DRAINAGE MEMORANDUM – REV 1

TO: City of Mercer Island

FROM: Ben Iddins, P.E.

DATE: June 5, 2020

RE: 3440 97th Ave SE, Mercer Island, WA
On-site Drainage System Design Summary

Digitally signed by Benjamin J. Iddins
Date: 2020.06.05 12:50:58 -07'00'

This memorandum summarizes the drainage system design in accordance with the 2012 edition of the Washington State Department of Ecology Stormwater Management Manual for Western Washington (as amended in 2014) and the City of Mercer Island Drainage Requirements (the combination of which is hereafter referred to as "the Manual").

1 PROJECT SUMMARY

The site at 3440 97th Ave SE on Mercer Island totals 9,146 square feet and will be developed with a single-family residence with an attached garage. The site is currently a vacant vegetated lot with a few large trees. All but one existing tree will be protected to remain. The site is accessed off 97th Ave SE via an existing asphalt driveway which will be replaced for utility installation. The total new plus replaced impervious surfaces is 4,651 square feet. See TABLE 1 for a summary of land cover calculations and Attachment A for photos of the existing site. A summary of the onsite soils is included in the following sections. Since the project will add greater than 2,000 SF but less than 5,000 SF of new plus replaced impervious surfaces, it is subject to Minimum Requirements 1 through 5 as outlined in Section I-2.4, Figure 2.4.2 of The Manual.

TABLE 1 **Land Cover Summary**

		Area (SF)	Area (acres)
Existing Conditions	Pervious Surface (landscape and trees)	9,146	.210
	Impervious Surface (adjacent property driveway)	1,096	.025
Developed Conditions	House	2,665	.061
	Driveway	890	.020
	Driveway on Adjacent Property	1,096	.025
	Total New Plus Replaced Impervious Surfaces	4,651	.106
	Total Impervious Surface	4,651	.106
	Pervious Surface (landscaping and trees)	5,591	.128

The areas in TABLE 1 were determined by area measurements in AutoCAD from a topographic survey. As shown in TABLE 1, the developed site total impervious surfaces are 4,651 SF, all of which are new and replaced impervious surfaces.

2 DRAINAGE SYSTEM

The onsite stormwater system is comprised of Type 1 catch basins, a 12" area drain, 4" and 6" SDR35 PVC pipe, 10" DI pipe, a duplex stormwater pump station, 36" CMP storage pipe, and a perforated PVC D2729 footing drain pipe. Stormwater runoff from the driveway will be collected by a Type 1 catch basin and routed to a duplex pump station located on the northeast side of the proposed residence. Likewise, runoff from the roof of the proposed residence will be routed to the duplex pump station. Any stormwater collected within the building footing drains will be routed to a 12" area drain with a 2' sump for the settlement of fines and then routed to the duplex pump station. The stormwater pump station was sized to handle 100-year flow according to WWHM2012. See Attachment C for the WWHM report and associated pump sizing calculations. The pump station is connected to a storage system that is designed to hold 25% of the total runoff volume for the 2 year, 24 hour design storm. The project site is located in an area with a 2 year, 24 hour storm of .2 inches per Figure III-B.1 of the manual. 25% of the 0.2 inch storm applied over the site area results in a storage volume of $(0.25) * 2in * \left(\frac{1ft}{12in}\right) * 3{,}555\ sf = 148\ CF$. A 21' long 36" diameter storage tank is provided for the pump station which holds 148 CF. See the Drainage Plan in Attachment B for additional details on the proposed drainage system.

3 LEVEL 1 DOWNSTREAM ANALYSIS

Per the Manual, development projects that discharge stormwater offsite shall submit an offsite analysis report that assesses the potential off-site water quality, erosion, slope stability, and drainage impacts associated with the project and the appropriate mitigation of those impacts up to 1/4 miles downstream of the site. Since this development is discharging stormwater offsite, a downstream analysis has been provided. See Attachment E for additional details on the downstream analysis.

4 MINIMUM REQUIREMENTS

Since the project will add less than 5,000 SF of new plus replaced impervious surfaces, it is subject to Minimum Requirements #1 through 5 (MR#1-5). The Project meets MR#1-5 as follows:

4.1 MINIMUM REQUIREMENT #1 – STORMWATER SITE PLANS

The Stormwater Site Plan was prepared in accordance with Volume 1 Chapter 3 of the Stormwater Manual and includes the minimum requirements applicable to the subject site based on thresholds of new and replaced site impervious coverage.

4.2 MINIMUM REQUIREMENT #2 – CONSTRUCTION STORMWATER POLLUTION PREVENTION

The Construction Stormwater Pollution Prevention Plan (SWPP) was prepared in accordance with Volume 1 Chapter 2 Section 2.5.2 of the Stormwater Manual and is described below in Section 6 of this report. The Temporary Erosion and Sediment Control Plan (TESC Plan) can be seen in in the Project Plans submitted under separate cover and serves as a guide for the contractor to implement a final TESC Plan. As the site disturbance is less than one acre, a Stormwater Permit is not required.

4.3 MINIMUM REQUIREMENT #3 – SOURCE CONTROL

The proposed catch basin and area drains with sumps, cleanouts, and stormwater pump station serve as source control of pollution on the project site. In order to control pollutants, proper maintenance and cleaning of debris, sediment, and oil from stormwater collection and conveyance systems is required per the operation and maintenance recommendations found in Volume 5 Section 4.6 of the Stormwater Manual in addition to the BMPs in Volume IV Section 2.2. See Attachment F for operation and maintenance requirements pertaining to the project.

4.4 MINIMUM REQUIREMENT #4 – PRESERVATION OF NATURAL DRAINAGE SYSTEMS AND OUTFALLS

The proposed drainage system will emulate the natural pre-developed conditions of the site (i.e., forested conditions) as much as possible as a portion of the undisturbed natural vegetation on the site will remain undisturbed. Stormwater discharged from the site will connect to the public drainage system within 97th Ave SE which eventually drains to Lake Washington, thus maintaining the natural drainage course from the site.

4.5 MINIMUM REQUIREMENT #5 – ON-SITE STORMWATER MANAGEMENT

The On-Site Stormwater Management requirements applicable to this project were determined using List #1. The project complies with List #1 as described below.

<u>Lawn and landscaped areas:</u>

All disturbed pervious surfaces will be amended in accordance with the Post-Construction Soil Quality and Depth requirements as listed under BMP T5.13 in Chapter 5 of Volume V.

Roof:

1. Full Dispersion is infeasible because the required vegetated flowpath is not available. Downspout Full Infiltration is infeasible because the site is mapped within the "Infiltrating LID facilities are not permitted" area according to Figure 3: Low Impact Development Infiltration Feasibility on Mercer Island Map, which is available online.
2. Bioretention or rain garden facilities are infeasible because the site is mapped within the "Infiltrating LID facilities are not permitted" area according to Figure 3: Low Impact Development Infiltration Feasibility on Mercer Island Map, which is available online.
3. Downspout Dispersion Systems is infeasible because the required vegetated flowpath is not available onsite.
4. Perforated Stub-out Connections is infeasible because the site is mapped within the "Infiltrating LID facilities are not permitted" area according to Figure 3: Low Impact Development Infiltration Feasibility on Mercer Island Map, which is available online.
5. On-site detention is not required for this project since the downstream drainage system does not include a watercourse (the downstream drainage system is comprised entirely of manmade elements until the outfall to Lake Washington; see the downstream analysis in Attachment E), a capacity problem was not identified in the conveyance system, and the entire downstream drainage system remains in the public right-of-way from the project site to the discharge location to Lake Washington.

Other Hard Surfaces:

1. Full dispersion is infeasible because the required vegetated flowpath is not available onsite.
2. Permeable pavement, rain gardens, and bioretention are infeasible because the site is mapped within the "Infiltrating LID facilities are not permitted" area according to Figure 3: Low Impact Development Infiltration Feasibility on Mercer Island Map, which is available online.
3. Sheet flow dispersion and concentrated flow dispersion are infeasible because the required vegetated flowpath is not available onsite due to the steep slope ECA downgradient of the site.
4. On-site detention is not required for this project since the downstream drainage system does not include a watercourse (the downstream drainage system is comprised entirely of manmade elements until the outfall to Lake Washington; see the downstream analysis in Attachment E) and a capacity problem was not identified in the conveyance system.

Therefore, the proposed Post-Construction Soil Quality and Depth requirements as listed under BMP T5.13 satisfies MR#5.

5 SOILS

A soils investigation was completed by Earth Solutions NW LLC, on September 12, 2018. Three test pits were excavated to maximum exploration depth of approximately 9 feet below the existing ground surface. Boring locations and details are summarized in the Geotechnical Report attached as Attachment D.

Subsurface exploration generally encountered silty silt fill at each test pit location extending to approximate depths of one to four feet below existing grade. The fill was characterized as loose to medium dense and encountered primarily in a moist condition. The top soil and fill can be categorized as USCS: ML. The native soils were observed from depths of two to nine feet below the existing grade in primarily moist conditions. The underlying native conditions encountered during the excavation van be categorized as glacial till. The till is characterized as a compact diamict of silt, sand, and sub-rounded to well-rounded gravel.

Based on the results of the subsurface study, it is the recommendation of the geotechnical engineer that the soil conditions at the site are not suitable for storm water infiltration. This is due to the high density and appreciable fines content of the native soils which will severely restrict the performance of any infiltration facility.

Additionally, the site is mapped within the "Infiltrating LID facilities are not permitted" area according to Figure 3: Low Impact Development Infiltration Feasibility on the City of Mercer Island's online map.

6 Construction Stormwater Pollution Prevention Plan (SWPP)

The SWPP was prepared in accordance with The Manual. An Erosion and Sediment Control Plan is required per The Manual. Erosion and sediment control (ESC) measures were designed for the project and are shown on the TESC plan submitted under separate cover. Both the SWPP and TESC Plan serve as guides as the contractor is required to design a working TESC plan for the site. The TESC is submitted under separate cover.

Element 1: Preserve Vegetation/Mark Clearing Limits
BMPs used:

- BMP C103: High Visibility Fence
- BMP C233: Silt Fence

High visibility fence will be placed around the site to mark the clearing limits, which is shown on the TESC Plan, and silt fence will be placed around the low points of the perimeter of the site.
Element 2: Establish Construction Access
BMPs used:

- BMP C105: Stabilize Construction Entrance/Exit

The project site will have one construction access connecting to 97TH Ave SE. The contractor shall install a temporary construction entrance made from quarry spalls. 97th Ave SE will be swept daily, or as needed, to remove sediment tracked from the project site.
Element 3: Control Flow Rates
BMPs used:

- BMP C235: Wattles

If necessary, the contractor will implement compost socks and/or straw wattles to control flow rates and disperse stormwater.
Element 4: Install Sediment Controls
BMPs used:

- BMP C233: Silt Fence
- BMP C235: Wattles

Silt fencing or straw wattles will be placed along the low points of the perimeter of the construction site to prevent sediment from escaping downstream of the site.

Element 5: Stabilize Soils

BMPs used:

- BMP C121: Mulching
- BMP C140: Dust Control

Mulch will be used by the contractor whenever soils will be left exposed for a significant amount of time or whenever a rainfall event is anticipated. During summer months water will be sprinkled on the site as needed to minimize the amount of dust coming off the site.

Element 6: Protect Slopes

BMPs used:

- BMP C121 Mulching

Mulch will be added to soils on significant slopes to provide temporary protection from erosion.

Element 7: Protect Drain Inlets

BMPs used:

- BMP C220: Storm Drain Inlet Protection

Temporary catch basin inlet protection on all existing catch basins adjacent to the site will be implemented to prevent sediment from entering the drainage system.

Element 8: Stabilize Channels and Outlets

N/A. There are no existing roadside ditches and channels which require stabilization

Element 9: Control Pollutants

BMPs used:

- BMP C153: Material Delivery, Storage and Containment
- BMP C154: Concrete Washout Area

A material delivery, storage and containment area shall be designated by the contractor and located away from traffic and near the construction entrance. An onsite concrete washout area for any concrete mixing shall be designated by the contractor as well.

Element 10: Control De-Watering

BMPs used:

- Water Bars

De-watering should not be an issue on this site as the groundwater table is not known to be near the surface. However, the contractor shall apply water bars during construction as needed.

Element 11: Maintain BMPs

BMPs used:

- BMP C150: Materials On Hand
- BMP C160: Certified Erosion and Sediment Control Lead

The contractor shall keep erosion prevention and sediment control materials onsite for regular maintenance and emergency situations. The contractor will be the person in charge of erosion and sediment control for this project.

Element 12: Manage the Project

BMPs used:

- BMP C150: Materials On Hand
- BMP C160: Certified Erosion and Sediment Control Lead
- BMP C162: Scheduling

The contractor will be in control of erosion and sediment control and will keep erosion prevention and sediment control materials onsite for regular maintenance and emergency situations. The construction project will be sequenced in an orderly manner to minimize the duration of exposed soil to erosion.
Element 13: Protect Low-Impact Development BMPs
BMPs used:

- BMP C102: Buffer Zone
- BMP C103: High Visibility Fence
- BMP C233: Silt Fence

N/A since to LID BMPs are feasible on the site besides Post-Construction Soil Quality and Depth for landscaped areas. See Section 4.5 of this report for more information on the infeasibility of LID BMPs.

