Contech Pipe Plant

Arlington, WA

J.O. SVA09-019

November 10, 2009

STORM WATER INFILTRATION AND WATER QUALITY CALCULATIONS

SISUL ENGINEERING

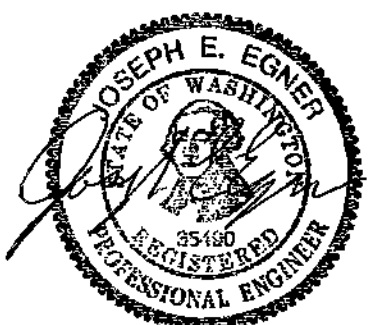
A Division of Sisul Enterprises, Inc.

4317 NE Thurston Way, Suite 210

Vancouver, WA 98662

phone: (360) 696-3664

fax: (360) 696-0977



EXPIRES 2/8/2010

Table of Contents

SECTION A – PROJECT OVERVIEW:

EXISTING SITE INFORMATION:

The site is bordered on the south and west sides by existing developed streets and on the north and east already developed properties. The site has its high point near the northeast corner of the lot and the lowest point on the northwest corner of the site. The lot drains mainly southwesterly on the east half of the site and northwesterly on the west half of the site toward the northwest corner of the site. The existing site has a system in place that allows for the sites runoff to be infiltrated. The storm lines in section along the east side of the lot have been cutoff from the rest of the site when a section of pipe was removed for a new build years back. This basin's infiltration has become an issue as the existing system appears to be silted in, not allowing the runoff to infiltrate back into the ground. This easterly section is the part of the site we are going to look at with these calculations. It is higher than the rest of the site so the other areas of the site will not affect this parts runoff. This basin is approximately 225-feet wide and 530-feet long giving a basin area of 119,250 Square Feet (2.738 Acres). Since we are looking at constructing an infiltration system the only storms we need to look at will be the developed basins water quality storm event and the 100 year event.

The 12 Elements:

Element #1

The site work is inside an existing corrugated metal pipe plant. Most of the existing site has either been paved, had building on it, or been rocked for machinery traffic paths. The work site itself is surrounded by the existing plant infrastructure and is flat indicting that runoff should not be an issue during construction.

Element #2

The construction entrance will have to be taken form the south entrance to the plant. This is a main driving surface into the plant area, past the existing office. This entrance is currently paved and the existing site is mostly covered with rock or impervious surface at this time.

Element #3

The entire plant drains to storm system that was designed to infiltrate the runoff back into the site soils. Most the site will continue to drain to the existing system during and after construction of the new facilities. The area of concern will be directed to the newly created infiltration facilities created by this project.

Element #4

The existing area we are doing work on has no treatment facility prior to the existing infiltration system. We believe this is the biggest contributor to the failing of the existing system. The new infiltration system will be protected from sediment loading by not hooking the new system into the existing system until the final step, and by the use of inlet protection installed in all existing drains that will receive runoff from the work area and along the entrance and exit route for the work area.

Element #5

The proposed project has been scheduled to be constructed during the fall and winter months. The site is almost flat with less than 1% fall across most of the area. Most the existing soils are currently covered by impervious surfaces so general erosion should not be a big issue. The work

area will be protected by sediment fences and other BMP's to keep the any runoff from the work area clean. Any stockpiles that would be created would be protected to prevent the degradation of the existing treatment facility presently working on the site.

Element #6
There are no slopes in the area of the work site. No major or even minor cut or fill slopes will be created by this work. The runoff from this site will continue to be infiltrated as it has been and the site flows will continue in the directions they have flowed, during and after construction of the new facilities. None of which impact any major slopes.

Element #7
The existing inlets will be protected during construction and until ground cover is established, by inlet sediment bags at each inlet.

Element #8
The flatness of the site will not require any new or temporary channels to be created.

Element #9
The site uses infiltration to dispose of the runoff from the site, and this will continue even after the work being done.

Element #10
De-Watering should not be a problem given the pervious nature of the site soils. The flows from the site, even de-watering flows will continue to be directed into the functioning storm infiltration system.

Element #11
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.

Element #12
The ongoing corrugated metal pipe plant operations will be a controlling factor in the process of construction the facilities. The project will not be phased but may be required to be built in steps to allow the mill to continue to function. The ongoing mill operations will require that issues are kept up with and dealt with in the proper way. The city of Arlington will be the permitting agency for the project and their standards will be met during all parts of the project.

SITE RAINFALL: (24hr precipitation)
24hr storm precipitation totals have been extrapolated from U.S. Dept. of Agriculture isopovuls for Washington, for the 2 year and the 100 year storm events (water quality storm is 72% of the 2 year storm). 24hr precipitation is as follows:

STORM EVENT	24hr Precip. (inches)
WQ	1.44
100 year	4.00

SOIL TYPE:
According to the National Resource Conservation Service (NRCS) Soils Survey this site soil is mapped as an Everett gravelly sandy loam a class 'A' soil type (see Web Soil Survey map attached). Per the NRCS Web Soil Survey the infiltration rate for this soil between 2-feet and 10-feet deep is 300 micrometers per second. This equates to an ultimate infiltration rate of 42.5 inches per hour. If we use a factor of safety of 2, this would give us just over 21 inches per hour, so we will use an infiltration rate of 20 inches per hour (3 minutes per inch) for this site design.

CURVE NUMBERS:

Soil hydrologic group 'A'

$C_N = 77$ (pervious) (grass cover on 50% to 75%)

$C_N = 98$ (impervious)

DEVELOPED BASIN INFORMATION:
This basin is higher than the rest of the site so no other parts of the site will drain into it. We will look at only this basin in sizing our water quality treatment and infiltration system for this basin. This basin is approximately 225-feet by 530-feet or 119,250 Sq.Ft. (2.738 acres). This whole basin will be considered impervious as most of it is paved or roofed and any other sections would be existing gravel except for maybe some small areas along the edge of the site. The impervious surface will be picked up by the existing drainage system that will need to be up graded and then ran through a treatment facility prior to being disposed of through infiltration on site.

DEVELOPED SITE:
The flows from the site are expected to be mainly impervious area flows so the minimum time of concentration of 5.0 minutes will be used for the improvements.

T_c ———————— Use minimum time of concentration 5 minutes

SECTION B – QUANTITY CONTROL ANALYSIS AND DESIGN:

For quantity control we will use the 100-year event to infiltrate. We will design our system to handle the largest event and the rest of the events will fit. First we need to find the flows and volumes we need to infiltrate. We will use the King County Hydrograph program to do this.

100 Year Storm Event – Total Basin 'A'

```
********** S.C.S. TYPE-1A DISTRIBUTION **********
*********   100-YEAR  24-HOUR STORM  ****  4.00" TOTAL PRECIP. *********
ENTER: A(PERV), CN(PERV), A(IMPERV), CN(IMPERV), TC FOR BASIN NO.  1
0,77,2.738,98,5.00

DATA PRINT-OUT:
  AREA(ACRES)     PERVIOUS     IMPERVIOUS    TC(MINUTES)
                  A     CN     A     CN
      2.7         .0   77.0    2.7   98.0        5.0

  PEAK-Q(CFS)   T-PEAK(HRS)     VOL(CU-FT)    100 Year Event Flow
     2.87          7.67           37421

ENTER [d:][path]filename[.ext] FOR STORAGE OF COMPUTED HYDROGRAPH:
CON.00D
```

BASIN 'A', 100 YEAR EVENT HYDROGRAPH DATA PRINT-OUT:

T(HRS)	Q(CFS)	T(HRS)	Q(CFS)	T(HRS)	Q(CFS)	T(HRS)	Q(CFS)
.00	.00	6.33	.61	12.67	.43	19.00	.26
.17	.00	6.50	.61	12.83	.38	19.17	.26
.33	.00	6.67	.74	13.00	.38	19.33	.26
.50	.02	6.83	.86	13.17	.38	19.50	.26
.67	.05	7.00	.87	13.33	.38	19.67	.26
.83	.08	7.17	1.02	13.50	.38	19.83	.26
1.00	.10	7.33	1.17	13.67	.38	20.00	.26
1.17	.12	7.50	1.69	13.83	.38	20.17	.26
1.33	.13	7.67	2.87	14.00	.38	20.33	.26
1.50	.15	7.83	2.65	14.17	.38	20.50	.26
1.67	.18	8.00	1.47	14.33	.38	20.67	.26
1.83	.21	8.17	1.03	14.50	.38	20.83	.26
2.00	.23	8.33	.88	14.67	.35	21.00	.26
2.17	.24	8.50	.88	14.83	.33	21.17	.26
2.33	.25	8.67	.73	15.00	.33	21.33	.26
2.50	.25	8.83	.58	15.17	.33	21.50	.26
2.67	.29	9.00	.58	15.33	.33	21.67	.26
2.83	.32	9.17	.58	15.50	.33	21.83	.26
3.00	.33	9.33	.58	15.67	.33	22.00	.26
3.17	.34	9.50	.58	15.83	.33	22.17	.26
3.33	.34	9.67	.58	16.00	.33	22.33	.26
3.50	.35	9.83	.58	16.17	.33	22.50	.26
3.67	.38	10.00	.58	16.33	.33	22.67	.26
3.83	.41	10.17	.58	16.50	.33	22.83	.26
4.00	.42	10.33	.58	16.67	.30	23.00	.26
4.17	.42	10.50	.58	16.83	.26	23.17	.26
4.33	.42	10.67	.53	17.00	.26	23.33	.26
4.50	.43	10.83	.47	17.17	.26	23.50	.26
4.67	.47	11.00	.47	17.33	.26	23.67	.26
4.83	.51	11.17	.47	17.50	.26	23.83	.26
5.00	.51	11.33	.47	17.67	.26	24.00	.13
5.17	.51	11.50	.47	17.83	.26	24.17	.00
5.33	.51	11.67	.47	18.00	.26	24.33	.00
5.50	.52	11.83	.47	18.17	.26	24.50	.00
5.67	.56	12.00	.47	18.33	.26	24.67	.00
5.83	.60	12.17	.47	18.50	.26	24.83	.00
6.00	.60	12.33	.47	18.67	.26	25.00	.00
6.17	.61	12.50	.47	18.83	.26	25.17	.00

SPECIFY: C - CONTINUE, N - NEWSTORM, P - PRINT, S - STOP

Now we need to route the 100 year events through a model of our new infiltration facility. A spreadsheet has been used to build model of the proposed infiltration system. We used the spreadsheet to build a routing file to route the design storm through. The 100 year event was used to design the system, and the routing data shows how the system handles the design event. Only the 8-foot bottom width is used for the basis of infiltration area to simplify the data and add a little extra safety by ignoring the side walls of the trench.

RESERVOIR ROUTING INFLOW/OUTFLOW ROUTINE

SPECIFY [d:][path]filename[.ext] OF ROUTING DATA
CONT.DET
DISPLAY ROUTING DATA (Y or N)?
Y

ROUTING DATA:

STAGE(FT)	DISCHARGE(CFS)	STORAGE(CU-FT)	PERM-AREA(SQ-FT)
.00	.00	.0	1280.0
.25	.00	128.0	1280.0
.50	.00	256.0	1280.0
.75	.00	384.0	1280.0
1.00	.00	512.0	1280.0

5/20

1.25	.00	678.4	1280.0
1.50	.00	876.5	1280.0
1.75	.00	1091.8	1280.0
2.00	.00	1321.6	1280.0
2.25	.00	1561.9	1280.0
2.50	.00	1810.9	1280.0
2.75	.00	2066.6	1280.0
3.00	.00	2328.0	1280.0
3.25	.00	2593.3	1280.0
3.50	.00	2862.4	1280.0
3.75	.00	3133.4	1280.0
4.00	.00	3405.4	1280.0
4.25	.00	3677.4	1280.0
4.50	.00	3947.5	1280.0
4.75	.00	4216.6	1280.0
5.00	.00	4481.9	1280.0
5.25	.00	4743.4	1280.0
5.50	.00	5000.0	1280.0
5.75	.00	5249.0	1280.0
6.00	.00	5489.3	1280.0
6.25	.00	5718.1	1280.0
6.50	.00	5934.3	1280.0
6.75	.00	6131.5	1280.0
7.00	.00	6297.9	1280.0
7.25	.00	6425.9	1280.0
7.50	.00	6553.9	1280.0
7.75	.00	6681.9	1280.0
8.00	.00	6809.9	1280.0

AVERAGE PERM-RATE: 3.0 MINUTES/INCH

ENTER [d:][path]filename[.ext] OF COMPUTED HYDROGRAPH:
CON.00D

INFLOW/OUTFLOW ANALYSIS:

PEAK-INFLOW(CFS)	PEAK-OUTFLOW(CFS)	OUTFLOW-VOL(CU-FT)
2.87	.00	0

INITIAL-STAGE(FT)	TIME-OF-PEAK(HRS)	PEAK-STAGE-ELEV(FT)
93.50	8.83	99.54

PEAK STORAGE: 5530 CU-FT

INFILTRATED VOLUME: 37383 CU-FT

ENTER [d:][path]filename[.ext] FOR STORAGE OF COMPUTED HYDROGRAPH:
CON-100.INF

SPECIFY: C - CONTINUE, N - NEWJOB, P - PRINT, S - STOP, R - REVISE
C

ENTER [d:][path]filename[.ext] OF COMPUTED HYDROGRAPH:
CON.WQ

INFLOW/OUTFLOW ANALYSIS:

PEAK-INFLOW(CFS)	PEAK-OUTFLOW(CFS)	OUTFLOW-VOL(CU-FT)
.96	.00	0

INITIAL-STAGE(FT)	TIME-OF-PEAK(HRS)	PEAK-STAGE-ELEV(FT)
93.50	8.00	94.22

PEAK STORAGE: 370 CU-FT

INFILTRATED VOLUME: 12082 CU-FT

ENTER [d:][path]filename[.ext] FOR STORAGE OF COMPUTED HYDROGRAPH:
CON-WQ.INF

The basin we are working with is fully infiltrated with the designed system of 160-feet of 72" pipe in an 8-foot by 8-foot trench. We have also routed the water quality event to be sure that the system did not back up into the water quality facilities during the water quality storm. As shown the water quality storm does not even fill the rock under the pipe. We have included a typical section of this infiltration trench which could be laid out in any shape and still meet the design, as only the bottom area was used for basis for the outgoing infiltration flow rate. The sidewalls will provide more outflow, but this could change with the configuration of the system and will only increase the factor of safety and provide extra infiltration if the bottom silts up.

SECTION C – WATER QUALITY DESIGN:

We need to treat the 6-month event for the impervious areas flowing to this new facility. The water quality storm is equivalent to 72% of the 2-yearstorm event. We need to treat this to help keep the new system from becoming silted in as the existing system has.

STORM EVENT	24hr Precip. (inches)
WQ Storm	1.44

Post-Development Runoff Rates: Water Quality Event

Water Quality Storm Event – Basin 'A' Area Only

```
********************* S.C.S. TYPE-1A DISTRIBUTION ********************
*********   1-YEAR  24-HOUR STORM  ****  1.44" TOTAL PRECIP. *********
ENTER: A(PERV), CN(PERV), A(IMPERV), CN(IMPERV), TC FOR BASIN NO.  1
0,77,2.738,98,5.00

DATA PRINT-OUT:
  AREA(ACRES)     PERVIOUS     IMPERVIOUS    TC(MINUTES)
                  A     CN     A     CN
       2.7         .0  77.0     2.7  98.0        5.0

PEAK-Q(CFS)    T-PEAK(HRS)      VOL(CU-FT)     Water Quality Event Developed Site Flows
       .96           7.67           12136
ENTER [d:][path]filename[.ext] FOR STORAGE OF COMPUTED HYDROGRAPH:
CON.WQ
```

WATER QUALITY:

The treatment for the water quality event will by using a treatment train to provide as much sediment removal as possible prior to infiltration to keep the new system from becoming plugged as the existing system has. The first part of the treatment will be to run the flows through a Vortechs unit for pretreatment of the flows. A Vortechs 3000 on-line has a maximum capacity of up to 4.5 cubic feet per second (cfs) and it has an optimal treatment flow of 1.5 cfs, more than the required treatment rate of 0.96 cfs for the entire basin impervious area. The second part of the treatment train will be the use of a CDS StormFilter Unit to remove and fines suspended in the flows that could pass through the Vortech unit. A StormFilter 816 outfitted with a full complement of 39, 27-inch tall cartridges at 11.3 GPM, gives a possible treatment rate of 440.7 GPM (0.98 cfs).

