INSIGHT ENGINEERING CO.

PRELIMINARY STORMWATER SITE PLAN
For
805 Project

RECEIVED
06/25/2020
PLANNING

Prepared for
The City of Snohomish
116 Union Avenue
Snohomish, WA 98290-2943
360.568.3115

Project Site Location:
805 13th Street
Snohomish, WA 98290

Applicant:
Kevin Shinn
731 2nd ST
Snohomish, WA 98290

Contact:
IECO
P.O. Box 1478
Everett, WA 98206
425-303-9363

Tax Id: 00487700001401
IECO Project: 20-1040

Certified Erosion and Sedimentation Control Lead:
To be named by contractor

Stormwater Site Plan Prepared By:

Jacob D. Mealey, E.I.T.

Stormwater Site Plan Preparation Date:

May 27, 2020

Approximate Construction Date:

March 1, 2021

BRIAN R. KALAB
STATE OF WASHINGTON
36499
REGISTERED
PROFESSIONAL ENGINEER

06/12/2020

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Acronyms and Abbreviations

BMP	Best Management Practices
DOE	Department of Ecology
EDDS	Engineering Design and Development Standards
ESC	Erosion and Sediment Control
IECO	Insight Engineering Company
MR	Minimum Requirement
SCC	Snohomish County Code
SCDM	Snohomish County Drainage Manual
SWPPP	Stormwater Pollution Prevention Plan
SWMMWW	Stormwater Management Manual for Western Washington
TESC	Temporary Erosion and Sediment Control
WWHM	Western Washington Hydrology Model

1.0 Executive Summary- Attachment "A"

The proposed project **805 *Project*** is located at 805 13th Street in the City of Snohomish, Washington. More generally, the site is located in Section 07, Township 28 North, and Range 6 East of the Willamette Meridian in Snohomish County, Washington. Please refer to the Vicinity Map attached later in the section. This report follows the City of Snohomish's requirements and the requirements defined in the 20012 DOE Stormwater Management manual.

The site is currently developed with a single family home, a detached garage, a gravel driveway from Hillcrest Dr and a walkway from 13th ST. There are no critical areas located within the site. The site slopes downwards in all direction from the central portion of the property. The site contains one drainage basin as the downstream flows combine within quarter of a mile. Please refer to the downstream analysis map for more details. Per SCC survey of Snohomish County, the project site contains Tokul soils that have a hydrologic classification of Type "C". Please refer to the soils map and descriptions attached later in this report for more details.

The site contains 0.54 Acres and the proposal is to construct a two single family units with associated utilities. The existing home will remain. The access to the site will be from Hillcrest Dr. The proposal also includes frontage improvements on Hillcrest Dr as per the City of Snohomish standards.

Per Figure 2.2 (flow chart for new development requirements) on page 2-9 of Volume I of the 20012 SWMMWW, Minimum requirements #1 through 9 shall apply for this project. See section 1.2 for the Minimum Requirements Summary included later in this report. Flow control requirements are exempt per the section 2.5.7 exceptions of the SWMMWW as the proposed development will increase the sites discharge by 0.10 CFS which is less than the 0.15 CFS (15-min timesteps) threshold for requiring flow control. Please refer to Section 5 for flow check modeling calculations. Water quality is exempt per section 2.5.6 of the SWMMWW because the PGIS is 2,790 SF which is less than the threshold area of 5,000 SF.

As Per Vol 1 section 2.5.5, this project does not have to achieve the LID performance standard, nor consider bioretention, rain gardens, permeable pavement, and full dispersion as its exempt for detention.

Onsite Stormwater Management (MR#5) BMPs have been evaluated using list #1. BMPs for the roof area were considered in the following order: Full dispersion, Full Infiltration, bioretention, downspout dispersion, and perforated stub-out connection. Full dispersion and bioretention are not being evaluated for this project and are not required under list #1. Full infiltration was considered first however as per the Geotech report by Cobalt Geosciences dated Mar 14,2020 the project site contains relatively dense to very dense glacial deposits that have a very low permeability, making infiltration infeasible. Also, the infiltration rate was found to be 0.04 inches per hour, that further limits infiltration. Downspout dispersion was considered next and was found to be infeasible as the required vegetated flow path could not be met without any erosion or flooding concerns. Onsite Stormwater Management (MR#5) requirements will be met using Perforated stub-out connections Per BMP T5.10C. The perforated stub out connection will be connected to the existing drainage system along Hillcrest Dr to continue the natural drainage course of the site. Sheet Flow Dispersion per BMP T5.12 is proposed for the driveway and will be met by a 2-foot wide gravel transition zone at the edge of the proposed pavement and a 10-ft minimum vegetated flow path. Post-Construction Soil Quality and Depth BMP T.5.13 is proposed to provide onsite stormwater management for the pervious areas of the site.

Figure 1 - Minimum Requirements (MR's) for New Development Projects

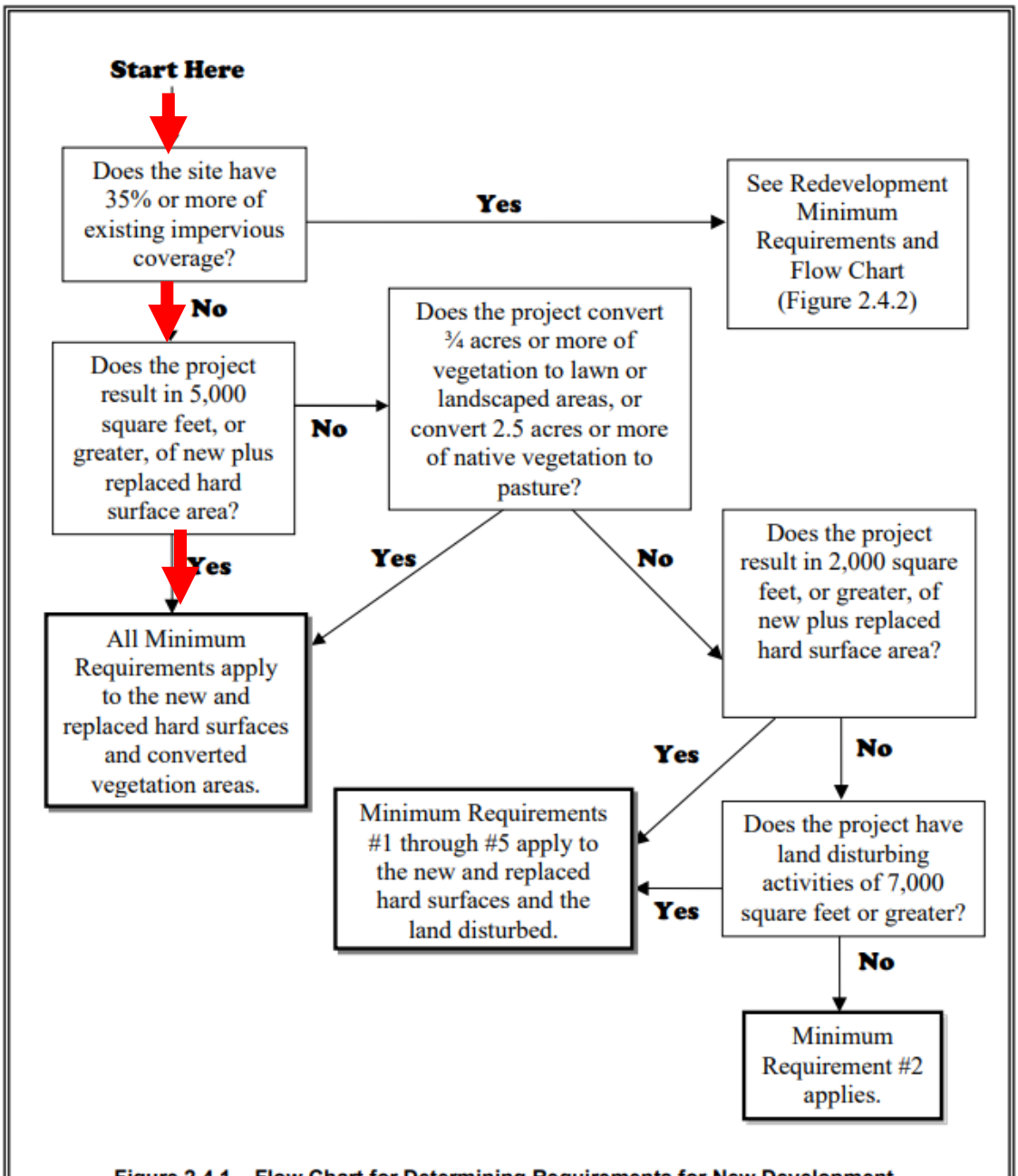
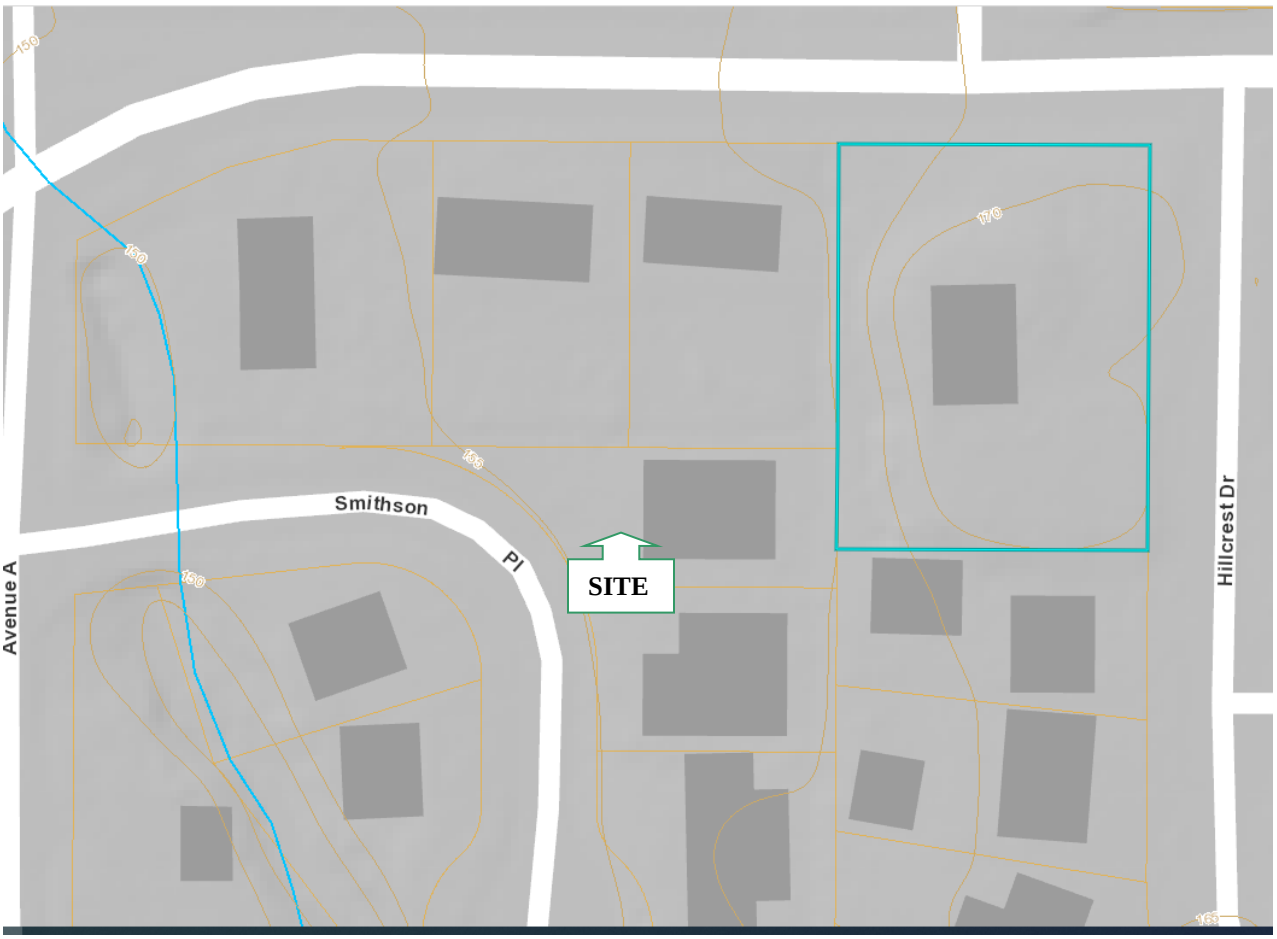


Figure 2.4.1 – Flow Chart for Determining Requirements for New Development

FIGURE 2. VICINITY MAP



Taken from Snohomish County PDS

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Figure 2 -Vicinity Map
805 13th Street
Snohomish, Washington

SCALE: NTS	**DATE:** 6/12/20	**JOB #:** 20-1040
BY: RJK	**FILE NAME:** 20-1040/doc/Stormwater Site Plan	

1.2 Minimum Requirements Summary - Attachment "C"

MR : Minimum Requirement

SWPPP : Stormwater Pollution Prevention Plan

MR #1 Stormwater Site Plan Narrative: The Stormwater Site Plan preparation follows the Snohomish County requirements and in accordance with the 2012 Stormwater Management Manual for Western Washington . Refer to the executive summary within Section 1.0.