7 ATTACHMENTS

ATTACHMENT A – SITE PHOTOS

ATTACHMENT B – DRAINAGE PLAN

ATTACHMENT C – WWHM REPORT (FOR STORMWATER PUMP SIZING) & PUMP CALCULATIONS

ATTACHMENT D – GEOTECHNICAL MEMORANDUM

ATTACHMENT E – DOWNSTREAM ANALYSIS

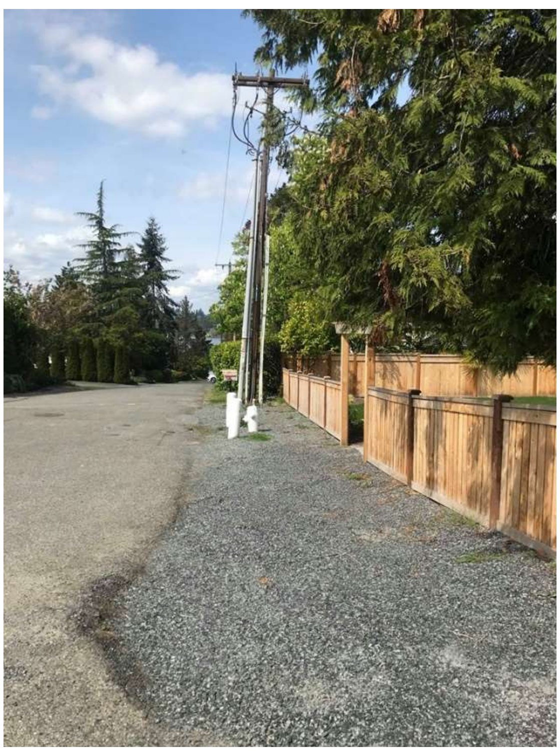
ATTACHMENT F – OPERATION AND MAINTENANCE MANUAL

ATTACHMENT A – SITE PHOTOS

Appendix A - Site Photos
Project: 3440 97th Ave SE Mercer Way, Parcel #0724059012

Existing house fronting 97th Ave SE. Project Site located on the east side of house pictured. (looking SE)

Existing Driveway from 97th Ave SE (looking E)



Ex frontage along 97th Ave SE (looking N)

Existing Driveway from 97th Ave SE on the project site (looking W)

Appendix A - Site Photos
Project: 3440 97th Ave SE Mercer Way, Parcel #0724059012

Project Site (looking NE)

Project Site (Looking NW)

Project Site (looking N)

Project Site (looking E)

ATTACHMENT B – DRAINAGE PLAN

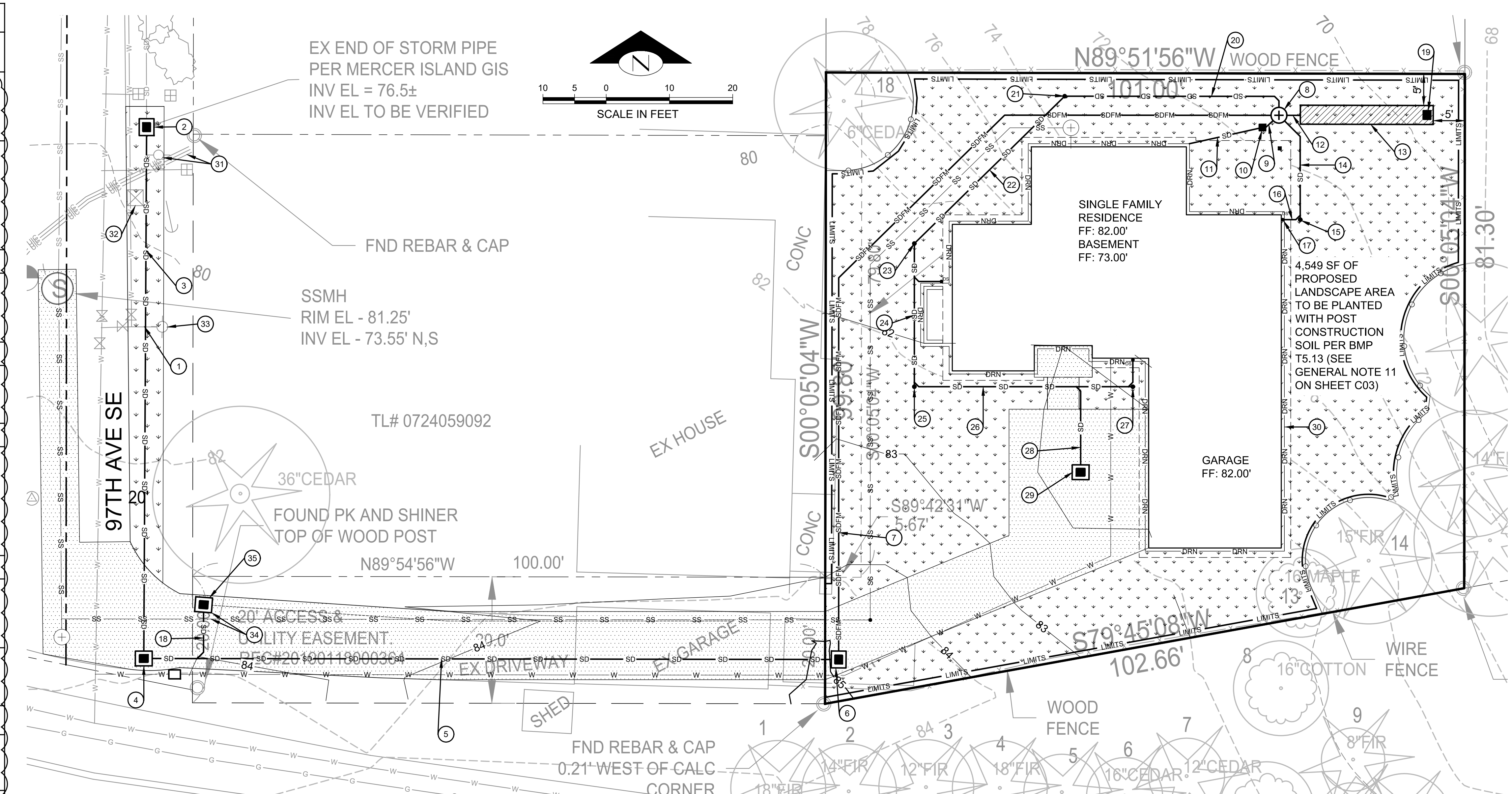
KEY NOTES

KEY	DESCRIPTION	DETAIL/ SHEET
1	SD & WATER CROSSING 10" SD IE 78.31± 8" WATER IE 76.10± MAINTAIN MIN 1.0' VERTICAL SEPARATION AT CROSSING	-
2	CB - TYPE 1 W/ SOLID, LOCKING LID RIM 79.50 10" IE (S) 77.10 12" IE (N) 76.50± 2' MIN SUMP CONTRACTOR TO CONFIRM IE OF EX 12" CONCRETE PIPE AND ADJUST ONSITE STORM SYSTEM AS NECESSARY	E/C05
3	80 LF 10" DI @ 2.00% MIN SLOPE	-
4	CB - TYPE 1 W/ SOLID, LOCKING LID RIM 83.46 10" IE (E) 80.57 10" IE (N) 80.47 2' MIN SUMP	E/C05
5	109 LF 10" DI @ 2.00% MIN SLOPE	-
6	CB - TYPE 1 W/ SOLID, LOCKING LID RIM 85.10 3" IE (N) 83.33 (SDFM) 10" IE (W) 82.75	E/C05
7	140 LF 3" PVC SDFM	-
8	STORMWATER PUMP STATION W/ SOLID LOCKING LID RIM 71.29 4" IE (N,SW,SE) 68.80 6" IE (E) 65.00 3" SDFM IE (W) 69.00 SUMP PER MANUFACTURER'S RECOMMENDATIONS	I/C06
9	2 LF 4" PVC SD @ 2.00% MIN SLOPE	-
10	12" AREA DRAIN RIM 71.40 4" IE (E) 69.00 4" IE (W) 69.10 (FTG DRN) 2' MIN SUMP	-
11	4" SOLID WALL PVC FOOTING DRAIN TIGHTLINE FROM BASEMENT LEVEL FOOTING DRAIN @ 2.00% MIN SLOPE 4" IE 70.00 @ BUILDING	-
12	2 LF 6" PVC SD TO BE LAID FLAT 6" IE 65.00	-
13	21 LF 36" Ø CMP FOR 148 CF EMERGENCY STORMWATER PUMP STATION STORAGE 36" IE 65.00	-
14	16 LF 4" PVC SD @ 2.00% MIN SLOPE	-
15	4" SDCO RIM 72.95 4" IE 69.60	F/C05
16	4" PVC ROOF DOWNSPOUT TIGHTLINE @ 2.00% MIN SLOPE & 2' MIN COVER (TYP)	-
17	4" ROOF DOWNSPOUT (TYP)	-
18	8 LF 6" SD @ 2.00% MIN	-
19	12" ACCESS PORT W/ OPEN GRATE LID FOR EMERGENCY OVERFLOW PATH IN CASE OF A PUMP FAILURE RIM 68.75	-
20	36 LF 4" PVC SD @ 2.00% MIN SLOPE	-
21	4" SDCO RIM 73.10 4" IE 70.60	F/C05
22	33 LF 4" PVC SD @ 2.00% MIN SLOPE	-
23	4" SDCO RIM 80.64 4" IE 77.95	F/C05
24	23 LF 4" PVC SD @ 2.00% MIN SLOPE	-
25	4" SDCO RIM 82.42 4" IE 78.45	F/C05
26	35 LF 4" PVC SD @ 2.00% MIN SLOPE	-
27	4" SDCO RIM 82.00 4' IE 79.15	F/C05
28	13 LF 4" PVC SD @ 2.00% MIN SLOPE	-

29	CB - TYPE 1 W/ OPEN-GRATE LID & OIL WATER SEPARATOR RIM 81.70 4" IE (N) 79.30 2' MIN SUMP	D&E/C05
30	PERIMETER FOOTING DRAIN - 4" PERFORATED PVC PIPE IN 6" MIN WASHED GRAVEL. WRAPPED IN NON-WOVEN FILTER FABRIC (TYP)	-
31	PROTECT EX POWER POLE AND UNDERGROUND POWER SERVICE DURING CONSTRUCTION	-
32	PROTECT EX MAILBOX DURING CONSTRUCTION AND REPLACE IN-KIND IF DAMAGED	-
33	PROTECT EX FIRE HYDRANT AND SERVICE DURING CONSTRUCTION	-
34	1' MIN CLEARANCE REQUIRED BETWEEN SSS & EDGE OF CB	-
35	CB - TYPE 1 W/ OPEN-GRATE LID & OIL WATER SEPARATOR RIM 83.30 6" IE (S) 80.90 2' MIN SUMP	D&E/C05

LEGEND:

- ASPHALT
- LANDSCAPE
- TREE PROTECTION FENCING
- LIMITS — LIMITS OF DISTURBANCE



DRAINAGE NOTES:

ROOF DRAINS:

1. NUMBER AND SIZE SHALL BE IN CONFORMANCE WITH THE UNIFORM PLUMBING CODE.
2. DOWNSPOUTS SHALL BE TIED INTO A NON-PERFORATED, RIGID, SMOOTH-BORE PIPE, WHICH DRAINS TO AN APPROVED STORM SYSTEM.
3. DRAINPIPE SHALL MEET MATERIAL STANDARDS FOR D2729 FOR P.V.C. PIPE, GR F-405 FOR SMOOTH-BORE H.D.P.E. PIPE.
4. PROVIDE CLEANOUTS AT THE UPPER END OF THE SYSTEM AND AT EACH CUMULATIVE CHANGE OF DIRECTION IN EXCESS OF 135 DEGREES.
5. ALL PIPE FITTINGS SHALL BE MADE OF THE SAME MATERIAL AS THE STRAIGHT PIPE. GLUED JOINTS SHALL USE A BONDING AGENT RECOMMENDED BY THE PIPE MANUFACTURER.

FOOTING DRAINS:

1. FOOTING DRAINS SHALL BE INSTALLED AROUND ALL FOUNDATIONS WHICH ENCLOSE A CRAWL SPACE, CELLAR, BASEMENT, GARAGE OR OTHER BUILDING SPACE.
2. DRAINS SHALL BE CONSTRUCTED OF PERFORATED PIPE INSTALLED AT THE BASE OF THE FOOTING.
3. DRAIN PIPE SHALL MEET MATERIAL STANDARDS FOR D2729 FOR P.V.C. PIPE, WITH THE PERFORATIONS DIRECTED DOWNWARD.
4. GRANULAR BACKFILL SHALL BE PLACED AROUND AND ABOVE THE FOOTING DRAIN TO A DEPTH OF 2/3 OF THE HEIGHT OF THE WALL.
5. A FILTER FABRIC SHALL BE USED TO PREVENT SOIL PARTICLES FROM ENTERING THE FOOTING DRAIN. IT IS PREFERABLE THAT THE FABRIC BE PLACED BETWEEN THE GRANULAR BACKFILL AND THE NATIVE SOILS.

