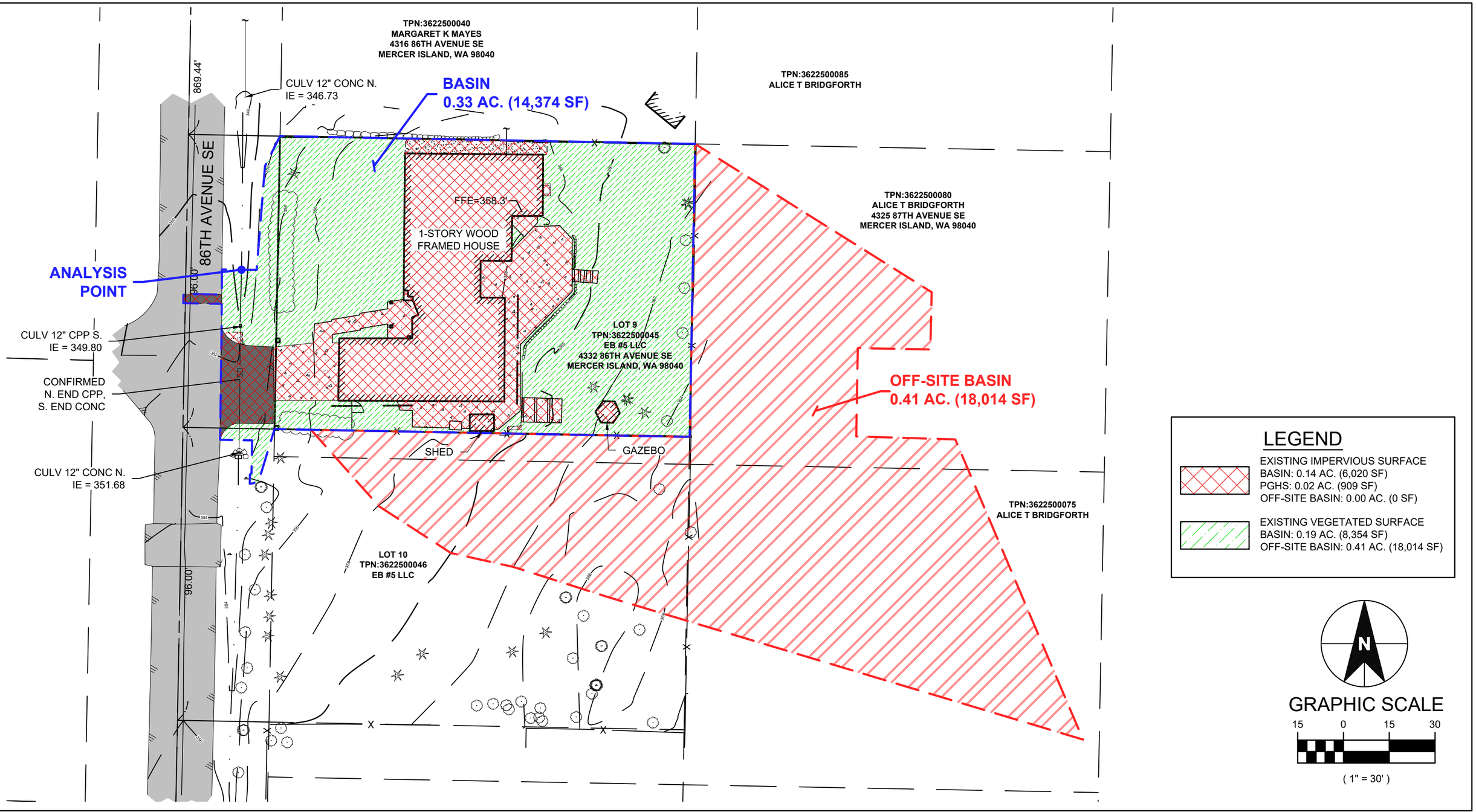
CHECKED BY:	GRW

EXISTING BASINS

EC-1



LEGEND

EXISTING IMPERVIOUS SURFACE
BASIN: 0.14 AC. (6,020 SF)
PGHS: 0.02 AC. (909 SF)
OFF-SITE BASIN: 0.00 AC. (0 SF)

EXISTING VEGETATED SURFACE
BASIN: 0.19 AC. (8,354 SF)
OFF-SITE BASIN: 0.41 AC. (18,014 SF)

N

GRAPHIC SCALE

15 0 15 30

(1" = 30')

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EXISTING CONDITIONS
LAND USE EXHIBIT

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EXISTING LAND USE

EC-2

Table 1: Existing Conditions Land Use			
Basin Name	**Impervious Area**	**Pervious Area**	**Total Area**
Basin	0.00 Acre	0.33 Acre	0.33 Acre
Off-Site Basin	0.00 Acre	0.41 Acre	0.41 Acre
Total	**0.00 Acre**	**0.74 Acre**	**0.74 Acre**

Table 2: Existing Conditions Runoff Rates	
Analysis Point	
2-Year	0.022 Cubic Feet per Second (CFS)
10-Year	0.045 CFS
50-Year	0.063 CFS
100-Year	0.070 CFS

Developed Conditions

The developed conditions at the project site consist of four (4) drainage basins that comprise the TDA analyzed for the project. There are no improvements proposed in the Off-Site Basin so the total area and the land use characteristics for the off-site areas are the same as in the existing condition. The Off-Site Basin is delineated into areas that will bypass the detention facility, and the area that will flow onto the project site, be collected by proposed yard drains, and be directed to the proposed stormwater detention facility. The Off-Site Basin (Bypass) consists of 2 separate areas that total to 0.06-acre. The Off-Site Basin (To Detention) consists of the remaining 0.35-acre of off-site vegetated area that will be collected by the proposed storm drainage system improvements and conveyed to the detention facility.

Like the Off-Site Basin, the on-site Basin has been broken into two separate basins. The Basin (To Detention) encompasses 0.21-acre of surface area, please reference the Developed Conditions Basin Exhibit. Impervious area comprises 0.10-acre of area that includes the proposed roof area and the patio. The remaining 0.11-acre is comprised of the yard area to the east and south of the proposed structure, please reference the Developed Conditions Land Use Exhibit. Runoff from the roof is proposed to be collected in a gutter system that discharges via roof downspouts. The roof downspouts are collected in a proposed tight-line drainage conveyance system that wraps around the perimeter of the structure. Yard drains are proposed on the eastern side of the proposed structure to collect runoff from the yard areas as well as the stormwater that will run onto the project site from the Off-Site Basin (To Detention). Runoff from Basin (To Detention) and Off-Site Basin (To Detention) are routed to the proposed stormwater detention facility located along the southern parcel boundary.

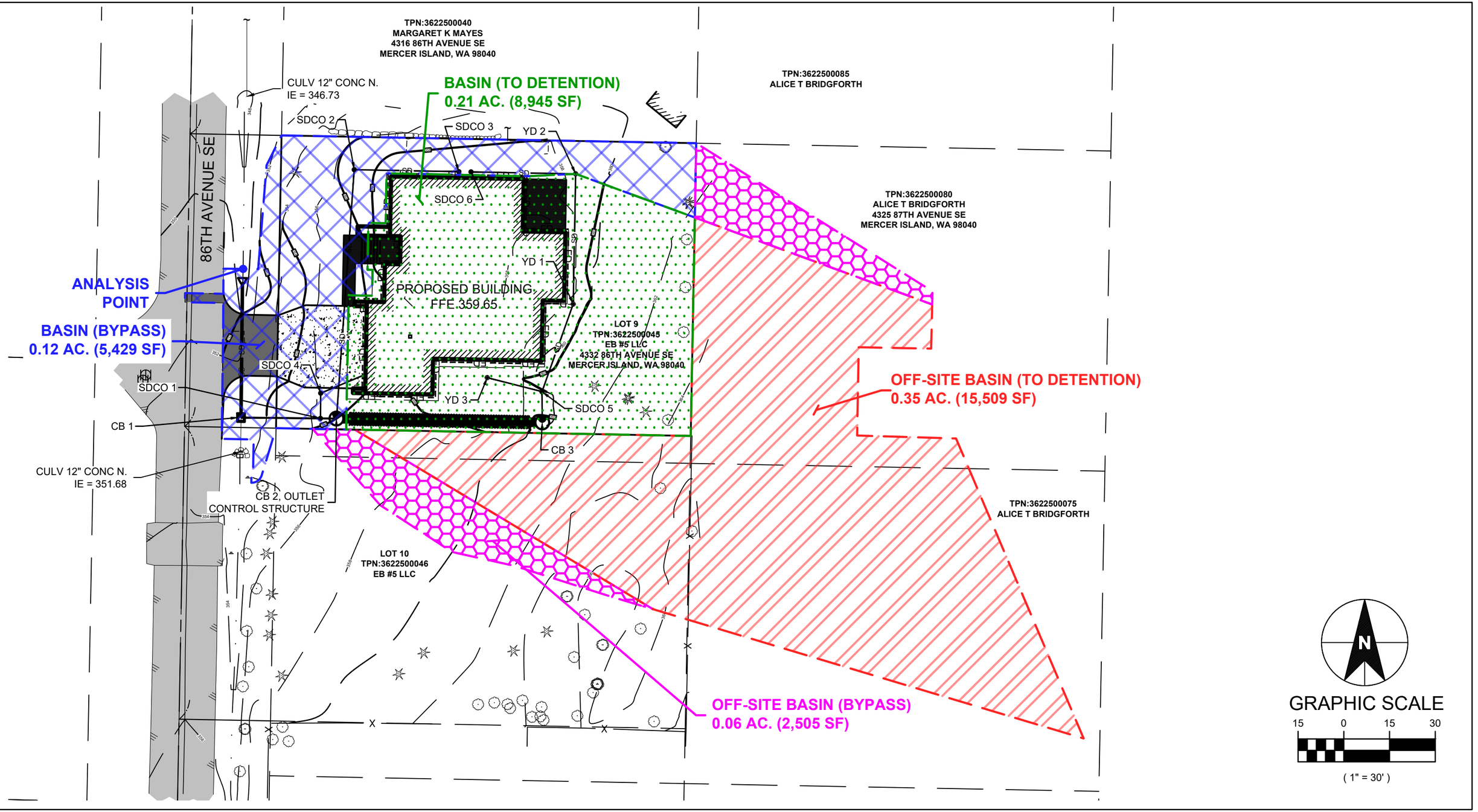
The Basin (Bypass) encompasses 0.12-acre of area which includes 0.03-acre of impervious surface area consisting of the driveway, driveway apron, the portion of the pathway to the front porch that is uncovered, and the restoration area in 86th Avenue SE. The remaining 0.09-acre consists of lawn and landscape area to the north and west of the structure, and the vegetated areas within the 86th Avenue SE right-of-way. Runoff

from Basin (Bypass) discharges via overland sheet flow west into the existing roadside swale along the eastern edge of 86th Avenue SE.

In accordance with the City of Mercer Island requirements, the project proposes the construction of a new stormwater detention tank. The amount of new and replaced impervious surface area tributary to the proposed detention system is 4,316 square feet. However, the project has utilized the entire new and replaced impervious surface area proposed by the project (both Basin (To Detention) and Basin (Bypass)) to inform sizing of the detention facility, which totals 5,469 square feet. Per the City of Mercer Island On-Site Detention Design Requirements for new and replaced impervious surface area between 5,001 square feet and 6,000 square feet in C series soils, a 48-inch diameter detention pipe measuring 59 feet in length is required. The outlet control structure (OCS) is proposed in catch basin CB 2 located on the downstream (west) end of the detention facility. The OCS is proposed to include a 0.5-inch diameter orifice at the bottom of the OCS as well as a 1.5-inch diameter orifice located 2.9 feet above the lowest orifice. Please reference annotated the On-Site Detention Requirements handout included in Appendix C for additional details on the detention facility.

The proposed on-site drainage conveyance network and outfall from the detention facility is proposed to connect to a new corrugated metal pipe (CMP) culvert extending under the proposed driveway at catch basin CB 1. The proposed culvert measures 12-inches in diameter and extends at a 2.00% slope to discharge to the existing roadside swale. Runoff from the proposed culvert will discharge through a flared end section and continue north along the existing drainage alignment and continue downstream to the quarter (1/4)-mile downstream location. Runoff from the project site is analyzed at the same AP location as in the existing condition. A summary of the land use characteristics used in the WWHM2012 analysis are provided in Table 3: Developed Conditions Land Use. A summary of the stormwater runoff rates in the developed condition are summarized in Table 4: Developed Conditions Runoff Rates.

A separate WWHM analysis was performed without accounting for the proposed detention system to demonstrate that the 100-year developed conditions runoff rates for the proposed development creates less than a 0.15-CFS increase over the existing conditions runoff rates at the analysis point when analyzed via WWHM2012 with 15-minute time steps. Therefore, the proposed development does not trigger the thresholds for flow control as detailed in Minimum Requirement #7 of the DOE Manual. Additionally, the project will not create or replace greater than 5,000 SF of PGHS and therefore does not trigger the thresholds for water quality treatment.



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DEVELOPED CONDITIONS
BASIN EXHIBIT

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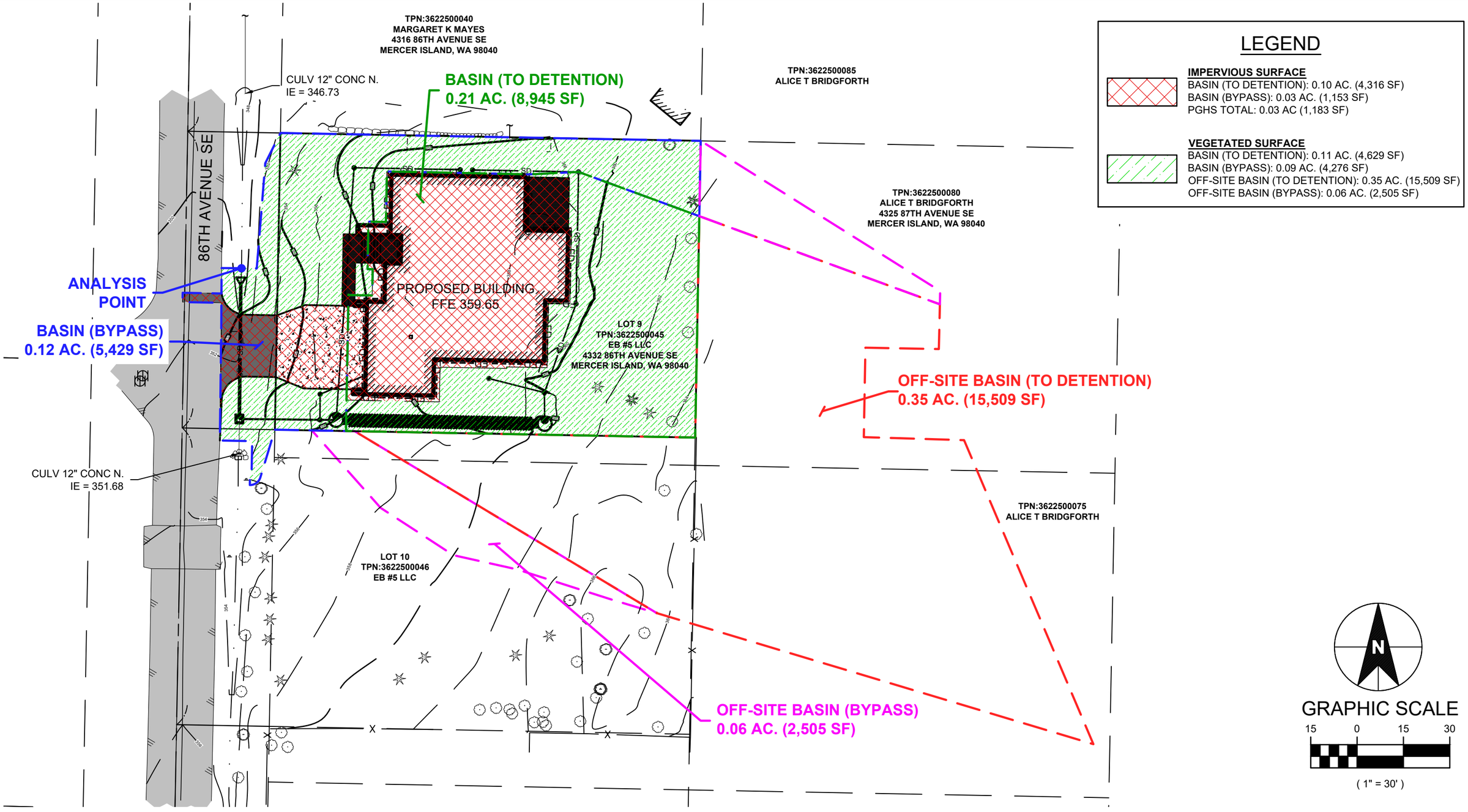
CHECKED BY:	GRW

DEVELOPED BASINS

DC-1



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CHECKED BY:	GRW

DEV. LAND USE

DC-2

Table 3: Developed Conditions Land Use			
Basin Name	**Impervious Area**	**Pervious Area**	**Total Area**
Basin (To Detention)	0.10 Acre	0.11 Acre	0.21 Acre
Basin (Bypass)	0.03 Acre	0.09 Acre	0.12 Acre
Off-Site Basin (To Detention)	0.00 Acre	0.35 Acre	0.35 Acre
Off-Site Basin (Bypass)	0.00 Acre	0.06 Acre	0.06 Acre
Total	**0.13 Acre**	**0.61 Acre**	**0.74 Acre**

Table 4: Developed Conditions Runoff Rates (with Detention)	
Analysis Point	
2-Year	0.036 CFS
10-Year	0.081 CFS
50-Year	0.140 CFS
100-Year	0.171 CFS

Table 5: Developed Conditions Runoff Rates (without Detention)	
Analysis Point	
2-Year	0.074 CFS
10-Year	0.126 CFS
50-Year	0.180 CFS
100-Year	0.205 CFS

APPENDIX A

GEOTECHNICAL ENGINEERING EVALUATION

NELSON GEOTECHNICAL
ASSOCIATES, INC.

17311-135th Ave. N.E. Suite A-500
Woodinville, WA 98072
(425) 486-1669
www.nelsongeotech.com

June 24, 2024

Ms. Heather Cochran
Cade Hill Homes
Via Email: heather@cadehillhomes.com

Geotechnical Engineering Evaluation
Cade Hill Homes 86th Avenue SE Residential Development
4332 and 43XX – 86th Avenue SE
Mercer Island, Washington
NGA File No. 1518224

Dear Ms. Cochran:

We are pleased to submit the attached report titled ***"Geotechnical Engineering Evaluation – Cade Hill Homes 86th Avenue SE Residential Development – 4332 and 43XX - 86th Avenue SE – Mercer Island, Washington."*** This report summarizes our observations of the existing surface and subsurface conditions within the site and provides general recommendations for the proposed site development. Our services were completed in general accordance with the proposal signed by you on May 7, 2024.

The northern property (4332 - 86th Avenue SE) is currently occupied by a single-family residence within the central portion of the property. The southern property (43XX – 86th Avenue SE) is currently vacant. The ground surface within the properties is generally relatively level to gently sloping down from the east to the west. We understand that the proposed development will include removal of the existing site structure within the northern property and construction of a new single-family residence within the central portion of both the northern and southern properties.

We explored the subsurface conditions within the site with seven trackhoe excavated test pits, including two infiltration test pits. Our explorations extended to depths in the range of 4.5 to 8.0 feet below the existing ground surface. Our explorations indicated that the site was underlain by surficial topsoil and/or undocumented fill with competent native glacial till soils at depth.

