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9740 Evergreen Way • Everett, WA 98204
P: (425) 356-2700 F: (425) 356-2708 W: WESI.CO

FULL STORMWATER DRAINAGE REPORT

for

BEC Investments, LLC
12900 Beverly Park Road
Mukilteo, WA 98275

ISSUE DATE: October 31, 2018
REVISION DATE: ***March 19, 2019***

PREPARED BY:
Timothy Sarkela, P.E.

REVIEWED BY:
JESSE A. JARRELL, P.E.

06-25-19

CLIENT(s)
BEC Investments, LLC
9326 Evergreen Way
Everett, WA. 98204
(206) 605-1658

ENGINEER
Western Engineers & Surveyors, Inc.
Job # 18-1758-A

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Minimum Requirement # 1: Stormwater Site Plan

Executive Summary

The project consists of clearing/grading and demolition of existing structures for the construction of a car sales building with a detached car detail and repair building along with associated drive aisle, parking, and utilities. The proposed buildings are to have an approximate combined roof area of 4,780 sf. along with proposed drive aisle, parking area paving, curbing, and walkways totaling approximately 17,820 sf. Total new and replaced impervious surface have been estimated at approximately 22,600 sf. The proposed site development will provide a driveway apron and walkway connections to Beverly Park Road directly south of the site. Drainage management for the site improvements will be provided by an underground detention vault with a pre-detention BioPod Biofilter underground vault for enhanced water quality treatment. Disturbed pervious areas will be amended per BMP T5.13. The project is to be designed according to the 2012 (with 2014 updates) DOE Stormwater Management Manual for Western Washington and the 2017 City of Mukilteo Development Standards.

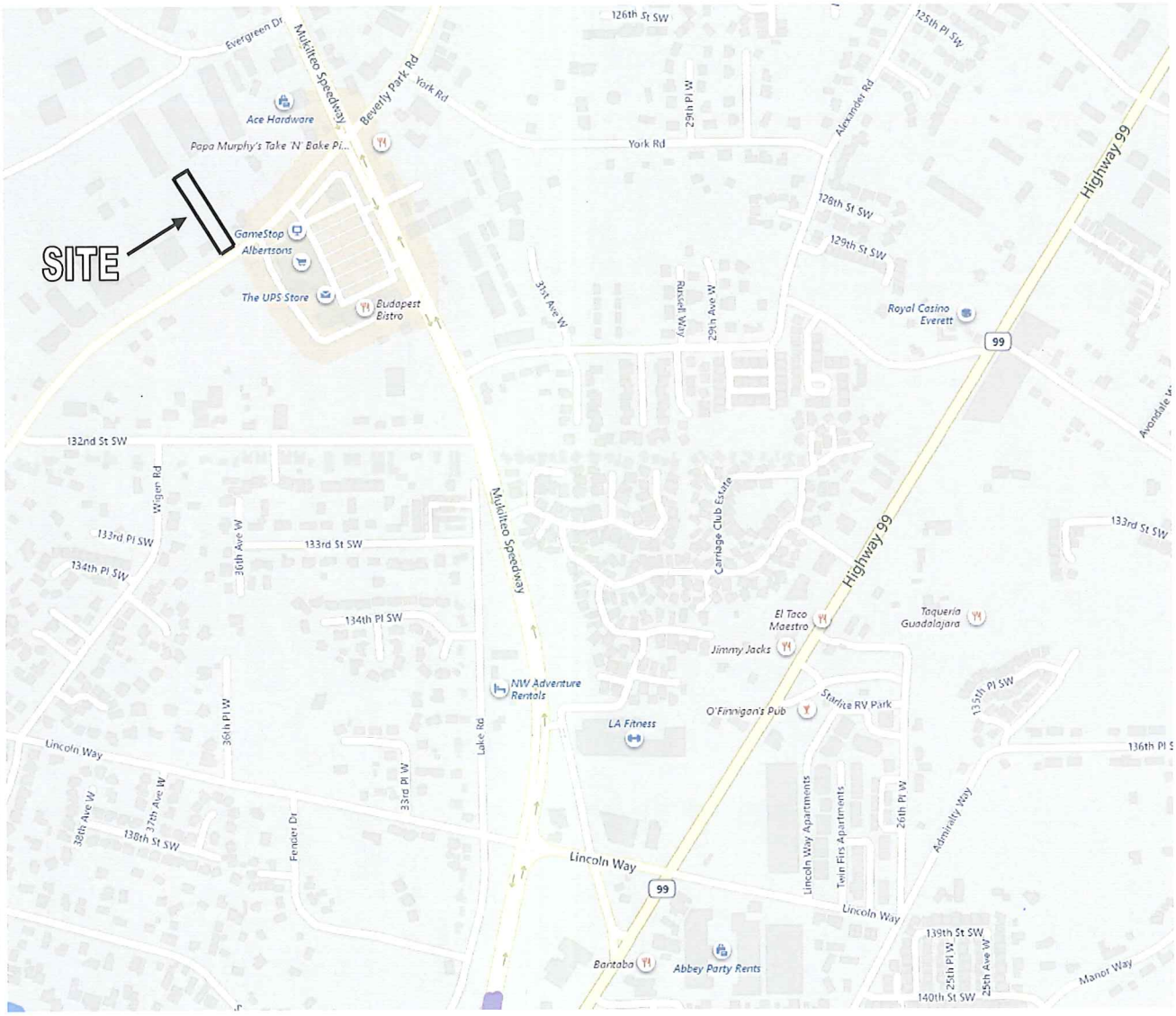
Existing Conditions Summary

The property is one tax parcel and contains a trailer and small sheds within the southern third of the property. The northern third of the property contains Category III wetlands and associated buffers and will lie outside the project clearing limits. The remainder of the property currently contains second/third growth forest vegetation. Slopes on-site are flat to moderate, ranging from 2% to 20%, and sloping northerly toward the on-site Category III wetland. Per NRCS/USDA soils mapping, the site contains Alderwood-Urban Land Complex type soils. According to soil tests pit and hand auger taken by The Riley Group, Inc., site soils resemble medium dense to dense silty sand. Refer to appendix II for soil information.

The adjacent parcel to the west contains a small business with associated parking area, the adjacent parcel to the east contains a vehicle storage yard, and a commercial park lies to the north of the site. Beverly Park Road right-of-way lies immediate south of the site.

VICINITY MAP

MAP TAKEN FROM BING MAPS:



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BEC INVESTMENTS, LLC
MUKILTEO, WA 98275

SCALE: 1" = ~820'	**DATE:** 11/01/18	**CHECKED:** JAJ
BY: JAJ	**JOB NUMBER:** 18-1758-A	**FILE NAME:** 181758A/VICINITYMAP

Upstream Analysis

The topography of the site and the surrounding area tends to slope northerly and northwesterly toward wetland areas on and adjacent to the site. Minor sheet flow runoff from properties to the east and west may be encountered, but each property contains stormwater conveyance systems and expected runoff is expected to be minimal. Runoff from Beverly Park Road is intercepted by the public storm drainage system within Beverly Park Road and does not enter the site. No evidence of erosion or concentrated flows was observed during site visit and other upstream flows appear to enter the site.

Downstream Analysis

A downstream analysis was provided by Timothy Sarkela of Western Engineers on February 28, 2019. Weather was partly sunny with a temperature around 40 degrees. Refer to the aerial map in the next section of this report for a depiction of runoff paths.

The entire property tends to slope northerly toward on-site Category III wetlands (see photos 1 & 2). Site runoff appears to sheet flow into the on-site wetland and continues westerly off-site through the wetland system (see photos 3 & 4). According to aerial maps and City of Mukilteo stormwater system maps, the wetland system appears to drain into a creek within the close vicinity of the property, approximately 100 feet west of the site. The creek appears to be a tributary of Picnic Point Creek and continues flowing westerly to Picnic Point Creek. As this creek is the closest receiving water, further downstream analysis is not required.

Drainage Complaints

There are no known drainage complaints for the site.

DOWNSTREAM AND AERIAL MAP

DOWNSTREAM PHOTOGRAPHS

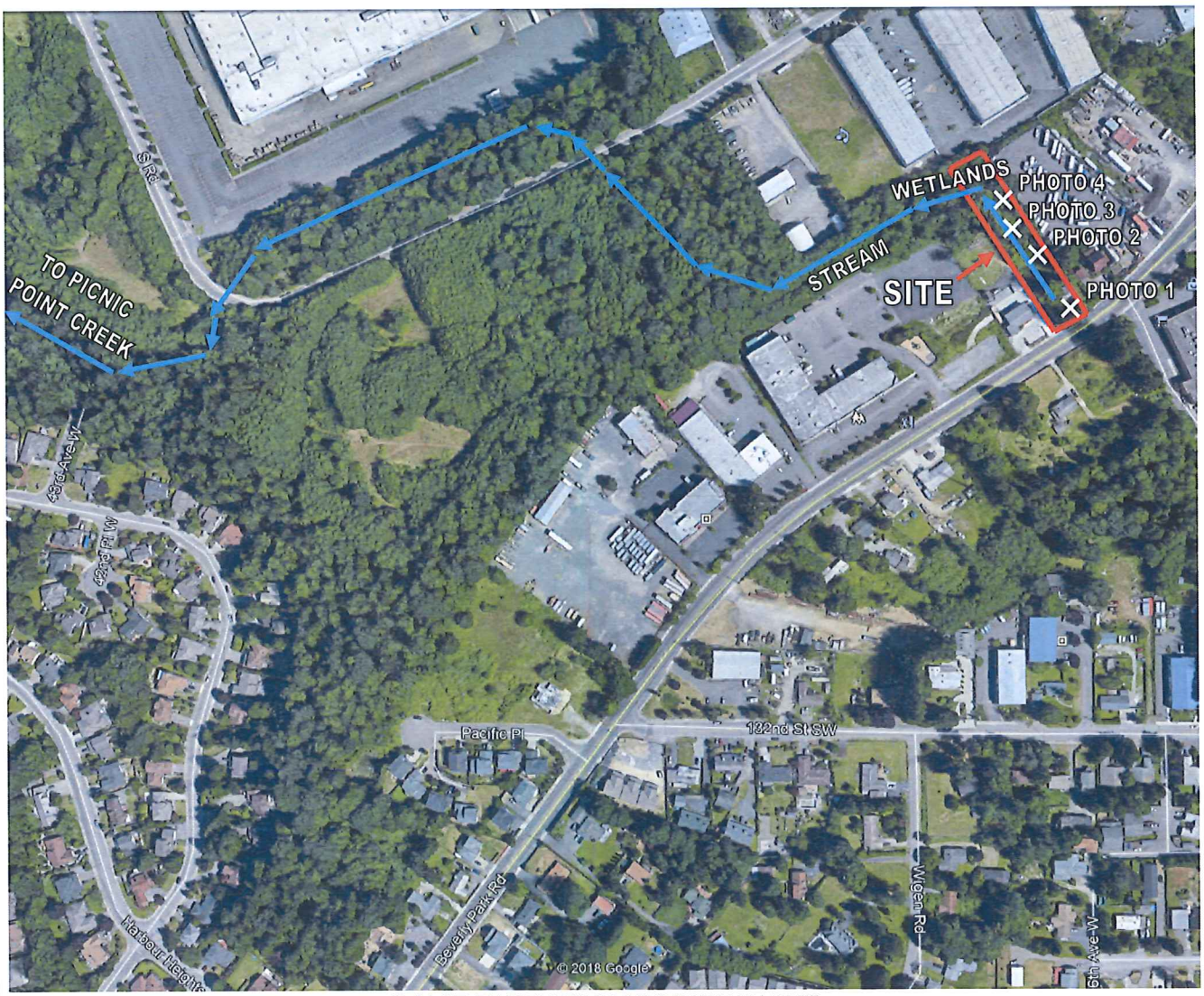

IMAGE TAKEN FROM GOOGLE EARTH

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SCALE: 1"=380'	**DATE:** 11/01/18	**SHEET:** 1 OF 1	
BY: JAJ	**JOB NUMBER:** 18-1758-A	**FILE NAME:** Downstream 1.DOC	

DOWNSTREAM PHOTOGRAPHS

DOWNSTREAM PHOTOGRAPHS

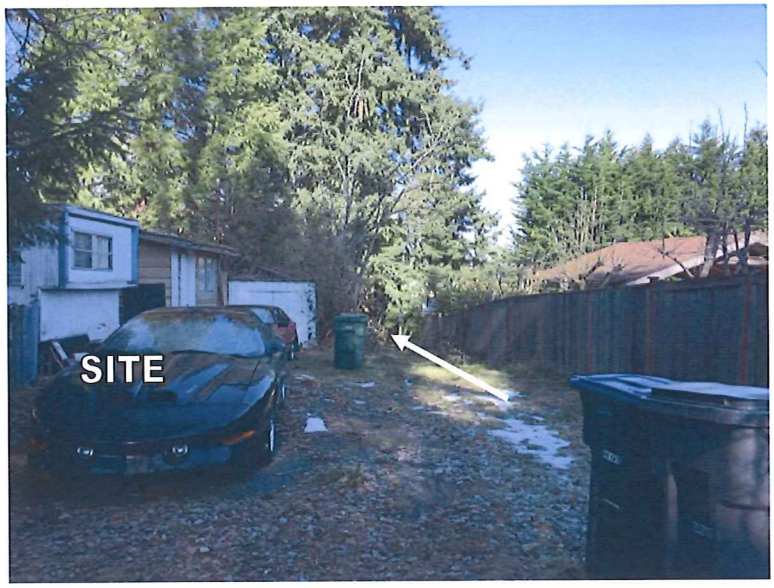

PHOTO 1:
Figure to the Left:
Looking north from near the southeast property corner.

PHOTO 2:
Figure to the Right:
Looking southerly from near the middle of the proposed site.

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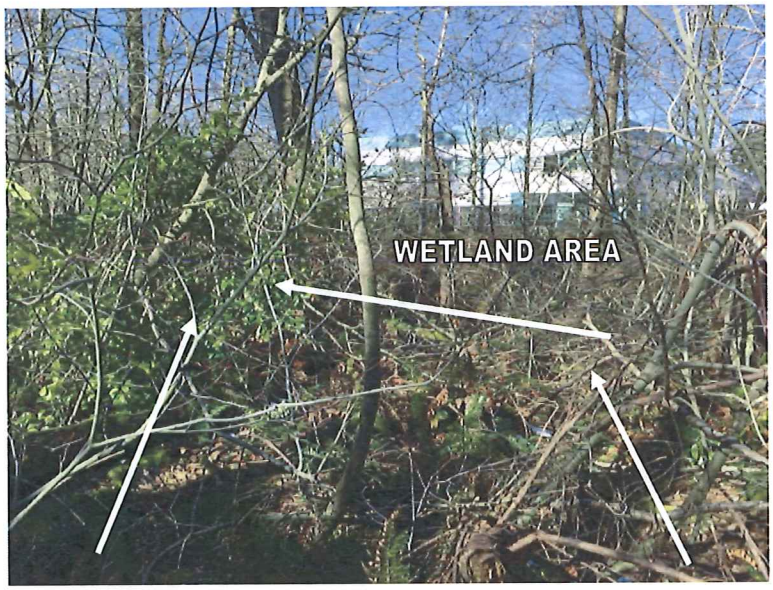
BEC INVESTMENTS, LLC
MUKILTEO, WA 98275

SCALE: None	**DATE:** 02/28/19	**SHEET:** 1 OF 2	
BY: JAJ	**JOB NUMBER:** 18-1758-A	**FILE NAME:** Downstream 1.DOC	

DOWNSTREAM PHOTOGRAPHS

PHOTO 3:
Figure to the Left:
Looking northerly from near the central portion of the property.

PHOTO 4:
Figure to the Right:
Looking northerly toward on-site wetland areas that flow off-site in a westerly direction.



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SCALE: None	**DATE:** 02/28/19	**SHEET:** 2 OF 2	
BY: JAJ	**JOB NUMBER:** 18-1758-A	**FILE NAME:** Downstream 2.DOC	

Minimum Requirement # 2: SWPPP Narrative

Element #1: Mark Clearing Limits
Clearing limits have been shown on the SWPPP Plan.

Element #2: Establish Construction Entrance
A temporary construction entrance (BMP C105) and construction parking area (BMP C107) have been shown on the SWPPP plan near the south end of the site. All vehicles shall be free of debris prior to leaving the site.

Element # 3: Control Flow Rates
Flow rates during construction are to be contained through the installation of a temporary sediment trap (BMP C240) near the northwest corner of the project clearing limits.