STORM EVENT	Storm Event Rates (cfs)	Vortech Unit Treatment Rate (cfs)	StomFilter Treatment Rate (cfs)
W.Q.	0.96	1.50	0.98

7/20

SECTION D – CONCLUSION:

The existing basin 'A' has an infiltration system that is plugged and no longer working as designed. We are proposing a new system that will fully infiltrate the 100-year event for the basin. We are providing treatment for this site in a two step treatment train to prevent the new system from becoming plugged with fines as the existing system has. The steps to the treatment will be to first run the flows through a Vortechs unit to remove any large debris and settable sediment in the treatment flows. The next step will be to run the flows through a filter system to insure the maximum removal of fine to help ensure that the infiltration system will function as designed for as long as possible.

The infiltration system designed has had the 100-year event routed through the system and the routing shows that we do not quite fill the proposed system to the top. The system design uses only the bottom area of the system for infiltration number to provide a little extra safety in the design. The maximum storage during the routing of the event is 5,530 cubic feet which is less than the 6,800 cubic feet that is available in this design. We have also shown that during the water quality events the treatment facilities will flow freely into the infiltration system.

The first part of the treatment will be to run the flows through a Vortechs unit for pretreatment of the flows. A Vortechs 3000 on-line has an optimal treatment flow of 1.50 cubic feet per second (cfs), more than the required treatment rate of 0.96 cfs for this entire basin impervious area.

The second part of the treatment train will be the use of a CDS StormFilter Unit to remove and fines suspended in the flows that could pass through the Vortech unit. A StormFilter 816 outfitted with a full complement of 39, 27-inch tall cartridges at 11.3 GPM, gives a possible treatment rate of 0.98 cfs exceeding the treatment rate required.

Supporting Data:

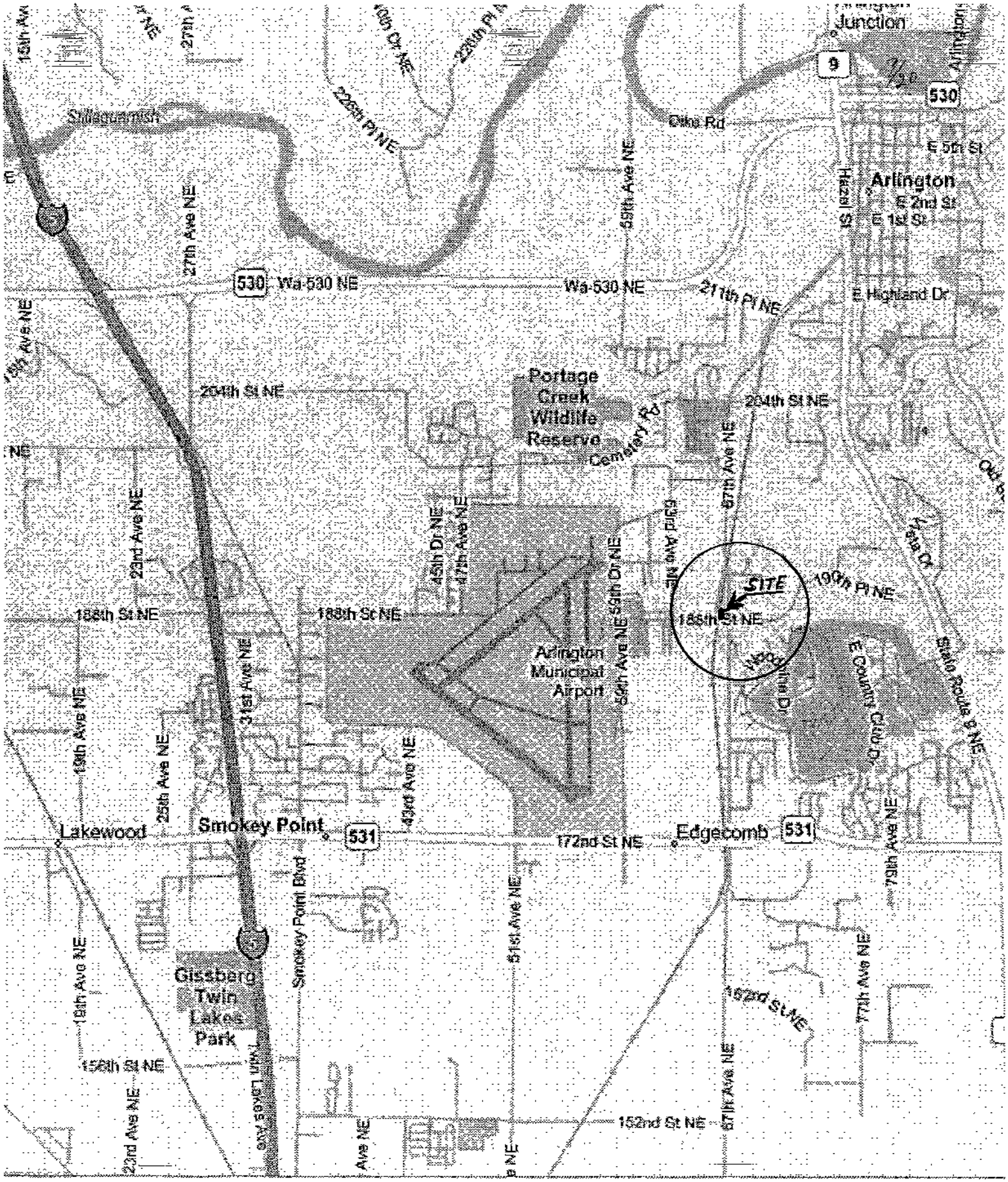

Junction
9
530
Arlington
Oso Rd
E 5th St
E 2nd St
E 1st St
Stillaguamish
27th Ave NE
Wa-530 NE
211th Pl NE
E Highland Dr
204th St NE
Portage Creek Wildlife Reserve
Cemetery Rd
67th Ave NE
59th Ave NE
45th Dr NE
47th Ave NE
SITE
190th Pl NE
188th St NE
Arlington Municipal Airport
56th Ave NE
E Country Club Dr
23rd Ave NE
31st Ave NE
19th Ave NE
25th Ave NE
43rd Ave NE
Lakewood
Smokey Point
531
172nd St NE
Edgecomb
Smokey Point Blvd
51st Ave NE
79th Ave NE
Gissberg Twin Lakes Park
152nd St NE
158th St NE
67th Ave NE
77th Ave NE
22nd Ave NE