It is our opinion that the proposed site development is feasible from a geotechnical engineering standpoint, provided that our recommendations for site development are incorporated into project plans. In general, the native glacial bearing soils underlying the site should adequately support the planned structure. Foundations should be advanced through any loose surficial and/or undocumented fill soils down to the competent glacial bearing material interpreted to underlie the site, for bearing capacity and settlement considerations. These soils should generally be encountered between approximately 2.0 to 3.0 feet below the existing ground surface, based on our explorations. If deeper areas of loose soils or undocumented fill are encountered in unexplored areas of the site, they should be removed and replaced with structural fill for foundation and pavement support.

Specific grading and stormwater plans had not been finalized at the time this report was prepared. However, we understand that stormwater from the proposed development may be directed into on-site infiltration systems, if feasible. The City of Mercer Island uses the Department of Ecology's 2019 Stormwater Management for Western Washington (2019 SWMMWW) to determine the design infiltration rate and overall system sizing. According to this manual and the City of Mercer Island requirements, system sizing for the proposed infiltration system can be determined by on-site infiltration testing consisting of the Small Pilot Infiltration Test (PIT). As a part of our evaluation, we performed two on-site small-scale PITs. Based on our on-site testing and observations, it is our opinion that stormwater infiltration within the site is not feasible within the native glacial till soils encountered at depth within the proposed development area.

In the attached report, we have also provided general recommendations for site grading, slabs-on-grade, structural fill placement, erosion control, and drainage. We should be retained to review and comment on final development plans and observe the earthwork phase of construction. We also recommend that NGA be retained to provide monitoring and consultation services during construction to confirm that the conditions encountered are consistent with those indicated by the explorations, to provide recommendations for design changes should the conditions revealed during construction differ from those anticipated, and to evaluate whether or not earthwork and foundation installation activities comply with contract plans and specifications.

It has been a pleasure to provide service to you on this project. Please contact us if you have any questions regarding this report or require further information.

Sincerely,

NELSON GEOTECHNICAL ASSOCIATES, INC.

Khaled M. Shawish, PE
Principal Engineer

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INTRODUCTION

This report presents the results of our geotechnical engineering investigation and evaluation of the planned residential development project on **Mercer Island, Washington.** The project site is located at the properties with addresses of **4332 – 86th Avenue SE** (northern property) and **43XX – 86th Avenue SE** (southern property), as shown on the Vicinity Map in Figure 1. The purpose of this study is to explore and characterize the site's surface and subsurface conditions and to provide geotechnical recommendations for the planned site development.

The northern property is currently occupied by a single-family residence within the central portion of the property. The southern property is currently vacant. The ground surface within the properties is generally relatively level to gently sloping down from the east to the west. We understand that the proposed development will include removal of the existing site structure within the northern property and construction of a new single-family residence within the central portion of both the northern and southern properties. Final development and grading plans had not been prepared at the time this report was issued. Final stormwater plans have also not been developed; however, we understand that stormwater may be directed to on-site infiltration systems, if feasible. The existing site layout is shown on the Schematic Site Plan in Figure 2.

SCOPE

The purpose of this study is to explore and characterize the site surface and subsurface conditions and provide general recommendations for site development. Specifically, our scope of services included the following:

1. Review available soil and geologic maps of the area.
2. Explore the subsurface soil and groundwater conditions within the site with trackhoe-excavated test pits. Trackhoe was provided by NGA.
3. Perform laboratory grain-size sieve analysis on soil samples, if necessary.
4. Provide recommendations for earthwork, foundation support, and slabs-on-grade.
5. Provide recommendations for temporary and permanent slopes.
6. Provide recommendations for pavement subgrade.
7. Provide recommendations for site drainage and erosion control.
8. Provide our opinion on the feasibility of infiltration for the onsite soils.
9. Provide recommendations for infiltration system installation.

10. Provide long-term design infiltration rates based on on-site Pilot Infiltration Testing (PIT) per the 2019 SWMMWW. One test was performed within each property for a total of two tests.
11. Document the results of our findings, conclusions, and recommendations a written geotechnical report.

SITE CONDITIONS

Surface Conditions

The sites consist of rectangular-shaped parcels each covering approximately 0.30 acres. The northern property is currently occupied by a single-family residence within the central portion of the property. The southern property is currently vacant. The ground surface within the properties is generally relatively level to gently sloping down from the east to the west. The properties are generally vegetated with grass, landscaping plants and young to mature trees. The properties are bordered to the north, east and south by existing residential properties, and to the west by 86th Avenue SE. We did not observe surface water within the site during our site visit on May 31, 2024.

Subsurface Conditions

Geology: The geologic units for this area are mapped on the Geologic Map of Mercer Island, Washington by Kathy G. Troost and Aaron P. Wisher, (University of Washington, 2006). The project site is mapped as Quaternary Vashon till (Q_{vt}). Vashon till is typically a mixture of relatively equal parts of silt, sand, and gravel, deposited during the last glaciation period approximately 12,000 to 15,000 years ago. Our explorations generally encountered surficial topsoil and/or undocumented fill soils underlain silty sand with gravel consistent with the description of the Vashon Till at depth throughout the site.

Explorations: The subsurface conditions within the site were explored on May 31, 2024 by excavating seven test pit explorations extending to depths in the range of 4.5 to 8.0 feet below the existing ground surface, two of which were utilized as an infiltration test pit. The approximate locations of our explorations are shown on the Schematic Site Plan in Figure 2. A geologist from NGA was present during the explorations, examined the soils and geologic conditions encountered, obtained samples of the different soil types, and maintained logs of the test pits. The soils were visually classified in general accordance with the Unified Soil Classification System, presented in Figure 3. The logs of our explorations are attached to this report and are presented as Figures 4 and 5. We present a brief summary of the subsurface conditions in the following paragraph. For a detailed description of the subsurface conditions, the logs of our explorations should be reviewed.

At the surface of all of our explorations, we encountered 1.0 to 3.0 feet of surficial topsoil and/or undocumented fill. Underlying the topsoil and/or undocumented fill in each of our explorations, we encountered medium dense to dense, brown-gray to gray, silty, fine to medium sand with gravel, which we interpreted to as native glacial till soils. All of the test pits were terminated within the native glacial till deposits at depths in the range of 4.5 to 8.0 feet below the existing ground surface.

Hydrogeologic Conditions

We did not encounter groundwater within our explorations. If groundwater is encountered during construction, we would interpret this groundwater seepage to be perched groundwater. Perched water occurs when surface water infiltrates through less dense, more permeable soils and accumulates on top of a relatively low permeability material. Perched water does not represent a regional groundwater "table" within the upper soil horizons. Perched water tends to vary spatially and is dependent upon the amount of rainfall. We would expect the amount of perched groundwater to decrease during drier times of the year and increase during wetter periods.

SENSITIVE AREA EVALUATION

Seismic Hazard

We reviewed the 2021 International Building Code (IBC) and the ASCE 7-16 for seismic site classification for this project. Since competent glacial till soils were encountered at depth within the subject site, the site conditions best fit the IBC description for Site Class D.

Table 1 below provides seismic design parameters for the site that are in conformance with the 2021 IBC, which specifies a design earthquake having a two percent probability of occurrence in 50 years (return interval of 2,475 years), and the 2014 USGS seismic hazard maps.

Table 1 – ASCE 7-16 Seismic Design Parameters

Site Class	Spectral Acceleration at 0.2 sec. (g) S_s	Spectral Acceleration at 1.0 sec. (g) S_1	Site Coefficients		Design Spectral Response Parameters	
			F_a	F_v	S_{DS}	S_{D1}
D	1.423	0.495	1.0	Null	0.949	Null

The spectral response accelerations were obtained from the ASCE Hazard Tool website (2014 data) for the project address.

Hazards associated with seismic activity include liquefaction potential and amplification of ground motion. Liquefaction is caused by a rise in pore pressures in a loose, fine sand deposit beneath the groundwater table. It is our opinion that the medium dense or better glacial till deposits interpreted to underlie the site and nearby vicinity have a low potential for liquefaction or amplification of ground motion, due to their high internal strength, grain size distribution, and lack of shallow groundwater conditions.

Erosion Hazard

The criteria used for determination of the erosion hazard for affected areas include soil type, slope gradient, vegetation cover, and groundwater conditions. The erosion sensitivity is related to vegetative cover and the specific surface soil types, which are related to the underlying geologic soil units. The Soil Survey of King County Area, Washington, by the Natural Resources Conservation Service (NRCS), was reviewed to determine the erosion hazard of the on-site soils. The surface soils for this site are mapped as Arents, Alderwood material, 6 to 15 percent slopes. The erosion hazard for these materials is listed as slight. It is our opinion that the erosion hazard for site soils should be low in areas where the site is not disturbed.

CONCLUSIONS AND RECOMMENDATIONS

General

It is our opinion that the planned development within the site is generally feasible from a geotechnical standpoint. Our explorations indicated that the site was generally underlain by competent native glacial till soils at depth within the site. The native glacial bearing soils encountered at depth should provide adequate support for foundation, slab, and pavement loads. We recommend that the planned structures be designed utilizing conventional shallow foundations. Footings should extend through any loose soil or undocumented fill soils and be founded on the underlying medium dense or better native glacial till soils, or structural fill extending to these soils. The medium dense or better native glacial bearing soils should typically be encountered approximately 2.0 to 3.0 feet below the existing surface, based on our explorations. We should note that localized areas of deeper unsuitable soils and/or undocumented fill could be encountered at this site. This condition would require additional excavations in foundation, slab, and pavement areas to remove the unsuitable soils.

Based on the results of our on-site infiltration testing and soil explorations throughout the site, it is our opinion that the onsite native glacial till soils encountered at depth within the proposed development area are not conducive for stormwater infiltration methods. This is further discussed in the **Site Drainage** section of this report.

The surficial soils encountered on this site are considered moisture-sensitive and will disturb easily when wet. We recommend that construction take place during the drier summer months, if possible. If construction is to take place during wet weather, the soils may disturb, and additional expenses and delays may be expected due to the wet conditions. Additional expenses could include the need for placing a blanket of rock spalls to protect exposed subgrades and construction traffic areas. Some of the native on-site soils may be suitable for use as structural fill depending on the moisture content of the soil during construction. NGA should be retained to determine if the on-site soils can be used as structural fill material during construction.

Erosion Control

The erosion hazard for the on-site soils is interpreted to be slight for exposed soils, but actual erosion potential will be dependent on how the site is graded and how water is allowed to concentrate. Best Management Practices (BMPs) should be used to control erosion. Areas disturbed during construction should be protected from erosion. Erosion control measures may include diverting surface water away from the stripped or disturbed areas. Silt fences and/or straw bales should be erected to prevent muddy water from leaving the site. Disturbed areas should be planted as soon as practical, and the vegetation should be maintained until it is established. The erosion potential of areas not stripped of vegetation should be low.

Site Preparation and Grading

After erosion control measures are implemented, site preparation should consist of stripping the topsoil, undocumented fill and loose soils from foundation, slab, pavement areas, and other structural areas, to expose medium dense or better native bearing glacial soils. The stripped soil should be removed from the site or stockpiled for later use as a landscaping fill. Based on our observations, we anticipate stripping depths of 2.0 to 3.0 feet, depending on the specific locations. However, additional stripping may be required if areas of deeper undocumented fill and/or loose soil are encountered in unexplored areas of the site.

After site stripping, if the exposed subgrade is deemed loose, it should be compacted to a non-yielding condition and then proof-rolled with a heavy rubber-tired piece of equipment. Areas observed to pump or weave during the proof-roll test should be reworked to structural fill specifications or over-excavated and replaced with properly compacted structural fill or rock spalls. If loose soils are encountered in the pavement areas, the loose soils should be removed and replaced with rock spalls or granular structural fill. If significant surface water flow is encountered during construction, this flow should be diverted around areas to be developed, and the exposed subgrades should be maintained in a semi-dry condition.

If wet conditions are encountered, alternative site stripping and grading techniques might be necessary. These could include using large excavators equipped with wide tracks and a smooth bucket to complete site grading and covering exposed subgrade with a layer of crushed rock for protection. If wet conditions are encountered or construction is attempted in wet weather, the subgrade should not be compacted as this could cause further subgrade disturbance. In wet conditions, it may be necessary to cover the exposed subgrade with a layer of crushed rock as soon as it is exposed to protect the moisture sensitive soils from disturbance by machine or foot traffic during construction. The prepared subgrade should be protected from construction traffic and surface water should be diverted around areas of prepared subgrade.

The site soils are considered to be moisture-sensitive and will disturb easily when wet. We recommend that construction take place during the drier summer months if possible. However, if construction takes place during the wet season, additional expenses and delays should be expected due to the wet conditions. Additional expenses could include the need for placing a blanket of rock spalls on exposed subgrades, construction traffic areas, and paved areas prior to placing structural fill. Wet weather grading will also require additional erosion control and site drainage measures. Some of the native on-site soils may be suitable for use as structural fill, depending on the moisture content of the soil at the time of construction. NGA should be retained to evaluate the suitability of all on-site and imported structural fill material during construction.

Temporary and Permanent Slopes

Temporary cut slope stability is a function of many factors, including the type and consistency of soils, depth of the cut, surcharge loads adjacent to the excavation, length of time a cut remains open, and the presence of surface or groundwater. It is exceedingly difficult under these variable conditions to estimate a stable, temporary, cut slope angle. Therefore, it should be the responsibility of the contractor to maintain safe slope configurations at all times as indicated in OSHA guidelines for cut slopes.

The following information is provided solely for the benefit of the owner and other design consultants and should not be construed to imply that Nelson Geotechnical Associates, Inc. assumes responsibility for job site safety. Job site safety is the sole responsibility of the project contractor.

For planning purposes, we recommend that temporary cuts in the upper surficial and/or undocumented fill soils be no steeper than 1.5 Horizontal to 1 Vertical (1.5H:1V). Temporary cuts in the competent native glacial till soils at depth should be no steeper than 1H:1V. We recommend that temporary cut slope excavations be performed as to not disturb the 1H:1V inclination extending down from the base of the neighboring residence foundations to the bottom of the temporary cuts. If temporary cut excavations are not able to achieve the recommended inclinations, we recommend that the cuts be temporarily shored with either an Ultra Block shoring wall or a soldier pile shoring wall as discussed in the **Temporary Ultra Block/Ecology Block Shoring Wall and Soldier Pile Shoring Wall** subsections of this report, respectively. Any temporary cut excavations to be located within a 1H:1V inclination from the neighboring residence foundations should be supported entirely with a soldier pile shoring wall. If a soldier pile shoring wall is utilized to support temporary excavations within this property, we recommend that the soldier piles be installed in drilled shafts filled with concrete due to the relatively dense, compact nature of the native glacial till soils encountered at depth. Due to the soil conditions, we would anticipate that installation of the beams via driven impact methods may prove difficult and adequate embedment depths may not be achieved.

If significant groundwater seepage or surface water flow were encountered, we would expect that flatter inclinations would be necessary. We recommend that cut slopes be protected from erosion. The slope protection measures may include covering cut slopes with plastic sheeting and diverting surface runoff away from the top of cut slopes. We do not recommend vertical slopes for cuts deeper than four feet, if worker access is necessary. We recommend that cut slope heights and inclinations conform to appropriate OSHA/WISHA regulations. Permanent cut and fill slopes should be no steeper than 2H:1V. However, flatter inclinations may be required in areas where loose soils are encountered. Permanent slopes should be vegetated, and the vegetative cover maintained until established.

If planned temporary excavations and shoring systems are to be located within close proximity to the neighboring properties and structures, we recommend that settlement monitoring survey points be installed on the surrounding structures during construction and monitored at least once a week until it is confirmed that no movement is occurring. We should be retained to discuss wall and surrounding structure monitoring plans as project plans are finalized. Additional photographic and visual pre-existing surveys of the project vicinity and neighboring structures prior to construction activities should also be performed to document existing conditions within the vicinity of the property.

Temporary Shoring Walls

General: Specific grading plans were not available at the time this report was prepared. However, we anticipate that tall cuts and retaining walls will likely be needed for the planned structures depending on the final grades. Due to the proposed depth of the anticipated cuts and tight site constraints from existing properties, we anticipate that temporary/permanent shoring walls may be needed to support the cut excavations for structure construction.

Temporary Ultra Block/Ecology Block Shoring Wall: If temporary cut excavations as recommended above cannot be accommodated because of close proximity of the excavations to the property-lines, we recommend that the cuts could be temporarily shored with an Ultra Block and/or ecology block shoring wall. Ultra Blocks typically consist of 2.5-ft by 2.5ft by 5-ft concrete blocks while ecology blocks typically measure 2.0-ft by 2.0-ft by 6.0-ft. The total height of the temporary Ultra Block shoring wall should not exceed 7.5 feet or three blocks tall. The total height of a temporary ecology block shoring wall should not exceed 8.0 feet or four blocks tall. The Ultra Block or ecology block shoring wall should be constructed with a slight 1H:10V inclination back towards the cut and should be supported directly on competent native bearing glacial soils. All vertical joints between blocks should be staggered at each row. Temporary cuts above the temporary Ultra Block shoring wall could be sloped back away from the wall at 1.5H:1V or flatter inclination and should be no greater than four feet in overall height. If ecology blocks are utilized, the ground surface should be level and no additional surcharges from traffic, temporary slopes, building or machinery loads should be located within a 1H:1V inclination extending back from the base of the blocks. All exposed soils above the shoring wall should be protected from erosion. The Ultra Block and ecology block walls are considered only a temporary excavation support measure and should be buried or removed, and permanent support established by the building retaining walls. Schematic wall details utilizing both ecology blocks and Ultra Blocks are shown on Figures 6 and 7, respectively.

Where space is limited for the Ultra Block or ecology block shoring wall between the proposed residence foundation and property lines, the proposed residence foundation can be designed with L-shaped foundations. The block wall materials should be readily available on site prior to beginning excavation of the temporary cuts to be shored. The cut should be sloped or benched as needed for temporary stability, and wall construction should be accomplished immediately after excavation of the temporary slopes. Safe worker access should be maintained at all times during wall construction. We recommend that the construction of the temporary block walls be performed in short segments no greater than 15 feet in length and be entirely completed using machinery. No personnel should be present between the wall and the cut at any time. Gaps between the wall and cuts should be backfilled with clean crushed rock.

Soldier Pile Shoring Walls

General: A soldier pile shoring wall could also be utilized to support cut excavations around the proposed structures. A soldier pile wall typically consists of a series of steel H-beams placed vertically at a certain spacing between H-beams (typically six to ten feet). The beams are usually placed in drilled shafts that are filled with structural concrete or a lean mix. The concrete shafts are typically embedded below the bottom of the planned excavation a distance equal to one to two times the exposed height of the wall. The steel beams are extended above finished ground surface to provide shoring capabilities for the area to be retained. The beams are typically spanned by pressure treated timber lagging or concrete panels. The H-beam size, shaft diameter, shaft embedment, and pile spacing are dependent on the nature of the soils anticipated to be retained by the wall and the soils at depth, wall height, drainage conditions, and the final geometry. A schematic detail of the wall is shown on the Soldier Pile Wall Detail in Figure 8.

