



Stormwater Site Plan Report

**For Carbcm Properties LLC Commercial Site
Buckley, Washington**

For

**Carbcm Properties, LLC
10010 181st Avenue Court East
Bonney Lake, WA 98391**

By

**LeRoy Surveyors & Engineers, Inc.
P.O. Box 740
Puyallup, Washington 98371
(253) 848-6608**

Contact: Steve T Nelson, P.E.

**April 2016
Job No: 10537**

I hereby state that this Stormwater Site Plan Report for Carbcom Properties LLC Commercial Site has been prepared by me or under my supervision and meets the standard of care and expertise which is usual and customary in this community for professional engineers. I understand that the City of Buckley does not and will not assume liability for the sufficiency, suitability, or performance of drainage facilities prepared by me.



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Section 1 – Proposed Project Overview

Project Name: Carbcom Properties LLC Commercial Site

Permit Type: Site Development

Site Address: 28xxx SR 410 E, Buckley, WA 98321

Parcel Numbers: 0619047002 & 0619047003

Zoning: GC (General Commercial)

Legal Descriptions:

Section 04 Township 19 Range 06 Quarter SW:

LEGAL DESCRIPTION:

Parcel 0619047002:

Real property in the county of Pierce, State of Washington, described as follows:

Parcel A:

Lot 2, Pierce County Short Plat No. 8012290114, according to map recorded December 29, 1980, records of Pierce County auditor.

Parcel B:

Non-exclusive easement for private road as delineated on Pierce County Short Plat No. 8012290114, according to map recorded December 29, 1980, and as granted by document recorded under recording no. 201510210273, records of Pierce County Auditor.

Situate in the City of Buckley, County of Pierce, State of Washington.

Parcel 0619047003:

Real property in the county of Pierce, state of Washington, described as follows:

Parcel a:

Lots 3, Pierce County Short Plat recorded December 29, 1980 under recording No. 8012290114, records of Pierce county auditor;

Parcel b:

Non-exclusive easement for private road as delineated on Pierce County Short Plat recorded under recording No. 8012290114, records of Pierce County Auditor.

Situate in the City of Buckley, County of Pierce, State of Washington.

Carbcom Properties LLC Commercial Site proposes to construct a single story 1,200 square foot office building and a 9,360 square foot Marijuana Grow Facility. Additional space has been reserved for a future expansion of approximately 9,360 square feet. All proposed storm and utilities have incorporated the future structure into the design. The proposed project area includes two (2) parcels 0619047002 & 0619047003. All proposed structures will be “pole buildings” with slab-on-grade floors. The proposed office building is to be located in the southwest corner of the project site. Parking areas will be paved while the access drives located around the building are proposed to be graveled. A meandering sidewalk is proposed to be constructed inside of the existing SR 410 Right-of-Way. An existing paved access drive into the facility is already constructed and will be utilized. Utilities are available from SR 410.

The project is located at 28xxx SR 410 E in the City of Buckley and is in the City of Buckley Fire Protection District. Utility services will be supplied by the following providers:

Sewer: City of Buckley
Water: City of Buckley
Electricity: Puget Sound Energy
Natural Gas: Puget Sound Energy
Telephone: Century Link Communication

The project is proposing to capture and convey runoff to a proposed stormwater detention/wet pond to be located on the north end of the parcel.

Stormwater design for the project is required to meet the 2005 Washington State Department of Ecology Stormwater Management Manual for Western Washington (“Manual”). Minimum Requirements #1 through #10 apply for this new development.

- Minimum Requirement #1: Preparation of Stormwater Site Plans
 - In accordance with Volume 1, Chapter 2, Section 2.5.1, a Stormwater Site Plan is required. This plan will include this Drainage Report, a Stormwater Pollution Prevention Plan (SWPPP), a Maintenance Report and the Site Development Drawings
- Minimum Requirement #2: Construction Stormwater Pollution Prevention (SWPP)
 - In accordance with Volume 1, Chapter 2, Section 2.5.2 each of the twelve elements of Construction SWPP will be considered, and applicable elements will be incorporated into the Construction SWPP Plans (CSWPPP). The CSWPPP will address each of the elements as described in Volume 2, Chapter 1, Section 1.4 and their applicability for stormwater pollution prevention. A CSWPPP narrative is included in this report (see Appendix).
- Minimum Requirement #3: Source Control of Pollutants
 - To prevent stormwater from coming into contact with pollutants, suggested Source Control BMPs outlined in Volumes II (for construction sites) and IV of

the Manual will be discussed in the Construction SWPPP narrative report described above.

▪ Minimum Requirement #4: Preservation of Natural Drainage Systems and Outfalls

- The Carbcum Properties LLC Commercial Site project proposes to capture and convey runoff to a proposed stormwater detention/wet pond where it will be released to the existing drainage corridor located at the northwest corner of the project site. The downstream drainage corridor from the site and within ¼ mile of the project is all through manmade conveyance systems along Hinkleman Road East. Proposed mitigation of the onsite stormwater will minimize erosion and protect the downstream from increased flow rates and volumes from the development. An existing drainage easement runs north from the site through parcel 0619047001 which was created as part of the short plat that created the two parcels which make up the project area as well as parcel 0619047001. The project is proposing to redefine the ditch through this parcel in order to ensure the neighboring downstream parcels are not impacted by the stormwater release.

▪ Minimum Requirement #5: Onsite Stormwater Management

- Due to the nature of the native soils, which contain a high degree of silt content, infiltrative BMPs are not feasible without raising existing site elevations to provide infiltrative areas with sufficient storage capacity which is considered cost prohibitive.
- Dispersion BMPs were examined to determine their viability as a stormwater management solution and were determined unfeasible due to the lack of separation necessary to achieve the required dispersion flow path lengths.
- Due to site constraints mentioned previously on-site detention was determined to be the most economical and viable alternative to manage runoff. The Carbcum Properties LLC Commercial Site drainage plans describe location, sizing, and release to downstream corridor. Hydrologic modeling calculations were performed utilizing MGS Flood (see Appendix).

▪ Minimum Requirement #6: Runoff Treatment

- In accordance with Volume 1, Chapter 2, Section 2.5.6, runoff treatment is required. Treatment facility sizing (wet pond) was completed using MGS Flood and meets the criteria for Water Quality Design Storm Volume.

▪ Minimum Requirement #7: Flow Control

Per Volume 1, Chapter 2, Section 2.5.7 thresholds, flow control is required:

- Stormwater discharges shall match developed discharge durations to pre-developed durations for the range of pre-developed discharge rates from 50% of the 2-year peak flow up to the full 50-year peak flow.
- The Carbcum Properties LLC Commercial Site Geotechnical Site Assessment (see Appendix) indicates the site has not been characterized by a forested condition for approximately 5,600 years due to the effects of the Osceola Mudflow; therefore, to more accurately reflect the pre-developed condition the site was modeled as pasture in the hydrologic modeling of MGS Flood.

▪ Minimum Requirement #8: Wetlands Protection

- There are no wetlands onsite according to the wetland assessment report prepared by H&S Consulting.

▪ Minimum Requirement #9: Basin/Watershed Planning

In accordance with Volume 1, Chapter 2, Section 2.5.9, the project is required to meet the objectives of the City of Buckley Shoreline Master Program; these objects are accomplished by the following:

- The White River is more than a mile downstream from the release point of the stormwater from the site and is conveyed entirely through man-made conveyance systems. It is not anticipated that the project will have any measurable impact to the shoreline of the White River.
- Discharge to the downstream corridor is accomplished maintaining pre-developed durations as mentioned in Minimum Requirement #7 above and should not impact land, vegetation or wildlife in the vicinity of the White River Shoreline.

▪ Minimum Requirement #10: Operations and Maintenance

- To ensure that stormwater control facilities are adequately maintained and operated properly, a Maintenance Report, which is included as part of the Stormwater Site Plan has been prepared in accordance with the Manual.

Section 2 – Existing Conditions Summary

Topography

The project site is generally flat and drains from south to north at just over 1.0 percent. The south end of the site is at an elevation of approximately 710 while the north end is at an approximate elevation of 704.

Ground Cover

The project area consists of an open field with close cropped grass that is free of trees and brush.

Drainage

The project is not within an aquifer recharge area and contains no drainage systems or evidence of channeling with the exception of a drainage easement located at the north end of project site.

Section 3 – Offsite Analysis Report

The Carbcom Properties LLC Commercial Site project is proposing construction of a new Marijuana Grow Facility with an adjacent office building and a planned future expansion. Construction will include paved parking areas with graveled access roads as well as a detention/wet pond. Stormwater runoff will be mitigated by collection and conveyance to a stormwater detention/wet pond and will be released to the natural drainage system matching pre-developed durations (see Minimum Requirement #7 above); therefore, there will be no increase in flows to the downstream corridor. Downstream drainage conveyance from the site and within ¼ mile of the project is all through manmade conveyance systems along Hinkleman Road East.

Since the project site and surrounding properties on the east and west side are generally flat (less than 2%) and drain from south to north the project site does not receive any appreciable onsite

flows. Drainage along the fronting SR 410 is contained inside of an existing drainage ditch which flow west.

Section 4 – Permanent Stormwater Control Plan

Carbcom Properties LLC Commercial Site project proposes to utilize a detention/wet pond to mitigate increased stormwater runoff from the project. Stormwater runoff will be collected via catch basin structures. Collected stormwater will be conveyed via underground piping to the onsite detention/wet pond and released to the existing drainage system in accordance with the storm manual (see Minimum Requirement #7 above).

Since the project site and surrounding properties on the east and west side are generally flat (less than 2%) and drain from south to north the project site does not receive any appreciable onsite flows. Drainage along the fronting SR 410 is contained inside of an existing drainage ditch which flow west.

Percolation rate tests were attempted by LS&E on February 12, 2016 within the proposed building footprint area, as well as the parking and drive areas. Three (3) separate tests were attempted at different locations. During excavation of test holes groundwater was observed intruding into the holes via seeps along the excavation walls and the holes quickly filling with water. Surface water was also observed at various locations across the site at the time of testing. Based on these conditions infiltration into the native soil was determined to be infeasible.

It was therefore determined that a stormwater detention/wet pond is the only feasible option to provide stormwater quality and quantity mitigation. Stormwater calculations have been provided in the Appendix. The existing drainage basin are is 2.29 acres and was modeled as Pasture as per the recommendation of the geotechnical report. Tables below provide the land use breakdown as well as the resulting peak flows:

Table 4-1: Developed Basin Land Use Breakdown

Description	Area (AC)
Roof (including future building)	0.43 (18,720 sf)
Office Building (Roof)	0.03 (1,200 sf)
Gravel areas (including 20' wide access road around future building)	0.40 (17,598 sf)
Parking (paved)	0.20 (8,415 sf)
Grass/Landscape	0.86 (37,637 sf)
Pond area	0.37 (16,181 sf)
Total	2.28

Table 4-2 – Predeveloped Basin peak flows

Event	Peak Q (cfs)
2 year	0.103
5 year	0.169
10 year	0.258
25 year	0.339
50 year	0.374
100 year	0.430

Table 4-2 shows the peak calculated flows for the predeveloped condition.

Table 4-3 – Mitigated Developed Basin peak flows

Event	Peak Q (cfs)
2 year	0.066
5 year	0.103
10 year	0.142
25 year	0.182
50 year	0.205
100 year	0.212

Table 4-3 shows the peak calculated flows for the mitigated developed condition.

Table 4-4 – Unmitigated Developed Basin peak flows

Event	Peak Q (cfs)
2 year	0.494
5 year	0.633
10 year	0.758
25 year	0.952
50 year	1.170
100 year	1.221

Table 4-4 shows the peak calculated flows for the un-mitigated developed condition.

All runoff to be conveyed to the detention pond will utilize 12” piping at a minimum slope of 0.50%. Utilizing Manning’s Equation the conveyance capacity for the 12” pipe, flowing half-full, is calculated to be 1.26 CFS – see Developed Conveyance Capacity Check in the Appendix. Therefore the 12” pipe is more than adequate to convey the 100 year return period.

MGS Flood hydrologic modeling software was used to analyze and size required stormwater detention/wet pond. Total site mitigation is achieved, per the manual, by addressing both quantity and quality mitigation. The modeling results for quantity mitigation require a minimum of 26,437 cubic feet (cf) of detention storage to achieve volume requirements; 28,063 cf of detention storage has been provided.

A basic wet pond will provide the quality mitigation. The minimum wet pond required is 9,016 cubic feet; 13,722 cubic feet has been provided. The stormwater analysis and pond sizing results can be found in the Stormwater Design Calculations portion of the Appendix.

Section 5 – Construction Stormwater Pollution Prevention Plan

A construction SWPPP has been prepared as a separate report and is also attached in the Appendix.

Section 6 – Special Reports and Studies

The developed site and subsequent drainage basin has been modeled to conform to the Manual. A Geotechnical Site Assessment was prepared by LSE, Inc. and may be found in the Appendix. The Geotechnical Site Assessment provides development recommendations for stormwater infiltration and foundation design in addition to background information as it relates to the existing soils onsite.

Section 7 – Other Permits

NPDES permit, SEPA.

Section 8 – Operations and Maintenance Manual

A separate Operations and Maintenance Manual has been prepared for the project, a copy of the O & M Manual is attached, see Appendix.

Section 9 – Bond Quantities Worksheet

Per Chapter 17.06 of the City of Buckley Municipal Code the project requires performance, maintenance and liability bonding, per sections 17.06.030, 17.06.040 and 17.06.050, respectively.

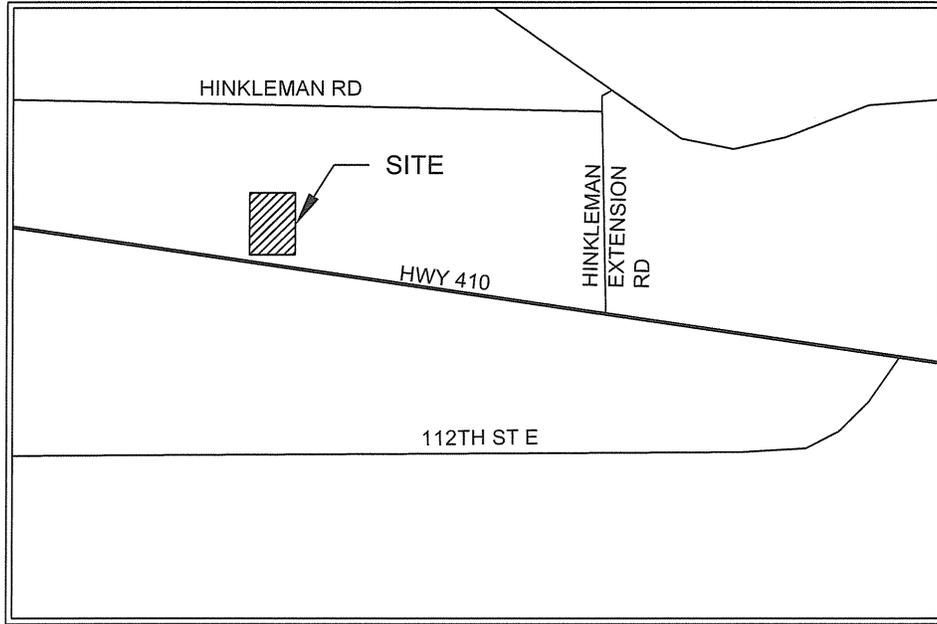
- A performance bond will be completed, and submitted, as part of the construction permit application.
- At the time of completion of the project, and release of the performance bond, a maintenance bond shall be submitted to the city.
- A liability bond will be submitted as part of the construction permit application.

LSE, Inc.
Steve T. Nelson, PE
Project Engineer

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Appendix A

Vicinity Map



VICINITY MAP

SCALE: 1" = 1000'

Appendix B

Stormwater Design Calculations

MGS FLOOD PROJECT REPORT

Program Version: MGSFlood 4.38
Program License Number: 201010005
Project Simulation Performed on: 03/25/2016 11:37 AM
Report Generation Date: 03/25/2016 11:37 AM

Input File Name: Carbcomrev.fld
Project Name: Carbcom Properties LLC
Analysis Title:
Comments:

PRECIPITATION INPUT

Computational Time Step (Minutes): 60

Extended Precipitation Time Series Selected
Climatic Region Number: 31

Full Period of Record Available used for Routing
Precipitation Station : 910050 Pierce Co. East 50 in 10/01/1939-10/01/2097
Evaporation Station : 911050 Pierce Co. East 50 in
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

***** Default HSPF Parameters Used (Not Modified by User) *****

***** WATERSHED DEFINITION *****

Predevelopment/Post Development Tributary Area Summary

		Predeveloped	Post Developed
Total Subbasin Area (acres)	2.290	2.290	
Area of Links that Include Precip/Evap (acres)	0.000	0.000	
Total (acres)	2.290	2.290	

-----SCENARIO: PREDEVELOPED

Number of Subbasins: 1

----- Subbasin : Predev -----
-----Area(Acres) -----
Till Forest 0.000
Till Pasture 2.290
Till Grass 0.000
Outwash Forest 0.000

Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User 2	0.000
Impervious	0.000

Subbasin Total 2.290

-----SCENARIO: POSTDEVELOPED

Number of Subbasins: 1

----- Subbasin : Dev -----

	-----Area(Acres) -----
Till Forest	0.000
Till Pasture	0.000
Till Grass	0.860
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User 2	0.000
Impervious	1.430

Subbasin Total 2.290

***** LINK DATA *****

-----SCENARIO: PREDEVELOPED

Number of Links: 1

Link Name: New Copy Lnk1

Link Type: Copy

Downstream Link: None

Structure Stage, Storage Discharge Tables

***** LINK DATA *****

-----SCENARIO: POSTDEVELOPED

Number of Links: 1

Link Name: New Structure Lnk1

Link Type: Structure

Downstream Link: None

Prismatic Pond Option Used

Pond Floor Elevation (ft) : 704.00
Riser Crest Elevation (ft) : 706.00
Max Pond Elevation (ft) : 707.00
Storage Depth (ft) : 2.00
Pond Bottom Length (ft) : 151.0
Pond Bottom Width (ft) : 75.0
Pond Side Slopes (ft/ft) : L1= 4.00 L2= 4.00 W1= 4.00 W2= 4.00
Bottom Area (sq-ft) : 11325.
Area at Riser Crest El (sq-ft) : 15,197.
(acres) : 0.349
Volume at Riser Crest (cu-ft) : 26,437.
(ac-ft) : 0.607
Area at Max Elevation (sq-ft) : 17325.
(acres) : 0.398
Vol at Max Elevation (cu-ft) : 44,207.
(ac-ft) : 1.015

Massmann Infiltration Option Used

Hydraulic Conductivity (in/hr) : 0.00
Depth to Water Table (ft) : 704.00
Bio-Fouling Potential : Low
Maintenance : Average or Better

Riser Geometry

Riser Structure Type : Circular
Riser Diameter (in) : 12.00
Common Length (ft) : 0.050
Riser Crest Elevation : 706.00 ft

Hydraulic Structure Geometry

Number of Devices: 2

---Device Number 1---

Device Type : Circular Orifice
Control Elevation (ft) : 704.00
Diameter (in) : 1.41
Orientation : Horizontal
Elbow : No

--- Device Number 2 ---

Device Type : Vertical Rectangular Orifice
Control Elevation (ft) : 704.92
Length (in) : 0.56
Height (in) : 13.00
Orientation : Vertical
Elbow : No

Structure Stage, Storage Discharge Tables

Link: Lnk1	New Structure Lnk1		
Elev (ft)	Storage (ac-ft)	Discharge (cfs)	Infil Discharge (cfs)
704.000	0.000	0.000	0.000
704.015	3.906E-03	0.006	0.000
704.030	7.823E-03	0.009	0.000
704.060	1.569E-02	0.013	0.000
704.120	3.152E-02	0.018	0.000
704.180	4.749E-02	0.022	0.000
704.240	6.362E-02	0.026	0.000
704.300	7.989E-02	0.029	0.000
704.360	9.632E-02	0.032	0.000
704.420	0.113	0.034	0.000
704.480	0.130	0.037	0.000
704.540	0.147	0.039	0.000
704.600	0.164	0.041	0.000
704.660	0.181	0.043	0.000
704.720	0.198	0.045	0.000
704.780	0.216	0.047	0.000
704.840	0.233	0.048	0.000
704.860	0.239	0.049	0.000
704.880	0.245	0.049	0.000
704.900	0.251	0.050	0.000
704.920	0.257	0.051	0.000
704.935	0.262	0.051	0.000
704.950	0.266	0.052	0.000
704.965	0.271	0.053	0.000
704.980	0.275	0.054	0.000
705.040	0.293	0.059	0.000
705.100	0.312	0.065	0.000
705.160	0.330	0.072	0.000
705.220	0.349	0.079	0.000
705.280	0.368	0.087	0.000
705.340	0.387	0.095	0.000
705.400	0.406	0.104	0.000
705.460	0.425	0.113	0.000
705.520	0.445	0.123	0.000
705.580	0.465	0.133	0.000
705.640	0.484	0.144	0.000
705.700	0.504	0.155	0.000
705.760	0.525	0.166	0.000
705.820	0.545	0.178	0.000
705.880	0.565	0.190	0.000
705.910	0.576	0.196	0.000
705.940	0.586	0.202	0.000
705.970	0.596	0.209	0.000
706.000	0.607	0.215	0.000
706.015	0.612	0.237	0.000
706.030	0.617	0.276	0.000
706.045	0.623	0.324	0.000
706.060	0.628	0.381	0.000
706.075	0.633	0.446	0.000

706.090	0.639	0.516	0.000
706.105	0.644	0.591	0.000
706.120	0.649	0.672	0.000
706.180	0.671	1.028	0.000
706.240	0.692	1.408	0.000
706.300	0.714	1.770	0.000
706.360	0.736	2.077	0.000
706.420	0.758	2.305	0.000
706.480	0.780	2.455	0.000
706.540	0.802	2.610	0.000
706.600	0.825	2.741	0.000
706.660	0.848	2.865	0.000
706.720	0.871	2.985	0.000
706.780	0.894	3.100	0.000
706.840	0.917	3.210	0.000
706.900	0.940	3.317	0.000
706.960	0.964	3.420	0.000
707.020	0.988	3.520	0.000
707.080	1.012	3.618	0.000
707.140	1.036	3.712	0.000
707.200	1.060	3.805	0.000
707.260	1.084	3.895	0.000
707.320	1.109	3.983	0.000
707.380	1.133	4.069	0.000
707.440	1.158	4.153	0.000
707.500	1.183	4.236	0.000

*****FLOOD FREQUENCY AND DURATION STATISTICS*****

-----SCENARIO: PREDEVELOPED

Number of Subbasins: 1
Number of Links: 1

-----SCENARIO: POSTDEVELOPED

Number of Subbasins: 1
Number of Links: 1

***** Link: New Structure Lnk1

***** Link WSEL

Stats

Annual Maxima WSEL

Max Date WSEL (ft)

=====

12/07/1939	705.172
01/18/1941	704.801
11/14/1941	704.894
11/15/1942	705.142
10/17/1943	704.504
02/07/1945	705.363
02/05/1946	704.867
11/18/1946	705.098
10/19/1947	705.334
02/22/1949	704.988
03/05/1950	705.195

02/09/1951	705.484
10/02/1951	704.597
01/11/1953	705.169
01/06/1954	705.030
11/19/1954	704.745
01/06/1956	705.299
02/26/1957	705.210
01/17/1958	705.006
01/13/1959	705.286
11/21/1959	705.388
11/24/1960	705.178
12/17/1961	704.692
02/04/1963	704.794
01/01/1964	704.791
12/01/1964	704.946
12/28/1965	704.935
12/13/1966	705.156
01/20/1968	704.845
12/11/1968	704.866
01/27/1970	704.995
12/07/1970	705.183
03/05/1972	705.493
12/23/1972	705.334
01/16/1974	705.125
12/27/1974	705.102
12/04/1975	705.124
08/26/1977	704.779
12/15/1977	705.284
03/05/1979	704.653
12/17/1979	705.660
12/30/1980	704.909
10/06/1981	705.727
01/05/1983	705.138
03/21/1984	704.607
11/04/1984	704.893
01/18/1986	705.529
11/24/1986	705.768
04/06/1988	704.897
04/05/1989	704.907
01/09/1990	705.961
04/05/1991	705.816
01/31/1992	705.205
03/23/1993	704.741
03/03/1994	704.665
02/20/1995	705.223
02/09/1996	705.944
01/02/1997	705.631
10/30/1997	704.787
11/26/1998	705.632
03/27/2000	705.065
05/05/2001	704.932
11/15/2001	704.960
03/31/2003	705.629
10/24/2003	705.131
02/08/2005	704.871
11/27/2005	705.243

12/15/2006	704.873
01/07/2008	705.277
02/18/2009	705.615
01/10/2010	705.262
11/17/2010	705.651
10/02/2011	705.213
01/20/2013	705.774
01/28/2014	705.060
03/30/2015	704.794
01/04/2016	705.397
11/01/2016	704.854
01/31/2018	705.126
01/12/2019	705.227
03/31/2020	704.811
02/10/2021	705.515
12/20/2021	705.038
03/30/2023	705.310
01/19/2024	705.221
12/22/2024	705.768
12/29/2025	705.179
01/29/2027	705.018
02/19/2028	705.246
12/04/2028	705.006
01/26/2030	705.249
12/30/2030	705.193
01/21/2032	705.524
12/23/2032	705.002
01/16/2034	705.743
02/19/2035	704.874
02/27/2036	705.089
03/09/2037	704.558
12/15/2037	705.215
12/01/2038	704.613
01/14/2040	705.099
12/25/2040	705.375
11/17/2041	705.109
08/30/2043	705.053
05/03/2044	704.750
11/03/2044	705.114
02/17/2046	705.173
02/02/2047	704.906
12/03/2047	705.411
11/25/2048	704.765
12/04/2049	705.116
04/06/2051	704.859
02/22/2052	704.727
12/10/2052	704.876
12/11/2053	704.857
10/27/2054	705.561
02/07/2056	705.945
11/19/2056	705.986
11/20/2057	705.092
11/26/2058	705.357
05/27/2060	704.769
12/13/2060	705.096
01/03/2062	704.987

12/30/2062	705.224
12/23/2063	705.440
12/01/2064	704.987
01/13/2066	704.625
12/16/2066	705.039
01/19/2068	705.422
09/23/2069	704.722
12/14/2069	704.643
02/14/2071	704.682
07/12/2072	704.975
12/25/2072	706.012
12/15/2073	705.158
11/20/2074	704.788
10/17/2075	705.421
10/31/2076	704.499
12/02/2077	704.857
02/25/2079	704.848
12/17/2079	705.916
11/21/2080	705.425
02/15/2082	705.360
02/12/2083	705.112
11/16/2083	705.359
12/14/2084	704.935
01/19/2086	705.099
11/24/2086	705.155
12/10/2087	704.768
11/06/2088	705.416
11/06/2089	705.114
12/11/2090	705.393
02/02/2092	705.454
03/25/2093	704.613
10/26/2093	704.769
12/03/2094	704.999
12/17/2095	705.102
03/23/2097	705.337

Ranked Annual Maxima Water Surface Elevation (ft)

Tr (Years)	WSEL (ft)
=====	
1.004	704.499
1.010	704.504
1.016	704.558
1.023	704.597
1.030	704.607
1.036	704.613
1.043	704.613
1.050	704.625
1.057	704.643
1.064	704.653
1.072	704.665
1.079	704.682
1.086	704.692
1.094	704.722
1.101	704.727
1.109	704.741
1.117	704.745

1.125	704.750
1.133	704.765
1.141	704.768
1.149	704.769
1.158	704.769
1.166	704.779
1.175	704.787
1.184	704.788
1.193	704.791
1.202	704.794
1.211	704.794
1.220	704.801
1.230	704.811
1.240	704.845
1.249	704.848
1.259	704.854
1.269	704.857
1.280	704.857
1.290	704.859
1.301	704.866
1.312	704.867
1.323	704.871
1.334	704.873
1.345	704.874
1.357	704.876
1.368	704.893
1.380	704.894
1.392	704.897
1.405	704.906
1.417	704.907
1.430	704.909
1.443	704.932
1.457	704.935
1.470	704.935
1.484	704.946
1.498	704.960
1.512	704.975
1.527	704.987
1.542	704.987
1.557	704.988
1.572	704.995
1.588	704.999
1.604	705.002
1.621	705.006
1.638	705.006
1.655	705.018
1.672	705.030
1.690	705.038
1.708	705.039
1.727	705.053
1.746	705.060
1.766	705.065
1.785	705.089
1.806	705.092
1.827	705.096
1.848	705.098

1.870	705.099
1.892	705.099
1.915	705.102
1.939	705.102
1.963	705.109
1.987	705.112
2.013	705.114
2.039	705.114
2.065	705.116
2.093	705.124
2.121	705.125
2.150	705.126
2.179	705.131
2.210	705.138
2.241	705.142
2.273	705.155
2.306	705.156
2.340	705.158
2.376	705.169
2.412	705.172
2.449	705.173
2.488	705.178
2.527	705.179
2.569	705.183
2.611	705.193
2.655	705.195
2.700	705.205
2.747	705.210
2.796	705.213
2.846	705.215
2.898	705.221
2.952	705.223
3.008	705.224
3.067	705.227
3.127	705.243
3.190	705.246
3.256	705.249
3.325	705.262
3.396	705.277
3.471	705.284
3.548	705.286
3.630	705.299
3.715	705.310
3.805	705.334
3.898	705.334
3.997	705.337
4.101	705.357
4.210	705.359
4.325	705.360
4.447	705.363
4.575	705.375
4.712	705.388
4.856	705.393
5.010	705.397
5.174	705.411
5.349	705.416

5.536	705.421
5.737	705.422
5.953	705.425
6.186	705.440
6.438	705.454
6.711	705.484
7.009	705.493
7.334	705.515
7.691	705.524
8.084	705.529
8.519	705.561
9.005	705.615
9.548	705.629
10.162	705.631
10.860	705.632
11.661	705.651
12.589	705.660
13.678	705.727
14.973	705.743
16.540	705.768
18.472	705.768
20.915	705.774
24.104	705.816
28.439	705.916
34.675	705.944
44.416	705.945
61.766	705.961
101.359	705.986
282.357	706.012

WSEL Frequency Data(ft)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05-Year	704.631
1.11-Year	704.743
1.25-Year	704.848
2.00-Year	705.113
3.33-Year	705.264
5-Year	705.396
10-Year	705.631
25-Year	705.837
50-Year	705.951
100-Year	705.986