FIGURE 1

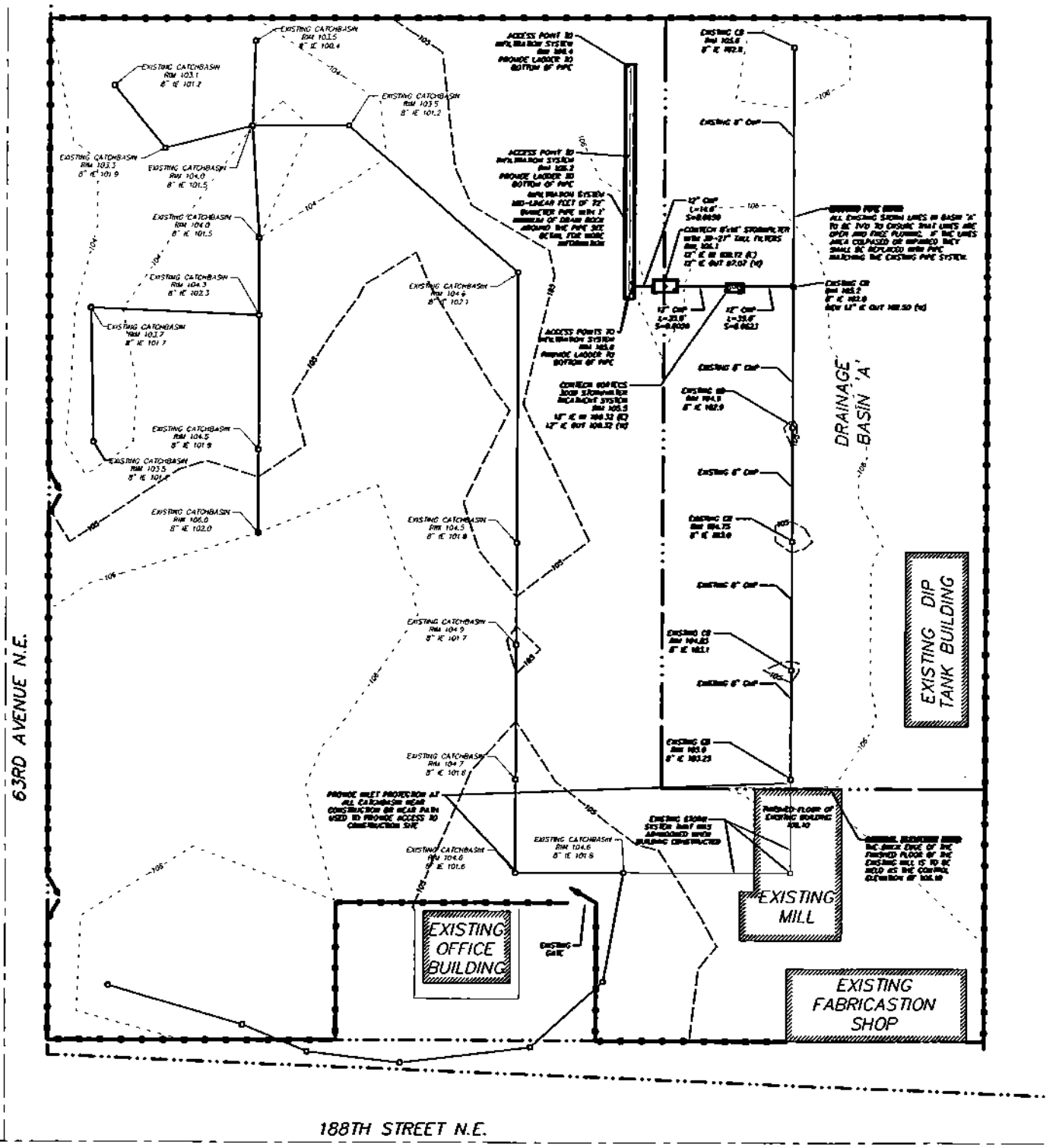

63RD AVENUE N.E.
188TH STREET N.E.
DRAINAGE BASIN 'A'
EXISTING DIP TANK BUILDING
EXISTING MILL
EXISTING OFFICE BUILDING
EXISTING FABRICASTION SHOP
EXISTING CATCHBASIN
EXISTING CB
EXISTING 8" CMP
ACCESS POINT TO
PROVIDE LADDER TO BOTTOM OF PIPE
PROVIDE INLET PROTECTION AT ALL CATCHBASIN NEAR CONSTRUCTION OR NEAR PATH USED TO PROVIDE ACCESS TO CONSTRUCTION SITE
EXISTING GATE

FIGURE 2

Web Soil Survey

Contact Us | Download Soils Data | Archived Soil Surveys | Soil Survey Status | Glossary | Preferences | Logout | Help

Area of Interest (AOI) | Soil Map | Soil Data Explorer | Shopping Cart (Free)

View Soil Information By Use: All Uses

Printable Version | Add to Shopping Cart

Intro to Soils | Suitabilities and Limitations for Use | Soil Properties and Qualities | Ecological Site Assessment | Soil Reports

Search

Properties and Qualities Ratings

Open All | Close All

Soil Chemical Properties

Soil Erosion Factors

Soil Physical Properties

- Available Water Capacity
- Available Water Supply, 0 to 100 cm
- Available Water Supply, 0 to 150 cm
- Available Water Supply, 0 to 25 cm
- Available Water Supply, 0 to 50 cm
- Bulk Density, 15 Bar
- Bulk Density, One-Tenth Bar
- Bulk Density, One-Third Bar
- Linear Extensibility
- Liquid Limit
- Organic Matter
- Percent Clay
- Percent Sand
- Percent Silt
- Plasticity Index
- **Saturated Hydraulic Conductivity (Ksat)**

View Description | View Rating

View Options

Map ☑
Table ☑
Description of Rating ☑
Rating Options ☑
☐ Detailed Description

Advanced Options

Aggregation Method: Dominant Component

Component Percent Cutoff:

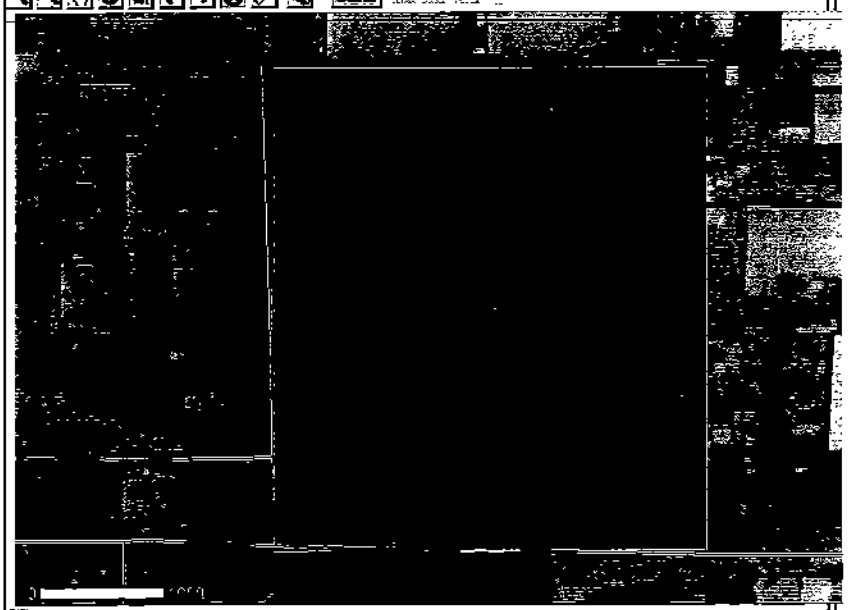
Tie-break Rule: ○ Slowest ◉ Fastest

Interpret Nulls as Zero: Yes ○ No

Layer Options: ○ Surface Layer

Map — Saturated Hydraulic Conductivity (Ksat)

Scale (not to scale)



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

You have zoomed in beyond the scale at which the soil map for this area is intended to be used. Mapping is done at a particular scale. The soil surveys that comprise your AOI were mapped at 1:24,000. The map units and the level of detail shown in the resulting soil map are dependent on that map scale.

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

Identify

To identify a feature in a map layer at a specific point on the map:

1. Open the *Legend* control by clicking the **Legend** tab.
2. Click a map layer name in the *Legend* panel to make it the active layer . You cannot identify a layer that is disabled because that layer does not appear at the current view scale. To identify a disabled layer, zoom in or out until it is visible.
3. Click the map at the location of interest.
4. The point you identified is marked with the ✛ cursor.

Tables — Saturated Hydraulic Conductivity (Ksat) — Summary By Map Unit

Summary by Map Unit — Snohomish County Area, Washington

Map unit symbol	Map unit name	Rating (micrometers per second)	Acres in AOI	Percent of AOI
17	Everett gravelly sandy loam, 0 to 8 percent slopes	230.7368	11.8	100.0%
Totals for Area of Interest			**11.8**	**100.0%**

Description — Saturated Hydraulic Conductivity (Ksat)

Saturated hydraulic conductivity (Ksat) refers to the ease with which pores in a saturated soil transmit water. The estimates are expressed in terms of micrometers per second. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Saturated hydraulic conductivity is considered in the design of soil drainage systems and septic tank absorption fields.

For each soil layer, this attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

