URS

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Client: **City of Arlington** Project: **Stormwater Comprehensive Plan**

Location: **Arlington, WA** Subject: **Edgecomb**

Project No: **33757537** Calculation No: **HM-3** Revision No. **0** Sheet **1** of **74**

Edgecomb Basin Analysis

(Title of Calculations/Document)

STEP 1

	Signature	Date
Methodology & Assumptions Developed		5/15/08
Methodology & Assumptions Approved	Carla Jalich	6/10/08

STEP 2

Calculations Completed		6/09/08
Calculations Checked	Carla Jalich	6/10/08

STEP 3

Task Manager Approved	n/a	
Project Manager Approved		

COMMENTS

R:\Enviromental\6 - WATER RESOURCES GROUP\PROJECTS\City of Arlington Stormwater\7 - Hydraulic Model\1 Edgecomb\Calculation Package\Edgecomb Calculation Cover.doc

Purpose: Evaluate the existing stormwater conveyance system that routes flows from within the Edgecomb Creek 5th tier basin to the wetland southwest of the intersection between 172nd Street NE and 67th Avenue NE.

Background: The focus of this evaluation was to locate potential problems within the existing Edgecomb Basin stormwater system. The only reported problems by the City of Arlington (City) staff were limited to the west side of the basin, therefore, only this section of the basin was analyzed.

Stormwater hydraulic problems previously identified in 1995, 1999, and 2003 assessment memos include: conveyance issues and backwater along 67th Avenue NE (between 180th Street and 172nd Street), and flooding within the two wetlands located south of 172nd Street NE during the winter months.

Approach: The Edgecomb Basin was evaluated to determine the capacity of the existing storm drainage network under fully developed conditions. The storm drainage network is not a continuous diameter storm drain; it includes a network of pipes with diameters ranging from 2- to 48-inch pipe diameters, open-channel ditches, and ponds.

The location of the Edgecomb Basin within the City is shown in Figure 1. The location of the 67th Avenue stormwater system is shown in Figure 2.

The hydrology was developed based on the 24-hour frequency design storm (See Attachment 1). This evaluation used the rainfall data from the 2-year, 10-year, 25-year, and 100-year 24-hour storms and identified culverts that may be undersized. A summary of the rainfall data is presented in Table 1.

In the northwest region of the Edgecomb Basin is a large infiltration pond, Woodlands Pond, that disperses flow through two outlet pipes; one 36-inch diameter that conveys water north to an infiltration field northwest of the intersection of 188th Street NE and 67th Avenue NE; and a second outlet pipe that has a 30-inch diameter and conveys water southbound parallel to 67th Avenue. To simplify the system, it was assumed that the flow rate entering the pond is the same as the flow rate leaving the pond, and that flow rate is split evenly between the two outlet pipes, since the invert elevations and diameters of the pipes are nearly equivalent. The City has not reported any stormwater problems to the north so this calculation package addresses flow to the south only.

The flow rate entering the Woodlands Pond was estimated using the Santa Barbara Urban Hydrograph (SBUH) method, for the 2-, 10-, 25-, and 100-yr, 24-hr storms. The conveyance system parallel to 67th Avenue NE also receives flow from a culvert located under 67th Avenue NE near Highland View Drive. The flow rate contribution from this culvert was also estimated using the SBUH method for the 2-, 10-, 25-, and 100-yr, 24-hr storms.

The runoff curve number input required for the SBUH method was estimated from the values suggested by the Natural Resources Conservation Service's (NRCS) TR-55 manual. The NRCS suggested runoff curve numbers corresponding to each hydrologic soil group for residential districts were averaged to determine one RCN for the entire basin. The calculations for the runoff curve number can be found in Attachment 2.

Results: The results from the SBUH method and Time of Concentration estimates are included in Attachments 3 and 4.

The existing stormwater system parallel to 67th Avenue NE was evaluated based on the 10-yr, 24-hr storm.

The results of the hydraulic analysis identified potential undersized culverts along the stormwater system line parallel to 67th Avenue NE at the following locations:

- Culvert No. 783, near 181st Street NE;
- Culvert under rail road spur; and
- Culverts No. 2330 through 2337, north of 172nd Street NE.

The above culvert number system is based on the numbering system used by Cascade Survey, dated August 7, 2008. See Attachment 5 for the survey data. See Figure 2 for the location of the culverts referenced above. See Table 2 for a summary of existing conditions and potential culvert upgrades within the Edgecomb Basin. Attachment 6 includes the backup calculations for the culvert sizing recommendations.

Stormwater issues at Culvert No. 783 and Culverts No. 2330 through 2337 have already been identified as problems in the 1995, 1999, and 2003 assessment reports and the City has planned projects to resolve these issues. The problem at Culvert No. 783 should be resolved during the completion of Project No. 13. The problem at Culverts No. 2330 through 2337 should be resolved during the completion of Project No. 14. See Attachment 7 for a brief description of these projects. A weir structure was observed during the surveying by Cascade Survey on August 7, 2008 downstream of Culverts No. 2330 through 2337. This structure may cause a backwater condition which will require a larger pipe diameter for Culverts No. 2330 through 2337 than the diameter proposed in Table 2. Prior to finalizing the diameter recommendation for Culverts No. 2330 through 2337, it will need to be determined if the backwater effect from the weir impact these culverts.

The soil types within Edgecomb Basin vary from being classified as hydrologic groups A, C, and D. Hydrologic soil group A soils have the highest infiltration rate while type D soils have a very slow infiltration rate. It is believed that more surface water infiltrates and the flows used in the calculations for this report are considered conservative. Therefore the pipes within the Edgecomb Basin may not receive as much flow as addressed in the calculations prepared for this report. At this time, it is recommended that the City monitor and record observations in the pipes mentioned above during and following storm events to determine if additional modeling and potentially upgrading the stormwater system, at these locations are necessary.

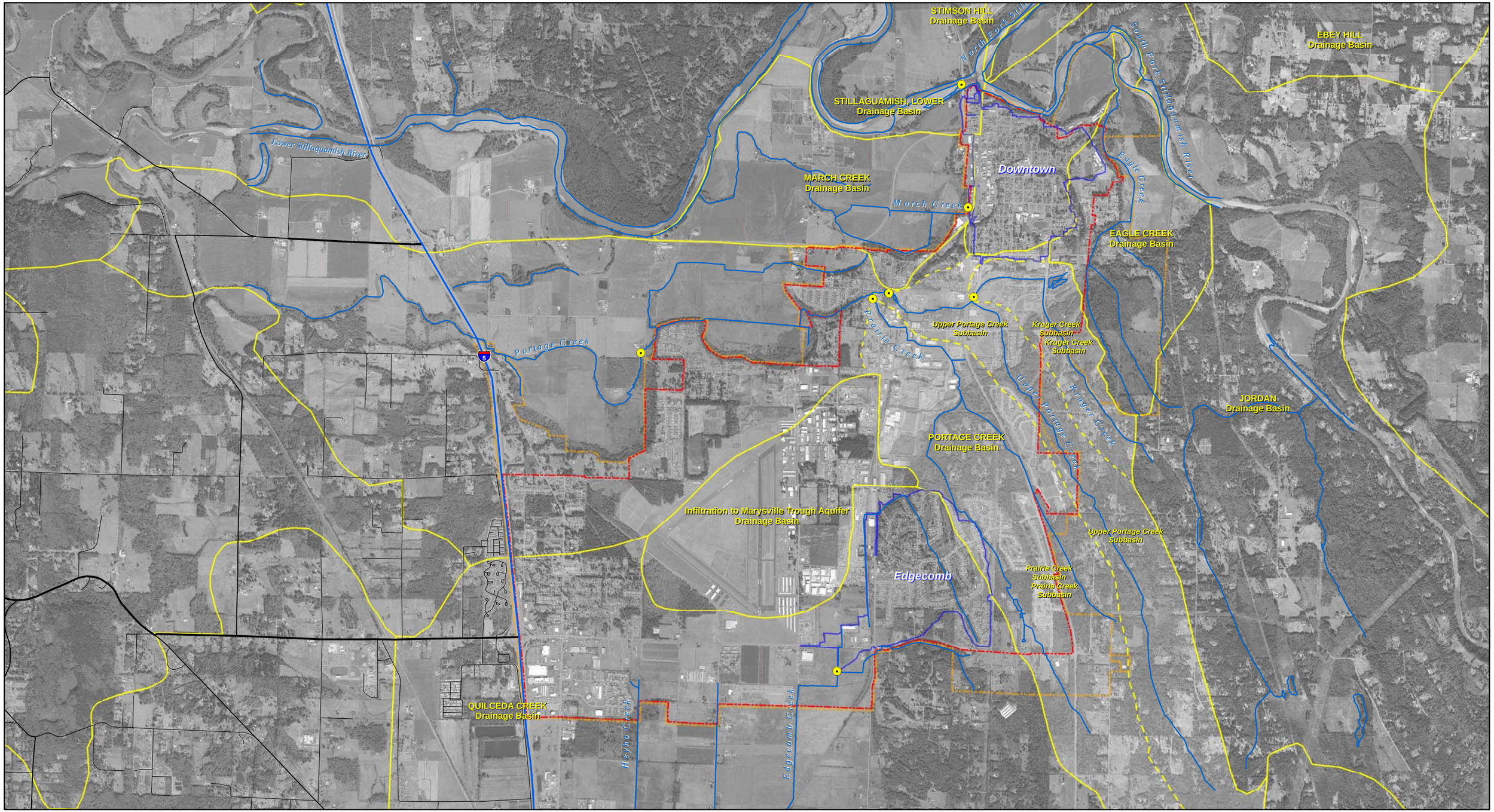
Table 1 – 24-Hour Design Rainfall

Return Period (years)	Rainfall Depth (inches)	Return Period (years)	Rainfall Depth (inches)
2-year	1.80	25-year	3.20
10-year	2.75	100-year	3.75

Table 2 - Hydraulic Analysis Results Undersized Culverts

Culvert No.	Existing Diameter (in.)	Existing Pipe Material	Proposed Diameter (in.)*
783	18	CMP	24
R/R Spur	24	CMP	27
2330 to 2337	18	Concrete	36

* The proposed diameter is based on designing the culverts with 4-ft of headwater and 0-ft of tail water during the 10-yr, 24-hour storm event.



Legend

- Drainage Basin Outfalls
- State Highway
- Arterial
- Street
- Arlington City Limits
- UGA Zones
- Drainage Basins
- Subbasins

N

1 0.5 0 1

Miles

Figure 1
Arlington Drainage Basins and Subbasins

\\Seaprojects\project\Arlington\GIS\maps\Figure 1 - Arlington Drainage Basins and Subbasins.mxd

Project 13.
- replacing culvert 783 w/ 8' ϕ arch (conserv. but ok)
- connects diten @ outlet of culvert ±297 due south. By passing 18" ϕ Storm drain
- new culvert near 172nd & 67th.

project 14 addresses flood storage/~~of~~ WQ concerns

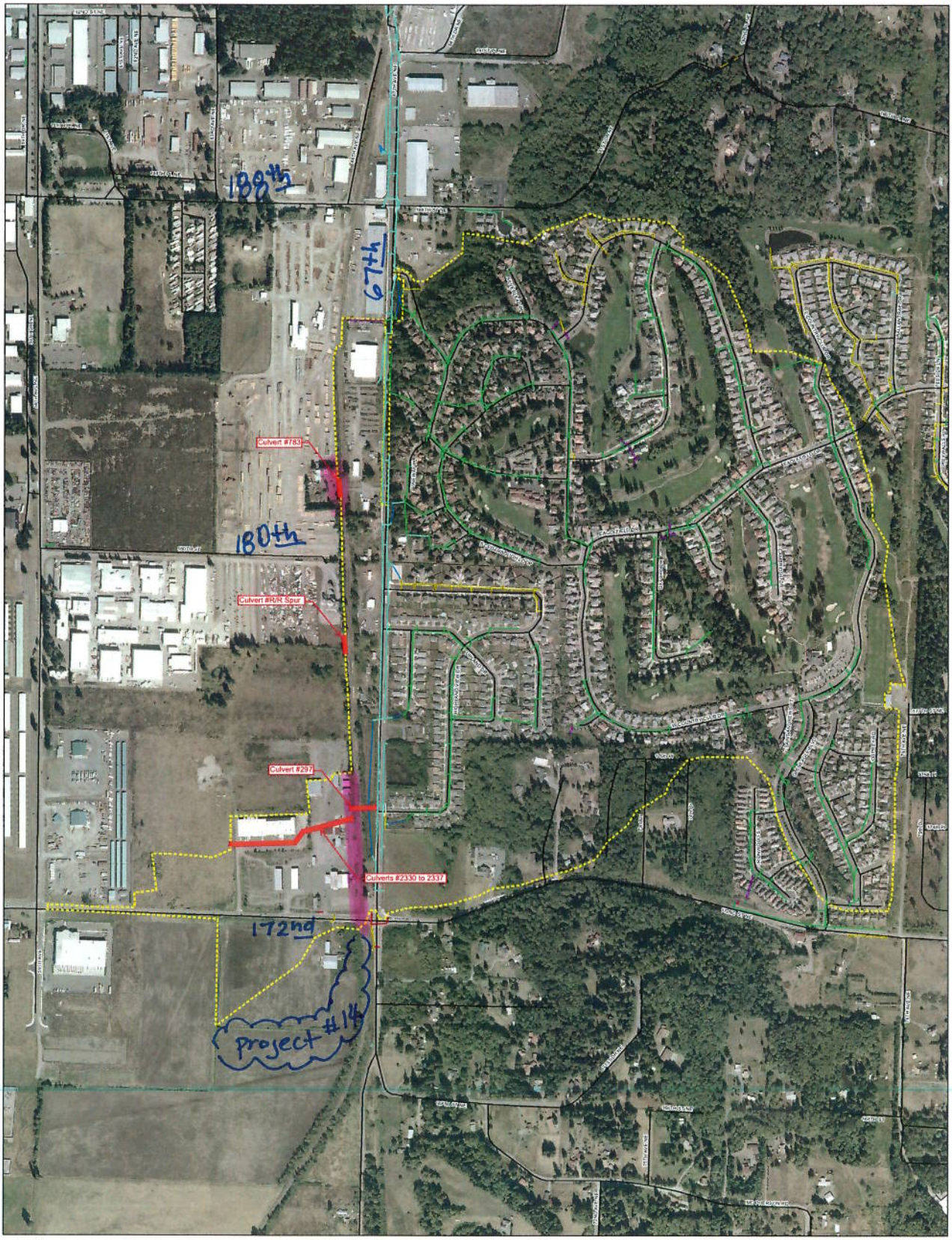


Figure 2
Edgecomb
Arlington

Project #13
Project #14

0 120240 Feet

0 57.6115.2172.8230.4 Meters

N

Pipe_network_0401			Watersheds WS4	
Unspecified	HDPE Smooth		Broadway	Haller Park
CMP Cor Metal	PVC Smooth		Butler East	Seventh Day Adventist
Concrete	Perforated HDPE		Butler West	Talcott
Ductal Iron	Perforated PVC		Centennial Trail	Utilities
HDPE Corrugated	Steel		Division Main	West
	Roads		Edgecomb	West RR
				Butler DT

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ATTACHMENT 1
Isopluvials of 24-Hour Precipitation

Site Location, ~ 1.80"

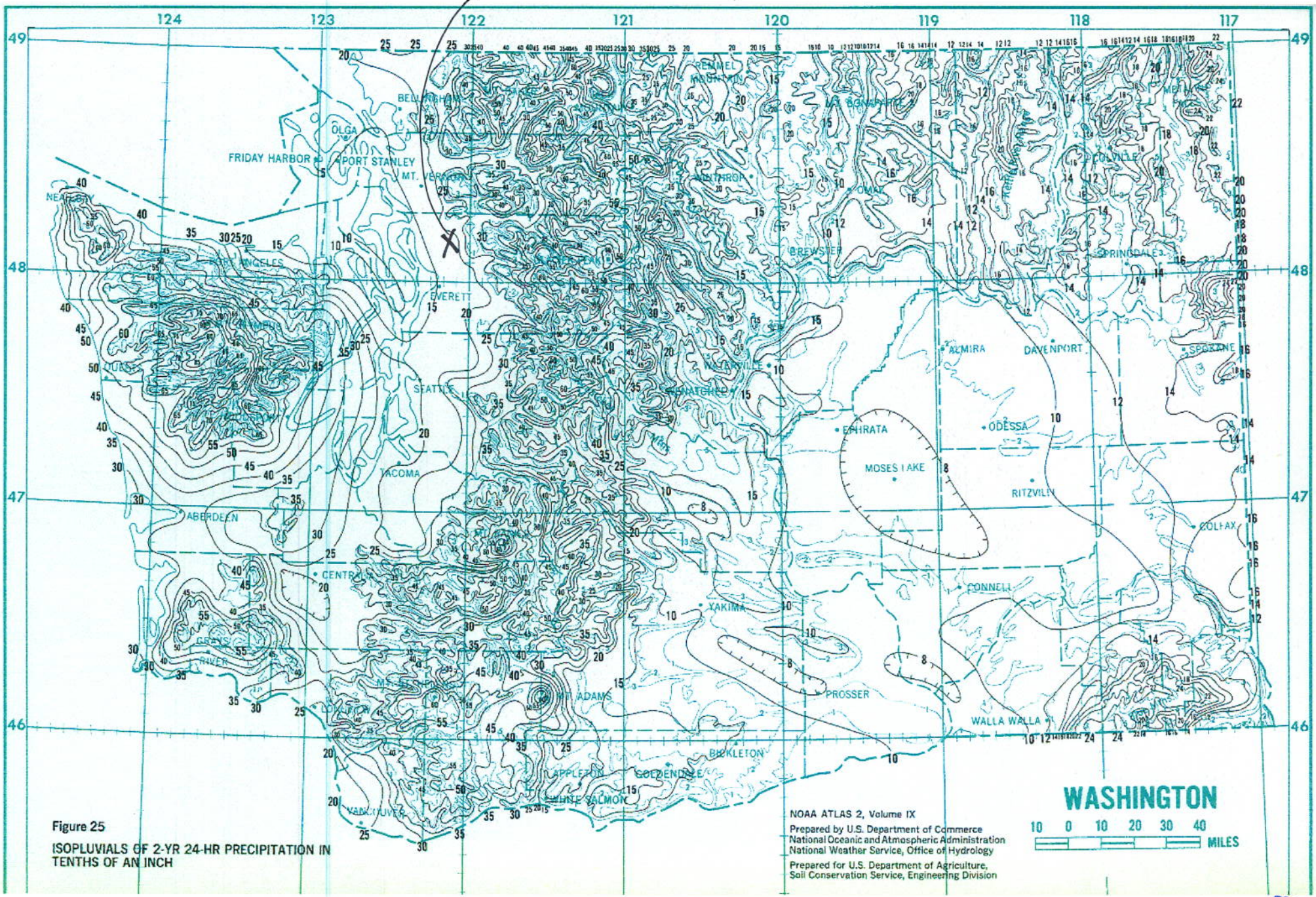

Figure 25

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

NOAA ATLAS 2, Volume IX

Prepared by U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service, Office of Hydrology

Prepared for U.S. Department of Agriculture,
Soil Conservation Service, Engineering Division

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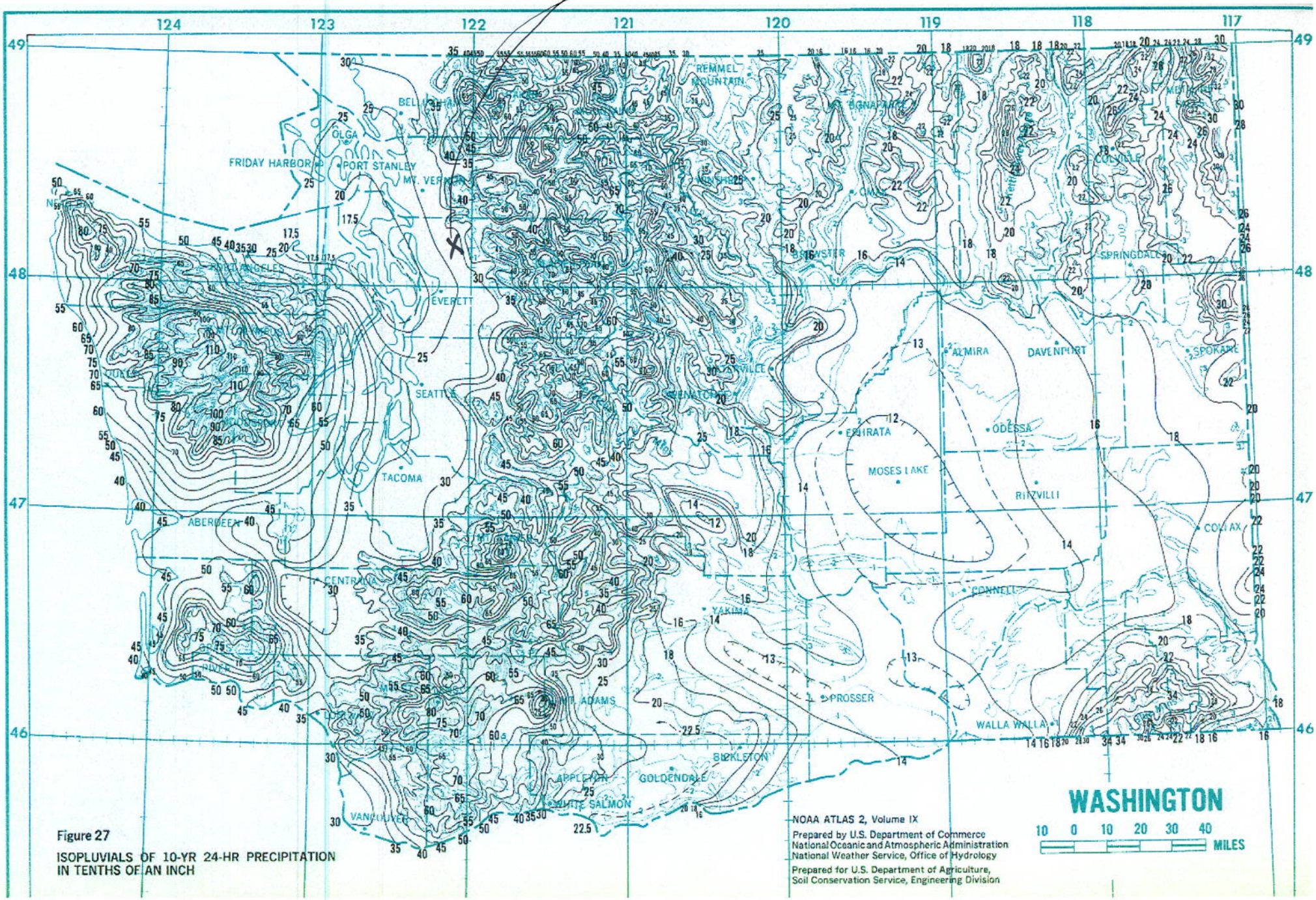