*****Groundwater Recharge Summary *****

Recharge is computed as input to Perlnd Groundwater Plus Infiltration in Structures

Model Element	Total Predeveloped Recharge During Simulation Recharge Amount (ac-ft)
Subbasin: Predev	454.257
Link: New Copy Lnk1	0.000
Total:	454.257

Total Post Developed Recharge During Simulation	
Model Element	Recharge Amount (ac-ft)
Subbasin: Dev	113.058
Link: New Structure Lnk1	0.000
Total:	113.058

Total Predevelopment Recharge is Greater than Post Developed Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 2.875 ac-ft/year, Post Developed: 0.716 ac-ft/year

*****Water Quality Facility Data *****

-----SCENARIO: PREDEVELOPED

Number of Links: 1

***** Link: New Copy Lnk1 *****

Infiltration/Filtration Statistics-----
 Inflow Volume (ac-ft): 562.89
 Inflow Volume Including PPT-Evap (ac-ft): 562.89
 Total Runoff Infiltrated (ac-ft): 0.00, 0.00%
 Total Runoff Filtered (ac-ft): 0.00, 0.00%
 Primary Outflow To Downstream System (ac-ft): 562.89
 Secondary Outflow To Downstream System (ac-ft): 0.00
 Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

-----SCENARIO: POSTDEVELOPED

Number of Links: 1

***** Link: New Structure Lnk1

Basic Wet Pond Volume (91% Exceedance): 9016. cu-ft
 Computed Large Wet Pond Volume, 1.5*Basic Volume: 13524. cu-ft

Infiltration/Filtration Statistics-----
 Inflow Volume (ac-ft): 1082.74
 Inflow Volume Including PPT-Evap (ac-ft): 1082.74
 Total Runoff Infiltrated (ac-ft): 0.00, 0.00%
 Total Runoff Filtered (ac-ft): 0.00, 0.00%
 Primary Outflow To Downstream System (ac-ft): 1082.67
 Secondary Outflow To Downstream System (ac-ft): 0.00
 Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

*****Compliance Point Results *****

Scenario Predeveloped Compliance Link: New Copy Lnk1
 Scenario Postdeveloped Compliance Link: New Structure Lnk1
****Point of Compliance Annual Maxima Flow Data ****

Predevelopment Runoff		Postdevelopment Runoff	
Date	Annual Max Q (cfs)	Date	Annual Max Q (cfs)
05/01/1940	0.103	12/07/1939	7.296E-02
12/20/1940	6.282E-02	01/18/1941	4.721E-02
12/15/1941	0.193	11/14/1941	4.989E-02
11/14/1942	8.405E-02	11/15/1942	6.950E-02
01/22/1944	4.742E-02	10/17/1943	3.743E-02
02/07/1945	0.157	02/07/1945	9.846E-02
01/24/1946	8.126E-02	02/05/1946	4.911E-02
02/01/1947	9.526E-02	11/18/1946	6.465E-02
03/21/1948	0.164	10/19/1947	9.425E-02
11/27/1948	9.090E-02	02/22/1949	5.473E-02
03/03/1950	0.389	03/05/1950	7.575E-02
02/09/1951	0.119	02/09/1951	0.117
06/29/1952	0.329	10/02/1951	4.074E-02
01/11/1953	6.801E-02	01/11/1953	7.262E-02
12/19/1953	8.229E-02	01/06/1954	5.819E-02
11/05/1954	4.855E-02	11/19/1954	4.554E-02
12/22/1955	8.559E-02	01/06/1956	8.927E-02
02/25/1957	7.743E-02	02/26/1957	7.755E-02
04/20/1958	0.109	01/17/1958	5.617E-02
01/13/1959	9.974E-02	01/13/1959	8.755E-02
12/15/1959	0.123	11/21/1959	0.102
02/14/1961	9.535E-02	11/24/1960	7.371E-02
12/17/1961	5.679E-02	12/17/1961	4.388E-02
02/03/1963	6.109E-02	02/04/1963	4.700E-02
01/01/1964	9.667E-02	01/01/1964	4.691E-02
02/27/1965	8.354E-02	12/01/1964	5.187E-02
01/05/1966	8.290E-02	12/28/1965	5.128E-02
01/19/1967	0.157	12/13/1966	7.101E-02
08/23/1968	0.104	01/20/1968	4.850E-02
12/03/1968	8.635E-02	12/11/1968	4.910E-02
01/14/1970	8.751E-02	01/27/1970	5.532E-02
12/06/1970	0.103	12/07/1970	7.434E-02
02/27/1972	0.214	03/06/1972	0.119
12/23/1972	7.565E-02	12/23/1972	9.425E-02
11/11/1973	0.101	01/16/1974	6.767E-02
12/27/1974	0.183	12/27/1974	6.508E-02
12/02/1975	8.767E-02	12/04/1975	6.751E-02
08/26/1977	5.303E-02	08/26/1977	4.657E-02
09/22/1978	0.138	12/15/1977	8.717E-02
03/04/1979	8.415E-02	03/05/1979	4.260E-02
12/14/1979	0.154	12/17/1979	0.148
11/21/1980	0.121	12/30/1980	5.028E-02
10/06/1981	0.292	10/06/1981	0.160
01/05/1983	9.992E-02	01/05/1983	6.903E-02
03/14/1984	0.102	03/21/1984	4.109E-02
02/11/1985	5.974E-02	11/04/1984	4.985E-02
01/18/1986	0.184	01/19/1986	0.125
11/24/1986	0.179	11/24/1986	0.168

04/06/1988	7.435E-02	04/06/1988	4.997E-02
04/05/1989	8.657E-02	04/05/1989	5.023E-02
01/09/1990	0.351	01/09/1990	0.207
11/24/1990	0.312	04/05/1991	0.177
01/27/1992	8.890E-02	01/31/1992	7.699E-02
03/23/1993	6.464E-02	03/23/1993	4.540E-02
03/03/1994	5.161E-02	03/03/1994	4.301E-02
02/19/1995	0.100	02/20/1995	7.922E-02
02/08/1996	0.236	02/09/1996	0.203
01/02/1997	0.167	01/02/1997	0.142
03/01/1998	6.004E-02	10/30/1997	4.680E-02
11/04/1998	0.340	11/26/1998	0.142
02/06/2000	9.765E-02	03/27/2000	6.147E-02
05/05/2001	7.931E-02	05/05/2001	5.112E-02
05/03/2002	0.287	11/15/2001	5.271E-02
02/06/2003	0.155	03/31/2003	0.142
01/01/2004	6.157E-02	10/24/2003	6.832E-02
02/05/2005	0.133	02/08/2005	4.924E-02
11/27/2005	0.105	11/27/2005	8.186E-02
12/14/2006	8.837E-02	12/15/2006	4.929E-02
03/22/2008	0.146	01/07/2008	8.628E-02
02/17/2009	0.170	02/19/2009	0.140
06/10/2010	0.656	01/10/2010	8.426E-02
11/17/2010	0.172	11/17/2010	0.146
01/31/2012	0.122	10/02/2011	7.794E-02
01/20/2013	0.272	01/20/2013	0.169
12/06/2013	0.168	01/28/2014	6.097E-02
02/28/2015	6.615E-02	03/30/2015	4.700E-02
01/04/2016	0.179	01/04/2016	0.103
06/14/2017	0.114	11/01/2016	4.874E-02
12/25/2017	0.109	01/31/2018	6.772E-02
11/12/2018	8.599E-02	01/12/2019	7.976E-02
03/30/2020	7.637E-02	03/31/2020	4.751E-02
11/24/2020	0.149	02/10/2021	0.122
12/20/2021	0.116	12/21/2021	5.886E-02
02/03/2023	0.151	03/30/2023	9.092E-02
01/19/2024	9.317E-02	01/19/2024	7.893E-02
12/22/2024	0.201	12/22/2024	0.168
03/09/2026	9.557E-02	12/29/2025	7.378E-02
01/28/2027	8.803E-02	01/29/2027	5.717E-02
02/19/2028	0.105	02/19/2028	8.224E-02
06/26/2029	0.118	12/04/2028	5.621E-02
11/04/2029	0.129	01/26/2030	8.263E-02
12/30/2030	0.106	12/30/2030	7.553E-02
01/20/2032	0.169	01/21/2032	0.124
03/01/2033	5.670E-02	12/23/2032	5.587E-02
01/16/2034	0.176	01/16/2034	0.163
02/19/2035	0.103	02/19/2035	4.933E-02
12/04/2035	0.134	02/27/2036	6.382E-02
03/08/2037	5.324E-02	03/09/2037	3.939E-02
11/25/2037	0.116	12/15/2037	7.814E-02
02/07/2039	5.990E-02	12/01/2038	4.129E-02
01/14/2040	0.264	01/14/2040	6.474E-02
12/25/2040	0.109	12/25/2040	0.100
02/20/2042	0.113	11/17/2041	6.592E-02
07/19/2043	0.261	08/30/2043	6.023E-02

05/01/2044	8.501E-02	05/03/2044	4.566E-02
11/02/2044	0.146	11/03/2044	6.638E-02
02/16/2046	9.113E-02	02/17/2046	7.312E-02
01/31/2047	6.708E-02	02/02/2047	5.021E-02
12/02/2047	0.103	12/03/2047	0.106
03/16/2049	6.769E-02	11/25/2048	4.614E-02
12/04/2049	0.142	12/04/2049	6.667E-02
02/02/2051	8.811E-02	04/06/2051	4.888E-02
04/16/2052	6.006E-02	02/22/2052	4.496E-02
06/04/2053	0.366	12/10/2052	4.937E-02
12/08/2053	4.850E-02	12/11/2053	4.883E-02
10/27/2054	0.155	10/27/2054	0.130
02/07/2056	0.250	02/07/2056	0.203
11/19/2056	0.338	11/19/2056	0.212
01/24/2058	0.150	11/20/2057	6.404E-02
11/26/2058	0.147	11/26/2058	9.754E-02
05/15/2060	0.120	05/27/2060	4.626E-02
10/23/2060	0.122	12/13/2060	6.449E-02
02/03/2062	0.431	01/03/2062	5.460E-02
12/30/2062	8.780E-02	12/30/2062	7.937E-02
12/23/2063	0.145	12/23/2063	0.110
11/29/2064	9.542E-02	12/01/2064	5.460E-02
01/13/2066	4.939E-02	01/13/2066	4.168E-02
01/19/2067	8.771E-02	12/16/2066	5.893E-02
01/18/2068	0.182	01/19/2068	0.107
01/04/2069	5.420E-02	09/23/2069	4.483E-02
04/09/2070	6.568E-02	12/14/2069	4.229E-02
02/14/2071	5.153E-02	02/14/2071	4.355E-02
11/03/2071	7.520E-02	07/12/2072	5.372E-02
12/25/2072	0.205	12/26/2072	0.233
03/16/2074	0.127	12/16/2073	7.132E-02
11/20/2074	4.834E-02	11/20/2074	4.683E-02
03/24/2076	0.152	10/17/2075	0.107
08/24/2077	3.789E-02	10/31/2076	3.723E-02
11/25/2077	7.859E-02	12/02/2077	4.884E-02
11/03/2078	8.777E-02	02/25/2079	4.857E-02
12/17/2079	0.261	12/17/2079	0.197
11/21/2080	0.122	11/21/2080	0.108
10/31/2081	0.116	02/15/2082	9.811E-02
03/29/2083	8.829E-02	02/12/2083	6.623E-02
11/26/2083	0.107	11/16/2083	9.791E-02
03/24/2085	7.417E-02	12/14/2084	5.129E-02
01/19/2086	9.361E-02	01/19/2086	6.476E-02
12/22/2086	0.115	11/24/2086	7.092E-02
01/15/2088	7.546E-02	12/11/2087	4.622E-02
11/06/2088	0.216	11/06/2088	0.106
11/05/2089	8.275E-02	11/06/2089	6.639E-02
12/06/2090	9.990E-02	12/11/2090	0.103
05/01/2092	0.265	02/02/2092	0.112
11/21/2092	5.686E-02	03/25/2093	4.129E-02
06/21/2094	5.985E-02	10/26/2093	4.626E-02
12/03/2094	7.352E-02	12/03/2094	5.564E-02
01/17/2096	7.530E-02	12/17/2095	6.504E-02
11/15/2096	0.167	03/23/2097	9.461E-02

****Point of Compliance Ranked Maxima Flow Data ****

Predevelopment		Postdevelopment	
Tr (yrs)	Q (cfs)	Tr (yrs)	Q (cfs)
1.004	3.789E-02	1.004	3.723E-02
1.010	4.742E-02	1.010	3.743E-02
1.016	4.834E-02	1.016	3.939E-02
1.023	4.850E-02	1.023	4.074E-02
1.030	4.855E-02	1.030	4.109E-02
1.036	4.939E-02	1.036	4.129E-02
1.043	5.153E-02	1.043	4.129E-02
1.050	5.161E-02	1.050	4.168E-02
1.057	5.303E-02	1.057	4.229E-02
1.064	5.324E-02	1.064	4.260E-02
1.072	5.420E-02	1.072	4.301E-02
1.079	5.670E-02	1.079	4.355E-02
1.086	5.679E-02	1.086	4.388E-02
1.094	5.686E-02	1.094	4.483E-02
1.101	5.974E-02	1.101	4.496E-02
1.109	5.985E-02	1.109	4.540E-02
1.117	5.990E-02	1.117	4.554E-02
1.125	6.004E-02	1.125	4.566E-02
1.133	6.006E-02	1.133	4.614E-02
1.141	6.109E-02	1.141	4.622E-02
1.149	6.157E-02	1.149	4.626E-02
1.158	6.282E-02	1.158	4.626E-02
1.166	6.464E-02	1.166	4.657E-02
1.175	6.568E-02	1.175	4.680E-02
1.184	6.615E-02	1.184	4.683E-02
1.193	6.708E-02	1.193	4.691E-02
1.202	6.769E-02	1.202	4.700E-02
1.211	6.801E-02	1.211	4.700E-02
1.220	7.352E-02	1.220	4.721E-02
1.230	7.417E-02	1.230	4.751E-02
1.240	7.435E-02	1.240	4.850E-02
1.249	7.520E-02	1.249	4.857E-02
1.259	7.530E-02	1.259	4.874E-02
1.269	7.546E-02	1.269	4.883E-02
1.280	7.565E-02	1.280	4.884E-02
1.290	7.637E-02	1.290	4.888E-02
1.301	7.743E-02	1.301	4.910E-02
1.312	7.859E-02	1.312	4.911E-02
1.323	7.931E-02	1.323	4.924E-02
1.334	8.126E-02	1.334	4.929E-02
1.345	8.229E-02	1.345	4.933E-02
1.357	8.275E-02	1.357	4.937E-02
1.368	8.290E-02	1.368	4.985E-02
1.380	8.354E-02	1.380	4.989E-02
1.392	8.405E-02	1.392	4.997E-02
1.405	8.415E-02	1.405	5.021E-02
1.417	8.501E-02	1.417	5.023E-02
1.430	8.559E-02	1.430	5.028E-02
1.443	8.599E-02	1.443	5.112E-02
1.457	8.635E-02	1.457	5.128E-02
1.470	8.657E-02	1.470	5.129E-02
1.484	8.751E-02	1.484	5.187E-02

1.498	8.767E-02	1.498	5.271E-02
1.512	8.771E-02	1.512	5.372E-02
1.527	8.777E-02	1.527	5.460E-02
1.542	8.780E-02	1.542	5.460E-02
1.557	8.803E-02	1.557	5.473E-02
1.572	8.811E-02	1.572	5.532E-02
1.588	8.829E-02	1.588	5.564E-02
1.604	8.837E-02	1.604	5.587E-02
1.621	8.890E-02	1.621	5.617E-02
1.638	9.090E-02	1.638	5.621E-02
1.655	9.113E-02	1.655	5.717E-02
1.672	9.317E-02	1.672	5.819E-02
1.690	9.361E-02	1.690	5.886E-02
1.708	9.526E-02	1.708	5.893E-02
1.727	9.535E-02	1.727	6.023E-02
1.746	9.542E-02	1.746	6.097E-02
1.766	9.557E-02	1.766	6.147E-02
1.785	9.667E-02	1.785	6.382E-02
1.806	9.765E-02	1.806	6.404E-02
1.827	9.974E-02	1.827	6.449E-02
1.848	9.990E-02	1.848	6.465E-02
1.870	9.992E-02	1.870	6.474E-02
1.892	0.100	1.892	6.476E-02
1.915	0.101	1.915	6.504E-02
1.939	0.102	1.939	6.508E-02
1.963	0.103	1.963	6.592E-02
1.987	0.103	1.987	6.623E-02
2.013	0.103	2.013	6.638E-02
2.039	0.103	2.039	6.639E-02
2.065	0.104	2.065	6.667E-02
2.093	0.105	2.093	6.751E-02
2.121	0.105	2.121	6.767E-02
2.150	0.106	2.150	6.772E-02
2.179	0.107	2.179	6.832E-02
2.210	0.109	2.210	6.903E-02
2.241	0.109	2.241	6.950E-02
2.273	0.109	2.273	7.092E-02
2.306	0.113	2.306	7.101E-02
2.340	0.114	2.340	7.132E-02
2.376	0.115	2.376	7.262E-02
2.412	0.116	2.412	7.296E-02
2.449	0.116	2.449	7.312E-02
2.488	0.116	2.488	7.371E-02
2.527	0.118	2.527	7.378E-02
2.569	0.119	2.569	7.434E-02
2.611	0.120	2.611	7.553E-02
2.655	0.121	2.655	7.575E-02
2.700	0.122	2.700	7.699E-02
2.747	0.122	2.747	7.755E-02
2.796	0.122	2.796	7.794E-02
2.846	0.123	2.846	7.814E-02
2.898	0.127	2.898	7.893E-02
2.952	0.129	2.952	7.922E-02
3.008	0.133	3.008	7.937E-02
3.067	0.134	3.067	7.976E-02
3.127	0.138	3.127	8.186E-02

3.190	0.142	3.190	8.224E-02	
3.256	0.145	3.256	8.263E-02	
3.325	0.146	3.325	8.426E-02	
3.396	0.146	3.396	8.628E-02	
3.471	0.147	3.471	8.717E-02	
3.548	0.149	3.548	8.755E-02	
3.630	0.150	3.630	8.927E-02	
3.715	0.151	3.715	9.092E-02	
3.805	0.152	3.805	9.425E-02	
3.898	0.154	3.898	9.425E-02	
3.997	0.155	3.997	9.461E-02	
4.101	0.155	4.101	9.754E-02	
4.210	0.157	4.210	9.791E-02	
4.325	0.157	4.325	9.811E-02	
4.447	0.164	4.447	9.846E-02	
4.575	0.167	4.575	0.100	
4.712	0.167	4.712	0.102	
4.856	0.168	4.856	0.103	
5.010	0.169	5.010	0.103	
5.174	0.170	5.174	0.106	
5.349	0.172	5.349	0.106	
5.536	0.176	5.536	0.107	
5.737	0.179	5.737	0.107	
5.953	0.179	5.953	0.108	
6.186	0.182	6.186	0.110	
6.438	0.183	6.438	0.112	
6.711	0.184	6.711	0.117	
7.009	0.193	7.009	0.119	
7.334	0.201	7.334	0.122	
7.691	0.205	7.691	0.124	
8.084	0.214	8.084	0.125	
8.519	0.216	8.519	0.130	
9.005	0.236	9.005	0.140	
9.548	0.250	9.548	0.142	
10.162	0.261	10.162	0.142	
10.860	0.261	10.860	0.142	
11.661	0.264	11.661	0.146	
12.589	0.265	12.589	0.148	
13.678	0.272	13.678	0.160	
14.973	0.287	14.973	0.163	
16.540	0.292	16.540	0.168	
18.472	0.312	18.472	0.168	
20.915	0.329	20.915	0.169	
24.104	0.338	24.104	0.177	
28.439	0.340	28.439	0.197	
34.675	0.351	34.675	0.203	
44.416	0.366	44.416	0.203	
61.766	0.389	61.766	0.207	
101.359	0.431	101.359	0.212	
282.357	0.656	282.357	0.233	

*** Point of Compliance Flow Frequency Data ***

Recurrence Interval Computed Using Gringorten Plotting Position

Predevelopment Runoff		Postdevelopment Runoff		Discharge (cfs) (un-mitigated)
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs) (mitigated)	
2-Year	0.103	2-Year	6.631E-02	0.494
5-Year	0.169	5-Year	0.103	0.633
10-Year	0.258	10-Year	0.142	0.758
25-Year	0.339	25-Year	0.182	0.952
50-Year	0.374	50-Year	0.205	1.170
100-Year	0.430	100-Year	0.212	1.221
200-Year	0.580	200-Year	0.226	1.450

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

*** Point of Compliance Flow Duration Data ***

Predevelopment Runoff		Postdevelopment Runoff	
Discharge (cfs) Probability	Exceedance Probability	Discharge (cfs)	Exceedance
0.000E+00	1.0000E+00	0.000E+00	1.0000E+00
3.280E-03	2.9224E-01	1.165E-03	4.7975E-01
6.561E-03	2.1393E-01	2.329E-03	4.4555E-01
9.841E-03	1.6237E-01	3.494E-03	4.2629E-01
1.312E-02	1.2476E-01	4.658E-03	4.1264E-01
1.640E-02	9.6160E-02	5.823E-03	4.0213E-01
1.968E-02	7.4739E-02	6.987E-03	3.8857E-01
2.296E-02	5.8638E-02	8.152E-03	3.7163E-01
2.624E-02	4.6287E-02	9.316E-03	3.5590E-01
2.952E-02	3.6660E-02	1.048E-02	3.3770E-01
3.280E-02	2.9079E-02	1.165E-02	3.2146E-01
3.608E-02	2.3158E-02	1.281E-02	3.0691E-01
3.936E-02	1.8400E-02	1.397E-02	2.8907E-01
4.265E-02	1.4818E-02	1.514E-02	2.7220E-01
4.593E-02	1.2067E-02	1.630E-02	2.5679E-01
4.921E-02	9.9095E-03	1.747E-02	2.4260E-01
5.164E-02	8.6270E-03	1.863E-02	2.2842E-01
5.577E-02	6.8402E-03	1.980E-02	2.1254E-01
5.905E-02	5.7139E-03	2.096E-02	1.9785E-01
6.233E-02	4.7999E-03	2.213E-02	1.8420E-01
6.561E-02	4.0591E-03	2.329E-02	1.6997E-01
6.889E-02	3.4317E-03	2.446E-02	1.5658E-01
7.217E-02	2.9450E-03	2.562E-02	1.4413E-01
7.545E-02	2.5183E-03	2.678E-02	1.3128E-01
7.873E-02	2.1667E-03	2.795E-02	1.1914E-01
8.201E-02	1.8700E-03	2.911E-02	1.0793E-01
8.529E-02	1.6166E-03	3.028E-02	9.6614E-02
8.857E-02	1.3956E-03	3.144E-02	8.6603E-02
9.185E-02	1.2151E-03	3.261E-02	7.6936E-02
9.513E-02	1.0671E-03	3.377E-02	6.8244E-02
9.841E-02	9.3210E-04	3.494E-02	6.0172E-02
0.103	7.7332E-04	0.036	5.2759E-02
0.105	7.2922E-04	0.037	4.6116E-02

0.108	6.5991E-04	0.038	4.0387E-02
0.112	5.9204E-04	0.040	3.5398E-02
0.115	5.2923E-04	0.041	3.1143E-02
0.118	4.7435E-04	0.042	2.7186E-02
0.121	4.1010E-04	0.043	2.3837E-02
0.125	3.5595E-04	0.044	2.0698E-02
0.128	3.1479E-04	0.045	1.7812E-02
0.131	2.8302E-04	0.047	1.5231E-02
0.134	2.5198E-04	0.048	1.2962E-02
0.138	2.2382E-04	0.049	1.0955E-02
0.141	2.0288E-04	0.050	9.2669E-03
0.144	1.8050E-04	0.052	7.7351E-03
0.148	1.6245E-04	0.052	7.3088E-03
0.151	1.4657E-04	0.054	6.7153E-03
0.154	1.3140E-04	0.055	6.2056E-03
0.157	1.1552E-04	0.056	5.7710E-03
0.161	1.0469E-04	0.057	5.3580E-03
0.164	9.5304E-05	0.058	4.9934E-03
0.167	8.5918E-05	0.059	4.6692E-03
0.169	8.0296E-05	0.061	4.3789E-03
0.174	6.7868E-05	0.062	4.0945E-03
0.177	6.1370E-05	0.063	3.8497E-03
0.180	5.3428E-05	0.064	3.6013E-03
0.184	4.9818E-05	0.065	3.3465E-03
0.187	4.3320E-05	0.066	3.1407E-03
0.190	3.6822E-05	0.068	2.9487E-03
0.194	3.3212E-05	0.069	2.7775E-03
0.197	3.2490E-05	0.070	2.6093E-03
0.200	2.9602E-05	0.071	2.4512E-03
0.203	2.4548E-05	0.072	2.3212E-03
0.207	2.2382E-05	0.073	2.2057E-03
0.210	2.2382E-05	0.075	2.1140E-03
0.213	2.1660E-05	0.076	2.0173E-03
0.217	2.0216E-05	0.077	1.9090E-03
0.220	2.0216E-05	0.078	1.8151E-03
0.223	1.9494E-05	0.079	1.7198E-03
0.226	1.9494E-05	0.080	1.6324E-03
0.230	1.9494E-05	0.082	1.5530E-03
0.233	1.8772E-05	0.083	1.4750E-03
0.236	1.7328E-05	0.084	1.4158E-03
0.239	1.6606E-05	0.085	1.3465E-03
0.243	1.5884E-05	0.086	1.2902E-03
0.246	1.5884E-05	0.087	1.2375E-03
0.249	1.5884E-05	0.089	1.1805E-03
0.253	1.5162E-05	0.090	1.1292E-03
0.256	1.4440E-05	0.091	1.0787E-03
0.259	1.4440E-05	0.092	1.0447E-03
0.262	1.2996E-05	0.093	9.9636E-04
0.266	1.1552E-05	0.094	9.5088E-04
0.269	1.1552E-05	0.095	9.1405E-04
0.272	1.0830E-05	0.097	8.8301E-04
0.276	1.0108E-05	0.098	8.4257E-04
0.279	1.0108E-05	0.099	8.1008E-04
0.282	1.0108E-05	0.100	7.8048E-04
0.285	1.0108E-05	0.101	7.4871E-04
0.289	9.3860E-06	0.102	7.1839E-04

0.292	8.6640E-06	0.103	6.9456E-04
0.295	8.6640E-06	0.105	6.5702E-04
0.299	8.6640E-06	0.106	6.3247E-04
0.302	8.6640E-06	0.107	6.0720E-04
0.305	8.6640E-06	0.108	5.8771E-04
0.308	8.6640E-06	0.109	5.6894E-04
0.312	8.6640E-06	0.111	5.5522E-04
0.315	7.9420E-06	0.112	5.3500E-04
0.318	7.2200E-06	0.113	5.1695E-04
0.321	7.2200E-06	0.114	5.0179E-04
0.325	7.2200E-06	0.115	4.7869E-04
0.328	7.2200E-06	0.116	4.6208E-04
0.331	6.4980E-06	0.118	4.4186E-04
0.335	6.4980E-06	0.119	4.2165E-04
0.338	6.4980E-06	0.120	4.0288E-04
0.341	5.0540E-06	0.121	3.8988E-04
0.344	5.0540E-06	0.122	3.7977E-04
0.348	5.0540E-06	0.123	3.6678E-04
0.351	5.0540E-06	0.125	3.5739E-04
0.354	4.3320E-06	0.126	3.4800E-04
0.358	4.3320E-06	0.127	3.3790E-04
0.361	4.3320E-06	0.128	3.2634E-04
0.364	4.3320E-06	0.129	3.1624E-04
0.367	3.6100E-06	0.130	3.0180E-04
0.371	3.6100E-06	0.132	2.8880E-04
0.374	2.8486E-06	0.133	2.8519E-04
0.377	2.8880E-06	0.134	2.7003E-04
0.381	2.8880E-06	0.135	2.6136E-04
0.384	2.8880E-06	0.136	2.5414E-04
0.387	2.8880E-06	0.137	2.4548E-04
0.390	2.1660E-06	0.139	2.3176E-04
0.394	2.1660E-06	0.140	2.2526E-04
0.397	2.1660E-06	0.141	2.1588E-04
0.400	2.1660E-06	0.142	2.0794E-04
0.403	2.1660E-06	0.143	1.9855E-04
0.407	2.1660E-06	0.144	1.8772E-04
0.410	2.1660E-06	0.146	1.7833E-04
0.413	1.4440E-06	0.147	1.7039E-04
0.417	1.4440E-06	0.148	1.6101E-04
0.420	1.4440E-06	0.149	1.5451E-04
0.423	1.4440E-06	0.150	1.5018E-04
0.426	1.4440E-06	0.151	1.4584E-04
0.430	1.4440E-06	0.153	1.4079E-04
0.433	7.2200E-07	0.154	1.3646E-04
0.436	7.2200E-07	0.155	1.3285E-04
0.440	7.2200E-07	0.156	1.2779E-04
0.443	7.2200E-07	0.157	1.2057E-04
0.446	7.2200E-07	0.158	1.1408E-04
0.449	7.2200E-07	0.160	1.0686E-04
0.453	7.2200E-07	0.161	1.0108E-04
0.456	7.2200E-07	0.162	9.6026E-05
0.459	7.2200E-07	0.163	8.6640E-05
0.463	7.2200E-07	0.164	8.3752E-05
0.466	7.2200E-07	0.165	7.9420E-05
0.469	7.2200E-07	0.167	7.2200E-05
0.472	7.2200E-07	0.168	6.7146E-05

0.476	7.2200E-07	0.169	6.2859E-05
0.479	7.2200E-07	0.170	6.2092E-05
0.482	7.2200E-07	0.171	6.0648E-05
0.485	7.2200E-07	0.172	5.9204E-05
0.489	7.2200E-07	0.174	5.8482E-05
0.492	7.2200E-07	0.175	5.6316E-05
0.495	7.2200E-07	0.176	5.4150E-05
0.499	7.2200E-07	0.177	5.2706E-05
0.502	7.2200E-07	0.178	5.0540E-05
0.505	7.2200E-07	0.179	4.6930E-05
0.508	7.2200E-07	0.181	4.5486E-05
0.512	7.2200E-07	0.182	4.4042E-05
0.515	7.2200E-07	0.183	4.3320E-05
0.518	7.2200E-07	0.184	4.3320E-05
0.522	7.2200E-07	0.185	3.9710E-05
0.525	7.2200E-07	0.186	3.8988E-05
0.528	7.2200E-07	0.187	3.8266E-05
0.531	7.2200E-07	0.189	3.7544E-05
0.535	7.2200E-07	0.190	3.7544E-05
0.538	7.2200E-07	0.191	3.1046E-05
0.541	7.2200E-07	0.192	2.9602E-05
0.545	7.2200E-07	0.193	2.5992E-05
0.548	7.2200E-07	0.194	2.4548E-05
0.551	7.2200E-07	0.196	2.1660E-05
0.554	7.2200E-07	0.197	1.9494E-05
0.558	7.2200E-07	0.198	1.7328E-05
0.561	7.2200E-07	0.199	1.5884E-05
0.564	7.2200E-07	0.200	1.5162E-05
0.568	7.2200E-07	0.201	1.4440E-05
0.571	7.2200E-07	0.203	1.2274E-05
0.574	7.2200E-07	0.204	1.0108E-05
0.577	7.2200E-07	0.205	8.6640E-06
0.581	7.2200E-07	0.206	7.2200E-06
0.584	7.2200E-07	0.207	6.4980E-06
0.587	7.2200E-07	0.208	5.7760E-06
0.590	7.2200E-07	0.210	5.0540E-06
0.594	7.2200E-07	0.211	4.3320E-06
0.597	7.2200E-07	0.212	3.6100E-06
0.600	7.2200E-07	0.213	2.1660E-06
0.604	7.2200E-07	0.214	1.4440E-06
0.607	7.2200E-07	0.215	1.4440E-06
0.610	7.2200E-07	0.217	1.4440E-06
0.613	7.2200E-07	0.218	1.4440E-06
0.617	7.2200E-07	0.219	1.4440E-06
0.620	7.2200E-07	0.220	1.4440E-06
0.623	7.2200E-07	0.221	1.4440E-06
0.627	7.2200E-07	0.222	1.4440E-06
0.630	7.2200E-07	0.224	1.4440E-06
0.633	7.2200E-07	0.225	1.4440E-06
0.636	7.2200E-07	0.226	1.4440E-06
0.640	7.2200E-07	0.227	1.4440E-06
0.643	7.2200E-07	0.228	1.4440E-06
0.646	7.2200E-07	0.229	1.4440E-06
0.650	7.2200E-07	0.231	1.4440E-06
0.653	7.2200E-07	0.232	1.4440E-06
0.656	7.2200E-07	0.233	7.2200E-07

**** **Flow Duration Performance** ****

Excursion at Predeveloped 50%Q2 (Must be Less Than 0%):	-9.0%	PASS	
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than 0%):	-9.0%	PASS	PASS
Maximum Excursion from Q2 to Q50 (Must be less than 10%):	8.1%	PASS	
Percent Excursion from Q2 to Q50 (Must be less than 50%):	10.7%	PASS	

MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS

POND VOLUME

Plan View Area

WETPOND PROVIDED

Elevation	area (SF)	Vol (CU FT)
701	2529	0
702	3740	3135
703	5208	7609
704	7018	13722

DETENTION POND PROVIDED

Elevation	area (SF)	Vol (CU FT)	
704	11959	0	
705	13993	12976	
706	16181	28063	RISER CREST
707	18512	45410	MAX WATER STORAGE

BASIC WETPOND VOLUME REQUIRED PER MGS FLOOD CALCULATIONS:
9,016 CU FT. (0.21 AC-FT)

DETENTION POND REQUIRED PER MGS FLOOD CALCULATIONS
26,437 CU FT (0.61 AC-FT) AT RISER CREST
44,207 CU FT (1.01 AC-FT) MAX WATER STORAGE

COMMON SECTIONS FOR DITCHES - CONVEYANCE

Flows based on manning's equation

Equations in this spreadsheet are based on the manning equation.