FIGURE 3

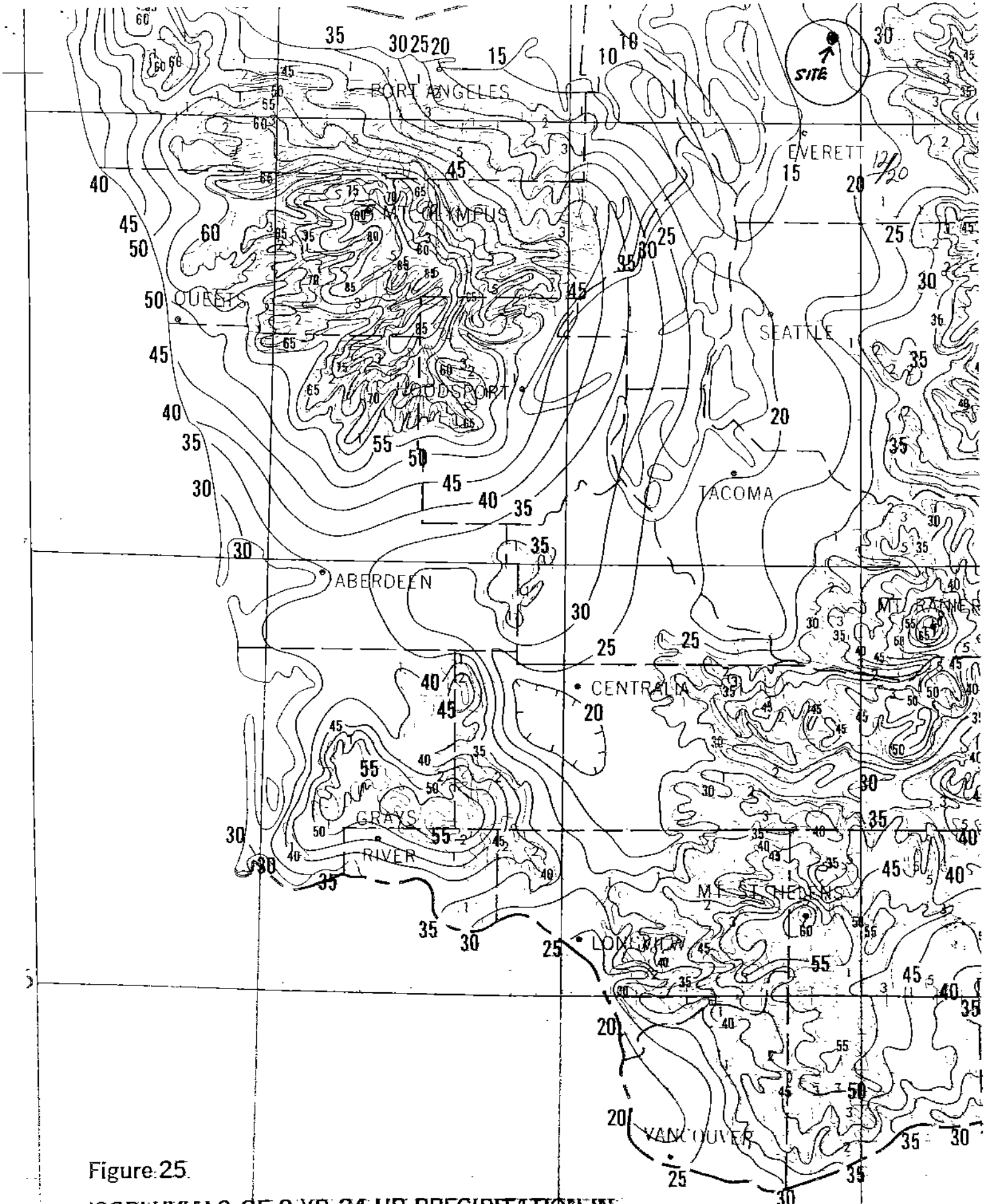


Figure 25

ISOPLUVIALS OF 2-YR 24-HR PRECIPITATION IN TENTHS OF AN INCH

FIGURE 4

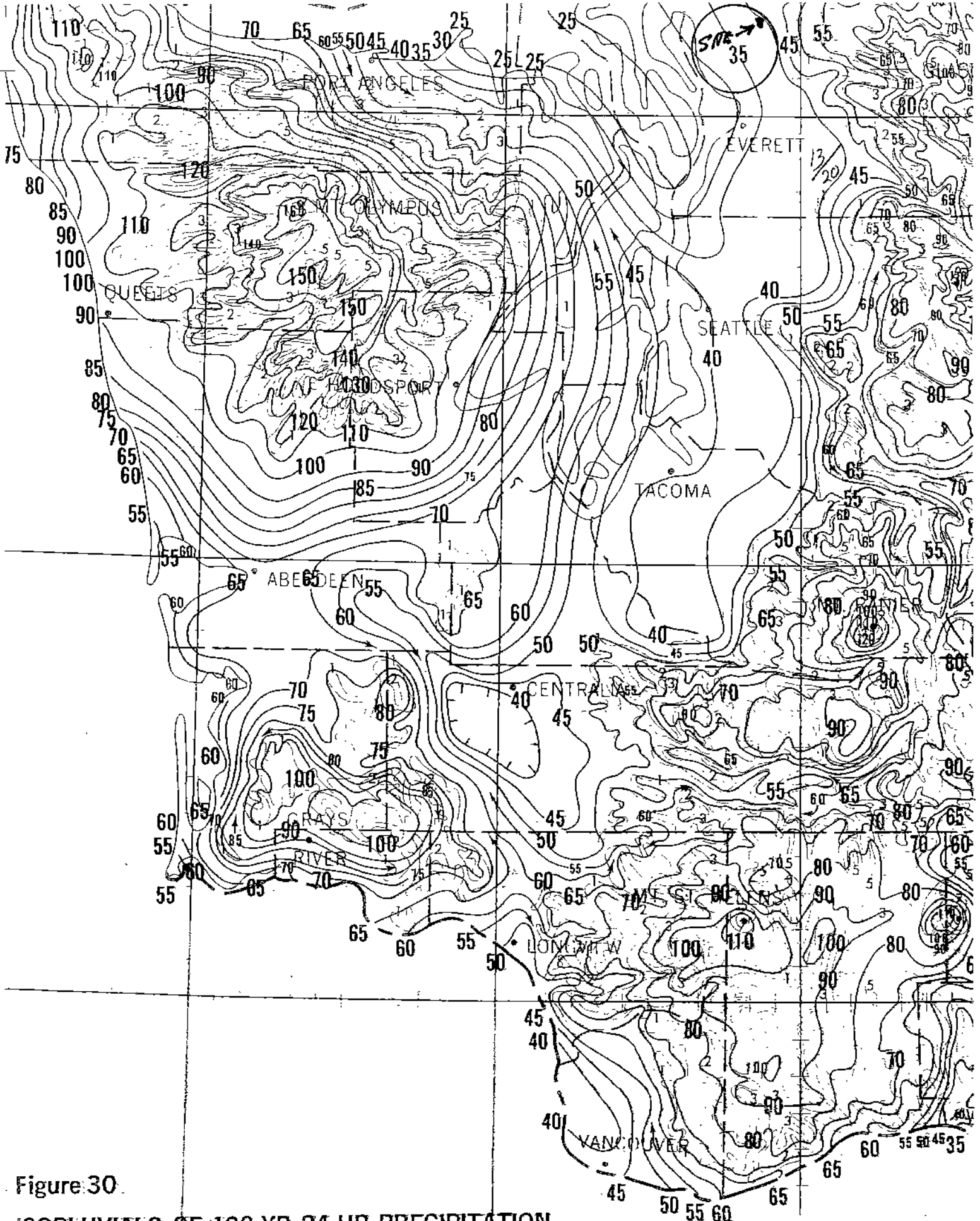


Figure 30

ISOPLUVIALS OF 100-YR 24-HR PRECIPITATION
IN TENTHS OF AN INCH

FIGURE 5

14/20

Table 2.2
Runoff Curve Numbers for Selected Agricultural, Suburban, and Urban Areas

(Sources: TR 55, 1986, and Stormwater Management Manual, 1992. See Section 2.1.1 for explanation)

Cover type and hydrologic condition.	CNs for hydrologic soil group A	B	C	D
Curve Numbers for Pre-Development Conditions				
Pasture, grassland, or range-continuous forage for grazing:				
Fair condition (ground cover 50% to 75% and not heavily grazed).	49	69	79	84
Good condition (ground cover >75% and lightly or only occasionally grazed)	39	61	74	80
Woods:				
Fair (Woods are grazed but not burned, and some forest litter covers the soil).	36	60	73	79
Good (Woods are protected from grazing, and litter and brush adequately cover the soil).	30	55	70	77
Curve Numbers for Post-Development Conditions				
Open space (lawns, parks, golf courses, cemeteries, landscaping, etc.)[1]				
Fair condition (grass cover on 50% - 75% of the area).	77	85	90	92
Good condition (grass cover on >75% of the area)	68	80	86	90
Impervious areas:				
Open water bodies: lakes, wetlands, ponds etc.	100	100	100	100
Paved parking lots, roofs[2], driveways, etc. (excluding right-of-way)	98	98	98	98
Permeable Pavement (See Appendix C to decide which condition below to use)				
Landscaped area	77	85	90	92
50% landscaped area/50% impervious	87	91	94	96
100% impervious area	98	98	98	98
Paved	98	98	98	98
Gravel (including right-of-way)	76	85	89	91
Dirt (including right-of-way)	72	82	87	89
Pasture, grassland, or range-continuous forage for grazing:				
Poor condition (ground cover <50% or heavily grazed with no mulch).	68	79	86	89
Fair condition (ground cover 50% to 75% and not heavily grazed).	49	69	79	84
Good condition (ground cover >75% and lightly or only occasionally grazed)	39	61	74	80
Woods:				
Poor (Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning).	45	66	77	83
Fair (Woods are grazed but not burned, and some forest litter covers the soil).	36	60	73	79
Good (Woods are protected from grazing, and litter and brush adequately cover the soil).	30	55	70	77

Single family residential[3]: Dwelling Unit/Gross Acre	Should only be used for subdivisions > 50 acres	Average Percent impervious area[3,4]	
1.0 DU/GA		15	Separate curve number
1.5 DU/GA		20	shall be selected for
2.0 DU/GA		25	pervious & impervious
2.5 DU/GA		30	portions of the site or
3.0 DU/GA		34	basin
3.5 DU/GA		38	
4.0 DU/GA		42	
4.5 DU/GA		46	
5.0 DU/GA		48	
5.5 DU/GA		50	
6.0 DU/GA		52	
6.5 DU/GA		54	
7.0 DU/GA		56	
7.5 DU/GA		58	

PUD's, condos, apartments, commercial businesses, industrial areas & & subdivisions < 50 acres	%impervious must be computed	Separate curve numbers shall be selected for pervious and impervious portions of the site

For a more detailed and complete description of land use curve numbers refer to chapter two (2) of the Soil Conservation Service's Technical Release No. 55 , (210-VI-TR-55, Second Ed., June 1986).