Element # 4: Install Sediment Controls
Sediment controls mainly consist of installation a temporary sediment trap (BMP C240) near the northwest corner of the project clearing limits along with silt fencing (BMP C233) on the western and northern clearing limits.

Element # 5: Stabilize Soils
All soils disturbed during site grading will be stabilized by use of the most appropriate BMP method available. These consist of short-term and long-term solutions. Short-term methods consist of compaction of the soils by vibratory roller or bulldozer. Long-term methods consist of straw covering over the soils (this is in the case of the project becoming dormant for greater than 1 month). During summer construction periods longer than 1 working week (7 days) where the soils are exposed and un-worked will use the proscribed methods in the Storm Water Management Manual for Western Washington to reduce sedimentation transported offsite. If winter grading is conducted, all exposed soils shall be covered within 2 days.

Element # 6: Protect Slopes
Steep slopes within the project clearing limits will be protected with Mulching (BMP C121) and/or Nets and Blankets (BMP C122).

Element # 7: Protect Drain Inlets
Catch basin inlets along the site frontage will be protected from with catch basin sediment inserts or equivalent per BMP C220.

Element # 8: Stabilize Channels and Outlets
Channels and drainage outlets are not needed around the proposed development area on site. No stabilization is necessary. Existing channels or drainage outlets located within 500-feet of the property of the property should be routinely inspected for debris that may dam and/or aid erosion.

Element # 9: Control Pollutants
All pollutants from construction vehicles will be contained and disposed of in the approved manner consistent with state environmental policies. Any vehicle maintenance will be performed by authorized mechanics using drip pans and waste containment vessels. All pollutants will be disposed offsite at approved facilities. Concrete washout areas to be established on site. All excess concrete shall be contained to a designated area and disposed of at a city approved site.

Element # 10: Control De-Watering
De-watering of the site is not expected. If dewatering of the site is needed, all groundwater removed shall be retained and recharged into the ground after de-watering has been finalized.

Element # 11: Maintain BMP's
All Temporary Erosion and Sedimentation Control (TESC) devices and equipment will be inspected and maintained on a weekly basis if not sooner, based on storm events contributing to runoff. When construction is complete and the site is stabilized, any existing sediment will be removed and stabilized onsite.

Element # 12: Manage the Project
A general construction manager will manage the project for or by the owners. The construction manager shall maintain all of the above items in order to minimize sediment transport and turbid water leaving the site. His job will entail continual observation of the grading operations to ensure minimal effects to adjacent properties and offsite waterways.

Element # 13: Protect Low Impact Development BMPs
LID BMP's mainly consist of soil amendement per BMP T5.13. The soil amendment areas are to be protected from compaction and sedimentation when feasible.

Minimal Requirement # 3: Water Pollution Source Control

Due to the commercial nature of the proposed site improvements, some Source Control BMPs may apply. The proposed commercial use primarily deals with auto sales and detailing. Vehicle maintenance is not proposed by this project. Source control BMPs that likely apply to the project are listed below:

S421 – Parking and Storage of Vehicles and Equipment
S426 – Spills of Oil and Hazardous Substances
S431 – Washing and Steam Cleaning of Vehicles

Minimum Requirement # 4: Preservation of Natural Drainage Systems and Outfalls, and provisions of off-site mitigation

No changes to the existing drainage systems and outfalls are proposed with this development. All proposed runoff from the project area is to flow to the north and northwest into the existing wetlands within the northern portion of the site.

Minimum Requirement #5 On-Site Storm Water Management

Due to the project proposing more than 5,000 sf of new hard surfaces, Minimum Requirements 1 through 9 must be evaluated. The project is required to meet BMPs described in List #2 of Section 2.5.5 of the 2014 WADOE SWDM or design the site to the LID performance standard. The project will meet the requirements of List #2. Refer to analysis below for breakdown of feasible On-Site Stormwater BMPs based on List #2.

Lawn & Landscape Areas:

- Design in accordance with BMP T5.13
  - ⇨ Project designed with all disturbed pervious areas of the site being amended with compost per option #2 of BMP T5.13

Roof Areas:

- Full Dispersion per BMP T5.30 or Full Infiltration per BMP T5.10A.
  - ⇨ The project area does not contain enough native forest to retain and is not considered a rural site. Full Dispersion infeasible.
  - ⇨ Due to less than 3' of permeable soils above till and substantial amount of proposed fill volume, roof drain infiltration is not recommended.
- Bioretention Cells, Swales and Planter Boxes per BMP T7.30.
  - ⇨ Bioretention without underdrains for infiltration is not recommended due to the amount of fill material being proposed throughout the site. Also, the proximity of fill walls, subsurface detention tank, and building foundations eliminates most area from being used for bioretention due to setback requirements.
  - ⇨ Bioretention areas with underdrains for partial infiltration are also infeasible because of proximity of fill walls, subsurface detention tank, and building foundations, according to setback requirements.
- Downspout Dispersion Systems per BMP T5.10B
  - ⇨ The proposed site does not contain adequate vegetated flow paths for roof drain dispersion. Roof drain dispersion is infeasible.
- Perforated Stub-Out Connections per BMP T5.10C
  - ⇨ Due to the amount of fill material being proposed throughout the site, infiltration and partial infiltration BMPs are not recommended. Roof runoff will be convey through the proposed on-site conveyance system to the proposed on-site underground detention tank.

Other Hard Surface Areas:

- Full Dispersion per BMP T5.30
  - ⇨ The project area does not contain enough native forest to retain and is not considered a rural site. Full Dispersion infeasible.
- Permeable Pavements per BMP T5.15
  - ⇨ Due to the substantial amount of fill material proposed throughout the site, permeable pavement infiltration is not recommended.
- Rain Gardens per BMP T5.14A and Bioretention per BMP T7.30.
  - ⇨ Bioretention without underdrains for infiltration is not recommended due to the amount of fill material being proposed throughout the site. Also, the proximity of fill walls, subsurface detention tank, and building foundations

eliminates most area from being used for bioretention due to setback requirements.

- ⇨ Bioretention areas with underdrains for partial infiltration are also infeasible because of proximity of fill walls, subsurface detention tank, and building foundations, according to setback requirements.

- Sheet Flow Dispersion BMP T5.12 and Concentrated Flow Dispersion BMP T5.11
  - ⇨ The proposed site does not contain adequate vegetated flow paths for sheet flow or concentrated flow dispersion. Such dispersion is infeasible.

Minimum Requirement # 6: Runoff Treatment

Due to the site proposing more than 5,000 sf. of new/replaced pollution generating impervious surfaces, runoff treatment is required. Runoff treatment for the site will be provided by a BioPod Biofilter underground water quality vault. The detention tank will also provide 6" dead storage depth at the bottom of the proposed detention tank.

Minimum Requirement # 7: Flow Control

Due to the site proposing more than 10,000 sf. of new/replaced impervious surfaces, flow control is required. Flow control for proposed runoff will be managed by an underground detention tank with a control structure that outlets northerly toward on-site wetland buffers. Refer to WWHM detention sizing calculations in the next section of this report for detention sizing and evaluation of flow rates.

Existing and Developed Site Summary

Total Property Area	= 38,834 sf. (0.892 Ac.)
Total Frontage Area	= 120 sf. (0.002 Ac.)
Total Project Area	= 38,954 sf. (0.894 Ac.)
Less Wetland and Buffers	= 12,650 sf. (0.290 Ac.)
Total Clearing Limits	= 26,304 sf. (0.604 Ac.)

Existing Site

On-site Hardscape Area:	
Ex. Trailer Roof	= 780 sf.
Ex. Shed and Other Roofs	= 820 sf.
Ex. Driveway	= 800 sf.
Total	= 2,400 sf. (0.055 Ac.)
On-site Pervious Area:	
Ex. Residential Lawn	= 2,000 sf. (0.046 Ac.)
Ex. Forested Area	= 21,784 sf. (0.500 Ac.)
Ex. Wetland and Buffer	= 12,650 sf. (0.290 Ac.)

*Note: Existing site will modeled as completely forested for WWHM vault sizing calculations.

Proposed Site

On-Site Hardscape Area:

Sales and Detail Building Roof	=	2,370 sf.
Repair Building Roof	=	2,410 sf.
*Curb and Sidewalks	=	1,430 sf.
*Pavement	=	16,390 sf.
Total	=	22,600 sf. (0.519 Ac.)

*Note: Does not include areas covered by roof overhangs

On-Site Pervious Area:

Commercial Landscaping	=	3,704 sf. (0.085 Ac.)
Ex. Wetland and Buffer	=	12,650 sf. (0.290 Ac.)

Total New/Replaced Hardscape Surface = 22,600 sf. (0.519 Ac.)

WWHM2012
UNDETAINED RUNOFF &
WATER QUALITY RATE

Summary of BMP Flow Credits Used for WWHM2012 Analysis:

- **Amended Soils (analyze as pasture).**

WWHM2012
PROJECT REPORT

Project Name: 18-1758-A TESC
Site Name:
Site Address:
City :
Report Date: 2/27/2019
Gage : Everett
Data Start : 1948/10/01
Data End : 2009/09/30
Precip Scale: 1.00
Version Date: 2018/03/08
Version : 4.2.14

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

High Flow Threshold for POC 1: 50 year

PREDEVELOPED LAND USE

Name : UNDEVELOPED
Bypass: No

GroundWater: No

Pervious Land Use	acre
C, Forest, Flat	0.124
C, Forest, Mod	0.480
Pervious Total	0.604

Impervious Land Use	acre
Impervious Total	0
Basin Total	0.604

MITIGATED LAND USE

Name : DEVELOPED
Bypass: No

GroundWater: No

Pervious Land Use	acre
C, Pasture, Flat	0.085
Pervious Total	0.085

Impervious Land Use	acre
ROOF TOPS FLAT	0.110
DRIVEWAYS FLAT	0.240
DRIVEWAYS MOD	0.136
SIDEWALKS FLAT	0.033
Impervious Total	0.519
Basin Total	0.604

ANALYSIS RESULTS
Stream Protection Duration

Predeveloped Landuse Totals for POC #1
Total Pervious Area:0.604
Total Impervious Area:0

Mitigated Landuse Totals for POC #1
Total Pervious Area:0.085
Total Impervious Area:0.519

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.013321
5 year	0.020279
10 year	0.025262
25 year	0.031931
50 year	0.037148
100 year	0.042565

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0.232054
5 year	0.313505
10 year	0.372998
25 year	0.454749
50 year	0.520592
100 year	0.590812

Water Quality BMP Flow and Volume for POC #1
On-line facility volume: 0.0535 acre-feet
On-line facility target flow: 0.0836 cfs.
Adjusted for 15 min: 0.0836 cfs.
Off-line facility target flow: 0.0473 cfs.
Adjusted for 15 min: 0.0473 cfs.

WWHM2012 3' DEEP DETENTION SIZING

- **To demonstrate that a 0.5 inch lower orifice can't be designed.**

WWHM2012
PROJECT REPORT

Project Name: 18-1758-A 3' TANK W notch
Site Name:
Site Address:
City :
Report Date: 3/7/2019
Gage : Everett
Data Start : 1948/10/01
Data End : 2009/09/30
Precip Scale: 1.00
Version Date: 2018/03/08
Version : 4.2.14

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

High Flow Threshold for POC 1: 50 year

PREDEVELOPED LAND USE

Name : UNDEVELOPED
Bypass: No

GroundWater: No

Pervious Land Use	acre
C, Forest, Flat	0.124
C, Forest, Mod	0.480
Pervious Total	0.604

Impervious Land Use	acre
Impervious Total	0
Basin Total	0.604

MITIGATED LAND USE

Name : DEVELOPED
Bypass: No

GroundWater: No

Pervious Land Use	acre
C, Pasture, Flat	0.085
Pervious Total	0.085

Impervious Land Use	acre
ROOF TOPS FLAT	0.110
DRIVEWAYS FLAT	0.240
DRIVEWAYS MOD	0.136
SIDEWALKS FLAT	0.033
Impervious Total	0.519
Basin Total	0.604

Element Flows To:

Surface	Interflow	Groundwater
Vault 1	Vault 1	

Name : Vault 1
Width : 33 ft.
Length : 86.1217811492003 ft.
Depth: 4 ft.
Discharge Structure
Riser Height: 3 ft.
Riser Diameter: 18 in.
Notch Type: Rectangular
Notch Width: 0.010 ft.
Notch Height: 0.669 ft.
Orifice 1 Diameter: 0.398 in. **Elevation:** 0 ft.

Element Flows To:

Outlet 1	Outlet 2

Vault Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.065	0.000	0.000	0.000
0.0444	0.065	0.002	0.000	0.000
0.0889	0.065	0.005	0.001	0.000
0.1333	0.065	0.008	0.001	0.000
0.1778	0.065	0.011	0.001	0.000
0.2222	0.065	0.014	0.002	0.000
0.2667	0.065	0.017	0.002	0.000
0.3111	0.065	0.020	0.002	0.000
0.3556	0.065	0.023	0.002	0.000
0.4000	0.065	0.026	0.002	0.000
0.4444	0.065	0.029	0.002	0.000
0.4889	0.065	0.031	0.003	0.000
0.5333	0.065	0.034	0.003	0.000
0.5778	0.065	0.037	0.003	0.000
0.6222	0.065	0.040	0.003	0.000
0.6667	0.065	0.043	0.003	0.000
0.7111	0.065	0.046	0.003	0.000
0.7556	0.065	0.049	0.003	0.000
0.8000	0.065	0.052	0.003	0.000
0.8444	0.065	0.055	0.004	0.000
0.8889	0.065	0.058	0.004	0.000
0.9333	0.065	0.060	0.004	0.000
0.9778	0.065	0.063	0.004	0.000
1.0222	0.065	0.066	0.004	0.000

1.0667	0.065	0.069	0.004	0.000
1.1111	0.065	0.072	0.004	0.000
1.1556	0.065	0.075	0.004	0.000
1.2000	0.065	0.078	0.004	0.000
1.2444	0.065	0.081	0.004	0.000
1.2889	0.065	0.084	0.004	0.000
1.3333	0.065	0.087	0.005	0.000
1.3778	0.065	0.089	0.005	0.000
1.4222	0.065	0.092	0.005	0.000
1.4667	0.065	0.095	0.005	0.000
1.5111	0.065	0.098	0.005	0.000
1.5556	0.065	0.101	0.005	0.000
1.6000	0.065	0.104	0.005	0.000
1.6444	0.065	0.107	0.005	0.000
1.6889	0.065	0.110	0.005	0.000
1.7333	0.065	0.113	0.005	0.000
1.7778	0.065	0.116	0.005	0.000
1.8222	0.065	0.118	0.005	0.000
1.8667	0.065	0.121	0.005	0.000
1.9111	0.065	0.124	0.005	0.000
1.9556	0.065	0.127	0.006	0.000
2.0000	0.065	0.130	0.006	0.000
2.0444	0.065	0.133	0.006	0.000
2.0889	0.065	0.136	0.006	0.000
2.1333	0.065	0.139	0.006	0.000
2.1778	0.065	0.142	0.006	0.000
2.2222	0.065	0.145	0.006	0.000
2.2667	0.065	0.147	0.006	0.000
2.3111	0.065	0.150	0.006	0.000
2.3556	0.065	0.153	0.006	0.000
2.4000	0.065	0.156	0.007	0.000
2.4444	0.065	0.159	0.008	0.000
2.4889	0.065	0.162	0.008	0.000
2.5333	0.065	0.165	0.009	0.000
2.5778	0.065	0.168	0.010	0.000
2.6222	0.065	0.171	0.011	0.000
2.6667	0.065	0.174	0.013	0.000
2.7111	0.065	0.176	0.014	0.000
2.7556	0.065	0.179	0.015	0.000
2.8000	0.065	0.182	0.016	0.000
2.8444	0.065	0.185	0.018	0.000
2.8889	0.065	0.188	0.019	0.000
2.9333	0.065	0.191	0.021	0.000
2.9778	0.065	0.194	0.022	0.000
3.0222	0.065	0.197	0.076	0.000
3.0667	0.065	0.200	0.297	0.000
3.1111	0.065	0.203	0.611	0.000
3.1556	0.065	0.205	0.993	0.000
3.2000	0.065	0.208	1.427	0.000
3.2444	0.065	0.211	1.900	0.000
3.2889	0.065	0.214	2.398	0.000
3.3333	0.065	0.217	2.906	0.000
3.3778	0.065	0.220	3.410	0.000
3.4222	0.065	0.223	3.895	0.000
3.4667	0.065	0.226	4.349	0.000
3.5111	0.065	0.229	4.761	0.000
3.5556	0.065	0.232	5.121	0.000