Flow Depth	Sides slope	mannings n	SLOPE ft/ft	Width at water surface		Sec. Area	Hydraulic Radius	Velocity fps	flow Q cfs	VR*	length	residence time time (mins)
				Top	Bottom							
0.50	2:1	0.027	0.002	3.00	1.00	1	0.31	1.22	1.22	0.38	313	4.3

COMMON SECTIONS FOR DITCHES

Flows based on manning's equation

Equations in this spreadsheet are based on the manning equation.

Flow Depth	Sides slope	mannings n	SLOPE ft/ft	Width at water surface		Sec. Area	Hydraulic Radius	Velocity fps	flow Q cfs	VR*	length	residence time time (mins)
				Top	Bottom							
0.35	2:1	0.027	0.01	2.40	1.00	0.595	0.23	2.08	1.24	0.48	313	2.5

Carbcom Properties

Developed Conveyance Capacity Check

MANNING'S EQUATION FOR OPEN CHANNEL FLOW
CIRCULAR PIPE CAPACITY

12" Conveyance

$$Q = \frac{1.49 AR^{\frac{2}{3}} S^{\frac{1}{2}}}{n}$$

Input Values

d = diameter of pipe	1.00 ft
h = height of flow	0.50 ft
S = longitudinal slope	0.0050 ft/ft
n = roughness coefficient	0.013

Calculated Variables

V = Velocity	3.22 fps	> 2 fps for cleansing velocity
A = Area		
P = Perimeter		
WA = Wetted Area	0.393 ft ²	
WP = Wetted Perimeter	1.571 ft	
R = Hydraulic Radius	0.250 ft	
Percent Full	50.0 %	
Q = Quantity of flow	1.26 cfs	

Q_{25-yr} = 0.92 cfs Site un-mitigated flow

Q_{100-yr} = 1.19 cfs Site un-mitigated flow

Capacity Check for Site Flows

Q_{pipe} > Q_{25-yr}

1.26 cfs > 0.92 cfs ==> **Meets capacity**

Q_{pipe} > Q_{100-yr}

1.26 cfs > 1.19 cfs ==> **Meets capacity**

48" EMERGENCY OVERFLOW

$$Q = ca\sqrt{2gh}$$

Given d

$$Q = c[(\pi)d^2/4][(2gh)^{1/2}]$$

d = **48.00** IN. Orifice diameter
c = **0.62** Sharp edged orifice constant
g = **32.2** Ft/Sec² gravitation constant
h = **0.010** FT. head on orifice

Q = 6.25 CFS (100-yr unmitigated = 1.22 cfs)

Appendix C

NRCS Soil Survey Data, Geotechnical Site Assessment

Soil Map—Pierce County Area, Washington



Map Scale: 1:3,820 if printed on A portrait (8.5" x 11") sheet.



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

MAP LEGEND

- Area of Interest (AOI)
- Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points
- Special Point Features**
 - Blowout
 - Borrow Pit
 - Clay Spot
 - Closed Depression
 - Gravel Pit
 - Gravelly Spot
 - Landfill
 - Lava Flow
 - Marsh or swamp
 - Mine or Quarry
 - Miscellaneous Water
 - Perennial Water
 - Rock Outcrop
 - Saline Spot
 - Sandy Spot
 - Severely Eroded Spot
 - Sinkhole
 - Slide or Slip
 - Sodic Spot
- Water Features**
 - Streams and Canals
- Transportation**
 - Rails
 - Interstate Highways
 - US Routes
 - Major Roads
 - Local Roads
- Background**
 - Aerial Photography

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
 Web Soil Survey URL: <http://websoilsurvey.nrcs.usda.gov>
 Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Pierce County Area, Washington
 Survey Area Data: Version 10, Sep 15, 2015

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Aug 1, 2011—Aug 20, 2011

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

MAP INFORMATION

Map Unit Legend

Pierce County Area, Washington (WA653)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
8A	Buckley gravelly silt loam, 0 to 3 percent slopes	66.8	98.7%
W	Water	0.9	1.3%
Totals for Area of Interest		67.6	100.0%



LEROY SURVEYORS & ENGINEERS, INC.

Surveying • Engineering • Geology • Septic Design • GPS • GIS Mapping

March 26, 2016

Geotechnical Site Assessment

Carbcom LLC Commercial Site

Site Address: 28xxx SR 410 E

Buckley, WA 98321

Parcel No's. 0619047003

LS&E Job No. 10537

For:

Carbcom Properties, LLC

10010 181st Avenue Ct. E.

Bonney Lake, WA 98391

253-431-6188

Matt Crowell, E.I.T.

Civil Engineering Technician



REX B. HUMPHREY

Rex Humphrey, L.E.G.
Engineering Geologist

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Appendix A – Soil Logs

Introduction

It is the intent of this assessment to describe the surface and near surface soil conditions in order to provide geotechnical recommendations for design and development of the Carbcom LLC Commercial Site. We evaluated soil conditions throughout the site to make recommendations for storm water management and slab on grade. LeRoy Surveyors and Engineers (LS&E) visited the site on February 4, 2016 to observe and describe the surface and subsurface conditions observed on the approximate 1.16 acres. The parcel is located north of SR 410 E in the City of Buckley. This Assessment is intended to describe our findings and make preliminary recommendations for development of the project.

This report is for the exclusive use of Carbcom Properties, LLC, their consultants and contractors for the intended purpose described. Site observations and exploration methods applied and described in this evaluation represent the standard of practices for the industry. Sources of information cited are uniformly accepted resources when utilized in conjunction with field reconnaissance as confirmation. Opinions are based on using these standardized practices to adequately characterize the local surficial geology and general conditions at the site.

Information Sources

Soil identification and mapping for this assessment is supported by information from the Natural Resource Conservation Service (the Survey), soil profile observations in multiple and representative locations throughout the project site. Geologic information for this assessment is supported by information from the Department of Natural Resources, Division of Geology and Earth Resources (DNR) as represented on the Pierce County Geographical Information System (GIS). Our understanding of site geology is supported by the review of geologic mapping, published topographic and relief map layers, and site observations. Our opinions are based on our interpretation of the cumulative information and the contemporary conditions of the geologic setting.

Published Information Accuracy

It should be noted that the Survey, the USGS and/or DNR geologic maps, and the Pierce County GIS define general areas of soil deposits, geology, and landforms. Given the large areas to identify and limited sample points, the authors of the above sources had to infer boundaries, contacts, and other representations in some areas. Only through on site reconnaissance can we further detail and adjust information from the maps as they relate to each site. They are not (from our experience) accurate on a lot by lot basis in all cases. In this case, the Survey and the DNR geologic map concur with our field findings.

Project Description

We reviewed the proposed Carbcom LLC Commercial Site and understand the applicant plans to build standard pole style buildings with metal siding and roof incorporating slab-on-grad with associated asphalt drive and parking areas.

The soil investigation will also evaluate the feasibility of on site infiltration.

The parcel is accessed from the north side of SR-410.

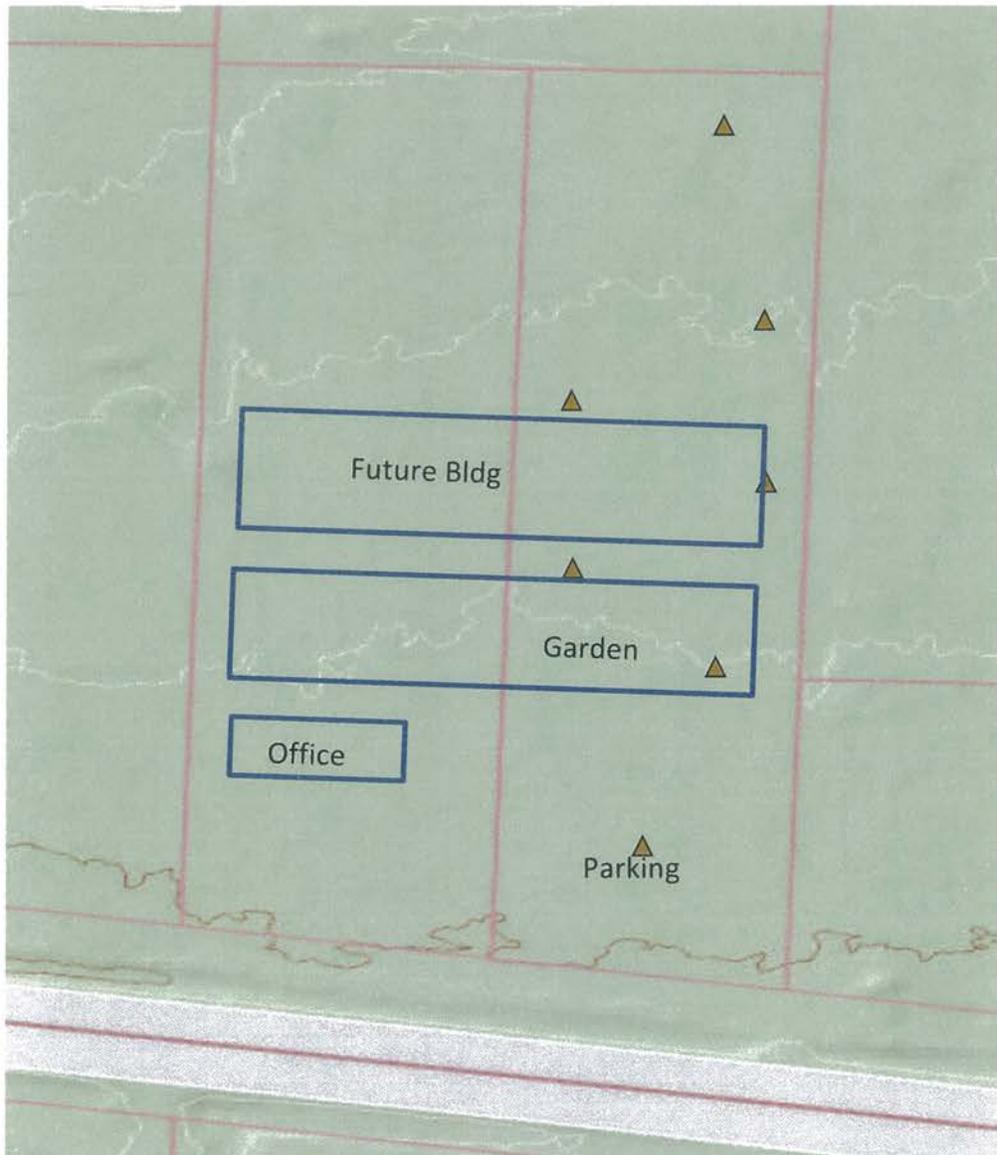
Site Description

The site is located on glacial uplands west of the Cascades and is dominated by more recent (5,600 yr) Ocoela Mud Flow. The textural characteristics of this mudflow are a gravelly sandy loam. On this property, we observed soils typical of the Buckley gravelly sandy loam, as reported by the NRCS.

The site is bounded by SR 410 East along the southern boundary, vacant lots to the east and west and single family residences to the north. The project area consists of an open field with close cropped grass free of trees and brush.

Grades across the site are very gentle, approaching approximately 1.0 percent; 5 feet of vertical relief occurs in the north-south direction descending from the southern boundary of the site toward the north property line.

Figure 1 –Approximate Test Pits (NTS)



Taken from – Pierce County GIS

Soil

As discussed in the 'Published Information Accuracy' section above; on-site reconnaissance is necessary to verify soil conditions on specific properties. The Survey identifies the soil types over the property as Buckley gravelly silt loam. The Survey limits interpretation of soil to the upper five feet of the earth; therefore soil profiles found at greater depth are not mapped. Through our test pit observations we were able to confirm the soil condition throughout the project site.

Buckley gravelly silt loam: This nearly level soil is poorly drained. It formed in the Osceola mudflow under coniferous and deciduous trees. Slopes mainly range from zero to two percent, but in places the slope is as much as four to five percent. Elevation ranges from 500 to 800 feet. The mean annual precipitation is about 50 inches, mean annual air temperature is about 50 degrees F, and the frost-free season average about 190 days.

Included with this soil in mapping are as much as 10 percent moderately well drained Alderwood soils on knolls and very poorly drained soils that formed in the decaying plant remains in depressions.

In a typical profile the surface layer is very dark brown, medium acid loam about 10 inches thick. The upper part of the subsoil is brown, medium acid, prominently mottled sandy loam and gravelly sandy loam about 28 inches thick. The lower part of the subsoil, to a depth of more than 60 inches, is grayish brown, slightly acid gravelly sandy clay loam.

Permeability is slow. The available water capacity is high. Surface runoff is very slow, and there is no erosion hazard. Very few roots penetrate the lower part of the firm subsoil.

The poor drainage limits this soil to water-tolerant trees, such as western redcedar and western hemlock. Red alder grows well and is suited to intensive management. The high water table remains close to the surface throughout the rainy season. Logging roads constructed on this soil require additional gravel and suitable drainage; otherwise, the movement of equipment is restricted to the very dry season. Hand planting of Douglas-fir is difficult and the survival rate is very low because of the saturated soil condition.

Residential development on this soil is centered mainly in and around the town of Buckley. The primary limitation for development is the high water table in winter and spring. Community sewerage systems must be used because septic tank drainage fields do not function properly during the rainy season.

Geology

The published (DNR) surficial geologic map and section of the Lake Tapps Quadrangle, Washington, 1956, describe the surficial geology as Osceola Mudflow. This suggests the geology would be characterized by an unsorted mixture of andesitic rock fragments in clayey sand matrix. This characterization generally agrees with the on-site reconnaissance and sub-surface exploration which reveal the surficial geology is characterized by gravelly sand with silt.

Site Development Considerations

General

Based on our field explorations, observations, research, and analyses, it is our opinion the area proposed for development is stable in its current setting. Our site development considerations are based, in part, on our interpretations and assumptions regarding site conditions; therefore, if variations in site conditions are observed at a later time, we may need to modify this report to reflect those changes.

Erosion Control

Before new construction begins, an appropriate erosion control system should be installed. This system should collect and filter all surface run off through either silt fencing or a series of properly placed and secured straw bales. If silt fencing is selected as a filter, this fencing fabric should meet the requirements of WSDOT Standard Specification 9-33.2 Table 3.

In addition, silt fencing should embed a minimum of 6 inches below existing grade.

If straw bailing is used as a filter, bales should be secured to the ground so that they will not shift under the weight of retained water. Regardless of the silt filter selected, an erosion control system requires occasional observation and maintenance. Specifically, holes in the filter and areas where the filter has shifted above ground surface should be replaced or repaired as soon as they are identified.

Temporary Drainage

We recommend intercepting and diverting any potential sources of surface or near-surface water within the construction zones before stripping begins. Because the selection of an appropriate drainage system will depend on the water quantity, season, weather conditions, construction sequence, and contractor's methods, final decisions regarding drainage systems are best made in the field at the time of construction. Based on our current understanding of the construction sketch, surface and subsurface conditions we anticipate silt fencing around the perimeter of the site should adequately contain surface runoff.

Clearing and Stripping

After surface and near-surface water sources have been controlled, the construction areas should be cleared and stripped of all duff and topsoil. Stripping is best performed during a period of dry weather. We anticipate 6 to 10 inches of black loam will be removed across the property.

Subgrade Compaction

Exposed subgrades for foundations and floors should be compacted to a firm, unyielding state before new concrete or fill soils are placed. Any localized zones of loose granular soils observed within a subgrade should be compacted to a density commensurate with the surrounding soils. In contrast, any organic, soft, or pumping soils observed within a subgrade should be over excavated and replaced with a suitable structural fill material.

Site Filling

Our conclusions regarding the reuse of on-site soils and our comments regarding wet-weather filling are presented subsequently. Regardless of soil type, all fill should be placed and

compacted according to our recommendations presented in the Structural Fill section of this letter. Specifically, building pad fill soil should be compacted to a uniform density of at least 95 percent (based on ASTM: D-1557).

It is our opinion that the Buckley gravelly silt loam is unsuitable as a structural fill due to the high content of silt in the soil matrix. The native soils should be removed from load bearing areas and used in non-structural areas, such as landscaping, or disposed of off-site. These soils may be used in parking and drive areas if the material is first dried and the moisture content can be controlled such that during material placement the compaction effort is able to achieve a uniform density of at least 95 percent (based on ASTM: D-1557). A suitable granular fill (pit run) from an approved source meeting the requirements of structural fill should then be imported and placed in such a manner that it conforms to the requirements in the Structural Fill section of this letter.

Mat Foundation

We understand based on conversations with representatives of Carbcom Properties, Inc. it is the intent of the owners to utilize a mat style slab-on-grad foundation for construction of the facilities. In our opinion a mat style slab foundation will provide adequate support if constructed according to manufacturer's recommendations.

Pole Buildings

Vertical support structures should be embedded per the manufacturer's recommendations. Excavations deeper than 30 inches can expect groundwater seepage into hole.

Bearing Subgrades: Slab-On-Grade foundations should bear on properly compacted structural fill, which bears on undisturbed native soils that have been stripped of surficial organic soils. In general, before foundation concrete is placed, any localized zones of loose soils exposed across the foundation subgrades should be compacted to a firm, unyielding condition, and any localized zones of soft, organic, or debris-laden soils should be over-excavated and replaced with suitable structural fill.

Subgrade Observation: All foundation subgrades should consist of firm, unyielding, structural fill materials compacted to a density of at least 95 percent (based on ASTM: D-1557). Prior to placement of structural fill; the subgrade should be proof-rolled to identify areas of pumping subgrade which should then be compacted to a medium dense, or denser condition. Foundations should never be cast atop loose, soft, or frozen soil, slough, debris, existing uncontrolled fill, or surfaces covered by standing water.

Bearing Pressures: In our opinion, for static loading, foundations that bear on properly prepared subgrades can be designed for a maximum allowable soil bearing pressure of 1,500 pounds per square foot (psf). A one-third increase in allowable soil bearing capacity may be used for short-term loads created by seismic or wind related activities.

Floor Subbase: Structural fill subbases should be used under soil-supported slab-on-grade floors at the site. However, the final decision regarding the need for subbases should be based on actual subgrade conditions observed at the time of construction. If a subbase is needed, all subbase fill should be compacted to a density of at least 95 percent (based on ASTM: D-1557).

Drainage Systems

We offer the following recommendations and comments for drainage design and construction purposes.

Perimeter Drains: We recommend that buildings be encircled with a perimeter drain system to collect seepage water where shallow ground water is encountered. This drain should consist of a 4-inch-diameter perforated pipe within an envelope of pea gravel or washed rock, extending at least 6 inches on all sides of the pipe, and the gravel envelope should be wrapped with filter fabric to reduce the migration of fines from the surrounding soils. Ideally, the drain invert would be installed no more than 8 inches above the base of the perimeter foundations.

Discharge Considerations: If possible, all perimeter drains should discharge to a storm water control system or other suitable location by gravity flow.

Runoff Water: Roof-runoff and surface-runoff water should not discharge into the perimeter drain system. Instead, these sources should discharge into separate tight line pipes and be routed away from the building to a storm drain or other appropriate location.

Grading and Capping: Final site grades should slope downward away from the buildings so that runoff water will flow by gravity to suitable collection points, rather than ponding near the building. Ideally, the area surrounding the building would be capped with concrete, asphalt, or low-permeability (silty) soils to minimize or preclude surface-water infiltration.

Structural Fill

The term "structural fill" refers to any soil placed under, retaining walls, slab-on-grade floors, sidewalks, pavements, and other structures. Our comments, conclusions, and recommendations concerning structural fill are presented in the following paragraphs.

On-Site Soils:

We offer the following evaluation of on-site soils in relation to potential use as structural fill:

- Buckley Gravelly Silty Loam: As mentioned previously, due to the high silt content, the native soils are not considered suitable as structural fill material.
- Surficial Organic Soils: The duff and topsoil mantling the site are not suitable for use as structural fill under any circumstances, due to their high organic content. Consequently, these materials can be used only for non-structural purposes, such as in landscaping areas.

Materials: Typical structural fill materials include clean sand, gravel, pea gravel, washed rock, crushed rock, well-graded mixtures of sand and gravel (commonly called "gravel borrow" or "pit-run"), and miscellaneous mixtures of silt, sand, and gravel. Recycled asphalt, concrete, and glass, which are derived from pulverizing the parent materials, are also potentially useful as structural fill in certain applications. Soils used for structural fill should not contain any organic matter or debris, or any individual particles greater than about 6 inches in diameter.

Fill Placement: Clean sand, gravel, crushed rock, soil mixtures, and recycled materials should be placed in horizontal lifts not exceeding 8 inches in loose thickness, and each lift should be thoroughly compacted with a mechanical compactor.

Compaction Criteria: Using the Modified Proctor test (ASTM: D-1557) as a standard, we recommend that structural fill used for various on-site applications be compacted to the following minimum densities:

<u>Fill Application</u>	<u>Minimum Compaction</u>
Foundation subgrade and bearing pad	95 percent
Foundation backfill	90 percent
Slab-on-grade floor subgrade and subbase	95 percent

Subgrade Observation and Compaction Testing: Regardless of material or location, all structural fill should be placed over firm, unyielding subgrades prepared in accordance with the Site Preparation section of this report. The condition of all subgrades should be observed by geotechnical personnel before filling or construction begins. Also, fill soil compaction should be verified by means of in-place density tests performed during fill placement so that adequacy of soil compaction efforts may be evaluated as earthwork progresses.

Soil Moisture Considerations: The suitability of soils used for structural fill depends primarily on their grain-size distribution and moisture content when they are placed. As the "fines" content (that soil fraction passing the U.S. No. 200 Sieve) increases, soils become more sensitive to small changes in moisture content. Soils containing more than about 5 percent fines (by weight) cannot be consistently compacted to a firm, unyielding condition when the moisture content is more than 2 percentage points above or below optimum. For fill placement during wet-weather site work, we recommend using "clean" fill, which refers to soils that have a fines content of 5 percent or less (by weight) based on the soil fraction passing the U.S. No. 4 Sieve.

Storm Water Control

Due to the near surface water table and the poor infiltrative properties of the Buckley gravelly silty loam, infiltration into the native soils is not recommended. Porous paving of the drive and parking areas may be used only if free draining gravel is placed over the native soils to provide storage for stormwater runoff. In conjunction with porous paving, we recommend the use of a stormwater facility (storm pond) to capture and treat runoff prior to release to the natural drainage corridor.

Based on our understanding of the Osceola Mudflow deposition, and it's detrimental impacted to forested areas in the vicinity of the lahar, it is our opinion that modeling of the project site to reflect a forested condition prior to development does not accurately reflect the vegetative history of the site over the past 5,600 years. This region of the mudflow has not historically possessed a vegetative nature consistent with a forested condition since the time of deposition.

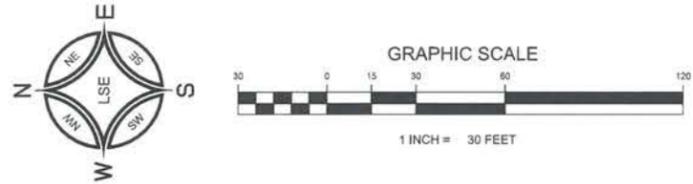
Closure

The conclusions and recommendations presented in this evaluation are based, in part, on our site explorations, research, existing mapping and reports at the time; therefore, variations in the subgrade conditions may be discovered. Future performance and integrity of site

development depends largely on proper initial site preparation, drainage, and construction procedures. Monitoring and testing by experienced geotechnical professional should be considered an integral part of the planning, development and construction process. LS&E is available to provide geotechnical monitoring of soils throughout construction.

