West Hendrickson Road
8 Plex site

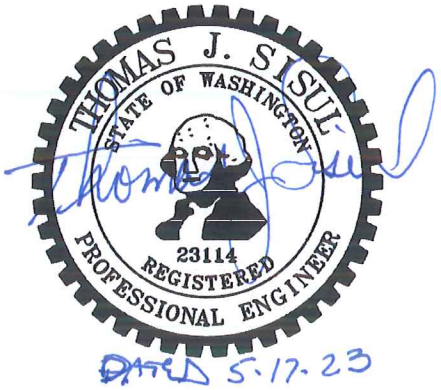
Parcel #03-30-19-82-0570

Sequim, WA

J.O. SVA 21-004

November 15, 2021
Updated May 17, 2023

TECHNICAL INFORMATION REPORT AND HYDROLOGY CALCULATIONS



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SECTION A – PROJECT OVERVIEW:

EXISTING SITE INFORMATION:
The site, currently without an address, is on the south side of W. Hendrickson Road between parcels with the address of 625 W. Hendrickson Road and 660 N. 7th Avenue (Parcel #033019820570). The site is 17,919 SF (0.41 acres) total area. There are no existing structures on the site, and the site is covered with pasture type grasses.

There are no known storm drainage facilities on the site.

DEVELOPED SITE INFORMATION:
Eight (8) attached townhome style dwellings will be constructed on the site. The dwellings will have rear entry garages coming off a shared driveway that has connection to W. Hendrickson Road.

The new impervious area (buildings, sidewalk, and pavement areas) will be approximately 15,431 SF. The landscape area will total approximately 2,488 SF. (Impervious area based on the Designer's plans dated 9-21-21

USGS Quadrangle Map of the site

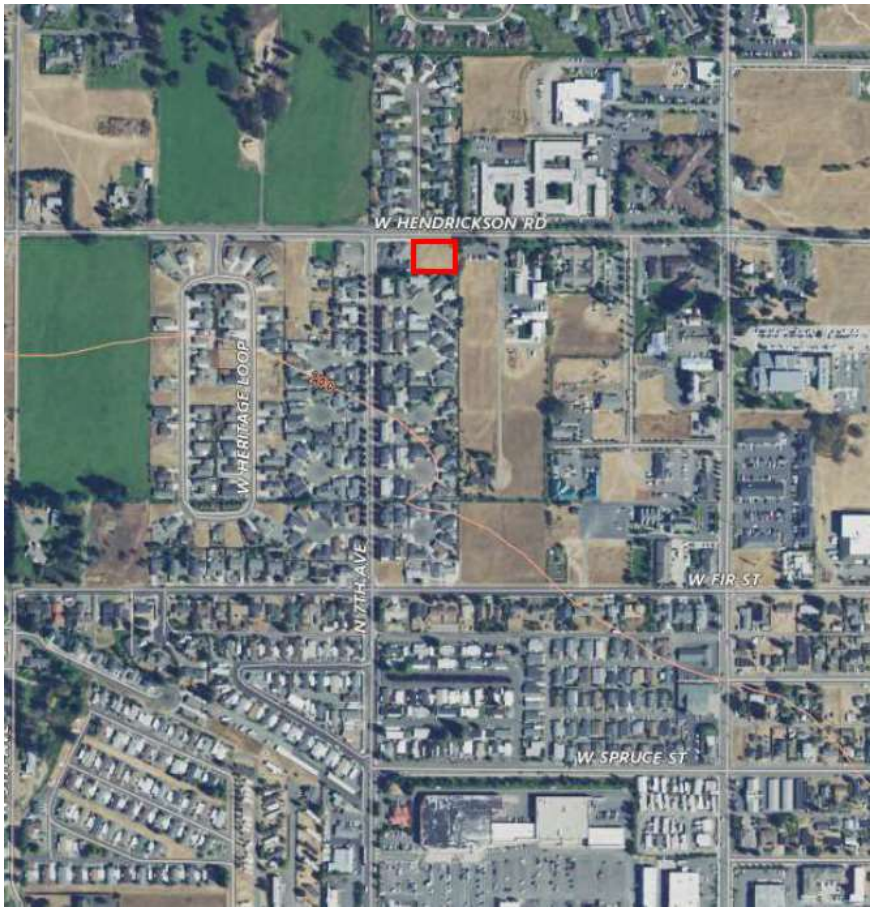


Figure 1

Aerial of the site



Figure 2

Proposed Infiltration

The soils on the site will accept infiltration, the site's drainage runoff will be infiltrated via StormTech chambers under the driveway.

SOIL SURVEY INFORMATION:

According to the geotechnical report prepared by Zenovic & Associates, Inc. dated October 15, 2021, the soil on the site consists topsoil for a depth of 12 inches and then Loamy Sandy Gravel to a depth of 40 inches and then Sandy Gravel to a depth of 80 inches. The infiltration rate was measured at a test pit approximately 30 inches deep and 4 feet wide and 5 feet long. Zenovic recommended for long term design infiltration rate that 4.9 inches per hour be used.

The site basin is the site itself and it catches no off-site drainage and there are no known flooding issues. The existing condition is a flat site with pasture type grasses. See Figure 3 below for the proposed improvement plan.

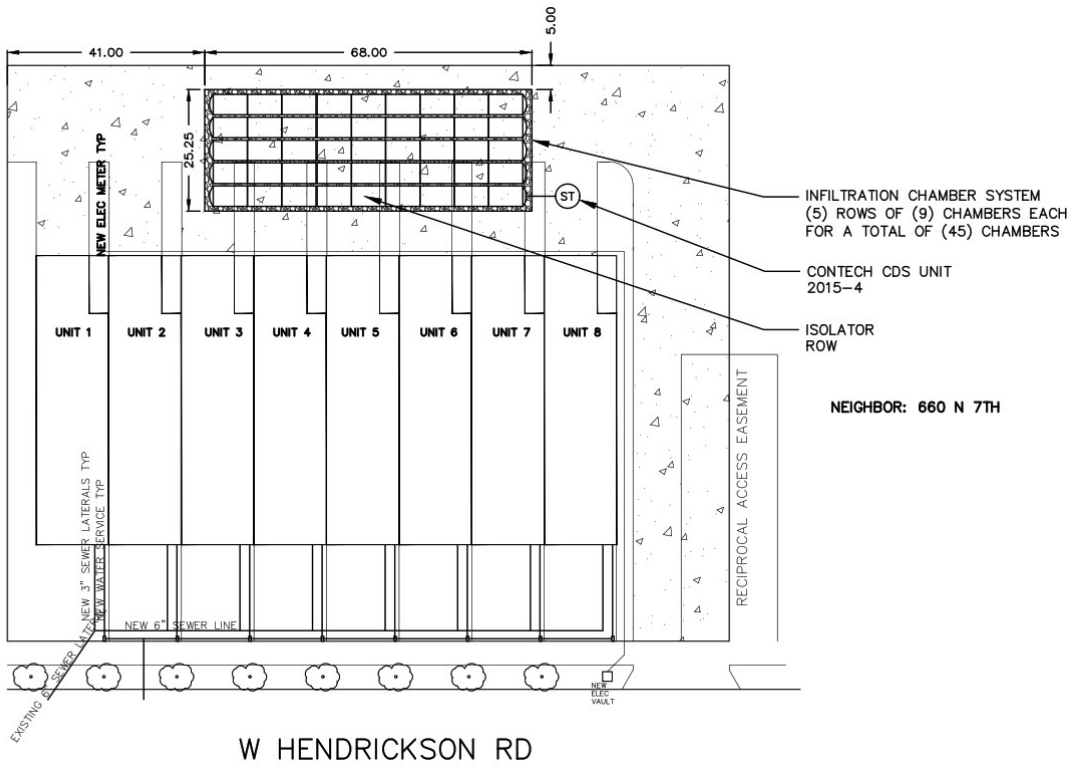


Figure 3

AREA SUMMARY TABLE

Total Site Area	**17,919 SF = 0.41 Acres**
Existing Pervious Area	0 SF = 0.0 Acres
Existing Impervious Areas	17,919 SF = 0.41 Acres
Construction Site Areas	
New Building Roof Area	7,345 SF = 0.17 Acres
Walkways and Driveway Area	8,086 SF = 0.19 Acres
TOTAL IMPERVIOUS	**15,431 SF = 0.35 Acres**
Landscape Area	2,488 SF = 0.06 Acres

Table 1

SECTION B – Core and Special Requirements:

CORE REQUIREMENT 1: Discharge at the Natural Location

The site has no obvious drainage release point, and we anticipate that onsite drainage currently infiltrates. With the proposed development, onsite runoff will be infiltrated into the ground via infiltration chambers.