MR #2 SWPPP Narrative: A SWPPP has been included in the Appendix A under Section 6.

MR #3 Water Pollution Source Control for New Development: No source control pollutants pertains to the proposed project; therefore, no BMP's are required.

MR #4 Preservation of Natural Drainage Systems and Outfalls: The proposed runoff will be connected to the existing drainage system along Hillcrest Dr to continue the natural drainage course of the site.

MR #5 Onsite Stormwater Management:

Onsite Stormwater Management (MR#5) BMPs have been evaluated using list #1. BMPs for the roof area were considered in the following order: Full dispersion, Full Infiltration, bioretention, downspout dispersion, and perforated stub-out connection. Full dispersion and bioretention are not being evaluated for this project and are not required under list #1. Full infiltration was considered first however as per the Geotech report by Cobalt Geosciences dated Mar 14,2020 the project site contains relatively dense to very dense glacial deposits that have a very low permeability, making infiltration infeasible. Also, the infiltration rate was found to be 0.04 inches per hour, that further limits infiltration. Downspout dispersion was considered next and was found to be infeasible as the required vegetated flow path could not be met without any erosion or flooding concerns. Onsite Stormwater Management (MR#5) requirements will be met using Perforated stub-out connections Per BMP T5.10C. The perforated stub out connection will be connected to the existing drainage system along Hillcrest Dr to continue the natural drainage course of the site. Sheet Flow Dispersion per BMP T5.12 is proposed for the driveway and will be met by a 2-foot wide gravel transition zone at the edge of the proposed pavement and a 10-ft

minimum vegetated flow path. Post-Construction Soil Quality and Depth BMP T.5.13 is proposed to provide onsite stormwater management for the pervious areas of the site.

MR #6 Runoff Treatment: Water quality is exempt per section 2.5.6 of the SWMMWW because the PGIS is 2,790 SF which is less than the threshold area of 5,000 SF.Water quality is exempt per section 2.5.6 of the SWMMWW because the PGIS is 2,790 SF which is less than the threshold area of 5,000 SF.

MR #7 Flow Control: Flow control requirements are exempt per the section 2.5.7 exceptions of the SWMMWW as the proposed development will increase the sites discharge by 0.10 CFS which is less than the 0.15 CFS (15-min timesteps) threshold for requiring flow control. Please refer to Section 5 for flow check modeling calculations.

MR #8 Wetlands Protection: N/A. There are no wetlands located on the site.

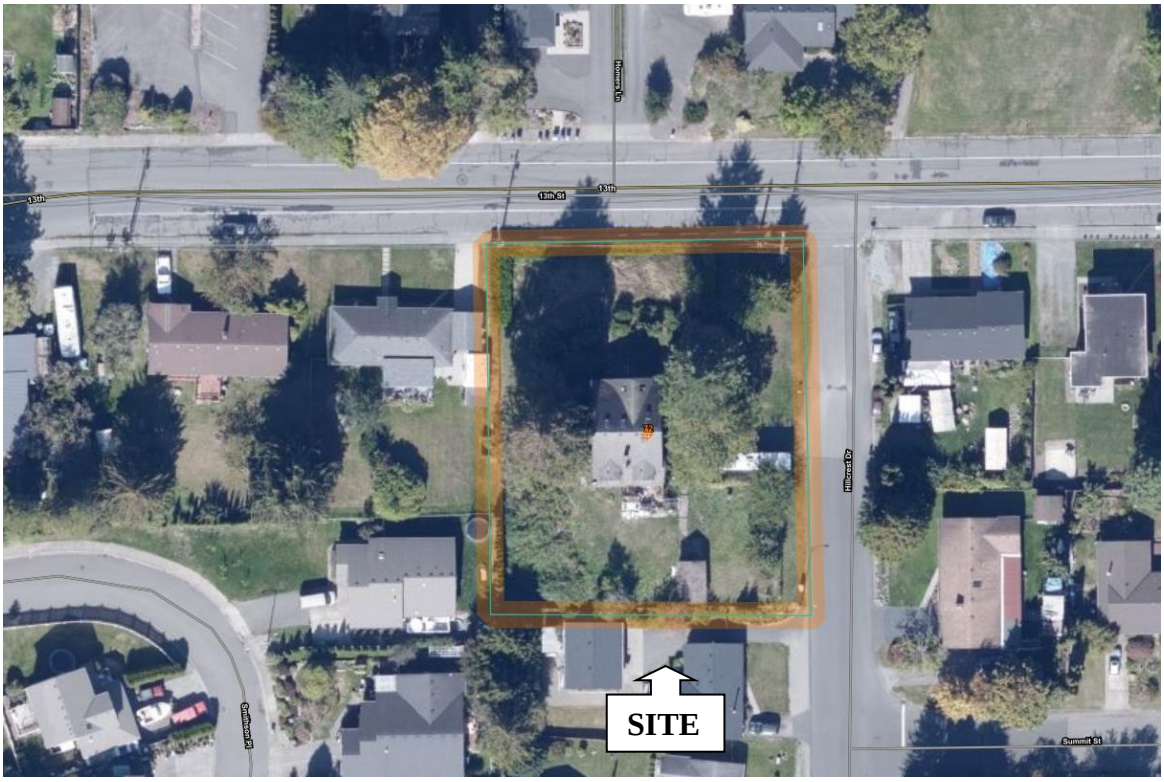
MR #9 Operations and Maintenance: A operations and maintenance manual will be submitted along with the construction plans.

2.0 Existing Conditions

The proposed project **805 *Project*** is located at 805 13th Street in the City of Snohomish, Washington. More generally, the site is located in Section 07, Township 28 North, and Range 6 East of the Willamette Meridian in Snohomish County, Washington.

The site is currently developed with a single family home, a detached garage, a gravel driveway from Hillcrest Dr and a walkway from 13th ST. There are no critical areas located within the site. The site slopes downwards in all direction from the central portion of the property. The site contains one drainage basin as the downstream flows combine within quarter of a mile. Please refer to the downstream analysis map for more details. Per SCC survey of Snohomish County, the project site contains Tokul soils that have a hydrologic classification of Type "C". Please refer to the soils map and descriptions attached later in this report for more details.

SOIL MAP



SOILS LEGEND

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

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Figure 3 - Soil Map
805 13th Street
Snohomish, Washington

SCALE: NONE	**DATE:** 6/12/20	**JOB #:** 20-1040
BY: JDM	**FILE NAME:** 20-1040/doc/Stormwater Site Plan	

Snohomish County Area, Washington

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

Map Unit Setting

- *National map unit symbol:* 2t61k
- *Elevation:* 160 to 1,150 feet
- *Mean annual precipitation:* 45 to 70 inches
- *Mean annual air temperature:* 46 to 52 degrees F
- *Frost-free period:* 140 to 200 days
- *Farmland classification:* All areas are prime farmland

Map Unit Composition

- *Tokul and similar soils:* 85 percent
- *Minor components:* 15 percent
- *Estimates are based on observations, descriptions, and transects of the mapunit.*

Description of Tokul

Setting

- *Landform:* Till plains, hillslopes
- *Landform position (two-dimensional):* Toeslope
- *Landform position (three-dimensional):* Side slope, tread
- *Down-slope shape:* Convex
- *Across-slope shape:* Convex
- *Parent material:* Volcanic ash mixed with loess over glacial till

Typical profile

- *Oi - 0 to 1 inches:* slightly decomposed plant material
- *Oa - 1 to 2 inches:* highly decomposed plant material
- *A - 2 to 6 inches:* gravelly medial loam
- *Bs1 - 6 to 9 inches:* gravelly medial loam
- *Bs2 - 9 to 17 inches:* gravelly medial loam
- *Bs3 - 17 to 24 inches:* gravelly medial loam
- *BC - 24 to 33 inches:* gravelly medial fine sandy loam
- *2Bsm - 33 to 62 inches:* cemented material

Properties and qualities

- *Slope:* 0 to 8 percent
- *Depth to restrictive feature:* 20 to 39 inches to cemented horizon; 20 to 39 inches to densic material
- *Natural drainage class:* Moderately well drained
- *Capacity of the most limiting layer to transmit water (Ksat):* Very low to moderately low (0.00 to 0.06 in/hr)
- *Depth to water table:* About 18 to 36 inches
- *Frequency of flooding:* None
- *Frequency of ponding:* None
- *Available water storage in profile:* Moderate (about 8.7 inches)

Interpretive groups

- *Land capability classification (irrigated):* None specified
- *Land capability classification (nonirrigated):* 3s
- *Hydrologic Soil Group:* B
- *Forage suitability group:* Limited Depth Soils (G002XN302WA), Limited Depth Soils (G002XF303WA)
- *Hydric soil rating:* No

Minor Components

Pastik

- *Percent of map unit:* 5 percent
- *Landform:* Terraces
- *Landform position (three-dimensional):* Tread
- *Down-slope shape:* Linear
- *Across-slope shape:* Linear
- *Hydric soil rating:* No

Barneston

- *Percent of map unit:* 5 percent
- *Landform:* Kames, eskers, moraines
- *Landform position (two-dimensional):* Summit, shoulder
- *Landform position (three-dimensional):* Crest, interfluve
- *Down-slope shape:* Convex

- *Across-slope shape:* Convex
- *Hydric soil rating:* No

Norma

- *Percent of map unit:* 3 percent
- *Landform:* Depressions, drainageways
- *Landform position (three-dimensional):* Dip
- *Down-slope shape:* Concave, linear
- *Across-slope shape:* Concave
- *Hydric soil rating:* Yes

Mckenna

- *Percent of map unit:* 2 percent
- *Landform:* Depressions, drainageways
- *Landform position (three-dimensional):* Dip
- *Down-slope shape:* Concave, linear
- *Across-slope shape:* Concave
- *Hydric soil rating:* Yes

3.0 Offsite Analysis

A site reconnaissance was performed by Brian R. Kalab, PE of Insight Engineering on January 15, 2019 to verify the downstream flow paths and observe any drainage problems downstream of the site. The sky was cloudy with a temperature of 40 degrees. No visible on-site drainage problems were observed at the time of field investigations.

The site slopes downwards in all direction from the central portion of the property. The site contains one drainage basin as the downstream flows combine within quarter of a mile. Please refer to the downstream analysis map for more details. Per SCC survey of Snohomish County, the project site contains Tokul soils that have a hydrologic classification of Type "C". Please refer to the soils map and descriptions attached later in this report for more details.

3.1 Upstream Analysis

Based on the site reconnaissance and the topographic survey of the site, the upstream flows are minimal. Refer to the Downstream Analysis Map attached in the next page for more details.

