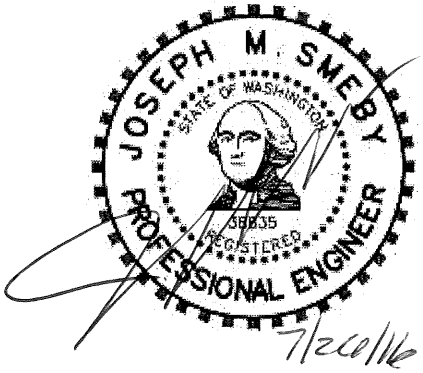
Preliminary Drainage Report
Currie Farms
PFN: M2016-

for

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

SITE LOCATION:
15831 171st Ave SE
Monroe, WA 98272



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

Job No: 15-0609
July 2016

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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 31 lot sub-division proposed on this site. The site covers 4.56 acres, of which approximately 4.0 acres will be cleared as a result of this project. Improvements to the east side of 171st Ave SE along this projects frontage along with a new road connection to the existing 173rd Ave SE stub in the northeast corner of this site will be part of the application.

This project proposes to construct a new public road within the plat to serve the future lots. In addition, frontage improvements along the east side of 171st 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 highly permeable at a depth of 4-6' below existing grade. Therefore, infiltration will be viable for this project. Refer to the geotechnical report prepared by Liu and Associates.

2. DRAINAGE INFORMATION SUMMARY FORM

Project: **Currie Farms**
PFN: **M2016-**
Engineer: **Omega Engineering, Inc.**
2707 Wetmore Ave
Everett, WA 98201
Attention: Joseph Smeby, P.E.

Total site area: **4.56 acres**
Offsite area: **0.12 acres**
Disturbed area: **4.00 acres**

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

Number of lots/Bldg: **31**

Drainage Basin Information	**East Basin**
On-site Developed Area	4.0 acres
Off-site Improved Area	0.12 acres
Types of storage proposed	Infiltration Trenches
Approximate total storage volume	Varies
Soil Types	Type A/B
Basin Data	
Pre-developed run-off rates: 2-year	0.30 cfs
50-year	0.88 cfs
Post-developed run-off rates: 2-year	0.00 cfs
50-year	0.00 cfs

3. EXISTING SITE CHARACTERISTICS and ASSUMPTIONS

The site is located east of 171st Ave SE and between the Mountain View Manor, Div. 2 and Currie East plats, and in Section 2, Township 27N, Range 6E, Willamette Meridian. See Figure 1 - Vicinity Map. The entire property consists of a single lot totaling 4.56 acres.

Land use around the site is single-family residential. This site currently contains some single-family buildings. Frontage improvements will be required along 171st Ave SE which will include pavement widening, curb, gutter, planter and sidewalk

The existing site is irregular in shape approximately 900-feet long running east-west and 230-feet running north-south. The grades on the site are flat. 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 east to west. The existing soils on this site are silty fine sand to a depth of 4-6' over garvelly fine to medium sand to 10'+. 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 July 17, 2016. The weather was clear with temperatures in the 60's. No surface water was observed on this site.

The soil hydrologic types for this site have been identified as Type C for the upper soil stratum and A/B for the lower stratum. The soil type mapped for this site is Puget silty clay loam. However, soil tests on this site found permeable soils at 4-6'. Refer to Geotechnical Report in Appendix C. The project Geotech therefore has 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 infiltration systems will be designed to mitigate for each sub-basin tributary to each specific infiltration trench. The systems have been sized to meet the 2012 DOE stormwater flow control and water quality standards.

The new on-site road and lot areas will be collected in the on-site conveyance system and directed to individual infiltration trenches spread around the site. The storm drainage system for this project has been designed to collect, treat and infiltrate all of the new landscaping and impervious areas on this site. The off-site new impervious areas within 171st Ave SE will be partially collected as well and conveyed to an infiltration trench for treatment and flow control.

The detention and water quality system has been designed using the WWHM2012 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 an interceptor swale system to capture site runoff and allow the water to infiltrate on-site in areas not proposed for future/permanent infiltration systems.

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 check dams will be installed in the on-site interceptor swales. The proposed on-site CBs will be installed with inlet filters but the outlet pipes connecting to infiltration trenches will be plugged until the site has been stabilized and the conveyance system flushed and cleaned. 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
Check dams will be used in any existing/proposed ditch on-site or adjacent to the site 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 infiltrated on-site. The contractor shall monitor the temporary system 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 state 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 runoff generated from the finished project will be fully infiltrated up to the 100-year storm event.

MINIMUM REQUIREMENT #5: ON-SITE STORMWATER MANAGEMENT

Runoff from the new public road and future lots will be collected CBs and conveyed to different infiltration trenches spread around the site. Roof runoff from each future SFR will be directed to either the road infiltration system or an infiltration system in Tract 999 along the east side of the site. The landscaping will be graded to drain toward the lot yard drains to the maximum extent feasible.

MINIMUM REQUIREMENT #6: RUNOFF TREATMENT

A soil treatment layer will be provided in the bottom of all infiltration trenches receiving runoff from PGHS. 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 an infiltration system which was sized using the WWHM2012 software.

MINIMUM REQUIREMENT #8: WETLAND PROTECTION

Full infiltration will recharge the groundwater and protect downstream critical areas.

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

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 0% to approximately 3.0%. The proposed internal road grades will be no greater than 2%.
CRITICAL AREAS: None on or adjacent to the site.
SOILS: In the development area of the site soils are hydrologic group C but underlain with group A/B, (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 an interceptor swale system to capture site runoff and allow the water to infiltrate on-site in areas not proposed for future/permanent infiltration systems.

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 check dams will be installed in the on-site interceptor swales. The proposed on-site CBs will be installed with inlet filters but the outlet pipes connecting to infiltration trenches will be plugged until the site has been stabilized and the conveyance system flushed and cleaned. 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
Check dams will be used in any existing/proposed ditch on-site or adjacent to the site 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 infiltrated on-site. The contractor shall monitor the temporary system 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 state 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 east of this project will drain onto the site but this is limited to only the State R/W. These flows are negligible in the existing condition and will be collected on-site and infiltrated with the other areas in the developed condition.

7. OFFSITE DRAINAGE ANALYSIS - DOWNSTREAM

The project is bordered to the north and south by subdivisions and to the east by SR 522. Since the proposed plat will account for the upstream offsite flows this project will fully infiltrate all runoff generated on-site and tributary to the site.

8. DETENTION STORAGE CALCULATIONS

Current City code requires this site be analyzed using the 2012 DOE manual and the WWHM2012 stormwater software. Since this site proposes using multiple infiltration systems to fully infiltrate the runoff from the developed site.

The infiltration trenches have been sized to accommodate the developed conditions for this project up to the 100-year condition.

Refer to appendix 'A' for the full output from the WWHM2012 software.

9. WATER QUALITY DESIGN

Water quality for this project will be provided in the form of a soil treatment layer in the bottom of any infiltration trench receiving runoff from PGHS. This meets the basic water quality requirements.

10. CONVEYANCE CALCULATIONS

All of the proposed pipes designed for this project will receive much less than 2.5 cfs peak flows from the 100-year storm event. These pipes are designed as 12" pipes (S=0.5%, min.) with a peak flowing full capacity of over 2.7 cfs and therefore ore then adequate capacity to handle the expected flows.

Therefore, all pipes designed for this project have more capacity then required based on the expected flow to each leg of the pipe system.

11. OPERATIONS AND MAINTENANCE MANUAL

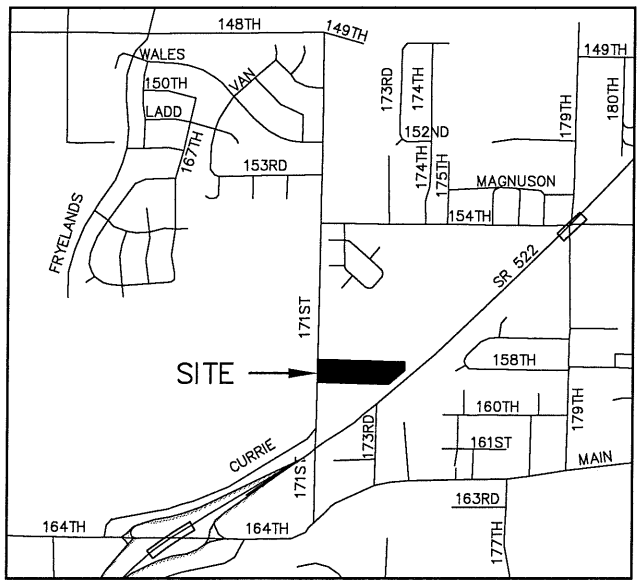
The Property Owners and HOA will be responsible for maintaining the stormwater and landscaping facilities within this development. Included in this manual are checklists for each feature specific to this project. Copies should be made of the checklists as necessary during routine inspections and required 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. (To be provided with full engineering plans in the future)



VICINITY MAP

SCALE 1" = 2000'