CORE REQUIREMENT 2: Offsite Analysis

As the site's drainage will be directed to an infiltration system, an offsite analysis was felt not to be necessary.

CORE REQUIREMENT 3: Flow Control Facilities

As the site runoff will be infiltrated flow control facilities are not necessary. Sizing for the infiltration facility was per the Stage-Storage-Discharge Table for the number and size of StormTech Chambers used and the void space of the surrounding drain rock as specified in the plans.

CORE REQUIREMENT 4: Conveyance System

The conveyance system will be internal private storm drain piping directed to the infiltration chambers under the parking lot. During larger events that exceed the base infiltration rate of the soil, there could be some detention within the storm drain chamber that will back up into the site's conveyance system. However, this backup will not exceed the ground elevations in areas of the conveyance system.

CORE REQUIREMENT 5: Construction Stormwater Pollution Prevention

The project will provide erosion and sediment controls (ESC) to prevent, to the maximum extent practical, the transport of sediment from the project site. As the site is virtually flat and the site infiltrates, it is expect that sediment controls to prevent sediment from being carried off the site via vehicle tires will need to be the main focus of sediment controls.

CORE REQUIREMENT 6: Maintenance and Operations

Maintenance and operation of all drainage and onsite conveyance facilities will be the responsibility of the property owner and/or property lessee. Maintenance and operation guidelines are provided in Section C.

CORE REQUIREMENT 7: Financial Guarantees and Liability

All stormwater facilities and BMPs will be located on the subject property. Therefore, no financial guarantees are required.

CORE REQUIREMENT 8: Water Quality Facilities

The water quality facility on the site, ahead of the infiltration chamber system will be a Contech CDS 2015-4 manhole unit. In addition an StormTech chamber isolator row will be installed on the chamber row in which the drainage will be directed to further provide sediment protection from clogging the infiltration system. The isolator row will have a maintenance access to allow cleaning of this chamber row.

CORE REQUIREMENT 9: Flow Control BMPs

As the site area will be drain into an infiltration system on site, no flow control is necessary. However, the infiltration system will consist of 45 SC-740 StormTech Chambers within a infiltration area consisting of 1717 SF, with 6 inches of drain rock above and below the 30 inch tall chambers.

SPECIAL REQUIREMENT #1: Other Adopted Area-Specific Requirements

No other area specific requirements are imposed on this property.

SPECIAL REQUIREMENT #2: Flood Hazard Area Delineation

The site is not known to be in a flood hazard area.

SPECIAL REQUIREMENT #3: Flood Protection Facilities

As the subject site is not believed to be in a flood hazard area, it would be exempt from flood protection measures.

SPECIAL REQUIREMENT #4: Source Control

As the site requires a residential (multi-family) building and site permit the source control requirements are applicable. The water quality source controls will be designed in to meet the City of Sequim requirements.

SPECIAL REQUIREMENT #5: Oil Control

This multi-family site is not considered a "high-use site" as parking areas is not the intended to be captured by the oil control thresholds. Oils from the small parking lot, which may get into the runoff, will be trapped in the Contech CDS manhole.

SECTION C- Flow Control, Water Quality and Conveyance:

SECTION C1 – FLOW CONTROL CALCULATIONS:

Flow Control is not required as the site will be infiltrated through the 100 year storm event. The infiltration facility was sized using the WWHM2012 program. Below are the WWHM program inputs.

Predeveloped - Existing Conditions

A/B, Pasture, Flat	0.41 Acres	(hydrologic group A/B, Pasture, Flat Slope)

Mitigated - Developed Conditions

A/B, Lawn, Flat	0.0571 Acres	(hydrologic group A/B, Lawn, Flat Slope)
Roof Tops, Flat	0.1686 Acres	(Roof Tops, Flat)
Driveways, Flat	0.1653 Acres	(Driveways, Flat)
Sidewalks, Flat	0.0203 Acres	(Walkways, Flat)

Infiltration Chambers design using the Stage-Storage-Discharge Table.
Stage: 0-3.5 feet
Infiltration Area: 0.038 acres
Storage Volume: 0 – 0.083 acre-feet
Outlet Structure: 0
Infiltration: 0.19 CFS

WWHM Results:

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.000273
5 year	0.000343
10 year	0.000377
25 year	0.000408
50 year	0.000425
100 year	0.000439

Flow Frequency Return Periods for Mitigated. POC #1

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

The results above show that the Mitigated flows into the infiltration chamber are totally infiltrated through the 100 year event. See attached WWHM Report. (Appendix B).

SECTION C2 – WATER QUALITY CALCULATIONS:

Contech CDS 2015-4 water quality manhole along with StormTech Chamber isolator row is used for catching oils and sediment in the runoff.

SECTION C3 – CONVEYANCE CALCULATIONS:

Any changes to off-site flows, will be to decrease off-site flows as the currently uncontrolled runoff from the existing site will be collected and directed to an infiltration system as part of the redevelopment of the site.

SECTION D- Special Reports or Studies

GEOTECHNICAL REPORT

A geotechnical study, including an infiltration analysis was prepared by Zenovic & Associates dated October 15, 2021 is included in Appendix A.

SECTION E- Other Permits

Permits required for this project include:

- Building Construction Permit

SECTION F- Erosion Control and Sediment Control

THE 12 ELEMENTS:

Element #1 – Mark Clearing Limits:
The site work will generally be limited to area bounded by Hendrickson Road on the north, and property boundaries to the south, east and west. Where not bounded by impervious surfaces silt fence shall be placed along the outside line of the work area to mark the work limits.

Element #2 – Establish Construction Entrance:
The proposed entrance, off Hendrickson Road will be used as the primary access to the site. This will serve as the access point for the project. If sediment is tracked off site during construction, it shall be cleaned thoroughly by shoveling or pick up sweeper by the end of the day or more frequently if during wet weather.

Element #3 – Control Flow Rates:
The area of improvement is self contained as it does not have run through from off-site flows. Flow control measures will be a part of the system improvements. During construction care runoff from the site will be directed to created depressions.

Element #4 – Installation of Sediment Controls
Prior to beginning of construction the clearing limits shall be marked and sediment fencing shall be place along side of all the work areas. All inlets in, close to of the work area shall be protected by inlet inserts installed prior to starting of site work. All sediment control facilities shall be in place prior to the starting of construction.

Element #5 – Stabilize Soils:
The proposed project construction schedule will be several months. However, initial groundwork has been scheduled to be constructed during the early fall and winter months. The site is flat. The work area will be protected by sediment fences and other BMP's to keep the any runoff from the work area clean. Each section shall be covered as soon as the work is completed with straw, compost or other means to prevent rainfall from disturbing the ground exposed by the work completed. Any stockpiles that would be created will be protected to prevent the erosion and degradation of the existing infiltration facilities presently functioning on the site.

Element #6 – Protect Slopes:
There are no slopes existing or to be created in the work area that will need protection.

Element #7 – Protect Drain Inlets:
The existing inlets and new inlets will be protected during construction and until ground cover is established, by inlet sediment bags at each inlet. The inlet protection shall be installed on the inlets in or near the construction areas prior to the beginning of construction.

Element #8 – Stabilize Channels and Outlets:
No stabilization of channels or outlets are needed during the duration of construction.

Element #9 – Control Pollutants:
The construction equipment shall be kept in one location when not in use. This area shall be inspected regularly to ensure any leaking or spillage is caught and cleaned up immediately. During establishment of the new landscaping fertilizers and pest control shall be kept to a minimum to prevent runoff of these pollutants.

Element #10 – Control De-Watering:
De-Watering is not anticipated to be required due to the well draining soils on site.

Element #11 – Maintain BMP'S:
As required the BMP's used to help control pollution will be maintained on a regular ongoing schedule as required by the erosion control plan. They shall be inspected regularly and after any big events to ensure the BMP's are in place and functioning.

Element #12 – Manage the Project:
The project will be built at one time, excavation spoils will need to be immediately placed in truck and hauled off. Large excavation spoils piles are not permitted. The work will be managed closely to minimize the open work part of the project. As each part of the project is completed, it will be finished up by establishing ground cover on that section before moving onward to the next section.

SECTION G- Operations and Maintenance

The owner and/or lessee of the site shall be responsible for maintaining the stormwater facilities. Proper maintenance is important for proper functioning of the stormwater facilities.