DRIVEWAY/PARKING AREA DRAINS:

1. LARGE IMPERVIOUS AREAS USED FOR PARKING OR MANEUVERING OF VEHICLES SHALL BE SLOPED TO DRAIN TO ONE OR MORE CATCH BASINS.
2. THE BASINS SHALL BE TIED INTO THE ON-SITE STORM DRAINAGE SYSTEM USING NON-PERFORATED PIPE OF THE SAME MATERIALS.
3. AT LEAST ONE CATCH BASIN SHALL HAVE AN OIL SEPARATOR TO CLEAN THE WATER, OIL AND SILT PRIOR TO ENTERING THE APPROVED STORM SYSTEM.
4. IN AREAS WHERE THE OFF-SITE STORM SYSTEM IS INADEQUATE, ON-SITE DETENTION OF RUNOFF MAY BE REQUIRED. (CONTACT THE DEVELOPMENT ENGINEER FOR MORE INFORMATION).

GENERAL:

1. SLOPE ALL DRAIN LINES AT 2% MINIMUM TOWARD THE OUTLET.
2. PROVIDE CLEANOUTS OR CONTROL STRUCTURES AS APPROPRIATE.
3. ALL DRAINAGE PIPING AND STRUCTURES ARE SUBJECT TO INSPECTION PRIOR TO BACKFILLING.
4. ROOF AND FOOTING DRAINS MAY BE COMBINED BEYOND THE LOWEST POINT OF THE FOOTING DRAIN.
5. USE SAND COLLARS AT CB CONNECTIONS TO P.V.C. PIPE.
6. UNLESS OTHERWISE SPECIFIED, 6" STORM DRAIN PIPE FOR ROOF DRAINS AND SEWER PIPE SHALL BE SDR35 PVC PIPE.
7. ALL FOOTING DRAIN AND PERFORATED PIPE SHALL BE D2729 PVC PIPE WITH THE PERFORATIONS DIRECTED DOWNWARDS.
8. ALL PERF PIPE SHALL BE 4" DIAMETER UNLESS OTHERWISE SHOWN.
9. CONTRACTOR TO VERIFY INVERTS OF STORM DRAIN IN ROW AND ADJUST ONSITE STORM SYSTEM AS NECESSARY.
10. CONTRACTOR TO FIELD LOCATE AND REROUTE ANY POTENTIAL UTILITY CONFLICTS WITH DETENTION FACILITY PRIOR TO CONSTRUCTION.
11. THE LAWN AND LANDSCAPE AREAS ARE REQUIRED TO PROVIDE POST-CONSTRUCTION SOIL QUALITY AND DEPTH IN ACCORDANCE WITH BMP T5.13. THE PROJECT CIVIL ENGINEER MUST PROVIDE A LETTER OF CERTIFICATION TO ENSURE THAT THE LAWN AND LANDSCAPE AREAS MEET THE POST-CONSTRUCTION SOIL QUALITY AND DEPTH REQUIREMENTS SPECIFIED ON THE APPROVED PLAN SET PRIOR TO FINAL INSPECTION OF THE PROJECT. CONTRACTOR MUST PROVIDE CIVIL ENGINEER W/ INFORMATION PROVING THE POST-CONSTRUCTION SOILS MEET THESE REQUIREMENTS.

No.	DATE	BY	REVISION
1	6/5/2020	BI	REVISIONS PER CITY REVIEW COMMENTS

LEED AP — LEED ACCREDITED PROFESSIONAL & THE RELATED ACRONYM, & THE LEED AP LOGO ARE TRADEMARKS OWNED BY THE U.S. GREEN BUILDING COUNCIL & ARE AWARDED TO INDIVIDUALS UNDER LICENSE BY THE GREEN BUILDING CERTIFICATION INSTITUTE.

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F: 206.523.1012
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BENJAMIN J. IDDINS — STATE OF WASHINGTON — REGISTERED PROFESSIONAL ENGINEER
Digitally signed by Benjamin J. Iddins
Date: 2020.06.05 15:12:16 -07'00'

BASE MAP/TOPOGRAPHY PROVIDED BY OTHERS. DCG CANNOT BE HELD LIABLE FOR ACCURACY. CONTRACTOR SHALL FIELD VERIFY GRADES, UTILITIES, & ALL OTHER EX FEATURES & CONDITIONS. IF CONDITIONS ARE NOT AS SHOWN &/OR PLANS CANNOT BE CONSTRUCTED AS SHOWN, CONTACT DCG PRIOR TO CONSTRUCTION.

OWNER: IN MY BACKYARD, LLC
4701 W MERCER WAY
MERCER ISLAND, WA 98040

PROJECT: 3440 97TH AVE SE
MERCER ISLAND, WA 98040
DRAINAGE PLAN

PROJ. MANAGER:	BI
DESIGNED BY:	LG
DRAWN BY:	JA
CHECKED BY:	BI
SCALE:	SCALE
DATE: 6/5/2020	REV. A — SHEET 3 OF 6

SHEET NUMBER
C03

CAD FILE NUMBER: \\DCG.LOCAL\FILESHARE\DCG\CLIENTS-CIVIL\VALERE DEVELOPMENT\3440 97TH AVE SE MERCER ISLAND\DWG\DRAWING\3440 97TH AVE SE MERCER ISLAND.DWG
LAST MODIFIED BY: MIKE - SAVE DATE: 6/5/2020 12:36 PM - SHEET SET: 3440 97TH AVE SE - ORIGINAL SHEET SIZE: ANSI FULL BLEED D (34.00 X 22.00 INCHES)
AUTOCAD VERSION: CIVIL 3D 2018

ATTACHMENT C – WWHM REPORT (FOR STORMWATER PUMP SIZING)
& Pump Calculations

WWHM2012

PROJECT REPORT

General Model Information

Project Name:	default[14]
Site Name:	My Backyard
Site Address:	3440 97th Ave SE
City:	Mercer Island
Report Date:	5/8/2019
Gage:	Seatac
Data Start:	1948/10/01
Data End:	2009/09/30
Timestep:	15 Minute
Precip Scale:	1.000
Version Date:	2018/10/10
Version:	4.2.16

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 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Pasture, Mod	0.21
Pervious Total	0.21
Impervious Land Use	acre
Impervious Total	0
Basin Total	0.21

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

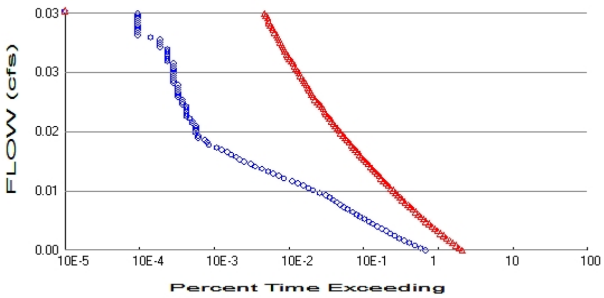
Basin 1

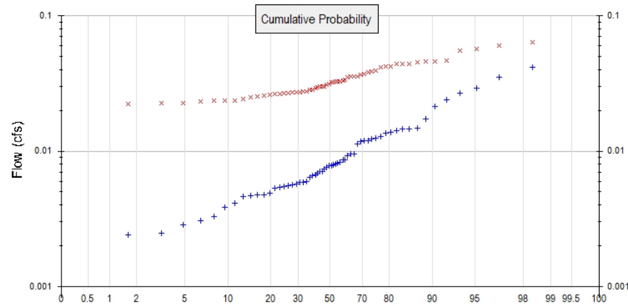
Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
ROOF TOPS FLAT	0.061
DRIVEWAYS MOD	0.02
Impervious Total	0.081
Basin Total	0.081

Element Flows To:

Surface	Interflow	Groundwater

Analysis Results
POC 1





+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 0.21
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 0
Total Impervious Area: 0.081

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.007935
5 year	0.013977
10 year	0.018908
25 year	0.026223
50 year	0.032477
100 year	0.039438

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0.031987
5 year	0.040447
10 year	0.046199
25 year	0.053665
50 year	0.059383
100 year	0.065242

100 year flow CFS*
448.8 = 0.0652*448.8
= 29.3 GPM

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1949	0.013	0.041
1950	0.014	0.044
1951	0.015	0.025
1952	0.005	0.022
1953	0.004	0.025
1954	0.006	0.026
1955	0.009	0.030
1956	0.010	0.028
1957	0.008	0.032
1958	0.007	0.027

1959	0.006	0.028
1960	0.012	0.027
1961	0.006	0.027
1962	0.004	0.024
1963	0.006	0.027
1964	0.008	0.027
1965	0.007	0.033
1966	0.005	0.022
1967	0.015	0.039
1968	0.008	0.046
1969	0.007	0.030
1970	0.006	0.030
1971	0.008	0.036
1972	0.012	0.036
1973	0.005	0.023
1974	0.008	0.033
1975	0.009	0.037
1976	0.007	0.026
1977	0.002	0.027
1978	0.006	0.035
1979	0.003	0.046
1980	0.024	0.042
1981	0.005	0.033
1982	0.014	0.046
1983	0.008	0.038
1984	0.005	0.024
1985	0.003	0.032
1986	0.012	0.028
1987	0.011	0.044
1988	0.005	0.027
1989	0.003	0.037
1990	0.042	0.056
1991	0.017	0.046
1992	0.007	0.023
1993	0.006	0.023
1994	0.002	0.023
1995	0.007	0.029
1996	0.021	0.033
1997	0.014	0.030
1998	0.006	0.031
1999	0.027	0.064
2000	0.005	0.031
2001	0.001	0.036
2002	0.009	0.039
2003	0.015	0.033
2004	0.012	0.060
2005	0.009	0.026
2006	0.008	0.024
2007	0.035	0.057
2008	0.029	0.044
2009	0.012	0.042

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.0418	0.0639
2	0.0353	0.0605
3	0.0294	0.0566

4	0.0267	0.0555
5	0.0239	0.0464
6	0.0215	0.0462
7	0.0173	0.0459
8	0.0148	0.0456
9	0.0145	0.0443
10	0.0145	0.0440
11	0.0142	0.0439
12	0.0137	0.0421
13	0.0136	0.0420
14	0.0128	0.0414
15	0.0124	0.0393
16	0.0124	0.0386
17	0.0120	0.0380
18	0.0120	0.0369
19	0.0118	0.0366
20	0.0113	0.0357
21	0.0095	0.0357
22	0.0095	0.0355
23	0.0093	0.0351
24	0.0086	0.0334
25	0.0086	0.0331
26	0.0083	0.0328
27	0.0082	0.0328
28	0.0080	0.0327
29	0.0079	0.0323
30	0.0078	0.0323
31	0.0078	0.0312
32	0.0076	0.0309
33	0.0074	0.0302
34	0.0071	0.0300
35	0.0071	0.0299
36	0.0069	0.0298
37	0.0067	0.0293
38	0.0066	0.0283
39	0.0064	0.0283
40	0.0060	0.0277
41	0.0059	0.0274
42	0.0058	0.0271
43	0.0057	0.0271
44	0.0057	0.0271
45	0.0055	0.0270
46	0.0055	0.0267
47	0.0054	0.0265
48	0.0053	0.0264
49	0.0049	0.0259
50	0.0048	0.0256
51	0.0047	0.0255
52	0.0047	0.0250
53	0.0046	0.0242
54	0.0041	0.0237
55	0.0038	0.0235
56	0.0033	0.0235
57	0.0031	0.0232
58	0.0028	0.0227
59	0.0025	0.0226
60	0.0024	0.0222
61	0.0014	0.0220

Duration Flows

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0040	14476	44553	307	Fail
0.0043	12254	40382	329	Fail
0.0045	10297	36660	356	Fail
0.0048	8722	33217	380	Fail
0.0051	7495	30201	402	Fail
0.0054	6406	27527	429	Fail
0.0057	5557	25004	449	Fail
0.0060	4851	22865	471	Fail
0.0063	4278	20839	487	Fail
0.0066	3752	19062	508	Fail
0.0068	3281	17487	532	Fail
0.0071	2858	16042	561	Fail
0.0074	2505	14675	585	Fail
0.0077	2199	13546	616	Fail
0.0080	1917	12476	650	Fail
0.0083	1721	11486	667	Fail
0.0086	1506	10607	704	Fail
0.0089	1301	9805	753	Fail
0.0092	1159	9037	779	Fail
0.0094	1043	8380	803	Fail
0.0097	939	7702	820	Fail
0.0100	850	7095	834	Fail
0.0103	753	6579	873	Fail
0.0106	664	6117	921	Fail
0.0109	551	5685	1031	Fail
0.0112	448	5313	1185	Fail
0.0115	389	4928	1266	Fail
0.0117	336	4596	1367	Fail
0.0120	282	4259	1510	Fail
0.0123	235	3946	1679	Fail
0.0126	183	3675	2008	Fail
0.0129	157	3450	2197	Fail
0.0132	132	3228	2445	Fail
0.0135	112	3020	2696	Fail
0.0138	93	2830	3043	Fail
0.0140	76	2633	3464	Fail
0.0143	66	2458	3724	Fail
0.0146	53	2301	4341	Fail
0.0149	46	2143	4658	Fail
0.0152	42	2006	4776	Fail
0.0155	36	1884	5233	Fail
0.0158	32	1762	5506	Fail
0.0161	27	1668	6177	Fail
0.0164	23	1549	6734	Fail
0.0166	18	1464	8133	Fail
0.0169	17	1358	7988	Fail
0.0172	16	1279	7993	Fail
0.0175	13	1209	9300	Fail
0.0178	13	1135	8730	Fail
0.0181	12	1060	8833	Fail
0.0184	12	1002	8350	Fail
0.0187	12	947	7891	Fail
0.0189	12	886	7383	Fail
0.0192	11	838	7618	Fail