Appendix D

Civil Design Construction Plans

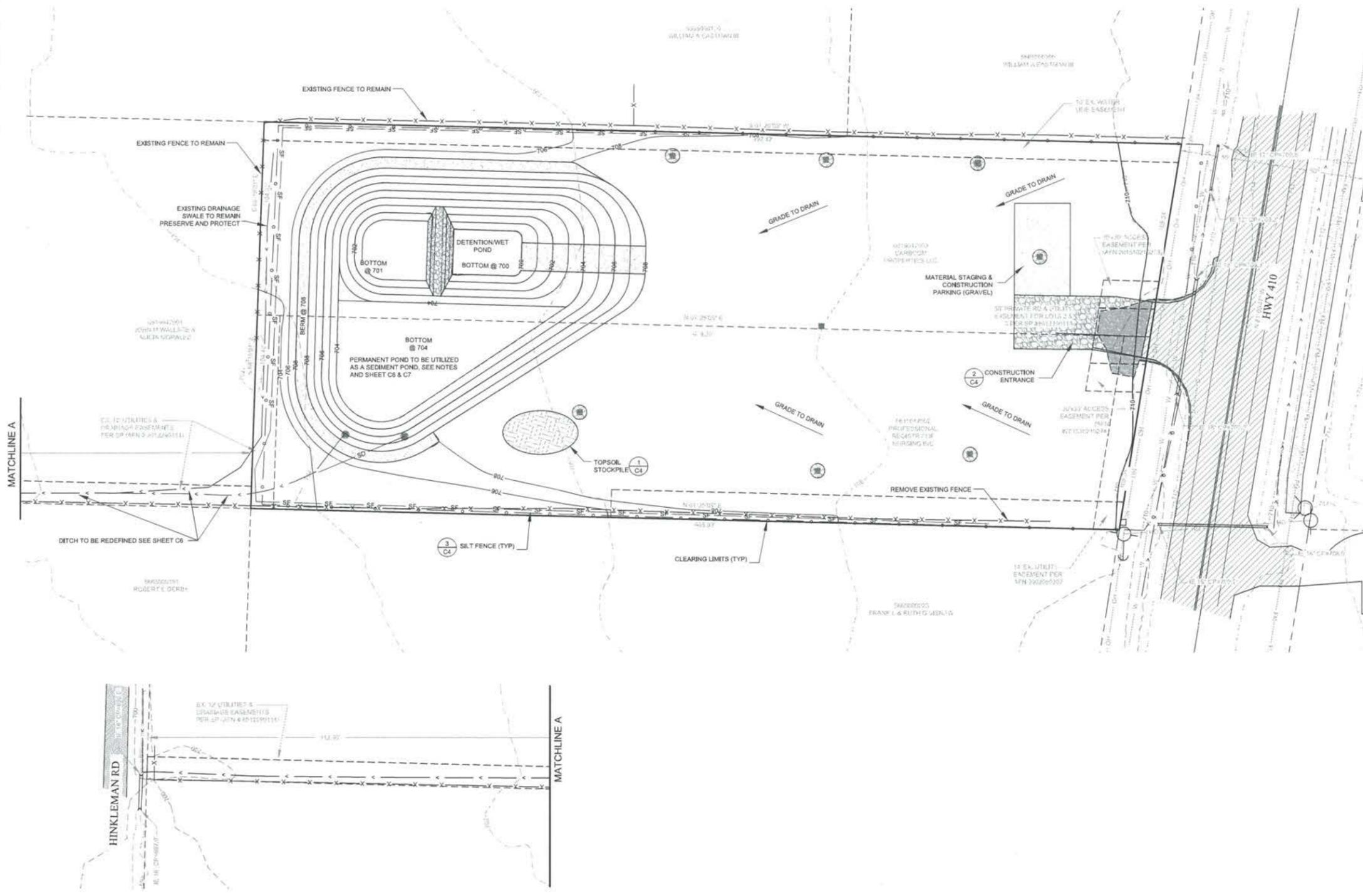


CARBCOM PROPERTIES COMMERCIAL SITE

A PORTION OF THE SE ¼ OF THE SW ¼ OF SECTION 4, TOWNSHIP 19 N, RANGE 06 E, W.M.
BUCKLEY, WASHINGTON

- ESC LEGEND**
- o — CLEARING LIMITS
 - SF — SILT FENCE (2/4)
 - ▨ CONSTRUCTION ENTRANCE (3/4)
 - TOPSOIL STOCKPILE (1/4)
 - ⊙ INLET PROTECTION (4/4)
 - ▲ SOIL LOG

- NOTES:**
- SEE SWPPP NOTES AND DETAILS ON SHEETS C3 AND C4.
 - INSTALL SILT FENCE AS SHOWN.
 - INSTALL CONSTRUCTION ENTRANCE AS SHOWN.
 - GRADE DETENTION POND FOR USE AS A SEDIMENT TRAP. MINIMUM 3.5 FEET DEEP WITH OVERFLOW TO DITCH BY WAY OF THE OVERFLOW STRUCTURE SHOWN ON SHEET C7.
- CONSTRUCTION SEQUENCE:**
- CONTACT THE CITY OF BUCKLEY AT 360-820-1821 TO SET UP PRE-CONSTRUCTION MEETING- ATTEND PRE-CONSTRUCTION MEETING.
 - FLAG LIMITS OF CLEARING AND GRADING IN THE CONSTRUCTION AREA PER APPROVED PLANS.
 - INSTALL TEMPORARY CONSTRUCTION ENTRANCE AND OTHER EROSION CONTROL MEASURES AS PER THE APPROVED PLANS.
 - CALL THE CITY OF BUCKLEY FOR INSPECTION NO. 1. INSTALLATION OF EROSION CONTROL FACILITIES PRIOR TO CLEARING.
 - MARK LOCATIONS WHERE PERMANENT STORM FACILITIES ARE TO BE CONSTRUCTED.
 - CLEAR SITE. RETAIN DUFF LAYER (STRIPPINGS), AND NATURAL VEGETATION IN AN UNDISTURBED STATE TO THE MAXIMUM DEGREE PRACTICAL. IF IT IS NOT PRACTICAL TO RETAIN IN-PLACE, THEN STOCKPILE THE STRIPPINGS ON-SITE. COVER TO PREVENT EROSION AND SAVE FOR REPLACEMENT.
 - CALL THE CITY OF BUCKLEY FOR INSPECTION NO. 2. COMPLETION OF CLEARING.
 - STABILIZE EXPOSED AND UNWORKED SOILS WITH TEMPORARY OR PERMANENT SEEDING OR OTHER MEASURE AS NECESSARY TO ASSURE COMPLIANCE WITH PERMIT CONDITIONS.
 - MAINTAIN AND REPAIR ALL TEMPORARY AND PERMANENT EROSION AND SEDIMENT CONTROL BMPS AS NECESSARY DURING CONSTRUCTION PHASE TO ASSURE CONTINUED PERFORMANCE OF THEIR INTENDED FUNCTION IN ACCORDANCE WITH BMP SPECIFICATIONS.
 - PROTECT ADJACENT PROPERTIES AND PUBLIC ROAD FROM SEDIMENT RUNOFF. IF SEDIMENT IS TRANSPORTED ONTO THE PAVED SURFACE, THEN THE ROAD SHALL BE CLEANED THOROUGHLY AT THE END OF EACH DAY.
 - MASS GRADE AND CONSTRUCT THE STORMWATER POND IN ACCORDANCE WITH THE APPROVED PLANS AND UTILIZE FOR EROSION CONTROL.
 - INSTALL THE STORMWATER CONVEYANCE SYSTEM IN ACCORDANCE WITH THE APPROVED PLANS.
 - CALL THE CITY OF BUCKLEY FOR INSPECTION NO. 3. UPON COMPLETION OF EXCAVATION, FILLING AND EARTHWORK.
 - CONSTRUCT POTABLE WATER SERVICE MAIN EXTENSION AND HYDRANTS ALONG WITH THE INDIVIDUAL WATER SERVICE.
 - OBTAIN NECESSARY PERMITS FROM WSDOT FOR BORING THE SEWER SYSTEM UNDERNEATH HIGHWAY 410 AND CONNECT TO THE EXISTING FORCE MAIN.
 - CONSTRUCT DRY UTILITIES.
 - PREPARE BUILDING PAD AREAS TO RECEIVE PROPOSED STRUCTURES.
 - CONSTRUCT STRUCTURES.
 - CONSTRUCT PARKING AREA AND SIDEWALK ALONG FRONTAGE.
 - PROVIDE SOIL AMENDMENTS PRIOR TO INSTALLATION OF LANDSCAPING.
 - PROVIDE LANDSCAPING PER APPROVED PLANS.
 - MAINTAIN EROSION CONTROL FACILITIES DURING CONSTRUCTION PHASE AND AMEND AS NECESSARY TO MAINTAIN SITE IN COMPLIANCE WITH PERMIT CONDITIONS.
 - CALL THE CITY OF BUCKLEY FOR INSPECTION NO. 4. COMPLETION OF PROJECT.
 - CALL THE CITY OF BUCKLEY FOR INSPECTION NO. 5. AS NEEDED, TO DETERMINE COMPLIANCE WITH APPROVED PLANS AND/OR SPECIFICATIONS.



DATE:	
DESIGNED BY:	ROBINSON
CHECKED BY:	STH
APPROVED BY:	STH

DATE:	04/04/2016
DESIGNED BY:	ROBINSON
CHECKED BY:	STH
APPROVED BY:	STH

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S.W.P.P.P. Plan

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CARBCOM PROPERTIES
12900 PACIFIC HWY SW
LACEWING, WA 98599
Phone: 253-431-6188

BEFORE ANY CONSTRUCTION CONTACT:
CALL BEFORE YOU DIG @ 1-800-424-5555

APPROVED FOR CONSTRUCTION

DATE: _____

CITY OF BUCKLEY, CITY ENGINEER

THESE DRAWINGS ARE APPROVED FOR CONSTRUCTION FOR A PERIOD OF 12 MONTHS FROM THE DATE SHOWN HEREON. THE CITY RESERVES THE RIGHT TO MAKE MODIFICATIONS SHOULD THE CONSTRUCTION BE DELAYED BEYOND THIS TIME LIMIT. THE CITY, BY APPROVING THESE DOCUMENTS, IN NO WAY WARRANTS THEIR ACCURACY OR ACKNOWLEDGES ANY OMISSIONS.

DRAWING

C3

SHEET 03
OF 09

K:\Users\jstevens\OneDrive\Documents\10337\CARCOM - LAST EDITION - 04/04/16.dwg - 10:41:58 AM - BTJ

CARBCOM PROPERTIES COMMERCIAL SITE

A PORTION OF THE SE ¼ OF THE SW ¼ OF SECTION 4, TOWNSHIP 19 N, RANGE 06 E, W.M. BUCKLEY, WASHINGTON

2005 DOE STORMWATER MANUAL BMP C125 TOPSOILING:

NATIVE SOILS SHOULD BE LEFT UNDISTURBED TO THE MAXIMUM EXTENT PRACTICABLE. NATIVE SOILS DISTURBED DURING THE CLEARING AND GRADING SHOULD BE RESTORED TO THE MAXIMUM EXTENT PRACTICABLE TO A CONDITION WHERE MOISTURE-HOLDING CAPACITY IS EQUAL TO OR BETTER THAN THE ORIGINAL SITE CONDITIONS. THE CRITERION CAN BE MET BY USING ON-SITE NATIVE TOPSOIL INCORPORATING AMENDMENTS INTO ON-SITE SOIL, OR IMPORTING BLENDED TOPSOIL.

SOIL AMENDMENT OPTION 1:

AMEND EXISTING SOILS IN PLACE

SCARIFY OR ROTOTILL EXISTING SUBGRADE TO 4 INCHES DEPTH (OR TO DEPTH NEEDED TO ACHIEVE A TOTAL DEPTH OF 12 INCHES OF UNCOMPACTED SOIL AFTER CALCULATED AMOUNT OF AMENDMENT IS ADDED. SEE SPECIFIC SUBSECTIONS BELOW). ENTIRE SURFACE SHOULD BE DISTURBED BY SCARIFICATION, DO NOT SCARIFY WITHIN DRIP LINE OF EXISTING TREES TO BE RETAINED.

WITHIN STORMWATER DRAINAGE SYSTEM LOCATIONS OR LANDSCAPED AREAS (10 PERCENT ORGANIC CONTENT) - PLACE AND ROTOTILL 3 INCHES OF COMPOSTED MATERIAL INTO 5 INCHES OF SOIL (A DEPTH OF ABOUT 9.5 INCHES, FOR A SETTLED DEPTH OF 8 INCHES). AS NOTED PREVIOUSLY, SUBSOILS BELOW THIS LAYER SHOULD BE SCARIFIED AT LEAST 4 INCHES. FOR A FINISHED MINIMUM DEPTH OF 12 INCHES OF UNCOMPACTED SOIL, RAKE BEDS TO SMOOTH AND REMOVE ROCKS LARGER THAN 2 INCHES IN DIAMETER, MULCH AREAS WITH 2 INCHES ORGANIC MULCH.

WITHIN LAWN AREAS (5 PERCENT ORGANIC CONTENT) - PLACE AND ROTOTILL 1.75 INCHES OF COMPOSTED MATERIAL INTO 6.25 INCHES OF SOIL (A TOTAL AMENDED DEPTH OF ABOUT 9.5 INCHES, FOR A SETTLED DEPTH OF 8 INCHES). SUBSOILS BELOW THIS LAYER SHOULD BE SCARIFIED AT LEAST 4 INCHES. FOR A FINISHED MINIMUM DEPTH OF 12 INCHES OF UNCOMPACTED SOIL, WATER OR ROLL TO COMPACT SOIL TO 85 PERCENT OF MAXIMUM. RAKE TO LEVEL, AND REMOVE SURFACE WOODY DEBRIS AND ROCKS LARGER THAN 1 INCH IN DIAMETER.

SOIL AMENDMENT OPTION 2:

STOCKPILE SITE TOPSOILS PRIOR TO GRADING FOR REAPPLICATION

IF PLACED TOPSOIL PLUS COMPOST OR OTHER ORGANIC MATERIAL WILL AMOUNT TO LESS THAN 12 INCHES: SCARIFY OR ROTOTILL SUBGRADE TO DEPTH NEEDED TO ACHIEVE 12 INCHES OF LOOSENEED 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.

WITHIN STORMWATER DRAINAGE SYSTEM LOCATIONS OR LANDSCAPED AREAS (10 PERCENT ORGANIC CONTENT) - PLACE AND ROTOTILL 3 INCHES OF COMPOSTED MATERIAL INTO 5 INCHES OF REPLACED SOIL (A TOTAL OF ABOUT 9.5 INCHES, FOR A SETTLED DEPTH OF 8 INCHES). SUBSOILS BELOW THIS LAYER SHOULD BE SCARIFIED AT LEAST 4 INCHES. FOR A FINISHED MINIMUM DEPTH OF UNCOMPACTED SOIL, RAKE BEDS TO SMOOTH AND REMOVE ROCKS LARGER THAN 2 INCHES IN DIAMETER, MULCH AREAS WITH 2 INCHES OF ORGANIC MULCH OR STOCKPILED DUFF.

WITHIN LAWN AREAS (5 PERCENT ORGANIC CONTENT) - PLACE AND ROTOTILL 1.75 INCHES OF COMPOSTED MATERIAL INTO 6.25 INCHES OF REPLACED SOIL (A TOTAL AMENDED DEPTH OF ABOUT 9.5 INCHES, FOR A SETTLED DEPTH OF 8 INCHES). SUBSOILS BELOW THIS LAYER SHOULD BE SCARIFIED AT LEAST 4 INCHES. FOR A FINISHED MINIMUM DEPTH OF 12 INCHES OF UNCOMPACTED SOIL, WATER OR ROLL TO COMPACT TO 85 PERCENT OF MAXIMUM, RAKE TO LEVEL, AND REMOVE SURFACE OF WOODY DEBRIS AND ROCKS LARGER THAN 1 INCH IN DIAMETER.

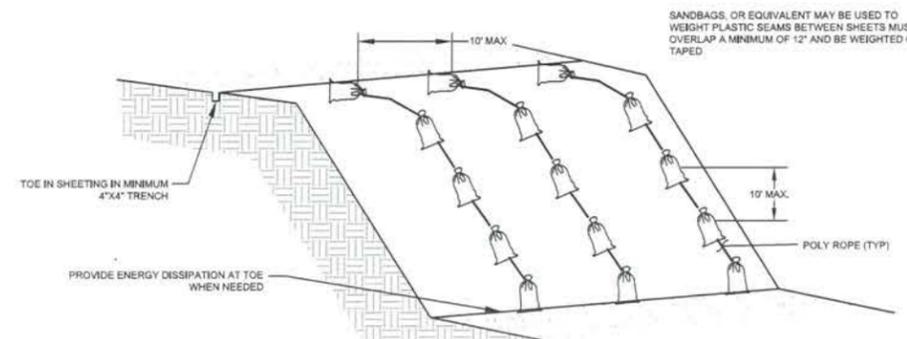
SOIL AMENDMENT OPTION 3:

IMPORT TOPSOIL MEETING ORGANIC MATTER CONTENT STANDARDS

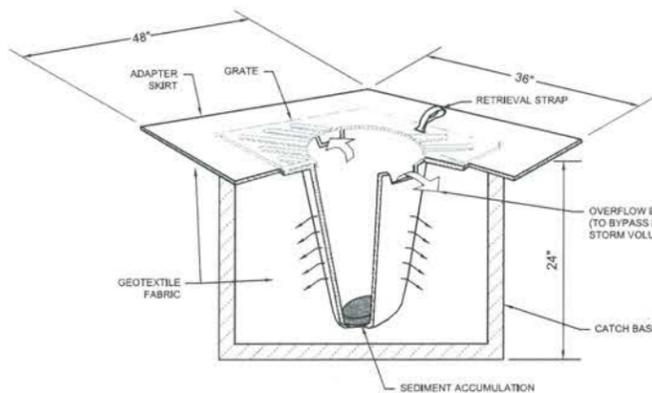
SCARIFY OR ROTOTILL SUBGRADE IN TWO DIFFERENT DIRECTIONS TO 8 INCHES DEPTH. ENTIRE SURFACE SHOULD BE DISTURBED BY SCARIFICATION. DO NOT SCARIFY WITHIN DRIP LINE OF EXISTING TREES TO BE RETAINED.

WITHIN STORMWATER DRAINAGE SYSTEM LOCATIONS OR LANDSCAPED AREAS (10 PERCENT ORGANIC CONTENT) - USE IMPORTED TOPSOIL MIX CONTAINING 10 PERCENT ORGANIC MATTER (TYPICALLY AROUND 40 PERCENT COMPOST). SOIL PORTION MUST BE SAND OR SANDY LOAM AS DEFINED BY THE USDA. PLACE 3 INCHES OF IMPORTED SOIL MIX ON SURFACE AND TILL INTO 2 INCHES OF SOIL. PLACE 3 INCHES OF TOPSOIL MIX ON THE SURFACE, RAKE SMOOTH AND REMOVE SURFACE ROCKS OVER 2 INCHES IN DIAMETER, MULCH PLANTING BEDS WITH 2 INCHES OF ORGANIC MULCH.

WITHIN LAWN AREAS (5 PERCENT ORGANIC CONTENT) - USE IMPORTED TOPSOIL MIX CONTAINING 5 PERCENT ORGANIC MATTER (TYPICALLY AROUND 25 PERCENT COMPOST). SOIL PORTION MUST BE SAND OR SANDY LOAM AS DEFINED BY THE USDA. PLACE 3 INCHES OF IMPORTED TOPSOIL MIX ON THE SURFACE AND TILL INTO 2 INCHES OF SOIL. WATER OR ROLL TO COMPACT SOIL TO 85 PERCENT MAXIMUM. RAKE TO LEVEL, AND REMOVE SURFACE ROCKS LARGER THAN 1 INCH IN DIAMETER.



1 TOPSOIL STOCKPILE DETAIL
SCALE: NTS



NOTE: FILTERS SHALL BE INSPECTED AFTER EACH STORM EVENT AND CLEANED OR REPLACED WHEN 1/3 FULL.

4 INLET PROTECTION
SCALE: NTS

NOTE: PROJECT WILL BE UTILIZING THE STORM DETENTION POND FOR TRAPPING SEDIMENT. THE CONTROL STRUCTURE WILL BE UTILIZED FOR OUTFLOW.

5 SEDIMENT TRAP
SCALE: NTS

COMPOST QUALITY:

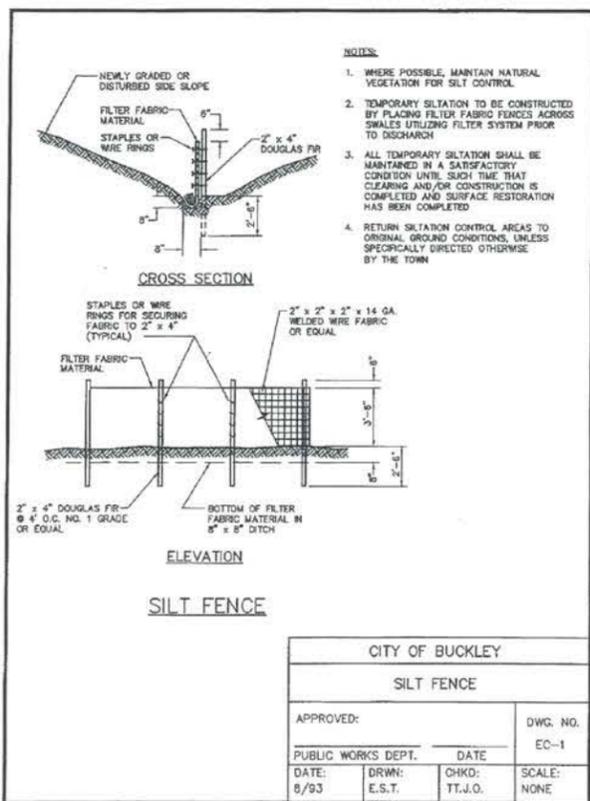
COMPOST SHALL BE PREPARED BY THE CONTROLLED DECOMPOSITION OF ORGANIC MATERIALS. ACCEPTABLE FEEDSTOCKS INCLUDE, BUT ARE NOT LIMITED TO, YARD DEBRIS, WOOD WASTE, LAND-CLEARING DEBRIS, BRUSH, BRANCHES, MANURE, BIOSOLIDS, FOOD RESIDUALS, AND FOREST BYPRODUCTS. THE PRODUCT SHALL HAVE A UNIFORM DARK, SOIL-LIKE APPEARANCE AND AN EARTHY LOAM-LIKE COLOR, NO AMMONIA OR PUTRID SMELLS SHALL BE PRESENT. MINIMUM ORGANIC MATTER SHALL BE 35 PERCENT (DRY-WEIGHT BASIS). PARTICLES SHALL BE 100 PERCENT PASSING THROUGH THE 1 INCH SIEVE. PH RANGE SHALL BE BETWEEN 6.0 AND 8.5 FOR WETLANDS AND STREAMSIDE LOCATIONS, AND 6.0 AND 8.0 FOR OTHER LOCATIONS. FOREIGN MATERIAL SHALL BE NO MORE THAN 2 PERCENT ON A DRY-WEIGHT OR VOLUME BASIS, WHICHEVER PROVIDES THE LEAST FOREIGN MATERIAL. MATERIAL SHALL COME FROM A SOURCE THAT IS PERMITTED BY (OR EXEMPT FROM) TACOMA-PIERCE COUNTY HEALTH DEPARTMENT (TPCHD) RULES.

COMPOST FOR THE APPROVED RATES LISTED ABOVE MUST BE CLASS A COMPOST PER WASHINGTON STATE DEPARTMENT OF ECOLOGY (ECOLGY) INTERIM COMPOST QUALITY GUIDELINES ("COMPOSTED MATERIALS" DEFINED IN WASHINGTON ADMINISTRATIVE CODE (WAC) CHAPTER 173-350 SECTION 220) OR TOPSOIL MANUFACTURED FROM THESE COMPOSTS PLUS SAND OR SANDY SOIL. PRODUCTS SHOULD BE IDENTIFIED ON THE SITE DEVELOPMENT PLANS AND RECENT PRODUCT TEST SHEETS PROVIDED SHOWING THAT THEY MEET ADDITIONAL REQUIREMENTS FOR ORGANIC MATTER CONTENT AND A CARBON TO NITROGEN RATION BELOW 25:1. THE CARBON TO NITROGEN RATIO MAY BE AS HIGH AS 35:1 FOR PLANTINGS COMPOSED ENTIRELY OF PLANTS ENTIRELY OF PLANTS NATIVE TO THE PUGET SOUND LOWLANDS REGION.

-UTILIZE ALTERNATIVES TO STRAW MULCH, SUCH AS COMPOSTED MULCH OR WOOD-BASED MULCH, FOR CONSTRUCTION EROSION AND SEDIMENT CONTROL.

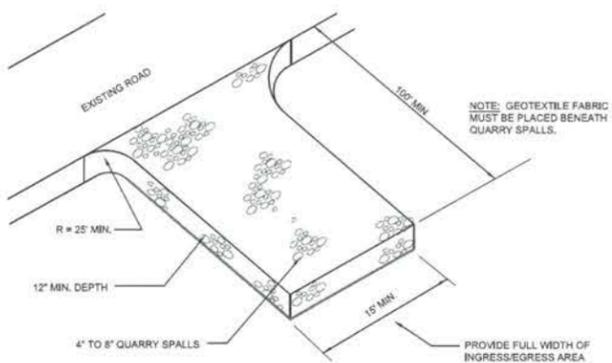
-APPLY COMPOST ON SLOPES INSTEAD OF HYDROMULCH.

-SOILS AMENDMENTS SHOULD BE INSTALLED POST-CONSTRUCTION, PRIOR TO INSTALLATION OF LANDSCAPING AND TURF, UNLESS USED AS A STEP IN THE LOT PREPARATION PROCESS INVOLVING MINIMAL EXCAVATION FOUNDATION SYSTEM.



- NOTES:
- WHERE POSSIBLE, MAINTAIN NATURAL VEGETATION FOR SILT CONTROL.
 - TEMPORARY SILTATION TO BE CONSTRUCTED BY PLACING FILTER FABRIC FENCES ACROSS SLOPES UTILIZING FILTER FABRIC SYSTEM PRIOR TO DISCHARGE.
 - ALL TEMPORARY SILTATION SHALL BE MAINTAINED IN A SATISFACTORY CONDITION UNTIL SUCH TIME THAT CLEARING AND/OR CONSTRUCTION IS COMPLETED AND SURFACE RESTORATION HAS BEEN COMPLETED.
 - RETURN SILTATION CONTROL AREAS TO ORIGINAL GROUND CONDITIONS, UNLESS SPECIFICALLY DIRECTED OTHERWISE BY THE TOWN.

CITY OF BUCKLEY			
SILT FENCE			
APPROVED:	DATE:	CHKD:	DWG. NO.
PUBLIC WORKS DEPT.	8/93	E.S.T.	EC-1
DATE:	DRWN:	TT.J.O.	SCALE:
8/93	E.S.T.	TT.J.O.	NONE



2 CONSTRUCTION ENTRANCE ROCK PAD
SCALE: NTS

3 SILT FENCE DETAIL
SCALE: NTS

APPROVED FOR CONSTRUCTION

DATE: _____

CITY OF BUCKLEY, CITY ENGINEER
THESE DRAWINGS ARE APPROVED FOR CONSTRUCTION FOR A PERIOD OF 12 MONTHS FROM THE DATE SHOWN HEREON. THE CITY RESERVES THE RIGHT TO MAKE MODIFICATIONS SHOULD THE CONSTRUCTION BE DELAYED BEYOND THIS TIME LIMIT. THE CITY, BY APPROVING THESE DOCUMENTS, IN NO WAY WARRANTS THEIR ACCURACY OR ACKNOWLEDGES ANY OMISSIONS.



DATE:	10/27/03
DESIGNED BY:	KOOSHTIN
CHECKED BY:	STH
APPROVED BY:	STH

DATE: 10/27/03
DESIGNED BY: KOOSHTIN
CHECKED BY: STH
APPROVED BY: STH

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LEROIY SURVEYORS & ENGINEERS
P.O. Box 740, Puyallup, Washington 98371
(253) 848-6606 Fax: (253) 840-4140
www.leroyinc.com

S.W.P.P. Notes & Details

CARBCOM PROPERTIES COMMERCIAL SITE
CARBCOM PROPERTIES
12900 PACIFIC HWY SW
LACKLAND, WA 98499
Phone: 253-431-6188

DRAWING
C4
SHEET 04
OF 09

CARBCOM PROPERTIES COMMERCIAL SITE

A PORTION OF THE SE ¼ OF THE SW ¼ OF SECTION 4, TOWNSHIP 19 N, RANGE 06 E, W.M. BUCKLEY, WASHINGTON



GENERAL NOTES:

- ALL MATERIALS AND WORKMANSHIP IN THE RIGHT-OF-WAY SHALL BE IN ACCORDANCE WITH THE REQUIREMENTS OF THE LATEST STATE OF WASHINGTON DEPARTMENT OF TRANSPORTATION STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION AND THE CITY OF BUCKLEY PUBLIC ROAD STANDARDS AND EMERGENCY VEHICLE ACCESS STANDARDS.
- IT WILL BE THE APPLICANT'S OR HIS AGENT'S RESPONSIBILITY TO CONTACT ALL UTILITY COMPANIES TO COORDINATE CONSTRUCTION. ALL UTILITY RELOCATION WORK SHALL BE AT THE EXPENSE OF THE APPLICANT AND MUST BE IN ACCORDANCE WITH THE STANDARDS OF THE CITY.
- BURIED UTILITIES ARE SHOWN IN THEIR APPROXIMATE LOCATION. THE APPLICANT OR HIS CONTRACTOR SHALL HAVE THE UTILITIES VERIFIED ON THE GROUND PRIOR TO ANY CONSTRUCTION.
- ANY REVISIONS TO THESE PLANS MUST BE REVIEWED AND APPROVED BY THE CITY OF BUCKLEY PUBLIC WORKS PRIOR TO ANY IMPLEMENTATION IN THE FIELD.
- BEFORE WORKING IN THE COUNTY RIGHT-OF-WAY, THE APPLICANT SHALL:
 - OBTAIN A GENERAL PERMIT FROM THE CITY.
 - SUBMIT A FINANCIAL GUARANTEE TO THE CITY TO ASSURE SATISFACTORY COMPLETION OF THE WORK.
 - PROVIDE PROOF OF LIABILITY INSURANCE IN AN AMOUNT REQUIRED BY THE CITY.
- THE CONTRACTOR SHALL NOTIFY THE APPLICANT'S ENGINEER IN THE EVENT OF DISCOVERY OF POOR SOILS, STANDING GROUND WATER, OR SEVERE DISCREPANCIES FROM SOIL LOG DESCRIPTIONS AS NOTED ON THESE PLANS.
- EXCAVATION STANDARDS

CUT SLOPES	
SLOPES SHALL NOT BE STEEPER THAN 2 HORIZONTAL TO 1 VERTICAL, OR AS RECOMMENDED BY A SOILS ENGINEER. THE CATCH POINT OF THE TOP OF THE SLOPE SHALL BE SET BACK FROM THE SITE BOUNDARY LINE IN ACCORDANCE WITH THE FOLLOWING TABLE, UNLESS A RETAINING WALL IS DESIGNED BY THE ENGINEER AND CONSTRUCTED FOR THE PROJECT.	SET BACK DISTANCE
UNDER 5 FEET	2 FEET
5 - 20 FEET	HEIGHT/2
OVER 20 FEET	10 FEET
- FILL STANDARDS

FILL LOCATION	
SLOPES SHALL NOT BE STEEPER THAN 2 HORIZONTAL TO 1 VERTICAL, OR AS RECOMMENDED BY A SOILS ENGINEER. FILL SITES MUST BE APPROVED BY THE ENGINEER AS SUITABLE LOCATIONS FOR THE PROPOSED FILL. THE TOE OR CATCH POINT OF FILL SLOPES SHALL BE SET BACK FROM THE SITE BOUNDARY LINE IN ACCORDANCE WITH THE FOLLOWING TABLE, UNLESS A RETAINING WALL IS DESIGNED BY THE ENGINEER AND CONSTRUCTED FOR THE PROJECT.	SET BACK DISTANCE
UNDER 5 FEET	2 FEET
5 - 40 FEET	HEIGHT/2
- PREPARATION OF GROUND

THE GROUND SURFACE FOR FILLS OVER TWO FEET IN HEIGHT SHALL BE PREPARED BY REMOVING VEGETATION, NON COMPLYING FILL, TOPSOIL, AND OTHER UNSUITABLE MATERIALS; SCARIFYING TO PROVIDE A BOND WITH THE NEW FILL; AND, WHERE EXISTING SLOPES ARE STEEPER THAN 5 HORIZONTAL TO 1 VERTICAL, BY BENCHING INTO COMPETENT MATERIAL AS DETERMINED BY THE ENGINEER. THE BENCH UNDER THE TOE OF A FILL ON A SLOPE STEEPER THAN 5 HORIZONTAL TO 1 VERTICAL SHALL BE AT LEAST 10 FEET WIDE, OR AS RECOMMENDED BY A SOILS ENGINEERS.
- THE CITY IS AUTHORIZED TO MAKE INSPECTIONS AND TAKE SUCH ACTIONS AS REQUIRED TO ENFORCE THESE REGULATIONS. THE CITY REPRESENTATIVE SHALL PRESENT PROPER CREDENTIALS AND MAKE A REASONABLE EFFORT TO CONTACT THE PROPERTY OWNER BEFORE ENTERING ONTO PRIVATE PROPERTY.
- SHOULD THE CITY BECOME AWARE OF CONDITIONS THAT INVALIDATE THE ORIGINAL DESIGN DATA USED TO OBTAIN THE PERMIT OR DETERMINE THAT THE APPLICANT IS NOT COMPLYING WITH THE CONDITIONS OF THE PERMIT OR APPROVED PLANS, THE CITY MAY REVOKE THE ORIGINAL PERMIT AND/OR ORDER WORK STOPPED ON THE PROJECT. THE CITY MAY REQUIRE THE APPLICANT TO RESUBMIT INFORMATION OR PLANS.

