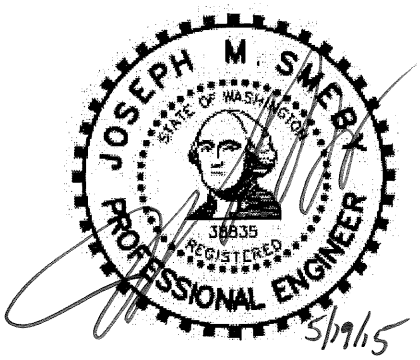
Drainage Report
Sky View Ridge
PFN: M2015-

for

Rick Hansen
P.O. Box 2289
Snohomish, WA 98291

SITE LOCATION:
13207 & 13221 191st Ave SE
Monroe, WA 98272



Prepared by:
Joseph M. Smeby, P.E.

Job No: 15-02093
May 2015

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1. INTRODUCTION

This document is intended to provide engineering information necessary to support the preliminary plat application to the City of Monroe for the three phase 31 lot sub-division proposed on this site. The site covers 11.4 acres, of which approximately 9.0 acres will be cleared as a result of this project. Improvements to the east side of 191st Ave SE along this projects frontage along with a new road connection to the future 133rd St SE, as part of the Eaglemont Plat Phase 4 new public roads within the sub-division will be part of the application.

This project proposes to construct new public roads within the plat to serve the future lots. In addition, frontage improvements along the east side of 191st including new pavement, curb, planter and sidewalk will be constructed along the west side of the plat. This project will require the construction of driveways for each future lot, stormwater facilities and other utilities. The existing on-site soils are sandy loam so infiltration will not be viable for this project. The proposed detention system will provide combined detention/water quality in open ponds/vaults.

2. DRAINAGE INFORMATION SUMMARY FORM

Project: **Sky View Ridge**
PFN: **M2015-**
Engineer: **Omega Engineering, Inc.**
2707 Wetmore Ave
Everett, WA 98201
Attention: Joseph Smeby, P.E.

Total site area: **11.40 acres**
Offsite area: **0.12 acres**
Disturbed area: **9.00 acres**

Applicant: **Hanson Homes**
P.O. Box 2289
Snohomish, WA 98291

Number of lots/Bldg: **31**

Drainage Basin Information	**West Basin**	**East Basin**
On-site Developed Area	5.40 acres	3.60 acres
Off-site Improved Area	0.12 acres	0.00 acres
Types of storage proposed	Detention Pond/Vault	Detention Pond/Vault
Approximate total storage volume	91,900 cf per calc	60,900 cf per calc
Soil Types	Type C	Type C
Basin Data		
Pre-developed run-off rates: 2-year	0.18 cfs	0.12 cfs
10-year	0.34 cfs	0.22 cfs
100-year	0.63 cfs	0.42 cfs
Post-developed run-off rates: 2-year	0.09 cfs	0.06 cfs
10-year	0.16 cfs	0.11 cfs
100-year	0.26 cfs	0.20 cfs

3. EXISTING SITE CHARACTERISTICS and ASSUMPTIONS

The site is located east of 191st Ave SE and north of the Eaglemont Plat, and in Section 36, Township 28N, Range 6E, Willamette Meridian. See Figure 1 - Vicinity Map. The entire property consists of a multiple lots totaling 11.4 acres.

Land use around the site is single-family residential. This site currently contains some single-family buildings. Frontage improvements will be required along 191st Ave SE which will include pavement widening, curb, gutter, planter and sidewalk. In addition approximately 150-feet of road extension for 194th Dr Se will be required to connect this projects improvements to the future road improvements within the Eaglemont Plat at the intersection of 194th Dr. SE and 133rd St SE.

The existing site is irregular in shape approximately 1,320-feet long running east-west and 330 to 660-feet running north-south. The grades on the site are moderate. The vegetation found on the existing property is a mixture of landscaping including grasses and shrubs and native vegetation.

Grades on the site generally run from north to south for the westerly basin and west to east for the easterly basin. The existing soils on this site are sandy loam, which is considered Till. Please refer to the attached geotechnical report in Appendix C for further discussion of the existing on-site soils. A site visit was conducted on April 17, 2015. The weather was overcast with temperatures in the 50's. No surface water was observed on this site.

The soil hydrologic types for this site have been identified as Type C or Till from the Snohomish County Soil Survey Map, see figure 5. The soil type mapped for this site is Ragnar fine sandy loam. Soil tests on this site found weathered till under 10-18" of topsoil. With hardpan at 1.8-2.5'. Refer to Geotechnical Report in Appendix C. The project Geotech therefore has not recommended that infiltration be used for this project.

4. NARRATIVE OF DEVELOPED SITE CHARACTERISTICS

This development proposes to create 31 new lots in three phases. The detention systems for both basins have been sized to meet the 2005 DOE stormwater flow control and water quality standards.

The undisturbed area is mainly in the power line easement area and the Cat. III wetland and buffer area. These areas will be collected in the on-site conveyance system and flow through the detention/water quality ponds. The storm drainage systems for this project have been designed to collect, treat and detain all of the new landscaping and impervious areas on this site. The off-site new impervious areas within 191st Ave SE will be collected but the improvements in 194th Dr SE south of the project cannot be collected since that area is lower than the site.

The detention and water quality systems have been designed using the WWHM3 software and meet the current State and City standards.

4A. DOE MINIMUM REQUIREMENTS

MINIMUM REQUIREMENT #1: PREPARATION OF STORMWATER SITE PLANS

This project proposes to construct new impervious surfaces in excess of the minimum threshold so a final stormwater site plan will be prepared with the full engineering plans for this project.

MINIMUM REQUIREMENT #2: CONSTRUCTION STORMWATER POLLUTION PREVENTION (SWPPP)

1: Mark Clearing Limits
One of the first steps in the "Construction Sequence" included on the clearing and grading plan sheets is for a surveyor to stake the limits of clearing and to have construction or silt fencing placed along the limits prior to any other construction activity.

2: Establish Construction Access
The SWPPP calls for the proposed construction entrance to be installed as the second step after the staking of clearing limits. A detail is provided on the plans.

3: Control Flow Rates
This project will construct the two detention/water quality pond/vaults as a first step. These will be used as sediment ponds during construction and the control structure will be in place to attenuate flows throughout construction.

4: Install Sediment Controls
This site and SWPPP proposes to construct a construction entrance to collect and contain the sediment on this site. In addition, inlet filters will be installed in the existing catch basins adjacent to the site. and straw bale check dams will be installed in the ditch along the east side of 191st Ave SE. Interceptor swales with check dams will be used on-site to capture runoff and direct it to the necessary sediment pond/vault. These features are intended to minimize the opportunity for sediment to leave the site via stormwater or on vehicles. The construction of these features is one of the first items required in the "Construction Sequence".

5: Stabilize Soils
The "Construction Sequence" and "TESC Notes" call for the stabilization of soils that remain unworked for certain lengths of time based on the time of year. Stabilization techniques may include but not limited to mulching, plastic sheeting or hydroseeding, notes have been added to the plan regarding protection for the stock pile area if necessary.

6: Protect Slopes
No slopes are expected on this site; however, any stockpile area will be protected as noted above.

7: Protect Drain Inlets
All existing & proposed catch basins and area drains will have inlet filters installed to protect the conveyance system.

8: Stabilize Channels and Outlets
Straw bale check dams will be used in the ditch along the east side of 191st Ave SE. Also, interceptor swales with check dams. These features will protect the existing and proposed channels from erosion.

9: Control Pollutants
No outside chemicals are expected to be necessary for the construction of this project. All vehicles working on and around the site would need to meet the State requirements for emissions.

10: Control DeWatering
Dewatering runoff will be directed to one of the two detention/water quality pond/vault systems. The contractor shall monitor the sediment pond/vault to ensure no erosion or excessive sedimentation occurs in the disposal areas.

11: Maintain BMPs
The construction supervisor will be responsible for maintaining all BMPs during construction and working with the City to relocate or add BMPs as necessary as site conditions change.

12: Manage the Project
It will be the responsibility of the Contractor and Developer to manage this project and coordinate with the City Inspector and Engineer.

Inspection and Monitoring:
Site inspections shall be done by a person who is knowledgeable in the principles and practices of erosion and sediment control. The person must have skills to first assess the site conditions and construction activities that could impact the quality of stormwater, and second assess the effectiveness of erosion and sediment control measures used to control the quality of stormwater discharges.
Whenever inspection and/or monitoring reveals that the BMPs identified in the Construction SWPPP are inadequate, due to the actual discharge of or potential to discharge a significant amount of any pollutant, appropriate BMPs or design changes shall be implemented as soon as possible.

Maintaining an Updated Construction SWPPP:
The construction SWPPP shall be retained on-site or within reasonable access to the site.

The SWPPP shall be modified whenever there is a change in the design, construction, operation, or maintenance at the construction site that has, or could have, a significant effect on the discharge of pollutants to waters of the state.

The SWPPP shall be modified if, during inspections or investigations conducted by the owner/operator, or the applicable local or stae regulatory authority, it is determined that the SWPPP is ineffective in eliminating or significantly minimizing pollutants in stormwater discharges from the site. The SWPPP shall be modified as necessary to include additional or modified BMPs designed to correct problems identified. Revisions to the SWPPP shall be completed within seven days following inspection.

MINIMUM REQUIREMENT #3: SOURCE CONTROL OF POLLUTANTS

The improvements proposed on this site will create 31-lots and new public roads. Residential sub-divisions do not require additional source control BMPS, but basic water quality is proposed on this site.

MINIMUM REQUIREMENT #4: PRESERVATION OF NATURAL DRAINAGE SYSTEMS AND OUTFALLS

The east and west basin outfalls will be connected to the conveyance system for the Eaglemont Plat. These are the natural downstream locations since that plat borders this project to the south and east.

MINIMUM REQUIREMENT #5: ON-SITE STORMWATER MANAGEMENT

Runoff from the new public road and future lots will be collected CBs and conveyed to one of two detention/water quality systems for this project. Roof runoff from each future SFR will be directed to an individual perforated stubout connection before discharging into the conveyance system within the future road right-of-way. The landscaping will be graded to drain toward the lot yard drains to the maximum extent feasible.

MINIMUM REQUIREMENT #6: RUNOFF TREATMENT

A combined detention/water quality pond/vault is proposed for both the east and west basins. This design meets the basic water quality treatment requirement for residential projects.

MINIMUM REQUIREMENT #7: FLOW CONTROL

The design and analysis for this project requires the construction of two pond/vault systems, one for each basin. Each system has been sized using the WWHM3 software.

MINIMUM REQUIREMENT #8: WETLAND PROTECTION

The existing on-site wetland within the power line easement will be protected within tracts 993 & 994. the buffer and open space tracts surrounding the wetland will aid in maintaining the existing hydrology.

MINIMUM REQUIREMENT #9: BASIN/WATERSHED PLANNING

The scope of this project is too small to justify a Watershed Plan.

MINIMUM REQUIREMENT #10: OPERATION AND MAINTENANCE

A complete O&M manual will be provided with the full drainage report.

5. DESCRIPTION OF PROPOSED EROSION CONTROL BMP's

Clearing, grading, and temporary erosion and sediment control plans have be prepared for all phases of this project. However, since a construction site is dynamic it will be necessary to re-assess the erosion control BMP's during construction and install additional measures when and if necessary.

Proposed temporary measures for this project will include the following BMP's:
-Installation of stabilized rock construction entrance(s).
-Interceptor swales
-Rip-Rap check dams
-Straw mulch, hydroseed or other mulching and planting method to stabilized unworked areas.
-Silt Fencing
-Sediment Pond/Vault

Permanent measures to reduce or eliminate erosion or water quality degradation will include the following BMP's: (Under Future Phase/Permit)
-Paving all traffic areas
-Drainage collection system, including catch basins and floatable material separators
-Permanent landscaping in pervious areas.
-Limiting cut and fill slopes to 2:1 maximum
-Routine maintenance and inspection of the grounds and response to developing problems.

These proposed erosion control BMP's have been engineered for anticipated conditions in compliance with DOE guidelines. With proper installation, maintenance and inspection the proposed BMP's should result in minimal impact to the surrounding environment. The City retains the authority by code to require additional measures should the existing measures prove insufficient.

A. SITE GRADING/EROSION CONTROL RISK ASSESSMENT

SLOPE: Existing grades onsite slope down from north to south to northwest to southeast ranging from 2.0% to approximately 8.0%. The proposed internal road grades will be no greater than 2%.
CRITICAL AREAS: Cat. III Wetland on-site.
SOILS: In the development area of the site soils are hydrologic group C, (from Geotechnical Report).
GROUND MOVEMENT POTENTIAL: N/A
SOURCES OF WATER FOR EROSION: Rainfall will be the only significant source of onsite runoff.
MEASURES PROPOSED TO PREVENT/MINIMIZE EROSION:
TEMPORARY MEASURES: Mulch cover, rock construction entrance(s), diversion swales, silt fencing are all proposed to be used to prevent or minimize erosion and siltation during construction.
PERMANENT MEASURES: Future measures will include permanent vegetative cover in pervious areas, limiting permanent cut and fill slopes to 2:1 maximum unless protected with a rockery face, asphalt pavement to stabilize all vehicle traffic areas and a piped conveyance system to control the location of runoff release. Routine maintenance of the grounds and response to developing problems will be a function of the property owner.
CONCLUSION: Proposed erosion control BMP's in compliance with DOE guidelines have been engineered for anticipated conditions. Civil construction plans include a detailed ESC plan that provides details and notes for the proposed BMP's. With proper installation, maintenance and inspection, the proposed BMP's should result in minimal impact to the surrounding environment. Based on the above information the Erosion Risk for this site is Low to Moderate. Reports, studies and designs for this site include:

SEPA Checklist, by Others
Preliminary Engineering Construction Plans, by Omega Engineering, Inc.
Getechnical Report, by Liu & Associates, Inc.

B. Minimum Elements

1: Mark Clearing Limits
One of the first steps in the "Construction Sequence" included on the clearing and grading plan sheets is for a surveyor to stake the limits of clearing and to have construction or silt fencing placed along the limits prior to any other construction activity.

2: Establish Construction Access
The SWPPP calls for the proposed construction entrance to be installed as the second step after the staking of clearing limits. A detail is provided on the plans.

3: Control Flow Rates
This project will construct the two detention/water quality pond/vaults as a first step. These will be used as sediment ponds during construction and the control structure will be in place to attenuate flows throughout construction.