FIG. 1

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

VICINITY MAP
CURRIE FARMS

DATE	JOB NO.	SCALE	SHEET
7/25/16	16-0609	1" = 2000'	1 OF 1

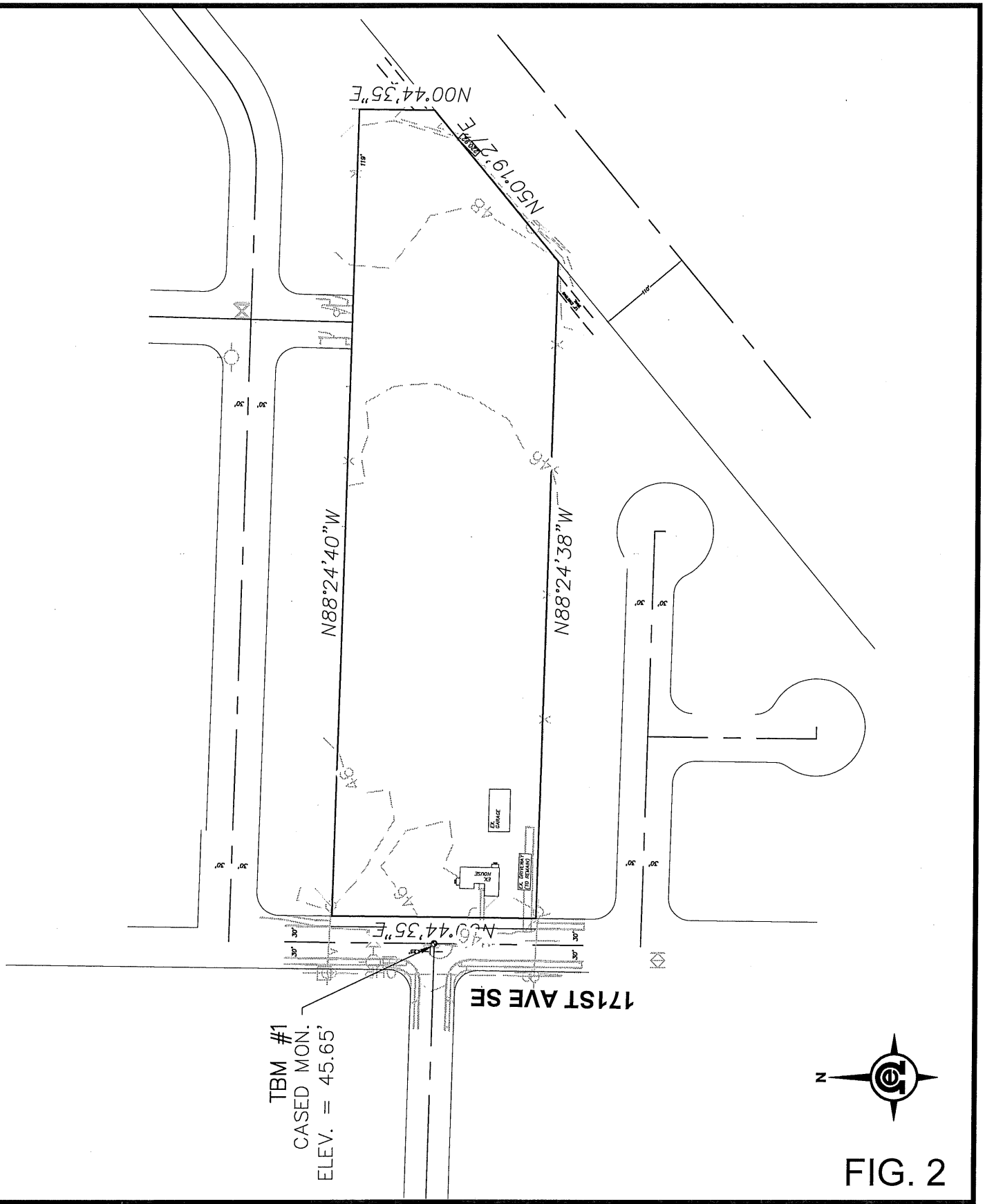


FIG. 2

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

EXISTING BASIN MAP
CURRIE FARMS

DATE	JOB NO.	SCALE	SHEET
7/25/16	16-0609	1" = 150'	1 OF 1

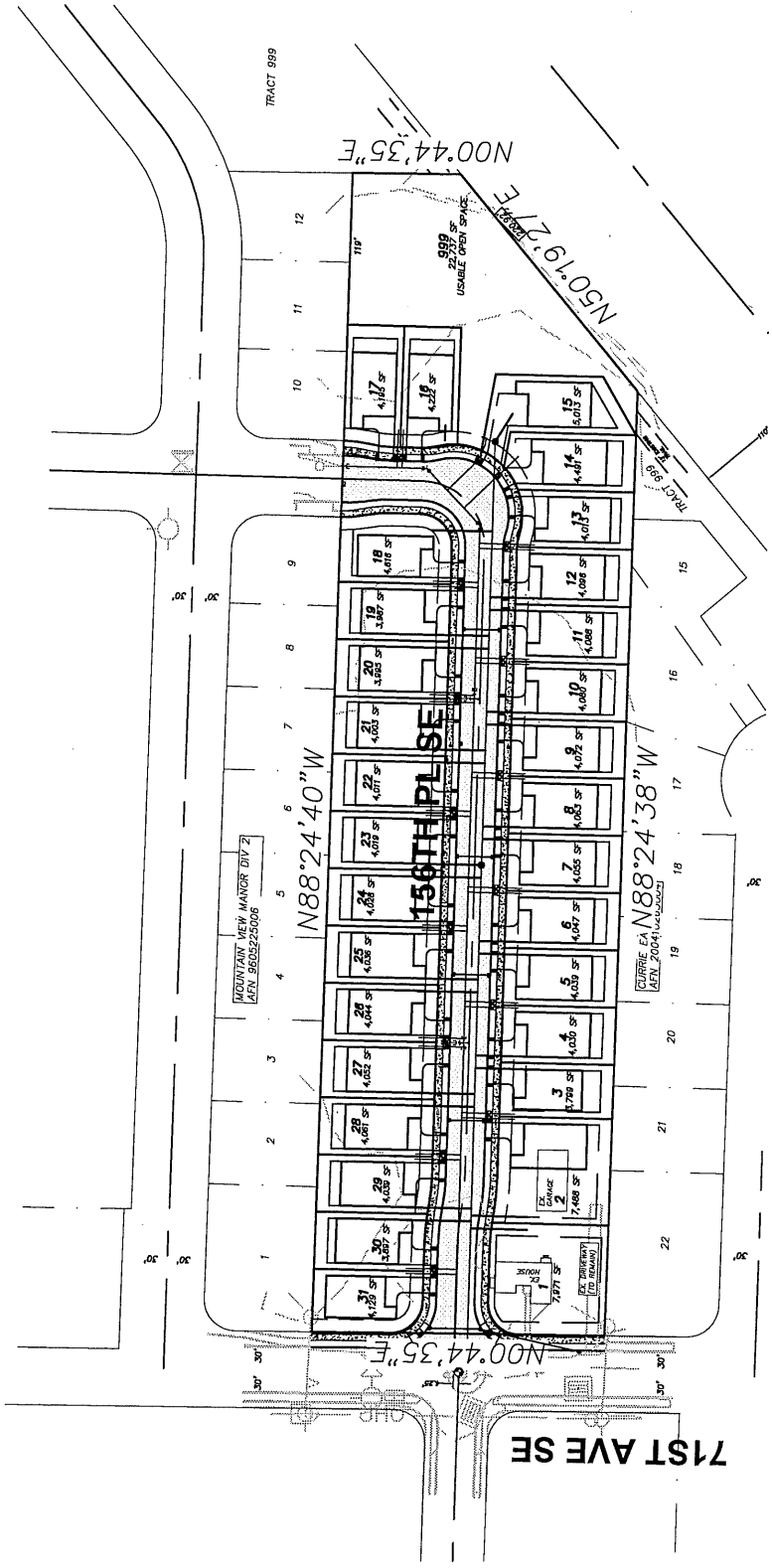


FIG. 3

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

DEVELOPED BASIN MAP
CURRIE FARMS

DATE	JOB NO.	SCALE	SHEET
7/25/16	16-0609	1" = 150'	1 OF 1

Soil Map—Snohomish County Area, Washington
(Currie Farms)

Map Scale: 1:1,840 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 25 50 100 150

Feet
0 50 100 200 300

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

APPENDIX A

STORMWATER CALCULATIONS

WWHM2012

PROJECT REPORT

General Model Information

Project Name:	default[15]
Site Name:	Currie Farms
Site Address:	
City:	Monroe
Report Date:	7/26/2016
Gage:	Everett
Data Start:	1948/10/01
Data End:	2009/09/30
Timestep:	15 Minute
Precip Scale:	1.20
Version Date:	2016/02/25
Version:	4.2.12

POC Thresholds

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

Landuse Basin Data

Predeveloped Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Forest, Flat	4.56
Pervious Total	4.56
Impervious Land Use	acre
Impervious Total	0
Basin Total	4.56

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

Basin 1

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
C, Lawn, Flat	1.3
Pervious Total	1.3

Impervious Land Use	acre
ROADS FLAT	0.75
ROOF TOPS FLAT	1.11
Impervious Total	1.86
Basin Total	3.16

Element Flows To:

Surface	Interflow	Groundwater
Gravel Trench Bed 1	Gravel Trench Bed 1	

Basin 2

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
C, Lawn, Flat	0.92
Pervious Total	0.92

Impervious Land Use	acre
ROOF TOPS FLAT	0.48
Impervious Total	0.48
Basin Total	1.4

Element Flows To:

Surface	Interflow	Groundwater
Gravel Trench Bed 2	Gravel Trench Bed 2	

Mitigated Routing

Gravel Trench Bed 1

Bottom Length:	572.00 ft.
Bottom Width:	5.00 ft.
Trench bottom slope 1:	0 To 1
Trench Left side slope 0:	0 To 1
Trench right side slope 2:	0 To 1
Material thickness of first layer:	6
Pour Space of material for first layer:	0.35
Material thickness of second layer:	0
Pour Space of material for second layer:	0
Material thickness of third layer:	0
Pour Space of material for third layer:	0
Infiltration On	
Infiltration rate:	2.1
Infiltration safety factor:	1
Total Volume Infiltrated (ac-ft.):	495.624
Total Volume Through Riser (ac-ft.):	4.991
Total Volume Through Facility (ac-ft.):	500.614
Percent Infiltrated:	99
Total Precip Applied to Facility:	0
Total Evap From Facility:	0
Discharge Structure	
Riser Height:	6 ft.
Riser Diameter:	8 in.
Element Flows To:	
Outlet 1	Outlet 2
Channel 1	

Gravel Trench Bed Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.065	0.000	0.000	0.000
0.0778	0.065	0.001	0.000	0.139
0.1556	0.065	0.003	0.000	0.139
0.2333	0.065	0.005	0.000	0.139
0.3111	0.065	0.007	0.000	0.139
0.3889	0.065	0.008	0.000	0.139
0.4667	0.065	0.010	0.000	0.139
0.5444	0.065	0.012	0.000	0.139
0.6222	0.065	0.014	0.000	0.139
0.7000	0.065	0.016	0.000	0.139
0.7778	0.065	0.017	0.000	0.139
0.8556	0.065	0.019	0.000	0.139
0.9333	0.065	0.021	0.000	0.139
1.0111	0.065	0.023	0.000	0.139
1.0889	0.065	0.025	0.000	0.139
1.1667	0.065	0.026	0.000	0.139
1.2444	0.065	0.028	0.000	0.139
1.3222	0.065	0.030	0.000	0.139
1.4000	0.065	0.032	0.000	0.139
1.4778	0.065	0.034	0.000	0.139
1.5556	0.065	0.035	0.000	0.139
1.6333	0.065	0.037	0.000	0.139
1.7111	0.065	0.039	0.000	0.139
1.7889	0.065	0.041	0.000	0.139

1.8667	0.065	0.042	0.000	0.139
1.9444	0.065	0.044	0.000	0.139
2.0222	0.065	0.046	0.000	0.139
2.1000	0.065	0.048	0.000	0.139
2.1778	0.065	0.050	0.000	0.139
2.2556	0.065	0.051	0.000	0.139
2.3333	0.065	0.053	0.000	0.139
2.4111	0.065	0.055	0.000	0.139
2.4889	0.065	0.057	0.000	0.139
2.5667	0.065	0.059	0.000	0.139
2.6444	0.065	0.060	0.000	0.139
2.7222	0.065	0.062	0.000	0.139
2.8000	0.065	0.064	0.000	0.139
2.8778	0.065	0.066	0.000	0.139
2.9556	0.065	0.067	0.000	0.139
3.0333	0.065	0.069	0.000	0.139
3.1111	0.065	0.071	0.000	0.139
3.1889	0.065	0.073	0.000	0.139
3.2667	0.065	0.075	0.000	0.139
3.3444	0.065	0.076	0.000	0.139
3.4222	0.065	0.078	0.000	0.139
3.5000	0.065	0.080	0.000	0.139
3.5778	0.065	0.082	0.000	0.139
3.6556	0.065	0.084	0.000	0.139
3.7333	0.065	0.085	0.000	0.139
3.8111	0.065	0.087	0.000	0.139
3.8889	0.065	0.089	0.000	0.139
3.9667	0.065	0.091	0.000	0.139
4.0444	0.065	0.092	0.000	0.139
4.1222	0.065	0.094	0.000	0.139
4.2000	0.065	0.096	0.000	0.139
4.2778	0.065	0.098	0.000	0.139
4.3556	0.065	0.100	0.000	0.139
4.4333	0.065	0.101	0.000	0.139
4.5111	0.065	0.103	0.000	0.139
4.5889	0.065	0.105	0.000	0.139
4.6667	0.065	0.107	0.000	0.139
4.7444	0.065	0.109	0.000	0.139
4.8222	0.065	0.110	0.000	0.139
4.9000	0.065	0.112	0.000	0.139
4.9778	0.065	0.114	0.000	0.139
5.0556	0.065	0.116	0.000	0.139
5.1333	0.065	0.118	0.000	0.139
5.2111	0.065	0.119	0.000	0.139
5.2889	0.065	0.121	0.000	0.139
5.3667	0.065	0.123	0.000	0.139
5.4444	0.065	0.125	0.000	0.139
5.5222	0.065	0.126	0.000	0.139
5.6000	0.065	0.128	0.000	0.139
5.6778	0.065	0.130	0.000	0.139
5.7556	0.065	0.132	0.000	0.139
5.8333	0.065	0.134	0.000	0.139
5.9111	0.065	0.135	0.000	0.139
5.9889	0.065	0.137	0.000	0.139
6.0667	0.065	0.142	0.121	0.139
6.1444	0.065	0.147	0.367	0.139
6.2222	0.065	0.152	0.610	0.139
6.3000	0.065	0.158	0.762	0.139

6.3778	0.065	0.163	0.860	0.139
6.4556	0.065	0.168	0.944	0.139
6.5333	0.065	0.173	1.022	0.139
6.6111	0.065	0.178	1.094	0.139
6.6889	0.065	0.183	1.161	0.139
6.7667	0.065	0.188	1.225	0.139
6.8444	0.065	0.193	1.286	0.139
6.9222	0.065	0.198	1.344	0.139
7.0000	0.065	0.204	1.399	0.139

Gravel Trench Bed 2

Bottom Length:	200.00 ft.
Bottom Width:	6.00 ft.
Trench bottom slope 1:	0 To 1
Trench Left side slope 0:	0 To 1
Trench right side slope 2:	0 To 1
Material thickness of first layer:	5
Pour Space of material for first layer:	0.35
Material thickness of second layer:	0
Pour Space of material for second layer:	0
Material thickness of third layer:	0
Pour Space of material for third layer:	0
Infiltration On	
Infiltration rate:	7.5
Infiltration safety factor:	1
Total Volume Infiltrated (ac-ft.):	192.002
Total Volume Through Riser (ac-ft.):	0.036
Total Volume Through Facility (ac-ft.):	192.039
Percent Infiltrated:	99.98
Total Precip Applied to Facility:	0
Total Evap From Facility:	0
Discharge Structure	
Riser Height:	5 ft.
Riser Diameter:	8 in.
Element Flows To:	
Outlet 1	Outlet 2
Channel 1	

Gravel Trench Bed Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.027	0.000	0.000	0.000
0.0667	0.027	0.000	0.000	0.208
0.1333	0.027	0.001	0.000	0.208
0.2000	0.027	0.001	0.000	0.208
0.2667	0.027	0.002	0.000	0.208
0.3333	0.027	0.003	0.000	0.208
0.4000	0.027	0.003	0.000	0.208
0.4667	0.027	0.004	0.000	0.208
0.5333	0.027	0.005	0.000	0.208
0.6000	0.027	0.005	0.000	0.208
0.6667	0.027	0.006	0.000	0.208
0.7333	0.027	0.007	0.000	0.208
0.8000	0.027	0.007	0.000	0.208
0.8667	0.027	0.008	0.000	0.208
0.9333	0.027	0.009	0.000	0.208
1.0000	0.027	0.009	0.000	0.208
1.0667	0.027	0.010	0.000	0.208
1.1333	0.027	0.010	0.000	0.208
1.2000	0.027	0.011	0.000	0.208
1.2667	0.027	0.012	0.000	0.208
1.3333	0.027	0.012	0.000	0.208
1.4000	0.027	0.013	0.000	0.208
1.4667	0.027	0.014	0.000	0.208
1.5333	0.027	0.014	0.000	0.208
1.6000	0.027	0.015	0.000	0.208
1.6667	0.027	0.016	0.000	0.208

1.7333	0.027	0.016	0.000	0.208
1.8000	0.027	0.017	0.000	0.208
1.8667	0.027	0.018	0.000	0.208
1.9333	0.027	0.018	0.000	0.208
2.0000	0.027	0.019	0.000	0.208
2.0667	0.027	0.019	0.000	0.208
2.1333	0.027	0.020	0.000	0.208
2.2000	0.027	0.021	0.000	0.208
2.2667	0.027	0.021	0.000	0.208
2.3333	0.027	0.022	0.000	0.208
2.4000	0.027	0.023	0.000	0.208
2.4667	0.027	0.023	0.000	0.208
2.5333	0.027	0.024	0.000	0.208
2.6000	0.027	0.025	0.000	0.208
2.6667	0.027	0.025	0.000	0.208
2.7333	0.027	0.026	0.000	0.208
2.8000	0.027	0.027	0.000	0.208
2.8667	0.027	0.027	0.000	0.208
2.9333	0.027	0.028	0.000	0.208
3.0000	0.027	0.028	0.000	0.208
3.0667	0.027	0.029	0.000	0.208
3.1333	0.027	0.030	0.000	0.208
3.2000	0.027	0.030	0.000	0.208
3.2667	0.027	0.031	0.000	0.208
3.3333	0.027	0.032	0.000	0.208
3.4000	0.027	0.032	0.000	0.208
3.4667	0.027	0.033	0.000	0.208
3.5333	0.027	0.034	0.000	0.208
3.6000	0.027	0.034	0.000	0.208
3.6667	0.027	0.035	0.000	0.208
3.7333	0.027	0.036	0.000	0.208
3.8000	0.027	0.036	0.000	0.208
3.8667	0.027	0.037	0.000	0.208
3.9333	0.027	0.037	0.000	0.208
4.0000	0.027	0.038	0.000	0.208
4.0667	0.027	0.039	0.000	0.208
4.1333	0.027	0.039	0.000	0.208
4.2000	0.027	0.040	0.000	0.208
4.2667	0.027	0.041	0.000	0.208
4.3333	0.027	0.041	0.000	0.208
4.4000	0.027	0.042	0.000	0.208
4.4667	0.027	0.043	0.000	0.208
4.5333	0.027	0.043	0.000	0.208
4.6000	0.027	0.044	0.000	0.208
4.6667	0.027	0.045	0.000	0.208
4.7333	0.027	0.045	0.000	0.208
4.8000	0.027	0.046	0.000	0.208
4.8667	0.027	0.046	0.000	0.208
4.9333	0.027	0.047	0.000	0.208
5.0000	0.027	0.049	0.000	0.208
5.0667	0.027	0.051	0.121	0.208
5.1333	0.027	0.053	0.329	0.208
5.2000	0.027	0.054	0.547	0.208
5.2667	0.027	0.056	0.711	0.208
5.3333	0.027	0.058	0.808	0.208
5.4000	0.027	0.060	0.885	0.208
5.4667	0.027	0.062	0.956	0.208
5.5333	0.027	0.064	1.022	0.208