Figure 27

ISOPLUVIALS OF 10-YR 24-HR PRECIPITATION IN TENTHS OF AN INCH

NOAA ATLAS 2, Volume IX

Prepared by U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service, Office of Hydrology

Prepared for U.S. Department of Agriculture,
Soil Conservation Service, Engineering Division

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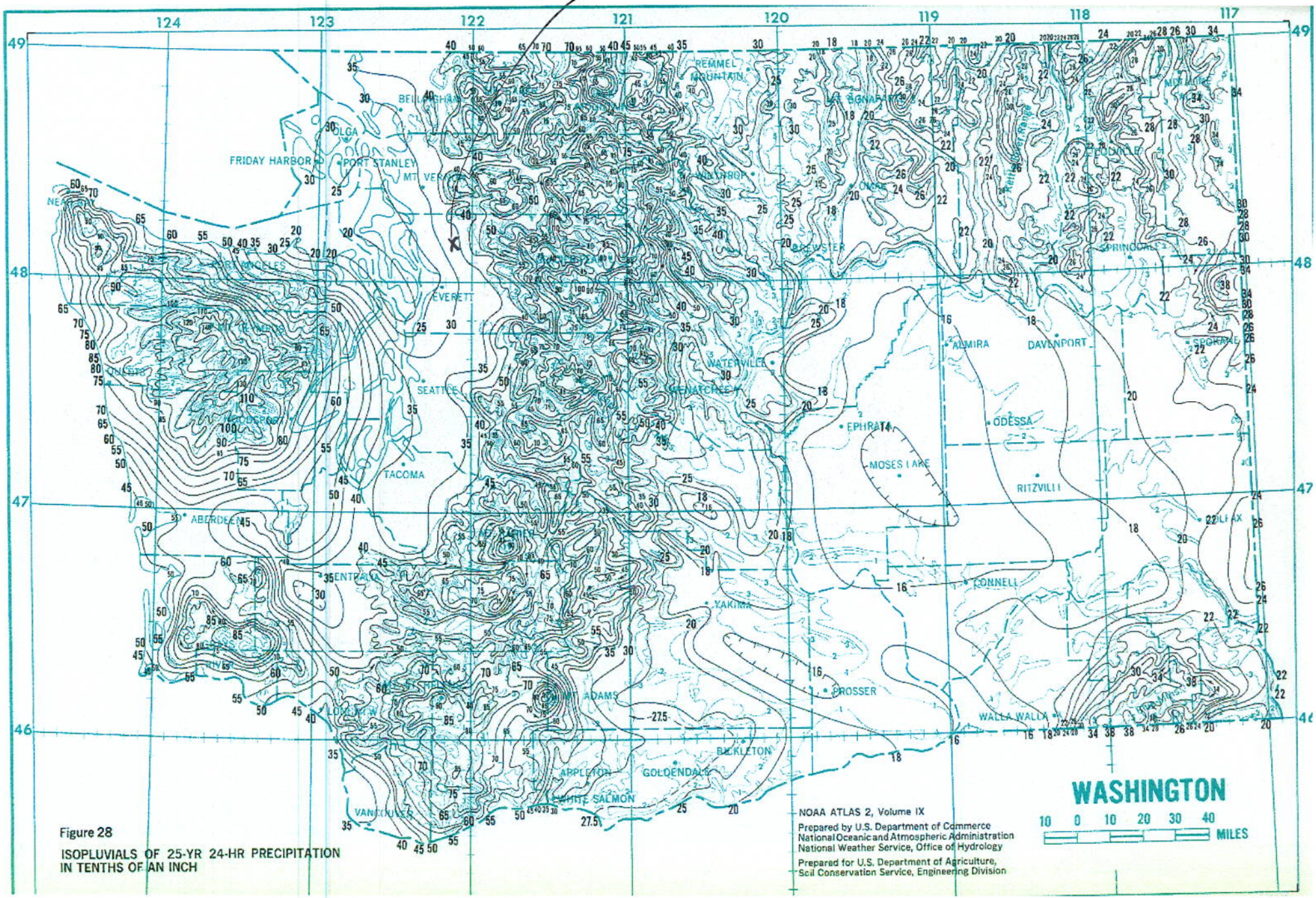

Figure 28

ISOPLUVIALS OF 25-YR 24-HR PRECIPITATION IN TENTHS OF AN INCH

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Site Location, ~ 3.75"

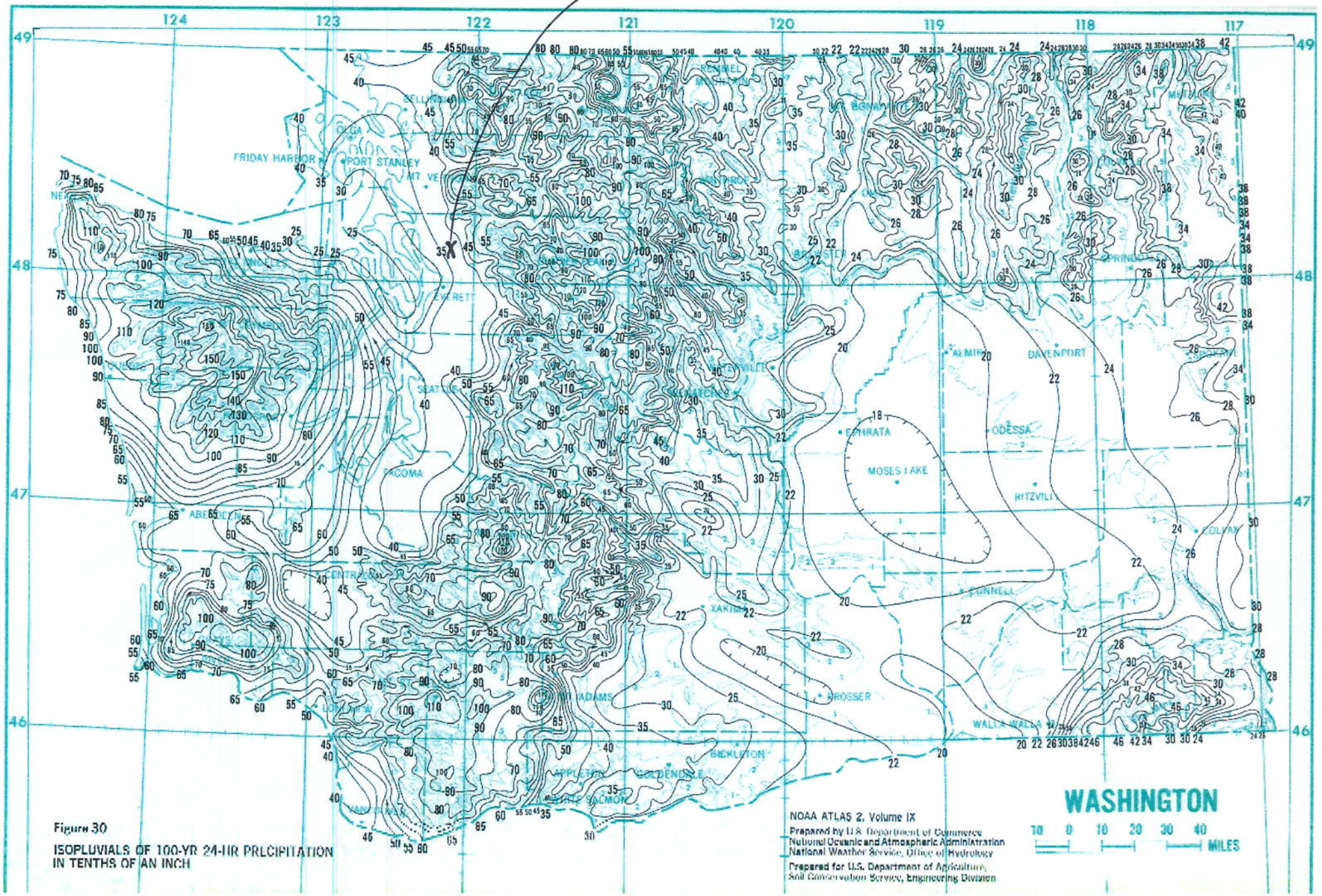

Figure 30

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

NOAA ATLAS 2, Volume IX

Prepared by U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service, Office of Hydrology

Prepared for U.S. Department of Agriculture
Soil Conservation Service, Engineering Division

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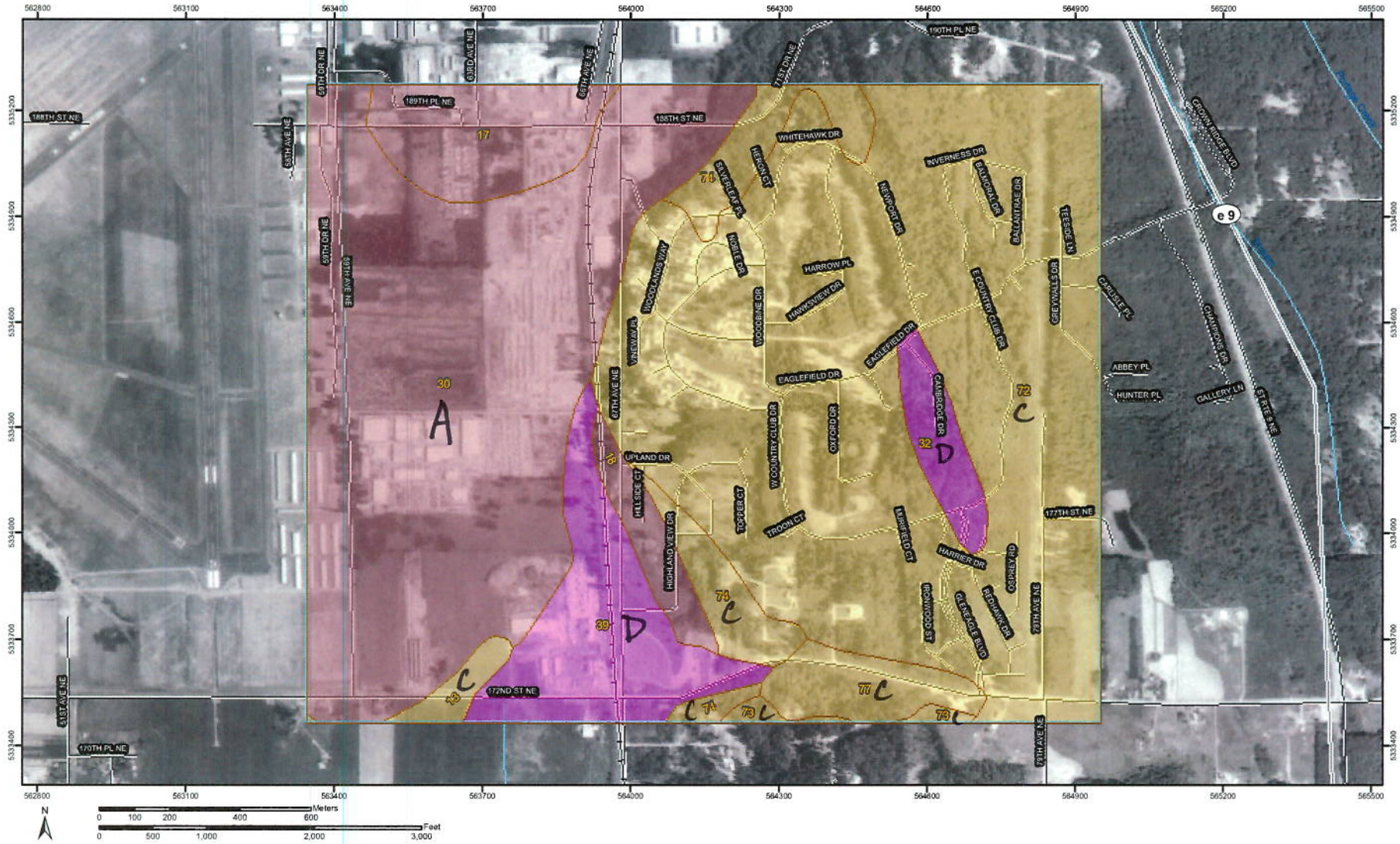
ATTACHMENT 2

Runoff Curve Number Evaluation & Hydrologic Soil Group Information

Hydrologic Soil Group–Snohomish County Area, Washington
(Edgecomb Soil Survey)



USDA Natural Resources Conservation Service

Web Soil Survey 2.0
National Cooperative Soil Survey

5/12/2008
Page 1 of 4

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MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Soil Ratings
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Political Features

Municipalities
- Cities
- Urban Areas

Water Features
- Oceans
- Streams and Canals

Transportation
- Rails

Roads
- Interstate Highways
- US Routes
- State Highways
- Local Roads
- Other Roads

MAP INFORMATION

Original soil survey map sheets were prepared at publication scale. Viewing scale and printing scale, however, may vary from the original. Please rely on the bar scale on each map sheet for proper map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 10N

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

Soil Survey Area: Snohomish County Area, Washington
Survey Area Data: Version 4, Dec 12, 2006

Date(s) aerial images were photographed: 7/10/1990; 7/18/1990; 8/4/1990

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

Hydrologic Soil Group— Summary by Map Unit — Snohomish County Area, Washington				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
13	Custer fine sandy loam	C	7.9	0.8%
17	Everett gravelly sandy loam, 0 to 8 percent slopes	A	45.0	4.5%
18	Everett gravelly sandy loam, 8 to 15 percent slopes	A	16.6	1.6%
30	Lynnwood loamy sand, 0 to 3 percent slopes	A	315.4	31.3%
32	McKenna gravelly silt loam, 0 to 8 percent slopes	D	19.0	1.9%
39	Norma loam	D	67.9	6.7%
72	Tokul gravelly loam, 0 to 8 percent slopes	C	464.1	46.1%
73	Tokul gravelly loam, 8 to 15 percent slopes	C	4.5	0.4%
74	Tokul gravelly loam, 15 to 25 percent slopes	C	43.5	4.3%
77	Tokul-Winston gravelly loams, 25 to 65 percent slopes	C	23.9	2.4%
Totals for Area of Interest (AOI)			1,007.7	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: Lower

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Job City of Arlington | Project No. | Page 17 of ____
Description Edgecomb RCN analysis | Computed by SMN | Sheet ____ of ____
Checked by | Date 5/15/08
Reference

1. East Basin is almost all type C

2. West Basin → ~40% type D
~45% type C
~15% type A

For impervious areas, CN = 98, regardless of surrounding soil type

Pervious RCN's:

1. East Basin:

Assume "residential district" with "1/4 acre" residential plots

For type C → CN = 83

[Source: USDA's TR-55 manual, Table 2-2a]

2. West Basin:

Same assumptions as East Basin, but different soil types

For type D → CN = 87
" " C → CN = 83
" " A → CN = 61

~Weighted Avg → $(0.4 \times 87) + (0.45 \times 83) + (0.15 \times 61) = 81.3$

~81

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Table 2-2a Runoff curve numbers for urban areas [1]

Cover description		Curve numbers for hydrologic soil group			
Cover type and hydrologic condition	Average percent impervious area [2]	A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.) [3]:					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only) [4]		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Developing urban areas					
Newly graded areas (pervious areas only, no vegetation) [5]		77	86	91	94
Idle lands (CN's are determined using cover types similar to those in table 2-2c).					

[1] Average runoff condition, and $I_a = 0.2S$.

[2] The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using figure 2-3 or 2-4.

[3] CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.

[4] Composite CN's for natural desert landscaping should be computed using figures 2-3 or 2-4 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.

[5] Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 2-3 or 2-4 based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

ATTACHMENT 3
Time of Concentration
And
SBUH results for East section of Edgecomb Basin

Time of Concentration Path

Edgecomb Arlington

0 120240 Feet

0 57.6115.2172.8230.4 Meters

N

Pipe_network_0401			Watersheds WS4	
Unspecified	HDPE Smooth		Broadway	Haller Park
CMP Cor Metal	PVC Smooth		Butler East	Seventh Day Adventist
Concrete	Perforated HDPE		Butler West	Talcott
Ductal Iron	Perforated PVC		Centennial Trail	Utilities
HDPE Corrugated	Steel		Division Main	West
	Roads		Edgecomb	West RR
				Butler DT

City of Arlington
Edgecomb
Time of Concentration
Start to FSP

Calculate Time of Concentration (Tc)

Tc = Sum(Tt)

Where:

Tt = travel time (min) = $\frac{L}{(60xV)}$ (for shallow concentrated flow or channel flow)

Tt = travel time (min)= $\frac{0.42(n_s L)^{0.8}}{(P_2)^{0.5}(s_o)^{0.4}}$ (for sheet flow)

Where:

V = avg. velocity (ft/s) = $V = k(s_o)^{0.5}$

k = time of concentration velocity factor (ft/s)

L = flow length (ft)

n_s = sheet flow Manning's effective roughness coefficient

P_2 = 2-year, 24-hour rainfall (in)

s_o = slope of hydraulic grade line (land slope, ft/ft)

	L (ft)	$k_{s/c}$	V (fps)	n_s	P_2	s_o (ft/ft)	Tt (min)
a - sheet (surface flow)	100	NA	NA	0.15	1.8	0.020	13.1
b - culvert (pipe)	1,490	42	8.6	NA	NA	0.042	2.9
c - shallow (pond)	1,650	11	0.3	NA	NA	0.001	79.1
d - channel (stream/ditch)	3,360	17	1.7	NA	NA	0.010	32.9
Total (Tc)							127.9

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Job City of Arlington | Project No. | Page 22 of 74
Description Edgecom b | Computed by SMN | Sheet ___ of ___
East Basin | Checked by | Date 5/15/08
Reference

Area => 236.67 Acres (10,309,499 SF)
(See CAD dwg)

Pervious → 40% estimated: 0.40 × 236.67 Acres = 94.67 Acres

Impervious → 60% estimated: 0.60 × 236.67 Acres = 142.00 Acres

SANTA BARBARA URBAN HYDROGRAPH (SBUH) METHOD
RUNOFF VOLUME CALCULATION

Project: City of Arlington - Edgecomb
Basin: East
Storm Event: 2-YEAR, 24-HOUR
Given:

Area = 236.67 acres
Pt = 1.80 inches
dt = 10 min.
Tc = 127.9 min.