The following maintenance practices should be followed:
.

- Site catch basin(s) shall be check quarterly to insure that there is not build up of debris in the catch basins or the Contech CDS water quality manhole. If sediment or debris is noted, the material shall be removed and properly disposed of.
- It is recommended that a Vactor truck service be hired for removal of sediment and debris removal from the StormTech isolator row chambers, on a yearly basis.

TECHNICAL APPENDIX INDEX

Appendix A - Geotechnical Report by Landau Associates
Appendix B – WWHM Report
Appendix C - Operation and Maintenance Specifications
Appendix D - Storm Drainage and SWPPP Plan Sheets
Appendix E – FEMA Product Report for SeaTac area Flood Maps
Appendix F – Web Soil Survey

Appendix A
Geotechnical Report by
Zenovic & Associates

ZENOVIC & ASSOCIATES
INCORPORATED

CIVIL ENGINEERING

301 East 6th Street, Suite 1
Port Angeles, Washington 98362
(360) 417-0501
Fax (360) 417-0514
E-mail: zenovic@olympus.net

October 15, 2021

Black Forest Construction LLC
Attn: Mr. Ben Grubb
7059 SE Thorburn Street
Portland, OR 97215

Re: West Hendrickson Road, Sequim, WA 98382
Parcel #03-30-19-82-0570
Onsite Soils Analysis

Dear Ben:

As per the City of Sequim's requirements for building permit approval, we completed an onsite soils analysis on the property referenced above to determine onsite soil infiltration rates. The site a 0.42 acre lot located on the south side of West Hendrickson Road just east of North 7th Avenue in Sequim. The site is currently vacant. This analysis consisted of excavation of one test pit to determine the soil profile and one for a Pilot Infiltration Test. The test pit was excavated in the center of the site and the PIT test was performed generally central on the site in the east-west direction and approximately 25 feet north of the south property line. Test pits were completed on September 1st, 2021 and the Pilot Infiltration Test was completed that same day.

The soil profile observed in the test pit was as follows:

Test pit log:

0 – 12" Topsoil
12 - 40" Loamy Sandy Gravel
40 – 80" Sandy Gravel

No water was encountered or other indication of high groundwater table.
No restrictive layer was observed.

Pit Test

The Pilot Infiltration Test consisted of excavation of a pit approximately 30 inches deep and approximately 4 feet wide by 5 feet long. Water was discharged into a bucket with holes drilled in the side disperse the flows and prevent suspension of sediment and possible blinding of the infiltrative area. A measuring rod was affixed to the bucket to provide an accurate measurement of water level.

Pre-Soak Period

The pit was then soaked for 6 hours maintaining a water level of approximately 12 inches above the base of the pit during that period.

Steady State Period

The water level in the pit was then maintained at 12 inches over the next hour and the flow rate required to maintain the level was recorded. The flow rate was determined by first establishing the steady state flow rate (flow required to maintain water level) and then measuring the time required to fill a 5 gallon bucket. The measured flow rate was approximately 6.8 gpm which correlates to a measured infiltration rate in the pit of approximately 17.5 inches per hour.

Falling Head Period

The pit was then monitored over the following hour to provide confirmation of the measured rates. No water was added during this period and the drop in water surface was recorded every 15 minutes. Some drop-off in the infiltration rate was observed during this time period with a measured average infiltration rate of 12 inches per hour. The pit completely drained over the course of this hour.

Results

As the infiltration rate did drop off during the falling head period the rate measured during that time period was utilized to determine the design infiltration rate. To calculate the design infiltration rate a combined correction factor of 0.41 was applied to the measured infiltration rate to calculate a long-term design infiltration rate of 4.9 inches per hour. A record of the Pilot Infiltration Test log is enclosed with this letter.

Please contact me if you have any questions or if you need further information.

Sincerely,
Zenovic & Associates, Inc.

Seth J. Rodman, P.E.
Senior Design Engineer

Enclosures

Fc: JN 21359



10/15/2021

INFILTRATION RATE - SMALL PILOT INFILTRATION TEST

PROJECT: Soils Analysis for Black Forest Const. LLC
LOCATION: West Hendrickson Road, Sequim Wa.
PARCEL NO: 03-30-19-82-0570

ZENOVIC & ASSOCIATES
301 EAST 6TH STREET, SUITE 1
PORT ANGELES, WA 98362
DATE: 9/1/2021
JOB NO. 21359
AUTHOR: Alex Knopp

PIT # 1 **DIMENSIONS** 30"Dx4'x5' **START TIME** 9/1/21 8:30 A.M.

6 HOUR PRESOAK PERIOD

Time	Depth (in)	Notes
8:30		Started filling
9:30	12	Added water to pit as needed throughout
10:30	11	hour to maintain 12" in depth
11:30	13	"
12:30	10	"
1:30	12.75	"
2:30	12	"

STEADY STATE PERIOD

Time	Depth (in)	Cumulative Volume (gal)	Flow Rate (gpm)	Infiltration Rate (in/hr)	Notes
2:30	12	0	0		Hose flow rate 6.82 gpm or 5 gal in 44 sec.
2:45	12	43.53	2.90	17.464	
3:00	12	87.07	2.90	17.466	
3:15	12	130.6	2.90	17.466	
3:30	12	174.14	2.90	17.466	
			Average =	17.47	

FALING HEAD PERIOD

Time	Depth (in)	Infiltration Rate (in/hr)	Notes
3:30	12	0	
3:45	9	12	
4:00	6	12	
4:15	3.375	10.5	
4:30	0	13.5	
Average =		12	

MEASURED INFILTRATION RATE =	12
CFm =	0.9
CFv =	0.9
CFt =	0.5
Combined Correction Factor =	0.41
DESIGN INFILTRATION RATE (measured x Correction Factor) =	4.9

Appendix B
WWHM Report

WWHM2012
PROJECT REPORT

Project Name: 45 chambers
Site Name: 8 plex
Site Address: 625 w hendrickson road
City : sequim
Report Date: 5/17/2023
Gage : Port Angelis
Data Start : 1948/10/01
Data End : 2009/09/30
(adjusted) **Precip Scale:** 0.00
Version Date: 2021/08/18
Version : 4.2.18

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

High Flow Threshold for POC 1: 50 year

PREDEVELOPED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	acre
A B, Pasture, Flat	.41
Pervious Total	0.41

Impervious Land Use	acre
Impervious Total	0
Basin Total	0.41

Element Flows To:

Surface	Interflow	Groundwater

MITIGATED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	acre
A B, Lawn, Flat	.0571
Pervious Total	0.0571

Impervious Land Use	acre
ROOF TOPS FLAT	0.1686
DRIVEWAYS FLAT	0.1653
SIDEWALKS FLAT	0.0203
Impervious Total	0.3542
Basin Total	0.4113

Element Flows To:

Surface	Interflow	Groundwater
SSD Table 1	SSD Table 1	

Name : SSD Table 1
Depth: 3.5 ft.
Discharge Structure: 1
Riser Height: 0 ft.
Riser Diameter: 0 in.

Element Flows To:

Outlet 1	Outlet 2

SSD Table Hydraulic Table

Stage (feet)	Area (ac.)	Volume (ac-ft.)	Outlet Struct	Infilt (cfs)	NotUsed	NotUsed	NotUsed
0.083	0.038	0.001	0.000	0.190	0.000	0.000	0.000
0.167	0.038	0.003	0.000	0.190	0.000	0.000	0.000
0.250	0.038	0.004	0.000	0.190	0.000	0.000	0.000
0.333	0.038	0.005	0.000	0.190	0.000	0.000	0.000
0.417	0.038	0.007	0.000	0.190	0.000	0.000	0.000
0.500	0.038	0.008	0.000	0.190	0.000	0.000	0.000
0.583	0.038	0.010	0.000	0.190	0.000	0.000	0.000
0.667	0.038	0.013	0.000	0.190	0.000	0.000	0.000
0.750	0.038	0.016	0.000	0.190	0.000	0.000	0.000
0.833	0.038	0.018	0.000	0.190	0.000	0.000	0.000
0.917	0.038	0.021	0.000	0.190	0.000	0.000	0.000
1.000	0.038	0.024	0.000	0.190	0.000	0.000	0.000
1.083	0.038	0.026	0.000	0.190	0.000	0.000	0.000
1.167	0.038	0.029	0.000	0.190	0.000	0.000	0.000
1.250	0.038	0.031	0.000	0.190	0.000	0.000	0.000
1.333	0.038	0.034	0.000	0.190	0.000	0.000	0.000
1.417	0.038	0.036	0.000	0.190	0.000	0.000	0.000
1.500	0.038	0.039	0.000	0.190	0.000	0.000	0.000