3.2 Downstream Analysis

The site slopes downwards in all direction from the central portion of the property. The site contains one drainage basin as the downstream flows combine within quarter of a mile. The western portion of the site sheet flows to the west for about 275 ft to join the an unnamed stream. The northern portion of the site slopes to 13th ST. The flow enters the existing drainage system along 13th St and flows west to join the unnamed stream. The eastern portion of the site slopes towards Hillcrest Dr and the flows eventually join the existing drainage system on 13th ST. The southern portion of the site sheet flows southwest to join the unnamed stream west of the property. All the flows join the unnamed stream within quarter of a mile. After the flows combine the stream flows north for about 950 to ft to join Blackmans Lake. This is where the 1-mile downstream analysis was concluded. No erosion or drainage issues were observed during the downstream analysis.

FIGURE 4. DOWNSTREAM ANALYSIS MAP 1

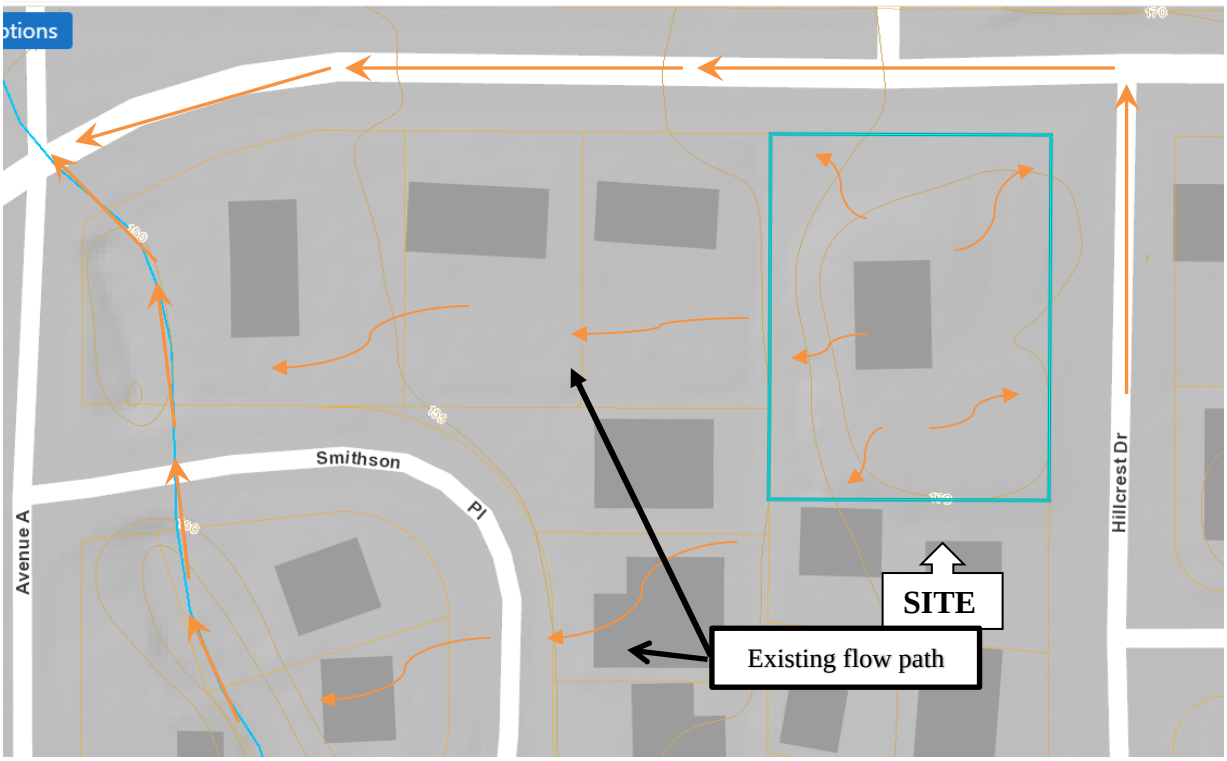

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Figure 4 - Downstream Analysis Map
805 13th Street
Snohomish, Washington

SCALE: NONE	**DATE:** 6/12/20	**JOB #:** 20-1040
BY: RJK	**FILE NAME:** 20-1040/doc/Stormwater Site Plan	

FIGURE 5. DOWNSTREAM ANALYSIS MAP 2

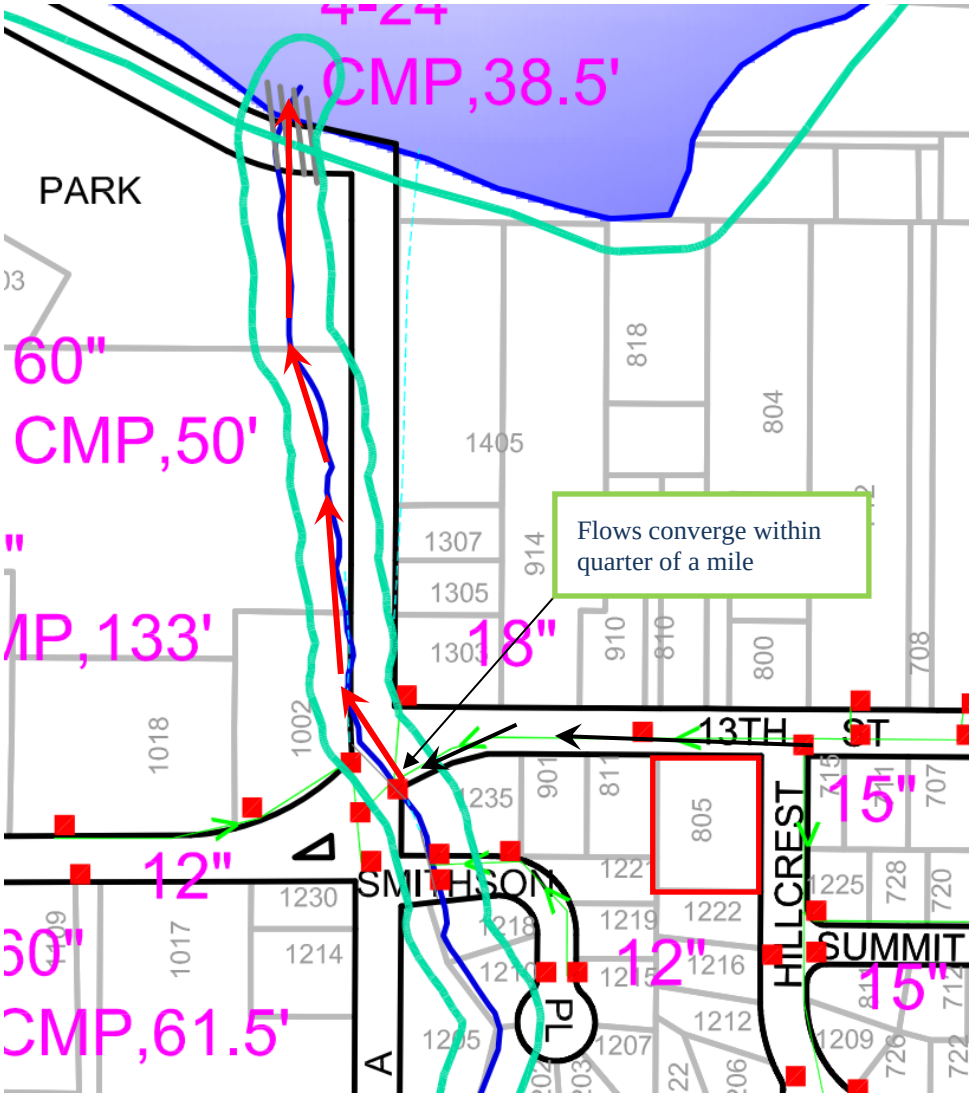

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Figure 5 - Downstream Analysis Map
805 13th Street
Snohomish, Washington

SCALE: NONE	**DATE:** 6/12/20	**JOB #:** 20-1040
BY: RJK	**FILE NAME:** 20-1040/doc/Stormwater Site Plan	

4.0 Developed Conditions

The proposed project **805 *Project*** is located at 805 13th Street in the City of Snohomish, Washington. More generally, the site is located in Section 07, Township 28 North, and Range 6 East of the Willamette Meridian in Snohomish County, Washington.The site slopes downwards in all direction from the central portion of the property. The site contains one drainage basin as the downstream flows combine within quarter of a mile. Please refer to the downstream analysis map for more details. Per SCC survey of Snohomish County, the project site contains Tokul soils that have a hydrologic classification of Type "C". Please refer to the soils map and descriptions attached later in this report for more details.

The site contains 0.54 Acres and the proposal is to construct a two single family units with associated utilities. The existing home will remain. The access to the site will be from Hillcrest Dr. The proposal also includes frontage improvements on Hillcrest Dr as per the City of Snohomish standards.

Per Figure 2.2 (flow chart for new development requirements) on page 2-9 of Volume I of the 20012 SWMMWW, Minimum requirements #1 through 9 shall apply for this project. See section 1.2 for the Minimum Requirements Summary included later in this report. Flow control requirements are exempt per the section 2.5.7 exceptions of the SWMMWW as the proposed development will increase the sites discharge by 0.10 CFS which is less than the 0.15 CFS (15-min timesteps) threshold for requiring flow control. Please refer to Section 5 for flow check modeling calculations. Water quality is exempt per section 2.5.6 of the SWMMWW because the PGIS is 2,790 SF which is less than the threshold area of 5,000 SF.

As Per Vol 1 section 2.5.5, this project does not have to achieve the LID performance standard, nor consider bioretention, rain gardens, permeable pavement, and full dispersion as its exempt for detention.

Onsite Stormwater Management (MR#5) BMPs have been evaluated using list #1. BMPs for the roof area were considered in the following order: Full dispersion, Full Infiltration, bioretention, downspout dispersion, and perforated stub-out connection. Full dispersion and bioretention are not being evaluated for this project and are not required under list #1. Full infiltration was considered first however as per the Geotech report by Cobalt Geosciences dated Mar 14,2020 the project site contains relatively dense to very dense glacial deposits that have a very low permeability, making infiltration infeasible. Also, the infiltration rate was found to be 0.04 inches per hour, that further limits infiltration. Downspout dispersion was considered next and was found to be infeasible as the required vegetated flow path could not be met without any erosion or flooding concerns. Onsite Stormwater Management (MR#5) requirements will be met using Perforated stub-out connections Per BMP T5.10C. The perforated stub out connection will be connected to the existing drainage system along Hillcrest Dr to continue the natural drainage course of the site. Sheet Flow Dispersion per BMP T5.12 is proposed for the driveway and will be met by a 2-foot wide gravel transition zone at the edge of the proposed pavement and a 10-ft minimum vegetated flow path. Post-Construction Soil Quality and Depth BMP T.5.13 is proposed to provide onsite stormwater management for the pervious areas of the site.

5.0 Site Hydraulic Conditions

Total Site Area	= 0.54 Acres
Frontage area	= 0.06 Acres
Total area included in the analysis	*= 0.60 Acres*

From the Soil Conservation Service Map of Snohomish County, the majority of the site contains Tokul type soils that have a hydrologic classification of Type "C".

