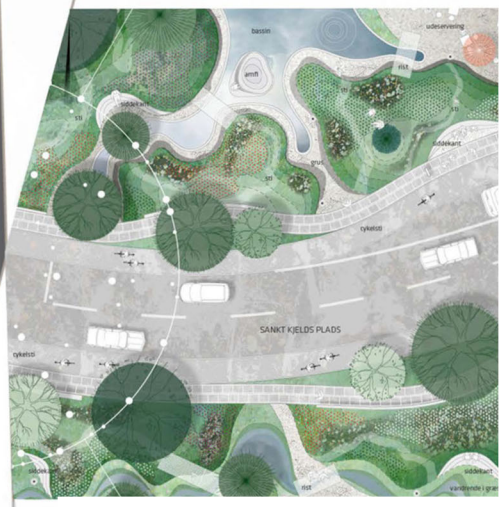
Technical Information Report & SWPPP



Advanced Building Four Plex
PARCEL #63620-000

Owner:
Brittany Cordova
303 NE Tomahawk Island Dr Ste 3
Portland OR , 97217

Applicant:
Brittany Cordova
303 NE Tomahawk Island Dr Ste 3
Portland OR , 97217

Contact:
Paul Williams, P.E.
PH: 360-931-3122
paulwilliamspe@gmail.com

Date:
November 16, 2022

Submitted To:
City of La Center
Permit Department
210 East 4th Street
La Center, WA 98629

Prepared by:
Engineering Northwest PLLC
7504 NW 10th Avenue
Vancouver, WA 98665
PH: 360-931-3122

ENGINEERING
NORTHWEST PLLC

CERTIFICATE OF THE ENGINEER

Advanced Builders

City of Vancouver, Washington

Final Technical Information Report

This Technical Information Report and the data contained herein were prepared by the undersigned whose seal, as a Professional Engineer licensed to practice as such, is affixed below. All Information required by VMCs 14.24, 14.25, 14.26, Stormwater and Erosion Control, is included in the final Stormwater Plan. This project complies with Condition S5.C5 of the Phase 1 Municipal Stormwater Permit.

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Section A – Project Overview

Section A.1 Site Information

Property Info

Project Address: E Ave, La Center, WA 98

Parcel Number: 63620-000

Size of Parcel (ac. or sq. ft.): 0.23 acres

Adjacent Street: NW Pacific Hwy Cross Street: 4th St

Project Description

The purpose of this stormwater report is to provide stormwater analysis for the construction of a multi-family residence and for the proposed public road, public sidewalks, and private driveways that will serve the proposed residence.

Currently, the subject parcel is 0.23-acre in size and vacant.

The site topography generally slopes away from the high point located approximately on the Northwest corner of the property. Slopes on the site are moderate to steep (10-25%). The four plex building will be placed on slopes that are less than 10%. Water enters the property through the north and west boundaries, sheet flows across and flows onto adjacent properties over the south and west boundaries. The vegetation on site is mainly native grasses and one tree located in the southwest corner of the parcel. Clark County GIS indicates no wetlands on the subject parcel and no habitat. See attachments for the habitat and wetland map. The Soil Conservation Service maps in the area of the building and upper driveway area is HoE Hillsboro silt loam which belongs in soil group 3. See attachment in Appendix A for the soil map. ***SEPA determination is not required for this project.***

Section A.2 – Determination of Applicable Minimum Requirements

The proposed land disturbance will consist of multi-family homes with a private driveways. Since the amount of proposed hard surfaces is over 5,000 square feet, this project is required to meet Minimum Requirements 1-9 per Figure 1.2 of the Stormwater Management Manual for Western Washington (see Appendix B).

Table A.1 Threshold Discharge Area	Square Feet	Acres
Existing Hard Surface	0	0
New Hard Surface	9,265	0.212
Native Vegetation Converted to Lawn/Landscape	-	-
Native Vegetation Converted to Pasture	-	-
Total Land Disturbing Activity	6,300	0.145
New and Replaced Pollution Generating Hard Surfaces (PGHS)	4,990	0.115
Non-Pollution Generating Surface	4,275	0.098
Total Area		**0.3**

The developed basin's effective hard surfaces and their applicability to meeting the Minimum Requirements 6-8 are summarized in Table A.2 below.

Table A.2: Effective Hard Surfaces			
Pollution Generating Hard Surface Area (SF)	MR#6 Required (Y/N)	MR#7 Required (Y/N)	MR#8 Required (Y/N)
4,990	N	N	N

Section B — Minimum Requirements

Minimum Requirement #1 — Preparation of a Stormwater Site Plan

Stormwater plans have been submitted to comply with City of la Center Code 18.320,.

The submitted stormwater plans have been prepared with sufficient engineering detail to construct the storm water facilities. The Final TIR has been prepared in conformance with La Center code 18.320.

Minimum Requirement #2 — Construction Stormwater Pollution Prevention

A Stormwater Pollution Prevention Plan (SWPPP) will be prepared and submit with final construction plans.

Minimum Requirement #3 — Source Control of Pollution

The SWPPP and the Erosion Control Plan developed for this project provide short term protection of the site and downstream areas from potential pollutants associated with the construction of the site. There are no long-term pollutant risks associated with this development that would require source control measures. Final SWPPP will be submitted with the final construction plans.

Minimum Requirement #4 — Preserve Natural Drainage Systems and Outfalls

The Stormwater Management Manual for Western Washington (SWMMWW) requires that natural drainage patterns shall be maintained and discharges from the project site shall occur at the natural location, to the extent practicable. SWMMWW also requires that the manner by which runoff is discharged from the project site must not cause a significant adverse impact to downstream receiving waters and down-gradient properties.

Best Management Practices (BMPs) have been designed and called out on the SWPPP and the Erosion Control Plans and Details to control sediment-laden runoff from leaving the site and impacting any neighboring properties. In addition, BMPs will be implemented as necessary to prevent pollutants from coming into contact with stormwater during construction. The result is that the runoff from the new impervious surface will be dispersed and/or infiltrated prior to discharging from the site. Furthermore, the capacity of the downstream drainage system will not be impacted and the water quality will be protected.

Minimum Requirement #5 — On-site Stormwater Management Minimum Requirement

The City of La Center code 18.320 does not require minimum requirement #5, however the project proposes to meet current adopted Washington State stormwater standards.

Projects triggering Minimum Requirements #1 through #5 must meet the requirements in table 2.5.1.

Table I-3.1: Minimum Requirement #5 Compliance Options for Projects Triggering Minimum Requirements #1 - #9

Project Location and Parcel Size	Minimum Requirement #5 Compliance Options
Projects inside the UGA, on any size parcel	• Use the LID BMPs from List #2 for all surfaces within each type of surface in List #2; or • Use any Flow Control BMPs desired to achieve the LID Performance Standard, and apply BMP T5.13: Post-Construction Soil Quality and Depth.
Projects outside the UGA, on a parcel smaller than 5 acres	
Projects outside the UGA, on a parcel 5 acres or larger	Use any Flow Control BMPs desired to achieve the LID Performance Standard, and apply BMP T5.13: Post-Construction Soil Quality and Depth.
Note: This text refers to the Urban Growth Area (UGA) as designated under the Growth Management Act (GMA) (Chapter 36.70A RCW) of the State of Washington. If the project is located in a county that is not subject to planning under the GMA, the city limits shall be used instead.	

List #2 requires for each surface, consider the BMPs in the order listed for that type of surface. Use the fist BMP that is considered feasible. No other On-site Stormwater Management BMP is necessary for that surface.

The proposed homes will utilize Perforated Stub-out Connections BMP T5.10A. Stormwater runoff from the downspout will be routed to a stub-out and drain to the East Fork Lewis River.

The public road, driveway, and sidewalks will utilize BMP T5.10A as well. They will all drain to a catch basin that will be filtered with Oldcastle/Kristar PerkFilter or Contech StormFilter units before they reach the stub-out and drain to the East Fork Lewis River.

Minimum Requirement #6 — Runoff Treatment

The City of La Center code 18.320 requires treatment BMPs shall be sized to capture, hold and trat the water quality design storm, defined as the six-month, 24-hours storm runoff volume however the project proposes to meet current adopted Washington State stormwater standards.

The development will use media filter cartridges in order to provide basic treatment for all pollution-generating sources on the site. Oldcastle/Kristar PerkFilter or Contech StormFilter units are proposed to be installed in two locations on the site in order to provide offline runoff treatment prior to infiltration. These filter systems are approved for use in Washington state.

Basic treatment is required for all stormwater runoff from pollution generating surfaces. Also, some separate small areas of non-pollution generating areas will directly mix or have the opportunity to mix with stormwater runoff from pollution generating areas, i.e., possibly driveways and green strip between back of sidewalk and R/W. An analysis to not include these areas and one to include these areas has been made and included in determining the runoff requiring water quality treatment.

Water Quality treatment is proposed to be provided by installation of mechanical filters with released discharges to rock trenches.
For the preliminary, water quality is proposed though application of media-filled cartridges.
PerkFilter (zeolite, perlite, and carbon) – ZPC) cartridges
Contech StormFilter would require (zeolite, perlite, and Granular Activated Carbon (GAC), i.e., ZPG specifications.
All phases will utilize concrete or steel structures.

The media filter facilities are designed based on the WWHM analysis found in Appendix C for an offline flow rate since the units are designed with an internal flow bypass system.

The filter systems sizing is determined by the flow rates set in the Washington Department of Ecology's General Use Level Designation (GULD) for the products are rated at 1.5 gpm/ft^2 of media surface. The rates in gpm per GULD are listed below with the conversions to cfs rates.

PerkFilter

Cartridge Size	WQ Rate (gpm)	WQ Rate (cfs)
12”	6.8	0.0152
18”	10.2	0.0227
12” + 12”	13.6	0.0300
12” + 18”	17.0	0.0379

StormFilter

Cartridge Size	WQ Rate (gpm)	WQ Rate (cfs)	WQ Rate (Phosphosorb) (cfs)
12”	5	0.0114	0.019
18”	7.5	0.0167	0.028
27”	11.3	0.0252	0.052

A summary of the sizing for each facility is included in Table B-1 below, and additional details of the units can be found on the Final Engineering Plans.

Table B-1A - Water Quality Summary (PerkFilter)

Basin	WQ Rate (cfs)	Unit Size (# Cartridges - Cartridge Size)	WQ Capacity Provided (cfs)
Add18 ft Frontage at Lots to street flow (drives and lawn)			
CB1	0.0129	12"	0.0152

Table B-1B - Water Quality Summary (StormFilter)

Basin	WQ Rate (cfs)	Unit Size (# Cartridges - Cartridge Size)	WQ Capacity Provided (cfs)
Add18 ft Frontage at Lots to street flow (drives and lawn)			
CB1	0.0129	18” PHOS	0.028

The individual lot systems do not require any runoff treatment prior to infiltration because each system only includes residential roofs and rear yards, with no pollution-generating surfaces.

Minimum Requirement #7 — Flow Control

There are three development thresholds that are reviewed for projects in order to determine the applicability of flow control requirements for projects. When any of the three thresholds are exceeded, the standard flow control requirements apply to the project. The first threshold is whether the project results in 10,000 square feet or more of effective impervious surfaces in a threshold drainage area. The second trigger is when the project converts ¾ acre or more of vegetation to lawn or landscape or converts 2.5 acres or more of native vegetation to pasture in a threshold discharge area. Finally, the full flow control requirements are triggered for projects that, through a combination of effective hard surfaces and converted vegetation areas, cause a 0.10 cubic feet per second increase in the 100-year flow frequency from a threshold discharge area as estimated using an approved continuous flow model and one-hour

time steps or a 0.15 cfs increase using 15-minute time steps. The 0.10 cfs (one-hour time steps) or 0.15 cfs (15-minute time steps) increase shall be a comparison of the post-project runoff to the existing condition runoff. For the purpose of applying this threshold, the existing condition is the pre-project land cover.

This proposed residential project will result in approximately 4,720 square feet of new roof area and 704 square feet of new driveway. This totals 5,424 square feet of new hard surfacing. The total area disturbed by the construction of the proposed site improvements totals 6,300 square feet, or 0.145 acres. The area disturbed by construction is less than 0.75 acres threshold for the conversion of pasture to lawn or landscaping.

In order to evaluate pre-development and post-development peak runoff rates in the 100-year storm event based on the proposed new hard surface, (i.e. proposed home and the driveway. The pre-development basin is 0.145 acre and 0.145 acre post-development basins were created.

Based on the existing runoff conditions, a pre-development basin containing 0.145 acres of the existing area was included for the purpose of comparing existing and mitigated peak runoff rates. As shown in Table B.1 WWHM Model Results, below, the pre-development peak runoff rate in the 100-year recurrence storm is 0.036 cfs while the mitigated peak 100-year runoff rate is 0.130 cfs. Since the mitigated peak 100-year runoff rate is less than the pre-developed rate increased by 0.1 cfs, as modeled in the WWHM, and the landscaped area is less than 0.75 acres, therefore this project meets minimum requirement #7.

The existing condition was model as forested condition. It is anticipated that the existing soil will not infiltrate per the geotechnical report which reports that the site soil is Clay. GIS indicates that the site soil to be Hillsboro silt loam. Typically, Hillsboro soil has some infiltration potential.

Table B.1 WWHM Model Results

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 0.145
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 0.021
Total Impervious Area: 0.124

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.003804
5 year	0.008837
10 year	0.013599
25 year	0.021383
50 year	0.028534
100 year	0.036893

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0.039436
5 year	0.060869
10 year	0.076372
25 year	0.097278
50 year	0.113735
100 year	0.130903

Section E — Conveyance Systems Analysis and Design

The only piping proposed with this project is piping to the catch basin located offsite. All piping will meet the minimum requirements of the International Plumbing Code. Based on the very limited drainage areas flowing to any of these pipes, all piping can be 8 inches in diameter or smaller.

Section F — Additional Requirements

All the runoff produced with the development will be infiltrated and dispersed. The BMPs proposed are considered adequate for both stormwater treatment and flow control per the current Washington State manual. As a result, the potential impact on downstream properties and conveyance systems is minimal.

Section F.1 – Off Site Analysis

The project does not trigger the requirement for an off-site analysis. La Center public works director recommended that the project connect to the offsite catch basin.

Section F.2 - Closed Depression Analysis

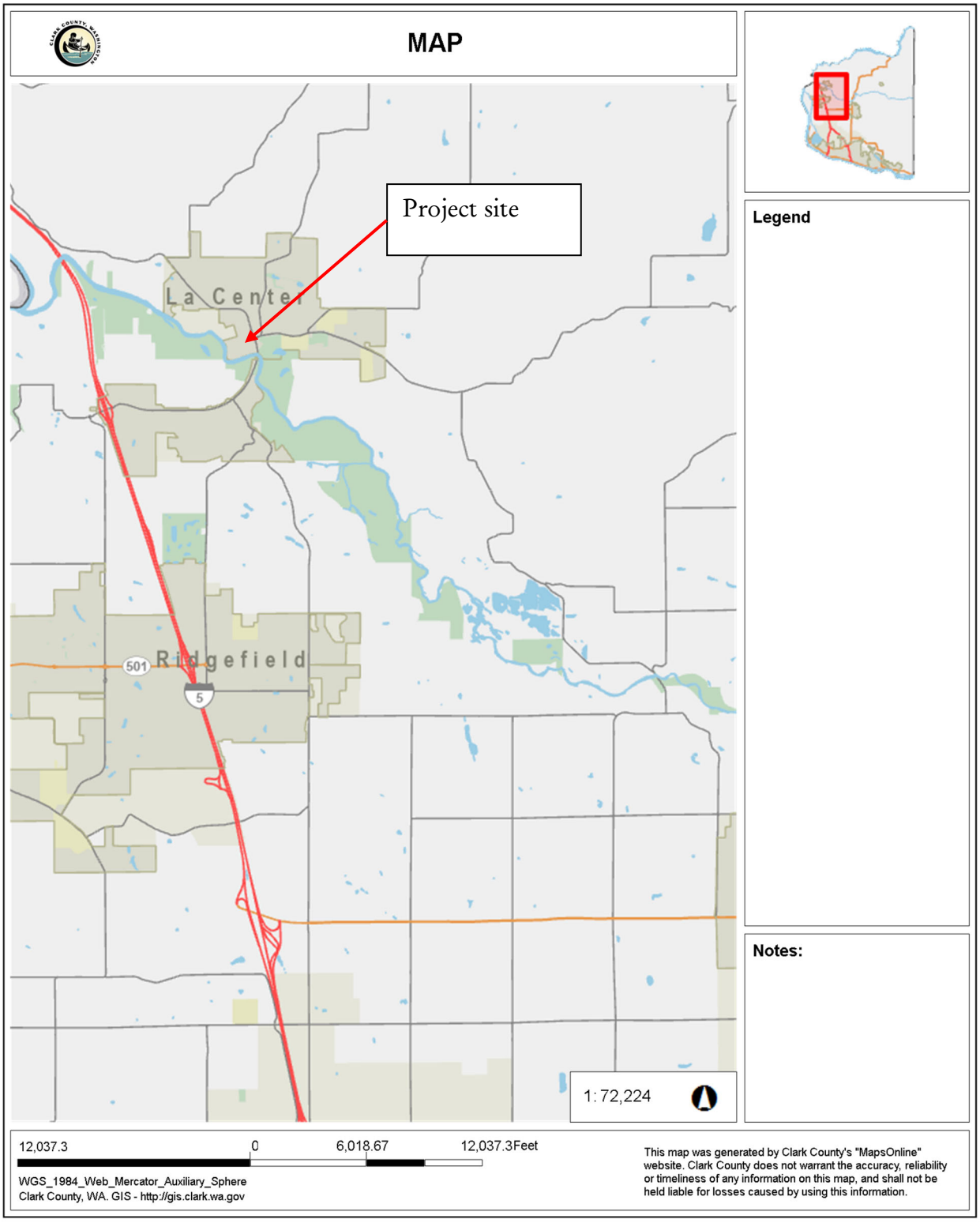
The site is not classified as a closed depression, therefore this section is not applicable.

Section F.3 – Other Permits
No other permits are required.

Section F.4—Approval Conditions Summary
There are no preliminary approval conditions for this project.

Section F.5 – Special Reports and Studies
There are no special reports or studies relating to stormwater or other site conditions for this project.

Appendix A: Maps


MAP
Project site
La Center
Ridgefield
501
5
Legend
Notes:
1:72,224
12,037.3
0
6,018.67
12,037.3Feet
WGS_1984_Web_Mercator_Auxiliary_Sphere
Clark County, WA. GIS - http://gis.clark.wa.gov
This map was generated by Clark County's "MapsOnline" website. Clark County does not warrant the accuracy, reliability or timeliness of any information on this map, and shall not be held liable for losses caused by using this information.