Wall Design: The shoring wall should be designed by an experienced structural engineer licensed in the State of Washington. The lateral earth pressure acting on the shoring wall will be dependent on the nature and density of the soil behind the wall, structure and traffic loads on the wall, and the amount of lateral wall movement that may occur as material is excavated from the front of the wall. If the shoring wall is free to yield at least one-thousandth of the retained height, an “active” loading condition develops. If the wall is restrained from movement by stiffness or bracing, the wall is considered in an “at-rest” loading condition. Active and at-rest earth pressure can be calculated based on equivalent fluid densities. The shoring wall should be designed to resist a lateral load resulting from a fluid with a unit weight of 40 and 60 pounds per cubic foot (pcf) for the active and at-rest loading conditions, respectively. An additional uniform surcharge of 8H should be applied to the wall design to account for seismic loading, if the shoring walls are intended to provide permanent support; **H** in this case, is the exposed height of the wall. These loads should be applied across the pile spacing above the excavation line. These loads can be resisted by a passive pressure of 250 pcf on the below grade very stiff or better soils encountered at depth. The passive pressure should be applied on two-pile diameters under the excavation line. These values of the passive pressure incorporate a factor of safety of 2.0. The upper two feet of pile embedment should be neglected when calculating the passive resistance for the permanent condition.

Also, for the permanent condition, the below-grade portion of the wall should be no less than 1.5 times the wall stick-up height. The above loads should be applied on the full center-to-center pile spacing above the base of the exposed portion of the wall. A 50 percent reduction of the active pressure could be applied for the purpose of designing the wall lagging. The above pressures assume that the on-site soils retained by the shoring wall are not significantly disturbed and that hydrostatic forces are not allowed to build up behind the wall. These values do not include the effects of surcharges other than what is described above.

The retained soils should be readily drained and collected water should be routed into a permanent storm system. Adequate gaps should be maintained between the lagging elements to allow for any potential water seepage buildup to flow through the wall. The wall designer should calculate the predicted wall deflection, including deflection resulting from the below-grade movement of the piles. The predicted deflection values should be confirmed in the field through a survey monitoring program. Also, surrounding structures should be monitored for any adverse effects resulting from shoring wall installation.

Shoring Wall Installation: The shoring wall should be installed by a shoring contractor experienced with this type of system. We anticipate that an open-hole drilling method may be feasible for installing the soldier piles in the on-site soils but recommend that the shoring contractor have the capability of casing the holes as sloughing and/or water seepage may be encountered. It might be prudent to perform one or more "test" holes to confirm installation conditions prior to finalizing budget and work plans. Any sloughing or water that may collect in the drilled holes should be removed prior to pumping grout. Grout should be readily available on site at the time the holes are drilled. If groundwater seepage is encountered, we recommend that water be pumped out of the holes and the concrete be tremied from the bottom of the excavations to displace the groundwater to the surface. Extra Portland Cement, or other additives, may also be placed in the excavations to reduce the effects of seepage. The spoils from the soldier pile excavations are expected to be moisture-sensitive materials and should be removed from the site. We should be retained to monitor on-site activities during the shoring wall installation on a full-time basis.

Foundations

Conventional shallow spread foundations should be placed on medium dense or better native glacial till soils or be supported on structural fill or rock spalls extending to those soils. Native medium dense or better glacial bearing soils should be encountered approximately 2.0 to 3.0 feet below the existing ground surface based on our explorations. Where undocumented fill or less dense soils are encountered at footing bearing elevation, the subgrade should be over-excavated to expose native bearing soil. The over-excavation may be filled with structural fill, or the footings may be extended down to the competent native soils. If footings are supported on structural fill, the fill zone should extend outside the edges of the footing a distance equal to half of the depth of the over-excavation below the bottom of the footing. In case of excessive undocumented fill thickness, deep foundation options may be required. NGA is available to work with the structural engineer to explore those options.

Footings should extend at least 18 inches below the lowest adjacent finished ground surface for frost protection and bearing capacity considerations. Foundations should be designed in accordance with the 2018 IBC. Footing widths should be based on the anticipated loads and allowable soil bearing pressure. Water should not be allowed to accumulate in footing trenches. All loose or disturbed soil should be removed from the foundation excavation prior to placing concrete.

For foundations constructed as outlined above, we recommend an allowable bearing pressure of not more than 2,500 pounds per square foot (psf) be used for the design of footings founded on the medium dense or better native soils or structural fill extending to the competent native bearing material. The foundation bearing soil should be evaluated by a representative of NGA. We should be consulted if higher bearing pressures are needed. Current IBC guidelines should be used when considering increased allowable bearing pressure for short-term transitory wind or seismic loads. Potential foundation settlement using the recommended allowable bearing pressure is estimated to be less than 1-inch total and ½-inch differential between adjacent footings or across a distance of about 20 feet, based on our experience with similar projects. Lateral loads may be resisted by friction on the base of the footing and passive resistance against the subsurface portions of the foundation. A coefficient of friction of 0.35 may be used to calculate the base friction and should be applied to the vertical dead load only. Passive resistance may be calculated as a triangular equivalent fluid pressure distribution. An equivalent fluid density of 250 pounds per cubic foot (pcf) should be used for passive resistance design for a level ground surface adjacent to the footing. This level surface should extend a distance equal to at least three times the footing depth. To achieve this value of passive resistance, the foundations should be poured “neat” against the native medium dense soils or compacted fill should be used as backfill against the front of the footing. We recommend that the upper one foot of soil be neglected when calculating the passive resistance.

Retaining Walls

Specific grading plans for this project were not available at the time this report was prepared, but retaining walls may be incorporated into project plans. In general, the lateral pressure acting on retaining walls is dependent on the nature and density of the soil behind the wall, the amount of lateral wall movement which can occur as backfill is placed, wall drainage conditions, and the inclination of the backfill. For walls that are free to yield at the top at least one thousandth of the height of the wall (active condition), soil pressures will be less than if movement is limited by such factors as wall stiffness or bracing (at-rest condition). We recommend that walls supporting horizontal backfill and not subjected to hydrostatic forces, be designed using a triangular earth pressure distribution equivalent to that exerted by a fluid with a density of 40 pcf for yielding (active condition) walls, and 60 pcf for non-yielding (at-rest condition) walls. A seismic design loading of 8H should also be included in the wall design, where “**H**” represents the total height of the wall.

These recommended lateral earth pressures are for a drained granular backfill and are based on the assumption of a horizontal ground surface behind the wall for a distance of at least the height of the wall, and do not account for surcharge loads. Additional lateral earth pressures should be considered for surcharge loads acting adjacent to walls and within a distance equal to the height of the wall. This would include the effects of surcharges such as traffic loads, floor slab loads, slopes, or other surface loads. We could consult with the structural engineer regarding additional loads on retaining walls during final design, if needed.

The lateral pressures on walls may be resisted by friction between the foundation and subgrade soil, and by passive resistance acting on the below-grade portion of the foundation. Recommendations for frictional and passive resistance to lateral loads are presented in the **Foundations** subsection of this report.

All wall backfill should be well compacted as outlined in the **Structural Fill** subsection of this report. Care should be taken to prevent the buildup of excess lateral soil pressures due to over-compaction of the wall backfill. This can be accomplished by placing wall backfill in 8-inch loose lifts and compacting the backfill with small, hand-operated compactors within a distance behind the wall equal to at least half the height of the wall. The thickness of the loose lifts should be reduced to accommodate the lower compactive energy of the hand-operated equipment. The recommended level of compaction should still be maintained.

Permanent drainage systems should be installed for retaining walls. Recommendations for these systems are found in the **Subsurface Drainage** subsection of this report. We recommend that we be retained to evaluate the proposed wall drain backfill material and observe installation of the drainage systems.

Structural Fill

General: Fill placed beneath foundations, pavement, or other settlement-sensitive structures should be placed as structural fill. Structural fill, by definition, is placed in accordance with prescribed methods and standards, and is monitored by an experienced geotechnical professional or soils technician. Field monitoring procedures would include the performance of a representative number of in-place density tests to document the attainment of the desired degree of relative compaction. The area to receive the fill should be suitably prepared as described in the **Site Preparation and Grading** subsection prior to beginning fill placement.

Materials: Structural fill should consist of a good quality, granular soil, free of organics and other deleterious material, and be well graded to a maximum size of about three inches. All-weather fill should contain no more than five-percent fines (soil finer than U.S. No. 200 sieve, based on that fraction passing the U.S. 3/4-inch sieve). Some of the more granular native on-site soils may be suitable for use as structural fill, but this will be highly dependent on the moisture content of these soils at the time of construction. We should be retained to evaluate all proposed structural fill material prior to placement.

Fill Placement: Following subgrade preparation, placement of structural fill may proceed. All filling should be accomplished in uniform lifts up to eight inches thick. Each lift should be spread evenly and be thoroughly compacted prior to placement of subsequent lifts. All structural fill underlying building areas and pavement subgrade should be compacted to a minimum of 95 percent of its maximum dry density. Maximum dry density, in this report, refers to that density as determined by the ASTM D-1557 Compaction Test procedure. The moisture content of the soils to be compacted should be within about two percent of optimum so that a readily compactable condition exists. It may be necessary to over-excavate and remove wet soils in cases where drying to a compactable condition is not feasible. All compaction should be accomplished by equipment of a type and size sufficient to attain the desired degree of compaction and should be tested.

Slab-on-Grade

Slab-on-grade should be supported on subgrade soils prepared as described in the **Site Preparation and Grading** subsection of this report. We recommend that all floor slabs be underlain by at least six inches of free-draining gravel with less than three percent by weight of the material passing Sieve #200 for use as a capillary break. A suitable vapor barrier, such as heavy plastic sheeting (6-mil, minimum), should be placed over the capillary break material. An additional 2-inch-thick moist sand layer may be used to cover the vapor barrier. This sand layer may be used to protect the vapor barrier membrane and to aid in curing the concrete.

Pavements

Pavement subgrade preparation and structural filling where required, should be completed as recommended in the **Site Preparation and Grading** and **Structural Fill** subsections of this report. The pavement subgrade should be proof-rolled with a heavy, rubber-tired piece of equipment, to identify soft or yielding areas that require repair. The pavement section should be underlain by a stable subgrade. We should be retained to observe the proof-rolling and recommend repairs prior to placement of the asphalt or hard surfaces.

Utilities

We recommend that underground utilities be bedded with a minimum six inches of pea gravel prior to backfilling the trench with on-site or imported material. Trenches within settlement sensitive areas should be compacted to 95 percent of the modified proctor as described in the Structural Fill subsection of this report. Trench backfill should be compacted to a minimum of 95 percent of the modified proctor maximum dry density. Trenches located in non-structural areas and five feet below roadway subgrade should be compacted to a minimum 90 percent of the maximum dry density. The trench backfill compaction should be tested.

Site Drainage

Infiltration: The 2019 Stormwater Management Manual for Western Washington (2019 SWMMWW) was utilized to determine the appropriate sizing of the proposed on-site infiltration systems. In accordance with this manual, on-site infiltration testing consisting of the Small-Scale Pilot Infiltration Test (Small PIT) was used to determine the long-term design infiltration rates. We conducted two Small PITs within Infiltration Pit 1 and Infiltration Pit 2 within the native glacial till soils as shown on the Schematic Site Plan in Figure 2. Infiltration Pits 1 and 2 measured 4.0-feet long by 3.0-feet wide by 4.5-feet deep. The holes were filled with approximately 12-inches of water and this level was maintained for six hours for the pre-soak period. After the 6-hour soaking period was completed, the water level was maintained at approximately 12-inches and the water flow rate into the hole was monitored with a Great Plains Industries (GPI) TM 050 water flow meter for one hour for the steady-state period of the test.

Infiltration Pit 1: The most conservative flow rate obtained from the steady state portion of the test within Infiltration Test Pit 1 was 0.024 gallons per minute (1.44 gallons per hour), which equates to an approximate infiltration rate of 0.19 inches per hour. The water was shut off after the steady-state period and the water level within the pit was monitored every 15 minutes for one hour. The water level within the pit had dropped 0.125 inches in 60 minutes, resulting in an infiltration rate of 0.125 inches per hour.

Infiltration Pit 2: After the six-hour pre-soak period, we observed that the water level remained at 12 inches with no additional water being added. After the one-hour steady-state portion of the test, the water level did not change resulting in a measured infiltration rate of zero inches per hour. As a result, the infiltration testing was concluded.

Based on the results of both of the small-PIT's and the relatively silty compact nature of the native glacial till soils that underlie the site, it is our opinion that the onsite native glacial till soils are not conducive for stormwater infiltration systems. We recommend that all stormwater generated from proposed structures and other hard surfaces be directed to on-site detention systems and ultimately into an approved point of discharge likely found within the adjacent roadways.

Surface Drainage: The finished ground surface should be graded such that stormwater is directed to an approved stormwater collection system. Water should not be allowed to stand in any areas where footings, slabs, or pavements are to be constructed. Final site grades should allow for drainage away from the residences. We suggest that the finished ground be sloped downward at a minimum gradient of three percent, for a distance of at least 10 feet away from the residences. Surface water should be collected by permanent catch basins and drain lines and be discharged into an approved discharge system.

Subsurface Drainage: If groundwater is encountered during construction, we recommend that the contractor slope the bottom of the excavation and collect the water into ditches and small sump pits where the water can be pumped out and routed into a permanent storm drain. We recommend the use of footing drains around the structures. Footing drains should be installed at least one foot below planned finished floor elevation. The drains should consist of a minimum 4-inch-diameter, rigid, slotted or perforated, PVC pipe surrounded by free-draining material wrapped in a filter fabric. We recommend that the free-draining material consist of an 18-inch-wide zone of clean (less than three-percent fines), granular material placed along the back of walls. Pea gravel is an acceptable drain material. The free-draining material should extend up the wall to one foot below the finished surface. The top foot of backfill should consist of impermeable soil placed over plastic sheeting or building paper to minimize surface water or fines migration into the footing drain. Footing drains should discharge into tightlines leading to an approved collection and discharge point with convenient cleanouts to prolong the useful life of the drains. Roof drains should not be connected to wall or footing drains.

CONSTRUCTION MONITORING

We should be retained to provide construction monitoring services during the earthwork phase of the project to evaluate subgrade conditions, temporary cut conditions, fill compaction, and drainage system installation.

USE OF THIS REPORT

NGA has prepared this report for **Ms. Heather Cochran with Cade Hill Homes,** and associated agents, for use in the planning and design of the development on this site only. The scope of our work does not include services related to construction safety precautions and our recommendations are not intended to direct the contractors' methods, techniques, sequences, or procedures, except as specifically described in our report for consideration in design. There are possible variations in subsurface conditions between the explorations and also with time. Our report, conclusions, and interpretations should not be construed as a warranty of subsurface conditions. A contingency for unanticipated conditions should be included in the budget and schedule.

We recommend that NGA be retained to provide monitoring and consultation services during construction to confirm that the conditions encountered are consistent with those indicated by the explorations, to provide recommendations for design changes should the conditions revealed differ from those anticipated, and to evaluate whether or not earthwork and foundation installation activities comply with contract plans and specifications. We should be contacted a minimum of one week prior to construction activities and could attend pre-construction meetings if requested.

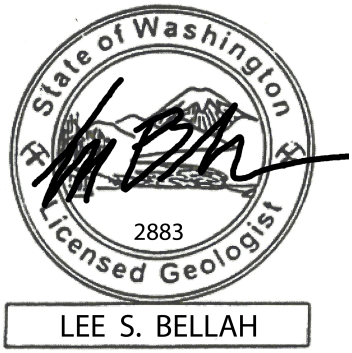
Within the limitations of scope, schedule, and budget, our services have been performed in accordance with generally accepted geotechnical engineering practices in effect in this area at the time this report was prepared. No other warranty, expressed or implied, is made. Our observations, findings, and opinions are a means to identify and reduce the inherent risks to the owner.

o-o-o

It has been a pleasure to provide service to you on this project. If you have any questions or require further information, please call.

Sincerely,

NELSON GEOTECHNICAL ASSOCIATES, INC.



Lee S. Bellah, LG
Senior Geologist

6.24.2024

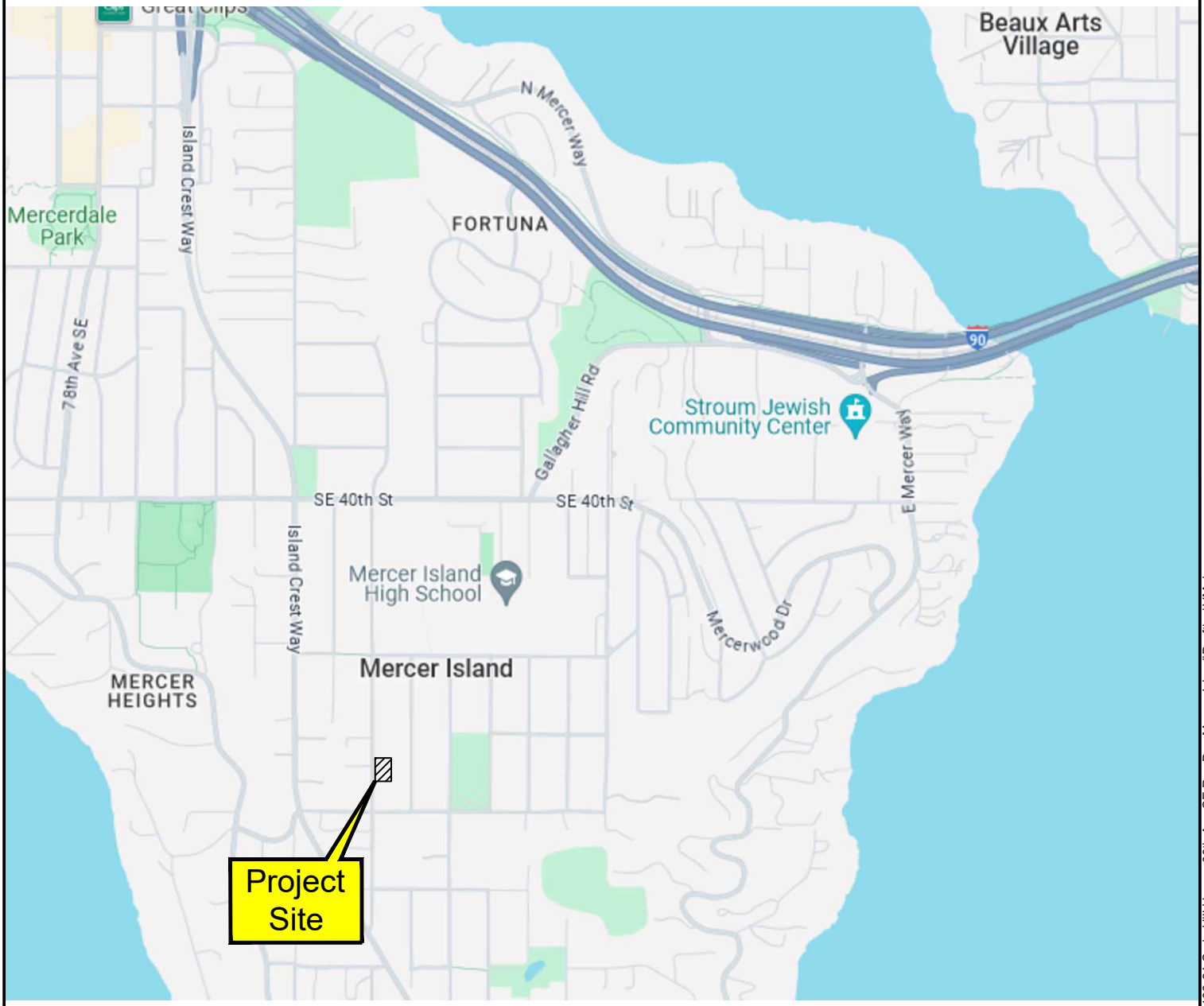
Khaled M. Shawish, PE
Principal

SAM:LSB:KMS:dy

Eight Figures Attached

VICINITY MAP

Not to Scale



Mercer Island, WA

Project Number 1518224	Cade Hill Homes 86th Avenue SE Residential Development Vicinity Map	NELSON GEOTECHNICAL ASSOCIATES, INC Woodinville Office: 17311-135th Ave. NE, A-500, Woodinville, WA 98072, (425) 486-1669 / Fax: 481-2510 Wenatchee Office: 105 Palouse St. Wenatchee, WA 98801, (509) 665-7696 / Fax: 665-7692 www.nelsongeotech.com
Figure 1		