0.0195	11	799	7263	Fail
0.0198	10	751	7510	Fail
0.0201	9	712	7911	Fail
0.0204	9	664	7377	Fail
0.0207	9	637	7077	Fail
0.0210	9	617	6855	Fail
0.0212	9	580	6444	Fail
0.0215	8	552	6900	Fail
0.0218	8	511	6387	Fail
0.0221	8	478	5975	Fail
0.0224	7	454	6485	Fail
0.0227	7	433	6185	Fail
0.0230	7	420	6000	Fail
0.0233	7	400	5714	Fail
0.0235	7	382	5457	Fail
0.0238	7	367	5242	Fail
0.0241	6	351	5850	Fail
0.0244	6	334	5566	Fail
0.0247	6	321	5350	Fail
0.0250	6	307	5116	Fail
0.0253	6	293	4883	Fail
0.0256	6	278	4633	Fail
0.0259	6	263	4383	Fail
0.0261	6	253	4216	Fail
0.0264	6	243	4050	Fail
0.0267	5	232	4640	Fail
0.0270	5	217	4340	Fail
0.0273	5	208	4160	Fail
0.0276	5	198	3959	Fail
0.0279	5	189	3780	Fail
0.0282	5	185	3700	Fail
0.0284	4	177	4425	Fail
0.0287	4	172	4300	Fail
0.0290	4	164	4100	Fail
0.0293	4	157	3925	Fail
0.0296	3	152	5066	Fail
0.0299	2	146	7300	Fail
0.0302	2	137	6850	Fail
0.0305	2	131	6550	Fail
0.0307	2	128	6400	Fail
0.0310	2	120	6000	Fail
0.0313	2	116	5800	Fail
0.0316	2	114	5700	Fail
0.0319	2	111	5550	Fail
0.0322	2	105	5250	Fail
0.0325	2	100	5000	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.

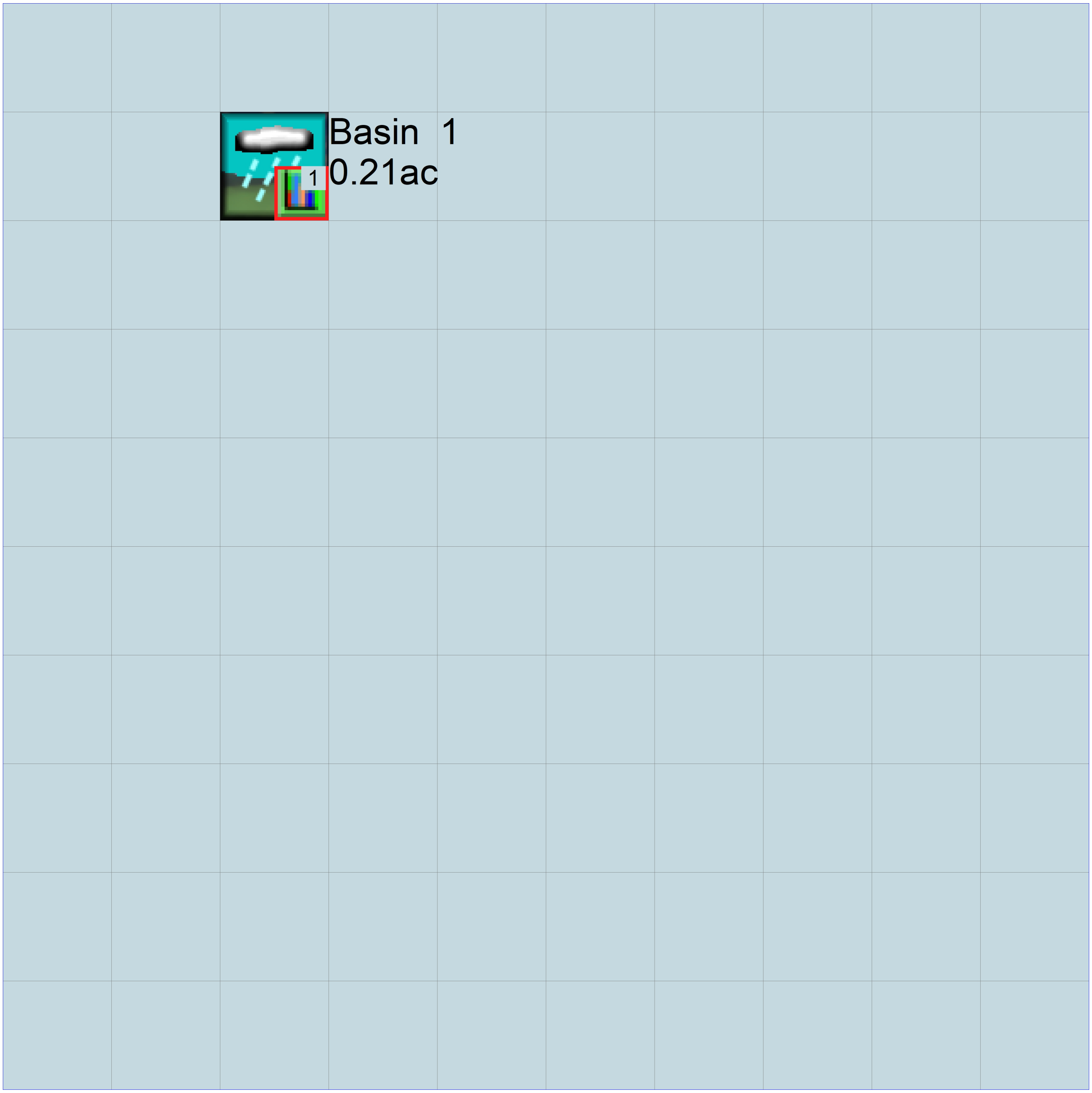
PERLND Changes

No PERLND changes have been made.

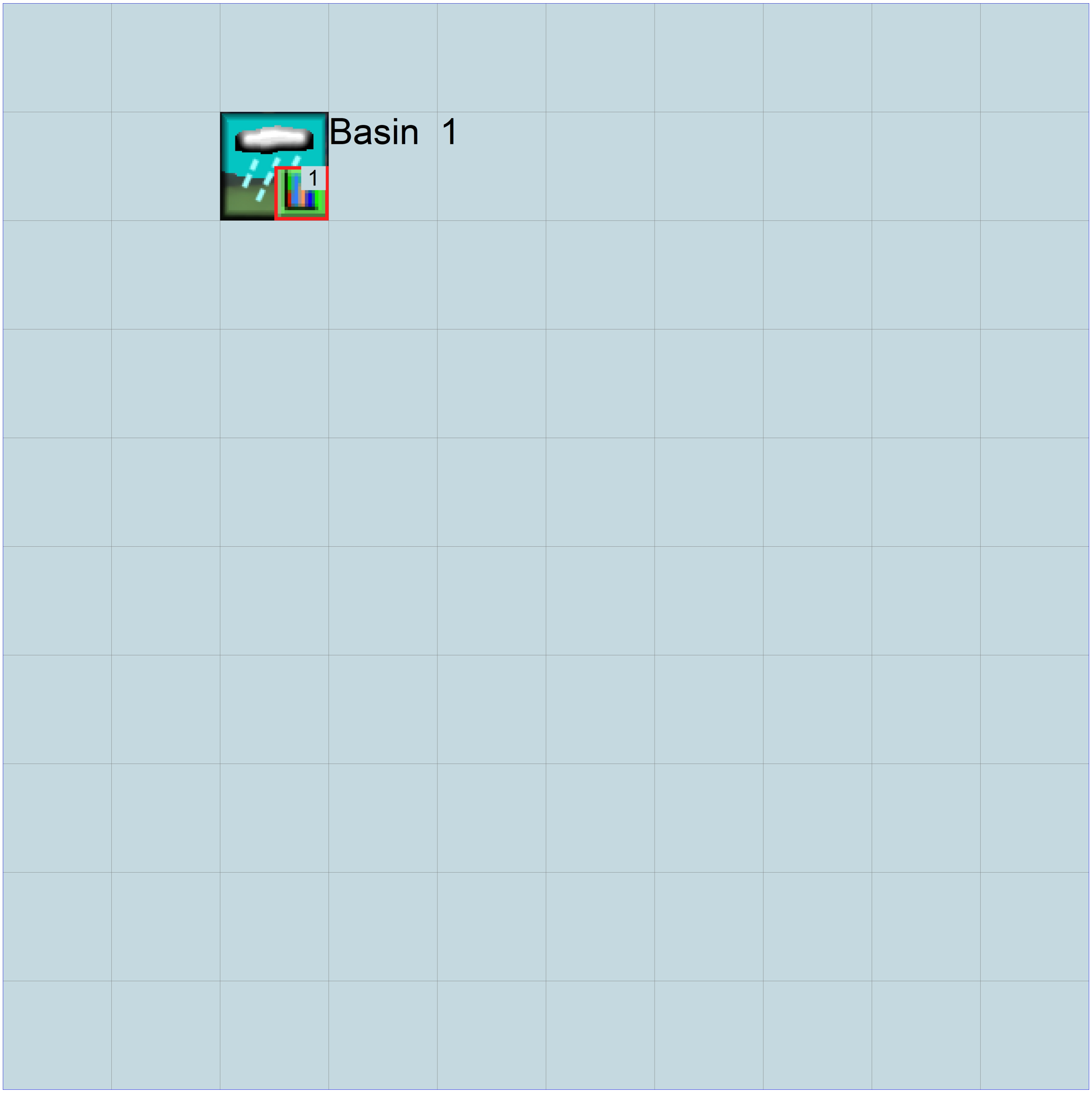
IMPLND Changes

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   default[14].wdm
MESSU      25   Predefault[14].MES
           27   Predefault[14].L61
           28   Predefault[14].L62
           30   POCdefault[14]1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      14
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Basin  1                    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           ***
   14     C, Pasture, 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 ***
   14         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  *********
   14         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 ***
   14         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
   14              0       4.5      0.06       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
   14              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                                   ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   14           0.15       0.4       0.3         6       0.5       0.4
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
              ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
   14              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  1***
PERLND  14                        0.21     COPY   501     12
PERLND  14                        0.21     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   default[14].wdm
MESSU      25   Mitdefault[14].MES
           27   Mitdefault[14].L61
           28   Mitdefault[14].L62
           30   POCdefault[14]1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      IMPLND       4
      IMPLND       6
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Basin  1                    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           ***
  END GEN-INFO
  *** Section PWATER***

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

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

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
```

```
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                               ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
  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
  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
    6      DRIVEWAYS/MOD          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
    6         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    0    1    9
    6         0    0    4    0    0    0    1    9
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    4         0    0    0    0    0
    6         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
    6            400      0.05       0.1      0.08
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    4              0         0
    6              0         0
  END IWAT-PARM3
```

```
  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    4             0         0
    6             0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
IMPLND   4                       0.061     COPY   501     15
IMPLND   6                        0.02     COPY   501     15

******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       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

Legal Notice

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Local (360)943-0304

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Flow Rates of Conveyance Systems Contributing to Pump Station:

Footing Drains:	10	gpm
Flow from WWHM:	29.280	gpm
	40.0	gpm

Outputs for Pump Detail Table

Flow (gpm)	100-yr TDH
40 gpm	21.96 ft

Force Main Diam.
3 in.