1.583	0.038	0.041	0.000	0.190	0.000	0.000	0.000
1.667	0.038	0.044	0.000	0.190	0.000	0.000	0.000
1.750	0.038	0.046	0.000	0.190	0.000	0.000	0.000
1.833	0.038	0.049	0.000	0.190	0.000	0.000	0.000
1.917	0.038	0.051	0.000	0.190	0.000	0.000	0.000
2.000	0.038	0.053	0.000	0.190	0.000	0.000	0.000
2.083	0.038	0.055	0.000	0.190	0.000	0.000	0.000
2.167	0.038	0.058	0.000	0.190	0.000	0.000	0.000
2.250	0.038	0.060	0.000	0.190	0.000	0.000	0.000
2.333	0.038	0.062	0.000	0.190	0.000	0.000	0.000
2.417	0.038	0.064	0.000	0.190	0.000	0.000	0.000

ANALYSIS RESULTS

Stream Protection Duration

Predeveloped Landuse Totals for POC #1
Total Pervious Area:0.41
Total Impervious Area:0

Mitigated Landuse Totals for POC #1
Total Pervious Area:0.0571
Total Impervious Area:0.3542

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.000273
5 year	0.000343
10 year	0.000377
25 year	0.000408
50 year	0.000425
100 year	0.000439

Flow Frequency Return Periods for Mitigated. POC #1

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

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

Year	Predeveloped	Mitigated
1949	0.000	0.000
1950	0.000	0.000
1951	0.000	0.000
1952	0.000	0.000

1953	0.000	0.000
1954	0.000	0.000
1955	0.000	0.000
1956	0.000	0.000
1957	0.000	0.000
1958	0.000	0.000
1959	0.000	0.000
1960	0.000	0.000
1961	0.000	0.000
1962	0.000	0.000
1963	0.000	0.000
1964	0.000	0.000
1965	0.000	0.000
1966	0.000	0.000
1967	0.000	0.000
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1997	0.000	0.000
1998	0.000	0.000
1999	0.000	0.000
2000	0.000	0.000
2001	0.000	0.000
2002	0.000	0.000
2003	0.000	0.000
2004	0.000	0.000
2005	0.000	0.000
2006	0.000	0.000
2007	0.000	0.000
2008	0.000	0.000
2009	0.000	0.000

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

Rank	Predeveloped	Mitigated
1	0.0003	0.0000
2	0.0003	0.0000
3	0.0003	0.0000
4	0.0003	0.0000
5	0.0003	0.0000
6	0.0003	0.0000
7	0.0003	0.0000
8	0.0003	0.0000
9	0.0003	0.0000
10	0.0003	0.0000
11	0.0003	0.0000
12	0.0003	0.0000
13	0.0003	0.0000
14	0.0003	0.0000
15	0.0003	0.0000
16	0.0003	0.0000
17	0.0003	0.0000
18	0.0003	0.0000
19	0.0003	0.0000
20	0.0003	0.0000
21	0.0003	0.0000
22	0.0003	0.0000
23	0.0003	0.0000
24	0.0003	0.0000
25	0.0003	0.0000
26	0.0003	0.0000
27	0.0003	0.0000
28	0.0003	0.0000
29	0.0003	0.0000
30	0.0003	0.0000
31	0.0003	0.0000
32	0.0003	0.0000
33	0.0003	0.0000
34	0.0003	0.0000
35	0.0003	0.0000
36	0.0003	0.0000
37	0.0003	0.0000
38	0.0003	0.0000
39	0.0003	0.0000
40	0.0003	0.0000
41	0.0003	0.0000
42	0.0003	0.0000
43	0.0003	0.0000
44	0.0002	0.0000
45	0.0002	0.0000
46	0.0002	0.0000
47	0.0002	0.0000
48	0.0002	0.0000
49	0.0002	0.0000
50	0.0002	0.0000
51	0.0002	0.0000
52	0.0002	0.0000

53	0.0002	0.0000
54	0.0002	0.0000
55	0.0002	0.0000
56	0.0002	0.0000
57	0.0002	0.0000
58	0.0001	0.0000
59	0.0001	0.0000
60	0.0001	0.0000
61	0.0000	0.0000

Stream Protection Duration
POC #1
The Facility PASSED

The Facility PASSED.

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0001	695	0	0	Pass
0.0001	652	0	0	Pass
0.0001	631	0	0	Pass
0.0001	607	0	0	Pass
0.0001	579	0	0	Pass
0.0002	554	0	0	Pass
0.0002	530	0	0	Pass
0.0002	508	0	0	Pass
0.0002	486	0	0	Pass
0.0002	461	0	0	Pass
0.0002	448	0	0	Pass
0.0002	431	0	0	Pass
0.0002	407	0	0	Pass
0.0002	398	0	0	Pass
0.0002	383	0	0	Pass
0.0002	367	0	0	Pass
0.0002	348	0	0	Pass
0.0002	332	0	0	Pass
0.0002	323	0	0	Pass
0.0002	311	0	0	Pass
0.0002	290	0	0	Pass
0.0002	277	0	0	Pass
0.0002	262	0	0	Pass
0.0002	257	0	0	Pass
0.0002	249	0	0	Pass
0.0002	238	0	0	Pass
0.0002	231	0	0	Pass
0.0002	227	0	0	Pass
0.0002	215	0	0	Pass
0.0002	202	0	0	Pass
0.0002	197	0	0	Pass
0.0002	191	0	0	Pass
0.0002	185	0	0	Pass
0.0002	173	0	0	Pass
0.0002	167	0	0	Pass
0.0002	161	0	0	Pass
0.0002	153	0	0	Pass
0.0002	148	0	0	Pass
0.0002	139	0	0	Pass

0.0003	131	0	0	Pass
0.0003	123	0	0	Pass
0.0003	119	0	0	Pass
0.0003	110	0	0	Pass
0.0003	105	0	0	Pass
0.0003	95	0	0	Pass
0.0003	88	0	0	Pass
0.0003	82	0	0	Pass
0.0003	79	0	0	Pass
0.0003	73	0	0	Pass
0.0003	69	0	0	Pass
0.0003	66	0	0	Pass
0.0003	64	0	0	Pass
0.0003	59	0	0	Pass
0.0003	54	0	0	Pass
0.0003	53	0	0	Pass
0.0003	45	0	0	Pass
0.0003	42	0	0	Pass
0.0003	39	0	0	Pass
0.0003	37	0	0	Pass
0.0003	34	0	0	Pass
0.0003	29	0	0	Pass
0.0003	24	0	0	Pass
0.0003	22	0	0	Pass
0.0003	20	0	0	Pass
0.0003	16	0	0	Pass
0.0003	16	0	0	Pass
0.0003	11	0	0	Pass
0.0003	8	0	0	Pass
0.0003	7	0	0	Pass
0.0003	1	0	0	Pass
0.0003	0	0	0	Pass
0.0003	0	0	0	Pass
0.0003	0	0	0	Pass
0.0003	0	0	0	Pass
0.0004	0	0	0	Pass
0.0004	0	0	0	Pass
0.0004

0.0004	0	0	0	Pass
0.0004	0	0	0	Pass
0.0004	0	0	0	Pass
0.0004	0	0	0	Pass

Water Quality BMP Flow and Volume for POC #1
On-line facility volume: 0 **acre-feet**
On-line facility target flow: 0 **cfs.**
Adjusted for 15 min: 0 **cfs.**
Off-line facility target flow: 0 **cfs.**
Adjusted for 15 min: 0 **cfs.**

LID Report

LID Technique	Used for Water Quality Treatment?	Total Volume Percent Needs Treatment (ac-ft)	Volume Through Facility (ac-ft)	Infiltration Volume (ac-ft.)	Cumulative Percent Volume Infiltration	Volume Infiltrated	Comment Water Quality Treated
SSD Table 1 POC	N	23.04					N
100.00							
Total Volume Infiltrated		23.04	0.00	0.00			
100.00	0.00	0%	No Treat. Credit				

Compliance with LID Standard 8
Duration Analysis Result = Passed

Perlnd and Implnd Changes

No changes have been made.