4: Install Sediment Controls
This site and SWPPP proposes to construct a construction entrance to collect and contain the sediment on this site. In addition, inlet filters will be installed in the existing catch basins adjacent to the site. and straw bale check dams will be installed in the ditch along the east side of 191st Ave SE. Interceptor swales with check dams will be used on-site to capture runoff and direct it to the necessary sediment pond/vault. These features are intended to minimize the opportunity for sediment to leave the site via stormwater or on vehicles. The construction of these features is one of the first items required in the "Construction Sequence".

5: Stabilize Soils
The "Construction Sequence" and "TESC Notes" call for the stabilization of soils that remain unworked for certain lengths of time based on the time of year. Stabilization techniques may include but not limited to mulching, plastic sheeting or hydroseeding, notes have been added to the plan regarding protection for the stock pile area if necessary.

6: Protect Slopes
No slopes are expected on this site; however, any stockpile area will be protected as noted above.

7: Protect Drain Inlets
All existing & proposed catch basins and area drains will have inlet filters installed to protect the conveyance system.

8: Stabilize Channels and Outlets
Straw bale check dams will be used in the ditch along the east side of 191st Ave SE. Also, interceptor swales with check dams. These features will protect the existing and proposed channels from erosion.

9: Control Pollutants
No outside chemicals are expected to be necessary for the construction of this project. All vehicles working on and around the site would need to meet the State requirements for emissions.

10: Control DeWatering
Dewatering runoff will be directed to one of the two detention/water quality pond/vault systems. The contractor shall monitor the sediment pond/vault to ensure no erosion or excessive sedimentation occurs in the disposal areas.

11: Maintain BMPs
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Whenever inspection and/or monitoring reveals that the BMPs identified in the Construction SWPPP are inadequate, due to the actual discharge of or potential to discharge a significant amount of any pollutant, appropriate BMPs or design changes shall be implemented as soon as possible.

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The SWPPP shall be modified if, during inspections or investigations conducted by the owner/operator, or the applicable local or stae regulatory authority, it is determined that the SWPPP is ineffective in eliminating or significantly minimizing pollutants in stormwater discharges from the site. The SWPPP shall be modified as necessary to include additional or modified BMPs designed to correct problems identified. Revisions to the SWPPP shall be completed within seven days following inspection.

6. OFFSITE DRAINAGE ANALYSIS - UPSTREAM

From field observation and review of the available topography, it appears that some small areas to the north of this project will drain onto the site but the majority of the offsite area to the north drains to the east, away from the site. These flows are negligible in the existing condition and will be collected on-site and passed through the site in the developed condition.

7. OFFSITE DRAINAGE ANALYSIS - DOWNSTREAM

The project is bordered to the south and east by the Eaglemont Plat. Since the proposed plat will account for the upstream offsite flows this project will connect the detention pond/vault outfall to the proposed conveyance system for that plat. Therefore, the project connects into an engineered conveyance system which has been sized to accommodate the existing upstream tributary flows. The release rates from this projected will match or be less than the existing conditions.

8. DETENTION STORAGE CALCULATIONS

Current City code requires this site be analyzed using the 2005 DOE manual and the WWHM3 stormwater software. Since this site proposes using combined detention/water quality ponds/vault the software will be used to size the systems necessary.

The west pond/vault has been sized to accommodate the developed conditions for this project and will release the flows to the south. At this time a level spreader is proposed but the future phases of the Eaglemont Plat will provide a connection point for the vault outfall and the system will be piped through the Eaglemont project.

The east pond/vault has also been sized to accommodate the developed conditions for this project and will release the flows to the south and east. The design will connect the vault outfall to the Eaglemont conveyance system within 133rd St. SE.

Both vaults were sized using the WWHM3 software for both detention and WQ requirements.

Refer to appendix 'A' for the full output from the WWHM3 software.

9. WATER QUALITY DESIGN

Water quality for this project will be provided in the form of a combined detention/water quality pond/vault for each basin. The WWHM3 software was used to calculate the required dead storage volume for each basin.

10. CONVEYANCE CALCULATIONS

All pipes designed for this project will receive less than 2.0 cfs peak flows from the 100-year storm event. The 12" pipes designed have a capacity of over 2.7 cfs and therefore ore then adequate capacity to handle the expected flows.

11. OPERATIONS AND MAINTENANCE MANUAL

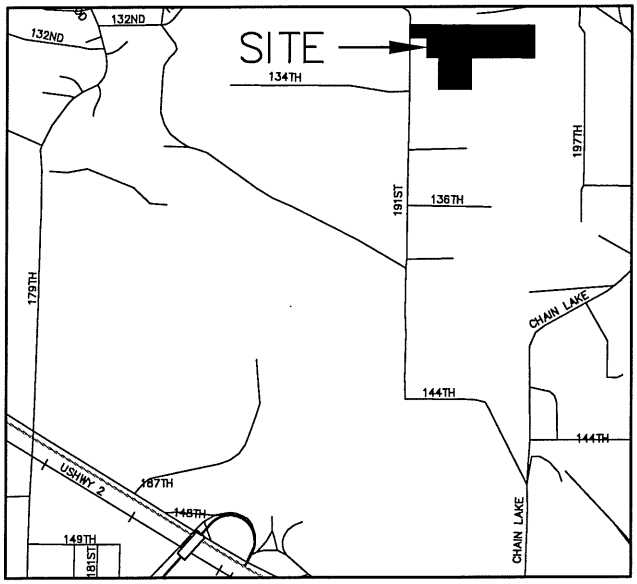
The Property Owners and HOA will be responsible for maintaining the stormwater and landscaping facilities within this development. Included in this manual are checklists for each feature specific to this project. Copies should be made of the checklists as necessary during routine inspections and required maintenance. Specific problems can be recorded along with the appropriate action taken.

These checklists are a guide for inspections and maintenance. The frequency of the inspections/maintenance is identified in the left hand column with the following abbreviations:

A = Annual (March or April preferred)
M = Monthly
S = After Major Storms (Use 1-inch in 24 hours as a guideline)

Routine inspections and maintenance will improve the long-term performance of the stormwater facilities. If at any time you are unsure if a problem exists or how to address a specific problem contact a Professional Engineer.

Refer to Appendix B for a list of each facility to be maintained and the appropriate maintenance checklist.



VICINITY MAP

SCALE 1" = 2000'

N

FIG. 1

OMEGA
ENGINEERING, INC.
2707 WETMORE AVE.
Everett, WA 98201
(o)425.387.3820 (f) 425.259.1958

VICINITY MAP
SKY VIEW RIDGE

DATE	JOB NO.	SCALE	SHEET
5/19/15	15-0209	1" = 2000'	1 OF 1

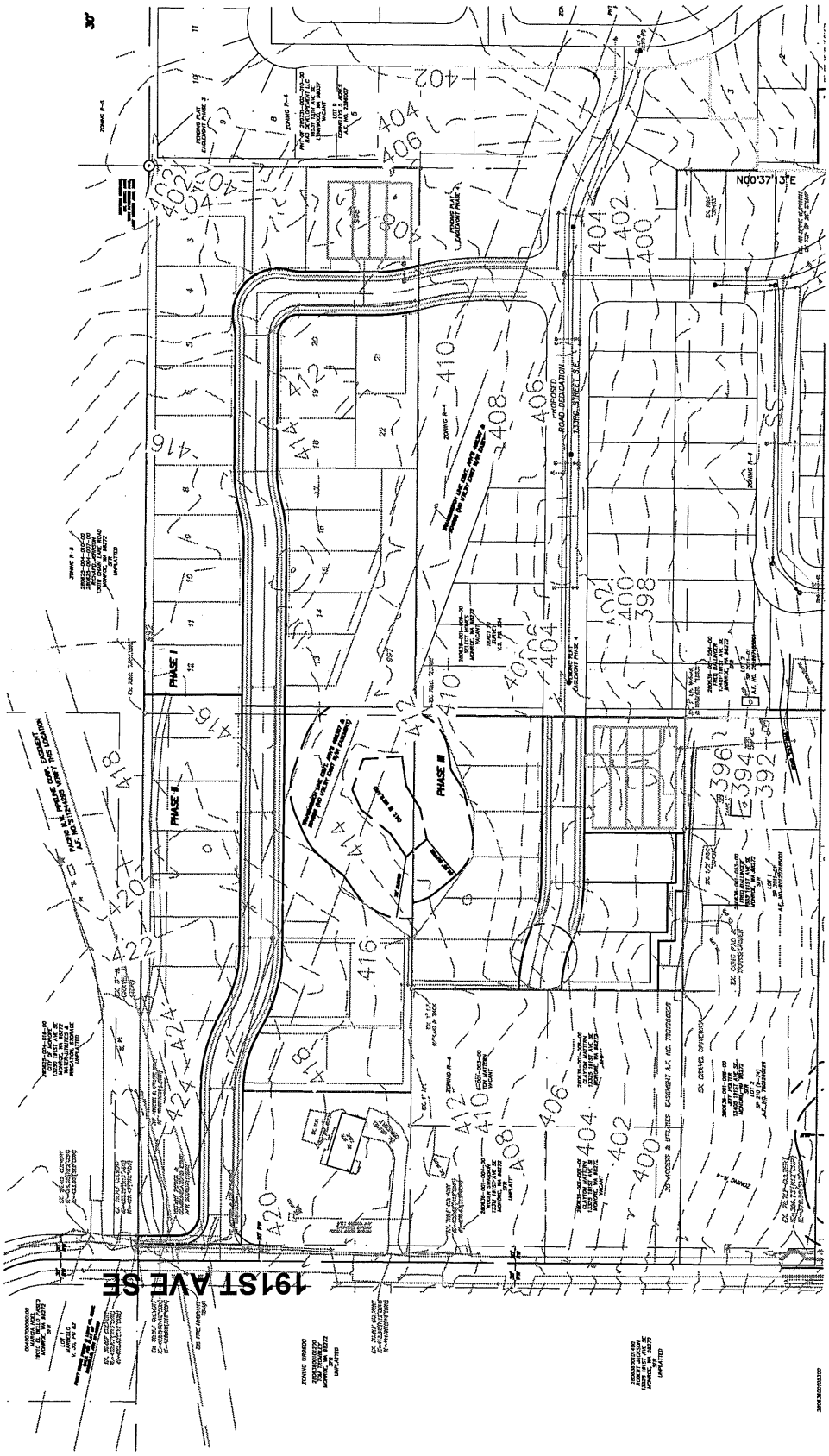


FIG. 2

OMEGA
ENGINEERING, INC.
2707 WETMORE AVE.
Everett, WA 98201
(o)425.387.3820 (f) 425.259.1958

EXISTING BASIN MAP
SKY VIEW RIDGE

DATE	JOB NO.	SCALE	SHEET
5/19/15	15-0209	1" = 200'	1 OF 1

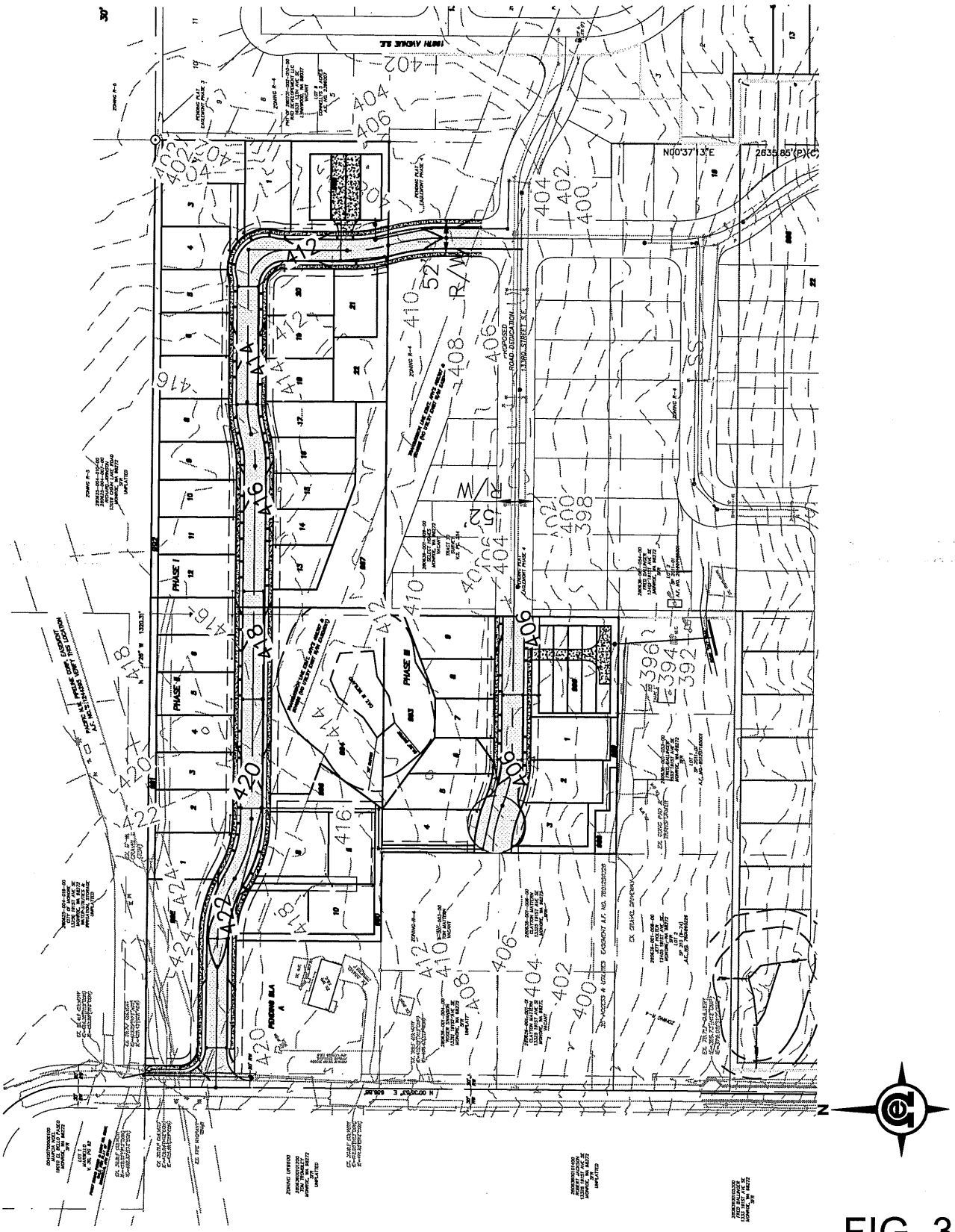


FIG. 3

OMEGA
ENGINEERING, INC.
2707 WETMORE AVE.
Everett, WA 98201
(o)425.387.3820 (f) 425.259.1958