No.	Date	Revision	By	CK
1	6/7/24	Original	ABT	LSB

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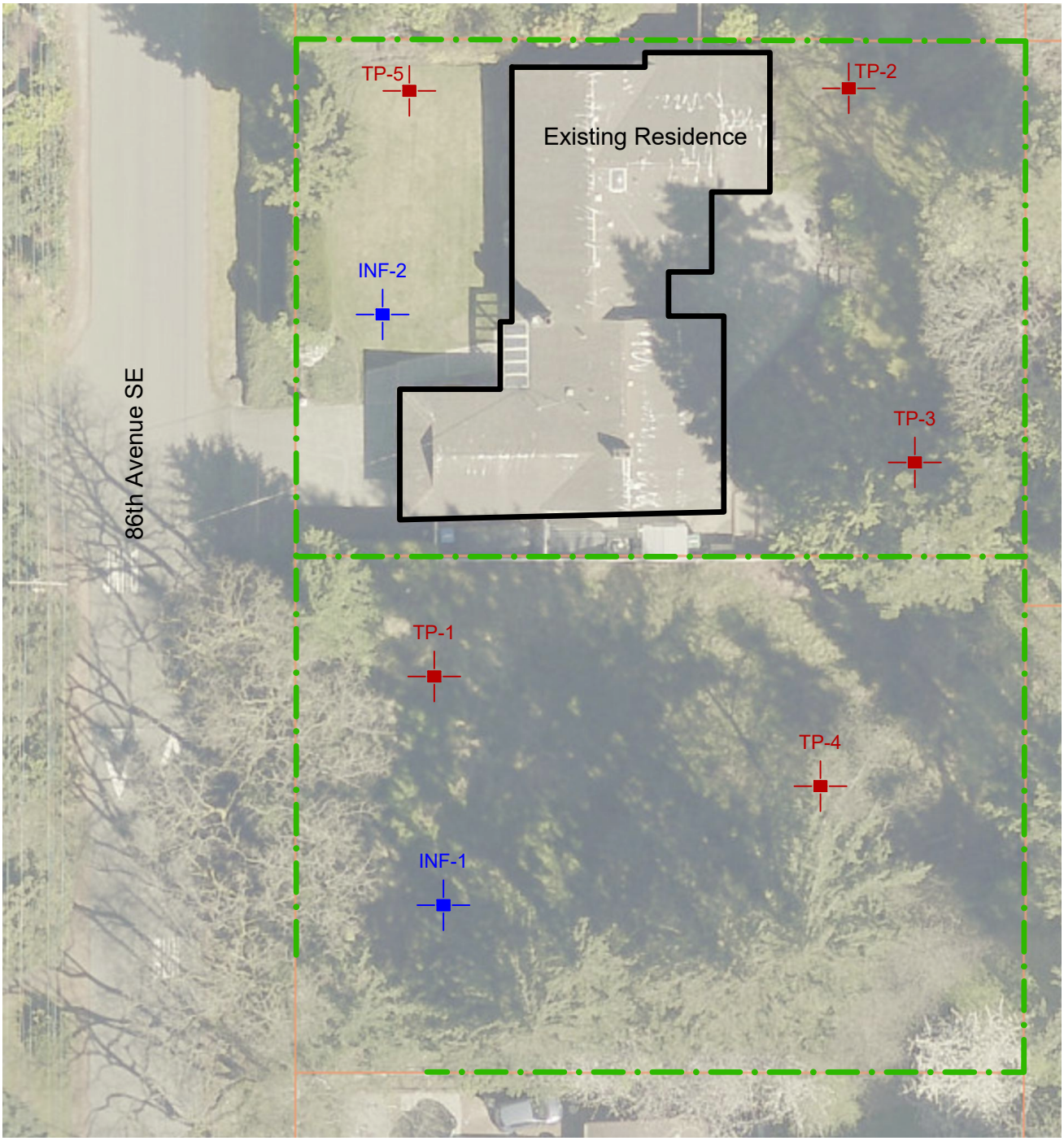
Site Plan



LEGEND

Property line

TP-1 — Number and approximate location of test pit

INF-1 — Number and approximate location of infiltration test pit

0 30 60

Approximate Scale: 1 inch = 30 feet

Reference: Site Plan based on field measurements, observations, and aerial parcel map review.

Project Number	Cade Hill Homes 86th Avenue SE Residential Development Site Plan
1518224	
Figure 2	

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UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GROUP SYMBOL	GROUP NAME
COARSE - GRAINED SOILS MORE THAN 50 % RETAINED ON NO. 200 SIEVE	GRAVEL MORE THAN 50 % OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVEL	GW	WELL-GRADED, FINE TO COARSE GRAVEL
			GP	POORLY-GRADED GRAVEL
		GRAVEL WITH FINES	GM	SILTY GRAVEL
			GC	CLAYEY GRAVEL
	SAND MORE THAN 50 % OF COARSE FRACTION PASSES NO. 4 SIEVE	CLEAN SAND	SW	WELL-GRADED SAND, FINE TO COARSE SAND
			SP	POORLY GRADED SAND
		SAND WITH FINES	SM	SILTY SAND
			SC	CLAYEY SAND
FINE - GRAINED SOILS MORE THAN 50 % PASSES NO. 200 SIEVE	SILT AND CLAY LIQUID LIMIT LESS THAN 50 %	INORGANIC	ML	SILT
			CL	CLAY
		ORGANIC	OL	ORGANIC SILT, ORGANIC CLAY
	SILT AND CLAY LIQUID LIMIT 50 % OR MORE	INORGANIC	MH	SILT OF HIGH PLASTICITY, ELASTIC SILT
			CH	CLAY OF HIGH PLASTICITY, FAT CLAY
		ORGANIC	OH	ORGANIC CLAY, ORGANIC SILT
HIGHLY ORGANIC SOILS			PT	PEAT

NOTES:

1) Field classification is based on visual examination of soil in general accordance with ASTM D 2488-93.

2) Soil classification using laboratory tests is based on ASTM D 2488-93.

3) Descriptions of soil density or consistency are based on interpretation of blowcount data, visual appearance of soils, and/or test data.

SOIL MOISTURE MODIFIERS:

Dry - Absence of moisture, dusty, dry to the touch

Moist - Damp, but no visible water.

Wet - Visible free water or saturated, usually soil is obtained from below water table

Project Number 1518224	Cade Hill Homes 86th Avenue SE Residential Development Soil Classification Chart	NELSON GEOTECHNICAL ASSOCIATES, INC
Figure 3		

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LOG OF EXPLORATION

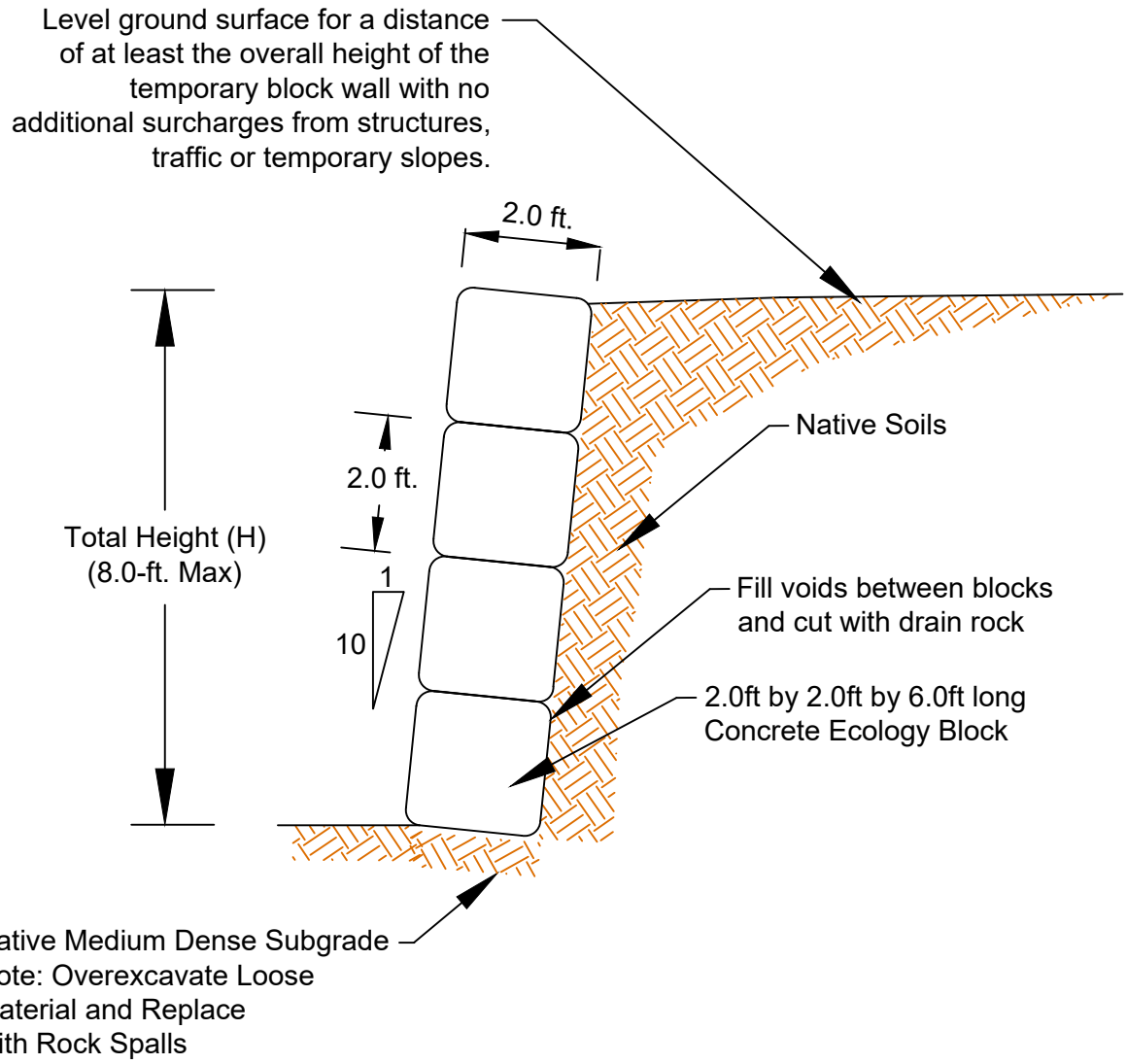
DEPTH (FEET)	USCS	SOIL DESCRIPTION
TEST PIT ONE		
0.0 – 1.0		GRASS / **TOPSOIL**
1.0 – 3.5	SM	BROWN-GRAY, SILTY, FINE TO MEDIUM SAND WITH GRAVEL (MEDIUM DENSE TO DENSE, MOIST)
3.5 – 8.0	SM	GRAY, SILTY, FINE TO MEDIUM SAND WITH GRAVEL (DENSE TO VERY DENSE, MOIST)
		SAMPLE WAS COLLECTED AT 4.0 FEET GROUNDWATER SEEPAGE WAS NOT ENCOUNTERED TEST PIT CAVING WAS NOT ENCOUNTERED TEST PIT WAS COMPLETED AT 8.0 FEET ON 5/31/24
TEST PIT TWO		
0.0 – 1.0		GRASS / **TOPSOIL**
1.0 – 2.5	SM	BROWN-GRAY, SILTY, FINE TO MEDIUM SAND WITH GRAVEL (MEDIUM DENSE TO DENSE, MOIST)
2.5 – 7.0	SM	GRAY, SILTY, FINE TO MEDIUM SAND WITH GRAVEL (DENSE TO VERY DENSE, MOIST)
		SAMPLE WAS COLLECTED 3.5 FEET GROUNDWATER SEEPAGE WAS NOT ENCOUNTERED TEST PIT CAVING WAS NOT ENCOUNTERED TEST PIT WAS COMPLETED AT 7.0 FEET ON 5/31/24
TEST PIT THREE		
0.0 – 1.0		GRASS / **TOPSOIL**
1.0 – 2.5	SM	BROWN-GRAY, SILTY, FINE TO MEDIUM SAND WITH GRAVEL (MEDIUM DENSE, MOIST)
2.5 – 7.0	SM	GRAY, SILTY, FINE TO MEDIUM SAND WITH GRAVEL (DENSE TO VERY DENSE, MOIST)
		SAMPLES WERE NOT COLLECTED GROUNDWATER SEEPAGE WAS NOT ENCOUNTERED TEST PIT CAVING WAS NOT ENCOUNTERED TEST PIT WAS COMPLETED AT 7.0 FEET ON 5/31/24
TEST PIT FOUR		
0.0 – 1.0		GRASS / **TOPSOIL**
1.0 – 2.5	SM	BROWN-GRAY, SILTY, FINE TO MEDIUM SAND WITH GRAVEL (MEDIUM DENSE, MOIST)
2.5 – 6.0	SM	GRAY, SILTY, FINE TO MEDIUM SAND WITH GRAVEL (DENSE TO VERY DENSE, MOIST)
		SAMPLES WAS COLLECTED AT 3.5 FEET GROUNDWATER SEEPAGE WAS NOT ENCOUNTERED TEST PIT CAVING WAS NOT ENCOUNTERED TEST PIT WAS COMPLETED AT 6.0 FEET ON 5/31/24
TEST PIT FIVE		
0.0 – 3.0		DARK BROWN, SILTY, FINE TO MEDIUM SAND WITH GRAVEL AND ORGANICS (LOOSE, MOIST) **FILL**
3.0 – 5.0	SM	RED-BROWN, SILTY, FINE TO MEDIUM SAND WITH GRAVEL (MEDIUM DENSE, MOIST)
5.0 – 8.0	SM	GRAY, SILTY, FINE TO MEDIUM SAND WITH GRAVEL (DENSE TO VERY DENSE, MOIST)
		SAMPLES WAS COLLECTED AT 5.5 FEET GROUNDWATER SEEPAGE WAS NOT ENCOUNTERED TEST PIT CAVING WAS NOT ENCOUNTERED TEST PIT WAS COMPLETED AT 8.0 FEET ON 5/31/24

LOG OF EXPLORATION

DEPTH (FEET)	USCS	SOIL DESCRIPTION
INFILTRATION TEST PIT ONE		
0.0 – 2.0		**TOPSOIL / FILL**
2.0 – 3.5	SM	RED-BROWN, SILTY, FINE TO MEDIUM SAND WITH GRAVEL (MEDIUM DENSE, MOIST)
3.5 – 4.5	SM	GRAY, SILTY, FINE TO MEDIUM SAND WITH GRAVEL (DENSE TO VERY DENSE, MOIST)
		SAMPLES WERE NOT COLLECTED GROUNDWATER SEEPAGE WAS NOT ENCOUNTERED TEST PIT CAVING WAS NOT ENCOUNTERED INFILTRATION TEST PIT WAS COMPLETED AT 4.5 FEET ON 5/31/24
INFILTRATION TEST PIT TWO		
0.0 – 2.5		**TOPSOIL / FILL**
2.5 – 3.5	SM	RED-BROWN, SILTY, FINE TO MEDIUM SAND WITH GRAVEL (MEDIUM DENSE, MOIST)
3.5 – 4.5	SM	GRAY, SILTY, FINE TO MEDIUM SAND WITH GRAVEL (DENSE TO VERY DENSE, MOIST)
		SAMPLES WERE NOT COLLECTED GROUNDWATER SEEPAGE WAS NOT ENCOUNTERED TEST PIT CAVING WAS NOT ENCOUNTERED INFILTRATION TEST PIT WAS COMPLETED AT 4.5 FEET ON 5/31/24

Temporary Ecology Block Shoring Wall Detail

(Not to Scale)



Project Number 1518224	Cade Hill Homes 86th Avenue SE Residential Development Temporary Ecology Block Shoring Wall Detail	NELSON GEOTECHNICAL ASSOCIATES, INC	No.	Date	Revision	By	CK
Figure 6		Woodinville Office 17311-135th Ave. NE, A-500 Woodinville, WA 98072 (425) 486-1669 / Fax: 481-2510	1	6/7/24	Original	LSB	KMS
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		www.nelsongeotech.com					

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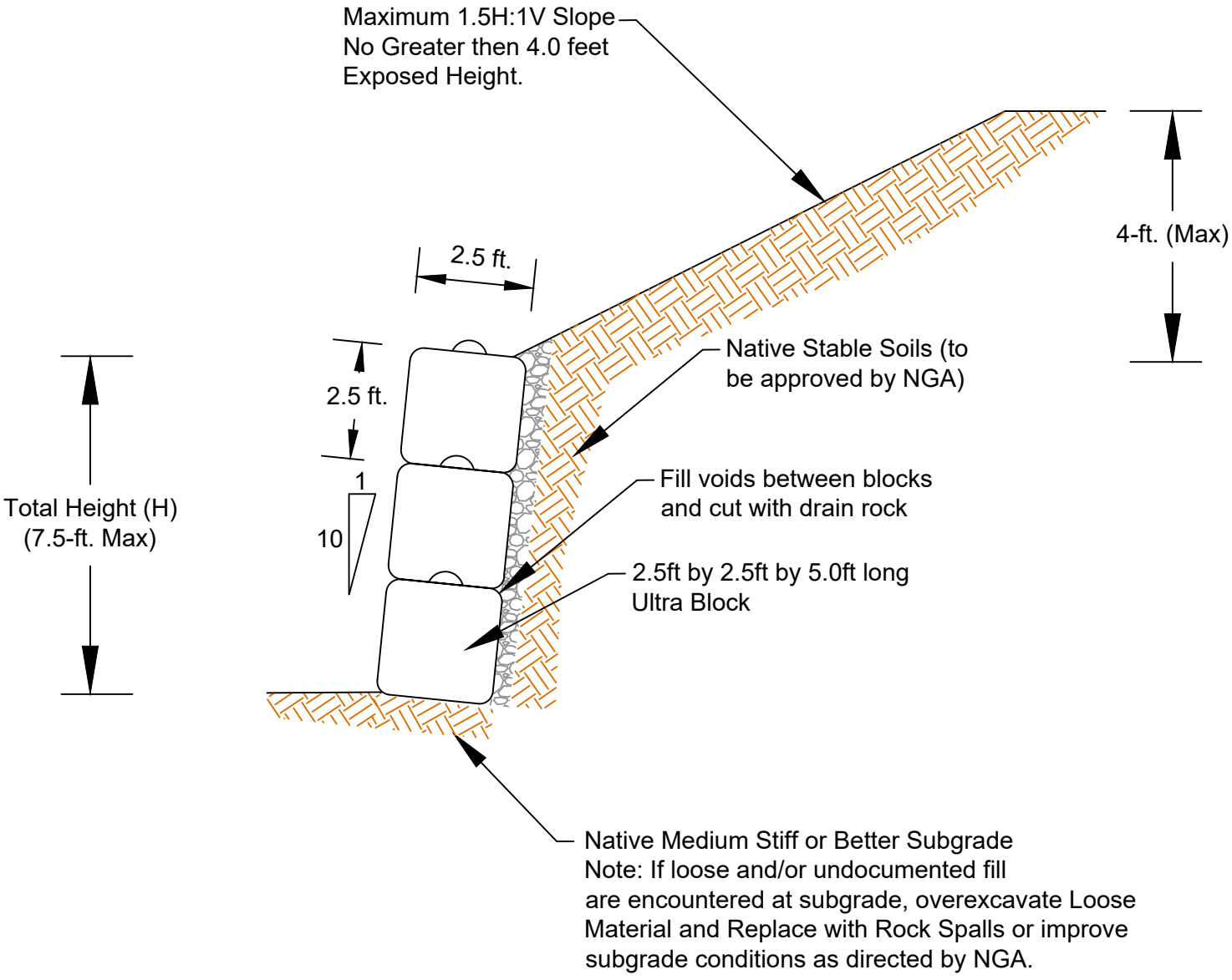
Temporary Ultra Block Shoring Wall Detail