PERVIOUS AREA (Interim Final Cover Area)			IMPERVIOUS AREA (Roads)		
Area =	94.67	acres	Area =	142.00	acres
CN =	83		CN =	98	
S =	2.05		S =	0.20	
0.2S =	0.41		0.2S =	0.04	

SUMMARY
T_{pk} (hrs) = 7.83
Tc (min) = 127.9
Q_{pk} (cfs) = 25.02
Vol (cf) = 938,230

Compute: Runoff Hydrograph

Column (3) = SCS Type IA Rainfall Distribution
Column (4) = Col. (3) x Pt
Column (5) = Accumulated Sum of Col. (4)
Column (6) = [If P <= 0.2S] = 0; Note, use PERVIOUS Area "S" value.
[If P > 0.2S] = (Col.(5) - 0.2S)^2/(Col.(5) + 0.8S); Using the PERVIOUS Area "S" value.
Column (7) = Col.(6) of Present Time Step - Col.(6) of Previous Time Step
Column (8) = Same method as for Col.(6), except use the IMPERVIOUS Area "S" value.
Column (9) = Col.(8) of the present time step - Col.(8) of the previous time step.
Column (10) = ((PERVIOUS area / Total area) x Col.(7)) + ((IMPERVIOUS area / Total area) x Col.(9))
Column (11) = (60.5 x Col.(10) x Total Area) / 10 (dt = 10 minutes)
Routing Constant, w = dt / (2Tc + dt) = 0.0376
Column (12) = Col.(12) of Previous Time Step + (w x [Col.(11) of Previous Time Step
+ Col.(11) of Present Time Step - (2 x Col.(12) of Previous Time Step)])

					Pervious Area		Impervious Area					
(1) Time Increment	(2) Time	(3) Rainfall distribution	(4) Incremental Rainfall	(5) Accumulated Rainfall	(6) Accumulated Runoff	(7) Incremental Runoff	(8) Accumulated Runoff	(9) Incremental Runoff	(10) Total Runoff	(11) Instant hydrograph	(12) design hydrograph	
	min.	% of Pt	in.	in.	in.	in.	in.	in.	in.	cfs	cfs	
1	10	0.0040	0.0072	0.0072	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.00	
2	20	0.0040	0.0072	0.0144	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.00	
3	30	0.0040	0.0072	0.0216	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.00	
4	40	0.0040	0.0072	0.0288	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.00	
5	50	0.0040	0.0072	0.0360	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.00	
6	60	0.0040	0.0072	0.0432	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.00	
7	70	0.0040	0.0072	0.0504	0.0000	0.0000	0.0004	0.0004	0.0002	0.3	0.01	
8	80	0.0040	0.0072	0.0576	0.0000	0.0000	0.0013	0.0008	0.0005	0.7	0.05	
9	90	0.0040	0.0072	0.0648	0.0000	0.0000	0.0025	0.0012	0.0007	1.1	0.12	
10	100	0.0040	0.0072	0.0720	0.0000	0.0000	0.0041	0.0016	0.0010	1.4	0.20	
11	110	0.0050	0.0090	0.0810	0.0000	0.0000	0.0066	0.0025	0.0015	2.1	0.32	
12	120	0.0050	0.0090	0.0900	0.0000	0.0000	0.0096	0.0029	0.0018	2.5	0.47	
13	130	0.0050	0.0090	0.0990	0.0000	0.0000	0.0129	0.0034	0.0020	2.9	0.64	
14	140	0.0050	0.0090	0.1080	0.0000	0.0000	0.0166	0.0037	0.0022	3.2	0.82	
15	150	0.0050	0.0090	0.1170	0.0000	0.0000	0.0207	0.0041	0.0024	3.5	1.01	
16	160	0.0050	0.0090	0.1260	0.0000	0.0000	0.0251	0.0044	0.0026	3.8	1.21	
17	170	0.0060	0.0108	0.1368	0.0000	0.0000	0.0307	0.0056	0.0034	4.8	1.44	
18	180	0.0060	0.0108	0.1476	0.0000	0.0000	0.0367	0.0060	0.0036	5.1	1.70	
19	190	0.0060	0.0108	0.1584	0.0000	0.0000	0.0430	0.0063	0.0038	5.4	1.97	
20	200	0.0060	0.0108	0.1692	0.0000	0.0000	0.0496	0.0066	0.0040	5.7	2.24	
21	210	0.0060	0.0108	0.1800	0.0000	0.0000	0.0564	0.0069	0.0041	5.9	2.51	
22	220	0.0060	0.0108	0.1908	0.0000	0.0000	0.0635	0.0071	0.0043	6.1	2.77	
23	230	0.0070	0.0126	0.2034	0.0000	0.0000	0.0721	0.0086	0.0051	7.4	3.07	
24	240	0.0070	0.0126	0.2160	0.0000	0.0000	0.0809	0.0088	0.0053	7.6	3.40	
25	250	0.0070	0.0126	0.2286	0.0000	0.0000	0.0900	0.0091	0.0054	7.8	3.72	
26	260	0.0070	0.0126	0.2412	0.0000	0.0000	0.0993	0.0093	0.0056	8.0	4.03	
27	270	0.0070	0.0126	0.2538	0.0000	0.0000	0.1088	0.0095	0.0057	8.2	4.34	
28	280	0.0070	0.0126	0.2664	0.0000	0.0000	0.1184	0.0097	0.0058	8.3	4.63	
29	290	0.0082	0.0148	0.2812	0.0000	0.0000	0.1300	0.0115	0.0069	9.9	4.97	
30	300	0.0082	0.0148	0.2959	0.0000	0.0000	0.1417	0.0117	0.0070	10.1	5.35	
31	310	0.0082	0.0148	0.3107	0.0000	0.0000	0.1537	0.0119	0.0072	10.3	5.71	
32	320	0.0082	0.0148	0.3254	0.0000	0.0000	0.1658	0.0121	0.0073	10.4	6.06	
33	330	0.0082	0.0148	0.3402	0.0000	0.0000	0.1780	0.0123	0.0074	10.5	6.39	
34	340	0.0082	0.0148	0.3550	0.0000	0.0000	0.1904	0.0124	0.0074	10.7	6.71	
35	350	0.0095	0.0171	0.3721	0.0000	0.0000	0.2050	0.0145	0.0087	12.5	7.07	
36	360	0.0095	0.0171	0.3892	0.0000	0.0000	0.2197	0.0147	0.0088	12.6	7.48	
37	370	0.0095	0.0171	0.4063	0.0000	0.0000	0.2345	0.0148	0.0089	12.7	7.88	
38	380	0.0095	0.0171	0.4234	0.0001	0.0001	0.2495	0.0150	0.0090	12.9	8.25	
39	390	0.0095	0.0171	0.4405	0.0005	0.0004	0.2645	0.0151	0.0092	13.2	8.61	
40	400	0.0095	0.0171	0.4576	0.0011	0.0006	0.2797	0.0152	0.0094	13.4	8.96	
41	410	0.0134	0.0241	0.4817	0.0024	0.0014	0.3014	0.0216	0.0135	19.3	9.52	
42	420	0.0134	0.0241	0.5058	0.0043	0.0019	0.3232	0.0218	0.0138	19.8	10.28	
43	430	0.0134	0.0241	0.5299	0.0067	0.0024	0.3451	0.0220	0.0141	20.2	11.01	
44	440	0.0180	0.0324	0.5623	0.0106	0.0039	0.3748	0.0297	0.0194	27.8	11.98	
45	450	0.0180	0.0324	0.5947	0.0153	0.0047	0.4048	0.0299	0.0199	28.4	13.20	
46	460	0.0340	0.0612	0.6559	0.0264	0.0111	0.4619	0.0571	0.0387	55.4	15.36	
47	470	0.0540	0.0972	0.7531	0.0493	0.0229	0.5537	0.0918	0.0642	92.0	19.75	
48	480	0.0270	0.0486	0.8017	0.0630	0.0137	0.6000	0.0463	0.0333	47.6	23.52	Q peak
49	490	0.0180	0.0324	0.8341	0.0729	0.0099	0.6310	0.0310	0.0225	32.3	24.75	
50	500	0.0134	0.0241	0.8582	0.0806	0.0077	0.6541	0.0231	0.0170	24.3	25.02	
51	510	0.0134	0.0241	0.8824	0.0886	0.0080	0.6773	0.0232	0.0171	24.5	24.97	
52	520	0.0134	0.0241	0.9065	0.0970	0.0083	0.7005	0.0232	0.0173	24.7	24.95	
53	530	0.0088	0.0158	0.9223	0.1026	0.0056	0.7158	0.0153	0.0114	16.4	24.62	
54	540	0.0088	0.0158	0.9382	0.1084	0.0058	0.7311	0.0153	0.0115	16.4	24.00	
55	550	0.0088	0.0158	0.9540	0.1143	0.0059	0.7464	0.0153	0.0115	16.5	23.43	
56	560	0.0088	0.0158	0.9698	0.1203	0.0060	0.7617	0.0153	0.0116	16.6	22.91	
57	570	0.0088	0.0158	0.9857	0.1264	0.0061	0.7770	0.0153	0.0117	16.7	22.44	
58	580	0.0088	0.0158	1.0015	0.1327	0.0062	0.7924	0.0153	0.0117	16.8	22.01	
59	590	0.0088	0.0158	1.0174	0.1391	0.0064	0.8077	0.0154	0.0118	16.8	21.62	
60	600	0.0088	0.0158	1.0332	0.1455	0.0065	0.8231	0.0154	0.0118	16.9	21.26	
61	610	0.0088	0.0158	1.0490	0.1521	0.0066	0.8385	0.0154	0.0119	17.0	20.94	
62	620	0.0088	0.0158	1.0649	0.1588	0.0067	0.8539	0.0154	0.0119	17.1	20.64	
63	630	0.0088	0.0158	1.0807	0.1656	0.0068	0.8693	0.0154	0.0120	17.1	20.38	
64	640	0.0088	0.0158	1.0966	0.1725	0.0069	0.8847	0.0154	0.0120	17.2	20.14	
65	650	0.0072	0.0130	1.1095	0.1782	0.0057	0.8973	0.0126	0.0099	14.1	19.80	
66	660	0.0072	0.0130	1.1225	0.1840	0.0058	0.9100	0.0126	0.0099	14.2	19.37	
67	670	0.0072	0.0130	1.1354	0.1899	0.0059	0.9226	0.0126	0.0099	14.2	18.98	

SANTA BARBARA URBAN HYDROGRAPH (SBUH) METHOD
RUNOFF VOLUME CALCULATION

					Pervious Area		Impervious Area				
(1) Time Increment	(2) Time min.	(3) Rainfall distribution % of Pt	(4) Incremental Rainfall in.	(5) Accumulated Rainfall in.	(6) Accumulated Runoff in.	(7) Incremental Runoff in.	(8) Accumulated Runoff in.	(9) Incremental Runoff in.	(10) Total Runoff in.	(11) Instant hydrograph cfs	(12) design hydrograph cfs
68	680	0.0072	0.0130	1.1484	0.1958	0.0059	0.9353	0.0126	0.0100	14.3	18.63
69	690	0.0072	0.0130	1.1614	0.2018	0.0060	0.9479	0.0126	0.0100	14.3	18.30
70	700	0.0072	0.0130	1.1743	0.2079	0.0061	0.9606	0.0127	0.0100	14.3	18.00
71	710	0.0072	0.0130	1.1873	0.2140	0.0061	0.9732	0.0127	0.0100	14.4	17.73
72	720	0.0072	0.0130	1.2002	0.2202	0.0062	0.9859	0.0127	0.0101	14.4	17.48
73	730	0.0072	0.0130	1.2132	0.2264	0.0062	0.9986	0.0127	0.0101	14.5	17.25
74	740	0.0072	0.0130	1.2262	0.2327	0.0063	1.0112	0.0127	0.0101	14.5	17.04
75	750	0.0072	0.0130	1.2391	0.2391	0.0064	1.0239	0.0127	0.0102	14.5	16.85
76	760	0.0072	0.0130	1.2521	0.2455	0.0064	1.0366	0.0127	0.0102	14.6	16.68
77	770	0.0057	0.0103	1.2623	0.2506	0.0051	1.0467	0.0100	0.0081	11.6	16.41
78	780	0.0057	0.0103	1.2726	0.2558	0.0052	1.0567	0.0101	0.0081	11.6	16.04
79	790	0.0057	0.0103	1.2829	0.2610	0.0052	1.0668	0.0101	0.0081	11.6	15.71
80	800	0.0057	0.0103	1.2931	0.2662	0.0052	1.0768	0.0101	0.0081	11.6	15.40
81	810	0.0057	0.0103	1.3034	0.2715	0.0053	1.0869	0.0101	0.0081	11.7	15.12
82	820	0.0057	0.0103	1.3136	0.2768	0.0053	1.0969	0.0101	0.0082	11.7	14.86
83	830	0.0057	0.0103	1.3239	0.2822	0.0053	1.1070	0.0101	0.0082	11.7	14.62
84	840	0.0057	0.0103	1.3342	0.2875	0.0054	1.1171	0.0101	0.0082	11.7	14.40
85	850	0.0057	0.0103	1.3444	0.2929	0.0054	1.1271	0.0101	0.0082	11.7	14.20
86	860	0.0057	0.0103	1.3547	0.2984	0.0054	1.1372	0.0101	0.0082	11.8	14.02
87	870	0.0057	0.0103	1.3649	0.3038	0.0055	1.1473	0.0101	0.0082	11.8	13.85
88	880	0.0057	0.0103	1.3752	0.3094	0.0055	1.1574	0.0101	0.0082	11.8	13.70
89	890	0.0050	0.0090	1.3842	0.3142	0.0049	1.1662	0.0088	0.0072	10.4	13.50
90	900	0.0050	0.0090	1.3932	0.3191	0.0049	1.1751	0.0088	0.0073	10.4	13.27
91	910	0.0050	0.0090	1.4022	0.3240	0.0049	1.1839	0.0088	0.0073	10.4	13.05
92	920	0.0050	0.0090	1.4112	0.3289	0.0049	1.1928	0.0088	0.0073	10.4	12.85
93	930	0.0050	0.0090	1.4202	0.3339	0.0050	1.2016	0.0088	0.0073	10.4	12.67
94	940	0.0050	0.0090	1.4292	0.3388	0.0050	1.2105	0.0089	0.0073	10.5	12.50
95	950	0.0050	0.0090	1.4382	0.3438	0.0050	1.2193	0.0089	0.0073	10.5	12.35
96	960	0.0050	0.0090	1.4472	0.3489	0.0050	1.2282	0.0089	0.0073	10.5	12.21
97	970	0.0050	0.0090	1.4562	0.3539	0.0050	1.2370	0.0089	0.0073	10.5	12.08
98	980	0.0050	0.0090	1.4652	0.3590	0.0051	1.2459	0.0089	0.0073	10.5	11.96
99	990	0.0050	0.0090	1.4742	0.3641	0.0051	1.2547	0.0089	0.0074	10.5	11.85
100	1000	0.0050	0.0090	1.4832	0.3692	0.0051	1.2636	0.0089	0.0074	10.5	11.75
101	1010	0.0040	0.0072	1.4904	0.3733	0.0041	1.2707	0.0071	0.0059	8.4	11.58
102	1020	0.0040	0.0072	1.4976	0.3774	0.0041	1.2778	0.0071	0.0059	8.5	11.35
103	1030	0.0040	0.0072	1.5048	0.3816	0.0041	1.2849	0.0071	0.0059	8.5	11.13
104	1040	0.0040	0.0072	1.5120	0.3857	0.0042	1.2920	0.0071	0.0059	8.5	10.93
105	1050	0.0040	0.0072	1.5192	0.3899	0.0042	1.2991	0.0071	0.0059	8.5	10.74
106	1060	0.0040	0.0072	1.5264	0.3941	0.0042	1.3062	0.0071	0.0059	8.5	10.57
107	1070	0.0040	0.0072	1.5336	0.3982	0.0042	1.3132	0.0071	0.0059	8.5	10.42
108	1080	0.0040	0.0072	1.5408	0.4024	0.0042	1.3203	0.0071	0.0059	8.5	10.27
109	1090	0.0040	0.0072	1.5480	0.4067	0.0042	1.3274	0.0071	0.0059	8.5	10.14
110	1100	0.0040	0.0072	1.5552	0.4109	0.0042	1.3345	0.0071	0.0060	8.5	10.02
111	1110	0.0040	0.0072	1.5624	0.4151	0.0042	1.3416	0.0071	0.0060	8.5	9.91
112	1120	0.0040	0.0072	1.5696	0.4194	0.0043	1.3487	0.0071	0.0060	8.5	9.80
113	1130	0.0040	0.0072	1.5768	0.4237	0.0043	1.3558	0.0071	0.0060	8.5	9.71
114	1140	0.0040	0.0072	1.5840	0.4280	0.0043	1.3629	0.0071	0.0060	8.6	9.62
115	1150	0.0040	0.0072	1.5912	0.4323	0.0043	1.3700	0.0071	0.0060	8.6	9.54
116	1160	0.0040	0.0072	1.5984	0.4366	0.0043	1.3771	0.0071	0.0060	8.6	9.47
117	1170	0.0040	0.0072	1.6056	0.4409	0.0043	1.3842	0.0071	0.0060	8.6	9.40
118	1180	0.0040	0.0072	1.6128	0.4452	0.0043	1.3914	0.0071	0.0060	8.6	9.34
119	1190	0.0040	0.0072	1.6200	0.4496	0.0043	1.3985	0.0071	0.0060	8.6	9.28
120	1200	0.0040	0.0072	1.6272	0.4539	0.0044	1.4056	0.0071	0.0060	8.6	9.23
121	1210	0.0040	0.0072	1.6344	0.4583	0.0044	1.4127	0.0071	0.0060	8.6	9.18
122	1220	0.0040	0.0072	1.6416	0.4627	0.0044	1.4198	0.0071	0.0060	8.6	9.14
123	1230	0.0040	0.0072	1.6488	0.4671	0.0044	1.4269	0.0071	0.0060	8.6	9.10
124	1240	0.0040	0.0072	1.6560	0.4715	0.0044	1.4340	0.0071	0.0060	8.6	9.07
125	1250	0.0040	0.0072	1.6632	0.4759	0.0044	1.4411	0.0071	0.0060	8.6	9.03
126	1260	0.0040	0.0072	1.6704	0.4804	0.0044	1.4482	0.0071	0.0060	8.6	9.01
127	1270	0.0040	0.0072	1.6776	0.4848	0.0044	1.4553	0.0071	0.0060	8.7	8.98
128	1280	0.0040	0.0072	1.6848	0.4893	0.0045	1.4624	0.0071	0.0061	8.7	8.95
129	1290	0.0040	0.0072	1.6920	0.4937	0.0045	1.4696	0.0071	0.0061	8.7	8.93
130	1300	0.0040	0.0072	1.6992	0.4982	0.0045	1.4767	0.0071	0.0061	8.7	8.91
131	1310	0.0040	0.0072	1.7064	0.5027	0.0045	1.4838	0.0071	0.0061	8.7	8.90
132	1320	0.0040	0.0072	1.7136	0.5072	0.0045	1.4909	0.0071	0.0061	8.7	8.88
133	1330	0.0040	0.0072	1.7208	0.5117	0.0045	1.4980	0.0071	0.0061	8.7	8.87
134	1340	0.0040	0.0072	1.7280	0.5163	0.0045	1.5051	0.0071	0.0061	8.7	8.85
135	1350	0.0040	0.0072	1.7352	0.5208	0.0045	1.5122	0.0071	0.0061	8.7	8.84
136	1360	0.0040	0.0072	1.7424	0.5254	0.0046	1.5194	0.0071	0.0061	8.7	8.83
137	1370	0.0040	0.0072	1.7496	0.5299	0.0046	1.5265	0.0071	0.0061	8.7	8.83
138	1380	0.0040	0.0072	1.7568	0.5345	0.0046	1.5336	0.0071	0.0061	8.7	8.82
139	1390	0.0040	0.0072	1.7640	0.5391	0.0046	1.5407	0.0071	0.0061	8.7	8.81
140	1400	0.0040	0.0072	1.7712	0.5437	0.0046	1.5478	0.0071	0.0061	8.7	8.81
141	1410	0.0040	0.0072	1.7784	0.5483	0.0046	1.5550	0.0071	0.0061	8.8	8.80
142	1420	0.0040	0.0072	1.7856	0.5529	0.0046	1.5621	0.0071	0.0061	8.8	8.80
143	1430	0.0040	0.0072	1.7928	0.5575	0.0046	1.5692	0.0071	0.0061	8.8	8.80
144	1440	0.0040	0.0072	1.8000	0.5622	0.0046	1.5763	0.0071	0.0061	8.8	8.80

Total Volume of Runoff[1] = 938,230 cu. ft.

Notes:

1. Total Runoff Volume is found by summing column (12) and multiplying by the time step, dt as follows:

V = SumQ x dt
V(cu.ft.) = SumQ(cu.ft/s) x dt(min.) x (60 s/min.)

SANTA BARBARA URBAN HYDROGRAPH (SBUH) METHOD
RUNOFF VOLUME CALCULATION

Project: City of Arlington - Edgecomb
Basin: East
Storm Event: 10-YEAR, 24-HOUR
Given:

Area = 236.67 acres
Pt = 2.75 inches
dt = 10 min.
Tc = 127.9 min.

