Nicholas Washington Ave.

Chehalis, WA

Drainage and Erosion Control Report

Fuller Designs Project No. 20104

June 07th, 2021

Prepared by:

FULLER DESIGNS

1101 Kresky Ave., Centralia, WA 98531; 360-807-4420

PRELIMINARY DRAINAGE AND EROSION CONTROL REPORT

Nicholas Washington Ave.
1176 SE Washington St.
Chehalis, WA 98532

Project Information

Contact: Thomas Nicholas
103 Macronovic Rd
Chehalis, WA 98532

Reviewing Agency

Jurisdiction: City of Chehalis
Contact: Trent Lougheed, City Engineer

References

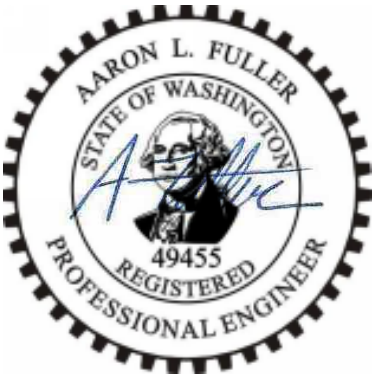
2019 Stormwater Management Manual for Western Washington (SWMMWW)
City of Winlock Design Guidelines (updated 2020)

Project Engineer

Prepared by: Fuller Designs, Inc.
1101 Kresky Ave.
Centralia, WA 98531
(360) 807-4420

Contact: Aaron Fuller, PE

"I hereby certify that this Drainage and Erosion Control Report for the Nicholas Washington Ave. project has been prepared by me or under my supervision and meets minimum standards of the City of Chehalis and normal standards of engineering practice. I hereby acknowledge and agree that the jurisdiction does not and will not assume liability for the sufficiency, suitability, or performance of drainage facilities designed by me."



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DRAINAGE AND EROSION CONTROL REPORT

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SECTION 1 – PROPOSED PROJECT DESCRIPTION

Site Address: 1176 SE Washington St, Chehalis, WA 98532

Parcel Number(s): 005604192001, 005492002000, 005853001000, 005490000000, 00000000000000000005490001000

Total Site Area: 3.02 Acres

Zoning: R1 – Single Family Residential

Sec, Twn, Rge: Section 32, Township 14N, Range 02W

Proposed Improvements
The site is located on Washington St. 350 feet South-East from its intersection with SE 11th St. This project will construct a 24-unit condominium and necessary access/parking.

Stormwater runoff from the proposed impervious areas will be collected via filter catch basins, and then conveyed to an enlarged detention pond just in-site. Runoff will then be sent to the adjacent natural drainage paths.

The lot will be served by:

City of Chehalis	Water
Lewis County Sewer District #4	Sewer
Lewis County PUD	Electricity
Centurylink & Comast	Telecommunications
Lemay	Refuse & Recycling

The subject property is completely bordered by residential zoning in the Chehalis UGA

SECTION 2 – EXISTING CONDITONS DESCRIPTION

The lot currently fronts Washington St. It is composed of 5 parcels, one of the five parcels that had been developed with a small residence and garage which are now demolished with the debris removed. The project area is fairly steep that drains to the south-west property line, reason why a geotechnical report was needed and is part of Section 7.

According to Sieve Analysis Data Sheet it was determined the soil onsite consists of SM (Silty Sand), and SC (Clayey Sand). The soils were determined to have a short-term K-value of 24.65-in/hr, and a long-term K-value of 2.93-in/hr. This Analysis can be found in Section 7 of this report.

The project utilities and improvements will be built in one phase. Asphalt extensions and individual site improvements will be constructed immediately. The proposed construction schedule would start in Spring of 2022 and be complete by Winter 2022.

SECTION 3 – OFFSITE ANALYSIS REPORTS

The area immediately adjacent to the proposed project properties is:

- West – R1 – Single Family Residential
- South – Developed Commercial (Safeway)
- East – R1 – Single Family Residential
- North – R1 – Single Family Residential

A portion of the watershed flows into a gravel road culvert which discharges southwest of the project site, the remaining watershed drains sheet flow towards the southeast of the project site converging with the forementioned watershed. Properties on all other sides are lower than this site and do not contribute runoff.

The proposed project plans to maintain the natural drainage paths by releasing stormwater to current drainage location southwest of the project site. This area has not been flagged as a possible stormwater problem area.

SECTION 4 – APPLICABLE MINIMUM REQUIREMENTS

The minimum requirements for stormwater development and redevelopment sites are listed in Volume I chapter 3 of the 2019 Washington State Department of Ecology Stormwater Management Manual for Western Washington (SWMMWW). Not all minimum requirements of this section apply to all projects. Determination of applicable minimum requirements is based on section I-3.3 of the WSDOE SWMMWW.

Based on the thresholds given in figures I-3.1 and I-3.2 of the SWMMWW, the proposed Nicholas Washington Ave. project will create more than 5000 square feet of new impervious surface and thus must address all minimum requirements. These requirements as they apply to the project are discussed in more detail below.

Minimum Requirement #1 – Preparation of Stormwater Site Plans:

A Stormwater Site Plan has been prepared (see Erosion Control and Drainage Plans).

Minimum Requirement #2 – Construction Stormwater Pollution Prevention Plan

A Construction Stormwater Pollution Prevention Plan (SWPPP) has been prepared. See section 7.

Minimum Requirement #3 – Source Control of Pollution

All known, available, and reasonable source control BMPs shall be applied to the project to limit pollutants from encountering stormwater. Construction specific BMP's will be provided during construction (see Section 7 SWPPP for reference).

Minimum Requirement #4 – Preservation of Natural Drainage Systems and Outfalls

Stormwater leaving the site will be either dispersed toward natural drainages or directed toward the southwestern ditch where runoff currently goes. The same discharge points will be used in both pre and post development. Improvements onsite do not propose to impact natural drainages inside their associated buffers.

Minimum Requirement #5 – On-site Stormwater Management

This project is inside the R1, therefore, List #2 from Section 3.4.5 in Volume I of the SWMMWW is applicable.

The proposed Best Management Practice's (BMP's) are as follows:

Lawn and Landscape Areas:

- All disturbed areas not being covered with a hard surface and all new lawn and landscape areas will contain soils meeting the Post-Construction Soil Quality and Depth (BMP T5.13) requirements.

Roof Areas:

- Roof area on the project shall use Downspout Dispersion (T5.10B), or Perforated Stubouts (T5.10C).

Other Hard Surface Areas:

- Stormwater runoff from the new paved areas will be routed to the proposed stormwater treatment and attenuation.

Minimum Requirement #6 – Runoff Treatment

This project proposes to create more than 5000 square feet of pollution-generating hard surface (PGHS) and is subject to this minimum requirement.

In the present, existing predeveloped condition of the site, runoff flows downhill from the northeastern to the southwestern side of the site, and down to the existing ditches north of the Washington St. In the proposed, developed condition runoff of basin 1 is proposed to be concentrated into 2 storm sewer collection systems to be treated by Contech 1-cartridge 27" storm filter concrete catch-basins, and then discharge into a proposed pond. After collection and treatment, 100-percent of the stormwater runoff will be infiltrated. WWHM2012 (WWHM2012 Report, Section 5) was utilized to determine the facility size necessary for developed condition of basin1. The site was determined to have a long K-value of approximately 2.93-in/hr (Soil Analysis, Section 7), as a factor of safety, a K-value of 2.9-in/hr was utilized.

These catch-basins were sized according to manufactures direction using the 2-year offline flowrate. Offline flow rate is appropriate for these devices as higher flows are bypassed via internal weir. Cartridges are rated to handle approximately 18.79 gpm each. Basin 1 has a flow rate of 35.52 gpm which divided by the 2 cartridges result in less than the 18.79 gpm maximum capacity, therefore this treatment is appropriate.

Minimum Requirement #7 – Flow Control

The development pre and post runoff rates were compared based on existing and proposed land coverage types using the WWHM2012 continuous inflow model. Runoff stormwater from this site will be completely treated and infiltrated within the treatment methods and flow control will not be required.

Minimum Requirement #8 – Wetlands Protection

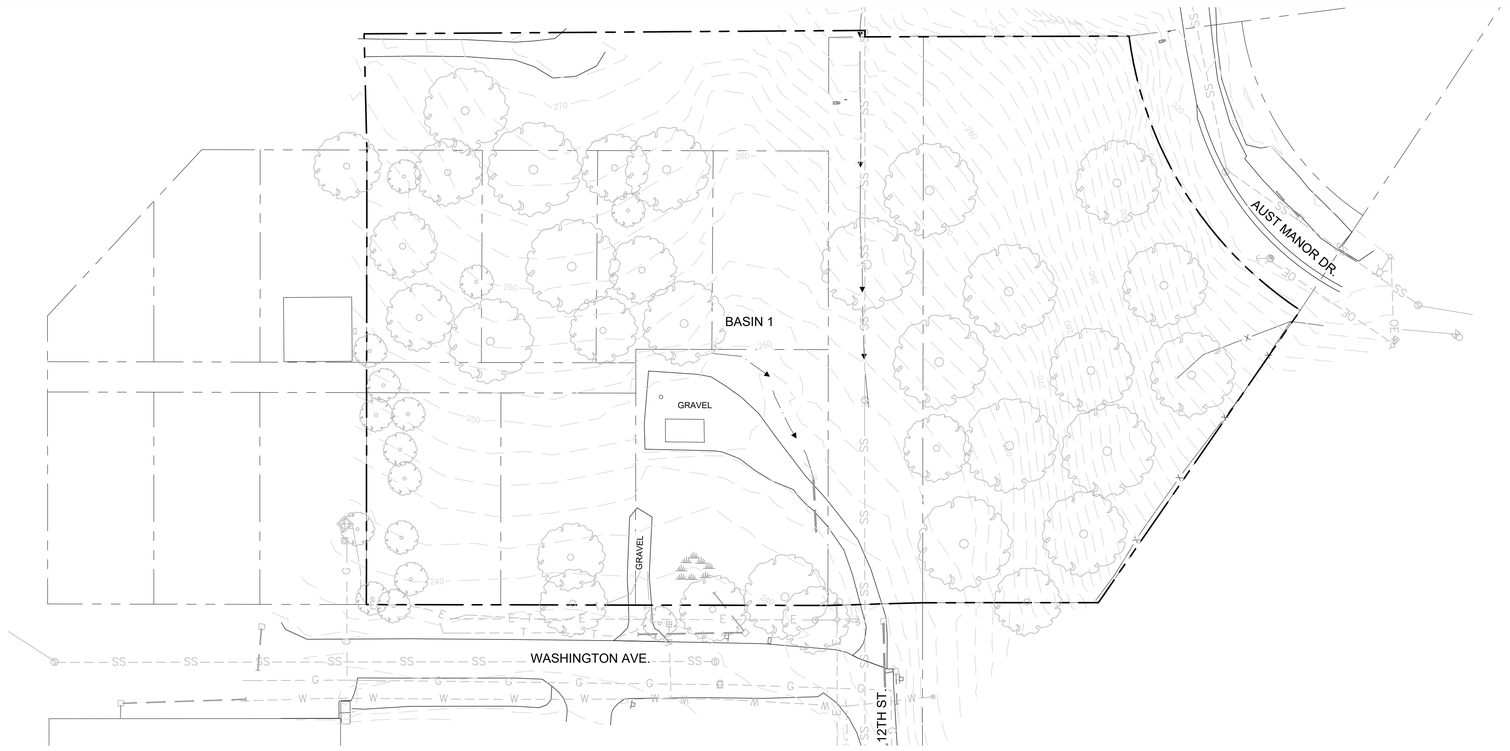
The thresholds identified in Minimum Requirement #6 – Runoff Treatment, and Minimum Requirement #7 – Flow Control are used to determine the applicability of this requirement to discharges to wetlands. Since Minimum Requirements #6 and #7 are properly mitigated, Minimum Requirement #8 is considered satisfied.

Minimum Requirement #9 – Operation and Maintenance

Maintenance of storm drainage facilities (catch basins, pond, French drain, etc..) will be the responsibility of the landowner whose property the individual structure is located on. All improvements within Washington Ave. and Aust Manor right-of-way (roadside ditches, culverts, etc..) will be maintained by Lewis County. A storm drainage operation and maintenance plan are included in this report. If required by the City of Chehalis, a performance bond or security can be obtained prior to final approval.

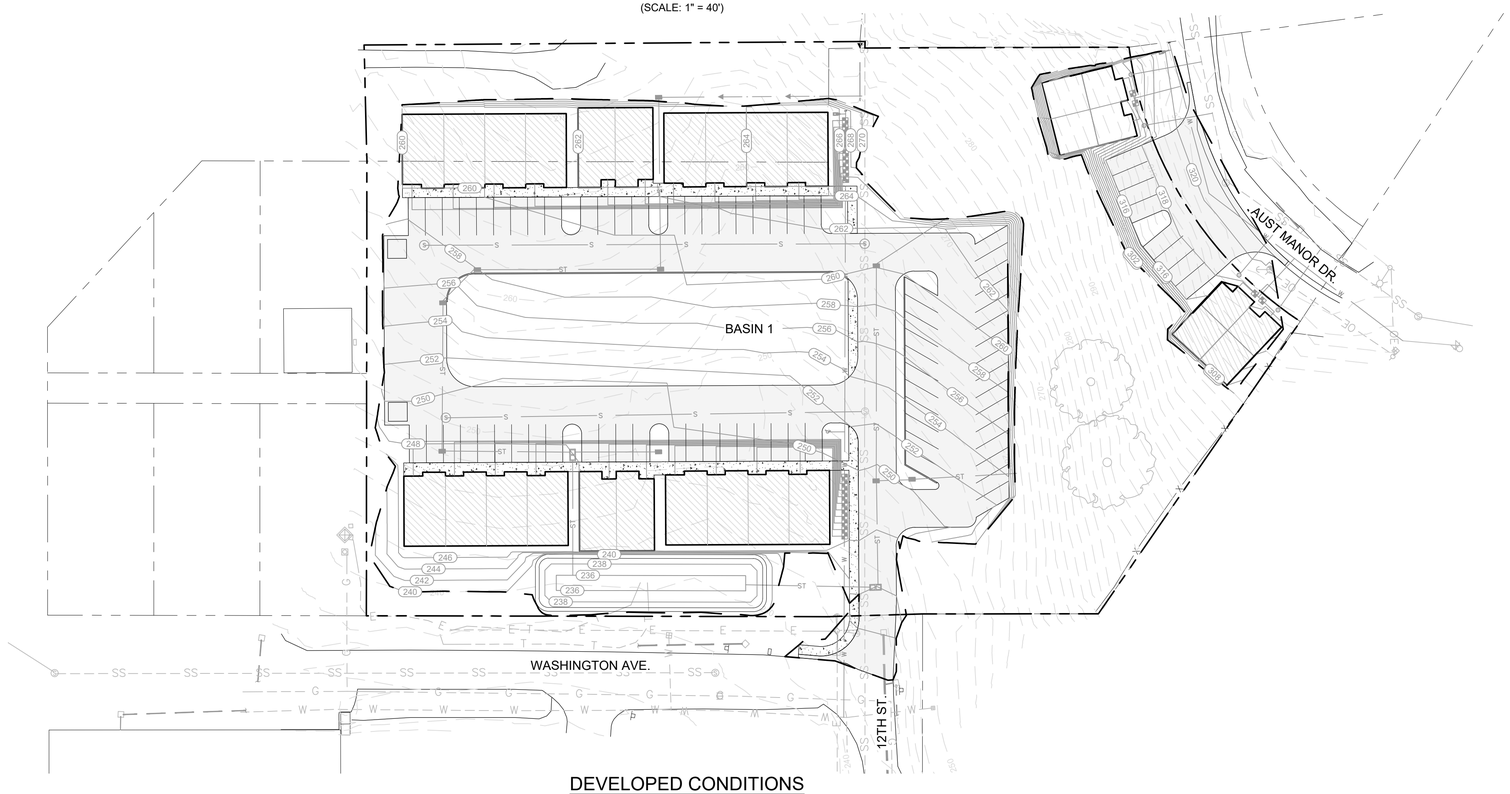
SECTION 5 – PERMANENT STORMWATER CONTROL PLAN

A pre/post basin flow control analysis, basin map, sub basin water quality analysis calculation has been provided in the next few pages.



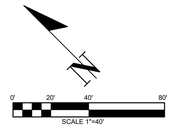
EXISTING CONDITIONS

(SCALE: 1" = 40')



DEVELOPED CONDITIONS

(SCALE: 1" = 40')



EXISTING CONDITIONS

BASIN 1

EXISTING FOREST	2.32 AC
EXISTING LAWN	0.58 AC
EXISTING GRAVEL	0.12 AC
BASIN 1 TOTAL	3.02 AC

DEVELOPED CONDITIONS

BASIN 1

EXISTING FOREST	0.66 AC
EXISTING GRAVEL	0.03 AC
EXISTING LAWN	0.66 AC
PROPOSED LAWN	0.38 AC
PROPOSED ASPHALT	0.74 AC
PROPOSED ROOF	0.45 AC
PROPOSED CONCRETE	0.1 AC
BASIN 1 TOTAL	3.02 AC

PRELIMINARY
FOR PERMIT ONLY

DRAWING TITLE: BASIN MAP
SCALE: 1" = 40'
DATE: 06/07/21
DRAWN: MM
CHECKED: ALF
PROJECT NAME: NICHOLAS WASHINGTON AVE.