IE of Lowest Inlet into Pump Station	Dist. from IE of Lowest Inlet to Top of Pump (ft)	LW Elev	Active Storage Depth (ft)	HW Elev	Highest FM Elev	LW Static Head (ft)	HW Static Head (ft)	Flow (gpm)	Flow (cfs)	FM Diam. (Inches)	FM Length (ft)	Fittings Equiv. Length (ft)	Total Length (ft)	C	hf (ft)	hf (psi)	Area (sf)	Velocity (ft/s)	Vel Head (ft)	hf+hv (ft)	HW TDH (ft)	LW TDH (ft)
65	2.00	63.00	2.00	65.00	**83.33**	20.33	18.33	40.0	0.089	3	140	140	280	130	1.58	0.683	0.049087	1.815671	0.05119	1.63	19.96	21.96

ATTACHMENT D – GEOTECHNICAL MEMORANDUM

Earth Solutions NW LLC
Geotechnical Engineering, Construction Observation/Testing and Environmental Services

September 12, 2018
ES-6182

Pacwest Construction, LLC
4118 – 96th Avenue Southeast
Mercer Island, Washington 98040

Attention: Mr. Vann Lanz

Subject: Geotechnical Evaluation
Proposed Single-Family Residence
3440 – 97th Avenue Southeast
Mercer Island, Washington

Reference: Kathy G. Troost and Aaron P. Wisher
Geologic Map of Mercer Island, Washington, October 2006
Mercer Island Landslide Hazard Assessment Map, April 2009
Mercer Island Erosion Hazard Assessment Map, April 2009
Mercer Island Seismic Hazard Assessment Map, April 2009

Herrera Environmental Consultants, Inc.
Low-Impact Development Infiltration Feasibility Map

King County Flood Control District
Liquefaction Susceptibility for King County, May 2010

United States Department of Agriculture (USDA)
Natural Resources Conservation Service (NRCS)
Online Web Soil Survey (WSS) Resource

Mercer Island City Code, Title 19.07.060

Dear Mr. Lanz:

As requested, Earth Solutions NW, LLC (ESNW) has prepared this letter for the proposed single-family residence to be constructed at the subject address. This evaluation was prepared in general accordance with our proposal dated June 15, 2018 and authorized by you on June 19, 2018. A summary of our subsurface exploration and preliminary geotechnical recommendations are provided in this letter.

Project Description

The subject site is located approximately 300 feet south of the intersection between Southeast 34th Street and 97th Avenue Southeast, in Mercer Island, Washington. The approximate project location is illustrated on the attached Vicinity Map (Plate 1). The site consists of one tax parcel (King County Parcel No. 072405-9012) totaling approximately 8,800 square feet. The attached Test Pit Location Plan (Plate 2) illustrates the approximate site limits.

We understand the subject site will be developed with a single-family residence and associated improvements. At the time of this evaluation, specific grading and building load plans were not available for review; however, based on our experience with similar projects, the proposed residence will likely be two to three stories in height and constructed using relatively lightly loaded wood framing supported on a conventional foundation. Perimeter footing loads will likely be about 2 to 3 kips per lineal foot, with slab-on-grade loading anticipated to be approximately 150 pounds per square foot (psf). Grade cuts and/or fills of about five feet are anticipated to achieve design elevations.

If the above design assumptions are incorrect or change, ESNW should be contacted to review the recommendations provided in this letter, which has been prepared for the exclusive use of Pacwest Construction, LLC and their representatives. No warranty, expressed or implied, is made. This letter was prepared in a manner consistent with the level of care and skill that is typical of other members in the profession currently practicing under similar conditions in this area. Variations in soil and groundwater conditions observed at the test pit locations may exist and may not become evident until construction. ESNW should reevaluate the conclusions provided in this evaluation if variations are encountered.

Surface Conditions

The subject site is bordered to the north and west by single-family residences, to the east by undeveloped land, and to the south by Interstate 90. The site is currently undeveloped and covered with dense brush growth. Site topography maintains a generally northeast-trending declination, with approximately 10 to 12 feet of elevation change occurring within the confines of the property.

Subsurface Conditions

ESNW observed, logged, and sampled three test pits within accessible locations of the site, for the purpose of evaluating soil and groundwater conditions. The test pits were excavated to a maximum exploration depth of about nine feet below the existing ground surface (bgs). The following is a general description of the soil and groundwater conditions encountered at the test pit locations. Please refer to the attached test pit logs for a more detailed description of subsurface conditions. Representative soil samples collected at the test pit locations were analyzed in general accordance with Unified Soil Classification System (USCS) and USDA schemes.

Topsoil and Fill

Where encountered, topsoil was present in about the upper six inches of existing grades. The topsoil was characterized by dark brown color, the presence of fine organic material, and small root intrusions. Silty sand and sandy silt fill was encountered at each test pit location, extending to approximate depths of one to four feet bgs. The fill was characterized as loose to medium dense and encountered primarily in a moist condition. Various construction-like and deleterious debris was encountered at each test pit location and observed at surficial grades across the site. An approximate depiction of observed areas containing fill is provided on Plate 2. Fill material may also be encountered in proximity to existing site features.

Native Soil

Underlying topsoil and fill, native soils were encountered as silt with varying sand amounts (USCS: ML), in a dense to very dense a moist condition. The native soils were observed primarily in a moist condition, extending to the maximum exploration depth of approximately nine feet bgs.

Geologic Setting

The referenced geologic map resource identifies recessional lacustrine deposits (Qvrl) as underlying the site and surrounding areas. The recessional lacustrine deposits are characterized as laminated silt and clay with local sand layers, peat, and other organic sediments. However, based on the encountered soil conditions, it is our opinion that native soils are more representative of glacial till (Qvt) deposits, which are mapped directly east of the site. The till is characterized as a compact diamict of silt, sand, and subrounded to well-rounded gravel.

The referenced WSS resource identifies soils of the Kitsap silt loam series (Map Unit Symbol: KpB) as underlying the site and surrounding area. The Kitsap loam in commonly found in terrace landforms, derived from lacustrine deposits. Based on our field observations, it is our opinion the native soils be considered representative of glacial till deposits.

Groundwater

During our July 2018 fieldwork, groundwater seepage was not encountered at the test pit locations. Groundwater seepage is common within glacial deposits, with rates and elevation fluctuations depending on many factors, including precipitation duration and intensity, the time of year, and soil conditions. In general, groundwater elevations and flow rates are higher during the winter, spring, and early summer months. In this regard, the contractor should be prepared to respond to and manage areas of perched groundwater seepage during construction activities.

Geologically Hazardous Areas

As part of our evaluation, we reviewed the referenced City of Mercer Island (City) hazard maps to identify the presence of geologically hazardous areas on, or immediately off, site. Our review indicates that a seismic hazard has been preliminarily identified within the property bounds by the City. Landslide and erosion hazard areas are not apparently mapped within the confines of the site, but appear to be present directly east of the property. For completeness, a review and assessment of each of the above hazard areas are provided below.

Landslide Hazard

As defined in the Mercer Island City Code (MICC), a landslide hazard area is any area subject to landslide based on a combination of geologic, topographic, and hydrologic factors. The landslide hazard criteria (italicized), as defined in MICC 19.16.010, as well as our classification to the presence of each criteria is presented below:

1. *Areas of historic failures;*

   No obvious indications of historic failures were observed at surficial grades or within the explored depths of our pits.

2. *Areas with all three of the following characteristics:*

   a. *Slopes steeper than 15 percent; and*

   b. *Hillsides intersecting geologic contacts with a relatively permeable sediment overlying a relatively impermeable sediment or bedrock; and*

   c. *Springs or ground water seepage;*

   Overall site gradients are generally under 11 percent, with total site elevation change of less than 15 feet. However, gradients immediately west of the site increase to approximately 32 percent, with an elevation change of about 20 feet. Native soils consist primarily of medium dense to dense silt (with varying degrees of sand) to the terminus of the exploration locations. Groundwater seepage was not encountered within the explored depths of the test pits.

3. *Areas that have shown evidence of past movement or that are underlain or covered by mass wastage debris from past movements;*

   Neither obvious indications of previous movement nor mass wastage deposits were encountered or observed during our July 2018 exploration and reconnaissance. Heavy brush and bramble growth covered the majority of the site during our exploration. The slope directly west of the site was vegetated with low-lying brush and sparse tree growth.

4. Areas potentially unstable because of rapid stream incision and stream bank erosion.

Based on our review, the site is not located within a geographical location that is considered susceptible to stream incision or stream bank erosion.

5. Steep slope, defined as any slope of 40 percent or greater calculated by measuring the vertical rise over any 30-foot horizontal run.

Delineated slope gradients are below 40 percent both on and immediately off site.

Based on our review, the site and immediately adjacent areas do not meet MICC criteria to be considered a landslide hazard area. In our opinion, restrictions relating to landslide hazards are not necessary for the proposed development.

Erosion Hazard

Defined in MICC 19.16.010, an erosion hazard area is any area greater than 15 percent slope and subject to a severe risk of erosion due to wind, rain, water, slope and other natural agents including those soil types and/or areas identified by the USDA NRCS as having a "severe" or "very severe" rill and inter-rill erosion hazard.

As discussed within the *Geologic Setting* section of this letter, site soils have been characterized as the Kitsap silt loam per the WSS. In our opinion, these soils have a moderate to severe erosion potential. However, provided adequate temporary erosion control BMPs (silt fencing, sediment barriers, covering of exposed soils and/or stockpiles, etc.) are implemented and adequately maintained during construction, surface water is managed, and permanent erosion control measures are installed after construction, it is our opinion the potential erosion hazard can be adequately mitigated.

Seismic Hazard

Defined in MICC 19.16.010, a seismic hazard area is any area subject to severe risk of damage as a result of earthquake-induced ground shaking, slope failure, settlement, soil liquefaction, or surface faulting.

Native site soils were primarily encountered as medium dense to dense silt with varying degrees of sand. Groundwater seepage was not encountered within the test pit locations during our July 2018 exploration. In our opinion, the dense in-situ nature of the native soils, appreciable fines contents, and absence of a uniformly established groundwater table are generally not conducive for liquefaction or slope failure resulting from a seismic event. In these regards, it is our opinion the site not be considered a seismic hazard. As such, restrictions relating to seismic hazards are not necessary for the proposed development.

Site Preparation and Earthwork

Initial site preparation activities will consist of installing temporary erosion control measures, establishing grading limits, and performing clearing and site stripping. Subsequent earthwork activities will involve minor grading activities and related residential infrastructure improvements.

Temporary Erosion Control

A temporary construction entrance, consisting of at least six inches of quarry spalls, should be considered to both minimize off-site soil tracking and provide a stable entrance surface. A woven geotextile fabric may be placed beneath the quarry spalls to provide greater stability of the temporary construction entrance. Erosion control measures should include silt fencing placed around the site perimeter. Soil stockpiles should be covered or otherwise protected to reduce soil erosion. Temporary approaches for controlling surface water runoff should be established prior to beginning earthwork activities. Additional Best Management Practices (BMPs), as specified by the project civil engineer and indicated on the plans, should be incorporated into construction activities. As needed, erosion control BMPs may be modified during construction, as approved by the site erosion control lead.

In-situ and Imported Soils

On-site soils are considered moisture sensitive, with successful use as structural fill being largely dictated by the moisture content of the soil at the time of placement and compaction. If site soils cannot be successfully compacted, the use of an imported soil may be necessary. In our opinion, a contingency should be provided in the project budget for export of soil that cannot be successfully compacted as structural fill. Soils with fines contents greater than 5 percent typically degrade rapidly when exposed to periods of rainfall.

Imported soil intended for use as structural fill should consist of a well-graded, granular soil with a moisture content that is at (or slightly above) the optimum level. During wet weather conditions, imported soil intended for use as structural fill should consist of a well-graded, granular soil with a fines content of 5 percent or less (where the fines content is defined as the percent passing the Number 200 sieve, based on the minus three-quarter-inch fraction).

Due to the extent of deleterious debris encountered during our fieldwork, existing fill is generally considered unsuitable for use as structural fill. If existing fill soil is pursued for use as structural fill, it must be approved by ESNW prior to placement and compaction.

Excavations and Slopes

Excavation activities are likely to expose both existing fill and dense native soils. Based on the soil conditions observed at the test pit locations, the following allowable temporary slope inclinations, as a function of horizontal to vertical (H:V) inclination, may be used for temporary excavations greater than four feet in height. The applicable Federal Occupation Safety and Health Administration (OSHA) and Washington Industrial Safety and Health Act (WISHA) soil classifications are also provided:

- Fill, regardless of in-situ density — 1.5H:1V (Type C)
- Areas containing groundwater seepage — 1.5H:1V (Type C)
- Loose to medium dense soil — 1.5H:1V (Type C)
- Medium dense to dense native soil — 1H:1V (Type B)

Steeper temporary slope inclinations within undisturbed, very dense glacial till may be feasible based on the soil and groundwater conditions exposed within the excavations. If pursued, steeper temporary slope inclinations must be approved and designed by ESNW either prior to or at the time of excavation.

Permanent slopes should be planted with vegetation to enhance stability and to minimize erosion and should maintain a gradient of 2H:1V or flatter. The presence of perched groundwater may cause localized sloughing of temporary slopes due to excess seepage forces. A representative of ESNW should observe temporary and permanent slopes to confirm the slope inclinations are suitable for the exposed soil conditions and to provide additional excavation and slope recommendations, as necessary. If the recommended temporary slope inclinations cannot be achieved, temporary shoring may be necessary to support excavations.

Structural Fill

Structural fill is defined as compacted soil placed in foundation, slab-on-grade, and roadway areas. Fill placed to construct permanent slopes and throughout retaining wall and utility trench backfill areas is considered structural fill as well. Soils placed in structural areas should be placed in loose lifts of 12 inches or less and compacted to a relative compaction of 95 percent, based on the laboratory maximum dry density as determined by the Modified Proctor Method (ASTM D1557). For soil placed in utility trenches underlying structural areas, compaction requirements are dictated by the local city, county, or utility district, and are typically specified to a relative compaction of at least 95 percent of the Modified Proctor value.