5.1 Existing Basin Summary

Existing Basin	**= 0.60 Acres**
Total area included in the analysis	*=0.60 Acres*
Impervious:	
Walkway	= 0.02 Acres (848 SF)
Roof Area	= 0.04 Acres (1,848 SF)
Gravel	= 0.03 Acres (1,450 SF)
Total Impervious	= 0.09 Acres (4,146 SF)

Pervious=0.60 Acres-0.09 Acres =0.51 Acres

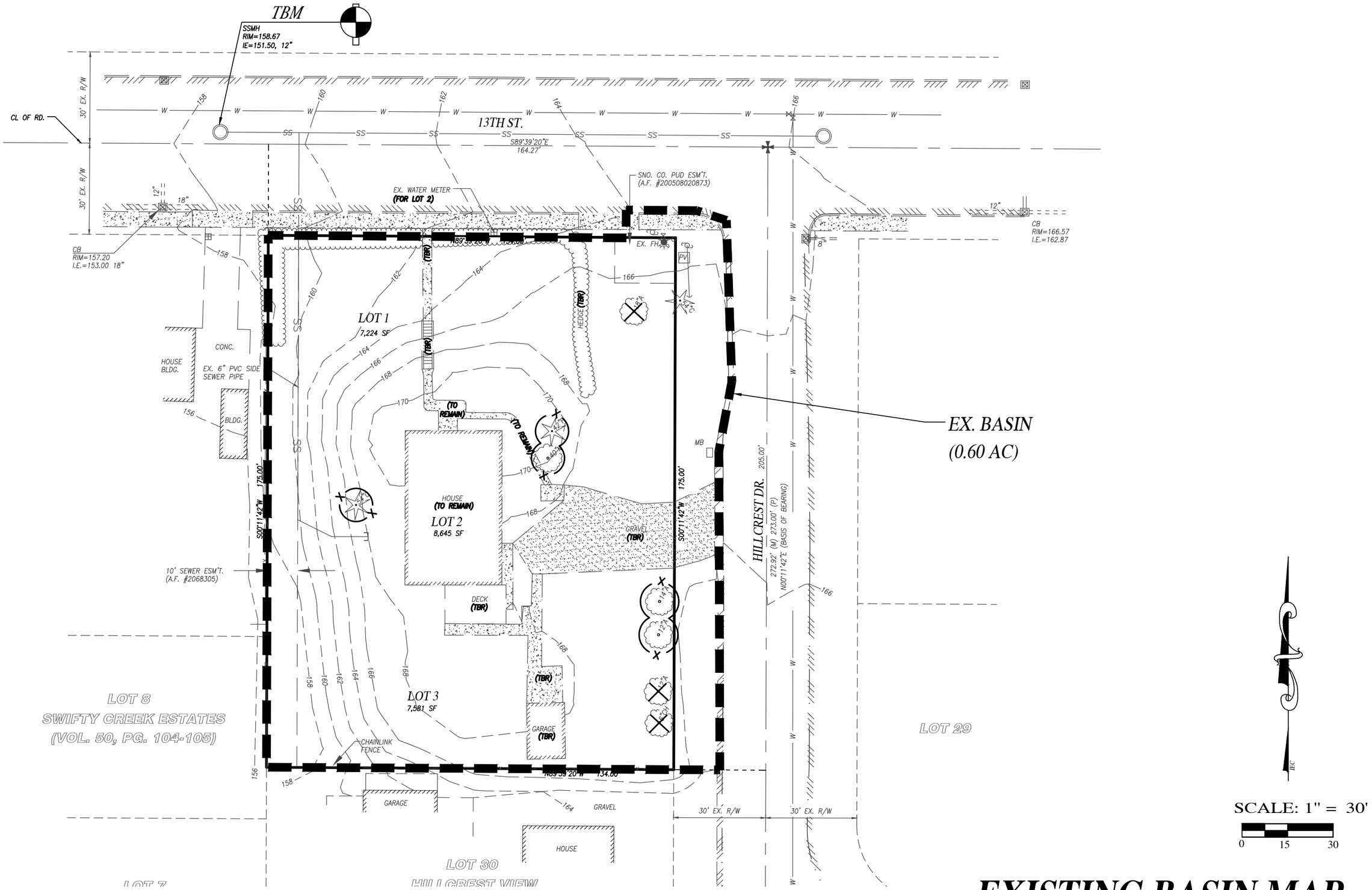
Refer to the Existing Basin Map and following pages for more details.

Developed Basin	**= 0.60 Acres**
Total area included in the analysis	*=0.60 Acres*
Impervious:	
Asphalt	= 0.01 Acres (660 SF)
Roof Area	= 0.13 Acres (5,685 SF)
Driveway	= 0.04 Acres (1,830 SF)
Ex Walkway	= 0.01 Acres (250 SF)
Sidewalk	= 0.02 Acres (945 SF)
Total Impervious	= 0.21 Acres (9,370 SF)

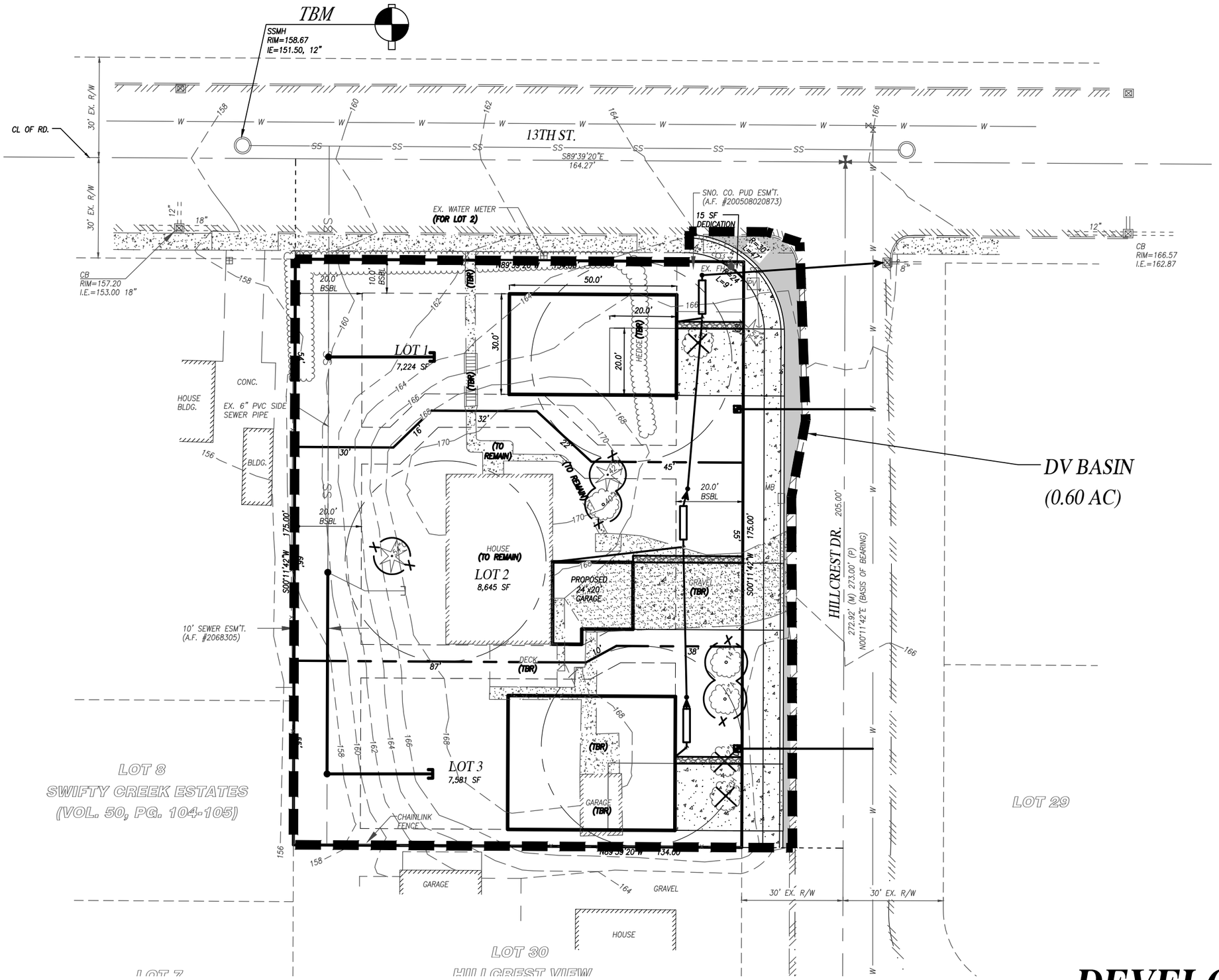
Pervious=0.60 Acres-0.21 Acres =0.39 Acres

Refer to the Developed Basin Map and following pages for more details.

100-yr Peak Flow Increase = 0.61 cfs – 0.50 cfs =- 0.11 cfs < 0.15 cfs



EXISTING BASIN MAP



DEVELOPED BASIN MAP

WWHM2012
PROJECT REPORT

Project Name: exempt
Site Name: 805 project
Site Address: 805 13th Street,
City : Snohomish
Report Date: 6/11/2020
Gage : Everett
Data Start : 1948/10/01
Data End : 2009/09/30
Precip Scale: 1.20
Version Date: 2018/10/10
Version : 4.2.16

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

High Flow Threshold for POC 1: 50 year

PREDEVELOPED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	acre
C, Pasture, Steep	.14
C, Lawn, Mod	.37
Pervious Total	0.51

Impervious Land Use	acre
ROOF TOPS FLAT	0.04
DRIVEWAYS MOD	0.03
SIDEWALKS MOD	0.02
Impervious Total	0.09
Basin Total	0.6

Element Flows To:

Surface	Interflow	Groundwater

MITIGATED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	acre
C, Lawn, Flat	.3
C, Lawn, Steep	.1
Pervious Total	0.4

Impervious Land Use	acre
ROADS FLAT	0.01
ROOF TOPS FLAT	0.13
DRIVEWAYS MOD	0.05
SIDEWALKS FLAT	0.02
Impervious Total	0.21
Basin Total	0.61

Element Flows To:

Surface	Interflow	Groundwater

ANALYSIS RESULTS

Stream Protection Duration

Predeveloped Landuse Totals for POC #1
Total Pervious Area:0.51
Total Impervious Area:0.09

Mitigated Landuse Totals for POC #1
Total Pervious Area:0.4
Total Impervious Area:0.21

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.125972
5 year	0.203447
10 year	0.264169
25 year	0.351865

50 year	0.425361
100 year	0.506032

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0.176447
5 year	0.266311
10 year	0.33628
25 year	0.43736
50 year	0.522366
100 year	0.616123

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

Perlnd and Implnd Changes

No changes have been made.

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Water quality is exempt per section 2.5.6 of the SWMMWW because the PGIS is 2,790 SF which is less than the threshold area of 5,000 SF.Water quality is exempt per section 2.5.6 of the SWMMWW because the PGIS is 2,790 SF which is less than the threshold area of 5,000 SF.**5.3 Water Quality**

Water quality is exempt per section 2.5.6 of the SWMMWW because the PGIS is 2,790 SF which is less than the threshold area of 5,000 SF.Water quality is exempt per section 2.5.6 of the SWMMWW because the PGIS is 2,790 SF which is less than the threshold area of 5,000 SF.

6.0 Appendix

A. Stormwater Pollution Prevention Plan
B. Geotech Report
C. Soil Amendment

A. STORMWATER POLLUTION PREVENTION PLAN

This Stormwater Pollution Prevention Plan (SWPPP) has been prepared as part of the Construction stormwater permit requirements for ***805 Project*** **Error! Reference source not found.**805 13th Street in the City of Snohomish, Washington. More generally, the site is located in Section 07, Township 28 North, and Range 6 East of the Willamette Meridian in Snohomish County, Washington. The site is currently developed with a single family home, a detached garage, a gravel driveway from Hillcrest Dr and a walkway from 13th ST. There are no critical areas located within the site. The site slopes downwards in all direction from the central portion of the property. The site contains one drainage basin as the downstream flows combine within quarter of a mile. The site contains 0.54 Acres and the proposal is to construct a two single family units with associated utilities. The existing home will remain. The access to the site will be from Hillcrest Dr.

The purpose of this SWPPP is to describe the proposed construction activities and all temporary and permanent erosion and sediment control (TESC) measures, pollution prevention measures, inspection/monitoring activities, and recordkeeping that will be implemented during the proposed construction project. The objectives of the SWPPP are to:

1. Implement Best Management Practices (BMPs) to prevent erosion and sedimentation, and to identify, reduce, eliminate or prevent stormwater contamination and water pollution from construction activity.