DEVELOPED BASIN MAP
SKY VIEW RIDGE

DATE	JOB NO.	SCALE	SHEET
5/19/15	15-0209	1" = 200'	1 OF 1

Soil Map—Snohomish County Area, Washington
(Sky View Ridge)

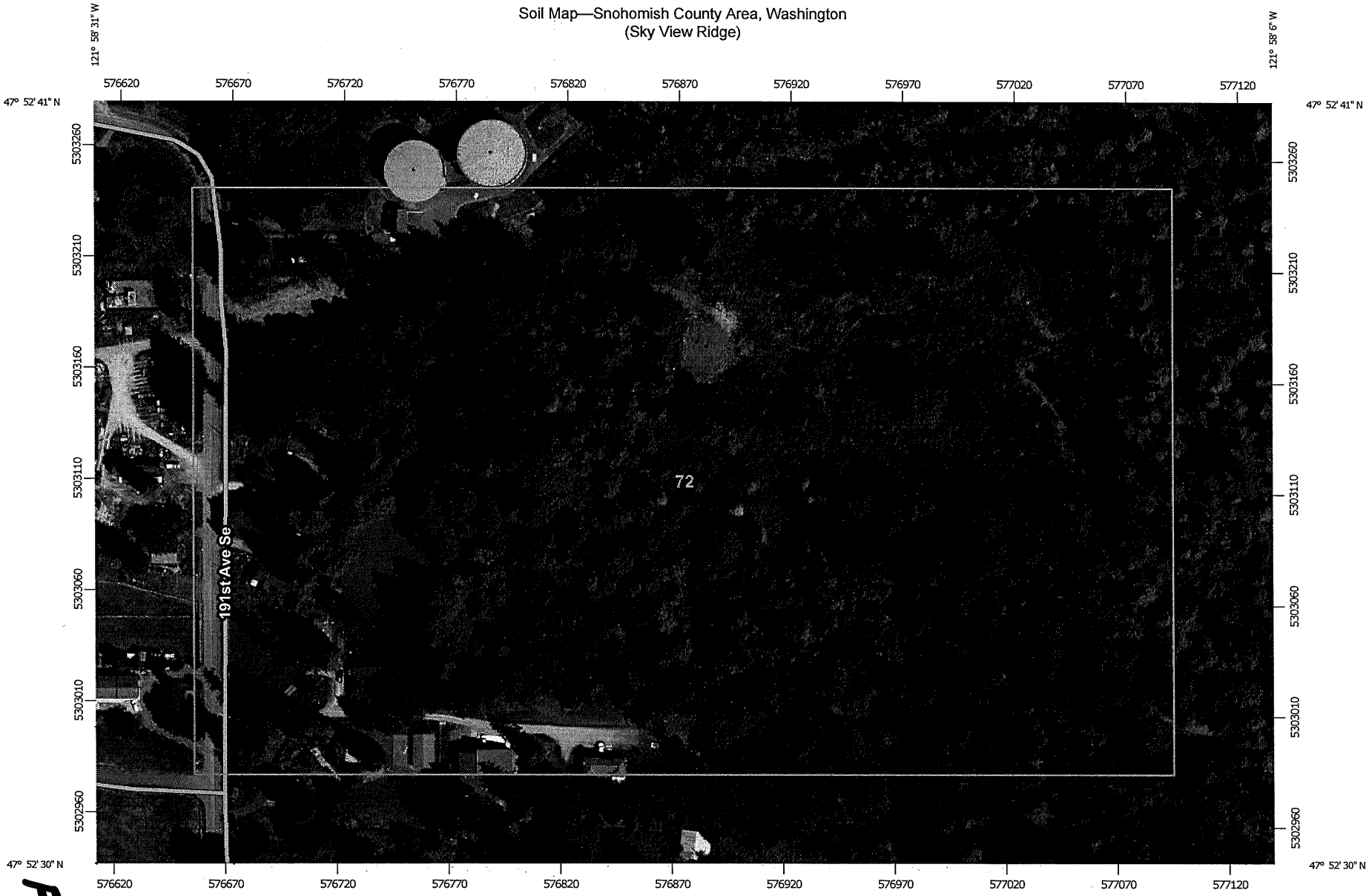


Fig 4

Map Scale: 1:2,410 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 35 70 140 210

Feet: 0 100 200 400 600

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

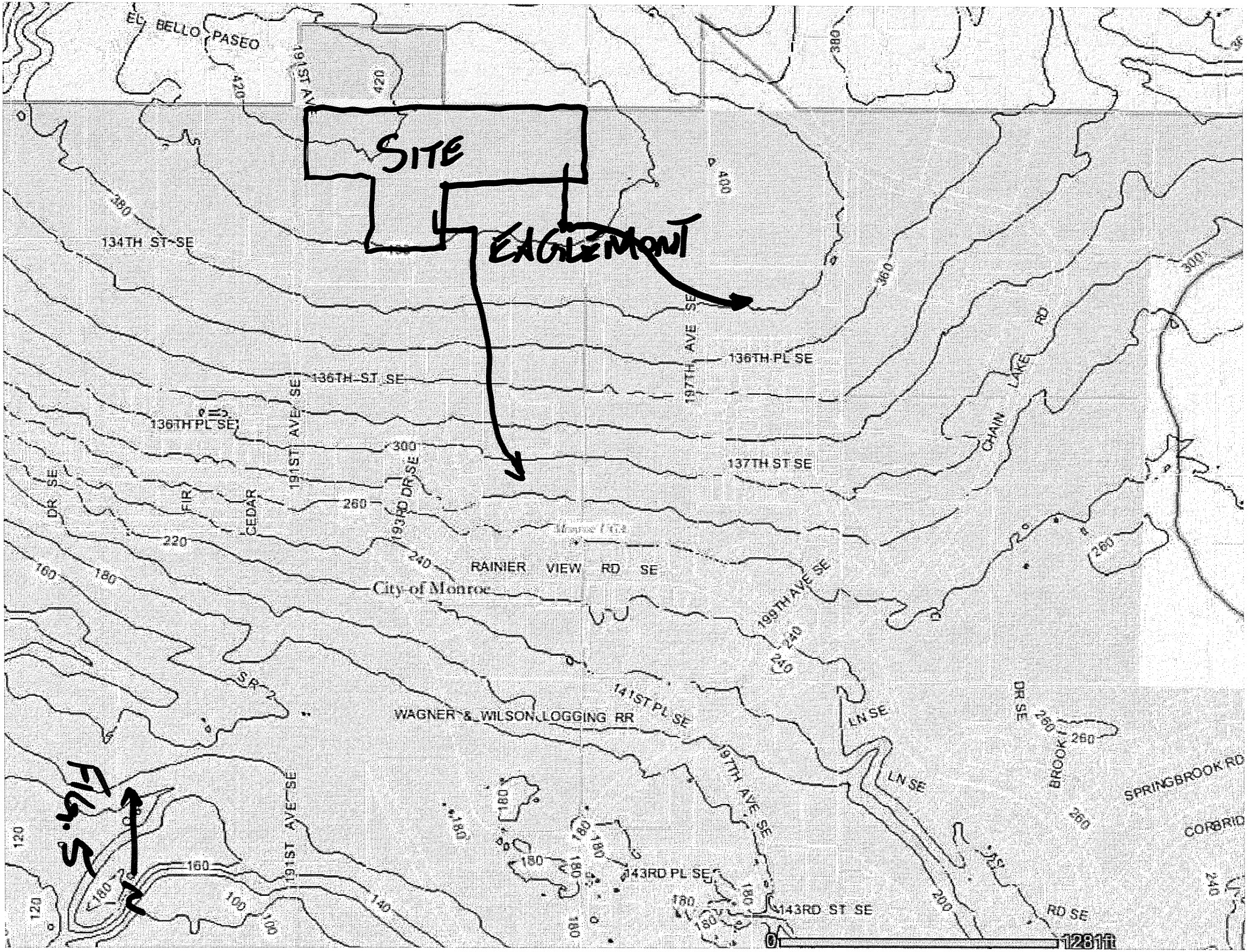

SITE
EAGLEMONT
EL BELLO PASEO
191ST AVE
134TH ST SE
136TH PL SE
136TH ST SE
136TH PL SE
197TH AVE SE
137TH ST SE
CHAIN LAKE RD
191ST AVE SE
193RD DR SE
FIR
CEDAR
DR SE
RAINIER VIEW RD SE
City of Monroe
199TH AVE SE
141ST PL SE
WAGNER & WILSON LOGGING RR
197TH AVE SE
LN SE
BROOK DR SE
SPRINGBROOK RD
143RD PL SE
143RD ST SE
RD SE
0
1281ft

Fig. 5

APPENDIX A

STORMWATER CALCULATIONS

Western Washington Hydrology Model
PROJECT REPORT

Project Name: SouthV
Site Address:
City : Monroe
Report Date : 5/19/2015
Gage : Everett
Data Start : 1948/10/01
Data End : 1997/09/30
Precip Scale: 1.20
WWHM3 Version:

PREDEVELOPED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	Acres
C, Forest, Mod	5.4

Impervious Land Use	Acres

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

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	Acres
C, Lawn, Flat	1.9

Impervious Land Use	Acres
ROADS FLAT	3.5

Element Flows To:
Surface **Interflow** **Groundwater**
Vault 1, Vault 1,

Name : Vault 1
Width : 107.298866279615 ft.
Length : 107.298866279615 ft.
Depth: 9ft.
Discharge Structure
Riser Height: 8 ft.
Riser Diameter: 18 in.
NotchType : Rectangular
Notch Width : 0.016 ft.
Notch Height: 3.552 ft.
Orifice 1 Diameter: 1.345 in. **Elevation:** 0 ft.

Element Flows To:
Outlet 1 **Outlet 2**

Vault Hydraulic Table

Stage(ft)	Area(acr)	Volume(acr-ft)	Dschrg(cfs)	Infilt(cfs)
0.000	0.264	0.000	0.000	0.000
0.100	0.264	0.026	0.015	0.000
0.200	0.264	0.053	0.021	0.000
0.300	0.264	0.079	0.026	0.000
0.400	0.264	0.106	0.030	0.000
0.500	0.264	0.132	0.034	0.000
0.600	0.264	0.159	0.037	0.000
0.700	0.264	0.185	0.040	0.000
0.800	0.264	0.211	0.042	0.000
0.900	0.264	0.238	0.045	0.000
1.000	0.264	0.264	0.048	0.000
1.100	0.264	0.291	0.050	0.000
1.200	0.264	0.317	0.052	0.000
1.300	0.264	0.344	0.054	0.000
1.400	0.264	0.370	0.056	0.000
1.500	0.264	0.396	0.058	0.000
1.600	0.264	0.423	0.060	0.000
1.700	0.264	0.449	0.062	0.000
1.800	0.264	0.476	0.064	0.000
1.900	0.264	0.502	0.065	0.000
2.000	0.264	0.529	0.067	0.000
2.100	0.264	0.555	0.069	0.000
2.200	0.264	0.581	0.070	0.000
2.300	0.264	0.608	0.072	0.000
2.400	0.264	0.634	0.074	0.000
2.500	0.264	0.661	0.075	0.000
2.600	0.264	0.687	0.077	0.000
2.700	0.264	0.714	0.078	0.000
2.800	0.264	0.740	0.080	0.000
2.900	0.264	0.766	0.081	0.000
3.000	0.264	0.793	0.082	0.000
3.100	0.264	0.819	0.084	0.000
3.200	0.264	0.846	0.085	0.000
3.300	0.264	0.872	0.086	0.000
3.400	0.264	0.899	0.088	0.000
3.500	0.264	0.925	0.089	0.000
3.600	0.264	0.951	0.090	0.000
3.700	0.264	0.978	0.091	0.000
3.800	0.264	1.004	0.093	0.000
3.900	0.264	1.031	0.094	0.000
4.000	0.264	1.057	0.095	0.000
4.100	0.264	1.084	0.096	0.000
4.200	0.264	1.110	0.097	0.000
4.300	0.264	1.137	0.099	0.000
4.400	0.264	1.163	0.100	0.000
4.500	0.264	1.189	0.101	0.000
4.600	0.264	1.216	0.105	0.000
4.700	0.264	1.242	0.110	0.000
4.800	0.264	1.269	0.115	0.000
4.900	0.264	1.295	0.120	0.000
5.000	0.264	1.322	0.126	0.000
5.100	0.264	1.348	0.132	0.000
5.200	0.264	1.374	0.138	0.000
5.300	0.264	1.401	0.145	0.000
5.400	0.264	1.427	0.151	0.000
5.500	0.264	1.454	0.158	0.000
5.600	0.264	1.480	0.166	0.000
5.700	0.264	1.507	0.174	0.000
5.800	0.264	1.533	0.182	0.000
5.900	0.264	1.559	0.212	0.000
6.000	0.264	1.586	0.223	0.000
6.100	0.264	1.612	0.235	0.000
6.200	0.264	1.639	0.247	0.000
6.300	0.264	1.665	0.259	0.000
6.400	0.264	1.692	0.271	0.000
6.500	0.264	1.718	0.284	0.000
6.600	0.264	1.744	0.297	0.000

6.700	0.264	1.771	0.310	0.000
6.800	0.264	1.797	0.323	0.000
6.900	0.264	1.824	0.337	0.000
7.000	0.264	1.850	0.351	0.000
7.100	0.264	1.877	0.365	0.000
7.200	0.264	1.903	0.380	0.000
7.300	0.264	1.929	0.395	0.000
7.400	0.264	1.956	0.410	0.000
7.500	0.264	1.982	0.425	0.000
7.600	0.264	2.009	0.440	0.000
7.700	0.264	2.035	0.456	0.000
7.800	0.264	2.062	0.472	0.000
7.900	0.264	2.088	0.488	0.000
8.000	0.264	2.114	0.504	0.000
8.100	0.264	2.141	0.967	0.000
8.200	0.264	2.167	1.813	0.000
8.300	0.264	2.194	2.907	0.000
8.400	0.264	2.220	4.203	0.000
8.500	0.264	2.247	5.673	0.000
8.600	0.264	2.273	7.299	0.000
8.700	0.264	2.299	9.066	0.000
8.800	0.264	2.326	10.96	0.000
8.900	0.264	2.352	12.98	0.000
9.000	0.264	2.379	15.12	0.000
9.100	0.264	2.405	17.37	0.000
9.200	0.000	0.000	19.72	0.000

MITIGATED LAND USE

ANALYSIS RESULTS

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.177254
5 year	0.265979
10 year	0.336238
25 year	0.439286
50 year	0.52719
100 year	0.625313