3.6000	0.065	0.234	5.425	0.000
3.6444	0.065	0.237	5.673	0.000
3.6889	0.065	0.240	5.872	0.000
3.7333	0.065	0.243	6.038	0.000
3.7778	0.065	0.246	6.274	0.000
3.8222	0.065	0.249	6.450	0.000
3.8667	0.065	0.252	6.621	0.000
3.9111	0.065	0.255	6.788	0.000
3.9556	0.065	0.258	6.951	0.000
4.0000	0.065	0.261	7.111	0.000
4.0444	0.065	0.263	7.266	0.000
4.0889	0.000	0.000	7.419	0.000

ANALYSIS RESULTS
Stream Protection Duration

Predeveloped Landuse Totals for POC #1
Total Pervious Area:0.604
Total Impervious Area:0

Mitigated Landuse Totals for POC #1
Total Pervious Area:0.085
Total Impervious Area:0.519

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.013321
5 year	0.020279
10 year	0.025262
25 year	0.031931
50 year	0.037148
100 year	0.042565

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0.008092
5 year	0.017549
10 year	0.028150
25 year	0.049162
50 year	0.072643
100 year	0.105368

Stream Protection Duration
Annual Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1949	0.007	0.006
1950	0.014	0.007
1951	0.013	0.006
1952	0.010	0.005
1953	0.008	0.005
1954	0.036	0.006
1955	0.020	0.021
1956	0.017	0.023

1957	0.019	0.006
1958	0.014	0.006
1959	0.014	0.006
1960	0.012	0.006
1961	0.013	0.015
1962	0.011	0.005
1963	0.016	0.006
1964	0.011	0.005
1965	0.013	0.006
1966	0.007	0.006
1967	0.016	0.006
1968	0.018	0.006
1969	0.017	0.006
1970	0.010	0.006
1971	0.016	0.033
1972	0.013	0.006
1973	0.010	0.008
1974	0.022	0.007
1975	0.010	0.005
1976	0.010	0.006
1977	0.008	0.005
1978	0.010	0.005
1979	0.022	0.005
1980	0.011	0.005
1981	0.009	0.005
1982	0.012	0.007
1983	0.020	0.006
1984	0.013	0.037
1985	0.018	0.021
1986	0.043	0.160
1987	0.018	0.056
1988	0.010	0.009
1989	0.010	0.005
1990	0.013	0.006
1991	0.014	0.007
1992	0.011	0.006
1993	0.007	0.005
1994	0.007	0.008
1995	0.014	0.011
1996	0.025	0.009
1997	0.048	0.246
1998	0.009	0.006
1999	0.012	0.009
2000	0.007	0.011
2001	0.002	0.004
2002	0.013	0.020
2003	0.010	0.006
2004	0.015	0.008
2005	0.011	0.006
2006	0.031	0.020
2007	0.025	0.015
2008	0.035	0.075
2009	0.011	0.007

Stream Protection Duration
Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.0477	0.2457
2	0.0426	0.1595
3	0.0364	0.0749
4	0.0346	0.0564
5	0.0311	0.0371

6	0.0251	0.0327
7	0.0248	0.0226
8	0.0216	0.0210
9	0.0216	0.0206
10	0.0202	0.0197
11	0.0197	0.0196
12	0.0192	0.0148
13	0.0185	0.0146
14	0.0184	0.0115
15	0.0178	0.0106
16	0.0173	0.0094
17	0.0172	0.0090
18	0.0159	0.0088
19	0.0158	0.0084
20	0.0156	0.0080
21	0.0150	0.0077
22	0.0145	0.0072
23	0.0143	0.0072
24	0.0143	0.0069
25	0.0137	0.0066
26	0.0136	0.0066
27	0.0134	0.0065
28	0.0131	0.0064
29	0.0129	0.0063
30	0.0128	0.0063
31	0.0127	0.0063
32	0.0126	0.0062
33	0.0126	0.0062
34	0.0124	0.0062
35	0.0123	0.0061
36	0.0122	0.0060
37	0.0114	0.0060
38	0.0114	0.0060
39	0.0112	0.0060
40	0.0110	0.0060
41	0.0109	0.0059
42	0.0109	0.0059
43	0.0103	0.0059
44	0.0102	0.0059
45	0.0102	0.0057
46	0.0102	0.0057
47	0.0101	0.0056
48	0.0098	0.0056
49	0.0097	0.0054
50	0.0096	0.0053
51	0.0095	0.0053
52	0.0095	0.0053
53	0.0086	0.0053
54	0.0081	0.0052
55	0.0076	0.0052
56	0.0073	0.0050
57	0.0072	0.0050
58	0.0071	0.0050
59	0.0070	0.0049
60	0.0066	0.0047
61	0.0023	0.0039

Stream Protection Duration
POC #1
The Facility PASSED

The Facility PASSED.

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0067	21177	10222	48	Pass
0.0070	18903	8810	46	Pass
0.0073	16827	7980	47	Pass
0.0076	14946	7347	49	Pass
0.0079	13334	6718	50	Pass
0.0082	11933	6231	52	Pass
0.0085	10726	5777	53	Pass
0.0088	9542	5298	55	Pass
0.0091	8558	4894	57	Pass
0.0094	7670	4511	58	Pass
0.0097	6834	4190	61	Pass
0.0100	6154	3923	63	Pass
0.0104	5544	3608	65	Pass
0.0107	5037	3379	67	Pass
0.0110	4558	3168	69	Pass
0.0113	4145	2979	71	Pass
0.0116	3696	2787	75	Pass
0.0119	3326	2624	78	Pass
0.0122	2969	2485	83	Pass
0.0125	2629	2340	89	Pass
0.0128	2389	2160	90	Pass
0.0131	2160	2019	93	Pass
0.0134	1974	1899	96	Pass
0.0137	1819	1757	96	Pass
0.0141	1685	1654	98	Pass
0.0144	1554	1575	101	Pass
0.0147	1446	1490	103	Pass
0.0150	1360	1403	103	Pass
0.0153	1285	1326	103	Pass
0.0156	1207	1260	104	Pass
0.0159	1143	1180	103	Pass
0.0162	1073	1108	103	Pass
0.0165	1002	1040	103	Pass
0.0168	937	986	105	Pass
0.0171	895	928	103	Pass
0.0174	856	868	101	Pass
0.0177	815	816	100	Pass
0.0181	768	771	100	Pass
0.0184	734	731	99	Pass
0.0187	697	687	98	Pass
0.0190	671	639	95	Pass
0.0193	647	591	91	Pass
0.0196	627	542	86	Pass
0.0199	610	490	80	Pass
0.0202	593	441	74	Pass
0.0205	575	403	70	Pass
0.0208	560	361	64	Pass
0.0211	547	328	59	Pass
0.0214	531	305	57	Pass
0.0218	514	271	52	Pass

0.0221	497	234	47	Pass
0.0224	473	196	41	Pass
0.0227	456	177	38	Pass
0.0230	445	176	39	Pass
0.0233	434	174	40	Pass
0.0236	420	172	40	Pass
0.0239	406	171	42	Pass
0.0242	400	166	41	Pass
0.0245	389	162	41	Pass
0.0248	372	162	43	Pass
0.0251	359	161	44	Pass
0.0254	354	157	44	Pass
0.0258	341	156	45	Pass
0.0261	330	152	46	Pass
0.0264	320	152	47	Pass
0.0267	311	151	48	Pass
0.0270	304	151	49	Pass
0.0273	300	149	49	Pass
0.0276	293	149	50	Pass
0.0279	285	147	51	Pass
0.0282	278	145	52	Pass
0.0285	269	142	52	Pass
0.0288	262	141	53	Pass
0.0291	252	136	53	Pass
0.0294	245	125	51	Pass
0.0298	236	122	51	Pass
0.0301	230	119	51	Pass
0.0304	214	116	54	Pass
0.0307	206	113	54	Pass
0.0310	201	113	56	Pass
0.0313	192	112	58	Pass
0.0316	187	109	58	Pass
0.0319	178	106	59	Pass
0.0322	172	104	60	Pass
0.0325	165	103	62	Pass
0.0328	158	100	63	Pass
0.0331	150	99	66	Pass
0.0335	144	98	68	Pass
0.0338	137	97	70	Pass
0.0341	129	96	74	Pass
0.0344	125	95	76	Pass
0.0347	117	95	81	Pass
0.0350	113	93	82	Pass
0.0353	110	93	84	Pass
0.0356	106	92	86	Pass
0.0359	104	91	87	Pass
0.0362	100	91	91	Pass
0.0365	96	90	93	Pass
0.0368	89	88	98	Pass
0.0371	81	87	107	Pass

Perlnd and Implnd Changes

No changes have been made.

WWHM2012 DETENTION SIZING CALCULATIONS

Summary of BMP Flow Credits Used for WWHM2012 Analysis:

- **Amended Soils (analyze as pasture).**

WWHM2012
PROJECT REPORT

Project Name: 18-1758-A 4.5' TANK W notch
Site Name:
Site Address:
City :
Report Date: 3/7/2019
Gage : Everett
Data Start : 1948/10/01
Data End : 2009/09/30
Precip Scale: 1.00
Version Date: 2018/03/08
Version : 4.2.14

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

High Flow Threshold for POC 1: 50 year

PREDEVELOPED LAND USE

Name : UNDEVELOPED
Bypass: No

GroundWater: No

Pervious Land Use	acre
C, Forest, Flat	0.124
C, Forest, Mod	0.480
Pervious Total	0.604

Impervious Land Use	acre
Impervious Total	0
Basin Total	0.604

MITIGATED LAND USE

Name : DEVELOPED
Bypass: No

GroundWater: No

Pervious Land Use	acre
C, Pasture, Flat	0.085
Pervious Total	0.085

Impervious Land Use	acre
ROOF TOPS FLAT	0.110
DRIVEWAYS FLAT	0.240
DRIVEWAYS MOD	0.136
SIDEWALKS FLAT	0.033
Impervious Total	0.519
Basin Total	0.604

Element Flows To:

Surface	Interflow	Groundwater
Vault 1	Vault 1	

Name : Vault 1
Width : 33 ft.
Length : 55.5 ft.
Depth: 5 ft.

Discharge Structure

Riser Height: 4.5 ft.
Riser Diameter: 12 in.
Notch Type: Rectangular
Notch Width: 0.042 ft.
Notch Height: 0.360 ft.
Orifice 1 Diameter: 0.371 in. **Elevation:** 0 ft.

Element Flows To:

Outlet 1	Outlet 2

Vault Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.042	0.000	0.000	0.000
0.0556	0.042	0.002	0.000	0.000
0.1111	0.042	0.004	0.001	0.000
0.1667	0.042	0.007	0.001	0.000
0.2222	0.042	0.009	0.001	0.000
0.2778	0.042	0.011	0.002	0.000
0.3333	0.042	0.014	0.002	0.000
0.3889	0.042	0.016	0.002	0.000
0.4444	0.042	0.018	0.002	0.000
0.5000	0.042	0.021	0.002	0.000
0.5556	0.042	0.023	0.002	0.000
0.6111	0.042	0.025	0.002	0.000
0.6667	0.042	0.028	0.003	0.000
0.7222	0.042	0.030	0.003	0.000
0.7778	0.042	0.032	0.003	0.000
0.8333	0.042	0.035	0.003	0.000
0.8889	0.042	0.037	0.003	0.000
0.9444	0.042	0.039	0.003	0.000
1.0000	0.042	0.042	0.003	0.000
1.0556	0.042	0.044	0.003	0.000
1.1111	0.042	0.046	0.003	0.000
1.1667	0.042	0.049	0.004	0.000
1.2222	0.042	0.051	0.004	0.000
1.2778	0.042	0.053	0.004	0.000

1.3333	0.042	0.056	0.004	0.000
1.3889	0.042	0.058	0.004	0.000
1.4444	0.042	0.060	0.004	0.000
1.5000	0.042	0.063	0.004	0.000
1.5556	0.042	0.065	0.004	0.000
1.6111	0.042	0.067	0.004	0.000
1.6667	0.042	0.070	0.004	0.000
1.7222	0.042	0.072	0.004	0.000
1.7778	0.042	0.074	0.005	0.000
1.8333	0.042	0.077	0.005	0.000
1.8889	0.042	0.079	0.005	0.000
1.9444	0.042	0.081	0.005	0.000
2.0000	0.042	0.084	0.005	0.000
2.0556	0.042	0.086	0.005	0.000
2.1111	0.042	0.088	0.005	0.000
2.1667	0.042	0.091	0.005	0.000
2.2222	0.042	0.093	0.005	0.000
2.2778	0.042	0.095	0.005	0.000
2.3333	0.042	0.098	0.005	0.000
2.3889	0.042	0.100	0.005	0.000
2.4444	0.042	0.102	0.005	0.000
2.5000	0.042	0.105	0.005	0.000
2.5556	0.042	0.107	0.006	0.000
2.6111	0.042	0.109	0.006	0.000
2.6667	0.042	0.112	0.006	0.000
2.7222	0.042	0.114	0.006	0.000
2.7778	0.042	0.116	0.006	0.000
2.8333	0.042	0.119	0.006	0.000
2.8889	0.042	0.121	0.006	0.000
2.9444	0.042	0.123	0.006	0.000
3.0000	0.042	0.126	0.006	0.000
3.0556	0.042	0.128	0.006	0.000
3.1111	0.042	0.130	0.006	0.000
3.1667	0.042	0.133	0.006	0.000
3.2222	0.042	0.135	0.006	0.000
3.2778	0.042	0.137	0.006	0.000
3.3333	0.042	0.140	0.006	0.000
3.3889	0.042	0.142	0.006	0.000
3.4444	0.042	0.144	0.006	0.000
3.5000	0.042	0.147	0.007	0.000
3.5556	0.042	0.149	0.007	0.000
3.6111	0.042	0.151	0.007	0.000
3.6667	0.042	0.154	0.007	0.000
3.7222	0.042	0.156	0.007	0.000
3.7778	0.042	0.158	0.007	0.000
3.8333	0.042	0.161	0.007	0.000
3.8889	0.042	0.163	0.007	0.000
3.9444	0.042	0.165	0.007	0.000
4.0000	0.042	0.168	0.007	0.000
4.0556	0.042	0.170	0.007	0.000
4.1111	0.042	0.172	0.007	0.000
4.1667	0.042	0.175	0.008	0.000
4.2222	0.042	0.177	0.010	0.000
4.2778	0.042	0.179	0.014	0.000
4.3333	0.042	0.182	0.019	0.000
4.3889	0.042	0.184	0.024	0.000
4.4444	0.042	0.186	0.029	0.000

4.5000	0.042	0.189	0.036	0.000
4.5556	0.042	0.191	0.174	0.000
4.6111	0.042	0.193	0.425	0.000
4.6667	0.042	0.196	0.739	0.000
4.7222	0.042	0.198	1.082	0.000
4.7778	0.042	0.200	1.419	0.000
4.8333	0.042	0.203	1.719	0.000
4.8889	0.042	0.205	1.957	0.000
4.9444	0.042	0.207	2.124	0.000
5.0000	0.042	0.210	2.239	0.000
5.0556	0.042	0.212	2.384	0.000
5.1111	0.000	0.000	2.498	0.000

ANALYSIS RESULTS
Stream Protection Duration

Predeveloped Landuse Totals for POC #1
Total Pervious Area:0.604
Total Impervious Area:0

Mitigated Landuse Totals for POC #1
Total Pervious Area:0.085
Total Impervious Area:0.519

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.013321
5 year	0.020279
10 year	0.025262
25 year	0.031931
50 year	0.037148
100 year	0.042565

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0.008263
5 year	0.018550
10 year	0.030389
25 year	0.054406
50 year	0.081803
100 year	0.120637

Stream Protection Duration
Annual Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1949	0.007	0.006
1950	0.014	0.007
1951	0.013	0.006
1952	0.010	0.006
1953	0.008	0.006
1954	0.036	0.006
1955	0.020	0.036
1956	0.017	0.053