2. Prevent violations of surface water quality, ground water quality, or sediment management standards.

3. Prevent, during the construction phase, adverse water quality impacts including impacts on beneficial uses of the receiving water by controlling peak flow rates and volumes of stormwater runoff at the Permittee's outfalls and downstream of the outfalls.

This SWPPP was prepared using the Ecology SWPPP Template. This SWPPP was prepared based on the requirements set forth in the Construction Stormwater General Permit and in the Stormwater Management Manual for Western Washington (SWMMWW 2005).

The 12 BMP Elements

Element #1 – Mark Clearing Limits

To protect adjacent properties and to reduce the area of soil exposed to construction, the limits of construction will be clearly marked before land-disturbing activities begin.

Element #2 – Establish Construction Access

Construction access or activities occurring on unpaved areas shall be minimized, yet where necessary, access points shall be stabilized to minimize the tracking of sediment onto public roads, and wheel washing, street sweeping, and street cleaning shall be employed to prevent sediment from entering state waters.

Install the temporary construction entrance, according to the approved construction plans, prior to any clearing or grading activities. Maintain until the access road is paved.

Element #3 – Control Flow Rates

In order to protect the properties and waterways downstream of the project site, stormwater discharges from the site will be controlled. In general, discharge rates of stormwater from the site will be controlled where increases in impervious area or soil compaction during construction could lead to downstream erosion, or where necessary to meet local agency stormwater discharge requirements.

Element #4 – Install Sediment Controls

Install silt fencing, according to the approved plans, prior to any clearing or grading activities. Maintain until all construction activities are completed.

Element #5 – Stabilize Soils

Exposed and un-worked soils shall be stabilized with the application of effective BMPs to prevent erosion throughout the life of the project.

Apply temporary hydro-seed to exposed and un-worked soils, according to the approved construction plans, as needed to prevent erosion during site grading. Apply permanent hydro-seed to areas at final grade as site grading is completed.

Apply mulching to exposed and un-worked soils, according to the approved construction plans, as needed to prevent erosion during site grading. Maintain until site grading is completed and permanent hydro-seed is applied.

Cover stockpiles with plastic sheeting, according to the approved construction plans, as needed to prevent erosion during site grading. Maintain until stockpiles are removed from site.

Element #6 – Protect Slopes

All cut and fill slopes will be designed, constructed, and protected in a manner than minimizes erosion. The following specific BMPs will be used to protect slopes for this project.

Element #7 – Protect Drain Inlets

All storm drain inlets and culverts made operable during construction shall be protected to prevent unfiltered or untreated water from entering the drainage conveyance system. However, the first

priority is to keep all access roads clean of sediment and keep street wash water separate from entering storm drains until treatment can be provided.

Element #8 – Stabilize Channels and Outlets

Where site runoff is to be conveyed in channels, or discharged to a stream or some other natural drainage point, efforts will be taken to prevent downstream erosion.

Element #9 – Control Pollutants

All pollutants, including waste materials and demolition debris, that occur onsite shall be handled and disposed of in a manner that does not cause contamination of stormwater. Good housekeeping and preventative measures will be taken to ensure that the site will be kept clean, well organized, and free of debris.

Element #10 – Control Dewatering

There will be no dewatering expected as part of this proposal. If it occurs, Baker tanks will be used for dewatering.

Element #11 – Maintain BMPs

All temporary and permanent erosion and sediment control BMPs shall be maintained and repaired as needed to assure continued performance of their intended function. Maintenance and repair shall be conducted in accordance with each particular BMP's specifications. Visual monitoring of the BMPs will be conducted at least once every calendar week and within 24 hours of any rainfall event that causes a discharge from the site. If the site becomes inactive, and is temporarily stabilized, the inspection frequency will be reduced to once every month. All temporary erosion and sediment control BMPs shall be removed within 30 days after the final site stabilization is achieved or after the temporary BMPs are no longer needed. Trapped sediment shall be removed or stabilized on site. Disturbed soil resulting from removal of BMPs or vegetation shall be permanently stabilized.

Element #12 – Manage the Project

Erosion and sediment control BMPs for this project have been designed based on the following principles:

Design the project to fit the existing topography, soils, and drainage patterns; Emphasize erosion control rather than sediment control; Minimize the extent and duration of the area exposed; Keep runoff velocities low; Retain sediment on site; Thoroughly monitor site and maintain all ESC measures and Schedule major earthwork during the dry season. 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 (7) days following the inspection.

Element #13 - Protect Onsite Stormwater Management BMPS for Runoff from Roofs and other Hard surfaces

Protect Area where the perforated stub-out connection will be placed from soil compaction by the use of BMP Cl03 high visibility fence.

B. GEOTECH REPORT

COBALT
GEOSCIENCES

Limited Geotechnical Investigation
Proposed Two Lot Development

805 13th Street
Snohomish, Washington

January 14, 2020

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1.0 Introduction

In accordance with your authorization, Cobalt Geosciences, LLC (Cobalt) has completed a limited geotechnical investigation for the proposed two lot development located at 805 13th Street in Snohomish, Washington (Figure 1).

The purpose of the geotechnical investigation was to identify subsurface conditions and to provide geotechnical recommendations for foundation design, earthwork, soil compaction, and suitability of the on-site soils for use as fill.

The scope of work for the geotechnical investigation consisted of a site investigation followed by engineering analyses to prepare this report. Recommendations presented herein pertain to various geotechnical aspects of the proposed development, including foundation design and stormwater management.

2.0 Project Description

The project includes subdivision of the parcel followed by construction of two new residences and driveways. Foundation loads are expected to be relatively light and site grading may include cuts or fills of 4 feet or less. We should be provided with the civil and structural plans when they become available.

3.0 Site Description

The site is located at 805 13th Street in Snohomish, Washington (Figure 1). The property consists of one rectangular parcel (No. 00487700001401) with a total area of 0.51 acres.

The central portion is developed with a single-family residence and driveway. The remainder of the property is undeveloped and vegetated with grasses, blackberry vines, bushes/shrubs, and sparse trees. The site slopes downward in all directions from the central portion of the property. Slopes have magnitudes of 5 to 10 percent and relief is about 10 feet.

The site is bordered to the north by 13th Street, to the east by Hillcrest Drive, and to the south and west by residential properties.

4.0 Field Investigation

4.1.1 Site Investigation Program

The geotechnical field investigation program was completed on January 10, 2020 and included excavating three hand borings within the property for subsurface analysis.

The soils encountered were logged in the field and are described in accordance with the Unified Soil Classification System (USCS). A dynamic cone penetrometer (DCP) was used to evaluate the relative density of the subsurface soils at several depths in each hand boring.

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A Cobalt Geosciences field representative conducted the explorations, collected disturbed soil samples, classified the encountered soils, kept a detailed log of the explorations, and observed and recorded pertinent site features.

The results of the hand boring sampling are presented on the hand boring logs enclosed in Appendix C.

5.0 Soil and Groundwater Conditions

5.1.1 Area Geology

The site lies within the Puget Lowland. The lowland is part of a regional north-south trending trough that extends from southwestern British Columbia to near Eugene, Oregon. North of Olympia, Washington, this lowland is glacially carved, with a depositional and erosional history including at least four separate glacial advances/retreats. The Puget Lowland is bounded to the west by the Olympic Mountains and to the east by the Cascade Range. The lowland is filled with glacial and non-glacial sediments consisting of interbedded gravel, sand, silt, till, and peat lenses.

The Geologic Map of Washington – Northwest Quadrant, indicates that the site is underlain by Vashon Glacial Till.

Vashon Glacial Till consists of an unsorted mixture of sand, silt, clay, and gravel. These materials are dense to very dense and nearly impermeable.

Hand Borings

The hand borings encountered approximately 6 inches of topsoil underlain by approximately 3.5 to 4.5 feet of loose to medium dense, silty-fine to medium grained sand with gravel (Weathered Glacial Till). These materials were underlain by dense, silty-fine to medium grained sand with gravel (Glacial Till), which continued to the termination depth of the hand borings.

There are likely areas of fill in yard areas around the residence. The fill is likely less than 2 feet in thickness and is likely associated with foundation excavation of the existing residence.

5.1.2 Groundwater

Groundwater was not encountered during our investigation. Seasonal perched groundwater can develop between weathered (loose) and unweathered (dense) native soils as precipitation will migrate downward until it becomes impeded on the nearly impermeable unweathered soils. We anticipate that groundwater is present at or near the elevation of the lake north of the site.

Water table elevations often fluctuate over time. The groundwater level will depend on a variety of factors that may include seasonal precipitation, irrigation, land use, climatic conditions and soil permeability. Water levels at the time of the field investigation may be different from those encountered during the construction phase of the project.

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6.0 Geologic Hazards

6.1 Erosion Hazard

The Natural Resources Conservation Services (NRCS) maps for Snohomish County indicate that the site is underlain by Tokul gravelly medial loam (0 to 8 percent slopes). These soils have a slight to moderate erosion potential in a disturbed state.

It is our opinion that soil erosion potential at this project site can be reduced through landscaping and surface water runoff control. Typically erosion of exposed soils will be most noticeable during periods of rainfall and may be controlled by the use of normal temporary erosion control measures, such as silt fences, hay bales, mulching, control ditches and diversion trenches. The typical wet weather season, with regard to site grading, is from October 31st to April 1st. Erosion control measures should be in place before the onset of wet weather.

6.2 Seismic Hazard

The overall subsurface profile corresponds to a Site Class *D* as defined by Table 1613.5.2 of the 2015 International Building Code (2015 IBC). A Site Class *D* applies to an overall profile consisting of dense to very dense soils within the upper 100 feet.

We referenced the U.S. Geological Survey (USGS) Earthquake Hazards Program Website to obtain values for S_S, S_1, F_a, and F_v. The USGS website includes the most updated published data on seismic conditions. The site specific seismic design parameters and adjusted maximum spectral response acceleration parameters are as follows:

PGA	(Peak Ground Acceleration, in percent of g)
S_S	124.40% of g
S_1	47.20% of g
F_A	1.002
F_V	1.528

Additional seismic considerations include liquefaction potential and amplification of ground motions by soft/loose soil deposits. The liquefaction potential is highest for loose sand with a high groundwater table. The relatively dense glacially consolidated materials that underlie the site have a low potential for liquefaction.

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7.0 DISCUSSION

7.1.1 General

It is our opinion that the proposed residences may be supported on shallow foundation systems bearing on medium dense or firmer native soils. These soils are anticipated to be encountered within 4 feet of the ground surface. Local overexcavation and replacement may be necessary if fill or loose soils are encountered during footing excavation work.

Stormwater infiltration is not feasible at this site. The site is underlain by Vashon Glacial Till which has a very low permeability in its unweathered state. We recommend utilizing dispersion devices or direct connection to City infrastructure.

8.0 Recommendations

8.1.1 Site Preparation

Trees, shrubs and other vegetation should be removed prior to stripping of surficial organic-rich soil. Based on observations from the site investigation program, it is anticipated that the stripping depth will range from 6 to 10 inches. Deeper excavations should be expected below larger vegetation and where undocumented fill is present.

The near-surface soils consist of silty-sand with gravel. These soils are suitable for use as structural fill provided it is within 3 percent of the optimum moisture. These soils are moisture sensitive and may not be suitable during the winter months.

Imported structural fill should consist of a sand and gravel mixture with a maximum grain size of 3 inches and less than 5 percent fines (material passing the U.S. Standard No. 200 Sieve). Structural fill should be placed in maximum lift thicknesses of 12 inches and should be compacted to a minimum of 95 percent of the modified proctor maximum dry density, as determined by the ASTM D 1557 test method.