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0.091781
5 year	0.128198
10 year	0.15549
25 year	0.193777
50 year	0.225182
100 year	0.259164

Yearly Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1950	0.118	0.082
1951	0.333	0.093
1952	0.119	0.078
1953	0.141	0.074
1954	0.189	0.074
1955	0.309	0.088
1956	0.289	0.108
1957	0.195	0.110
1958	0.312	0.100
1959	0.300	0.085
1960	0.169	0.089
1961	0.153	0.094
1962	0.212	0.104
1963	0.271	0.077
1964	0.430	0.082
1965	0.152	0.067

1966	0.148	0.093
1967	0.091	0.077
1968	0.195	0.079
1969	0.219	0.095
1970	0.332	0.084
1971	0.118	0.081
1972	0.187	0.119
1973	0.144	0.087
1974	0.122	0.094
1975	0.160	0.090
1976	0.130	0.073
1977	0.113	0.088
1978	0.104	0.080
1979	0.129	0.075
1980	0.458	0.081
1981	0.131	0.074
1982	0.164	0.075
1983	0.141	0.101
1984	0.169	0.080
1985	0.161	0.129
1986	0.226	0.105
1987	0.473	0.195
1988	0.228	0.150
1989	0.114	0.102
1990	0.222	0.073
1991	0.153	0.098
1992	0.160	0.092
1993	0.150	0.096
1994	0.091	0.068
1995	0.101	0.094
1996	0.155	0.105
1997	0.276	0.102
1998	0.637	0.840

Ranked Yearly Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.6373	0.8403
2	0.4727	0.1951
3	0.4580	0.1504
4	0.4297	0.1290
5	0.3332	0.1187
6	0.3323	0.1095
7	0.3121	0.1084
8	0.3091	0.1051
9	0.2997	0.1051
10	0.2889	0.1037
11	0.2755	0.1022
12	0.2713	0.1018
13	0.2277	0.1007
14	0.2259	0.1001
15	0.2217	0.0985
16	0.2193	0.0957
17	0.2116	0.0951
18	0.1948	0.0943
19	0.1946	0.0940
20	0.1893	0.0935
21	0.1868	0.0932
22	0.1693	0.0930
23	0.1686	0.0919
24	0.1639	0.0899
25	0.1612	0.0886
26	0.1600	0.0879
27	0.1596	0.0876
28	0.1551	0.0866
29	0.1533	0.0846
30	0.1532	0.0840
31	0.1520	0.0824
32	0.1496	0.0818
33	0.1484	0.0809
34	0.1438	0.0805
35	0.1409	0.0797

36	0.1406	0.0797
37	0.1311	0.0791
38	0.1299	0.0778
39	0.1290	0.0773
40	0.1219	0.0765
41	0.1187	0.0750
42	0.1181	0.0746
43	0.1178	0.0744
44	0.1141	0.0744
45	0.1130	0.0742
46	0.1038	0.0731
47	0.1009	0.0727
48	0.0909	0.0685
49	0.0909	0.0673

POC #1

The Facility PASSED.

Flow(CFS)	Predev	Dev	Percentage	Pass/Fail
0.0886	3472	3465	99	Pass
0.0931	2946	2273	77	Pass
0.0975	2620	1624	61	Pass
0.1019	2309	996	43	Pass
0.1063	1964	536	27	Pass
0.1108	1738	341	19	Pass
0.1152	1482	265	17	Pass
0.1196	1293	216	16	Pass
0.1241	1118	193	17	Pass
0.1285	1004	175	17	Pass
0.1329	886	162	18	Pass
0.1374	751	151	20	Pass
0.1418	650	143	22	Pass
0.1462	560	131	23	Pass
0.1506	499	118	23	Pass
0.1551	428	110	25	Pass
0.1595	389	106	27	Pass
0.1639	352	103	29	Pass
0.1684	311	96	30	Pass
0.1728	283	93	32	Pass
0.1772	251	87	34	Pass
0.1817	234	83	35	Pass
0.1861	215	77	35	Pass
0.1905	203	72	35	Pass
0.1949	189	66	34	Pass
0.1994	175	62	35	Pass
0.2038	164	60	36	Pass
0.2082	154	59	38	Pass
0.2127	143	58	40	Pass
0.2171	135	56	41	Pass
0.2215	130	55	42	Pass
0.2260	123	53	43	Pass
0.2304	119	52	43	Pass
0.2348	115	51	44	Pass
0.2392	112	47	41	Pass
0.2437	109	45	41	Pass
0.2481	103	42	40	Pass
0.2525	97	41	42	Pass
0.2570	96	40	41	Pass
0.2614	94	38	40	Pass
0.2658	91	37	40	Pass
0.2703	89	36	40	Pass
0.2747	85	35	41	Pass
0.2791	81	31	38	Pass
0.2835	76	29	38	Pass
0.2880	76	26	34	Pass
0.2924	72	24	33	Pass
0.2968	69	24	34	Pass
0.3013	67	23	34	Pass
0.3057	66	21	31	Pass
0.3101	63	20	31	Pass

0.3146	61	19	31	Pass
0.3190	60	18	30	Pass
0.3234	58	17	29	Pass
0.3278	57	16	28	Pass
0.3323	55	15	27	Pass
0.3367	52	13	25	Pass
0.3411	51	12	23	Pass
0.3456	48	12	25	Pass
0.3500	47	11	23	Pass
0.3544	44	11	25	Pass
0.3589	42	10	23	Pass
0.3633	39	9	23	Pass
0.3677	38	9	23	Pass
0.3721	36	7	19	Pass
0.3766	35	7	20	Pass
0.3810	34	7	20	Pass
0.3854	34	7	20	Pass
0.3899	32	7	21	Pass
0.3943	31	7	22	Pass
0.3987	31	6	19	Pass
0.4032	29	6	20	Pass
0.4076	28	6	21	Pass
0.4120	24	6	25	Pass
0.4164	24	6	25	Pass
0.4209	24	6	25	Pass
0.4253	20	6	30	Pass
0.4297	20	6	30	Pass
0.4342	18	6	33	Pass
0.4386	16	6	37	Pass
0.4430	16	6	37	Pass
0.4475	13	6	46	Pass
0.4519	13	6	46	Pass
0.4563	13	6	46	Pass
0.4607	11	6	54	Pass
0.4652	11	4	36	Pass
0.4696	11	4	36	Pass
0.4740	8	4	50	Pass
0.4785	8	4	50	Pass
0.4829	6	4	66	Pass
0.4873	6	3	50	Pass
0.4918	5	3	60	Pass
0.4962	3	3	100	Pass
0.5006	3	3	100	Pass
0.5050	3	3	100	Pass
0.5095	3	3	100	Pass
0.5139	2	2	100	Pass
0.5183	2	2	100	Pass
0.5228	2	2	100	Pass
0.5272	2	2	100	Pass

Water Quality BMP Flow and Volume for POC 1.
On-line facility volume: 0.1495 acre-feet
On-line facility target flow: 0.01 **cfs.**
Adjusted for 15 min: 0.0822 **cfs.**
Off-line facility target flow: 0.0504 **cfs.**
Adjusted for 15 min: 0.0546 **cfs.**

Perlnd and Implnd Changes

No changes have been made.

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Western Washington Hydrology Model
PROJECT REPORT

Project Name: EastV
Site Address:
City : Monroe
Report Date : 5/19/2015
Gage : Everett
Data Start : 1948/10/01
Data End : 1997/09/30
Precip Scale: 1.20
WWHM3 Version:

PREDEVELOPED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	Acres
C, Forest, Mod	3.6

Impervious Land Use	Acres

Element Flows To:

Surface	Interflow	Groundwater

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	Acres
C, Lawn, Flat	1.3

Impervious Land Use	Acres
ROADS FLAT	2.3

Element Flows To:

Surface	Interflow	Groundwater
Vault 1, Vault 1,		

Name : Vault 1
Width : 44.8050974626772 ft.
Length : 224.025487313385 ft.
Depth: 7ft.
Discharge Structure
Riser Height: 6 ft.
Riser Diameter: 18 in.
NotchType : Rectangular
Notch Width : 0.014 ft.
Notch Height: 2.484 ft.
Orifice 1 Diameter: 1.175 in. **Elevation:** 0 ft.

Element Flows To:

Outlet 1	Outlet 2

Vault Hydraulic Table

Stage(ft)	Area(acr)	Volume(acr-ft)	Dschrg(cfs)	Infilt(cfs)
0.000	0.230	0.000	0.000	0.000
0.078	0.230	0.018	0.010	0.000
0.156	0.230	0.036	0.014	0.000
0.233	0.230	0.054	0.018	0.000
0.311	0.230	0.072	0.020	0.000
0.389	0.230	0.090	0.023	0.000
0.467	0.230	0.108	0.025	0.000
0.544	0.230	0.125	0.027	0.000
0.622	0.230	0.143	0.029	0.000
0.700	0.230	0.161	0.030	0.000
0.778	0.230	0.179	0.032	0.000
0.856	0.230	0.197	0.034	0.000
0.933	0.230	0.215	0.035	0.000
1.011	0.230	0.233	0.036	0.000
1.089	0.230	0.251	0.038	0.000
1.167	0.230	0.269	0.039	0.000
1.244	0.230	0.287	0.040	0.000
1.322	0.230	0.305	0.042	0.000
1.400	0.230	0.323	0.043	0.000
1.478	0.230	0.341	0.044	0.000
1.556	0.230	0.358	0.045	0.000
1.633	0.230	0.376	0.046	0.000
1.711	0.230	0.394	0.047	0.000
1.789	0.230	0.412	0.048	0.000
1.867	0.230	0.430	0.050	0.000
1.944	0.230	0.448	0.051	0.000
2.022	0.230	0.466	0.052	0.000
2.100	0.230	0.484	0.053	0.000
2.178	0.230	0.502	0.054	0.000
2.256	0.230	0.520	0.054	0.000
2.333	0.230	0.538	0.055	0.000
2.411	0.230	0.556	0.056	0.000
2.489	0.230	0.574	0.057	0.000
2.567	0.230	0.591	0.058	0.000
2.644	0.230	0.609	0.059	0.000
2.722	0.230	0.627	0.060	0.000
2.800	0.230	0.645	0.061	0.000
2.878	0.230	0.663	0.062	0.000
2.956	0.230	0.681	0.062	0.000
3.033	0.230	0.699	0.063	0.000
3.111	0.230	0.717	0.064	0.000
3.189	0.230	0.735	0.065	0.000
3.267	0.230	0.753	0.066	0.000
3.344	0.230	0.771	0.066	0.000
3.422	0.230	0.789	0.067	0.000
3.500	0.230	0.807	0.068	0.000
3.578	0.230	0.824	0.069	0.000
3.656	0.230	0.842	0.072	0.000
3.733	0.230	0.860	0.075	0.000
3.811	0.230	0.878	0.078	0.000
3.889	0.230	0.896	0.081	0.000
3.967	0.230	0.914	0.085	0.000
4.044	0.230	0.932	0.089	0.000
4.122	0.230	0.950	0.093	0.000
4.200	0.230	0.968	0.097	0.000
4.278	0.230	0.986	0.101	0.000
4.356	0.230	1.004	0.105	0.000
4.433	0.230	1.022	0.109	0.000
4.511	0.230	1.039	0.114	0.000
4.589	0.230	1.057	0.119	0.000
4.667	0.230	1.075	0.124	0.000
4.744	0.230	1.093	0.129	0.000
4.822	0.230	1.111	0.135	0.000
4.900	0.230	1.129	0.140	0.000
4.978	0.230	1.147	0.164	0.000
5.056	0.230	1.165	0.172	0.000
5.133	0.230	1.183	0.179	0.000

5.211	0.230	1.201	0.187	0.000
5.289	0.230	1.219	0.195	0.000
5.367	0.230	1.237	0.203	0.000
5.444	0.230	1.255	0.211	0.000
5.522	0.230	1.272	0.219	0.000
5.600	0.230	1.290	0.228	0.000
5.678	0.230	1.308	0.236	0.000
5.756	0.230	1.326	0.245	0.000
5.833	0.230	1.344	0.254	0.000
5.911	0.230	1.362	0.263	0.000
5.989	0.230	1.380	0.272	0.000
6.067	0.230	1.398	0.525	0.000
6.144	0.230	1.416	1.076	0.000
6.222	0.230	1.434	1.805	0.000
6.300	0.230	1.452	2.676	0.000
6.378	0.230	1.470	3.668	0.000
6.456	0.230	1.488	4.768	0.000
6.533	0.230	1.505	5.967	0.000
6.611	0.230	1.523	7.257	0.000
6.689	0.230	1.541	8.631	0.000
6.767	0.230	1.559	10.09	0.000
6.844	0.230	1.577	11.62	0.000
6.922	0.230	1.595	13.22	0.000
7.000	0.230	1.613	14.89	0.000
7.078	0.230	1.631	16.63	0.000
7.156	0.000	0.000	18.43	0.000

MITIGATED LAND USE

ANALYSIS RESULTS

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.118169
5 year	0.177319
10 year	0.224158
25 year	0.292857
50 year	0.35146
100 year	0.416876

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0.062535
5 year	0.08988
10 year	0.111268
25 year	0.142349
50 year	0.168663
100 year	0.197874

Yearly Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1950	0.079	0.055
1951	0.222	0.062
1952	0.079	0.052
1953	0.094	0.050
1954	0.126	0.050
1955	0.206	0.059
1956	0.193	0.084
1957	0.130	0.086
1958	0.208	0.067
1959	0.200	0.057
1960	0.113	0.059
1961	0.102	0.063
1962	0.141	0.072
1963	0.181	0.051
1964	0.286	0.055
1965	0.101	0.045

1966	0.099	0.062
1967	0.061	0.052
1968	0.130	0.053
1969	0.146	0.064
1970	0.222	0.056
1971	0.079	0.054
1972	0.125	0.097
1973	0.096	0.058
1974	0.081	0.062
1975	0.106	0.060
1976	0.087	0.049
1977	0.075	0.059
1978	0.069	0.053
1979	0.086	0.050
1980	0.305	0.054
1981	0.087	0.050
1982	0.109	0.050
1983	0.094	0.067
1984	0.112	0.053
1985	0.107	0.104
1986	0.151	0.075
1987	0.315	0.175
1988	0.152	0.121
1989	0.076	0.069
1990	0.148	0.049
1991	0.102	0.066
1992	0.107	0.062
1993	0.100	0.064
1994	0.061	0.046
1995	0.067	0.063
1996	0.103	0.076
1997	0.184	0.069
1998	0.425	0.553

Ranked Yearly Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.4248	0.5531
2	0.3152	0.1745
3	0.3054	0.1209
4	0.2865	0.1041
5	0.2221	0.0966
6	0.2216	0.0862
7	0.2081	0.0840
8	0.2061	0.0757
9	0.1998	0.0754
10	0.1926	0.0717
11	0.1837	0.0688
12	0.1809	0.0686
13	0.1518	0.0674
14	0.1506	0.0671
15	0.1478	0.0659
16	0.1462	0.0641
17	0.1411	0.0637
18	0.1299	0.0630
19	0.1297	0.0629
20	0.1262	0.0624
21	0.1246	0.0624
22	0.1129	0.0622
23	0.1124	0.0616
24	0.1093	0.0600
25	0.1075	0.0593
26	0.1067	0.0589
27	0.1064	0.0586
28	0.1034	0.0580
29	0.1022	0.0566
30	0.1021	0.0562
31	0.1013	0.0550
32	0.0997	0.0546
33	0.0989	0.0542
34	0.0959	0.0538
35	0.0939	0.0533

36	0.0937	0.0532
37	0.0874	0.0529
38	0.0866	0.0521
39	0.0860	0.0516
40	0.0812	0.0513
41	0.0792	0.0502
42	0.0787	0.0499
43	0.0786	0.0497
44	0.0761	0.0497
45	0.0753	0.0496
46	0.0692	0.0489
47	0.0673	0.0485
48	0.0606	0.0458
49	0.0606	0.0450

POC #1

The Facility PASSED.