1957	0.019	0.007
1958	0.014	0.006
1959	0.014	0.006
1960	0.012	0.006
1961	0.013	0.008
1962	0.011	0.005
1963	0.016	0.006
1964	0.011	0.005
1965	0.013	0.007
1966	0.007	0.006
1967	0.016	0.006
1968	0.018	0.007
1969	0.017	0.006
1970	0.010	0.006
1971	0.016	0.030
1972	0.013	0.006
1973	0.010	0.007
1974	0.022	0.007
1975	0.010	0.005
1976	0.010	0.007
1977	0.008	0.006
1978	0.010	0.006
1979	0.022	0.005
1980	0.011	0.006
1981	0.009	0.005
1982	0.012	0.007
1983	0.020	0.006
1984	0.013	0.033
1985	0.018	0.028
1986	0.043	0.159
1987	0.018	0.062
1988	0.010	0.007
1989	0.010	0.005
1990	0.013	0.007
1991	0.014	0.007
1992	0.011	0.007
1993	0.007	0.005
1994	0.007	0.007
1995	0.014	0.007
1996	0.025	0.007
1997	0.048	0.251
1998	0.009	0.006
1999	0.012	0.007
2000	0.007	0.007
2001	0.002	0.004
2002	0.013	0.020
2003	0.010	0.006
2004	0.015	0.007
2005	0.011	0.006
2006	0.031	0.026
2007	0.025	0.014
2008	0.035	0.098
2009	0.011	0.007

Stream Protection Duration
Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.0477	0.2514
2	0.0426	0.1589
3	0.0364	0.0979
4	0.0346	0.0621
5	0.0311	0.0531

6	0.0251	0.0358
7	0.0248	0.0326
8	0.0216	0.0301
9	0.0216	0.0276
10	0.0202	0.0263
11	0.0197	0.0200
12	0.0192	0.0135
13	0.0185	0.0082
14	0.0184	0.0074
15	0.0178	0.0073
16	0.0173	0.0072
17	0.0172	0.0072
18	0.0159	0.0072
19	0.0158	0.0071
20	0.0156	0.0071
21	0.0150	0.0071
22	0.0145	0.0071
23	0.0143	0.0070
24	0.0143	0.0070
25	0.0137	0.0069
26	0.0136	0.0069
27	0.0134	0.0069
28	0.0131	0.0068
29	0.0129	0.0068
30	0.0128	0.0067
31	0.0127	0.0066
32	0.0126	0.0066
33	0.0126	0.0065
34	0.0124	0.0064
35	0.0123	0.0064
36	0.0122	0.0064
37	0.0114	0.0064
38	0.0114	0.0063
39	0.0112	0.0063
40	0.0110	0.0063
41	0.0109	0.0062
42	0.0109	0.0062
43	0.0103	0.0062
44	0.0102	0.0062
45	0.0102	0.0060
46	0.0102	0.0059
47	0.0101	0.0059
48	0.0098	0.0059
49	0.0097	0.0057
50	0.0096	0.0057
51	0.0095	0.0056
52	0.0095	0.0056
53	0.0086	0.0056
54	0.0081	0.0055
55	0.0076	0.0055
56	0.0073	0.0054
57	0.0072	0.0053
58	0.0071	0.0053
59	0.0070	0.0051
60	0.0066	0.0050
61	0.0023	0.0042

Stream Protection Duration
POC #1
The Facility PASSED

The Facility PASSED.

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0067	21177	21205	100	Pass
0.0070	18903	12641	66	Pass
0.0073	16827	7133	42	Pass
0.0076	14946	2618	17	Pass
0.0079	13334	2231	16	Pass
0.0082	11933	1919	16	Pass
0.0085	10726	1823	16	Pass
0.0088	9542	1760	18	Pass
0.0091	8558	1695	19	Pass
0.0094	7670	1639	21	Pass
0.0097	6834	1582	23	Pass
0.0100	6154	1530	24	Pass
0.0104	5544	1464	26	Pass
0.0107	5037	1406	27	Pass
0.0110	4558	1349	29	Pass
0.0113	4145	1291	31	Pass
0.0116	3696	1245	33	Pass
0.0119	3326	1208	36	Pass
0.0122	2969	1175	39	Pass
0.0125	2629	1141	43	Pass
0.0128	2389	1107	46	Pass
0.0131	2160	1074	49	Pass
0.0134	1974	1048	53	Pass
0.0137	1819	1020	56	Pass
0.0141	1685	996	59	Pass
0.0144	1554	976	62	Pass
0.0147	1446	945	65	Pass
0.0150	1360	915	67	Pass
0.0153	1285	891	69	Pass
0.0156	1207	874	72	Pass
0.0159	1143	852	74	Pass
0.0162	1073	829	77	Pass
0.0165	1002	812	81	Pass
0.0168	937	791	84	Pass
0.0171	895	772	86	Pass
0.0174	856	750	87	Pass
0.0177	815	730	89	Pass
0.0181	768	708	92	Pass
0.0184	734	693	94	Pass
0.0187	697	677	97	Pass
0.0190	671	660	98	Pass
0.0193	647	645	99	Pass
0.0196	627	628	100	Pass
0.0199	610	611	100	Pass
0.0202	593	596	100	Pass
0.0205	575	581	101	Pass
0.0208	560	569	101	Pass
0.0211	547	550	100	Pass
0.0214	531	537	101	Pass
0.0218	514	526	102	Pass

0.0221	497	514	103	Pass
0.0224	473	502	106	Pass
0.0227	456	483	105	Pass
0.0230	445	468	105	Pass
0.0233	434	459	105	Pass
0.0236	420	432	102	Pass
0.0239	406	424	104	Pass
0.0242	400	413	103	Pass
0.0245	389	400	102	Pass
0.0248	372	386	103	Pass
0.0251	359	377	105	Pass
0.0254	354	368	103	Pass
0.0258	341	362	106	Pass
0.0261	330	351	106	Pass
0.0264	320	336	104	Pass
0.0267	311	326	104	Pass
0.0270	304	304	100	Pass
0.0273	300	299	99	Pass
0.0276	293	290	98	Pass
0.0279	285	276	96	Pass
0.0282	278	270	97	Pass
0.0285	269	258	95	Pass
0.0288	262	248	94	Pass
0.0291	252	241	95	Pass
0.0294	245	227	92	Pass
0.0298	236	214	90	Pass
0.0301	230	206	89	Pass
0.0304	214	199	92	Pass
0.0307	206	186	90	Pass
0.0310	201	180	89	Pass
0.0313	192	176	91	Pass
0.0316	187	167	89	Pass
0.0319	178	163	91	Pass
0.0322	172	157	91	Pass
0.0325	165	151	91	Pass
0.0328	158	147	93	Pass
0.0331	150	142	94	Pass
0.0335	144	137	95	Pass
0.0338	137	130	94	Pass
0.0341	129	126	97	Pass
0.0344	125	120	96	Pass
0.0347	117	115	98	Pass
0.0350	113	110	97	Pass
0.0353	110	104	94	Pass
0.0356	106	97	91	Pass
0.0359	104	91	87	Pass
0.0362	100	89	89	Pass
0.0365	96	89	92	Pass
0.0368	89	89	100	Pass
0.0371	81	89	109	Pass

Perlnd and Implnd Changes

No changes have been made.

Minimum Requirement # 8: Wetland Protection

Wetlands and associated buffers exist within the northern end of the site. Impacts to wetland buffers will be mitigated according to a wetland plan and report by Acre Environmental Consulting, LLC. Wetlands will be protected during construction by well-marked clearing limits.

Minimum Requirement # 9: Operation and Maintenance

BMP T5.13 Post-Construction Soil Quality and Depth

Maintenance

- Soil quality and depth should be established toward the end of construction and once established, should be protected from compaction, such as from large machinery use, and from erosion.
- Soil should be planted and mulched after installation.
- Plant debris or its equivalent should be left on the soil surface to replenish organic matter.

No. 3 – Underground Detention Pipes/Tanks

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	The average sediment depth measured at multiple locations exceeds 10% of the detention pipe diameter (or the depth of the storage area) or the sediment depth measured at any single point exceeds 15% of the pipe diameter. (Example: The sediment depth in a 60-inch diameter detention pipe is measured at three locations. The sediment would need to be removed if the average depth of the three measurements is at least 6 inches or if the depth of any single measurement is at least 9 inches.	All sediment, debris, and organic matter removed from storage area.
	Joints Between Tank/Pipe Section	Any openings or voids at section joint allowing material to seep into or water to leak out of facility. Note: This may need an engineering analysis to assess the structural stability.	All joints between tank/pipe sections are sealed.
	Tank or Pipe Bent Out of Shape	Any part of tank/pipe is bent out of shape more than 10% of its design shape. Note: This may need an engineering analysis to assess the structural stability.	Tank/pipe section is repaired or replaced to design.
	Tank/Pipe Material	Any visible holes or cracks wider than a quarter of an inch or evidence of material seeping into or water leaking out of pipe wall, or qualified maintenance or inspection personnel determine that tank/pipe is not structurally sound.	Tank/pipe is repaired or replaced to design specifications and is structurally sound.
Access Hole	Cover Not in Place	Cover is missing or only partially in place. Any open manhole requires maintenance.	Manhole is closed.
	Locking Mechanism Not Working	Locking mechanism cannot be opened or lock bolts cannot be removed by one maintenance person with proper hand tools.	Mechanism or lock bolts open with proper hand tools.
	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure with proper hand tools. Intent is to keep cover from sealing off access to maintenance.	Cover can be removed and reinstalled by one maintenance person with proper hand tools.
	Ladder Rungs Unsafe	Ladder is unsafe due to missing rungs, cracked/broken rungs, misalignment, rungs not securely attached to structure wall, rust, or cracks.	Ladder meets design standards and allows maintenance person safe access.
Catch Basins	See "Catch Basins" (No. 5)	See "Catch Basins" (No. 5).	See "Catch Basins" (No. 5).
Standpipe, Cleanout Gate, Orifice Plate	Obstructions, Damaged, or Missing	See "Control Structure/Flow Restrictors" (No. 4)	See "Control Structure/Flow Restrictors" (No. 4)

No. 4 – Control Structure/Flow Restrictors

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Standpipe	Obstructions	Any material blocking (or having the potential of blocking) the pipe overflow.	Pipe is free of all obstructions and works as designed.
	Structural Damage	Structure is not securely attached to manhole wall.	Structure is securely attached to wall and outlet pipe.
		Structure is not in upright position (allow up to 10% from plumb).	Structure is in correct position.
		Connections to outlet pipe are not watertight and show signs of rust.	Connections to outlet pipe are water tight; structure repaired or replaced and works as designed.
		Any holes other than designed holes in the structure.	Structure has no holes other than designed holes.
Cleanout Gate	Damaged or Missing	Cleanout gate is not watertight or is missing.	Gate is watertight and works as designed.
		Gate cannot be moved up and down by one maintenance person.	Gate moves up and down easily and is watertight.
		Chain/rod leading to gate is missing or damaged.	Chain is in place and works as designed.
		Gate is rusted over 50% of its surface area.	Gate is repaired or replaced to meet design standards.
Orifice Plate	Damaged or Missing	Control device is not working properly due to missing, out of place, or bent orifice plate.	Plate is in place and works as designed.
	Obstructions	Any trash, debris, sediment, or vegetation blocking the plate.	Plate is free of all obstructions and works as designed.
Overflow Pipe	Obstructions	Any trash or debris blocking (or having the potential of blocking) the overflow pipe.	Pipe is free of all obstructions and works as designed.
Access Hole	Cover Not in Place	Cover is missing or only partially in place. Any open manhole requires maintenance.	Manhole is closed.
	Locking Mechanism Not Working	Locking mechanism cannot be opened or lock bolts cannot be removed by one maintenance person with proper hand tools.	Mechanism or lock bolts open with proper hand tools.
	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure with proper hand tools. Intent is to keep cover from sealing off access to maintenance.	Cover can be removed and reinstalled by one maintenance person with proper hand tools.
	Ladder Rungs Unsafe	Ladder is unsafe due to missing rungs, cracked/broken rungs, misalignment, rungs not securely attached to structure wall, rust, or cracks.	Ladder meets design standards and allows maintenance person safe access.

No. 5 – Catch Basins

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is performed
General	Sediment & Debris	Sediment, trash, and/or other debris material is located immediately in front of the catch basin opening or is blocking inletting capacity of the basin by more than 10%.	No sediment or debris is located immediately in front of catch basin or on grate opening.
		Sediment, trash, and/or other debris material (located in the catch basin) exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of six inches clearance from the debris surface to the invert of the lowest pipe.	No sediment or debris is in the catch basin.
		Sediment, trash, and/or other debris material located in any inlet or outlet pipe is blocking more than 1/3 of its height.	Inlet and outlet pipes are free of sediment and debris.
		Dead animals or vegetation that impair catch basin function or that could generate odors that could cause complaints or dangerous gases (e.g., methane).	No dead animals or vegetation are present within 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 seeping into the catch basin).	Top slab is free of holes and cracks. No water and/or soil is seeping into the catch 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	Frame is sitting flush on the riser rings or top slab and firmly attached.
	Fractures or Cracks in Basin Walls/ Bottom	Cracks wider than 1/2 inch or evidence of soil particles entering the structure through the cracks, or qualified maintenance or inspection personnel determine that the vault is not structurally sound.	Catch basin is replaced or repaired to design standards.
		Grout fillet has separated or cracked wider than 1/2 inch and longer than 1 foot at the joint of any inlet/outlet pipe or any evidence of soil particles entering catch basin through cracks.	Pipe is regrouted and secure at basin wall.
	Settlement/ Misalignment	Settlement of misalignment of the catch basin causes a safety, function, or design problem.	Catch basin is replaced or repaired to design standards.
	Contaminants and Pollution	Any evidence of oil, gasoline, contaminants or other pollutants Note: Coordinate removal/cleanup with local and/or state water quality response agency.	Contaminants or pollutants are removed.
Access Hole Cover	Cover Not in Place	Cover is missing or only partially in place. Any open catch basin requires maintenance.	Catch basin cover is fully in place
	Locking Mechanism Not Working	Locking mechanism cannot be opened or lock bolts cannot be removed by one maintenance person with proper hand tools.	Mechanism or lock bolts open with proper hand tools.
	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure with proper hand tools. Intent is keep cover from sealing off access to maintenance.	Cover can be removed and reinstalled by one maintenance person with proper hand tools.

No. 5 – Catch Basins

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is performed
Ladder	Ladder Rungs Unsafe	Ladder is unsafe due to missing rungs, cracked/broken rungs, 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)	Trash and Debris	Trash and debris that is blocking more than 20% of grate surface inletting capacity.	Grate free of trash and debris.
	Damaged or Missing.	Grate missing or broken member(s) of the grate.	Grate is in place and meets design standards.

No. 7 – Energy Dissipaters

Maintenance Components	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
External:			
Rock Pad	Missing or Moved Rock	Only one layer of rock exists above native soil in area five square feet or larger, or any exposure of native soil.	Rock pad replaced to design standards.
	Erosion	Soil erosion in or adjacent to rock pad.	Rock pad replaced to design standards.
Dispersion Trench	Pipe Plugged with Sediment	Accumulated sediment that exceeds 20% of the design depth.	Pipe cleaned/flushed so that it matches design.
	Not Discharging Water Properly	Visual evidence of water discharging at concentrated points along trench (normal condition is a "sheet flow" of water along trench). Intent is to prevent erosion damage.	Trench redesigned or rebuilt to standards.
	Perforations Plugged.	Over 1/2 of perforations in pipe are plugged with debris and sediment.	Perforated pipe cleaned or replaced.
	Water Flows Out Top of "Distributor" Catch Basin.	Maintenance person observes or receives credible report of water flowing out during any storm less than the design storm or its causing or appears likely to cause damage.	Facility rebuilt or redesigned to standards.
	Receiving Area Over-Saturated	Water in receiving area is causing or has potential of causing landslide problems.	No danger of landslides.
Internal:			
Manhole/Chamber	Worn or Damaged Post, Baffles, Side of Chamber	Structure dissipating flow deteriorates to 1/2 of original size or any concentrated worn spot exceeding one square foot which would make structure unsound.	Structure replaced to design standards.
	Other Defects	See "Catch Basins" (No. 5).	See "Catch Basins" (No. 5).

STORMTANK®
A Brentwood Brand

Maintenance Guidelines

General:

The StormTank™ Stormwater Storage Module is a component in a stormwater collection system, providing storage for the detention or infiltration of runoff. No two systems are the same; with varying shapes, sizes and configurations. Some include pre-treatment to remove sediment and/or contaminants prior to entering the storage area and some do not. Systems without pre-treatment require greater attention to system functionality and may require additional maintenance.

In order to sustain system functionality Brentwood offers the following general maintenance guidelines.