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Appendix C
Operation and Maintenance Specifications

Appendix D
Storm Drainage and SWPPP Plan Sheets

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Detention • Retention • Water Quality

A division of ADS

Save Valuable Land and Protect Water Resources



Isolator® Row O&M Manual

StormTech® Chamber System for Stormwater Management

1.0 The Isolator® Row

1.1 INTRODUCTION

An important component of any Stormwater Pollution Prevention Plan is inspection and maintenance. The StormTech Isolator Row is a patented technique to inexpensively enhance Total Suspended Solids (TSS) removal and provide easy access for inspection and maintenance.



Looking down the Isolator Row from the manhole opening, woven geotextile is shown between the chamber and stone base.

1.2 THE ISOLATOR ROW

The Isolator Row is a row of StormTech chambers, either SC-310, SC-310-3, SC-740, DC-780, MC-3500 or MC-4500 models, that is surrounded with filter fabric and connected to a closely located manhole for easy access. The fabric-wrapped chambers provide for settling and filtration of sediment as storm water rises in the Isolator Row and ultimately passes through the filter fabric. The open bottom chambers and perforated sidewalls (SC-310, SC-310-3 and SC-740 models) allow storm water to flow both vertically and horizontally out of the chambers. Sediments are captured in the Isolator Row protecting the storage areas of the adjacent stone and chambers from sediment accumulation.

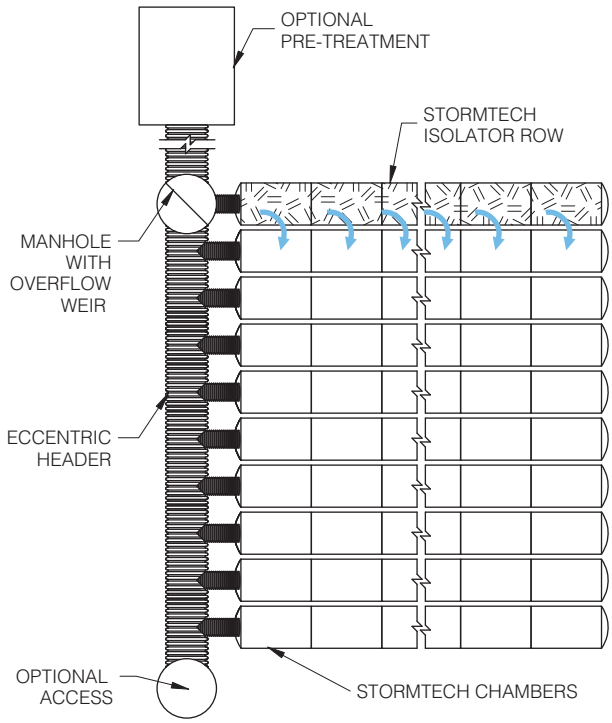
Two different fabrics are used for the Isolator Row. A woven geotextile fabric is placed between the stone and the Isolator Row chambers. The tough geotextile provides a media for storm water filtration and provides a durable surface for maintenance operations. It is also designed to prevent scour of the underlying stone and remain intact during high pressure jetting. A non-woven fabric is placed over the chambers to provide a filter media for flows passing through the perforations in the sidewall of the chamber. The non-woven fabric is not required over the DC-780, MC-3500 or MC-4500 models as these chambers do not have perforated side walls.

The Isolator Row is typically designed to capture the "first flush" and offers the versatility to be sized on a volume basis or flow rate basis. An upstream manhole not only provides access to the Isolator Row but typically includes a high flow weir such that storm water flowrates or volumes that exceed the capacity of the Isolator Row overtop the over flow weir and discharge through a manifold to the other chambers.

The Isolator Row may also be part of a treatment train. By treating storm water prior to entry into the chamber system, the service life can be extended and pollutants such as hydrocarbons can be captured. Pre-treatment best management practices can be as simple as deep sump catch basins, oil-water separators or can be innovative storm water treatment devices. The design of the treatment train and selection of pretreatment devices by the design engineer is often driven by regulatory requirements. Whether pretreatment is used or not, the Isolator Row is recommended by StormTech as an effective means to minimize maintenance requirements and maintenance costs.

Note: See the StormTech Design Manual for detailed information on designing inlets for a StormTech system, including the Isolator Row.

StormTech Isolator Row with Overflow Spillway
(not to scale)



2.0 Isolator Row Inspection/Maintenance

2.1 INSPECTION

The frequency of Inspection and Maintenance varies by location. A routine inspection schedule needs to be established for each individual location based upon site specific variables. The type of land use (i.e. industrial, commercial, residential), anticipated pollutant load, percent imperviousness, climate, etc. all play a critical role in determining the actual frequency of inspection and maintenance practices.

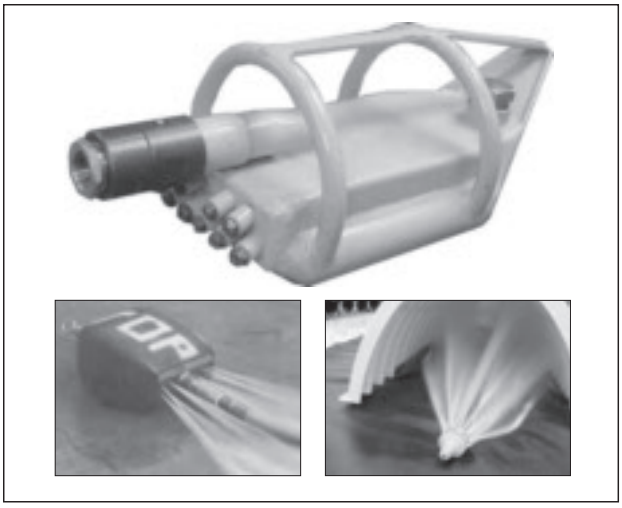
At a minimum, StormTech recommends annual inspections. Initially, the Isolator Row should be inspected every 6 months for the first year of operation. For subsequent years, the inspection should be adjusted based upon previous observation of sediment deposition.

The Isolator Row incorporates a combination of standard manhole(s) and strategically located inspection ports (as needed). The inspection ports allow for easy access to the system from the surface, eliminating the need to perform a confined space entry for inspection purposes.

If upon visual inspection it is found that sediment has accumulated, a stadia rod should be inserted to determine the depth of sediment. When the average depth of sediment exceeds 3 inches throughout the length of the Isolator Row, clean-out should be performed.

2.2 MAINTENANCE

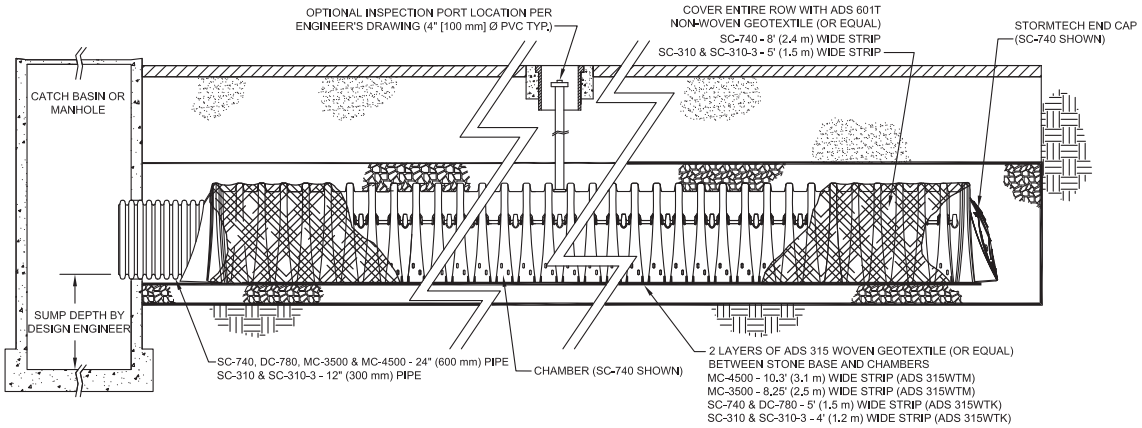
The Isolator Row was designed to reduce the cost of periodic maintenance. By "isolating" sediments to just one row, costs are dramatically reduced by eliminating the need to clean out each row of the entire storage bed. If inspection indicates the potential need for maintenance, access is provided via a manhole(s) located on the end(s) of the row for cleanout. If entry into the manhole is required, please follow local and OSHA rules for a confined space entries.



Examples of culvert cleaning nozzles appropriate for Isolator Row maintenance. (These are not StormTech products.)