Flow(CFS)	Predev	Dev	Percentage	Pass/Fail
0.0591	3401	3289	96	Pass
0.0620	2946	2231	75	Pass
0.0650	2705	1670	61	Pass
0.0679	2350	1004	42	Pass
0.0709	2034	631	31	Pass
0.0739	1772	515	29	Pass
0.0768	1526	444	29	Pass
0.0798	1310	395	30	Pass
0.0827	1150	343	29	Pass
0.0857	1015	293	28	Pass
0.0886	886	245	27	Pass
0.0916	757	225	29	Pass
0.0945	650	205	31	Pass
0.0975	566	181	31	Pass
0.1004	499	168	33	Pass
0.1034	437	151	34	Pass
0.1063	389	140	35	Pass
0.1093	348	131	37	Pass
0.1122	311	124	39	Pass
0.1152	280	115	41	Pass
0.1182	251	107	42	Pass
0.1211	233	97	41	Pass
0.1241	215	93	43	Pass
0.1270	202	88	43	Pass
0.1300	192	86	44	Pass
0.1329	177	83	46	Pass
0.1359	165	79	47	Pass
0.1388	156	75	48	Pass
0.1418	145	73	50	Pass
0.1447	137	72	52	Pass
0.1477	130	71	54	Pass
0.1506	123	70	56	Pass
0.1536	119	68	57	Pass
0.1565	115	66	57	Pass
0.1595	112	64	57	Pass
0.1624	109	62	56	Pass
0.1654	103	59	57	Pass
0.1684	97	55	56	Pass
0.1713	95	52	54	Pass
0.1743	94	47	50	Pass
0.1772	91	44	48	Pass
0.1802	89	44	49	Pass
0.1831	85	43	50	Pass
0.1861	81	42	51	Pass
0.1890	76	41	53	Pass
0.1920	76	41	53	Pass
0.1949	72	39	54	Pass
0.1979	70	38	54	Pass
0.2008	67	35	52	Pass
0.2038	66	32	48	Pass
0.2067	64	29	45	Pass

0.2097	61	27	44	Pass
0.2127	60	25	41	Pass
0.2156	58	25	43	Pass
0.2186	57	23	40	Pass
0.2215	56	22	39	Pass
0.2245	52	21	40	Pass
0.2274	51	21	41	Pass
0.2304	48	20	41	Pass
0.2333	47	18	38	Pass
0.2363	44	17	38	Pass
0.2392	42	16	38	Pass
0.2422	39	16	41	Pass
0.2451	38	15	39	Pass
0.2481	36	14	38	Pass
0.2510	35	12	34	Pass
0.2540	34	12	35	Pass
0.2570	34	11	32	Pass
0.2599	33	11	33	Pass
0.2629	32	10	31	Pass
0.2658	31	8	25	Pass
0.2688	29	7	24	Pass
0.2717	28	7	25	Pass
0.2747	25	6	24	Pass
0.2776	24	6	25	Pass
0.2806	24	6	25	Pass
0.2835	20	6	30	Pass
0.2865	20	6	30	Pass
0.2894	18	6	33	Pass
0.2924	16	6	37	Pass
0.2953	16	6	37	Pass
0.2983	13	6	46	Pass
0.3013	13	6	46	Pass
0.3042	13	6	46	Pass
0.3072	11	6	54	Pass
0.3101	11	6	54	Pass
0.3131	11	5	45	Pass
0.3160	8	4	50	Pass
0.3190	8	4	50	Pass
0.3219	6	4	66	Pass
0.3249	6	3	50	Pass
0.3278	5	3	60	Pass
0.3308	3	3	100	Pass
0.3337	3	3	100	Pass
0.3367	3	3	100	Pass
0.3396	3	3	100	Pass
0.3426	2	2	100	Pass
0.3456	2	2	100	Pass
0.3485	2	2	100	Pass
0.3515	2	2	100	Pass

Water Quality BMP Flow and Volume for POC 1.
On-line facility volume: 0.1 acre-feet
On-line facility target flow: 0.01 **cfs.**
Adjusted for 15 min: 0.0549 **cfs.**
Off-line facility target flow: 0.0337 **cfs.**
Adjusted for 15 min: 0.0365 **cfs.**

Perlnd and Implnd Changes

No changes have been made.

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APPENDIX B

MAINTENANCE & OPERATIONS MANUAL

4.6 Maintenance Standards for Drainage Facilities

The facility-specific maintenance standards contained in this section are intended to be conditions for determining if maintenance actions are required as identified through inspection. They are not intended to be measures of the facility's required condition at all times between inspections. In other words, exceedence of these conditions at any time between inspections and/or maintenance does not automatically constitute a violation of these standards. However, based upon inspection observations, the inspection and maintenance schedules shall be adjusted to minimize the length of time that a facility is in a condition that requires a maintenance action.

Table 4.5 – Maintenance Standards

No. 1 – Detention Ponds

Maintenance Component	Defect	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed
General	Trash & Debris	Any trash and debris which exceed 5 cubic feet per 1,000 square feet (this is about equal to the amount of trash it would take to fill up one standard size garbage can). In general, there should be no visual evidence of dumping. If less than threshold all trash and debris will be removed as part of next scheduled maintenance.	Trash and debris cleared from site.
	Poisonous Vegetation and noxious weeds	Any poisonous or nuisance vegetation which may constitute a hazard to maintenance personnel or the public. Any evidence of noxious weeds as defined by State or local regulations. (Apply requirements of adopted IPM policies for the use of herbicides).	No danger of poisonous vegetation where maintenance personnel or the public might normally be. (Coordinate with local health department) Complete eradication of noxious weeds may not be possible. Compliance with State or local eradication policies required
	Contaminants and Pollution	Any evidence of oil, gasoline, contaminants or other pollutants (Coordinate removal/cleanup with local water quality response agency).	~~No contaminants or pollutants present.~~
	Rodent Holes	Any evidence of rodent holes if facility is acting as a dam or berm, or any evidence of water piping through dam or berm via rodent holes.	Rodents destroyed and dam or berm repaired. (Coordinate with local health department; coordinate with Ecology Dam Safety Office if pond exceeds 10 acre-feet.)

No. 1 – Detention Ponds

Maintenance Component	Defect	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed
	Beaver Dams	Dam results in change or function of the facility.	Facility is returned to design function. (Coordinate trapping of beavers and removal of dams with appropriate permitting agencies)
	Insects	When insects such as wasps and hornets interfere with maintenance activities.	Insects destroyed or removed from site. Apply insecticides in compliance with adopted IPM policies
	Tree Growth and Hazard Trees	Tree growth does not allow maintenance access or interferes with maintenance activity (i.e., slope mowing, silt removal, vactoring, or equipment movements). If trees are not interfering with access or maintenance, do not remove If dead, diseased, or dying trees are identified (Use a certified Arborist to determine health of tree or removal requirements)	Trees do not hinder maintenance activities. Harvested trees should be recycled into mulch or other beneficial uses (e.g., alders for firewood). Remove hazard Trees
Side Slopes of Pond	Erosion	Eroded damage over 2 inches deep where cause of damage is still present or where there is potential for continued erosion. Any erosion observed on a compacted berm embankment.	Slopes should be stabilized using appropriate erosion control measure(s); e.g., rock reinforcement, planting of grass, compaction. If erosion is occurring on compacted berms a licensed civil engineer should be consulted to resolve source of erosion.
Storage Area	Sediment	Accumulated sediment that exceeds 10% of the designed pond depth unless otherwise specified or affects inletting or outletting condition of the facility.	Sediment cleaned out to designed pond shape and depth; pond reseeded if necessary to control erosion.
	Liner (If Applicable)	Liner is visible and has more than three 1/4-inch holes in it.	Liner repaired or replaced. Liner is fully covered.

No. 1 – Detention Ponds

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

No. 3 – Closed Detention Systems (Tanks/Vaults)

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
Storage Area	Plugged Air Vents	One-half of the cross section of a vent is blocked at any point or the vent is damaged.	Vents open and functioning.
	Debris and Sediment	Accumulated sediment depth exceeds 10% of the diameter of the storage area for 1/2 length of storage vault or any point depth exceeds 15% of diameter. (Example: 72-inch storage tank would require cleaning when sediment reaches depth of 7 inches for more than 1/2 length of tank.)	All sediment and debris removed from storage area.
	Joints Between Tank/Pipe Section	Any openings or voids allowing material to be transported into facility. (Will require engineering analysis to determine structural stability).	All joint between tank/pipe sections are sealed.
	Tank Pipe Bent Out of Shape	Any part of tank/pipe is bent out of shape more than 10% of its design shape. (Review required by engineer to determine structural stability).	Tank/pipe repaired or replaced to design.
	Vault Structure Includes Cracks in Wall, Bottom, Damage to Frame and/or Top Slab	Cracks wider than 1/2-inch and any evidence of soil particles entering the structure through the cracks, or maintenance/inspection personnel determines that the vault is not structurally sound. Cracks wider than 1/2-inch at the joint of any inlet/outlet pipe or any evidence of soil particles entering the vault through the walls.	Vault replaced or repaired to design specifications and is structurally sound. No cracks more than 1/4-inch wide at the joint of the inlet/outlet pipe.
Manhole	Cover Not in Place	Cover is missing or only partially in place. Any open manhole requires maintenance.	Manhole is closed.
	Locking Mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than 1/2 inch of thread (may not apply to self-locking lids).	Mechanism opens with proper tools.
	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure. Intent is to keep cover from sealing off access to maintenance.	Cover can be removed and reinstalled by one maintenance person.
	Ladder Rungs Unsafe	Ladder is unsafe due to missing rungs, misalignment, not securely attached to structure wall, rust, or cracks.	Ladder meets design standards. Allows maintenance person safe access.
Catch Basins	See "Catch Basins" (No. 5)	See "Catch Basins" (No. 5).	See "Catch Basins" (No. 5).

No. 4 – Control Structure/Flow Restrictor

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Trash and Debris (Includes Sediment)	Material exceeds 25% of sump depth or 1 foot below orifice plate.	Control structure orifice is not blocked. All trash and debris removed.
	Structural Damage	Structure is not securely attached to manhole wall.	Structure 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 "Closed Detention Systems" (No. 3).	See "Closed Detention Systems" (No. 3).	See "Closed Detention Systems" (No. 3).
Catch Basin	See "Catch Basins" (No. 5).	See "Catch Basins" (No. 5).	See "Catch Basins" (No. 5).

No. 5 – Catch Basins

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is performed
General	Trash & Debris	Trash or debris which is located immediately in front of the catch basin opening or is blocking inletting capacity of the basin by more than 10%.	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.	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.

No. 5 – Catch Basins

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is performed
	Contamination and Pollution	See "Detention Ponds" (No. 1).	No pollution present.
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.

No. 6 – Debris Barriers (e.g., Trash Racks)

Maintenance Components	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Trash and Debris	Trash or debris that is plugging more than 20% of the openings in the barrier.	Barrier cleared to design flow capacity.
Metal	Damaged/ Missing Bars.	Bars are bent out of shape more than 3 inches.	Bars in place with no bends more than 3/4 inch.
		Bars are missing or entire barrier missing.	Bars in place according to design.
		Bars are loose and rust is causing 50% deterioration to any part of barrier.	Barrier replaced or repaired to design standards.
	Inlet/Outlet Pipe	Debris barrier missing or not attached to pipe	Barrier firmly attached to pipe

No. 11 – Wetponds

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Water level	First cell is empty, doesn't hold water.	Line the first cell to maintain at least 4 feet of water. Although the second cell may drain, the first cell must remain full to control turbulence of the incoming flow and reduce sediment resuspension.
	Trash and Debris	Accumulation that exceeds 1 CF per 1000-SF of pond area.	Trash and debris removed from pond.
	Inlet/Outlet Pipe	Inlet/Outlet pipe clogged with sediment and/or debris material.	No clogging or blockage in the inlet and outlet piping.
	Sediment Accumulation in Pond Bottom	Sediment accumulations in pond bottom that exceeds the depth of sediment zone plus 6-inches, usually in the first cell.	Sediment removed from pond bottom.
	Oil Sheen on Water	Prevalent and visible oil sheen.	Oil removed from water using oil-absorbent pads or vactor truck. Source of oil located and corrected. If chronic low levels of oil persist, plant wetland plants such as Juncus effusus (soft rush) which can uptake small concentrations of oil.
	Erosion	Erosion of the pond's side slopes and/or scouring of the pond bottom, that exceeds 6-inches, or where continued erosion is prevalent.	Slopes stabilized using proper erosion control measures and repair methods.
	Settlement of Pond Dike/Berm	Any part of these components that has settled 4-inches or lower than the design elevation, or inspector determines dike/berm is unsound.	Dike/berm is repaired to specifications.
	Internal Berm	Berm dividing cells should be level.	Berm surface is leveled so that water flows evenly over entire length of berm.
	Overflow Spillway	Rock is missing and soil is exposed at top of spillway or outside slope.	Rocks replaced to specifications.