[1] Composite CN's may be computed for other combinations of open space cover type.

[2] Where roof runoff and driveway runoff are infiltrated or dispersed according to the requirements in Chapter 3, the average percent impervious area may be adjusted in accordance with the procedure described under "Flow Credit for Roof Downspout Infiltration" (Section 3.1.1), and "Flow Credit for Roof Downspout Dispersion" (Section 3.1.2).

[3] Assumes roof and driveway runoff is directed into street/storm system.

[4] All the remaining pervious area (lawn) are considered to be in good condition for these curve numbers.

FIGURE 6

ROUTING DATA FOR DETENTION CALCS

15/20

FOR: SUB A

PIPE DIAMETER	72	inches
PIPE LENGTH	160	feet
TRENCH WIDTH	8.0	feet
INFILTRATION RATE	20.000	inches/hour

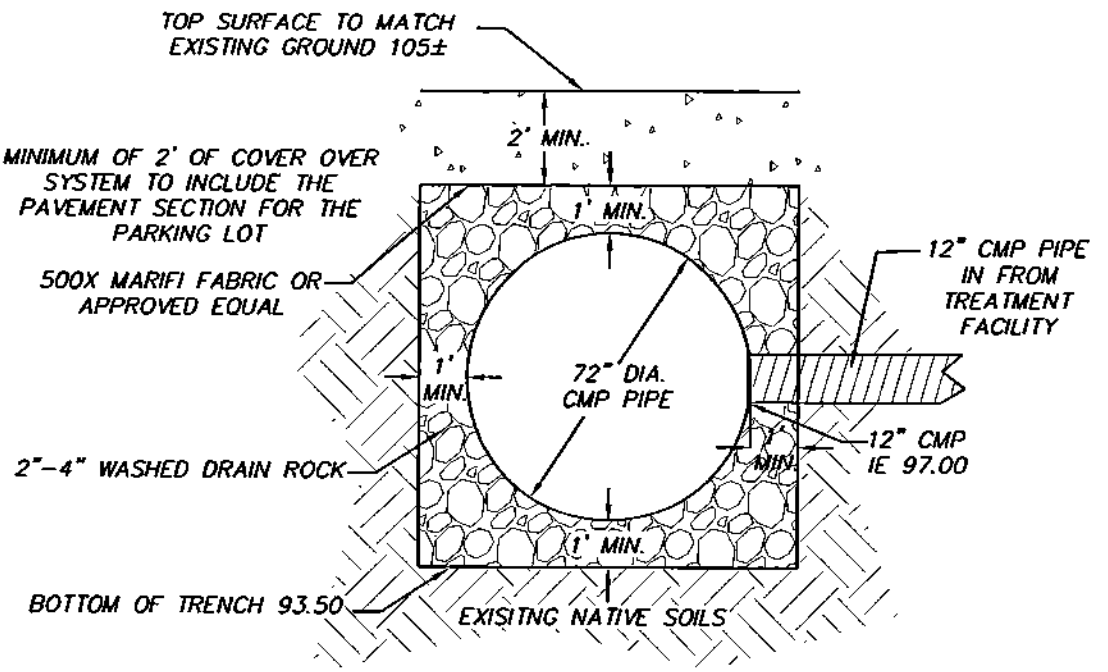
ELEV. (N)	ROCK AREA (ft^2)	BEG. PIPE AREA (ft^2)	STORAGE VOL. (ft^3)	DISCHARGE1 cfs
0.00	0.00	0.00	0.0	0.593
0.25	2.00	0.00	128.0	0.593
0.50	4.00	0.00	256.0	0.593
0.75	6.00	0.00	384.0	0.593
1.00	8.00	0.00	512.0	0.593
1.25	9.60	0.40	678.4	0.593
1.50	10.87	1.13	876.5	0.593
1.75	11.96	2.04	1091.8	0.593
2.00	12.90	3.10	1321.6	0.593
2.25	13.73	4.27	1561.9	0.593
2.50	14.47	5.53	1810.9	0.593
2.75	15.14	6.86	2066.6	0.593
3.00	15.75	8.25	2328.0	0.593
3.25	16.32	9.68	2593.3	0.593
3.50	16.85	11.15	2862.4	0.593
3.75	17.36	12.64	3133.4	0.593
4.00	17.86	14.14	3405.4	0.593
4.25	18.36	15.64	3677.4	0.593
4.50	18.88	17.12	3947.5	0.593
4.75	19.41	18.59	4216.6	0.593
4.85	19.63	19.17	4323.5	0.593
5.00	19.98	20.02	4481.9	0.593
5.25	20.59	21.41	4743.4	0.593
5.50	21.25	22.75	5000.0	0.593
5.75	21.99	24.01	5249.0	0.593
6.00	22.82	25.18	5489.3	0.593
6.25	23.77	26.23	5718.1	0.593
6.50	24.85	27.15	5934.4	0.593
6.75	26.13	27.87	6131.5	0.593
7.00	27.73	28.27	6297.9	0.593
7.25	29.73	28.27	6425.9	0.593
7.50	31.73	28.27	6553.9	0.593
7.75	33.73	28.27	6681.9	0.593
8.00	35.73	28.27	6809.9	0.593

FIGURE 7

16/20

IFILTRATION TRENCH NOTES:

1) INFILTRATION TRENCH SHALL CONSIST OF A MINIMUM 8'x8' TRENCH WITH A 6' DIAMETER CMP PIPE CENTERED IN IT PER THE TYPICAL TRENCH SECTION.
2) THE 6' PIPE SHALL BE PERFORATED TO ALLOW FOR THE WATER TO MOVE FREELY BETWEEN THE PIPE AND SURROUNDING DRAIN ROCK.
3) THE DESIGN LENGTH OF THE TRENCH IS 160-FEET, AND MAY BE INSTALLED IN A SINGLE LINE OR MULTIPLE PARRALLEL LINES. IF PARRALLEL LINES ARE USE PIPES SHALL HAVE A MINIMUM OF 2-FOOT OF SEPARATION BETEWWEN THEM AND THE TOTAL PIPE LENGTH MUST BE AT LEAST 160-FEET.
4) IF MULTIPLE PIPES ARE USED THE PIPE SECTIONS SHALL BE CONNECTED TOGETHER BY 12" CMP PIPES WITH A MAXIMUM SPACING OF 50' FEET BETWEEN THEM.



TYPICAL TRENCH SECTION

NTS

FIGURE 8

WASHINGTON STATE DEPARTMENT OF ECOLOGY

17/20

November 19, 2003
(Updated August 2007)

GENERAL USE LEVEL DESIGNATION FOR PRETREATMENT (TSS)

For

CONTECH Stormwater Solutions Inc. Vortechs® System

Ecology's Decision:

Based on the CONTECH Stormwater Solutions Inc. (CONTECH) application submissions for the Vortechs System® and recommendations by the Technical Review Committee (TRC), Ecology hereby issues the following use designations for the Vortechs technology:

1. General Use Level Designation (GULD) for pretreatment use – as defined in the Ecology Manual Volume I, a) ahead of infiltration treatment, or b) to protect and extend the maintenance cycle of a Basic or Enhanced treatment device (e.g., sand or media filter). This GULD applies to Vortechs units sized at an operating rate of no more than 35 gpm/sf of grit chamber area at the Water Quality design flow rate as determined using the Western Washington Hydrology Model (WWHM). The following table shows flow rates associated with various grit chamber sizes.