AERIAL
W 5th St
W 8 Ave
High Point
Basin 1 (Low Point)
No existing erosion
issues
Proposed
Structure
Legend
Taxlots
All Roads
Interstate
State Route
Arterial
Forest Arterial
Minor Collector
Forest Collector
Private or Other
Notes:
1:564
94.0
0
47.00
94.0 Feet
WGS_1984_Web_Mercator_Auxiliary_Sphere
Clark County, WA. GIS - http://gis.clark.wa.gov
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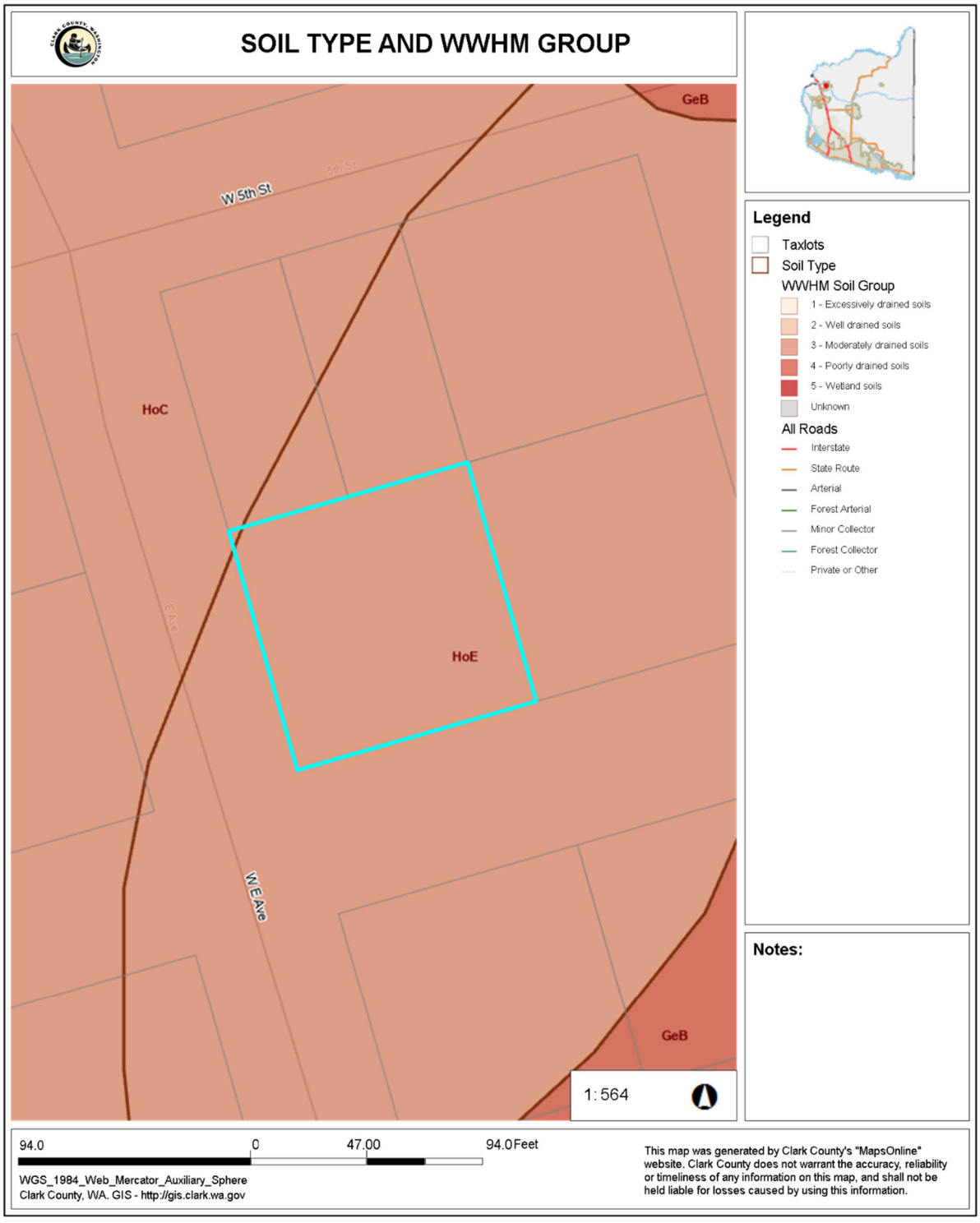
SOIL TYPE AND WWHM GROUP
GeB
W 5th St
5th St
HoC
HoE
E Ave
W E Ave
GeB
1:564
Legend
Taxlots
Soil Type
WWHM Soil Group
1 - Excessively drained soils
2 - Well drained soils
3 - Moderately drained soils
4 - Poorly drained soils
5 - Wetland soils
Unknown
All Roads
Interstate
State Route
Arterial
Forest Arterial
Minor Collector
Forest Collector
Private or Other
Notes:
94.0
0
47.00
94.0 Feet
WGS_1984_Web_Mercator_Auxiliary_Sphere
Clark County, WA. GIS - http://gis.clark.wa.gov
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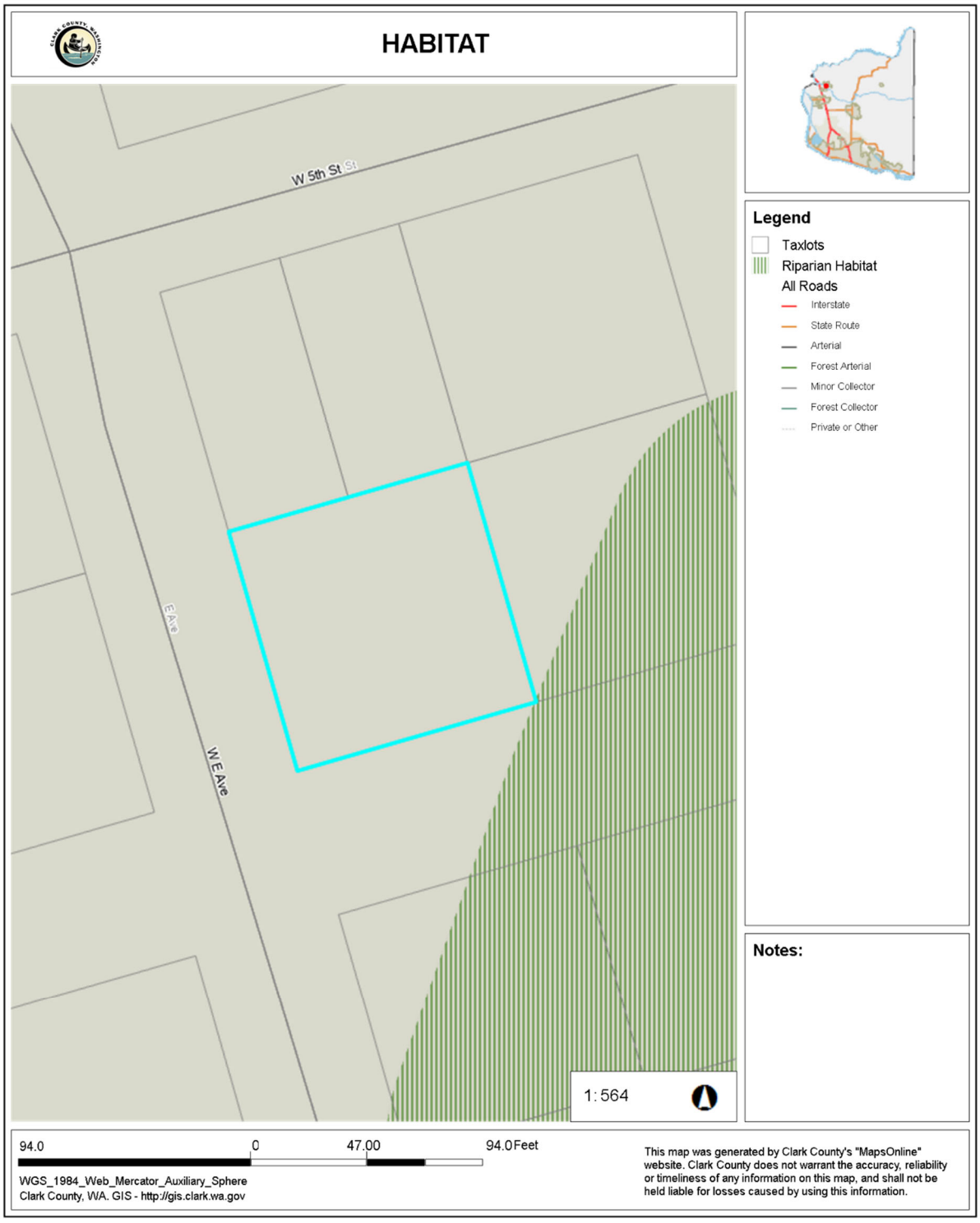
HABITAT
W 5th St
E Ave
W E Ave
Legend
Taxlots
Riparian Habitat
All Roads
Interstate
State Route
Arterial
Forest Arterial
Minor Collector
Forest Collector
Private or Other
Notes:
1:564
94.0
0
47.00
94.0 Feet
WGS_1984_Web_Mercator_Auxiliary_Sphere
Clark County, WA. GIS - http://gis.clark.wa.gov
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WETLANDS
W 5th St
E Ave
W E Ave
Legend
Taxlots
Potential Wetlands Presence
All Roads
Interstate
State Route
Arterial
Forest Arterial
Minor Collector
Forest Collector
Private or Other
Notes:
1:564
94.0
0
47.00
94.0 Feet
WGS_1984_Web_Mercator_Auxiliary_Sphere
Clark County, WA. GIS - http://gis.clark.wa.gov
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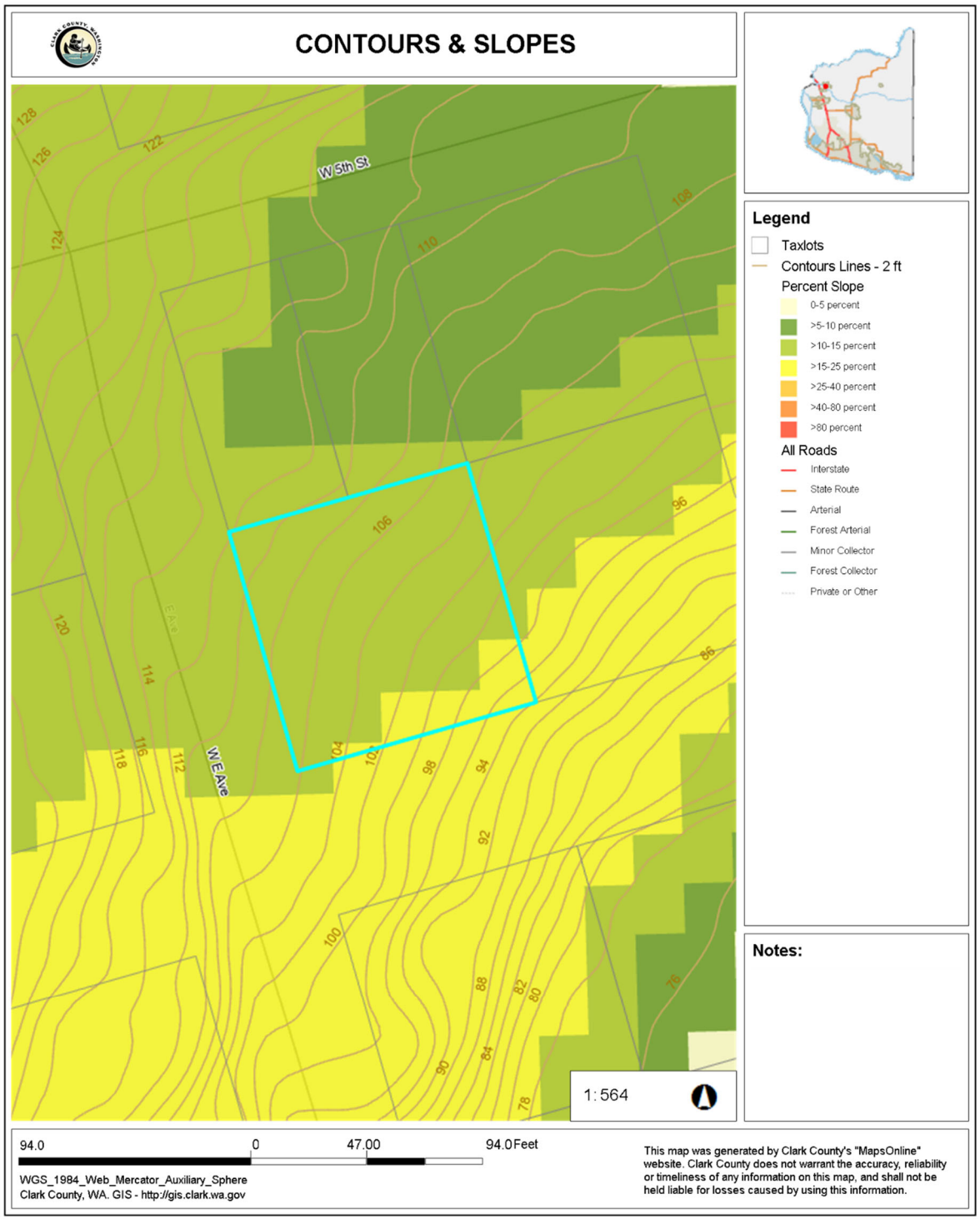
CONTOURS & SLOPES
W 5th St
W E Axe
E Axe
128
126
122
124
110
108
106
96
120
114
116
118
112
104
102
98
94
86
92
100
88
82
80
76
90
84
78
1:564
Legend
Taxlots
Contours Lines - 2 ft
Percent Slope
0-5 percent
>5-10 percent
>10-15 percent
>15-25 percent
>25-40 percent
>40-80 percent
>80 percent
All Roads
Interstate
State Route
Arterial
Forest Arterial
Minor Collector
Forest Collector
Private or Other
Notes:
94.0
0
47.00
94.0 Feet
WGS_1984_Web_Mercator_Auxiliary_Sphere
Clark County, WA. GIS - http://gis.clark.wa.gov
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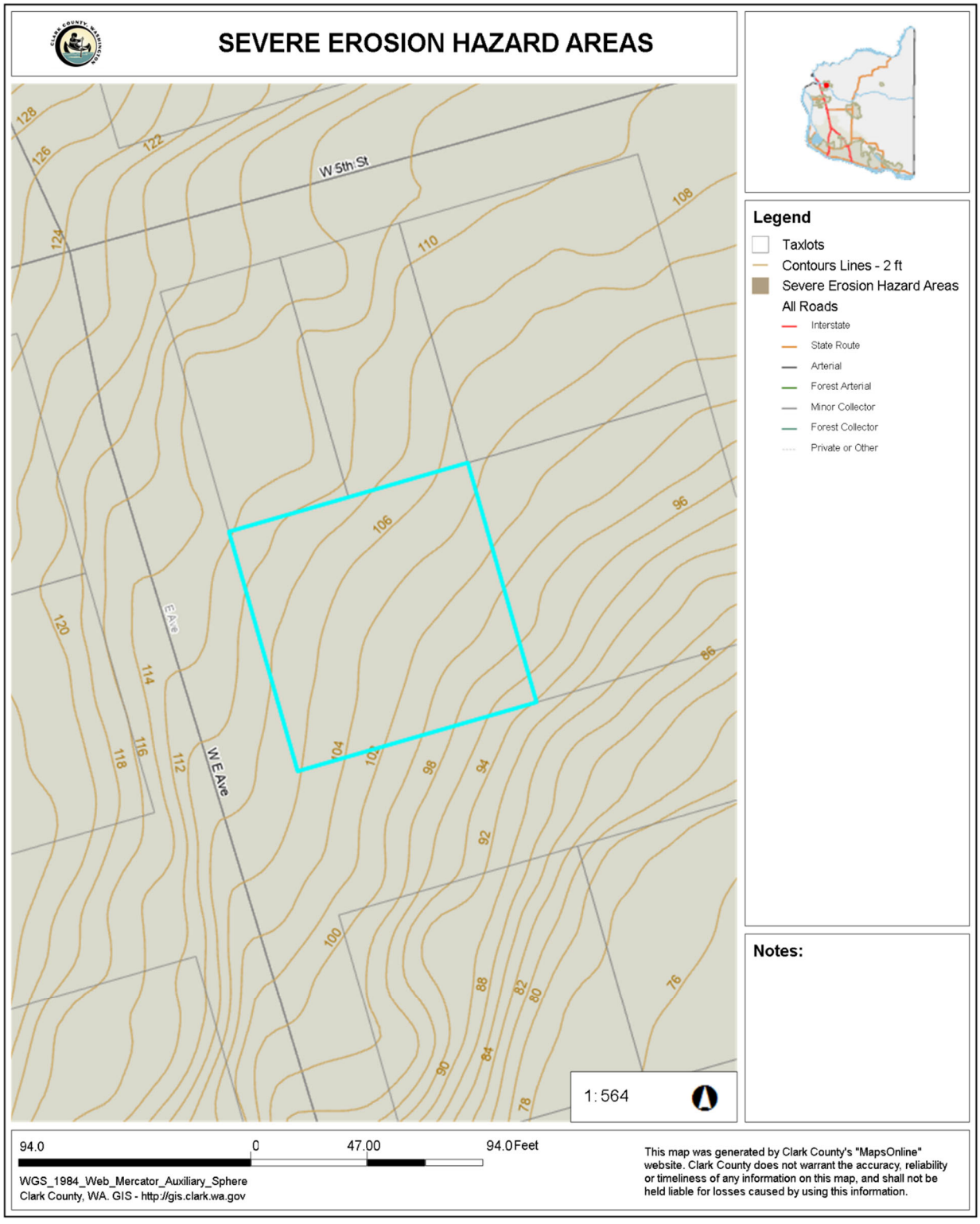
SEVERE EROSION HAZARD AREAS
W 5th St
E Ave
W E Ave
128
126
122
124
120
114
116
118
112
110
108
106
104
102
100
98
96
94
92
90
88
86
84
82
80
78
76
1:564
Legend
Taxlots
Contours Lines - 2 ft
Severe Erosion Hazard Areas
All Roads
Interstate
State Route
Arterial
Forest Arterial
Minor Collector
Forest Collector
Private or Other
Notes:
94.0
0
47.00
94.0 Feet
WGS_1984_Web_Mercator_Auxiliary_Sphere
Clark County, WA. GIS - http://gis.clark.wa.gov
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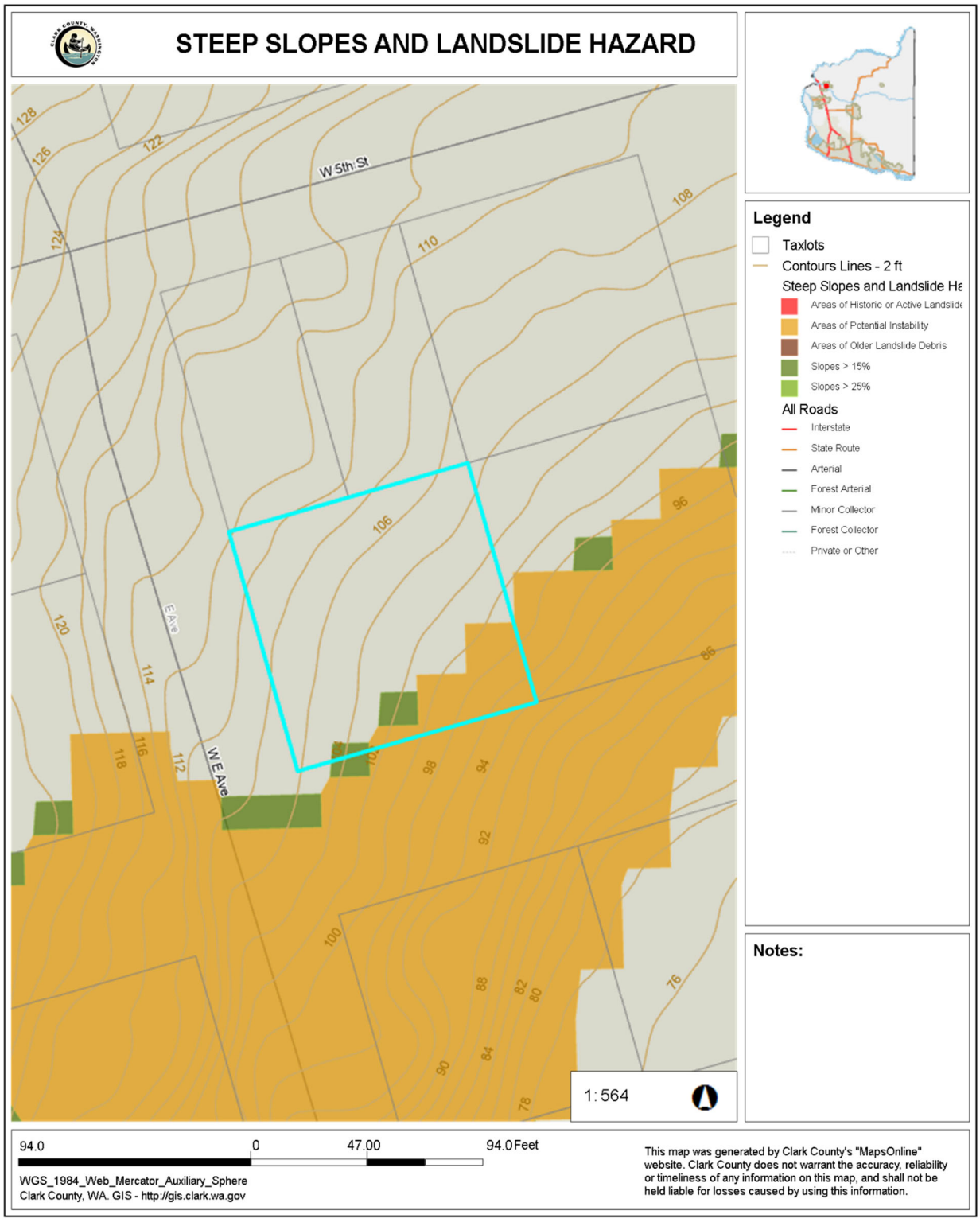
STEEP SLOPES AND LANDSLIDE HAZARD
W 5th St
W E Ave
E Ave
128
126
122
124
108
110
106
120
114
116
118
112
96
86
98
94
92
100
88
82
80
76
90
84
78
1:564
Legend
Taxlots
Contours Lines - 2 ft
Steep Slopes and Landslide Ha
Areas of Historic or Active Landslide
Areas of Potential Instability
Areas of Older Landslide Debris
Slopes > 15%
Slopes > 25%
All Roads
Interstate
State Route
Arterial
Forest Arterial
Minor Collector
Forest Collector
Private or Other
Notes:
94.0
0
47.00
94.0 Feet
WGS_1984_Web_Mercator_Auxiliary_Sphere
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Appendix B: New Development Flow Charts

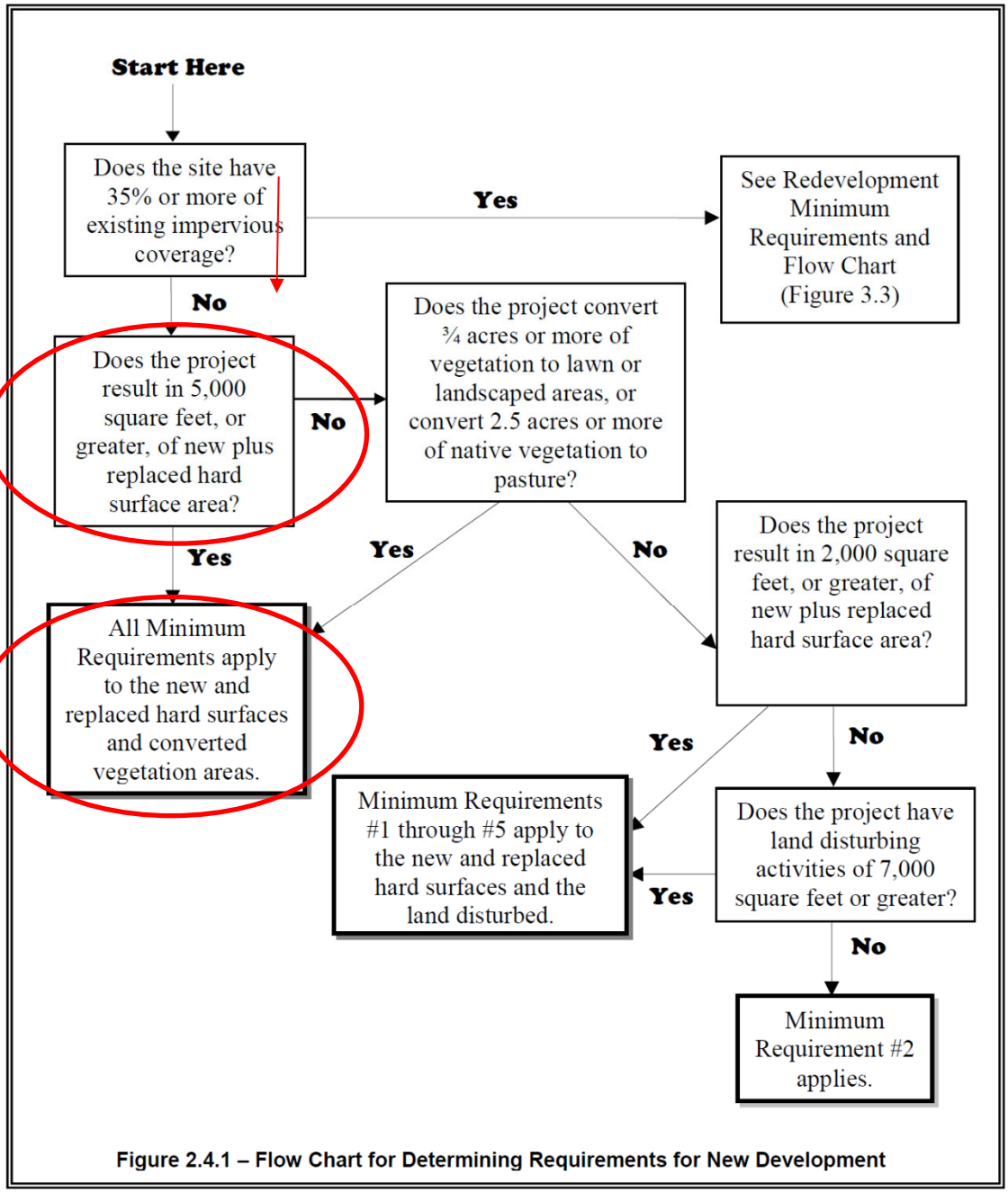


Figure 1.2: New Development Flow Chart

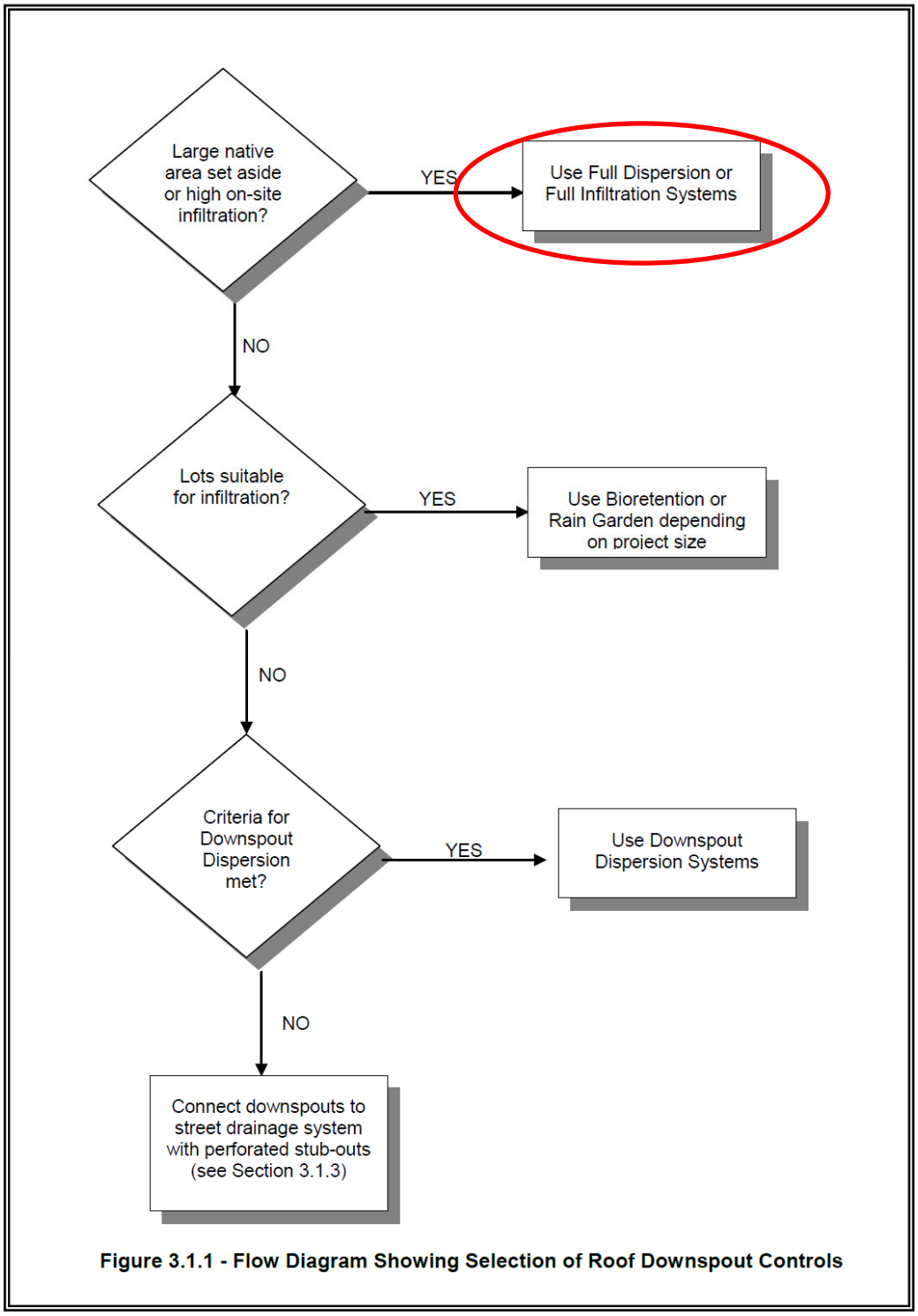


Figure 3.1.1 - Flow Diagram Showing Selection of Roof Downspout Controls

Figure 1.4: Minimum Requirement #8 Flow Chart

Appendix C: Erosion and Sediment Control BMPs

Table of Contents

BMP C101: Preserving Natural Vegetation
BMP C103: High Visibility Fence
BMP C105: Stabilized Construction Entrance / Exit
BMP C121: Mulching
BMP C123: Plastic Covering
BMP C160: Certified Erosion and Sediment Control Lead (CESCL)
BMP C233: Silt Fence
BMP C154: Concrete Washout Area
BMP C235: Wattles

Use the BMP design criteria and illustrations in this section to select and design BMPs temporary erosion and sediment control.