No. 12 – Wetvaults

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Trash/Debris Accumulation	Trash and debris accumulated in vault, pipe or inlet/outlet (includes floatables and non-floatables).	Remove trash and debris from vault.
	Sediment Accumulation in Vault	Sediment accumulation in vault bottom exceeds the depth of the sediment zone plus 6-inches.	Remove sediment from vault.
	Damaged Pipes	Inlet/outlet piping damaged or broken and in need of repair.	Pipe repaired and/or replaced.
	Access Cover Damaged/Not Working	Cover cannot be opened or removed, especially by one person.	Pipe repaired or replaced to proper working specifications.
	Ventilation	Ventilation area blocked or plugged.	Blocking material removed or cleared from ventilation area. A specified % of the vault surface area must provide ventilation to the vault interior (see design specifications).
	Vault Structure Damage - Includes Cracks in Walls Bottom, Damage to Frame and/or Top Slab	Maintenance/inspection personnel determine that the vault is not structurally sound.	Vault replaced or repairs made so that vault meets design specifications and is structurally sound.
		Cracks wider than 1/2-inch at the joint of any inlet/outlet pipe or evidence of soil particles entering through the cracks.	Vault repaired so that no cracks exist wider than 1/4-inch at the joint of the inlet/outlet pipe.
	Baffles	Baffles corroding, cracking, warping and/or showing signs of failure as determined by maintenance/inspection staff.	Baffles repaired or replaced to specifications.
	Access Ladder Damage	Ladder is corroded or deteriorated, not functioning properly, not attached to structure wall, missing rungs, has cracks and/or misaligned. Confined space warning sign missing.	Ladder replaced or repaired to specifications, and is safe to use as determined by inspection personnel. Replace sign warning of confined space entry requirements. Ladder and entry notification complies with OSHA standards.

APPENDIX C

GEOTECHNICAL REPORT

LIU & ASSOCIATES, INC.

Geotechnical Engineering | Engineering Geology | Earth Science

February 21, 2015

Mr. Rick Hanson
Hanson Homes
P. O. Box 2289
Snohomish, WA 98291

Dear Mr. Hanson:

Subject: Geotechnical Engineering Study
Sky View Ridge
132xx – 191st Avenue SE
Monroe, Washington
L&A Job No. 15-009

INTRODUCTION

We understand the development of a residential plat project is proposed for the subject site located at the above address in Monroe, Washington. The project site is consisted of three parcels: Parcel No. 28063600100500 (13221 – 191st Avenue SE, referred hereinafter as Parcel A), Parcel No. 28063600101000 (13207 – 191st Avenue NE, referred hereinafter as Parcel B), and Parcel No. 28063600100200 (no street address, referred hereinafter as Parcel C), located in Snohomish County, Washington, just outside of Monroe. The existing residence in the southwest portion of Parcel A is to remain through a boundary line adjustment. Parcels B and C, and Parcel A less the existing residence are to be platted into single-family residence building lots, with supporting infrastructures. The purposes of this study are to explore and characterize the subsurface conditions of the site, and provide geotechnical recommendations for grading, erosion mitigation, surface and ground water drainage control, onsite stormwater disposal, and foundation support to

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proposed residences of the proposed development. Presented in this report are our findings and geotechnical recommendations.

PROJECT DESCRIPTION

For our use in this study, you provided us with a topographic and plat plan of the proposed development of the project site. A wetland straddles the boundary between Parcel A and Parcel C in the eastern portion of these parcels. According to this plan, Parcel A, fronted by 191st Avenue SE to the west, minus the existing residence and the wetland, is to be platted into 9 lots; Parcel B, abutting the east side of Parcel B, is to be platted into 21 lots; and Parcel C adjoining the east half of Parcel A, minus the wetland, is to be platted into 9 lots. The lots on Parcels A and B is to be accessed from 191st Avenue SE via a paved road going east towards the west end of Parcel B then turning south. The lots on Parcel C is to be accessed by a second paved road entering the east side of this parcel. The project site is to be developed in three phases: Phase I for Parcel A, Phase II for Parcel B, and Phase III for Parcel C.

SCOPE OF SERVICES

Our scope of services for this study comprises specifically the following:

1 Review the geologic and subsurface conditions at the project site based on a published geologic map.

2. Explore the site for subsurface conditions with backhoe test pits excavated to a firm bearing soil stratum or to the maximum depth (about 10 feet) capable by the backhoe used in excavating the test pits, whichever occurs first.

3. Perform necessary geotechnical analyses and provide geotechnical recommendations for grading, erosion mitigation, surface and ground water drainage control, stormwater disposal and/or detention, and foundation support to proposed residences, based on subsurface conditions encountered by the test pits and results of our geotechnical analyses.

4. Prepare a written report to present our findings, conclusions, and recommendations.

SITE CONDITIONS

SURFACE CONDITION

The general location of the project site is shown on Plate 1 – Vicinity Map. The site is situated on a gentle, southeasterly declining plain. The site generally slopes down gently easterly to southeasterly. It is dotted by tall mature evergreen trees with occasional deciduous trees mixed in between, and is covered by overgrown grass and brush.

While digging test pits to explore subsurface conditions of the project site on February 6, 2015, we noticed standing surface water over almost the entire Parcel B. We also found a network of rising sprinkler heads attached to PVC pipes lying on the ground of the neighboring property adjoining the south side of Parcel B. We believe this is a surface dispersion system used to dispose stormwater collected from the nearby residential development project on the adjoining property. The surface water on Parcel B and the groundwater encountered by test pits are likely contributed by the sprinkler stormwater disposal system on the neighboring property. Existence of surface water and near-surface groundwater would make grading and stormwater disposal difficult and more costly.

GEOLOGIC SETTING

The Surficial Geologic Map of the Skykomish and Snoqualmie Rivers Area, Snohomish and King Counties, Washington, by Derek B Booth, published by U. S. Geological Survey in 1990, was referenced for the geologic and soil conditions at the project site. According to this publication, the surficial soil unit at and in the vicinity of the subject residence site is mapped as Vashon Till (Q_{vt}) deposits.

The geology of the Puget Sound Lowland has been modified by the advance and retreat of several glaciers in the past one million years or so and the subsequent deposits and erosions. The latest glacier advanced to the Puget Sound Lowland is referred to as the Vashon Stade of the Fraser Glaciation which had occurred during the later stages of the Pleistocene Epoch, and retreated from the region some 12,500 years ago.

The deposits of the Vashon till soil unit were plowed directly under glacial ice during the most recent glacial period as the glacier advanced over an eroded, irregular surface of older formations and sediments. This soil unit is composed of a mixture of unsorted clay, silt, sand, gravel, and scattered cobbles and boulders. The Vashon till soil over the top two to three feet is normally weathered to a medium-dense state, and is moderately permeable and compressible. The underlying fresh till soil, commonly referred to as "hard pan", is very dense and weakly cemented. The fresh till soil possesses a compressive strength comparable to that of low-grade concrete and can remain stable on steep natural slopes or man-make cuts for a long period. The fresh till deposits are practically impervious to stormwater infiltration and can provide excellent foundation support with little or no settlement.

SOIL CONDITION

Subsurface conditions of the project site were explored with six test pits. The test pits were excavated on February 6, 2015, with a rubber-track backhoe to depths from 7.0 to 10.0 feet. The approximate locations of the test pits are shown on Plate 2 - Site and Exploration Location Plan. The test pits were located with either a tape measure or by visual reference to existing topographic features in the field and on the topographic survey map, and their locations should be considered only as accurate to the measuring method used.

A geotechnical engineer from our office was present during subsurface exploration, examined the soil and geologic conditions encountered, and completed logs of test pits. Soil samples obtained from each soil unit in the test pits were visually classified in general accordance with United Soil Classification System, a copy of which is presented on Plate 3. Detailed descriptions of soils encountered during site exploration are presented in test pit logs on Plates 4 through 6.

The test pits encountered a layer of loose, organic topsoil from about 10 to 18 inches thick, mantling the project site. Underlying the topsoil is a layer of weathered soil of brown, loose to medium-dense, silty fine sand with trace gravel, from 1.8 to 2.5 feet thick. This layer of weathered soil is underlain to the depths explored by a light-brown to light-gray, Vashon till deposit of very-dense, cemented, gravelly, silty, fine sand with occasional cobble.

GROUNDWATER CONDITION

Groundwater was encountered in each of the six test pits excavated on the project site. The very-dense, cemented fresh till deposits underlying the site at shallow depth are of extremely low permeability and would perch stormwater infiltrating into the more permeable surficial soils. The influx into the test pits varied from a trickle in Test Pits 5 and 6 to about 1.0 to 4.0 gpm (gallons per minute) in the remaining test pits. The amount of and the depth to the near-surface perched groundwater would fluctuate seasonally, depending on precipitation, surface runoff, ground vegetation cover, site utilization, and other factors. The perched groundwater may dry up completely during the dryer summer and early fall seasons and accumulate and rise in the wet winter and early spring seasons.

GEOLOGIC HAZARDS AND MITIGATION

Landslide Hazard

The site is gently sloped and is underlain at shallow depth by very-dense cemented glacial till soil. The glacial till deposits are of very-high shear strength and are highly resistant against slope failures. Therefore, the potential for deep-seated slides to occur on the site should be nil.

Erosion Hazard

The surficial topsoil and weathered soil are of low resistance against erosion, while the underlying very-dense cemented till deposits are highly resistant against erosion. The site is gently sloped and the erosion hazard of the site should be minimal if exposed ground is covered with vegetation. To further minimize erosion hazard, areas disturbed by construction should be re-vegetated. Concentrated stormwater should not be discharged uncontrolled onto the ground within the site or onto neighboring properties. Stormwater

over impervious surfaces, such as roofs and paved roadways/driveways, should be captured by underground drain line systems connected to roof downspouts and by catch basins installed in paved roadway/driveways. Water collected by these drain line systems should be tightlined to discharge into a storm sewer system or suitable stormwater disposal facilities.

Seismic Hazard

The Puget Sound region is in an active seismic zone. The site is underlain at shallow depth by very-dense cemented glacial till deposits of very-high shear strength. Therefore, the potential for seismic hazards, such as landslides, liquefaction, lateral soil spreading, to occur on the site should be minimal. Proposed residences to be constructed on the site, however, should be designed for seismic forces induced by strong earthquakes. Based on the soil conditions encountered by the test pits, it is our opinion that Seismic Use Group I and Site Class D should be used in the seismic design of the proposed residences in accordance with the 2012 International Building Code (IBC).

DISCUSSION AND RECOMMENDATIONS

GENERAL

Based on the soil conditions encountered by test pits excavated on the project site, it is our opinion that the site is suitable for the proposed development from the geotechnical engineering viewpoint, provided that the recommendations in this report are fully implemented and observed during construction. Conventional footing foundations constructed on or into the underlying very-dense cemented glacial till soil may be used to support the proposed residences. Unsuitable surficial topsoil and weathered soil should be stripped within footprint of roadways and areas of structural fill.

The surficial topsoil and weathered soil contain a high percentage of fines and can be easily disturbed when saturated. Earthwork in the wet winter season can cause significant complications for construction work. To minimize weather-related complications, grading and foundation construction work should proceed and be completed during the dryer period from April 1st to October 31st, if possible. Erosion protection and drainage control measures recommended in this report should be implemented for site stabilization if grading and foundation construction work is to go beyond the above dryer period.

The project site is underlain by very-dense cemented glacial till deposits. Therefore, onsite disposal of stormwater solely by infiltration will most likely not work well. Instead, rain gardens or concrete vaults may be considered for detain stormwater onsite to allow stored water to discharge into public storm facility off peak time.

TEMPORARY DRAINAGE AND EROSION CONTROL

The onsite surficial weak soils are sensitive to moisture and can be easily disturbed by construction traffic. A layer of clean, 2-to-4-inch quarry spalls should be placed over areas of frequent traffic, such as the entrance to the site, as required, to protect the subgrade soils from disturbance by construction traffic.

A silt fence should be installed along the downhill sides of construction areas to minimize transport of sediment by storm runoff into adjacent wetland or onto neighboring properties or the street. The bottom of the filter cloth of the silt fences should be anchored in a trench filled with onsite soil.

Intercepting ditches or trench drains should be installed around the construction areas, as required, to intercept and drain away storm runoff and near-surface groundwater seepage. Water captured by such ditches or interceptor trench drains should be stored in temporary holding and settling pits onsite. Only clear and clean water may be discharged into nearby wetland by surface dispersion through a perforated PVC pipe located in well vegetated wetland buffer zones.

Spoil soils should be hauled off of the site as soon as possible. Spoil soils and imported structural fill material to be stored onsite should be securely covered with plastic tarps, as required, for protection against erosion.

SITE PREPARATION AND GENERAL GRADING

Vegetation within construction limits should be cleared and grubbed. Loose topsoil and weak weathered soil should be completely stripped down to the very-dense glacial till soils within the building pads of proposed residences; while topsoil and unsuitable soil in the root zone should be stripped down to the medium-dense weathered soils and/or very-dense glacial till soils within paved roadways and driveways. The exposed soils should be compacted to a non-yielding state with a mechanical compactor and proof-rolled with a piece of heavy earthwork equipment.

EXCAVATION AND FILL SLOPES FOR GENERAL GRADING WORK

Under no circumstance should excavation slopes be steeper than the limits specified by local, state and federal safety regulations if workers have to perform construction work in excavated areas. Unsupported temporary cuts greater than 4 feet in height should be no steeper than 1H:1V in topsoil and weathered soil, and may be vertical in the underlying

very-dense cemented glacial till soil if the overall depth of cut does not exceed 15 feet. Otherwise, cut in fresh till soil should be no steeper than 1/2H:1V. Permanent cut banks, except detention pond cut banks, should be no steeper than 2-1/2H:1V in topsoil and weathered soil, and no steeper than 1H:1V in the underlying very-dense fresh till soil. The soil units and the stability of cut slopes should be observed and verified by a geotechnical engineer during excavation.

Permanent fill embankments required to support structural or traffic load should be constructed with compacted structural fill placed over undisturbed, proof-rolled, firm, native, fresh till soil after the surficial unsuitable soils are completely stripped. The slope of permanent fill embankments should be no steeper than 2-1/4H:1V. Upon completion, the sloping face of permanent fill embankments should be thoroughly compacted to a non-yielding state with a hoe-pack.