Precautions:

1. Prior to & During Construction - Siltation prevention of the stormwater system.
   a. Conform to all local, state and federal regulations for sediment and erosion control during construction.
   b. Install site erosion and sediment BMP's (Best Management Practices) required to prevent siltation of the stormwater system.
   c. Inspect and maintain erosion and sediment BMP's during construction.
2. Post Construction - Prior to commissioning the StormTank™ system.
   a. Remove and properly dispose of construction erosion and sediment BMP's per all local, state and federal regulations. Care should be taken during removal of the BMP's as not to allow collected sediment or debris into the stormwater system.
   b. Flush the StormTank™ system to remove any sediment or construction debris immediately after the BMP's removal. Follow the maintenance procedure outlined.

Inspections:

Follow all local, state, and federal regulations regarding stormwater BMP inspection requirements.

Brentwood Industries makes the following recommendations:

1. Frequency
   a. During the first service year a visual inspection should be completed during and after each major rainfall event, in addition to semi-annually, to establish a pattern of sediment and debris buildup.
      i. Each stormwater system is unique and multiple criteria can affect maintenance frequency such as:

a) System Design: pre-treatment/no-pretreatment, inlet protection, stand alone device.
b) Surface Area Collecting From: hardscape, gravel, soil.
c) Adjacent Area: soil runoff, gravel, trash.
d) Seasonal Changes: fall-leaves, winter-salt/cinders.

b. Second year plus; establish an annual inspection frequency based on the information collected during the first year. At a minimum an inspection should be perform semi-annually.
c. Seasonal change; regional areas affected by seasonal change (spring, summer, fall, winter) may require additional inspections at the change of seasons in addition to semi-annually.

2. Inspect:
   a. Inspection ports.
   b. Inflow and outflow points including the inlet/manhole and pipes.
   c. Discharge area.
3. Identify and Report maintenance required:
   a. Sediment and debris accumulation.
   b. System backing up.
   c. Flow rate change.

Maintenance Procedures:

1. Conform to all local, state and federal regulations.
2. Determine if maintenance is required. If a pre-treatment device is installed, follow manufacturer recommendations.
3. Using a vacuum pump truck evacuate debris from the inflow and outflow points.
4. Flush the system with clean water forcing debris from the system. Take care to avoid extreme direct water pressure when flushing the system.
5. Repeat steps 3 and 4 until no debris is evident.

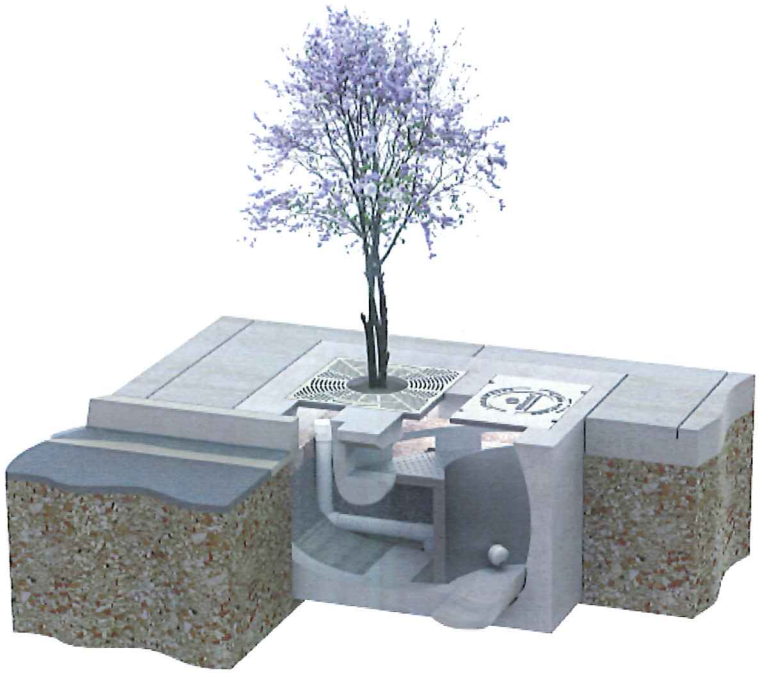
These maintenance guidelines were written by Brentwood Industries, Inc. with the express purpose of providing helpful hints. These guidelines are no to be construed as the only Brentwood approved methods for StormTank™ system maintenance or the final authority in system maintenance. Check with the stormwater system owner/project engineer for their contract/specification requirements and or recommendations. Contact your local StormTank™ distributor or Brentwood Industries for additional technical support if required.

Oldcastle Infrastructure™
A CRH COMPANY

BIOPOD™ SYSTEM

WITH STORMMIX™ MEDIA

Inspection and Maintenance Guide



Water

Oldcastle Infrastructure™ A CRH COMPANY

INSPECTION AND MAINTENANCE GUIDE

BioPod™ Biofilter with StormMix™ Biofiltration Media

Description

The BioPod™ Biofilter System (BioPod) is a stormwater biofiltration treatment system used to remove pollutants from stormwater runoff. Impervious surfaces and other urban and suburban landscapes generate a variety of contaminants that can enter stormwater and pollute downstream receiving waters unless treatment is provided. The BioPod system uses proprietary StormMix™ biofiltration media to capture and retain pollutants including total suspended solids (TSS), metals, nutrients, gross solids, trash and debris as well as petroleum hydrocarbons.

Function

The BioPod system uses engineered, high-flow rate filter media to remove stormwater pollutants, allowing for a smaller footprint than conventional bioretention systems. Contained within a compact precast concrete vault, the BioPod system consists of a biofiltration chamber and an optional integrated high-flow bypass with a contoured inlet rack to minimize scour. The biofiltration chamber is filled with horizontal layers of aggregate (which may or may not include an underdrain), biofiltration media and mulch. Stormwater passes vertically down through the mulch and biofiltration media for treatment. The mulch provides pretreatment by retaining most of the solids or sediment. The biofiltration media provides further treatment by retaining finer sediment and dissolved pollutants. The aggregate allows the media bed to drain evenly for discharge through an underdrain pipe or by infiltration.

Configuration

The BioPod system can be configured with either an internal or external bypass. The internal bypass allows both water quality and bypass flows to enter the treatment vault. The water quality flows are directed to the biofiltration chamber while the excess flows are diverted over the bypass weir without entering the biofiltration chamber. Both the treatment and bypass flows are combined in the outlet area prior to discharge from the structure. BioPod units without an internal bypass are designed such that only treatment flows enter the treatment structure. When the system has exceeded its treatment capacity, ponding will force bypass flows to continue down the gutter to the nearest standard catch basin or other external bypass structure.

The BioPod system can be configured as a tree box filter with tree and grated inlet, as a planter box filter with shrubs, grasses and an open top, or as an underground filter with access risers, doors and a subsurface inlet pipe. The optional internal bypass may be incorporated with any of these configurations. In addition, an open bottom configuration may be used to promote infiltration and groundwater recharge. The configuration and size of the BioPod system is designed to meet the requirements of a specific project.

Inspection & Maintenance Overview

State and local regulations require all stormwater management systems to be inspected on a regular basis and maintained as necessary to ensure performance and protect downstream receiving waters. Without maintenance, excessive pollutant buildup can limit system performance by reducing the operating capacity of the system and increasing the potential for scouring of pollutants during periods of high flow.

Some configurations of the BioPod may require periodic irrigation to establish and maintain vegetation. Vegetation will typically become established about two years after planting. Irrigation requirements are ultimately dependent on climate, rainfall and the type of vegetation selected.

Maintenance Frequency

Periodic inspection is essential for consistent system performance and is easily completed. Inspection is typically conducted a minimum of twice per year, but since pollutant transport and deposition varies from site to site, a site-specific maintenance frequency should be established during the first two or three years of operation.

Inspection Equipment

The following equipment is helpful when conducting BioPod inspections:

- Recording device (pen and paper form, voice recorder, iPad, etc.)
- Suitable clothing (appropriate footwear, gloves, hardhat, safety glasses, etc.)
- Traffic control equipment (cones, barricades, signage, flagging, etc.)
- Manhole hook or pry bar
- Flashlight
- Tape measure

Inspection Procedures

BioPod inspections are visual and are conducted without entering the unit. To complete an inspection, safety measures including traffic control should be deployed before the access covers or tree grates are removed. Once the covers have been removed, the following items should be checked and recorded (see form provided on page 6) to determine whether maintenance is required:

- If the BioPod unit is equipped with an internal bypass, inspect the contoured inlet rack and outlet chamber and note whether there are any broken or missing parts. In the unlikely event that internal parts are broken or missing, contact Oldcastle Stormwater at (800) 579-8819 to determine appropriate corrective action.
- Note whether the curb inlet, inlet pipe, or – if the unit is equipped with an internal bypass – the inlet rack is blocked or obstructed.
- If the unit is equipped with an internal bypass, observe, quantify and record the accumulation of trash and debris in the inlet rack. The significance of accumulated trash and debris is a matter of judgment. Often, much of the trash and debris may be removed manually at the time of inspection if a separate maintenance visit is not yet warranted.
- If it has not rained within the past 24 hours, note whether standing water is observed in the biofiltration chamber.
- Finally, observe, quantify and record presence of invasive vegetation and the amount of trash and debris and sediment load in the biofiltration chamber. Erosion of the mulch and biofiltration media bed should also be recorded. Sediment load may be rated light, medium or heavy depending on the conditions. Loading characteristics may be determined as follows:
  - Light sediment load – sediment is difficult to distinguish among the mulch fibers at the top of the mulch layer; the mulch appears almost new.
  - Medium sediment load – sediment accumulation is apparent and may be concentrated in some areas; probing the mulch layer reveals lighter sediment loads under the top 1" of mulch.
  - Heavy sediment load – sediment is readily apparent across the entire top of the mulch layer; individual mulch fibers are difficult to distinguish; probing the mulch layer reveals heavy sediment load under the top 1" of mulch.

Often, much of the invasive vegetation and trash and debris may be removed manually at the time of inspection if a separate maintenance visit is not yet warranted.

Maintenance Indicators

Maintenance should be scheduled if any of the following conditions are identified during inspection:

- The concrete structure is damaged or the tree grate or access cover is damaged or missing.
- The curb inlet or inlet rack is obstructed.
- Standing water is observed in the biofiltration chamber more than 24 hours after a rainfall event (use discretion if the BioPod is located downstream of a storage system that attenuates flow).
- Trash and debris in the inlet rack cannot be easily removed at the time of inspection.
- Trash and debris, invasive vegetation or sediment load in the biofiltration chamber is heavy or excessive erosion has occurred.

Maintenance Equipment

The following equipment is helpful when conducting BioPod maintenance:

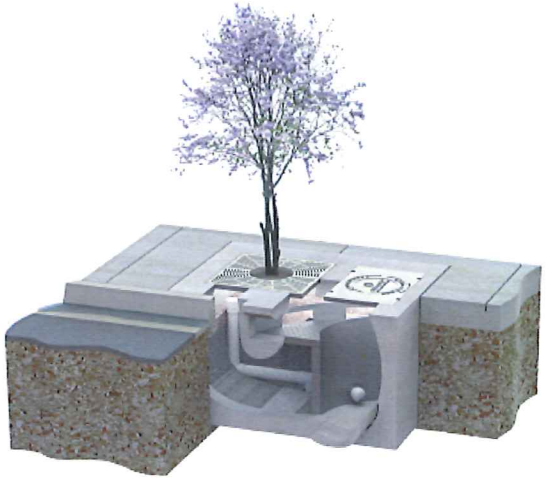
- Suitable clothing (appropriate footwear, gloves, hardhat, safety glasses, etc.)
- Traffic control equipment (cones, barricades, signage, flagging, etc.)
- Manhole hook or pry bar
- Flashlight
- Tape measure
- Rake, hoe, shovel and broom
- Bucket
- Pruners
- Vacuum truck (optional)

Maintenance Procedures

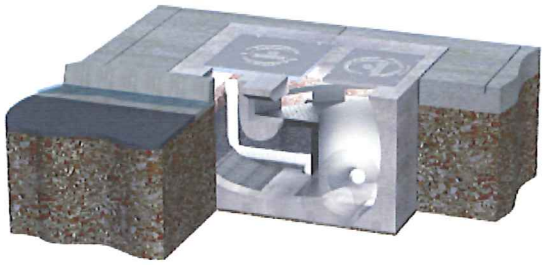
Maintenance should be conducted during dry weather when no flows are entering the system. All maintenance may be conducted without entering the BioPod structure. Once safety measures such as traffic control are deployed, the access covers may be removed and the following activities may be conducted to complete maintenance:

- Remove all trash and debris from the curb inlet and inlet rack manually or by using a vacuum truck as required.
- Remove all trash and debris and invasive vegetation from the biofiltration chamber manually or by using a vacuum truck as required.
- If the sediment load is medium or light but erosion of the biofiltration media bed is evident, redistribute the mulch with a rake or replace missing mulch as appropriate. If erosion persists, rocks may be placed in the eroded area to help dissipate energy and prevent recurring erosion.
- If the sediment load is heavy, remove the mulch layer using a hoe, rake, shovel and bucket, or by using a vacuum truck as required. If the sediment load is particularly heavy, inspect the surface of the biofiltration media once the mulch has been removed. If the media appears clogged with sediment, remove and replace one or two inches of biofiltration media prior to replacing the mulch layer.
- Prune vegetation as appropriate and replace damaged or dead plants as required.
- Replace the tree grate and/or access covers and sweep the area around the BioPod to leave the site clean.
- All material removed from the BioPod during maintenance must be disposed of in accordance with local environmental regulations. In most cases, the material may be handled in the same manner as disposal of material removed from sumped catch basins or manholes.

Natural, shredded hardwood mulch should be used in the BioPod. Timely replacement of the mulch layer according to the maintenance indicators described above should protect the biofiltration media below the mulch layer from clogging due to sediment accumulation. However, whenever the mulch is replaced, the BioPod should be visited 24 hours after the next major storm event to ensure that there is no standing water in the biofiltration chamber. Standing water indicates that the biofiltration media below the mulch layer is clogged and must be replaced. Please contact Oldcastle Infrastructure at (800) 579-8819 to purchase the proprietary StormMix™ biofiltration media.

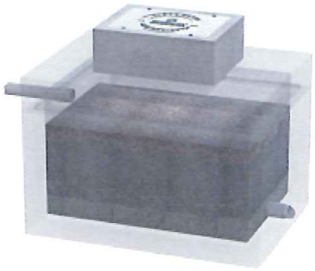


BioPod Tree Module



BioPod Media Module

BioPod Planter Module



BioPod Media Vault

BioPod Inspection & Maintenance Log

BioPod Model_____ Inspection Date_____

Location_____

Condition of Internal Components Notes:

☐ Good ☐ Damaged ☐ Missing

Curb Inlet or Inlet Rack Blocked Notes:

☐ Yes ☐ No

Standing Water in Biofiltration Chamber Notes:

☐ Yes ☐ No

Trash and Debris in Inlet Rack Notes:

☐ Yes ☐ No

Trash and Debris in Biofiltration Chamber Notes:

☐ Yes ☐ No

Invasive Vegetation in Biofiltration Chamber Notes:

☐ Yes ☐ No

Sediment in Biofiltration Chamber Notes:

☐ Light ☐ Medium ☐ Heavy

Erosion in Biofiltration Chamber Notes:

☐ Yes ☐ No

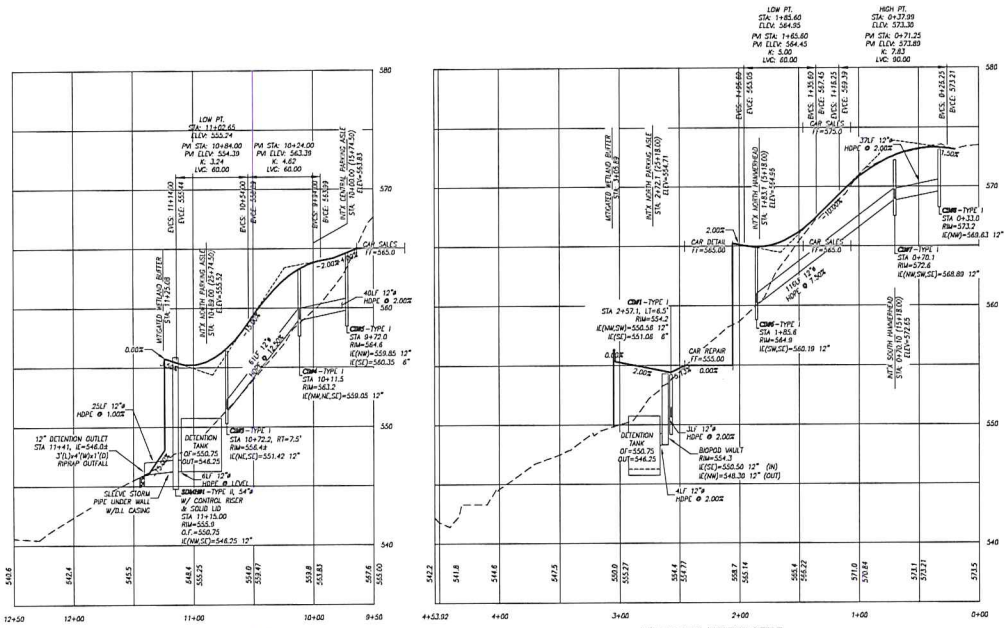
Maintenance Requirements

☐ **Yes - Schedule Maintenance** ☐ **No - Schedule Re-Inspection**

APPENDIX I

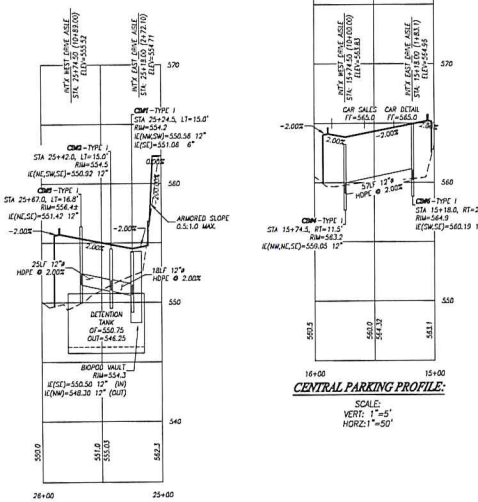
Drainage Plan

SE 1/4, SW 1/4, SEC.27, T.28, R.04, W.M.
CITY OF MUKILTEO, WASHINGTON



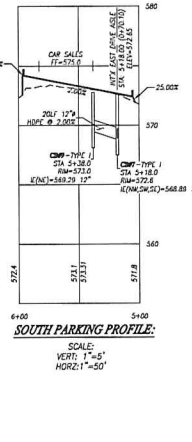
WEST DRIVE AISLE PROFILE:
SCALE: VERT: 1"=5' HORZ:1"=50'

EAST DRIVE AISLE PROFILE:
SCALE: VERT: 1"=5' HORZ:1"=50'

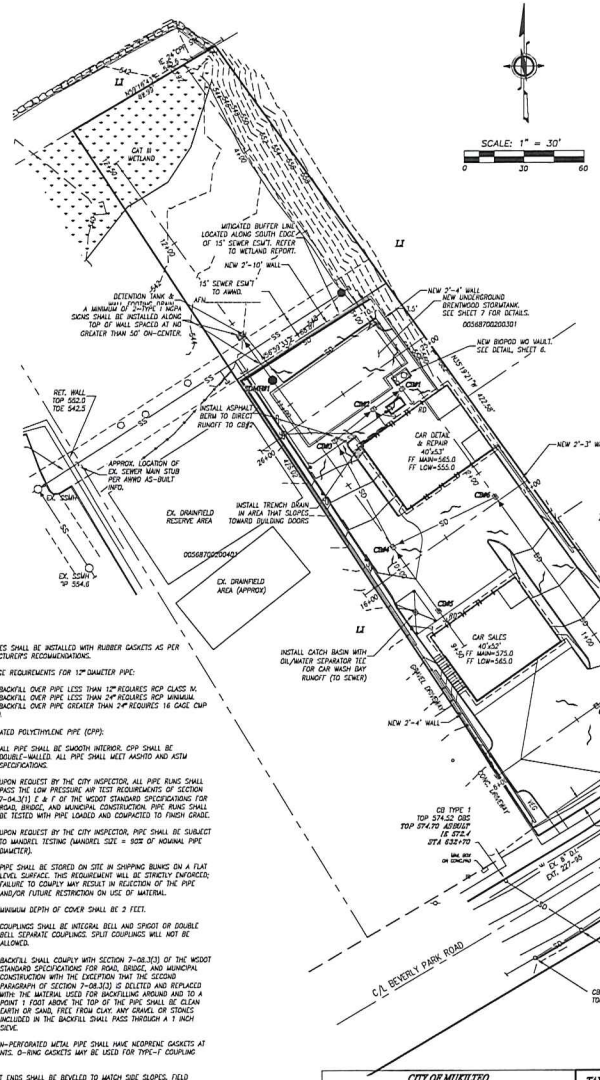


NORTH PARKING PROFILE:
SCALE: VERT: 1"=5' HORZ:1"=50'

CENTRAL PARKING PROFILE:
SCALE: VERT: 1"=5' HORZ:1"=50'



SOUTH PARKING PROFILE:
SCALE: VERT: 1"=5' HORZ:1"=50'



STORM DRAIN NOTES:

1. ALL PIPE SHALL BE PLACED ACCORDING DIVISION 7 OF THE WSDOT STANDARD SPECIFICATIONS.
2. BACKFILL SHALL BE PLACED EQUALLY ON BOTH SIDES OF THE PIPE OR PIPE-ARCH IN 8" AVERAGE DEPTH LOOSE LIFTS. MAXIMUM LIFT DEPTH SHALL NOT EXCEED 9". EACH LIFT SHALL BE THOROUGHLY COMPACTED. COMPACTED LIFTS MUST EXTEND AT LEAST ONE PIPE DIAMETER ON EACH SIDE OF THE PIPE OR TO THE SIDE OF THE TRENCH. BACKFILL OVER THE PIPE SHALL BE PERFORMED IN ACCORDANCE WITH SECTIONS 7- 08.3(3) THE WSDOT STANDARD SPECIFICATIONS.
3. ALL GRATES LOCATED IN THE GUTTER FLOW LINE (INLET AND CATCH BASIN) SHALL BE DEPRESSED 0.1 FEET BELOW PAVEMENT LEVEL.
4. ALL CATCH BASINS ARE TO BE TYPE 1 UNLESS OTHERWISE APPROVED BY THE CITY OR DESIGNATED REPRESENTATIVE. THE USE AND INSTALLATION OF INLETS IS NOT ALLOWED.
5. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ADJUSTING ALL MANHOLE, INLET AND CATCH BASIN FRAMES AND GRATES TO GRADE JUST PRIOR TO CURB INSTALLATION AND/OR PAVING.
6. ALL CATCH BASINS WITH A DEPTH OF 3 FEET OR GREATER TO THE FLOW LINE SHALL BE TYPE II CATCH BASINS.
7. VANED GRATES ARE REQUIRED ON ALL STORM STRUCTURES. ALL CATCH BASINS AND MANHOLES SHALL HAVE LOCKING LIDS. ROLLED GRATES ARE NOT APPROVED FOR USE.
8. POLYPROPYLENE SAFETY STEPS AND LADDER STEPS SHALL BE PROVIDED IN ALL MANHOLES AND SHALL BE POSITIONED CORRECTLY WITH THE BOLT AREAS ON THE RIM.
9. CATCH BASIN FRAMES AND GRATES SHALL BE OLYMPIC FOUNDRY MODEL SM63, SM63, OR SM44, LOCKING TYPE OR EQUIVALENT. MODEL SM63 SHALL BE REFERRED TO AS A "THROUGH CURB INLET" ON THE PLANS.
10. DETENTION PONDS WITH SIDE SLOPES STEEPER THAN 3:1 OR WITH A MAXIMUM WATER DEPTH GREATER THAN 3 FEET SHALL REQUIRE A VINYL COATED CHAIN LINK PERIMETER FENCE. SIDE SLOPE AVERAGING SHALL NOT BE ALLOWED. ALL INLET AND OUTFALL PIPES SHALL HAVE A TRASH RACK INSTALLED AND A MORTARED RIPRAP HEADWALL.
11. PRIOR TO SIDEWALK CONSTRUCTION, LOT DRAINAGE SYSTEMS, STUB-OUTS AND ANY BEHIND SIDEWALK DRAINS MUST BE INSTALLED AS REQUIRED. PIPE SHALL BE PVC 3034, OR SDR-35. STUB-OUTS SHALL BE MARKED WITH A 2"X 4" WITH 3 FEET VISIBLE ABOVE GRADE AND MARKED "STORM". LOCATIONS OF THESE INSTALLATIONS SHALL BE SHOWN ON THE AS-BUILT CONSTRUCTION PLANS SUBMITTED TO THE CITY.
12. STORM WATER RETENTION/DETENTION FACILITIES, STORM DRAINAGE PIPE AND CATCH BASINS SHALL BE FLUSHED AND CLEANED BY THE DEVELOPER PRIOR TO:
    A. CITY OF MUKILTEO FINAL ACCEPTANCE OF THE PROJECT AND;
    B. UPON COMMENCEMENT AND COMPLETION OF THE 2 YEAR WARRANTY PERIOD FOR THE STORM DRAINAGE SYSTEM. AN INVOICE DETAILING THE FLUSHING AND CLEANING SHALL BE PROVIDED TO THE CITY.
13. ALL PIPES SHALL BE INSTALLED WITH RUBBER GASKETS AS PER MANUFACTURERS RECOMMENDATIONS.
14. COVERAGE REQUIREMENTS FOR 12" DIAMETER PIPE:
    BACKFILL OVER PIPE LESS THAN 12" REQUIRES RCP CLASS IV. BACKFILL OVER PIPE LESS THAN 24" REQUIRES RCP WALEAU. BACKFILL OVER PIPE GREATER THAN 24" REQUIRES 16 GAGE CMP MINIMUM.
15. CORRUGATED POLYETHYLENE PIPE (CPP):
    A. ALL PIPE SHALL BE SMOOTH INTERIOR. CPP SHALL BE DOUBLE-WALLED. ALL PIPE SHALL MEET AASHTO AND ASTM SPECIFICATIONS.
    B. UPON REQUEST BY THE CITY INSPECTOR, ALL PIPE RUNS SHALL PASS THE LOW PRESSURE AIR TEST REQUIREMENTS OF SECTION 7-04.3(1) E & F OF THE WSDOT STANDARD SPECIFICATIONS FOR ROAD, BRIDGE, AND MUNICIPAL CONSTRUCTION. PIPE RUNS SHALL BE TESTED WITH PIPE LOADED AND COMPACTED TO FINISH GRADE.
    C. UPON REQUEST BY THE CITY INSPECTOR, PIPE SHALL BE SUBJECT TO MANDREL TESTING (MANDREL SIZE = 92% OF NOMINAL PIPE DIAMETER).
    D. PIPE SHALL BE STORED ON SITE IN SHIPPING BUNKS ON A FLAT LEVEL SURFACE. THIS REQUIREMENT WILL BE STRICTLY ENFORCED; FAILURE TO COMPLY MAY RESULT IN REJECTION OF THE PIPE AND/OR FUTURE RESTRICTION ON USE OF MATERIAL.
    E. MINIMUM DEPTH OF COVER SHALL BE 2 FEET.
    F. COUPLINGS SHALL BE INTEGRAL BELL AND SPIGOT OR DOUBLE BELL SEPARATE COUPLINGS. SPLIT COUPLINGS WILL NOT BE ALLOWED.
    G. BACKFILL SHALL COMPLY WITH SECTION 7-08.3(3) OF THE WSDOT STANDARD SPECIFICATIONS FOR ROAD, BRIDGE, AND MUNICIPAL CONSTRUCTION WITH THE EXCEPTION THAT THE SECOND PARAGRAPH OF SECTION 7-08.3(3) IS DELETED AND REPLACED WITH: THE MATERIAL USED FOR BACKFILLING AROUND AND TO A POINT 1 FOOT ABOVE THE TOP OF THE PIPE SHALL BE CLEAN EARTH OR SAND, FREE FROM CLAY, ANY GRAVEL OR STONES INCLUDED IN THE BACKFILL SHALL PASS THROUGH A 1 INCH SIEVE.
16. ALL NON-PERFORATED METAL PIPE SHALL HAVE NEOPRENE GASKETS AT THE JOINTS. O-RING GASKETS MAY BE USED FOR TYPE-F COUPLING BAND.
17. CULVERT ENDS SHALL BE BEVELED TO MATCH SIDE SLOPES. FIELD CUTTING OF CULVERT ENDS IS PERMITTED WHEN APPROVED BY THE CITY.
18. ALL FIELD CUT CULVERT PIPE SHALL BE TREATED AS REQUIRED IN THE STANDARD SPECIFICATIONS OR GENERAL SPECIAL PROVISIONS.

HARDSCAPE SURFACE CALCS:

PROPERTY AREA = 38,834 SF. (0.892 AC.)

ON-SITE IMPROVEMENTS	
SALES AND DETAIL ROOF	= 2,370 SF.
REPAIR BUILDING ROOF	= 2,410 SF.
*CURBS AND SIDEWALKS	= 1,430 SF.
*PAVEMENT AND PARKING	=16,390 SF.
TOTAL	=22,600 SF.

TOTAL NEW/REPLACED HARDSCAPE SURFACE = 22,600 SF.

CITY OF MUKILTEO
PLANNING AND DEVELOPMENT SERVICES
APPROVED FOR CONSTRUCTION
BY: _____
NAME: _____
R/W PERMIT NUMBER: _____

TAX ACCOUNT NO.(S): 00568700200402

SITE ADDRESS: 12900 BEVERLY PARK ROAD MUKILTEO, WA 98275

UTILITY CONFLICT NOTE:

CAUTION:
THE CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING THE LOCATION, DIMENSION, AND DEPTH OF ALL EXISTING UTILITIES WHETHER SHOWN ON THESE PLANS OR NOT, BY POTHOLING THE UTILITIES AND SURVEYING THE HORIZONTAL AND VERTICAL LOCATION PRIOR TO CONSTRUCTION. THIS SHALL INCLUDE CALLING UTILITY LOCATE @ 8-1-1 AND THEN POTHOLING ALL OF THE EXISTING UTILITIES AT LOCATIONS OF NEW UTILITY CROSSINGS TO PHYSICALLY VERIFY WHETHER OR NOT CONFLICTS EXIST. LOCATIONS OF SAID UTILITIES AS SHOWN ON THESE PLANS ARE BASED UPON THE UNVERIFIED PUBLIC INFORMATION AND ARE SUBJECT TO VARIATION. IF CONFLICTS SHOULD OCCUR, THE CONTRACTOR SHALL CONSULT WESTERN ENGINEERS & SURVEYORS, INC. TO RESOLVE ALL PROBLEMS PRIOR TO PROCEEDING WITH CONSTRUCTION.

CALL TWO (2) BUSINESS DAYS BEFORE YOU DIG 8-1-1

REGISTERED PROFESSIONAL ENGINEER — PAUL A. FARRELL — 45044 — STATE OF WASHINGTON

Western Engineers & Surveyors (425) 356-2700
SURVEYORS • PLANNERS • ENGINEERS
LAND USE CONSULTANTS
CIVIL ENGINEERS • LAND SURVEYORS
*** 9740 EVERGREEN WAY • EVERETT • WA • 98204 ***

DRAINAGE PLAN FOR:
BEC INVESTMENTS
SE 1/4, SW 1/4, SEC.27, T.28, R.04, W.M.
CITY OF MUKILTEO, WASHINGTON

DRAWN BY	DATE	REV. BY	DATE	PROJECT MANAGER	SCALE
TAS	03-06-19	-	-	J. JARRELL	1" = 30'
DRAWING FILE NAME		CHK. BY	F.B. NO.	JOB NO.	SHT. NO.
18175BABASE.DWG			-	18-1758-A	5 OF 7

APPENDIX II

SOIL INFORMATION

Site Soil Logs

A field exploration was performed by The Riley Group, Inc. and the soil test pit and hand auger findings are summarized below. Refer to the Geotechnical Engineering Report provided by The Riley Group of Bothell, Washington dated May 4, 2018 for additional geotechnical information.