5.6000	0.027	0.065	1.084	0.208
5.6667	0.027	0.067	1.143	0.208
5.7333	0.027	0.069	1.198	0.208
5.8000	0.027	0.071	1.252	0.208
5.8667	0.027	0.073	1.303	0.208
5.9333	0.027	0.075	1.352	0.208
6.0000	0.027	0.077	1.399	0.208

Channel 1

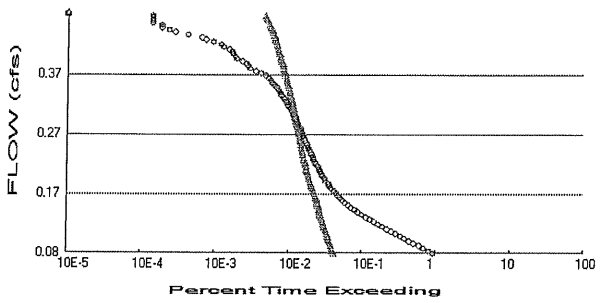
Bottom Length:	10.00 ft.
Bottom Width:	5.00 ft.
Manning's n:	0.03
Channel bottom slope 1:	0.2 To 1
Channel Left side slope 0:	3 To 1
Channel right side slope 2:	3 To 1
Discharge Structure	
Riser Height:	0 ft.
Riser Diameter:	0 in.
Element Flows To:	
Outlet 1	Outlet 2

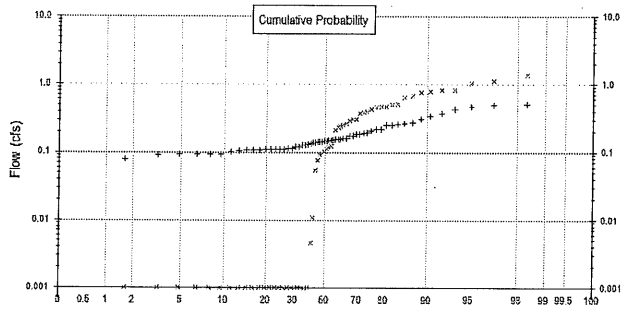
Channel Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.001	0.000	0.000	0.000
0.0111	0.001	0.000	0.061	0.000
0.0222	0.001	0.000	0.195	0.000
0.0333	0.001	0.000	0.385	0.000
0.0444	0.001	0.000	0.623	0.000
0.0556	0.001	0.000	0.906	0.000
0.0667	0.001	0.000	1.231	0.000
0.0778	0.001	0.000	1.595	0.000
0.0889	0.001	0.000	1.997	0.000
0.1000	0.001	0.000	2.435	0.000
0.1111	0.001	0.000	2.909	0.000
0.1222	0.001	0.000	3.417	0.000
0.1333	0.001	0.000	3.960	0.000
0.1444	0.001	0.000	4.535	0.000
0.1556	0.001	0.000	5.143	0.000
0.1667	0.001	0.000	5.784	0.000
0.1778	0.001	0.000	6.456	0.000
0.1889	0.001	0.000	7.159	0.000
0.2000	0.001	0.000	7.894	0.000
0.2111	0.001	0.000	8.660	0.000
0.2222	0.001	0.000	9.456	0.000
0.2333	0.001	0.000	10.28	0.000
0.2444	0.001	0.000	11.14	0.000
0.2556	0.001	0.000	12.02	0.000
0.2667	0.001	0.000	12.94	0.000
0.2778	0.001	0.000	13.89	0.000
0.2889	0.001	0.000	14.86	0.000
0.3000	0.001	0.000	15.87	0.000
0.3111	0.001	0.000	16.91	0.000
0.3222	0.001	0.000	17.97	0.000
0.3333	0.001	0.000	19.07	0.000
0.3444	0.001	0.000	20.20	0.000
0.3556	0.001	0.000	21.35	0.000
0.3667	0.001	0.000	22.54	0.000
0.3778	0.001	0.000	23.75	0.000
0.3889	0.001	0.000	24.99	0.000
0.4000	0.001	0.000	26.27	0.000
0.4111	0.001	0.000	27.57	0.000
0.4222	0.001	0.000	28.90	0.000
0.4333	0.001	0.000	30.26	0.000

0.4444	0.001	0.000	31.66	0.000
0.4556	0.001	0.000	33.08	0.000
0.4667	0.001	0.000	34.53	0.000
0.4778	0.001	0.000	36.01	0.000
0.4889	0.001	0.000	37.52	0.000
0.5000	0.001	0.000	39.07	0.000
0.5111	0.001	0.000	40.64	0.000
0.5222	0.001	0.000	42.24	0.000
0.5333	0.001	0.000	43.87	0.000
0.5444	0.001	0.000	45.53	0.000
0.5556	0.002	0.000	47.23	0.000
0.5667	0.002	0.000	48.95	0.000
0.5778	0.002	0.000	50.70	0.000
0.5889	0.002	0.000	52.49	0.000
0.6000	0.002	0.000	54.30	0.000
0.6111	0.002	0.001	56.15	0.000
0.6222	0.002	0.001	58.03	0.000
0.6333	0.002	0.001	59.93	0.000
0.6444	0.002	0.001	61.87	0.000
0.6556	0.002	0.001	63.84	0.000
0.6667	0.002	0.001	65.84	0.000
0.6778	0.002	0.001	67.88	0.000
0.6889	0.002	0.001	69.94	0.000
0.7000	0.002	0.001	72.04	0.000
0.7111	0.002	0.001	74.16	0.000
0.7222	0.002	0.001	76.32	0.000
0.7333	0.002	0.001	78.52	0.000
0.7444	0.002	0.001	80.74	0.000
0.7556	0.002	0.001	82.99	0.000
0.7667	0.002	0.001	85.28	0.000
0.7778	0.002	0.001	87.60	0.000
0.7889	0.002	0.001	89.95	0.000
0.8000	0.002	0.001	92.34	0.000
0.8111	0.002	0.001	94.75	0.000
0.8222	0.002	0.001	97.20	0.000
0.8333	0.002	0.001	99.69	0.000
0.8444	0.002	0.001	102.2	0.000
0.8556	0.002	0.001	104.7	0.000
0.8667	0.002	0.001	107.3	0.000
0.8778	0.002	0.001	109.9	0.000
0.8889	0.002	0.001	112.6	0.000
0.9000	0.002	0.001	115.2	0.000
0.9111	0.002	0.001	118.0	0.000
0.9222	0.002	0.001	120.7	0.000
0.9333	0.002	0.001	123.5	0.000
0.9444	0.002	0.001	126.3	0.000
0.9556	0.002	0.001	129.2	0.000
0.9667	0.002	0.001	132.0	0.000
0.9778	0.002	0.001	135.0	0.000
0.9889	0.002	0.001	137.9	0.000
1.0000	0.002	0.001	140.9	0.000
1.0111	0.002	0.001	143.9	0.000

Analysis Results
POC 1





\+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 4.56
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 2.22
Total Impervious Area: 2.34

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.153218
5 year	0.235041
10 year	0.298145
25 year	0.38843
50 year	0.463622
100 year	0.545856

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0.525849
5 year	1.22945
10 year	1.748535
25 year	2.390653
50 year	2.834698
100 year	3.240123

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1949	0.153	0.000
1950	0.157	0.252
1951	0.140	0.093
1952	0.110	0.000
1953	0.092	0.000
1954	0.500	0.000
1955	0.197	0.642
1956	0.174	0.289
1957	0.216	0.245
1958	0.156	1.363

1959	0.155	0.000
1960	0.144	0.306
1961	0.272	1.139
1962	0.134	0.473
1963	0.221	0.304
1964	0.159	0.000
1965	0.133	0.000
1966	0.078	0.000
1967	0.158	0.402
1968	0.192	0.428
1969	0.467	0.097
1970	0.110	0.000
1971	0.174	0.077
1972	0.128	0.830
1973	0.121	0.000
1974	0.263	0.005
1975	0.107	0.000
1976	0.110	0.118
1977	0.093	0.000
1978	0.110	0.000
1979	0.306	0.837
1980	0.144	0.000
1981	0.113	0.000
1982	0.146	0.460
1983	0.249	0.136
1984	0.150	0.114
1985	0.182	0.517
1986	0.428	0.789
1987	0.204	0.390
1988	0.106	0.054
1989	0.108	0.000
1990	0.143	0.000
1991	0.147	0.230
1992	0.112	0.000
1993	0.093	0.000
1994	0.102	0.011
1995	0.150	0.101
1996	0.255	0.688
1997	0.508	1.037
1998	0.093	0.373
1999	0.122	0.000
2000	0.092	0.000
2001	0.037	0.000
2002	0.139	0.000
2003	0.109	0.000
2004	0.183	0.471
2005	0.128	0.210
2006	0.340	0.495
2007	0.269	0.270
2008	0.377	0.758
2009	0.115	0.124

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.5075	1.3625
2	0.5005	1.1394
3	0.4670	1.0373

4	0.4279	0.8368
5	0.3773	0.8304
6	0.3397	0.7894
7	0.3065	0.7579
8	0.2722	0.6885
9	0.2688	0.6424
10	0.2627	0.5171
11	0.2552	0.4950
12	0.2489	0.4726
13	0.2214	0.4713
14	0.2157	0.4605
15	0.2042	0.4282
16	0.1972	0.4020
17	0.1921	0.3898
18	0.1833	0.3731
19	0.1820	0.3060
20	0.1741	0.3037
21	0.1739	0.2893
22	0.1593	0.2703
23	0.1579	0.2515
24	0.1565	0.2448
25	0.1559	0.2303
26	0.1546	0.2105
27	0.1531	0.1365
28	0.1503	0.1241
29	0.1496	0.1181
30	0.1471	0.1139
31	0.1460	0.1007
32	0.1440	0.0972
33	0.1436	0.0929
34	0.1429	0.0771
35	0.1399	0.0540
36	0.1391	0.0108
37	0.1343	0.0046
38	0.1330	0.0000
39	0.1283	0.0000
40	0.1276	0.0000
41	0.1220	0.0000
42	0.1214	0.0000
43	0.1150	0.0000
44	0.1125	0.0000
45	0.1121	0.0000
46	0.1104	0.0000
47	0.1102	0.0000
48	0.1102	0.0000
49	0.1100	0.0000
50	0.1090	0.0000
51	0.1077	0.0000
52	0.1069	0.0000
53	0.1057	0.0000
54	0.1020	0.0000
55	0.0934	0.0000
56	0.0929	0.0000
57	0.0928	0.0000
58	0.0925	0.0000
59	0.0916	0.0000
60	0.0779	0.0000
61	0.0368	0.0000

Duration Flows

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0766	20048	898	4	Pass
0.0805	17299	863	4	Pass
0.0844	14902	843	5	Pass
0.0883	12882	826	6	Pass
0.0922	11017	809	7	Pass
0.0962	9484	786	8	Pass
0.1001	8185	762	9	Pass
0.1040	7332	746	10	Pass
0.1079	6342	728	11	Pass
0.1118	5448	706	12	Pass
0.1157	4757	692	14	Pass
0.1196	4147	668	16	Pass
0.1235	3621	649	17	Pass
0.1274	3172	638	20	Pass
0.1313	2781	623	22	Pass
0.1352	2468	607	24	Pass
0.1392	2160	591	27	Pass
0.1431	1895	573	30	Pass
0.1470	1709	569	33	Pass
0.1509	1534	561	36	Pass
0.1548	1394	547	39	Pass
0.1587	1266	534	42	Pass
0.1626	1167	525	44	Pass
0.1665	1078	511	47	Pass
0.1704	1013	500	49	Pass
0.1743	955	487	50	Pass
0.1782	892	473	53	Pass
0.1822	826	458	55	Pass
0.1861	777	444	57	Pass
0.1900	746	436	58	Pass
0.1939	694	421	60	Pass
0.1978	660	409	61	Pass
0.2017	625	399	63	Pass
0.2056	604	393	65	Pass
0.2095	585	387	66	Pass
0.2134	564	377	66	Pass
0.2173	540	370	68	Pass
0.2213	508	365	71	Pass
0.2252	489	362	74	Pass
0.2291	473	351	74	Pass
0.2330	461	348	75	Pass
0.2369	443	337	76	Pass
0.2408	427	332	77	Pass
0.2447	414	330	79	Pass
0.2486	397	321	80	Pass
0.2525	380	314	82	Pass
0.2564	369	310	84	Pass
0.2603	354	306	86	Pass
0.2643	341	303	88	Pass
0.2682	333	298	89	Pass
0.2721	322	291	90	Pass
0.2760	314	287	91	Pass
0.2799	308	283	91	Pass
0.2838	293	278	94	Pass

0.2877	285	274	96	Pass
0.2916	277	264	95	Pass
0.2955	267	261	97	Pass
0.2994	259	254	98	Pass
0.3033	243	252	103	Pass
0.3073	234	250	106	Pass
0.3112	226	248	109	Pass
0.3151	212	245	115	Fail
0.3190	205	241	117	Fail
0.3229	195	239	122	Fail
0.3268	187	234	125	Fail
0.3307	177	229	129	Fail
0.3346	166	224	134	Fail
0.3385	160	221	138	Fail
0.3424	153	218	142	Fail
0.3463	146	211	144	Fail
0.3503	135	209	154	Fail
0.3542	128	205	160	Fail
0.3581	120	200	166	Fail
0.3620	112	197	175	Fail
0.3659	103	192	186	Fail
0.3698	88	189	214	Fail
0.3737	75	184	245	Fail
0.3776	64	180	281	Fail
0.3815	59	178	301	Fail
0.3854	56	176	314	Fail
0.3893	50	168	336	Fail
0.3933	42	163	388	Fail
0.3972	40	160	400	Fail
0.4011	37	158	427	Fail
0.4050	36	155	430	Fail
0.4089	33	152	460	Fail
0.4128	28	150	535	Fail
0.4167	26	146	561	Fail
0.4206	20	142	710	Fail
0.4245	16	138	862	Fail
0.4284	14	136	971	Fail
0.4323	9	133	1477	Fail
0.4363	6	127	2116	Fail
0.4402	5	124	2480	Fail
0.4441	4	118	2950	Fail
0.4480	4	115	2875	Fail
0.4519	3	113	3766	Fail
0.4558	3	106	3533	Fail
0.4597	3	104	3466	Fail
0.4636	3	100	3333	Fail

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

Water Quality

Water Quality BMP Flow and Volume for POC #1

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

LID Report

LID Technique	Used for Treatment ?	Total Volume Needs Treatment (ac-ft)	Volume Through Facility (ac-ft)	Infiltration Volume (ac-ft)	Cumulative Volume Infiltration Credit	Percent Volume Infiltrated	Water Quality	Percent Water Quality Treated	Comment
Channel 1 POC	☐	4.58			☐	0.00			
Gravel Trench Bed 1	☐	455.63			☐	98.99			
Gravel Trench Bed 2	☐	174.92			☐	99.89			
Total Volume Infiltrated		635.12	0.00	0.00		98.52	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Failed

Model Default Modifications

Total of 0 changes have been made.