Washington State Vortechs System Sizing		
Vortechs System Model ID	Grit Chamber Diameter	35 gpm/ft2 Flow Rate
	ft	cfs
1000	3	0.35
2000	4	1.0
3000	5	1.5
4000	6	2.2
5000	7	3.0
7000	8	3.9
9000	9	5.0
11000	10	6.1
16000	12	8.8

2. Properly designed and operated Vortechs systems may also have applicability in other situations (example, low-head situations such as bridges or ferry docks) for TSS and oil/grease removal where, on a case-by-case basis, it is found to be infeasible or impracticable to use any other approved practice. Local jurisdictions should follow established variance or exception procedures in approving such applications.

FIGURE 9

WASHINGTON STATE DEPARTMENT OF ECOLOGY

January 2005
(Updated December 2007)

GENERAL USE LEVEL DESIGNATION FOR BASIC (TSS) TREATMENT

For

CONTECH Stormwater Solutions Inc.
Stormwater Management StormFilter®

Ecology's Decision:

Based on the CONTECH Stormwater Solution Inc. (CONTECH) application submissions and recommendations by the Technical Review Committee (TRC), Ecology hereby issues a General Use Level Designation (GULD) for the Stormwater Management StormFilter®:

- As a basic stormwater treatment practice for total suspended solids (TSS) removal;
- Using ZPG™ media (zeolite/perlite/granular activated carbon), with the size distribution described below;
- Sized at a hydraulic loading rate of 1 gpm/ft² of media surface area, per Table 1; and
- Internal bypassing needs to be consistent with the design guidelines in CONTECH's current product design manual.

Table 1: StormFilter Design Flow Rates per Cartridge

Effective Cartridge Height (inches)	12	18	27
Cartridge Flow Rate (gpm/cartridge)	5.1	7.5	11.3

This designation has no expiration date, but it may be amended or revoked by Ecology, and is subject to the conditions specified below.

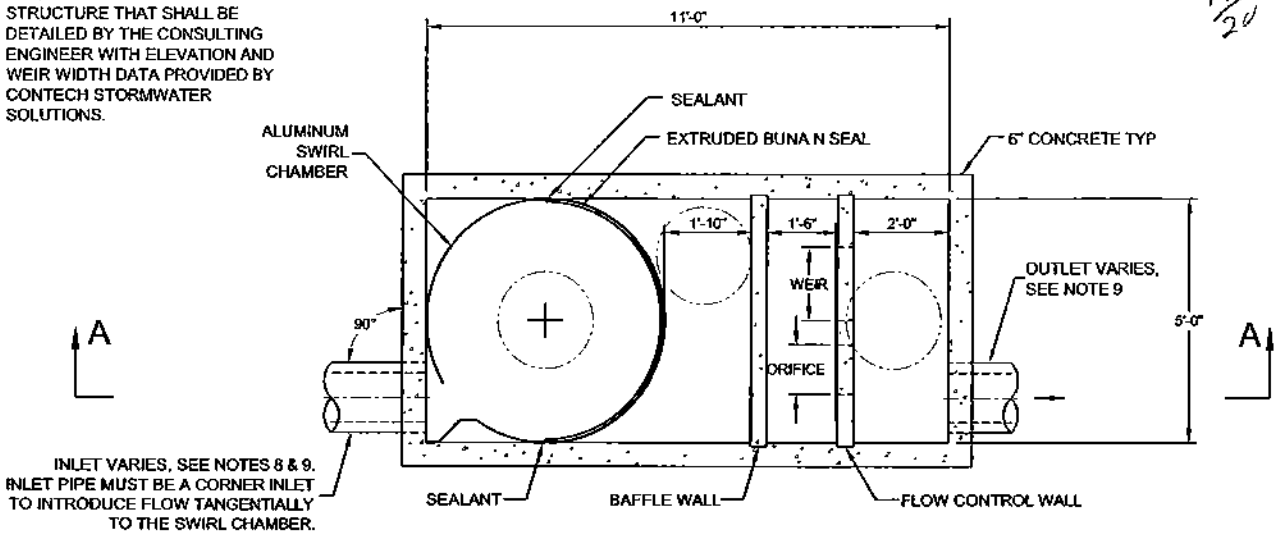
Ecology's Conditions of Use:

The StormFilter shall be designed, installed, and maintained to comply with these conditions:

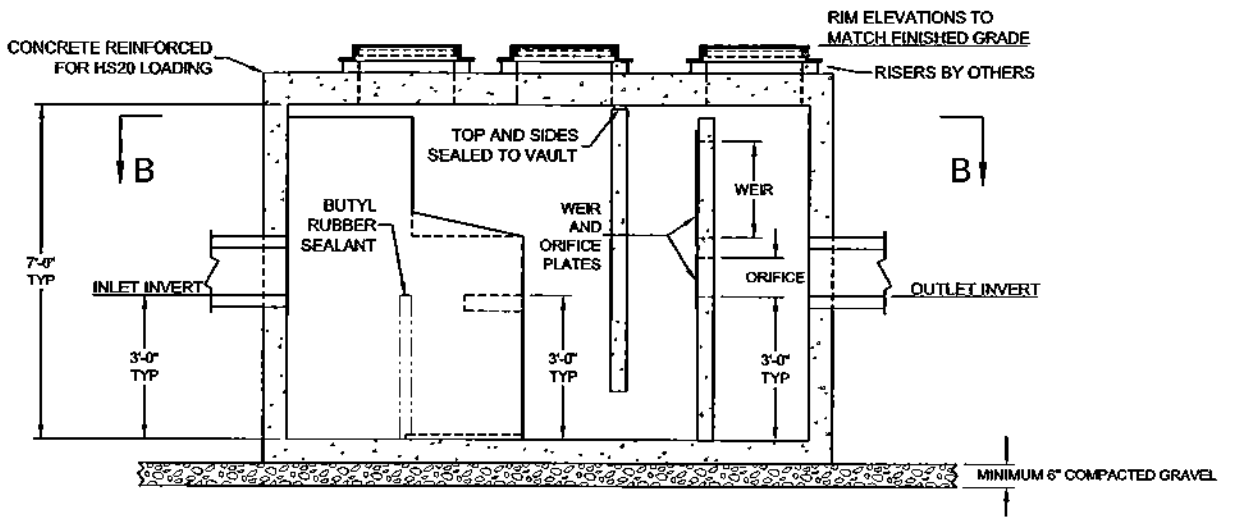
1. StormFilter systems containing ZPG (zeolite/perlite/granular activated carbon) media are approved for basic treatment at the hydraulic loading rate of 1 gpm/ft² of media surface area, per Table 1, at the 15-minute water quality design flow rate (as specified in Ecology's most recent Stormwater Manual), as

FIGURE 10

NOTE:
VORTECHS SYSTEMS INSTALLED IN A BYPASS CONFIGURATION REQUIRE AN UPSTREAM DIVERSION STRUCTURE THAT SHALL BE DETAILED BY THE CONSULTING ENGINEER WITH ELEVATION AND WEIR WIDTH DATA PROVIDED BY CONTECH STORMWATER SOLUTIONS.



PLAN VIEW B - B



SECTION A - A

NOTES:
1. STORMWATER TREATMENT SYSTEM (SWTS) SHALL HAVE:
   PEAK TREATMENT CAPACITY: 4.5 CFS
   SEDIMENT STORAGE: 1.8 CU YD
   SEDIMENT CHAMBER DIA: 5' MIN
2. SWTS SHALL BE CONTAINED IN ONE RECTANGULAR STRUCTURE
3. SWTS REMOVAL EFFICIENCY SHALL BE DOCUMENTED BASED ON PARTICLE SIZE
4. SWTS SHALL RETAIN FLOATABLES AND TRAPPED SEDIMENT UP TO AND INCLUDING PEAK TREATMENT CAPACITY
5. SWTS INVERTS IN AND OUT ARE TYPICALLY AT THE SAME ELEVATION
6. SWTS SHALL NOT BE COMPROMISED BY EFFECTS OF DOWNSTREAM TAILWATER
7. SWTS SHALL HAVE NO INTERNAL COMPONENTS THAT OBSTRUCT MAINTENANCE ACCESS
8. INLET PIPE MUST BE PERPENDICULAR TO THE STRUCTURE
9. PIPE ORIENTATION MAY VARY; SEE SITE PLAN FOR SIZE AND LOCATION
10. PURCHASER SHALL NOT BE RESPONSIBLE FOR ASSEMBLY OF UNIT
11. MANHOLE FRAMES AND PERFORATED COVERS SUPPLIED WITH SYSTEM, NOT INSTALLED
12. PURCHASER TO PREPARE EXCAVATION AND PROVIDE CRANE FOR OFF-LOADING AND SETTING AT TIME OF DELIVERY
13. VORTECHS SYSTEMS BY CONTECH STORMWATER SOLUTIONS; PORTLAND, OR (800)548-4667; SCARBOROUGH, ME (877) 907-8676; LINTHICUM, MD (866) 740-3318.