(Not to Scale)



Project Number	Cade Hill Homes 86th Avenue SE Residential Development Temporary Ultra Block Shoring Wall Detail	NELSON GEOTECHNICAL ASSOCIATES, INC www.nelsongeotech.com **Woodinville Office** 17311-135th Ave. NE, A-500 Woodinville, WA 98072 (425) 486-1669 / Fax: 481-2510 **Wenatchee Office** 105 Palouse St. Wenatchee, WA 98801 (509) 665-7696 / Fax: 665-7692
1518224		
Figure 7		

No.	Date	Revision	By	CK
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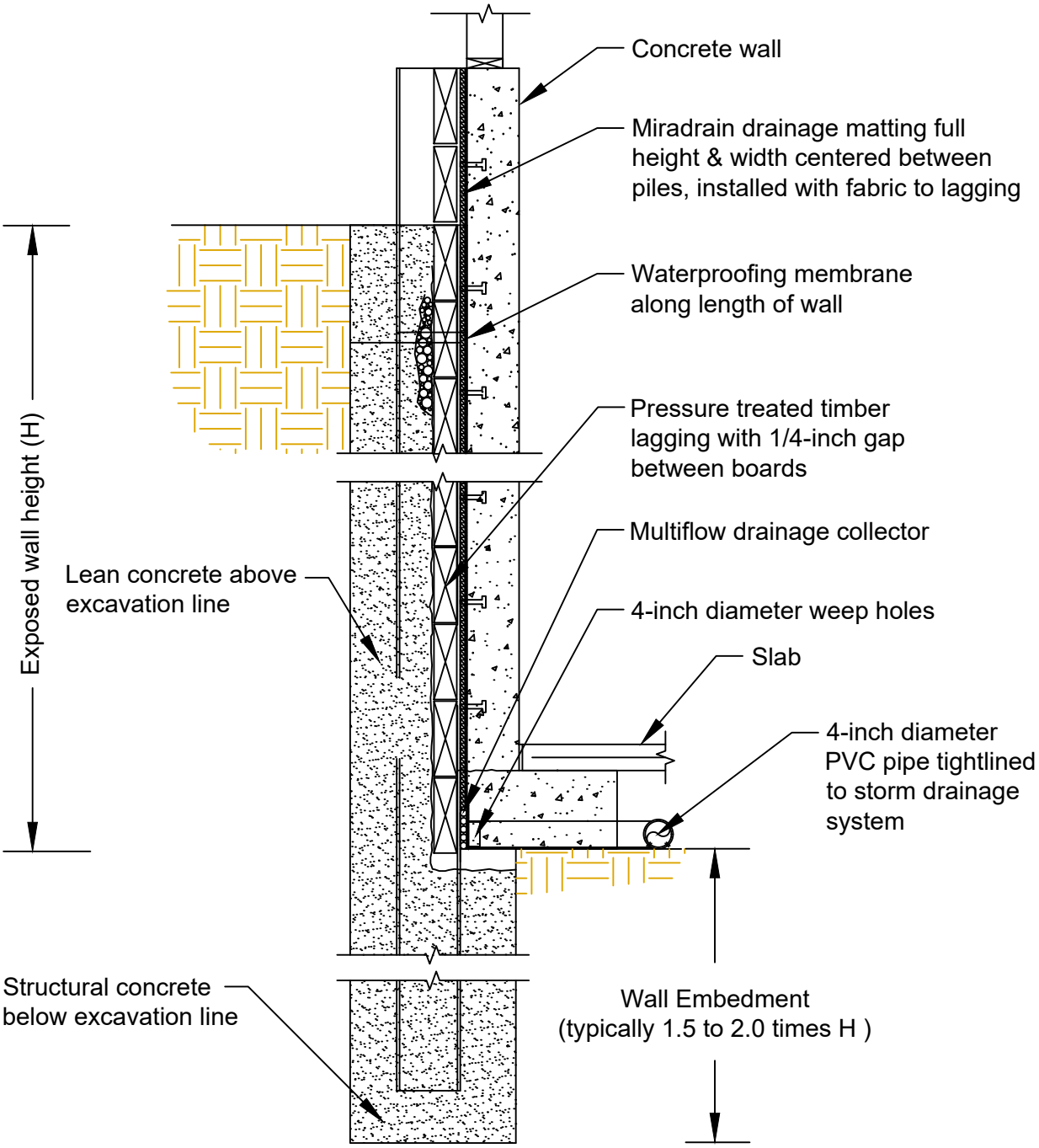
Conceptual Soldier Pile Wall Detail

NOT FOR CONSTRUCTION USE



NOT TO SCALE

Project Number 1518224	Cade Hill Homes 86th Avenue SE Residential Development Soldier Pile Wall Detail	NELSON GEOTECHNICAL ASSOCIATES, INC	No.	Date	Revision	By	CK
Figure 8			1	6/6/24	Original	LSB	LSB

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APPENDIX B

WWHM ANALYSIS

WWHM2012

PROJECT REPORT

General Model Information

WWHM2012 Project Name: 4332MI WWHM Analysis

Site Name:	4332MI
Site Address:	4332 86th Avenue SE
City:	Mercer Island
Report Date:	10/21/2025
Gage:	Seatac
Data Start:	1948/10/01
Data End:	2009/09/30
Timestep:	15 Minute
Precip Scale:	1.000
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

Basin

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Forest, Mod	0.33
Pervious Total	0.33
Impervious Land Use	acre
Impervious Total	0
Basin Total	0.33

Off-Site Basin

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Forest, Mod	0.41
Pervious Total	0.41
Impervious Land Use	acre
Impervious Total	0
Basin Total	0.41

Mitigated Land Use

Basin (to detention)

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Lawn, Mod	0.11
Pervious Total	0.11
Impervious Land Use	acre
ROOF TOPS FLAT	0.1
Impervious Total	0.1
Basin Total	0.21

Off-Site Basin (to detention)

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Forest, Mod	0.35
Pervious Total	0.35
Impervious Land Use	acre
Impervious Total	0
Basin Total	0.35

Basin Bypass

Bypass:	Yes
GroundWater:	No

Pervious Land Use	acre
C, Lawn, Mod	0.09
Pervious Total	0.09

Impervious Land Use	acre
ROOF TOPS FLAT	0.03
Impervious Total	0.03
Basin Total	0.12

Off-Site Basin Bypass

Bypass:	Yes
GroundWater:	No
Pervious Land Use	acre
C, Forest, Mod	0.06
Pervious Total	0.06
Impervious Land Use	acre
Impervious Total	0
Basin Total	0.06

Routing Elements
Predeveloped Routing

Mitigated Routing

Detention System

Dimensions
Depth: 4 ft.
Tank Type: Circular
Diameter: 4 ft.
Length: 59 ft.
Discharge Structure
Riser Height: 3.57 ft.
Riser Diameter: 12 in.
Orifice 1 Diameter: 0.500 in. Elevation:0 ft.
Orifice 2 Diameter: 1.500 in. Elevation:2.9 ft.
Element Flows To:
Outlet 1 Outlet 2

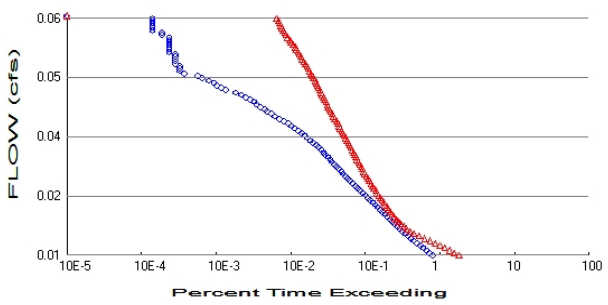
Tank Hydraulic Table

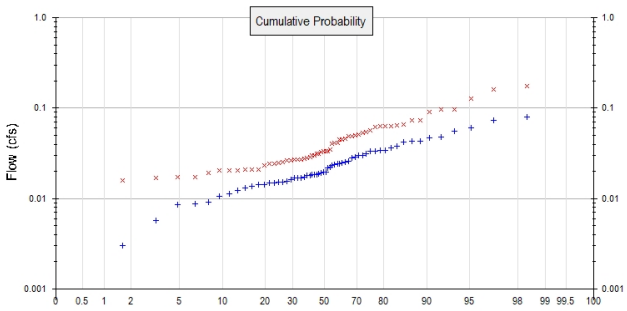
Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.000000	0.000000	0.000	0.000
0.0444	0.001136	0.000034	0.001	0.000
0.0889	0.001597	0.000095	0.002	0.000
0.1333	0.001945	0.000174	0.002	0.000
0.1778	0.002233	0.000267	0.002	0.000
0.2222	0.002482	0.000372	0.003	0.000
0.2667	0.002703	0.000487	0.003	0.000
0.3111	0.002902	0.000612	0.003	0.000
0.3556	0.003084	0.000745	0.004	0.000
0.4000	0.003251	0.000886	0.004	0.000
0.4444	0.003405	0.001034	0.004	0.000
0.4889	0.003549	0.001188	0.004	0.000
0.5333	0.003683	0.001349	0.005	0.000
0.5778	0.003809	0.001516	0.005	0.000
0.6222	0.003927	0.001688	0.005	0.000
0.6667	0.004038	0.001865	0.005	0.000
0.7111	0.004143	0.002046	0.005	0.000
0.7556	0.004241	0.002233	0.005	0.000
0.8000	0.004334	0.002423	0.006	0.000
0.8444	0.004422	0.002618	0.006	0.000
0.8889	0.004505	0.002816	0.006	0.000
0.9333	0.004583	0.003018	0.006	0.000
0.9778	0.004657	0.003224	0.006	0.000
1.0222	0.004726	0.003432	0.006	0.000
1.0667	0.004792	0.003644	0.007	0.000
1.1111	0.004853	0.003858	0.007	0.000
1.1556	0.004911	0.004075	0.007	0.000
1.2000	0.004966	0.004295	0.007	0.000
1.2444	0.005016	0.004516	0.007	0.000
1.2889	0.005064	0.004740	0.007	0.000
1.3333	0.005108	0.004966	0.007	0.000
1.3778	0.005149	0.005194	0.008	0.000
1.4222	0.005187	0.005424	0.008	0.000
1.4667	0.005222	0.005655	0.008	0.000
1.5111	0.005253	0.005888	0.008	0.000
1.5556	0.005282	0.006122	0.008	0.000
1.6000	0.005308	0.006358	0.008	0.000

1.6444	0.005332	0.006594	0.008	0.000
1.6889	0.005352	0.006832	0.008	0.000
1.7333	0.005369	0.007070	0.008	0.000
1.7778	0.005384	0.007309	0.009	0.000
1.8222	0.005396	0.007548	0.009	0.000
1.8667	0.005406	0.007788	0.009	0.000
1.9111	0.005412	0.008029	0.009	0.000
1.9556	0.005416	0.008270	0.009	0.000
2.0000	0.005418	0.008510	0.009	0.000
2.0444	0.005416	0.008751	0.009	0.000
2.0889	0.005412	0.008992	0.009	0.000
2.1333	0.005406	0.009232	0.009	0.000
2.1778	0.005396	0.009472	0.010	0.000
2.2222	0.005384	0.009712	0.010	0.000
2.2667	0.005369	0.009951	0.010	0.000
2.3111	0.005352	0.010189	0.010	0.000
2.3556	0.005332	0.010426	0.010	0.000
2.4000	0.005308	0.010663	0.010	0.000
2.4444	0.005282	0.010898	0.010	0.000
2.4889	0.005253	0.011132	0.010	0.000
2.5333	0.005222	0.011365	0.010	0.000
2.5778	0.005187	0.011596	0.010	0.000
2.6222	0.005149	0.011826	0.011	0.000
2.6667	0.005108	0.012054	0.011	0.000
2.7111	0.005064	0.012280	0.011	0.000
2.7556	0.005016	0.012504	0.011	0.000
2.8000	0.004966	0.012726	0.011	0.000
2.8444	0.004911	0.012946	0.011	0.000
2.8889	0.004853	0.013163	0.011	0.000
2.9333	0.004792	0.013377	0.022	0.000
2.9778	0.004726	0.013588	0.028	0.000
3.0222	0.004657	0.013797	0.033	0.000
3.0667	0.004583	0.014002	0.036	0.000
3.1111	0.004505	0.014204	0.040	0.000
3.1556	0.004422	0.014403	0.042	0.000
3.2000	0.004334	0.014597	0.045	0.000
3.2444	0.004241	0.014788	0.048	0.000
3.2889	0.004143	0.014974	0.050	0.000
3.3333	0.004038	0.015156	0.052	0.000
3.3778	0.003927	0.015333	0.054	0.000
3.4222	0.003809	0.015505	0.056	0.000
3.4667	0.003683	0.015671	0.058	0.000
3.5111	0.003549	0.015832	0.060	0.000
3.5556	0.003405	0.015987	0.062	0.000
3.6000	0.003251	0.016135	0.119	0.000
3.6444	0.003084	0.016276	0.280	0.000
3.6889	0.002902	0.016409	0.498	0.000
3.7333	0.002703	0.016533	0.752	0.000
3.7778	0.002482	0.016649	1.026	0.000
3.8222	0.002233	0.016753	1.303	0.000
3.8667	0.001945	0.016846	1.564	0.000
3.9111	0.001597	0.016925	1.795	0.000
3.9556	0.001136	0.016987	1.985	0.000
4.0000	0.000000	0.017021	2.128	0.000
4.0444	0.000000	0.000000	2.233	0.000

Analysis Results

POC 1





\+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 0.74
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 0.61
Total Impervious Area: 0.13

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.022034
5 year	0.036104
10 year	0.045151
25 year	0.055913
50 year	0.063367
100 year	0.07033

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0.036167
5 year	0.060363
10 year	0.080693
25 year	0.11191
50 year	0.13959
100 year	0.171422

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1949	0.025	0.041
1950	0.030	0.045
1951	0.048	0.064
1952	0.015	0.021
1953	0.012	0.017
1954	0.019	0.030
1955	0.030	0.051
1956	0.024	0.050
1957	0.019	0.034
1958	0.022	0.034

1959	0.019	0.025
1960	0.033	0.062
1961	0.018	0.027
1962	0.011	0.017
1963	0.016	0.026
1964	0.022	0.031
1965	0.015	0.031
1966	0.014	0.021
1967	0.034	0.054
1968	0.019	0.033
1969	0.019	0.029
1970	0.015	0.027
1971	0.017	0.033
1972	0.037	0.066
1973	0.016	0.020
1974	0.018	0.028
1975	0.025	0.054
1976	0.018	0.030
1977	0.003	0.019
1978	0.015	0.024
1979	0.009	0.023
1980	0.043	0.049
1981	0.014	0.027
1982	0.028	0.091
1983	0.024	0.041
1984	0.014	0.021
1985	0.009	0.026
1986	0.038	0.063
1987	0.033	0.063
1988	0.013	0.017
1989	0.009	0.016
1990	0.080	0.175
1991	0.042	0.097
1992	0.017	0.024
1993	0.017	0.021
1994	0.006	0.013
1995	0.024	0.045
1996	0.056	0.074
1997	0.043	0.065
1998	0.011	0.026
1999	0.047	0.056
2000	0.017	0.028
2001	0.003	0.021
2002	0.019	0.046
2003	0.029	0.035
2004	0.031	0.096
2005	0.023	0.041
2006	0.026	0.049
2007	0.060	0.160
2008	0.074	0.129
2009	0.034	0.074

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.0798	0.1754
2	0.0735	0.1599
3	0.0603	0.1287

4	0.0559	0.0971
5	0.0481	0.0958
6	0.0473	0.0915
7	0.0431	0.0737
8	0.0430	0.0736
9	0.0423	0.0661
10	0.0378	0.0648
11	0.0365	0.0636
12	0.0343	0.0631
13	0.0338	0.0629
14	0.0333	0.0622
15	0.0332	0.0563
16	0.0311	0.0543
17	0.0301	0.0538
18	0.0299	0.0508
19	0.0291	0.0496
20	0.0279	0.0493
21	0.0259	0.0485
22	0.0254	0.0462
23	0.0250	0.0454
24	0.0242	0.0445
25	0.0241	0.0410
26	0.0239	0.0410
27	0.0231	0.0405
28	0.0221	0.0347
29	0.0216	0.0337
30	0.0195	0.0336
31	0.0195	0.0334
32	0.0190	0.0325
33	0.0187	0.0311
34	0.0185	0.0311
35	0.0185	0.0303
36	0.0183	0.0303
37	0.0180	0.0288
38	0.0179	0.0284
39	0.0173	0.0277
40	0.0169	0.0271
41	0.0168	0.0271
42	0.0168	0.0269
43	0.0162	0.0263
44	0.0156	0.0262
45	0.0151	0.0255
46	0.0151	0.0246
47	0.0149	0.0244
48	0.0147	0.0241
49	0.0144	0.0235
50	0.0141	0.0211
51	0.0135	0.0210
52	0.0132	0.0209
53	0.0122	0.0206
54	0.0114	0.0206
55	0.0106	0.0204
56	0.0091	0.0191
57	0.0087	0.0174
58	0.0085	0.0173
59	0.0057	0.0170
60	0.0030	0.0158
61	0.0026	0.0134

Duration Flows

The Duration Matching Failed

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0110	17096	38307	224	Fail
0.0115	15498	33238	214	Fail
0.0121	14074	28768	204	Fail
0.0126	12803	24790	193	Fail
0.0131	11567	21453	185	Fail
0.0137	10515	18467	175	Fail
0.0142	9580	15821	165	Fail
0.0147	8763	13415	153	Fail
0.0152	8046	11251	139	Fail
0.0158	7351	9548	129	Fail
0.0163	6737	8521	126	Fail
0.0168	6192	7694	124	Fail
0.0174	5728	7022	122	Fail
0.0179	5309	6462	121	Fail
0.0184	4924	5974	121	Fail
0.0189	4571	5578	122	Fail
0.0195	4239	5219	123	Fail
0.0200	3955	4911	124	Fail
0.0205	3645	4641	127	Fail
0.0211	3390	4372	128	Fail
0.0216	3133	4147	132	Fail
0.0221	2915	3948	135	Fail
0.0227	2701	3758	139	Fail
0.0232	2490	3593	144	Fail
0.0237	2316	3409	147	Fail
0.0242	2136	3249	152	Fail
0.0248	1973	3093	156	Fail
0.0253	1825	2947	161	Fail
0.0258	1702	2802	164	Fail
0.0264	1577	2674	169	Fail
0.0269	1442	2545	176	Fail
0.0274	1326	2428	183	Fail
0.0279	1233	2319	188	Fail
0.0285	1147	2218	193	Fail
0.0290	1086	2123	195	Fail
0.0295	1020	2035	199	Fail
0.0301	947	1960	206	Fail
0.0306	886	1884	212	Fail
0.0311	824	1800	218	Fail
0.0316	761	1736	228	Fail
0.0322	725	1667	229	Fail
0.0327	675	1598	236	Fail
0.0332	623	1543	247	Fail
0.0338	589	1478	250	Fail
0.0343	549	1419	258	Fail
0.0348	506	1361	268	Fail
0.0353	469	1317	280	Fail
0.0359	427	1279	299	Fail
0.0364	388	1222	314	Fail
0.0369	356	1164	326	Fail
0.0375	328	1112	339	Fail
0.0380	298	1071	359	Fail
0.0385	270	1035	383	Fail
0.0390	241	987	409	Fail

0.0396	218	958	439	Fail
0.0401	197	919	466	Fail
0.0406	174	878	504	Fail
0.0412	152	834	548	Fail
0.0417	130	805	619	Fail
0.0422	119	769	646	Fail
0.0427	104	735	706	Fail
0.0433	95	712	749	Fail
0.0438	83	679	818	Fail
0.0443	74	658	889	Fail
0.0449	69	635	920	Fail
0.0454	61	611	1001	Fail
0.0459	53	589	1111	Fail
0.0464	46	568	1234	Fail
0.0470	39	552	1415	Fail
0.0475	29	526	1813	Fail
0.0480	25	503	2012	Fail
0.0486	22	487	2213	Fail
0.0491	20	471	2355	Fail
0.0496	17	450	2647	Fail
0.0501	14	432	3085	Fail
0.0507	12	415	3458	Fail
0.0512	8	400	5000	Fail
0.0517	7	382	5457	Fail
0.0523	7	369	5271	Fail
0.0528	7	353	5042	Fail
0.0533	6	335	5583	Fail
0.0538	6	321	5350	Fail
0.0544	6	302	5033	Fail
0.0549	6	291	4850	Fail
0.0554	6	279	4650	Fail
0.0560	5	270	5400	Fail
0.0565	5	256	5120	Fail
0.0570	5	246	4920	Fail
0.0576	5	228	4560	Fail
0.0581	5	216	4320	Fail
0.0586	5	209	4180	Fail
0.0591	5	194	3880	Fail
0.0597	4	184	4600	Fail
0.0602	4	177	4425	Fail
0.0607	3	169	5633	Fail
0.0613	3	163	5433	Fail
0.0618	3	156	5200	Fail
0.0623	3	152	5066	Fail
0.0628	3	147	4900	Fail
0.0634	3	138	4600	Fail

The development has an increase in flow durations from 1/2 Predeveloped 2 year flow to the 2 year flow or more than a 10% increase from the 2 year to the 50 year flow.
The development has an increase in flow durations for more than 50% of the flows for the range of the duration analysis.