EROSION CONTROL NOTES:

- ON-SITE EROSION CONTROL MEASURES SHALL BE THE RESPONSIBILITY OF THE DEVELOPER. ANY PROBLEMS OCCURRING BEFORE FINAL ACCEPTANCE OF THE STORM SYSTEM BY THE MUNICIPALITY SHALL BE CORRECTED BY THE APPLICANT AND/OR THE CONTRACTOR.
- IN CASE EROSION OR SEDIMENTATION OCCURS TO ADJACENT PROPERTY, ALL CONSTRUCTION WORK WITHIN THE DEVELOPMENT THAT WILL AGGRAVATE THE SITUATION MUST CEASE AND THE APPLICANT/CONTRACTOR SHALL IMMEDIATELY COMMENCE RESTORATION OR MITIGATION MEASURES. RESTORATION ACTIVITY SHALL CONTINUE UNTIL SUCH TIME AS THE PROBLEM IS RECTIFIED.
- ALL EROSION AND SEDIMENTATION CONTROL DEVICES SHOWN ON THIS DRAWING SHALL BE INSTALLED PRIOR TO OR AS THE FIRST STAGE OF SITE PREPARATION.
- SHOULD THE TEMPORARY EROSION AND SEDIMENTATION CONTROL MEASURES AS SHOWN ON THIS DRAWING NOT PROVE ADEQUATE TO CONTROL EROSION AND SEDIMENTATION, THE APPLICANT/CONTRACTOR SHALL INSTALL ADDITIONAL FACILITIES AS NECESSARY TO PROTECT ADJACENT PROPERTIES, SENSITIVE AREAS, NATURAL WATER COURSES, AND/OR STORM DRAINAGE SYSTEMS.
- IN ANY AREA WHICH HAS BEEN STRIPPED OF VEGETATION OR EXPERIENCED LAND DISTURBING ACTIVITIES AND WHERE NO FURTHER WORK IS ANTICIPATED FOR A PERIOD EXCEEDING FIVE DAYS, ALL DISTURBED AREAS MUST BE IMMEDIATELY STABILIZED WITH MULCHING, GRASS PLANTING, OR OTHER APPROVED EROSION CONTROL TREATMENT APPLICABLE TO THE TIME OF YEAR IN QUESTION. GRASS SEEDING ALONE WILL BE ACCEPTABLE ONLY DURING THE MONTHS OF APRIL THROUGH SEPTEMBER, INCLUSIVE. SEEDING MAY PROCEED, HOWEVER, WHENEVER IT IS IN THE INTEREST OF THE APPLICANT/CONTRACTOR, BUT MUST BE AUGMENTED WITH MULCHING, NETTING, OR OTHER TREATMENT.
- THE PROJECT ENGINEER OR PROJECT SURVEYOR WILL BE RESPONSIBLE FOR FIELD LOCATING THE CLEARING LIMITS AND ESTABLISHING THOSE BOUNDARIES WITH BRIGHT COLORED FLAGGING, THE CONTRACTOR SHALL CLEAR TO THE LIMITS AS ESTABLISHED ON THIS PLAN AND AS FLAGGED IN THE FIELD.
- THE CITY SHALL BE RESPONSIBLE FOR THE INSPECTION AND ACCEPTANCE OF ALL CLEARING AND GRADING WORK AND EROSION AND SEDIMENTATION CONTROL FACILITIES. THE APPLICANT AND/OR CONTRACTOR SHALL NOTIFY THE CITY FORTY-EIGHT HOURS IN ADVANCE OF EACH REQUIRED EROSION AND SEDIMENT CONTROL INSPECTION.

INSPECTION NO. 1 -	INSTALLATION OF EROSION CONTROL FACILITIES/PRIOR TO CLEARING.
INSPECTION NO. 2 -	COMPLETION OF CLEARING.
INSPECTION NO. 3 -	UPON COMPLETION OF EXCAVATION, FILLING, AND EARTHWORK.
INSPECTION NO. 4 -	COMPLETION OF PROJECT.
INSPECTION NO. 5 -	AS NEEDED TO DETERMINE COMPLIANCE WITH APPROVED PLANS AND/OR SPECIFICATIONS. (DOES NOT REQUIRE ADVANCE NOTICE.)

ALL WORK ASSOCIATED WITH STABILIZING THE DISTURBED AREAS SHALL BE IN ACCORDANCE WITH THE CITY OF BUCKLEY STORMWATER REGULATIONS.
- ALL NECESSARY FACILITIES SHALL BE MAINTAINED ON SITE TO PREVENT DEBRIS, DUST, AND MUD FROM ACCUMULATING ON THE PUBLIC RIGHT-OF-WAY.

SEED MIXTURE FOR EROSION CONTROL

NAME:	% BY WEIGHT:	% PURITY:	%
REDTOP (AGROSTIS ALBA)	10 PERCENT	92 PERCENT	90 PERCENT
ANNUAL RYE (LOLIUM MULTIFLORUM)	40 PERCENT	98 PERCENT	90 PERCENT
CHEWING FESCUE (FESTUCA RUBRA COMMUTATA - JAMESTOWN, BANNER, SHADOW, OR KORBBET)	40 PERCENT	97 PERCENT	80 PERCENT
WHITE DUTCH CLOVER (TRIFOLIUM REPENS)	10 PERCENT	96 PERCENT	90 PERCENT

SOIL STOCKPILE NOTES:

- STOCKPILES SHALL BE STABILIZED (WITH PLASTIC COVERING OR OTHER APPROVED DEVICE) DAILY BETWEEN NOVEMBER 1 AND MARCH 31.
- IN ANY SEASON, SEDIMENT LEACHING FROM STOCK PILES MUST BE PREVENTED.
- TOPSOIL SHALL NOT BE PLACED WHILE IN A FROZEN OR MUDDY CONDITION, WHEN THE SUBGRADE IS EXCESSIVELY WET, OR WHEN CONDITIONS EXIST THAT MAY OTHERWISE BE DETRIMENTAL TO PROPER GRADING OR PROPOSED SODDING OR SEEDING.
- PREVIOUSLY ESTABLISHED GRADES ON THE AREAS TO BE TOPSOILED SHALL BE MAINTAINED ACCORDING TO THE APPROVED PLAN.
- STOCKPILES MUST BE LOCATED MORE THAN 50 FEET FROM ALL DRAINAGE FEATURES.

PLASTIC COVERING NOTES:

- PLASTIC SHEETING SHALL HAVE A MINIMUM THICKNESS OF 6 MILS AND SHALL MEET THE REQUIREMENTS OF THE STATE STANDARD SPECIFICATIONS SECTION 9-14.5.
- COVERING SHALL BE INSTALLED AND MAINTAINED TIGHTLY IN PLACE BY USING SANDBAGS OR TIRES ON ROPES WITH A MAXIMUM 10-FOOT GRID SPACING IN ALL DIRECTIONS. ALL SEAMS SHALL BE TAPED OR WEIGHTED DOWN FULL LENGTH AND THERE SHALL BE A LEAST A 12 INCH OVERLAP OF ALL SEAMS.
- CLEAR PLASTIC COVERING SHALL BE INSTALLED IMMEDIATELY ON AREAS SEEDED BETWEEN NOVEMBER 1 AND MARCH 31 AND REMAIN UNTIL VEGETATION IS FIRMLY ESTABLISHED.
- WHEN THE COVERING IS USED ON UN-SEEDED SLOPES, IT SHALL BE KEPT IN PLACE UNTIL THE NEXT SEEDING PERIOD.
- PLASTIC COVERING SHEETS SHALL BE BURIED TWO FEET AT THE TOP OF SLOPES IN ORDER TO PREVENT SURFACE WATER FLOW BENEATH SHEETS.
- PROPER MAINTENANCE INCLUDES REGULAR CHECKS FOR RIPS AND DISLODGED ENDS.

MULCHING NOTES:

- MULCH MATERIALS USED SHALL BE HAY OR STRAW AND SHALL BE APPLIED AT A RATE OF 75-100 POUNDS PER 1000 SQUARE FEET, OR 90-120 BALES PER ACRE TO A MIN. DEPTH OF 2 INCHES.
- MULCHES SHALL BE APPLIED IN ALL AREAS WITH EXPOSED SLOPES GREATER THAN 2:1.
- MULCHING SHALL BE USED IMMEDIATELY AFTER SEEDING OR IN AREAS WHICH CANNOT BE SEEDED BECAUSE OF THE SEASON.
- ALL AREAS NEEDED MULCH SHALL BE COVERED BY NOVEMBER 1.

SEEDING NOTES:

- SEED MIXTURE SHALL BE 10% REDTOP (92% PURITY, 90% GERMINATION); 40% ANNUAL RYE (98% PURITY, 90% GERMINATION); 40% CHEWING FESCUE (97% PURITY, 80% GERMINATION); AND 10% WHITE DUTCH CLOVER (96% PURITY, 90% GERMINATION) AND SHALL BE APPLIED AT THE RATE OF 120 POUNDS PER ACRE.
- SEED BEDS PLANTED BETWEEN MAY 1 AND OCTOBER 31 WILL REQUIRE IRRIGATION AND OTHER MAINTENANCE AS NECESSARY TO FOSTER AND PROTECT THE ROOT STRUCTURE.
- FOR SEED BEDS PLANTED BETWEEN OCTOBER 31 AND APRIL 30, ARMORING OF THE SEED BED WILL BE NECESSARY. (E.G., GEOTEXTILES, JUTE MAT, CLEAR PLASTIC COVERING).
- BEFORE SEEDING, INSTALL NEEDED SURFACE RUNOFF CONTROL MEASURES SUCH AS GRADIENT TERRACES, INTERCEPTOR DIKES, SWALES, LEVEL SPREADERS AND SEDIMENT BASINS.
- THE SEEDBED SHALL BE FIRM WITH A FAIRLY FINE SURFACE, FOLLOWING SURFACE ROUGHENING. PERFORM ALL OPERATION ACROSS OR AT RIGHT ANGLES TO THE SLOPE.
- FERTILIZERS ARE TO BE USED ACCORDING TO SUPPLIERS RECOMMENDATIONS. AMOUNTS USED SHOULD BE MINIMIZED, ESPECIALLY ADJACENT TO WATER BODIES AND WETLANDS.
- EROSION CONTROL SEEDING SHALL NOT BE USED IN AREAS SUBJECT TO WEAR BY CONSTRUCTION TRAFFIC.
- EROSION CONTROL SEEDING MAY BE USED IN ALL AREAS OF 5% OR LESS SLOPE. IN AREAS BETWEEN 5 AND 10% SLOPE, EROSION CONTROL SEEDING MAY BE USED FOR A MAXIMUM HORIZONTAL DISTANCE OF 100 FEET. USE MULCH OR NETTING OR OTHER TREATMENTS FOR STEEPER AND LONGER SLOPES.

SILT FENCE NOTES:

- FILTER FABRIC SHALL BE PURCHASED IN A CONTINUOUS ROLL AND CUT TO THE LENGTH OF THE BARRIER TO AVOID USE OF JOINTS. WHEN JOINTS ARE NECESSARY, FILTER CLOTH SHALL BE SPICED TOGETHER ONLY AT A SUPPORT POST, WITH A MINIMUM 6-INCH OVERLAP, AND SECURELY FASTENED AT BOTH ENDS TO POSTS.
- POSTS SHALL BE SPACED A MAXIMUM OF 6 FEET APART AND DRIVEN SECURELY INTO THE GROUND (MINIMUM OF 30 INCHES).
- A TRENCH SHALL BE EXCAVATED APPROXIMATELY 8 INCHES WIDE AND 12 INCHES DEEP ALONG THE LINE OF POSTS AND UPSLOPE FROM THE BARRIER. THIS TRENCH SHALL BE BACKFILLED WITH WASHED GRAVEL.
- WHEN STANDARD STRENGTH FILTER FABRIC IS USED, A WIRE MESH SUPPORT FENCE SHALL BE FASTENED SECURELY TO THE UPSLOPE SIDE OF THE POSTS USING HEAVY-DUTY WIRE STAPLES AT LEAST 1 INCH THE TRENCH A MINIMUM OF 4 INCHES AND SHALL NOT EXTEND MORE THAN 24 INCHES ABOVE THE ORIGINAL GROUND SURFACE.
- THE STANDARD STRENGTH FILTER FABRIC SHALL BE STAPLED OR WIRED TO THE FENCE, AND 20 INCHES OF THE FABRIC SHALL BE EXTENDED INTO THE TRENCH. THE FABRIC SHALL NOT EXTEND MORE THAN 24 INCHES ABOVE THE ORIGINAL GROUND SURFACE. FILTER FABRIC SHALL NOT BE STAPLED TO EXISTING TREES.
- WHEN EXTRA-STRENGTH FILTER FABRIC AND CLOSER POST SPACING IS USED, THE WIRE MESH SUPPORT FENCE MAY BE ELIMINATED. IN SUCH A CASE, THE FILTER FABRIC IS STAPLED OR WIRED DIRECTLY TO THE POSTS WITH ALL OTHER PROVISIONS OF ABOVE NOTES APPLYING.
- FILTER FABRIC FENCES SHALL NOT BE REMOVED BEFORE THE UPSLOPE AREA HAS BEEN PERMANENTLY STABILIZED.
- FILTER FABRIC FENCES SHALL BE INSPECTED IMMEDIATELY AFTER EACH RAINFALL AND AT LEAST DAILY DURING PROLONGED RAINFALL. ANY REQUIRED REPAIRS SHALL BE MADE IMMEDIATELY.
- SILT FENCES WILL BE INSTALLED PARALLEL TO ANY SLOPE CONTOURS.
- CONTRIBUTING LENGTH TO FENCE WILL NOT BE GREATER THAN 100 FEET.
- DO NOT INSTALL BELOW AN OUTLET PIPE OR WIRE.
- INSTALL DOWNSLOPE OF EXPOSED AREAS.
- DO NOT DRIVE OVER OR FILL OVER SILT FENCES.

CONSTRUCTION ENTRANCE NOTES:

- MATERIAL SHALL BE 4 INCH TO 8 INCH QUARRY SPALLS (4 TO 6 INCH FOR RESIDENTIAL SINGLE FAMILY LOTS) AND MAY BE TOP-DRESSED WITH 1 INCH TO 3 INCH ROCK. (STATE STANDARD SPECIFICATIONS, SECTION 8-15)
- THE ROCK PAD SHALL BE AT LEAST 12 INCHES THICK AND 50 FEET LONG (20 FEET FOR SITES WITH LESS THAN 1 ACRE OF DISTURBED SOIL). WIDTH SHALL BE THE FULL WIDTH OF THE VEHICLE INGRESS AND EGRESS AREA. SMALLER PADS MAY BE APPROVED FOR SINGLE-FAMILY RESIDENTIAL AND SMALL COMMERCIAL SITES.
- ADDITIONAL ROCK SHALL BE ADDED PERIODICALLY TO MAINTAIN PROPER FUNCTION OF THE PAD.
- IF THE PAD DOES NOT ADEQUATELY REMOVE THE MUD FROM THE VEHICLE WHEELS, THE WHEELS SHALL BE HOSED OFF BEFORE THE VEHICLE ENTERS A PAVED STREET. THE WASHING SHALL BE DONE ON AN AREA COVERED WITH CRUSHED ROCK AND WASH WATER SHALL DRAIN TO A SEDIMENT RETENTION FACILITY OR THROUGH A SILT FENCE.

INLET PROTECTION NOTES:

FILTER FABRIC FENCE - INSTALLATION PROCEDURE

- PLACE 2-INCH BY 2-INCH WOODEN STAKES AROUND THE PERIMETER OF THE INLET A MAXIMUM OF 3 FEET APART AND DRIVE THEM AT LEAST 8-INCHES INTO THE GROUND. THE STAKES MUST BE AT LEAST 3 FEET LONG.
- EXCAVATE A TRENCH APPROXIMATELY 8-INCHES WIDE AND 12-INCHES DEEP AROUND THE OUTSIDE PERIMETER OF THE STAKES.
- STAPLE THE FILTER FABRIC TO THE WOODEN STAKES SO THAT 32-INCHES OF THE FABRIC EXTENDS AND CAN BE FORMED INTO THE TRENCH, AND USE HEAVY-DUTY WIRE STAPLES AT LEAST 1/2-INCHES LONG.
- BACKFILL THE TRENCH WITH 3/4-INCH MINUS WASHED GRAVEL ALL THE WAY AROUND.

TEMPORARY DIKES AND SWALES:

- SEED AND MULCH SHALL BE APPLIED WITHIN 5 DAYS OF DIKE CONSTRUCTION (SEE VEGETATION).
- THE UPSLOPE SIDE OF THE DIKE SHALL PROVIDE POSITIVE DRAINAGE TO THE DIKE OUTLET.
- NO EROSION SHALL OCCUR AT THE DIKE OUTLET. PROVIDE ENERGY DISSIPATION MEASURES AS NECESSARY.
- SEDIMENT LADEN RUNOFF MUST BE RELEASED THROUGH A SEDIMENT TRAPPING FACILITY SUCH AS A POND, TRAP, OR SILT FENCE AS APPROPRIATE TO DRAINAGE AREA SIZE.

INSPECTION SEQUENCE:

TEMPORARY EROSION AND SEDIMENT CONTROL MEASURES REQUIRING INSPECTION FOR THIS PROJECT:

- CLEARING AND GRADING LIMITS
- TEMPORARY CONSTRUCTION ENTRANCE
- TEMPORARY SILTATION FENCING
- VEGETATION AND STABILIZATION OF EXPOSED SURFACES
- STOCKPILE PLASTIC SHEETING
- STABILIZE EXPOSED SOILS WITH SOIL AMENDMENT OPTIONS. SEE SHEET 2

PERMANENT EROSION AND SEDIMENT CONTROL MEASURES REQUIRED FOR THIS PROJECT:

- STABILIZE ALL EXPOSED AREAS WITH SOIL AMENDMENTS SEE NOTES
- SEEDING AND/OR LANDSCAPING OF NON-IMPERVIOUS SURFACES
- PAVING (ASPHALT OR CONCRETE)
- SEDIMENT CONTROL AS NOTED IN PLANS

INSPECTION SCHEDULE:

- SILTATION FENCE - INSPECT: PRIOR TO CLEARING, AFTER MAJOR STORM EVENTS, MONTHLY
- TEMPORARY CONSTRUCTION ENTRANCE - INSPECT: PRIOR TO CLEARING, AFTER MAJOR STORM EVENTS, MONTHLY
- STOCKPILES - INSPECT: MONTHLY AND AFTER MAJOR STORM EVENTS FOR RIPPING AND LOOSE SEAMS
- CATCH BASINS AND STORM DRAINAGE PIPES - INSPECT: MONTHLY AND AFTER MAJOR STORM EVENTS
- INSPECTIONS SHALL CONTINUE UNTIL SITE HAS STABILIZED.

THE ESC LEAD FOR THIS PROJECT WILL BE DECIDED BY THE CONTRACTOR.

(A "MAJOR STORM EVENT" IS DESCRIBED AS 1 OR MORE INCHES OF RAINFALL IN A PERIOD OF 24 HOURS OR LESS.)

BEFORE ANY CONSTRUCTION CONTACT:
CALL BEFORE YOU DIG @ 1-800-424-5555

APPROVED FOR CONSTRUCTION

DATE: _____

CITY OF BUCKLEY, CITY ENGINEER

THESE DRAWINGS ARE APPROVED FOR CONSTRUCTION FOR A PERIOD OF 12 MONTHS FROM THE DATE SHOWN HEREON. THE CITY RESERVES THE RIGHT TO MAKE MODIFICATIONS SHOULD THE CONSTRUCTION BE DELAYED BEYOND THIS TIME LIMIT. THE CITY, BY APPROVING THESE DOCUMENTS, IN NO WAY WARRANTS THEIR ACCURACY OR ACKNOWLEDGES ANY OMISSIONS.



CARBOM PROPERTIES COMMERCIAL SITE
 CARBCOM PROPERTIES
 12910 PACIFIC HWY SW
 LAKEWOOD, WA 98499
 Phone: 253-4131-0188

S.W.P.P.P Notes

DRAWING

C5

SHEET 05
OF 09

Appendix E

Construction SWPPP



Stormwater Pollution Prevention Plan (SWPPP)

**For Carbcom LLC Commercial Site
Buckley, Washington**

For

**Carbcom Properties, LLC
10010 181st Avenue Court East
Bonney Lake, WA 98391**

By

**LeRoy Surveyors & Engineers, Inc.
P.O. Box 740
Puyallup, Washington 98371
(253) 848-6608**

Contact: Steve T Nelson, P.E.

**April 2016
Job No: 10537**

I hereby state that this Stormwater Pollution Prevention Plan for the Carbcom LLC Commercial Site has been prepared by me or under my supervision and meets the standard of care and expertise which is usual and customary in this community for professional engineers. I understand that the City of Buckley does not and will not assume liability for the sufficiency, suitability, or performance of drainage facilities prepared by me.

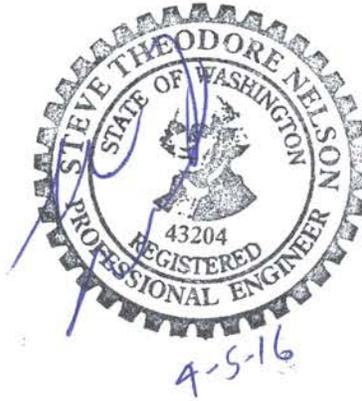


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Appendix B – Facility Sizing

Certified Erosion Control Lead

Because this construction site will disturb more than 1 acre a Certified Erosion and Sediment Control Lead (CESCL) shall be identified in the Construction SWPPP and shall be onsite or on-call at all times. Also, an Engineer's Inspection Report Form shall be on file with the City before the project is accepted as being complete.

A sample Engineer's Inspection Report Form can be found in Attachments Section G of the 2005 Pierce County Stormwater Management and Site Development Manual.

Section 1 – Twelve Elements

Element #1 – Mark Clearing Limits

All clearing limits will be clearly marked prior to any land disturbing activity. The project clearing limits and the landscape buffer will be clearly marked with high visibility plastic fence. The clearing limits are clearly shown on the SWPPP drawings. The native top soil layer, where disturbed, should be stockpiled on site, covered to prevent erosion, and replaced immediately upon completion of the ground disturbing activities. The native top soil and natural vegetation shall be retained in an undisturbed state to the maximum extent practical.

BMP's to be utilized:

- BMP C101: Preserving Natural Vegetation
- BMP C103: High Visibility Plastic Fencing

Element #2 – Establish Construction Access

The Stabilized Construction Entrance location and a standard detail are shown on the SWPPP drawings. There will be one stabilized access points for the project. If sediment is tracked off site, roads shall be cleaned thoroughly at the end of each day, or more frequently during wet weather, if necessary to prevent sediment from leaving the project site.

BMP's to be utilized:

- BMP C105: Stabilized Construction Entrance

Element #3 – Control Flow Rates

The project proposes to utilize temporary ditches to convey onsite drainage to a temporary erosion control sediment trap which will be constructed in the permanent pond location. The sediment trap (see Facility Sizing in Appendix) is designed with a bottom elevation matching that of the wetpond treatment facility incorporated into the permanent storm pond design. In addition, the project will install silt fencing.

BMP's to be utilized:

- BMP C240: Sediment Trap

Element #4 – Install Sediment Controls

Silt fences will be placed at the downgradient end of all land disturbing activities. In addition, a temporary erosion control sediment trap with temporary ditching will be installed in order to minimize sediment laden water from leaving the site. Silt fence locations are clearly shown on the SWPPP drawings.

BMP's to be utilized:

- BMP C233: Silt Fence
- BMP C240: Sediment Trap

Element #5 – Stabilize Soils

Standard notes and details for soil stabilization are shown on the SWPPP drawings. All exposed and unworked soils shall be stabilized with temporary seeding to protect the soil from the erosive forces of nature. Topsoil stockpiles, if necessary will be stabilized from erosion with plastic covering if not being worked. Temporary erosion control measures shall remain in place until permanent measures are established.

BMP's to be utilized:

- BMP C120: Temporary and Permanent Seeding
- BMP C121: Mulching
- BMP C123: Plastic Covering
- BMP C140: Dust Control

Element #6 – Protect Slopes

There are no steep slopes within or adjacent to the proposed land disturbing activities. The soils on any exposed slopes will be stabilized as specified in Element #5.

Element #7 – Protect Drain Inlets

There are no existing storm drainage catch basins that require inlet protection; however there are proposed catch basins that will require inlet protection.

BMP's to be utilized:

- BMP C220: Storm Drain Inlet Protection

Element #8 – Stabilize Channels and Outlets

There are no channels on the site. The sediment trap outfall utilizes outlet protection.

- BMP C209: Outlet Protection

Element #9 – Control Pollutants

All pollutants, including waste materials and demolition debris, shall be handled and disposed of in a manner that does not contaminate stormwater. All chemicals, liquid products, and petroleum products shall be covered, contained and protected from vandalism. Concrete handling BMPs shall be used to prevent process water and slurry that contain fine particles and high pH from leaving the project site. Volume II, Chapter 4 of the 2005 Stormwater Management Manual for Western Washington should be referenced for Source Control BMPs.

BMP's to be utilized:

- BMP C151: Concrete Handling
- BMP C152: Sawcutting and Surfacing Pollution Prevention

Element #10 – Control Dewatering

Construction is anticipated in the dry season, dewatering is not anticipated.

Element #11 – Maintain BMPs

The ESC notes on the SWPPP drawings give the contractor specific instructions on how to construct and maintain all temporary BMPs. All temporary ESC BMPs shall be removed within 30 days after final site stabilization is achieved or after the temporary BMPs are no longer needed. Any trapped sediment shall be removed or stabilized on-site. Disturbed soil resulting from removal of BMPs or vegetation shall be permanently stabilized. A maintenance and inspection sequence for the project's ESC BMPs can be found in Section 4 of this report.

Element #12 – Manage the Project

The general contractor will be responsible for managing and coordinating all construction activities, including temporary erosion and sediment control. The contractor will assign the CESCL. The project's construction will not be phased.

BMP's to be utilized:

- BMP C160: Certified Erosion and Sediment Control Lead

Section 2 – Project Description & Existing Site Conditions

The Carbcom LLC Commercial Site proposes to construct three (3) commercial buildings in which building footprints for two (2) of the structures extend across two (2) adjoining parcels (parcel numbers 0619047002 & 0619047003). The first structure, a Quonset Hut on a slab-on-grade mat foundation, located in the south central portion of the site will house a commercial grow facility (garden). A second Quonset Hut is planned for future expansion, and will be located north of the proposed structure. A proposed office building is to be located southwest of the proposed garden. All three (3) structures are shown on the site plans. Parking and drive areas will be paved with gravel, including the area of the future expansion. A proposed sidewalk located on the southern end of the site extends east-west parallel to the public road.

The project is proposing to capture and convey runoff to a proposed stormwater detention pond to be located on the north end of the parcel.

Topography

The project site is generally flat, and slopes over the site are very gentle, approaching approximately 1.0 percent. 5 feet of vertical relief occurs in the north-south direction descending from the southern portion of the site toward the northern property boundary.

Ground Cover

The project area is consists of an open field with close cropped grass that is free of trees and brush.

Drainage

The project is not within an aquifer recharge area; there is no evidence of surface water runoff conveyance systems onsite. The proposed site drainage facilities are designed to mimic the existing conditions in the mitigated condition.

Section 3 – Soils & Potential Erosion Problem Areas

The Carbcom LLC Commercial Site project is proposing to construct permanent storm drainage facilities. Stormwater runoff from the proposed garden facility, office, parking and drive areas, as well as the future expansion will be captured and conveyed to an on-site stormwater detention pond. Site soils are Buckley gravelly silty loam, 0-3 percent slopes. This nearly level soil is poorly drained.

Surface runoff is very slow and there is no erosion hazard.

Section 4 – Construction Phasing & Construction Schedule

Construction Phasing:

The project proposes to construct improvements in one phase.

Construction Sequence:

1. Contact the City of Buckley at 360-829-1921 to set up pre-construction meeting; attend pre-construction meeting.
2. Flag limits of clearing and grading in the construction area per approved plans.
3. Install temporary construction entrance and other erosion control measures as per the approved plans.
4. Call the City of Buckley for Inspection No. 1, installation of erosion control facilities/prior to clearing.
5. Mark locations where permanent storm facilities are to be constructed.
6. Clear site. Retain duff layer (strippings), and natural vegetation in an undisturbed state to the maximum degree practical. If it is not practical to retain in-place, then stockpile the strippings on-site, cover to prevent erosion and save for replacement.
7. Call the City of Buckley for Inspection No. 2, completion of clearing.

8. Stabilize exposed and unworked soils with temporary or permanent seeding or other measure as necessary to assure compliance with permit conditions.
9. Maintain and repair all temporary and permanent erosion and sediment control BMPs as necessary during construction phase to assure continued performance of their intended function in accordance with BMP specifications.
10. Protect adjacent properties and Public Road from sediment runoff. If sediment is transported onto the paved surface, then the road shall be cleaned thoroughly at the end of each day.
11. Mass grade and construct the stormwater pond in accordance with the approved plans and utilize for erosion control.
12. Install the stormwater conveyance system in accordance with the approved plans.
13. Call the City of Buckley for Inspection No. 3, upon completion of excavation, filling and earthwork.
14. Construct potable water service main extension and hydrants along with the individual water service.
15. Obtain necessary permits from WSDOT for boring the sewer system underneath Highway 410 and connect to the existing force main.
16. Construct dry utilities.
17. Prepare building pad areas to receive proposed structures.
18. Construct structures.
19. Construct parking area and sidewalk along frontage.
20. Provide soil amendments prior to installation of landscaping.
21. Provide landscaping per approved plans.
22. Maintain erosion control facilities during construction phase and amend as necessary to maintain site in compliance with permit conditions.
23. Call the City of Buckley for Inspection No. 4, completion of project.
24. Call the City of Buckley for Inspection No. 5, as needed, to determine compliance with approved plans and/or specifications.