CONTECH® STORMWATER SOLUTIONS
contechstormwater.com

STANDARD DETAIL
STORMWATER TREATMENT SYSTEM
VORTECHS® MODEL 3000

DATE: 10/4/06 | SCALE: NONE | FILE NAME: STD3K

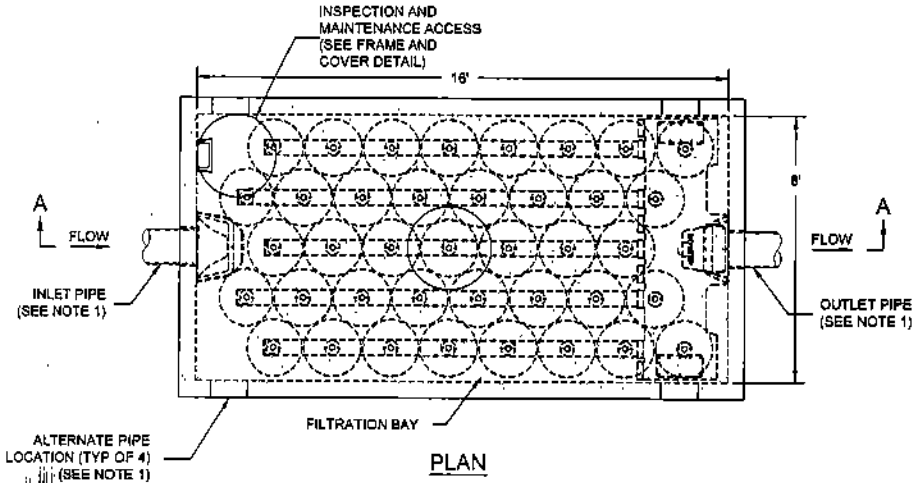
FIGURE 11

STORMFILTER DESIGN TABLE

The Stormwater Management StormFilter®

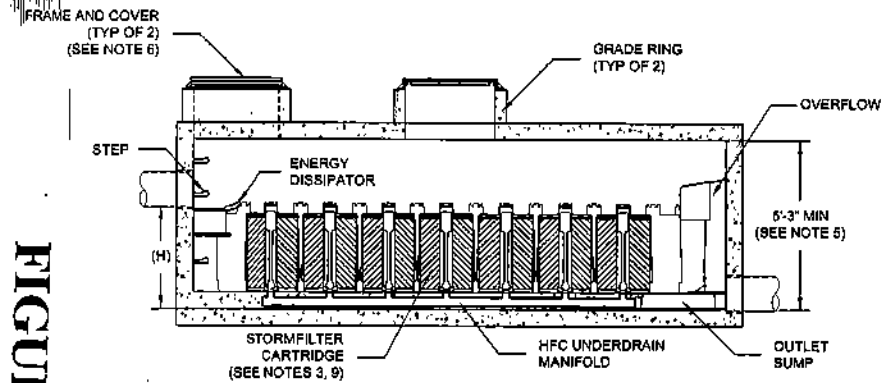
- THE 8'x 16' STORMFILTER TREATMENT CAPACITY VARIES BY NUMBER OF FILTER CARTRIDGES INSTALLED AND BY REGION SPECIFIC INTERNAL FLOW CONTROLS. CONVEYANCE CAPACITY IS RATED AT 1.8 CFS.
- THE STANDARD CONFIGURATION IS SHOWN. ACTUAL CONFIGURATION OF THE SPECIFIED STRUCTURE(S) PER CIVIL ENGINEER WILL BE SHOWN ON SUBMITTAL DRAWING(S).
- ALL PARTS PROVIDED AND INTERNAL ASSEMBLY BY CONTECH STORMWATER SOLUTIONS UNLESS OTHERWISE NOTED.

CARTRIDGE HEIGHT	27"		18"		12"	
SYSTEM HYDRAULIC DROP(H - REQ'D. MIN.)	3.05'		2.3'		1.6'	
TREATMENT BY MEDIA SURFACE AREA	2 gpm/ft²	1 gpm/ft²	2 gpm/ft²	1 gpm/ft²	2 gpm/ft²	1 gpm/ft²
CARTRIDGE FLOW RATE (gpm)	22.5	11.25	15	7.5	10	5



PLAN

(ACCESS FRAME AND COVERS OMITTED FOR CLARITY)



SECTION A - A

FIGURE 12

GENERAL NOTES

1. INLET AND OUTLET PIPING SHALL BE SPECIFIED BY SITE CIVIL ENGINEER (SEE PLANS) AND PROVIDED BY CONTRACTOR. STORMFILTER IS PROVIDED WITH OPENINGS AT INLET AND OUTLET LOCATIONS.
2. IF THE PEAK FLOW RATE, AS DETERMINED BY THE SITE CIVIL ENGINEER, EXCEEDS THE PEAK HYDRAULIC CAPACITY OF THE PRODUCT, AN UPSTREAM BYPASS STRUCTURE IS REQUIRED. PLEASE CONTACT CONTECH STORMWATER SOLUTIONS FOR OPTIONS.
3. THE FILTER CARTRIDGE(S) ARE SIPHON-ACTUATED AND SELF-CLEANING. THE STANDARD DETAIL DRAWING SHOWS THE MAXIMUM NUMBER OF CARTRIDGES. THE ACTUAL NUMBER SHALL BE SPECIFIED BY THE SITE CIVIL ENGINEER ON SITE PLANS OR IN DATA TABLE BELOW. PRECAST STRUCTURE TO BE CONSTRUCTED IN ACCORDANCE WITH ASTM C857 AND C858.
4. SEE STORMFILTER DESIGN TABLE FOR REQUIRED HYDRAULIC DROP. FOR SHALLOW, LOW DROP OR SPECIAL DESIGN CONSTRAINTS, CONTACT CONTECH STORMWATER SOLUTIONS FOR DESIGN OPTIONS.
5. ALL WATER QUALITY PRODUCTS REQUIRE PERIODIC MAINTENANCE AS OUTLINED IN THE O&M GUIDELINES. PROVIDE MINIMUM CLEARANCE FOR MAINTENANCE ACCESS.
6. STRUCTURE AND ACCESS COVERS TO MEET AASHTO H-20 LOAD RATING.
7. THE STRUCTURE THICKNESSES SHOWN ARE FOR REPRESENTATIONAL PURPOSES AND VARY REGIONALLY.
8. ANY BACKFILL DEPTH, SUB-BASE, AND OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY SITE CIVIL ENGINEER.
9. STANDARD CARTRIDGE HEIGHT IS 27" (SHOWN). CARTRIDGE HEIGHT AND ASSOCIATED DESIGN PARAMETERS PER STORMFILTER DESIGN TABLE.
10. STORMFILTER BY CONTECH STORMWATER SOLUTIONS: (800) 925-5240.

SITE SPECIFIC DATA REQUIREMENTS

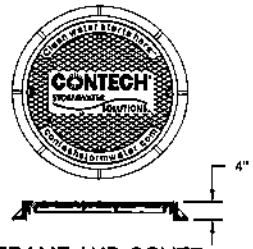
STRUCTURE ID	SF-1
WATER QUALITY FLOW RATE (cfs)	0.98
PEAK FLOW RATE (cfs)	2.93
RETURN PERIOD OF PEAK FLOW (yrs)	100
# OF CARTRIDGES REQUIRED	39
CARTRIDGE FLOW RATE	11.3
MEDIA TYPE (CSF, PERLITE, ZPG)	ZPG

PIPE DATA:	I.E.	MATERIAL	DIAMETER
INLET PIPE #1	100.12	CMP	12"
INLET PIPE #2	NA	NA	NA
OUTLET PIPE	97.07	CMP	12"

UPSTREAM RIM ELEVATION	105.8
CENTER RIM ELEVATION	105.6
DOWNSTREAM RIM ELEVATION	105.8

ANTI-FLOTATION BALLAST	WIDTH	HEIGHT
	NA	NA

NOTES/SPECIAL REQUIREMENTS:
* PER SITE CIVIL ENGINEER



FRAME AND COVER

(DIAMETER VARIES. SEE SUBMITTAL DRAWINGS)

CONTECH STORMWATER SOLUTIONS
contechstormwater.com

THE STORMWATER MANAGEMENT STORMFILTER ®
8' x 16' STORMFILTER
STANDARD DETAIL