06/14/2021

AARON L. FULLER
STATE OF WASHINGTON
49455
REGISTERED
PROFESSIONAL ENGINEER

12/21/2022

FULLER DESIGNS
1101 KRESKY AVE
CENTRALIA, WA 98531
(360) 807-4420

REV:	DESCRIPTION:	DATE:
0	PRELIMINARY - FOR PERMIT	06/07/21

BASIN

1 OF 1

WWHM2012

PROJECT REPORT

General Model Information

Project Name:	BASIN 1
Site Name:	Washington Ave
Site Address:	0 Washington Ave
City:	Chehalis
Report Date:	6/6/2021
Gage:	Olympia
Data Start:	1955/10/01
Data End:	2008/09/30
Timestep:	15 Minute
Precip Scale:	0.800
Version Date:	2019/09/13
Version:	4.2.17

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
A B, Forest, Steep	2.32
A B, Lawn, Steep	0.58
Pervious Total	2.9

Impervious Land Use	acre
ROADS FLAT	0.12
Impervious Total	0.12
Basin Total	3.02

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

Basin 1

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
A B, Lawn, Mod	0.38
A B, Forest, Steep	0.66
A B, Lawn, Steep	0.66
Pervious Total	1.7

Impervious Land Use	acre
ROADS FLAT	0.03
ROADS MOD	0.74
SIDEWALKS FLAT	0.1
Impervious Total	0.87
Basin Total	2.57

Element Flows To:

Surface	Interflow	Groundwater
Trapezoidal Pond 1	Trapezoidal Pond 1	

Routing Elements
Predeveloped Routing

Mitigated Routing

Trapezoidal Pond 1

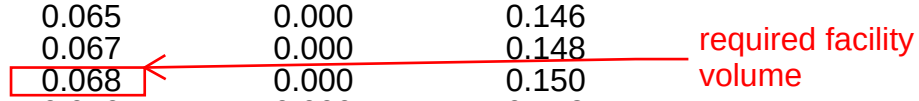
facility depth

Bottom Length:	100.00 ft.
Bottom Width:	8.00 ft.
Depth:	3 ft.
Volume at riser head:	0.1288 acre-feet.
Infiltration On	
Infiltration rate:	2.9
Infiltration safety factor:	1
Wetted surface area On	
Total Volume Infiltrated (ac-ft.):	129.203
Total Volume Through Riser (ac-ft.):	0
Total Volume Through Facility (ac-ft.):	129.203
Percent Infiltrated:	100
Total Precip Applied to Facility:	0
Total Evap From Facility:	0.347
Side slope 1:	3 To 1
Side slope 2:	3 To 1
Side slope 3:	3 To 1
Side slope 4:	3 To 1
Discharge Structure	
Riser Height:	0 ft.
Riser Diameter:	0 in.
Element Flows To:	
Outlet 1	Outlet 2

Pond Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.018	0.000	0.000	0.000
0.0333	0.018	0.000	0.000	0.055
0.0667	0.019	0.001	0.000	0.056
0.1000	0.019	0.001	0.000	0.058
0.1333	0.020	0.002	0.000	0.059
0.1667	0.020	0.003	0.000	0.061
0.2000	0.021	0.004	0.000	0.062
0.2333	0.021	0.004	0.000	0.064
0.2667	0.022	0.005	0.000	0.065
0.3000	0.022	0.006	0.000	0.067
0.3333	0.023	0.007	0.000	0.068
0.3667	0.023	0.007	0.000	0.070
0.4000	0.024	0.008	0.000	0.071
0.4333	0.025	0.009	0.000	0.073
0.4667	0.025	0.010	0.000	0.074
0.5000	0.026	0.011	0.000	0.076
0.5333	0.026	0.012	0.000	0.077
0.5667	0.027	0.012	0.000	0.079
0.6000	0.027	0.013	0.000	0.080
0.6333	0.028	0.014	0.000	0.082
0.6667	0.028	0.015	0.000	0.083
0.7000	0.029	0.016	0.000	0.085
0.7333	0.029	0.017	0.000	0.086
0.7667	0.030	0.018	0.000	0.088
0.8000	0.030	0.019	0.000	0.090
0.8333	0.031	0.020	0.000	0.091

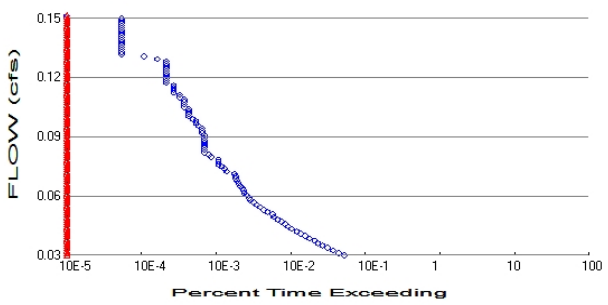
0.8667	0.031	0.021	0.000	0.093
0.9000	0.032	0.022	0.000	0.094
0.9333	0.033	0.023	0.000	0.096
0.9667	0.033	0.025	0.000	0.098
1.0000	0.034	0.026	0.000	0.099
1.0333	0.034	0.027	0.000	0.101
1.0667	0.035	0.028	0.000	0.102
1.1000	0.035	0.029	0.000	0.104
1.1333	0.036	0.030	0.000	0.106
1.1667	0.036	0.032	0.000	0.107
1.2000	0.037	0.033	0.000	0.109
1.2333	0.038	0.034	0.000	0.111
1.2667	0.038	0.035	0.000	0.112
1.3000	0.039	0.037	0.000	0.114
1.3333	0.039	0.038	0.000	0.116
1.3667	0.040	0.039	0.000	0.117
1.4000	0.040	0.041	0.000	0.119
1.4333	0.041	0.042	0.000	0.121
1.4667	0.042	0.043	0.000	0.122
1.5000	0.042	0.045	0.000	0.124
1.5333	0.043	0.046	0.000	0.126
1.5667	0.043	0.048	0.000	0.127
1.6000	0.044	0.049	0.000	0.129
1.6333	0.044	0.051	0.000	0.131
1.6667	0.045	0.052	0.000	0.132
1.7000	0.046	0.054	0.000	0.134
1.7333	0.046	0.055	0.000	0.136
1.7667	0.047	0.057	0.000	0.138
1.8000	0.047	0.058	0.000	0.139
1.8333	0.048	0.060	0.000	0.141
1.8667	0.049	0.062	0.000	0.143
1.9000	0.049	0.063	0.000	0.145
1.9333	0.050	0.065	0.000	0.146
1.9667	0.050	0.067	0.000	0.148
2.0000	0.051	0.068	0.000	0.150
2.0333	0.052	0.070	0.000	0.152
2.0667	0.052	0.072	0.000	0.153
2.1000	0.053	0.073	0.000	0.155
2.1333	0.053	0.075	0.000	0.157
2.1667	0.054	0.077	0.000	0.159
2.2000	0.055	0.079	0.000	0.161
2.2333	0.055	0.081	0.000	0.162
2.2667	0.056	0.083	0.000	0.164
2.3000	0.057	0.084	0.000	0.166
2.3333	0.057	0.086	0.000	0.168
2.3667	0.058	0.088	0.000	0.170
2.4000	0.058	0.090	0.000	0.172
2.4333	0.059	0.092	0.000	0.173
2.4667	0.060	0.094	0.000	0.175
2.5000	0.060	0.096	0.000	0.177
2.5333	0.061	0.098	0.000	0.179
2.5667	0.062	0.100	0.000	0.181
2.6000	0.062	0.102	0.000	0.183
2.6333	0.063	0.105	0.000	0.185
2.6667	0.063	0.107	0.000	0.186
2.7000	0.064	0.109	0.000	0.188
2.7333	0.065	0.111	0.000	0.190
2.7667	0.065	0.113	0.000	0.192

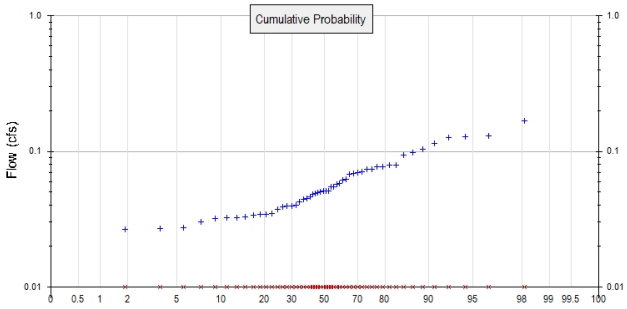


2.8000	0.066	0.115	0.000	0.194
2.8333	0.067	0.118	0.000	0.196
2.8667	0.067	0.120	0.000	0.198
2.9000	0.068	0.122	0.000	0.200
2.9333	0.069	0.124	0.000	0.202
2.9667	0.069	0.127	0.000	0.204
3.0000	0.070	0.129	0.000	0.206
3.0333	0.071	0.131	0.000	0.207

Analysis Results

POC 1





\+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 2.9
Total Impervious Area: 0.12

Mitigated Landuse Totals for POC #1
Total Pervious Area: 1.7
Total Impervious Area: 0.87

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.052228
5 year	0.078496
10 year	0.098444
25 year	0.126641
50 year	0.149882
100 year	0.175093

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0
5 year	0
10 year	0
25 year	0
50 year	0
100 year	0

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1956	0.057	0.000
1957	0.094	0.000
1958	0.048	0.000
1959	0.039	0.000
1960	0.067	0.000
1961	0.071	0.000
1962	0.033	0.000
1963	0.131	0.000
1964	0.077	0.000
1965	0.073	0.000

1966	0.032	0.000
1967	0.044	0.000
1968	0.032	0.000
1969	0.032	0.000
1970	0.043	0.000
1971	0.040	0.000
1972	0.079	0.000
1973	0.030	0.000
1974	0.050	0.000
1975	0.050	0.000
1976	0.069	0.000
1977	0.058	0.000
1978	0.055	0.000
1979	0.062	0.000
1980	0.037	0.000
1981	0.097	0.000
1982	0.049	0.000
1983	0.073	0.000
1984	0.051	0.000
1985	0.034	0.000
1986	0.061	0.000
1987	0.168	0.000
1988	0.027	0.000
1989	0.040	0.000
1990	0.115	0.000
1991	0.127	0.000
1992	0.034	0.000
1993	0.027	0.000
1994	0.026	0.000
1995	0.040	0.000
1996	0.070	0.000
1997	0.079	0.000
1998	0.077	0.000
1999	0.045	0.000
2000	0.055	0.000
2001	0.034	0.000
2002	0.046	0.000
2003	0.024	0.000
2004	0.051	0.000
2005	0.035	0.000
2006	0.051	0.000
2007	0.129	0.000
2008	0.104	0.000

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.1678	0.0000
2	0.1307	0.0000
3	0.1288	0.0000
4	0.1273	0.0000
5	0.1149	0.0000
6	0.1036	0.0000
7	0.0973	0.0000
8	0.0938	0.0000
9	0.0793	0.0000
10	0.0790	0.0000
11	0.0773	0.0000

12	0.0771	0.0000
13	0.0733	0.0000
14	0.0733	0.0000
15	0.0711	0.0000
16	0.0695	0.0000
17	0.0687	0.0000
18	0.0675	0.0000
19	0.0621	0.0000
20	0.0612	0.0000
21	0.0579	0.0000
22	0.0569	0.0000
23	0.0549	0.0000
24	0.0548	0.0000
25	0.0510	0.0000
26	0.0508	0.0000
27	0.0507	0.0000
28	0.0499	0.0000
29	0.0495	0.0000
30	0.0487	0.0000
31	0.0484	0.0000
32	0.0460	0.0000
33	0.0448	0.0000
34	0.0442	0.0000
35	0.0426	0.0000
36	0.0399	0.0000
37	0.0398	0.0000
38	0.0396	0.0000
39	0.0392	0.0000
40	0.0375	0.0000
41	0.0346	0.0000
42	0.0343	0.0000
43	0.0341	0.0000
44	0.0336	0.0000
45	0.0328	0.0000
46	0.0323	0.0000
47	0.0322	0.0000
48	0.0318	0.0000
49	0.0300	0.0000
50	0.0272	0.0000
51	0.0268	0.0000
52	0.0264	0.0000
53	0.0240	0.0000

Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0261	980	0	0	Pass
0.0274	814	0	0	Pass
0.0286	693	0	0	Pass
0.0299	584	0	0	Pass
0.0311	497	0	0	Pass
0.0324	431	0	0	Pass
0.0336	387	0	0	Pass
0.0349	332	0	0	Pass
0.0361	291	0	0	Pass
0.0374	250	0	0	Pass
0.0386	223	0	0	Pass
0.0399	192	0	0	Pass
0.0411	173	0	0	Pass
0.0424	156	0	0	Pass
0.0436	141	0	0	Pass
0.0449	124	0	0	Pass
0.0461	111	0	0	Pass
0.0474	106	0	0	Pass
0.0486	91	0	0	Pass
0.0499	81	0	0	Pass
0.0511	72	0	0	Pass
0.0524	66	0	0	Pass
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0.0924	12	0	0	Pass
0.0936	11	0	0	Pass
0.0949	10	0	0	Pass
0.0961	10	0	0	Pass
0.0974	9	0	0	Pass
0.0986	8	0	0	Pass
0.0999	8	0	0	Pass
0.1011	8	0	0	Pass
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0.1199	4	0	0	Pass
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0.1286	3	0	0	Pass
0.1299	2	0	0	Pass
0.1311	1	0	0	Pass
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0.1336	1	0	0	Pass
0.1349	1	0	0	Pass
0.1361	1	0	0	Pass
0.1374	1	0	0	Pass
0.1386	1	0	0	Pass
0.1399	1	0	0	Pass
0.1411	1	0	0	Pass
0.1424	1	0	0	Pass
0.1436	1	0	0	Pass
0.1449	1	0	0	Pass
0.1461	1	0	0	Pass
0.1474	1	0	0	Pass
0.1486	1	0	0	Pass
0.1499	1	0	0	Pass

Water Quality

Water Quality BMP Flow and Volume for POC #1

On-line facility volume:	0.1151 acre-feet
On-line facility target flow:	0.1393 cfs.
Adjusted for 15 min:	0.1393 cfs.
Off-line facility target flow:	0.0791 cfs.
Adjusted for 15 min:	0.0791 cfs.

WQ flow is 35.52gpm

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
Trapezoidal Pond 1 POC	☐	117.57			☐	100.00			
Total Volume Infiltrated		117.57	0.00	0.00		100.00	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Passed

Model Default Modifications

Total of 0 changes have been made.

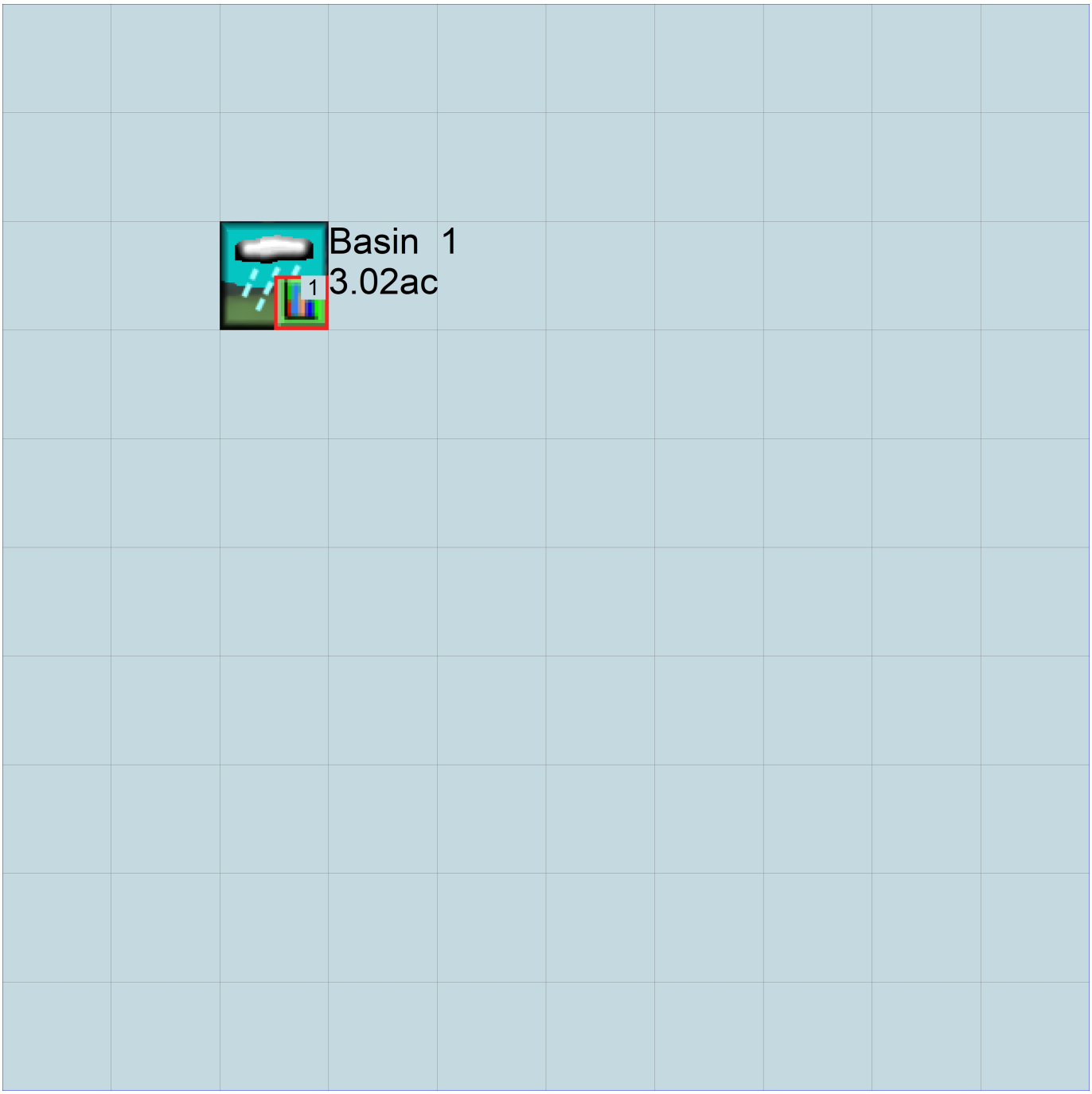
PERLND Changes

No PERLND changes have been made.

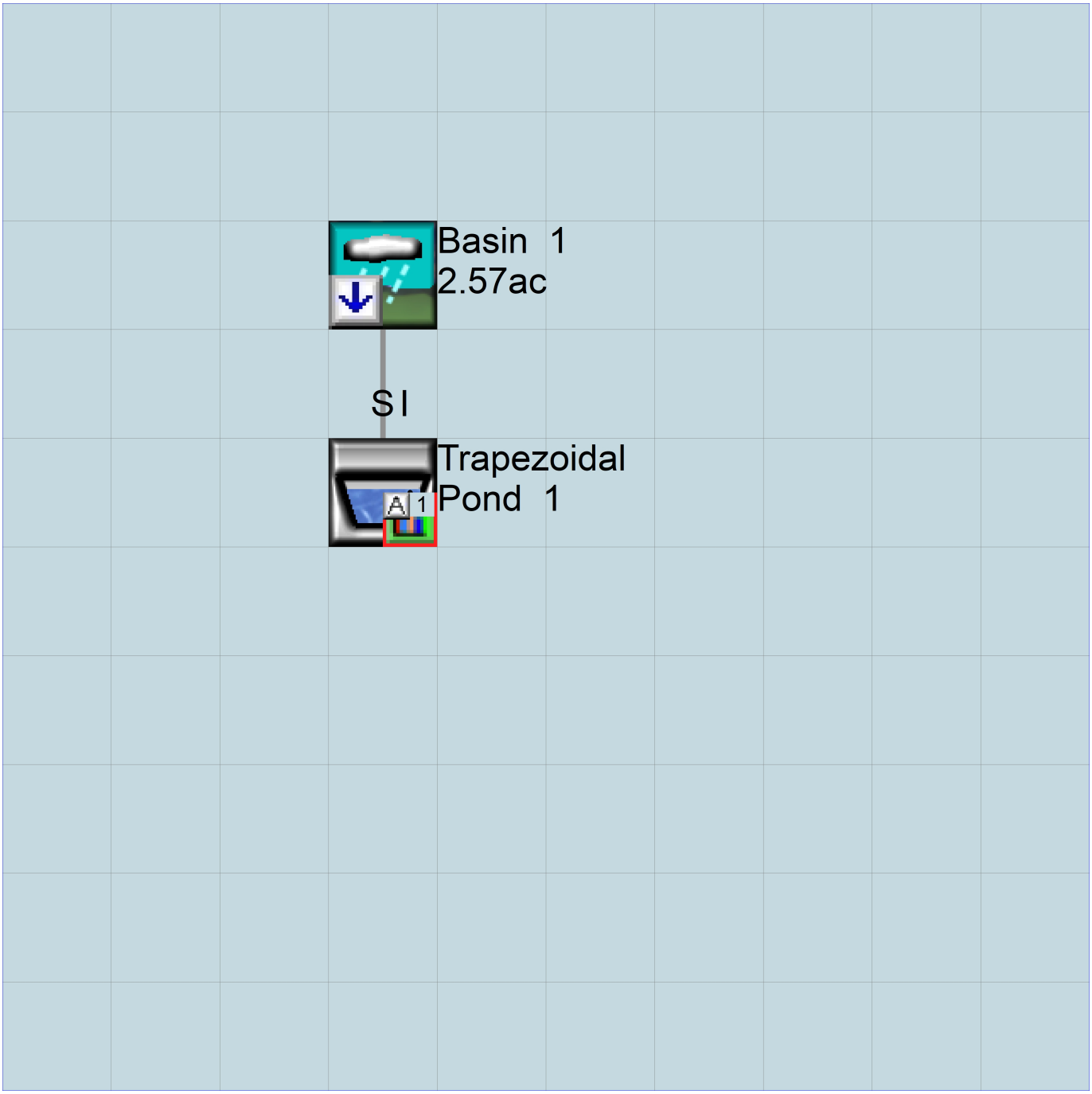
IMPLND Changes

No IMPLND changes have been made.