Temporary Erosion and Sediment Control measures required for this project:

1. Clearing and Grading Limits
2. Temporary Construction Entrance
3. Catch Basin Protection
4. Temporary Siltation Fencing
5. Vegetation and Stabilization of exposed surfaces
6. Stockpile Plastic Sheeting

Permanent Erosion and Sediment Control measures required for this project:

1. Seeding and/or landscaping and soil amendments
2. Paving surfacing
3. Sidewalk surfacing

Inspection sequence:

1. Siltation Fence - inspect: prior to clearing, after major storm events, monthly
2. Construction Entrance –inspect: prior to clearing, after major storm events, monthly
3. Stockpiles – inspect: monthly and after major storm events

Inspections shall continue until site has stabilized.

The ESC Lead (CESCL) for this project will be decided by the contractor.

Steve T Nelson, PE
Project Engineer
LSE, Inc.

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Appendix E.1

Erosion Control BMPs

4.1 Source Control BMPs

BMP C101: Preserving Natural Vegetation

Purpose

The purpose of preserving natural vegetation is to reduce erosion wherever practicable. Limiting site disturbance is the single most effective method for reducing erosion. For example, conifers can hold up to about 50 percent of all rain that falls during a storm. Up to 20-30 percent of this rain may never reach the ground but is taken up by the tree or evaporates. Another benefit is that the rain held in the tree can be released slowly to the ground after the storm.

Conditions of Use

- Natural vegetation should be preserved on steep slopes, near perennial and intermittent watercourses or swales, and on building sites in wooded areas.
- As required by local governments.

Design and Installation Specifications

Natural vegetation can be preserved in natural clumps or as individual trees, shrubs and vines.

The preservation of individual plants is more difficult because heavy equipment is generally used to remove unwanted vegetation. The points to remember when attempting to save individual plants are:

- Is the plant worth saving? Consider the location, species, size, age, vigor, and the work involved. Local governments may also have ordinances to save natural vegetation and trees.
- Fence or clearly mark areas around trees that are to be saved. It is preferable to keep ground disturbance away from the trees at least as far out as the dripline.

Plants need protection from three kinds of injuries:

- *Construction Equipment* - This injury can be above or below the ground level. Damage results from scarring, cutting of roots, and compaction of the soil. Placing a fenced buffer zone around plants to be saved prior to construction can prevent construction equipment injuries.
- *Grade Changes* - Changing the natural ground level will alter grades, which affects the plant's ability to obtain the necessary air, water, and minerals. Minor fills usually do not cause problems although sensitivity between species does vary and should be checked. Trees can tolerate fill of 6 inches or less. For shrubs and other plants, the fill should be less.

When there are major changes in grade, it may become necessary to supply air to the roots of plants. This can be done by placing a layer of gravel and a tile system over the roots before the fill is made. A tile

system protects a tree from a raised grade. The tile system should be laid out on the original grade leading from a dry well around the tree trunk. The system should then be covered with small stones to allow air to circulate over the root area.

Lowering the natural ground level can seriously damage trees and shrubs. The highest percentage of the plant roots are in the upper 12 inches of the soil and cuts of only 2-3 inches can cause serious injury. To protect the roots it may be necessary to terrace the immediate area around the plants to be saved. If roots are exposed, construction of retaining walls may be needed to keep the soil in place. Plants can also be preserved by leaving them on an undisturbed, gently sloping mound. To increase the chances for survival, it is best to limit grade changes and other soil disturbances to areas outside the dripline of the plant.

- *Excavations* - Protect trees and other plants when excavating for drainfields, power, water, and sewer lines. Where possible, the trenches should be routed around trees and large shrubs. When this is not possible, it is best to tunnel under them. This can be done with hand tools or with power augers. If it is not possible to route the trench around plants to be saved, then the following should be observed:

Cut as few roots as possible. When you have to cut, cut clean. Paint cut root ends with a wood dressing like asphalt base paint.

Backfill the trench as soon as possible.

Tunnel beneath root systems as close to the center of the main trunk to preserve most of the important feeder roots.

Some problems that can be encountered with a few specific trees are:

- Maple, Dogwood, Red alder, Western hemlock, Western red cedar, and Douglas fir do not readily adjust to changes in environment and special care should be taken to protect these trees.
- The windthrow hazard of Pacific silver fir and madronna is high, while that of Western hemlock is moderate. The danger of windthrow increases where dense stands have been thinned. Other species (unless they are on shallow, wet soils less than 20 inches deep) have a low windthrow hazard.
- Cottonwoods, maples, and willows have water-seeking roots. These can cause trouble in sewer lines and infiltration fields. On the other hand, they thrive in high moisture conditions that other trees would not.
- Thinning operations in pure or mixed stands of Grand fir, Pacific silver fir, Noble fir, Sitka spruce, Western red cedar, Western hemlock,

Pacific dogwood, and Red alder can cause serious disease problems. Disease can become established through damaged limbs, trunks, roots, and freshly cut stumps. Diseased and weakened trees are also susceptible to insect attack.

***Maintenance
Standards***

- Inspect flagged and/or fenced areas regularly to make sure flagging or fencing has not been removed or damaged. If the flagging or fencing has been damaged or visibility reduced, it shall be repaired or replaced immediately and visibility restored.
- If tree roots have been exposed or injured, “prune” cleanly with an appropriate pruning saw or loppers directly above the damaged roots and recover with native soils. Treatment of sap flowing trees (fir, hemlock, pine, soft maples) is not advised as sap forms a natural healing barrier.

BMP C103: High Visibility Plastic or Metal Fence

Purpose

Fencing is intended to: (1) restrict clearing to approved limits; (2) prevent disturbance of sensitive areas, their buffers, and other areas required to be left undisturbed; (3) limit construction traffic to designated construction entrances or roads; and, (4) protect areas where marking with survey tape may not provide adequate protection.

Conditions of Use

To establish clearing limits, plastic or metal fence may be used:

- At the boundary of sensitive areas, their buffers, and other areas required to be left uncleared.
- As necessary to control vehicle access to and on the site.

Design and Installation Specifications

- High visibility plastic fence shall be composed of a high-density polyethylene material and shall be at least four feet in height. Posts for the fencing shall be steel or wood and placed every 6 feet on center (maximum) or as needed to ensure rigidity. The fencing shall be fastened to the post every six inches with a polyethylene tie. On long continuous lengths of fencing, a tension wire or rope shall be used as a top stringer to prevent sagging between posts. The fence color shall be high visibility orange. The fence tensile strength shall be 360 lbs./ft. using the ASTM D4595 testing method.

- Metal fences shall be designed and installed according to the manufacturer's specifications.
- Metal fences shall be at least 3 feet high and must be highly visible.
- Fences shall not be wired or stapled to trees.

Maintenance Standards

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

BMP C105: Stabilized Construction Entrance

Purpose

Construction entrances are stabilized to reduce the amount of sediment transported onto paved roads by vehicles or equipment by constructing a stabilized pad of quarry spalls at entrances to construction sites.

Conditions of Use

Construction entrances shall be stabilized wherever traffic will be leaving a construction site and traveling on paved roads or other paved areas within 1,000 feet of the site.

On large commercial, highway, and road projects, the designer should include enough extra materials in the contract to allow for additional stabilized entrances not shown in the initial Construction SWPPP. It is difficult to determine exactly where access to these projects will take place; additional materials will enable the contractor to install them where needed.

Design and Installation Specifications

- See Figure 4.2 for details. Note: the 100' minimum length of the entrance shall be reduced to the maximum practicable size when the size or configuration of the site does not allow the full length (100').
- A separation geotextile shall be placed under the spalls to prevent fine sediment from pumping up into the rock pad. The geotextile shall meet the following standards:

Grab Tensile Strength (ASTM D4751)	200 psi min.
Grab Tensile Elongation (ASTM D4632)	30% max.
Mullen Burst Strength (ASTM D3786-80a)	400 psi min.
AOS (ASTM D4751)	20-45 (U.S. standard sieve size)

- Consider early installation of the first lift of asphalt in areas that will be paved; this can be used as a stabilized entrance. Also consider the installation of excess concrete as a stabilized entrance. During large concrete pours, excess concrete is often available for this purpose.
- Hog fuel (wood-based mulch) may be substituted for or combined with quarry spalls in areas that will not be used for permanent roads. Hog fuel is generally less effective at stabilizing construction entrances and should be used only at sites where the amount of traffic is very limited. Hog fuel is not recommended for entrance stabilization in urban areas. The effectiveness of hog fuel is highly variable and it generally requires more maintenance than quarry spalls. The inspector may at any time require the use of quarry spalls if the hog fuel is not preventing sediment from being tracked onto pavement or if the hog fuel is being carried onto pavement. Hog fuel is prohibited in permanent roadbeds because organics in the subgrade soils cause degradation of the subgrade support over time.
- Fencing (see BMPs C103 and C104) shall be installed as necessary to restrict traffic to the construction entrance.

Maintenance Standards

- Whenever possible, the entrance shall be constructed on a firm, compacted subgrade. This can substantially increase the effectiveness of the pad and reduce the need for maintenance.
- Quarry spalls (or hog fuel) shall be added if the pad is no longer in accordance with the specifications.
- If the entrance is not preventing sediment from being tracked onto pavement, then alternative measures to keep the streets free of sediment shall be used. This may include street sweeping, an increase in the dimensions of the entrance, or the installation of a wheel wash.
- Any sediment that is tracked onto pavement shall be removed by shoveling or street sweeping. The sediment collected by sweeping shall be removed or stabilized on site. The pavement shall not be cleaned by washing down the street, except when sweeping is ineffective and there is a threat to public safety. If it is necessary to wash the streets, the construction of a small sump shall be considered. The sediment would then be washed into the sump where it can be controlled.
- Any quarry spalls that are loosened from the pad, which end up on the roadway shall be removed immediately.
- If vehicles are entering or exiting the site at points other than the construction entrance(s), fencing (see BMPs C103 and C104) shall be installed to control traffic.
- Upon project completion and site stabilization, all construction accesses intended as permanent access for maintenance shall be permanently stabilized.

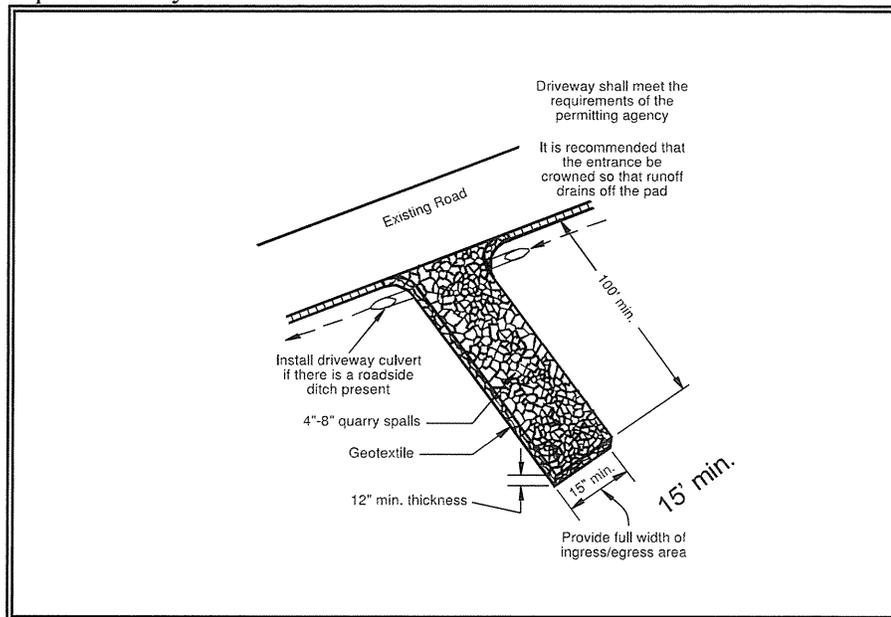


Figure 4.2 – Stabilized Construction Entrance

BMP C120: Temporary and Permanent Seeding

Purpose

Seeding is intended to reduce erosion by stabilizing exposed soils. A well-established vegetative cover is one of the most effective methods of reducing erosion.

Conditions of Use

- Seeding may be used throughout the project on disturbed areas that have reached final grade or that will remain unworked for more than 30 days.
- Channels that will be vegetated should be installed before major earthwork and hydroseeded with a Bonded Fiber Matrix. The vegetation should be well established (i.e., 75 percent cover) before water is allowed to flow in the ditch. With channels that will have high flows, erosion control blankets should be installed over the hydroseed. If vegetation cannot be established from seed before water is allowed in the ditch, sod should be installed in the bottom of the ditch over hydromulch and blankets.
- Retention/detention ponds should be seeded as required.
- Mulch is required at all times because it protects seeds from heat, moisture loss, and transport due to runoff.
- All disturbed areas shall be reviewed in late August to early September and all seeding should be completed by the end of September. Otherwise, vegetation will not establish itself enough to provide more than average protection.
- At final site stabilization, all disturbed areas not otherwise vegetated or stabilized shall be seeded and mulched. Final stabilization means the completion of all soil disturbing activities at the site and the establishment of a permanent vegetative cover, or equivalent permanent stabilization measures (such as pavement, riprap, gabions or geotextiles) which will prevent erosion.

Design and Installation Specifications

- Seeding should be done during those seasons most conducive to growth and will vary with the climate conditions of the region. Local experience should be used to determine the appropriate seeding periods.
- The optimum seeding windows for western Washington are April 1 through June 30 and September 1 through October 1. Seeding that occurs between July 1 and August 30 will require irrigation until 75 percent grass cover is established. Seeding that occurs between October 1 and March 30 will require a mulch or plastic cover until 75 percent grass cover is established.
- To prevent seed from being washed away, confirm that all required surface water control measures have been installed.

- The seedbed should be firm and rough. All soil should be roughened no matter what the slope. If compaction is required for engineering purposes, slopes must be track walked before seeding. Backblading or smoothing of slopes greater than 4:1 is not allowed if they are to be seeded.
- New and more effective restoration-based landscape practices rely on deeper incorporation than that provided by a simple single-pass rototilling treatment. Wherever practical the subgrade should be initially ripped to improve long-term permeability, infiltration, and water inflow qualities. At a minimum, permanent areas shall use soil amendments to achieve organic matter and permeability performance defined in engineered soil/landscape systems. For systems that are deeper than 8 inches the rototilling process should be done in multiple lifts, or the prepared soil system shall be prepared properly and then placed to achieve the specified depth.
- Organic matter is the most appropriate form of “fertilizer” because it provides nutrients (including nitrogen, phosphorus, and potassium) in the least water-soluble form. A natural system typically releases 2-10 percent of its nutrients annually. Chemical fertilizers have since been formulated to simulate what organic matter does naturally.
- In general, 10-4-6 N-P-K (nitrogen-phosphorus-potassium) fertilizer can be used at a rate of 90 pounds per acre. Slow-release fertilizers should always be used because they are more efficient and have fewer environmental impacts. It is recommended that areas being seeded for final landscaping conduct soil tests to determine the exact type and quantity of fertilizer needed. This will prevent the over-application of fertilizer. Fertilizer should not be added to the hydromulch machine and agitated more than 20 minutes before it is to be used. If agitated too much, the slow-release coating is destroyed.
- There are numerous products available on the market that take the place of chemical fertilizers. These include several with seaweed extracts that are beneficial to soil microbes and organisms. If 100 percent cottonseed meal is used as the mulch in hydroseed, chemical fertilizer may not be necessary. Cottonseed meal is a good source of long-term, slow-release, available nitrogen.
- Hydroseed applications shall include a minimum of 1,500 pounds per acre of mulch with 3 percent tackifier. Mulch may be made up of 100 percent: cottonseed meal; fibers made of wood, recycled cellulose, hemp, and kenaf; compost; or blends of these. Tackifier shall be plant-based, such as guar or alpha plantago, or chemical-based such as polyacrylamide or polymers. Any mulch or tackifier product used shall be installed per manufacturer’s instructions. Generally, mulches come in 40-50 pound bags. Seed and fertilizer are added at time of application.

- Mulch is always required for seeding. Mulch can be applied on top of the seed or simultaneously by hydroseeding.
- On steep slopes, Bonded Fiber Matrix (BFM) or Mechanically Bonded Fiber Matrix (MBFM) products should be used. BFM/MBFM products are applied at a minimum rate of 3,000 pounds per acre of mulch with approximately 10 percent tackifier. Application is made so that a minimum of 95 percent soil coverage is achieved. Numerous products are available commercially and should be installed per manufacturer's instructions. Most products require 24-36 hours to cure before a rainfall and cannot be installed on wet or saturated soils. Generally, these products come in 40-50 pound bags and include all necessary ingredients except for seed and fertilizer.

BFMs and MBFMs have some advantages over blankets:

- No surface preparation required;
- Can be installed via helicopter in remote areas;
- On slopes steeper than 2.5:1, blanket installers may need to be roped and harnessed for safety;
- They are at least \$1,000 per acre cheaper installed.

In most cases, the shear strength of blankets is not a factor when used on slopes, only when used in channels. BFMs and MBFMs are good alternatives to blankets in most situations where vegetation establishment is the goal.

- When installing seed via hydroseeding operations, only about 1/3 of the seed actually ends up in contact with the soil surface. This reduces the ability to establish a good stand of grass quickly. One way to overcome this is to increase seed quantities by up to 50 percent.
- Vegetation establishment can also be enhanced by dividing the hydromulch operation into two phases:
 1. Phase 1- Install all seed and fertilizer with 25-30 percent mulch and tackifier onto soil in the first lift;
 2. Phase 2- Install the rest of the mulch and tackifier over the first lift.

An alternative is to install the mulch, seed, fertilizer, and tackifier in one lift. Then, spread or blow straw over the top of the hydromulch at a rate of about 800-1000 pounds per acre. Hold straw in place with a standard tackifier. Both of these approaches will increase cost moderately but will greatly improve and enhance vegetative establishment. The increased cost may be offset by the reduced need for:

1. Irrigation
2. Reapplication of mulch
3. Repair of failed slope surfaces

This technique works with standard hydromulch (1,500 pounds per acre minimum) and BFM/MBFMs (3,000 pounds per acre minimum).

- Areas to be permanently landscaped shall provide a healthy topsoil that reduces the need for fertilizers, improves overall topsoil quality, provides for better vegetal health and vitality, improves hydrologic characteristics, and reduces the need for irrigation. This can be accomplished in a number of ways:

Recent research has shown that the best method to improve till soils is to amend these soils with compost. The optimum mixture is approximately two parts soil to one part compost. This equates to 4 inches of compost mixed to a depth of 12 inches in till soils. Increasing the concentration of compost beyond this level can have negative effects on vegetal health, while decreasing the concentrations can reduce the benefits of amended soils. Please note: The compost should meet specifications for Grade A quality compost in Ecology Publication 94-038.

Other soils, such as gravel or cobble outwash soils, may require different approaches. Organics and fines easily migrate through the loose structure of these soils. Therefore, the importation of at least 6 inches of quality topsoil, underlain by some type of filter fabric to prevent the migration of fines, may be more appropriate for these soils.

Areas that already have good topsoil, such as undisturbed areas, do not require soil amendments.

- Areas that will be seeded only and not landscaped may need compost or meal-based mulch included in the hydroseed in order to establish vegetation. Native topsoil should be re-installed on the disturbed soil surface before application.
- Seed that is installed as a temporary measure may be installed by hand if it will be covered by straw, mulch, or topsoil. Seed that is installed as a permanent measure may be installed by hand on small areas (usually less than 1 acre) that will be covered with mulch, topsoil, or erosion blankets. The seed mixes listed below include recommended mixes for both temporary and permanent seeding. These mixes, with the exception of the wetland mix, shall be applied at a rate of 120 pounds per acre. This rate can be reduced if soil amendments or slow-release fertilizers are used. Local suppliers or the local conservation district should be consulted for their recommendations because the appropriate mix depends on a variety of factors, including location, exposure, soil type, slope, and expected foot traffic. Alternative seed mixes approved by the local authority may be used.

Table 4.1 represents the standard mix for those areas where just a temporary vegetative cover is required.

Table 4.1 Temporary Erosion Control Seed Mix			
	% Weight	% Purity	% Germination
Chewings or annual blue grass <i>Festuca rubra var. commutata</i> or <i>Poa annua</i>	40	98	90
Perennial rye - <i>Lolium perenne</i>	50	98	90
Redtop or colonial bentgrass <i>Agrostis alba</i> or <i>Agrostis tenuis</i>	5	92	85
White dutch clover <i>Trifolium repens</i>	5	98	90

Table 4.2 provides just one recommended possibility for landscaping seed.

Table 4.2 Landscaping Seed Mix			
	% Weight	% Purity	% Germination
Perennial rye blend <i>Lolium perenne</i>	70	98	90
Chewings and red fescue blend <i>Festuca rubra var. commutata</i> or <i>Festuca rubra</i>	30	98	90

This turf seed mix in Table 4.3 is for dry situations where there is no need for much water. The advantage is that this mix requires very little maintenance.

Table 4.3 Low-Growing Turf Seed Mix			
	% Weight	% Purity	% Germination
Dwarf tall fescue (several varieties) <i>Festuca arundinacea var.</i>	45	98	90
Dwarf perennial rye (Barclay) <i>Lolium perenne var. barclay</i>	30	98	90
Red fescue <i>Festuca rubra</i>	20	98	90
Colonial bentgrass <i>Agrostis tenuis</i>	5	98	90

Table 4.4 presents a mix recommended for bioswales and other intermittently wet areas.

Table 4.4 Bioswale Seed Mix*			
	% Weight	% Purity	% Germination
Tall or meadow fescue <i>Festuca arundinacea</i> or <i>Festuca elatior</i>	75-80	98	90
Seaside/Creeping bentgrass <i>Agrostis palustris</i>	10-15	92	85
Redtop bentgrass <i>Agrostis alba</i> or <i>Agrostis gigantea</i>	5-10	90	80

* Modified Briargreen, Inc. Hydroseeding Guide Wetlands Seed Mix

The seed mix shown in Table 4.5 is a recommended low-growing, relatively non-invasive seed mix appropriate for very wet areas that are not regulated wetlands. Other mixes may be appropriate, depending on the soil type and hydrology of the area. Recent research suggests that bentgrass (*agrostis* sp.) should be emphasized in wet-area seed mixes. Apply this mixture at a rate of 60 pounds per acre.

Table 4.5 Wet Area Seed Mix*			
	% Weight	% Purity	% Germination
Tall or meadow fescue <i>Festuca arundinacea</i> or <i>Festuca elatior</i>	60-70	98	90
Seaside/Creeping bentgrass <i>Agrostis palustris</i>	10-15	98	85
Meadow foxtail <i>Alepecurus pratensis</i>	10-15	90	80
Alsike clover <i>Trifolium hybridum</i>	1-6	98	90
Redtop bentgrass <i>Agrostis alba</i>	1-6	92	85

* Modified Briargreen, Inc. *Hydroseeding Guide Wetlands Seed Mix*

The meadow seed mix in Table 4.6 is recommended for areas that will be maintained infrequently or not at all and where colonization by native plants is desirable. Likely applications include rural road and utility right-of-way. Seeding should take place in September or very early October in order to obtain adequate establishment prior to the winter months. The appropriateness of clover in the mix may need to be considered, as this can be a fairly invasive species. If the soil is amended, the addition of clover may not be necessary.

Table 4.6 Meadow Seed Mix			
	% Weight	% Purity	% Germination
Redtop or Oregon bentgrass <i>Agrostis alba</i> or <i>Agrostis oregonensis</i>	20	92	85
Red fescue <i>Festuca rubra</i>	70	98	90
White dutch clover <i>Trifolium repens</i>	10	98	90

Maintenance Standards

- Any seeded areas that fail to establish at least 80 percent cover (100 percent cover for areas that receive sheet or concentrated flows) shall be reseeded. If reseeding is ineffective, an alternate method, such as sodding, mulching, or nets/blankets, shall be used. If winter weather prevents adequate grass growth, this time limit may be relaxed at the discretion of the local authority when sensitive areas would otherwise be protected.

- After adequate cover is achieved, any areas that experience erosion shall be reseeded and protected by mulch. If the erosion problem is drainage related, the problem shall be fixed and the eroded area reseeded and protected by mulch.
- Seeded areas shall be supplied with adequate moisture, but not watered to the extent that it causes runoff.

BMP C121: Mulching

<i>Purpose</i>	The purpose of mulching soils is to provide immediate temporary protection from erosion. Mulch also enhances plant establishment by conserving moisture, holding fertilizer, seed, and topsoil in place, and moderating soil temperatures. There is an enormous variety of mulches that can be used. Only the most common types are discussed in this section.
<i>Conditions of Use</i>	As a temporary cover measure, mulch should be used: <ul style="list-style-type: none">• On disturbed areas that require cover measures for less than 30 days.• As a cover for seed during the wet season and during the hot summer months.• During the wet season on slopes steeper than 3H:1V with more than 10 feet of vertical relief.• Mulch may be applied at any time of the year and must be refreshed periodically.
<i>Design and Installation Specifications</i>	For mulch materials, application rates, and specifications, see Table 4.7. Note: Thicknesses may be increased for disturbed areas in or near sensitive areas or other areas highly susceptible to erosion. Mulch used within the ordinary high-water mark of surface waters should be selected to minimize potential flotation of organic matter. Composted organic materials have higher specific gravities (densities) than straw, wood, or chipped material.
<i>Maintenance Standards</i>	<ul style="list-style-type: none">• The thickness of the cover must be maintained.• Any areas that experience erosion shall be remulched and/or protected with a net or blanket. If the erosion problem is drainage related, then the problem shall be fixed and the eroded area remulched.

**Table 4.7
Mulch Standards and Guidelines**

Mulch Material	Quality Standards	Application Rates	Remarks
Straw	Air-dried; free from undesirable seed and coarse material.	2"-3" thick; 5 bales per 1000 sf or 2-3 tons per acre	Cost-effective protection when applied with adequate thickness. Hand-application generally requires greater thickness than blown straw. The thickness of straw may be reduced by half when used in conjunction with seeding. In windy areas straw must be held in place by crimping, using a tackifier, or covering with netting. Blown straw always has to be held in place with a tackifier as even light winds will blow it away. Straw, however, has several deficiencies that should be considered when selecting mulch materials. It often introduces and/or encourages the propagation of weed species and it has no significant long-term benefits. Straw should be used only if mulches with long-term benefits are unavailable locally. It should also not be used within the ordinary high-water elevation of surface waters (due to flotation).
Hydromulch	No growth inhibiting factors.	Approx. 25-30 lbs per 1000 sf or 1500 - 2000 lbs per acre	Shall be applied with hydromulcher. Shall not be used without seed and tackifier unless the application rate is at least doubled. Fibers longer than about ¾-1 inch clog hydromulch equipment. Fibers should be kept to less than ¾ inch.
Composted Mulch and Compost	No visible water or dust during handling. Must be purchased from supplier with Solid Waste Handling Permit (unless exempt).	2" thick min.; approx. 100 tons per acre (approx. 800 lbs per yard)	More effective control can be obtained by increasing thickness to 3". Excellent mulch for protecting final grades until landscaping because it can be directly seeded or tilled into soil as an amendment. Composted mulch has a coarser size gradation than compost. It is more stable and practical to use in wet areas and during rainy weather conditions.
Chipped Site Vegetation	Average size shall be several inches. Gradations from fines to 6 inches in length for texture, variation, and interlocking properties.	2" minimum thickness	This is a cost-effective way to dispose of debris from clearing and grubbing, and it eliminates the problems associated with burning. Generally, it should not be used on slopes above approx. 10% because of its tendency to be transported by runoff. It is not recommended within 200 feet of surface waters. If seeding is expected shortly after mulch, the decomposition of the chipped vegetation may tie up nutrients important to grass establishment.
Wood-based Mulch	No visible water or dust during handling. Must be purchased from a supplier with a Solid Waste Handling Permit or one exempt from solid waste regulations.	2" thick; approx. 100 tons per acre (approx. 800 lbs. per cubic yard)	This material is often called "hog or hogged fuel." It is usable as a material for Stabilized Construction Entrances (BMP C105) and as a mulch. The use of mulch ultimately improves the organic matter in the soil. Special caution is advised regarding the source and composition of wood-based mulches. Its preparation typically does not provide any weed seed control, so evidence of residual vegetation in its composition or known inclusion of weed plants or seeds should be monitored and prevented (or minimized).

BMP C123: Plastic Covering

Purpose

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

Conditions of Use

- Plastic covering may be used on disturbed areas that require cover measures for less than 30 days, except as stated below.
- Plastic is particularly useful for protecting cut and fill slopes and stockpiles. Note: The relatively rapid breakdown of most polyethylene sheeting makes it unsuitable for long-term (greater than six months) applications.
- Clear plastic sheeting can be used over newly-seeded areas to create a greenhouse effect and encourage grass growth if the hydroseed was installed too late in the season to establish 75 percent grass cover, or if the wet season started earlier than normal. Clear plastic should not be used for this purpose during the summer months because the resulting high temperatures can kill the grass.
- Due to rapid runoff caused by plastic sheeting, this method shall not be used upslope of areas that might be adversely impacted by concentrated runoff. Such areas include steep and/or unstable slopes.
- While plastic is inexpensive to purchase, the added cost of installation, maintenance, removal, and disposal make this an expensive material, up to \$1.50-2.00 per square yard.
- Whenever plastic is used to protect slopes, water collection measures must be installed at the base of the slope. These measures include plastic-covered berms, channels, and pipes used to convey clean rainwater away from bare soil and disturbed areas. At no time is clean runoff from a plastic covered slope to be mixed with dirty runoff from a project.
- Other uses for plastic include:
 1. Temporary ditch liner;
 2. Pond liner in temporary sediment pond;
 3. Liner for bermed temporary fuel storage area if plastic is not reactive to the type of fuel being stored;
 4. Emergency slope protection during heavy rains; and,
 5. Temporary drainpipe (“elephant trunk”) used to direct water.

***Design and
Installation
Specifications***

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

***Maintenance
Standards***

- Torn sheets must be replaced and open seams repaired.
- If the plastic begins to deteriorate due to ultraviolet radiation, it must be completely removed and replaced.
- When the plastic is no longer needed, it shall be completely removed.
- Dispose of old tires appropriately.

BMP C140: Dust Control

Purpose

Dust control prevents wind transport of dust from disturbed soil surfaces onto roadways, drainage ways, and surface waters.

Conditions of Use

- In areas (including roadways) subject to surface and air movement of dust where on-site and off-site impacts to roadways, drainage ways, or surface waters are likely.