Maintenance is accomplished with the JetVac process. The JetVac process utilizes a high pressure water nozzle to propel itself down the Isolator Row while scouring and suspending sediments. As the nozzle is retrieved, the captured pollutants are flushed back into the manhole for vacuuming. Most sewer and pipe maintenance companies have vacuum/JetVac combination vehicles. Selection of an appropriate JetVac nozzle will improve maintenance efficiency. Fixed nozzles designed for culverts or large diameter pipe cleaning are preferable. Rear facing jets with an effective spread of at least 45" are best. Most JetVac reels have 400 feet of hose allowing maintenance of an Isolator Row up to 50 chambers long. **The JetVac process shall only be performed on StormTech Isolator Rows that have AASHTO class 1 woven geotextile (as specified by StormTech) over their angular base stone.**

StormTech Isolator Row (not to scale)



NOTE: NON-WOVEN FABRIC IS ONLY REQUIRED OVER THE INLET PIPE CONNECTION INTO THE END CAP FOR DC-780, MC-3500 AND MC-4500 CHAMBER MODELS AND IS NOT REQUIRED OVER THE ENTIRE ISOLATOR ROW.

3.0 Isolator Row Step By Step Maintenance Procedures

Step 1) Inspect Isolator Row for sediment

A) Inspection ports (if present)

i. Remove lid from floor box frame

ii. Remove cap from inspection riser

iii. Using a flashlight and stadia rod, measure depth of sediment and record results on maintenance log.

iv. If sediment is at, or above, 3 inch depth proceed to Step 2. If not proceed to step 3.

B) All Isolator Rows

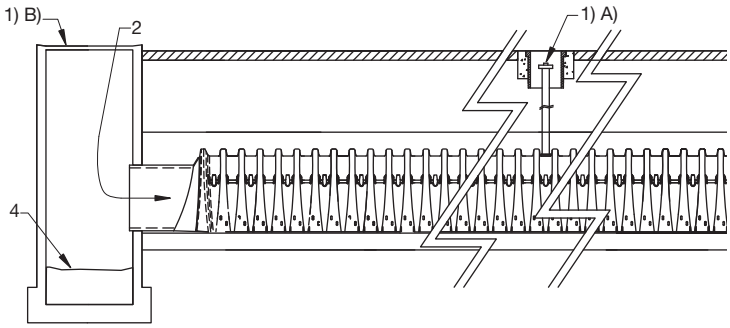
i. Remove cover from manhole at upstream end of Isolator Row

ii. Using a flashlight, inspect down Isolator Row through outlet pipe

1. Mirrors on poles or cameras may be used to avoid a confined space entry
2. Follow OSHA regulations for confined space entry if entering manhole

iii. If sediment is at or above the lower row of sidewall holes (approximately 3 inches) proceed to Step 2. If not proceed to Step 3.

StormTech Isolator Row (not to scale)



Step 2) Clean out Isolator Row using the JetVac process

A) A fixed culvert cleaning nozzle with rear facing nozzle spread of 45 inches or more is preferable

B) Apply multiple passes of JetVac until backflush water is clean

C) Vacuum manhole sump as required

Step 3) Replace all caps, lids and covers, record observations and actions

Step 4) Inspect & clean catch basins and manholes upstream of the StormTech system

Sample Maintenance Log

Date	Stadia Rod Readings		Sediment Depth (1) - (2)	Observations/Actions	Inspector
	Fixed point to chamber bottom (1)	Fixed point to top of sediment (2)			
3/15/01	6.3 ft.	none		New installation. Fixed point is CI frame at grade	djm
9/24/01		6.2	0.1 ft.	Some grit felt	sm
6/20/03		5.8	0.5 ft.	Mucky feel, debris visible in manhole and in Isolator row, maintenance due	rv
7/7/03	6.3 ft.		0	System jetted and vacuumed	djm

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70 Inwood Road, Suite 3 | Rocky Hill | Connecticut | 06067

860.529.8188 | 888.892.2694 | fax 866.328.8401 | www.stormtech.com

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#11011 03/16

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CONTECH®
ENGINEERED SOLUTIONS

CDS® Inspection and Maintenance Guide



CDS TECHNOLOGIES

Maintenance

The CDS system should be inspected at regular intervals and maintained when necessary to ensure optimum performance. The rate at which the system collects pollutants will depend more heavily on site activities than the size of the unit. For example, unstable soils or heavy winter sanding will cause the grit chamber to fill more quickly but regular sweeping of paved surfaces will slow accumulation.

Inspection

Inspection is the key to effective maintenance and is easily performed. Pollutant transport and deposition may vary from year to year and regular inspections will help ensure that the system is cleaned out at the appropriate time. At a minimum, inspections should be performed twice per year (e.g. spring and fall) however more frequent inspections may be necessary in climates where winter sanding operations may lead to rapid accumulations, or in equipment washdown areas. Installations should also be inspected more frequently where excessive amounts of trash are expected.

The visual inspection should ascertain that the system components are in working order and that there are no blockages or obstructions in the inlet and separation screen. The inspection should also quantify the accumulation of hydrocarbons, trash, and sediment in the system. Measuring pollutant accumulation can be done with a calibrated dipstick, tape measure or other measuring instrument. If absorbent material is used for enhanced removal of hydrocarbons, the level of discoloration of the sorbent material should also be identified during inspection. It is useful and often required as part of an operating permit to keep a record of each inspection. A simple form for doing so is provided.

Access to the CDS unit is typically achieved through two manhole access covers. One opening allows for inspection and cleanout of the separation chamber (cylinder and screen) and isolated sump. The other allows for inspection and cleanout of sediment captured and retained outside the screen. For deep units, a single manhole access point would allows both sump cleanout and access outside the screen.

The CDS system should be cleaned when the level of sediment has reached 75% of capacity in the isolated sump or when an appreciable level of hydrocarbons and trash has accumulated. If absorbent material is used, it should be replaced when significant discoloration has occurred. Performance will not be impacted until 100% of the sump capacity is exceeded however it is recommended that the system be cleaned prior to that for easier removal of sediment. The level of sediment is easily determined by measuring from finished grade down to the top of the sediment pile. To avoid underestimating the level of sediment in the chamber, the measuring device must be lowered to the top of the sediment pile carefully. Particles at the top of the pile typically offer less resistance to the end of the rod than consolidated particles toward the bottom of the pile. Once this measurement is recorded, it should be compared to the as-built drawing for the unit to determine weather the height of the sediment pile off the bottom of the sump floor exceeds 75% of the total height of isolated sump.

Cleaning

Cleaning of a CDS systems should be done during dry weather conditions when no flow is entering the system. The use of a vacuum truck is generally the most effective and convenient method of removing pollutants from the system. Simply remove the manhole covers and insert the vacuum hose into the sump. The system should be completely drained down and the sump fully evacuated of sediment. The area outside the screen should also be cleaned out if pollutant build-up exists in this area.

In installations where the risk of petroleum spills is small, liquid contaminants may not accumulate as quickly as sediment. However, the system should be cleaned out immediately in the event of an oil or gasoline spill should be cleaned out immediately. Motor oil and other hydrocarbons that accumulate on a more routine basis should be removed when an appreciable layer has been captured. To remove these pollutants, it may be preferable to use absorbent pads since they are usually less expensive to dispose than the oil/water emulsion that may be created by vacuuming the oily layer. Trash and debris can be netted out to separate it from the other pollutants. The screen should be power washed to ensure it is free of trash and debris.

Manhole covers should be securely seated following cleaning activities to prevent leakage of runoff into the system from above and also to ensure that proper safety precautions have been followed. Confined space entry procedures need to be followed if physical access is required. Disposal of all material removed from the CDS system should be done in accordance with local regulations. In many jurisdictions, disposal of the sediments may be handled in the same manner as the disposal of sediments removed from catch basins or deep sump manholes.



CDS Model	Diameter		Distance from Water Surface to Top of Sediment Pile		Sediment Storage Capacity	
	ft	m	ft	m	y^3	m^3
CDS1515	3	0.9	3.0	0.9	0.5	0.4
CDS2015	4	1.2	3.0	0.9	0.9	0.7
CDS2015	5	1.3	3.0	0.9	1.3	1.0
CDS2020	5	1.3	3.5	1.1	1.3	1.0
CDS2025	5	1.3	4.0	1.2	1.3	1.0
CDS3020	6	1.8	4.0	1.2	2.1	1.6
CDS3025	6	1.8	4.0	1.2	2.1	1.6
CDS3030	6	1.8	4.6	1.4	2.1	1.6
CDS3035	6	1.8	5.0	1.5	2.1	1.6
CDS4030	8	2.4	4.6	1.4	5.6	4.3
CDS4040	8	2.4	5.7	1.7	5.6	4.3
CDS4045	8	2.4	6.2	1.9	5.6	4.3
CDS5640	10	3.0	6.3	1.9	8.7	6.7
CDS5653	10	3.0	7.7	2.3	8.7	6.7
CDS5668	10	3.0	9.3	2.8	8.7	6.7
CDS5678	10	3.0	10.3	3.1	8.7	6.7

Table 1: CDS Maintenance Indicators and Sediment Storage Capacities



Support

- Drawings and specifications are available at www.contechstormwater.com.
- Site-specific design support is available from our engineers.