BMP C101: Preserving Natural Vegetation

Purpose and Description

Preserving trees, brush and ground cover helps reduce erosion generated by a project. Phasing a project to preserve vegetation reduces the need for erosion and sediment controls. In addition, proper preservation of trees and vegetation limit potential for wind throw, preserves the interception of rainfall on the site, and protects root zones that hold the soil in place.

Conditions of Use

Native vegetation must be preserved to the extent feasible on steep slopes, near perennial and intermittent watercourses or swales, and on building sites in wooded areas.
All projects are subject to Clark County Critical Areas Protection requirements under Title 40 of the Clark County Code (CCC).

Design Criteria

- Phase construction to preserve trees, brush, and ground cover on the project site for as long as possible during the construction period.
- Fence or clearly mark areas around native vegetation and existing trees that are designated to be saved.
- For Trees to be Preserved
- Identify the critical root zone for trees to be protected (within the drip line). Place a protective fence just outside the dripline, add colored flagging if necessary to increase visibility of fence;
- No construction activities shall take place within a vegetation's critical root zone, including storage of materials, parking of vehicles or placement of utilities;
- Do not alter the soil grade within the critical root zone of the vegetation; placement of mulch in the critical root zone will help protect the vegetation during construction;
- Avoid cuts to roots within the critical root zone. If the utility trenches are necessary, tunnel under the root and then carefully backfill to original grade as soon as possible.
- Do not place fill greater than six inches within the dripline of trees to be saved.
- Cut as few tree roots as possible, and cut cleanly when cutting cannot be avoided. Paint cut root ends with a wood dressing like asphalt base paint if roots will be exposed for more than 24- hours.
- Backfill trench near tree roots as soon as possible.

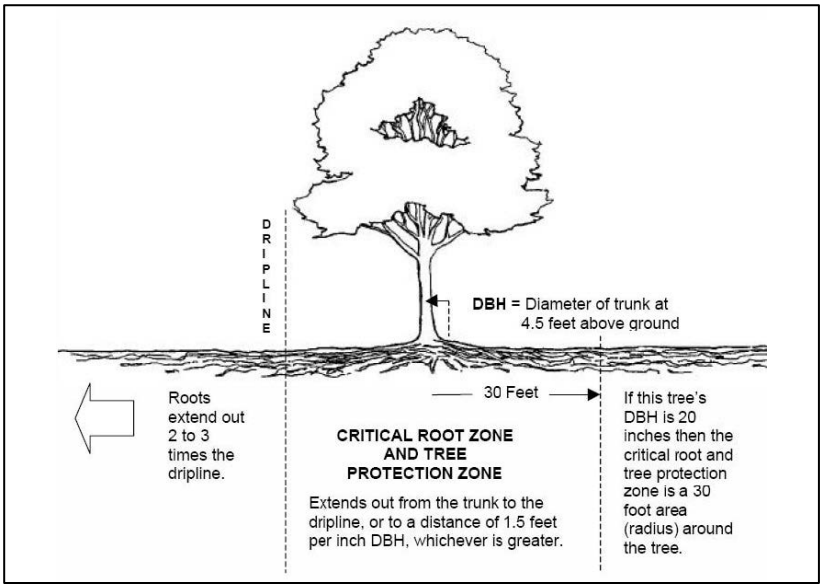


Figure 30: Illustration of Tree's Critical Root Zone

See Stormwater Management Manual for Western Washington (Ecology, 2014) Volume II, pages Res-4 and Res-5 for more information on protecting specific trees species from injuries.

Maintenance Standards

- Inspect flagged and/or fenced areas regularly to make sure flagging or fencing has not been removed or damaged. If the flagging or fencing has been damaged or visibility reduced, repair or replace it immediately and visibility restored.
- If tree roots have been exposed or injured, "prune" cleanly with an appropriate pruning saw or loppers directly above the damaged roots and cover with native soils. Treatment of sap flowing trees (fir, hemlock, pine, soft maples) is not advised as sap forms a natural healing barrier.
- Inspect protected vegetation at completion of construction. Document and repair any damage to the areas, including the addition of mulch to protect the root zone.

BMP C103: High Visibility Fence

Purpose and Description

Use high-visibility plastic or metal fencing to restrict clearing to approved limits; protect wetlands, streams, and other areas required to be left undisturbed; and limit construction traffic to the designated entrance.

Conditions of Use

(Appropriate for all sites)

Design Criteria

- High visibility plastic fence shall be composed of a high-density polyethylene material and shall be at least four feet in height. Posts for the fencing shall be steel or wood and placed every 6 feet on center (maximum) or as needed to ensure rigidity. The fencing shall be fastened to the post every six inches with a polyethylene tie. On long continuous lengths of fencing, a tension wire or rope shall be used as a top stringer to prevent sagging between posts. The fence color shall be high visibility orange. The fence tensile strength shall be 360 lbs./ft. using the ASTM D4595 testing method.
- If appropriate install fabric silt fence in accordance with BMP C233 to act as high visibility fence. Silt fence shall be at least 3 feet high and must be highly visible to meet the requirements of this BMP.
- Metal fences shall be designed and installed according to the manufacturer's specifications.
- Metal fences shall be at least 3 feet high and must be highly visible.
- Fences shall not be wired or stapled to trees.

Maintenance Standards

If the fence has been damaged or visibility reduced, it shall be repaired or replaced immediately and visibility restored.

BMP C105: Stabilized Construction Entrance / Exit

Purpose and Description

Stabilized construction entrances are established to reduce the amount of sediment transported onto paved roads by vehicles or equipment.

Conditions of Use

Use on all construction sites where traffic will be entering or leaving the site if paved roads or other paved areas are within 1,000 feet of the site.

Design Criteria

- Limit vehicle access to the site to one entrance/exit.
- Stabilize access points with a 12-inch thick pad of two-inch diameter gravel, four-inch diameter quarry spalls, or coarse crushed rock.
- Entrance must be wide enough for construction vehicles and the maximum practical length for the site.

Figure 31: Small-scale Construction Entrance

Maintenance Standards

- If the entrance is not preventing sediment from being tracked onto pavement, then replace or clean gravel/quarry spall or increase the dimensions of the entrance.
- Shoveling or street sweeping any sediment that gets tracked onto the adjacent road. Do not hose down the street.
- Immediately remove any quarry spalls or gravel that end up on the roadway.

BMP C121: Mulching

Purpose and Description

Placing mulch over exposed soils provides immediate temporary protection from erosion. Mulch also enhances plant establishment by conserving moisture, holding fertilizer, seed, and topsoil in place, and moderating soil temperatures.

Conditions of Use

- As a temporary cover measure, mulch should be used and may be applied at any time

of the year and must be refreshed periodically.
- For less than 30 days on disturbed areas that require cover.
- At all times on seeded areas.
- During the wet season on slopes steeper than 3H:1V with more than 10 feet of vertical relief.

Design Criteria

- Apply mulch to a thickness of 2 inches or sufficient thickness so that the ground is not visible under the mulch layer, whichever is greater. The Responsible Official may require increased thickness on disturbed areas in or near sensitive areas or other areas highly susceptible to erosion.
- The following materials are allowed as mulch.
- Chipped Site Vegetation
- Apply a minimum thickness of 2" chipped site vegetation
- Do not use on slopes greater than 10%
- Do not use within 200 feet of surface water
- Straw
- Apply a minimum thickness of 2-3" or 5 bales per 1,000 sq. ft.
- Straw must be certified weed-free
- If wind may blow straw away, then cover with netting
- Do not apply with the high water mark of a stream, pond, or lake
- May be applied by blowing, if a tackifier is used
- Coarse Compost
- Where the option of "Compost" is selected, it should be a coarse compost that meets the following size gradations when tested in accordance with the U.S. Composting Council "Test Methods for the Examination of Compost and Composting" (TMECC) Test Method 02.02-B.
- Minimum Percent passing 3" sieve openings 100%
- Minimum Percent passing 1" sieve openings 90%
- Minimum Percent passing ¾" sieve openings 70%
- Minimum Percent passing ¼" sieve openings 40%.
- For seeded areas mulch may be made up of 100 percent: cottonseed meal; fibers made of wood, recycled cellulose, hemp, kenaf; compost; or blends of these.
- Hog Fuel
- Must be purchased from a supplier with a Solid Waste Handling Permit or one exempt from solid waste regulations
- Apply approximately 800 lbs. per cubic yard

- Wood Strand Mulch
- A minimum of 95-percent of the wood strand shall have lengths between 2 and 10-inches, with a width and thickness between 1/16 and ⅜-inches.
- The mulch shall not contain resin, tannin, or other compounds in quantities that would be detrimental to plant life.
  - Sawdust or wood shavings shall not be used as mulch

Maintenance Standards

- The thickness of the cover must be maintained.
- Any areas that experience erosion shall be re-mulched and/or protected with a net or blanket. If the erosion problem is drainage related, then the problem shall be fixed and the eroded area re-mulched.

BMP C123: Plastic Covering

Purpose and Description

Plastic covering provides immediate, short-term erosion protection to slopes and disturbed areas.

Figure 32: Covering a Stockpile

Conditions of Use

- Plastic covering may be used on disturbed areas that require cover measures for less than 30 days, except as stated below.
- Plastic is particularly useful for protecting cut and fill slopes and stockpiles. Note: The relatively rapid breakdown of most polyethylene sheeting makes it unsuitable for long-term (greater than six months) applications.
- Due to rapid runoff caused by plastic covering, do not use this method upslope of areas that might be adversely impacted by concentrated runoff. Such areas include steep and/or unstable slopes.
- Plastic sheeting may result in increased runoff volumes and velocities, requiring additional on- site measures to counteract the increases. Creating a trough with wattles or other material can convey clean water away from these areas.
- To prevent undercutting, trench and backfill rolled plastic covering products.
- While plastic is inexpensive to purchase, the added cost of installation, maintenance, removal, and disposal make this an expensive material, up to $1.50-2.00 per square yard.
- Whenever plastic is used to protect slopes install water collection measures at the base of the slope. These measures include plastic-covered berms, channels, and pipes used to covey clean rainwater away from bare soil and disturbed areas. Do not mix clean runoff from a plastic covered slope with dirty runoff from a project.

Design Criteria

- Plastic slope cover must be installed as follows:

- Run plastic up and down slope, not across slope.
- Plastic may be installed perpendicular to a slope if the slope length is less than 10 feet.
- Minimum of 8-inch overlap at seams.
- On long or wide slopes, or slopes subject to wind, tape all seams.
- Place plastic into a small (12-inch wide by 6-inch deep) slot trench at the top of the slope and backfill with soil to keep water from flowing underneath.
- Place sand filled burlap or geotextile bags every 3 to 6 feet along seams and tie them together with twine to hold them in place.
- Inspect plastic for rips, tears, and open seams regularly and repair immediately. This prevents high velocity runoff from contacting bare soil which causes extreme erosion.
- Sandbags may be lowered into place tied to ropes. However, all sandbags must be staked in place.
- Plastic sheeting shall have a minimum thickness of 0.06 millimeters.
- If erosion at the toe of a slope is likely, a gravel berm, riprap, or other suitable protection shall be installed at the toe of the slope in order to reduce the velocity of runoff.

Maintenance Standards

- Torn sheets must be replaced and open seams repaired.
- Completely remove and replace the plastic if it begins to deteriorate due to ultraviolet radiation.
- Completely remove plastic when no longer needed.

BMP C160: Certified Erosion and Sediment Control Lead (CESCL)

Purpose and Description

The project proponent designates at least one person as the responsible representative in charge of erosion and sediment control (ESC), and water quality protection. The designated person shall be the Certified Erosion and Sediment Control Lead (CESCL) who is responsible for ensuring compliance with all local, state, and federal erosion and sediment control and water quality requirements.

Conditions of Use

The CESCL shall:

Have a current certificate proving attendance in an erosion and sediment control training course that meets the minimum ESC training and certification requirements established by Ecology (see details below). Ecology will maintain a list of ESC training and certification providers at: http://www.ecy.wa.gov/programs/wq/stormwater/cescl.html.

OR

Be a Certified Professional in Erosion and Sediment Control (CPESC); for additional information go to: www.cpesc.net.

Specifications

The CESCL shall have authority to act on behalf of the contractor or developer and shall be available, or on-call, 24 hours per day throughout the period of construction.

Duties and responsibilities of the CESCL shall include, but are not limited to the following:
Maintaining the erosion control plan and the erosion control log on site.
Directing BMP installation, inspection, maintenance, modification, and removal.
Keeping daily logs, and inspection reports.

BMP C233: Silt Fence

Purpose and Description

A silt fence reduces the transport of coarse sediment from a construction site by providing a temporary physical barrier to sediment and reducing the runoff velocities of overland flow.

Conditions of Use

- Silt fence may be used downslope of all disturbed areas.
- Silt fence shall prevent soil carried by runoff water from going beneath, though, or over the top of the silt fence, but shall allow the water to pass through the fence.
- Silt fence is not included to treat concentered flows, nor is it intended to treat substantial amounts of overland flow. Convey any concentrated flows through the drainage system to a sediment pond.
- Do not use silt fences in streams or in V-shaped ditches.

Design Criteria

- Use in combination with sediment basins or other BMPs.
- Maximum slope steepness perpendicular to the fence line shall be 1H:1V.
- Maximum sheet or overland flow path length to the fence shall be 100 feet.
- Maximum flow to the silt fence shall be 0.5 cfs.
- Support standard strength fabrics with wire mesh, chicken wire, 2-inch x 2-inch wire, safety fence, or jute mesh to increase the strength of the fabric. Silt fence materials are available that have synthetic mesh backing attached.
- Filter fabric material shall contain ultraviolet ray inhibitors and stabilizers to provide a minimum of six months of expected usable construction life at a temperature range of 0°F. to 120°F.
- The silt fence shall have a 2-feet minimum and a 2½-feet maximum height above the original ground surface.
- The filter fabric shall be sewn together at the point of manufacture to form filter fabric lengths as required. Locate all sewn seams at support posts. Alternatively, two sections of silt fence can be overlapped, provided that the overlap is long enough and that the adjacent fence sections are close enough together to prevent silt laden water from escaping through the fence at the overlap.
- The filter fabric shall be attached on the up-slope side of the posts and secured with

staples, wire, or in accordance with the manufacturer's recommendations, in a manner that reduces the potential for tearing.

- Bury the bottom of the filter fabric a minimum of 4 inches below the ground surface. Backfill and tamp soil in place over the buried portion of the filter fabric, so that no flow can pass beneath the fence and scouring cannot occur. When wire or polymeric back-up support mesh is used, the wire or polymeric mesh shall extend into the ground a minimum of 3 inches.
- Use wood, steel or equivalent posts. The spacing of the support posts shall be a maximum of 6 feet. Posts shall consist of either:
- Wood with dimensions of 2-inches by 2-inches wide min. and a 3-feet min. length. Wood posts shall be free of defects such as knots, splits, or gouges.
- No. 6 steel rebar or larger.
- ASTM A 120 steel pipe with a minimum diameter of 1-inch.
- U, T, L, or C shape steel posts with a minimum weight of 1.35 lbs./ft.
- Other steel posts having equivalent strength and bending resistance to the post sizes listed above.
- Locate silt fences on contour as much as possible, except at the ends of the fence, where the fence shall be turned uphill such that the silt fence captures the runoff water and prevents water from flowing around the end of the fence.
- If the fence must cross contours, with the exception of the ends of the fence, place gravel check dams perpendicular to the back of the fence to minimize concentrated flow and erosion. The slope of the fence line where contours must be crossed shall not be steeper than 3H:1V.

Maintenance Standards

- Repair any damage immediately.
- Intercept and convey all evident concentrated flows uphill of the silt fence to a sediment pond.
- Check the uphill side of the fence for signs of the fence clogging and acting as a barrier to flow and then causing channelization of flows parallel to the fence. If this occurs, replace the fence or remove the trapped sediment.
- Remove sediment deposits when the deposit reaches approximately one-third the height of the silt fence, or install a second silt fence.
- Replace filter fabric that has deteriorated due to ultraviolet breakdown.

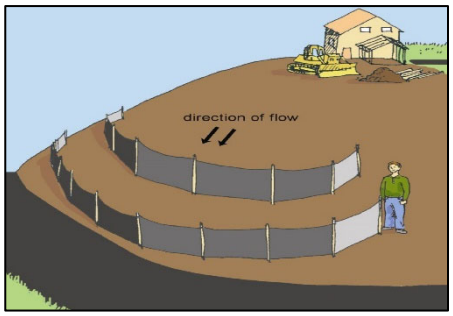


Figure 40 Illustration of Silt Fence

BMP C153: Material Delivery, Storage and Containment

Purpose

Prevent, reduce, or eliminate the discharge of pollutants to the stormwater system or watercourses from material delivery and storage. Minimize the storage of hazardous materials on-site, store materials in a designated area, and install secondary containment.

Conditions of Use

These procedures are suitable for use at all construction sites with delivery and storage of the following materials:

- Petroleum products such as fuel, oil and grease
- Soil stabilizers and binders (e.g. Polyacrylamide)
- Fertilizers, pesticides and herbicides
- Detergents
- Asphalt and concrete compounds
- Hazardous chemicals such as acids, lime, adhesives, paints, solvents and curing compounds
- Any other material that may be detrimental if released to the environment

Design and Installation Specifications

The following steps should be taken to minimize risk:

- Temporary storage area should be located away from vehicular traffic, near the construction entrance(s), and away from waterways or storm drains.
- Material Safety Data Sheets (MSDS) should be supplied for all materials stored. Chemicals should be kept in their original labeled containers.
- Hazardous material storage on-site should be minimized.
- Hazardous materials should be handled as infrequently as possible.
- During the wet weather season (Oct 1 – April 30), consider storing materials in a covered area.
- Materials should be stored in secondary containments, such as earthen dike, horse trough, or even a children's wading pool for non-reactive materials such as detergents, oil, grease, and paints. Small amounts of material may be secondarily contained in "bus boy" trays or concrete mixing trays.
- Do not store chemicals, drums, or bagged materials directly on the ground. Place these items on a pallet and, when possible, and within secondary containment.
- If drums must be kept uncovered, store them at a slight angle to reduce ponding of rainwater on the lids to reduce corrosion. Domed plastic covers are inexpensive and snap to the top of drums, preventing water from collecting.

Material Storage Areas and Secondary Containment Practices:

- Liquids, petroleum products, and substances listed in 40 CFR Parts 110, 117, or 302 shall be stored in approved containers and drums and shall not be overfilled. Containers and drums shall be stored in temporary secondary containment facilities.
- Temporary secondary containment facilities shall provide for a spill containment volume able to contain 10% of the total enclosed container volume of all containers, or 110% of the capacity of the largest container within its boundary, whichever is greater.
- Secondary containment facilities shall be impervious to the materials stored therein for a minimum contact time of 72 hours.
- Secondary containment facilities shall be maintained free of accumulated rainwater and spills. In the event of spills or leaks, accumulated rainwater and spills shall be collected and placed into drums. These liquids shall be handled as hazardous waste unless testing determines them to be non-hazardous.
- Sufficient separation should be provided between stored containers to allow for spill cleanup and emergency response access.
- During the wet weather season (Oct 1 – April 30), each secondary containment facility shall be covered during non-working days, prior to and during rain events.
- Keep material storage areas clean, organized and equipped with an ample supply of appropriate spill clean-up material (spill kit).
- The spill kit should include, at a minimum:
  - 1-Water Resistant Nylon Bag
  - 3-Oil Absorbent Socks 3"x 4'
  - 2-Oil Absorbent Socks 3"x 10'
  - 12-Oil Absorbent Pads 17"x19"
  - 1-Pair Splash Resistant Goggles
  - 3-Pair Nitrile Gloves
  - 10-Disposable Bags with Ties
  - Instructions

BMP C154: Concrete Washout Area

Purpose

Prevent or reduce the discharge of pollutants from concrete waste to stormwater by conducting washout off-site, or performing on-site washout in a designated area.

Conditions of Use

Concrete washout areas are implemented on construction projects where:

- Concrete is used as a construction material
- It is not possible to dispose of all concrete wastewater and washout off-site (ready mix plant, etc.).
- Concrete truck drums are washed on-site.

  Note that auxiliary concrete truck components (e.g. chutes and hoses) and small concrete handling equipment (e.g. hand tools, screeds, shovels, rakes, floats, trowels, and wheel-barrows) may be washed into formed areas awaiting concrete pour.

At no time shall concrete be washed off into the footprint of an area where an infiltration feature will be installed.

Implementation

- Perform washout of concrete truck drums at an approved off-site location or in designated concrete washout areas only.
- Do not wash out concrete onto non-formed areas, or into storm drains, open ditches, streets, or streams.
- Wash equipment difficult to move, such as concrete paving machines, in areas that do not directly drain to natural or constructed stormwater conveyance or potential infiltration areas.
- Do not allow excess concrete to be dumped on-site, except in designated concrete washout areas as allowed above.
- Concrete washout areas may be prefabricated concrete washout containers, or self-installed structures (above-grade or below-grade).
- Prefabricated containers are most resistant to damage and protect against spills and leaks. Companies may offer delivery service and provide regular maintenance and disposal of solid and liquid waste.
- If self-installed concrete washout areas are used, below-grade structures are preferred over above-grade structures because they are less prone to spills and leaks.
- Self-installed above-grade structures should only be used if excavation is not practical.
- Concrete washout areas shall be constructed and maintained in sufficient quantity and size to contain all liquid and concrete waste generated by washout operations.

Education

- Discuss the concrete management techniques described in this BMP with the ready-mix concrete supplier before any deliveries are made.
- Educate employees and subcontractors on the concrete waste management techniques described in this BMP.
- Arrange for the contractor's superintendent or Certified Erosion and Sediment Control Lead (CESCL) to oversee and enforce concrete waste management procedures.
- A sign should be installed adjacent to each concrete washout area to inform concrete equipment operators to utilize the proper facilities.

Contracts

Incorporate requirements for concrete waste management into concrete supplier and subcontractor agreements.

Location and Placement

- Locate concrete washout areas at least 50 feet from sensitive areas such as storm drains, open ditches, water bodies, or wetlands.
- Allow convenient access to the concrete washout area for concrete trucks, preferably near the area where the concrete is being poured.
- If trucks need to leave a paved area to access the concrete washout area, prevent track-out with a pad of rock or quarry spalls (see BMP C105: Stabilized Construction Access). These areas should be far enough away from other construction traffic to reduce the likelihood of accidental damage and spills.
- The number of concrete washout areas you install should depend on the expected demand for storage capacity.
- On large sites with extensive concrete work, concrete washout areas should be placed in multiple locations for ease of use by concrete truck drivers.

Concrete Truck Washout Procedures

- Washout of concrete truck drums shall be performed in designated concrete washout areas only.
- Concrete washout from concrete pumper bins can be washed into concrete pumper trucks and discharged into designated concrete washout areas or properly disposed of off-site.

Concrete Washout Area Installation

- Concrete washout areas should be constructed as shown in the figures below, with a recommended minimum length and minimum width of 10 ft, but with sufficient quantity and volume to contain all liquid and concrete waste generated by washout operations.
- Plastic lining material should be a minimum of 10 mil polyethylene sheeting and should be free of holes, tears, or other defects that compromise the impermeability of the material.
- Lath and flagging should be commercial type.
- Liner seams shall be installed in accordance with manufacturers' recommendations.
- Soil base shall be prepared free of rocks or other debris that may cause tears or holes in the plastic lining material.