Appendix
Predeveloped Schematic



Mitigated Schematic



SECTION 6 – CONSTRUCTION SWPPP

This project is required to prepare a construction Storm Water Pollution Prevention Plan in accordance with Minimum Requirement #2 and must be prepared in accordance with Volume II chapter 3 of the SWMMWW.

This drainage and erosion control report is intended to supplement the construction SWPPP by utilizing other sections in this report to cover required narrative elements. Also, the construction and erosion control plans supplied for the project are to act as the required drawing component of the construction SWPPP.

Intended BMPs which should be used during construction include but are not limited to:

- BMP C101: Preserving Natural Vegetation
- BMP C102: Buffer Zones
- BMP C105: Stabilized Construction Entrance / Exit
- BMP C120: Temporary and Permanent Seeding
- BMP C140: Dust Control
- BMP C153: Material Delivery, Storage and Containment
- BMP C160: Certified Erosion and Sediment Control Lead
- BMP C162: Scheduling
- BMP C220: Inlet Protection
- BMP C233: Silt Fence

CONSTRUCTION STORMWATER POLLUTION PREVENTION PLAN (SWPPP)

FOR

Nicholas Washington Ave.

1176 SE Washington St.

Chehalis, WA 98532

Prepared by:

FULLER DESIGNS

1101 Kresky Ave.
Centralia, WA 98531
(360) 807-4420

General Requirements

Clearing and grading activities for this project shall be permitted only to the approved site development plan. These clearing and grading areas were established to preserve sensitive areas, buffers, native growth protection easements, and tree retention areas. These areas are delineated on the site plans and shall be marked on the development site.

The SWPPP shall be implemented beginning with initial land disturbance and until final stabilization. Sediment and Erosion control BMPs shall be consistent with the BMPs contained in chapters 3 and 4 of Volume II of the SWMMWW.

Seasonal Work Limitations - From October 15 through April 1, clearing, grading, and other soil disturbing activities shall only be permitted if shown to the satisfaction of the local permitting authority that silt-laden runoff will be prevented from leaving the site through a combination of the following:

1. Site conditions including existing vegetative coverage, slope, soil type and proximity to receiving waters.
2. Limitations on activities and the extent of disturbed areas.
3. Proposed erosion and sediment control measures.

Project Requirements - Construction SWPPP Elements

In most cases, all the following elements shall apply and be implemented throughout construction. Self-contained sites (discharges only to groundwater) must comply with all elements except for Element 3: Control Flow Rates.

Element 1: Preserve Vegetation/Mark Clearing Limits

- Before beginning land disturbing activities, including clearing and grading, clearly mark all clearing limits, sensitive areas and their buffers, and trees that are to be preserved within the construction area.
- Retain the duff layer, native topsoil, and natural vegetation in an undisturbed state to the maximum degree practicable.

Element 2: Establish Construction Access

- Limit construction vehicle access and exit to one route, if possible.
- Stabilize access points with a pad of quarry spalls, crushed rock, or other equivalent BMPs, to minimize tracking of sediment onto public roads.
- Locate wheel wash or tire baths on site. If the stabilized construction entrance is not effective in preventing tracking sediment onto roads.
- If sediment is tracked off site, clean the affected roadway thoroughly at the end of each day, or more frequently as necessary (for example, during wet weather). Remove sediment from roads by shoveling, sweeping, or pick up and transport the sediment to a controlled sediment disposal area.
- Conduct street washing only after sediment is removed in accordance with the above bullet.

- Control street wash wastewater by pumping back on-site, or otherwise prevent it from discharging into systems tributary to waters of the State.

Element 3: Control Flow Rates

- Protect properties and waterways downstream of development sites from erosion and the associated discharge of turbid waters due to increases in the velocity and peak volumetric flow rate of stormwater runoff from the project site.
- Where necessary to comply with the bullet above, construct stormwater retention or detention facilities as one of the first steps in grading. Assure that detention facilities function properly before constructing site improvements (e.g. impervious surfaces).
- If permanent infiltration ponds are used for flow control during construction, protect these facilities from siltation during the construction phase.

Element 4: Install Sediment Controls

- Design, install, and maintain effective erosion controls and sediment controls to minimize the discharge of pollutants.
- Construct sediment control BMPs (sediment ponds, traps, filters, etc.) as one of the first steps in grading. These BMPs shall be functional before other land disturbing activities take place.
- Minimize sediment discharges from the site. The design, installation and maintenance of erosion and sediment controls must address factors such as the amount, frequency, intensity and duration of precipitation, the nature of resulting stormwater runoff, and soil characteristics, including the range of soil particle sizes expected to be present on the site.
- Direct stormwater runoff from disturbed areas through a sediment pond or other appropriate sediment removal BMP, before the runoff leaves a construction site or before discharge to an infiltration facility. Runoff from fully stabilized areas may be discharged without a sediment removal BMP but must meet the flow control performance standard in Element #3, bullet #1.
- Locate BMPs intended to trap sediment on-site in a manner to avoid interference with the movement of juvenile salmonids attempting to enter off-channel areas or drainages.
- Where feasible, design outlet structures that withdraw impounded stormwater from the surface to avoid discharging sediment that is still suspended lower in the water column.

Element 5: Stabilize Soils

- Stabilize exposed and unworked soils by application of effective BMPs that prevent erosion. Applicable BMPs include but are not limited to: temporary and permanent seeding, sodding, mulching, plastic covering, erosion control fabrics and matting, soil application of polyacrylamide (PAM), the early application of gravel base early on areas to be paved, and dust control.
- Control stormwater volume and velocity within the site to minimize soil erosion.
- Control stormwater discharges, including both peak flow rates and total stormwater volume, to minimize erosion at outlets and to minimize downstream channel and stream bank erosion.
- Soils must not remain exposed and unworked for more than the time periods set forth below to prevent erosion:
    - During the dry season (April 2 – October 14): 7 days

    - During the wet season (October 15 - April 1): 2 days
    - Note that projects performing work under a NPDES Construction Stormwater General Permit issued by Ecology will have more restrictive time periods.
- Stabilize soils at the end of the shift before a holiday or weekend if needed based on the weather forecast.
- Stabilize soil stockpiles from erosion, protected with sediment trapping measures, and where possible, be located away from storm drain inlets, waterways and drainage channels.
- Minimize the amount of soil exposed during construction activity.
- Minimize the disturbance of steep slopes.
- Minimize soil compaction and, unless infeasible, preserve topsoil.

Element 6: Protect Slopes

- Design and construct cut-and-fill slopes in a manner to minimize erosion. Applicable practices include, but are not limited to, reducing continuous length of slope with terracing and diversions, reducing slope steepness, and roughening slope surfaces (for example, track walking).
- Divert off-site stormwater (run-on) or ground water away from slopes and disturbed areas with interceptor dikes, pipes and/or swales. Off-site stormwater should be managed separately from stormwater generated on the site.
- At the top of slopes, collect drainage in pipe slope drains or protected channels to prevent erosion.
- Place excavated material on the uphill side of trenches, consistent with safety and space considerations.
- Place check dams at regular intervals within constructed channels that are cut down a slope.

Element 7: Protect Drain Inlets

- Protect all storm drain inlets made operable during construction so that stormwater runoff shall not enter the conveyance system without first being filtered or treated to remove sediment.
- Clean or remove and replace inlet protection devices when sediment has filled one-third of the available storage (unless a different standard is specified by the product manufacturer).

Element 8: Stabilize Channels and Outlets

- Design, construct, and stabilize all on-site conveyance channels.
- Provide stabilization, including armoring material, adequate to prevent erosion of outlets, adjacent stream banks, slopes and downstream reaches at the outlets of all conveyance systems.

Element 9: Control Pollutants

- Design, install, implement and maintain effective pollution prevention measures to minimize the discharge of pollutants.

- Handle and dispose of all pollutants, including waste materials and demolition debris that occur on-site in a manner that does not cause contamination of stormwater.
- Provide cover, containment, and protection from vandalism for all chemicals, liquid products, petroleum products, and other materials that have the potential to pose a threat to human health or the environment. On-site fueling tanks must include secondary containment. Secondary containment means placing tanks or containers within an impervious structure capable of containing 110% of the volume contained in the largest take within the containment structure. Double-walled tanks do not require additional secondary containment.
- Conduct maintenance, fueling, and repair of heavy equipment and vehicles using spill prevention and control measures. Clean contaminated surfaces immediately following any spill incident.
- Discharge wheel wash or tire bath wastewater to a separate on-site treatment system that prevents discharge to surface water, such as closed-loop recirculation or upland application, or to the sanitary sewer, with local sewer district approval.
- Apply fertilizers and pesticides in a manner and at application rates that will not result in loss of chemical to stormwater runoff. Follow manufacturers' label requirements for application rates and procedures.
- Use BMPs to prevent contamination of stormwater runoff by pH modifying sources. The sources for this contamination include, but are not limited to: bulk cement, cement kiln dust, fly ash, new concrete washing and curing waters, waste streams generated from concrete grinding and sawing, exposed aggregate processes, dewatering concrete vaults, concrete pumping and mixer washout waters.
- Adjust the pH of stormwater if necessary to prevent violations of water quality standards.
- Assure that washout of concrete trucks is performed off-site or in designated concrete washout areas only. Do not wash out concrete trucks onto the ground, or into storm drains, open ditches, streets, or streams. Do not dump excess concrete on-site, except in designated concrete washout areas. Concrete spillage or concrete discharge to surface waters of the State is prohibited.
- Obtain written approval from Ecology before using chemical treatment other than CO2 or dry ice to adjust pH.

Element 10: Control De-Watering

- Discharge foundation, vault, and trench de-watering water, which has similar characteristics to stormwater runoff at the site, into a controlled conveyance system before discharge to a sediment trap or sediment pond.
- Discharge clean, non-turbid de-watering water, such as well-point ground water, to systems tributary to, or directly into surface waters of the State, as specified in Element #8, provided the de-watering flow does not cause erosion or flooding of receiving waters. Do not route clean dewatering water through stormwater sediment ponds. Note that "surface waters of the State" may exist on a construction site as well as off site; for example, a creek running through a site.
- Handle highly turbid or otherwise contaminated dewatering water separately from stormwater.
- Other treatment or disposal options may include:
    1. Infiltration.

2. Transport off-site in a vehicle, such as a vacuum flush truck, for legal disposal in a manner that does not pollute state waters.
3. Ecology-approved on-site chemical treatment or other suitable treatment technologies.
4. Sanitary or combined sewer discharge with local sewer district approval, if there is no other option.
5. Use of a sedimentation bag that discharges to a ditch or swale for small volumes of localized dewatering.

Element 11: Maintain BMPs

- Maintain and repair all temporary and permanent erosion and sediment control BMPs as needed to assure continued performance of their intended function in accordance with BMP specifications.
- Remove all temporary erosion and sediment control BMPs within 30 days after achieving final site stabilization or after the temporary BMPs are no longer needed.

Element 12: Manage the Project

- Phase development projects to the maximum degree practicable and consider seasonal work limitations.
- Inspection and monitoring – Inspect, maintain and repair all BMPs as needed to assure continued performance of their intended function. Projects regulated under the Construction Stormwater General Permit must conduct site inspections and monitoring in accordance with Special Condition S4 of the Construction Stormwater General Permit.
- Maintaining an updated construction SWPPP – Maintain, update, and implement the SWPPP.
- Projects that disturb one or more acres must have site inspections conducted by a Certified Erosion and Sediment Control Lead (CESCL). Project sites disturbing less than one acre may have a CESCL or a person without CESCL certification conduct inspections. By the initiation of construction, the SWPPP must identify the CESCL or inspector, who must be present onsite or on-call at all times.
- The CESCL or inspector (project sites less than one acre) must have the skills to assess the:
    - Site conditions and construction activities that could impact the quality of stormwater.
    - Effectiveness of erosion and sediment control measures used to control the quality of stormwater discharges.
- The CESCL or inspector must examine stormwater visually for the presence of suspended sediment, turbidity, discoloration, and oil sheen. They must evaluate the effectiveness of BMPs and determine if it is necessary to install, maintain, or repair BMPs to improve the quality of stormwater discharges.
- Based on the results of the inspection, construction site operators must correct the problems identified by:
    - Reviewing the SWPPP for compliance with the 13 construction SWPPP elements and making appropriate revisions within seven (7) calendar days of the inspection.
- Immediately beginning the process of fully implementing and maintaining appropriate source control and/or treatment BMPs as soon as possible, addressing the problems not

later than within 10 days of the inspection. If installation of necessary treatment BMPs is not feasible within 10 days, the construction site operator may request an extension within the initial 10day response period.

- Documenting BMP implementation and maintenance in the site log book (sites larger than 1 acre).
- The CESCL or inspector must inspect all areas disturbed by construction activities, all BMPs, and all stormwater discharge points at least once every calendar week and within 24 hours of any discharge from the site. (For purposes of this condition, individual discharge events that last more than one day do not require daily inspections. For example, if a stormwater pond discharges continuously over the course of a week, only one inspection is required that week.) The CESCL or inspector may reduce the inspection frequency for temporary stabilized, inactive sites to once every calendar month.

Element 13: Protect Low Impact Development BMPs

- Protect all Bioretention and Rain Garden BMPs from sedimentation through installation and maintenance of erosion and sediment control BMPs on portions of the site that drain into the Bioretention and/or Rain Garden BMPs. Restore the BMPs to their fully functioning condition if they accumulate sediment during construction. Restoring the BMP must include removal of sediment and any sediment-laden Bioretention/rain garden soils, and replacing the removed soils with soils meeting the design specification.
- Prevent compacting Bioretention and rain garden BMPs by excluding construction equipment and foot traffic. Protect completed lawn and landscaped areas from compaction due to construction equipment.
- Control erosion and avoid introducing sediment from surrounding land uses onto permeable pavements. Do not allow muddy construction equipment on the base material or pavement. Do not allow sediment-laden runoff onto permeable pavements or base materials.
- Pavement fouled with sediments or no longer passing an initial infiltration test must be cleaned using procedures in accordance with this manual or the manufacturer's procedures.
- Keep all heavy equipment off existing soils under LID facilities that have been excavated to final grade to retain the infiltration rate of the soils.

SECTION 7 – SPECIAL REPORTS AND STUDIES

A sieve analysis data sheet is included on the next pages. The information from this soil report was used to approximate subsurface site conditions and runoff potential. Also, a geotechnical report was performed and is included as well.