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CDS Inspection & Maintenance Log

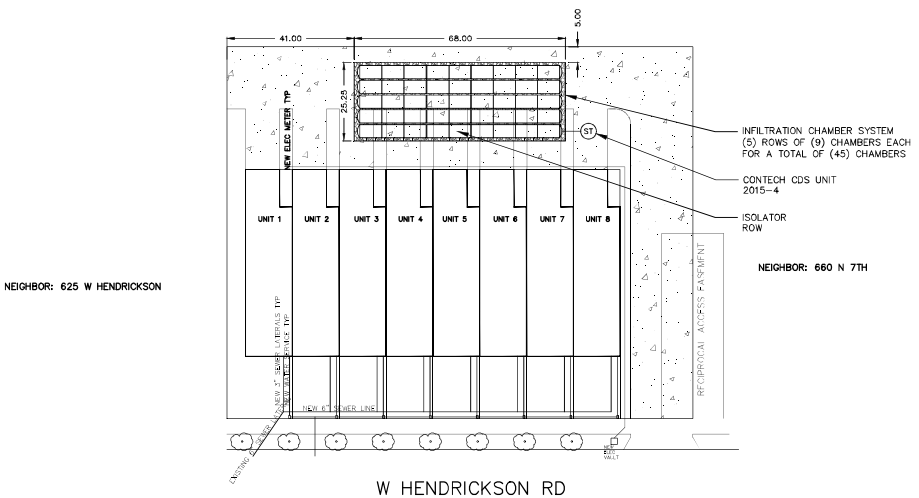
CDS Model: _____ Location: _____

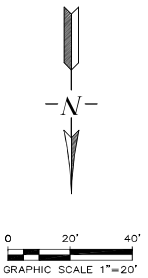
Date	Water depth to sediment[1]	Floatable Layer Thickness[2]	Describe Maintenance Performed	Maintenance Personnel	Comments

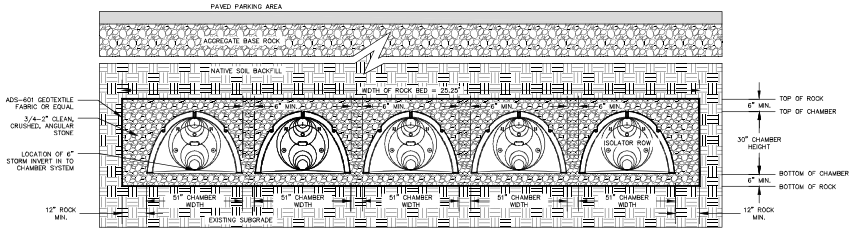
1. The water depth to sediment is determined by taking two measurements with a stadia rod: one measurement from the manhole opening to the top of the sediment pile and the other from the manhole opening to the water surface. If the difference between these measurements is less than the values listed in table 1 the system should be cleaned out. **Note: to avoid underestimating the volume of sediment in the chamber, the measuring device must be carefully lowered to the top of the sediment pile.**

2. For optimum performance, the system should be cleaned out when the floating hydrocarbon layer accumulates to an appreciable thickness. In the event of an oil spill, the system should be cleaned immediately.

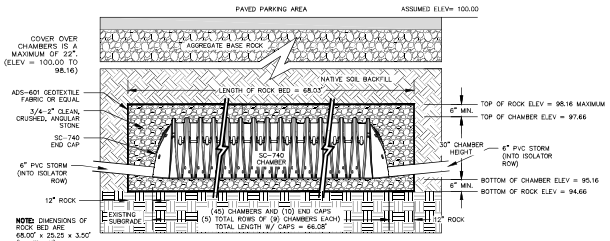
Appendix D
Storm Drainage and SWPPP Plan Sheets







ADS SC-740 CHAMBER – FRONT VIEW
(LOOKING EAST)
N.T.S.



ADS SC-740 CHAMBER – SIDE VIEW
(LOOKING SOUTH)
N.T.S.

THOMAS J. SISUL
STATE OF WASHINGTON
20114
REGISTERED
PROFESSIONAL ENGINEER

REVISIONS	BY
STORM PLAN (11-4-21)	JJM
REVISED (11-8-21)	JJM

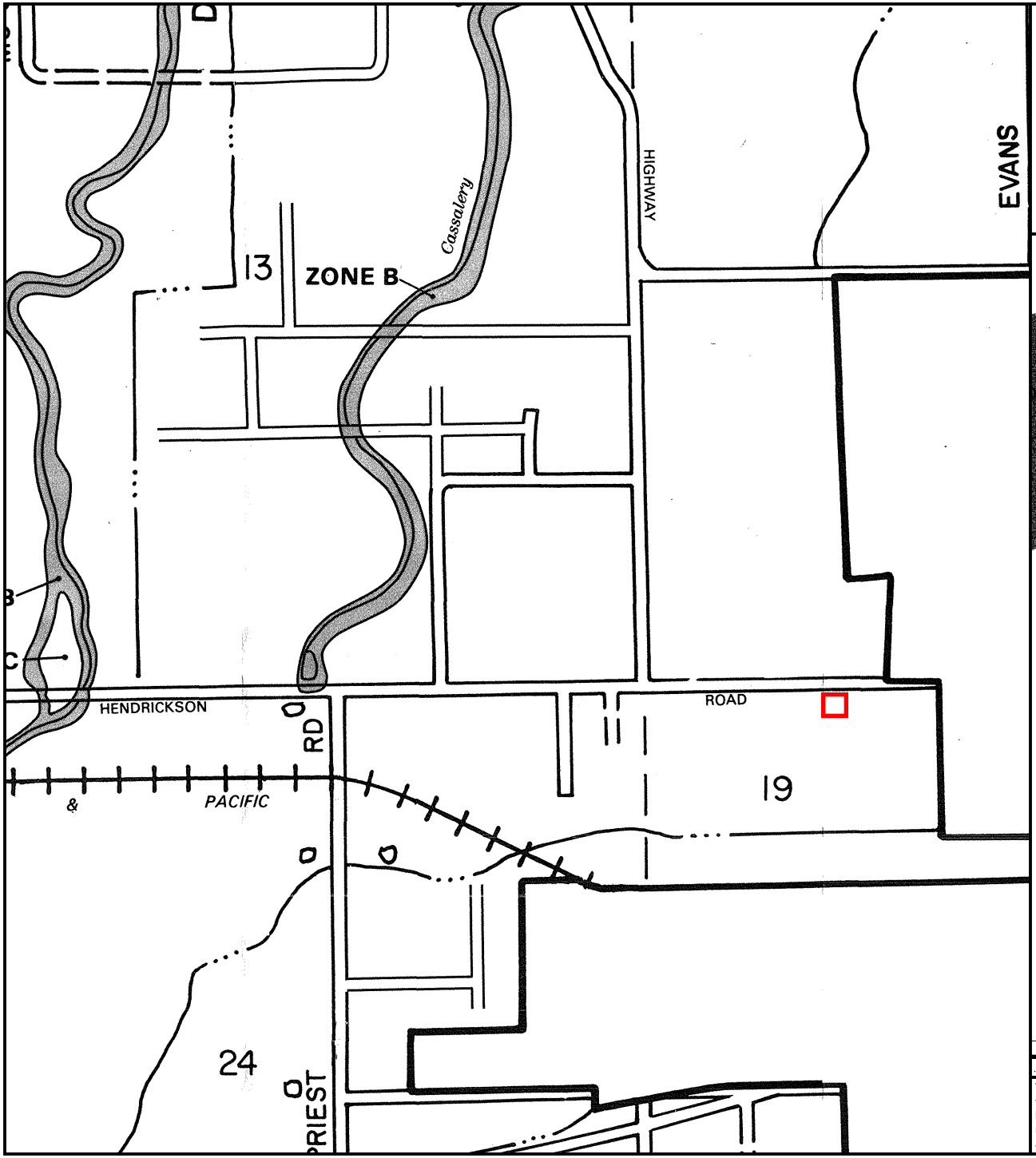
W HENDRICKSON RD SITE
SEQUIM, WASHINGTON
BLACK FOREST CONSTRUCTION, LLC

STORM PLAN

SISUL ENGINEERING
375 PORTLAND AVENUE
GLADSTONE, OREGON 97027
(503) 657-0188

DATE NOV 2021
SCALE NOTED
DRAWN JJM
JOB SVA21-004
SHEET 1
OF 1 SHEETS

Appendix E
FEMA Product Report for Sequim area Flood Maps



APPROXIMATE SCALE IN FEET

1000 0 1000

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

CLALLAM COUNTY, WASHINGTON (UNINCORPORATED AREAS)