TP-1 – Test Pit 1
0.0' – 1.2' Topsoil and rootmass
1.2' – 3.0' Silty Sand with trace gravel, moist, medium dense
3.0' – 6.0' Silty Sand with trace gravel, moist, dense, slight iron oxidation
Test Pit Terminated at 6.0', No Groundwater Encountered

TP-2 – Test Pit 2
0.0' – 1.0' Topsoil and rootmass
1.2' – 3.0' Silty Sand with trace gravel, moist, medium dense
3.0' – 5.5' Silty Sand with some gravel, moist, dense, slight iron oxidation
Test Pit Terminated at 5.5', No Groundwater Encountered

TP-3 – Test Pit 3
0.0' – 0.9' Topsoil and rootmass
0.9' – 4.5' Silty Sand with trace gravel, moist, medium dense
4.5' – 6.0' Silty Sand with some gravel, moist, dense, slight iron oxidation
Test Pit Terminated at 6.0', No Groundwater Encountered

HA-1 – Hand Auger 1
0.0' – 0.3' Topsoil and rootmass
0.3' – 2.5' Silty Sand, moist, medium dense
2.5' – 3.5' Silty Sand with some gravel, moist, dense, slight iron oxidation
Test Pit Terminated at 3.5', No Groundwater Encountered

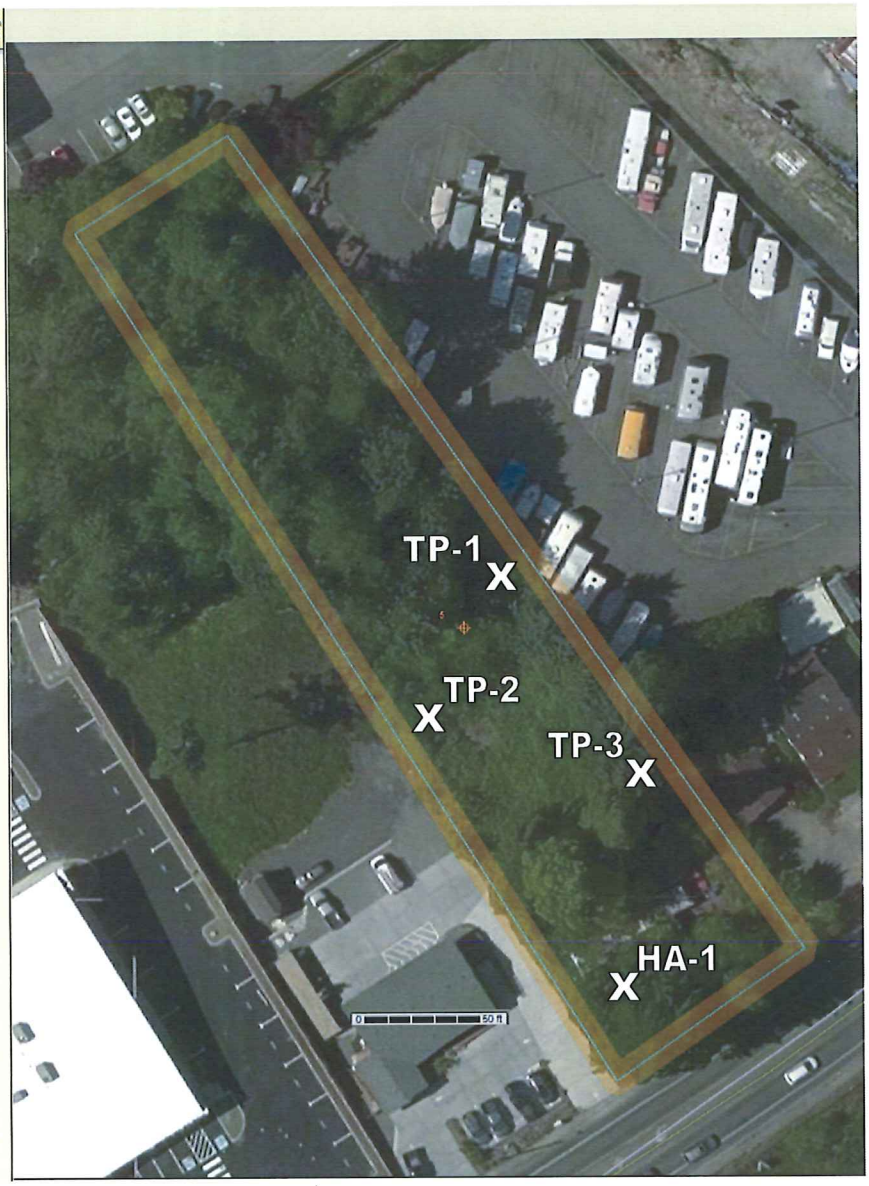
USDA Soil Map

Map Unit Legend

Snohomish County Area, Washington (WA661)

Snohomish County Area, Washington (WA661)

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
5	Alderwood-Urban land complex, 2 to 8 percent slopes	0.9	100.0%
Totals for Area of Interest		0.9	100.0%



USDA Soil Map Legend

5—Alderwood-Urban land complex, 2 to 8 percent slopes

Map Unit Setting

- *National map unit symbol:* 2hz9
- *Elevation:* 50 to 800 feet
- *Mean annual precipitation:* 25 to 60 inches
- *Mean annual air temperature:* 48 to 52 degrees F
- *Frost-free period:* 180 to 220 days
- *Farmland classification:* Not prime farmland

Map Unit Composition

- *Alderwood and similar soils:* 60 percent
- *Urban land:* 25 percent
- *Minor components:* 15 percent
- *Estimates are based on observations, descriptions, and transects of the mapunit.*

Description of Alderwood

Setting

- *Landform:* Till plains
- *Parent material:* Basal till

Typical profile

- *H1 - 0 to 7 inches:* gravelly ashy sandy loam
- *H2 - 7 to 35 inches:* very gravelly ashy sandy loam
- *H3 - 35 to 60 inches:* gravelly sandy loam

Properties and qualities

- *Slope:* 2 to 8 percent
- *Depth to restrictive feature:* 20 to 40 inches to densic material
- *Natural drainage class:* Moderately well drained
- *Capacity of the most limiting layer to transmit water (Ksat):* Very low to moderately low (0.00 to 0.06 in/hr)
- *Depth to water table:* About 18 to 36 inches
- *Frequency of flooding:* None
- *Frequency of ponding:* None
- *Available water storage in profile:* Low (about 3.0 inches)

Interpretive groups

- *Land capability classification (irrigated):* None specified
- *Land capability classification (nonirrigated):* 4s
- *Hydrologic Soil Group:* B
- *Forage suitability group:* Limited Depth Soils (G002XN302WA)
- *Hydric soil rating:* No

Minor Components

Mckenna

- *Percent of map unit:* 5 percent
- *Landform:* Depressions
- *Hydric soil rating:* Yes

Norma, undrained

- *Percent of map unit:* 5 percent
- *Landform:* Depressions
- *Hydric soil rating:* Yes

Terric medisaprists, undrained

- *Percent of map unit:* 5 percent
- *Landform:* Depressions
- *Hydric soil rating:* Yes

APPENDIX III

SOIL AMENDMENT

SECTION FOUR

AMENDMENT OPTIONS

Select the soil preparation options that best suit each area of the project site.
Either choose a pre-approved default amendment rate, or have a qualified professional calculate a custom rate based on soil and amendment tests described in Section 5, using the calculation method described in Section 7 "Resources").

OPTION 1: Leave native vegetation and soil undisturbed, and protect from compaction during construction.

Identify areas of the site that will not be stripped, logged, graded or driven on, and fence off those areas to prevent impacts during construction. If neither soils nor vegetation are disturbed, these areas do not require amendment.

OPTION 2: Amend existing site topsoil or subsoil

either at default "pre-approved" rates, or at custom calculated rates based on specifier's tests of the soil and amendment.

Scarification. Scarify or till subgrade to 8 inches depth (or to depth needed to achieve a total depth of 12 inches of uncompacted soil after calculated amount of amendment is added). Entire surface should be disturbed by scarification. Do not scarify within drip line of existing trees to be retained. Amend soil to meet required organic content.

A. Planting Beds

1. PRE-APPROVED RATE: Place 3 inches of composted material and rototill into 5 inches of soil (a total amended depth of about 9.5 inches, for a settled depth of 8 inches).
2. CALCULATED RATE: Place calculated amount of composted material or approved organic material and rototill into depth of soil needed to achieve 8 inches of settled soil at 10% organic content.

Rake beds to smooth and remove surface rocks larger than 2 inches diameter.

Mulch planting beds with 2 inches of organic mulch.

B. Turf Areas

1. PRE-APPROVED RATE: Place 1.75 inches of composted material and rototill into 6.25 inches of soil (a total amended depth of about 9.5 inches, for a settled depth of 8 inches).
2. CALCULATED RATE: Place calculated amount of composted material or approved organic material and rototill into depth of soil needed to achieve 8 inches of settled soil at 5% organic content.

Water or roll to compact to 85% of maximum dry density.

Rake to level, and remove surface woody debris and rocks larger than 1 inch diameter.

OPTION 3: Stockpile existing topsoil during grading. Replace it before planting.

Stockpiled topsoil must also be amended if needed to meet the organic matter or depth requirements, either at a pre-approved default rate or at a custom calculated rate.

Scarification. If placed topsoil plus compost or other organic material will amount to less than 12 inches:
Scarify or till subgrade to depth needed to achieve 12 inches of loosened soil after topsoil and amendment are placed.
Entire surface should be disturbed by scarification. Do not scarify within drip line of existing trees to be retained.

Stockpile and cover soil with weed barrier material that sheds moisture yet allows air transmission, in approved location, prior to grading.

Replace stockpiled topsoil prior to planting. Amend if needed to meet required organic content.

A. Planting Beds

1. PRE-APPROVED RATE: Place 3 inches of composted material and rototill into 5 inches of replaced soil (a total amended depth of about 9.5 inches, for a settled depth of 8 inches).
2. CALCULATED RATE: Place calculated amount of composted material or approved organic material and rototill into depth of replaced soil needed to achieve 8 inches of settled soil at 10% organic content.

Rake beds to smooth and remove surface rocks larger than 2 inches diameter.

Mulch planting beds with 2 inches of organic mulch or stockpiled duff.

B. Turf Areas

1. PRE-APPROVED RATE: Place 1.75 inches of composted material and rototill into 6.25 inches of replaced soil (a total amended depth of about 9.5 inches, for a settled depth of 8 inches).
2. CALCULATED RATE: Place calculated amount of composted material or approved organic material and rototill into depth of replaced soil needed to achieve 8 inches of settled soil at 5% organic content.

Water or roll to compact soil to 85% of maximum dry density.

Rake to level, and remove surface rocks larger than 1 inch diameter.

OPTION 4: Import topsoil mix of sufficient organic content and depth to meet the requirements.

Scarification. Scarify or till subgrade in two directions to 6 inches depth.
Entire surface should be disturbed by scarification. Do not scarify within drip line of existing trees to be retained.

A. Planting Beds

Use imported topsoil mix containing 10% organic matter (typically around 40% compost). Soil portion must be sand or sandy loam as defined by the USDA.

Place 3 inches of imported topsoil mix on surface and till into 2 inches of soil.

Place 3 inches of imported topsoil mix on surface and till into 2 inches of soil.

Place second lift of 3 inches topsoil mix on surface.

Rake beds to smooth, and remove surface rocks over 2 inches diameter.

Mulch planting beds with 2 inches of organic mulch.

B. Turf Areas

Use imported topsoil mix containing 5% organic matter (typically around 25% compost). Soil portion must be sand or sandy loam as defined by the USDA.

Place 3 inches of imported topsoil mix on surface and till into 2 inches of soil.

Place second lift of 3 inches topsoil mix on surface.

Water or roll to compact soil to 85% of maximum.

Rake to level, and remove surface rocks larger than 1 inch diameter.

GUIDE TO DEVELOPING A SOIL MANAGEMENT PLAN

This section outlines steps for professional specifiers to prepare a Soil Management Plan (SMP) to meet the provisions of BMP T5.13 in the Department of Ecology's Stormwater Manual for Western Washington. The main steps to creating the SMP are:

Step 1: Review Site Landscape Plans and Grading Plans.

Examine all areas that will not be covered by structures, impervious surfaces, or stormwater detention / infiltration structures, to assess how grading will impact soil conditions and determine areas where different soil treatments may be applied.

Those allowed soil treatment options are:

Option 1: Areas where native soil and/or vegetation will be retained in place;
Option 2: Areas where topsoil or subsoil will be amended in place;
Option 3: Areas where topsoil will be stripped and stockpiled prior to grading for reapplication, and;
Option 4: Areas where imported topsoil will be applied.

Step 2: Visit Site to Determine Soil Conditions

Working with plans, check the soil in each area to identify information outlined in the chart below.
Identify compaction of subgrade in each area by digging down to a level that will be 12" below finished grade.
Use a shovel or "rod penetrometer" driven solely by the your weight, as described in Section 3, and illustrated in Section 6 "Field Guide to Verifying Soil Quality and Depth."

Areas	Assess Conditions	Include Information on SMP
Native vegetation / undisturbed soil to be preserved	✓ Established native plants. ✓ Undisturbed topsoil and duff layer.	✓ Identify those areas to be left undisturbed and fenced during construction.
Topsoil not requiring grading, but cleared of native vegetation	✓ Depth of compacted layers less than 12 inches deep. ✓ Presence of organic matter that may make amendment unnecessary, or allow calculation of reduced amendment rate. ✓ If planning to use calculated amendment rate, sample and test soil as described in Step 4.	✓ Will scarification be needed? What depth of scarification is required to allow compost incorporation and achieve 12 inches uncompacted depth? ✓ Will area be amended with compost or topsoil at "pre-approved" rate, or custom calculated rate? ✓ Can areas be protected from compaction during construction?
Areas to be cut during grading	✓ Quantity of topsoil that can pbe stockpiled and reapplied. ✓ Depth of any compacted layer less than 12 inches below ultimate finished grade. ✓ Presence of organic matter in subgrade or topsoil that may make amendment unnecessary, or allow calculation of reduced amendment rate. ✓ If planning to use calculated amendment rate, sample and test soil as described in Step 4.	✓ Will scarification be needed? What depth of scarification is required to allow compost incorporation and achieve 12 inches uncompacted depth? ✓ Will topsoil be stockpiled during grading and reapplied? Will it require supplemental topsoil or compost to achieve 8 inches depth at specified organic content? ✓ Will area be amended with compost or topsoil at "pre-approved" rate, or at custom calculated rate?
Areas to be filled during grading	✓ Estimate what subgrade conditions will be when fill is in place. ✓ Depth of any compacted layer less than 12 inches below ultimate finished grade. ✓ Presence of organic matter in fill soil that may make amendment unnecessary, or allow calculation of reduced amendment rate. ✓ If planning to use calculated amendment rate, sample and test soil as described in Step 4.	✓ What depth of scarification is required to allow compost incorporation and achieve 12 inches uncompacted depth? ✓ Will area be amended with compost or topsoil at "pre-approved" rate, or custom calculated rate?

Step 3: Select Amendment Options.

The most convenient and economic method for achieving the Soil Quality and Depth guidelines depends on: site soil conditions, grading, and resulting subgrade compaction; the practicality of stockpiling topsoil during grading; and site access issues.

"Pre-Approved" or custom calculated rates?
Use of "Pre-Approved" amendment rates may simplify planning, however custom calculated rates can save substantial effort and expense—easily repaying the expense of testing and calculations. (See testing required for custom rates at right and on next page, and calculation method in Section 7 "Resources".)

Often pasture or woodland soils have adequate organic matter if existing organic layers are preserved. Also, compost products will frequently provide the desired soil organic matter content at lower applications than the Pre-Approved rates (which are based on "average" conditions).

Identifying Options on the Site Plan and SMP form

- Identify the areas where each amendment option will be applied by outlining each area on the site plan with a dark, thick-line pen.
- Assign each area an identifying number or letter (A, B, C…) on the plan, and on the Soil Management Plan form.

Step 4: Identify Compost, Topsoils and Other Organic Materials for Amendment and Mulch.

Amendments for Pre-Approved rates must be compost meeting the definition for "Composted Materials" in WAC 173-350, section 220, (available online at www.ecy.wa.gov/programs/swfa/organics/soil.html) or topsoil manufactured from these composts plus clean sand or sandy loam soil. Products must be identified on the Soil Management Plan form, and recent product test results must be provided showing that they meet the additional requirements in this Guide for organic matter content and carbon to nitrogen ratio (see specification in Section 3).

For Custom Calculated amendment rates (see right, next page, and formula in Section 7 "Resources"), organic matter may be provided by:

- Compost (as defined above), or
- Other by organic materials with a carbon to nitrogen ratio under 25:1 (35:1 for native plantings), meeting the same contaminant standards as "Composted Materials" in WAC 173-350, section 220.

These products must be identified on the Soil Management Plan form, and recent test results provided showing that they meet these requirements.

Step 5: Calculate Amendment, Topsoil and Mulch Volumes on SMP form

- For Pre-Approved amendment rates, figure the square footage of each area and complete the simple calculation to convert inches of amendment into cubic yards.
- To compute custom calculated amendment rates, use soil and amendment test results and the *Model Amendment Rate Calculator Spreadsheet* and/or the *Equation for Calculating Compost Application Rates* (both are in Section 7 "Resources") to achieve the target Soil Organic Matter content (10% SOM for landscape beds, or 5% SOM for turf areas).