Maintenance Standards

Inspection and Maintenance

- Inspect and verify that concrete washout areas are in place prior to the commencement of concrete work.
- Once concrete wastes are washed into the designated washout area and allowed to harden,

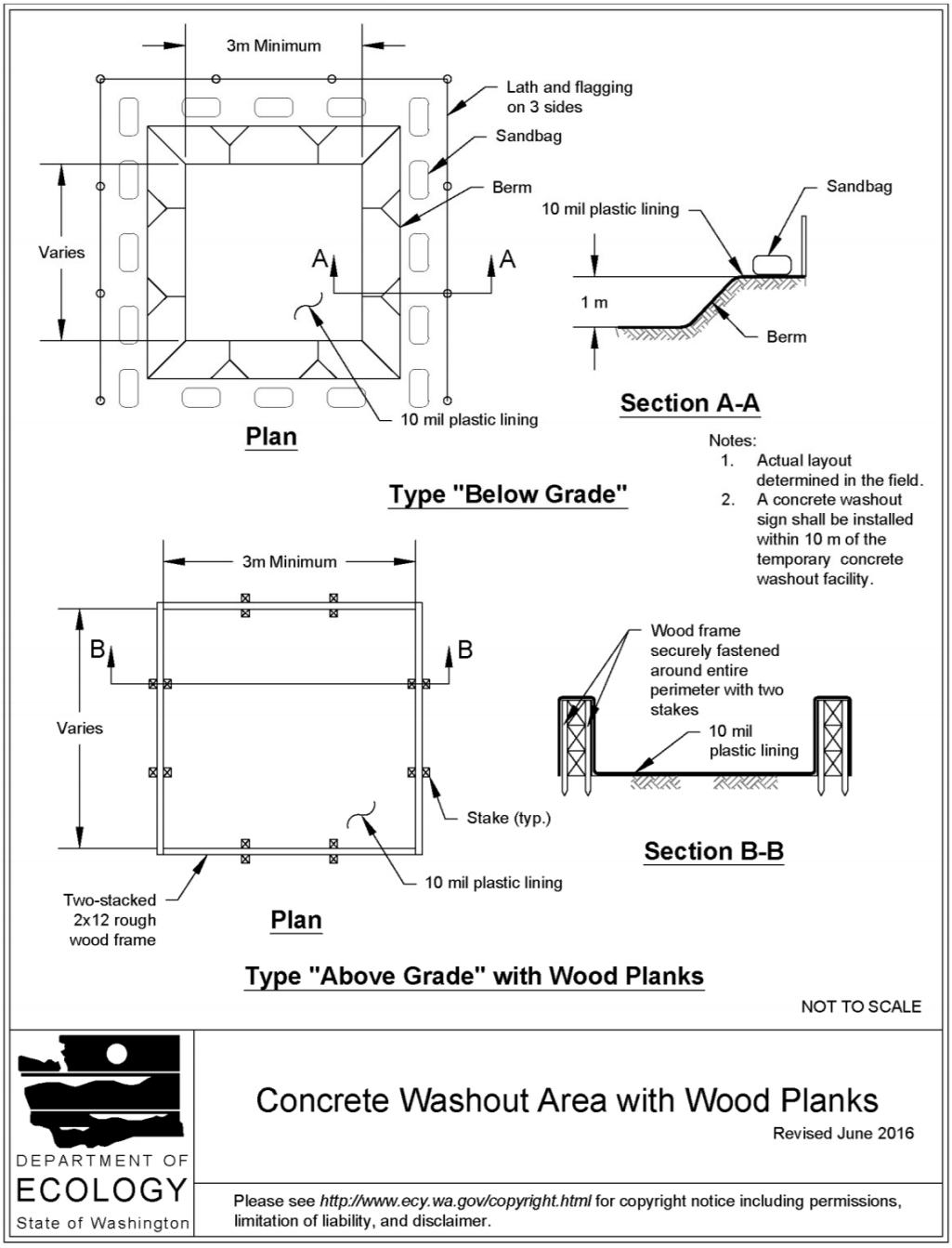
the concrete should be broken up, removed, and disposed of per applicable solid waste regulations. Dispose of hardened concrete on a regular basis.

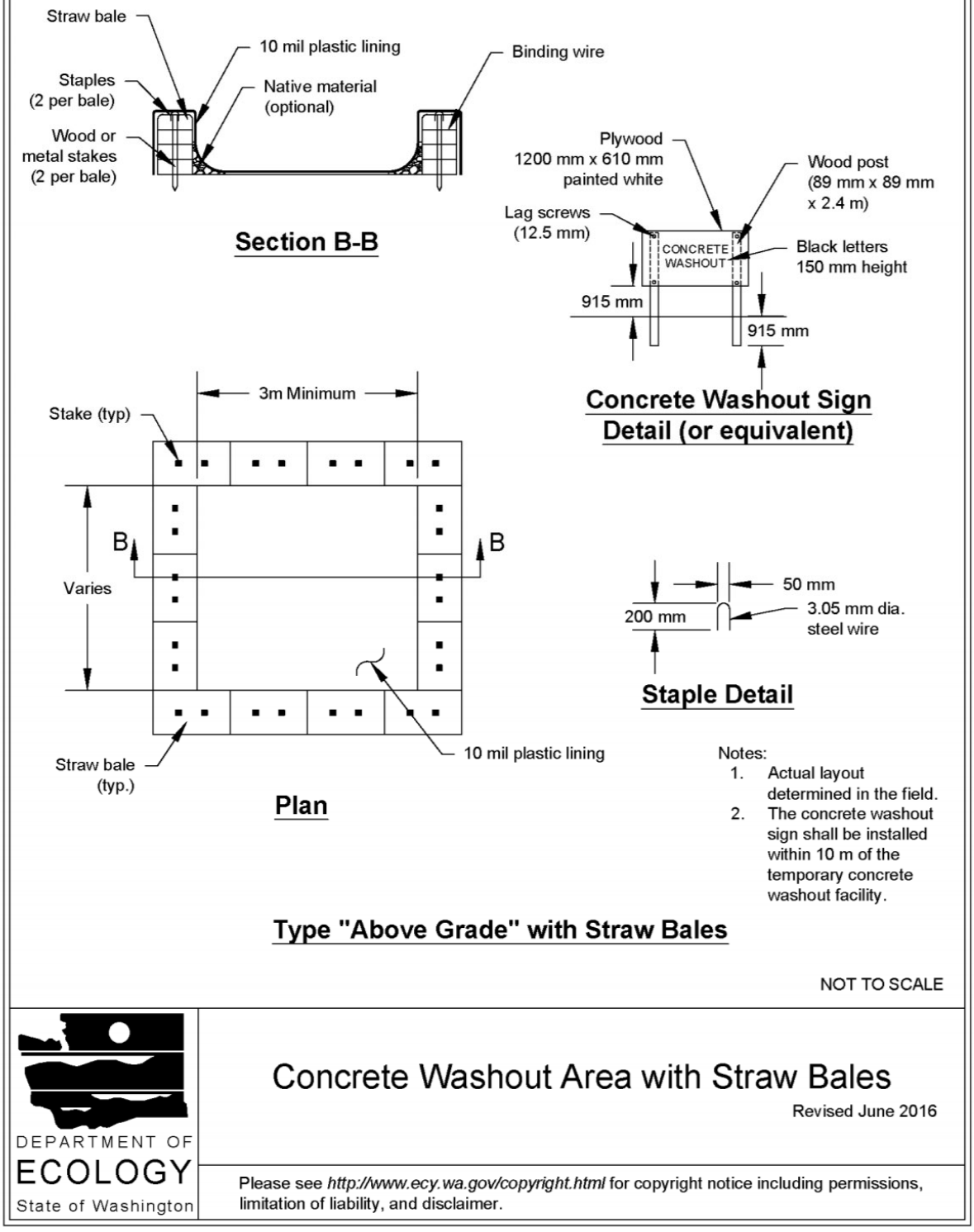
- During periods of concrete work, inspect the concrete washout areas daily to verify continued performance.
    - Check overall condition and performance.
    - Check remaining capacity (% full).
    - If using self-installed concrete washout areas, verify plastic liners are intact and sidewalls are not damaged.
    - If using prefabricated containers, check for leaks.
- Maintain the concrete washout areas to provide adequate holding capacity with a minimum freeboard of 12 inches.
- Concrete washout areas must be cleaned, or new concrete washout areas must be constructed and ready for use once the concrete washout area is 75% full.
- If the concrete washout area is nearing capacity, vacuum and dispose of the waste material in an approved manner.
    - Do not discharge liquid or slurry to waterways, storm drains or directly onto ground.
    - Do not discharge to the sanitary sewer without local approval.
    - Place a secure, non-collapsing, non-water collecting cover over the concrete washout area prior to predicted wet weather to prevent accumulation and overflow of precipitation.
    - Remove and dispose of hardened concrete and return the structure to a functional condition. Concrete may be reused on-site or hauled away for disposal or recycling.
- When you remove materials from a self-installed concrete washout area, build a new structure; or, if the previous structure is still intact, inspect for signs of weakening or damage, and make any necessary repairs. Re-line the structure with new plastic after each cleaning.

Removal of Concrete Washout Areas

- When concrete washout areas are no longer required for the work, the hardened concrete, slurries and liquids shall be removed and properly disposed of.
- Materials used to construct concrete washout areas shall be removed from the site of the work and disposed of or recycled.
- Holes, depressions or other ground disturbance caused by the removal of the concrete washout areas shall be backfilled, repaired, and stabilized to prevent erosion.

Figure II-3.7: Concrete Washout Area with Wood Planks




Straw bale
10 mil plastic lining
Binding wire
Staples
(2 per bale)
Native material
(optional)
Wood or
metal stakes
(2 per bale)
Section B-B
Plywood
1200 mm x 610 mm
painted white
Wood post
(89 mm x 89 mm
x 2.4 m)
Lag screws
(12.5 mm)
CONCRETE
WASHOUT
Black letters
150 mm height
915 mm
915 mm
Concrete Washout Sign
Detail (or equivalent)
3m Minimum
Stake (typ)
B
B
Varies
Straw bale
(typ.)
10 mil plastic lining
Plan
50 mm
200 mm
3.05 mm dia.
steel wire
Staple Detail
Notes:
1. Actual layout determined in the field.
2. The concrete washout sign shall be installed within 10 m of the temporary concrete washout facility.
Type "Above Grade" with Straw Bales
NOT TO SCALE
DEPARTMENT OF
ECOLOGY
State of Washington
Concrete Washout Area with Straw Bales
Revised June 2016
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BMP C235: Wattles

Purpose

Wattles are temporary erosion and sediment control barriers consisting of straw, compost, or other material that is wrapped in netting made of natural plant fiber or similar encasing material. They reduce the velocity and can spread the flow of rill and sheet runoff, and can capture and retain sediment.

Conditions of Use

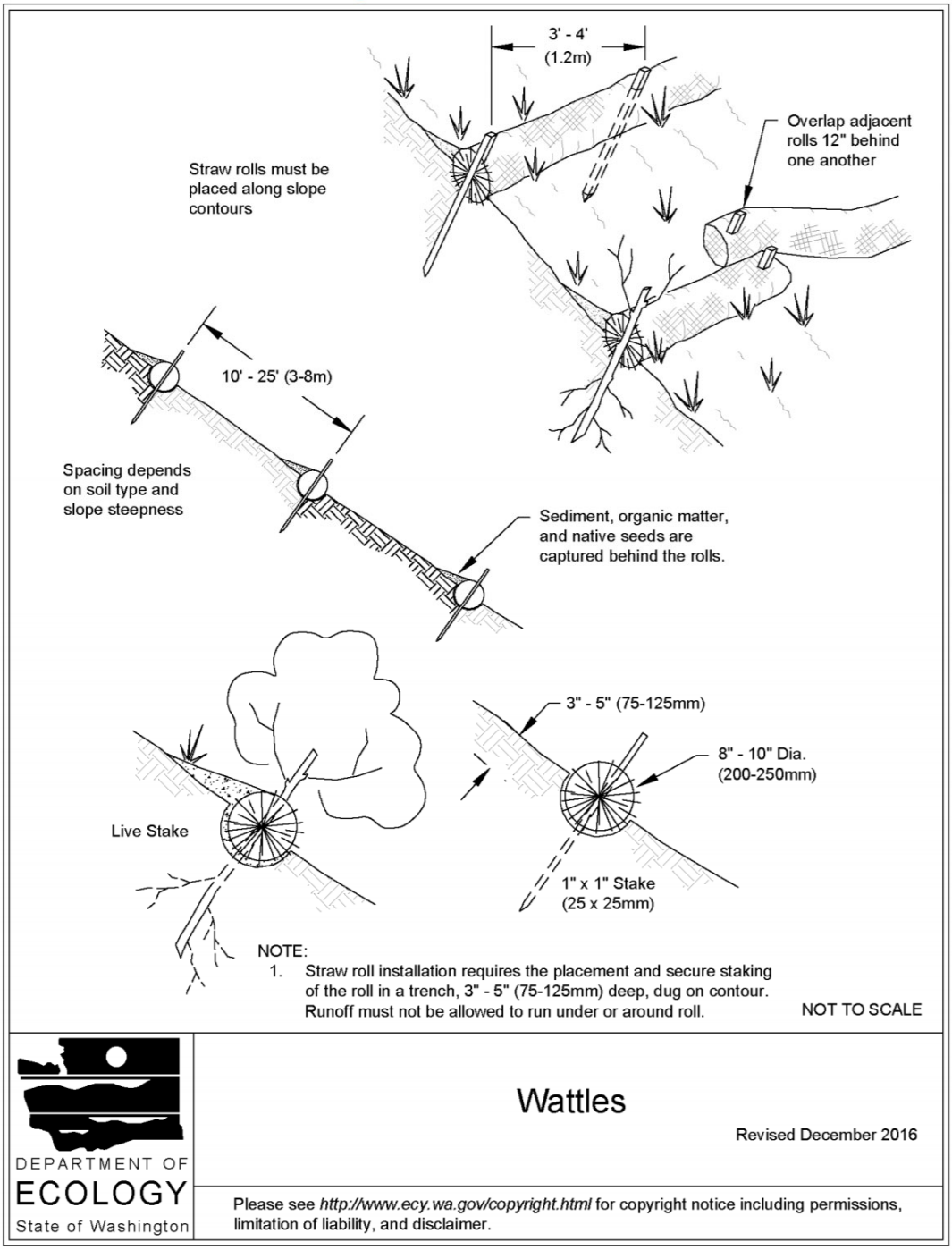
- Wattles shall consist of cylinders of plant material such as weed-free straw, coir, wood chips, excelsior, or wood fiber or shavings encased within netting made of natural plant fibers unaltered by synthetic materials.
- Use wattles:
    - In disturbed areas that require immediate erosion protection.
    - On exposed soils during the period of short construction delays, or over winter months.
    - On slopes requiring stabilization until permanent vegetation can be established.
- The material used dictates the effectiveness period of the wattle. Generally, wattles are effective for one to two seasons.

- Prevent rilling beneath wattles by entrenching and overlapping wattles to prevent water from passing between them.

Design Criteria

- See Figure II-3.24: Wattles for typical construction details.
- Wattles are typically 8 to 10 inches in diameter and 25 to 30 feet in length.
- Install wattles perpendicular to the flow direction and parallel to the slope contour.
- Place wattles in shallow trenches, staked along the contour of disturbed or newly constructed slopes. Dig narrow trenches across the slope (on contour) to a depth of 3- to 5-inches on clay soils and soils with gradual slopes. On loose soils, steep slopes, and areas with high rainfall, the trenches should be dug to a depth of 5- to 7- inches, or 1/2 to 2/3 of the thickness of the wattle.
- Start building trenches and installing wattles from the base of the slope and work up. Spread excavated material evenly along the uphill slope and compact it using hand tamping or other methods.
- Construct trenches at intervals of 10- to 25-feet depending on the steepness of the slope, soil type, and rainfall. The steeper the slope the closer together the trenches.
- Install the wattles snugly into the trenches and overlap the ends of adjacent wattles 12 inches behind one another.
- Install stakes at each end of the wattle, and at 4-foot centers along entire length of wattle.
- If required, install pilot holes for the stakes using a straight bar to drive holes through the wattle and into the soil.
- Wooden stakes should be approximately 0.75 x 0.75 x 24 inches min. Willow cuttings or 3/8-inch rebar can also be used for stakes.
- Stakes should be driven through the middle of the wattle, leaving 2 to 3 inches of the stake protruding above the wattle.

Figure II-3.24: Wattles



Maintenance Standards

- Wattles may require maintenance to ensure they are in contact with soil and thoroughly entrenched, especially after significant rainfall on steep sandy soils.
- Inspect the slope after significant storms and repair any areas where wattles are not tightly abutted or water has scoured beneath the wattles.

Approved as Functionally Equivalent

Ecology has approved products as able to meet the requirements of this BMP. The products did not pass through the Technology Assessment Protocol – Ecology (TAPE) process. Local jurisdictions may choose not to accept these products, or may require additional testing prior to consideration for local use. Products that Ecology has approved as functionally equivalent are available for review on Ecology's website at:

https://ecology.wa.gov/Regulations-Permits/Guidance-technical-assistance/Stormwater-permittee-guidance-resources/Emerging-stormwater-treatment-technologies

Appendix D: Source Control BMPs for Residential Properties

BMPs for Residential Properties

Residential properties in our community contribute to stormwater quality. How residents care for their properties through tasks such as yard maintenance, waste storage, car washing and maintenance can adversely impact water quality. Many residents may not realize that the storm drains in our community may not have treatment features that remove pollutants from the water prior to discharging to creeks, streams and rivers.

Residents can apply Best Management Practices (BMPs) to their properties to keep stormwater from becoming polluted in the first place. Clark County is required to educate community members about these best management practices and how to play a role in protecting the creeks, streams and rivers in our community as well as our water contribution to the Columbia River.

A full list of BMPs and information is available on our website at www.clarkgreenneighbors.org. Click on the Resources tab at the top of the page and scroll down to Clean Water for more information and ideas about how to keep stormwater from residential properties from adversely affecting our waterways.

If you see a spill of materials into a storm drain or stormwater facility that may impact water quality, residents are encouraged to call **Washington Department of Ecology 24-hour Surface Water Quality and Spill Complaint line: (800) 258-5990. Citizens can find more information on the Clark County "Report stormwater, erosion or drainage concerns" web page at:** www.clark.wa.gov/environmental-services/report-stormwater-erosion-or-drainage-concerns**.**

A general list of BMPs for homeowners includes:

- Automobile Washing
- Automobile Maintenance
- Household Hazardous Material Use, Storage, and Disposal
- Yard Maintenance and Gardening
- Pet Waste
- Swimming Pool and Spa Maintenance
- General Home Maintenance

Automobile Washing (for Single-Family Residences)

- Car washing at home may cause wash water to enter the storm drains and flow untreated into surface waters.
- Soaps and detergents, even the biodegradable ones, can have immediate and long-term effects.

Suggested BMPs:

- Engine degreasing or washing of internal engine components should not be completed at home. Take car to a commercial car wash that allows engine washing.
- The safest option to protect waterways is to take cars to a commercial car wash that discharges wastewater to the sanitary system for treatment.
- Minimize the impact of wash water to stormwater facilities by following the practices listed below.

At Home

- Wash cars directly over lawn areas or make sure the wash water drains to a vegetated area.
- Only use soaps or detergents without phosphates.
- Consider using commercial products that allow cleaning a vehicle without water.
- Use a hose nozzle with a shut-off valve to save water.
- Do not wash cars if rain is expected.
- Pour the bucket of soapy, dirty wash water down your sink to a sanitary sewer connection.

Away from Home

- For fundraising car washes, follow the same BMP principles listed above.
- For fundraising car washes, block storm drains and redirect runoff to vegetated areas or sanitary sewer connection. Refer to Clark County's web site to develop a safe river car wash kit for fundraising events to minimize pollutants from entering storm drains and waterways.

Automobile Maintenance

Fluids and materials leaking from automobiles can contribute a significant amount of pollution to stormwater runoff. If materials are left on hard surfaces, rainwater can then wash materials down storm drains. Proper maintenance and repairs of vehicles can minimize the pollution risk.

Suggested BMPs

- Never dump new or used automotive fluids or solvents on the ground, in a storm drain or street gutter, or in a waterbody.
- Recycle all oils, antifreeze, solvents, and batteries per the Clark County Recycling Directory A-Z.
- Do not mix wastes. Always keep your wastes in properly-labeled separate containers and store them under cover.
- Household Hazardous Waste cannot be disposed of with regular garbage. Refer to the Recycling Directory or contact your local waste hauler for details of how to properly dispose of your household hazardous waste.
- Fix all leaks to ensure materials stay off the streets and out of the stormwater system and local waterways.
- A tarp, ground cloth, sheet of cardboard, drip pans, or other materials to contain drips must be used beneath the vehicle or equipment to capture all spills and drips. Keep a bag of kitty litter on hand to absorb any spills. Sprinkle a layer on the spill, let it absorb and sweep it up. Dispose of the contaminated litter in the regular garbage in a tied plastic bag. Do not leave kitty litter out in the rain.
- If body work is performed outside, be sure to use a tarp to catch material resulting from grinding, sanding, and painting. Dispose of this waste by double bagging in plastic and placing in garbage.

Household Hazardous Material Use, Storage, and Disposal

There are numerous hazardous materials typically used in a residential setting such as oil-based paints, stains, paint thinner, gasoline, charcoal starter fluid, cleaners, waxes, pesticides, fingernail polish remover, and wood preservatives. When hazardous materials leak or are dumped on the ground or in a storm drain, they can be washed directly to storm drains and streams. These pollutants can harm fish and wildlife that use the waterways. Serious environmental harm may result if improper methods of storage, usage, and disposal are employed.

Suggested BMPs

- Dispose of hazardous materials and their containers properly. Never dump products labeled as poisonous, corrosive, caustic, flammable, inflammable, volatile, explosive danger, warning, caution, or dangerous outdoors, in a storm drain or stormwater facility.
- Store containers of hazardous materials under cover and off the ground. Keep them out of the weather to avoid rusting, freezing, cracking, labels being washed off, etc.
- Check hazardous material containers frequently for signs of leakage. If a container is rusty and has the potential of leaking soon, place it in a secondary container before the leak occurs to prevent a clean-up problem.
- Keep appropriate spill cleanup materials on hand. Cat litter is good for many oil-based spills.
- Ground cloths and drip pans should be used under any work outdoors that involves hazardous materials such as oil-based paints, stains, rust removers, masonry cleaners, and other supplies bearing label warnings as outlined above.
- When hazardous materials are in use, place the container inside a tub or bucket to minimize spills.

Yard Waste and Gardening

This section deals with the normal yard maintenance activities typically performed on residential properties. Overwatering, overfertilizing, improper herbicide application, and improper disposal of trimmings and clippings can all contribute to serious water pollution problems. The Clark County Naturally Beautiful Backyards program and the Washington State University Extension office have extensive information on caring for properties while minimizing potential stormwater runoff and pollutants.

Suggested BMPs

- Follow the manufacturer's directions exactly for mixing and applying herbicides, fungicides, and pesticides. Do not apply when it is windy or when rain is expected. Do not apply over water or within 100 feet of a well-head. Use caution and follow manufacturer’s directions when applying chemicals adjacent to streams, wetlands, or other bodies of water. Triple-rinse empty containers, using the rinse for mixing the

next batch of spray, and then dispose of the empty container in your regular garbage.
- Never dispose of grass clippings or other vegetation in or near storm drains, stormwater facilities or rivers. Review Clark County's website for grass-cycling information to minimize waste and protect water quality.
- Make sure all fertilizers and pesticides are stored in a covered location.
- Use natural, organic soil amendments and products whenever possible. Consult your local garden center for products that may be applicable based on your soil type and landscape needs.
- Save water and prevent pollution problems by avoiding overwatering lawns. Lawns and gardens typically need the equivalent of 1-inch of rainfall per week. Watering to the point where the water runs off the lawn surface is called overwatering, and the practice can carry polluting nutrients to the nearest storm drain.
- Consider planting a vegetated buffer zone adjacent to streams or other water bodies as well as reducing lawn areas that require higher maintenance.

Pet Waste

Pets and pet-care can generate pollutants from waste, animal washing, and cage or kennel cleaning. Pollutants include bacteria, which can pollute waterways. With over 11,000 pets in our community, every effort to minimize pollution waste can add up. Clark County's Canines for Clean Water campaign provides a list of key information for pet owners to help protect stormwater runoff. Pet owners can also take a pledge to commit to picking up pet waste in their yards as well as when out for walks. Visit www.clark.wa.gov/environmental-services/canines-clean-water for information.

Suggested BMPs

- Regularly scoop, sweep and clean up pet waste deposited on walks and at home. Dispose of pet waste in the garbage. Cat litter should be disposed of properly with garbage.
- When cleaning out cages and kennels, wash directly over lawn areas or make sure the wash water drains to a vegetated area. Alternately, dispose of the wash water down the toilet or a mop sink.
- Do not dispose of unused pet pharmaceuticals in a storm drain, in a toilet, or down a sink. Check the Clark County Recycling Directory for proper disposal locations of pet medications.

Swimming Pool and Spa Cleaning and Maintenance

The water from pools and spas is considered wastewater and should not be dumped down a storm drain. The nutrients, pH, and chlorine can adversely affect fish and wildlife in creeks, streams and rivers.

Suggested BMPs

- Swimming pool wastewater and filter backwash shall not be discharged to the storm drain or stormwater facility.

- Pool and spa water must be dechlorinated if it is to be emptied into a ditch, on the ground or a lawn, or to the storm drainage system. The discharges shall be dechlorinated to a concentration of 0.1 ppm or less, pH-adjusted and reoxygenated if necessary, and volumetrically and velocity controlled to prevent resuspension of sediments in the stormwater system. The rate of flow into the ditch or drainage system must be moderated so that it does not cause problems such as erosion, surcharging, or flooding.
- If pool and spa water cannot be dechlorinated, it must be discharged to the sanitary sewer.
- Hire a professional pool service company to collect pool water for proper disposal if a proper disposal on site is not available. Make sure to ask where the water will be disposed of and ensure the proper permits have been obtained.

General Home Maintenance

A number of normal maintenance activities typically performed in residential settings can be modified to reduce the risk of stormwater pollution.