Sieve Analysis Data Sheet

ASTM D422-63(2007)

Project Name:	Nichols Washington Street	**Tested By:**	AF	**Date:**	5/3/2021
Location:	Chehalis, WA	**Checked By:**	AF	**Date:**	5/3/2021
Boring No:	1	**Test Number:**	1		
Sample Depth:	10	**Gnd Elev.:**	n/a		

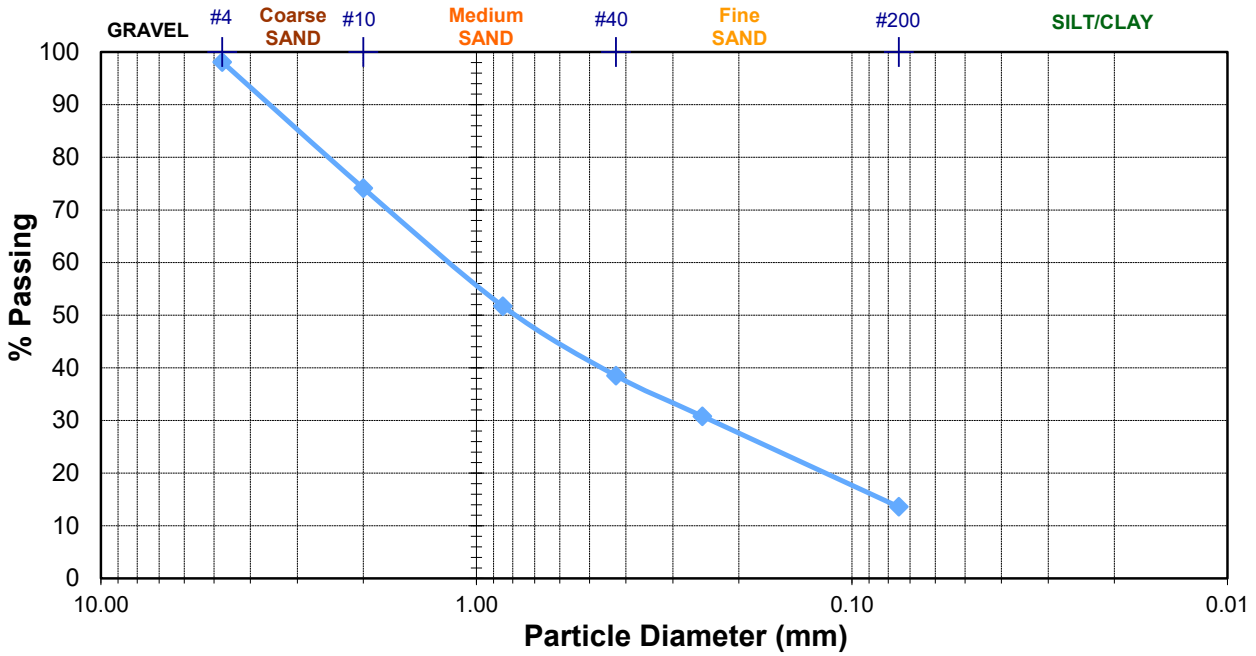
USCS Soil Classification: SM or SC

Notes: Sample taken 4/27/21

Weight of Container (g): 414.1 **Weight of Container & Soil (g):** 653.8

Weight of Dry Sample (g): 239.7

Sieve Number	Diameter (mm)	Mass of Sieve (g)	Mass of Sieve & Soil (g)	Soil Retained (g)	Soil Retained (%)	Soil Passing (%)
#4	4.75	486.2	490.8	4.6	1.9	98.1
#10	2.00	452.9	510.3	57.4	23.9	74.1
#20	0.85	383	436.8	53.8	22.4	51.7
#40	0.43	346.5	378.1	31.6	13.2	38.5
#60	0.25	329.1	347.6	18.5	7.7	30.8
#200	0.075	315	356.2	41.2	17.2	13.6
Pan		348	380	32.0	13.4	0.0
			TOTAL:	**239.1**	**99.7**	



Grain Size Distribution Curve Results:

% Gravel:	1.9	**D_{10}:**	0.06	**Short-K_{sat}:**	24.65
% Sand:	84.5	**D_{30}:**	0.25	**Long-K_{sat}:**	2.93
% Fines:	13.4	**D_{60}:**	1.3		
		D_{90}:	3.5		
		fines	13.350%		

Saturation Correction Factors

CF_v:	0.3
CF_t:	0.4
CF_m:	0.9
CF_T:	0.12

GEOTECHNICAL REPORT
DEVELOPMENT PROPERTIES
3 @ 0 SE WASHINGTON AVENUE; 1176 SE WASHINGTON AVENUE; AND 0 SE 12TH STREET
CHEHALIS, WASHINGTON

PREPARED FOR

AARON FULLER

BY

ALL AMERICAN GEOTECHNICAL, INC.
OLYMPIA, WASHINGTON

APRIL 14, 2021

CONTACT INFORMATION

PREPARER INFORMATION

AAG PROJECT NUMBER:	AAG21-057
CONTACT:	CURTIS D. CUSHMAN
ADDRESS:	8947 BUTTONWOOD LANE NE OLYMPIA, WASHINGTON 98516
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CLIENT INFORMATION

CLIENT:	AARON FULLER FULLER DESIGN
TELEPHONE:	(360) 807-4420
BILLING ADDRESS:	FULLER DESIGNS 1101 KRESKY AVENUE CHEHALIS, WASHINGTON 98531
EMAIL:	AFULLER@FULLERDESIGNS.ORG
SITE ADDRESSES:	3 PARCELS @ 0 SE WASHINGTON AVENUE; 1176 SE WASHINGTON AVENUE; AND 0 SE 12TH STREET WINLOCK, WASHINGTON
PARCELS:	005490000000; 005490001000; 0054923002000; 005853001000; & 005604192001 (IN ORDER OF ADDRESSES, ABOVE)
GPS LOCATION:	46.654969 -122.952562 (DD)

ALL AMERICAN GEOTECHNICAL

SCOPE OF UNDERSTANDING

AARON FULLER
FULLER DESIGNS
1101 KRESKY AVENUE
CENTRALIA, WA 98531
APRIL 14, 2021

RE: GEOTECHNICAL REPORT
0 SE WASHINGTON AVENUE; 1176 SE WASHINGTON AVENUE;
& 0 SE 12TH STREET
CHEHALIS, WASHINGTON
PNS: 005490000000; 005490001000; 0054923002000;
005853001000; & 005604192001
46.654969-122.952562 DD

Dear Aaron Fuller:

Aaron Fuller (client) hired All American Geotechnical, Inc. (AAG) in March of 2021 to prepare a geotechnical report for the above-named properties located off SE Washington Avenue in Chehalis, Washington. The five parcels will be developed for residences. The total area is 2.26 acres with an access to SE Washington via 12th Street which divides four conjoining parcels from the largest parcel on the east of the bloc, PN# 005604192001. SE Washington Avenue and SE 12th Street separate the parcels from the Safeway Store on S Market Boulevard.

The three parcels at 0 SE Washington (005490000000; 005490001000; & 0054923002000) conjoin in a rectangular bloc with the fourth parcel on SE Washington (005853001000). This last parcel was the only one of the five total parcels that had been developed with a small residence and garage which are now demolished with the debris removed. These will be referred to as the *4-parcel bloc*.

The largest parcel is the irregular shaped fifth parcel to the east of the others across SE 12th Street. This parcel will be referred to as the *12th Street parcel*. This is the parcel with the steep slope requiring a geotechnical report.

Construction on the 4-parcel bloc will be on a gentle to moderate slope descending to the south. Construction on this bloc will take place outside the 50' buffer below the Landslide Hazard Area (LHA)

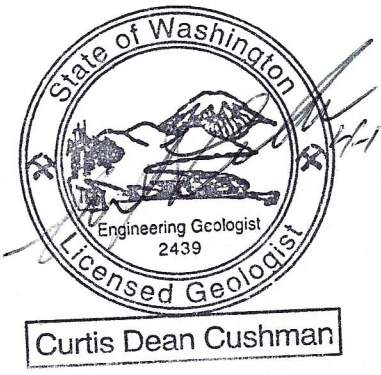
There is nothing permanently developed on any of the parcels. The LHA identified on the 12th Street parcel has portions of its slope exceeding 35%.

The building footprint geotechnically suitable for development is mapped for this report. Earthwork will be needed to level the building site, install utilities, and install access. No major grading is expected on the 4-parcel bloc. Grading may be required if the 12th Street Parcel is eventually developed.

As per client request, we have conducted a soils exploration, foundation evaluation, and slope stability analysis for the above-mentioned parcel. The results of this investigation are to be found in the following report. We will provide the report in PDF form.

The services described in this evaluation were prepared under the responsible charge of Curtis Cushman, L.E.G. Curtis Cushman verifies the accuracy of this report as well as all assumptions relied upon in the report. We appreciate this opportunity to be of service to you and we look forward to working with you in the future. If you have any questions concerning the above items, the procedures used, or if we can be of any further assistance please call us at a phone number listed below.

Respectfully Submitted,
ALL AMERICAN GEOTECHNICAL, INC.



4-14-2021

Curtis D Cushman, L.G., L.E.G.
Senior Engineering Geologist

TABLE OF CONTENTS

INTRODUCTION

This report summarizes the results of our geotechnical consulting services for the proposed development residence on the parcels herein described. The five parcels are located off SE Washington Avenue at SE 12th Street and accessed from I–5 via W Main Street to S Market Boulevard. Four parcels conjoin into a rectangle on a gentle to medium slope (4-parcel bloc). The fifth parcel is southeast of these parcel, across a private extension of SE 12th and has a Landslide Hazard Area (LHA) descending toward the flatter area to the west.

The site is registered with Lewis County as located in Chehalis, Washington. The location of the site is shown relative to the surrounding area on the Vicinity Map, *Figure 1*. Our understanding of the project is based on information from the client.

The location proposed for construction is on the Tertiary-aged sedimentary rocks of the Lincoln Creek Formation. These will be described in "Geology," below. Grading will be for levelling the building sites and road access. The footings will be developed without further major grading. The approximate layout of the site is shown on the Site Plan, *Figure 2*. No building envelopes have been mapped to provide latitude for the placement of the residences.

The purpose of our services is to evaluate the surface and subsurface conditions at the site in order to satisfy the requirements of the Lewis County Critical Areas Ordinance with reference to landslide potential, and as a basis for providing geotechnical recommendations and design criteria for the project. All American Geotechnical is therefore providing geologic and hydrogeologic services for the project. Specifically, our scope of services for this project includes the following:

1. A review of the available geologic, hydrogeological and geotechnical data for the site area.
2. A geologic reconnaissance of the site area and surrounding vicinity.
3. Investigation and identification of shallow subsurface conditions at the site by characterizing the exposed soil, reviewing published well logs, examining the column on the hillside in roadcuts, an auger pit, and soil sampling.
4. Comparison of the sites to published geologic maps, previous field investigations, and open file reports. Inspection of aerial photographs to determine the geomorphology of the sites.
5. Evaluation of the landslide, erosion, and seismic hazards at the site per the Lewis County Critical Areas Ordinance.
6. Building setbacks determined from static and dynamic slope stability modeling.
7. Geotechnical recommendations for site grading including site preparation, subgrade preparation, fill placement criteria temporary and permanent cut and fill slopes, drainage, and typical erosion control measures (*Figure 3*).

The most critical slopes are south of the building site. There are slopes 10 feet in height with a slope of 35% or greater, qualifying them as Landslide Hazard Areas (LHAs). The relevant LHAs are mapped on *Figure 2*.

SITE CONDITIONS

SURFACE CONDITIONS

The proposed residence is located in an area of where lowland urban development begins to wane toward the hills rise northeast of Chehalis. These hills are marked by limited tract developments and single-family dwellings. The developments become sparser on the far side of Coal Creek, again to the northeast.

The area overall is of low hills cut extensively by numerous dendritic streams and some small rivers. According to the Lewis County Assessor the 4-parcel bloc together contains 1.27 acres. There are three lots facing SE Washington Ave to its northeast, while backing these three, further to the northeast, is a fourth lot, somewhat larger. A narrow easement runs partially through the parcels, running southeast to the northwest. Together the four parcels and easement form a square. The building sites are yet to be determined at the time of this report.

This 4-parcel bloc rises from SE Washington Street with a gentle to medium slope to the northeast. The elevation at SE Washington Avenue is 238 feet and the highest contour at 268 feet at the center of the northeast property line (by Lewis County GIS). The 4-parcel bloc will be serviced by utilities. Retaining walls may be needed, depending on design criteria. The overall 4-parcel bloc is open to the southwest. Drainage will be in the same directions. The main steep slope is off of this bloc to the southeast.

The fifth parcel in this project is southeast of the other four across an easement, and is marked by a steep slope ascending to the east-southeast. This parcel is 0.99 acres in area and is an irregular pentagon curved on its eastern side where it rises to match the curve of SE Aust Manor Drive. This slope is largely steeper than 35% and is well over 10 feet in height although it is not a smooth drop from top to bottom.

The site was visited by Curtis D Cushman L.G., L.E.G. and Blaise Jelinek E.I.T. on March 17, 2021. The purpose of a site visit is to physically observe the property and adjacent properties in order to identify any recognized geologic conditions. Surficial exploration and sampling were performed. Sampling provides representative material for evaluation; soils were evaluated on site. Photographs and visual observations were documented. A site map has been prepared identifying features of the property.

17.38.710 (4) (a)

Please see *Figure 2* in the appendix. The proposed site has yet to have definitive structures on it. The landslide hazard research for this report will concentrate on the LHA associated with the eastern parcel with the steep slope.

The proposed development is mapped as being on Tertiary marine deposits of the Lincoln Creek. The Lincoln Creek deposits are locally exposed in column on the steep slope and locally on the 4-parcel block.

Lawn grass covers the south part of the 4-parcel bloc with forestation comprised of juvenile trees, mainly conifers, in the north. The eastern parcel is forested. On a ledge, perhaps man-made, there appear to be old abandoned fruit trees.

At the time of the latest site visit, there was no significant erosion seen at any of the parcels. There are no wetlands. There are no erosion hazards mapped. There is a bizarrely mapped "Unclassified Watercourse" that has two branches, the easternmost of which is mapped as climbing approximately 50 feet up-slope on a slant without the benefit of a streambed, while the other, which just crosses the northeast corner of the 4-parcel bloc, then is mapped as traversing a low ridge and flowing through several houses. These "watercourses" do not appear in the field, do not show up on LiDAR and have not been mapped with any setbacks. (All from Lewis County GIS.)

17.38.710 (4) (b)

Figure 2 has 2-foot contours.

SUBSURFACE EXPLORATIONS

The site locally has extensive exposed deposits on the various parcels, notably where the old residence was demolished in the 4-parcel bloc as well as on the eastern parcel, where the column is seen and which was sampled in a hand-dug pit.

No groundwater was seen on the hillside and no perched water was encountered. Deposits were field classified by Curtis D Cushman L.G., L.E.G.

SUBSURFACE CONDITIONS

The Lincoln Creek deposits underlie all five parcels. These are suitable for the proposed construction bearing in mind the possibility of some clay, although silts dominate as the fine-grained fraction.

GEOLOGICALLY HAZARDOUS AREAS

Lewis County Critic Areas Ordinance Article V Geologically Hazardous Areas

17.38.640 Classification of Erosion Hazard Areas.

17.38.640 Classification of Erosion Hazard Areas.
(1) Erosion hazard areas are those areas that have severe or very severe erosion potential as detailed in the soil descriptions contained in the Web Soil Survey for Lewis County, Washington. Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. Web Soil Survey.

The Soil Survey of Lewis County has both the *Scamman silty clay loam, 5 to 15 percent slopes* and the *Centralia loam, 15 to 30 percent slope* (eastern parcel), described as follows: "the hazard of water erosion is moderate."

17.38.650 Classification of Steep Slope and Landslide Hazard Areas.

The slope of the eastern parcel is classified as a Landslide Hazard Areas as it fits the criteria of 17.38.650 (1) in having a slope of 35 or greater and are higher than 10 feet.

The *Slope Stability of the Centralia-Chehalis Area, Lewis County Washington* (Fiksdal, 1978) maps the five parcels as "Stable."

GEOSEISMIC SETTING

According to the Seismic Zone Map of the United States (Figure 1613.3.1(1)) contained in the 2015 International Building Code (IBC), the project site is located where the maximum spectral response acceleration is greater than 45 percent of gravity (g).

We recommend following seismic factors for design purposes.

- Site Class: B (Rock)
- Spectral response acceleration, short period (S_{MS}): 1.146g ($F_a = 1.0$)
- Spectral response acceleration, 1-second period (S_{M1}): 0.498g ($F_v = 1.5$)
- Peak Ground Acceleration 0.495

SITE SOILS

The USDA Web Soil Survey has mapped the soil in the building site as follows (from the USDA WSS).

In the 4-parcel bloc:

194—Scamman silty clay loam, 5 to 15 percent slopes

Map Unit Setting

- *National map unit symbol:* 2hcb
- *Elevation:* 150 to 2,000 feet
- *Mean annual precipitation:* 40 to 70 inches
- *Mean annual air temperature:* 48 to 50 degrees F
- *Frost-free period:* 150 to 200 days

Map Unit Composition

- *Scamman and similar soils:* 90 percent
- *Minor components:* 10 percent

Description of Scamman

Setting

- *Landform:* Terraces
- *Parent material:* Residuum from outwash and sedimentary rocks

Typical profile

- *H1 - 0 to 6 inches:* silty clay loam
- *H2 - 6 to 13 inches:* silty clay loam
- *H3 - 13 to 23 inches:* silty clay loam
- *H4 - 23 to 60 inches:* silty clay

Properties and qualities

- *Slope:* 5 to 15 percent
- *Depth to restrictive feature:* More than 80 inches
- *Drainage class:* Somewhat poorly drained
- *Capacity of the most limiting layer to transmit water (Ksat):* Moderately low to moderately high (0.06 to 0.20 in/hr)
- *Depth to water table:* About 6 to 18 inches
- *Frequency of flooding:* None
- *Frequency of ponding:* None
- *Available water capacity:* High (about 11.1 inches)

The soils on the 4-parcel bloc correspond to this description with the exception that the soils appear to have a higher silt content than clay and they locally have sand. Clay may be locally present.

East parcel:

44—Centralia loam, 15 to 30 percent slopes

Map Unit Setting

- *National map unit symbol:* 2hg6
- *Elevation:* 200 to 1,600 feet
- *Mean annual precipitation:* 40 to 70 inches
- *Mean annual air temperature:* 48 to 50 degrees F
- *Frost-free period:* 150 to 200 days

Map Unit Composition

- *Centralia and similar soils:* 90 percent
- *Minor components:* 2 percent

Description of Centralia

Setting

- *Landform:* Hillslopes, ridges
- *Parent material:* Residuum and colluvium from sandstone

Typical profile

- *H1 - 0 to 17 inches:* loam
- *H2 - 17 to 38 inches:* clay loam
- *H3 - 38 to 60 inches:* clay loam

Properties and qualities

- *Slope:* 15 to 30 percent
- *Depth to restrictive feature:* More than 80 inches
- *Drainage class:* Well drained
- *Capacity of the most limiting layer to transmit water (Ksat):* Moderately high to high (0.57 to 1.98 in/hr)
- *Depth to water table:* More than 80 inches
- *Frequency of flooding:* None
- *Frequency of ponding:* None
- *Available water capacity:* High (about 10.6 inches)

The soils on the bluff differ from this description in that a weathered zone where clay dominates was not locally obvious and, while fine-grained material dominated, the samples appeared to have substantial sand and locally gravel.

Weathering, erosion, and the resultant sloughing and shallow landsliding are natural processes that can affect steep slope areas. Instability of this nature is typically confined to the upper weathered or disturbed zone, which has been disturbed and has a lower strength. The undisturbed slope soils will be little affected by general weathering and erosion.

SITE GEOLOGY

The mapping on the Washington Portal has the site mapped as:

Geologic Unit Label:OEm(lc)
Geologic Age: Oligocene-Eocene
Lithology:marine sedimentary rocks
Named Units: Lincoln Creek Formation
Symbology: Tertiary sedimentary rocks and deposits

This is equivalent to the **Tlc** as described in The *Geologic Map of the Centralia Quadrangle, Washington*, compiled by H. W. Schasse; DNR Open File OF-87-11.

This geologic formation is not seen in outcrop in the field. The soils derived from it are characteristic and it is mapped throughout the area.