8.1.2 Temporary Excavations

Based on our understanding of the project, we anticipate that the grading could include local cuts on the order of approximately 4 feet or less for foundation placement. If deeper excavations are proposed, they should be sloped no steeper than 1H:1V (Horizontal:Vertical) in medium dense native soils. If an excavation is subject to heavy vibration or surcharge loads, we recommend that the excavations be sloped no steeper than 1.5H: 1V, where room permits.

Temporary cuts should be in accordance with the Washington Administrative Code (WAC) Part N, Excavation, Trenching, and Shoring. Temporary slopes should be visually inspected daily by a qualified person during construction activities and the inspections should be documented in daily reports. The contractor is responsible for maintaining the stability of the temporary cut slopes and reducing slope erosion during construction.

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Temporary cut slopes should be covered with visqueen to help reduce erosion during wet weather, and the slopes should be closely monitored until the permanent retaining systems or slope configurations are complete. Materials should not be stored or equipment operated within 10 feet of the top of any temporary cut slope.

Soil conditions may not be completely known from the geotechnical investigation. In the case of temporary cuts, the existing soil conditions may not be completely revealed until the excavation work exposes the soil. Typically, as excavation work progresses the maximum inclination of temporary slopes will need to be re-evaluated by the geotechnical engineer so that supplemental recommendations can be made. Soil and groundwater conditions can be highly variable. Scheduling for soil work will need to be adjustable, to deal with unanticipated conditions, so that the project can proceed and required deadlines can be met.

If any variations or undesirable conditions are encountered during construction, we should be notified so that supplemental recommendations can be made. If room constraints or groundwater conditions do not permit temporary slopes to be cut to the maximum angles allowed by the WAC, temporary shoring systems may be required. The contractor should be responsible for developing temporary shoring systems, if needed. We recommend that Cobalt Geosciences and the project structural engineer review temporary shoring designs prior to installation, to verify the suitability of the proposed systems.

8.1.3 Erosion and Sediment Control

Erosion and sediment control (ESC) is used to reduce the transportation of eroded sediment to wetlands, streams, lakes, drainage systems, and adjacent properties. Erosion and sediment control measures should be implemented and these measures should be in general accordance with local regulations. At a minimum, the following basic recommendations should be incorporated into the design of the erosion and sediment control features for the site:

- Schedule the soil, foundation, utility, and other work requiring excavation or the disturbance of the site soils, to take place during the dry season (generally May through September). However, provided precautions are taken using Best Management Practices (BMP's), grading activities can be completed during the wet season (generally October through April).
- All site work should be completed and stabilized as quickly as possible.
- Additional perimeter erosion and sediment control features may be required to reduce the possibility of sediment entering the surface water. This may include additional silt fences, silt fences with a higher Apparent Opening Size (AOS), construction of a berm, or other filtration systems.
- Any runoff generated by dewatering discharge should be treated through construction of a sediment trap if there is sufficient space. If space is limited other filtration methods will need to be incorporated.

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8.1.4 Foundation Design

The proposed residences may be supported on shallow spread footing foundation systems bearing on undisturbed medium dense or firmer native soils or on properly compacted structural fill placed on the suitable native soils. If structural fill is used to support foundations, then the zone of structural fill should extend beyond the faces of the footing a lateral distance at least equal to the thickness of the structural fill.

For shallow foundation support, we recommend widths of at least 16 and 24 inches, respectively, for continuous wall and isolated column footings supporting the proposed structure. Provided that the footings are supported as recommended above, a net allowable bearing pressure of 2,500 pounds per square foot (psf) may be used for design. Detention vaults at a depth of 5 feet below grade or more may be designed within an allowable bearing pressure of 5,000 psf.

A 1/3 increase in the above value may be used for short duration loads, such as those imposed by wind and seismic events. Structural fill placed on bearing, native subgrade should be compacted to at least 95 percent of the maximum dry density based on ASTM Test Method D1557. Footing excavations should be inspected to verify that the foundations will bear on suitable material.

Exterior footings should have a minimum depth of 18 inches below pad subgrade (soil grade) or adjacent exterior grade, whichever is lower. Interior footings should have a minimum depth of 12 inches below pad subgrade (soil grade) or adjacent exterior grade, whichever is lower.

If constructed as recommended, the total foundation settlement is not expected to exceed 1 inch. Differential settlement, along a 25-foot exterior wall footing, or between adjoining column footings, should be less than ½ inch. This translates to an angular distortion of 0.002. Most settlement is expected to occur during construction, as the loads are applied. However, additional post-construction settlement may occur if the foundation soils are flooded or saturated. All footing excavations should be observed by a qualified geotechnical consultant.

Resistance to lateral footing displacement can be determined using an allowable friction factor of 0.40 acting between the base of foundations and the supporting subgrades. Lateral resistance for footings can also be developed using an allowable equivalent fluid passive pressure of 250 pounds per cubic foot (pcf) acting against the appropriate vertical footing faces (neglect the upper 12 inches below grade in exterior areas). The allowable friction factor and allowable equivalent fluid passive pressure values include a factor of safety of 1.5. The frictional and passive resistance of the soil may be combined without reduction in determining the total lateral resistance.

Care should be taken to prevent wetting or drying of the bearing materials during construction. Any extremely wet or dry materials, or any loose or disturbed materials at the bottom of the footing excavations, should be removed prior to placing concrete. The potential for wetting or drying of the bearing materials can be reduced by pouring concrete as soon as possible after completing the footing excavation and evaluating the bearing surface by the geotechnical engineer or his representative.

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8.1.5 Reinforced Concrete Retaining Walls

The following table, titled **Wall Design Criteria**, presents the recommended soil related design parameters for retaining walls with a level backslope, if this information is required. Contact Cobalt if an alternate retaining wall system is used.

Wall Design Criteria	
"At-rest" Conditions (Lateral Earth Pressure – EFD+)	55 pcf (Equivalent Fluid Density)
"Active" Conditions (Lateral Earth Pressure – EFD+)	35 pcf (Equivalent Fluid Density)
Seismic Increase for "At-rest" Conditions (Lateral Earth Pressure)	14H* (Uniform Distribution)
Seismic Increase for "Active" Conditions (Lateral Earth Pressure)	7H* (Uniform Distribution)
Passive Earth Pressure on Low Side of Wall (Allowable, includes F.S. = 1.5)	Neglect upper 2 feet, then 300 pcf EFD+
Soil-Footing Coefficient of Sliding Friction (Allowable; includes F.S. = 1.5)	0.40

*H is the height of the wall; Increase based on one in 500 year seismic event (10 percent probability of being exceeded in 50 years),
+ EFD – Equivalent Fluid Density

The stated lateral earth pressures do not include the effects of hydrostatic pressure generated by water accumulation behind the retaining walls. Uniform horizontal lateral active and at-rest pressures on the retaining walls from vertical surcharges behind the wall may be calculated using active and at-rest lateral earth pressure coefficients of 0.3 and 0.5, respectively. The soil unit weight of 125 pcf may be used to calculate vertical earth surcharges.

To reduce the potential for the buildup of water pressure against the walls, continuous footing drains (with cleanouts) should be provided at the bases of the walls. The footing drains should consist of a minimum 4-inch diameter perforated pipe, sloped to drain, with perforations placed down and enveloped by a minimum 6 inches of pea gravel in all directions.

The backfill adjacent to and extending a lateral distance behind the walls at least 2 feet should consist of free-draining granular material. All free draining backfill should contain less than 3 percent fines (passing the U.S. Standard No. 200 Sieve) based upon the fraction passing the U.S. Standard No. 4 Sieve with at least 30 percent of the material being retained on the U.S. Standard No. 4 Sieve. The primary purpose of the free-draining material is the reduction of hydrostatic pressure. Some potential for the moisture to contact the back face of the wall may exist, even with treatment, which may require that more extensive waterproofing be specified for walls, which require interior moisture sensitive finishes.

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We recommend that the backfill be compacted to at least 90 percent of the maximum dry density based on ASTM Test Method D1557. In place density tests should be performed to verify adequate compaction. Soil compactors place transient surcharges on the backfill. Consequently, only light hand operated equipment is recommended within 3 feet of walls so that excessive stress is not imposed on the walls.

8.1.6 Stormwater Recommendations

The site is underlain by Vashon Glacial Till which becomes denser with depth. We performed a small scale Pilot Infiltration Test (PIT) in an excavated area adjacent to HB-2. Following saturation and falling head testing at a depth of 3 feet below grade, the infiltration rate was 0.7 inches per hour. After application of correction factors of 0.33 for site variability, 0.9 for influent control, and 0.5 for testing, the infiltration rate was 0.104 inches per hour. This is lower than what is considered to be feasible.

We recommend utilizing dispersion systems if there is adequate space or direct connection to City infrastructure if there is inadequate space for shallow systems. Detention systems may be required if there is inadequate space for shallow devices. We can provide additional recommendations upon request.

8.1.7 Slab-on-Grade

We recommend that the upper 12 inches of the native soils within any proposed slab areas be compacted to at least 95 percent of the modified proctor (ASTM D1557 Test Method). Any remaining loose or unstable soils should be removed prior to fill placement and compaction.

Often, a vapor barrier is considered below concrete slab areas. However, the usage of a vapor barrier could result in curling of the concrete slab at joints. Floor covers sensitive to moisture typically requires the usage of a vapor barrier. A materials or structural engineer should be consulted regarding the detailing of the vapor barrier below concrete slabs. Exterior slabs typically do not utilize vapor barriers.

The American Concrete Institutes ACI 360R-06 Design of Slabs on Grade and ACI 302.1R-04 Guide for Concrete Floor and Slab Construction are recommended references for vapor barrier selection and floor slab detailing.

Slabs on grade may be designed using a coefficient of subgrade reaction of 200 pounds per cubic inch (pci) assuming the slab-on-grade base course is underlain by structural fill placed and compacted as outlined in Section 8.1. A 4 to 6 inch thick capillary break consisting of 5/8 inch clean angular rock or pea gravel should be placed over the prepared subgrade.

A perimeter drainage system is recommended unless interior slab areas are elevated a minimum of 12 inches above adjacent exterior grades. If installed, a perimeter drainage system should consist of a 4 inch diameter perforated drain pipe surrounded by a minimum 6 inches of drain rock wrapped in a non-woven geosynthetic filter fabric to reduce migration of soil particles into the drainage system. The perimeter drainage system should discharge by gravity flow to a suitable stormwater system.

Exterior grades surrounding buildings should be sloped at a minimum of one percent to facilitate surface water flow away from these buildings and preferably with a relatively impermeable surface cover immediately adjacent to the buildings.

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8.1.8 Groundwater Influence on Construction

Groundwater was not encountered during our investigation. We do not expect significant volumes of groundwater if the earthwork takes place during the dry season. Groundwater should be expected at or near the elevation of the lake north of the site.

If groundwater is encountered during construction, we anticipate that sump excavations and small pumps will adequate de-water short-term excavations. We can provide additional recommendations if necessary.

9.0 Construction Field Reviews

Cobalt Geosciences should be retained to provide part time field review during construction in order to verify that the soil conditions encountered are consistent with our design assumptions and that the intent of our recommendations is being met. This will require field and engineering review to:

- Monitor and test structural fill placement and soil compaction
- Observe bearing capacity at footing locations
- Monitor excavation
- Verify drainage placement
- Monitor temporary and permanent erosion control

Geotechnical design services should also be anticipated during the subsequent final design phase to support the structural design and address specific issues arising during this phase. Field and engineering review services will also be required during the construction phase in order to provide a Final Letter for the project.

10.0 Closure

This report was prepared for the exclusive use of IECO and their appointed consultants. Any use of this report or the material contained herein by third parties, or for other than the intended purpose, should first be approved in writing by Cobalt Geosciences, LLC.

The recommendations contained in this report are based on assumed continuity of soils with those of our test holes, and assumed structural loads. Cobalt Geosciences should be provided with final architectural and civil drawings when they become available in order that we may review our design recommendations and advise of any revisions, if necessary.