Suggested BMPs

- Pressure washing of building facades, rooftops, driveways, sidewalks and patios should be conducted in a manner that minimizes runoff and pollutants leaving the property. Temporary curbs, dikes, or berms may be used to direct water away from storm drains or stormwater facilities. Water should be directed to the sanitary system or to an area where it can infiltrate in a landscape bed or evaporate. Debris generated from pressure washing should be swept up and disposed of properly.
- Carpet cleaning wash water should be disposed of to a sanitary sewer facility. It is preferred that the dirty wash water be discharged into a toilet or mop sink at the place where it was generated.
- Do not clean brushes or tools where the wastewater can enter a storm drain or stormwater facility. Clean brushes and tools coated with non-water-based paints, finishes, or other materials in a manner that allows collection of used solvents (e.g. paint thinner, turpentine, xylol, etc.) for proper disposal at a Household Hazardous Waste Facility. Refer to the Clark County Recycling A-Z Directory for locations based on the materials used.
- Regularly sweep the property curbs along the street to minimize debris and litter that can clog storm drains and carry pollutants to the drains. Properly dispose of waste that is collected. Do not sweep leaves and clippings into the street.

Appendix E: Onsite BMP Design Criteria and Details

BMP T5.13: Post-Construction Soil Quality and Depth

Purpose and Description

Naturally occurring (undisturbed) soil and vegetation provide important stormwater functions including: water infiltration; nutrient, sediment, and pollutant adsorption; sediment and pollutant biofiltration; water interflow storage and transmission; and pollutant decomposition. These functions are largely lost when development strips away native soil and vegetation and replaces it with minimal topsoil and sod. Not only are these important stormwater functions lost, but such landscapes themselves begin to generate pollution due to increased use of pesticides, fertilizers and other landscaping and household/industrial chemicals, the concentration of pet wastes, and pollutants that accompany roadside litter.Establishing soil quality and depth regains greater stormwater functions in the post development landscape, provides increased treatment of pollutants and sediments that result from development and habitation, and minimizes the need for some landscaping chemicals, thus reducing pollution through prevention.

Cross Reference Guide

Soils Assessment	N/A
Meets Minimum Requirements	#5
Related BMPs	BMP T5.13
Selection Criteria	Book 1, Sections 2.2 and 2.5.3
Maintenance	Book 4

Applications, Limitations and Setbacks

Establishing a minimum soil quality and depth is not the same as preservation of naturally occurring soil and vegetation. However, establishing a minimum soil quality and depth will provide improved onsite management of stormwater flow and water quality. Soil organic matter can be attained through addition of numerous materials such as compost, composted woody material, biosolids, and forest product residuals. It is important that the materials used to meet the soil quality and depth BMP be appropriate and beneficial to the plant cover to be established. Likewise, it is important that imported topsoil's improve soil conditions and do not have an excessive percent of clay fines. This BMP can be considered infeasible on till soil slopes greater than 33 percent.

Soil and vegetation provide significant benefits, including:

- Water infiltration.
- Absorption of nutrients, sediments and pollutants.
- Biofiltration of sediment and pollutants.

- Water interflow storage and transmission.
- Pollutant decomposition.

These functions are largely lost when development strips away native soil and vegetation and replaces it with minimal topsoil and sod. Establishing in-situ soil quality and depth regains greater stormwater functions in the post development landscape and also minimizes the need for some landscaping chemicals, further limiting pollution.
This BMP is mandatory for all projects required to follow Minimum Requirements #1 – #5 or Minimum Requirements #1 – #9.

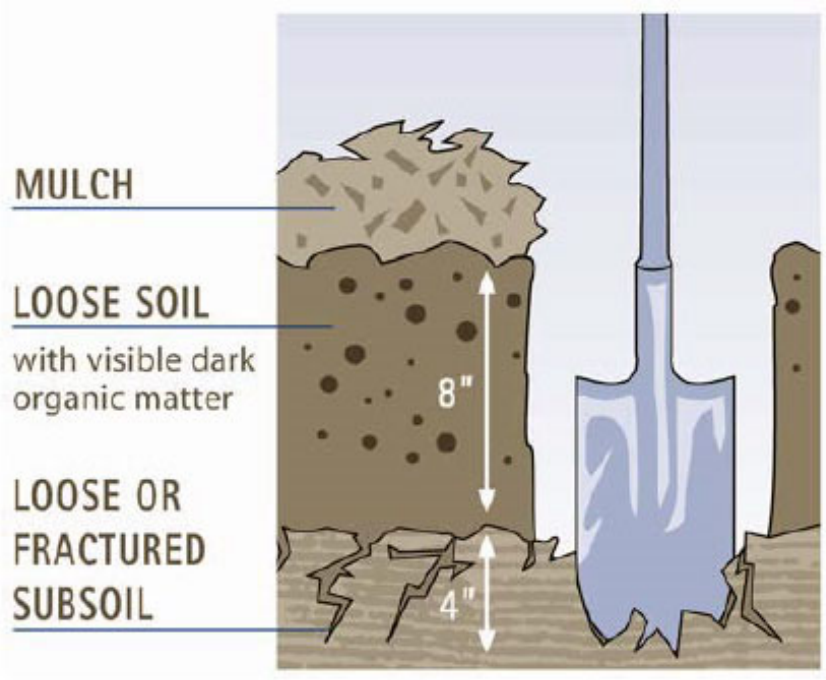


Figure 2.11: Typical Planting Bed Cross-section
(Source: Washington Organic Recycling Council graphic in SMMWW)

Design Criteria

- Retain, in an undisturbed state, the duff layer and native topsoil to the maximum extent practicable. In any areas requiring grading remove and stockpile the duff layer and topsoil on site in a designated, controlled area, not adjacent to public resources and critical areas, to be reapplied to other portions of the site where feasible.
- Areas subject to clearing and grading that have not been covered by hard surfaces, used for a drainage facility, or where the soils have been engineered as structural fill or slope, shall demonstrate the following after completion of the project:
    - A topsoil layer with:
        - A minimum organic matter content of 10% dry weight in planting beds.
        - 5% organic matter content in turf areas.

        - A pH from 6.0 to 8.0 or matching the pH of the undisturbed soil.
        - A minimum topsoil layer depth of 8 inches except where tree roots do not allow this.
    - Subsoils below the topsoil layer should be scarified at least 4 inches with some incorporation of the upper material to avoid stratified layers, where feasible.
    - Mulch planting beds with 2 inches of organic material.
    - Use compost and other materials that meet the following specifications:
        - The organic content for pre-approved (by Ecology) amendment rates can be met only using compost meeting the compost specification for Bioretention (BMP T7.30), with the exception that the compost may have up to 35% biosolids or manure. The compost must also have an organic matter content of 40% to 65%, and a carbon to nitrogen ratio below 25:1. The carbon to nitrogen ratio may be as high as 35:1 for plantings composed entirely of plants native to the Portland/Vancouver region.
        - Calculated amendment rates may be met through use of composted material meeting (a.) above; or other organic materials amended to meet the carbon to nitrogen ratio requirements, and not exceeding the contaminant limits identified in Table 220-B, Testing Parameters, in WAC 173-350-220.
    - The resulting soil should be conducive to the type of vegetation to be established.
- Only one of these methods can be used to meet the above criteria for a specific area on the site:
    - Native vegetation and soil should remain undisturbed and protected from compaction during construction.
    - Amend existing topsoil or subsoil either at default "pre-approved" rates, or at custom calculated rates based on soil tests of the soil and amendments.
    - Stockpile existing topsoil during grading and replace it over disturbed areas prior to planting. Stockpiled topsoil must also be amended if needed to meet the organic matter or depth requirements, either at a default "pre-approved" rate or at a custom calculated rate.
    - Import topsoil mix of sufficient organic content and depth to meet the requirements.
    - More than one method may be used on different portions of the same site. Soil that already meets the depth and organic matter quality standards need not be amended.
    - Scarification of subsoils can be accomplished using mechanical methods such as a rototiller.

Runoff Modeling Representation

- Areas meeting the design guidelines may be entered into approved runoff models as "Pasture" rather than "Lawn."
- Flow reduction credits can be taken in runoff modeling when BMP T5.13 is used as part of a dispersion design under the conditions described in:
- BMP T5.10C Downspout Dispersion
- BMP T5.11 Concentrated Flow Dispersion

- BMP T5.12 Sheet Flow Dispersion
- BMP T5.18 Reverse Slope Sidewalks
- BMP T5.30A Full Dispersion (for public road projects)

Appendix F: WWHM results

WWHM2012

PROJECT REPORT

General Model Information

Project Name:	Advanced Builders Project Flow Control Forest
Site Name:	63620000
Site Address:	
City:	La Center
Report Date:	1/21/2022
Gage:	Ridgefield
Data Start:	1948/10/01
Data End:	2008/09/30
Timestep:	15 Minute
Precip Scale:	1.110
Version Date:	2021/08/18
Version:	4.2.18

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
SG5, Forest, Mod	0.213
Pervious Total	0.213
Impervious Land Use	acre
Impervious Total	0
Basin Total	0.213

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

Roof

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
ROOF TOPS FLAT	0.098
Impervious Total	0.098
Basin Total	0.098

Element Flows To:

Surface	Interflow	Groundwater

Road/DW/SW

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
DRIVEWAYS MOD	0.114
Impervious Total	0.114
Basin Total	0.114

Element Flows To:

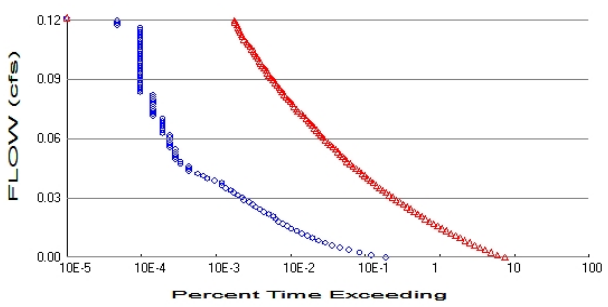
Surface	Interflow	Groundwater

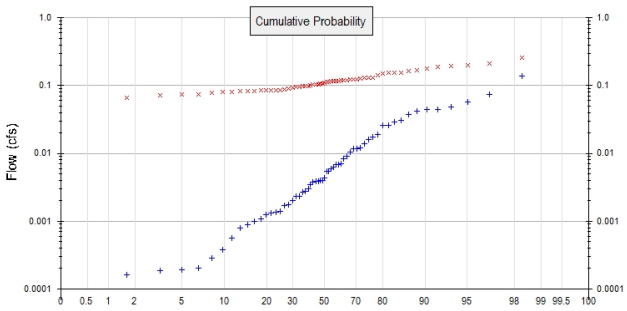
Routing Elements
Predeveloped Routing

Mitigated Routing

Analysis Results

POC 1





\+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 0.213
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 0
Total Impervious Area: 0.212

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.004588
5 year	0.018656
10 year	0.037625
25 year	0.077642
50 year	0.122401
100 year	0.182772

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0.109061
5 year	0.142947
10 year	0.166634
25 year	0.198055
50 year	0.22258
100 year	0.248089

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1949	0.006	0.198
1950	0.005	0.086
1951	0.045	0.110
1952	0.012	0.113
1953	0.004	0.074
1954	0.026	0.123
1955	0.003	0.089
1956	0.057	0.118
1957	0.002	0.072
1958	0.003	0.124

1959	0.003	0.081
1960	0.002	0.102
1961	0.012	0.116
1962	0.001	0.085
1963	0.002	0.107
1964	0.006	0.082
1965	0.007	0.085
1966	0.004	0.130
1967	0.003	0.104
1968	0.001	0.187
1969	0.029	0.151
1970	0.136	0.258
1971	0.007	0.154
1972	0.026	0.119
1973	0.001	0.103
1974	0.042	0.155
1975	0.009	0.086
1976	0.038	0.093
1977	0.000	0.074
1978	0.010	0.118
1979	0.001	0.130
1980	0.019	0.088
1981	0.004	0.142
1982	0.031	0.105
1983	0.073	0.164
1984	0.005	0.078
1985	0.000	0.117
1986	0.000	0.131
1987	0.008	0.097
1988	0.001	0.194
1989	0.002	0.080
1990	0.000	0.121
1991	0.001	0.082
1992	0.001	0.086
1993	0.001	0.099
1994	0.000	0.083
1995	0.004	0.113
1996	0.049	0.167
1997	0.045	0.179
1998	0.007	0.121
1999	0.018	0.096
2000	0.004	0.063
2001	0.000	0.066
2002	0.016	0.124
2003	0.012	0.107
2004	0.001	0.126
2005	0.000	0.155
2006	0.014	0.097
2007	0.004	0.096
2008	0.002	0.211

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.1363	0.2584
2	0.0730	0.2107
3	0.0570	0.1984
4	0.0490	0.1940

5	0.0448	0.1867
6	0.0448	0.1794
7	0.0420	0.1672
8	0.0376	0.1637
9	0.0310	0.1552
10	0.0293	0.1549
11	0.0260	0.1540
12	0.0257	0.1513
13	0.0191	0.1417
14	0.0176	0.1312
15	0.0159	0.1301
16	0.0138	0.1297
17	0.0120	0.1259
18	0.0116	0.1244
19	0.0116	0.1241
20	0.0103	0.1229
21	0.0090	0.1205
22	0.0083	0.1205
23	0.0071	0.1188
24	0.0068	0.1177
25	0.0067	0.1176
26	0.0062	0.1168
27	0.0059	0.1157
28	0.0055	0.1132
29	0.0054	0.1129
30	0.0043	0.1097
31	0.0040	0.1069
32	0.0040	0.1067
33	0.0039	0.1048
34	0.0038	0.1036
35	0.0037	0.1027
36	0.0034	0.1020
37	0.0030	0.0987
38	0.0027	0.0971
39	0.0027	0.0971
40	0.0023	0.0963
41	0.0023	0.0959
42	0.0020	0.0928
43	0.0017	0.0892
44	0.0017	0.0876
45	0.0014	0.0863
46	0.0013	0.0861
47	0.0013	0.0858
48	0.0012	0.0847
49	0.0011	0.0846
50	0.0010	0.0831
51	0.0009	0.0821
52	0.0008	0.0818
53	0.0006	0.0807
54	0.0004	0.0803
55	0.0003	0.0780
56	0.0002	0.0738
57	0.0002	0.0736
58	0.0002	0.0718
59	0.0002	0.0665
60	0.0001	0.0629

Duration Flows

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0023	3938	155327	3944	Fail
0.0035	2512	123495	4916	Fail
0.0047	1753	101384	5783	Fail
0.0059	1269	84974	6696	Fail
0.0071	961	71846	7476	Fail
0.0084	751	61285	8160	Fail
0.0096	607	52596	8664	Fail
0.0108	501	45464	9074	Fail
0.0120	411	39258	9551	Fail
0.0132	353	34040	9643	Fail
0.0144	298	29496	9897	Fail
0.0156	253	25709	10161	Fail
0.0169	212	22469	10598	Fail
0.0181	189	19711	10429	Fail
0.0193	165	17338	10507	Fail
0.0205	142	15295	10771	Fail
0.0217	134	13502	10076	Fail
0.0229	122	12009	9843	Fail
0.0241	107	10694	9994	Fail
0.0253	91	9516	10457	Fail
0.0266	81	8512	10508	Fail
0.0278	72	7631	10598	Fail
0.0290	64	6821	10657	Fail
0.0302	58	6072	10468	Fail
0.0314	49	5432	11085	Fail
0.0326	47	4887	10397	Fail
0.0338	41	4414	10765	Fail
0.0351	36	3966	11016	Fail
0.0363	33	3589	10875	Fail
0.0375	28	3259	11639	Fail
0.0387	25	2958	11832	Fail
0.0399	25	2689	10756	Fail
0.0411	20	2455	12275	Fail
0.0423	16	2255	14093	Fail
0.0435	14	2062	14728	Fail
0.0448	12	1891	15758	Fail
0.0460	9	1725	19166	Fail
0.0472	9	1584	17600	Fail
0.0484	9	1444	16044	Fail
0.0496	7	1331	19014	Fail
0.0508	7	1203	17185	Fail
0.0520	6	1129	18816	Fail
0.0532	6	1048	17466	Fail
0.0545	6	960	16000	Fail
0.0557	6	896	14933	Fail
0.0569	6	834	13900	Fail
0.0581	5	775	15500	Fail
0.0593	5	713	14260	Fail
0.0605	5	656	13120	Fail
0.0617	5	610	12200	Fail
0.0630	5	566	11320	Fail
0.0642	5	528	10560	Fail
0.0654	4	502	12550	Fail
0.0666	4	464	11600	Fail

0.0678	4	437	10925	Fail
0.0690	4	409	10225	Fail
0.0702	4	382	9550	Fail
0.0714	4	360	9000	Fail
0.0727	4	338	8450	Fail
0.0739	3	307	10233	Fail
0.0751	3	290	9666	Fail
0.0763	3	263	8766	Fail
0.0775	3	251	8366	Fail
0.0787	3	232	7733	Fail
0.0799	3	224	7466	Fail
0.0812	3	208	6933	Fail
0.0824	3	195	6500	Fail
0.0836	3	182	6066	Fail
0.0848	3	173	5766	Fail
0.0860	2	162	8100	Fail
0.0872	2	153	7650	Fail
0.0884	2	147	7350	Fail
0.0896	2	138	6900	Fail
0.0909	2	129	6450	Fail
0.0921	2	123	6150	Fail
0.0933	2	114	5700	Fail
0.0945	2	107	5350	Fail
0.0957	2	103	5150	Fail
0.0969	2	99	4950	Fail
0.0981	2	93	4650	Fail
0.0994	2	87	4350	Fail
0.1006	2	84	4200	Fail
0.1018	2	81	4050	Fail
0.1030	2	76	3800	Fail
0.1042	2	73	3650	Fail
0.1054	2	69	3450	Fail
0.1066	2	67	3350	Fail
0.1078	2	63	3150	Fail
0.1091	2	60	3000	Fail
0.1103	2	56	2800	Fail
0.1115	2	54	2700	Fail
0.1127	2	50	2500	Fail
0.1139	2	47	2350	Fail
0.1151	2	46	2300	Fail
0.1163	2	44	2200	Fail
0.1175	2	43	2150	Fail
0.1188	2	41	2050	Fail
0.1200	1	40	4000	Fail
0.1212	1	37	3700	Fail
0.1224	1	37	3700	Fail

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

Water Quality

Water Quality BMP Flow and Volume for POC #1

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

LID Report

LID Technique	Used for Treatment ?	Total Volume Needs Treatment (ac-ft)	Volume Through Facility (ac-ft)	Infiltration Volume (ac-ft)	Cumulative Volume Infiltration Credit	Percent Volume Infiltrated	Water Quality	Percent Water Quality Treated	Comment
Total Volume Infiltrated		0.00	0.00	0.00		0.00	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Failed

Model Default Modifications

Total of 0 changes have been made.

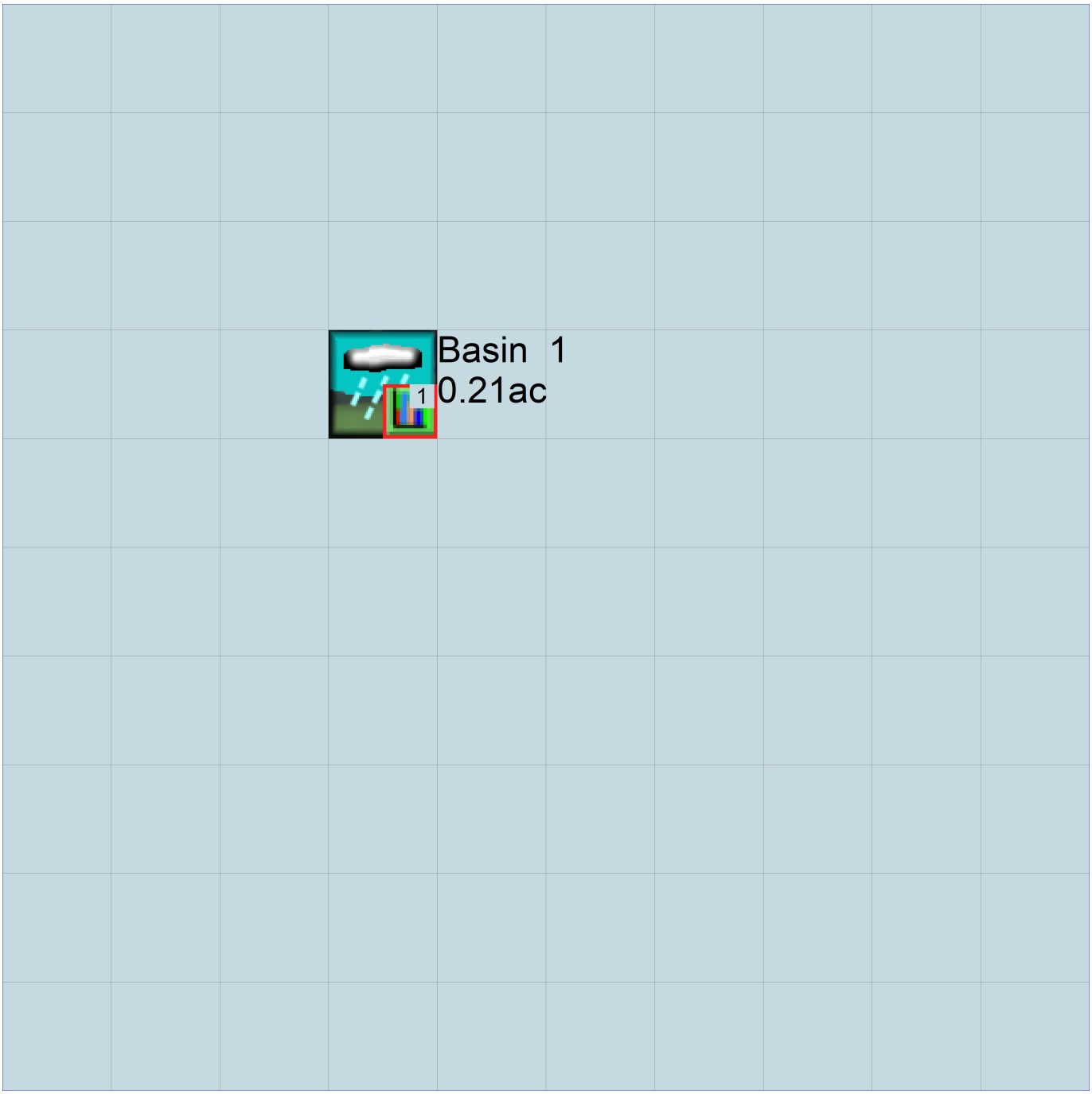
PERLND Changes

No PERLND changes have been made.

IMPLND Changes

No IMPLND changes have been made.

Appendix
Predeveloped Schematic



Mitigated Schematic

Predeveloped UCI File

Mitigated UCI File

Predeveloped HSPF Message File

Mitigated HSPF Message File

Disclaimer

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Clear Creek Solutions, Inc.
6200 Capitol Blvd. Ste F
Olympia, WA. 98501
Toll Free 1(866)943-0304
Local (360)943-0304

www.clearcreeksolutions.com

Appendix H: Geotechnical Report

Carlson Geotechnical

A Division of Carlson Testing, Inc.
Phone: (503) 601-8250
www.carlsontesting.com

Bend Office	**(541) 330-9155**
Eugene Office	**(541) 345-0289**
Salem Office	**(503) 589-1252**
Tigard Office	**(503) 684-3460**

Engineering Geologic Report
Miller Residence
East of 410 W E Avenue
La Center, Washington

CGT Project Number G2005397

Prepared for

Brandon Miller
2805 E 27th Street
Vancouver, Washington 98661

December 9, 2020

Carlson Geotechnical

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Phone: (503) 601-8250
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Bend Office (541) 330-9155
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Tigard Office (503) 684-3460

December 9, 2020

Brandon Miller
2805 E 27th Street
Vancouver, Washington 98661

Engineering Geologic Report
Miller Residence
East of 410 W E Avenue
La Center, Washington

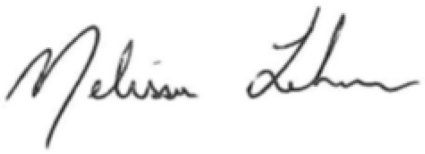
CGT Project Number G2005397

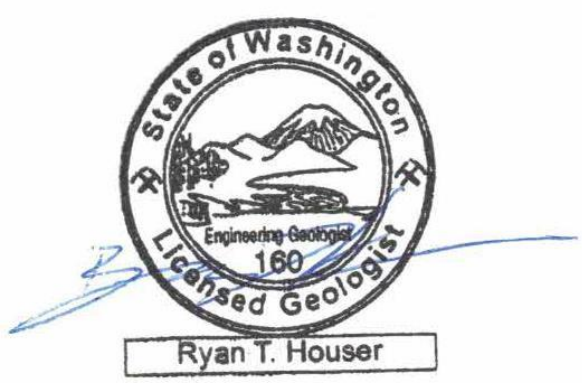
Dear Mr. Miller:

Carlson Geotechnical (CGT), a division of Carlson Testing, Inc. (CTI), is pleased to submit this Critical Areas Report (engineering geologic report) for the proposed Miller Residence project. The site is located on the lot east of 410 W E Avenue in La Center, Washington. We performed our work in general accordance with CGT Proposal GP9166, dated November 10, 2020. Written authorization for our services was received on November 18, 2020.