The building site is on material that appears to be Lincoln Creek. The builders must be aware of the possibility of clay in section. The material is likely classified as **ML** – *Sandy silt* or **SM** - *Silty Sand.*

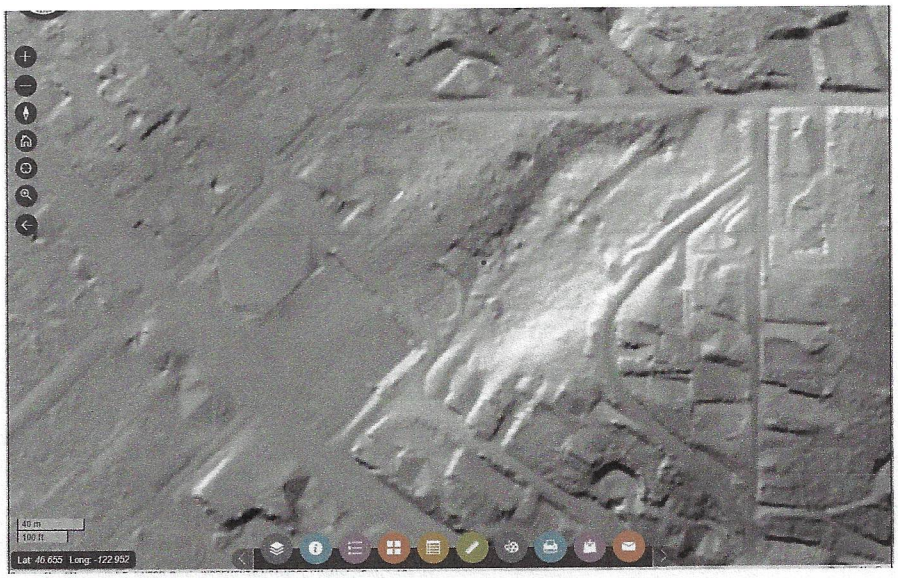
The *Geologic Map of the Centralia Quadrangle, Washington*; shows that the parcel is located in an area of some faulting, all confined to rocks of Eocene and possibly Miocene-Oligocene age. There are none mapped in the Quaternary deposits so the there is no evidence of local tectonic activity.

Seismic activity does occur in and around this area due to the ongoing Cascadian Orogeny.

There are "mass wasting" deposits in the area. These are seen as the Qls "Landslide debris" of Schasse and the "Landslides" of Fiksdal. These deposits are mapped well to the southeast of the client parcels. They would pose no threat to the proposed development.

GROUNDWATER

At the proposed building sites, no ponding water was seen. Water wells located are either mislocated or not relevant to this area.



UPLAND WATER BODIES

There are no upland water bodies.

LIDAR IMAGERY

The LiDAR from the Interactive Map of Washington shows the area to be of low topography rising to the northeast cut by moderately steep drainage channels. These is no evidence seen of local landsliding.

SITE PLAN

A site plan is attached as *Figure 2* at the end of this report identifying geological and development features.

SAMPLE LOCATIONS

No laboratory samples were taken for this study, but the described units were seen over the site and in a hand-dug pit. Hand samples were field classified by Curtis D Cushman, L.G., L.E.G.

BOUNDARIES AND SETBACKS

The area of the proposed development on the 4-parcel bloc, is located at least 50 feet from the toe of any LHA on the eastern parcel. As the eastern parcel is approximately 70 feet in height where it is steepest, this is an acceptable runout.

Boundaries of the landslide hazard area (LHA), and associated setbacks are demarcated on *Figure 2* Site Plan at the end of this report. Appropriate geology is labeled on this figure.

SEISMIC LIQUEFACTION HAZARD

The *Liquefaction Susceptibility Map of Lewis County, Washington* by Palmer, Magsino, Poelstra, Bilderback, Folger, and Niggemann (September 2004) maps liquefaction hazard of the site as **Bedrock**.

Soil liquefaction is an episode in which saturated, cohesionless, or granular soils experience a significant drop in strength due to additional build-up of pore water pressure during cyclic loading such as that induced by earthquakes.

If the residence is built on the Lincoln Creek deposits, liquefaction is not a major concern.

SEISMIC SITE CLASS

The *Site Class Map of Lewis County, Washington* by Palmer, Magsino, Bilderback, Poelstra, Folger, and Niggemann (September 2004) maps the site area as **Site Class B**. Site Class B is Rock.

17.38.710 (4) (c)

SLOPE PROFILES

Two slope profiles are attached to this report as the model output of line **A–A'**. These analyses include the intercepting slopes above the proposed residence. Any development will not alter the slope profiles

SLOPE STABILITY AND ANALYSIS

Factors of safety were determined using the Bishop (semi-circular) method. The site was modeled monolithically with information from the glacial unit described in the literature and as seen on-site. The parameters used in this modeling were based on experience with the surroundings and the types of materials encountered on site. A continuous load of 1500-lb per foot was placed across the intercept of the proposed footprint of the home on the cross-sections. No groundwater was included in the model, based upon field observations.

Slope stability was modeled using the GALENA 6.1 program in both static and dynamic conditions (c_a = 0.298). "Static" condition refers to an "as is" state of a given slope. "Dynamic" puts seismic acceleration into the model for earthquake conditions. The factor for ground acceleration (c_a) was determined from the Peak Ground Acceleration from the USGS Seismic Design Maps, included in the Appendix.

The depositional material was field identified as **Sandy silt (ML) or Silty sand (SM).** This contains varying amounts of silt and sand with possible clay locally. This classification requires selecting conservative values in the interests of safety.

The site was modeled with the **Lincoln Creek** as a monolithic unit. The unit was modeled using the following soil parameters presented in ***Table 1. Geologic Modeling Values***.

Table 1. Geologic Modeling Values

Geologic Unit	Unit Weight	Cohesion	Phi Angle
OEm(lc) - Lincoln Creek Formation	120	300	34

Six analyses were calculated along the three cross-sections, itemized on ***Table 2. Modeling Parameters and Findings.*** The Analysis Number corresponds to the output presented on pages 27-28. The slope was modeled based upon observations, field measurements, and available mapping. Cross-section A-A′ is located through the possible building envelope. Initial positions were selected based upon the placement of the structure and the shape of the slopes. The initial points were varied over the analysis range indicated; with 50 different positions tested across these ranges. A total of 125,001 calculations were performed for each. Calculated Factors of Safety are presented in *Table 2.*

Table 2. Modeling Parameters and Findings

Analysis Number	Load Across Building Envelope	Analysis Type	Slope to Building	Initial Positions (Analysis Range)			Configurations Analyzed	Factor of Safety
				Lower	Upper	Radius		
Cross-Section A-A'								
Analysis 1	No load defined	Static	undefined	115 (100)	260 (70)	240 (40)	125,001	2.44
Analysis 2	No load defined	Dynamic	undefined	115 (100)	260 (70)	240 (40)	125,001	1.27

Under static conditions, the slopes generally did not show susceptibility to deep-seated failure that would cause damage to the proposed residence. Under dynamic loading (Ca=0.298), the computations demonstrated that the slope is safe and not susceptible to a deep-seated movement.

These calculated Factors of Safety (FoS) meet the requirements set forth by Lewis County for static conditions (1.50) and meet the requirement (1.20) for dynamic loading scenarios. The site appears stable based on our slope models representing critical slopes at the subject site.

SLOPE MODELS

The slope models are included in the appendix. As the slope is not proposed for development, there is no surcharge.

GRADING

No major grading is proposed.

EARTHWORK

RECOMMENDATIONS FOR SITE PREPARATION

All areas to be excavated should be cleared of deleterious matter including any debris, duff, and vegetation. Any soils material that is excavated may be stockpiled and later used for erosion control and/or landscaping. Surficial material unsuitable for these tasks should be removed from the project site. No foundation elements shall be constructed on "untested" fill material.

The material immediately on site may not be suitable for structural fill due to the silty nature of the material. Where placement of fill material is required, the exposed subgrade areas should be compacted to a firm and unyielding surface prior to placement of any fill. Over-excavation in any building area

should be backfilled with structural fill, compacted to the density requirements described in the "Structural Fill" section of this report.

If structural fill is needed, we recommend that a member of our staff evaluate the exposed subgrade conditions

RECOMMENDATIONS FOR STRUCTURAL FILL

All fill material should be placed as structural fill. In general, the structural fill should be placed in horizontal lifts of 8 inches to allow adequate and uniform compaction of each lift. Fill should be compacted to at least 95 percent of MDD (maximum dry density as determined in accordance with ASTM D-1557 to grade.

The final appropriate lift thickness will depend on the fill characteristics and compaction equipment used. We recommend that a field representative evaluate the appropriate lift thickness during construction. Material placed for structural fill should be free of debris, organic matter, trash, and cobbles greater than 6 inches in diameter. The moisture content of the fill material should be adjusted for proper compaction.

RECOMMENDATIONS FOR SUITABILITY OF ONSITE SOILS AS FILL

Onsite soils may be considered for use as structural fill only if industry standards are satisfied. Fill material requirements are found on page 9-26 to 9-30 of the WSDOT Standard Specifications 2010. In general, a native soil (sand, silt, and gravel) encountered on a site must have less than 10 percent fines (material passing the US No. 200 sieve) to be suitable for use as structural fill. To qualify, a soil must be tested in a geotechnical laboratory for gradation. On-site soils may not be acceptable as structural fill. Testing would be required.

RECOMMENDATIONS FOR FOUNDATION SUPPORT

The residences will effectively rest on standard footings.

A net allowable soil bearing capacity of 1,500 psf to 1800 (pounds per square foot) for combined dead and long-term live loads in areas of Class **B** would be used for any future modelling of this site, depending on design criteria..

Before the placing of any concrete floors or pavements on the site, or before any floor supporting fill is placed, the subgrade should be probed to confirm that the subgrade contains no soft or deflecting areas. Areas of excessive yielding should be excavated and backfilled with structural fill.

Any additional fill used to increase the elevation of the floor slab should meet the requirement for structural fill. Structural fill should be placed in layers of not more than 12 inches in thickness, at moisture contents at or above optimum, and compacted to a minimum density of 95 percent of the maximum dry density as determined by ASTM designation D-1557.

A granular mat should be provided below floor slabs. This should be a minimum of four inches in thickness and properly compacted. The mat should consist of sand or sand and gravel mixture with non-

plastic fines. The material should all pass a ¾ inch sieve and should contain less than 10 percent passing the #200 sieve. A moisture barrier should be placed beneath all floor slabs.

EROSION HAZARD CLASSIFICATION

The entire 5-parcel site has erosion potential described in the Thurston County Soil Survey as "moderate."

LATERAL EARTH PRESSURES

Lateral loads may be resisted by friction on the bases of footings and floor slabs and as passive pressure on the sides of footings. An allowable coefficient of friction of 0.40 may be used to calculate friction between the concrete and the underlying native soil. We recommend the following be used to determine the lateral earth pressures considering the onsite **ML** or **SM**:

- ϕ (soil friction angle) 34 degrees
- K_o (at rest earth pressure coefficient) 0.441
- K_a (active earth pressure coefficient) 0.282
- K_p (passive earth pressure coefficient) 3.54

Please note these pressures do not apply if unaltered sandstones are encountered.

RECOMMENDATIONS FOR CUT AND FILL SLOPES

All job site safety issues and precautions are the responsibility of the contractor providing services and/or work. The following cut/fill slope guidelines are provided for planning purposes.

As a general guide, temporary slopes of 1 to 1 (horizontal to vertical) or flatter may be used for temporary cuts in the upper few feet of the soils, if present, that are weathered to a loose/medium-dense condition.

Surface drainage should be directed away from all steep slope faces. Straw, hay, or jute matting shall be used to cover the exposed soils until permanent vegetation is established. All slopes should be seeded as soon as practical to facilitate the development of a protective vegetative cover, or otherwise protected.

RECOMMENDATIONS FOR RETAINING WALLS

If retaining walls are to be used, they must conform to Lewis County requirements for permitting and engineering of said walls. Any retaining wall over four feet in height is required by Lewis County to be permitted and engineered. Lower retaining walls with surcharges are also required to be engineered. An engineer should be consulted before any retaining wall is constructed. When constructing retaining walls on a slope, there must be a setback between walls. If a four-foot wall is being constructed with a second four-foot wall behind it, we recommend that the distance between the two walls be no less than twice the wall height or as per the engineer's design.

EROSION CONTROL AND DRAINAGE

SURFACE WATER CONTROL

RECOMMENDATIONS FOR EROSION CONTROL

These erosion control methods are applicable wherever earthmoving or excavation is done. The final determination of requirements is with the County authorities.

Even though the erosion hazard is moderate, temporary and permanent erosion control measures should be implemented and maintained as needed during placement and/or as soon as practical thereafter to limit influx of water to exposed areas and protect potential receiving waters. Revegetation should occur immediately following construction. All barren construction areas on slopes should be protected with jute, sisal, or a synthetic mix of degradable netting and replanted as soon as possible. Surface water should be confined and/or directed away from the immediate downslope area. No concentration of water should flow over and unto the LHA slopes.

Erosion control measures should include, but not be limited to, silt fences, berms, and swales with ground cover/protection in exposed areas. Typical erosion control notes and a silt fence detail are included on *Figure 3 Erosion Control*. The drain feature on *Figure 3* is considered possible for drainage control at this site (see Site Drainage below).

RECOMMENDATIONS FOR SITE DRAINAGE

In general, all ground surfaces, pavements and sidewalks should be sloped away from the residence and associated structures. Surface water runoff should be controlled by a system of curbs, berms, drainage swales, and/or catch basins and tightlined into the appropriate drainage facilities. We recommend that conventional roof drains be installed following the recommendations of the manufacturer. Roof water may be dispersed by discharge pipes at a distance of 10 feet or more from the residence and these should be equipped with splash blocks or a similar system to reduce outflow energy.

Otherwise, water needs to be captured and directed into a tightline to transport it away from the structure and downslope to a suitable drainage facility such as a trench, drywell, or public drain. Due to the nature of the topography, dispersal of water into an urban storm system may be possible.

The material on-site possibly will likely support some construction activity in the winter season. However, rain or snow may make this difficult. Procedures to permit ongoing construction in the winter season will require well-prepared pads and suitable access.

RECOMMENDATIONS FOR BUILDING SETBACK

The proposed building areas on the 4-parcel bloc are well outside the LHAs. All of the potential building sites lie outside the 50-foot vegetation buffer. Vegetation within the LHA will not be disturbed.

VEGETATIVE MANAGEMENT

Some general vegetation recommendations are located elsewhere in the report (such as Erosion Control above). These recommendations and the following may be modified subject to approval or do not apply. "No disturb" zones will not be needed.

The vegetation at the potential building sites is primarily of grass and juvenile trees with shrub. These may be cleared for construction as they are outside the 50-foot vegetation buffer. The area of development will be revegetated as needed. When residential plantings or any plantings on the periphery of the residential area and the slopes are planned, native species should be considered as the primary vegetation in areas away from lawn and ornamental plantings. Shallow rooted species, such as grass, should be planted closer than 10 feet from underground drainages. Any area shorn of vegetation should be immediately protected and revegetated to prevent erosion. No vegetation in the LHA will be disturbed.

Densely rooted evergreen shrubs are preferable than tree species on slopes greater than 15% gradient. Tall trees may become unstable in wet soils under high wind conditions. Planting of tall growth trees should be avoided on such slopes.

To summarize, in order to manage and reduce the potential for erosional processes, we recommend the following:

- No drainage of concentrated surface water or significant sheet flow onto steeper sloped areas
- Use vegetation to maximize erosion control.
- Observe setbacks and buffers as shown on *Figure 2* and cross-sections.

17.38.710 (4) (d)

SITE DEVELOPMENT ALTERNATIVES

The proposed location is suitable. The setbacks are suitable, the erosion hazard is manageable and the slope stability models indicate deep-seated failures are unlikely.

RECOMMENDATIONS FOR STRUCTURAL MITIGATION

There is no structural mitigation for this project.

SEPTIC IMPACT

The area will be on a public sewer.

ON- AND OFF-SITE IMPACT

None is foreseen.

CONCLUSIONS AND RECOMMENDATIONS

Based on the results of our site reconnaissance, subsurface observations, and our experience in the area, it is our opinion that the site is suitable for the proposed project. Storm and drain water may be discharged through drain pipes or as otherwise designed by the Engineer of Record. With these provisos followed, the proposed building locations are not threatened by deep-seated failure of the slope on the eastern parcel. The structures will not undermine adjacent slopes. Proper drainage control measures should eliminate the potential for erosion.

The project will cause no significant environmental impact for the life of the project.

As a general rule, we recommend that earthwork be undertaken during favorable weather conditions. This is certainly true here, but the existing access likely can be made all-weather, so construction may proceed as long as safety is not compromised. Conventional construction equipment may be utilized for work at the site. Slab on grade or standard footings may be utilized at the site. A vapor barrier is recommended for all slabs-on-grade.

Revegetation should be done as per recommendations in the text, above.

REPORT LIMITATIONS AND GUIDELINES FOR USE

We have prepared this report for the exclusive use of Aaron Fuller and his authorized agents for the proposed development location in Lewis County, Washington. Site inspections, research, and mapping have culminated in this report. This report is intended to meet the requirements of the Lewis County Critical Areas Ordinance. This report does not specify setbacks for: line-of-sight setbacks, FWHCA setbacks, eagle tree setbacks, wetland setbacks, or property line setbacks. Within the limitations of scope, schedule and budget, our services have been executed in accordance with generally accepted practices in the field of geotechnical engineering in this area at the time this report was prepared. No warranty or other conditions, expressed or implied, should be understood.

CONTRACTORS ARE RESPONSIBLE FOR SITE SAFETY ON THEIR OWN CONSTRUCTION PROJECTS

Our geotechnical recommendations are not intended to direct the contractor's procedures, methods, schedule or management of the work site. The contractor is solely responsible for job site safety and for managing construction operations to minimize risks to onsite personnel and to adjacent properties.

READ THESE PROVISIONS CLOSELY

Some clients, design professionals, and contractors may not recognize that the geoscience practices (geotechnical engineering or geology) are far less exact than other engineering and natural science disciplines. This lack of understanding can create unrealistic expectations that could lead to disappointments, claims and disputes. All American Geotechnical, Inc. includes these explanatory "limitations" provisions in our reports to help reduce such risks.

Clients and property owners must understand that, while a slope may be found to have an acceptable Factor of Safety related to deep-seated mass wasting, surficial failure and landslides can and do occur on steep slopes. The property owners should monitor the stability of their property following construction.

Moreover, acceptable Factors of Safety do not guarantee there cannot be failures. It is the responsibility of the property owners to understand that there are always risks in building on or near steeply sloped areas.

The equipment, techniques and personnel used to perform an environmental study differ significantly from those used to perform a geotechnical or geologic study and vice versa. For that reason, geotechnical engineering or geologic reporting does not usually relate any environmental findings, conclusions or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. Similarly, environmental reports are not used to address geotechnical or geologic concerns regarding a specific project.