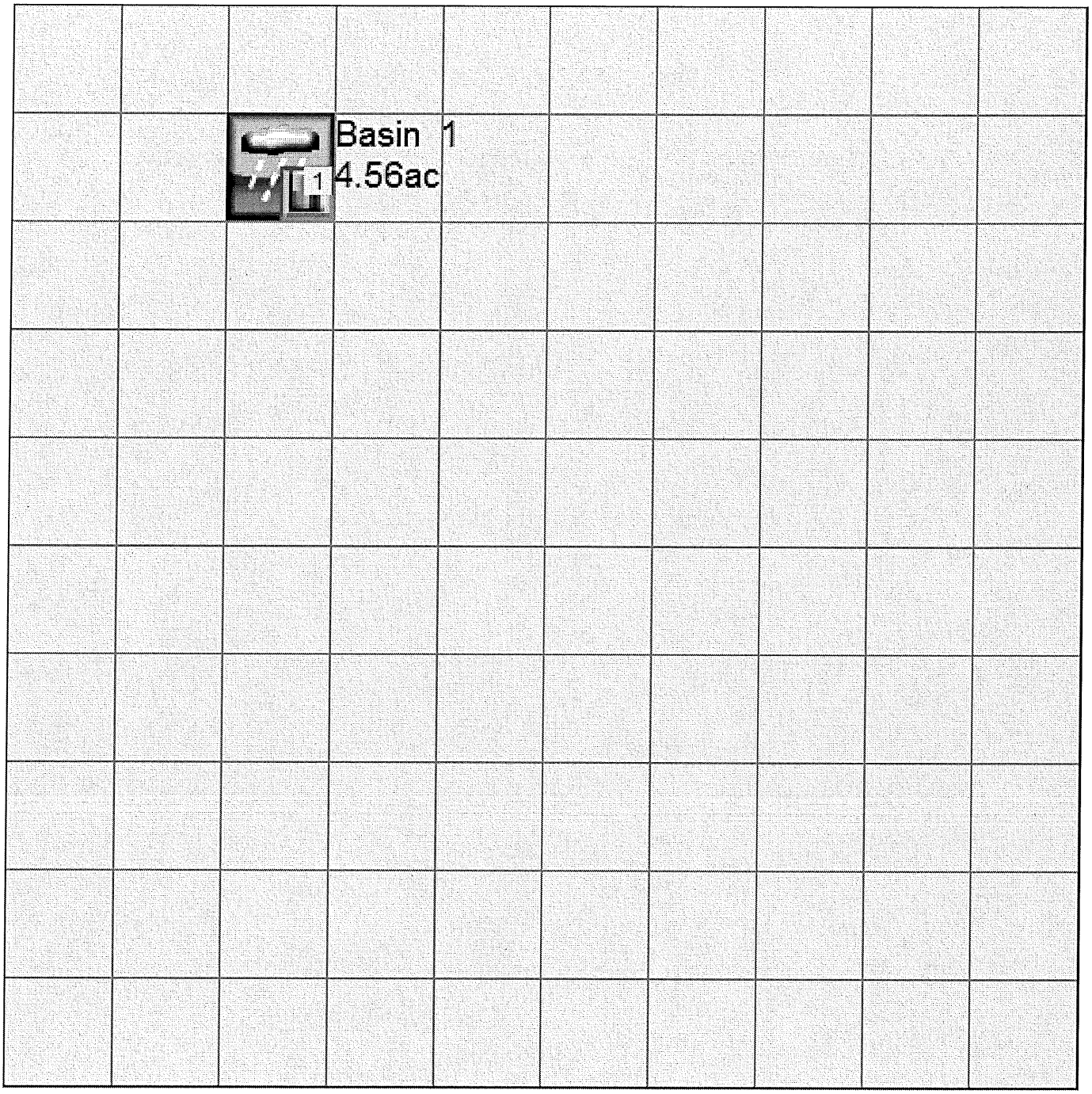
PERLND Changes

No PERLND changes have been made.

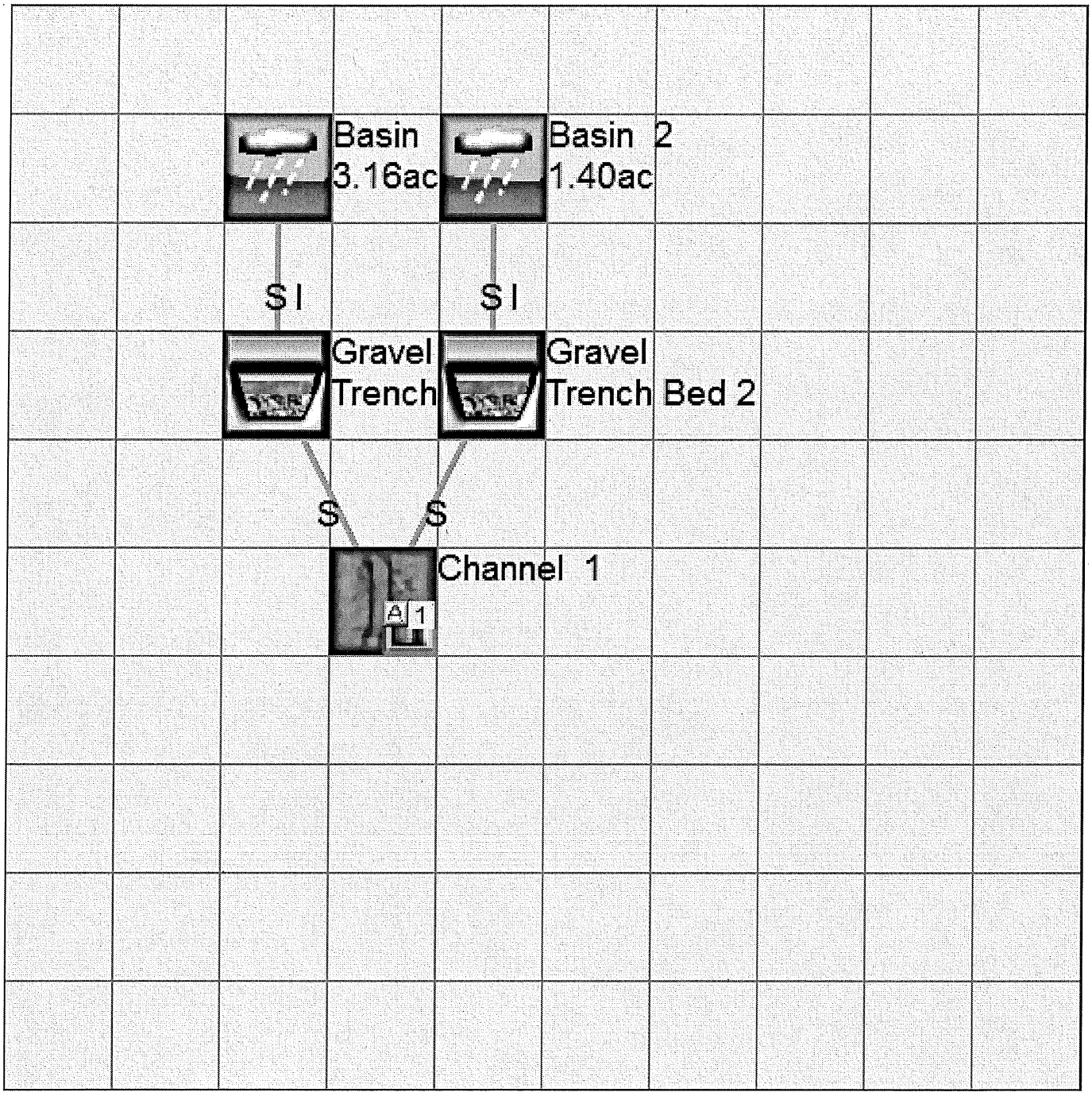
IMPLND Changes

No IMPLND changes have been made.

Appendix
Predeveloped Schematic



Mitigated Schematic



```
RUN

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

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM         26   default[15].wdm
MESSU       25   Predefault[15].MES
            27   Predefault[15].L61
            28   Predefault[15].L62
            30   POCdefault[15]1.dat
END FILES

OPN SEQUENCE
    INGRP               INDELT 00:15
      PERLND      10
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Basin  1                    MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1          1    1
  501          1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                       in  out           ***
   10     C, Forest, Flat         1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections ******************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   10          0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   10          0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO
```

```
    PWAT-PARM1
      <PLS >  PWATER variable monthly parameter value flags  ***
      # -   # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
     10          0    0    0    0    0    0    0    0    0    0
    END PWAT-PARM1

    PWAT-PARM2
      <PLS >       PWATER input info: Part 2          ***
      # -   # ***FOREST      LZSN    INFILT      LSUR     SLSUR      KVARY      AGWRC
     10               0       4.5      0.08       400      0.05        0.5      0.996
    END PWAT-PARM2

    PWAT-PARM3
      <PLS >       PWATER input info: Part 3          ***
      # -   # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
     10              0         0         2         2         0         0         0
    END PWAT-PARM3
    PWAT-PARM4
      <PLS >      PWATER input info: Part 4                              ***
      # -   #      CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
     10            0.2       0.5      0.35         6       0.5       0.7
    END PWAT-PARM4

    PWAT-STATE1
      <PLS > *** Initial conditions at start of simulation
                ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
      # -   # ***  CEPS      SURS       UZS       IFWS       LZS       AGWS       GWVS
     10             0         0         0          0       2.5          1          0
    END PWAT-STATE1

END PERLND

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

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

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

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

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

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

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

```
 END IMPLND

 SCHEMATIC
 <-Source->                  <--Area-->     <-Target->   MBLK   ***
 <Name>   #                  <-factor->     <Name>   #   Tbl#   ***
 Basin  1***
 PERLND  10                        4.56     COPY   501     12
 PERLND  10                        4.56     COPY   501     13

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

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



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

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

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

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

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

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

 SPEC-ACTIONS
 END SPEC-ACTIONS
 FTABLES
 END FTABLES

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

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

END EXT SOURCES

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

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

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


END MASS-LINK

END RUN
```

Mitigated UCI File

```
RUN

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

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM         26   default[15].wdm
MESSU       25   Mitdefault[15].MES
            27   Mitdefault[15].L61
            28   Mitdefault[15].L62
            30   POCdefault[15]1.dat
END FILES

OPN SEQUENCE
    INGRP               INDELT 00:15
      PERLND       16
      IMPLND        1
      IMPLND        4
      RCHRES        1
      RCHRES        2
      RCHRES        3
      COPY          1
      COPY        501
      DISPLY        1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Channel  1                  MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #          K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                       in  out           ***
   16     C, Lawn, Flat           1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************ Active Sections ******************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   16        0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY
```

```
  PRINT-INFO
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   16        0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   16         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2          ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR      KVARY      AGWRC
   16              0       4.5      0.03       400      0.05        0.5      0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3          ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   16             0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                                  ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   16          0.1      0.25      0.25         6       0.5      0.25
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
             ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS       IFWS       LZS       AGWS       GWVS
   16             0         0         0          0       2.5          1          0
  END PWAT-STATE1