Foundations

The proposed single-family residence can be constructed on a conventional continuous and spread footing foundation bearing on competent native soil, recompacted native soil, or new structural fill placed directly on competent native soils. Due to the extent of deleterious debris encountered within the existing fill, it is our opinion foundation elements should only be placed on competent native soil or new structural fill placed directly on competent native soil. In this respect, it may be necessary to overexcavate foundation subgrade areas that do not extend through existing fill. In general, where loose or unsuitable soil conditions are exposed at foundation subgrade elevations, compaction of soils to the specifications of structural fill, or overexcavation and replacement with suitable structural fill, will be necessary.

Provided the structure will be supported as described above, the following parameters can be used for design of the new foundation:

- Allowable soil bearing capacity 2,500 psf
- Passive earth pressure 300 pcf (equivalent fluid)
- Coefficient of friction 0.40

A one-third increase in the allowable soil bearing capacity may be assumed for short-term wind and seismic loading conditions. With structural loading as expected, total settlement in the range of one inch and differential settlement of about one-half inch is anticipated. The majority of the settlements should occur during construction, as dead loads are applied.

Seismic Design

The 2015 International Building Code recognizes the American Society of Civil Engineers (ASCE) for seismic site class definitions. In accordance with Table 20.3-1 of the ASCE Minimum Design Loads for Buildings and Other Structures manual, Site Class D should be used for design.

The referenced liquefaction susceptibility map indicates the site and surrounding areas maintain very low liquefaction susceptibility. Liquefaction is a phenomenon where saturated and loose sandy soils suddenly lose internal strength and behave as a fluid. This behavior is in response to increased pore water pressures resulting from an earthquake or other intense ground shaking. In our opinion, site susceptibility to liquefaction may be considered negligible. The relatively high in-situ density, appreciable fines contents of the native soils, and the absence of a uniformly established, shallow groundwater table were the primary bases for this opinion.

Retaining Walls

Retaining walls should be designed to resist lateral earth pressures and applicable surcharge loads. The following parameters may be used for retaining wall design:

- Active earth pressure (yielding condition) — 35 pcf (equivalent fluid)
- At-rest earth pressure (restrained condition) — 55 pcf
- Traffic surcharge (passenger vehicles) — 70 psf (rectangular distribution)*
- Passive earth pressure — 300 pcf (equivalent fluid)
- Coefficient of friction — 0.40
- Seismic surcharge — 6H psf**

* *Where applicable*
** *Where H equals the retained height (in feet)*

The above design parameters are based on a level backfill condition and level grade at the wall toe. Revised design values will be necessary if sloping grades are to be used above or below retaining walls. Additional surcharge loading from adjacent foundations, sloped backfill, or other relevant loads should be included in the retaining wall design.

Retaining walls should be backfilled with free-draining material that extends along the height of the wall and a distance of at least 18 inches behind the wall. The upper 12 inches of the wall backfill may consist of a less permeable soil, if desired. A perforated drainpipe should be placed along the base of the wall and connected to an approved discharge location. A typical retaining wall drainage detail is provided on Plate 3. If drainage is not provided, hydrostatic pressures should be included in the wall design.

Drainage

Groundwater seepage was not encountered at the test pit locations during our July 2018 fieldwork. However, zones of perched groundwater seepage may be anticipated in site excavations depending on the time of year grading operations take place. Temporary measures to control surface water runoff and groundwater during construction would likely involve interceptor trenches and sumps. ESNW should be consulted during preliminary grading to identify areas of seepage and to provide recommendations to reduce the potential for instability related to seepage effects.

Finish grades must be designed to direct surface drain water away from structures and slopes to the extent feasible. Water must not be allowed to pond adjacent to structures or slopes. In our opinion, foundation drains should be installed along building perimeter footings. A typical foundation drain detail is provided on Plate 4.

Infiltration Feasibility

As indicated in the *Subsurface* section of this letter, native soils encountered during our fieldwork were characterized as silt with varying degrees of sand. Based upon the results of USDA textural analyses performed on representative soil samples, native soils may also be classified as slightly gravelly loam. Irrespective of gravel content, fines contents within the native loam were about 70 to 94 percent.

Review of the City infiltration feasibility map indicates the site has been designated by the City as infeasible for Low-Impact Development (LID) facilities. Additionally, the high in-situ density and appreciable fines contents of the native loam will severely restrict the performance of any infiltration facility. In our opinion, infiltration is not feasible from a geotechnical standpoint.

Additional Services

ESNW should have an opportunity to review final site designs with respect to the geotechnical recommendations provided in this letter. ESNW should also be retained to provide earthwork observation, testing, and supplementary consultation services (as needed) during development and construction.

We trust this letter meets your current needs. Should you have questions regarding the content herein, or require additional information, please call.

Sincerely,

EARTH SOLUTIONS NW, LLC

KEVEN D. HOFFMANN
STATE OF WASHINGTON
53734
REGISTERED PROFESSIONAL ENGINEER
09/12/2018

Chase G. Halsen
Staff Geologist

Keven D. Hoffmann, P.E.
Senior Project Engineer

Attachments: Plate 1 – Vicinity Map
Plate 2 – Test Pit Location Plan
Plate 3 – Retaining Wall Drainage Detail
Plate 4 – Footing Drain Detail
Test Pit Logs
Grain Size Distribution

Reference:
King County, Washington
Map 596
By The Thomas Guide
Rand McNally
32nd Edition

NORTH

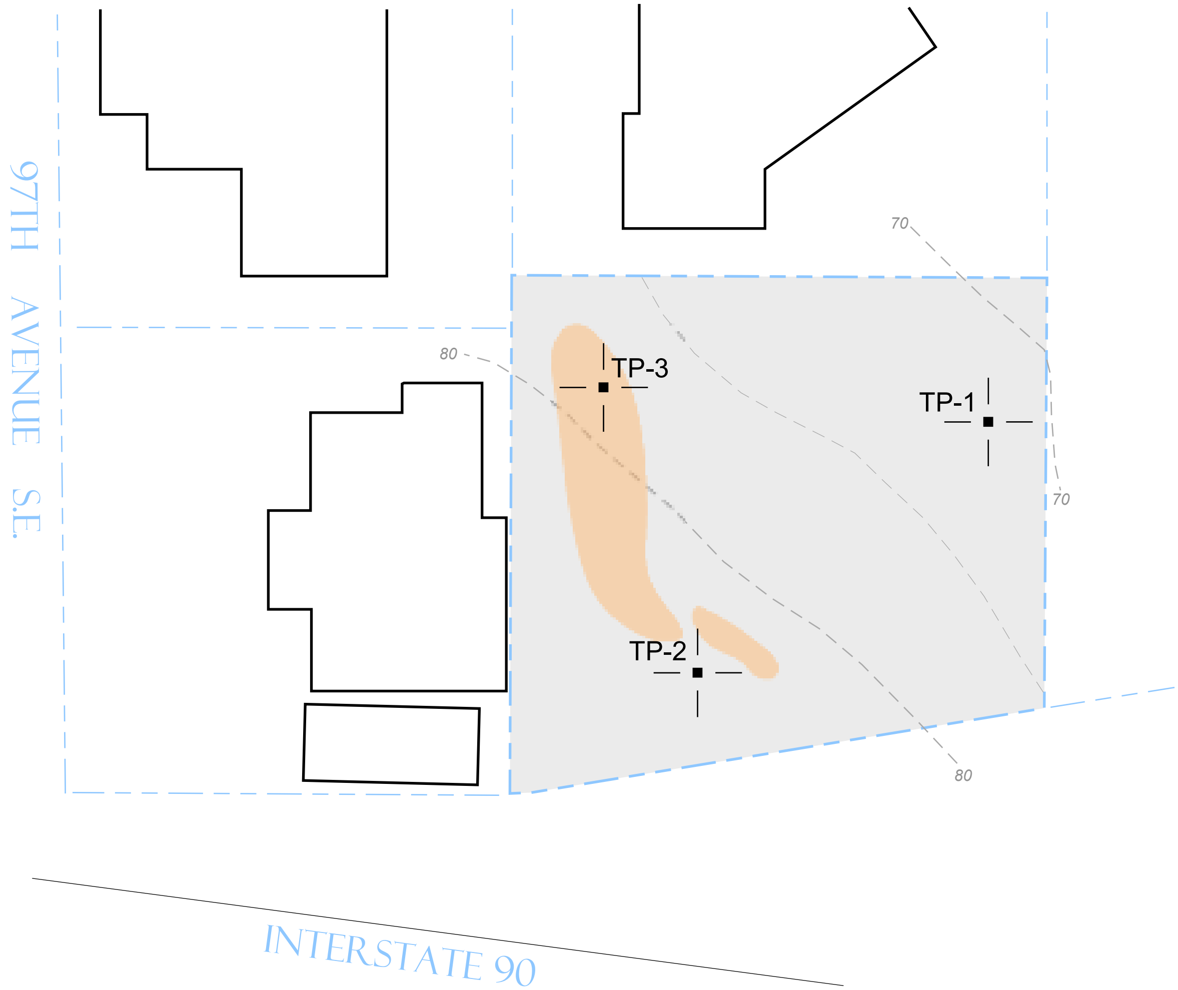
NOTE: This plate may contain areas of color. ESNW cannot be responsible for any subsequent misinterpretation of the information resulting from black & white reproductions of this plate.

Earth Solutions NW LLC

Geotechnical Engineering, Construction Observation/Testing and Environmental Services

Vicinity Map
97th Avenue SFR
Mercer Island, Washington

Drwn. MRS	Date 08/08/2018	Proj. No. 6182
Checked CGH	Date Aug. 2018	Plate 1



LEGEND

TP-1 — Approximate Location of ESNW Test Pit, Proj. No. ES-6182, July 2018

Subject Site

Existing Building

Anticipated Areas of Fill

NORTH

NOT - TO - SCALE

NOTE: The graphics shown on this plate are not intended for design purposes or precise scale measurements, but only to illustrate the approximate test locations relative to the approximate locations of existing and / or proposed site features. The information illustrated is largely based on data provided by the client at the time of our study. ESNW cannot be responsible for subsequent design changes or interpretation of the data by others.

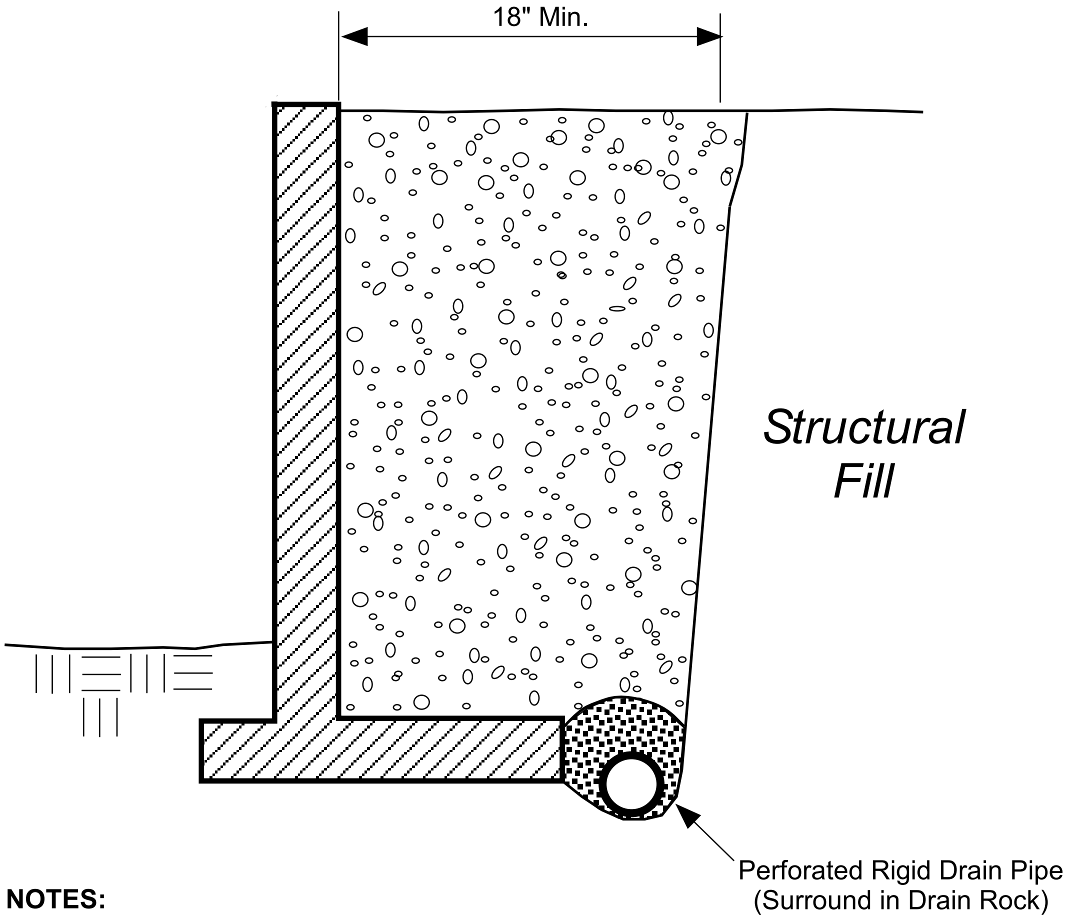
NOTE: This plate may contain areas of color. ESNW cannot be responsible for any subsequent misinterpretation of the information resulting from black & white reproductions of this plate.