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Lewis County Government Information Services
(http://www.co.lewis.wa.us)

Puget Sound Lidar Consortium (Through the Washington Geologic Portal)
(http://pugetsoundlidar.ess.washington.edu/lidardata/index.html)

Slope Stabilization Erosion Control Using Vegetation A Manual of Practice for Coastal Bluff
(http://www.ecy.wa.gov/biblio/9330.html)

United States Department of Agriculture Natural Resource Conservation Service
(http://soildatamart.nrcs.usda.gov)

Washington Administrative Code
(http://apps.leg.wa.gov/wac/)

Washington Department of Ecology
(http://apps.ecy.wa.gov/welllog)
(https://fortress.wa.gov/ecy/coastalatlas/viewer.htm)

APPENDIX

2015 IBC Design Summary

Computer Models

Figure 1. Vicinity Map

Figure 2. Site Map

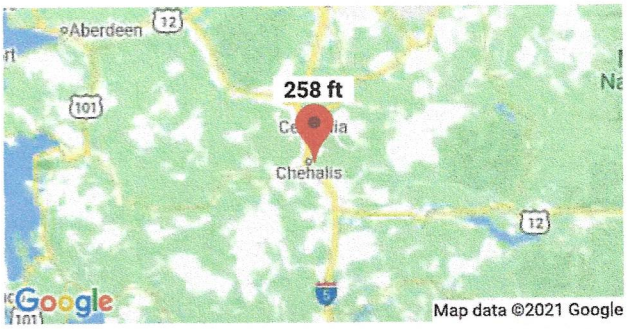
Figure 3. Erosion Control Notes

USGS SEISMIC DESIGN SUMMARY – IBC – 2015

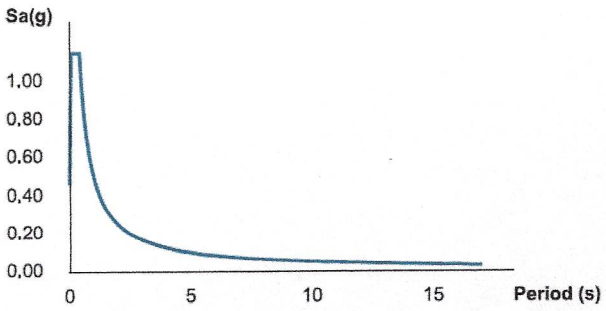
ATC Hazards by Location

Search Information

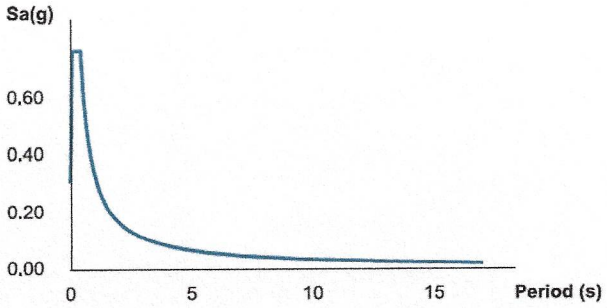
Coordinates:	46.655068, -122.952299
Elevation:	258 ft
Timestamp:	2021-04-12T23:06:32.580Z
Hazard Type:	Seismic
Reference Document:	IBC-2015
Risk Category:	III
Site Class:	B



MCER Horizontal Response Spectrum



Design Horizontal Response Spectrum



Basic Parameters

Name	Value	Description
S_S	1.146	MCE_R ground motion (period=0.2s)
S_1	0.498	MCE_R ground motion (period=1.0s)
S_{MS}	1.146	Site-modified spectral acceleration value
S_{M1}	0.498	Site-modified spectral acceleration value
S_{DS}	0.764	Numeric seismic design value at 0.2s SA
S_{D1}	0.332	Numeric seismic design value at 1.0s SA

▾Additional Information

Name	Value	Description
SDC	D	Seismic design category
F_a	1	Site amplification factor at 0.2s
F_v	1	Site amplification factor at 1.0s
CR_S	0.947	Coefficient of risk (0.2s)

IBC Seismic Design Summary continued

CR_1	0.904	Coefficient of risk (1.0s)
PGA	0.495	MCE_G peak ground acceleration
F_{PGA}	1	Site amplification factor at PGA
PGA_M	0.495	Site modified peak ground acceleration
T_L	16	Long-period transition period (s)
SsRT	1.146	Probabilistic risk-targeted ground motion (0.2s)
SsUH	1.211	Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years)
SsD	1.5	Factored deterministic acceleration value (0.2s)
S1RT	0.498	Probabilistic risk-targeted ground motion (1.0s)
S1UH	0.551	Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years)
S1D	0.6	Factored deterministic acceleration value (1.0s)
PGAd	0.6	Factored deterministic acceleration value (PGA)

The results indicated here DO NOT reflect any state or local amendments to the values or any delineation lines made during the building code adoption process. Users should confirm any output obtained from this tool with the local Authority Having Jurisdiction before proceeding with design.

Disclaimer

Hazard loads are provided by the U.S. Geological Survey Seismic Design Web Services.

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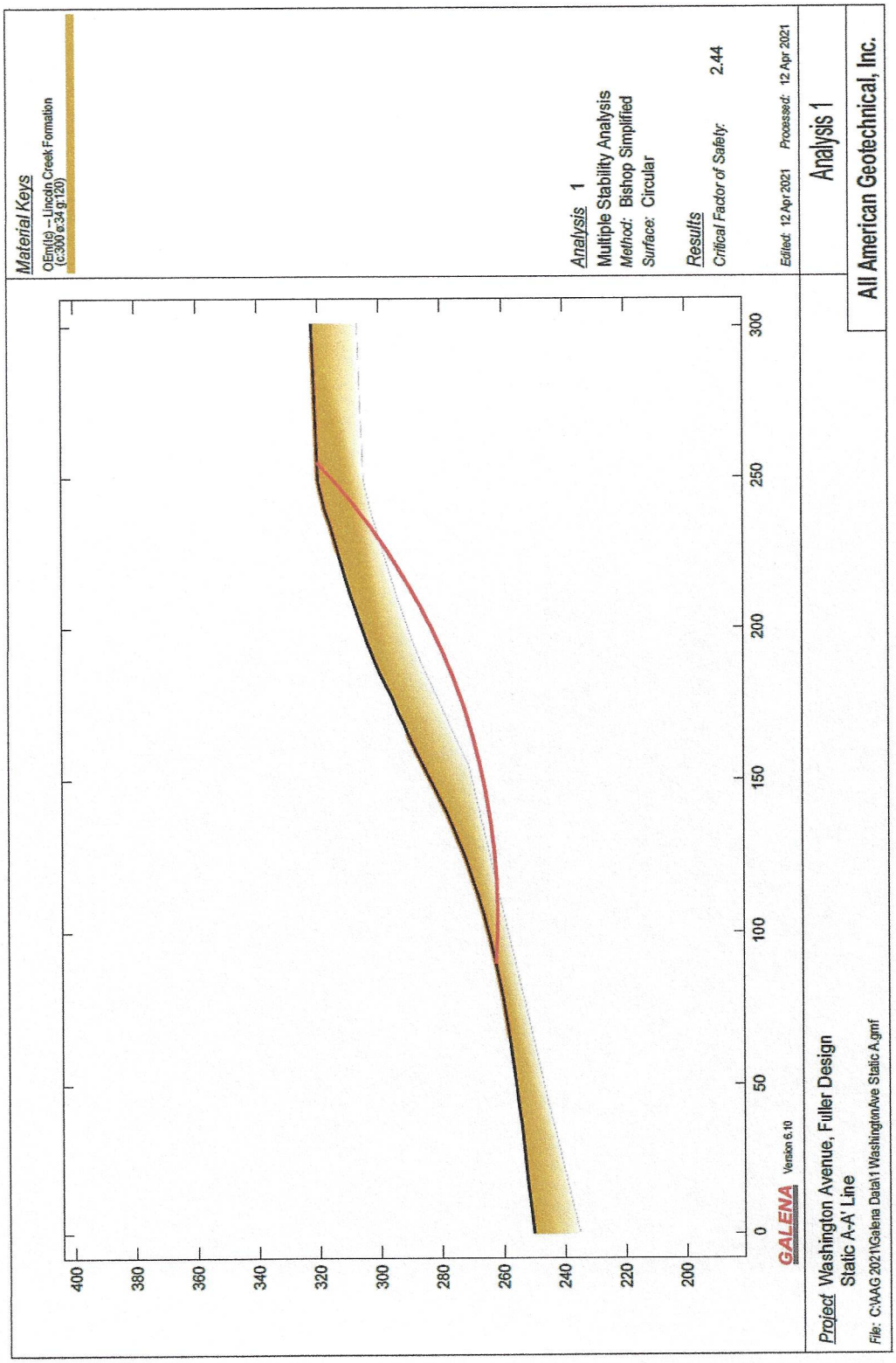
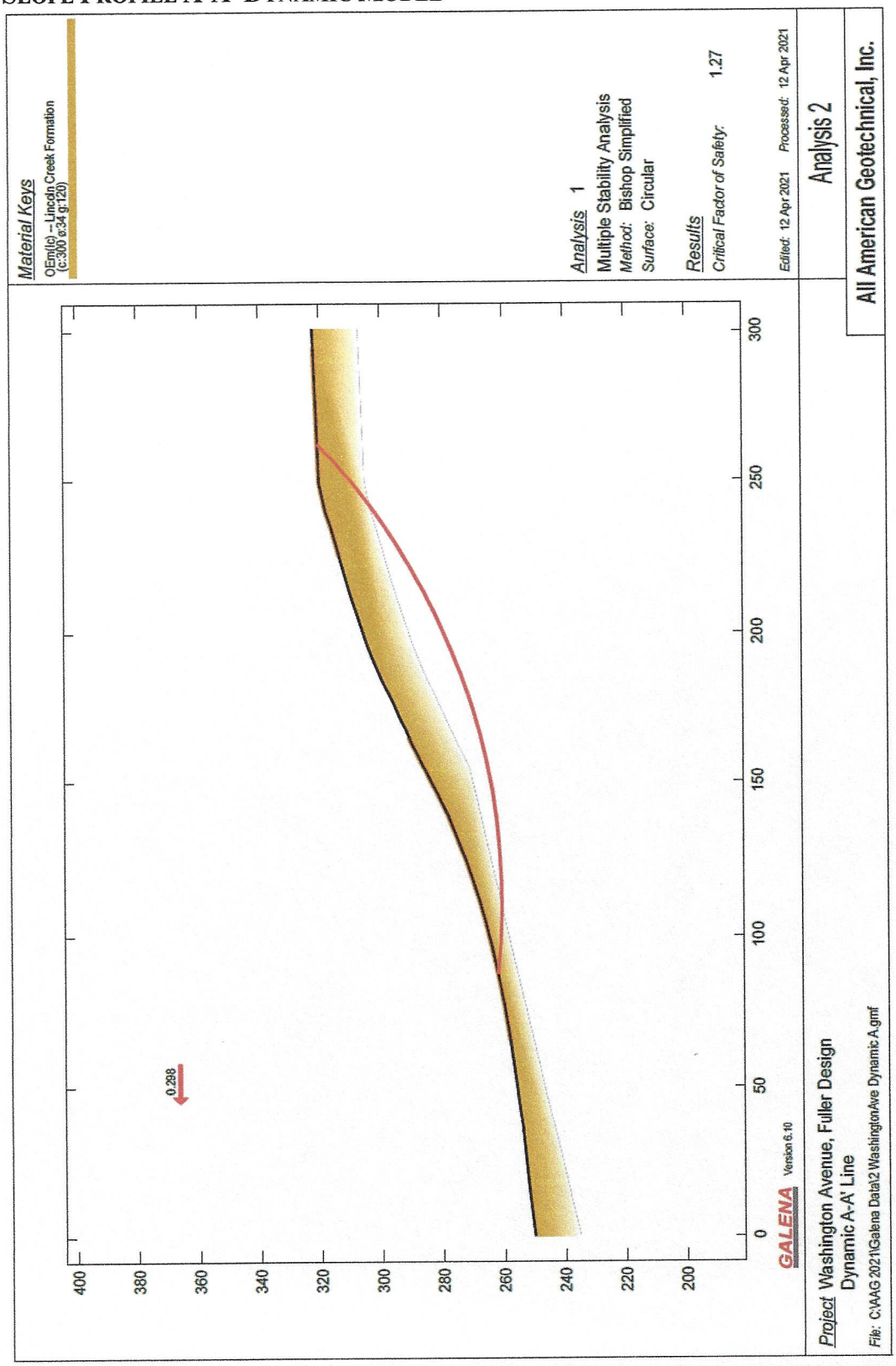
COMPUTER MODELS

SLOPE PROFILE A-A' STATIC MODEL



SLOPE PROFILE A-A' DYNAMIC MODEL



FIGURES

FIGURE 1. VICINITY MAP

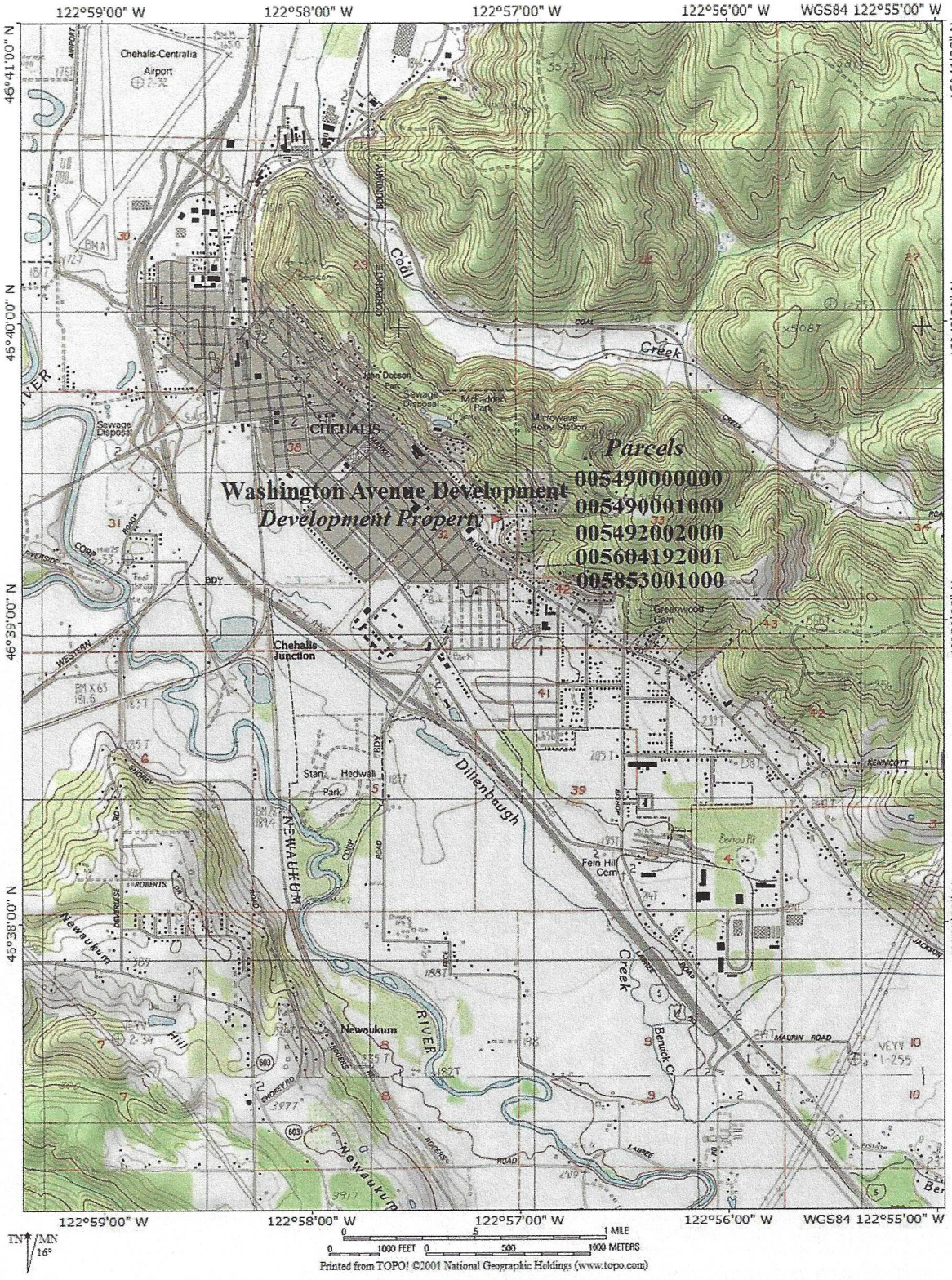


FIGURE 2. SITE PLAN

FIGURE 3. EROSION CONTROL NOTES

SECTION 8 – OPERATION AND MAINTENANCE MANUAL

The Following pages contain maintenance needs for most of the components that are part of your drainage system, as well as components that you may not have. Let us know if there are any components that are missing from these pages. Ignore the requirements that do not apply to your system. You should plan to complete a checklist for all system components on the following schedule

1. Monthly from November through April
2. Once in late summer (preferably September).
3. After any major storm (use 1" of precipitation in 24 hours) for any items marked "S".

Using photocopies of these pages, check off the items you looked for after each inspection. Add comments on issues found and actions taken. Keep these records in your files. These files will be needed to write your annual report if required. Some items may not need to be looked at every time an inspection is done. Use the suggest frequency at the left of each item as a guideline for your inspection.

You may call the jurisdiction for technical assistance. Please do not hesitate to call, especially if you are unsure whether a situation you have discovered may be a developing issue.

Appendix V-A: BMP Maintenance Tables

Ecology intends the facility-specific maintenance standards contained in this section to be conditions for determining if maintenance actions are required as identified through inspection. Recognizing that Permittees have limited maintenance funds and time, Ecology does not require that a Permittee perform all these maintenance activities on all their stormwater BMPs. We leave the determination of importance of each maintenance activity and its priority within the stormwater program to the Permittee. We do expect, however, that sufficient maintenance will occur to ensure that the BMPs continue to operate as designed to protect ground and surface waters.

Ecology doesn't intend that these measures identify the facility's required condition at all times between inspections. In other words, exceedance of these conditions at any time between inspections and/or maintenance does not automatically constitute a violation of these standards. However, based upon inspection observations, the Permittee shall adjust inspection and maintenance schedules to minimize the length of time that a facility is in a condition that requires a maintenance action.