The above recommended cut and fill slopes are under the assumption that groundwater seepage would not be encountered during construction. If groundwater is encountered, grading work should be immediately halted and slope stability re-evaluated. The slopes may have to be flattened and other measures taken to stabilize the slopes. Stormwater should not allowed to flow uncontrolled over cut and fill slopes. Permanent cut slopes or fill embankments should be seeded and vegetated as soon as possible for erosion protection and long-term stability, and should be covered with clear plastic sheets, as required, to protect them from erosion until the vegetation is fully established.

STORMWATER DETENTION POND

Open detention ponds may be considered to detain stormwater collected over impervious surfaces. Cut banks and fill embankments may be required in constructing the ponds. In order to detain water, the base of fill embankments, if any, of the pond should be keyed at least 18 inches into the underlying very-dense cemented fresh till soil.

Fill embankments should be constructed of clean, fine-grained, fine-sandy to clayey silt or clay soil, free of organics and other deleterious substances, with the following gradation requirements:

% Passing	U.S. Standard Sieve No.
100	20
90	40
80	60
65	100
30	200

Fill embankments should be placed in lifts no more than 8-inch thick in loose state and compacted to at least 92% of the maximum dry density determined by ASTM D1557 (Modified Proctor method). After completion, the sloping face of cut banks and fill embankments should be compacted to a non-yielding state with a hoe-pack.

Sloping face of fill embankments should be no steeper than 3H:1V for inside slopes and no steeper than 2-1/4H:1V for outside slopes of the ponds. Fill should be placed in lifts no more than 8 inches thick in loose state, with each lifts compacted to at least 92% of the

maximum dry density determined by ASTM D1557 (Modified Proctor method) with a sheep-foot or elephant-foot mechanical compactor. Cut banks of the ponds should be no steeper than 3H:1V in the surficial topsoil and weathered soil and no steeper than 1-1/4H:1V in the underlying very-dense fresh till soil.

Both the fill and cut sloping faces should be compacted to a non-yielding state with a mechanical compactor after the completion of the ponds. The pond banks should be vegetated and covered up with plastic tarps until vegetation is fully establish. .

Detention Vaults

Concrete vaults may also be considered to detain stormwater collected over impervious surfaces within the project site. Surface runoff or groundwater seepage, if encountered around and/or in the excavated detention vault pits, should be intercepted and drain away with an intercepting trench drain constructed around the top of detention vault pits. A trench should also be excavated along the base of cut banks in the pits to intercept and direct water into a sump pit or pits from which water can be pumped out.

The detention vaults may be supported on footings founded on very-dense till soil. An allowable soil bearing pressure of 6,000 psf may be used for the design of the vault footing foundations.

A drain line consisting of perforated, rigid, PVC, drain pipe, at least 6 inches in diameter, should be installed at a few inches below bottom of the perimeter footings of the vault walls to intercept and drain away groundwater which may flow towards the vault. The drain lines should have sufficient slope (0.5% minimum) to generate flow by gravity, and

water collected in the drain line should be tightlined to discharge into a storm sewer or a suitable stormwater disposal facility. The vault footing drain lines should be wrapped in a non-woven filter fabric sock and completely embedded in clean pea gravel or 3/4 to 1-1/2 inch washed gravel. A vertical drainage blanket at least 12 inches thick horizontally, consisting of the same gravel, should be placed against the perimeter vault walls. The remaining backfill should be constructed of structural fill. Alternatively, a vertical drain mat, such as Miradrain 6000 by Mirafi Inc. or equivalent, may be placed against the perimeter vault walls as the vertical drainage blanket. The vertical drainage blankets or drain mats should be hydraulically connected to the drain lines at the base of the vault perimeter walls. Sufficient number of cleanouts at strategic locations should be installed for periodical cleaning of the vault wall drain lines to prevent clogging.

The perimeter walls of the detention vaults would also serve as retaining walls to support cut banks and backfill. The perimeter walls of the vaults capped with a lid would be restrained at their top from horizontal movement and should be designed for at-rest lateral soil pressure. For the condition that groundwater behind the perimeter vault walls can be fully drained by the drain lines provided at the base of the walls, we recommend an at-rest soil pressure of 55 pcf equivalent fluid density (EFD) be used for the design of vault perimeter walls. To counter the at-rest soil pressure, a passive lateral soil pressure of 375 pcf EFD may be used, except that the passive pressure within the top 12 inches of the finish subgrade should be ignored. The above passive pressure assumes the backslopes of the walls is level or ascending away from the walls. The at-rest soil pressure may also be resisted by the friction force between the footings and the subgrade soils based on a coefficient of friction of 0.55.

If the site is graded in such way that it is not feasible to completely drain groundwater behind the vault walls with a gravity drain line system, the hydrostatic pressure on the perimeter vault walls should also be taken into consideration for the design of the vault perimeter walls. For the condition that a perimeter drain lines have to be placed higher than bottom of the footing level, the perimeter vault walls should be designed for a lateral soils pressure of 55 pcf EFD above the drain line level and a combined lateral soil and hydrostatic pressure of 105 pcf EFD below the drain line level. The above lateral pressures on the walls may be countered by a passive soil pressure of 375 pcf EFD above the drain line and 210 pcf EFD below.

The detention vault walls should also be designed for seismic loading based on a 100-year seismic event. Based on the soil conditions in the detention vault area, we recommend the vault walls be designed for an invert triangular lateral soil pressure diagram with the pressure at the top of the triangle to be 10H psf for a 100-year seismic event, where H is the height from finish grade above the top of the vault to bottom of footings in feet. A one-third increase in the above recommended allowable soil bearing pressure may be used when considering the seismic loading condition.

The above design parameters are unfactored ultimate values. Proper factors of safety should be applied for the design of the vault walls against sliding and overturning failures.

STRUCTURAL FILL

Structural fill is the fill that supports structural or traffic load. Structural fill for grading work should consist of clean granular soils free of organic, debris and other deleterious

substances and with particles not larger than three inches. Structural fill should have a moisture content within one percent of its optimum moisture content at the time of placement. The optimum moisture content is the water content in the soils that enable the soils to be compacted to the highest dry density for a given compaction effort. Onsite clean soils meeting the above requirements may be used as structural fill. Imported material to be used as structural fill should be clean, free-draining, granular soils containing no more than 5 percent by weight finer than the No. 200 sieve based on the fraction of the material passing No. 4 sieve, and should have individual particles not larger than three inches.

The ground over which structural fill is to be placed should be prepared in accordance with recommendations in the SITE PREPARATION AND GENERAL GRADING and EXCAVATION AND FILL SLOPES sections of this report. Structural fill placed on ground steeper than 15% should be structurally supported. Ground steeper than 20% should be stepped with vertical step no more than 4 feet before placing structural fill. Structural fill should be placed in lifts no more than 10 inches thick in its loose state, with each lift compacted to a minimum percentage of the maximum dry density determined by ASTM D1557 (Modified Proctor Method) as follows:

Application	% of Maximum Dry Density
Within building pads and under foundations	95%
Roadway/driveway subgrade	95% for top 3 feet and 90% below
Retaining/foundation wall backfill	92%
Utility trench backfill	95% for top 4 feet and 90% below

In-situ density of structural fill should be tested with a nuclear densometer by a testing agency specialized in fill placement and construction work. Testing frequency should be one test per every 250 square feet per lift.

BUILDING FOUNDATIONS

Conventional footing foundations may be used to support the proposed residences. The footing foundations should be placed on or into the underlying, very-dense cemented glacial till soil, or on structural fill placed over this undisturbed competent basal deposit. Water should not be allowed to accumulate in excavated footing trenches. Disturbed soils in footing trenches should be completely removed down to native, undisturbed, fresh till soil prior to pouring concrete for the footings.

If the above recommendations are followed, our recommended design criteria for footing foundations are as follows:

- The allowable soil bearing pressure for design of footing foundations, including dead and live loads, should be no greater than 3,000 psf if constructed on or into very-dense fresh till soils, and no greater than 2,500 psf if constructed on structural fill placed over the fresh till basal soil. The footing bearing soils should be verified by a geotechnical engineer after the footing trenches are excavated and before the footings poured.

- The minimum depth to bottom of perimeter footings below adjacent final exterior grade should be no less than 18 inches. The minimum depth to bottom of the interior footings below top of floor slab should be no less than 12 inches.

- The minimum width should be no less than 16 inches for continuous footings, and no less than 24 inches for individual footings, except those footings supporting light-weight decks or porches.

A one-third increase in the above recommended allowable soil bearing pressure may be used when considering short-term, transitory, wind or seismic loads. For footing foundations designed and constructed per recommendations above, we estimate that the maximum total post-construction settlement of the buildings should be 1/2 inch or less and the differential settlement across building width should be 3/8 inch or less.

Lateral loads on the proposed buildings may be resisted by the friction force between the foundations and the subgrade soils or the passive earth pressure acting on the below-grade portion of the foundations. For the latter, the foundations must be poured "neat" against undisturbed soils or backfilled with a clean, free-draining, compacted structural fill. We recommend that an equivalent fluid density (EFD) of 300 pcf (pounds per cubic foot) for the passive earth pressure be used for lateral resistance. The above passive pressure assumes that the backfill is level or inclines upward away from the foundations for a horizontal distance at least twice the depth of the foundations below the final grade. A coefficient of friction of 0.55 between the foundations and the subgrade soils may be used. The above soil parameters are unfactored values, and a proper factor of safety should be used in calculating the resisting forces against lateral loads on the buildings.

SLAB-ON-GRADE FLOORS

Slab-on-grade floors, if used for the proposed residential buildings, should be placed on firm subgrade soil prepared as outlined in the SITE PREPARATION AND GENERAL

EARTHWORK and the STRUCTURAL FILL sections of this report. Where moisture control is critical, the slab-on-grade floors should be placed on a capillary break which is in turn placed on the compacted subgrade. The capillary break should consist of a minimum four-inch-thick layer of clean, free-draining, 7/8-inch crushed rock, containing no more than 5 percent by weight passing the No. 4 sieve. A vapor barrier, such as a 6-mil plastic membrane, may be placed over the capillary break, as required, to keep moisture from migrating upwards.

PAVED ROADWAY AND DRIVEWAYS

Performance of roadway and driveway pavement is critically related to the conditions of the underlying subgrade soils. We recommend that the subgrade soils under the roadways/driveways be treated and prepared as described in the SITE PREPARATION AND GENERAL EARTHWORK section of this report. Prior to placing base material, the subgrade soils should be compacted to a non-yielding state with a vibratory roller compactor and proof-rolled with a piece of heavy construction equipment, such as a fully-loaded dump truck. Any areas with excessive flexing or pumping should be over-excavated and re-compacted or replaced with a structural fill or crushed rock placed and compacted in accordance with the recommendations provided in the STRUCTURAL FILL section of this report.

We recommend that a layer of compacted, 7/8-inch crushed rock base (CRB), be placed for the roadway/driveways. This crushed rock base should be at least 6 inches for the public roadways and 4 inches for the private driveways. This crushed rock base may be reduced to a 2-to-3-inch layer of leveling course consisting of 7/8-inch crushed rock if the roadways/driveways are based on cuts into undisturbed, very-dense, fresh till soils. This

crushed rock base should be overlain with a 3-inch asphalt treated base (ATB) topped by a 2-inch-thick Class B asphalt concrete (AC) surficial course for the public roads and overlain by a 3-inch-thick Class B asphalt concrete (AC) surficial course for the private driveways.

DRAINAGE CONTROL

Detention Vault and Building Footprint Excavation

Footprint excavation for detention vaults and proposed residences, if encountering groundwater seepage, should have bottom of excavation sloped slightly and ditches excavated along bases of the cut banks to direct collected groundwater into sump pits from which water can be pumped out. A layer of 2-inch crushed rock should be placed over footing bearing subgrade soils, as required, to protect the soils from disturbance by construction traffic. This crushed rock base should be built to a few inches above groundwater level, but not less than 6 inches thick. The crush rock base should be compacted in 12-inch lifts to a non-yielding state with a vibratory mechanical compactor.

Runoff over Impervious Surfaces

Storm runoff over impervious surfaces, such as roofs and paved roadway/driveways, should be collected by underground drain line systems connected to downspouts and by catch basins installed in paved roadway/driveways. Stormwater thus collected should be tightlined to discharge into a storm sewer or suitable stormwater disposal facilities.

Building Footing Drains

A subdrain should be installed, around the perimeter footings of each proposed residence. The subdrains should consist of a 4-inch-minimum-diameter, perforated, rigid, drain pipe,

laid a few inches below bottom of the perimeter footings of the buildings. The trenches and the drain lines should have a sufficient gradient (0.5% minimum) to generate flow by gravity. The drain lines should be wrapped in a non-woven filter fabric sock and completely enclosed in clean 3/4 to 1-1/2 inch washed gravel. The remaining trenches may be backfilled with clean onsite soils. Water collected by the perimeter footing subdrain systems should be tightlined, separately from the roof and surface stormwater drain lines, to discharge into a storm sewer or suitable stormwater disposal facilities.

Surface Drainage

Water should not be allowed to stand in any areas where footings, on-grade slabs, or pavement is to be constructed. Finish ground surface should be graded to direct surface runoff away from the townhome buildings. We recommend the finish ground be sloped at a gradient of 3 percent minimum for a distance of at least 10 feet away from the buildings, except in the areas to be paved.

Cleanouts

Sufficient number of cleanouts at strategic locations should be provided for underground drain lines. The underground drain lines should be cleaned and maintained periodically to prevent clogging.

RISK EVALUATION STATEMENT

The subject site is underlain at shallow depth by very-dense cemented glacial till soil. The glacial till deposits are of very-high shear strength and the site should be quite stable. It is our opinion that if the recommendations in this report are fully implemented and observed during construction and following the completion of construction, the areas

disturbed by construction will be stabilized and will remain stable, and will not increase the potential for soil movement. In our opinion, the risk for damages to the proposed development and from the development to adjacent properties from soil instability should be minimal.

LIMITATIONS

This report has been prepared for the specific application to this project for the exclusive use by Hanson Homes, and its associates, representatives, consultants and contractors. We recommend that this report, in its entirety, be included in the project contract documents for the information of the prospective contractors for their estimating and bidding purposes and for compliance with the recommendations in this report during construction. The conclusions and interpretations in this report, however, should not be construed as a warranty of the subsurface conditions. The scope of this study does not include services related to construction safety precautions and our recommendations are not intended to direct the contractor's methods, techniques, sequences or procedures, except as specifically described in this report for design considerations. All geotechnical construction work should be monitored by a geotechnical engineer during construction.

Our recommendations and conclusions are based on the geologic and soil conditions encountered in the test pits, and our experience and engineering judgment. The conclusions and recommendations are professional opinions derived in a manner consistent with the level of care and skill ordinarily exercised by other members of the profession currently practicing under similar conditions in this area. No warranty, expressed or implied, is made.