END PERLND

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

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

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

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

  IWAT-PARM2
```

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

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

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

END IMPLND

SCHEMATIC
<-Source->                    <--Area-->      <-Target->   MBLK   ***
<Name>   #                    <-factor->      <Name>   #   Tbl#   ***
Basin  1***
PERLND  16                          1.3       RCHRES   1      2
PERLND  16                          1.3       RCHRES   1      3
IMPLND   1                         0.75       RCHRES   1      5
IMPLND   4                         1.11       RCHRES   1      5
Basin  2***
PERLND  16                         0.92       RCHRES   2      2
PERLND  16                         0.92       RCHRES   2      3
IMPLND   4                         0.48       RCHRES   2      5

******Routing******
RCHRES   1                            1       RCHRES   3      7
RCHRES   1                                    COPY     1     17
RCHRES   2                            1       RCHRES   3      7
RCHRES   2                                    COPY     1     17
RCHRES   3                            1       COPY   501     16
END SCHEMATIC

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



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

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG           ***
                                       in  out                              ***
    1     Gravel Trench Be-007    2    1    1    1   28    0    1
    2     Gravel Trench Be-009    2    1    1    1   28    0    1
    3     Channel  1              1    1    1    1   28    0    1
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************ Active Sections ******************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
    1         1    0    0    0    0    0    0    0    0    0
    2         1    0    0    0    0    0    0    0    0    0
```

```
    3         1     0     0     0     0     0     0     0     0     0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -   # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
    1         4    0    0    0    0    0    0    0    0    0    1    9
    2         4    0    0    0    0    0    0    0    0    0    1    9
    3         4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                    ***
    # -   #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
           FG FG FG FG  possible  exit  *** possible  exit      possible  exit
            *  *  *  *    *  *  *  *  *       *  *  *  *  *        ***
    1       0  1  0  0    4  5  0  0  0       0  0  0  0  0        2  2  2  2  2
    2       0  1  0  0    4  5  0  0  0       0  0  0  0  0        2  2  2  2  2
    3       0  1  0  0    4  0  0  0  0       0  0  0  0  0        2  2  2  2  2
  END HYDR-PARM1

  HYDR-PARM2
    # -   #    FTABNO       LEN      DELTH     STCOR       KS      DB50        ***
  <------><--------><--------><--------><--------><--------><--------->       ***
    1               1      0.11       0.0       0.0       0.5       0.0
    2               2      0.04       0.0       0.0       0.5       0.0
    3               3      0.01       0.0       0.0       0.5       0.0
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                       ***
    # -   # ***   VOL     Initial value of COLIND     Initial value of OUTDGT
          *** ac-ft     for each possible exit       for each possible exit
  <------><--------->     <---><---><---><---><---> *** <---><---><---><---><--->
    1             0       4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    2             0       4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    3             0       4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
  FTABLE      1
   92    5
     Depth      Area     Volume  Outflow1  Outflow2  Velocity  Travel Time***
      (ft)    (acres) (acre-ft)    (cfs)     (cfs)   (ft/sec)    (Minutes)***
  0.000000  0.065657  0.000000  0.000000  0.000000
  0.077778  0.065657  0.001787  0.000000  0.139028
  0.155556  0.065657  0.003575  0.000000  0.139028
  0.233333  0.065657  0.005362  0.000000  0.139028
  0.311111  0.065657  0.007149  0.000000  0.139028
  0.388889  0.065657  0.008937  0.000000  0.139028
  0.466667  0.065657  0.010724  0.000000  0.139028
  0.544444  0.065657  0.012511  0.000000  0.139028
  0.622222  0.065657  0.014299  0.000000  0.139028
  0.700000  0.065657  0.016086  0.000000  0.139028
  0.777778  0.065657  0.017873  0.000000  0.139028
  0.855556  0.065657  0.019660  0.000000  0.139028
  0.933333  0.065657  0.021448  0.000000  0.139028
  1.011111  0.065657  0.023235  0.000000  0.139028
  1.088889  0.065657  0.025022  0.000000  0.139028
  1.166667  0.065657  0.026810  0.000000  0.139028
  1.244444  0.065657  0.028597  0.000000  0.139028
  1.322222  0.065657  0.030384  0.000000  0.139028
  1.400000  0.065657  0.032172  0.000000  0.139028
  1.477778  0.065657  0.033959  0.000000  0.139028
  1.555556  0.065657  0.035746  0.000000  0.139028
  1.633333  0.065657  0.037534  0.000000  0.139028
  1.711111  0.065657  0.039321  0.000000  0.139028
  1.788889  0.065657  0.041108  0.000000  0.139028
```

```
 1.866667  0.065657  0.042896  0.000000  0.139028
 1.944444  0.065657  0.044683  0.000000  0.139028
 2.022222  0.065657  0.046470  0.000000  0.139028
 2.100000  0.065657  0.048258  0.000000  0.139028
 2.177778  0.065657  0.050045  0.000000  0.139028
 2.255556  0.065657  0.051832  0.000000  0.139028
 2.333333  0.065657  0.053620  0.000000  0.139028
 2.411111  0.065657  0.055407  0.000000  0.139028
 2.488889  0.065657  0.057194  0.000000  0.139028
 2.566667  0.065657  0.058981  0.000000  0.139028
 2.644444  0.065657  0.060769  0.000000  0.139028
 2.722222  0.065657  0.062556  0.000000  0.139028
 2.800000  0.065657  0.064343  0.000000  0.139028
 2.877778  0.065657  0.066131  0.000000  0.139028
 2.955556  0.065657  0.067918  0.000000  0.139028
 3.033333  0.065657  0.069705  0.000000  0.139028
 3.111111  0.065657  0.071493  0.000000  0.139028
 3.188889  0.065657  0.073280  0.000000  0.139028
 3.266667  0.065657  0.075067  0.000000  0.139028
 3.344444  0.065657  0.076855  0.000000  0.139028
 3.422222  0.065657  0.078642  0.000000  0.139028
 3.500000  0.065657  0.080429  0.000000  0.139028
 3.577778  0.065657  0.082217  0.000000  0.139028
 3.655556  0.065657  0.084004  0.000000  0.139028
 3.733333  0.065657  0.085791  0.000000  0.139028
 3.811111  0.065657  0.087579  0.000000  0.139028
 3.888889  0.065657  0.089366  0.000000  0.139028
 3.966667  0.065657  0.091153  0.000000  0.139028
 4.044444  0.065657  0.092941  0.000000  0.139028
 4.122222  0.065657  0.094728  0.000000  0.139028
 4.200000  0.065657  0.096515  0.000000  0.139028
 4.277778  0.065657  0.098302  0.000000  0.139028
 4.355556  0.065657  0.100090  0.000000  0.139028
 4.433333  0.065657  0.101877  0.000000  0.139028
 4.511111  0.065657  0.103664  0.000000  0.139028
 4.588889  0.065657  0.105452  0.000000  0.139028
 4.666667  0.065657  0.107239  0.000000  0.139028
 4.744444  0.065657  0.109026  0.000000  0.139028
 4.822222  0.065657  0.110814  0.000000  0.139028
 4.900000  0.065657  0.112601  0.000000  0.139028
 4.977778  0.065657  0.114388  0.000000  0.139028
 5.055556  0.065657  0.116176  0.000000  0.139028
 5.133333  0.065657  0.117963  0.000000  0.139028
 5.211111  0.065657  0.119750  0.000000  0.139028
 5.288889  0.065657  0.121538  0.000000  0.139028
 5.366667  0.065657  0.123325  0.000000  0.139028
 5.444444  0.065657  0.125112  0.000000  0.139028
 5.522222  0.065657  0.126900  0.000000  0.139028
 5.600000  0.065657  0.128687  0.000000  0.139028
 5.677778  0.065657  0.130474  0.000000  0.139028
 5.755556  0.065657  0.132262  0.000000  0.139028
 5.833333  0.065657  0.134049  0.000000  0.139028
 5.911111  0.065657  0.135836  0.000000  0.139028
 5.988889  0.065657  0.137623  0.000000  0.139028
 6.066667  0.065657  0.142730  0.121030  0.139028
 6.144444  0.065657  0.147837  0.367036  0.139028
 6.222222  0.065657  0.152943  0.610909  0.139028
 6.300000  0.065657  0.158050  0.762603  0.139028
 6.377778  0.065657  0.163157  0.860390  0.139028
 6.455556  0.065657  0.168263  0.944817  0.139028
 6.533333  0.065657  0.173370  1.022295  0.139028
 6.611111  0.065657  0.178476  1.094302  0.139028
 6.688889  0.065657  0.183583  1.161854  0.139028
 6.766667  0.065657  0.188690  1.225689  0.139028
 6.844444  0.065657  0.193796  1.286360  0.139028
 6.922222  0.065657  0.198903  1.344296  0.139028
 7.000000  0.065657  0.204010  1.399836  0.139028
 7.077778  0.065657  0.209116  1.453254  0.139028
END FTABLE  1
FTABLE      2
```

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Depth (ft)	Area (acres)	Volume (acre-ft)	Outflow1 (cfs)	Outflow2 (cfs)	Velocity (ft/sec)	Travel Time*** (Minutes)***
0.000000	0.027548	0.000000	0.000000	0.000000		
0.066667	0.027548	0.000643	0.000000	0.208333		
0.133333	0.027548	0.001286	0.000000	0.208333		
0.200000	0.027548	0.001928	0.000000	0.208333		
0.266667	0.027548	0.002571	0.000000	0.208333		
0.333333	0.027548	0.003214	0.000000	0.208333		
0.400000	0.027548	0.003857	0.000000	0.208333		
0.466667	0.027548	0.004500	0.000000	0.208333		
0.533333	0.027548	0.005142	0.000000	0.208333		
0.600000	0.027548	0.005785	0.000000	0.208333		
0.666667	0.027548	0.006428	0.000000	0.208333		
0.733333	0.027548	0.007071	0.000000	0.208333		
0.800000	0.027548	0.007713	0.000000	0.208333		
0.866667	0.027548	0.008356	0.000000	0.208333		
0.933333	0.027548	0.008999	0.000000	0.208333		
1.000000	0.027548	0.009642	0.000000	0.208333		
1.066667	0.027548	0.010285	0.000000	0.208333		
1.133333	0.027548	0.010927	0.000000	0.208333		
1.200000	0.027548	0.011570	0.000000	0.208333		
1.266667	0.027548	0.012213	0.000000	0.208333		
1.333333	0.027548	0.012856	0.000000	0.208333		
1.400000	0.027548	0.013499	0.000000	0.208333		
1.466667	0.027548	0.014141	0.000000	0.208333		
1.533333	0.027548	0.014784	0.000000	0.208333		
1.600000	0.027548	0.015427	0.000000	0.208333		
1.666667	0.027548	0.016070	0.000000	0.208333		
1.733333	0.027548	0.016713	0.000000	0.208333		
1.800000	0.027548	0.017355	0.000000	0.208333		
1.866667	0.027548	0.017998	0.000000	0.208333		
1.933333	0.027548	0.018641	0.000000	0.208333		
2.000000	0.027548	0.019284	0.000000	0.208333		
2.066667	0.027548	0.019927	0.000000	0.208333		
2.133333	0.027548	0.020569	0.000000	0.208333		
2.200000	0.027548	0.021212	0.000000	0.208333		
2.266667	0.027548	0.021855	0.000000	0.208333		
2.333333	0.027548	0.022498	0.000000	0.208333		
2.400000	0.027548	0.023140	0.000000	0.208333		
2.466667	0.027548	0.023783	0.000000	0.208333		
2.533333	0.027548	0.024426	0.000000	0.208333		
2.600000	0.027548	0.025069	0.000000	0.208333		
2.666667	0.027548	0.025712	0.000000	0.208333		
2.733333	0.027548	0.026354	0.000000	0.208333		
2.800000	0.027548	0.026997	0.000000	0.208333		
2.866667	0.027548	0.027640	0.000000	0.208333		
2.933333	0.027548	0.028283	0.000000	0.208333		
3.000000	0.027548	0.028926	0.000000	0.208333		
3.066667	0.027548	0.029568	0.000000	0.208333		
3.133333	0.027548	0.030211	0.000000	0.208333		
3.200000	0.027548	0.030854	0.000000	0.208333		
3.266667	0.027548	0.031497	0.000000	0.208333		
3.333333	0.027548	0.032140	0.000000	0.208333		
3.400000	0.027548	0.032782	0.000000	0.208333		
3.466667	0.027548	0.033425	0.000000	0.208333		
3.533333	0.027548	0.034068	0.000000	0.208333		
3.600000	0.027548	0.034711	0.000000	0.208333		
3.666667	0.027548	0.035354	0.000000	0.208333		
3.733333	0.027548	0.035996	0.000000	0.208333		
3.800000	0.027548	0.036639	0.000000	0.208333		
3.866667	0.027548	0.037282	0.000000	0.208333		
3.933333	0.027548	0.037925	0.000000	0.208333		
4.000000	0.027548	0.038567	0.000000	0.208333		
4.066667	0.027548	0.039210	0.000000	0.208333		
4.133333	0.027548	0.039853	0.000000	0.208333		
4.200000	0.027548	0.040496	0.000000	0.208333		
4.266667	0.027548	0.041139	0.000000	0.208333		
4.333333	0.027548	0.041781	0.000000	0.208333		
4.400000	0.027548	0.042424	0.000000	0.208333		

```
 4.466667  0.027548  0.043067  0.000000  0.208333
 4.533333  0.027548  0.043710  0.000000  0.208333
 4.600000  0.027548  0.044353  0.000000  0.208333
 4.666667  0.027548  0.044995  0.000000  0.208333
 4.733333  0.027548  0.045638  0.000000  0.208333
 4.800000  0.027548  0.046281  0.000000  0.208333
 4.866667  0.027548  0.046924  0.000000  0.208333
 4.933333  0.027548  0.047567  0.000000  0.208333
 5.000000  0.027548  0.049403  0.000000  0.208333
 5.066667  0.027548  0.051240  0.121030  0.208333
 5.133333  0.027548  0.053076  0.329384  0.208333
 5.200000  0.027548  0.054913  0.547841  0.208333
 5.266667  0.027548  0.056749  0.711272  0.208333
 5.333333  0.027548  0.058586  0.808195  0.208333
 5.400000  0.027548  0.060422  0.885334  0.208333
 5.466667  0.027548  0.062259  0.956270  0.208333
 5.533333  0.027548  0.064096  1.022295  0.208333
 5.600000  0.027548  0.065932  1.084308  0.208333
 5.666667  0.027548  0.067769  1.142961  0.208333
 5.733333  0.027548  0.069605  1.198748  0.208333
 5.800000  0.027548  0.071442  1.252051  0.208333
 5.866667  0.027548  0.073278  1.303176  0.208333
 5.933333  0.027548  0.075115  1.352370  0.208333
 6.000000  0.027548  0.076951  1.399836  0.208333
 6.066667  0.027548  0.078788  1.445744  0.208333
END FTABLE  2
FTABLE      3
 91    4
    Depth       Area     Volume  Outflow1 Velocity  Travel Time***
     (ft)    (acres) (acre-ft)    (cfs)    (ft/sec)     (Minutes)***
0.000000  0.001148  0.000000  0.000000
0.011111  0.001164  0.000013  0.061553
0.022222  0.001179  0.000026  0.195775
0.033333  0.001195  0.000039  0.385529
0.044444  0.001211  0.000052  0.623916
0.055556  0.001227  0.000066  0.906776
0.066667  0.001243  0.000080  1.231251
0.077778  0.001259  0.000094  1.595221
0.088889  0.001275  0.000108  1.997049
0.100000  0.001291  0.000122  2.435424
0.111111  0.001307  0.000136  2.909278
0.122222  0.001323  0.000151  3.417723
0.133333  0.001339  0.000166  3.960014
0.144444  0.001355  0.000181  4.535515
0.155556  0.001371  0.000196  5.143687
0.166667  0.001387  0.000211  5.784063
0.177778  0.001403  0.000227  6.456242
0.188889  0.001419  0.000242  7.159875
0.200000  0.001435  0.000258  7.894660
0.211111  0.001451  0.000274  8.660336
0.222222  0.001467  0.000290  9.456676
0.233333  0.001483  0.000307  10.28348
0.244444  0.001499  0.000323  11.14059
0.255556  0.001515  0.000340  12.02785
0.266667  0.001531  0.000357  12.94513
0.277778  0.001547  0.000374  13.89235
0.288889  0.001564  0.000391  14.86939
0.300000  0.001580  0.000409  15.87620
0.311111  0.001596  0.000427  16.91272
0.322222  0.001612  0.000444  17.97889
0.333333  0.001628  0.000462  19.07469
0.344444  0.001645  0.000481  20.20010
0.355556  0.001661  0.000499  21.35509
0.366667  0.001677  0.000517  22.53967
0.377778  0.001693  0.000536  23.75383
0.388889  0.001710  0.000555  24.99760
0.400000  0.001726  0.000574  26.27098
0.411111  0.001742  0.000593  27.57401
0.422222  0.001759  0.000613  28.90671
0.433333  0.001775  0.000633  30.26912
```

```
   0.444444  0.001791  0.000652  31.66128
   0.455556  0.001808  0.000672  33.08324
   0.466667  0.001824  0.000693  34.53505
   0.477778  0.001840  0.000713  36.01675
   0.488889  0.001857  0.000733  37.52842
   0.500000  0.001873  0.000754  39.07012
   0.511111  0.001890  0.000775  40.64190
   0.522222  0.001906  0.000796  42.24384
   0.533333  0.001923  0.000817  43.87600
   0.544444  0.001939  0.000839  45.53848
   0.555556  0.001956  0.000860  47.23133
   0.566667  0.001972  0.000882  48.95464
   0.577778  0.001989  0.000904  50.70850
   0.588889  0.002005  0.000927  52.49298
   0.600000  0.002022  0.000949  54.30817
   0.611111  0.002038  0.000971  56.15416
   0.622222  0.002055  0.000994  58.03105
   0.633333  0.002071  0.001017  59.93891
   0.644444  0.002088  0.001040  61.87785
   0.655556  0.002105  0.001063  63.84796
   0.666667  0.002121  0.001087  65.84933
   0.677778  0.002138  0.001111  67.88207
   0.688889  0.002155  0.001134  69.94626
   0.700000  0.002171  0.001159  72.04202
   0.711111  0.002188  0.001183  74.16943
   0.722222  0.002205  0.001207  76.32861
   0.733333  0.002221  0.001232  78.51966
   0.744444  0.002238  0.001256  80.74267
   0.755556  0.002255  0.001281  82.99776
   0.766667  0.002271  0.001307  85.28502
   0.777778  0.002288  0.001332  87.60458
   0.788889  0.002305  0.001357  89.95652
   0.800000  0.002322  0.001383  92.34097
   0.811111  0.002339  0.001409  94.75803
   0.822222  0.002355  0.001435  97.20780
   0.833333  0.002372  0.001461  99.69041
   0.844444  0.002389  0.001488  102.2059
   0.855556  0.002406  0.001514  104.7545
   0.866667  0.002423  0.001541  107.3363
   0.877778  0.002440  0.001568  109.9513
   0.888889  0.002457  0.001596  112.5997
   0.900000  0.002473  0.001623  115.2816
   0.911111  0.002490  0.001650  117.9971
   0.922222  0.002507  0.001678  120.7464
   0.933333  0.002524  0.001706  123.5294
   0.944444  0.002541  0.001734  126.3465
   0.955556  0.002558  0.001763  129.1976
   0.966667  0.002575  0.001791  132.0828
   0.977778  0.002592  0.001820  135.0024
   0.988889  0.002609  0.001849  137.9564
   1.000000  0.002626  0.001878  140.9449
  END FTABLE  3
END FTABLES

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

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>    #       <Name> # #<-factor->strg <Name>    # <Name>    tem strg strg***
RCHRES    3 HYDR    RO     1 1         1      WDM   1004 FLOW     ENGL      REPL
RCHRES    3 HYDR    STAGE  1 1         1      WDM   1005 STAG     ENGL      REPL
COPY      1 OUTPUT  MEAN   1 1      48.4      WDM    701 FLOW     ENGL      REPL
```

```
COPY    501 OUTPUT MEAN    1 1      48.4       WDM     801 FLOW      ENGL       REPL
END EXT TARGETS

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

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

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

  MASS-LINK         7
RCHRES      OFLOW  OVOL    1                 RCHRES          INFLOW IVOL
  END MASS-LINK     7

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

  MASS-LINK        17
RCHRES      OFLOW  OVOL    1                 COPY            INPUT  MEAN
  END MASS-LINK    17


END MASS-LINK

END RUN
```