Table V-A.1: Maintenance Standards - Detention Ponds

Maintenance Component	Defect	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed
General	Trash & Debris	Any trash and debris which exceed 1 cubic feet per 1,000 square feet. In general, there should be no visual evidence of dumping. If less than threshold all trash and debris will be removed as part of next scheduled maintenance.	Trash and debris cleared from site
	Poisonous Vegetation and noxious weeds	Any poisonous or nuisance vegetation which may constitute a hazard to maintenance personnel or the public. Any evidence of noxious weeds as defined by State or local regulations. (Apply requirements of adopted IPM policies for the use of herbicides).	No danger of poisonous vegetation where maintenance personnel or the public might normally be. (Coordinate with local health department) Complete eradication of noxious weeds may not be possible. Compliance with State or local eradication policies required
	Contaminants and Pollution	Any evidence of oil, gasoline, contaminants or other pollutants (Coordinate removal/cleanup with local water quality response agency).	No contaminants or pollutants present.
	Rodent Holes	Any evidence of rodent holes if facility is acting as a dam or berm, or any evidence of water piping through dam or berm via rodent holes.	Rodents destroyed and dam or berm repaired. (Coordinate with local health department; coordinate with Ecology Dam Safety Office if pond exceeds 10 acre-feet.)
	Beaver Dams	Dam results in change or function of the facility.	Facility is returned to design function. (Coordinate trapping of beavers and removal of dams with appropriate permitting agencies)
	Insects	When insects such as wasps and hornets interfere with maintenance activities.	Insects destroyed or removed from site. Apply insecticides in compliance with adopted IPM policies
	Tree Growth and Hazard Trees	Tree growth does not allow maintenance and inspection access or interferes with maintenance activity (i.e., slope mowing, silt removal, vactoring, or equipment movements). If trees are not interfering with access or maintenance, do not remove If dead, diseased, or dying trees are identified (Use a certified Arborist to determine health of tree or removal requirements)	Trees do not hinder maintenance activities. Harvested trees should be recycled into mulch or other beneficial uses (e.g., alders for firewood). Remove hazard Trees
Side Slopes of Pond	Erosion	Eroded damage over 2 inches deep where cause of damage is still present or where there is potential for continued erosion. Any erosion observed on a compacted berm embankment.	Slopes should be stabilized using appropriate erosion control measure(s); e.g.,rock reinforcement, planting of grass, compaction. If erosion is occurring on compacted berms a licensed engineer in the state of Washington should be consulted to resolve source of erosion.
Storage Area	Sediment	Accumulated sediment that exceeds 10% of the designed pond depth unless otherwise specified or affects inletting or outletting condition of the facility.	Sediment cleaned out to designed pond shape and depth; pond reseeded if necessary to control erosion.

Table V-A.1: Maintenance Standards - Detention Ponds (continued)

Maintenance Component	Defect	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed
	Liner (if Applicable)	Liner is visible and has more than three 1/4-inch holes in it.	Liner repaired or replaced. Liner is fully covered.
Ponds Berms (Dikes)	Settlements	Any part of berm which has settled 4 inches lower than the design elevation If settlement is apparent, measure berm to determine amount of settlement Settling can be an indication of more severe problems with the berm or outlet works. A licensed engineer in the state of Washington should be consulted to determine the source of the settlement.	Dike is built back to the design elevation.
	Piping	Discernable water flow through pond berm. Ongoing erosion with potential for erosion to continue. (Recommend a Goethechnical engineer be called in to inspect and evaluate condition and recommend repair of condition.	Piping eliminated. Erosion potential resolved.
Emergency Overflow/ Spillway and Berms over 4 feet in height	Tree Growth	Tree growth on emergency spillways creates blockage problems and may cause failure of the berm due to uncontrolled overtopping. Tree growth on berms over 4 feet in height may lead to piping through the berm which could lead to failure of the berm.	Trees should be removed. If root system is small (base less than 4 inches) the root system may be left in place. Otherwise the roots should be removed and the berm restored. A licensed engineer in the state of Washington should be consulted for proper berm/spillway restoration.
	Piping	Discernable water flow through pond berm. Ongoing erosion with potential for erosion to continue. (Recommend a Geotechnical engineer be called in to inspect and evaluate condition and recommend repair of condition.	Piping eliminated. Erosion potential resolved.
Emergency Overflow/Spillway	Emergency Overflow/Spillway	Only one layer of rock exists above native soil in area five square feet or larger, or any exposure of native soil at the top of out flow path of spillway. (Rip-rap on inside slopes need not be replaced.)	Rocks and pad depth are restored to design standards.
	Erosion	See "Side Slopes of Pond"	

Table V-A.2: Maintenance Standards - Infiltration

Maintenance Component	Defect	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed
General	Trash & Debris	See Table V-A.1: Maintenance Standards - Detention Ponds	See Table V-A.1: Maintenance Standards - Detention Ponds
	Poisonous/Noxious Vegetation	See Table V-A.1: Maintenance Standards - Detention Ponds	See Table V-A.1: Maintenance Standards - Detention Ponds
	Contaminants and Pollution	See Table V-A.1: Maintenance Standards - Detention Ponds	See Table V-A.1: Maintenance Standards - Detention Ponds
	Rodent Holes	See Table V-A.1: Maintenance Standards - Detention Ponds	See Table V-A.1: Maintenance Standards - Detention Ponds
Storage Area	Sediment	Water ponding in infiltration pond after rainfall ceases and appropriate time allowed for infiltration. Treatment basins should infiltrate Water Quality Design Storm Volume within 48 hours, and empty within 24 hours after cessation of most rain events.	Sediment is removed and/or facility is cleaned so that infiltration system works according to design.

Table V-A.2: Maintenance Standards - Infiltration (continued)

Maintenance Component	Defect	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed
		(A percolation test pit or test of facility indicates facility is only working at 90% of its designed capabilities. Test every 2 to 5 years. If two inches or more sediment is present, remove).	
Filter Bags (if applicable)	Filled with Sediment and Debris	Sediment and debris fill bag more than 1/2 full.	Filter bag is replaced or system is redesigned.
Rock Filters	Sediment and Debris	By visual inspection, little or no water flows through filter during heavy rain storms.	Gravel in rock filter is replaced.
Side Slopes of Pond	Erosion	See Table V-A.1: Maintenance Standards - Detention Ponds	See Table V-A.1: Maintenance Standards - Detention Ponds
Emergency Overflow Spillway and Berms over 4 feet in height.	Tree Growth	See Table V-A.1: Maintenance Standards - Detention Ponds	See Table V-A.1: Maintenance Standards - Detention Ponds
	Piping	See Table V-A.1: Maintenance Standards - Detention Ponds	See Table V-A.1: Maintenance Standards - Detention Ponds
Emergency Overflow Spillway	Rock Missing	See Table V-A.1: Maintenance Standards - Detention Ponds	See Table V-A.1: Maintenance Standards - Detention Ponds
	Erosion	See Table V-A.1: Maintenance Standards - Detention Ponds	See Table V-A.1: Maintenance Standards - Detention Ponds
Pre-settling Ponds and Vaults	Facility or sump filled with Sediment and/or debris	6" or designed sediment trap depth of sediment.	Sediment is removed.

Table V-A.3: Maintenance Standards - Closed Detention Systems (Tanks/Vaults)

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
Storage Area	Plugged Air Vents	One-half of the cross section of a vent is blocked at any point or the vent is damaged.	Vents open and functioning.
	Debris and Sediment	Accumulated sediment depth exceeds 10% of the diameter of the storage area for 1/2 length of storage vault or any point depth exceeds 15% of diameter. (Example: 72-inch storage tank would require cleaning when sediment reaches depth of 7 inches for more than 1/2 length of tank.)	All sediment and debris removed from storage area.
	Joints Between Tank/Pipe Section	Any openings or voids allowing material to be transported into facility. (Will require engineering analysis to determine structural stability).	All joint between tank/pipe sections are sealed.
	Tank Pipe Bent Out of Shape	Any part of tank/pipe is bent out of shape more than 10% of its design shape. (Review required by engineer to determine structural stability).	Tank/pipe repaired or replaced to design.
	Vault Structure Includes Cracks in Wall, Bottom, Damage to Frame and/or Top Slab	Cracks wider than 1/2-inch and any evidence of soil particles entering the structure through the cracks, or maintenance/inspection personnel determines that the vault is not structurally sound. Cracks wider than 1/2-inch at the joint of any inlet/outlet pipe or any evidence of soil particles entering the vault through the walls.	Vault replaced or repaired to design specifications and is structurally sound. No cracks more than 1/4-inch wide at the joint of the inlet/outlet pipe.

Table V-A.5: Maintenance Standards - Catch Basins

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is performed
General	Trash & Debris	Trash or debris which is located immediately in front of the catch basin opening or is blocking inletting capacity of the basin by more than 10%. Trash or debris (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of six inches clearance from the debris surface to the invert of the lowest pipe. Trash or debris in any inlet or outlet pipe blocking more than 1/3 of its height. Dead animals or vegetation that could generate odors that could cause complaints or dangerous gases (e.g., methane).	No Trash or debris located immediately in front of catch basin or on grate opening. No trash or debris in the catch basin. Inlet and outlet pipes free of trash or debris. No dead animals or vegetation present within the catch basin.
	Sediment	Sediment (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of 6 inches clearance from the sediment surface to the invert of the lowest pipe.	No sediment in the catch basin
	Structure Damage to Frame and/or Top Slab	Top slab has holes larger than 2 square inches or cracks wider than 1/4 inch. (Intent is to make sure no material is running into basin). Frame not sitting flush on top slab, i.e., separation of more than 3/4 inch of the frame from the top slab. Frame not securely attached	Top slab is free of holes and cracks. Frame is sitting flush on the riser rings or top slab and firmly attached.
	Fractures or Cracks in Basin Walls/ Bottom	Maintenance person judges that structure is unsound. Grout fillet has separated or cracked wider than 1/2 inch and longer than 1 foot at the joint of any inlet/outlet pipe or any evidence of soil particles entering catch basin through cracks.	Basin replaced or repaired to design standards. Pipe is regrouted and secure at basin wall.
	Settlement/ Misalignment	If failure of basin has created a safety, function, or design problem.	Basin replaced or repaired to design standards.
	Vegetation	Vegetation growing across and blocking more than 10% of the basin opening. Vegetation growing in inlet/outlet pipe joints that is more than six inches tall and less than six inches apart.	No vegetation blocking opening to basin. No vegetation or root growth present.
	Contamination and Pollution	See Table V-A.1: Maintenance Standards - Detention Ponds	No pollution present.
Catch Basin Cover	Cover Not in Place	Cover is missing or only partially in place. Any open catch basin requires maintenance.	Cover/grate is in place, meets design standards, and is secured
	Locking Mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than 1/2 inch of thread.	Mechanism opens with proper tools.
	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure. (Intent is keep cover from sealing off access to maintenance.)	Cover can be removed by one maintenance person.
Ladder	Ladder Rungs Unsafe	Ladder is unsafe due to missing rungs, not securely attached to basin wall, misalignment, rust, cracks, or sharp edges.	Ladder meets design standards and allows maintenance person safe access.
Metal Grates (If Applicable)	Grate opening Unsafe	Grate with opening wider than 7/8 inch.	Grate opening meets design standards.
	Trash and Debris	Trash and debris that is blocking more than 20% of grate surface inletting capacity.	Grate free of trash and debris.
	Damaged or Missing.	Grate missing or broken member(s) of the grate.	Grate is in place, meets the design standards, and is installed and aligned with the flow path.

Table V-A.8: Maintenance Standards - Typical Biofiltration Swale (continued)

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Recommended Maintenance to Correct Problem
	Constant Baseflow	When small quantities of water continually flow through the swale, even when it has been dry for weeks, and an eroded, muddy channel has formed in the swale bottom.	Add a low-flow pea-gravel drain the length of the swale or by-pass the baseflow around the swale.
	Poor Vegetation Coverage	When grass is sparse or bare or eroded patches occur in more than 10% of the swale bottom.	Determine why grass growth is poor and correct that condition. Re-plant with plugs of grass from the upper slope: plant in the swale bottom at 8-inch intervals. Or re-seed into loosened, fertile soil.
	Vegetation	When the grass becomes excessively tall (greater than 10-inches); when nuisance weeds and other vegetation starts to take over.	Mow vegetation or remove nuisance vegetation so that flow not impeded. Grass should be mowed to a height of 3 to 4 inches. Remove grass clippings.
	Excessive Shading	Grass growth is poor because sunlight does not reach swale.	If possible, trim back over-hanging limbs and remove brushy vegetation on adjacent slopes.
	Inlet/Outlet	Inlet/outlet areas clogged with sediment and/or debris.	Remove material so that there is no clogging or blockage in the inlet and outlet area.
	Trash and Debris Accumulation	Trash and debris accumulated in the bio-swale.	Remove trash and debris from bioswale.
	Erosion/Scouring	Eroded or scoured swale bottom due to flow channelization, or higher flows.	For ruts or bare areas less than 12 inches wide, repair the damaged area by filling with crushed gravel. If bare areas are large, generally greater than 12 inches wide, the swale should be re-graded and re-seeded. For smaller bare areas, overseed when bare spots are evident, or take plugs of grass from the upper slope and plant in the swale bottom at 8-inch intervals.

Table V-A.9: Maintenance Standards - Wet Biofiltration Swale

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Recommended Maintenance to Correct Problem
General	Sediment Accumulation	Sediment depth exceeds 2-inches in 10% of the swale treatment area.	Remove sediment deposits in treatment area.
	Water Depth	Water not retained to a depth of about 4 inches during the wet season.	Build up or repair outlet berm so that water is retained in the wet swale.
	Wetland Vegetation	Vegetation becomes sparse and does not provide adequate filtration, OR vegetation is crowded out by very dense clumps of cattail, which do not allow water to flow through the clumps.	Determine cause of lack of vigor of vegetation and correct. Replant as needed. For excessive cattail growth, cut cattail shoots back and compost off-site. Note: normally wetland vegetation does not need to be harvested unless die-back is causing oxygen depletion in downstream waters.
	Inlet/Outlet	Inlet/outlet area clogged with sediment and/or debris.	Remove clogging or blockage in the inlet and outlet areas.
	Trash and Debris Accumulation	See Table V-A.1: Maintenance Standards - Detention Ponds	Remove trash and debris from wet swale.
	Erosion/Scouring	Swale has eroded or scoured due to flow channelization, or higher flows.	Check design flows to assure swale is large enough to handle flows. By-pass excess flows or enlarge swale. Replant eroded areas with fibrous-rooted plants such as Juncus effusus (soft rush) in wet areas or snowberry (Symphoricarpos albus) in dryer areas.

Table V-A.21: Maintenance Standards - Bioretention Facilities

Maintenance Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
Facility Footprint				
Earthen side slopes and berms	B, S		Erosion (gullies/ rills) greater than 2 inches deep around inlets, outlet, and alongside slopes	• Eliminate cause of erosion and stabilize damaged area (regrade, rock, vegetation, erosion control matting) • For deep channels or cuts (over 3 inches in ponding depth), temporary erosion control measures should be put in place until permanent repairs can be made. • Properly designed, constructed and established facilities with appropriate flow velocities should not have erosion problems except perhaps in extreme events. If erosion problems persist, the following should be reassessed: (1) flow volumes from contributing areas and bioretention facility sizing; (2) flow velocities and gradients within the facility; and (3) flow dissipation and erosion protection strategies at the facility inlet.
	A		Erosion of sides causes slope to become a hazard	Take actions to eliminate the hazard and stabilize slopes
	A, S		Settlement greater than 3 inches (relative to undisturbed sections of berm)	Restore to design height
	A, S		Downstream face of berm wet, seeps or leaks evident	Plug any holes and compact berm (may require consultation with engineer, particularly for larger berms)
	A		Any evidence of rodent holes or water piping in berm	• Eradicate rodents (see "Pest control") • Fill holes and compact (may require consultation with engineer, particularly for larger berms)
Concrete sidewalls	A		Cracks or failure of concrete sidewalls	• Repair/ seal cracks • Replace if repair is insufficient
Rockery sidewalls	A		Rockery side walls are insecure	Stabilize rockery sidewalls (may require consultation with engineer, particularly for walls 4 feet or greater in height)
Facility area		All maintenance visits (at least biannually)	Trash and debris present	Clean out trash and debris
Facility bottom area	A, S		Accumulated sediment to extent that infiltration rate is reduced (see "Ponded water") or surface storage capacity significantly impacted	• Remove excess sediment • Replace any vegetation damaged or destroyed by sediment accumulation and removal • Mulch newly planted vegetation • Identify and control the sediment source (if feasible) • If accumulated sediment is recurrent, consider adding presettlement or installing berms to create a forebay at the inlet
		During/after fall leaf drop	Accumulated leaves in facility	Remove leaves if there is a risk to clogging outlet structure or water flow is impeded
Low permeability check dams and weirs	A, S		Sediment, vegetation, or debris accumulated at or blocking (or having the potential to block) check dam, flow control weir or orifice	Clear the blockage
	A, S		Erosion and/or undercutting present	Repair and take preventative measures to prevent future erosion and/or undercutting
	A		Grade board or top of weir damaged or not level	Restore to level position

Table V-A.21: Maintenance Standards - Bioretention Facilities (continued)

Maintenance Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
Ponded water	B, S		Excessive ponding water: Water overflows during storms smaller than the design event or ponded water remains in the basin 48 hours or longer after the end of a storm.	Determine cause and resolve in the following order: 1. Confirm leaf or debris buildup in the bottom of the facility is not impeding infiltration. If necessary, remove leaf litter/debris. 2. Ensure that underdrain (if present) is not clogged. If necessary, clear underdrain. 3. Check for other water inputs (e.g., groundwater, illicit connections). 4. Verify that the facility is sized appropriately for the contributing area. Confirm that the contributing area has not increased. If steps #1-4 do not solve the problem, the bioretention soil is likely clogged by sediment accumulation at the surface or has become overly compacted. Dig a small hole to observe soil profile and identify compaction depth or clogging front to help determine the soil depth to be removed or otherwise rehabilitated (e.g., tilled). Consultation with an engineer is recommended.
Bioretention soil mix	As needed		Bioretention soil mix protection is needed when performing maintenance requiring entrance into the facility footprint	• Minimize all loading in the facility footprint (foot traffic and other loads) to the degree feasible in order to prevent compaction of bioretention soils. • Never drive equipment or apply heavy loads in facility footprint. • Because the risk of compaction is higher during saturated soil conditions, any type of loading in the cell (including foot traffic) should be minimized during wet conditions. • Consider measures to distribute loading if heavy foot traffic is required or equipment must be placed in facility. As an example, boards may be placed across soil to distribute loads and minimize compaction. • If compaction occurs, soil must be loosened or otherwise rehabilitated to original design state.
Inlets/Outlets/Pipes				
Splash block inlet	A		Water is not being directed properly to the facility and away from the inlet structure	Reconfigure/ repair blocks to direct water to facility and away from structure
Curb cut inlet/outlet	M during the wet season and before severe storm is forecasted	Weekly during fall leaf drop	Accumulated leaves at curb cuts	Clear leaves (particularly important for key inlets and low points along long, linear facilities)
Pipe inlet/outlet	A		Pipe is damaged	Repair/ replace
	W		Pipe is clogged	Remove roots or debris
	A, S		Sediment, debris, trash, or mulch reducing capacity of inlet/outlet	• Clear the blockage • Identify the source of the blockage and take actions to prevent future blockages
		Weekly during fall leaf drop	Accumulated leaves at inlets/outlets	Clear leaves (particularly important for key inlets and low points along long, linear facilities)
		A	Maintain access for inspections	• Clear vegetation (transplant vegetation when possible) within 1 foot of inlets and outlets, maintain access pathways • Consultation with a landscape architect is recommended for removal, transplant, or substitution of plants

Table V-A.21: Maintenance Standards - Bioretention Facilities (continued)