PERVIOUS AREA (Interim Final Cover Area)			IMPERVIOUS AREA (Roads)		
Area =	94.67	acres	Area =	142.00	acres
CN =	83		CN =	98	
S =	2.05		S =	0.20	
0.2S =	0.41		0.2S =	0.04	

SUMMARY
T_{pk} (hrs) = 7.83
T_c (min) = 127.9
Q_{pk} (cfs) = 44.21
Vol (cf) = 1,616,958

Compute: Runoff Hydrograph

Column (3) = SCS Type IA Rainfall Distribution
Column (4) = Col. (3) x Pt
Column (5) = Accumulated Sum of Col. (4)
Column (6) = [If P <= 0.2S] = 0; Note, use PERVIOUS Area "S" value.
[If P > 0.2S] = (Col.(5) - 0.2S)^2/(Col.(5) + 0.8S); Using the PERVIOUS Area "S" value.
Column (7) = Col.(6) of Present Time Step - Col.(6) of Previous Time Step
Column (8) = Same method as for Col.(6), except use the IMPERVIOUS Area "S" value.
Column (9) = Col.(8) of the present time step - Col.(8) of the previous time step.
Column (10) = ((PERVIOUS area / Total area) x Col.(7)) + ((IMPERVIOUS area / Total area) x Col.(9))
Column (11) = (60.5 x Col.(10) x Total Area) / 10 (dt = 10 minutes)
Routing Constant, w = dt / (2Tc + dt) = 0.0376
Column (12) = Col.(12) of Previous Time Step + (w x [Col.(11) of Previous Time Step + Col.(11) of Present Time Step - (2 x Col.(12) of Previous Time Step)])

					Pervious Area		Impervious Area					
(1) Time Increment	(2) Time min.	(3) Rainfall distribution % of Pt	(4) Incremental Rainfall in.	(5) Accumulated Rainfall in.	(6) Accumulated Runoff in.	(7) Incremental Runoff in.	(8) Accumulated Runoff in.	(9) Incremental Runoff in.	(10) Total Runoff in.	(11) Instant hydrograph cfs	(12) design hydrograph cfs	
1	10	0.0040	0.0110	0.0110	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.00	
2	20	0.0040	0.0110	0.0220	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.00	
3	30	0.0040	0.0110	0.0330	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.00	
4	40	0.0040	0.0110	0.0440	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.00	
5	50	0.0040	0.0110	0.0550	0.0000	0.0000	0.0009	0.0009	0.0005	0.7	0.03	
6	60	0.0040	0.0110	0.0660	0.0000	0.0000	0.0028	0.0018	0.0011	1.6	0.12	
7	70	0.0040	0.0110	0.0770	0.0000	0.0000	0.0054	0.0027	0.0016	2.3	0.25	
8	80	0.0040	0.0110	0.0880	0.0000	0.0000	0.0089	0.0034	0.0020	2.9	0.43	
9	90	0.0040	0.0110	0.0990	0.0000	0.0000	0.0129	0.0040	0.0024	3.5	0.64	
10	100	0.0040	0.0110	0.1100	0.0000	0.0000	0.0175	0.0046	0.0028	4.0	0.87	
11	110	0.0050	0.0138	0.1238	0.0000	0.0000	0.0240	0.0064	0.0039	5.5	1.16	
12	120	0.0050	0.0138	0.1375	0.0000	0.0000	0.0311	0.0071	0.0043	6.1	1.51	
13	130	0.0050	0.0138	0.1513	0.0000	0.0000	0.0388	0.0077	0.0046	6.6	1.88	
14	140	0.0050	0.0138	0.1650	0.0000	0.0000	0.0470	0.0082	0.0049	7.0	2.25	
15	150	0.0050	0.0138	0.1788	0.0000	0.0000	0.0556	0.0086	0.0052	7.4	2.63	
16	160	0.0050	0.0138	0.1925	0.0000	0.0000	0.0647	0.0090	0.0054	7.8	3.00	
17	170	0.0060	0.0165	0.2090	0.0000	0.0000	0.0760	0.0113	0.0068	9.7	3.43	
18	180	0.0060	0.0165	0.2255	0.0000	0.0000	0.0877	0.0118	0.0071	10.1	3.92	
19	190	0.0060	0.0165	0.2420	0.0000	0.0000	0.0999	0.0121	0.0073	10.4	4.40	
20	200	0.0060	0.0165	0.2585	0.0000	0.0000	0.1124	0.0125	0.0075	10.7	4.86	
21	210	0.0060	0.0165	0.2750	0.0000	0.0000	0.1251	0.0128	0.0077	11.0	5.31	
22	220	0.0060	0.0165	0.2915	0.0000	0.0000	0.1382	0.0131	0.0078	11.2	5.75	
23	230	0.0070	0.0193	0.3108	0.0000	0.0000	0.1537	0.0155	0.0093	13.3	6.24	
24	240	0.0070	0.0193	0.3300	0.0000	0.0000	0.1695	0.0158	0.0095	13.6	6.78	
25	250	0.0070	0.0193	0.3493	0.0000	0.0000	0.1856	0.0161	0.0096	13.8	7.30	
26	260	0.0070	0.0193	0.3685	0.0000	0.0000	0.2019	0.0163	0.0098	14.0	7.80	
27	270	0.0070	0.0193	0.3878	0.0000	0.0000	0.2184	0.0165	0.0099	14.2	8.28	
28	280	0.0070	0.0193	0.4070	0.0000	0.0000	0.2351	0.0167	0.0100	14.3	8.73	
29	290	0.0082	0.0226	0.4296	0.0002	0.0002	0.2549	0.0198	0.0119	17.1	9.25	
30	300	0.0082	0.0226	0.4521	0.0009	0.0007	0.2749	0.0200	0.0123	17.5	9.86	
31	310	0.0082	0.0226	0.4747	0.0020	0.0011	0.2950	0.0202	0.0125	18.0	10.45	
32	320	0.0082	0.0226	0.4972	0.0036	0.0016	0.3154	0.0203	0.0128	18.4	11.03	
33	330	0.0082	0.0226	0.5198	0.0056	0.0020	0.3358	0.0205	0.0131	18.7	11.60	
34	340	0.0082	0.0226	0.5423	0.0081	0.0025	0.3564	0.0206	0.0133	19.1	12.15	
35	350	0.0095	0.0261	0.5684	0.0114	0.0034	0.3804	0.0240	0.0158	22.6	12.80	
36	360	0.0095	0.0261	0.5946	0.0153	0.0039	0.4046	0.0242	0.0161	23.0	13.55	
37	370	0.0095	0.0261	0.6207	0.0197	0.0044	0.4289	0.0243	0.0163	23.4	14.28	
38	380	0.0095	0.0261	0.6468	0.0246	0.0049	0.4533	0.0244	0.0166	23.8	14.98	
39	390	0.0095	0.0261	0.6729	0.0300	0.0054	0.4778	0.0245	0.0169	24.1	15.65	
40	400	0.0095	0.0261	0.6991	0.0358	0.0058	0.5025	0.0246	0.0171	24.5	16.31	
41	410	0.0134	0.0369	0.7359	0.0448	0.0090	0.5373	0.0349	0.0245	35.1	17.32	
42	420	0.0134	0.0369	0.7728	0.0547	0.0099	0.5723	0.0350	0.0250	35.7	18.68	
43	430	0.0134	0.0369	0.8096	0.0653	0.0107	0.6075	0.0352	0.0254	36.3	19.99	
44	440	0.0180	0.0495	0.8591	0.0809	0.0155	0.6549	0.0474	0.0347	49.6	21.72	
45	450	0.0180	0.0495	0.9086	0.0977	0.0169	0.7026	0.0476	0.0353	50.6	23.85	
46	460	0.0340	0.0935	1.0021	0.1329	0.0352	0.7929	0.0904	0.0683	97.8	27.64	
47	470	0.0540	0.1485	1.1506	0.1968	0.0639	0.9374	0.1445	0.1122	160.7	35.29	
48	480	0.0270	0.0743	1.2249	0.2321	0.0352	1.0100	0.0726	0.0576	82.5	41.78	Q peak
49	490	0.0180	0.0495	1.2744	0.2567	0.0246	1.0584	0.0485	0.0389	55.7	43.84	
50	500	0.0134	0.0369	1.3112	0.2756	0.0189	1.0945	0.0361	0.0292	41.8	44.21	
51	510	0.0134	0.0369	1.3481	0.2949	0.0193	1.1307	0.0362	0.0294	42.1	44.04	
52	520	0.0134	0.0369	1.3849	0.3146	0.0197	1.1669	0.0362	0.0296	42.4	43.91	
53	530	0.0088	0.0242	1.4091	0.3278	0.0132	1.1907	0.0238	0.0195	28.0	43.25	
54	540	0.0088	0.0242	1.4333	0.3411	0.0134	1.2145	0.0238	0.0196	28.1	42.11	
55	550	0.0088	0.0242	1.4575	0.3546	0.0135	1.2383	0.0238	0.0197	28.2	41.06	
56	560	0.0088	0.0242	1.4817	0.3683	0.0137	1.2621	0.0238	0.0198	28.3	40.10	
57	570	0.0088	0.0242	1.5059	0.3822	0.0139	1.2860	0.0238	0.0198	28.4	39.21	
58	580	0.0088	0.0242	1.5301	0.3962	0.0140	1.3098	0.0238	0.0199	28.5	38.40	
59	590	0.0088	0.0242	1.5543	0.4104	0.0142	1.3337	0.0239	0.0200	28.6	37.66	
60	600	0.0088	0.0242	1.5785	0.4247	0.0143	1.3575	0.0239	0.0200	28.7	36.98	
61	610	0.0088	0.0242	1.6027	0.4391	0.0145	1.3814	0.0239	0.0201	28.8	36.36	
62	620	0.0088	0.0242	1.6269	0.4538	0.0146	1.4053	0.0239	0.0202	28.9	35.80	
63	630	0.0088	0.0242	1.6511	0.4685	0.0147	1.4292	0.0239	0.0202	29.0	35.28	
64	640	0.0088	0.0242	1.6753	0.4834	0.0149	1.4531	0.0239	0.0203	29.1	34.81	
65	650	0.0072	0.0198	1.6951	0.4957	0.0123	1.4726	0.0196	0.0166	23.8	34.18	
66	660	0.0072	0.0198	1.7149	0.5080	0.0124	1.4922	0.0196	0.0167	23.9	33.40	
67	670	0.0072	0.0198	1.7347	0.5205	0.0125	1.5117	0.0196	0.0167	23.9	32.69	

SANTA BARBARA URBAN HYDROGRAPH (SBUH) METHOD
RUNOFF VOLUME CALCULATION

(1) Time Increment	(2) Time min.	(3) Rainfall distribution % of Pt	(4) Incremental Rainfall in.	(5) Accumulated Rainfall in.	Pervious Area (6) Accumulated Runoff in.	Pervious Area (7) Incremental Runoff in.	Impervious Area (8) Accumulated Runoff in.	Impervious Area (9) Incremental Runoff in.	(10) Total Runoff in.	(11) Instant hydrograph cfs	(12) design hydrograph cfs
68	680	0.0072	0.0198	1.7545	0.5330	0.0125	1.5313	0.0196	0.0168	24.0	32.03
69	690	0.0072	0.0198	1.7743	0.5457	0.0126	1.5509	0.0196	0.0168	24.1	31.43
70	700	0.0072	0.0198	1.7941	0.5584	0.0127	1.5705	0.0196	0.0168	24.1	30.88
71	710	0.0072	0.0198	1.8139	0.5712	0.0128	1.5901	0.0196	0.0169	24.2	30.37
72	720	0.0072	0.0198	1.8337	0.5840	0.0129	1.6097	0.0196	0.0169	24.2	29.90
73	730	0.0072	0.0198	1.8535	0.5970	0.0129	1.6293	0.0196	0.0169	24.3	29.48
74	740	0.0072	0.0198	1.8733	0.6100	0.0130	1.6489	0.0196	0.0170	24.3	29.09
75	750	0.0072	0.0198	1.8931	0.6231	0.0131	1.6685	0.0196	0.0170	24.3	28.73
76	760	0.0072	0.0198	1.9129	0.6363	0.0132	1.6881	0.0196	0.0170	24.4	28.40
77	770	0.0057	0.0157	1.9286	0.6468	0.0105	1.7036	0.0155	0.0135	19.3	27.91
78	780	0.0057	0.0157	1.9443	0.6573	0.0105	1.7191	0.0155	0.0135	19.4	27.26
79	790	0.0057	0.0157	1.9599	0.6679	0.0106	1.7346	0.0155	0.0135	19.4	26.67
80	800	0.0057	0.0157	1.9756	0.6785	0.0106	1.7502	0.0155	0.0136	19.4	26.13
81	810	0.0057	0.0157	1.9913	0.6892	0.0107	1.7657	0.0155	0.0136	19.5	25.62
82	820	0.0057	0.0157	2.0070	0.6999	0.0107	1.7812	0.0155	0.0136	19.5	25.16
83	830	0.0057	0.0157	2.0226	0.7106	0.0107	1.7968	0.0155	0.0136	19.5	24.73
84	840	0.0057	0.0157	2.0383	0.7214	0.0108	1.8123	0.0155	0.0136	19.5	24.34
85	850	0.0057	0.0157	2.0540	0.7322	0.0108	1.8279	0.0155	0.0137	19.6	23.98
86	860	0.0057	0.0157	2.0697	0.7431	0.0109	1.8434	0.0155	0.0137	19.6	23.65
87	870	0.0057	0.0157	2.0853	0.7540	0.0109	1.8589	0.0155	0.0137	19.6	23.34
88	880	0.0057	0.0157	2.1010	0.7650	0.0110	1.8745	0.0155	0.0137	19.6	23.06
89	890	0.0050	0.0138	2.1148	0.7746	0.0096	1.8881	0.0136	0.0120	17.2	22.71
90	900	0.0050	0.0138	2.1285	0.7843	0.0097	1.9018	0.0136	0.0121	17.3	22.30
91	910	0.0050	0.0138	2.1423	0.7940	0.0097	1.9154	0.0136	0.0121	17.3	21.92
92	920	0.0050	0.0138	2.1560	0.8037	0.0097	1.9291	0.0136	0.0121	17.3	21.57
93	930	0.0050	0.0138	2.1698	0.8135	0.0098	1.9427	0.0136	0.0121	17.3	21.25
94	940	0.0050	0.0138	2.1835	0.8233	0.0098	1.9563	0.0136	0.0121	17.3	20.96
95	950	0.0050	0.0138	2.1973	0.8331	0.0098	1.9700	0.0136	0.0121	17.3	20.68
96	960	0.0050	0.0138	2.2110	0.8429	0.0098	1.9836	0.0136	0.0121	17.4	20.43
97	970	0.0050	0.0138	2.2248	0.8528	0.0099	1.9973	0.0136	0.0121	17.4	20.20
98	980	0.0050	0.0138	2.2385	0.8627	0.0099	2.0109	0.0137	0.0121	17.4	19.99
99	990	0.0050	0.0138	2.2523	0.8726	0.0099	2.0246	0.0137	0.0122	17.4	19.80
100	1000	0.0050	0.0138	2.2660	0.8826	0.0100	2.0382	0.0137	0.0122	17.4	19.62
101	1010	0.0040	0.0110	2.2770	0.8906	0.0080	2.0492	0.0109	0.0097	14.0	19.32
102	1020	0.0040	0.0110	2.2880	0.8986	0.0080	2.0601	0.0109	0.0098	14.0	18.92
103	1030	0.0040	0.0110	2.2990	0.9066	0.0080	2.0710	0.0109	0.0098	14.0	18.55
104	1040	0.0040	0.0110	2.3100	0.9146	0.0080	2.0819	0.0109	0.0098	14.0	18.20
105	1050	0.0040	0.0110	2.3210	0.9227	0.0080	2.0929	0.0109	0.0098	14.0	17.89
106	1060	0.0040	0.0110	2.3320	0.9307	0.0081	2.1038	0.0109	0.0098	14.0	17.59
107	1070	0.0040	0.0110	2.3430	0.9388	0.0081	2.1147	0.0109	0.0098	14.0	17.32
108	1080	0.0040	0.0110	2.3540	0.9469	0.0081	2.1256	0.0109	0.0098	14.0	17.08
109	1090	0.0040	0.0110	2.3650	0.9550	0.0081	2.1366	0.0109	0.0098	14.0	16.85
110	1100	0.0040	0.0110	2.3760	0.9631	0.0081	2.1475	0.0109	0.0098	14.0	16.64
111	1110	0.0040	0.0110	2.3870	0.9713	0.0081	2.1584	0.0109	0.0098	14.1	16.44
112	1120	0.0040	0.0110	2.3980	0.9794	0.0082	2.1694	0.0109	0.0098	14.1	16.26
113	1130	0.0040	0.0110	2.4090	0.9876	0.0082	2.1803	0.0109	0.0098	14.1	16.10
114	1140	0.0040	0.0110	2.4200	0.9958	0.0082	2.1912	0.0109	0.0098	14.1	15.94
115	1150	0.0040	0.0110	2.4310	1.0040	0.0082	2.2022	0.0109	0.0098	14.1	15.80
116	1160	0.0040	0.0110	2.4420	1.0122	0.0082	2.2131	0.0109	0.0098	14.1	15.68
117	1170	0.0040	0.0110	2.4530	1.0205	0.0082	2.2240	0.0109	0.0099	14.1	15.56
118	1180	0.0040	0.0110	2.4640	1.0287	0.0083	2.2350	0.0109	0.0099	14.1	15.45
119	1190	0.0040	0.0110	2.4750	1.0370	0.0083	2.2459	0.0109	0.0099	14.1	15.35
120	1200	0.0040	0.0110	2.4860	1.0453	0.0083	2.2568	0.0109	0.0099	14.1	15.26
121	1210	0.0040	0.0110	2.4970	1.0536	0.0083	2.2678	0.0109	0.0099	14.1	15.17
122	1220	0.0040	0.0110	2.5080	1.0619	0.0083	2.2787	0.0109	0.0099	14.2	15.10
123	1230	0.0040	0.0110	2.5190	1.0702	0.0083	2.2896	0.0109	0.0099	14.2	15.03
124	1240	0.0040	0.0110	2.5300	1.0785	0.0083	2.3006	0.0109	0.0099	14.2	14.96
125	1250	0.0040	0.0110	2.5410	1.0869	0.0084	2.3115	0.0109	0.0099	14.2	14.90
126	1260	0.0040	0.0110	2.5520	1.0953	0.0084	2.3224	0.0109	0.0099	14.2	14.85
127	1270	0.0040	0.0110	2.5630	1.1036	0.0084	2.3334	0.0109	0.0099	14.2	14.80
128	1280	0.0040	0.0110	2.5740	1.1120	0.0084	2.3443	0.0109	0.0099	14.2	14.75
129	1290	0.0040	0.0110	2.5850	1.1204	0.0084	2.3553	0.0109	0.0099	14.2	14.71
130	1300	0.0040	0.0110	2.5960	1.1288	0.0084	2.3662	0.0109	0.0099	14.2	14.68
131	1310	0.0040	0.0110	2.6070	1.1373	0.0084	2.3771	0.0109	0.0099	14.2	14.64
132	1320	0.0040	0.0110	2.6180	1.1457	0.0084	2.3881	0.0109	0.0099	14.2	14.61
133	1330	0.0040	0.0110	2.6290	1.1542	0.0085	2.3990	0.0109	0.0099	14.2	14.58
134	1340	0.0040	0.0110	2.6400	1.1627	0.0085	2.4100	0.0109	0.0100	14.3	14.56
135	1350	0.0040	0.0110	2.6510	1.1711	0.0085	2.4209	0.0109	0.0100	14.3	14.54
136	1360	0.0040	0.0110	2.6620	1.1796	0.0085	2.4318	0.0109	0.0100	14.3	14.51
137	1370	0.0040	0.0110	2.6730	1.1882	0.0085	2.4428	0.0109	0.0100	14.3	14.50
138	1380	0.0040	0.0110	2.6840	1.1967	0.0085	2.4537	0.0109	0.0100	14.3	14.48
139	1390	0.0040	0.0110	2.6950	1.2052	0.0085	2.4647	0.0109	0.0100	14.3	14.47
140	1400	0.0040	0.0110	2.7060	1.2138	0.0085	2.4756	0.0109	0.0100	14.3	14.45
141	1410	0.0040	0.0110	2.7170	1.2223	0.0086	2.4866	0.0109	0.0100	14.3	14.44
142	1420	0.0040	0.0110	2.7280	1.2309	0.0086	2.4975	0.0109	0.0100	14.3	14.43
143	1430	0.0040	0.0110	2.7390	1.2395	0.0086	2.5085	0.0109	0.0100	14.3	14.42
144	1440	0.0040	0.0110	2.7500	1.2481	0.0086	2.5194	0.0109	0.0100	14.3	14.42

Total Volume of Runoff[1] = 1,616,958 cu. ft.

Notes:

1. Total Runoff Volume is found by summing column (12) and multiplying by the time step, dt as follows:

   V = SumQ x dt
   V(cu.ft.) = SumQ(cu.ft/s) x dt(min.) x (60 s/min.)

SANTA BARBARA URBAN HYDROGRAPH (SBUH) METHOD
RUNOFF VOLUME CALCULATION

Project: City of Arlington - Edgecomb
Basin: East
Storm Event: 25-YEAR, 24-HOUR
Given:

Area = 236.67 acres
Pt = 3.20 inches
dt = 10 min.
Tc = 127.9 min.