Use of this report is subject to the Statement of General Conditions provided in Appendix A. It is the responsibility of IECO who is identified as “the Client” within the Statement of General Conditions, and its agents to review the conditions and to notify Cobalt Geosciences should any of these not be satisfied.

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Respectfully submitted,

Cobalt Geosciences, LLC
Original signed by:

Exp. 6/26/2020

Phil Haberman, PE, LG, LEG
Principal

PH/sc

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APPENDIX A
Statement of General Conditions

Statement of General Conditions

USE OF THIS REPORT: This report has been prepared for the sole benefit of the Client or its agent and may not be used by any third party without the express written consent of Cobalt Geosciences and the Client. Any use which a third party makes of this report is the responsibility of such third party.

BASIS OF THE REPORT: The information, opinions, and/or recommendations made in this report are in accordance with Cobalt Geosciences present understanding of the site specific project as described by the Client. The applicability of these is restricted to the site conditions encountered at the time of the investigation or study. If the proposed site specific project differs or is modified from what is described in this report or if the site conditions are altered, this report is no longer valid unless Cobalt Geosciences is requested by the Client to review and revise the report to reflect the differing or modified project specifics and/or the altered site conditions.

STANDARD OF CARE: Preparation of this report, and all associated work, was carried out in accordance with the normally accepted standard of care in the state of execution for the specific professional service provided to the Client. No other warranty is made.

INTERPRETATION OF SITE CONDITIONS: Soil, rock, or other material descriptions, and statements regarding their condition, made in this report are based on site conditions encountered by Cobalt Geosciences at the time of the work and at the specific testing and/or sampling locations. Classifications and statements of condition have been made in accordance with normally accepted practices which are judgmental in nature; no specific description should be considered exact, but rather reflective of the anticipated material behavior. Extrapolation of in situ conditions can only be made to some limited extent beyond the sampling or test points. The extent depends on variability of the soil, rock and groundwater conditions as influenced by geological processes, construction activity, and site use.

VARYING OR UNEXPECTED CONDITIONS: Should any site or subsurface conditions be encountered that are different from those described in this report or encountered at the test locations, Cobalt Geosciences must be notified immediately to assess if the varying or unexpected conditions are substantial and if reassessments of the report conclusions or recommendations are required. Cobalt Geosciences will not be responsible to any party for damages incurred as a result of failing to notify Cobalt Geosciences that differing site or sub-surface conditions are present upon becoming aware of such conditions.

PLANNING, DESIGN, OR CONSTRUCTION: Development or design plans and specifications should be reviewed by Cobalt Geosciences, sufficiently ahead of initiating the next project stage (property acquisition, tender, construction, etc), to confirm that this report completely addresses the elaborated project specifics and that the contents of this report have been properly interpreted. Specialty quality assurance services (field observations and testing) during construction are a necessary part of the evaluation of sub-subsurface conditions and site preparation works. Site work relating to the recommendations included in this report should only be carried out in the presence of a qualified geotechnical engineer; Cobalt Geosciences cannot be responsible for site work carried out without being present.

APPENDIX B
Figures: Vicinity Map, Site Plan

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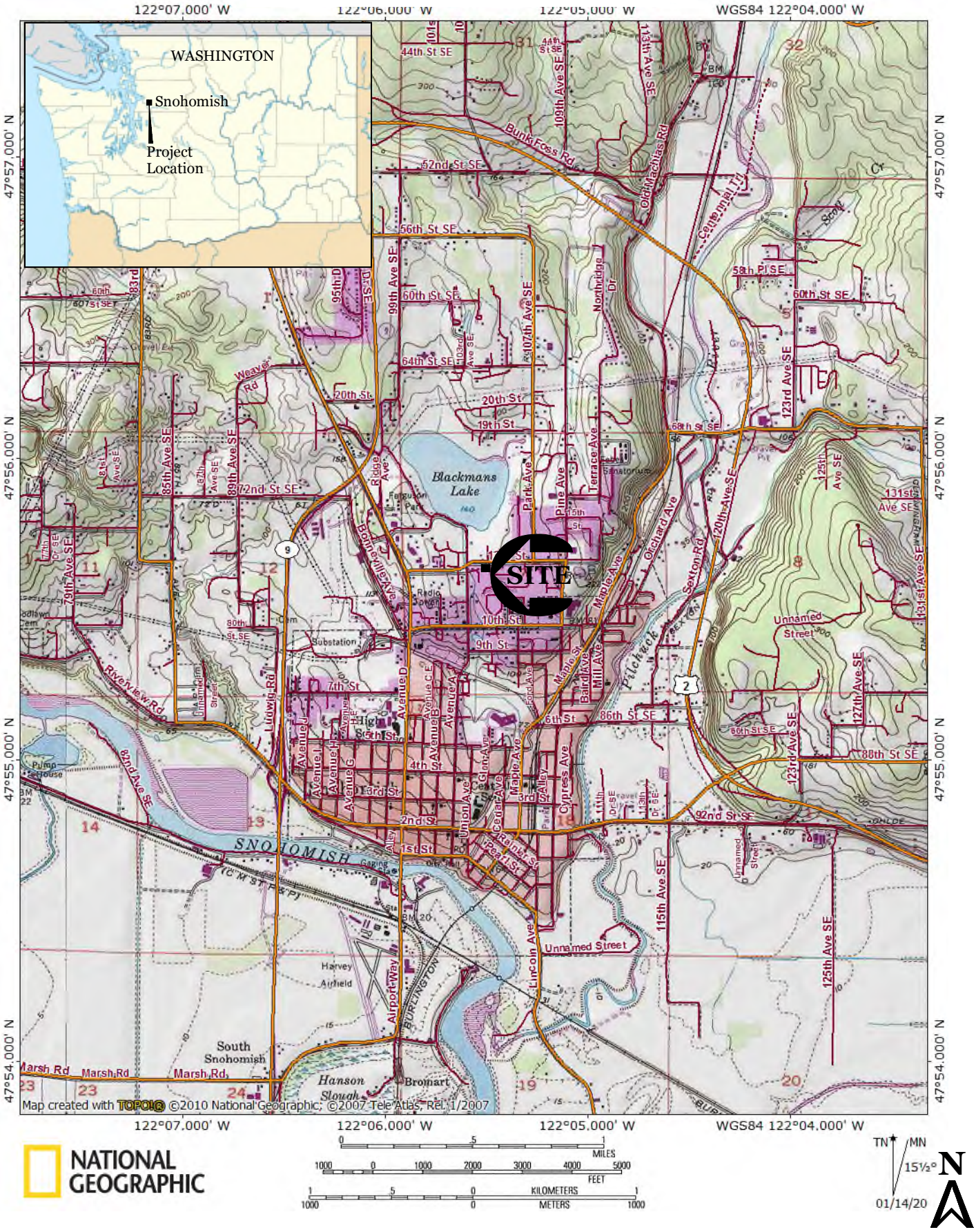

COBALT GEOSCIENCES

Proposed Two Lot Development
805 13th Street
Snohomish, Washington

VICINITY MAP
FIGURE 1

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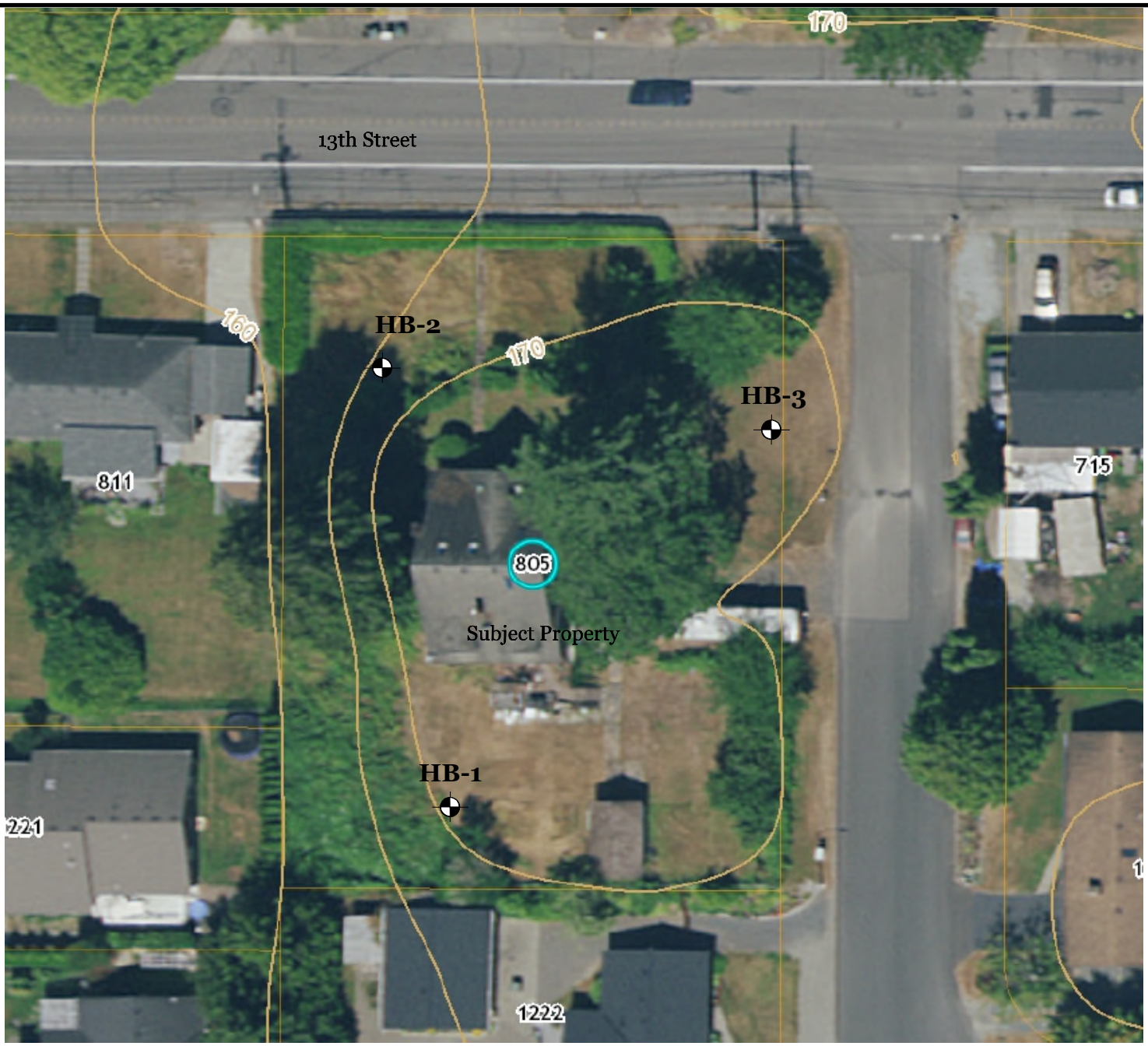

HB-1 **Approximate Hand Boring Location**

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COBALT GEOSCIENCES

Proposed Two Lot Development
805 13th Street
Snohomish, Washington

SITE PLAN

FIGURE 2

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APPENDIX C
Exploration Logs

Unified Soil Classification System (USCS)

MAJOR DIVISIONS			SYMBOL	TYPICAL DESCRIPTION
COARSE GRAINED SOILS (more than 50% retained on No. 200 sieve)	Gravels (more than 50% of coarse fraction retained on No. 4 sieve)	Clean Gravels (less than 5% fines)	GW	Well-graded gravels, gravels, gravel-sand mixtures, little or no fines
			GP	Poorly graded gravels, gravel-sand mixtures, little or no fines
		Gravels with Fines (more than 12% fines)	GM	Silty gravels, gravel-sand-silt mixtures
			GC	Clayey gravels, gravel-sand-clay mixtures
	Sands (50% or more of coarse fraction passes the No. 4 sieve)	Clean Sands (less than 5% fines)	SW	Well-graded sands, gravelly sands, little or no fines
			SP	Poorly graded sand, gravelly sands, little or no fines
		Sands with Fines (more than 12% fines)	SM	Silty sands, sand-silt mixtures
			SC	Clayey sands, sand-clay mixtures
FINE GRAINED SOILS (50% or more passes the No. 200 sieve)	Silts and Clays (liquid limit less than 50)	Inorganic	ML	Inorganic silts of low to medium plasticity, sandy silts, gravelly silts, or clayey silts with slight plasticity
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays silty clays, lean clays
		Organic	OL	Organic silts and organic silty clays of low plasticity
	Silts and Clays (liquid limit 50 or more)	Inorganic	MH	Inorganic silts, micaceous or diatomaceous fine sands or silty soils, elastic silt
			CH	Inorganic clays of medium to high plasticity, sandy fat clay, or gravelly fat clay
		Organic	OH	Organic clays of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS	Primarily organic matter, dark in color, and organic odor		PT	Peat, humus, swamp soils with high organic content (ASTM D4427)

Classification of Soil Constituents

MAJOR constituents compose more than 50 percent, by weight, of the soil. Major constituents are capitalized (i.e., SAND).