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The actual subsurface conditions of the site may vary from those encountered by the test pits excavated on the site. The nature and extent of such variations may not become evident until construction starts. If variations appear then, we should be retained to re-evaluate the recommendations of this report, and to verify or modify them in writing prior to proceeding further with the construction of the proposed development of the site.

CLOSURE

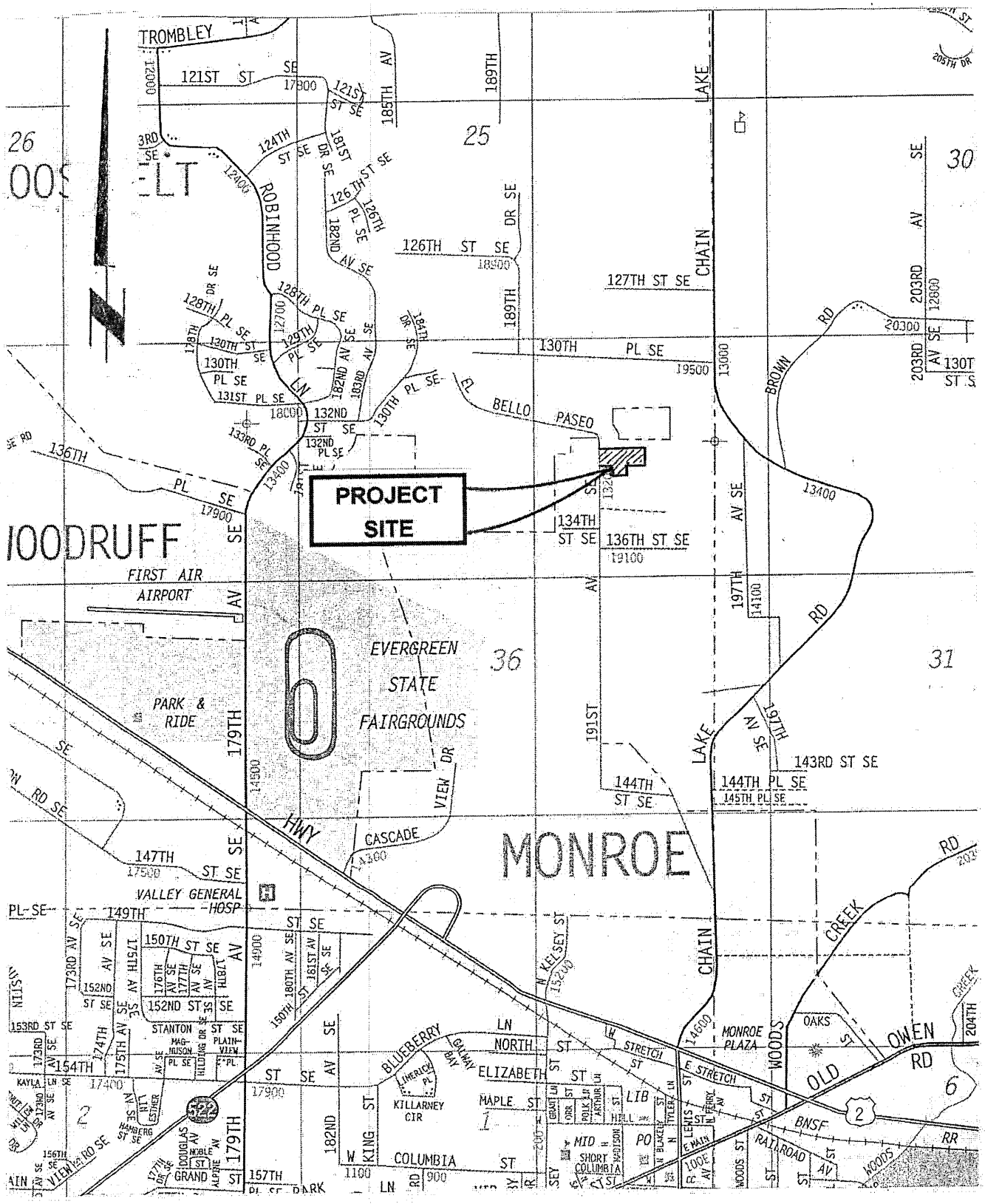
We are pleased to be of service to you on this project. Please feel free to call us if you have any questions regarding this report or need further consultation.

JEONG S. LIU
STATE OF WASHINGTON
27589
REGISTERED
PROFESSIONAL ENGINEER
2/21/2015

Yours very truly,
LIU & ASSOCIATES, INC.

J. S. (Julian) Liu, Ph.D., P.E.
Consulting Geotechnical Engineer

Six plates attached



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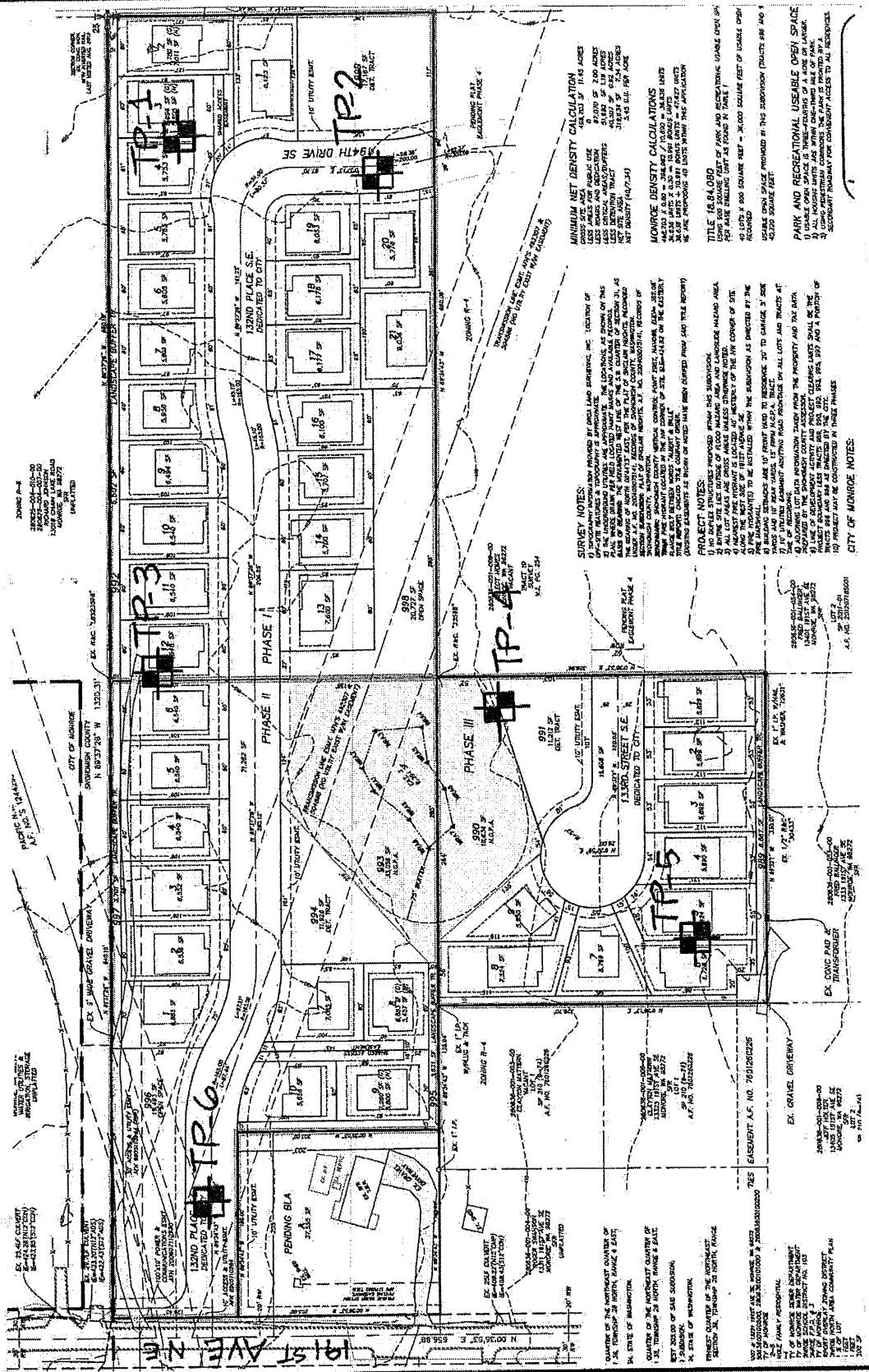
VICINITY MAP
SKY VIEW RIDGE
132XX - 191ST AVENUE SE
MONROE, WASHINGTON

JOB NO. 15-009	DATE 2/6/2015	PLATE 1



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SITE AND EXPLORATION LOCATION PLAN
SKY VIEW RIDGE
132XX - 191ST AVENUE SE
MONROE, WASHINGTON

JOB NO. 15-009	DATE 2/6/2015	PLATE 2

UNIFIED SOIL CLASSIFICATION SYSTEM

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

NOTES:

1. FIELD CLASSIFICATION IS BASED ON VISUAL EXAMINATION OF SOIL IN GENERAL ACCORDANCE WITH ASTM D2488-83.
2. SOIL CLASSIFICATION USING LABORATORY TESTS IS BASED ON ASTM D2487-83.
3. DESCRIPTIONS OF SOIL DENSITY OR CONSISTENCY ARE BASED ON INTERPRETATION OF BLOW-COUNT DATA, VISUAL APPEARANCE OF SOILS, AND/OR TEST DATA.

SOIL MOISTURE MODIFIERS:

DRY - ABSENCE OF MOISTURE, DUSTY, DRY TO THE TOUCH

SLIGHTLY MOIST - TRACE MOISTURE, NOT DUSTY

MOIST - DAMP, BUT NO VISIBLE WATER

VERY MOIST - VERY DAMP, MOISTURE FELT TO THE TOUCH

WET - VISIBLE FREE WATER OR SATURATED, USUALLY SOIL IS OBTAINED FROM BELOW WATER TABLE

TEST PIT NO. 1

Logged By: JSL Date: 2/5/2015 Ground El. ±

Depth ft.		USCS CLASS.	Soil Description	Sample No.	W %	Other Test
1		OL	Dark-brown to black, loose, organic, silty fine SAND, with roots, very moist (TOPSOIL)			
2		SM	Brown, medium-dense, silty fine SAND, trace gravel, very moist to wet			
3						
4		SM	Light-brown to light-gray, very-dense, gravelly, silty, fine sand, cemented, slightly moist (VASHON TILL)			
5						
6						
7						
8						
9						
10						
11			Test pit terminated at 10.0 ft; groundwater seepage (about 3 gpm) @ 3.5 ft			

TEST PIT NO. 2

Logged By: JSL Date: 2/5/2015 Ground El. ±

Depth ft.		USCS CLASS.	Soil Description	Sample No.	W %	Other Test
1		OL	Dark-brown to black, loose, organic, silty fine SAND, with roots, very moist (TOPSOIL)			
2		SM	Brown, loose to medium-dense, silty fine SAND, trace gravel, very moist to wet			
3						
4		SM	Light-gray, very-dense, gravelly, silty, fine sand, occasional cobble, cemented, moist (VASHON TILL)			
5						
6						
7						
8						
9						
10			Test pit terminated at 8.0 ft; groundwater seepage (about 1 to 2 gpm) @ 3.3 ft.			

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TEST PIT LOGS
SKY VIEW RIDGE
132XX - 191ST AVENUE SE
MONROE, WASHINGTON

JOB NO. 15-009 | DATE 2/6/2015 | PLATE 4

TEST PIT NO. 3

Logged By: JSL Date: 2/5/2015 Ground El. ±

Depth ft.		USCS CLASS.	Soil Description	Sample No.	W %	Other Test
1		OL	Dark-brown, loose, organic, silty fine SAND, with roots, moist (TOPSOIL)			
2		SM	Brown, medium-dense, silty fine SAND, trace gravel, very moist to wet			
3						
4		SM	Light-gray, very-dense, gravelly, silty, fine sand, occasional cobble, cemented, moist (VASHON TILL)			
5						
6						
7						
8			Test pit terminated at 7.0 ft; trickle groundwater seepage @ 2.7 ft..			
9						
10						

TEST PIT NO. 4

Logged By: JSL Date: 2/5/2015 Ground El. ±

Depth ft.		USCS CLASS.	Soil Description	Sample No.	W %	Other Test
1		OL	Dark-brown, loose, organic, silty fine SAND, with roots, very moist (TOPSOIL)			
2		SM	Brown, medium-dense, silty fine SAND, trace gravel, moist			
3						
4		SM	Light-gray, very-dense, gravelly, silty, fine sand, occasional cobble, cemented, moist (VASHON TILL)			
5						
6						
7						
8						
9			Test pit terminated at 7.5 ft; groundwater seepage (3 to 4 gpm) @ 3.0 ft.			
10						

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TEST PIT LOGS
SKY VIEW RIDGE
132XX - 191ST AVENUE SE
MONROE, WASHINGTON

JOB NO. 15-009 | DATE 2/6/2015 | PLATE 5

TEST PIT NO. 5

Logged By: JSL Date: 2/6/2015 Ground El. ±

Depth ft.		USCS CLASS.	Soil Description	Sample No.	W %	Other Test
1		OL	Dark-brown, loose, organic, silty fine SAND, with roots, moist (TOPSOIL)			
2		SM	Brown, medium-dense, silty fine SAND, trace gravel, moist			
3						
4		SM	Light-gray, very-dense, gravelly, silty, fine sand, occasional cobble, cemented, moist (VASHON TILL)			
5						
6						
7						
8						
9						
10			Test pit terminated at 9.0 ft; trickle groundwater seepage @ 3.5 ft.			

TEST PIT NO. 6

Logged By: JSL Date: 2/5/2015 Ground El. ±

Depth ft.		USCS CLASS.	Soil Description	Sample No.	W %	Other Test
1		OL	Dark-brown, loose, organic, silty fine SAND, with roots, moist (TOPSOIL)			
2		SM	Brown, medium-dense, silty fine SAND, trace gravel, moist to wet			
3		SM	Light-gray, very-dense, gravelly, silty, fine SAND, occasional cobble, cemented, moist (VASHON TILL)			
4						
5						
6						
7						
8						
9			Test pit terminated at 8.0 ft; trickle groundwater seepage @ 2.6 ft.			
10						

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TEST PIT LOGS
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JOB NO. 15-009 | DATE 2/6/2015 | PLATE 6