PERVIOUS AREA (Interim Final Cover Area)			IMPERVIOUS AREA (Roads)		
Area =	94.67	acres	Area =	142.00	acres
CN =	83		CN =	98	
S =	2.05		S =	0.20	
0.2S =	0.41		0.2S =	0.04	

SUMMARY
T_{pk} (hrs) = 7.83
Tc (min) = 127.9
Q_{pk} (cfs) = 53.80
Vol (cf) = 1,951,476

Compute: Runoff Hydrograph

Column (3) = SCS Type IA Rainfall Distribution
Column (4) = Col. (3) x Pt
Column (5) = Accumulated Sum of Col. (4)
Column (6) = [If P <= 0.2S] = 0; Note, use PERVIOUS Area "S" value.
[If P > 0.2S] = (Col.(5) - 0.2S)^2/(Col.(5) + 0.8S); Using the PERVIOUS Area "S" value.
Column (7) = Col.(6) of Present Time Step - Col.(6) of Previous Time Step
Column (8) = Same method as for Col.(6), except use the IMPERVIOUS Area "S" value.
Column (9) = Col.(8) of the present time step - Col.(8) of the previous time step.
Column (10) = ((PERVIOUS area / Total area) x Col.(7)) + ((IMPERVIOUS area / Total area) x Col.(9))
Column (11) = (60.5 x Col.(10) x Total Area) / 10 (dt = 10 minutes)
Routing Constant, w = dt / (2Tc + dt) = 0.0376
Column (12) = Col.(12) of Previous Time Step + (w x [Col.(11) of Previous Time Step
+ Col.(11) of Present Time Step - (2 x Col.(12) of Previous Time Step)])

					Pervious Area		Impervious Area				
(1) Time increment	(2) Time min.	(3) Rainfall distribution % of Pt	(4) Incremental Rainfall in.	(5) Accumulated Rainfall in.	(6) Accumulated Runoff in.	(7) Incremental Runoff in.	(8) Accumulated Runoff in.	(9) Incremental Runoff in.	(10) Total Runoff in.	(11) Instant hydrograph cfs	(12) design hydrograph cfs	
1	10	0.0040	0.0128	0.0128	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.00	
2	20	0.0040	0.0128	0.0256	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.00	
3	30	0.0040	0.0128	0.0384	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.00	
4	40	0.0040	0.0128	0.0512	0.0000	0.0000	0.0005	0.0005	0.0003	0.4	0.02	
5	50	0.0040	0.0128	0.0640	0.0000	0.0000	0.0024	0.0019	0.0011	1.6	0.09	
6	60	0.0040	0.0128	0.0768	0.0000	0.0000	0.0054	0.0030	0.0018	2.6	0.24	
7	70	0.0040	0.0128	0.0896	0.0000	0.0000	0.0094	0.0040	0.0024	3.5	0.45	
8	80	0.0040	0.0128	0.1024	0.0000	0.0000	0.0143	0.0049	0.0029	4.2	0.71	
9	90	0.0040	0.0128	0.1152	0.0000	0.0000	0.0199	0.0056	0.0034	4.8	0.99	
10	100	0.0040	0.0128	0.1280	0.0000	0.0000	0.0261	0.0062	0.0037	5.3	1.30	
11	110	0.0050	0.0160	0.1440	0.0000	0.0000	0.0347	0.0086	0.0051	7.3	1.68	
12	120	0.0050	0.0160	0.1600	0.0000	0.0000	0.0439	0.0093	0.0056	8.0	2.13	
13	130	0.0050	0.0160	0.1760	0.0000	0.0000	0.0539	0.0099	0.0060	8.5	2.59	
14	140	0.0050	0.0160	0.1920	0.0000	0.0000	0.0643	0.0105	0.0063	9.0	3.05	
15	150	0.0050	0.0160	0.2080	0.0000	0.0000	0.0753	0.0109	0.0066	9.4	3.52	
16	160	0.0050	0.0160	0.2240	0.0000	0.0000	0.0866	0.0114	0.0068	9.8	3.97	
17	170	0.0060	0.0192	0.2432	0.0000	0.0000	0.1008	0.0141	0.0085	12.1	4.50	
18	180	0.0060	0.0192	0.2624	0.0000	0.0000	0.1153	0.0146	0.0087	12.5	5.09	
19	190	0.0060	0.0192	0.2816	0.0000	0.0000	0.1303	0.0150	0.0090	12.9	5.66	
20	200	0.0060	0.0192	0.3008	0.0000	0.0000	0.1457	0.0153	0.0092	13.2	6.21	
21	210	0.0060	0.0192	0.3200	0.0000	0.0000	0.1613	0.0156	0.0094	13.4	6.75	
22	220	0.0060	0.0192	0.3392	0.0000	0.0000	0.1772	0.0159	0.0095	13.7	7.26	
23	230	0.0070	0.0224	0.3616	0.0000	0.0000	0.1961	0.0189	0.0113	16.2	7.84	
24	240	0.0070	0.0224	0.3840	0.0000	0.0000	0.2152	0.0192	0.0115	16.5	8.47	
25	250	0.0070	0.0224	0.4064	0.0000	0.0000	0.2346	0.0194	0.0116	16.7	9.08	
26	260	0.0070	0.0224	0.4288	0.0002	0.0002	0.2542	0.0196	0.0119	17.0	9.67	
27	270	0.0070	0.0224	0.4512	0.0008	0.0006	0.2741	0.0198	0.0122	17.4	10.23	
28	280	0.0070	0.0224	0.4736	0.0019	0.0011	0.2941	0.0200	0.0125	17.8	10.79	
29	290	0.0082	0.0262	0.4998	0.0038	0.0019	0.3178	0.0237	0.0149	21.4	11.45	
30	300	0.0082	0.0262	0.5261	0.0063	0.0025	0.3416	0.0238	0.0153	21.9	12.22	
31	310	0.0082	0.0262	0.5523	0.0093	0.0030	0.3656	0.0240	0.0156	22.4	12.96	
32	320	0.0082	0.0262	0.5786	0.0129	0.0036	0.3898	0.0242	0.0159	22.8	13.69	
33	330	0.0082	0.0262	0.6048	0.0170	0.0041	0.4141	0.0243	0.0162	23.2	14.39	
34	340	0.0082	0.0262	0.6310	0.0216	0.0046	0.4386	0.0244	0.0165	23.6	15.07	
35	350	0.0095	0.0304	0.6614	0.0276	0.0060	0.4670	0.0285	0.0195	27.9	15.88	
36	360	0.0095	0.0304	0.6918	0.0342	0.0066	0.4956	0.0286	0.0198	28.4	16.80	
37	370	0.0095	0.0304	0.7222	0.0414	0.0072	0.5244	0.0287	0.0201	28.8	17.69	
38	380	0.0095	0.0304	0.7526	0.0492	0.0078	0.5532	0.0288	0.0204	29.2	18.54	
39	390	0.0095	0.0304	0.7830	0.0576	0.0084	0.5822	0.0289	0.0207	29.7	19.36	
40	400	0.0095	0.0304	0.8134	0.0665	0.0089	0.6112	0.0290	0.0210	30.0	20.15	
41	410	0.0134	0.0429	0.8563	0.0800	0.0135	0.6523	0.0411	0.0300	43.0	21.38	
42	420	0.0134	0.0429	0.8992	0.0944	0.0145	0.6935	0.0412	0.0305	43.7	23.04	
43	430	0.0134	0.0429	0.9421	0.1099	0.0154	0.7349	0.0414	0.0310	44.4	24.62	
44	440	0.0180	0.0576	0.9997	0.1320	0.0221	0.7906	0.0557	0.0423	60.5	26.71	
45	450	0.0180	0.0576	1.0573	0.1556	0.0236	0.8465	0.0559	0.0430	61.6	29.30	
46	460	0.0340	0.1088	1.1661	0.2040	0.0484	0.9525	0.1060	0.0830	118.8	33.88	
47	470	0.0540	0.1728	1.3389	0.2900	0.0860	1.1217	0.1692	0.1359	194.6	43.12	
48	480	0.0270	0.0864	1.4253	0.3367	0.0467	1.2066	0.0849	0.0696	99.7	50.95	Q peak
49	490	0.0180	0.0576	1.4829	0.3690	0.0323	1.2633	0.0567	0.0469	67.2	53.39	
50	500	0.0134	0.0429	1.5258	0.3937	0.0247	1.3055	0.0422	0.0352	50.4	53.80	
51	510	0.0134	0.0429	1.5686	0.4188	0.0252	1.3478	0.0423	0.0354	50.7	53.56	
52	520	0.0134	0.0429	1.6115	0.4445	0.0256	1.3901	0.0423	0.0356	51.0	53.35	
53	530	0.0088	0.0282	1.6397	0.4615	0.0171	1.4179	0.0278	0.0235	33.7	52.52	
54	540	0.0088	0.0282	1.6678	0.4788	0.0173	1.4457	0.0278	0.0236	33.8	51.11	
55	550	0.0088	0.0282	1.6960	0.4962	0.0174	1.4735	0.0278	0.0237	33.9	49.81	
56	560	0.0088	0.0282	1.7242	0.5139	0.0176	1.5013	0.0278	0.0237	34.0	48.62	
57	570	0.0088	0.0282	1.7523	0.5317	0.0178	1.5292	0.0278	0.0238	34.1	47.52	
58	580	0.0088	0.0282	1.7805	0.5496	0.0180	1.5570	0.0278	0.0239	34.2	46.51	
59	590	0.0088	0.0282	1.8086	0.5678	0.0181	1.5849	0.0279	0.0240	34.3	45.59	
60	600	0.0088	0.0282	1.8368	0.5861	0.0183	1.6127	0.0279	0.0240	34.4	44.75	
61	610	0.0088	0.0282	1.8650	0.6045	0.0185	1.6406	0.0279	0.0241	34.5	43.97	
62	620	0.0088	0.0282	1.8931	0.6231	0.0186	1.6685	0.0279	0.0242	34.6	43.27	
63	630	0.0088	0.0282	1.9213	0.6419	0.0188	1.6964	0.0279	0.0242	34.7	42.62	
64	640	0.0088	0.0282	1.9494	0.6608	0.0189	1.7243	0.0279	0.0243	34.8	42.03	
65	650	0.0072	0.0230	1.9725	0.6764	0.0156	1.7471	0.0228	0.0199	28.5	41.25	
66	660	0.0072	0.0230	1.9955	0.6921	0.0157	1.7699	0.0228	0.0200	28.6	40.29	
67	670	0.0072	0.0230	2.0186	0.7078	0.0158	1.7928	0.0228	0.0200	28.6	39.41	

SANTA BARBARA URBAN HYDROGRAPH (SBUH) METHOD
RUNOFF VOLUME CALCULATION

					Pervious Area		Impervious Area				
(1) Time Increment	(2) Time min.	(3) Rainfall distri-bution % of Pt	(4) Incre-mental Rainfall in.	(5) Accumu-lated Rainfall in.	(6) Accumu-lated Runoff in.	(7) Incre-mental Runoff in.	(8) Accumu-lated Runoff in.	(9) Incre-mental Runoff in.	(10) Total Runoff in.	(11) Instant hydro-graph cfs	(12) design hydro-graph cfs
68	680	0.0072	0.0230	2.0416	0.7237	0.0159	1.8156	0.0228	0.0200	28.7	38.61
69	690	0.0072	0.0230	2.0646	0.7396	0.0159	1.8384	0.0228	0.0201	28.8	37.86
70	700	0.0072	0.0230	2.0877	0.7557	0.0160	1.8613	0.0228	0.0201	28.8	37.18
71	710	0.0072	0.0230	2.1107	0.7718	0.0161	1.8841	0.0229	0.0202	28.9	36.55
72	720	0.0072	0.0230	2.1338	0.7880	0.0162	1.9070	0.0229	0.0202	28.9	35.98
73	730	0.0072	0.0230	2.1568	0.8043	0.0163	1.9299	0.0229	0.0202	29.0	35.45
74	740	0.0072	0.0230	2.1798	0.8207	0.0164	1.9527	0.0229	0.0203	29.0	34.96
75	750	0.0072	0.0230	2.2029	0.8371	0.0165	1.9756	0.0229	0.0203	29.1	34.52
76	760	0.0072	0.0230	2.2259	0.8536	0.0165	1.9985	0.0229	0.0203	29.1	34.11
77	770	0.0057	0.0182	2.2442	0.8668	0.0131	2.0166	0.0181	0.0161	23.1	33.51
78	780	0.0057	0.0182	2.2624	0.8800	0.0132	2.0347	0.0181	0.0161	23.1	32.72
79	790	0.0057	0.0182	2.2806	0.8932	0.0132	2.0528	0.0181	0.0162	23.1	32.00
80	800	0.0057	0.0182	2.2989	0.9065	0.0133	2.0709	0.0181	0.0162	23.2	31.33
81	810	0.0057	0.0182	2.3171	0.9198	0.0133	2.0890	0.0181	0.0162	23.2	30.72
82	820	0.0057	0.0182	2.3354	0.9332	0.0134	2.1071	0.0181	0.0162	23.2	30.16
83	830	0.0057	0.0182	2.3536	0.9466	0.0134	2.1253	0.0181	0.0162	23.3	29.64
84	840	0.0057	0.0182	2.3718	0.9601	0.0135	2.1434	0.0181	0.0163	23.3	29.16
85	850	0.0057	0.0182	2.3901	0.9736	0.0135	2.1615	0.0181	0.0163	23.3	28.71
86	860	0.0057	0.0182	2.4083	0.9871	0.0135	2.1796	0.0181	0.0163	23.3	28.31
87	870	0.0057	0.0182	2.4266	1.0007	0.0136	2.1977	0.0181	0.0163	23.4	27.93
88	880	0.0057	0.0182	2.4448	1.0143	0.0136	2.2159	0.0181	0.0163	23.4	27.59
89	890	0.0050	0.0160	2.4608	1.0263	0.0120	2.2318	0.0159	0.0143	20.5	27.17
90	900	0.0050	0.0160	2.4768	1.0383	0.0120	2.2477	0.0159	0.0144	20.5	26.67
91	910	0.0050	0.0160	2.4928	1.0504	0.0121	2.2636	0.0159	0.0144	20.6	26.21
92	920	0.0050	0.0160	2.5088	1.0625	0.0121	2.2795	0.0159	0.0144	20.6	25.78
93	930	0.0050	0.0160	2.5248	1.0746	0.0121	2.2954	0.0159	0.0144	20.6	25.39
94	940	0.0050	0.0160	2.5408	1.0867	0.0121	2.3113	0.0159	0.0144	20.6	25.03
95	950	0.0050	0.0160	2.5568	1.0989	0.0122	2.3272	0.0159	0.0144	20.6	24.70
96	960	0.0050	0.0160	2.5728	1.1111	0.0122	2.3431	0.0159	0.0144	20.7	24.40
97	970	0.0050	0.0160	2.5888	1.1233	0.0122	2.3590	0.0159	0.0144	20.7	24.12
98	980	0.0050	0.0160	2.6048	1.1356	0.0123	2.3749	0.0159	0.0145	20.7	23.86
99	990	0.0050	0.0160	2.6208	1.1479	0.0123	2.3909	0.0159	0.0145	20.7	23.62
100	1000	0.0050	0.0160	2.6368	1.1602	0.0123	2.4068	0.0159	0.0145	20.7	23.40
101	1010	0.0040	0.0128	2.6496	1.1701	0.0099	2.4195	0.0127	0.0116	16.6	23.05
102	1020	0.0040	0.0128	2.6624	1.1800	0.0099	2.4322	0.0127	0.0116	16.6	22.56
103	1030	0.0040	0.0128	2.6752	1.1899	0.0099	2.4450	0.0127	0.0116	16.6	22.11
104	1040	0.0040	0.0128	2.6880	1.1998	0.0099	2.4577	0.0127	0.0116	16.6	21.70
105	1050	0.0040	0.0128	2.7008	1.2097	0.0099	2.4704	0.0127	0.0116	16.6	21.32
106	1060	0.0040	0.0128	2.7136	1.2197	0.0100	2.4832	0.0127	0.0116	16.6	20.97
107	1070	0.0040	0.0128	2.7264	1.2297	0.0100	2.4959	0.0127	0.0116	16.7	20.64
108	1080	0.0040	0.0128	2.7392	1.2396	0.0100	2.5087	0.0127	0.0116	16.7	20.34
109	1090	0.0040	0.0128	2.7520	1.2497	0.0100	2.5214	0.0127	0.0116	16.7	20.06
110	1100	0.0040	0.0128	2.7648	1.2597	0.0100	2.5341	0.0127	0.0117	16.7	19.81
111	1110	0.0040	0.0128	2.7776	1.2697	0.0100	2.5469	0.0127	0.0117	16.7	19.57
112	1120	0.0040	0.0128	2.7904	1.2798	0.0101	2.5596	0.0127	0.0117	16.7	19.36
113	1130	0.0040	0.0128	2.8032	1.2898	0.0101	2.5723	0.0127	0.0117	16.7	19.16
114	1140	0.0040	0.0128	2.8160	1.2999	0.0101	2.5851	0.0127	0.0117	16.7	18.98
115	1150	0.0040	0.0128	2.8288	1.3100	0.0101	2.5978	0.0127	0.0117	16.7	18.81
116	1160	0.0040	0.0128	2.8416	1.3201	0.0101	2.6106	0.0127	0.0117	16.7	18.65
117	1170	0.0040	0.0128	2.8544	1.3303	0.0101	2.6233	0.0127	0.0117	16.7	18.51
118	1180	0.0040	0.0128	2.8672	1.3404	0.0101	2.6360	0.0127	0.0117	16.8	18.37
119	1190	0.0040	0.0128	2.8800	1.3506	0.0102	2.6488	0.0127	0.0117	16.8	18.25
120	1200	0.0040	0.0128	2.8928	1.3608	0.0102	2.6615	0.0127	0.0117	16.8	18.14
121	1210	0.0040	0.0128	2.9056	1.3710	0.0102	2.6743	0.0127	0.0117	16.8	18.04
122	1220	0.0040	0.0128	2.9184	1.3812	0.0102	2.6870	0.0127	0.0117	16.8	17.95
123	1230	0.0040	0.0128	2.9312	1.3914	0.0102	2.6998	0.0127	0.0117	16.8	17.86
124	1240	0.0040	0.0128	2.9440	1.4016	0.0102	2.7125	0.0127	0.0117	16.8	17.78
125	1250	0.0040	0.0128	2.9568	1.4119	0.0103	2.7253	0.0127	0.0117	16.8	17.71
126	1260	0.0040	0.0128	2.9696	1.4221	0.0103	2.7380	0.0127	0.0118	16.8	17.64
127	1270	0.0040	0.0128	2.9824	1.4324	0.0103	2.7507	0.0127	0.0118	16.8	17.58
128	1280	0.0040	0.0128	2.9952	1.4427	0.0103	2.7635	0.0127	0.0118	16.8	17.52
129	1290	0.0040	0.0128	3.0080	1.4530	0.0103	2.7762	0.0127	0.0118	16.9	17.47
130	1300	0.0040	0.0128	3.0208	1.4633	0.0103	2.7890	0.0127	0.0118	16.9	17.43
131	1310	0.0040	0.0128	3.0336	1.4737	0.0103	2.8017	0.0127	0.0118	16.9	17.39
132	1320	0.0040	0.0128	3.0464	1.4840	0.0103	2.8145	0.0127	0.0118	16.9	17.35
133	1330	0.0040	0.0128	3.0592	1.4944	0.0104	2.8272	0.0127	0.0118	16.9	17.31
134	1340	0.0040	0.0128	3.0720	1.5047	0.0104	2.8400	0.0127	0.0118	16.9	17.28
135	1350	0.0040	0.0128	3.0848	1.5151	0.0104	2.8527	0.0127	0.0118	16.9	17.25
136	1360	0.0040	0.0128	3.0976	1.5255	0.0104	2.8655	0.0127	0.0118	16.9	17.23
137	1370	0.0040	0.0128	3.1104	1.5359	0.0104	2.8782	0.0128	0.0118	16.9	17.20
138	1380	0.0040	0.0128	3.1232	1.5464	0.0104	2.8910	0.0128	0.0118	16.9	17.18
139	1390	0.0040	0.0128	3.1360	1.5568	0.0104	2.9037	0.0128	0.0118	16.9	17.16
140	1400	0.0040	0.0128	3.1488	1.5673	0.0105	2.9165	0.0128	0.0118	16.9	17.14
141	1410	0.0040	0.0128	3.1616	1.5777	0.0105	2.9292	0.0128	0.0118	16.9	17.13
142	1420	0.0040	0.0128	3.1744	1.5882	0.0105	2.9420	0.0128	0.0118	17.0	17.12
143	1430	0.0040	0.0128	3.1872	1.5987	0.0105	2.9547	0.0128	0.0118	17.0	17.10
144	1440	0.0040	0.0128	3.2000	1.6092	0.0105	2.9675	0.0128	0.0119	17.0	17.09

Total Volume of Runoff[1] = 1,951,476 cu. ft.

Notes:

1. Total Runoff Volume is found by summing column (12) and multiplying by the time step, dt as follows:

   V = SumQ x dt
   V(cu.ft.) = SumQ(cu.ft/s) x dt(min.) x (60 s/min.)

SANTA BARBARA URBAN HYDROGRAPH (SBUH) METHOD
RUNOFF VOLUME CALCULATION

Project: City of Arlington - Edgecomb
Basin: East
Storm Event: 100-YEAR, 24-HOUR
Given:

Area = 236.67 acres
Pt = 3.75 inches
dt = 10 min.
Tc = 127.9 min.