We appreciate the opportunity to work with you on this project. Please contact us at (503) 601-8250 if you have any questions regarding this report.

Respectfully Submitted,
CARLSON GEOTECHNICAL





Melissa L. Lehman
Geotechnical Project Manager
mlehman@carlsontesting.com

Ryan T. Houser, LEG
Senior Engineering Geologist
rhouser@carlsontesting.com

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Steep Slope and Landslide Hazards Overlay ..... Figure 4
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1.0 INTRODUCTION

Carlson Geotechnical (CGT), a division of Carlson Testing, Inc. (CTI), is pleased to submit this engineering geologic report for the proposed Miller Residence project. The site is located on the lot east of 410 W E Avenue (La Center Lots 3 and 4, Block 25) in La Center, Washington, as shown on the attached Site Location, Figure 1.

1.1 Project Information

CGT developed an understanding of the proposed project based on our correspondence with you and review of the Plot Plan, prepared by Adair Homes, Inc., dated January 30, 2020. Based on our review, we understand the project will include construction of a new, two-story, single-family residence. The new residence will be constructed at-grade with no subsurface (basement) levels.

We understand that a portion of the site contains slopes in excess of 20 percent, and that the City of La Center requires an engineering geologic report (critical areas report) be completed for the project prior to issuance of a building permit to ensure the proposed development will not negatively impact slope stability in the area.

1.2 Scope of Services

The purpose of our work will be to identify erosion and landslide hazards that may affect the property. Our specific scope of services will include the following:

- Review available literature for geologic hazards in the vicinity of the site. Specific hazards to be addressed by this study include:
  - Erosion potential
  - Landslide potential / Slope stability
- Review readily available historical aerial photographs of the site.
- Review available topographic, geologic, and geologic hazard maps for the area.
- Perform a surface reconnaissance of the site. The reconnaissance will include preparation of a cross-section of the site that includes pertinent slope features.
- Visit the site to mark (stake or paint) the locations of our proposed explorations for utility locating.
- Contact the Washington Utilities Notification Center to mark the locations of public utilities at the site within a 20-foot radius of our planned explorations.
- Explore shallow subsurface conditions at the site by advancing two, 3-inch-diameter, hand auger borings to depths of up to 5 feet below ground surface (bgs).
- Provide **qualitative** conclusions regarding the potential impacts of geologic hazards on the proposed development, and vice versa.
- Provide this written report summarizing the results of our study in general accordance with the La Center Municipal Code Division 4, Critical Lands, Chapter 18.300 specifically addressing slope stability and erosion on the subject property.

2.0 GEOLOGY

2.1 Regional Geology

The site is located on the eastern edge of the Portland Basin physiographic province in southwestern Washington (Moses, 2002[1]). The Portland Basin is included within the Willamette Valley physiographic province in Oregon. The Portland basin is a structural lowland situated between the Willapa Hills (coast range) to the west and Cascade Range to the east. The basin is surrounded and underlain by Miocene (16 to 13 million years ago) Columbia River Basalts. Pliocene (3 to 1.6 million years ago) infilling of the basin produced claystone, sandstone, and conglomerate of the Troutdale formation. Pleistocene catastrophic glacial flooding of the Missoula Floods (18,000 to 15,000 years ago[2]) carved the steep walls of the Columbia River Gorge, scoured channels within the basin and subsequently deposited unconsolidated silt, sands and gravels. Recent alluvium of the Columbia River included unconsolidated clay, silt, and sand flood deposits with sand, and gravel channel deposits (Schuster, 2002[3]). Modern development adjacent to the Columbia River included placement of dredge sand fill over recent alluvial deposits.

2.2 Site Geology

Based on available geologic mapping[4] of the area, the site is underlain by Pleistocene Catastrophic Flood Deposits (Figure 2). The flood deposits were produced by the periodic failure of glacial ice dams, which impounded Lake Missoula between 18,000 to 15,000 years ago[5]. Floodwaters raged through eastern Washington and through the Columbia River Gorge. Floodwaters in the Portland-Vancouver area were as much as 400 feet deep, leaving only the tops of the tallest hills dry. The flood deposits are typically split into two different facies in Clark County; the fine-grained facies and the coarse-grained (gravel) facies. The map indicates the site is located in the fine-grained facies, which consists primarily of silt and sand that extends to depths of up to about 70 feet bgs in the area of the site. Well logs indicate these soils are underlain at depth by Pleistocene conglomerate consisting of semi-consolidated pebble and cobbles. The conglomerate extends to about 100 feet bgs in the vicinity of the site.

3.0 LOCAL TOPOGRAPHY

Topography in the vicinity of the site is shown on the attached Figure 3. The site is situated on a gently undulating broad terrace approximately 1,000 feet north-northeast of the East Fork Lewis River at an elevation of 108 feet above mean sea level (MSL). The terrace trends to the southeast in the vicinity of the property. Above the site the slope ascends to the northwest at a gradient of 9 horizontal to 1 vertical (9H:1V). Below the site, slope gradients are generally flatter than 20H:1V. Site topography observed during our reconnaissance is discussed in detail in Section 5.1 below.

---

1 Moses, Lynn, 2002. The Geology of Washington State: Washington State Department of Natural Resource.
2 Allen, John Eliot, Burns, Marjorie, and Burns, Scott, 2009. Cataclysms on the Columbia, The Great Missoula Floods, Revised Second Edition: Ooligan Press, Portland State University.
3 Schuster, J., Eric, 2002. Geologic Map of Washington: Washington State Department of Natural Resources.
4 Evarts, R.C., Dinterman, Philip, and Block, Jessica, 2004, Geologic map of the Ridgefield quadrangle, Clark and Cowlitz Counties, Washington: U.S. Geological Survey, Scientific Investigations Map SIM-2844, scale 1:24,000.
5 Allen, John Eliot, et al., 2009. Cataclysms on the Columbia, The Great Missoula Floods, Revised Second Edition: Ooligan Press, Portland State University.

4.0 HAZARDS

4.1 Landslides

Landsliding is a common hazard in the Pacific Northwest that can be initiated on marginally stable slopes by human disturbances such as grading and deforestation, and by natural processes including earthquake shaking, volcanism, heavy rainfalls, and rapid snow melt. Recent studies indicate that the most common causes for slope failures are intense rainfall and human alteration, including the placement of building loads on slopes, excavating or over-steepening slopes, and the infiltration or diversion of storm water runoff. For example, excavation into the base of marginally stable slopes may reduce forces resisting failure on those slopes, thus causing movement. Adding fill and/or a structure to the top or mid portion of a slope increases the driving forces on a slope and may contribute to failure. Redirecting water onto or into slopes may exploit existing planes of weakness within those slopes, causing failure.

The Clark County Property Information Center[6] shows a small portion of the southeast portion of the site within an Area of Potential Instability (landslide hazard area). The site and landslide hazard area are shown on the attached Figure 4. The landslide hazard zone was assigned based on topography (slope gradient). As shown on Figure 4, the area of proposed development is not located within this zone. In addition, as described in Section 5.1 below, the maximum gradient observed in the southeast portion of the site was about 5H:1V, and no signs of instability or past landsliding were noted.

Review of the Washington State Geologic Information Portal[7], indicates that no landslides are mapped on or in the immediate vicinity the site. Two small landslide masses are located about 1,000 feet to the west and southeast, respectively. These landslide masses are located on slopes adjacent to the East Fork Lewis River, and are likely the result of stream bank erosion. These slides are considered remote to the site and have no impact on stability at the site.

We also reviewed Light Detection and Ranging (lidar) data and imagery available from the Washington State Department of Natural Resources Division of Geology and Earth Resources on the Washington Lidar Portal (WLP). WLP provides contours and bare earth imagery, which has been filtered to remove foliage and buildings. The lidar data portray the topography at a much greater level of detail than traditional mapping methods, and can reveal features that are otherwise difficult to ascertain. In areas where human activity has modified the topography extensively, such as through road-building and general grading, the resulting "background noise" can mask features that might otherwise be apparent. The lidar data shows previous grading in the vicinity of the site consisted of minor cuts and fills, particularly in the commercial properties southeast of the site. Based on our review of the lidar data, we did not observe any obvious signs of previous landslides at or in the immediate vicinity of the site. A portion of the lidar map showing the area of the site is presented as Figure 3.

---

[6] Clark County Information Center, 2020, Steep Slope and Landslide Hazards Map, Clark County, Washington, *accessed December 2020*, from Clark County website: https://gis.clark.wa.gov/mapsonline/.

[7] Washington State Department of Natural Resources, 2020. Washington State Geologic Information Portal, *accessed December 2020,* from Washington State DNR website: https://geologyportal-qa.dnr.wa.gov/.

4.2 Erosion

The Clark County Property Information Center[8] does not show that the site is within an area mapped as a severe erosion hazard. Erosion hazards are characterized as the breakdown, transport, and redistribution of sediment by forces of water, wind, and/or gravity. These areas are identified by the United States Department of Agriculture-Natural Resources Conservation Service (USDA-NRCS) as having moderate to very severe rill and inter-rill erosive hazards. Based on the overall moderate gradient and vegetation onsite, we conclude the erosion hazard is very low.

5.0 SITE RECONNAISSANCE

Melissa Lehman, GIT, under supervision of CGT Senior Engineering Geologist Ryan Houser, LG, LEG, performed a reconnaissance of the site on November 30, 2020.

5.1 Surface Conditions

5.1.1 On Site

The proposed site layout and conditions are shown on the attached Site Plan (Figure 5) and Site Photographs (Figure 6).

The approximate 0.23-acre site was bordered by West E Avenue to the west, developed residential properties to the north and south, and a vacant lot to the east. The site was vegetated with grasses and scattered trees. The site was not occupied by any structures or previous development at the time of our site visit.

The site descended to the southeast below West E Avenue at gradients ranging from about 8H:1V near the street to about 5H:1V near the southeast corner of the property. Topography of the site is shown on the Site Plan (Figure 5) and Site Topographic Profile (Figure 7).

No indicators of recent or ongoing slope instability were observed on the site during the reconnaissance.

5.1.2 Area Conditions

The site was observed from publically accessible areas from all cardinal directions of the site. The neighborhood where the site was located generally descended gradually to the southeast toward a commercial parking lot. No abrupt cuts were noted upslope or downslope of the site.

5.2 Site Subsurface Conditions

5.2.1 Subsurface Investigation

Our subsurface investigation consisted of two hand auger borings (HA-1 and HA-2) completed on November 30, 2020. The approximate exploration locations are shown on the Site Plan, attached as Figure 5. In summary, the borings were advanced to depths of 5 feet bgs. Details regarding the subsurface investigation, logs of the explorations are presented in Appendix A. Subsurface conditions encountered during our investigation are summarized below.

[8] Clark County Information Center, 2020, Environmental Hazards Map, Clark County, Washington, *accessed December 2020*, from Clark County website: https://gis.clark.wa.gov/mapsonline/.

5.2.2 Subsurface Materials

Logs of the explorations are presented in Appendix A. The following describes each of the subsurface materials encountered at the site.

Organic Soil (OL)
Organic soil was encountered at the surface of both borings and extended to approximately ½ foot bgs. The soil was generally dark brown, moist, exhibited low plasticity, and included abundant rootlets.

Lean Clay (CL)
Lean clay was encountered below the organic soil in both hand auger borings and extended to the full depths explored in both borings, approximately 5 feet bgs. The clay was generally medium stiff, brown, moist to wet, exhibited medium plasticity, and included some fine-grained sand.

The soils encountered during our subsurface investigation were consistent with the fine-grained Missoula Flood deposits described in Section 2.2.

5.2.3 Groundwater

Minor groundwater seepage was noted at 1 and 1½ feet bgs within the hand auger borings on November 30, 2020. We researched available well logs located within Section 3, Township 4 North, Range 1 East on the Washington Department of Ecology (WDE)[9] website. Our review indicated that groundwater levels in the area generally ranged from about 30 to 45 feet bgs. It should be noted that groundwater levels vary with local topography. In addition, the groundwater levels reported on the WDE logs often reflect the purpose of the well, so water well logs may only report deeper, confined groundwater, while geotechnical or environmental borings will often report any groundwater encountered, including shallow, unconfined groundwater. Therefore, the levels reported on the WDE well logs referenced above are considered generally indicative of local water levels and may not reflect actual groundwater levels at the project site.

It is our opinion that the groundwater seepage noted within the borings represents a “perched” groundwater condition, since the on-site, lean clay has a low transmissivity and is conducive to formation of perched groundwater.

6.0 FINDINGS & RECOMMENDATIONS

The Clark Regional Emergency Services Agency (CRESA)[10] shows a small portion of the southeast portion of the site within a potential landslide hazard area, where slopes exceed 15 percent. We did not observe signs of previous or ongoing instability during our reconnaissance of the site or surrounding areas. As described in Section 1.1, the proposed development will include construction of a new, two-story, single-family residence. The new residence will be constructed at-grade with no subsurface (basement) levels.

We anticipate that with proper construction control, the geology and topography of the site and the surrounding area will not adversely affect the proposed project, and the project will have no impact on the

[9] Washington State Department of Ecology, 2020. Well Log Records, *accessed November 2020*, from web site: https://fortress.wa.gov/ecy/waterresources/map/WCLSWebMap/textsearch.aspx

[10] Clark Regional Emergency Services Agency, 2020, Hazard Maps, Clark County, Washington, *accessed December 2020*, from CRESA website: https:// http://cresa911.org/emergency-management/mitigation/hazard-maps/

stability of adjacent properties. It is our opinion that, with the use of generally accepted construction techniques and by strictly following the recommendations contained in this report and in the building code, the site is geologically suitable for the proposed development.

Any construction within hillside areas inherently bears greater risk of slope instability. The on-site and off-site slopes may be susceptible to slope instability resulting from factors beyond the owner's control, such as off-site grading, erosion and other ground disturbance, a major earthquake, or heavy precipitation. The owners must recognize and accept the risk of potential slope instability from causes beyond their control or as yet unrecognized.

In no case should surface runoff or discharge from drains be directed onto the site slopes. The ground surface adjacent to the building should be sloped to drain away from the building and surface runoff should be collected and routed to a suitable discharge point. Surface water should not be directed into foundation drains. Surface and any subsurface drains should be connected to the nearest storm drain or other suitable discharge point.

7.0 LIMITATIONS

The scope of this assignment did not include services related to geotechnical engineering for the proposed development such as bearing capacity evaluation, settlement estimates, recommendations regarding stripping and filling, or the use of footing/floor slab drains, etc. Additionally, quantitative soil or rock slope stability analyses was not performed. Our recommendations are not intended to indicate that all geologic hazards can be mitigated by proper engineering. They are provided in order to assist the project engineer in evaluating site conditions based on geologic research and preliminary, site specific, surface and shallow subsurface exploration. If you would like CGT to provide geotechnical recommendations or geotechnical construction observations during site construction, we can prepare a geotechnical report for the site for an additional fee.

We have prepared this report for use by the owner/developer and other members of the design and construction team for the proposed development. The opinions and recommendations contained within this report are not intended to be, nor should they be construed as, a warranty of subsurface conditions, but are forwarded to assist in the planning and design process.

This site evaluation consisted of visual examinations of exposed soil conditions within shallow excavations and a review of readily available geologic resources judged pertinent to the evaluation. Accordingly, the limitations of the site evaluation must be recognized. An exploration of subsurface conditions at depth was not conducted for this evaluation. An investigation to explore subsurface conditions at depth using deeper soil borings or excavations could be conducted at additional cost to the owner to further define the risk of unforeseen, adverse geological issues on this site. However, based on our observations and the information available, the risk of unforeseen adverse geological issues on this site appear to be small and could, in our opinion, be assumed by the owner.

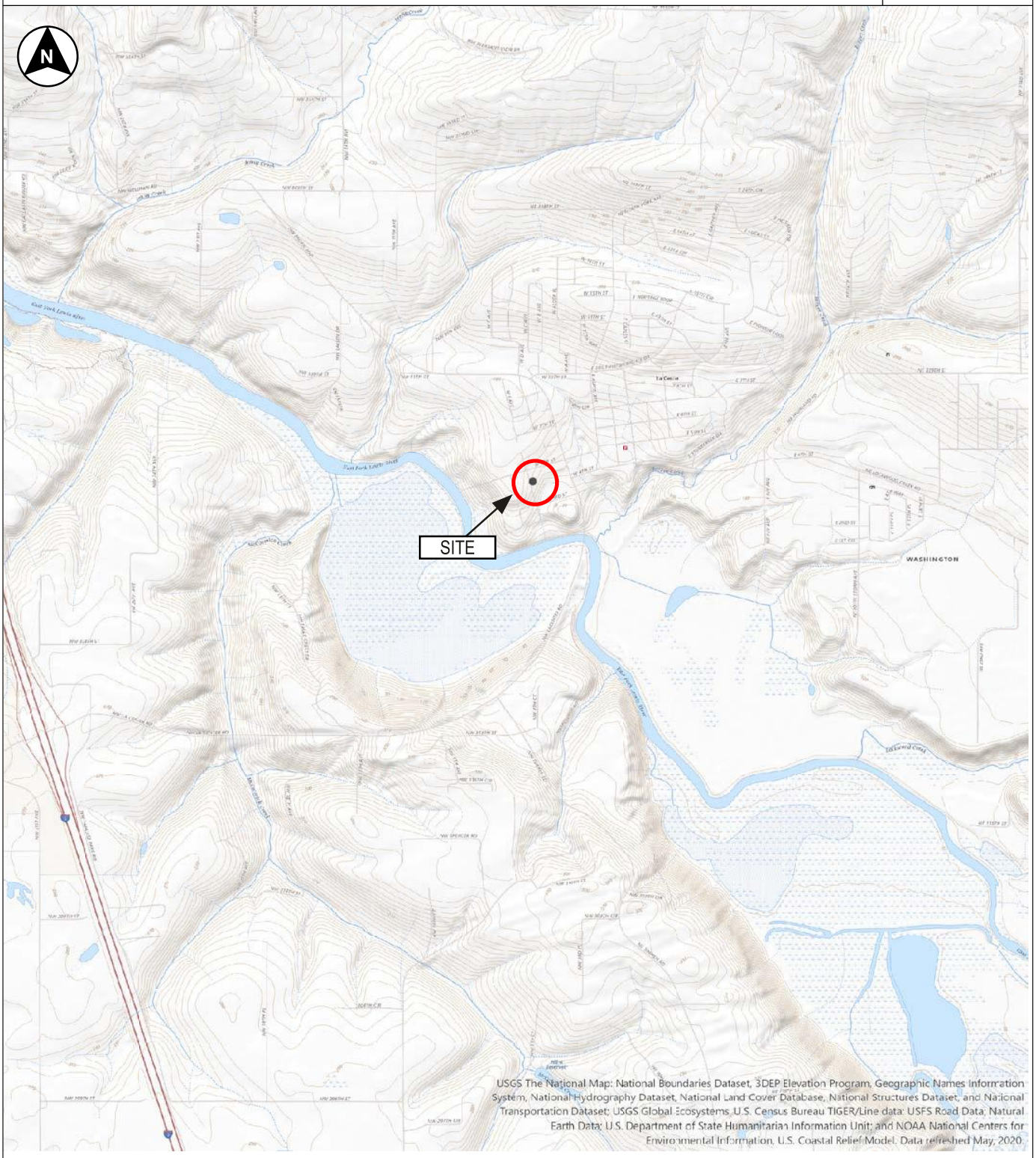
We have made observations based on our explorations that indicate the soil conditions at only those specific locations and only to the depths penetrated. These observations do not necessarily reflect soil types, strata thickness, or water level variations that may exist between or away from the explorations. If subsurface conditions vary from those encountered in our site exploration, CGT should be alerted to the change in

conditions so that we may provide additional recommendations, if necessary. Observation by experienced geotechnical personnel should be considered an integral part of the construction process. The owner/developer is responsible for insuring that the project designers and contractors implement our recommendations.

Within the limitations of scope, schedule, and budget, our services have been executed in accordance with the generally accepted practices in this area at the time this report was prepared. No warranty or other conditions, expressed or implied, should be understood. This report is subject to review and should not be relied upon after a period of three years.

MILLER RESIDENCE - LA CENTER, WASHINGTON
Project Number G2005397

FIGURE 1
Site Location



CARLSON CGT GEOTECHNICAL
503-601-8250
Drafted by: MLL

USGS Topographic base map created with The National Map, 2020, at https://viewer.nationalmap.gov/advanced-viewer/

Township 4 North, Range 1 East, Section 3, Willamette Meridian

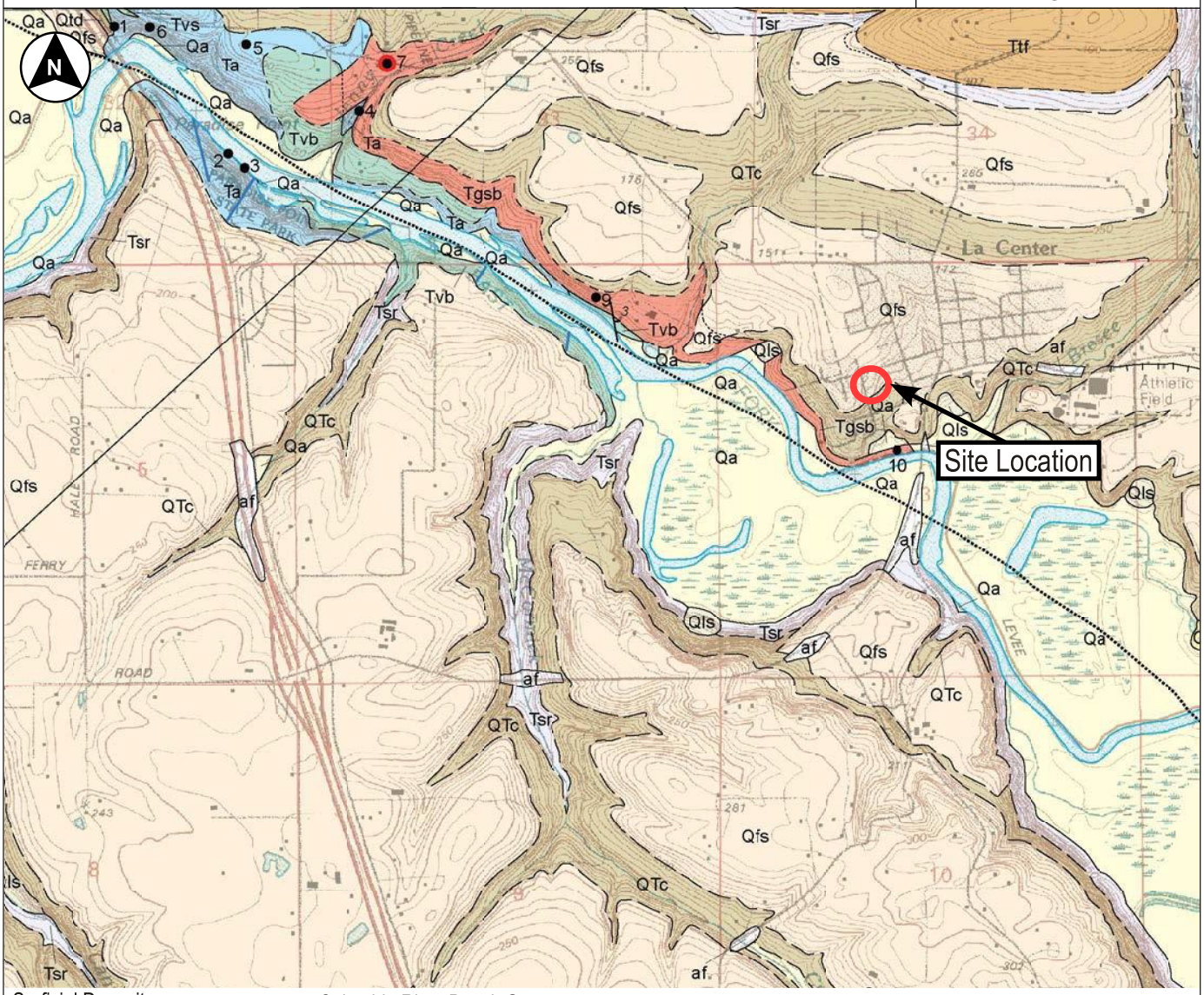
Latitude: 45.861879° North
Longitude: 122.674906° West