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
Detention System POC	☐	35.20			☐	0.00			
Total Volume Infiltrated		35.20	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

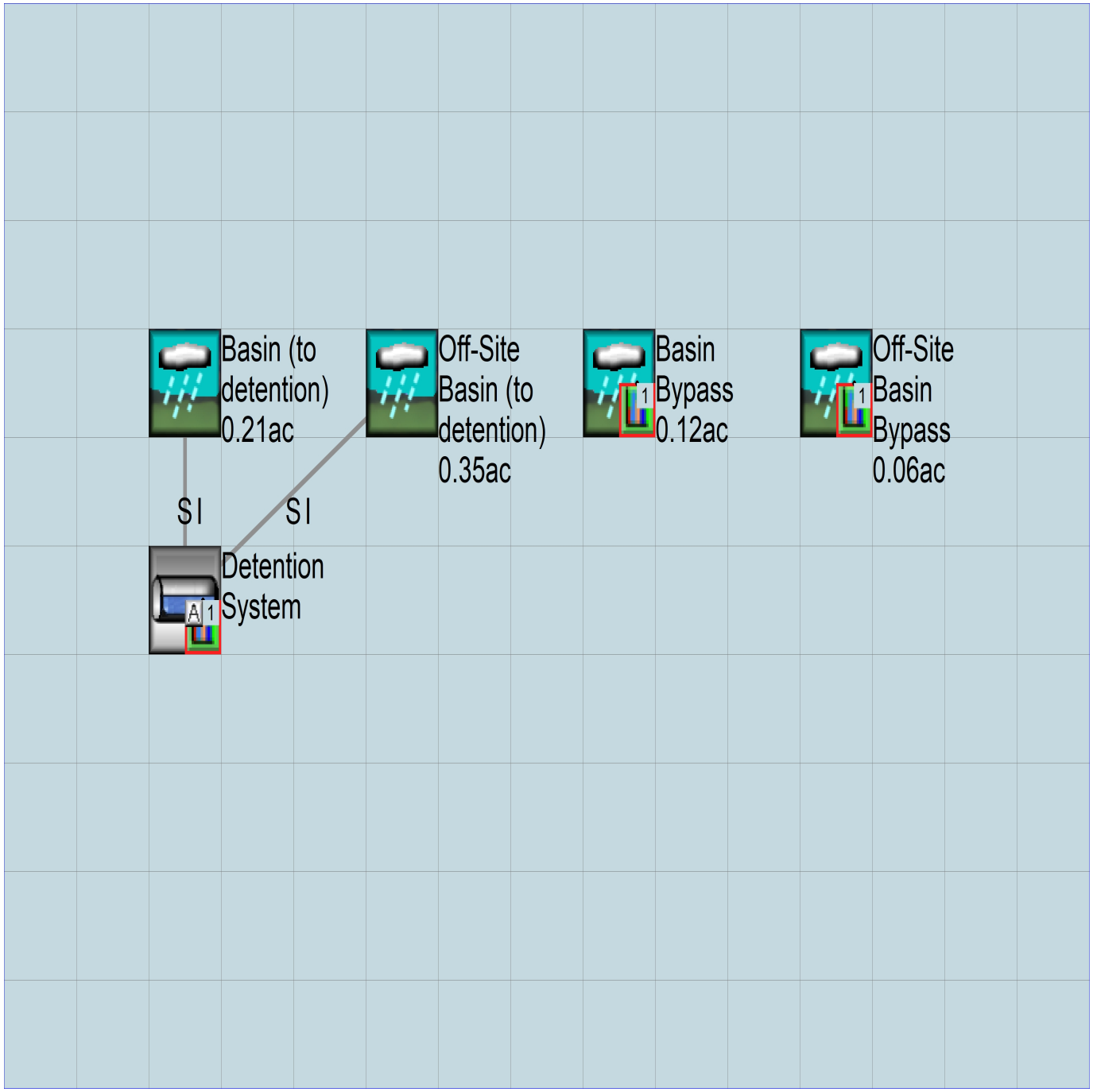
No PERLND changes have been made.

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   4332MI WWHM Analysis.wdm
MESSU       25   Pre4332MI WWHM Analysis.MES
            27   Pre4332MI WWHM Analysis.L61
            28   Pre4332MI WWHM Analysis.L62
            30   POC4332MI WWHM Analysis1.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        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    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#   ***
Basin***
PERLND  11                       0.33     COPY   501     12
PERLND  11                       0.33     COPY   501     13
Off-Site Basin***
PERLND  11                       0.41     COPY   501     12
PERLND  11                       0.41     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              PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1              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   4332MI WWHM Analysis.wdm
MESSU       25   Mit4332MI WWHM Analysis.MES
            27   Mit4332MI WWHM Analysis.L61
            28   Mit4332MI WWHM Analysis.L62
            30   POC4332MI WWHM Analysis1.dat
END FILES

OPN SEQUENCE
    INGRP               INDELT 00:15
      PERLND      17
      IMPLND       4
      PERLND      11
      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        Detention System            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           ***
   17     C, Lawn, Mod             1    1    1    1   27    0
   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 ***
   17         0    0    1    0    0    0    0    0    0    0    0    0
   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  *********
   17         0    0    4    0    0    0    0    0    0    0    0    0    1    9
   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 ***
   17         0    0    0    0    0    0    0    0    0    0    0
   11         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
   17              0       4.5      0.03       400       0.1       0.5     0.996
   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
   17              0         0         2         2         0         0         0
   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 ***
   17            0.1      0.25      0.25         6       0.5      0.25
   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
   17              0         0         0         0       2.5         1         0
   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           ***
    4      ROOF TOPS/FLAT         1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

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

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

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

```
    4         0    0    0    0    0
  END IWAT-PARM1

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

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

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

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin (to detention)***
PERLND  17                        0.11     RCHRES   1      2
PERLND  17                        0.11     RCHRES   1      3
IMPLND   4                         0.1     RCHRES   1      5
Off-Site Basin (to detention)***
PERLND  11                        0.35     RCHRES   1      2
PERLND  11                        0.35     RCHRES   1      3
Basin Bypass***
PERLND  17                        0.09     COPY   501     12
PERLND  17                        0.09     COPY   601     12
PERLND  17                        0.09     COPY   501     13
PERLND  17                        0.09     COPY   601     13
IMPLND   4                        0.03     COPY   501     15
IMPLND   4                        0.03     COPY   601     15
Off-Site Basin Bypass***
PERLND  11                        0.06     COPY   501     12
PERLND  11                        0.06     COPY   601     12
PERLND  11                        0.06     COPY   501     13
PERLND  11                        0.06     COPY   601     13

******Routing******
PERLND  17                        0.11     COPY     1     12
IMPLND   4                         0.1     COPY     1     15
PERLND  17                        0.11     COPY     1     13
PERLND  11                        0.35     COPY     1     12
PERLND  11                        0.35     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     Detention System-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      0.01       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  0.000000  0.000000  0.000000
  0.044444  0.001136  0.000034  0.001430
  0.088889  0.001597  0.000095  0.002023
  0.133333  0.001945  0.000174  0.002477
  0.177778  0.002233  0.000267  0.002860
  0.222222  0.002482  0.000372  0.003198
  0.266667  0.002703  0.000487  0.003503
  0.311111  0.002902  0.000612  0.003784
  0.355556  0.003084  0.000745  0.004045
  0.400000  0.003251  0.000886  0.004291
  0.444444  0.003405  0.001034  0.004523
  0.488889  0.003549  0.001188  0.004744
  0.533333  0.003683  0.001349  0.004954
  0.577778  0.003809  0.001516  0.005157
  0.622222  0.003927  0.001688  0.005351
  0.666667  0.004038  0.001865  0.005539
  0.711111  0.004143  0.002046  0.005721
  0.755556  0.004241  0.002233  0.005897
  0.800000  0.004334  0.002423  0.006068
  0.844444  0.004422  0.002618  0.006234
  0.888889  0.004505  0.002816  0.006396
  0.933333  0.004583  0.003018  0.006554
  0.977778  0.004657  0.003224  0.006708
  1.022222  0.004726  0.003432  0.006859
```

```
  1.066667  0.004792  0.003644  0.007007
  1.111111  0.004853  0.003858  0.007151
  1.155556  0.004911  0.004075  0.007293
  1.200000  0.004966  0.004295  0.007432
  1.244444  0.005016  0.004516  0.007568
  1.288889  0.005064  0.004740  0.007702
  1.333333  0.005108  0.004966  0.007834
  1.377778  0.005149  0.005194  0.007963
  1.422222  0.005187  0.005424  0.008091
  1.466667  0.005222  0.005655  0.008216
  1.511111  0.005253  0.005888  0.008340
  1.555556  0.005282  0.006122  0.008461
  1.600000  0.005308  0.006358  0.008581
  1.644444  0.005332  0.006594  0.008700
  1.688889  0.005352  0.006832  0.008817
  1.733333  0.005369  0.007070  0.008932
  1.777778  0.005384  0.007309  0.009046
  1.822222  0.005396  0.007548  0.009158
  1.866667  0.005406  0.007788  0.009269
  1.911111  0.005412  0.008029  0.009379
  1.955556  0.005416  0.008270  0.009487
  2.000000  0.005418  0.008510  0.009594
  2.044444  0.005416  0.008751  0.009700
  2.088889  0.005412  0.008992  0.009805
  2.133333  0.005406  0.009232  0.009909
  2.177778  0.005396  0.009472  0.010012
  2.222222  0.005384  0.009712  0.010113
  2.266667  0.005369  0.009951  0.010214
  2.311111  0.005352  0.010189  0.010314
  2.355556  0.005332  0.010426  0.010412
  2.400000  0.005308  0.010663  0.010510
  2.444444  0.005282  0.010898  0.010607
  2.488889  0.005253  0.011132  0.010703
  2.533333  0.005222  0.011365  0.010798
  2.577778  0.005187  0.011596  0.010892
  2.622222  0.005149  0.011826  0.010986
  2.666667  0.005108  0.012054  0.011079
  2.711111  0.005064  0.012280  0.011170
  2.755556  0.005016  0.012504  0.011262
  2.800000  0.004966  0.012726  0.011352
  2.844444  0.004911  0.012946  0.011442
  2.888889  0.004853  0.013163  0.011531
  2.933333  0.004792  0.013377  0.022767
  2.977778  0.004726  0.013588  0.028735
  3.022222  0.004657  0.013797  0.033140
  3.066667  0.004583  0.014002  0.036807
  3.111111  0.004505  0.014204  0.040020
  3.155556  0.004422  0.014403  0.042918
  3.200000  0.004334  0.014597  0.045579
  3.244444  0.004241  0.014788  0.048054
  3.288889  0.004143  0.014974  0.050380
  3.333333  0.004038  0.015156  0.052579
  3.377778  0.003927  0.015333  0.054673
  3.422222  0.003809  0.015505  0.056674
  3.466667  0.003683  0.015671  0.058594
  3.511111  0.003549  0.015832  0.060443
  3.555556  0.003405  0.015987  0.062229
  3.600000  0.003251  0.016135  0.119069
  3.644444  0.003084  0.016276  0.280535
  3.688889  0.002902  0.016409  0.498016
  3.733333  0.002703  0.016533  0.752310
  3.777778  0.002482  0.016649  1.026447
  3.822222  0.002233  0.016753  1.302992
  3.866667  0.001945  0.016846  1.564590
  3.911111  0.001597  0.016925  1.795706
  3.955556  0.001136  0.016987  1.985084
  4.000000  0.001000  0.017021  2.128715
  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             PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1             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***
RCHRES   1 HYDR   RO     1 1        1      WDM   1000 FLOW     ENGL      REPL
RCHRES   1 HYDR   STAGE  1 1        1      WDM   1001 STAG     ENGL      REPL
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
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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WWHM2012

PROJECT REPORT

ANALYSIS WITHOUT DETENTION

General Model Information

WWHM2012 Project Name: 4332MI WWHM Analysis (without Detention)

Site Name:	4332MI
Site Address:	4332 86th Avenue SE
City:	Mercer Island
Report Date:	10/23/2025
Gage:	Seatac
Data Start:	1948/10/01
Data End:	2009/09/30
Timestep:	15 Minute
Precip Scale:	1.000
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

Basin

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Forest, Mod	0.33
Pervious Total	0.33
Impervious Land Use	acre
Impervious Total	0
Basin Total	0.33

Off-Site Basin

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Forest, Mod	0.41
Pervious Total	0.41
Impervious Land Use	acre
Impervious Total	0
Basin Total	0.41

Mitigated Land Use

Basin (to detention)

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Lawn, Mod	0.11
Pervious Total	0.11
Impervious Land Use	acre
ROOF TOPS FLAT	0.1
Impervious Total	0.1
Basin Total	0.21

Off-Site Basin (to detention)

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Forest, Mod	0.35
Pervious Total	0.35
Impervious Land Use	acre
Impervious Total	0
Basin Total	0.35

Basin Bypass

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
C, Lawn, Mod	0.09
Pervious Total	0.09

Impervious Land Use	acre
ROOF TOPS FLAT	0.03
Impervious Total	0.03
Basin Total	0.12

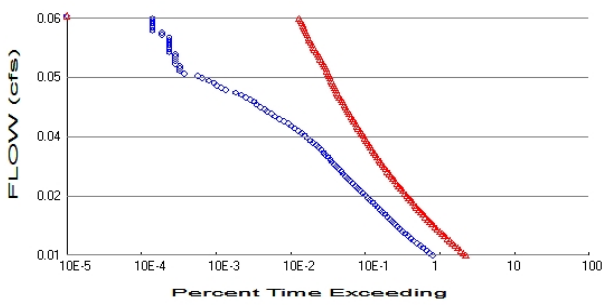
Off-Site Basin Bypass

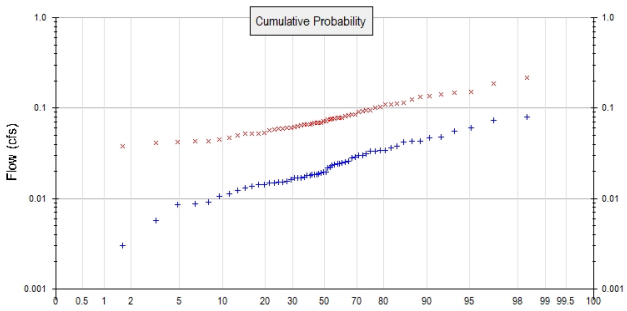
Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Forest, Mod	0.06
Pervious Total	0.06
Impervious Land Use	acre
Impervious Total	0
Basin Total	0.06

Mitigated Routing

Analysis Results

POC 1





\+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 0.74
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 0.61
Total Impervious Area: 0.13

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.022034
5 year	0.036104
10 year	0.045151
25 year	0.055913
50 year	0.063367
100 year	0.07033

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0.073589
5 year	0.10393
10 year	0.125913
25 year	0.155869
50 year	0.17979
100 year	0.205106

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1949	0.025	0.115
1950	0.030	0.110
1951	0.048	0.076
1952	0.015	0.047
1953	0.012	0.042
1954	0.019	0.061
1955	0.030	0.063
1956	0.024	0.060
1957	0.019	0.085
1958	0.022	0.054

1959	0.019	0.043
1960	0.033	0.082
1961	0.018	0.067
1962	0.011	0.043
1963	0.016	0.066
1964	0.022	0.058
1965	0.015	0.084
1966	0.014	0.050
1967	0.034	0.110
1968	0.019	0.092
1969	0.019	0.072
1970	0.015	0.069
1971	0.017	0.079
1972	0.037	0.102
1973	0.016	0.045
1974	0.018	0.079
1975	0.025	0.090
1976	0.018	0.065
1977	0.003	0.053
1978	0.015	0.065
1979	0.009	0.075
1980	0.043	0.134
1981	0.014	0.069
1982	0.028	0.126
1983	0.024	0.068
1984	0.014	0.053
1985	0.009	0.067
1986	0.038	0.078
1987	0.033	0.077
1988	0.013	0.042
1989	0.009	0.052
1990	0.080	0.215
1991	0.042	0.148
1992	0.017	0.057
1993	0.017	0.038
1994	0.006	0.035
1995	0.024	0.060
1996	0.056	0.113
1997	0.043	0.086
1998	0.011	0.062
1999	0.047	0.151
2000	0.017	0.074
2001	0.003	0.059
2002	0.019	0.100
2003	0.029	0.095
2004	0.031	0.137
2005	0.023	0.073
2006	0.026	0.069
2007	0.060	0.189
2008	0.074	0.143
2009	0.034	0.094

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.0798	0.2154
2	0.0735	0.1889
3	0.0603	0.1508

4	0.0559	0.1479
5	0.0481	0.1425
6	0.0473	0.1372
7	0.0431	0.1337
8	0.0430	0.1256
9	0.0423	0.1152
10	0.0378	0.1133
11	0.0365	0.1103
12	0.0343	0.1102
13	0.0338	0.1024
14	0.0333	0.1002
15	0.0332	0.0951
16	0.0311	0.0944
17	0.0301	0.0919
18	0.0299	0.0901
19	0.0291	0.0857
20	0.0279	0.0849
21	0.0259	0.0842
22	0.0254	0.0816
23	0.0250	0.0790
24	0.0242	0.0788
25	0.0241	0.0781
26	0.0239	0.0770
27	0.0231	0.0759
28	0.0221	0.0754
29	0.0216	0.0744
30	0.0195	0.0725
31	0.0195	0.0718
32	0.0190	0.0695
33	0.0187	0.0692
34	0.0185	0.0688
35	0.0185	0.0684
36	0.0183	0.0668
37	0.0180	0.0665
38	0.0179	0.0663
39	0.0173	0.0653
40	0.0169	0.0646
41	0.0168	0.0629
42	0.0168	0.0619
43	0.0162	0.0607
44	0.0156	0.0604
45	0.0151	0.0599
46	0.0151	0.0592
47	0.0149	0.0583
48	0.0147	0.0568
49	0.0144	0.0536
50	0.0141	0.0525
51	0.0135	0.0525
52	0.0132	0.0525
53	0.0122	0.0497
54	0.0114	0.0474
55	0.0106	0.0445
56	0.0091	0.0433
57	0.0087	0.0433
58	0.0085	0.0420
59	0.0057	0.0416
60	0.0030	0.0381
61	0.0026	0.0350

Duration Flows

The Duration Matching Failed

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0110	17096	47547	278	Fail
0.0115	15498	43612	281	Fail
0.0121	14074	40083	284	Fail
0.0126	12803	36832	287	Fail
0.0131	11567	33923	293	Fail
0.0137	10515	31313	297	Fail
0.0142	9580	28918	301	Fail
0.0147	8763	26693	304	Fail
0.0152	8046	24640	306	Fail
0.0158	7351	22843	310	Fail
0.0163	6737	21143	313	Fail
0.0168	6192	19609	316	Fail
0.0174	5728	18193	317	Fail
0.0179	5309	16871	317	Fail
0.0184	4924	15687	318	Fail
0.0189	4571	14643	320	Fail
0.0195	4239	13646	321	Fail
0.0200	3955	12728	321	Fail
0.0205	3645	11858	325	Fail
0.0211	3390	11067	326	Fail
0.0216	3133	10410	332	Fail
0.0221	2915	9779	335	Fail
0.0227	2701	9216	341	Fail
0.0232	2490	8665	347	Fail
0.0237	2316	8151	351	Fail
0.0242	2136	7659	358	Fail
0.0248	1973	7174	363	Fail
0.0253	1825	6765	370	Fail
0.0258	1702	6365	373	Fail
0.0264	1577	5972	378	Fail
0.0269	1442	5602	388	Fail
0.0274	1326	5285	398	Fail
0.0279	1233	5001	405	Fail
0.0285	1147	4727	412	Fail
0.0290	1086	4462	410	Fail
0.0295	1020	4211	412	Fail
0.0301	947	3989	421	Fail
0.0306	886	3777	426	Fail
0.0311	824	3604	437	Fail
0.0316	761	3420	449	Fail
0.0322	725	3230	445	Fail
0.0327	675	3056	452	Fail
0.0332	623	2917	468	Fail
0.0338	589	2774	470	Fail
0.0343	549	2642	481	Fail
0.0348	506	2507	495	Fail
0.0353	469	2398	511	Fail
0.0359	427	2280	533	Fail
0.0364	388	2182	562	Fail
0.0369	356	2094	588	Fail
0.0375	328	1987	605	Fail
0.0380	298	1903	638	Fail
0.0385	270	1812	671	Fail
0.0390	241	1723	714	Fail

0.0396	218	1639	751	Fail
0.0401	197	1578	801	Fail
0.0406	174	1496	859	Fail
0.0412	152	1445	950	Fail
0.0417	130	1371	1054	Fail
0.0422	119	1311	1101	Fail
0.0427	104	1250	1201	Fail
0.0433	95	1203	1266	Fail
0.0438	83	1153	1389	Fail
0.0443	74	1107	1495	Fail
0.0449	69	1058	1533	Fail
0.0454	61	1009	1654	Fail
0.0459	53	953	1798	Fail
0.0464	46	923	2006	Fail
0.0470	39	890	2282	Fail
0.0475	29	863	2975	Fail
0.0480	25	835	3340	Fail
0.0486	22	804	3654	Fail
0.0491	20	771	3855	Fail
0.0496	17	746	4388	Fail
0.0501	14	718	5128	Fail
0.0507	12	698	5816	Fail
0.0512	8	673	8412	Fail
0.0517	7	657	9385	Fail
0.0523	7	635	9071	Fail
0.0528	7	612	8742	Fail
0.0533	6	580	9666	Fail
0.0538	6	557	9283	Fail
0.0544	6	532	8866	Fail
0.0549	6	511	8516	Fail
0.0554	6	490	8166	Fail
0.0560	5	468	9360	Fail
0.0565	5	447	8940	Fail
0.0570	5	430	8600	Fail
0.0576	5	410	8200	Fail
0.0581	5	394	7880	Fail
0.0586	5	378	7560	Fail
0.0591	5	368	7360	Fail
0.0597	4	357	8925	Fail
0.0602	4	343	8575	Fail
0.0607	3	330	11000	Fail
0.0613	3	323	10766	Fail
0.0618	3	313	10433	Fail
0.0623	3	298	9933	Fail
0.0628	3	290	9666	Fail
0.0634	3	276	9200	Fail

The development has an increase in flow durations from 1/2 Predeveloped 2 year flow to the 2 year flow or more than a 10% increase from the 2 year to the 50 year flow.
The development has an increase in flow durations for more than 50% of the flows for the range of the duration analysis.

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
Total Volume Infiltrated		0.00	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   4332MI WWHM Analysis (without Detention).wdm
MESSU       25   Pre4332MI WWHM Analysis (without Detention).MES
            27   Pre4332MI WWHM Analysis (without Detention).L61
            28   Pre4332MI WWHM Analysis (without Detention).L62
            30   POC4332MI WWHM Analysis (without Detention)1.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        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    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#   ***
Basin***
PERLND  11                       0.33     COPY   501     12
PERLND  11                       0.33     COPY   501     13
Off-Site Basin***
PERLND  11                       0.41     COPY   501     12
PERLND  11                       0.41     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              PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1              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   4332MI WWHM Analysis (without Detention).wdm
MESSU       25   Mit4332MI WWHM Analysis (without Detention).MES
            27   Mit4332MI WWHM Analysis (without Detention).L61
            28   Mit4332MI WWHM Analysis (without Detention).L62
            30   POC4332MI WWHM Analysis (without Detention)1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      17
      IMPLND       4
      PERLND      11
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title---------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Basin (to detention)        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           ***
   17     C, Lawn, Mod            1    1    1    1   27    0
   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 ***
   17         0    0    1    0    0    0    0    0    0    0    0    0
   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  *********
   17         0    0    4    0    0    0    0    0    0    0    0    0    1    9
   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 ***
   17         0    0    0    0    0    0    0    0    0    0    0
   11         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
   17              0       4.5      0.03       400       0.1       0.5     0.996
   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
   17              0         0         2         2         0         0         0
   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 ***
   17            0.1      0.25      0.25         6       0.5      0.25
   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
   17              0         0         0         0       2.5         1         0
   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           ***
    4      ROOF TOPS/FLAT         1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

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

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

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

  IWAT-PARM2
```