Design and Installation Specifications

- Vegetate or mulch areas that will not receive vehicle traffic. In areas where planting, mulching, or paving is impractical, apply gravel or landscaping rock.
- Limit dust generation by clearing only those areas where immediate activity will take place, leaving the remaining area(s) in the original condition, if stable. Maintain the original ground cover as long as practical.
- Construct natural or artificial windbreaks or windscreens. These may be designed as enclosures for small dust sources.
- Sprinkle the site with water until surface is wet. Repeat as needed. To prevent carryout of mud onto street, refer to Stabilized Construction Entrance (BMP C105).
- Irrigation water can be used for dust control. Irrigation systems should be installed as a first step on sites where dust control is a concern.
- Spray exposed soil areas with a dust palliative, following the manufacturer's instructions and cautions regarding handling and application. Used oil is prohibited from use as a dust suppressant. Local governments may approve other dust palliatives such as calcium chloride or PAM.
- PAM (BMP C126) added to water at a rate of 0.5 lbs. per 1,000 gallons of water per acre and applied from a water truck is more effective than water alone. This is due to the increased infiltration of water into the soil and reduced evaporation. In addition, small soil particles are bonded together and are not as easily transported by wind. Adding PAM may actually reduce the quantity of water needed for dust control, especially in eastern Washington. Since the wholesale cost of PAM is about \$ 4.00 per pound, this is an extremely cost-effective dust control method.

Techniques that can be used for unpaved roads and lots include:

- Lower speed limits. High vehicle speed increases the amount of dust stirred up from unpaved roads and lots.
- Upgrade the road surface strength by improving particle size, shape, and mineral types that make up the surface and base materials.

- Add surface gravel to reduce the source of dust emission. Limit the amount of fine particles (those smaller than .075 mm) to 10 to 20 percent.
- Use geotextile fabrics to increase the strength of new roads or roads undergoing reconstruction.
- Encourage the use of alternate, paved routes, if available.
- Restrict use by tracked vehicles and heavy trucks to prevent damage to road surface and base.
- Apply chemical dust suppressants using the admix method, blending the product with the top few inches of surface material. Suppressants may also be applied as surface treatments.
- Pave unpaved permanent roads and other trafficked areas.
- Use vacuum street sweepers.
- Remove mud and other dirt promptly so it does not dry and then turn into dust.
- Limit dust-causing work on windy days.
- Contact your local Air Pollution Control Authority for guidance and training on other dust control measures. Compliance with the local Air Pollution Control Authority constitutes compliance with this BMP.

Maintenance Standards

Respray area as necessary to keep dust to a minimum.

BMP C209: Outlet Protection

<i>Purpose</i>	Outlet protection prevents scour at conveyance outlets and minimizes the potential for downstream erosion by reducing the velocity of concentrated stormwater flows.
<i>Conditions of use</i>	Outlet protection is required at the outlets of all ponds, pipes, ditches, or other conveyances, and where runoff is conveyed to a natural or manmade drainage feature such as a stream, wetland, lake, or ditch.
<i>Design and Installation Specifications</i>	<p>The receiving channel at the outlet of a culvert shall be protected from erosion by rock lining a minimum of 6 feet downstream and extending up the channel sides a minimum of 1-foot above the maximum tailwater elevation or 1-foot above the crown, whichever is higher. For large pipes (more than 18 inches in diameter), the outlet protection lining of the channel is lengthened to four times the diameter of the culvert.</p> <ul style="list-style-type: none">• Standard wingwalls, and tapered outlets and paved channels should also be considered when appropriate for permanent culvert outlet protection. (See WSDOT Hydraulic Manual, available through WSDOT Engineering Publications).• Organic or synthetic erosion blankets, with or without vegetation, are usually more effective than rock, cheaper, and easier to install. Materials can be chosen using manufacturer product specifications. ASTM test results are available for most products and the designer can choose the correct material for the expected flow.• With low flows, vegetation (including sod) can be effective.• The following guidelines shall be used for riprap outlet protection:<ol style="list-style-type: none">1. If the discharge velocity at the outlet is less than 5 fps (pipe slope less than 1 percent), use 2-inch to 8-inch riprap. Minimum thickness is 1-foot.2. For 5 to 10 fps discharge velocity at the outlet (pipe slope less than 3 percent), use 24-inch to 4-foot riprap. Minimum thickness is 2 feet.3. For outlets at the base of steep slope pipes (pipe slope greater than 10 percent), an engineered energy dissipater shall be used.• Filter fabric or erosion control blankets should always be used under riprap to prevent scour and channel erosion.• New pipe outfalls can provide an opportunity for low-cost fish habitat improvements. For example, an alcove of low-velocity water can be created by constructing the pipe outfall and associated energy dissipater back from the stream edge and digging a channel, over-widened to the upstream side, from the outfall. Overwintering juvenile and migrating adult salmonids may use the alcove as shelter during

high flows. Bank stabilization, bioengineering, and habitat features may be required for disturbed areas. See Volume V for more information on outfall system design.

***Maintenance
Standards***

- Inspect and repair as needed.
- Add rock as needed to maintain the intended function.
- Clean energy dissipater if sediment builds up.

BMP C220: Storm Drain Inlet Protection

Purpose To prevent coarse sediment from entering drainage systems prior to permanent stabilization of the disturbed area.

Conditions of Use Where storm drain inlets are to be made operational before permanent stabilization of the disturbed drainage area. Protection should be provided for all storm drain inlets downslope and within 500 feet of a disturbed or construction area, unless the runoff that enters the catch basin will be conveyed to a sediment pond or trap. Inlet protection may be used anywhere to protect the drainage system. It is likely that the drainage system will still require cleaning.

Table 4.9 lists several options for inlet protection. All of the methods for storm drain inlet protection are prone to plugging and require a high frequency of maintenance. Drainage areas should be limited to 1 acre or less. Emergency overflows may be required where stormwater ponding would cause a hazard. If an emergency overflow is provided, additional end-of-pipe treatment may be required.

Table 4.9 Storm Drain Inlet Protection			
Type of Inlet Protection	Emergency Overflow	Applicable for Paved/ Earthen Surfaces	Conditions of Use
Drop Inlet Protection			
Excavated drop inlet protection	Yes, temporary flooding will occur	Earthen	Applicable for heavy flows. Easy to maintain. Large area Requirement: 30' X 30'/acre
Block and gravel drop inlet protection	Yes	Paved or Earthen	Applicable for heavy concentrated flows. Will not pond.
Gravel and wire drop inlet protection	No		Applicable for heavy concentrated flows. Will pond. Can withstand traffic.
Catch basin filters	Yes	Paved or Earthen	Frequent maintenance required.
Curb Inlet Protection			
Curb inlet protection with a wooden weir	Small capacity overflow	Paved	Used for sturdy, more compact installation.
Block and gravel curb inlet protection	Yes	Paved	Sturdy, but limited filtration.
Culvert Inlet Protection			
Culvert inlet sediment trap			18 month expected life.

***Design and
Installation
Specifications***

Excavated Drop Inlet Protection - An excavated impoundment around the storm drain. Sediment settles out of the stormwater prior to entering the storm drain.

- Depth 1-2 ft as measured from the crest of the inlet structure.
- Side Slopes of excavation no steeper than 2:1.
- Minimum volume of excavation 35 cubic yards.
- Shape basin to fit site with longest dimension oriented toward the longest inflow area.
- Install provisions for draining to prevent standing water problems.
- Clear the area of all debris.
- Grade the approach to the inlet uniformly.
- Drill weep holes into the side of the inlet.
- Protect weep holes with screen wire and washed aggregate.
- Seal weep holes when removing structure and stabilizing area.
- It may be necessary to build a temporary dike to the down slope side of the structure to prevent bypass flow.

Block and Gravel Filter - A barrier formed around the storm drain inlet with standard concrete blocks and gravel. See Figure 4.14.

- Height 1 to 2 feet above inlet.
- Recess the first row 2 inches into the ground for stability.
- Support subsequent courses by placing a 2x4 through the block opening.
- Do not use mortar.
- Lay some blocks in the bottom row on their side for dewatering the pool.
- Place hardware cloth or comparable wire mesh with ½-inch openings over all block openings.
- Place gravel just below the top of blocks on slopes of 2:1 or flatter.
- An alternative design is a gravel donut.
- Inlet slope of 3:1.
- Outlet slope of 2:1.
- 1-foot wide level stone area between the structure and the inlet.
- Inlet slope stones 3 inches in diameter or larger.
- Outlet slope use gravel ½- to ¾-inch at a minimum thickness of 1-foot.

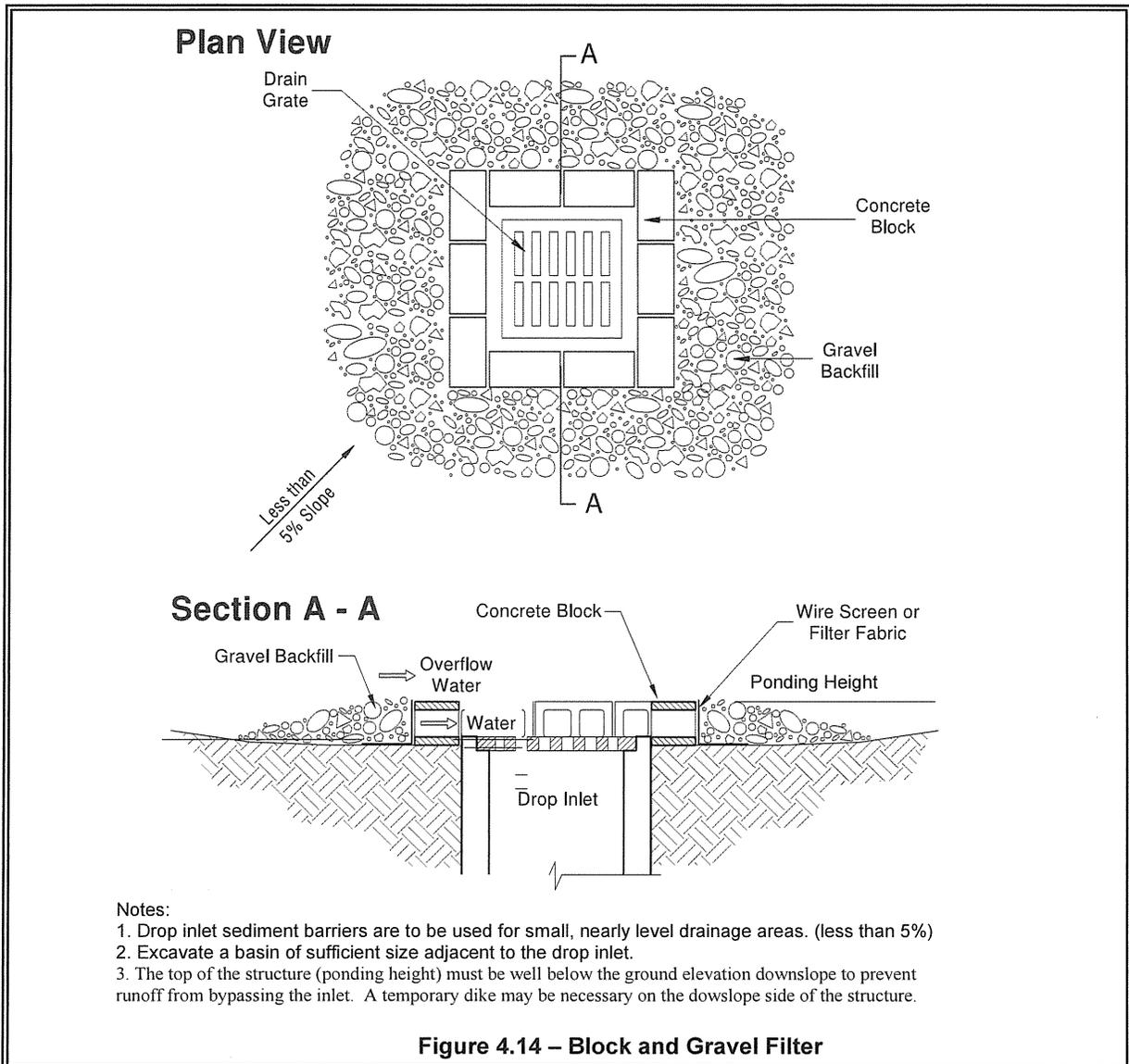


Figure 4.14 – Block and Gravel Filter

Gravel and Wire Mesh Filter - A gravel barrier placed over the top of the inlet. This structure does not provide an overflow.

- Hardware cloth or comparable wire mesh with ½-inch openings.
- Coarse aggregate.
- Height 1-foot or more, 18 inches wider than inlet on all sides.
- Place wire mesh over the drop inlet so that the wire extends a minimum of 1-foot beyond each side of the inlet structure.
- If more than one strip of mesh is necessary, overlap the strips.
- Place coarse aggregate over the wire mesh.
- The depth of the gravel should be at least 12 inches over the entire inlet opening and extend at least 18 inches on all sides.

Catchbasin Filters - Inserts should be designed by the manufacturer for use at construction sites. The limited sediment storage capacity increases the amount of inspection and maintenance required, which may be daily for heavy sediment loads. The maintenance requirements can be reduced by combining a catchbasin filter with another type of inlet protection. This type of inlet protection provides flow bypass without overflow and therefore may be a better method for inlets located along active rights-of-way.

- 5 cubic feet of storage.
- Dewatering provisions.
- High-flow bypass that will not clog under normal use at a construction site.
- The catchbasin filter is inserted in the catchbasin just below the grating.

Curb Inlet Protection with Wooden Weir – Barrier formed around a curb inlet with a wooden frame and gravel.

- Wire mesh with ½-inch openings.
- Extra strength filter cloth.
- Construct a frame.
- Attach the wire and filter fabric to the frame.
- Pile coarse washed aggregate against wire/fabric.
- Place weight on frame anchors.

Block and Gravel Curb Inlet Protection – Barrier formed around an inlet with concrete blocks and gravel. See Figure 4.14.

- Wire mesh with ½-inch openings.
- Place two concrete blocks on their sides abutting the curb at either side of the inlet opening. These are spacer blocks.
- Place a 2x4 stud through the outer holes of each spacer block to align the front blocks.
- Place blocks on their sides across the front of the inlet and abutting the spacer blocks.
- Place wire mesh over the outside vertical face.
- Pile coarse aggregate against the wire to the top of the barrier.

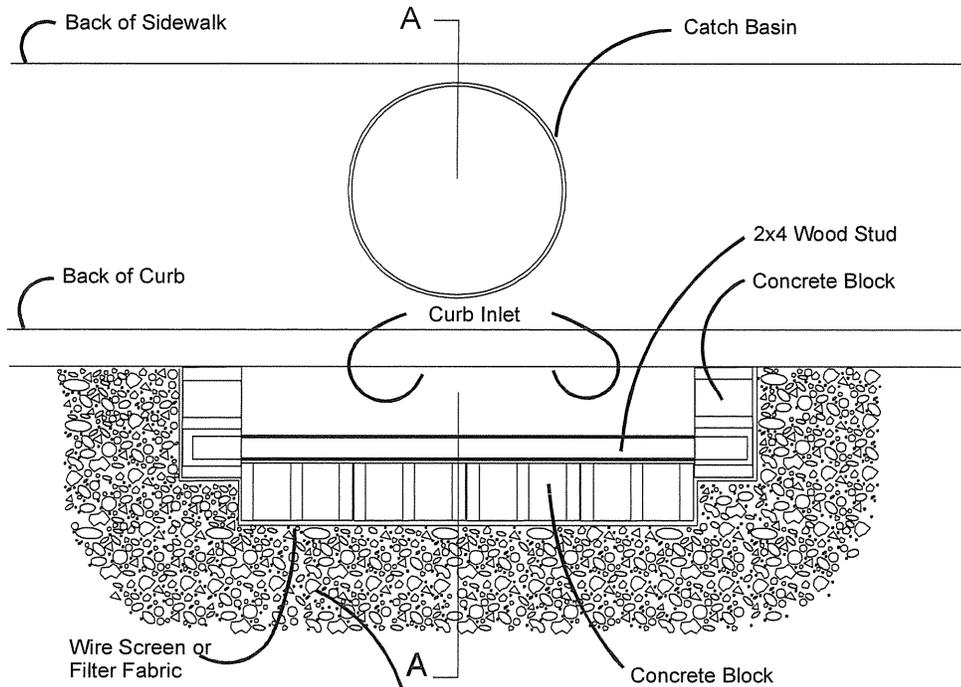
Curb and Gutter Sediment Barrier – Sandbag or rock berm (riprap and aggregate) 3 feet high and 3 feet wide in a horseshoe shape. See Figure 4.16.

- Construct a horseshoe shaped berm, faced with coarse aggregate if using riprap, 3 feet high and 3 feet wide, at least 2 feet from the inlet.
- Construct a horseshoe shaped sedimentation trap on the outside of the berm sized to sediment trap standards for protecting a culvert inlet.

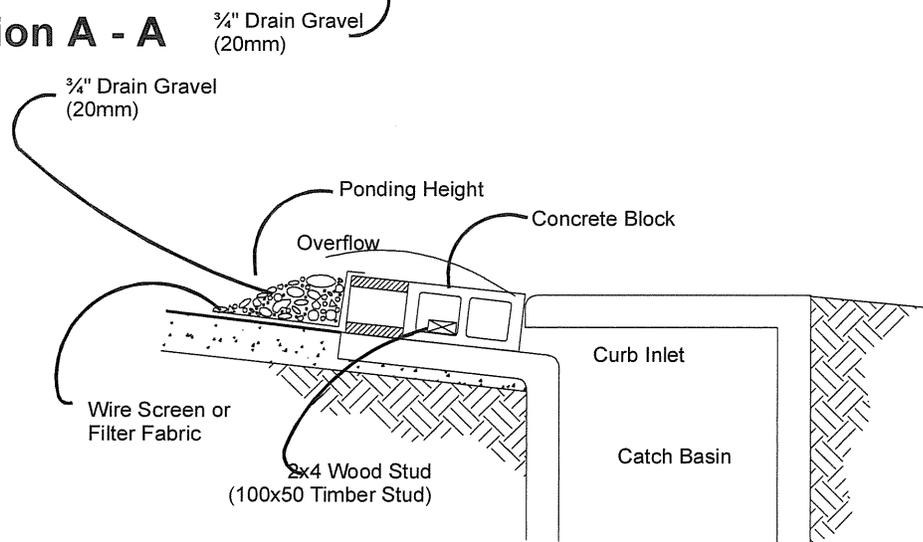
***Maintenance
Standards***

- Catch basin filters should be inspected frequently, especially after storm events. If the insert becomes clogged, it should be cleaned or replaced.
- For systems using stone filters: If the stone filter becomes clogged with sediment, the stones must be pulled away from the inlet and cleaned or replaced. Since cleaning of gravel at a construction site may be difficult, an alternative approach would be to use the clogged stone as fill and put fresh stone around the inlet.
- Do not wash sediment into storm drains while cleaning. Spread all excavated material evenly over the surrounding land area or stockpile and stabilize as appropriate.

Plan View



Section A - A

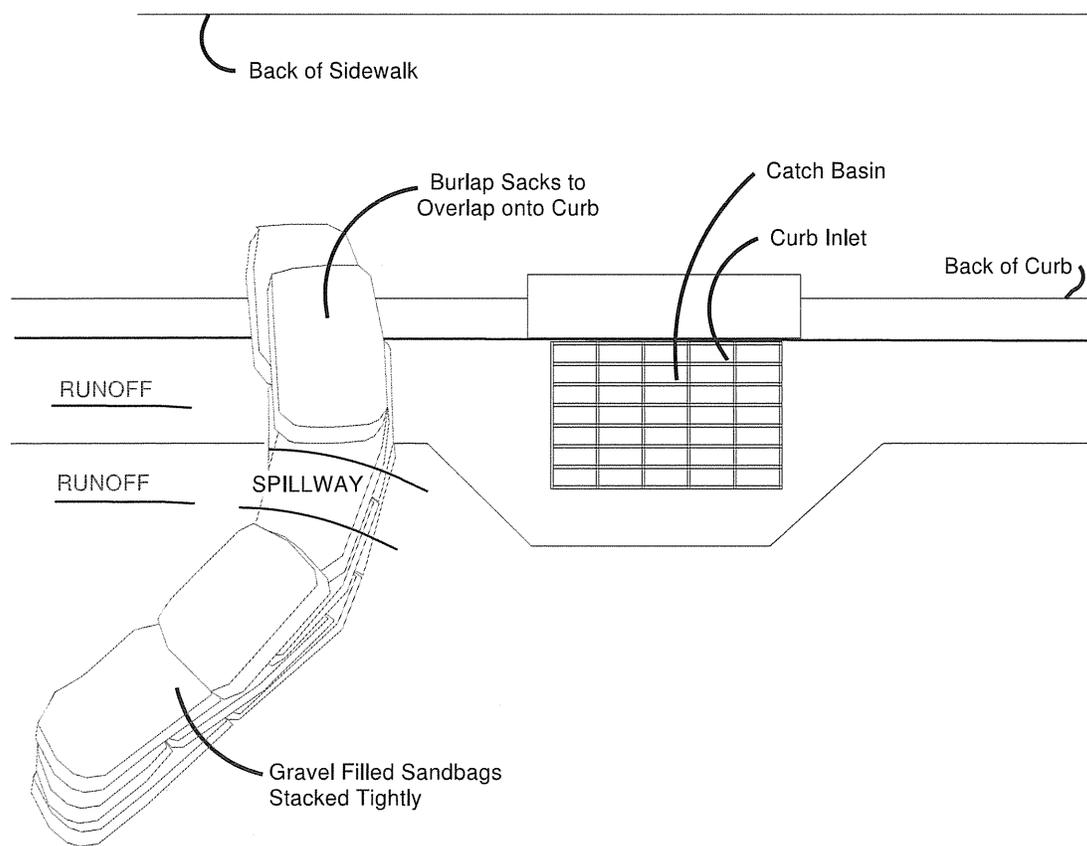


NOTES:

1. Use block and gravel type sediment barrier when curb inlet is located in gently sloping street segment, where water can pond and allow sediment to separate from runoff.
2. Barrier shall allow for overflow from severe storm event.
3. Inspect barriers and remove sediment after each storm event. Sediment and gravel must be removed from the traveled way immediately.

Figure 4.15 – Block and Gravel Curb Inlet Protection

Plan View



NOTES:

1. Place curb type sediment barriers on gently sloping street segments, where water can pond and allow sediment to separate from runoff.
2. Sandbags of either burlap or woven 'geotextile' fabric, are filled with gravel, layered and packed tightly.
3. Leave a one sandbag gap in the top row to provide a spillway for overflow.
4. Inspect barriers and remove sediment after each storm event. Sediment and gravel must be removed from the traveled way immediately.

Figure 4.16 – Curb and Gutter Barrier

BMP C230: Straw Bale Barrier

Purpose

To decrease the velocity of sheet flows and intercept and detain small amounts of sediment from disturbed areas of limited extent, preventing sediment from leaving the site. See Figure 4.17 for details on straw bale barriers.

Conditions of Use

Below disturbed areas subject to sheet and rill erosion.

- Straw bales are among the most used and **least effective BMPs**. The best use of a straw bale is hand spread on the site.
- Where the size of the drainage area is no greater than 1/4 acre per 100 feet of barrier length; the maximum slope length behind the barrier is 100 feet; and the maximum slope gradient behind the barrier is 2:1.
- Where effectiveness is required for less than three months.
- **Under no circumstances should straw bale barriers be constructed in streams, channels, or ditches.**
- Straw bale barriers should not be used where rock or hard surfaces prevent the full and uniform anchoring of the barrier.

Design and Installation Specifications

Bales shall be placed in a single row, lengthwise on the contour, with ends of adjacent bales tightly abutting one another.

All bales shall be either wire-bound or string-tied. Straw bales shall be installed so that bindings are oriented around the sides rather than along the tops and bottoms of the bales in order to prevent deterioration of the bindings.

- The barrier shall be entrenched and backfilled. A trench shall be excavated the width of a bale and the length of the proposed barrier to a minimum depth of 4 inches. The trench must be deep enough to remove all grass and other material that might allow underflow. After the bales are staked and chinked (filled by wedging), the excavated soil shall be backfilled against the barrier. Backfill soil shall conform to the ground level on the downhill side and shall be built up to 4 inches against the uphill side of the barrier.
- Each bale shall be securely anchored by at least two stakes or re-bars driven through the bale. The first stake in each bale shall be driven toward the previously laid bale to force the bales together. Stakes or re-bars shall be driven deep enough into the ground to securely anchor the bales. Stakes should not extend above the bales but instead should be driven in flush with the top of the bale for safety reasons.
- The gaps between the bales shall be chinked (filled by wedging) with straw to prevent water from escaping between the bales. Loose straw scattered over the area immediately uphill from a straw bale barrier tends to increase barrier efficiency. Wedging must be done carefully in order not to separate the bales.

BMP C233: Silt Fence

Purpose

Use of a silt fence reduces the transport of coarse sediment from a construction site by providing a temporary physical barrier to sediment and reducing the runoff velocities of overland flow. See Figure 4.19 for details on silt fence construction.

Conditions of Use

Silt fence may be used downslope of all disturbed areas.

- Silt fence is not intended to treat concentrated flows, nor is it intended to treat substantial amounts of overland flow. Any concentrated flows must be conveyed through the drainage system to a sediment pond. The only circumstance in which overland flow can be treated solely by a silt fence, rather than by a sediment pond, is when the area draining to the fence is one acre or less and flow rates are less than 0.5 cfs.
- Silt fences should not be constructed in streams or used in V-shaped ditches. They are not an adequate method of silt control for anything deeper than sheet or overland flow.

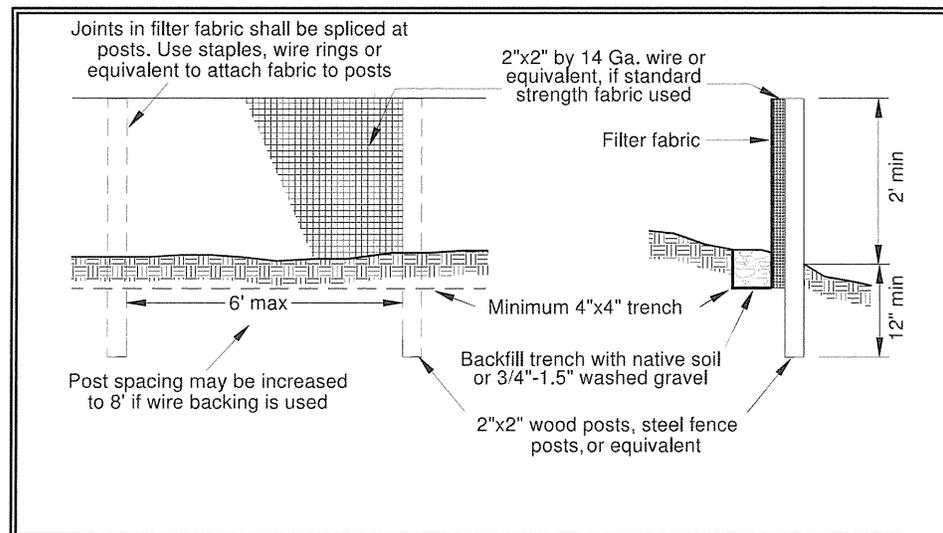


Figure 4.19 – Silt Fence

Design and Installation Specifications

- Drainage area of 1 acre or less or in combination with sediment basin in a larger site.
- Maximum slope steepness (normal (perpendicular) to fence line) 1:1.
- Maximum sheet or overland flow path length to the fence of 100 feet.
- No flows greater than 0.5 cfs.
- The geotextile used shall meet the following standards. All geotextile properties listed below are minimum average roll values (i.e., the test result for any sampled roll in a lot shall meet or exceed the values shown in Table 4.10):

Table 4.10 Geotextile Standards	
Polymeric Mesh AOS (ASTM D4751)	0.60 mm maximum for slit film wovens (#30 sieve). 0.30 mm maximum for all other geotextile types (#50 sieve). 0.15 mm minimum for all fabric types (#100 sieve).
Water Permittivity (ASTM D4491)	0.02 sec ⁻¹ minimum
Grab Tensile Strength (ASTM D4632)	180 lbs. Minimum for extra strength fabric. 100 lbs minimum for standard strength fabric.
Grab Tensile Strength (ASTM D4632)	30% maximum
Ultraviolet Resistance (ASTM D4355)	70% minimum

- Standard strength fabrics shall be supported with wire mesh, chicken wire, 2-inch x 2-inch wire, safety fence, or jute mesh to increase the strength of the fabric. Silt fence materials are available that have synthetic mesh backing attached.
- Filter fabric material shall contain ultraviolet ray inhibitors and stabilizers to provide a minimum of six months of expected usable construction life at a temperature range of 0°F. to 120°F.
- 100 percent biodegradable silt fence is available that is strong, long lasting, and can be left in place after the project is completed, if permitted by local regulations.
- Standard Notes for construction plans and specifications follow. Refer to Figure 4.19 for standard silt fence details.

The contractor shall install and maintain temporary silt fences at the locations shown in the Plans. The silt fences shall be constructed in the areas of clearing, grading, or drainage prior to starting those activities. A silt fence shall not be considered temporary if the silt fence must function beyond the life of the contract. The silt fence shall prevent soil carried by runoff water from going beneath, through, or over the top of the silt fence, but shall allow the water to pass through the fence.

The minimum height of the top of silt fence shall be 2 feet and the maximum height shall be 2½ feet above the original ground surface.

The geotextile shall be sewn together at the point of manufacture, or at an approved location as determined by the Engineer, to form geotextile lengths as required. All sewn seams shall be located at a support post. Alternatively, two sections of silt fence can be overlapped, provided the Contractor can demonstrate, to the satisfaction of the Engineer, that the overlap is long enough and that the adjacent fence sections are close enough together to prevent silt laden water from escaping through the fence at the overlap.

The geotextile shall be attached on the up-slope side of the posts and support system with staples, wire, or in accordance with the manufacturer's recommendations. The geotextile shall be attached to the posts in a manner that reduces the potential for geotextile tearing at the staples, wire, or other connection device. Silt fence back-up support for the geotextile in the form of a wire or plastic mesh is dependent on the properties of the geotextile selected for use. If wire or plastic back-up mesh is used, the mesh shall be fastened securely to the up-slope of the posts with the geotextile being up-slope of the mesh back-up support.