Maintenance Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
Erosion control at inlet	A		Concentrated flows are causing erosion	Maintain a cover of rock or cobbles or other erosion protection measure (e.g., matting) to protect the ground where concentrated water enters the facility (e.g., a pipe, curb cut or swale)
Trash rack	S		Trash or other debris present on trash rack	Remove/dispose
	A		Bar screen damaged or missing	Repair/replace
Overflow	A, S		Capacity reduced by sediment or debris	Remove sediment or debris/dispose
Underdrain pipe	Clean pipe as needed	Clean orifice at least biannually (may need more frequent cleaning during wet season)	• Plant roots, sediment or debris reducing capacity of underdrain • Prolonged surface ponding (see "Ponded water"	• Jet clean or rotary cut debris/roots from underdrain(s) • If underdrains are equipped with a flow restrictor (e.g., orifice) to attenuate flows, the orifice must be cleaned regularly.
Vegetation				
Facility bottom area and upland slope vegetation	Fall and Spring		Vegetation survival rate falls below 75% within first two years of establishment (unless project O&M manual or record drawing stipulates more or less than 75% survival rate).	• Determine cause of poor vegetation growth and correct condition • Replant as necessary to obtain 75% survival rate or greater. Refer to original planting plan, or approved jurisdictional species list for appropriate plant replacements (See Appendix 3 - Bioretention Plant List, in the *LID Technical Guidance Manual for Puget Sound*, (Hinman and Wulkan, 2012)). • Confirm that plant selection is appropriate for site growing conditions • Consultation with a landscape architect is recommended for removal, transplant, or substitution of plants
Vegetation (general)	As needed		Presence of diseased plants and plant material	• Remove any diseased plants or plant parts and dispose of in an approved location (e.g., commercial landfill) to avoid risk of spreading the disease to other plants • Disinfect gardening tools after pruning to prevent the spread of disease • See the *Pacific Northwest Plant Disease Management Handbook* (Pscheidt and Ocamb, 2016) for information on disease recognition and for additional resources • Replant as necessary according to recommendations provided for "facility bottom area and upland slope vegetation".
Trees and shrubs		All pruning seasons (timing varies by species)	Pruning as needed	• Prune trees and shrubs in a manner appropriate for each species. Pruning should be performed by landscape professionals familiar with proper pruning techniques • All pruning of mature trees should be performed by or under the direct guidance of an ISA certified arborist
	A		Large trees and shrubs interfere with operation of the facility or access for maintenance	• Prune trees and shrubs using most current ANSI A300 standards and ISA BMPs. • Remove trees and shrubs, if necessary.
	Fall and Spring		Standing dead vegetation is present	• Remove standing dead vegetation • Replace dead vegetation within 30 days of reported dead and dying plants (as practical depending on weather/planting season) • If vegetation replacement is not feasible within 30 days, and absence of vegetation may result in erosion problems, temporary erosion control measures should be put in place immediately. • Determine cause of dead vegetation and address issue, if possible

Table V-A.21: Maintenance Standards - Bioretention Facilities (continued)

Maintenance Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
				• If specific plants have a high mortality rate, assess the cause and replace with appropriate species. Consultation with a landscape architect is recommended.
	Fall and Spring		Planting beneath mature trees	• When working around and below mature trees, follow the most current ANSI A300 standards and ISA BMPs to the extent practicable (e.g., take care to minimize any damage to tree roots and avoid compaction of soil). • Planting of small shrubs or groundcovers beneath mature trees may be desirable in some cases; such plantings should use mainly plants that come as bulbs, bare root or in 4-inch pots; plants should be in no larger than 1-gallon containers.
	Fall and Spring		Presence of or need for stakes and guys (tree growth, maturation, and support needs)	• Verify location of facility liners and underdrain (if any) prior to stake installation in order to prevent liner puncture or pipe damage • Monitor tree support systems: Repair and adjust as needed to provide support and prevent damage to tree. • Remove tree supports (stakes, guys, etc.) after one growing season or maximum of 1 year. • Backfill stake holes after removal.
Trees and shrubs adjacent to vehicle travel areas (or areas where visibility needs to be maintained)	A		Vegetation causes some visibility (line of sight) or driver safety issues	• Maintain appropriate height for sight clearance • When continued, regular pruning (more than one time/ growing season) is required to maintain visual sight lines for safety or clearance along a walk or drive, consider relocating the plant to a more appropriate location. • Remove or transplant if continual safety hazard • Consultation with a landscape architect is recommended for removal, transplant, or substitution of plants
Flowering plants		A	Dead or spent flowers present	Remove spent flowers (deadhead)
Perennials		Fall	Spent plants	Cut back dying or dead and fallen foliage and stems
Emergent vegetation		Spring	Vegetation compromises conveyance	Hand rake sedges and rushes with a small rake or fingers to remove dead foliage before new growth emerges in spring or earlier only if the foliage is blocking water flow (sedges and rushes do not respond well to pruning)
Ornamental grasses (perennial)		Winter and Spring	Dead material from previous year's growing cycle or dead collapsed foliage	• Leave dry foliage for winter interest • Hand rake with a small rake or fingers to remove dead foliage back to within several inches from the soil before new growth emerges in spring or earlier if the foliage collapses and is blocking water flow
Ornamental grasses (evergreen)		Fall and Spring	Dead growth present in spring	• Hand rake with a small rake or fingers to remove dead growth before new growth emerges in spring • Clean, rake, and comb grasses when they become too tall • Cut back to ground or thin every 2-3 years as needed
Noxious weeds		M (March - October, preceding seed dispersal)	Listed noxious vegetation is present (refer to current county noxious weed list)	• By law, class A & B noxious weeds must be removed, bagged and disposed as garbage immediately • Reasonable attempts must be made to remove and dispose of class C noxious weeds • It is strongly encouraged that herbicides and pesticides not be used in order to protect water quality; use of herbicides and pesticides may be prohibited in some jurisdictions • Apply mulch after weed removal (see "Mulch")
Weeds		M (March - October,	Weeds are present	• Remove weeds with their roots manually with pincer-type weeding tools, flame weeders, or hot water weeders as

Table V-A.21: Maintenance Standards - Bioretention Facilities (continued)

Maintenance Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
		preceding seed dispersal)		appropriate • Follow IPM protocols for weed management (see "Additional Maintenance Resources" section for more information on IPM protocols)
Excessive vegetation		Once in early to mid- May and once in early- to mid-September	Low-lying vegetation growing beyond facility edge onto sidewalks, paths, or street edge poses pedestrian safety hazard or may clog adjacent permeable pavement surfaces due to associated leaf litter, mulch, and soil	• Edge or trim groundcovers and shrubs at facility edge • Avoid mechanical blade-type edger and do not use edger or trimmer within 2 feet of tree trunks • While some clippings can be left in the facility to replenish organic material in the soil, excessive leaf litter can cause surface soil clogging
	As needed		Excessive vegetation density inhibits stormwater flow beyond design ponding or becomes a hazard for pedestrian and vehicular circulation and safety	• Determine whether pruning or other routine maintenance is adequate to maintain proper plant density and aesthetics • Determine if planting type should be replaced to avoid ongoing maintenance issues (an aggressive grower under perfect growing conditions should be transplanted to a location where it will not impact flow) • Remove plants that are weak, broken or not true to form; replace in-kind • Thin grass or plants impacting facility function without leaving visual holes or bare soil areas • Consultation with a landscape architect is recommended for removal, transplant, or substitution of plants
	As needed		Vegetation blocking curb cuts, causing excessive sediment buildup and flow bypass	Remove vegetation and sediment buildup
Mulch				
Mulch		Following weeding	Bare spots (without mulch cover) are present or mulch depth less than 2 inches	• Supplement mulch with hand tools to a depth of 2 to 3 inches • Replenish mulch per O&M manual. Often coarse compost is used in the bottom of the facility and arborist wood chips are used on side slopes and rim (above typical water levels) • Keep all mulch away from woody stems
Watering				
Irrigation system (if any)		Based on manufacturer's instructions	Irrigation system present	Follow manufacturer's instructions for O&M
	A		Sprinklers or drip irrigation not directed/located to properly water plants	Redirect sprinklers or move drip irrigation to desired areas
Summer watering (first year)		Once every 1-2 weeks or as needed during prolonged dry periods	Trees, shrubs and groundcovers in first year of establishment period	• 10 to 15 gallons per tree • 3 to 5 gallons per shrub • 2 gallons water per square foot for groundcover areas • Water deeply, but infrequently, so that the top 6 to 12 inches of the root zone is moist • Use soaker hoses or spot water with a shower type wand when irrigation system is not present ◦ Pulse water to enhance soil absorption, when feasible

Table V-A.21: Maintenance Standards - Bioretention Facilities (continued)

Maintenance Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
				◦ Pre-moisten soil to break surface tension of dry or hydrophobic soils/mulch, followed by several more passes. With this method , each pass increases soil absorption and allows more water to infiltrate prior to runoff • Add a tree bag or slow-release watering device (e.g., bucket with a perforated bottom) for watering newly installed trees when irrigation system is not present
Summer watering (second and third years)		Once every 2-4 weeks or as needed during prolonged dry periods	Trees, shrubs and groundcovers in second or third year of establishment period	• 10 to 15 gallons per tree • 3 to 5 gallons per shrub • 2 gallons water per square foot for groundcover areas • Water deeply, but infrequently, so that the top 6 to 12 inches of the root zone is moist • Use soaker hoses or spot water with a shower type wand when irrigation system is not present ◦ Pulse water to enhance soil absorption, when feasible ◦ Pre-moisten soil to break surface tension of dry or hydrophobic soils/mulch, followed by several more passes. With this method , each pass increases soil absorption and allows more water to infiltrate prior to runoff
Summer watering (after establishment)		As needed	Established vegetation (after 3 years)	• Plants are typically selected to be drought tolerant and not require regular watering after establishment; however, trees may take up to 5 years of watering to become fully established • Identify trigger mechanisms for drought-stress (e.g., leaf wilt, leaf senescence, etc.) of different species and water immediately after initial signs of stress appear • Water during drought conditions or more often if necessary to maintain plant cover
Pest Control				
Mosquitoes	B, S		Standing water remains for more than 3 days after the end of a storm	• Identify the cause of the standing water and take appropriate actions to address the problem (see "Ponded water") • To facilitate maintenance, manually remove standing water and direct to the storm drainage system (if runoff is from non pollution-generating surfaces) or sanitary sewer system (if runoff is from pollution-generating surfaces) after getting approval from sanitary sewer authority. • Use of pesticides or *Bacillus thuringiensis israelensis* (Bti) may be considered only as a temporary measure while addressing the standing water cause. If overflow to a surface water will occur within 2 weeks after pesticide use, apply for coverage under the Aquatic Mosquito Control NPDES General Permit.
Nuisance animals	As needed		Nuisance animals causing erosion, damaging plants, or depositing large volumes of feces	• Reduce site conditions that attract nuisance species where possible (e.g., plant shrubs and tall grasses to reduce open areas for geese, etc.) • Place predator decoys • Follow IPM protocols for specific nuisance animal issues (see "Additional Maintenance Resources" section for more information on IPM protocols) • Remove pet waste regularly • For public and right-of-way sites consider adding garbage cans with dog bags for picking up pet waste.
Insect pests	Every site visit associated with		Signs of pests, such as wilting leaves, chewed leaves and bark, spotting or other indicators	• Reduce hiding places for pests by removing diseased and dead plants • For infestations, follow IPM protocols (see "Additional Maintenance Resources" section for more information on IPM

Table V-A.21: Maintenance Standards - Bioretention Facilities (continued)

Maintenance Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
	vegetation management			protocols)

Note that the inspection and routine maintenance frequencies listed above are recommended by Ecology. They do not supersede or replace the municipal stormwater permit requirements for inspection frequency required of municipal stormwater permittees for "stormwater treatment and flow control BMPs/facilities".

[a] Frequency: A = Annually; B = Biannually (twice per year); M = Monthly; W = At least one visit should occur during the wet season (for debris/clog related maintenance, this inspection/maintenance visit should occur in the early fall, after deciduous trees have lost their leaves); S = Perform inspections after major storm events (24-hour storm event with a 10-year or greater recurrence interval).

IPM - Integrated Pest Management

ISA - International Society of Arboriculture

Table V-A.22: Maintenance Standards - Permeable Pavement

Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
Surface/Wearing Course				
Permeable Pavements, all	A, S		Runoff from adjacent pervious areas deposits soil, mulch or sediment on paving	• Clean deposited soil or other materials from permeable pavement or other adjacent surfacing • Check if surface elevation of planted area is too high, or slopes towards pavement, and can be regraded (prior to regrading, protect permeable pavement by covering with temporary plastic and secure covering in place) • Mulch and/or plant all exposed soils that may erode to pavement surface
Porous asphalt or pervious concrete		A or B	None (routine maintenance)	Clean surface debris from pavement surface using one or a combination of the following methods: • Remove sediment, debris, trash, vegetation, and other debris deposited onto pavement (rakes and leaf blowers can be used for removing leaves) • Vacuum/sweep permeable paving installation using: ◦ Walk-behind vacuum (sidewalks) ◦ High efficiency regenerative air or vacuum sweeper (roadways, parking lots) ◦ ShopVac or brush brooms (small areas) • Hand held pressure washer or power washer with rotating brushes Follow equipment manufacturer guidelines for when equipment is most effective for cleaning permeable pavement. Dry weather is more effective for some equipment.
	A_b		Surface is clogged: Ponding on surface or water flows off the permeable pavement surface during a rain event (does not infiltrate)	• Review the overall performance of the facility (note that small clogged areas may not reduce overall performance of facility) • Test the surface infiltration rate using ASTM C1701 as a corrective maintenance indicator. Perform one test per installation, up to 2,500 square feet. Perform an additional test for each additional 2,500 square feet up to 15,000 square feet total. Above 15,000 square feet, add one test for every 10,000 square feet. • If the results indicate an infiltration rate of 10 inches per hour or less, then perform corrective maintenance to restore permeability. To clean clogged pavement surfaces, use one or combination of the following methods:

SECTION 9 – DRAFT STORMWATER MAINTENANCE AGREEMENT

The following pages contain a draft maintenance agreement to be completed prior to final approval. Upon completion of road construction and stormwater facilities; a signed agreement will be executed, and a copy provided to the City of Chehalis.

AFTER RECORDING RETURN TO:

_____

_____

_____

PLEASE PRINT OR TYPE ALL INFORMATION DOCUMENT TITLE(S) (OR TRANSACTIONS CONTAINED THEREIN):
Stormwater Maintenance Agreement

REFERENCE NUMBER(S) OF DOCUMENTS ASSIGNED/RELEASED:

_____

GRANTOR/BORROWER (LAST NAME FIRST, FIRST NAME AND INITIALS):
Nicholas, Thomas P.

ADDITIONAL NAMES LISTED ON PAGE N / A OF DOCUMENT.

GRANTEE/ASSIGNEE/BENEFICIARY (LAST NAME FIRST, FIRST NAME AND INITIALS):
City of Washington, Chehalis

ADDITIONAL NAMES LISTED ON PAGE N / A OF DOCUMENT.

LEGAL DESCRIPTION (ABBREVIATED: I.E. LOT, BLOCK, PLAT OR SECTION, TOWNSHIP, RANGE)
Section 32 Township 14N Range 02W

COMPLETE LEGAL DESCRIPTION IS LISTED ON PAGE N / A OF DOCUMENT.

ASSESSOR'S TAX PARCEL NUMBER(S)

005604192001, 005492002000, 05853001000, 005490000000 & 05490001000

THE AUDITOR/RECORDER WILL RELY ON THE INFORMATION PROVIDED ON THIS FORM. THE STAFF WILL NOT READ THE DOCUMENT TO VERIFY THE ACCURACY OR COMPLETENESS OF THE INDEXING INFORMATION PROVIDED HEREIN.

Parcel Number(s): 005604192001, 05492002000, 05853001000, 005490000000 & 05490001000
Project Name: Nicholas Washington Ave.
Address: 1176 SE Washington St, Chehalis, WA 98532

THIS AGREEMENT, made this_____day of_____, 20 , by and between Nicholas, Thomas P & Cara L, hereinafter referred to as the "Owners(s)" of the following property and Lewis County hereinafter referred to as the "County".

WITNESSETH, that

WHEREAS, Owner has submitted for approval by County a permit application and Site Plan for the construction and installation of stormwater management facilities pursuant to County Code chapter 15.45; and

WHEREAS, the County Code requires, as a condition of permit approval, a maintenance agreement between the County and the Owner ensuring the Owner constructs and maintains the stormwater facilities identified in the Site Plan.

THEREFORE, the Owner of certain real property, with full authority to execute deeds, mortgages, other covenants, do hereby covenant with the County and agree as follows:

1. Owner shall construct and install stormwater management facilities as depicted and shown on the Record Drawings for the above referenced parcel number(s)

2. Owner shall continuously maintain the stormwater management facilities as shown on the Site Plan in good working order and as specified in the maintenance schedule.

3. Owner hereby grants County, its authorized agents and employees, to enter onto the Property to inspect the stormwater facilities pursuant to Chapter 15.45 of the County Code.

4. In the event Owner fails to maintain the stormwater management facilities as shown on the Site Plan in good working order acceptable to the County, the County may enter the Property and take whatever steps deemed necessary and appropriate to maintain (including repair or replace) said stormwater facilities. It is expressly understood and agreed that the County is under no obligation to maintain or repair or replace said facilities, and in no event shall this Agreement be construed to impose such an obligation on the County.

5. In the event that the County performs work of any nature pursuant to section 4 of this agreement or expends any funds in performance of such work for labor, equipment, supplies or materials, Owner shall reimburse County for all reasonable costs incurred. Owner, its executors, administrators, assigns, heirs, and any other successors in interest, shall reimburse County for all costs within thirty (30) days of Owner's receipt of written

demand by the County for reasonable costs incurred, including but not limited to attorney fees, collection costs, and interest at the statutory rate.

6. It is the intent of this Agreement to ensure the continuous and proper maintenance of stormwater management facilities by the Owner, its heirs, successors and assigns; provided, however, that this Agreement shall not be deemed to create or affect any additional liability of any party for damage alleged to result from or caused by stormwater management.

7. Owner, its executors, administrators, assigns, and any other successors in interest, shall indemnify and hold the County, its agents and employees harmless from any and all damages, accidents, casualties, occurrences, or claims which might arise or be asserted against County, its agents or employees, from the construction, presence, existence, or maintenance, of the stormwater management facilities by Owner.

8. This Agreement shall be recorded among the land records of Lewis County, Washington, and shall constitute a covenant running with the land, and shall be binding upon Owner, its administrators, executors, assigns, heirs, and any other successor in interest.

Date : _____ Signature: _____

Name: _____

Title: _____

State of Washington

County of _____

I certify that I know or have satisfactory evidence that_____(name of person) is the person who appeared before me, and said person acknowledged that (he/she) signed this instrument and acknowledged it to be (his/her) free and voluntary act for the uses and purposes mentioned in the instrument.

Dated:_____

(Seal or stamp)

_____
Signature

_____
Title

My appointment expires:____