Minor constituents compose 12 to 50 percent of the soil and precede the major constituents (i.e., silty SAND). Minor constituents preceded by "slightly" compose 5 to 12 percent of the soil (i.e., slightly silty SAND).

Trace constituents compose 0 to 5 percent of the soil (i.e., slightly silty SAND, trace gravel).

Grain Size Definitions

Description	Sieve Number and/or Size
Fines	<#200 (0.08 mm)
Sand	
-Fine	#200 to #40 (0.08 to 0.4 mm)
-Medium	#40 to #10 (0.4 to 2 mm)
-Coarse	#10 to #4 (2 to 5 mm)
Gravel	
-Fine	#4 to 3/4 inch (5 to 19 mm)
-Coarse	3/4 to 3 inches (19 to 76 mm)
Cobbles	3 to 12 inches (75 to 305 mm)
Boulders	>12 inches (305 mm)

Relative Density (Coarse Grained Soils)

N, SPT, Blows/FT	Relative Density
0 - 4	Very loose
4 - 10	Loose
10 - 30	Medium dense
30 - 50	Dense
Over 50	Very dense

Consistency (Fine Grained Soils)

N, SPT, Blows/FT	Relative Consistency
Under 2	Very soft
2 - 4	Soft
4 - 8	Medium stiff
8 - 15	Stiff
15 - 30	Very stiff
Over 30	Hard

Moisture Content Definitions

Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, from below water table

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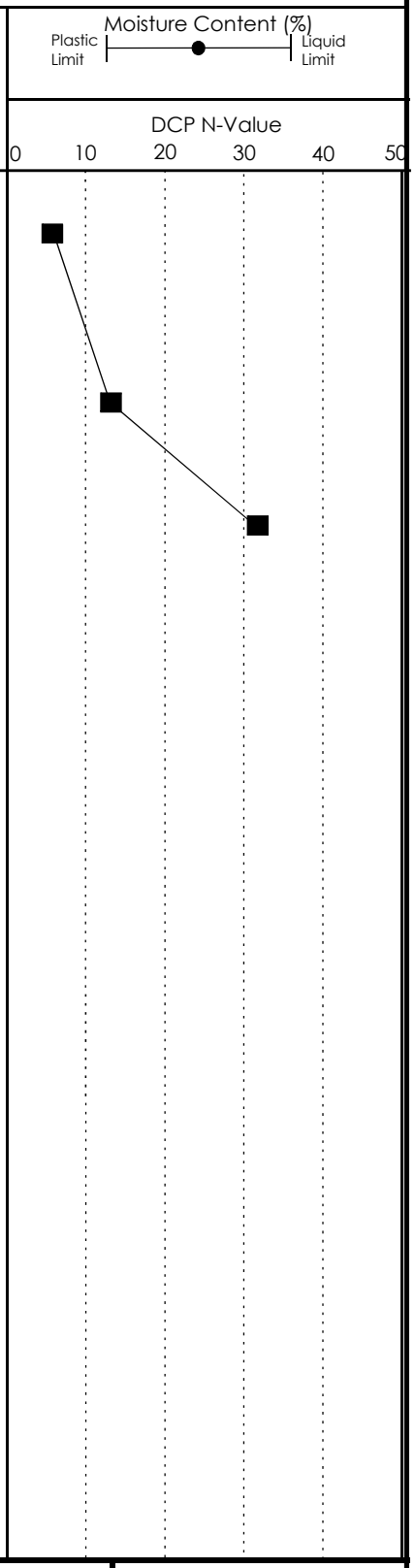
Soil Classification Chart

Figure C1

Log of Hand Boring HB-1

Date: January 10, 2020	Depth: 6'	Initial Groundwater: None
Contractor:	Elevation: N/A	Sample Type: Grab
Method: Hand Auger	Logged By: PH Checked By: SC	Final Groundwater: N/A

Depth (Feet)	Interval	% Recovery	Blows/6"	Graphic Log	USCS Symbol	Material Description	Groundwater
						Vegetation/Topsoil	
1					SM	Loose to medium dense, silty-fine to medium grained sand with gravel, mottled yellowish brown to grayish brown. (Weathered Glacial Till)	
2	■						
3							
4					SM	Dense, silty-fine to medium grained sand with gravel, grayish brown, moist. (Glacial Till)	
5	■						
6						End of Hand Boring 6'	
7							
8							
9							
10							
12							



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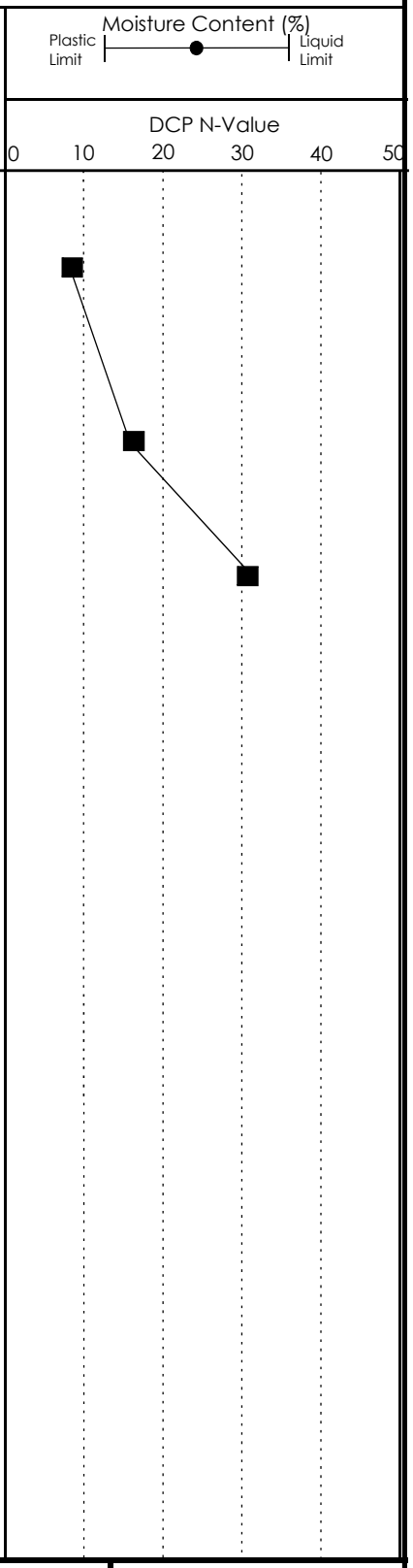
Hand Boring Log

Log of Hand Boring HB-2

Date: January 10, 2020	Depth: 7'	Initial Groundwater: None
Contractor:	Elevation: N/A	Sample Type: Grab
Method: Hand Auger	Logged By: PH Checked By: SC	Final Groundwater: N/A

Depth (Feet)	Interval	% Recovery	Blows/6"	Graphic Log	USCS Symbol	Material Description	Groundwater
						Vegetation/Topsoil	
1					SM	Loose to medium dense, silty-fine to medium grained sand with gravel, mottled yellowish brown to grayish brown, moist. (Weathered Glacial Till)	
2	■						
3							
4							
5					SM	Dense, silty-fine to medium grained sand with gravel, grayish brown, moist. (Glacial Till)	
6	■						
7						End of Hand Boring 7'	
8							
9							
10							
12							



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Hand Boring Log

Log of Hand Boring HB-3

Date: January 10, 2020	Depth: 8'	Initial Groundwater: None
Contractor:	Elevation: N/A	Sample Type: Grab
Method: Hand Auger	Logged By: PH Checked By: SC	Final Groundwater: N/A

Depth (Feet)	Interval	% Recovery	Blows/6"	Graphic Log	USCS Symbol	Material Description	Groundwater
						Vegetation/Topsoil	
1					SM	Loose to medium dense, silty-fine to fine grained sand trace gravel trace roots, dark yellowish brown to yellowish brown, moist. (Weathered Glacial Till)	
2							
3	■						
4							
5					SM	Dense, silty-fine to medium grained sand with gravel, yellowish brown to grayish brown, moist. (Glacial Till)	
6							
7	■						
8						End of Hand Boring 8'	
9							
10							

Moisture Content (%)
Plastic Limit — Liquid Limit

SPT N-Value
0 10 20 30 40 50

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Hand Boring Log

C. SOIL AMENDMENT

Compost and Topsoil Calculation Worksheet for the Pre-approved Amendment Rate

NOTE: For Options 2 and 3, use this worksheet if you plan to use the pre-approved compost amendment rate of 2 inches. This worksheet should not be used if a custom compost amendment rate is selected for Options 2 and/or 3.

Option 1

Leave native soil undisturbed, and protect from compaction during construction.

- Enter lettered areas from site plan where this option will be used:

_____ _____ _____ _____ _____ _____

No calculations for compost or topsoil are necessary for this option.

Option 2

Amend existing soil in-place (2-inch layer of compost).

- Enter lettered areas from site plan where this option will be used:

_____ _____ _____ _____ _____ _____

- Enter combined square footage of lettered areas in thousands _____ — (example: for 4,525 sq ft, enter 4.525; for 500 sq ft, enter 0.5)

- Multiply combined square footage by **6.2** and enter product in box A :

A	=Cubic Yards

AMOUNT OF COMPOST NEEDED FOR THESE AREAS

Note: MR 5 is triggered on sites with more than 2,000 sq. ft. of new, replaced, or new plus replaced impervious surface, or 7,000 sq. ft. or greater of land disturbing activity.

Option 3

Native Soil – stockpile site duff and topsoil and reapply after grading and construction.

- Enter lettered areas from site plan where this option will be used:

16,941 SF

- Enter combined square footage of lettered areas in thousands 16.94
  (example: for 4,525 sq ft, enter 4.525; for 500 sq ft, enter 0.5)

- Multiply **combined square footage** by **25** and enter product in box B :

B	423 =Cubic Yards

AMOUNT OF TOPSOIL TO BE STOCKPILED AND REAPPLIED IN THESE AREAS

Option 4

Import topsoil.

- Enter lettered areas from site plan where this option will be used:

_____ _____ _____ _____ _____ _____

- Enter combined square footage of lettered areas in thousands _____
  (example: for 4,525 sq ft, enter 4.525; for 500 sq ft, enter 0.5)

- Multiply **combined square footage** by **25** and enter product in box C:

C	=Cubic Yards

AMOUNT OF IMPORTED TOPSOITHESE NEEDED FOR THESE AREAS

Order

Order These Amounts:

- Enter amount in Box **A:** _____**Cubic Yards of Compost**

- Enter amount in Box **C :** _____**Cubic Yards of Topsoil**

Note: MR 5 is triggered on sites with more than 2,000 sq. ft. of new, replaced, or new plus replaced impervious surface, or 7,000 sq. ft. or greater of land disturbing activity.