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APPENDIX B

MAINTENANCE & OPERATIONS MANUAL

APPENDIX C

GEOTECHNICAL REPORT

LIU & ASSOCIATES, INC.

Geotechnical Engineering | Engineering Geology | Earth Science

June 26, 2016

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

Dear Mr. Hanson:

Subject: Geotechnical Investigation
Currie Farm
15831 - 171st Avenue SE
Monroe, Washington
L&A Job No. 16-085

INTRODUCTION

We understand the development of a single-family residential project is proposed for the subject property, located at the above address in Monroe, Washington. The proposed development is to plat the property into 20 single-family residential building lots with supporting infrastructure. We also understand that onsite stormwater disposal by infiltration is being considered for the development. At your request, we have completed a geotechnical investigation for the proposed development project.

The purpose of this investigation is to explore and characterize subsurface conditions of the project site and provide geotechnical recommendations on grading, onsite stormwater disposal, erosion mitigation, surface and ground water drainage control, and foundation support to buildings for the proposed development. Presented in this report are our findings of the site conditions, conclusion, and geotechnical recommendations.

19213 Kenlake Place NE · Kenmore, Washington 98028
Phone (425) 483-9134 · Fax (425) 486-2746

PROJECT DESCRIPTION

For our use in this investigation, you provided us with a site and plat plan of the proposed development. According to this plan the site, elongated in the east-west direction, is to be divided into 20 building lots with a open tract (Tract 999) at its east end. The lots are to be accessed with an L-shaped paved road swing through the site between 171st Avenue SE to the west and Mountain View Road to the north. Stormwater collected over impervious surfaces of the project will be disposed with infiltration trenches or galleries installed in Tract 999 and/or under the access road. The proposed residences will be two-story, above-grade, wood-framed structures supported on perimeter concrete foundation walls and interior load-bearing walls, beams, and columns. Due to the nearly flat terrain of the site, grading and construction of the residences will require minimal cut and fill.

SCOPE OF SERVICES

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

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

2. Explore the site for subsurface conditions with backhoe test pits to depth where a firm bearing soil stratum or a soil layer suitable for disposing stormwater by infiltration is encountered, or to the maximum depth (about 12 feet) capable by the backhoe used in excavating the test pits, whichever occurs first.

3. Conduct soil particle distribution test on soil samples obtained from targeted soil layer in test pits in accordance with Washington State Department of Ecology 2012 Stormwater Management Manual for Western Washington to determine infiltration rate of the targeted soil layer.

4. Perform geotechnical analyses and provide geotechnical recommendations on onsite stormwater disposal, erosion mitigation, surface and ground water drainage control, and foundation support to buildings for the proposed development based on subsurface conditions encountered by the test pits and results of our geotechnical analyses and laboratory tests on soil samples.

5. 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 in a flood plain of the nearby Skykomish River and its tributary creeks. It is bounded by 171st Avenue SE to the west, the right-of-way of State Highway 522 to the east, and adjoined by residential development to the north and south.

The terrain within the site is nearly flat. It is currently an open cultivated land utilized for plant nursery.

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 condition of the project site. According to this publication, the surficial soil unit at and in the vicinity of the project site is mapped as Younger Alluvium Deposits (Q_{yal}).

The younger alluvium deposits were geologically recent sediment transported and deposited by flooding water of the nearby Skykomish River and its tributary creeks, following the retreat of the last glacier, the Vashon Stade of the Fraser Glaciation, which occurred during the later stages of the Pleistocene Epoch and retreated from the region some 12,500 years ago. The coarser materials of the alluvium deposits, such as coarse sand, gravel, cobble and boulder, were deposited closer to the river and tributary creek channels and are highly permeable, while the finer materials of the alluvium deposits, such as clay, silt and fine sand, were laid down farther away from the river/tributary creek channels and are less permeable. The younger alluvium deposits had not been over-ridden by glacier and are generally loose to medium-dense in their natural, undisturbed state.

SOIL CONDITION

Subsurface conditions of the project site were explored with four test pits. The test pits were excavated on June 15, 2016, with a rubber-tired backhoe to depths from 9.0 to 11.0 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 site survey map, and their locations should be considered as only 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 the test pits. Soil samples obtained from each soil layer 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 and 5.

The test pits generally encountered a layer of loose, organic topsoil, from about 10 to 15 inches thick, mantling the project site. The topsoil is underlain by a layer of weathered soil of brown to yellowish-brown, loose, silty fine sand, from 1.5 to 3.0 feet thick. This weathered soil layer is underlain by a layer of light-gray, stiff to very-stiff, silty fine sand to fine-sandy silt, from 1.1 to 4.8 feet thick, increasing in thickness to the west. Underlying this layer of fine-grained soils to the depths explored is a light-gray, medium-dense to dense, gravelly sand deposit, which appears to be an alluvium deposit.

GROUNDWATER CONDITION

Groundwater was not encountered by any of the four test pits excavated on the site. The stiff to very-stiff, silty fine sand to fine-sandy silt soil layer is of low permeability and would perch stormwater infiltrating into the more permeable surficial soils. 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 fall months and would accumulate and rise in the wet winter and early spring months. The underlying alluvium deposit of gravelly sand is of very-high permeability and would allow water to seep through very easily.

GEOLOGIC HAZARDS AND MITIGATION

Erosion and Landslide Hazard

The site is nearly flat and is underlain at shallow depth by a medium-dense to dense gravelly sand deposit of moderately high shear strength. Therefore, there should be little or no hazard for soil erosion and landslide to occur on the project site. To further minimize erosion hazard of the site, vegetation cover outside of construction areas should be protected and maintained. Concentrated stormwater should not be discharged uncontrolled onto the ground within the site. Stormwater over impervious surfaces, such as roofs and paved roadway, driveways and parking areas, should be captured by underground drain line systems connected to roof downspouts and catch basins installed in paved areas. Water collected into these drain line systems should be tightlined to discharge into a storm sewer or suitable stormwater disposal facilities.

Seismic Hazard

The Puget Sound region is in an active seismic zone. The project site is underlain at shallow depth by medium-dense to dense, gravelly sand soil of very-high permeability. Also, the site is nearly level. Therefore, the potential for seismic hazards, such as landslides, liquefaction, lateral soil spreading, to occur on the site should be minimal. The proposed residences, 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 project 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 and following completion of construction. Conventional footing foundations constructed on or into the underlying medium-dense to dense alluvium deposit of gravelly sand deposit underlying the site at shallow depth may be used to support proposed residences. Unsuitable surficial topsoil and weak surficial weathered soil should be stripped within footprint of roadway, driveways, parking areas, and areas of structural fill.

The surficial topsoil and weathered soils contain a high percentage of fines and can be easily disturbed when saturated. Grading work in wet winter months may cause complications and difficulties. Therefore, earth work should be scheduled and completed between April 1 and October 31, if possible. Otherwise, erosion protection and drainage control measures recommended in this report should be implemented for site stabilization and to facilitate earthwork if it is to be carried out beyond the above dryer period.

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 entrances to and exit from 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 onto neighboring properties or streets. 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 construction areas, as required, to intercept and drain away storm runoff and near-surface groundwater seepage. Water captured by such ditches or trench drains should be stored in temporary holding and settling ponds onsite. Only clear and clean water may be discharged into the alluvium deposit under the site or into a nearby storm inlet. The storm inlet into which collected stormwater is to be discharged should be covered with a non-woven filter fabric sock to prevent sediment from entering the storm sewer system. The filter sock should be cleaned frequently during construction to prevent clogging, and should be removed after completion of construction.

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 unsuitable surficial soils should be completely stripped down to the medium-dense to dense alluvium deposit of gravelly sand soil within building pads of residences and within paved roadway, driveways, and parking areas. Exposed soils after stripping should be compacted to a non-yielding state with a vibratory mechanical compactor and proof-

rolled with a piece of heavy earthwork equipment prior to roadway, driveway, and parking area construction.

EXCAVATION AND FILL SLOPES

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. Permanent cut banks should be no steeper than 2-1/4H:1V. Soil condition encountered by cuts and 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, alluvium soils 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. Permanent fill embankments constructed over ground of 20% or more should be structurally supported laterally.

The above recommended cut slopes and fill embankments are under the assumption that groundwater seepage would not be encountered during construction. If groundwater is encountered, the grading work should be immediately halted and the 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 slopes and fill

embankments. 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 securely covered with clear plastic sheets, as required, to protect them from erosion until the vegetation is fully established.

STRUCTURAL FILL

Structural fill is the fill that supports structural or traffic load. Structural fill 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 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 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 of fill.

ONSITE STORMWATER DISPOSAL

General

The alluvium soil unit of gravelly sand deposit underlying the site at depths of about 4.0 to 8.0 feet below existing ground surface is of very high permeability and would be able to support onsite stormwater disposal by infiltration easily.

Particle Size Distribution Tests and Estimated Infiltration Rates

Four soil samples, one from each of the four test pits excavated on the site, were obtained from the alluvium deposit and taken to HWA laboratory for Soil Particle Size Distribution test. These soil samples are listed in the table below and their test reports are presented on Plates A1-1 and A1-2 in the attached appendix.

LIST OF SOIL SAMPLES

Sample No.	Test Pit No.	Depth feet	Soil Description
1	TP-1	6.0 - 7.0	Dark yellowish-brown, poorly-graded GRAVEL w/ sand
2	TP-2	5.0 - 6.0	Dark yellowish-brown, poorly-graded SAND w/ gravel
3	TP-3	6.0 - 7.0	Dark yellowish-brown, well-graded GRAVEL w/ sand
4	TP-4	9.0 - 10.0	Dark yellowish-brown, poorly-graded GRAVEL w/ sand

The percentages of clay, silt, and sand/gravel of the soil samples determined from the particle size distribution tests are summarized on Plates A1-1 and A1-2. Based on these percentages the soil samples were classified according to the USDA (U.S. Department of Agriculture) Texture Triangle chart, a copy of which is shown on Plate A2 in the attached Appendix. The classifications of soil samples are presented in the table below.

USDA TEXTURE TRIANGLE CLASSIFICATION OF SOIL SAMPLES

Sample No.	Percentage Clay	Percentage Silt	Percentage Sand/Gravel	USDA Texture Triangle Classification
1	0.3	2.3	97.4	Sand
2	0.2	1.6	98.3	Sand
3	0.3	1.8	97.8	Sand
4	0.3	1.9	97.8	Sand

Volume III, Section 3.3.6, Article 3 - Soil Grain Size Analysis Method, of the Stormwater Management Manual for Western Washington, 2012 Edition, published by Washington State Department of Ecology, is used to determine estimated design infiltration rates of the target alluvium deposit. This method uses D_{10} , D_{60}, D_{90}, and f_{fines} in calculating the

saturated infiltration rate (conductivity), K_{sat} in cm/sec; where D_{10} , D_{60}, D_{90} are the sizes in millimeters of soil particles of 10%, 60%, and 90%, respectively, passing by weight, and f_{fines} is the fraction of the fines passing the No. 200 sieve by weight (i.e., the sum of clay and silt). The values of D_{10} , D_{60}, D_{90}, and f_{fines} are shown or obtained from test results on Plates A1-1 and A1-2, and the determination of K_{sat} for the four soil samples are shown in the table below.

ESTIMATED INITIAL INFILTRATION RATES, K_{sat}

Sample No.	Test Pit No.	D_{10} Size	D_{60} Size	D_{90} Size	f_{fines}	[a] K_{sat} cm/sec	K_{sat} in/hour
1	TP-1	0.2831	14.24	27.79	0.026	0.0589	83.48
2	TP-2	0.3043	5.74	19.50	0.018	0.0631	89.43
3	TP-3	0.4759	7.75	20.50	0.021	0.1380	195.59
4	TP-4	0.2870	10.58	28.00	0.022	0.0520	73.70

[a] $\log_{10}(K_{sat}) = -1.57 + 1.90(D_{10}) + 0.015(D_{60}) - 0.013(D_{90}) - 2.08(f_{fines})$

Recommended Design Infiltration Rate

The design infiltration rate for infiltration trenches or galleries to be used for onsite stormwater disposal for the subject project is determined by applying the K_{sat} values shown in the above table with a factor safety of 4.0. We recommend, on the conservative side, that a design infiltration rate of 7.5 iph (inches per hour) be used for design of infiltration trenches or galleries to dispose stormwater into in the alluvium deposits of gravelly sand underlying the site.