The geotextile at the bottom of the fence shall be buried in a trench to a minimum depth of 4 inches below the ground surface. The trench shall be backfilled and the soil tamped in place over the buried portion of the geotextile, such that no flow can pass beneath the fence and scouring can not occur. When wire or polymeric back-up support mesh is used, the wire or polymeric mesh shall extend into the trench a minimum of 3 inches.

The fence posts shall be placed or driven a minimum of 18 inches. A minimum depth of 12 inches is allowed if topsoil or other soft subgrade soil is not present and a minimum depth of 18 inches cannot be reached. Fence post depths shall be increased by 6 inches if the fence is located on slopes of 3:1 or steeper and the slope is perpendicular to the fence. If required post depths cannot be obtained, the posts shall be adequately secured by bracing or guying to prevent overturning of the fence due to sediment loading.

Silt fences shall be located on contour as much as possible, except at the ends of the fence, where the fence shall be turned uphill such that the silt fence captures the runoff water and prevents water from flowing around the end of the fence.

If the fence must cross contours, with the exception of the ends of the fence, gravel check dams placed perpendicular to the back of the fence shall be used to minimize concentrated flow and erosion along the back of the fence. The gravel check dams shall be approximately 1-foot deep at the back of the fence. It shall be continued perpendicular to the fence at the same elevation until the top of the check dam intercepts the ground surface behind the fence. The gravel check dams shall consist of crushed surfacing base course, gravel backfill for walls, or shoulder ballast. The gravel check dams shall be located every 10 feet along the fence where the fence must cross contours. The slope of the fence line where contours must be crossed shall not be steeper than 3:1.

Wood, steel or equivalent posts shall be used. Wood posts shall have minimum dimensions of 2 inches by 2 inches by 3 feet minimum length, and shall be free of defects such as knots, splits, or gouges.

Steel posts shall consist of either size No. 6 rebar or larger, ASTM A 120 steel pipe with a minimum diameter of 1-inch, U, T, L, or C shape steel posts with a minimum weight of 1.35 lbs./ft. or other steel posts having equivalent strength and bending resistance to the post sizes listed. The spacing of the support posts shall be a maximum of 6 feet.

Fence back-up support, if used, shall consist of steel wire with a maximum mesh spacing of 2 inches, or a prefabricated polymeric mesh. The strength of the wire or polymeric mesh shall be equivalent to or greater than 180 lbs. grab tensile strength. The polymeric mesh must be as resistant to ultraviolet radiation as the geotextile it supports.

- Silt fence installation using the slicing method specification details follow. Refer to Figure 4.20 for slicing method details.

The base of both end posts must be at least 2 to 4 inches above the top of the silt fence fabric on the middle posts for ditch checks to drain properly. Use a hand level or string level, if necessary, to mark base points before installation.

Install posts 3 to 4 feet apart in critical retention areas and 6 to 7 feet apart in standard applications.

Install posts 24 inches deep on the downstream side of the silt fence, and as close as possible to the fabric, enabling posts to support the fabric from upstream water pressure.

Install posts with the nipples facing away from the silt fence fabric.

Attach the fabric to each post with three ties, all spaced within the top 8 inches of the fabric. Attach each tie diagonally 45 degrees through the fabric, with each puncture at least 1 inch vertically apart. In addition, each tie should be positioned to hang on a post nipple when tightening to prevent sagging.

Wrap approximately 6 inches of fabric around the end posts and secure with 3 ties.

No more than 24 inches of a 36-inch fabric is allowed above ground level.

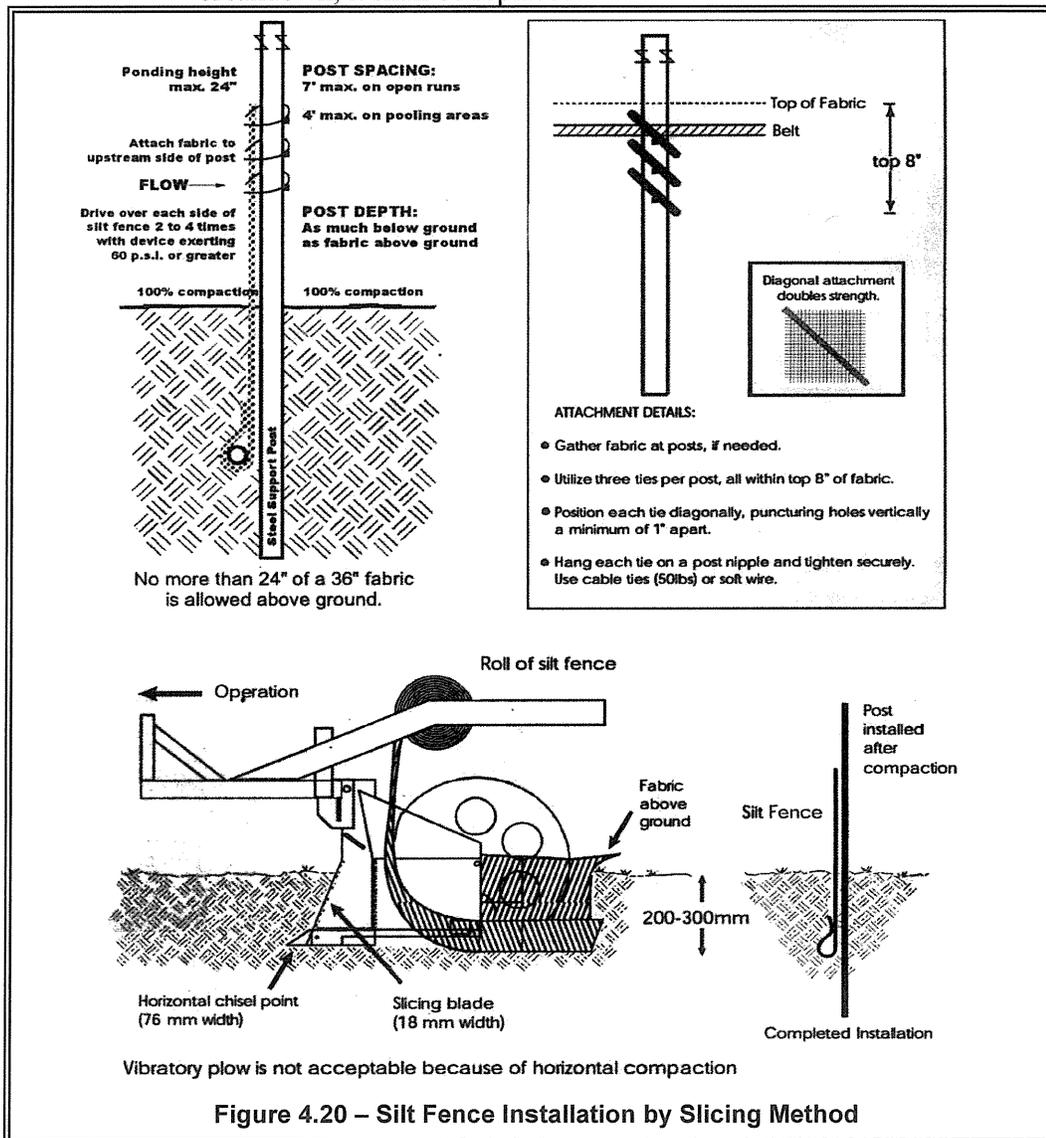
The rope lock system must be used in all ditch check applications.

The installation should be checked and corrected for any deviation before compaction. Use a flat-bladed shovel to tuck fabric deeper into the ground if necessary.

Compaction is vitally important for effective results. Compact the soil immediately next to the silt fence fabric with the front wheel of the tractor, skid steer, or roller exerting at least 60 pounds per square inch. Compact the upstream side first and then each side twice for a total of four trips.

Maintenance Standards

- Any damage shall be repaired immediately.
- If concentrated flows are evident uphill of the fence, they must be intercepted and conveyed to a sediment pond.
- It is important to check the uphill side of the fence for signs of the fence clogging and acting as a barrier to flow and then causing channelization of flows parallel to the fence. If this occurs, replace the fence or remove the trapped sediment.
- Sediment deposits shall either be removed when the deposit reaches approximately one-third the height of the silt fence, or a second silt fence shall be installed.
- If the filter fabric (geotextile) has deteriorated due to ultraviolet breakdown, it shall be replaced.



BMP C240: Sediment Trap

Purpose

A sediment trap is a small temporary ponding area with a gravel outlet used to collect and store sediment from sites cleared and/or graded during construction. Sediment traps, along with other perimeter controls, shall be installed before any land disturbance takes place in the drainage area.

Conditions of Use

Prior to leaving a construction site, stormwater runoff must pass through a sediment pond or trap or other appropriate sediment removal best management practice. Non-engineered sediment traps may be used on-site prior to an engineered sediment trap or sediment pond to provide additional sediment removal capacity.

It is intended for use on sites where the tributary drainage area is less than 3 acres, with no unusual drainage features, and a projected build-out time of six months or less. The sediment trap is a temporary measure (with a design life of approximately 6 months) and shall be maintained until the site area is permanently protected against erosion by vegetation and/or structures.

Sediment traps and ponds are only effective in removing sediment down to about the medium silt size fraction. Runoff with sediment of finer grades (fine silt and clay) will pass through untreated, emphasizing the need to control erosion to the maximum extent first.

Whenever possible, sediment-laden water shall be discharged into onsite, relatively level, vegetated areas (see BMP C234 – Vegetated Strip). This is the only way to effectively remove fine particles from runoff unless chemical treatment or filtration is used. This can be particularly useful after initial treatment in a sediment trap or pond. The areas of release must be evaluated on a site-by-site basis in order to determine appropriate locations for and methods of releasing runoff. Vegetated wetlands shall not be used for this purpose. Frequently, it may be possible to pump water from the collection point at the downhill end of the site to an upslope vegetated area. Pumping shall only augment the treatment system, not replace it, because of the possibility of pump failure or runoff volume in excess of pump capacity.

All projects that are constructing permanent facilities for runoff quantity control should use the rough-graded or final-graded permanent facilities for traps and ponds. This includes combined facilities and infiltration facilities. When permanent facilities are used as temporary sedimentation facilities, the surface area requirement of a sediment trap or pond must be met. If the surface area requirements are larger than the surface area of the permanent facility, then the trap or pond shall be enlarged to comply with the surface area requirement. The permanent pond shall also be divided into two cells as required for sediment ponds.

Either a permanent control structure or the temporary control structure (described in BMP C241, Temporary Sediment Pond) can be used. If a permanent control structure is used, it may be advisable to partially restrict the lower orifice with gravel to increase residence time while still allowing dewatering of the pond. A shut-off valve may be added to the control structure to allow complete retention of stormwater in emergency situations. In this case, an emergency overflow weir must be added.

A skimmer may be used for the sediment trap outlet if approved by the Local Permitting Authority.

***Design and
Installation
Specifications***

- See Figures 4.22 and 4.23 for details.
- If permanent runoff control facilities are part of the project, they should be used for sediment retention.
- To determine the sediment trap geometry, first calculate the design surface area (SA) of the trap, measured at the invert of the weir. Use the following equation:

$$SA = FS(Q_2/V_s)$$

where

Q_2 = Design inflow based on the peak discharge from the developed 2-year runoff event from the contributing drainage area as computed in the hydrologic analysis. The 10-year peak flow shall be used if the project size, expected timing and duration of construction, or downstream conditions warrant a higher level of protection. If no hydrologic analysis is required, the Rational Method may be used.

V_s = The settling velocity of the soil particle of interest. The 0.02 mm (medium silt) particle with an assumed density of 2.65 g/cm³ has been selected as the particle of interest and has a settling velocity (V_s) of 0.00096 ft/sec.

FS = A safety factor of 2 to account for non-ideal settling.

Therefore, the equation for computing surface area becomes:

$$SA = 2 \times Q_2 / 0.00096 \text{ or}$$

2080 square feet per cfs of inflow

Note: Even if permanent facilities are used, they must still have a surface area that is at least as large as that derived from the above formula. If they do not, the pond must be enlarged.

- To aid in determining sediment depth, all sediment traps shall have a staff gauge with a prominent mark 1-foot above the bottom of the trap.

- Sediment traps may not be feasible on utility projects due to the limited work space or the short-term nature of the work. Portable tanks may be used in place of sediment traps for utility projects.

Maintenance Standards

- Sediment shall be removed from the trap when it reaches 1-foot in depth.
- Any damage to the pond embankments or slopes shall be repaired.

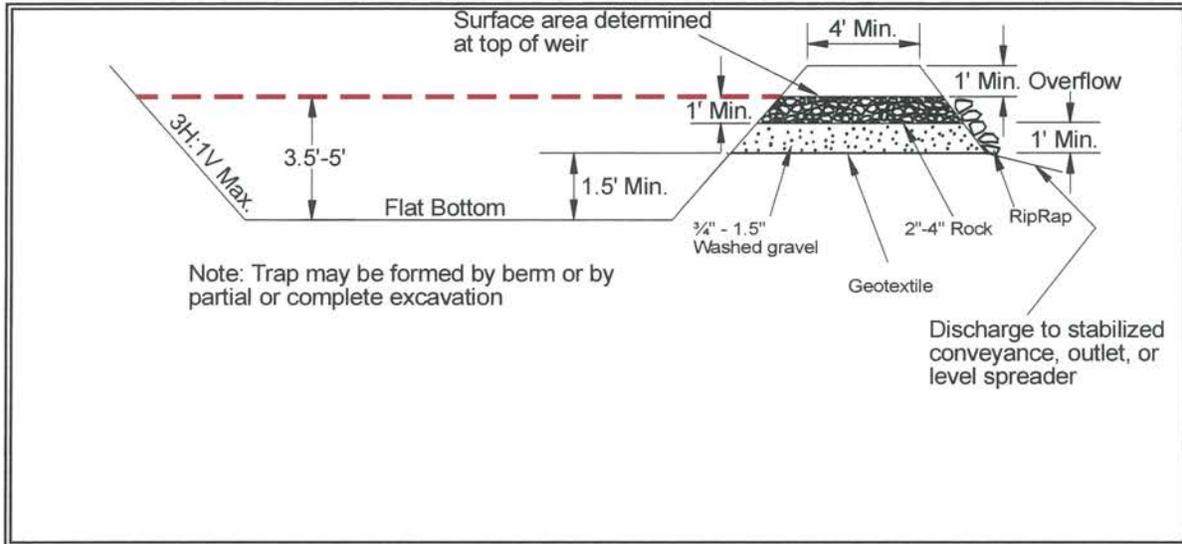


Figure 4.22 Cross Section of Sediment Trap

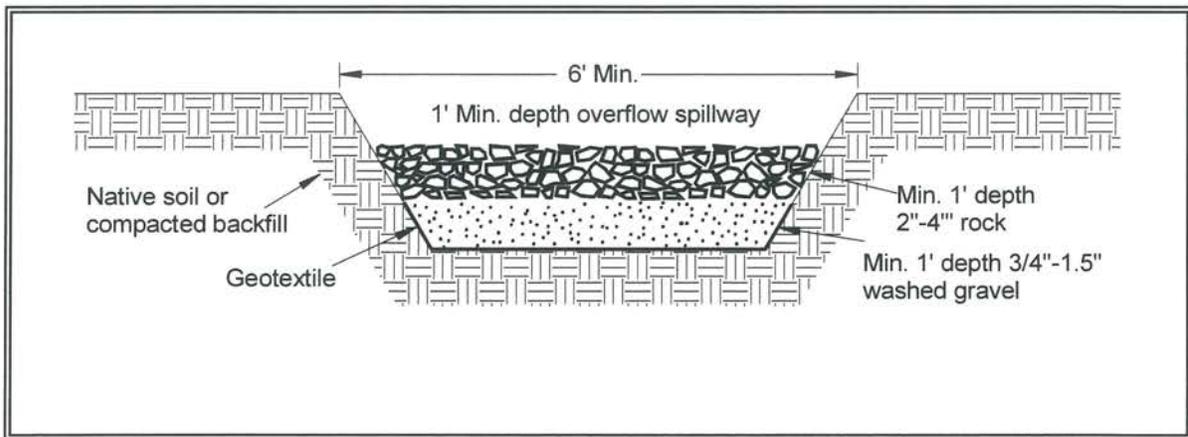


Figure 4.23 Sediment Trap Outlet

Appendix E.2

Sediment Trap Sizing Calculations

Size Sediment Trap (2005 DOE)

Surface Area = $FS(Q_2/V_{sed})$

Q₂ = 0.49 cfs (Peak Flow , developed 2-yr return period)

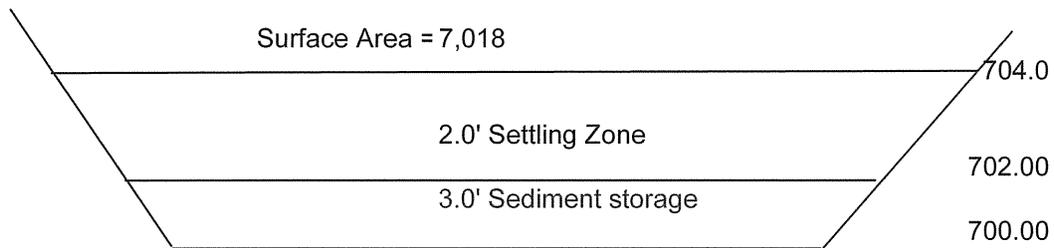
V_{sed} = 0.00096 ft/s (Particle Settling Velocity-All Soils)

FS = 2 (Factor of Safety)

SA = $2*Q_2 / V_{sed}$ = **1029.17** sf, (Surface area at Top of Overflow Weir)

(Per 2005 DOE BMP C240: Sediment Trap)

Project proposes to utilize the permanent stormwater pond for sediment control



Appendix F

Operations & Maintenance Manual



Carbcom Properties LLC
PRIVATE STORM DRAINAGE
MAINTENANCE AND POLLUTION CONTROL PLAN

FOR: Carbcom Properties, LLC
10010 181st Avenue Court East
Bonney Lake, WA 98391

BY: LEROY SURVEYORS & ENGINEERS, INC.
P.O. Box 740
Puyallup, WA 98371
(253) 848-6608

DATE: March 2016

JOB NO: 10537

ENGINEER: Steve T. Nelson, P.E.

CONTACT: Steve T. Nelson, P.E.
LeRoy Surveyors & Engineers, Inc.
P.O. Box 740
Puyallup, WA 98371
(253)-848-6608

MAINTENANCE PLAN

An “Agreement to Maintain Stormwater Facilities and to Implement a Pollution Source Control Plan” must be made between the property owner and the City of Buckley. The private drainage facilities will be owned and maintained by the owner of the property.

This attachment includes checklists for maintenance of the storm drainage facilities. Maintenance is required on the following items:

- Catch Basins
- Fencing/Shrubbery Screen/Other Landscaping
- Grounds
- Conveyance Systems
- Amended Soil
- Paving

Each of these facilities requires inspections after major storms as well as on a monthly and annual basis. The checklists include specific interval and maintenance information.

The cost of maintaining the proposed storm drainage facilities for this project is estimated to be approximately \$1,500 per year.

During construction and until the site has stabilized, the temporary erosion and sedimentation controls also require maintenance. The TESC facilities utilized for this project include siltation fencing. Maintenance for the fencing should include inspections after every major storm event as well as monthly inspections. The fence should be repaired or replaced whenever it cannot function as designed. The design of the fence is to allow surface runoff to filter through while sediment is filtered out. Sediment should be removed whenever it restricts flow through the fence or achieves a depth of six inches.

The detention/wet pond should be inspected once per year, preferably in late summer and after major storm events. The pond should be checked for accumulated sediment that exceeds 10% of the designed pond depth, or affects inletting or outletting condition of the facility. Other conditions requiring maintenance are listed in the maintenance stands attached in the appendix of this report.

The catch basins should be inspected once per year, preferably in late summer and after major storm events. The debris barriers should be inspected once per year, preferably in late summer and after major storm events. The grounds should be inspected once per year, preferably in late summer and after major storm events. The conveyance systems should be inspected once per year, preferably in late summer and after major storm events. Any soils that are amended should be inspected once per year, preferably in late summer and after major storm events. Weeds should be removed monthly. The asphalt pavement should be inspected once per year, preferably in late summer and after major storm events. It may be necessary to adjust the inspection/maintenance schedule depending on the actual operating conditions encountered by the system. In general, inspection activities can be conducted any time, and maintenance should occur, if warranted, in late summer to early fall when flows into the system are not likely to be present.

Organization Responsible for Maintenance

The property owner is responsible for maintenance of the storm drainage facilities for this project.

ATTACHMENT "A"

**CARBCOM PROPERTIES, LLC COMMERCIAL SITE
PRIVATE STORM DRAINAGE**

**MAINTENANCE PROGRAM
COVER SHEET FOR CITY OF BUCKLEY**

Inspection Period: _____

Number of Sheets Attached: _____

Date Inspected: _____

Name of Inspector: _____

Inspector's Signature: _____

INSTRUCTIONS FOR USE OF MAINTENANCE CHECKLISTS

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

- (M) Monthly from November through April.
- (A) Once in late summer (preferable September)
- (S) After any major storm (use 1-inch in 24 hours as a guideline).

Use photocopies of these pages and check off the problems you looked for each time you did an inspection. Add comments on problems found and actions taken. Keep these "checked" sheets in your files, as they will be used to write your annual report (due in May). Some items do not need to be looked at every time an inspection is done. Use the suggested frequency at the left of each item as a guideline for your inspection.

The facility-specific maintenance standards contained in this section are intended to be conditions for determining if maintenance actions are required as identified through inspection. They are not intended to be measures of the facility's required condition at all times between inspections. In other words, exceeding these conditions at any time between inspections and/or maintenance does not automatically constitute a violation of these standards. However, based upon inspection observations, the inspection and maintenance schedules shall be adjusted to minimize the length of time that a facility is in a condition that requires a maintenance action.

4.6 Maintenance Standards for Drainage Facilities

The facility-specific maintenance standards contained in this section are intended to be conditions for determining if maintenance actions are required as identified through inspection. They are not intended to be measures of the facility's required condition at all times between inspections. In other words, exceedence of these conditions at any time between inspections and/or maintenance does not automatically constitute a violation of these standards. However, based upon inspection observations, the inspection and maintenance schedules shall be adjusted to minimize the length of time that a facility is in a condition that requires a maintenance action.

Table 4.5 – Maintenance Standards

No. 1 – Detention Ponds

Maintenance Component	Defect	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed
General	Trash & Debris	Any trash and debris which exceed 5 cubic feet per 1,000 square feet (this is about equal to the amount of trash it would take to fill up one standard size garbage can). In general, there should be no visual evidence of dumping. If less than threshold all trash and debris will be removed as part of next scheduled maintenance.	Trash and debris cleared from site.
	Poisonous Vegetation and noxious weeds	Any poisonous or nuisance vegetation which may constitute a hazard to maintenance personnel or the public. Any evidence of noxious weeds as defined by State or local regulations. (Apply requirements of adopted IPM policies for the use of herbicides).	No danger of poisonous vegetation where maintenance personnel or the public might normally be. (Coordinate with local health department) Complete eradication of noxious weeds may not be possible. Compliance with State or local eradication policies required
	Contaminants and Pollution	Any evidence of oil, gasoline, contaminants or other pollutants (Coordinate removal/cleanup with local water quality response agency).	No contaminants or pollutants present.
	Rodent Holes	Any evidence of rodent holes if facility is acting as a dam or berm, or any evidence of water piping through dam or berm via rodent holes.	Rodents destroyed and dam or berm repaired. (Coordinate with local health department; coordinate with Ecology Dam Safety Office if pond exceeds 10 acre-feet.)

No. 1 – Detention Ponds

Maintenance Component	Defect	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed
	Beaver Dams	Dam results in change or function of the facility.	Facility is returned to design function. (Coordinate trapping of beavers and removal of dams with appropriate permitting agencies)
	Insects	When insects such as wasps and hornets interfere with maintenance activities.	Insects destroyed or removed from site. Apply insecticides in compliance with adopted IPM policies
	Tree Growth and Hazard Trees	Tree growth does not allow maintenance access or interferes with maintenance activity (i.e., slope mowing, silt removal, vactoring, or equipment movements). If trees are not interfering with access or maintenance, do not remove If dead, diseased, or dying trees are identified (Use a certified Arborist to determine health of tree or removal requirements)	Trees do not hinder maintenance activities. Harvested trees should be recycled into mulch or other beneficial uses (e.g., alders for firewood). Remove hazard Trees
Side Slopes of Pond	Erosion	Eroded damage over 2 inches deep where cause of damage is still present or where there is potential for continued erosion. Any erosion observed on a compacted berm embankment.	Slopes should be stabilized using appropriate erosion control measure(s); e.g., rock reinforcement, planting of grass, compaction. If erosion is occurring on compacted berms a licensed civil engineer should be consulted to resolve source of erosion.
Storage Area	Sediment	Accumulated sediment that exceeds 10% of the designed pond depth unless otherwise specified or affects inletting or outletting condition of the facility.	Sediment cleaned out to designed pond shape and depth; pond reseeded if necessary to control erosion.
	Liner (If Applicable)	Liner is visible and has more than three 1/4-inch holes in it.	Liner repaired or replaced. Liner is fully covered.

No. 1 – Detention Ponds

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

No. 4 – Control Structure/Flow Restrictor

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Trash and Debris (Includes Sediment)	Material exceeds 25% of sump depth or 1 foot below orifice plate.	Control structure orifice is not blocked. All trash and debris removed.
	Structural Damage	Structure is not securely attached to manhole wall.	Structure securely attached to wall and outlet pipe.
		Structure is not in upright position (allow up to 10% from plumb).	Structure 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.
Manhole	See "Closed Detention Systems" (No. 3).	See "Closed Detention Systems" (No. 3).	See "Closed Detention Systems" (No. 3).
Catch Basin	See "Catch Basins" (No. 5).	See "Catch Basins" (No. 5).	See "Catch Basins" (No. 5).

No. 5 – Catch Basins

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is performed
General	Trash & Debris	Trash or debris which is located immediately in front of the catch basin opening or is blocking inletting capacity of the basin by more than 10%.	No Trash or debris located immediately in front of catch basin or on grate opening.
		Trash or debris (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of six inches clearance from the debris surface to the invert of the lowest pipe.	No trash or debris in the catch basin.
		Trash or debris in any inlet or outlet pipe blocking more than 1/3 of its height.	Inlet and outlet pipes free of trash or debris.
		Dead animals or vegetation that could generate odors that could cause complaints or dangerous gases (e.g., methane).	No dead animals or vegetation present within the catch basin.
	Sediment	Sediment (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of 6 inches clearance from the sediment surface to the invert of the lowest pipe.	No sediment in the catch basin
	Structure Damage to Frame and/or Top Slab	Top slab has holes larger than 2 square inches or cracks wider than 1/4 inch (Intent is to make sure no material is running into basin).	Top slab is free of holes and cracks.
		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	Maintenance person judges that structure is unsound.	Basin 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 regouted and secure at basin wall.
	Settlement/ Misalignment	If failure of basin has created a safety, function, or design problem.	Basin replaced or repaired to design standards.
	Vegetation	Vegetation growing across and blocking more than 10% of the basin opening.	No vegetation blocking opening to basin.
		Vegetation growing in inlet/outlet pipe joints that is more than six inches tall and less than six inches apart.	No vegetation or root growth present.

No. 5 – Catch Basins

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is performed
	Contamination and Pollution	See "Detention Ponds" (No. 1).	No pollution present.
Catch Basin Cover	Cover Not in Place	Cover is missing or only partially in place. Any open catch basin requires maintenance.	Catch basin cover is closed
	Locking Mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than 1/2 inch of thread.	Mechanism opens with proper tools.
	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure. (Intent is keep cover from sealing off access to maintenance.)	Cover can be removed by one maintenance person.
Ladder	Ladder Rungs Unsafe	Ladder is unsafe due to missing rungs, not securely attached to basin wall, misalignment, rust, cracks, or sharp edges.	Ladder meets design standards and allows maintenance person safe access.
Metal Grates (If Applicable)	Grate opening Unsafe	Grate with opening wider than 7/8 inch.	Grate opening meets design standards.
	Trash and Debris	Trash and debris that is blocking more than 20% of grate surface inletting capacity.	Grate free of trash and debris.
	Damaged or Missing.	Grate missing or broken member(s) of the grate.	Grate is in place and meets design standards.

No. 6 – Debris Barriers (e.g., Trash Racks)

Maintenance Components	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Trash and Debris	Trash or debris that is plugging more than 20% of the openings in the barrier.	Barrier cleared to design flow capacity.
Metal	Damaged/ Missing Bars.	Bars are bent out of shape more than 3 inches.	Bars in place with no bends more than 3/4 inch.
		Bars are missing or entire barrier missing.	Bars in place according to design.
		Bars are loose and rust is causing 50% deterioration to any part of barrier.	Barrier replaced or repaired to design standards.
	Inlet/Outlet Pipe	Debris barrier missing or not attached to pipe	Barrier firmly attached to pipe

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).

No. 11 – Wetponds

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Water level	First cell is empty, doesn't hold water.	Line the first cell to maintain at least 4 feet of water. Although the second cell may drain, the first cell must remain full to control turbulence of the incoming flow and reduce sediment resuspension.
	Trash and Debris	Accumulation that exceeds 1 CF per 1000-SF of pond area.	Trash and debris removed from pond.
	Inlet/Outlet Pipe	Inlet/Outlet pipe clogged with sediment and/or debris material.	No clogging or blockage in the inlet and outlet piping.
	Sediment Accumulation in Pond Bottom	Sediment accumulations in pond bottom that exceeds the depth of sediment zone plus 6-inches, usually in the first cell.	Sediment removed from pond bottom.
	Oil Sheen on Water	Prevalent and visible oil sheen.	Oil removed from water using oil-absorbent pads or vactor truck. Source of oil located and corrected. If chronic low levels of oil persist, plant wetland plants such as <i>Juncus effusus</i> (soft rush) which can uptake small concentrations of oil.
	Erosion	Erosion of the pond's side slopes and/or scouring of the pond bottom, that exceeds 6-inches, or where continued erosion is prevalent.	Slopes stabilized using proper erosion control measures and repair methods.
	Settlement of Pond Dike/Berm	Any part of these components that has settled 4-inches or lower than the design elevation, or inspector determines dike/berm is unsound.	Dike/berm is repaired to specifications.
	Internal Berm	Berm dividing cells should be level.	Berm surface is leveled so that water flows evenly over entire length of berm.
Overflow Spillway	Rock is missing and soil is exposed at top of spillway or outside slope.	Rocks replaced to specifications.	