1 Inch = 2,000 feet

0 2000 4000

MILLER RESIDENCE - LA CENTER, WASHINGTON
Project Number G2005397

FIGURE 2
Geologic Map



Surficial Deposits

- af — Artificial fill
- Qa — Alluvium deposits
- Qoa — Older alluvium deposits
- Qls — Landslide deposits
- Ql — Lake deposits
- Qfs — Cataclysmic-flood deposits
- Qtd — Terrace deposits

Basin-Fill Deposits

- QTc — Conglomerate
- Ttf — Troutdale formation
- Tsr — Sandy River Mudstone

Columbia River Basalt Group

- Tgsb — Member of Sentinel Bluffs

Bedrock

- Ta — Andesite
- Tvb — Volcanic breccia

Contact—Dashed where approximately located; short-dashed where inferred; dotted where concealed

Fault—Dashed where inferred; dotted where concealed

Anticline—Dashed where inferred; dotted where concealed

Strike and dip of beds
Inclined
Horizontal

Terrace scarp

Sample locality for chemical analysis—See table 1

Glacial erratic

Oil well

Sample locality for paleomagnetic measurement

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Map adapted from Evarts, R.C., 2004, Geologic Map of the Ridgefield Quadrangle, Clark and Cowlitz Counties, Washington: U.S. Geological Survey, Scientific Investigation Map SIM-2844

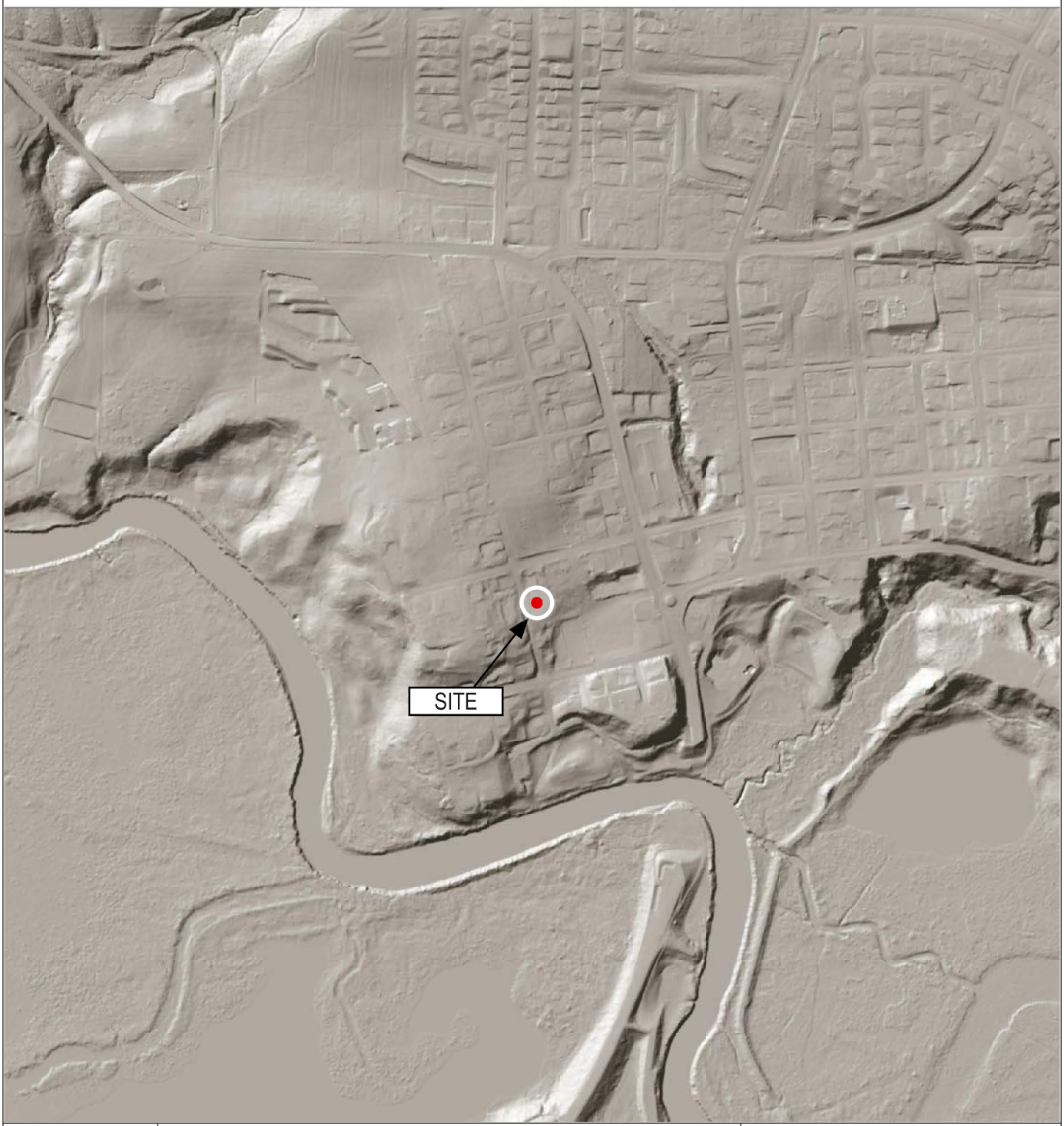
Township 4 North, Range 1 East, Section 3 Willamette Meridian

Latitude: 45.861879° North
Longitude: 122.674906° West

1 Inch = 2,000 feet

0 2000 4000

MILLER RESIDENCE - LA CENTER, WASHINGTON *Project Number G2005397*	**FIGURE 3** **Local Topography**



CARLSON CGT GEOTECHNICAL 503-601-8250

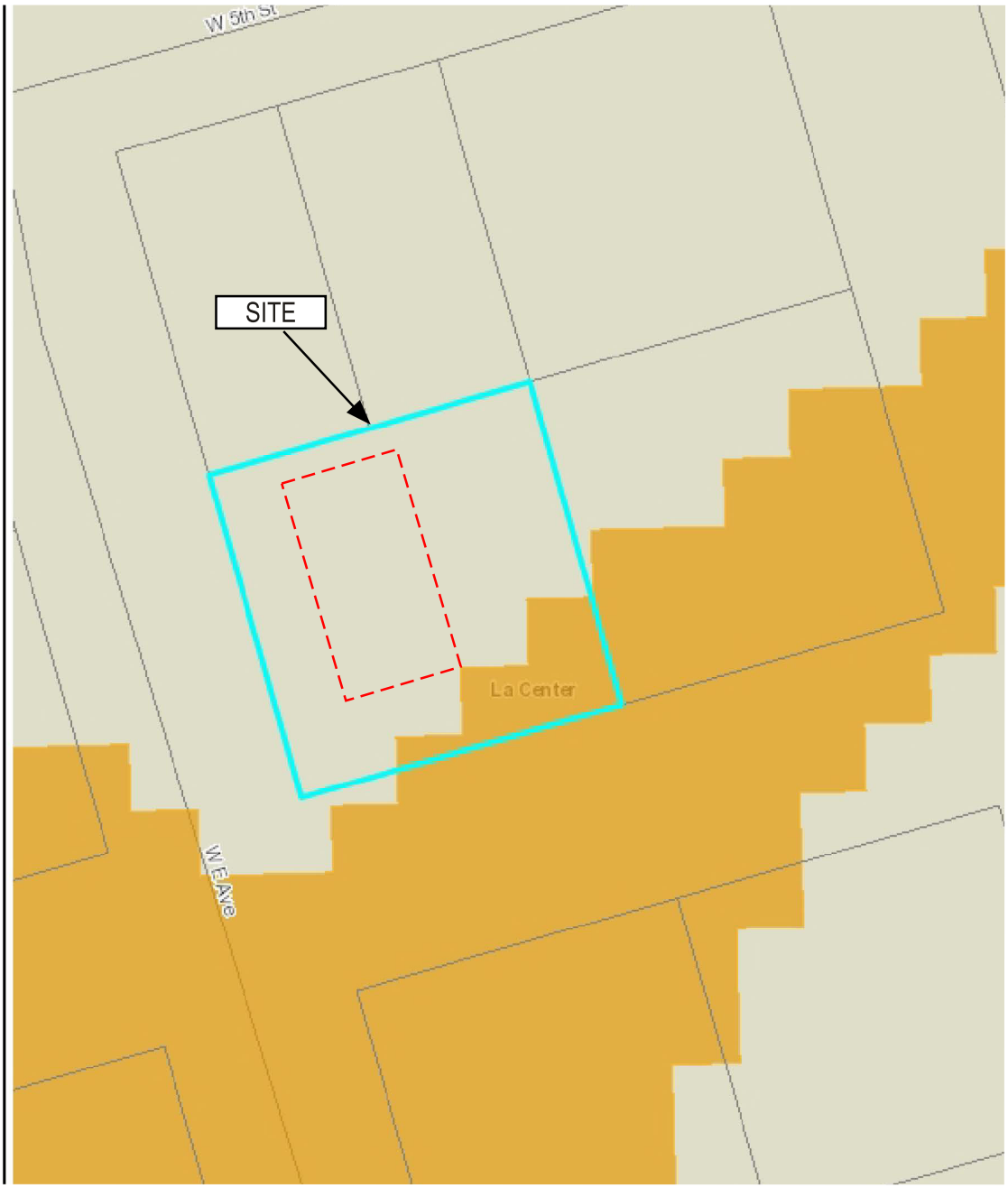
NOTES: Bare Earth Lidar Hillshade mapping obtained from Washington State Department of Natural Resources, 2020. Washington State Geologic Information Portal, accessed November 2020, from Washington State DNR website: https://geologyportal-qa.dnr.wa.gov/

Latitude: 45.861879° North
Longitude: 122.674906° West

1 Inch = 600 Feet

0 600 1,200

MILLER RESIDENCE - LA CENTER, WASHINGTON *Project Number G2005397*	**FIGURE 4** **Steep Slopes and Landslide Hazards Overlay**



LEGEND

Areas of Potential Instability

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Map adapted from Clark County Property Information Center, Environmental Hazards Map, accessed December 2020, https://gis.clark.wa.gov/mapsonline/

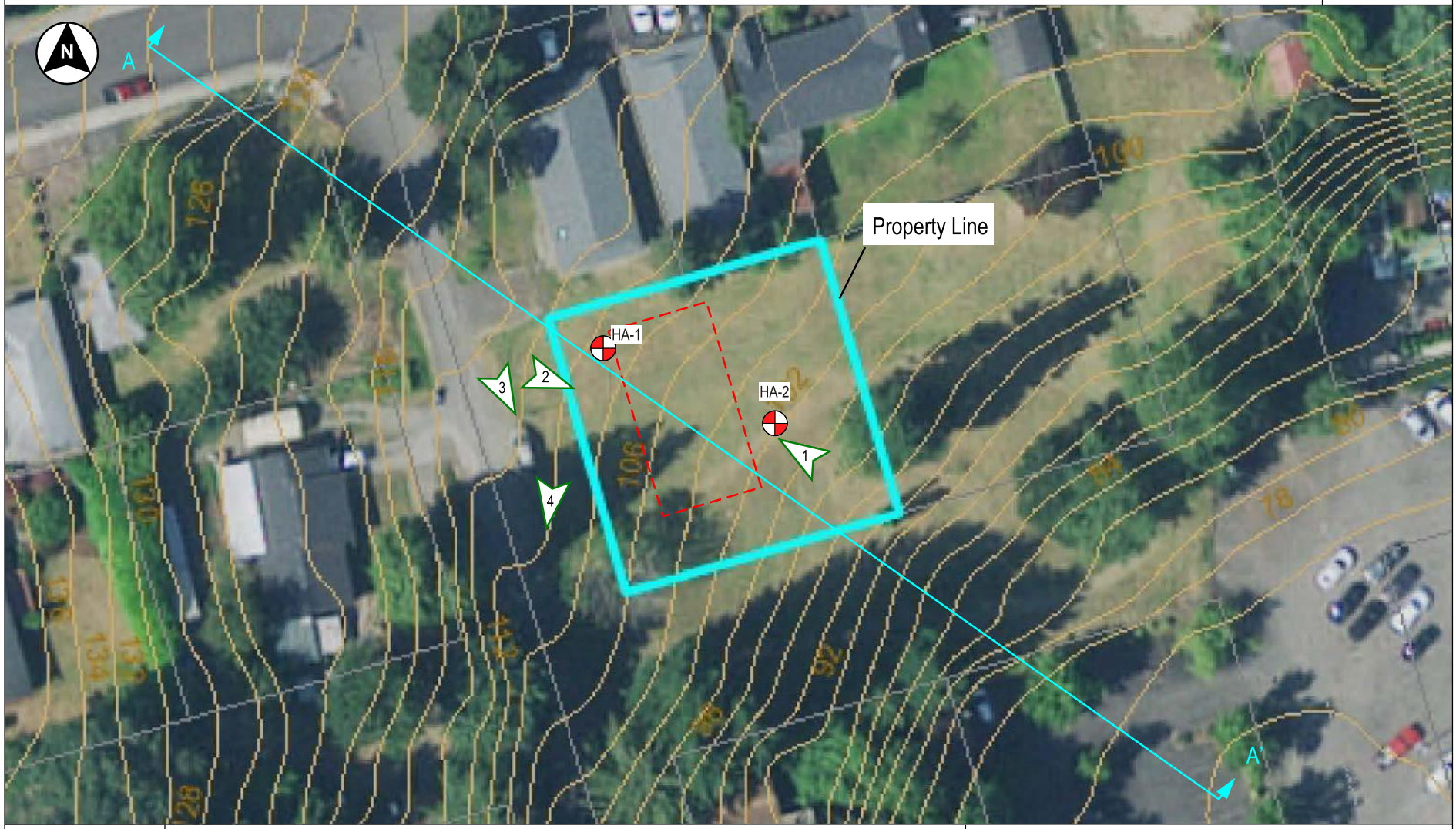
Latitude: 45.861879° North
Longitude: 122.674906° West

1 Inch = 50 feet

0 50 100

MILLER RESIDENCE - LA CENTER, WASHINGTON
Project Number G2005397

FIGURE 5
Site Plan



CARLSON CGT GEOTECHNICAL
503-601-8250

Drafted by: MLL

LEGEND

HA-1 Hand auger boring

1 Orientation of site photographs shown on Figure 9

A A' Location of cross section shown on Figure 10

Proposed residence location

1 Inch = 50 Feet

0 50 100

NOTES: 2019 aerial photograph, contours and property lines from Clark County Washington Geographical Information Services data, accessed November 2020, from website: http://gis.clark.wa.gov. Exploration locations are approximate.

FIGURE 6
Site Photographs

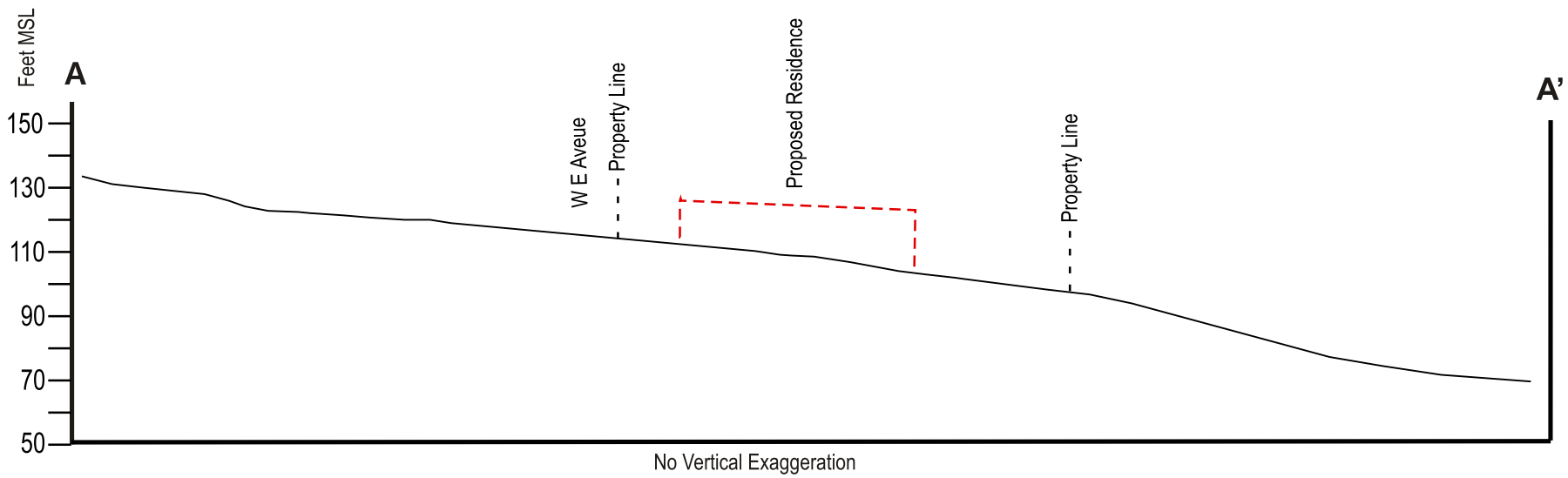
Photograph 1

Photograph 2

Photograph 3

Photograph 4

See Figure 8 for approximate photograph locations and directions. Photographs were taken at the time of our fieldwork.



1 Inch = 50 Feet

0 50 100

Note: Existing topography from Figure 5

CARLSON CGT GEOTECHNICAL 503-601-8250

Carlson Geotechnical
P.O. Box 23814
Tigard, Oregon 97281

MILLER RESIDENCE - LA CENTER, WASHINGTON
Project Number G2005397

FIGURE 7

Topographic Profile

Carlson Geotechnical

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Phone: (503) 601-8250
www.carlsontesting.com

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Salem Office	**(503) 589-1252**
Tigard Office	**(503) 684-3460**

Appendix A: Subsurface Investigation

Miller Residence
East of 410 W E Avenue
La Center, Washington

CGT Project Number G2005397

December 9, 2020

Prepared For:

Brandon Miller
2805 E 27th Street
Vancouver, Washington 98661

Prepared by
Carlson Geotechnical

Exploration Key ..... Figure A1
Soil Classification ..... Figure A2
Exploration Logs ..... Figures A3 – A4

A.1.0 SUBSURFACE INVESTIGATION

Our field investigation consisted of two hand auger borings completed in November 2020. The exploration locations are shown on the Site Plan, attached to the engineering geologic report as Figure 5. The exploration locations shown therein were determined based on measurements from existing site features (roadways, property boundaries, etc.) and are approximate. Surface elevations indicated on the logs were estimated based on the topographic contours shown on the referenced Site Plan and are approximate. The attached figures detail the exploration methods (Figure A1), soil classification criteria (Figure A2), and present detailed logs of the explorations (Figures A3 and A4), as discussed below.

A.1.1 Hand Auger Borings

CGT advanced two hand auger borings (HA-1 and HA-2) at the site on November 30, 2020, to depths of 5 feet bgs using equipment provided and operated by CGT. The hand auger borings were loosely backfilled with the excavated materials upon completion.

A.1.2 Material Classification & Sampling

Representative grab samples of the soils encountered were obtained at select intervals within the hand auger borings. A qualified member of CGT's geological staff collected the samples and logged the soils in general accordance with the Visual-Manual Procedure (ASTM D2488). An explanation of this classification system is attached as Figure A2. The grab samples were stored in sealable plastic bags and transported to our soils laboratory for further examination. Our geotechnical staff visually examined all samples in order to refine the initial field classifications.

A.1.3 Subsurface Conditions

Subsurface conditions are summarized in Section 5.2 of the engineering geologic report. Detailed logs of the explorations are presented on the attached exploration logs, Figures A3 and A4.

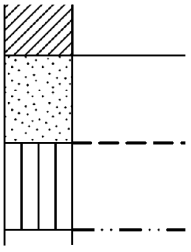
MILLER RESIDENCE - LA CENTER, WASHINGTON Project Number G2005397	FIGURE A1 Exploration Key

PL — LL MC	Atterberg limits (plasticity) test results (ASTM D4318): PL = Plastic Limit, LL = Liquid Limit, and MC= Moisture Content (ASTM D2216)
☐ FINES CONTENT (%)	Percentage passing the U.S. Standard No. 200 Sieve (ASTM D1140)

SAMPLING

GRAB	Grab sample
BULK	Bulk sample
SPT	**Standard Penetration Test** (SPT) consists of driving a 2-inch, outside-diameter, split-spoon sampler into the undisturbed formation with repeated blows of a 140-pound, hammer falling a vertical distance of 30 inches (ASTM D1586). The number of blows (N-value) required to drive the sampler the last 12 inches of an 18-inch sample interval is used to characterize the soil consistency or relative density. The drill rig was equipped with an cat-head or automatic hammer to conduct the SPTs. The observed N-values, hammer efficiency, and N_{60} are noted on the boring logs.
MC	**Modified California** sampling consists of 3-inch, outside-diameter, split-spoon sampler (ASTM G3550) driven similarly to the SPT sampling method described above. A sampler diameter correction factor of 0.44 is applied to calculate the equivalent SPT N_{60} value per Lacroix and Horn, 1973.
CORE	**Rock Coring** interval
SH	**Shelby Tube** is a 3-inch, inner-diameter, thin-walled, steel tube push sampler (ASTM D1587) used to collect relatively undisturbed samples of fine-grained soils.
WDCP	**Wildcat Dynamic Cone Penetrometer** (WDCP) test consists of driving 1.1-inch diameter, steel rods with a 1.4-inch diameter, cone tip into the ground using a 35-pound drop hammer with a 15-inch free-fall height. The number of blows required to drive the steel rods is recorded for each 10 centimeters (3.94 inches) of penetration. The blow count for each interval is then converted to the corresponding SPT N_{60} values.
DCP	**Dynamic Cone Penetrometer** (DCP) test consists of driving a 20-millimeter diameter, hardened steel cone on 16-millimeter diameter steel rods into the ground using a 10-kilogram drop hammer with a 460-millimeter free-fall height. The depth of penetration in millimeters is recorded for each drop of the hammer.
POCKET PEN. (tsf)	**Pocket Penetrometer** test is a hand-held instrument that provides an approximation of the unconfined compressive strength in tons per square foot (tsf) of cohesive, fine-grained soils.

CONTACTS



Observed (measured) contact between soil or rock units.

Inferred (approximate) contact between soil or rock units.

Transitional (gradational) contact between soil or rock units.

ADDITIONAL NOTATIONS

Italics	Notes drilling action or digging effort
{ Braces }	Interpretation of material origin/geologic formation (e.g. { Base Rock } or { Columbia River Basalt })

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All measurements are approximate.

MILLER RESIDENCE - LA CENTER, WASHINGTON
Project Number G2005397

FIGURE A2
Soil Classification

Classification of Terms and Content

NAME: Group Name and Symbol
Relative Density or Consistency
Color
Moisture Content
Plasticity
Other Constituents
Other: Grain Shape, Approximate Gradation
Organics, Cement, Structure, Odor, etc.
Geologic Name or Formation

Grain Size

		U.S. Standard Sieve
Fines		<#200 (0.075 mm)
Sand	Fine	#200 - #40 (0.425 mm)
	Medium	#40 - #10 (2 mm)
	Coarse	#10 - #4 (4.75 mm)
Gravel	Fine	#4 - 0.75 inch
	Coarse	0.75 inch - 3 inches
Cobbles		3 to 12 inches
Boulders		> 12 inches

Coarse-Grained (Granular) Soils

Relative Density

SPT N_{60}-Value	Density
0 - 4	Very Loose
4 - 10	Loose
10 - 30	Medium Dense
30 - 50	Dense
>50	Very Dense

Minor Constituents

Percent by Volume	Descriptor	Example
0 - 5%	"Trace" as part of soil description	"trace silt"
5 - 15%	"With" as part of group name	"**POORLY GRADED SAND WITH SILT**"
15 - 49%	Modifier to group name	"**SILTY SAND**"

Fine-Grained (Cohesive) Soils

SPT N_{60}-Value	Torvane tsf Shear Strength	Pocket Pen tsf Unconfined	Consistency	Manual Penetration Test
<2	<0.13	<0.25	Very Soft	Thumb penetrates more than 1 inch
2 - 4	0.13 - 0.25	0.25 - 0.50	Soft	Thumb penetrates about 1 inch
4 - 8	0.25 - 0.50	0.50 - 1.00	Medium Stiff	Thumb penetrates about ¼ inch
8 - 15	0.50 - 1.00	1.00 - 2.00	Stiff	Thumb penetrates less than ¼ inch
15 - 30	1.00 - 2.00	2.00 - 4.00	Very Stiff	Readily indented by thumbnail
>30	>2.00	>4.00	Hard	Difficult to indent by thumbnail

Minor Constituents

Percent by Volume	Descriptor	Example
0 - 5%	"Trace" as part of soil description	"trace fine-grained sand"
5 - 15%	"Some" as part of soil description	"some fine-grained sand"
15 - 30%	"With" as part of group name	"**SILT WITH SAND**"
30 - 49%	Modifier to group name	"**SANDY SILT**"

Moisture Content

Dry: Absence of moisture, dusty, dry to the touch
Moist: Leaves moisture on hand
Wet: Visible free water, likely from below water table

	Plasticity	Dry Strength	Dilatancy	Toughness
ML	Non to Low	Non to Low	Slow to Rapid	Low, can't roll
CL	Low to Medium	Medium to High	None to Slow	Medium
MH	Medium to High	Low to Medium	None to Slow	Low to Medium
CH	Medium to High	High to Very High	None	High

Structure

Stratified: Alternating layers of material or color >6 mm thick
Laminated: Alternating layers < 6 mm thick
Fissured: Breaks along definite fracture planes
Slickensided: Striated, polished, or glossy fracture planes
Blocky: Cohesive soil that can be broken down into small angular lumps which resist further breakdown
Lenses: Has small pockets of different soils, note thickness
Homogeneous: Same color and appearance throughout

Visual-Manual Classification

Major Divisions			Group Symbols	Typical Names
Coarse Grained Soils: More than 50% retained on No. 200 sieve	Gravels: 50% or more *retained* on the No. 4 sieve	Clean Gravels	GW	Well-graded gravels and gravel/sand mixtures, little or no fines
			GP	Poorly-graded gravels and gravel/sand mixtures, little or no fines
		Gravels with Fines	GM	Silty gravels, gravel/sand/silt mixtures
			GC	Clayey gravels, gravel/sand/clay mixtures
	Sands: More than 50% *passing* the No. 4 sieve	Clean Sands	SW	Well-graded sands and gravelly sands, little or no fines
			SP	Poorly-graded sands and gravelly sands, little or no fines
		Sands with Fines	SM	Silty sands, sand/silt mixtures
			SC	Clayey sands, sand/clay mixtures
Fine-Grained Soils: 50% or more Passes No. 200 Sieve	Silt and Clays Low Plasticity Fines		ML	Inorganic silts, rock flour, clayey silts
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, lean clays
			OL	Organic soil of low plasticity
	Silt and Clays High Plasticity Fines		MH	Inorganic silts, clayey silts
			CH	Inorganic clays of high plasticity, fat clays
			OH	Organic soil of medium to high plasticity
Highly Organic Soils			PT	Peat, muck, and other highly organic soils

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References:

ASTM D2487 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D2488 Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)
Terzaghi, K., and Peck, R.B., 1948, Soil Mechanics in Engineering Practice, John Wiley & Sons.