PERVIOUS AREA (Interim Final Cover Area)			IMPERVIOUS AREA (Roads)		
Area =	94.67	acres	Area =	142.00	acres
CN =	83		CN =	98	
S =	2.05		S =	0.20	
0.2S =	0.41		0.2S =	0.04	

SUMMARY
T_{pk} (hrs) = 7.83
T_c (min) = 127.9
Q_{pk} (cfs) = 65.79
Vol (cf) = 2,367,561

Compute: Runoff Hydrograph

Column (3) = SCS Type IA Rainfall Distribution
Column (4) = Col. (3) x Pt
Column (5) = Accumulated Sum of Col. (4)
Column (6) = [If P <= 0.2S] = 0; Note, use PERVIOUS Area "S" value.
[If P > 0.2S] = (Col.(5) - 0.2S)^2/(Col.(5) + 0.8S); Using the PERVIOUS Area "S" value.
Column (7) = Col.(6) of Present Time Step - Col.(6) of Previous Time Step
Column (8) = Same method as for Col.(6), except use the IMPERVIOUS Area "S" value.
Column (9) = Col.(8) of the present time step - Col.(8) of the previous time step.
Column (10) = ((PERVIOUS area / Total area) x Col.(7)) + ((IMPERVIOUS area / Total area) x Col.(9))
Column (11) = (60.5 x Col.(10) x Total Area) / 10 (dt = 10 minutes)
Routing Constant, w = dt / (2Tc + dt) = 0.0376
Column (12) = Col.(12) of Previous Time Step + (w x [Col.(11) of Previous Time Step
+ Col.(11) of Present Time Step - (2 x Col.(12) of Previous Time Step)])

					Pervious Area		Impervious Area				
(1) Time Increment	(2) Time min.	(3) Rainfall distribution % of Pt	(4) Incremental Rainfall in.	(5) Accumulated Rainfall in.	(6) Accumulated Runoff in.	(7) Incremental Runoff in.	(8) Accumulated Runoff in.	(9) Incremental Runoff in.	(10) Total Runoff in.	(11) Instant hydrograph cfs	(12) design hydrograph cfs	
1	10	0.0040	0.0150	0.0150	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.00	
2	20	0.0040	0.0150	0.0300	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.00	
3	30	0.0040	0.0150	0.0450	0.0000	0.0000	0.0001	0.0001	0.0001	0.1	0.00	
4	40	0.0040	0.0150	0.0600	0.0000	0.0000	0.0016	0.0016	0.0009	1.3	0.06	
5	50	0.0040	0.0150	0.0750	0.0000	0.0000	0.0049	0.0033	0.0020	2.8	0.21	
6	60	0.0040	0.0150	0.0900	0.0000	0.0000	0.0096	0.0046	0.0028	4.0	0.45	
7	70	0.0040	0.0150	0.1050	0.0000	0.0000	0.0154	0.0058	0.0035	5.0	0.75	
8	80	0.0040	0.0150	0.1200	0.0000	0.0000	0.0221	0.0068	0.0041	5.8	1.10	
9	90	0.0040	0.0150	0.1350	0.0000	0.0000	0.0297	0.0076	0.0046	6.5	1.48	
10	100	0.0040	0.0150	0.1500	0.0000	0.0000	0.0381	0.0083	0.0050	7.1	1.89	
11	110	0.0050	0.0188	0.1688	0.0000	0.0000	0.0493	0.0112	0.0067	9.7	2.38	
12	120	0.0050	0.0188	0.1875	0.0000	0.0000	0.0613	0.0120	0.0072	10.3	2.95	
13	130	0.0050	0.0188	0.2063	0.0000	0.0000	0.0741	0.0127	0.0076	10.9	3.53	
14	140	0.0050	0.0188	0.2250	0.0000	0.0000	0.0874	0.0133	0.0080	11.4	4.10	
15	150	0.0050	0.0188	0.2438	0.0000	0.0000	0.1012	0.0138	0.0083	11.9	4.67	
16	160	0.0050	0.0188	0.2625	0.0000	0.0000	0.1154	0.0142	0.0085	12.2	5.23	
17	170	0.0060	0.0225	0.2850	0.0000	0.0000	0.1330	0.0176	0.0106	15.1	5.86	
18	180	0.0060	0.0225	0.3075	0.0000	0.0000	0.1511	0.0181	0.0108	15.5	6.57	
19	190	0.0060	0.0225	0.3300	0.0000	0.0000	0.1695	0.0185	0.0111	15.9	7.26	
20	200	0.0060	0.0225	0.3525	0.0000	0.0000	0.1884	0.0188	0.0113	16.2	7.92	
21	210	0.0060	0.0225	0.3750	0.0000	0.0000	0.2075	0.0191	0.0115	16.4	8.55	
22	220	0.0060	0.0225	0.3975	0.0000	0.0000	0.2269	0.0194	0.0116	16.7	9.15	
23	230	0.0070	0.0263	0.4238	0.0001	0.0001	0.2498	0.0229	0.0138	19.8	9.83	
24	240	0.0070	0.0263	0.4500	0.0008	0.0007	0.2730	0.0232	0.0142	20.3	10.60	
25	250	0.0070	0.0263	0.4763	0.0021	0.0013	0.2965	0.0235	0.0146	20.9	11.35	
26	260	0.0070	0.0263	0.5025	0.0040	0.0019	0.3202	0.0237	0.0150	21.5	12.09	
27	270	0.0070	0.0263	0.5288	0.0065	0.0025	0.3440	0.0239	0.0153	22.0	12.82	
28	280	0.0070	0.0263	0.5550	0.0096	0.0031	0.3681	0.0241	0.0157	22.4	13.52	
29	290	0.0082	0.0308	0.5858	0.0139	0.0043	0.3965	0.0284	0.0187	26.8	14.36	
30	300	0.0082	0.0308	0.6165	0.0190	0.0050	0.4250	0.0286	0.0191	27.4	15.32	
31	310	0.0082	0.0308	0.6473	0.0247	0.0057	0.4537	0.0287	0.0195	28.0	16.25	
32	320	0.0082	0.0308	0.6780	0.0311	0.0064	0.4826	0.0289	0.0199	28.5	17.15	
33	330	0.0082	0.0308	0.7088	0.0381	0.0070	0.5116	0.0290	0.0202	28.9	18.02	
34	340	0.0082	0.0308	0.7395	0.0458	0.0076	0.5407	0.0291	0.0205	29.4	18.86	
35	350	0.0095	0.0356	0.7751	0.0553	0.0096	0.5746	0.0339	0.0242	34.6	19.85	
36	360	0.0095	0.0356	0.8108	0.0657	0.0103	0.6086	0.0340	0.0245	35.1	20.98	
37	370	0.0095	0.0356	0.8464	0.0768	0.0111	0.6427	0.0341	0.0249	35.6	22.06	
38	380	0.0095	0.0356	0.8820	0.0885	0.0118	0.6769	0.0342	0.0252	36.1	23.10	
39	390	0.0095	0.0356	0.9176	0.1010	0.0124	0.7113	0.0343	0.0256	36.6	24.10	
40	400	0.0095	0.0356	0.9533	0.1140	0.0131	0.7457	0.0344	0.0259	37.0	25.06	
41	410	0.0134	0.0503	1.0035	0.1335	0.0195	0.7943	0.0486	0.0370	52.9	26.56	
42	420	0.0134	0.0503	1.0538	0.1541	0.0206	0.8431	0.0488	0.0375	53.7	28.57	
43	430	0.0134	0.0503	1.1040	0.1758	0.0217	0.8920	0.0489	0.0380	54.4	30.49	
44	440	0.0180	0.0675	1.1715	0.2066	0.0308	0.9578	0.0658	0.0518	74.2	33.03	
45	450	0.0180	0.0675	1.2390	0.2390	0.0325	1.0238	0.0660	0.0526	75.3	36.17	
46	460	0.0340	0.1275	1.3665	0.3047	0.0656	1.1488	0.1250	0.1013	145.0	41.74	
47	470	0.0540	0.2025	1.5690	0.4190	0.1144	1.3481	0.1993	0.1653	236.7	52.96	
48	480	0.0270	0.1013	1.6703	0.4803	0.0612	1.4481	0.0999	0.0844	120.9	62.43	Q peak
49	490	0.0180	0.0675	1.7378	0.5224	0.0422	1.5148	0.0667	0.0569	81.4	65.35	
50	500	0.0134	0.0503	1.7880	0.5545	0.0320	1.5644	0.0497	0.0426	61.0	65.79	
51	510	0.0134	0.0503	1.8383	0.5870	0.0326	1.6142	0.0497	0.0429	61.4	65.44	
52	520	0.0134	0.0503	1.8885	0.6201	0.0331	1.6639	0.0497	0.0431	61.7	65.15	
53	530	0.0088	0.0330	1.9215	0.6420	0.0220	1.6966	0.0327	0.0284	40.7	64.10	
54	540	0.0088	0.0330	1.9545	0.6642	0.0222	1.7293	0.0327	0.0285	40.8	62.34	
55	550	0.0088	0.0330	1.9875	0.6866	0.0224	1.7620	0.0327	0.0286	40.9	60.72	
56	560	0.0088	0.0330	2.0205	0.7092	0.0226	1.7947	0.0327	0.0287	41.0	59.23	
57	570	0.0088	0.0330	2.0535	0.7319	0.0228	1.8274	0.0327	0.0287	41.1	57.87	
58	580	0.0088	0.0330	2.0865	0.7549	0.0229	1.8601	0.0327	0.0288	41.2	56.61	
59	590	0.0088	0.0330	2.1195	0.7780	0.0231	1.8928	0.0327	0.0289	41.4	55.46	
60	600	0.0088	0.0330	2.1525	0.8012	0.0233	1.9256	0.0327	0.0290	41.5	54.40	
61	610	0.0088	0.0330	2.1855	0.8247	0.0235	1.9583	0.0327	0.0290	41.6	53.43	
62	620	0.0088	0.0330	2.2185	0.8483	0.0236	1.9911	0.0328	0.0291	41.7	52.54	
63	630	0.0088	0.0330	2.2515	0.8721	0.0238	2.0238	0.0328	0.0292	41.8	51.73	
64	640	0.0088	0.0330	2.2845	0.8960	0.0239	2.0566	0.0328	0.0292	41.9	50.98	
65	650	0.0072	0.0270	2.3115	0.9157	0.0197	2.0834	0.0268	0.0240	34.3	50.01	
66	660	0.0072	0.0270	2.3385	0.9355	0.0198	2.1103	0.0268	0.0240	34.4	48.83	
67	670	0.0072	0.0270	2.3655	0.9554	0.0199	2.1371	0.0268	0.0240	34.4	47.75	

SANTA BARBARA URBAN HYDROGRAPH (SBUH) METHOD
RUNOFF VOLUME CALCULATION

					Pervious Area		Impervious Area				
(1) Time Increment	(2) Time	(3) Rainfall distri-bution	(4) Incre-mental Rainfall	(5) Accumu-lated Rainfall	(6) Accumu-lated Runoff	(7) Incre-mental Runoff	(8) Accumu-lated Runoff	(9) Incre-mental Runoff	(10) Total Runoff	(11) Instant hydro-graph	(12) design hydro-graph
	min.	% of Pt	in.	in.	in.	in.	in.	in.	in.	cfs	cfs
68	680	0.0072	0.0270	2.3925	0.9754	0.0200	2.1639	0.0268	0.0241	34.5	46.75
69	690	0.0072	0.0270	2.4195	0.9954	0.0201	2.1907	0.0268	0.0241	34.5	45.83
70	700	0.0072	0.0270	2.4465	1.0156	0.0202	2.2176	0.0268	0.0242	34.6	44.98
71	710	0.0072	0.0270	2.4735	1.0359	0.0203	2.2444	0.0268	0.0242	34.7	44.20
72	720	0.0072	0.0270	2.5005	1.0562	0.0203	2.2712	0.0268	0.0242	34.7	43.49
73	730	0.0072	0.0270	2.5275	1.0766	0.0204	2.2981	0.0268	0.0243	34.8	42.83
74	740	0.0072	0.0270	2.5545	1.0972	0.0205	2.3249	0.0268	0.0243	34.8	42.22
75	750	0.0072	0.0270	2.5815	1.1178	0.0206	2.3518	0.0268	0.0243	34.9	41.67
76	760	0.0072	0.0270	2.6085	1.1384	0.0207	2.3786	0.0269	0.0244	34.9	41.16
77	770	0.0057	0.0214	2.6299	1.1549	0.0164	2.3999	0.0213	0.0193	27.7	40.42
78	780	0.0057	0.0214	2.6513	1.1713	0.0165	2.4212	0.0213	0.0193	27.7	39.46
79	790	0.0057	0.0214	2.6726	1.1879	0.0165	2.4424	0.0213	0.0194	27.7	38.57
80	800	0.0057	0.0214	2.6940	1.2044	0.0166	2.4637	0.0213	0.0194	27.8	37.76
81	810	0.0057	0.0214	2.7154	1.2211	0.0166	2.4849	0.0213	0.0194	27.8	37.01
82	820	0.0057	0.0214	2.7368	1.2377	0.0167	2.5062	0.0213	0.0194	27.8	36.32
83	830	0.0057	0.0214	2.7581	1.2544	0.0167	2.5275	0.0213	0.0194	27.8	35.68
84	840	0.0057	0.0214	2.7795	1.2712	0.0168	2.5488	0.0213	0.0195	27.9	35.09
85	850	0.0057	0.0214	2.8009	1.2880	0.0168	2.5700	0.0213	0.0195	27.9	34.55
86	860	0.0057	0.0214	2.8223	1.3049	0.0168	2.5913	0.0213	0.0195	27.9	34.05
87	870	0.0057	0.0214	2.8436	1.3217	0.0169	2.6126	0.0213	0.0195	28.0	33.59
88	880	0.0057	0.0214	2.8650	1.3387	0.0169	2.6339	0.0213	0.0195	28.0	33.17
89	890	0.0050	0.0188	2.8838	1.3536	0.0149	2.6525	0.0187	0.0172	24.6	32.65
90	900	0.0050	0.0188	2.9025	1.3685	0.0149	2.6712	0.0187	0.0172	24.6	32.04
91	910	0.0050	0.0188	2.9213	1.3834	0.0150	2.6899	0.0187	0.0172	24.6	31.48
92	920	0.0050	0.0188	2.9400	1.3984	0.0150	2.7085	0.0187	0.0172	24.6	30.96
93	930	0.0050	0.0188	2.9588	1.4134	0.0150	2.7272	0.0187	0.0172	24.6	30.49
94	940	0.0050	0.0188	2.9775	1.4285	0.0150	2.7459	0.0187	0.0172	24.7	30.05
95	950	0.0050	0.0188	2.9963	1.4435	0.0151	2.7645	0.0187	0.0172	24.7	29.64
96	960	0.0050	0.0188	3.0150	1.4587	0.0151	2.7832	0.0187	0.0172	24.7	29.27
97	970	0.0050	0.0188	3.0338	1.4738	0.0151	2.8019	0.0187	0.0173	24.7	28.92
98	980	0.0050	0.0188	3.0525	1.4889	0.0152	2.8206	0.0187	0.0173	24.7	28.61
99	990	0.0050	0.0188	3.0713	1.5041	0.0152	2.8392	0.0187	0.0173	24.7	28.32
100	1000	0.0050	0.0188	3.0900	1.5194	0.0152	2.8579	0.0187	0.0173	24.8	28.05
101	1010	0.0040	0.0150	3.1050	1.5315	0.0122	2.8728	0.0149	0.0138	19.8	27.61
102	1020	0.0040	0.0150	3.1200	1.5438	0.0122	2.8878	0.0149	0.0138	19.8	27.03
103	1030	0.0040	0.0150	3.1350	1.5560	0.0122	2.9027	0.0149	0.0139	19.8	26.49
104	1040	0.0040	0.0150	3.1500	1.5682	0.0122	2.9177	0.0149	0.0139	19.9	25.99
105	1050	0.0040	0.0150	3.1650	1.5805	0.0123	2.9326	0.0149	0.0139	19.9	25.53
106	1060	0.0040	0.0150	3.1800	1.5928	0.0123	2.9476	0.0149	0.0139	19.9	25.10
107	1070	0.0040	0.0150	3.1950	1.6051	0.0123	2.9625	0.0149	0.0139	19.9	24.71
108	1080	0.0040	0.0150	3.2100	1.6174	0.0123	2.9774	0.0149	0.0139	19.9	24.35
109	1090	0.0040	0.0150	3.2250	1.6297	0.0123	2.9924	0.0149	0.0139	19.9	24.01
110	1100	0.0040	0.0150	3.2400	1.6421	0.0123	3.0073	0.0149	0.0139	19.9	23.70
111	1110	0.0040	0.0150	3.2550	1.6544	0.0124	3.0223	0.0149	0.0139	19.9	23.42
112	1120	0.0040	0.0150	3.2700	1.6668	0.0124	3.0372	0.0149	0.0139	19.9	23.15
113	1130	0.0040	0.0150	3.2850	1.6792	0.0124	3.0522	0.0149	0.0139	19.9	22.91
114	1140	0.0040	0.0150	3.3000	1.6916	0.0124	3.0671	0.0149	0.0139	20.0	22.69
115	1150	0.0040	0.0150	3.3150	1.7041	0.0124	3.0821	0.0149	0.0139	20.0	22.48
116	1160	0.0040	0.0150	3.3300	1.7165	0.0124	3.0970	0.0149	0.0139	20.0	22.29
117	1170	0.0040	0.0150	3.3450	1.7290	0.0125	3.1120	0.0149	0.0140	20.0	22.12
118	1180	0.0040	0.0150	3.3600	1.7414	0.0125	3.1269	0.0149	0.0140	20.0	21.96
119	1190	0.0040	0.0150	3.3750	1.7539	0.0125	3.1419	0.0149	0.0140	20.0	21.81
120	1200	0.0040	0.0150	3.3900	1.7664	0.0125	3.1568	0.0150	0.0140	20.0	21.67
121	1210	0.0040	0.0150	3.4050	1.7789	0.0125	3.1718	0.0150	0.0140	20.0	21.55
122	1220	0.0040	0.0150	3.4200	1.7915	0.0125	3.1867	0.0150	0.0140	20.0	21.43
123	1230	0.0040	0.0150	3.4350	1.8040	0.0125	3.2017	0.0150	0.0140	20.0	21.33
124	1240	0.0040	0.0150	3.4500	1.8166	0.0126	3.2166	0.0150	0.0140	20.0	21.23
125	1250	0.0040	0.0150	3.4650	1.8292	0.0126	3.2316	0.0150	0.0140	20.0	21.14
126	1260	0.0040	0.0150	3.4800	1.8418	0.0126	3.2465	0.0150	0.0140	20.1	21.06
127	1270	0.0040	0.0150	3.4950	1.8544	0.0126	3.2615	0.0150	0.0140	20.1	20.98
128	1280	0.0040	0.0150	3.5100	1.8670	0.0126	3.2764	0.0150	0.0140	20.1	20.92
129	1290	0.0040	0.0150	3.5250	1.8796	0.0126	3.2914	0.0150	0.0140	20.1	20.85
130	1300	0.0040	0.0150	3.5400	1.8923	0.0126	3.3063	0.0150	0.0140	20.1	20.80
131	1310	0.0040	0.0150	3.5550	1.9049	0.0127	3.3213	0.0150	0.0140	20.1	20.74
132	1320	0.0040	0.0150	3.5700	1.9176	0.0127	3.3363	0.0150	0.0140	20.1	20.69
133	1330	0.0040	0.0150	3.5850	1.9303	0.0127	3.3512	0.0150	0.0140	20.1	20.65
134	1340	0.0040	0.0150	3.6000	1.9430	0.0127	3.3662	0.0150	0.0141	20.1	20.61
135	1350	0.0040	0.0150	3.6150	1.9557	0.0127	3.3811	0.0150	0.0141	20.1	20.57
136	1360	0.0040	0.0150	3.6300	1.9684	0.0127	3.3961	0.0150	0.0141	20.1	20.54
137	1370	0.0040	0.0150	3.6450	1.9812	0.0127	3.4110	0.0150	0.0141	20.1	20.51
138	1380	0.0040	0.0150	3.6600	1.9939	0.0128	3.4260	0.0150	0.0141	20.2	20.48
139	1390	0.0040	0.0150	3.6750	2.0067	0.0128	3.4410	0.0150	0.0141	20.2	20.46
140	1400	0.0040	0.0150	3.6900	2.0195	0.0128	3.4559	0.0150	0.0141	20.2	20.44
141	1410	0.0040	0.0150	3.7050	2.0322	0.0128	3.4709	0.0150	0.0141	20.2	20.42
142	1420	0.0040	0.0150	3.7200	2.0450	0.0128	3.4858	0.0150	0.0141	20.2	20.40
143	1430	0.0040	0.0150	3.7350	2.0579	0.0128	3.5008	0.0150	0.0141	20.2	20.38
144	1440	0.0040	0.0150	3.7500	2.0707	0.0128	3.5157	0.0150	0.0141	20.2	20.37

Total Volume of Runoff[1] = 2,367,561 cu. ft.

Notes:

1. Total Runoff Volume is found by summing column (12) and multiplying by the time step, dt as follows:

   V = SumQ x dt
   V(cu.ft.) = SumQ(cu.ft/s) x dt(min.) x (60 s/min.)