Earth Solutions NW LLC

Earth Solutions NW LLC
Geotechnical Engineering, Construction Observation/Testing and Environmental Services

Test Pit Location Plan
97th Avenue SFR
Mercer Island, Washington

Drwn. MRS	Date 08/08/2018	Proj. No. 6182
Checked CGH	Date Aug. 2018	Plate 2



NOTES:

- Free-draining Backfill should consist of soil having less than 5 percent fines. Percent passing No. 4 sieve should be 25 to 75 percent.
- Sheet Drain may be feasible in lieu of Free-draining Backfill, per ESNW recommendations.
- Drain Pipe should consist of perforated, rigid PVC Pipe surrounded with 1-inch Drain Rock.

SCHEMATIC ONLY - NOT TO SCALE
NOT A CONSTRUCTION DRAWING

LEGEND:

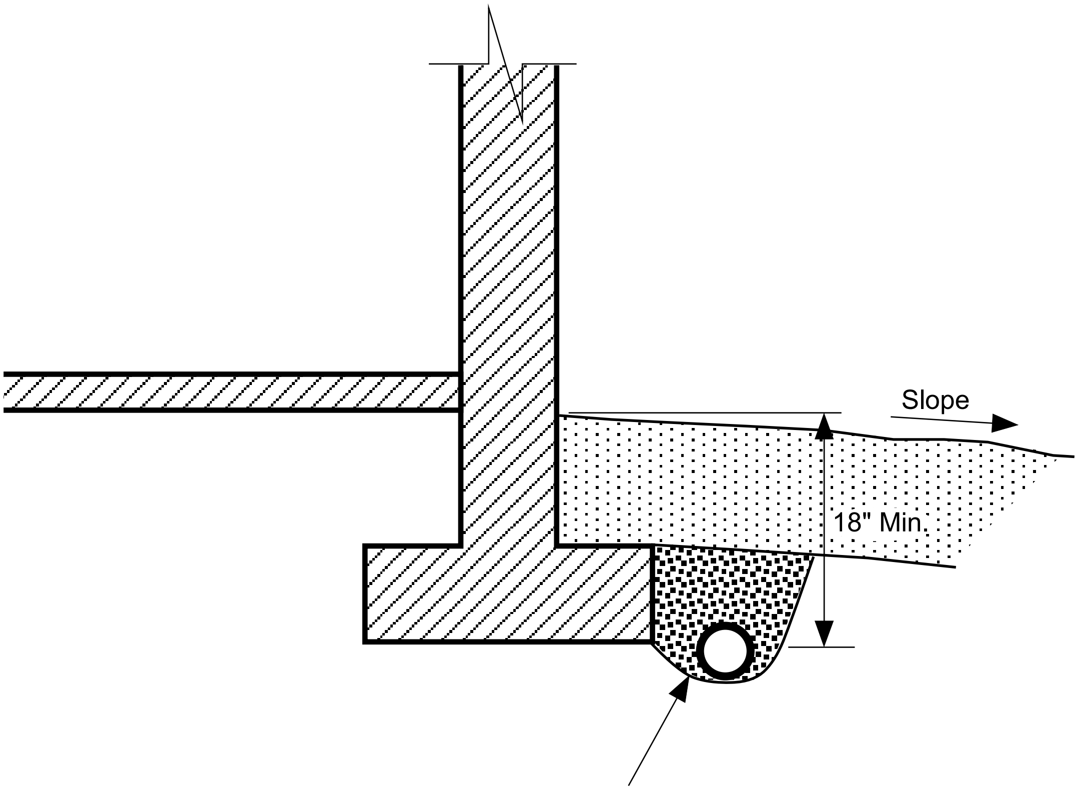
Free-draining Structural Backfill

1-inch Drain Rock

Earth Solutions NW LLC
Earth Solutions NWLLC
Geotechnical Engineering Construction
Observation/Testing and Environmental Services

Retaining Wall Drainage Detail
97th Avenue SFR
Mercer Island, Washington

Drwn. MRS	Date 08/08/2018	Proj. No. 6182
Checked CGH	Date Aug. 2018	Plate 3

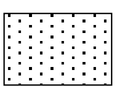


NOTES:

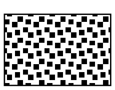
- Do NOT tie roof downspouts to Footing Drain.
- Surface Seal to consist of 12" of less permeable, suitable soil. Slope away from building.

SCHEMATIC ONLY - NOT TO SCALE
NOT A CONSTRUCTION DRAWING

LEGEND:



Surface Seal: native soil or other low-permeability material.



1-inch Drain Rock

Earth Solutions NW LLC
Geotechnical Engineering, Construction Observation/Testing and Environmental Services

Footing Drain Detail
97th Avenue SFR
Mercer Island, Washington

Drwn. MRS	Date 08/08/2018	Proj. No. 6182
Checked CGH	Date Aug. 2018	Plate 4

Earth Solutions NW LLC

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

DUAL SYMBOLS are used to indicate borderline soil classifications.

The discussion in the text of this report is necessary for a proper understanding of the nature of the material presented in the attached logs.

Earth Solutions NW LLC

Earth Solutions NW
1805 - 136th Place N.E., Suite 201
Bellevue, Washington 98005
Telephone: 425-449-4704
Fax: 425-449-4711

TEST PIT NUMBER TP-1

PROJECT NUMBER ES-6182 **PROJECT NAME** 97th Avenue SFR

DATE STARTED 7/10/18 **COMPLETED** 7/10/18 **GROUND ELEVATION** 72 ft **TEST PIT SIZE**

EXCAVATION CONTRACTOR NW Excavating **GROUND WATER LEVELS:**

EXCAVATION METHOD

AT TIME OF EXCAVATION ---

LOGGED BY CGH **CHECKED BY** SSR **AT END OF EXCAVATION** ---

NOTES Depth of Topsoil & Sod 6": brush **AFTER EXCAVATION** ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elev.
0			TPSL	0.5	Dark brown TOPSOIL, root intrusions to 2'	71.5
			SM	1.5	Brown silty SAND, loose, moist (Fill) -light plastic debris	70.5
		MC = 19.20%	ML		Gray sandy SILT, medium dense, moist	
5		MC = 23.40% Fines = 90.70%			-becomes silt, dense -minor iron oxide staining [USDA Classification: slightly gravelly LOAM]	
		MC = 29.50%				
		MC = 20.70%		9.0		63.0

Test pit terminated at 9.0 feet below existing grade. No groundwater encountered during excavation. No caving observed.

Bottom of test pit at 9.0 feet.

Earth Solutions NW
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Bellevue, Washington 98005
Telephone: 425-449-4704
Fax: 425-449-4711

TEST PIT NUMBER TP-2

PROJECT NUMBER ES-6182 **PROJECT NAME** 97th Avenue SFR

DATE STARTED 7/10/18 **COMPLETED** 7/10/18 **GROUND ELEVATION** 82 ft **TEST PIT SIZE**

EXCAVATION CONTRACTOR NW Excavating **GROUND WATER LEVELS:**

EXCAVATION METHOD

AT TIME OF EXCAVATION ---

LOGGED BY CGH **CHECKED BY** SSR **AT END OF EXCAVATION** ---

NOTES Surface Conditions: brush/grass **AFTER EXCAVATION** ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0			SM	1.0	Brown silty SAND, loose, moist (Fill) -minor plastic debris, root intrusions to 4'	81.0
		MC = 11.60% Fines = 68.80%	ML		Gray sandy SILT, very dense, moist -moderate iron oxide staining [USDA Classification: slightly gravelly LOAM]	
5					-becomes silt	
		MC = 34.00%		6.0		76.0

Test pit terminated at 6.0 feet below existing grade. No groundwater encountered during excavation. No caving observed.

Bottom of test pit at 6.0 feet.

Earth Solutions NW
1805 - 136th Place N.E., Suite 201
Bellevue, Washington 98005
Telephone: 425-449-4704
Fax: 425-449-4711

TEST PIT NUMBER TP-3

PROJECT NUMBER ES-6182 **PROJECT NAME** 97th Avenue SFR

DATE STARTED 7/10/18 **COMPLETED** 7/10/18 **GROUND ELEVATION** 78 ft **TEST PIT SIZE**

EXCAVATION CONTRACTOR NW Excavating **GROUND WATER LEVELS:**

EXCAVATION METHOD

AT TIME OF EXCAVATION ---

LOGGED BY CGH **CHECKED BY** SSR **AT END OF EXCAVATION** ---

NOTES Surface Conditions: brush **AFTER EXCAVATION** ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elevation
0		MC = 18.40% Fines = 62.70%	ML		Brown sandy SILT, loose to medium dense, moist (Fill) -root intrusions to 4' -plastic debris -brick debris [USDA Classification: slightly gravelly LOAM]	
		MC = 18.00%		4.0		74.0
5		MC = 23.10%	ML		Brown sandy SILT, medium dense, moist -light iron oxide staining -becomes gray silt, dense	
		MC = 24.70%		8.0		70.0

Test pit terminated at 8.0 feet below existing grade. No groundwater encountered during excavation. No caving observed.

Bottom of test pit at 8.0 feet.

Earth Solutions NW, LLC
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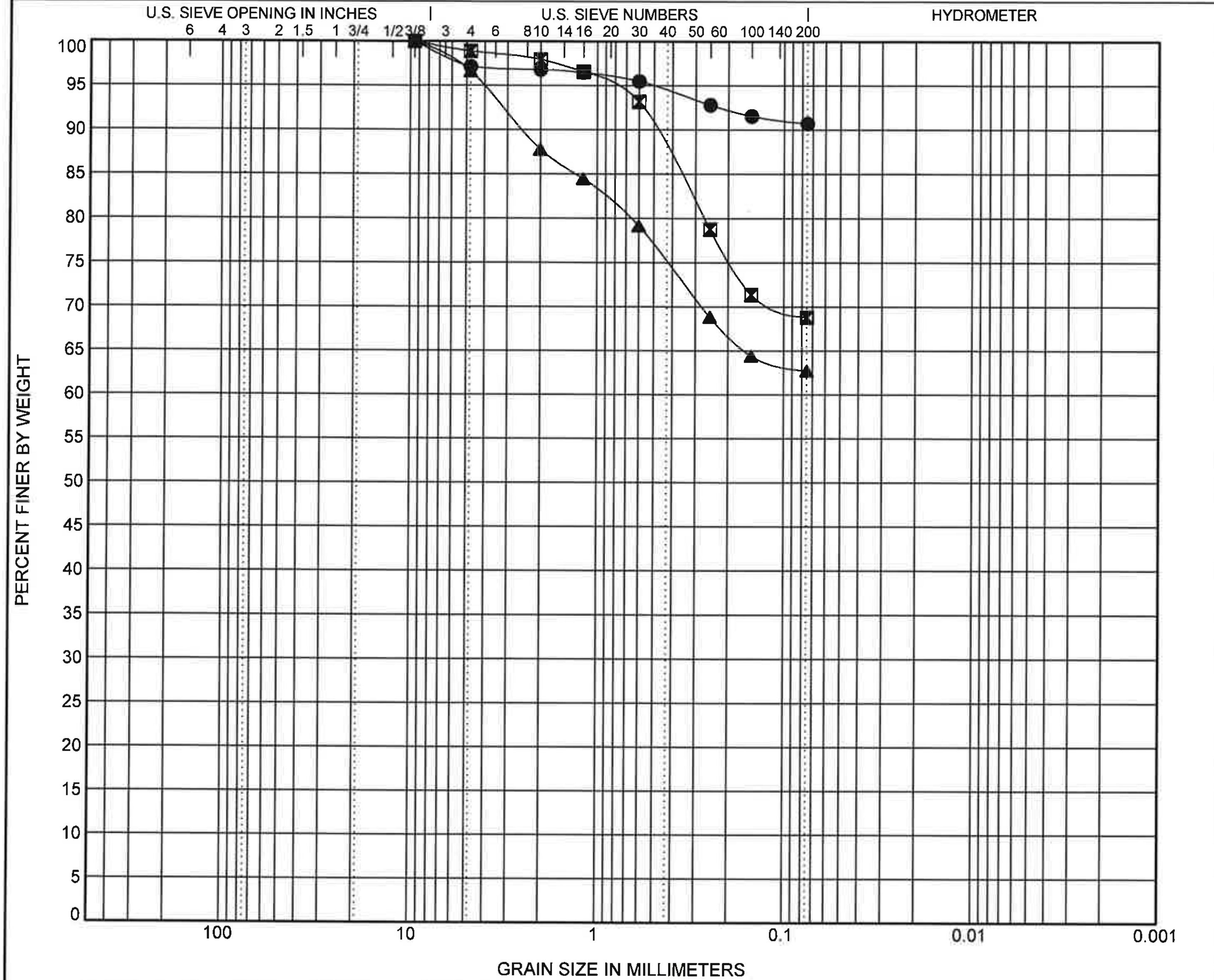
Bellevue, WA 98005
Telephone: 425-449-4704
Fax: 425-449-4711

GRAIN SIZE DISTRIBUTION

PROJECT NUMBER ES-6182 **PROJECT NAME** 97th Avenue SFR



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification		Classification	Cc	Cu
● TP-01	5.00ft.	USDA: Gray Slightly Gravelly Loam. USCS: ML.		
⊠ TP-02	2.00ft.	USDA: Gray Slightly Gravelly Loam. USCS: Sandy ML.		
▲ TP-03	2.00ft.	USDA: Gray Slightly Gravelly Loam. USCS: Sandy ML.		