INFILTRATION TRENCHES/GALLERIES

General

It is our opinion that based on the soil conditions encountered by the test pits and the results of particle size distribution test on the soil samples, the targeted alluvium deposit underlying the site are capable of supporting infiltration trenches/galleries to be used for onsite stormwater disposal. Infiltration trenches/galleries should be set back at least 5 feet from property lines and 10 feet from adjacent building footing foundations or utility trenches. The bottom of infiltration trenches or galleries should be at least one foot lower than adjacent building footing foundations or utility trenches. Infiltration trenches/galleries should be installed at several locations in Tract 999 and under the access road to disperse disposed water over a wide area under the site to minimize potential problems from concentration of disposed stormwater.

Infiltration Trench/Gallery Construction

Infiltration trenches/galleries should be cut at least 6 inches into the alluvium deposit of gravelly sand soil. To reach this target soil stratum the trenches/galleries would have to be excavated to depths of about 4.5 to 8.5 feet or more. The condition of the soil unit at bottom of trenches/galleries should be verified by a geotechnical engineer. The stability of the trench cut banks should also be verified by a geotechnical engineer during excavation.

The trenches/galleries should be at least 24 inches wide. The side walls (but not the bottom) of the trenches/galleries should be lined with a layer of non-woven filter fabric

(MIRAFI 140NS). The trenches/galleries are then to be filled with clean washed 3/4 to 1-1/2 inch gravel or crushed rock to within about 12 inches of finish grade. The dispersion pipes should be constructed of 4-inch rigid PVC pipes and laid level in the gravel or crushed rock filled trenches/galleries at about 24 inches below the top of trenches/galleries. The dispersion pipes should be spaced at no more than 4 feet apart. The top of the gravel or crushed rock fill should also be covered with the filter fabric liner. The remaining trenches/galleries should then be backfilled in lifts with compacted onsite clean sandy soils. The gravel or crushed rock fill should be placed in lifts no more than 10 inches thick in loose state, with each lift compacted to a non-yielding state with a vibratory mechanical compactor. The compaction and densification of trench fill is critical if it is to support roadway or driveways or parking areas. Stormwater captured over paved roadway, driveways, or parking areas should be routed into a catch basin equipped with an oil-water separator before being released into the infiltration trenches/galleries.

If maintaining groundwater quality is critical, the bottom of trenches/galleries should be filled with a minimum 12-inch layer of uncompacted amended soil for filtering out pollutants. The amended soil should contain 40 percent (by volume) of compost, mixed with clean, medium to coarse, sand, to achieve an organic content of at least 10% by dry weight.

BUILDING FOUNDATIONS

Conventional footing foundations may be used to support the proposed residences. The footing foundations should be constructed on or into the underlying alluvium deposit of medium-dense to dense, gravelly sand soil or on structural fill constructed on alluvium deposit. Water should not be allowed to accumulate in excavated footing trenches. Disturbed soils in footing trenches should be completely removed down to above competent deposit in their native, undisturbed state 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 2,500 psf. 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 3/4 inch or less and the differential settlement across building width should be 1/2 inch or less.

Lateral loads on the proposed residences 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 275 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 residences, 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/DRIVEWAYS AND PARKING AREAS

Performance of roadway, driveways, and parking area pavement is critically related to the conditions of the underlying subgrade soils. We recommend that the subgrade soils under the roadways, driveways and parking areas 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 roadways, driveways, and parking areas. This crushed rock base should be at least 6 inches for the public roadways and 4 inches for the private driveways and parking areas. 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 private driveways and parking areas.

DRAINAGE CONTROL

Building Footprint Excavation

Footprint excavation for the 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, paved roadway, driveways and parking areas, should be collected by underground drain line systems connected to downspouts and by catch basins installed in paved roadways, driveways and parking areas. 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 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 residences. 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 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 residences. We recommend the finish ground be sloped at a gradient of 3 percent minimum for a distance of at least 10 feet away from 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 an alluvium deposit of medium-dense to dense, gravelly sand. This deposit is of moderately-high shear strength and the site is nearly level. Therefore, the site should be quite stable. It is our opinion that if the recommendations in this report are fully implemented and observed during and following completion of construction, the areas disturbed by construction will be stabilized and will remain stable, and will not increase potential for soil movement. In our opinion, the risk

for damages to the proposed development and from the development to adjacent properties due to soil movement should be minimal.

LIMITATIONS

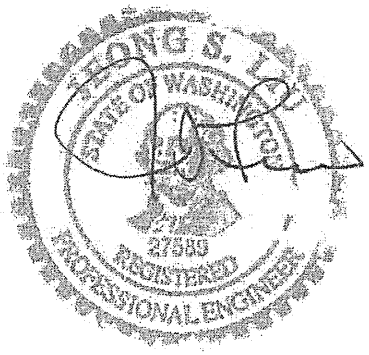
This report has been prepared for the specific application to this project for the exclusive use by Hanson Homes and its associates, representatives, consultants and contractors. We recommend that this report, in its entirety, be included in the project contract documents for the information of prospective 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 and inspected by a geotechnical engineer during construction.

Our recommendations and conclusions are based on the geologic and soil conditions encountered in the test pits excavated on the site, 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.

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

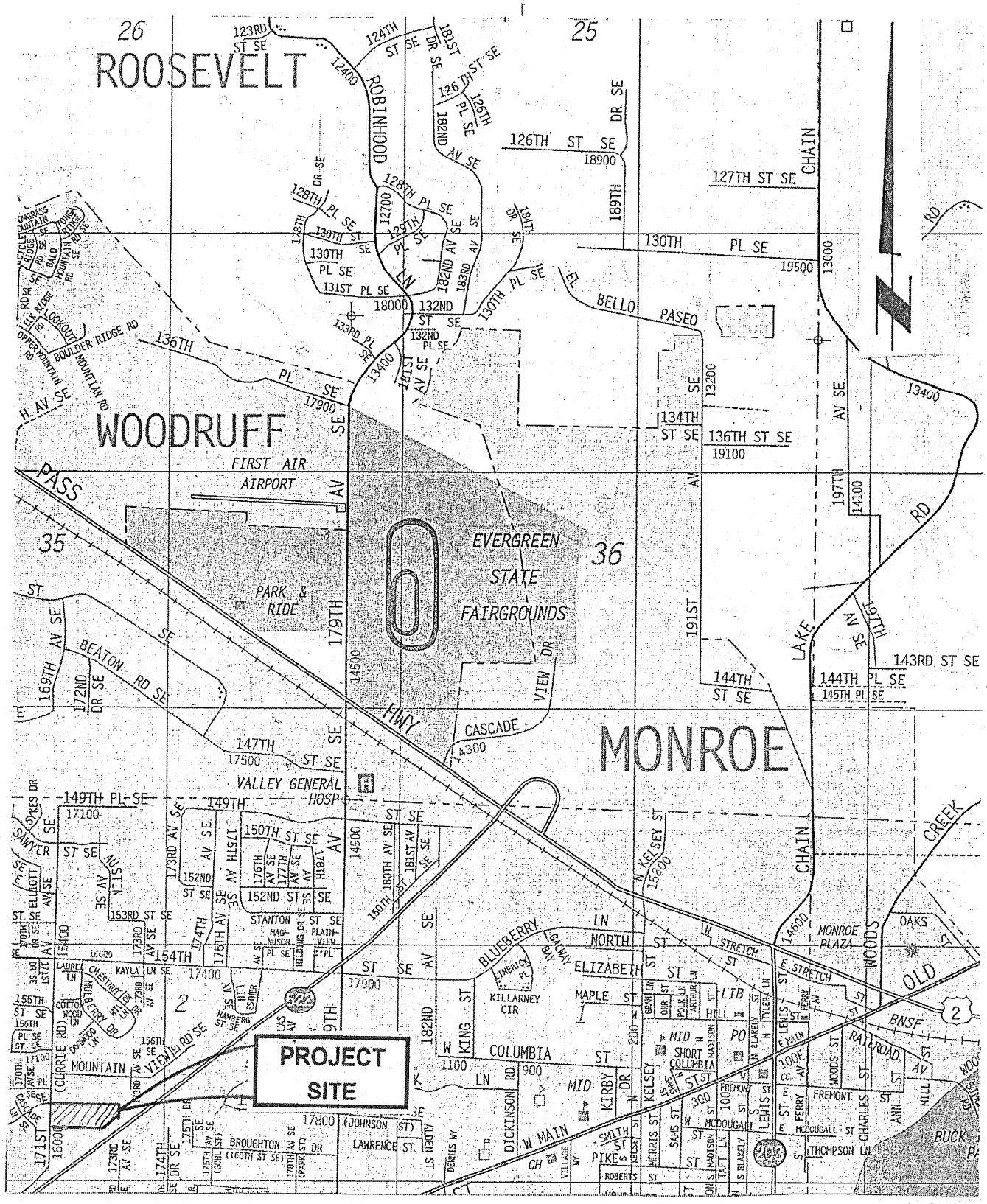
We are pleased to be of service to you on this project. Please feel free to contact us if you have questions regarding this report or need further consultation.



Yours very truly,
LIU & ASSOCIATES, INC.

J. S. (Julian) Liu, Ph.D., P.E.
Principal

Attached: Five Plates and Appendix



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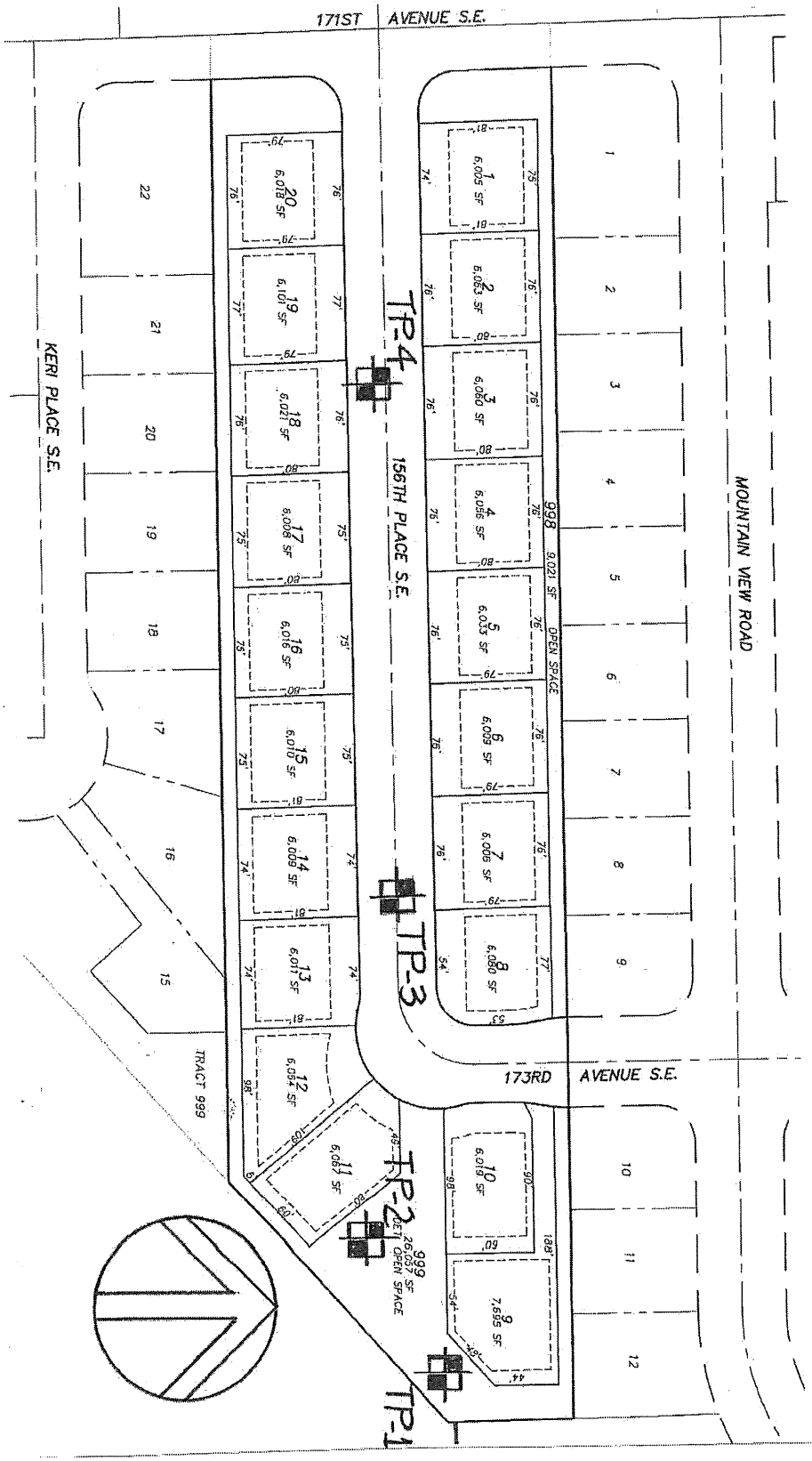
VICINITY MAP
CURRIE FARM
15831 - 171ST AVENUE SE
MONROE, WASHINGTON

JOB NO. 16-085	DATE 6/24/2016	PLATE 1



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SITE AND EXPLORATION LOCATION PLAN
CURRIE FARM
15831 - 171ST AVENUE SE
MONROE, WASHINGTON

JOB NO. 16-085	DATE 6/24/2016	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: 6/15/2016 Ground El. ±

Depth ft.		USCS CLASS.	Soil Description	Sample No.	W %	Other Test
1		OL	Dark-brown, loose, organic, silty fine SAND, very-moist (TOPSOIL)			
2		SM	Brown, loose, silty fine SAND, moist			
3						
4						
5		ML/SM	Light-gray, stiff, silty fine SAND to fine-sandy SILT, slightly-moist			
6		SW	Light-gray, medium-dense to dense, gravelly, fine to medium SAND, slightly-moist (ALLUVIUM)			
7						
8						
9						
10						
11			Test pit terminated at 10.0 ft; groundwater not encountered,			
12						

TEST PIT NO. 2

Logged By: JSL Date: 6/15/2016 Ground El. ±

Depth ft.		USCS CLASS.	Soil Description	Sample No.	W %	Other Test
1		OL	Dark-brown, loose, organic, silty fine SAND, very-moist (TOPSOIL)			
2		SM	Brown, loose, silty fine SAND, moist			
3						
4		ML/SM	Light-gray, stiff, silty fine SAND to fine-sandy SILT, slightly-moist			
5		SW	Light-gray, medium-dense to dense, gravelly, fine to medium SAND, slightly-moist (ALLUVIUM)			
6						
7						
8						
9						
10			Test pit terminated at 10.5 ft; groundwater not encountered.			