ATTACHMENT 4
Time of Concentration
And
SBUH results for West/Southwest section of Edgecomb Basin

Time of Concentration Path

Edgecomb Arlington

0 120240 Feet

0 57.6115.2172.8230.4 Meters

N

Pipe_network_0401			Watersheds WS4	
Unspecified	HDPE Smooth		Broadway	Haller Park
CMP Cor Metal	PVC Smooth		Butler East	Seventh Day Adventist
Concrete	Perforated HDPE		Butler West	Talcott
Ductal Iron	Perforated PVC		Centennial Trail	Utilities
HDPE Corrugated	Steel		Division Main	West
	Roads		Edgecomb	West RR
				Butler DT

City of Arlington
Edgecomb
Time of Concentration
West Basin 1

Calculate Time of Concentration (Tc)

Tc = Sum(Tt)

Where:

Tt = travel time (min) = $\frac{L}{(60xV)}$ (for shallow concentrated flow or channel flow)

Tt = travel time (min)= $\frac{0.42(n_s L)^{0.8}}{(P_2)^{0.5}(s_o)^{0.4}}$ (for sheet flow)

Where:

V = avg. velocity (ft/s) = $V = k(s_o)^{0.5}$

k = time of concentration velocity factor (ft/s)

L = flow length (ft)

n_s = sheet flow Manning's effective roughness coefficient

P_2 = 2-year, 24-hour rainfall (in)

s_o = slope of hydraulic grade line (land slope, ft/ft)

	L (ft)	$k_{s/c}$	V (fps)	n_s	P_2	s_o (ft/ft)	Tt (min)
a - sheet (surface flow)	0	NA	NA	0.15	1.8	0.003	0.0
b - culvert (pipe)	1,390	42	4.2	NA	NA	0.010	5.5
c - shallow (pond)	0	11	1.1	NA	NA	0.010	0.0
d - channel (stream/ditch)	3,550	17	0.9	NA	NA	0.003	63.5
Total (Tc)							69.1

Job City of Arlington — Project No. — Sheet ___ of ___

Description Edgecomb West Basin — Computed by SMN — Date 5/15/08

Checked by — Date

Reference

Area → 99.59 Acres (4,338,023 SF)

Pervious → 40% estimated : 0.40 × 99.59 Acres = 39.84 Acres

Impervious → 60% estimated : 0.60 × 99.59 Acres = 59.75 Acres

Flows estimated using SBUH method :

2 yr → 13.85 cfs

10 yr → 24.44 cfs

25 yr → 29.75 cfs

100 yr → 36.40 cfs

SANTA BARBARA URBAN HYDROGRAPH (SBUH) METHOD
RUNOFF VOLUME CALCULATION

Project: City of Arlington - Edgecomb
Basin: West
Storm Event: 2-YEAR, 24-HOUR
Given:

Area = 99.59 acres
Pt = 1.80 inches
dt = 10 min.
Tc = 69.1 min.

PERVIOUS AREA (Interim Final Cover Area)			IMPERVIOUS AREA (Roads)		
Area =	39.84	acres	Area =	59.75	acres
CN =	81		CN =	98	
S =	2.35		S =	0.20	
0.2S =	0.47		0.2S =	0.04	

SUMMARY
T_{pk} (hrs) = 7.83
Tc (min) = 69.1
Q_{pk} (cfs) = 13.85
Vol (cf) = 396,704

Compute: Runoff Hydrograph

Column (3) = SCS Type IA Rainfall Distribution
Column (4) = Col. (3) x Pt
Column (5) = Accumulated Sum of Col. (4)
Column (6) = [If P <= 0.2S] = 0; Note, use PERVIOUS Area "S" value.
[If P > 0.2S] = (Col.(5) - 0.2S)^2/(Col.(5) + 0.8S); Using the PERVIOUS Area "S" value.
Column (7) = Col.(6) of Present Time Step - Col.(6) of Previous Time Step
Column (8) = Same method as for Col.(6), except use the IMPERVIOUS Area "S" value.
Column (9) = Col.(8) of the present time step - Col.(8) of the previous time step.
Column (10) = ((PERVIOUS area / Total area) x Col.(7)) + ((IMPERVIOUS area / Total area) x Col.(9))
Column (11) = (60.5 x Col.(10) x Total Area) / 10 (dt = 10 minutes)
Routing Constant, w = dt / (2Tc + dt) = 0.0675
Column (12) = Col.(12) of Previous Time Step + (w x [Col.(11) of Previous Time Step + Col.(11) of Present Time Step - (2 x Col.(12) of Previous Time Step)])

					Pervious Area		Impervious Area					
(1) Time Increment	(2) Time	(3) Rainfall distribution	(4) Incremental Rainfall	(5) Accumulated Rainfall	(6) Accumulated Runoff	(7) Incremental Runoff	(8) Accumulated Runoff	(9) Incremental Runoff	(10) Total Runoff	(11) Instant hydrograph	(12) design hydrograph	
	min.	% of Pt	in.	in.	in.	in.	in.	in.	in.	cfs	cfs	
1	10	0.0040	0.0072	0.0072	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.00	
2	20	0.0040	0.0072	0.0144	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.00	
3	30	0.0040	0.0072	0.0216	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.00	
4	40	0.0040	0.0072	0.0288	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.00	
5	50	0.0040	0.0072	0.0360	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.00	
6	60	0.0040	0.0072	0.0432	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.00	
7	70	0.0040	0.0072	0.0504	0.0000	0.0000	0.0004	0.0004	0.0002	0.1	0.01	
8	80	0.0040	0.0072	0.0576	0.0000	0.0000	0.0013	0.0008	0.0005	0.3	0.04	
9	90	0.0040	0.0072	0.0648	0.0000	0.0000	0.0025	0.0012	0.0007	0.5	0.09	
10	100	0.0040	0.0072	0.0720	0.0000	0.0000	0.0041	0.0016	0.0010	0.6	0.14	
11	110	0.0050	0.0090	0.0810	0.0000	0.0000	0.0066	0.0025	0.0015	0.9	0.22	
12	120	0.0050	0.0090	0.0900	0.0000	0.0000	0.0096	0.0029	0.0018	1.1	0.33	
13	130	0.0050	0.0090	0.0990	0.0000	0.0000	0.0129	0.0034	0.0020	1.2	0.44	
14	140	0.0050	0.0090	0.1080	0.0000	0.0000	0.0166	0.0037	0.0022	1.3	0.55	
15	150	0.0050	0.0090	0.1170	0.0000	0.0000	0.0207	0.0041	0.0024	1.5	0.67	
16	160	0.0050	0.0090	0.1260	0.0000	0.0000	0.0251	0.0044	0.0026	1.6	0.78	
17	170	0.0060	0.0108	0.1368	0.0000	0.0000	0.0307	0.0056	0.0034	2.0	0.92	
18	180	0.0060	0.0108	0.1476	0.0000	0.0000	0.0367	0.0060	0.0036	2.2	1.08	
19	190	0.0060	0.0108	0.1584	0.0000	0.0000	0.0430	0.0063	0.0038	2.3	1.23	
20	200	0.0060	0.0108	0.1692	0.0000	0.0000	0.0496	0.0066	0.0040	2.4	1.38	
21	210	0.0060	0.0108	0.1800	0.0000	0.0000	0.0564	0.0069	0.0041	2.5	1.52	
22	220	0.0060	0.0108	0.1908	0.0000	0.0000	0.0635	0.0071	0.0043	2.6	1.66	
23	230	0.0070	0.0126	0.2034	0.0000	0.0000	0.0721	0.0086	0.0051	3.1	1.82	
24	240	0.0070	0.0126	0.2160	0.0000	0.0000	0.0809	0.0088	0.0053	3.2	1.99	
25	250	0.0070	0.0126	0.2286	0.0000	0.0000	0.0900	0.0091	0.0054	3.3	2.16	
26	260	0.0070	0.0126	0.2412	0.0000	0.0000	0.0993	0.0093	0.0056	3.4	2.32	
27	270	0.0070	0.0126	0.2538	0.0000	0.0000	0.1088	0.0095	0.0057	3.4	2.46	
28	280	0.0070	0.0126	0.2664	0.0000	0.0000	0.1184	0.0097	0.0058	3.5	2.60	
29	290	0.0082	0.0148	0.2812	0.0000	0.0000	0.1300	0.0115	0.0069	4.2	2.77	
30	300	0.0082	0.0148	0.2959	0.0000	0.0000	0.1417	0.0117	0.0070	4.2	2.96	
31	310	0.0082	0.0148	0.3107	0.0000	0.0000	0.1537	0.0119	0.0072	4.3	3.14	
32	320	0.0082	0.0148	0.3254	0.0000	0.0000	0.1658	0.0121	0.0073	4.4	3.30	
33	330	0.0082	0.0148	0.3402	0.0000	0.0000	0.1780	0.0123	0.0074	4.4	3.45	
34	340	0.0082	0.0148	0.3550	0.0000	0.0000	0.1904	0.0124	0.0074	4.5	3.59	
35	350	0.0095	0.0171	0.3721	0.0000	0.0000	0.2050	0.0145	0.0087	5.3	3.76	
36	360	0.0095	0.0171	0.3892	0.0000	0.0000	0.2197	0.0147	0.0088	5.3	3.96	
37	370	0.0095	0.0171	0.4063	0.0000	0.0000	0.2345	0.0148	0.0089	5.4	4.15	
38	380	0.0095	0.0171	0.4234	0.0000	0.0000	0.2495	0.0150	0.0090	5.4	4.32	
39	390	0.0095	0.0171	0.4405	0.0000	0.0000	0.2645	0.0151	0.0091	5.5	4.47	
40	400	0.0095	0.0171	0.4576	0.0000	0.0000	0.2797	0.0152	0.0091	5.5	4.60	
41	410	0.0134	0.0241	0.4817	0.0001	0.0001	0.3014	0.0216	0.0130	7.8	4.88	
42	420	0.0134	0.0241	0.5058	0.0006	0.0005	0.3232	0.0218	0.0133	8.0	5.29	
43	430	0.0134	0.0241	0.5299	0.0015	0.0010	0.3451	0.0220	0.0136	8.2	5.67	
44	440	0.0180	0.0324	0.5623	0.0036	0.0020	0.3748	0.0297	0.0186	11.2	6.21	
45	450	0.0180	0.0324	0.5947	0.0064	0.0028	0.4048	0.0299	0.0191	11.5	6.91	
46	460	0.0340	0.0612	0.6559	0.0138	0.0074	0.4619	0.0571	0.0372	22.4	8.26	
47	470	0.0540	0.0972	0.7531	0.0307	0.0169	0.5537	0.0918	0.0618	37.3	11.18	
48	480	0.0270	0.0486	0.8017	0.0413	0.0106	0.6000	0.0463	0.0320	19.3	13.48	Q peak
49	490	0.0180	0.0324	0.8341	0.0491	0.0078	0.6310	0.0310	0.0217	13.1	13.85	
50	500	0.0134	0.0241	0.8582	0.0554	0.0062	0.6541	0.0231	0.0164	9.9	13.53	
51	510	0.0134	0.0241	0.8824	0.0619	0.0065	0.6773	0.0232	0.0165	10.0	13.04	
52	520	0.0134	0.0241	0.9065	0.0687	0.0068	0.7005	0.0232	0.0167	10.0	12.63	
53	530	0.0088	0.0158	0.9223	0.0734	0.0047	0.7158	0.0153	0.0110	6.6	12.05	
54	540	0.0088	0.0158	0.9382	0.0782	0.0048	0.7311	0.0153	0.0111	6.7	11.32	
55	550	0.0088	0.0158	0.9540	0.0831	0.0049	0.7464	0.0153	0.0111	6.7	10.70	
56	560	0.0088	0.0158	0.9698	0.0881	0.0050	0.7617	0.0153	0.0112	6.7	10.16	
57	570	0.0088	0.0158	0.9857	0.0932	0.0051	0.7770	0.0153	0.0113	6.8	9.71	
58	580	0.0088	0.0158	1.0015	0.0985	0.0053	0.7924	0.0153	0.0113	6.8	9.31	
59	590	0.0088	0.0158	1.0174	0.1039	0.0054	0.8077	0.0154	0.0114	6.8	8.98	
60	600	0.0088	0.0158	1.0332	0.1093	0.0055	0.8231	0.0154	0.0114	6.9	8.69	
61	610	0.0088	0.0158	1.0490	0.1149	0.0056	0.8385	0.0154	0.0115	6.9	8.45	
62	620	0.0088	0.0158	1.0649	0.1207	0.0057	0.8539	0.0154	0.0115	6.9	8.24	
63	630	0.0088	0.0158	1.0807	0.1265	0.0058	0.8693	0.0154	0.0116	7.0	8.07	
64	640	0.0088	0.0158	1.0966	0.1324	0.0059	0.8847	0.0154	0.0116	7.0	7.92	
65	650	0.0072	0.0130	1.1095	0.1373	0.0049	0.8973	0.0126	0.0095	5.8	7.72	
66	660	0.0072	0.0130	1.1225	0.1423	0.0050	0.9100	0.0126	0.0096	5.8	7.45	
67	670	0.0072	0.0130	1.1354	0.1474	0.0051	0.9226	0.0126	0.0096	5.8	7.23	

SANTA BARBARA URBAN HYDROGRAPH (SBUH) METHOD
RUNOFF VOLUME CALCULATION

					Pervious Area		Impervious Area				
(1) Time Increment	(2) Time min.	(3) Rainfall distri-bution % of Pt	(4) Incre-mental Rainfall in.	(5) Accumu-lated Rainfall in.	(6) Accumu-lated Runoff in.	(7) Incre-mental Runoff in.	(8) Accumu-lated Runoff in.	(9) Incre-mental Runoff in.	(10) Total Runoff in.	(11) Instant hydro-graph cfs	(12) design hydro-graph cfs
68	680	0.0072	0.0130	1.1484	0.1525	0.0051	0.9353	0.0126	0.0096	5.8	7.03
69	690	0.0072	0.0130	1.1614	0.1577	0.0052	0.9479	0.0126	0.0097	5.8	6.87
70	700	0.0072	0.0130	1.1743	0.1630	0.0053	0.9606	0.0127	0.0097	5.8	6.73
71	710	0.0072	0.0130	1.1873	0.1683	0.0053	0.9732	0.0127	0.0097	5.9	6.61
72	720	0.0072	0.0130	1.2002	0.1737	0.0054	0.9859	0.0127	0.0098	5.9	6.51
73	730	0.0072	0.0130	1.2132	0.1792	0.0055	0.9986	0.0127	0.0098	5.9	6.43
74	740	0.0072	0.0130	1.2262	0.1847	0.0055	1.0112	0.0127	0.0098	5.9	6.36
75	750	0.0072	0.0130	1.2391	0.1903	0.0056	1.0239	0.0127	0.0098	5.9	6.30
76	760	0.0072	0.0130	1.2521	0.1959	0.0056	1.0366	0.0127	0.0099	5.9	6.25
77	770	0.0057	0.0103	1.2623	0.2004	0.0045	1.0467	0.0100	0.0078	4.7	6.13
78	780	0.0057	0.0103	1.2726	0.2050	0.0045	1.0567	0.0101	0.0079	4.7	5.94
79	790	0.0057	0.0103	1.2829	0.2096	0.0046	1.0668	0.0101	0.0079	4.7	5.77
80	800	0.0057	0.0103	1.2931	0.2142	0.0046	1.0768	0.0101	0.0079	4.7	5.64
81	810	0.0057	0.0103	1.3034	0.2189	0.0047	1.0869	0.0101	0.0079	4.8	5.52
82	820	0.0057	0.0103	1.3136	0.2236	0.0047	1.0969	0.0101	0.0079	4.8	5.42
83	830	0.0057	0.0103	1.3239	0.2283	0.0047	1.1070	0.0101	0.0079	4.8	5.33
84	840	0.0057	0.0103	1.3342	0.2331	0.0048	1.1171	0.0101	0.0079	4.8	5.26
85	850	0.0057	0.0103	1.3444	0.2379	0.0048	1.1271	0.0101	0.0080	4.8	5.19
86	860	0.0057	0.0103	1.3547	0.2427	0.0048	1.1372	0.0101	0.0080	4.8	5.14
87	870	0.0057	0.0103	1.3649	0.2476	0.0049	1.1473	0.0101	0.0080	4.8	5.10
88	880	0.0057	0.0103	1.3752	0.2525	0.0049	1.1574	0.0101	0.0080	4.8	5.06
89	890	0.0050	0.0090	1.3842	0.2568	0.0043	1.1662	0.0088	0.0070	4.2	4.99
90	900	0.0050	0.0090	1.3932	0.2612	0.0044	1.1751	0.0088	0.0070	4.2	4.89
91	910	0.0050	0.0090	1.4022	0.2655	0.0044	1.1839	0.0088	0.0071	4.3	4.80
92	920	0.0050	0.0090	1.4112	0.2699	0.0044	1.1928	0.0088	0.0071	4.3	4.73
93	930	0.0050	0.0090	1.4202	0.2744	0.0044	1.2016	0.0088	0.0071	4.3	4.67
94	940	0.0050	0.0090	1.4292	0.2788	0.0045	1.2105	0.0089	0.0071	4.3	4.61
95	950	0.0050	0.0090	1.4382	0.2833	0.0045	1.2193	0.0089	0.0071	4.3	4.57
96	960	0.0050	0.0090	1.4472	0.2878	0.0045	1.2282	0.0089	0.0071	4.3	4.53
97	970	0.0050	0.0090	1.4562	0.2923	0.0045	1.2370	0.0089	0.0071	4.3	4.50
98	980	0.0050	0.0090	1.4652	0.2969	0.0046	1.2459	0.0089	0.0071	4.3	4.47
99	990	0.0050	0.0090	1.4742	0.3015	0.0046	1.2547	0.0089	0.0071	4.3	4.45
100	1000	0.0050	0.0090	1.4832	0.3061	0.0046	1.2636	0.0089	0.0072	4.3	4.43
101	1010	0.0040	0.0072	1.4904	0.3098	0.0037	1.2707	0.0071	0.0057	3.5	4.35
102	1020	0.0040	0.0072	1.4976	0.3135	0.0037	1.2778	0.0071	0.0057	3.5	4.23
103	1030	0.0040	0.0072	1.5048	0.3172	0.0037	1.2849	0.0071	0.0057	3.5	4.13
104	1040	0.0040	0.0072	1.5120	0.3210	0.0037	1.2920	0.0071	0.0058	3.5	4.04
105	1050	0.0040	0.0072	1.5192	0.3247	0.0038	1.2991	0.0071	0.0058	3.5	3.96
106	1060	0.0040	0.0072	1.5264	0.3285	0.0038	1.3062	0.0071	0.0058	3.5	3.90
107	1070	0.0040	0.0072	1.5336	0.3323	0.0038	1.3132	0.0071	0.0058	3.5	3.84
108	1080	0.0040	0.0072	1.5408	0.3361	0.0038	1.3203	0.0071	0.0058	3.5	3.79
109	1090	0.0040	0.0072	1.5480	0.3399	0.0038	1.3274	0.0071	0.0058	3.5	3.75
110	1100	0.0040	0.0072	1.5552	0.3437	0.0038	1.3345	0.0071	0.0058	3.5	3.71
111	1110	0.0040	0.0072	1.5624	0.3476	0.0038	1.3416	0.0071	0.0058	3.5	3.68
112	1120	0.0040	0.0072	1.5696	0.3514	0.0039	1.3487	0.0071	0.0058	3.5	3.66
113	1130	0.0040	0.0072	1.5768	0.3553	0.0039	1.3558	0.0071	0.0058	3.5	3.64
114	1140	0.0040	0.0072	1.5840	0.3592	0.0039	1.3629	0.0071	0.0058	3.5	3.62
115	1150	0.0040	0.0072	1.5912	0.3631	0.0039	1.3700	0.0071	0.0058	3.5	3.60
116	1160	0.0040	0.0072	1.5984	0.3670	0.0039	1.3771	0.0071	0.0058	3.5	3.59
117	1170	0.0040	0.0072	1.6056	0.3709	0.0039	1.3842	0.0071	0.0058	3.5	3.58
118	1180	0.0040	0.0072	1.6128	0.3748	0.0039	1.3914	0.0071	0.0058	3.5	3.57
119	1190	0.0040	0.0072	1.6200	0.3788	0.0040	1.3985	0.0071	0.0058	3.5	3.56
120	1200	0.0040	0.0072	1.6272	0.3828	0.0040	1.4056	0.0071	0.0059	3.5	3.56
121	1210	0.0040	0.0072	1.6344	0.3867	0.0040	1.4127	0.0071	0.0059	3.5	3.55
122	1220	0.0040	0.0072	1.6416	0.3907	0.0040	1.4198	0.0071	0.0059	3.5	3.55
123	1230	0.0040	0.0072	1.6488	0.3947	0.0040	1.4269	0.0071	0.0059	3.5	3.55
124	1240	0.0040	0.0072	1.6560	0.3988	0.0040	1.4340	0.0071	0.0059	3.5	3.55
125	1250	0.0040	0.0072	1.6632	0.4028	0.0040	1.4411	0.0071	0.0059	3.5	3.55
126	1260	0.0040	0.0072	1.6704	0.4068	0.0040	1.4482	0.0071	0.0059	3.5	3.55
127	1270	0.0040	0.0072	1.6776	0.4109	0.0041	1.4553	0.0071	0.0059	3.5	3.55
128	1280	0.0040	0.0072	1.6848	0.4150	0.0041	1.4624	0.0071	0.0059	3.6	3.55
129	1290	0.0040	0.0072	1.6920	0.4190	0.0041	1.4696	0.0071	0.0059	3.6	3.55
130	1300	0.0040	0.0072	1.6992	0.4231	0.0041	1.4767	0.0071	0.0059	3.6	3.55
131	1310	0.0040	0.0072	1.7064	0.4273	0.0041	1.4838	0.0071	0.0059	3.6	3.55
132	1320	0.0040	0.0072	1.7136	0.4314	0.0041	1.4909	0.0071	0.0059	3.6	3.55
133	1330	0.0040	0.0072	1.7208	0.4355	0.0041	1.4980	0.0071	0.0059	3.6	3.55
134	1340	0.0040	0.0072	1.7280	0.4397	0.0041	1.5051	0.0071	0.0059	3.6	3.56
135	1350	0.0040	0.0072	1.7352	0.4438	0.0042	1.5122	0.0071	0.0059	3.6	3.56
136	1360	0.0040	0.0072	1.7424	0.4480	0.0042	1.5194	0.0071	0.0059	3.6	3.56
137	1370	0.0040	0.0072	1.7496	0.4522	0.0042	1.5265	0.0071	0.0059	3.6	3.56
138	1380	0.0040	0.0072	1.7568	0.4564	0.0042	1.5336	0.0071	0.0059	3.6	3.57
139	1390	0.0040	0.0072	1.7640	0.4606	0.0042	1.5407	0.0071	0.0060	3.6	3.57
140	1400	0.0040	0.0072	1.7712	0.4648	0.0042	1.5478	0.0071	0.0060	3.6	3.57
141	1410	0.0040	0.0072	1.7784	0.4690	0.0042	1.5550	0.0071	0.0060	3.6	3.57
142	1420	0.0040	0.0072	1.7856	0.4732	0.0042	1.5621	0.0071	0.0060	3.6	3.58
143	1430	0.0040	0.0072	1.7928	0.4775	0.0043	1.5692	0.0071	0.0060	3.6	3.58
144	1440	0.0040	0.0072	1.8000	0.4818	0.0043	1.5763	0.0071	0.0060	3.6	3.58

Total Volume of Runoff[1] = 396,704 cu. ft.