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

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

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

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin (to detention)***
PERLND  17                        0.11     COPY   501     12
PERLND  17                        0.11     COPY   501     13
IMPLND   4                         0.1     COPY   501     15
Off-Site Basin (to detention)***
PERLND  11                        0.35     COPY   501     12
PERLND  11                        0.35     COPY   501     13
Basin Bypass***
PERLND  17                        0.09     COPY   501     12
PERLND  17                        0.09     COPY   501     13
IMPLND   4                        0.03     COPY   501     15
Off-Site Basin Bypass***
PERLND  11                        0.06     COPY   501     12
PERLND  11                        0.06     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              PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1              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
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

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


END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

Mitigated HSPF Message File

Disclaimer

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Local (360)943-0304

www.clearcreeksolutions.com

APPENDIX C

CITY OF MERCER ISLAND ON-SITE DETENTION REQUIREMENTS

CITY OF MERCER ISLAND

DEVELOPMENT SERVICES GROUP
9611 SE 36TH STREET | MERCER ISLAND, WA 98040
PHONE: 206.275.7605 | www.mercergov.org
Inspection Requests: Online: www.MyBuildingPermits.com VM: 206.275.7730

ON-SITE DETENTION DESIGN REQUIREMENTS

General Requirements

This guidance applies only to projects that meet the thresholds specified below in "Is On-site Detention Required for My Project?" if all of the on-site stormwater BMPs included on List #1 and List #2 are determined to be infeasible for roofs and/or other hard surfaces.

Is On-site Detention Required For My Project?

YES, if my project:

1) Results in 2,000 square feet, or greater, of new plus replaced hard surface area, or
2) Has a land disturbing activity or 7,000 square feet or greater, or
3) Results in a ***net increase*** of impervious surface of 500 square feet or greater.

AND

1) All of the on-site stormwater BMPs included on List #1 and List #2 are determined to be infeasible for roofs and/or other hard surfaces, and
2) Drainage from the site will be discharged to a storm and surface water system that includes a watercourse or there is a capacity constraint in the system.

NO, if my project:

1) Results in less than 2,000 square feet of new plus replaced hard surface area, and
2) Has a land disturbing activity less than 7,000 square feet, and
3) Results in a **net increase of less than 500 square feet** of impervious surface area.
4) The project discharges ***directly*** to Lake Washington, or findings from a ¼-mile downstream analysis confirm that the downstream system is free of capacity constraints.

Designing Your On-Site Detention System

All on-site detention system designs must be prepared by a professional engineer registered in the State of Washington. The Standard On-site Detention System worksheet (Attachment 1) must be submitted on 18" x 24" (minimum) size sheets.

Construction that results in 500 to 9,500 square feet of new plus replaced impervious surfaces: Size system according to Table 1. The configuration of the on-site detention system shall be as shown on Attachment 1 (Standard On-Site Detention Systems Worksheet) or as specifically designed by the engineer for the site.

Note:

- The applicant may pay a fee-in-lieu-of constructing an on-site detention system when allowed by the City Engineer. The fee will not be an option when in the opinion of the City Engineer, undetained runoff from the development may adversely exacerbate an existing problem (MICC 15.11) or if flow control is required by Minimum Requirement #7.
- **Construction that results in more than 9,500 square feet of new plus replaced impervious surfaces and/or exceeds a 100-year flow frequency of 0.15 cubic feet per second (for moderate and steep sloped sites greater than a 5% slope):** Size system according to Minimum Requirement #7 (Flow Control) in the Stormwater Management Manual for Western Washington (Ecology 2014).

Table 1

ON-SITE DETENTION DESIGN FOR PROJECTS BETWEEN 500 SF AND 9,500 SF NEW PLUS REPLACED IMPERVIOUS SURFACE AREA

New and Replaced Impervious Surface Area (sf)	Detention Pipe Diameter (in)	Detention Pipe Length (ft)		Lowest Orifice Diameter (in)[3]		Distance from Outlet Invert to Second Orifice (ft)		Second Orifice Diameter (in)	
		B soils	C soils	B soils	C soils	B soils	C soils	B soils	C soils
500 to 1,000 sf	36"	30	22	0.5	0.5	2.2	2.0	0.5	0.8
	48"	18	11	0.5	0.5	3.3	3.2	0.9	0.8
	60"	11	7	0.5	0.5	4.2	3.4	0.5	0.6
1,001 to 2,000 sf	36"	66	43	0.5	0.5	2.2	2.3	0.9	1.4
	48"	34	23	0.5	0.5	3.2	3.3	0.9	1.2
	60"	22	14	0.5	0.5	4.3	3.6	0.9	0.9
2,001 to 3,000 sf	36"	90	66	0.5	0.5	2.2	2.4	0.9	1.9
	48"	48	36	0.5	0.5	3.1	2.8	0.9	1.5
	60"	30	20	0.5	0.5	4.2	3.7	0.9	1.1
3,001 to 4,000 sf	36"	120	78	0.5	0.5	2.4	2.2	1.4	1.6
	48"	62	42	0.5	0.5	2.8	2.9	0.8	1.3
	60"	42	26	0.5	0.5	3.8	3.9	0.9	1.3
4,001 to 5,000 sf	36"	134	91	0.5	0.5	2.8	2.2	1.7	1.5
	48"	73	49	0.5	0.5	3.6	2.9	1.6	1.5
	60"	46	31	0.5	0.5	4.6	3.5	1.6	1.3
5,001 to 6,000 sf	36"	162	109	0.5	0.5	2.7	2.2	1.8	1.6
	48"	90	59	0.5	0.5	3.5	2.9	1.7	1.5
	60"	54	37	0.5	0.5	4.6	3.6	1.6	1.4
6,001 to 7,000 sf	36"	192	128	0.5	0.5	2.7	2.2	1.9	1.8
	48"	102	68	0.5	0.5	3.7	2.9	1.9	1.6
	60"	64	43	0.5	0.5	4.6	3.6	1.8	1.5
7,001 to 8,000 sf	36"	216	146	0.5	0.5	2.8	2.2	2.0	1.9
	48"	119	79	0.5	0.5	3.8	2.9	2.2	1.7
	60"	73	49	0.5	0.5	4.5	3.6	2.0	1.6
8,001 to 8,500 sf[1]	36"	228	155	0.5	0.5	2.8	2.2	2.1	1.9
	48"	124	84	0.5	0.5	3.7	2.9	1.9	1.8
	60"	77	53	0.5	0.5	4.6	3.6	2.0	1.6
8,501 to 9,000 sf	36"	NA [1]	164	0.5	0.5	NA [1]	2.2	NA [1]	1.9
	48"	NA [1]	89	0.5	0.5	NA [1]	2.9	NA [1]	1.9
	60"	NA [1]	55	0.5	0.5	NA [1]	3.6	NA [1]	1.7
9,001 to 9,500 sf[2]	36"	NA [1]	174	0.5	0.5	NA [1]	2.2	NA [1]	2.1
	48"	NA [1]	94	0.5	0.5	NA [1]	2.9	NA [1]	2.0
	60"	NA [1]	58	0.5	0.5	NA [1]	3.7	NA [1]	1.7

Notes:

▪ Minimum Requirement #7 (Flow Control) is required when the 100-year flow frequency causes a 0.15 cubic feet per second increase (when modeled in WWHM with a 15-minute timestep). Breakpoints shown in this table are based on a flat slope (0-5%). The 100-year flow frequency will need to be evaluated on a site-specific basis for projects on moderate (5-15%) or steep (> 15%) slopes.

▪ Soil type to be determined by geotechnical analysis or soil map.

▪ Sizing includes a Volume Correction Factor of 120%.

▪ Upper bound contributing area used for sizing.

[1] On Type B soils, new plus replaced impervious surface areas exceeding 8,500 sf trigger Minimum Requirement #7 (Flow Control)

[2] On Type C soils, new plus replaced impervious surface areas exceeding 9,500 sf trigger Minimum Requirement #7 (Flow Control)

[3] Minimum orifice diameter = 0.5 inches

in = inch

ft = feet

sf = square feet

Basis of Sizing Assumptions:

Sized per MR#5 in the Stormwater Management Manual for Puget Sound Basin (1992 Ecology Manual)

SBUH, Type 1A, 24-hour hydrograph

2-year, 24-hour storm = 2 in; 10-year, 24-hour storm = 3 in; 100-year, 24-hour storm = 4 in

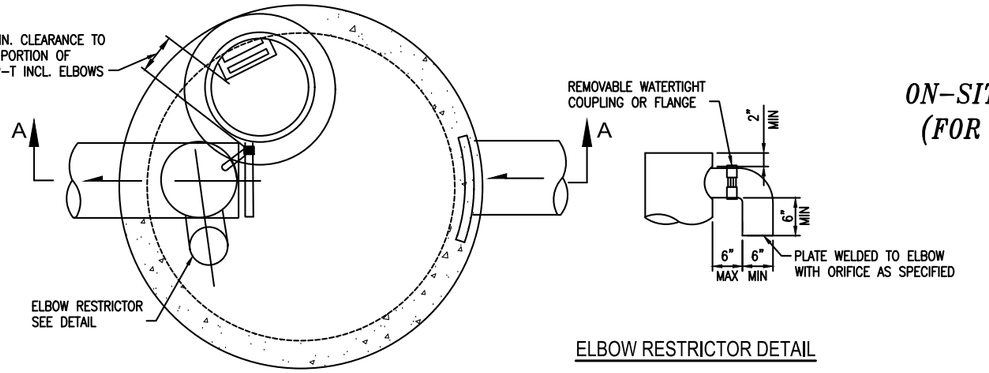
Predeveloped = second growth forest (CN = 72 for Type B soils, CN = 81 for Type C soils)

Developed = impervious (CN = 98)

0.5 foot of sediment storage in detention pipe

Overland slope = 5%

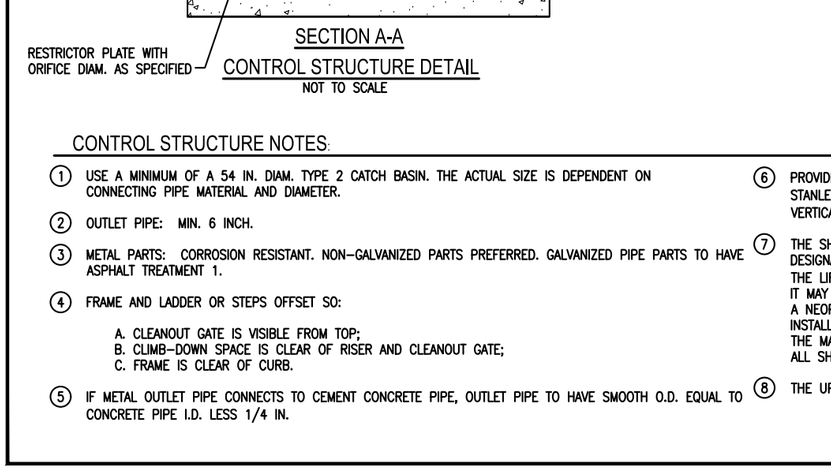
ATTACHMENT 1
CITY OF MERCER ISLAND
ON-SITE DETENTION SYSTEM WORKSHEET
(FOR NEW PLUS REPLACED IMPERVIOUS AREA OF 9,500 SF OR LESS)