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TEST PIT LOGS
CURRIE FARM
15831 - 171ST AVENUE SE
MONROE, WASHINGTON

JOB NO. 16-085 | DATE 6/15/2016 | PLATE 4

TEST PIT NO. 3

Logged By: JSL Date: 6/15/2016 Ground El. ±

Depth ft.	USCS CLASS.	Soil Description	Sample No.	W %	Other Test
1	OL	Dark-brown, loose, organic, silty fine SAND, very-moist (TOPSOIL)			
2	SM	Yellowish-brown, loose, silty fine SAND, moist			
3					
4					
5	ML/SM	Light-brown to light-gray, very-stiff, silty fine SAND to fine-sandy SILT, slightly-moist			
6	SW	Light-gray, medium-dense to dense, gravelly, fine to medium SAND, slightly-moist (ALLUVIUM)			
7					
8					
9					
10		Test pit terminated at 9.0 ft; groundwater not encountered,			

TEST PIT NO. 4

Logged By: JSL Date: 6/15/2016 Ground El. ±

Depth ft.	USCS CLASS.	Soil Description	Sample No.	W %	Other Test
1	OL	Dark-brown, loose, organic, silty fine SAND, very-moist (TOPSOIL)			
2	SM	Yellowish-brown, loose, silty fine SAND, moist			
3					
4	ML/SM	Light-gray, stiff to very-stiff, silty fine SAND to fine-sandy SILT, slightly-moist			
5					
6					
7					
8					
9	SW	Light-gray, medium-dense to dense, gravelly, fine to medium SAND, slightly-moist (ALLUVIUM)			
10					
11					
12		Test pit terminated at 11.0 ft; groundwater not encountered.			

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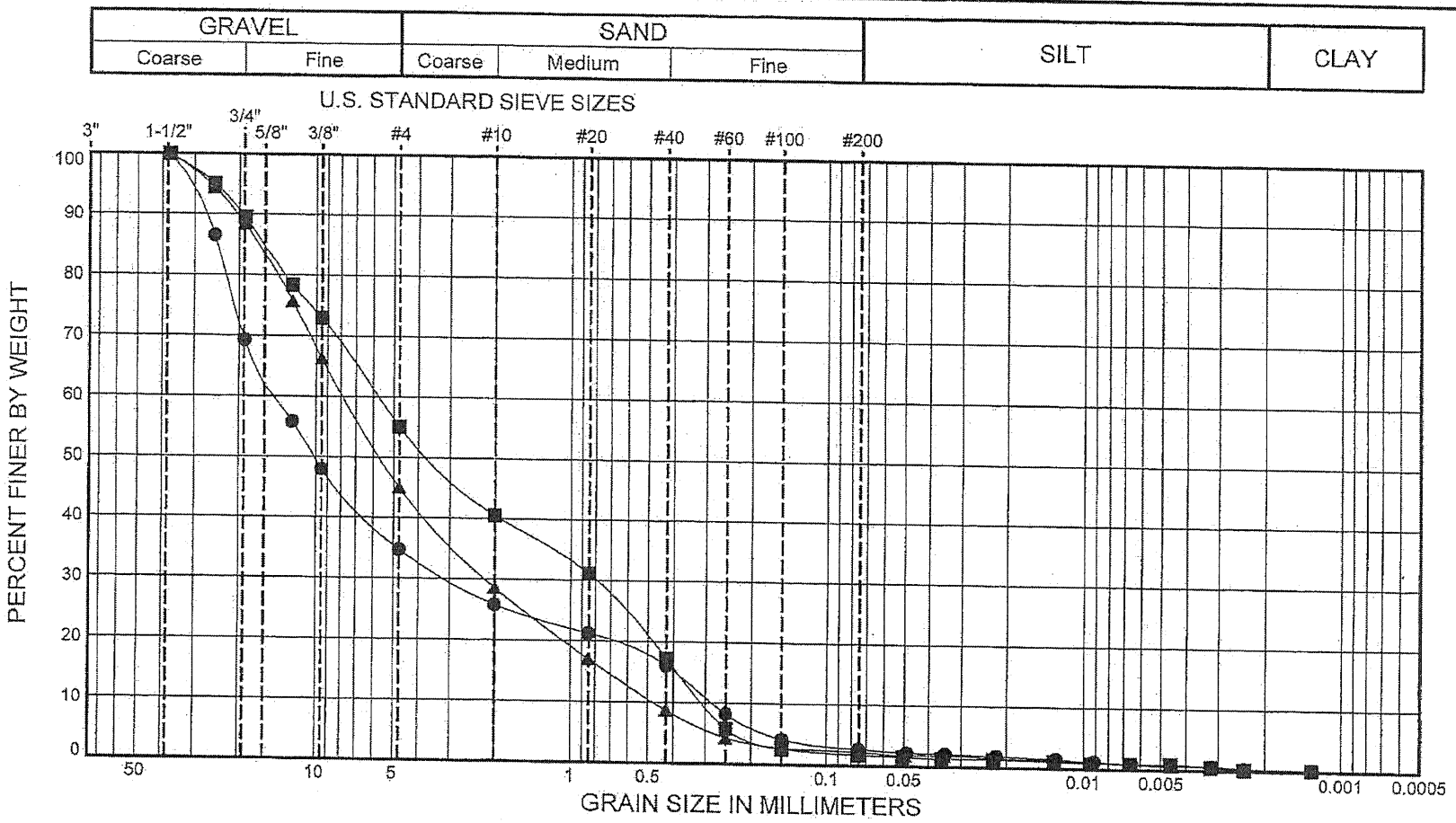
TEST PIT LOGS
CURRIE FARM
15831 - 171ST AVENUE SE
MONROE, WASHINGTON

JOB NO. 16-085 DATE 6/15/2016 PLATE 5

APPENDIX

Soil Particle Size Distribution Test Report
Currie Farm
15831 – 171st Avenue SE
Monroe, Washington
L&A Job No. 16-085

LIU & ASSOCIATES, INC.

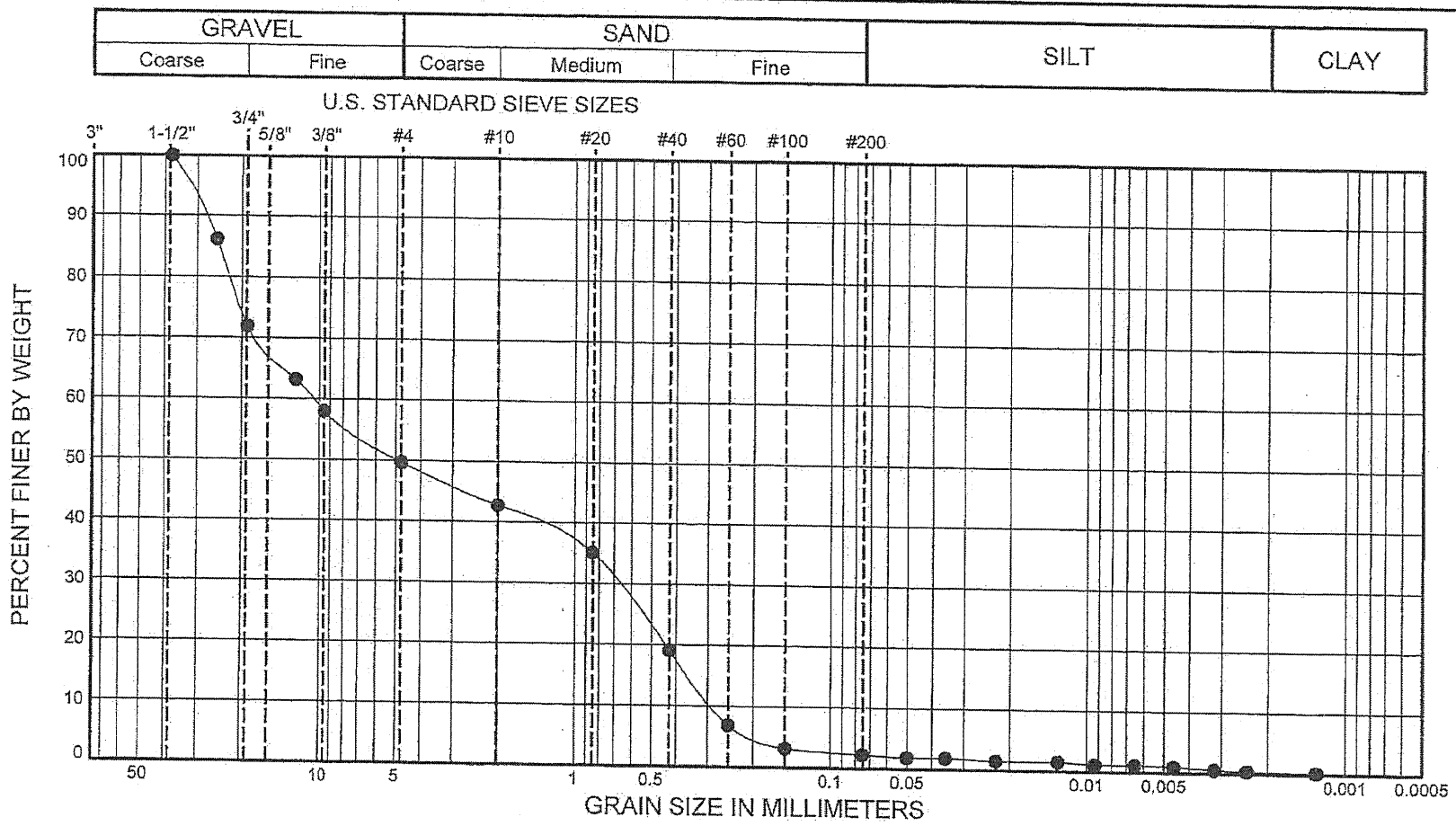


SYMBOL	SAMPLE		DEPTH (ft)	CLASSIFICATION OF SOIL- ASTM D2487 Group Symbol and Name	% MC	D90	D60	D10	Gravel %	Sand %	Silt %	Clay %
●	TP-1	S-1	6.0 - 7.0	(GW) Dark yellowish brown, well graded GRAVEL with sand	2	27.79	14.24	0.2831	65.3	32.1	2.3	0.3
■	TP-2	S-2	5.0 - 6.0	(SP) Dark yellowish brown, poorly graded SAND with gravel	3	19.50	5.74	0.3043	44.9	53.4	1.6	0.2
▲	TP-3	S-3	6.0 - 7.0	(GW) Dark yellowish brown, well graded GRAVEL with sand	4	20.50	7.75	0.4759	55.0	42.8	1.8	0.3

HWA GEOSCIENCES INC.

Testing for Liu & Associates Inc.
Hanson Plat
Liu Project No. 16-085

PARTICLE-SIZE ANALYSIS
OF SOILS
METHOD ASTM D422



SYMBOL	SAMPLE		DEPTH (ft)	CLASSIFICATION OF SOIL- ASTM D2487 Group Symbol and Name	% MC	D90	D60	D10	Gravel %	Sand %	Silt %	Clay %
●	TP-4	S-4	9.0 - 10.0	(GP) Dark yellowish brown, poorly graded GRAVEL with sand	5	28.00	10.58	0.2870	50.4	47.4	1.9	0.3

HWA GEOSCIENCES INC.

Testing for Liu & Associates Inc.
Hanson Plat
Liu Project No. 16-085

PARTICLE-SIZE ANALYSIS
OF SOILS
METHOD ASTM D422

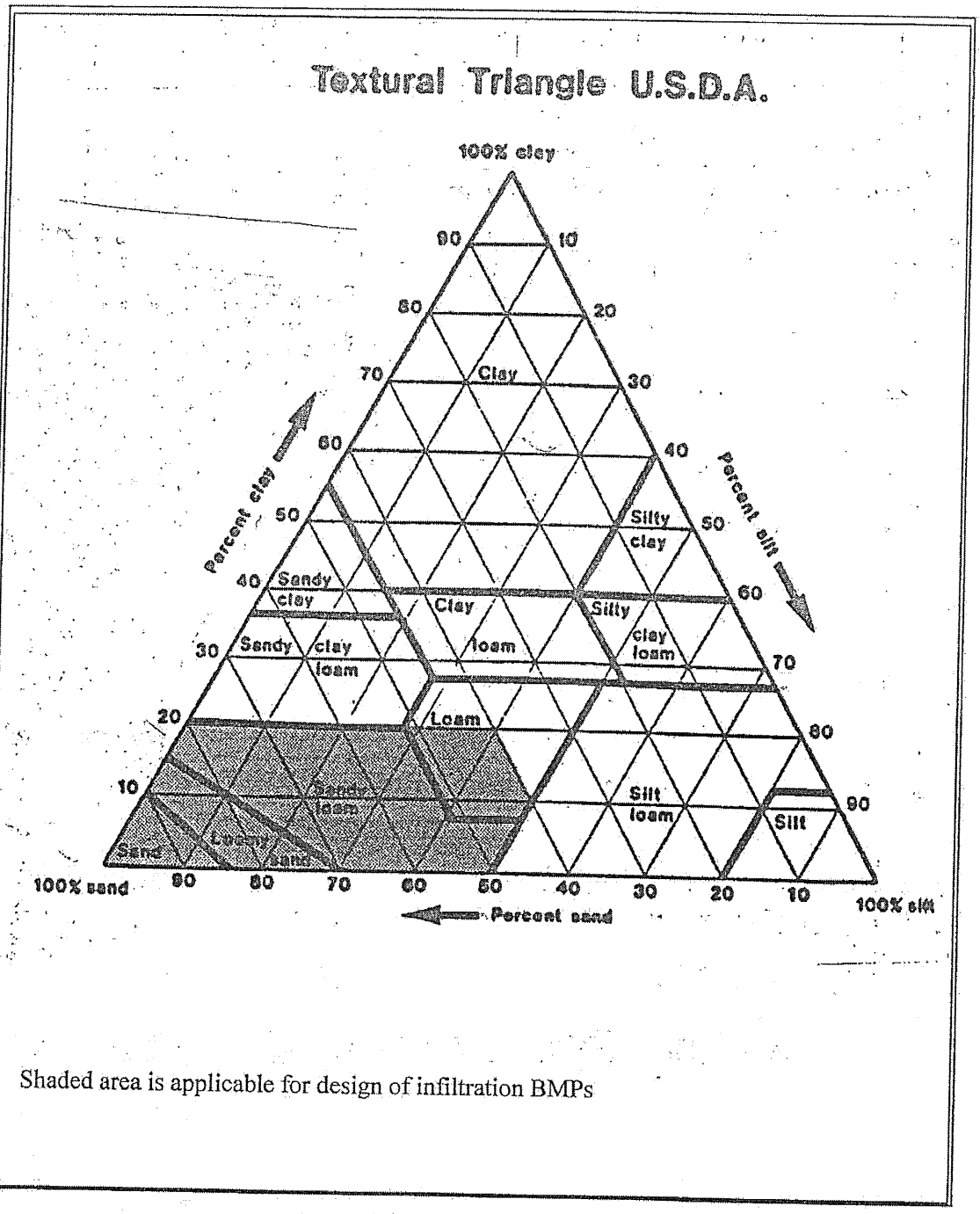


Figure 3.27 USDA Textural Triangle

Source: U.S. Department of Agriculture

PLATE A2