PANEL 530 OF 725

(SEE MAP INDEX FOR PANELS NOT PRINTED)

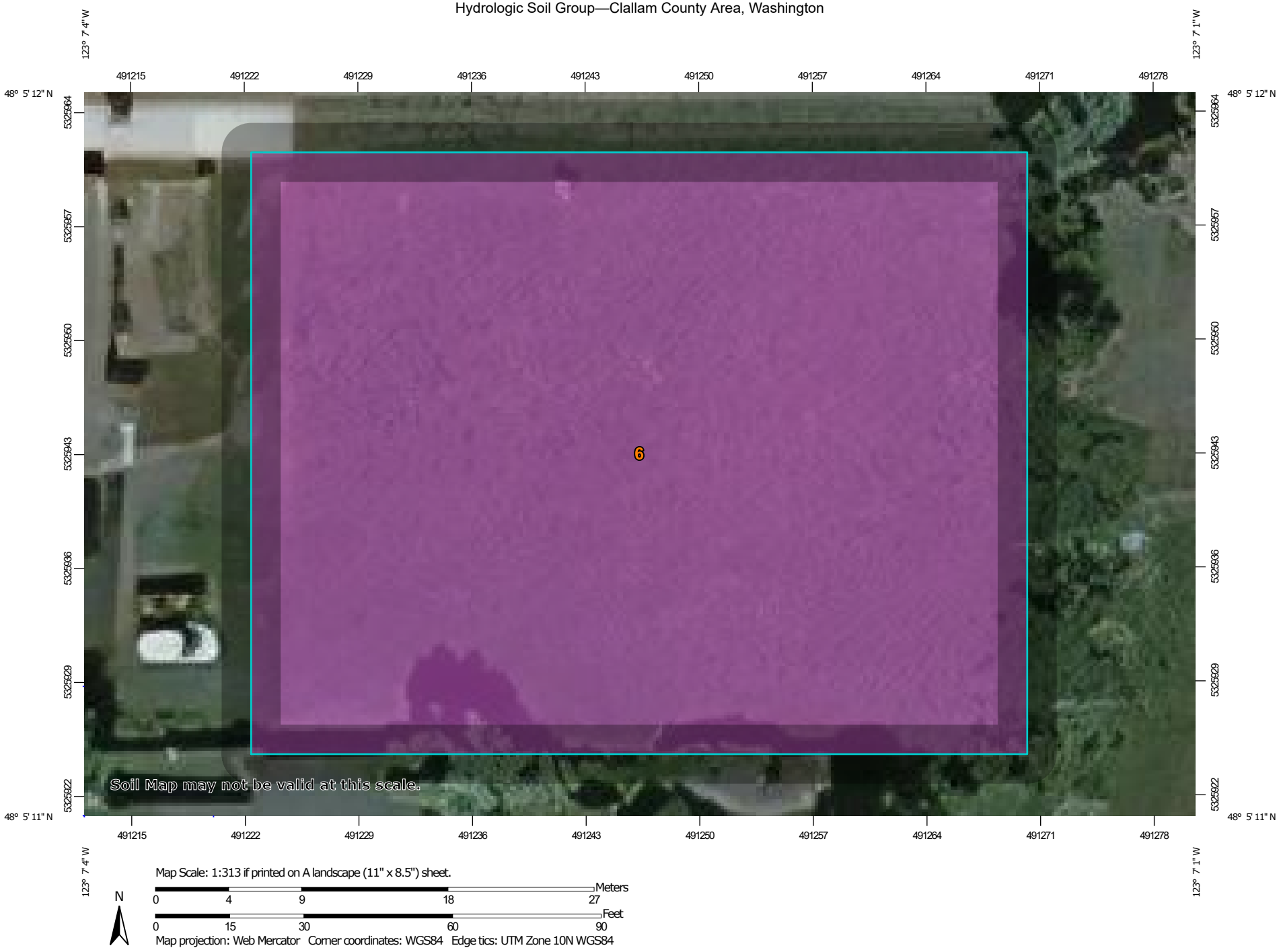
COMMUNITY-PANEL NUMBER
530021 0530 D

MAP REVISED:
DECEMBER 5, 1989

Federal Emergency Management Agency

This is an official FIRMette showing a portion of the above-referenced flood map created from the MSC FIRMette Web tool. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For additional information about how to make sure the map is current, please see the Flood Hazard Mapping Updates Overview Fact Sheet available on the FEMA Flood Map Service Center home page at https://msc.fema.gov.

Appendix F
Web Soil Survey



Map Scale: 1:313 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 4 9 18 27

Feet
0 15 30 60 90

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

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Lines

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Points

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

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:
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: Clallam County Area, Washington
Survey Area Data: Version 19, Aug 23, 2021

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

Date(s) aerial images were photographed: May 10, 2019—Jul 25, 2019

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.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
6	Carlsborg gravelly sandy loam, 0 to 5 percent slopes	A	0.4	100.0%
Totals for Area of Interest			**0.4**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Engineering Properties

This table gives the engineering classifications and the range of engineering properties for the layers of each soil in the survey area.

Hydrologic soil group is a group of soils having similar runoff potential under similar storm and cover conditions. The criteria for determining Hydrologic soil group is found in the National Engineering Handbook, Chapter 7 issued May 2007(http://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=17757.wba). Listing HSGs by soil map unit component and not by soil series is a new concept for the engineers. Past engineering references contained lists of HSGs by soil series. Soil series are continually being defined and redefined, and the list of soil series names changes so frequently as to make the task of maintaining a single national list virtually impossible. Therefore, the criteria is now used to calculate the HSG using the component soil properties and no such national series lists will be maintained. All such references are obsolete and their use should be discontinued. Soil properties that influence runoff potential are those that influence the minimum rate of infiltration for a bare soil after prolonged wetting and when not frozen. These properties are depth to a seasonal high water table, saturated hydraulic conductivity after prolonged wetting, and depth to a layer with a very slow water transmission rate. Changes in soil properties caused by land management or climate changes also cause the hydrologic soil group to change. The influence of ground cover is treated independently. There are four hydrologic soil groups, A, B, C, and D, and three dual groups, A/D, B/D, and C/D. In the dual groups, the first letter is for drained areas and the second letter is for undrained areas.

The four hydrologic soil groups are described in the following paragraphs:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Depth to the upper and lower boundaries of each layer is indicated.

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is 15 percent or more, an appropriate modifier is added, for example, "gravelly."

Classification of the soils is determined according to the Unified soil classification system (ASTM, 2005) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO, 2004).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to particle-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of particle-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Percentage of rock fragments larger than 10 inches in diameter and 3 to 10 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage. Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field. Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination. Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

References:

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Report—Engineering Properties

Absence of an entry indicates that the data were not estimated. The asterisk '*' denotes the representative texture; other possible textures follow the dash. The criteria for determining the hydrologic soil group for individual soil components is found in the National Engineering Handbook, Chapter 7 issued May 2007(http://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=17757.wba). Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

Engineering Properties–Clallam County Area, Washington

Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			In				*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*
6—Carlsborg gravelly sandy loam, 0 to 5 percent slopes														
Carlsborg	100	A	0-9	Gravelly sandy loam	SM	A-1, A-2, A-4	0- 0- 0	0- 5- 10	65-73-80	55-65-75	35-43-50	15-28-40	0-7 -14	NP
			9-20	Very gravelly loamy sand, very cobbly loamy sand, very gravelly sand	SP-SM, SM	A-1	0- 0- 0	15-25-35	55-60-65	35-45-55	20-30-40	5-13- 20	0-7 -14	NP
			20-60	Extremely gravelly loamy sand, extremely gravelly sand, extremely cobbly loamy sand	GP-GM, GP	A-1	0- 0- 0	35-43-50	20-38-55	10-23-35	5-18- 30	0- 5- 10	0-7 -14	NP

Data Source Information

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