Site Assessment Supplies

- Copy of site grading plan
- Sturdy shovel
- Tape measure

If using custom calculated amendment rates requiring soil tests:

- Clean bucket or stainless steel bowl for mixing soil samples
- Sealable bags for soil samples, and indelible ink pen to label

Sampling and Testing for Custom Calculated Amendment Rates

Soil and amendments submitted for testing should be a composite of samples taken from several spots on a site or in a pile of amendment.

Soil:

Gather samples from soil that will be the subgrade after all grading operations are completed, before placement of imported topsoil or amendments.

- Take samples from 10-12 spots in each area. Imagine a line dividing the area in half lengthwise, then divide each half into five near equal sized widths. Take samples near the middle of each subsection.
- At each sampling spot dig a spades-width hole at least 8 inches deep, then shave a 1 inch slice from the side of the hole to use in the composite sample.
- Thoroughly mix the 10-12 samples from each turf or planting area together in a clean plastic bucket or bowl. Place 2 cups of the mix into a sealable plastic bag for testing (some tests may require more soil, ask laboratories).
- Label the bag with the site information, area of sample; plus your name, address and phone number.

Amendment:

Producers of composts and manufactured topsoils can usually provide test results for their products. If tests are

nonexistent or incomplete, conduct necessary tests on each proposed amendment.

- Take samples from 10-12 spots in pile of material. Imagine a line dividing the pile in half lengthwise, then gather samples from five spots equally spaced along the length of each side of the pile.
- At each sampling spot, dig a spades-width hole at least 8 inches deep. Use a clean cup or trowel to collect a cup of amendment from the bottom of each hole.
- Thoroughly mix the 10-12 samples from each pile together in a clean plastic bucket or bowl. Place 2 cups of the mix into a sealable plastic bag for testing (some tests may require more compost, ask laboratories).
- Label the bag with the product and supplier information; plus your name, address and phone number.

Tests to Conduct for Custom Calculated Amendment Rates:

Soil	Compost Amendment
- Bulk Density	- Bulk Density
- Percent Organic Matter (by "loss on ignition" method)	- Percent Organic Matter (by "loss on ignition" method)
	- Moisture Content as is
	- Carbon to Nitrogen Ratio (C:N)
	- Heavy Metals Analysis (per WAC 173-350, section 220)

Model SOIL MANAGEMENT PLAN for BMP T5.13

(available as MS Word file at www.SoilsforSalmon.org)

PROJECT INFORMATION **Page # ____ of ____ pages**

Complete all information on page 1; only site address and permit number on additional pages.

Site Address / Lot No.: 12900 Beverly Park Road, Mukilteo, WA 98275	
Permit Type: Commercial	**Permit Number:**
Permit Holder: BEC Investments	**Phone:** 206-605-1658
Mailing Address: 9326 Evergreen Way, Everett, WA 98204	
Contact Person: Jesse Jarrell, P.E.	**Phone:** 425-356-2700
Plan Prepared By: Timothy Sarkela, P.E.	

ATTACHMENTS REQUIRED *(Check off required items that are attached to this plan)*

___ **Site Plan showing, to scale:**	___ Areas of undisturbed native vegetation (no amendment required) ___ New planting beds and turf areas (amendment required) ___ Type of soil improvement proposed for each area
___ **Soil test results (required if proposing custom amendment rates)**	
___ **Product test results for proposed amendments**	

AREA #_____ *(should match Area # on Site Plan)*

PLANTING TYPE ___ Turf ___ Planting Beds	___ Undisturbed native vegetation ___ Other: _____	
SQUARE FOOTAGE OF THIS AREA: _____ square feet		
SCARIFICATION ___ Subsoil will be scarified	___ inches (depth) of scarification needed to achieve finished total 12" loosened depth.	
PRE-APPROVED AMENDMENT METHOD: ___ Topsoil import X Amend with compost ___ Stockpile and amend (____ cu. yds. stockpiled)	1.75 inches of compost or imported topsoil applied X 3.1 *(conversion factor, inches to cubic yards)* 5.43 = cu. yards per 1,000 sq. ft. X 3.7 ,000s sq.ft. in this area 20.1 = cubic yards of amendment → → → → → *(needed to cover this area to designated depth)*	PRODUCT: Compost QUANTITY: 20.1 CU. YDS.
CUSTOM AMENDMENT ___ Topsoil import ___ Topsoil & compost lift ___ Amend ___ Stockpile and amend (____ cu. yds. stockpiled)	**Attach test results and calculations.** ____ inches organic matter or topsoil import X 3.1 ____ = cu. yards / 1,000 sq. ft. X ___ ,000s sq.ft. in this area ____ = cubic yards of amendment → → → → →	PRODUCT: _____ QUANTITY: _____ CU. YDS.
MULCH	___ ,000 sq.ft. X 6.2 *(conversion, to give 2 inch mulch depth)* ____ = cubic yards of mulch → → → → → →	PRODUCT: _____ QUANTITY: _____ CU. YDS.

TOTAL AMENDMENT/TOPSOIL/MULCH FOR ALL AREAS *(complete on page 1 only, totaling all areas/pages in this Plan)*

❑ **Product #1:** _____	❑ **Quantity:** _____ **cu. yds.**	
❑ **Test Results:** ___ **% organic matter**	___ **C:N ratio <25:1** (except mulch, or <35:1 for native plants)	___ **"stable"** (yes/no)
❑ **Product #2:** _____	❑ **Quantity:** _____ **cu. yds.**	
❑ **Test Results:** ___ **% organic matter**	___ **C:N ratio <25:1** (except mulch, or <35:1 for native plants)	___ **"stable"** (yes/no)
❑ **Product #3:** _____	❑ **Quantity:** _____ **cu. yds.**	
❑ **Test Results:** ___ **% organic matter**	___ **C:N ratio <25:1** (except mulch, or <35:1 for native plants)	___ **"stable"** (yes/no)

Date:	**Inspector:**	**Approved:**	**Revisions Required:**
Date:	**Inspector:**	**Approved:**	**Revisions Required:**

COMMENTS: _____

FIELD GUIDE TO VERIFYING SOIL QUALITY AND DEPTH IN NEW LANDSCAPES

This guide is provided to help professional inspectors verify implementation of soil improvements to fulfill BMP T5.13 "Post Construction Soil Quality and Depth" in the Washington Department of Ecology's Stormwater Management Manual Western Washington.

The main conditions to be confirmed are:

1. Provision of eight inches of topsoil containing 10% organic matter in planting beds, or 5% in turf areas.
2. Scarification of compacted subsoil four inches below the topsoil layer (for a total uncompacted depth of 12 inches).
3. Placement of two inches of mulch on all planting beds.

Site Inspection Supplies

- A copy of the approved Soil Management Plan (SMP) for the site, with site drawing.
- A sturdy shovel
- Tape measure or 12" ruler
- 3/8 inch diameter 3-4 foot stainless steel "rod penetrometer" with a 1/8" bevel cut into the tip at 30 degrees from the side, and a 90 degree bend at top to form a handle (*see illustration, next page*).
- Field Verification Form to record results

The following steps may be completed at multiple visits as a project progresses or in one final project approval inspection, depending on local practices:

STEP 1: Compare site conditions with approved Soil Management Plan (SMP).

The SMP approved with the site permit describes soil treatments approved for each area. Make sure site conditions match these details in the SMP:

- Site location and permit holder.
- Turf and planting areas match approved drawings.
- Areas to remain as undisturbed native soil and vegetation have been fenced off during construction to prevent soil compaction or damage to plants.

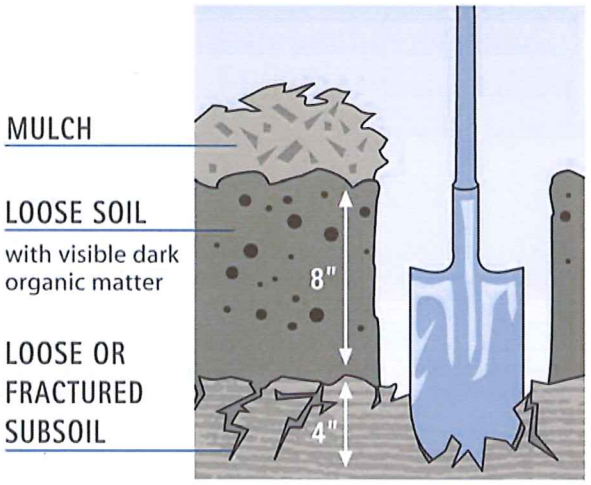
STEP 2: Inspect delivery tickets for compost, topsoil and mulches.

Permitee must provide original delivery tickets for all soil and mulch products. Compare delivery tickets with the SMP to match the following information:

- Delivery location.
- Total quantities for each soil product and mulch.
- Product descriptions and sources.
  If materials other than those listed in the SMP were delivered, laboratory test results must be provided to confirm that they are equivalent to approved products.

STEP 3: Verify depth of amended soil and scarification.

Use a shovel to dig at least one test hole per acre for turf and one per acre for planting beds to verify eight inch topsoil depth (below mulch layer), incorporation of amendments, and four inches of uncompacted subsoil.



Test holes should be about one foot deep (after first scraping away any mulch) and about one foot square.

Eight Inch Depth of Amended Soil. The top eight inches of soil should be easy to dig using a garden spade driven solely by your weight. The soil should be darker than the unamended soil below, and particles of added organic

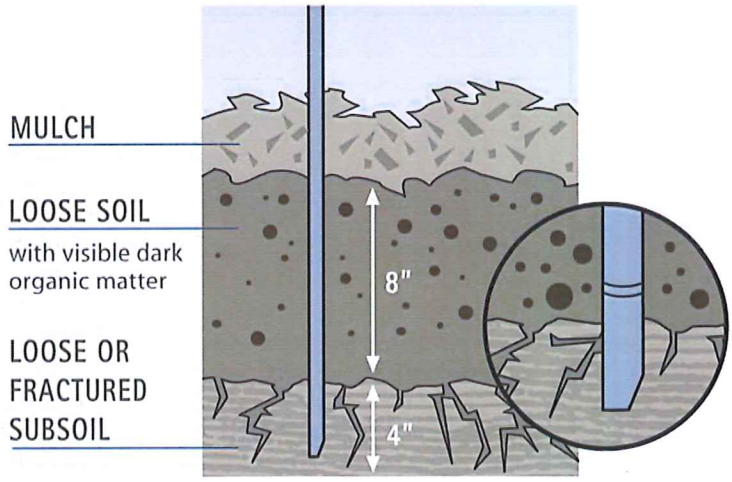
matter are likely to be visible. Clay soil that been saturated and then dried may require jumping on the shovel step to penetrate, but the soil should yield easily when moist. Soil that requires vigorous chipping with the shovel to penetrate probably does not meet the specification.

Four Inch Depth of Scarified Subsoil. The next four-inch depth of soil should be loose enough to penetrate with the shovel. It may be rocky, and the loosened depth may vary due to the pattern of scarifying equipment – but some sections of subsoil in a one foot square hole should be loose four inches deep into the subsoil (that is, to a total 12 inch depth from the soil surface).

STEP 4: Check soil depth in several spots.

Use a simple "rod penetrometer" (illustration below) to confirm that the soil is uncompacted twelve inches deep at ten locations per acre – with a minimum of ten on smaller sites. To locate test spots, imagine a line dividing the site (or each acre) in half lengthwise, then divide each half into five nearly equal sections. Conduct tests near the middle of each section. Additional test locations are encouraged.

The rod penetrometer should enter the soil twelve inches deep, driven solely by the inspector's weight. Irregular scarification or rocks in the lower layer may require probing a few spots at each location to reach the full depth.



A rod penetrometer is a 4 foot long, 3/8 inch or 10 mm diameter stainless steel rod with a 90 degree bend 5 inches form the top to make a handle, and a 30 degree bevel cut 1/8 inch or 3 mm into the side of the tip.

STEP 5: Check mulch depth.

Use a shovel to scrape away and reveal surface mulch thickness. A two inch layer of organic material (mulch) such as composted sawdust, wood chips, or ground bark should be distinguished from the underlying soil on all planting beds.

FINAL STEP: Record results on "Field Verification Form" or similar document ***(see sample form on next page).***

What should be attached to the Soil Management Plan?

- Scale drawings showing layout of turf and planting beds, and identifying where soil treatments described in the SMP will be applied.
- Copies of compost and topsoil test results demonstrating that products contain adequate organic matter, and meet carbon to nitrogen ratio and stability standards.
- Where custom calculated amendment rates are used, include laboratory analyses of the soil and organic matter sources plus calculations by a qualified professional showing that the organic matter requirement will be achieved.

What If A Site Does Not Meet the Soil Management Plan Requirements?

If inspection indicates that an installation does not fulfill the approved SMP, the permit holder or their agent should be notified of what steps are needed to comply. When results are unclear or disputed, an independent consultant should conduct sampling for analytical testing of organic matter as described in the project specifications.
Qualified consultants include: Certified Soil Scientists, Crop Advisors or Agronomists; or Licensed Landscape Architects, Civil Engineers or Geologists.

Model FIELD VERIFICATION FORM for BMP T5.13

(available as MS Word file at www.SoilsforSalmon.org)

PROJECT INFORMATION **Page # ____ of ____ pages**

Complete all information on page 1, only site address and permit number on additional pages.

Site Address:	
Permit Type:	**Permit Number:**
Permit Holder:	**Phone:**
Mailing Address:	
Customer Representative At Inspection:	**Phone:**
Plan Prepared By:	

VISIT RECORD

Date:	Inspector:	Items Approved: __ Fencing off undisturbed areas __ Soil preparation __ Mulch __ Other:
Date:	Inspector:	Items Approved: __ Fencing off undisturbed areas __ Soil preparation __ Mulch __ Other:
Date:	Inspector:	Items Approved: __ Fencing off undisturbed areas __ Soil preparation __ Mulch __ Other:

DELIVERY TICKETS FOR AMENDMENT, TOPSOIL & MULCH.

(Check if tickets match Soil Management Plan (SMP). Total volumes for all areas should be on page 1 of the SMP).

❑ **Product #1:** _____ ❑ **Test Results:** ___ **% organic matter** ____**C:N ratio <25:1** ____ **"stable"** (Y/N) ❑ **Quantity:** _____ **cu. yds.** (except mulch, or <35:1 for native plants)	**Comments:**
❑ **Product #2:** _____ ❑ **Test Results:** ___ **% organic matter** ____**C:N ratio <25:1** ____ **"stable"** (Y/N) ❑ **Quantity:** _____ **cu. yds.** (except mulch, or <35:1 for native plants)	
❑ **Product #3:** _____ ❑ **Test Results:** ___ **% organic matter** ____**C:N ratio <25:1** ____ **"stable"** (Y/N) ❑ **Quantity:** _____ **cu. yds.** (except mulch, or <35:1 for native plants)	

AREA #___ *(refer to Areas mapped on Site Plan and described on Soil Management Plan)*

PLANTING TYPE	**Test Holes**	**Rod Test**
___ Undisturbed vegetation ___ Turf ___ Planting Beds ___ Other: _____ **Square footage:**_____	**Number Test Holes Required:**____ (minimum 1 hole/acre) **Soil Amended 8 Inches Deep?** **Y / N** **Amendment Matches Soil Mgmt. Plan?** **Y / N** ❑ Topsoil Product ? ❑ Amendment Visible ? **Subsoil Loose/Scarified 12 Inches Deep?** **Y / N**	**Number Rod Tests Required:**____ (minimum 10 tests/acre) **Rod penetrates 12 inches deep in all areas?** **Y / N**
(If Planting Bed, Mulch is Required After Planting) **Mulch Product:** _____ **Mulch two inches deep?** **Y / N**	**Comments:**	

AREA #___

PLANTING TYPE	**Test Holes**	**Rod Test**
___ Undisturbed vegetation ___ Turf ___ Planting Beds ___ Other: _____ **Square footage:**_____	**Number Test Holes Required:**____ (minimum 1 hole/acre) **Soil Amended 8 Inches Deep?** **Y / N** **Amendment Matches Soil Mgmt. Plan?** **Y / N** ❑ Topsoil Product ? ❑ Amendment Visible ? **Subsoil Loose/Scarified 12 Inches Deep?** **Y / N**	**Number Rod Tests Required:**____ (minimum 10 tests/acre) **Rod penetrates 12 inches deep in all areas?** **Y / N**
(If Planting Bed, Mulch is Required After Planting) **Mulch Product:** _____ **Mulch two inches deep?** **Y / N**	**Comments:**	

Add additional sheets for additional Areas