Specimen Identification		D100	D60	D30	D10	LL	PL	PI	%Silt	%Clay
● TP-01	5.0ft.	9.5							90.7	
⊠ TP-02	2.0ft.	9.5							68.8	
▲ TP-03	2.0ft.	9.5							62.7	

ATTACHMENT E – DOWNSTREAM ANALYSIS

DOWNSTREAM DRAINAGE SYSTEM ANALYSIS

Date: 5/10/2019

Project: 3440 97th Ave SE
Owner:
Parcels: 00724059012

Basin: Lake Washington
Subbasin: N/A
Subbasin #: N/A

Date of Inspection: 4/26/2019
Weather: Sunny

Symbol	Drainage Component Type, Name, and Size	Drainage Component Description	Slope	Length	Distance from site discharge			Existing Problems	Potential Problems	Observations of field inspector, resource reviewer, or resident
see map	Type: sheet flow, swale, stream, channel, pipe, pond; Size: diameter, surface area	drainage basin, vegetation, cover, depth, type of sensitive area, volume	%	ft	¼ ml = 1,320 ft.			constrictions, under capacity, ponding, overtopping, flooding, habitat or organism destruction, scouring, bank sloughing, sedimentation, incision, other erosion		tributary area, likelihood of problem, overflow pathways, potential impacts
1 to 4	From catch basin #1 through 8" corrugated inlet to manhole #2 in 97th Ave SE.	Pavement	2.0%	90	0	to	90	No Problems	No Problems	None
4 to 6	From manhole #2 through 12" concrete pipe to catch basin #3 in 97th Ave SE.	Pavement	2.0%	90	90	to	180	No Problems	No Problems	None
6 to 8	From catch basin #3 through 12" concrete pipe to catch basin #4 in 97th Ave SE.	Pavement	2.0%	140	180	to	320	No Problems	No Problems	None
8 to 9	From catch basin #4 through 12" concrete pipe to catch basin #5 in 97th Ave SE.	Pavement	2.0%	105	320	to	425	No Problems	No Problems	None
9 to 11	From catch basin #5 through 12" concrete pipe to catch basin #6 in 97th Ave SE.	Pavement	2.0%	105	425	to	530	No Problems	No Problems	None
11 to 13	From catch basin #6 through 12" concrete pipe to catch basin #7 in 97th Ave SE.	Pavement/Landscape	2.0%	15	530	to	545	No Problems	No Problems	None
13 to 15	From catch basin #7 through 12" concrete pipe to catch basin #8 in 97th Ave SE.	Landscape	2.0%	50	545	to	595	No Problems	No Problems	None
15 to 17	From catch basin #8 through 12" concrete pipe to catch basin #9 in 97th Ave SE.	Landscape	2.0%	15	595	to	610	No Problems	No Problems	None
17 to 18	From catch basin #9 through 12" concrete pipe to manhole #10 in 97th Ave SE.	Landscape	2.0%	50	610	to	660	No Problems	No Problems	None

DOWNSTREAM DRAINAGE SYSTEM ANALYSIS

Date: 5/10/2019

DOWNSTREAM DRAINAGE SYSTEM ANALYSIS

Date: 5/10/2019

Project: 3440 97th Ave SE
Owner:
Parcels: 00724059012

Basin: Lake Washington
Subbasin: N/A
Subbasin #: N/A

Date of Inspection: 4/26/2019
Weather: Sunny

Symbol see map	**Drainage Component Type, Name, and Size** Type: sheet flow, swale, stream, channel, pipe, pond; Size: diameter, surface area	**Drainage Component Description** drainage basin, vegetation, cover, depth, type of sensitive area, volume	**Slope** %	**Length** ft	**Distance from site discharge** ¼ ml = 1,320 ft.			**Existing Problems**	**Potential Problems**	**Observations of field inspector, resource reviewer, or resident** tributary area, likelihood of problem, overflow pathways, potential impacts
								constrictions, under capacity, ponding, overtopping, flooding, habitat or organism destruction, scouring, bank sloughing, sedimentation, incision, other erosion		
1 to 4	From catch basin #1 through 8" corrugated inlet to manhole #2 in 97th Ave SE.	Pavement	2.0%	90	0	to	90	No Problems	No Problems	None
4 to 6	From manhole #2 through 12" concrete pipe to catch basin #3 in 97th Ave SE.	Pavement	2.0%	90	90	to	180	No Problems	No Problems	None
6 to 8	From catch basin #3 through 12" concrete pipe to catch basin #4 in 97th Ave SE.	Pavement	2.0%	140	180	to	320	No Problems	No Problems	None
8 to 9	From catch basin #4 through 12" concrete pipe to catch basin #5 in 97th Ave SE.	Pavement	2.0%	105	320	to	425	No Problems	No Problems	None
9 to 11	From catch basin #5 through 12" concrete pipe to catch basin #6 in 97th Ave SE.	Pavement	2.0%	105	425	to	530	No Problems	No Problems	None
11 to 13	From catch basin #6 through 12" concrete pipe to catch basin #7 in 97th Ave SE.	Pavement/Landscape	2.0%	15	530	to	545	No Problems	No Problems	None
13 to 15	From catch basin #7 through 12" concrete pipe to catch basin #8 in 97th Ave SE.	Landscape	2.0%	50	545	to	595	No Problems	No Problems	None
15 to 17	From catch basin #8 through 12" concrete pipe to catch basin #9 in 97th Ave SE.	Landscape	2.0%	15	595	to	610	No Problems	No Problems	None
17 to 18	From catch basin #9 through 12" concrete pipe to manhole #10 in 97th Ave SE.	Landscape	2.0%	50	610	to	660	No Problems	No Problems	None

DOWNSTREAM DRAINAGE SYSTEM ANALYSIS

Date: 5/10/2019

ATTACHMENT F – OPERATION AND MAINTENANCE MANUAL

3440 97th Ave SE SFR
Operation and Maintenance Manual

Person or Organization Responsible for Maintenance of the On-Site Storm System:

In My Backyard, LLC
Rick Posmantur
4701 W Mercer Way
Mercer Island, WA 98040

The Location Where the Operation and Maintenance Manual is to be Kept:

3440 97th Ave SE
Mercer Island, WA 98040

*Note: The manual and maintenance activity log must be made available to the City of Mercer Island for inspection purposes.

Description of On-Site Storm System

The on-site storm system for 3440 97th Ave SE consists of 3-6" conveyance pipe, stormwater pump station, 12" area drain, and a Type 1 catch basin.

Stormwater runoff from the proposed single-family residence will be captured in a gutter and downspout system and conveyed to a stormwater pump station. Drainage from the driveway will be collected by a Type I catch basin with 2' sump and oil/water separator prior to being routed to the stormwater pump station. Additionally, subsurface drainage will be collected by perforated PVC building footing drains and routed to a 12" area drain with a 2' sump for sedimentation before being conveyed to the stormwater pump station. Stormwater will then be pumped from the stormwater pump station located north of the house to a cleanout located at the top of the driveway before being routed to the public storm main in 97th Ave SE.

The Type I catch basin, stormwater pump station, 12" area drain, and storm drain cleanouts serve as source control of pollution for the project site. In order to control pollutants, proper maintenance and cleaning of debris, sediments, and oil from stormwater collection and conveyance systems is required per the operation and maintenance recommendations found in Volume 5 Section 4.6 of the Stormwater Manual in addition to the BMPs in Volume IV Section 2.2. See the attached sheets for operation and maintenance requirements pertaining to the project.

Contact Information for Stormwater Facility Manufacturers and Installers:

Contractor (Installer of On-Site Stormwater Facilities)
TBD

Civil Engineer (Designer of On-Site Stormwater Facilities)
Ben Iddins, P.E.
Davido Consulting Group, Inc
9706 4th Ave NE, Suite 300
Seattle, WA 98115
Phone – 206.523.0024 Ext. 115
ben@dcgengr.com

Attachments

- Operation and Maintenance Manual for Control Structures and Catch Basins (2012 DOE Manual)
- Maintenance Instructions for Stormwater Pump Station

Maintenance. Control structures and catch basins have a history of maintenance-related problems and it is imperative to establish a good maintenance program for them to function properly. Typical sediment builds up inside the structure, which blocks or restricts flow to the inlet. To prevent this problem routinely clean out these structures at least twice per year. Conduct regular inspections of control structures to detect the need for non-routine cleanout, especially if construction or land-disturbing activities occur in the contributing drainage area.

Instal a 15-foot wide access road to the control structure for inspection and maintenance.

Table 3.2.5 provides maintenance recommendations for control structures and catch basins.

Table 3.2.5
Maintenance of Control Structures and Catchbasins

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 securely attached to wall and outlet pipe.
		Structure is not in upright position (allow up to 10% from plumb).	Structure in correct position.
		Connections to outlet pipe are not watertight and show signs of rust.	Connections to outlet pipe are water tight; structure repaired or replaced and works as designed.
		Any holes--other than designed holes--in the structure.	Structure has no holes other than designed holes.
Cleanout Gate	Damaged or Missing	Cleanout gate is not watertight or is missing.	Gate is watertight and works as designed.
		Gate cannot be moved up and down by one maintenance person.	Gate moves up and down easily and is watertight.
		Chain/rod leading to gate is missing or damaged.	Chain is in place and works as designed.
		Gate is rusted over 50% of its surface area.	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 3.4	See Table 3..4	See Table 3.4
CATCH BASINS			

Table 3.2.5
Maintenance of Control Structures and Catchbasins

Maintenance Component	Defect	Condition 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%.	No Trash or debris located immediately in front of catch basin or on grate opening.
		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.	No trash or debris in the catch basin.
		Trash or debris in any inlet or outlet pipe blocking more than 1/3 of its height.	Inlet and outlet pipes free of trash or debris.
		Dead animals or vegetation that could generate odors that could cause complaints or dangerous gases (e.g., methane).	No dead animals or vegetation present within 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. Measured from the bottom of basin to invert of the lowest pipe into or out of the basin.	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).	Top slab is free of holes and cracks.
		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	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.	Basin replaced or repaired to design standards.
		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.	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.	No vegetation blocking opening to basin.
		Vegetation growing in inlet/outlet pipe joints that is more than six inches tall and less than six inches apart.	No vegetation or root growth present.
	Contamination and Pollution	See "Detention Ponds".	No pollution present.

Table 3.2.5 Maintenance of Control Structures and Catchbasins			
Maintenance Component	**Defect**	**Condition When Maintenance is Needed**	**Results Expected When Maintenance is Performed**
Catch Basin Cover	Cover Not in Place	Cover is missing or only partially in place. Any open catch basin requires maintenance.	Catch basin cover 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.	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 and meets design standards.

Methods of Analysis

This section presents the methods and equations for design of **control structure restrictor devices.** Included are details for the design of orifices, rectangular sharp-crested weirs, v-notch weirs, sutro weirs, and overflow risers.

Orifices. Flow-through orifice plates in the standard tee section or turn-down elbow may be approximated by the general equation:

$$Q = C\,A\sqrt{2gh} \qquad \text{(equation 4)}$$

where
Q = flow (cfs)
C = coefficient of discharge (0.62 for plate orifice)
A = area of orifice (ft^2)
h = hydraulic head (ft)
g = gravity (32.2 ft/sec^2)

Figure 3.2.12 illustrates this simplified application of the orifice equation.

MAINTENANCE INSTRUCTIONS FOR STORMWATER PUMP STATION:

Your property contains a drainage facility called "Stormwater Pump Station," which was installed on the northeast side of the single-family residence and pumps stormwater to a cleanout located at the top of the driveway. Pump manufacturer maintenance recommendations shall be followed and supersede the recommendations in this document if conflicts occur. The Stormwater Pump Station shall be maintained as follows:

The Stormwater Pump Station is to be inspected annually and after major storm events. A typical maintenance inspection should include a visual inspection of the pumps, pump components, and structure housing the pumps, to identify and repair any physical defects. Pump floats shall be inspected and cleaned to prevent excessive sediment and grease buildup on the floats, which can prevent the floats from working properly. Check valves are to be inspected and tested to ensure they are in good working order and to prevent backflow from the force mains to the pump station. All electrical connections and components shall be inspected to ensure there are no poor connections or loose parts. Inspect the impellers and internal wear components of the pumps for corrosion, erosion, and cavitation. The alarm system shall be inspected and tested to ensure it is in good working order.

If any portion of the structure housing the pump station, including but not limited to the cover/lid, ladder rungs, or side walls are missing or damaged, they must be repaired immediately. The structure housing the pump station shall have a lid that is flush with the surrounding grade and locked at all times other than during maintenance activities. Sediment shall be removed from the pump station if accumulation depth exceeds 4 inches.