PLAN VIEW

ELBOW RESTRICTOR DETAIL

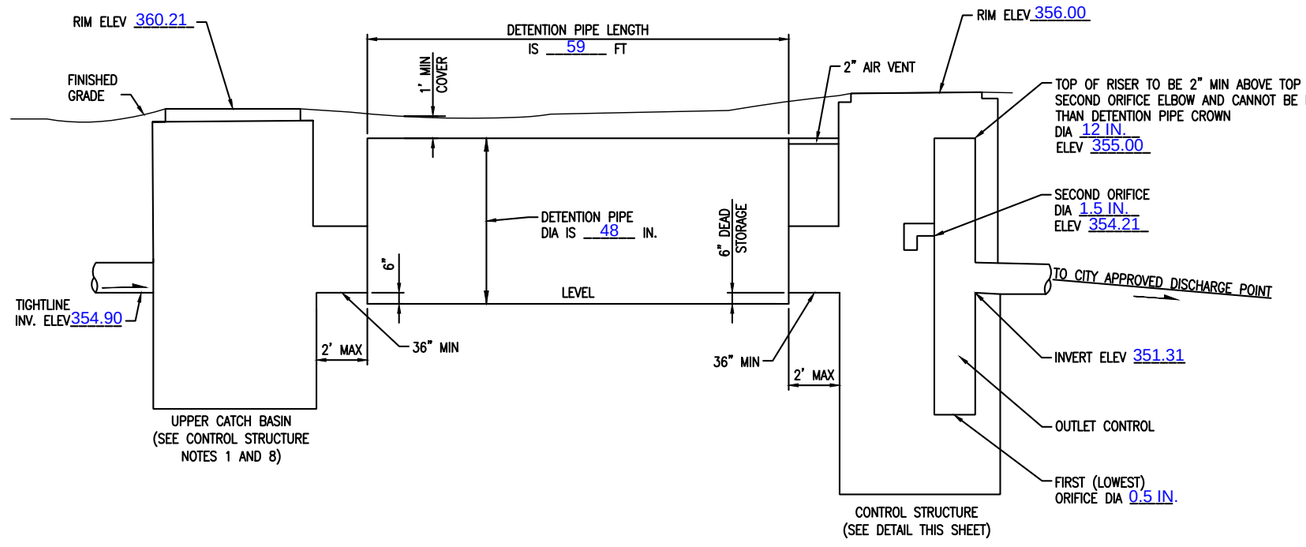
OWNER: EB #5, LLC	ADDRESS: 4332 86TH AVENUE SE	PREPARED BY: WINE ENGINEERING, PLLC	
PERMIT #:	MERCER ISLAND, WA 98040	PHONE: (864) 520-6130	
		DATE: OCTOBER 21, 2025	
NEW PLUS REPLACED IMPERVIOUS SURFACE AREA (SF): 5,469	DETENTION PIPE DIA (INCH): 48	DETENTION PIPE LENGTH (FT): 59	ORIFICE #1 DIA 0.5 INCH, ELEV 351.31
SOIL TYPE: QUATERNARY VASHON TILL (Qvt)	PIPE MATERIAL: LCPE		ORIFICE #2 DIA 1.5 INCH, ELEV 354.21



SECTION A-A

CONTROL STRUCTURE DETAIL

NOT TO SCALE



ON-SITE DETENTION SYSTEM

NOT TO SCALE (ENGINEER TO FILL IN BLANKS)

CONTROL STRUCTURE NOTES:

1. USE A MINIMUM OF A 54 IN. DIAM. TYPE 2 CATCH BASIN. THE ACTUAL SIZE IS DEPENDENT ON CONNECTING PIPE MATERIAL AND DIAMETER.
2. OUTLET PIPE: MIN. 6 INCH.
3. METAL PARTS: CORROSION RESISTANT. NON-GALVANIZED PARTS PREFERRED. GALVANIZED PIPE PARTS TO HAVE ASPHALT TREATMENT 1.
4. FRAME AND LADDER OR STEPS OFFSET SO:
   A. CLEANOUT GATE IS VISIBLE FROM TOP;
   B. CLIMB-DOWN SPACE IS CLEAR OF RISER AND CLEANOUT GATE;
   C. FRAME IS CLEAR OF CURB.
5. IF METAL OUTLET PIPE CONNECTS TO CEMENT CONCRETE PIPE, OUTLET PIPE TO HAVE SMOOTH O.D. EQUAL TO CONCRETE PIPE I.D. LESS 1/4 IN.
6. PROVIDE AT LEAST ONE 3 X 0.090 GAUGE SUPPORT BRACKET ANCHORED TO CONCRETE WALL WITH 5/8 IN. STANLESS STEEL EXPANSION BOLTS OR EMBEDDED SUPPORTS 2 IN. INTO CATCH BASIN WALL (MAXIMUM 3'-0" VERTICAL SPACING).
7. THE SHEAR GATE SHALL BE MADE OF ALUMINUM ALLOY IN ACCORDANCE WITH ASTM B 26M AND ASTM B 275, DESIGNATION ZG32A; OR CAST IRON IN ACCORDANCE WITH ASTM A 48, CLASS 30B.
   THE LIFT HANDLE SHALL BE MADE OF A SIMILAR METAL TO THE GATE (TO PREVENT GALVANIC CORROSION), IT MAY BE OF SOLID ROD OR HOLLOW TUBING, WITH ADJUSTABLE HOOK AS REQUIRED.
   A NEOPRENE RUBBER GASKET IS REQUIRED BETWEEN THE RISER MOUNTING FLANGE AND THE GATE FLANGE.
   INSTALL THE GATE SO THAT THE LEVEL-LINE MARK IS LEVEL WHEN THE GATE IS CLOSED.
   THE MATING SURFACES OF THE LID AND THE BODY SHALL BE MACHINED FOR PROPER FIT.
   ALL SHEAR GATE BOLTS SHALL BE STAINLESS STEEL.
8. THE UPPER CATCH BASIN IS REQUIRED IF THE LENGTH OF THE DETENTION PIPE IS GREATER THAN 50 FT.

ON-SITE DETENTION SYSTEM NOTES:

1. CALL DEVELOPMENT SERVICES (206-275-7605) 24 HOURS IN ADVANCE FOR A DETENTION SYSTEM INSPECTION BEFORE BACKFILLING AND FOR FINAL INSPECTIONS.
2. RESPONSIBILITY FOR OPERATION AND MAINTANANCE OF DRAINAGE SYSTEMS ON PRIVATE PROPERTY IS RESPONSIBILITY OF THE PROPERTY OWNER. MATERIAL ACCUMULATED IN THE STORAGE PIPE MUST BE REMOVED FROM CATCH BASINS TO ALLOW PROPER OPERATION. THE OUTLET CONTROL ORIFICE MUST BE KEPT OPEN AT ALL TIMES.
3. PIPE MATERIAL, JOINT, AND PROTECTIVE TREATMENT SHALL BE IN ACCORDANCE WITH SECTION 7.04 AND 9.05 OF THE WSDOT STANDARD SPECIFICATION FOR ROAD, BRIDGE, AND MUNICIPAL CONSTRUCTION, LATEST VERSION. SUCH MATERIALS INCLUDE THE FOLLOWING, LINED CORRUGATED POLYETHYLENE PIPE (LCPE), ALUMINIZED TYPE 2 CORRUGATED STEEL PIPE AND PIPE ARCH (MEETS AASHTO DESIGNATIONS M274 AND M36), CORRUGATED OR SPIRAL RIB ALUMINUM PIPE, OR REINFORCED CONCRETE PIPE. CORRUGATED STEEL PIPE IS NOT ALLOWED.
4. FOOTING DRAINS SHALL NOT BE CONNECTED TO THE DETENTION SYSTEM.

APPENDIX D

CONSTRUCTION STORMWATER POLLUTION PREVENTION PLAN

Construction Storm Water Pollution Prevention Plan (CSWPPP)

PROJECT NUMBER:	25-0018.01
PROJECT NAME:	4332 86th Avenue SE
PROJECT ADDRESS:	4332 86th Avenue SE Mercer Island, Washington 98040

PREPARED FOR:	
APPLICANT NAME:	EB #5, LLC
APPLICANT ADDRESS:	4044 148th Avenue NE Redmond, Washington 98052
APPLICANT TELEPHONE:	(206) 351-7801
APPLICANT EMAIL ADDRESS:	kevin@cadehillhomes.com

PREPARED BY:	
ENGINEER NAME:	Garrett Wine, PE
ENGINEER FIRM:	Wine Engineering, PLLC
ENGINEER ADDRESS:	Post Office Box 34334 Las Vegas, Nevada 89133
ENGINEER TELEPHONE:	(864) 520-6130
ENGINEER EMAIL ADDRESS:	garrett@winecivil.com

Construction Stormwater Pollution Prevention Plan Checklist

Project Name: 4332 86th Avenue SE

Date: December 31, 2025

Section I - Construction SWPPP Narrative

1. Construction Stormwater Pollution Prevention Elements

13 Elements - Construction Stormwater Pollution Prevention Plan

1. Mark Clearing Limits – Clearing limits shall be defined by a combination of high visibility fencing, tree protection fencing, and silt fencing encircling the project site as demonstrated on Sheet C3 - Demolition & TESC Plan. Tree protection fencing shall be installed in accordance with the plans and arborist recommendations for the site. High visibility fence shall be installed in accordance with WSDOT Standard Plan I.10.10-01, and silt fence shall be installed in accordance with WSDOT Standard Plan I-30.15-02. Please reference the Details sheets included in the civil engineering plan set for the project (under separate cover). No land disturbing activities shall occur on adjacent parcels.
2. Establish Construction Access – A stabilized construction entrance shall be installed in accordance with WSDOT Standard Plan I-80.10-02 as demonstrated on the plans. In the event sediment is tracked off-site during construction activities, the contractor shall remove sediment from the off-site roadways via sweeping or similar means and methods. Sediment shall not be washed into the storm drainage network.
3. Control Flow Rates – Silt fencing shall be installed along the perimeter to control and filter stormwater runoff.
4. Install Sediment Controls – Silt fencing is proposed around the perimeter of the disturbed area (limits of disturbance) within the private property. Storm drainage inlet protection is proposed for the existing and proposed catch basins in the vicinity of the project site.
5. Stabilize Soils – Temporary stockpiles shall be covered with plastic sheeting in accordance with the Temporary Stockpile detail provided on Sheet C7 – Details (Sheet 1 of 5).
6. Protect Slopes – Silt fencing is proposed along the perimeter of the property to protect adjacent properties. Existing areas on-site shall be stabilized via straw, mulch, or other approved means to protect slopes on-site. Additional BMPs such as check dams or straw wattles may be implemented during construction as site conditions dictate.
7. Protect Drain Inlets – Storm drainage inlet protection is proposed for the existing and proposed catch basins in the vicinity of the project site.
8. Stabilize Channels and Outlets – Areas of land disturbance within the existing roadside drainage swale along 86th Avenue SE shall be fully stabilized as part of the proposed construction activities to a condition equal to or better than the existing condition prior to construction.
9. Control Pollutants – Waste materials shall be removed from the site and disposed of

in accordance with local, state, and federal requirements. Storm drain projection inserts shall be installed and maintained throughout the duration of the project to minimize the potential for contamination of stormwater. Paint shall be stored under cover (such as locked in the house with good ventilation). Fueling for construction equipment is anticipated to be completed by truck with no on-site storage of fuels. Lighting shall be provided for any fueling activities occurring at night. Plastic sheeting shall be used in the event maintenance or repairs are required to construction equipment on-site. A spill kit shall be maintained on-site throughout the duration of the project. Contractor shall adhere to manufacturer's recommendations for the application of any chemicals or fertilizers which may be required as part of the project. Contractor shall provide a temporary lined sump for concrete washout activities. Concrete waste shall be removed from the site once dry.

10. Control De-Watering - If dewatering is necessary, pump discharge shall be directed to the existing drainage swale along 86th Avenue SE. The contractor shall coordinate with the City of Mercer Island Public Works Department field inspector prior to beginning dewatering discharge.
11. Maintain BMPs – Monitor the BMPs on a regular frequent basis throughout the duration of construction. Repair, replace, or implement additional BMPs as site conditions dictate until final stabilization is achieved. Remove temporary BMPs following final stabilization.
12. Manage the Project – Schedule, document, and track work being completed by contractors and materials being utilized on the project site.
13. Protect Low Impact Development BMPs – No LID BMPs are proposed as part of this project.

2. Project Description

The project includes the demolition and removal of the existing single-family residential dwelling, outbuildings (shed, gazebo), driveway, and concrete pathways / patios. Proposed improvements consist of the construction of a new single-family home with a concrete driveway, concrete patio, pedestrian pathway to the front porch, and lawn/landscape areas. The project also proposes to remove and replace the existing drainage culvert beneath the existing driveway as part of the improvements.

1. Total project area: 13,056 SF (0.30 AC) – excludes right-of-way (ROW) restoration area
2. Total proposed impervious area: 5,469 SF (0.13 AC) including ROW restoration
3. Total proposed area to be disturbed: 14,374 SF (0.33 AC)
4. Total volumes of proposed cut and fill: Cut: 95 CY, Fill: 167 CY, Net: 72 CY (fill)

3. Existing Site Conditions

The Basin encompasses 0.33-acre of surface area which includes the entire project site as well as the portion of the 86th Avenue SE right-of-way that is anticipated to be disturbed as part of the proposed improvements. Land use at the project site includes 0.14-acre of impervious area comprised of the existing single-family residence, concrete driveway, concrete patio, pathways, and the impervious portion of 86th Avenue SE that is proposed to be disturbed by the project. The remaining 0.19-acre is comprised of yard areas, which consists of lawn and landscaped spaces surrounding the existing residence and the vegetated portion of the 86th Avenue SE right-of-way, please reference the Existing Conditions Land Use Exhibit. The existing residence has a roof gutter system which collects runoff from the roof and discharges it to the existing ground surface via splash blocks. Runoff from the project site flows from the southeastern portion of the property via overland flow across hard surfaces and through landscape / lawn areas surrounding the residence prior to discharging to the 86th Avenue SE right-of-way and onto the neighboring residential parcel to the north. The analysis point has been demonstrated in the flow line of the existing roadside drainage swale north of the proposed culvert outfall.

4. Adjacent Areas

The project site is bound to the north and east by existing single-family homes, to the south by a vacant parcel zoned for residential use, and to the west by 86th Avenue SE. The vacant parcel to the south, and the vegetated areas of the residential properties located to the east and southeast of the project site direct runoff onto the eastern portion of the subject property via overland flow. The residential property to the north is located downgradient of the project site. 86th Avenue SE is a crowned two-lane paved roadway with a roadside drainage swale along the eastern edge, and limited pavement markings. 86th Avenue SE is located downstream of the project site, and no stormwater runoff from 86th Avenue SE right-of-way flows onto the project site. There is an existing 12-inch diameter culvert that extends beneath the existing driveway serving the project site. The roadside drainage swale is well vegetated, approximately two (2) feet deep with steep side slopes, and a running slope of approximately 2.70% along the project's frontage.

5. Critical Areas

There are no critical areas on or adjacent to the project site.

6. Soils

Per the Geotechnical Engineering Evaluation prepared by Nelson Geotechnical Associates, Inc. soils located at the project site were observed to include:

- At the surface of all explorations, NGA encountered 1.0 to 3.0 feet of surficial topsoil and/or undocumented fill
- Underlying the topsoil and/or undocumented fill in each of the explorations , NGA encountered medium dense to dense, brown-gray to gray, silty, fine to medium sand with gravel, which was interested as native glacial till soils.
- Geologic map identifies Quarternary Vashon till (Q_{vt}) across the subject property and surrounding areas.

Please reference Appendix A of the Storm Drainage Report for the Geotechnical Engineering Evaluation by Nelson Geotechnical Associates, Inc.

7. Erosion Problem Areas

There are no existing known erosion problems at the project site. BMPs shall be implemented during construction to minimize the potential for off-site sedimentation and to filter runoff from the development. Monitor and maintain proposed BMPs throughout the duration of construction and implement additional measures as site conditions dictate.

8. Construction Phasing

Construction Sequence:

1. Conduct pre-construction meeting.
2. Flag or fence clearing limits.
3. Post sign with name and phone number of TESC supervisor
4. Install catch basin protection downstream and as directed by the city inspector.
5. Grade and install construction entrance.
6. Install perimeter sediment controls (silt fence, etc.)
7. Construction surface water controls simultaneously with clearing and grading for the project.
8. Maintain erosion and sediment control measures in accordance with manufacturer's recommendations.
9. Relocate erosion and sediment control measures or install new measures as site conditions dictate.
10. Cover disturbed areas within the specified time frame with straw, wood fiber mulch, compost, plastic sheeting, crushed rock, or equivalent measure.
11. Stabilize areas that reach final grade within 7 days. Seed or stabilize areas to remain unworked for more than 30 days.
12. Upon completion of the project, all disturbed areas shall be stabilized and best management practices shall be removed.

9. Construction Schedule

Contractor shall provide a construction schedule, including any construction activities which may take place during the wet season. Construction schedule currently TBD.

10. Financial/Ownership Responsibilities

Property owner responsible for the initiation of any and all bonds and/or financial securities for the project, including financial responsibility for liability associated with erosion and sedimentation impacts: EB #5, LLC and/or assigns.

11. Engineering Calculations

Provide Design Calculations for the following:

- Sediment Ponds/traps: Not Applicable
- Diversions: Not Applicable
- Waterways: Not Applicable
- Runoff/Stormwater Detention Calculations: See Appendix B of the Storm Drainage Report for the WWHM 2012 stormwater calculations. The project does not meet the thresholds that trigger flow control per the DOE Manual; however, a 48-inch diameter

detention tank is proposed on the south side of the project in accordance with the City of Mercer Island On-Site Detention requirements. Please reference Appendix C of the Storm Drainage Report for the annotated City of Mercer Island On-Site Detention requirements for the project.

Section II – Temporary Erosion and Sediment Control (TESC) Plans

Please reference the civil engineering plan set (under separate cover) in support of the proposed development for TESC measures and proposed BMPs.

APPENDIX E

OPERATIONS AND MAINTENANCE

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 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.17: Maintenance Standards - Coalescing Plate Oil/Water Separators

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Monitoring	Inspection of discharge water for obvious signs of poor water quality.	Effluent discharge from vault should be clear without thick visible sheen.
	Sediment Accumulation	Sediment depth in bottom of vault exceeds 6-inches in depth and/or visible signs of sediment on plates.	No sediment deposits on vault bottom and plate media, which would impede flow through the vault and reduce separation efficiency.
	Trash and 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.
	Oil Accumulation	Oil accumulation that exceeds 1-inch at the water surface.	Oil is extracted from vault using vactoring methods. Coalescing plates are cleaned by thoroughly rinsing and flushing. Should be no visible oil depth on water.
	Damaged Coalescing Plates	Plate media broken, deformed, cracked and/or showing signs of failure.	A portion of the media pack or the entire plate pack is replaced depending on severity of failure.
	Damaged Pipes	Inlet or outlet piping damaged or broken and in need of repair.	Pipe repaired and or replaced.
	Baffles	Baffles corroding, cracking, warping and/or showing signs of failure as determined by maintenance/inspection person.	Baffles repaired or replaced to specifications.
	Vault Structure Damage - 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.
	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.

Table V-A.18: Maintenance Standards - Catch Basin Inserts

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Sediment Accumulation	When sediment forms a cap over the insert media of the insert and/or unit.	No sediment cap on the insert media and its unit.
	Trash and Debris Accumulation	Trash and debris accumulates on insert unit creating a blockage/restriction.	Trash and debris removed from insert unit. Runoff freely flows into catch basin.
	Media Insert Not Removing Oil	Effluent water from media insert has a visible sheen.	Effluent water from media insert is free of oils and has no visible sheen.
	Media Insert Water Saturated	Catch basin insert is saturated with water and no longer has the capacity to absorb.	Remove and replace media insert
	Media Insert-Oil Saturated	Media oil saturated due to petroleum spill that drains into catch basin.	Remove and replace media insert.
	Media Insert Use Beyond Product Life	Media has been used beyond the typical average life of media insert product.	Remove and replace media at regular intervals, depending on insert product.

Table V-A.19: Maintenance Standards - Media Filter Drain (MFD)

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Sediment accumulation on grass filter strip	Sediment depth exceeds 2 inches or creates uneven grading that interferes with flow.	Remove sediment deposits on grass treatment area of the embankment. When finished, embankment should be level from side to side and drain freely toward the toe of the embankment slope. There shall be no areas of standing water once inflow has ceased.
	No-vegetati	Flow spreader is uneven or clogged so that flows are not uniformly distributed over entire embankment width.	Level the spreader and clean to spread flows evenly over entire embankment width.