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FIGURE A3
Boring HA-1

CLIENT Brandon Miller
PROJECT NAME Miller Residence
PROJECT NUMBER G2005397
PROJECT LOCATION East of 410 W E Avenue - La Center, Washington
DATE STARTED 11/30/20 **GROUND ELEVATION** 109 ft
ELEVATION DATUM See Figure 5
WEATHER ~45 degrees **SURFACE** grass
LOGGED BY MLL **REVIEWED BY** RTH
DRILLING CONTRACTOR CGT
SEEPAGE 1.0 ft / El. 108.0 ft
EQUIPMENT 3-inch diameter hand auger
GROUNDWATER DURING DRILLING ---
DRILLING METHOD Manual 3-inch diameter Hand Auger & WDCP
GROUNDWATER AFTER DRILLING ---

ELEVATION (ft)	GRAPHIC LOG	GROUP SYMBOL	MATERIAL DESCRIPTION	GROUNDWATER	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	WDCP N_{60} VALUE	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ WDCP N_{60} VALUE ▲ PL LL MC ☐ FINES CONTENT (%) ☐ 0 20 40 60 80 100
		OL	**ORGANIC SOIL:** Dark brown, moist, low plasticity, abundant rootlets.		0						
108		CL	**LEAN CLAY:** *Medium stiff,* brown, moist to wet, medium plasticity. Brown with gray and orange mottling, some fine-grained sand below 1½ feet bgs.		2	GRAB 1	100				
106					4						
104											
102			• Boring terminated at 5 feet bgs. • Minor groundwater seepage noted at 1 foot bgs. • No caving encountered. • Loosely backfilled with excavated material upon completion.								
100											

CGT EXPLORATION WITH WDCP HAND AUGER LOGS.GPJ 12/9/20 DRAFTED BY: MLL

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FIGURE A4
Boring HA-2

CLIENT Brandon Miller
PROJECT NAME Miller Residence
PROJECT NUMBER G2005397
PROJECT LOCATION East of 410 W E Avenue - La Center, Washington
DATE STARTED 11/30/20 **GROUND ELEVATION** 102 ft
ELEVATION DATUM See Figure 5
WEATHER ~45 degrees **SURFACE** grass
LOGGED BY MLL **REVIEWED BY** RTH
DRILLING CONTRACTOR CGT
SEEPAGE 1.5 ft / El. 100.5 ft
EQUIPMENT 3-inch diameter hand auger
GROUNDWATER DURING DRILLING ---
DRILLING METHOD Manual 3-inch diameter Hand Auger & WDCP
GROUNDWATER AFTER DRILLING ---

ELEVATION (ft)	GRAPHIC LOG	GROUP SYMBOL	MATERIAL DESCRIPTION	GROUNDWATER	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	WDCP N_{60} VALUE	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ WDCP N_{60} VALUE ▲ PL LL MC ☐ FINES CONTENT (%) ☐ 0 20 40 60 80 100
		OL	**ORGANIC SOIL:** Dark brown, moist, low plasticity, abundant rootlets.		0						
			LEAN CLAY: *Medium stiff,* brown, moist to wet, medium plasticity.	≈							
100			Brown with gray and orange mottling, some fine-grained sand below 1¾ feet bgs.		2						
		CL									
98					4						
96											
94											
92											

- Boring terminated at 5 feet bgs.
- Minor groundwater seepage noted at 1½ feet bgs.
- No caving encountered.
- Loosely backfilled with excavated material upon completion.

CGT EXPLORATION WITH WDCP HAND AUGER LOGS.GPJ 12/9/20 DRAFTED BY: MLL

Appendix I: WWHM Results water quality

WWHM2012

PROJECT REPORT

General Model Information

Project Name:	Advanced Builders Project Flow Control
Site Name:	63620000
Site Address:	
City:	
Report Date:	11/17/2022
Gage:	Ridgefield
Data Start:	1948/10/01
Data End:	2008/09/30
Timestep:	15 Minute
Precip Scale:	1.110
Version Date:	2021/08/18
Version:	4.2.18

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
SG3, Forest, Mod	0.115
Pervious Total	0.115
Impervious Land Use	acre
Impervious Total	0
Basin Total	0.115

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

Public Road

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
ROADS MOD	0.064
Impervious Total	0.064
Basin Total	0.064

Element Flows To:

Surface	Interflow	Groundwater

Driveway

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
DRIVEWAYS MOD	0.034
Impervious Total	0.034
Basin Total	0.034

Element Flows To:

Surface	Interflow	Groundwater

Sidewalk

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
SIDEWALKS MOD	0.017
Impervious Total	0.017
Basin Total	0.017

Element Flows To:

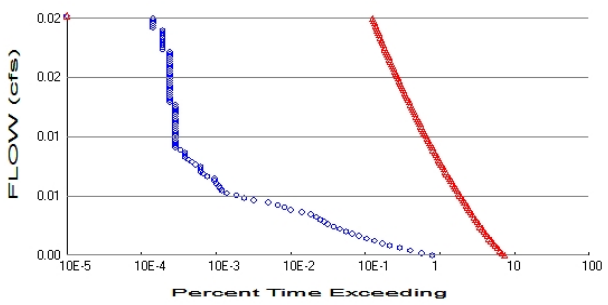
Surface	Interflow	Groundwater

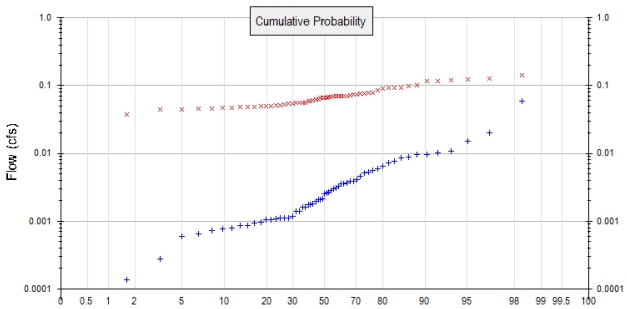
Routing Elements
Predeveloped Routing

Mitigated Routing

Analysis Results

POC 1





\+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 0.115
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 0
Total Impervious Area: 0.115

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.002454
5 year	0.006369
10 year	0.010262
25 year	0.016794
50 year	0.022886
100 year	0.030058

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0.064746
5 year	0.085481
10 year	0.100057
25 year	0.119476
50 year	0.134692
100 year	0.150567

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1949	0.003	0.116
1950	0.003	0.054
1951	0.010	0.065
1952	0.004	0.062
1953	0.003	0.044
1954	0.004	0.079
1955	0.001	0.055
1956	0.015	0.069
1957	0.002	0.046
1958	0.001	0.070

1959	0.002	0.047
1960	0.001	0.056
1961	0.005	0.069
1962	0.001	0.049
1963	0.001	0.062
1964	0.004	0.050
1965	0.003	0.050
1966	0.005	0.077
1967	0.002	0.059
1968	0.004	0.122
1969	0.003	0.093
1970	0.059	0.144
1971	0.002	0.090
1972	0.009	0.070
1973	0.001	0.066
1974	0.011	0.092
1975	0.003	0.048
1976	0.006	0.052
1977	0.000	0.045
1978	0.007	0.065
1979	0.001	0.073
1980	0.004	0.051
1981	0.010	0.086
1982	0.006	0.065
1983	0.020	0.099
1984	0.002	0.045
1985	0.001	0.069
1986	0.001	0.073
1987	0.004	0.060
1988	0.001	0.126
1989	0.001	0.050
1990	0.001	0.076
1991	0.001	0.047
1992	0.002	0.048
1993	0.001	0.055
1994	0.002	0.052
1995	0.001	0.070
1996	0.010	0.092
1997	0.008	0.118
1998	0.002	0.073
1999	0.006	0.055
2000	0.001	0.037
2001	0.000	0.037
2002	0.009	0.071
2003	0.005	0.068
2004	0.001	0.078
2005	0.000	0.102
2006	0.003	0.059
2007	0.002	0.055
2008	0.001	0.117

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.0589	0.1437
2	0.0200	0.1258
3	0.0151	0.1222
4	0.0108	0.1185

5	0.0101	0.1174
6	0.0096	0.1161
7	0.0095	0.1015
8	0.0087	0.0986
9	0.0086	0.0933
10	0.0077	0.0922
11	0.0073	0.0922
12	0.0064	0.0902
13	0.0059	0.0856
14	0.0056	0.0790
15	0.0053	0.0781
16	0.0051	0.0768
17	0.0046	0.0758
18	0.0041	0.0732
19	0.0039	0.0732
20	0.0039	0.0727
21	0.0036	0.0707
22	0.0036	0.0702
23	0.0035	0.0701
24	0.0033	0.0697
25	0.0031	0.0694
26	0.0030	0.0691
27	0.0028	0.0689
28	0.0027	0.0680
29	0.0026	0.0664
30	0.0026	0.0655
31	0.0021	0.0653
32	0.0021	0.0653
33	0.0021	0.0623
34	0.0019	0.0621
35	0.0018	0.0602
36	0.0017	0.0589
37	0.0017	0.0588
38	0.0016	0.0560
39	0.0016	0.0554
40	0.0014	0.0550
41	0.0014	0.0550
42	0.0012	0.0546
43	0.0011	0.0538
44	0.0011	0.0522
45	0.0011	0.0518
46	0.0011	0.0509
47	0.0011	0.0504
48	0.0010	0.0503
49	0.0010	0.0497
50	0.0009	0.0486
51	0.0009	0.0482
52	0.0009	0.0480
53	0.0008	0.0471
54	0.0008	0.0469
55	0.0007	0.0460
56	0.0007	0.0451
57	0.0006	0.0448
58	0.0003	0.0442
59	0.0001	0.0370
60	0.0001	0.0369

Duration Flows

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0012	16429	153664	935	Fail
0.0014	11832	142262	1202	Fail
0.0017	8361	132289	1582	Fail
0.0019	6078	123516	2032	Fail
0.0021	4471	115774	2589	Fail
0.0023	3530	108600	3076	Fail
0.0025	2794	102120	3654	Fail
0.0028	2177	96335	4425	Fail
0.0030	1722	91012	5285	Fail
0.0032	1395	86152	6175	Fail
0.0034	1154	81545	7066	Fail
0.0036	946	77442	8186	Fail
0.0039	790	73361	9286	Fail
0.0041	647	69763	10782	Fail
0.0043	584	66208	11336	Fail
0.0045	523	62884	12023	Fail
0.0047	461	59833	12978	Fail
0.0049	393	56951	14491	Fail
0.0052	297	54321	18289	Fail
0.0054	209	51754	24762	Fail
0.0056	172	49398	28719	Fail
0.0058	140	47105	33646	Fail
0.0060	106	44854	42315	Fail
0.0063	67	42729	63774	Fail
0.0065	50	40878	81756	Fail
0.0067	39	38984	99958	Fail
0.0069	29	37196	128262	Fail
0.0071	25	35534	142136	Fail
0.0074	24	33998	141658	Fail
0.0076	23	32546	141504	Fail
0.0078	21	31032	147771	Fail
0.0080	20	29664	148320	Fail
0.0082	20	28402	142010	Fail
0.0084	16	27140	169625	Fail
0.0087	14	25982	185585	Fail
0.0089	13	24867	191284	Fail
0.0091	13	23815	183192	Fail
0.0093	13	22806	175430	Fail
0.0095	11	21901	199100	Fail
0.0098	10	20990	209900	Fail
0.0100	9	20161	224011	Fail
0.0102	8	19334	241675	Fail
0.0104	8	18541	231762	Fail
0.0106	8	17828	222850	Fail
0.0109	7	17172	245314	Fail
0.0111	6	16463	274383	Fail
0.0113	6	15796	263266	Fail
0.0115	6	15198	253300	Fail
0.0117	6	14615	243583	Fail
0.0119	6	14041	234016	Fail
0.0122	6	13526	225433	Fail
0.0124	6	13027	217116	Fail
0.0126	6	12539	208983	Fail
0.0128	6	12097	201616	Fail

0.0130	6	11657	194283	Fail
0.0133	6	11243	187383	Fail
0.0135	6	10854	180900	Fail
0.0137	6	10452	174200	Fail
0.0139	6	10107	168450	Fail
0.0141	6	9741	162350	Fail
0.0144	6	9389	156483	Fail
0.0146	6	9059	150983	Fail
0.0148	6	8756	145933	Fail
0.0150	6	8462	141033	Fail
0.0152	5	8169	163380	Fail
0.0154	5	7860	157200	Fail
0.0157	5	7568	151360	Fail
0.0159	5	7328	146560	Fail
0.0161	5	7050	141000	Fail
0.0163	5	6804	136080	Fail
0.0165	5	6572	131440	Fail
0.0168	5	6351	127019	Fail
0.0170	5	6162	123240	Fail
0.0172	5	5966	119319	Fail
0.0174	5	5769	115380	Fail
0.0176	5	5560	111200	Fail
0.0179	5	5365	107300	Fail
0.0181	5	5199	103980	Fail
0.0183	5	5022	100440	Fail
0.0185	5	4851	97020	Fail
0.0187	5	4702	94040	Fail
0.0189	5	4559	91180	Fail
0.0192	5	4410	88200	Fail
0.0194	5	4281	85620	Fail
0.0196	5	4128	82560	Fail
0.0198	5	3999	79980	Fail
0.0200	4	3882	97050	Fail
0.0203	4	3766	94150	Fail
0.0205	4	3650	91250	Fail
0.0207	4	3524	88100	Fail
0.0209	4	3433	85825	Fail
0.0211	4	3326	83150	Fail
0.0214	4	3227	80675	Fail
0.0216	4	3141	78525	Fail
0.0218	4	3051	76275	Fail
0.0220	3	2958	98600	Fail
0.0222	3	2895	96500	Fail
0.0224	3	2802	93400	Fail
0.0227	3	2712	90400	Fail
0.0229	3	2628	87600	Fail

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

Water Quality

Water Quality BMP Flow and Volume for POC #1

On-line facility volume:	0.014 acre-feet
On-line facility target flow:	0.0229 cfs.
Adjusted for 15 min:	0.0229 cfs.
Off-line facility target flow:	0.0129 cfs.
Adjusted for 15 min:	0.0129 cfs.

LID Report

LID Technique	Used for Treatment ?	Total Volume Needs Treatment (ac-ft)	Volume Through Facility (ac-ft)	Infiltration Volume (ac-ft)	Cumulative Volume Infiltration Credit	Percent Volume Infiltrated	Water Quality	Percent Water Quality Treated	Comment
Total Volume Infiltrated		0.00	0.00	0.00		0.00	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Failed

Model Default Modifications

Total of 0 changes have been made.

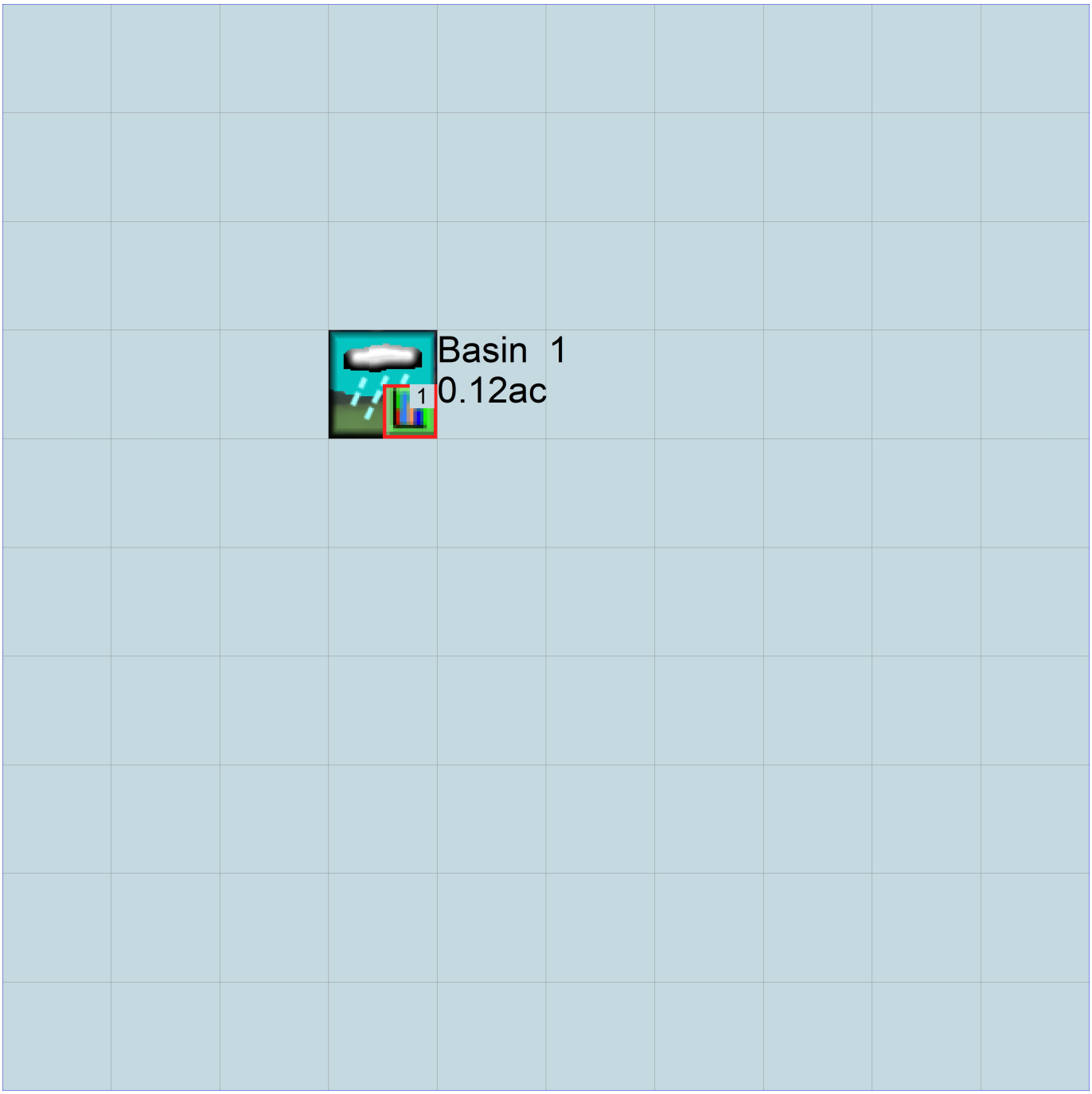
PERLND Changes

No PERLND changes have been made.

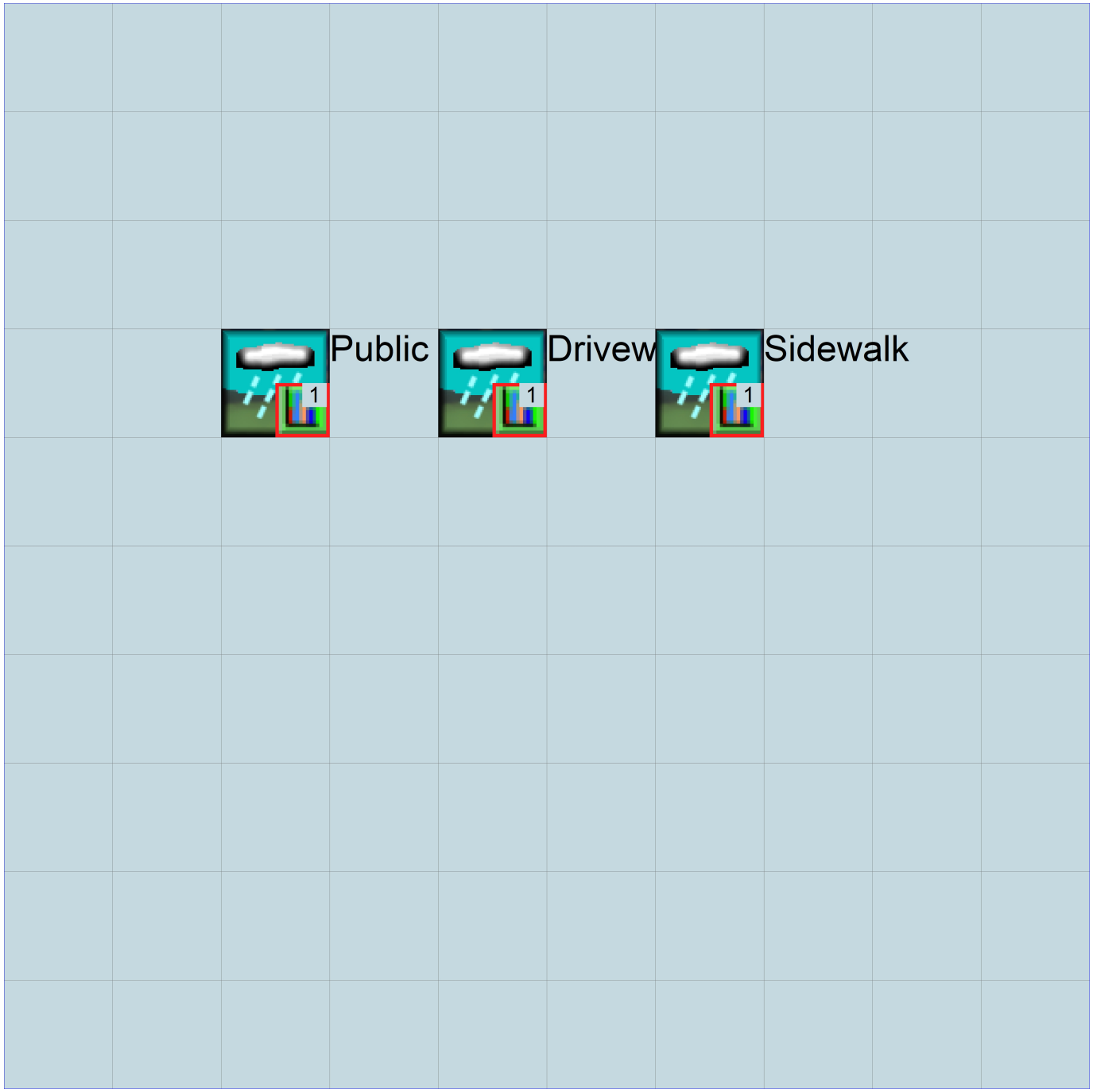
IMPLND Changes

No IMPLND changes have been made.

Appendix
Predeveloped Schematic



Mitigated Schematic



Predeveloped UCI File

Mitigated UCI File

Predeveloped HSPF Message File

Mitigated HSPF Message File

Disclaimer

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Clear Creek Solutions, Inc.
6200 Capitol Blvd. Ste F
Olympia, WA. 98501
Toll Free 1(866)943-0304
Local (360)943-0304

www.clearcreeksolutions.com