Notes:

1. Total Runoff Volume is found by summing column (12) and multiplying by the time step, dt as follows:

   V = SumQ x dt
   V(cu.ft.) = SumQ(cu.ft/s) x dt(min.) x (60 s/min.)

SANTA BARBARA URBAN HYDROGRAPH (SBUH) METHOD
RUNOFF VOLUME CALCULATION

Project: City of Arlington - Edgecomb
Basin: West
Storm Event: 10-YEAR, 24-HOUR
Given:

Area = 99.59 acres
Pt = 2.75 inches
dt = 10 min.
Tc = 69.1 min.

PERVIOUS AREA (Interim Final Cover Area)			IMPERVIOUS AREA (Roads)		
Area =	39.84	acres	Area =	59.75	acres
CN =	81		CN =	98	
S =	2.35		S =	0.20	
0.2S =	0.47		0.2S =	0.04	

SUMMARY
T_{pk} (hrs) = 7.83
Tc (min) = 69.1
Q_{pk} (cfs) = 24.44
Vol (cf) = 684,575

Compute: Runoff Hydrograph

Column (3) = SCS Type IA Rainfall Distribution
Column (4) = Col. (3) x Pt
Column (5) = Accumulated Sum of Col. (4)
Column (6) = [If P <= 0.2S] = 0; Note, use PERVIOUS Area "S" value.
[If P > 0.2S] = (Col.(5) - 0.2S)^2/(Col.(5) + 0.8S); Using the PERVIOUS Area "S" value.
Column (7) = Col.(6) of Present Time Step - Col.(6) of Previous Time Step
Column (8) = Same method as for Col.(6), except use the IMPERVIOUS Area "S" value.
Column (9) = Col.(8) of the present time step - Col.(8) of the previous time step.
Column (10) = ((PERVIOUS area / Total area) x Col.(7)) + ((IMPERVIOUS area / Total area) x Col.(9))
Column (11) = (60.5 x Col.(10) x Total Area) / 10 (dt = 10 minutes)
Routing Constant, w = dt / (2Tc + dt) = 0.0675
Column (12) = Col.(12) of Previous Time Step + (w x [Col.(11) of Previous Time Step
+ Col.(11) of Present Time Step - (2 x Col.(12) of Previous Time Step)])

					Pervious Area		Impervious Area					
(1) Time Increment	(2) Time	(3) Rainfall distri-bution	(4) Incre-mental Rainfall	(5) Accumu-lated Rainfall	(6) Accumu-lated Runoff	(7) Incre-mental Runoff	(8) Accumu-lated Runoff	(9) Incre-mental Runoff	(10) Total Runoff	(11) Instant hydro-graph	(12) design hydro-graph	
	min.	% of Pt	in.	in.	in.	in.	in.	in.	in.	cfs	cfs	
1	10	0.0040	0.0110	0.0110	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.00	
2	20	0.0040	0.0110	0.0220	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.00	
3	30	0.0040	0.0110	0.0330	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.00	
4	40	0.0040	0.0110	0.0440	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.00	
5	50	0.0040	0.0110	0.0550	0.0000	0.0000	0.0009	0.0009	0.0005	0.3	0.02	
6	60	0.0040	0.0110	0.0660	0.0000	0.0000	0.0028	0.0018	0.0011	0.7	0.09	
7	70	0.0040	0.0110	0.0770	0.0000	0.0000	0.0054	0.0027	0.0016	1.0	0.19	
8	80	0.0040	0.0110	0.0880	0.0000	0.0000	0.0089	0.0034	0.0020	1.2	0.31	
9	90	0.0040	0.0110	0.0990	0.0000	0.0000	0.0129	0.0040	0.0024	1.5	0.45	
10	100	0.0040	0.0110	0.1100	0.0000	0.0000	0.0175	0.0046	0.0028	1.7	0.60	
11	110	0.0050	0.0138	0.1238	0.0000	0.0000	0.0240	0.0064	0.0039	2.3	0.79	
12	120	0.0050	0.0138	0.1375	0.0000	0.0000	0.0311	0.0071	0.0043	2.6	1.01	
13	130	0.0050	0.0138	0.1513	0.0000	0.0000	0.0388	0.0077	0.0046	2.8	1.24	
14	140	0.0050	0.0138	0.1650	0.0000	0.0000	0.0470	0.0082	0.0049	3.0	1.46	
15	150	0.0050	0.0138	0.1788	0.0000	0.0000	0.0556	0.0086	0.0052	3.1	1.67	
16	160	0.0050	0.0138	0.1925	0.0000	0.0000	0.0647	0.0090	0.0054	3.3	1.88	
17	170	0.0060	0.0165	0.2090	0.0000	0.0000	0.0760	0.0113	0.0068	4.1	2.12	
18	180	0.0060	0.0165	0.2255	0.0000	0.0000	0.0877	0.0118	0.0071	4.2	2.40	
19	190	0.0060	0.0165	0.2420	0.0000	0.0000	0.0999	0.0121	0.0073	4.4	2.66	
20	200	0.0060	0.0165	0.2585	0.0000	0.0000	0.1124	0.0125	0.0075	4.5	2.90	
21	210	0.0060	0.0165	0.2750	0.0000	0.0000	0.1251	0.0128	0.0077	4.6	3.12	
22	220	0.0060	0.0165	0.2915	0.0000	0.0000	0.1382	0.0131	0.0078	4.7	3.33	
23	230	0.0070	0.0193	0.3108	0.0000	0.0000	0.1537	0.0155	0.0093	5.6	3.58	
24	240	0.0070	0.0193	0.3300	0.0000	0.0000	0.1695	0.0158	0.0095	5.7	3.86	
25	250	0.0070	0.0193	0.3493	0.0000	0.0000	0.1856	0.0161	0.0096	5.8	4.12	
26	260	0.0070	0.0193	0.3685	0.0000	0.0000	0.2019	0.0163	0.0098	5.9	4.35	
27	270	0.0070	0.0193	0.3878	0.0000	0.0000	0.2184	0.0165	0.0099	6.0	4.57	
28	280	0.0070	0.0193	0.4070	0.0000	0.0000	0.2351	0.0167	0.0100	6.0	4.76	
29	290	0.0082	0.0226	0.4296	0.0000	0.0000	0.2549	0.0198	0.0119	7.1	5.01	
30	300	0.0082	0.0226	0.4521	0.0000	0.0000	0.2749	0.0200	0.0120	7.2	5.30	
31	310	0.0082	0.0226	0.4747	0.0000	0.0000	0.2950	0.0202	0.0121	7.3	5.56	
32	320	0.0082	0.0226	0.4972	0.0003	0.0003	0.3154	0.0203	0.0123	7.4	5.81	
33	330	0.0082	0.0226	0.5198	0.0011	0.0007	0.3358	0.0205	0.0126	7.6	6.03	
34	340	0.0082	0.0226	0.5423	0.0022	0.0011	0.3564	0.0206	0.0128	7.7	6.25	
35	350	0.0095	0.0261	0.5684	0.0040	0.0018	0.3804	0.0240	0.0151	9.1	6.55	
36	360	0.0095	0.0261	0.5946	0.0064	0.0023	0.4046	0.0242	0.0154	9.3	6.90	
37	370	0.0095	0.0261	0.6207	0.0092	0.0028	0.4289	0.0243	0.0157	9.5	7.24	
38	380	0.0095	0.0261	0.6468	0.0125	0.0033	0.4533	0.0244	0.0160	9.6	7.55	
39	390	0.0095	0.0261	0.6729	0.0163	0.0038	0.4778	0.0245	0.0162	9.8	7.84	
40	400	0.0095	0.0261	0.6991	0.0205	0.0042	0.5025	0.0246	0.0165	9.9	8.11	
41	410	0.0134	0.0369	0.7359	0.0272	0.0067	0.5373	0.0349	0.0236	14.2	8.65	
42	420	0.0134	0.0369	0.7728	0.0348	0.0076	0.5723	0.0350	0.0240	14.5	9.42	
43	430	0.0134	0.0369	0.8096	0.0432	0.0084	0.6075	0.0352	0.0244	14.7	10.12	
44	440	0.0180	0.0495	0.8591	0.0556	0.0124	0.6549	0.0474	0.0334	20.1	11.10	
45	450	0.0180	0.0495	0.9086	0.0693	0.0138	0.7026	0.0476	0.0341	20.5	12.35	
46	460	0.0340	0.0935	1.0021	0.0987	0.0293	0.7929	0.0904	0.0660	39.7	14.75	
47	470	0.0540	0.1485	1.1506	0.1534	0.0547	0.9374	0.1445	0.1086	65.4	19.85	
48	480	0.0270	0.0743	1.2249	0.1841	0.0307	1.0100	0.0726	0.0558	33.6	23.86	Q peak
49	490	0.0180	0.0495	1.2744	0.2058	0.0216	1.0584	0.0485	0.0377	22.7	24.44	
50	500	0.0134	0.0369	1.3112	0.2224	0.0167	1.0945	0.0361	0.0283	17.1	23.83	
51	510	0.0134	0.0369	1.3481	0.2396	0.0171	1.1307	0.0362	0.0285	17.2	22.93	
52	520	0.0134	0.0369	1.3849	0.2571	0.0176	1.1669	0.0362	0.0287	17.3	22.16	
53	530	0.0088	0.0242	1.4091	0.2689	0.0118	1.1907	0.0238	0.0190	11.4	21.11	
54	540	0.0088	0.0242	1.4333	0.2809	0.0120	1.2145	0.0238	0.0191	11.5	19.81	
55	550	0.0088	0.0242	1.4575	0.2930	0.0121	1.2383	0.0238	0.0191	11.5	18.69	
56	560	0.0088	0.0242	1.4817	0.3053	0.0123	1.2621	0.0238	0.0192	11.6	17.73	
57	570	0.0088	0.0242	1.5059	0.3178	0.0125	1.2860	0.0238	0.0193	11.6	16.90	
58	580	0.0088	0.0242	1.5301	0.3304	0.0126	1.3098	0.0238	0.0194	11.7	16.19	
59	590	0.0088	0.0242	1.5543	0.3432	0.0128	1.3337	0.0239	0.0194	11.7	15.58	
60	600	0.0088	0.0242	1.5785	0.3562	0.0130	1.3575	0.0239	0.0195	11.8	15.06	
61	610	0.0088	0.0242	1.6027	0.3693	0.0131	1.3814	0.0239	0.0196	11.8	14.62	
62	620	0.0088	0.0242	1.6269	0.3826	0.0133	1.4053	0.0239	0.0196	11.8	14.24	
63	630	0.0088	0.0242	1.6511	0.3960	0.0134	1.4292	0.0239	0.0197	11.9	13.92	
64	640	0.0088	0.0242	1.6753	0.4096	0.0136	1.4531	0.0239	0.0198	11.9	13.64	
65	650	0.0072	0.0198	1.6951	0.4208	0.0112	1.4726	0.0196	0.0162	9.8	13.27	
66	660	0.0072	0.0198	1.7149	0.4321	0.0113	1.4922	0.0196	0.0163	9.8	12.80	
67	670	0.0072	0.0198	1.7347	0.4435	0.0114	1.5117	0.0196	0.0163	9.8	12.39	

SANTA BARBARA URBAN HYDROGRAPH (SBUH) METHOD
RUNOFF VOLUME CALCULATION

					Pervious Area		Impervious Area				
(1) Time Increment	(2) Time min.	(3) Rainfall distri-bution % of Pt	(4) Incre-mental Rainfall in.	(5) Accumu-lated Rainfall in.	(6) Accumu-lated Runoff in.	(7) Incre-mental Runoff in.	(8) Accumu-lated Runoff in.	(9) Incre-mental Runoff in.	(10) Total Runoff in.	(11) Instant hydro-graph cfs	(12) design hydro-graph cfs
68	680	0.0072	0.0198	1.7545	0.4550	0.0115	1.5313	0.0196	0.0163	9.8	12.05
69	690	0.0072	0.0198	1.7743	0.4666	0.0116	1.5509	0.0196	0.0164	9.9	11.75
70	700	0.0072	0.0198	1.7941	0.4783	0.0117	1.5705	0.0196	0.0164	9.9	11.50
71	710	0.0072	0.0198	1.8139	0.4900	0.0118	1.5901	0.0196	0.0165	9.9	11.28
72	720	0.0072	0.0198	1.8337	0.5019	0.0118	1.6097	0.0196	0.0165	9.9	11.10
73	730	0.0072	0.0198	1.8535	0.5138	0.0119	1.6293	0.0196	0.0165	10.0	10.95
74	740	0.0072	0.0198	1.8733	0.5258	0.0120	1.6489	0.0196	0.0166	10.0	10.81
75	750	0.0072	0.0198	1.8931	0.5379	0.0121	1.6685	0.0196	0.0166	10.0	10.70
76	760	0.0072	0.0198	1.9129	0.5501	0.0122	1.6881	0.0196	0.0166	10.0	10.61
77	770	0.0057	0.0157	1.9286	0.5598	0.0097	1.7036	0.0155	0.0132	7.9	10.39
78	780	0.0057	0.0157	1.9443	0.5695	0.0097	1.7191	0.0155	0.0132	8.0	10.06
79	790	0.0057	0.0157	1.9599	0.5793	0.0098	1.7346	0.0155	0.0132	8.0	9.78
80	800	0.0057	0.0157	1.9756	0.5891	0.0098	1.7502	0.0155	0.0133	8.0	9.54
81	810	0.0057	0.0157	1.9913	0.5990	0.0099	1.7657	0.0155	0.0133	8.0	9.33
82	820	0.0057	0.0157	2.0070	0.6090	0.0099	1.7812	0.0155	0.0133	8.0	9.15
83	830	0.0057	0.0157	2.0226	0.6189	0.0100	1.7968	0.0155	0.0133	8.0	9.00
84	840	0.0057	0.0157	2.0383	0.6290	0.0100	1.8123	0.0155	0.0133	8.0	8.87
85	850	0.0057	0.0157	2.0540	0.6390	0.0101	1.8279	0.0155	0.0134	8.0	8.75
86	860	0.0057	0.0157	2.0697	0.6491	0.0101	1.8434	0.0155	0.0134	8.1	8.66
87	870	0.0057	0.0157	2.0853	0.6593	0.0102	1.8589	0.0155	0.0134	8.1	8.58
88	880	0.0057	0.0157	2.1010	0.6695	0.0102	1.8745	0.0155	0.0134	8.1	8.51
89	890	0.0050	0.0138	2.1148	0.6785	0.0090	1.8881	0.0136	0.0118	7.1	8.39
90	900	0.0050	0.0138	2.1285	0.6875	0.0090	1.9018	0.0136	0.0118	7.1	8.21
91	910	0.0050	0.0138	2.1423	0.6966	0.0090	1.9154	0.0136	0.0118	7.1	8.06
92	920	0.0050	0.0138	2.1560	0.7056	0.0091	1.9291	0.0136	0.0118	7.1	7.94
93	930	0.0050	0.0138	2.1698	0.7148	0.0091	1.9427	0.0136	0.0118	7.1	7.83
94	940	0.0050	0.0138	2.1835	0.7239	0.0091	1.9563	0.0136	0.0118	7.1	7.73
95	950	0.0050	0.0138	2.1973	0.7331	0.0092	1.9700	0.0136	0.0119	7.1	7.65
96	960	0.0050	0.0138	2.2110	0.7423	0.0092	1.9836	0.0136	0.0119	7.2	7.58
97	970	0.0050	0.0138	2.2248	0.7515	0.0092	1.9973	0.0136	0.0119	7.2	7.53
98	980	0.0050	0.0138	2.2385	0.7608	0.0093	2.0109	0.0137	0.0119	7.2	7.48
99	990	0.0050	0.0138	2.2523	0.7701	0.0093	2.0246	0.0137	0.0119	7.2	7.44
100	1000	0.0050	0.0138	2.2660	0.7794	0.0093	2.0382	0.0137	0.0119	7.2	7.40
101	1010	0.0040	0.0110	2.2770	0.7869	0.0075	2.0492	0.0109	0.0095	5.8	7.28
102	1020	0.0040	0.0110	2.2880	0.7944	0.0075	2.0601	0.0109	0.0096	5.8	7.07
103	1030	0.0040	0.0110	2.2990	0.8019	0.0075	2.0710	0.0109	0.0096	5.8	6.89
104	1040	0.0040	0.0110	2.3100	0.8094	0.0075	2.0819	0.0109	0.0096	5.8	6.74
105	1050	0.0040	0.0110	2.3210	0.8170	0.0076	2.0929	0.0109	0.0096	5.8	6.61
106	1060	0.0040	0.0110	2.3320	0.8246	0.0076	2.1038	0.0109	0.0096	5.8	6.50
107	1070	0.0040	0.0110	2.3430	0.8322	0.0076	2.1147	0.0109	0.0096	5.8	6.40
108	1080	0.0040	0.0110	2.3540	0.8398	0.0076	2.1256	0.0109	0.0096	5.8	6.32
109	1090	0.0040	0.0110	2.3650	0.8474	0.0076	2.1366	0.0109	0.0096	5.8	6.24
110	1100	0.0040	0.0110	2.3760	0.8550	0.0076	2.1475	0.0109	0.0096	5.8	6.18
111	1110	0.0040	0.0110	2.3870	0.8627	0.0077	2.1584	0.0109	0.0096	5.8	6.13
112	1120	0.0040	0.0110	2.3980	0.8704	0.0077	2.1694	0.0109	0.0096	5.8	6.09
113	1130	0.0040	0.0110	2.4090	0.8781	0.0077	2.1803	0.0109	0.0096	5.8	6.05
114	1140	0.0040	0.0110	2.4200	0.8858	0.0077	2.1912	0.0109	0.0096	5.8	6.02
115	1150	0.0040	0.0110	2.4310	0.8935	0.0077	2.2022	0.0109	0.0097	5.8	5.99
116	1160	0.0040	0.0110	2.4420	0.9013	0.0077	2.2131	0.0109	0.0097	5.8	5.97
117	1170	0.0040	0.0110	2.4530	0.9090	0.0078	2.2240	0.0109	0.0097	5.8	5.95
118	1180	0.0040	0.0110	2.4640	0.9168	0.0078	2.2350	0.0109	0.0097	5.8	5.93
119	1190	0.0040	0.0110	2.4750	0.9246	0.0078	2.2459	0.0109	0.0097	5.8	5.92
120	1200	0.0040	0.0110	2.4860	0.9324	0.0078	2.2568	0.0109	0.0097	5.8	5.90
121	1210	0.0040	0.0110	2.4970	0.9403	0.0078	2.2678	0.0109	0.0097	5.8	5.90
122	1220	0.0040	0.0110	2.5080	0.9481	0.0078	2.2787	0.0109	0.0097	5.8	5.89
123	1230	0.0040	0.0110	2.5190	0.9560	0.0079	2.2896	0.0109	0.0097	5.8	5.88
124	1240	0.0040	0.0110	2.5300	0.9638	0.0079	2.3006	0.0109	0.0097	5.9	5.88
125	1250	0.0040	0.0110	2.5410	0.9717	0.0079	2.3115	0.0109	0.0097	5.9	5.87
126	1260	0.0040	0.0110	2.5520	0.9796	0.0079	2.3224	0.0109	0.0097	5.9	5.87
127	1270	0.0040	0.0110	2.5630	0.9875	0.0079	2.3334	0.0109	0.0097	5.9	5.87
128	1280	0.0040	0.0110	2.5740	0.9955	0.0079	2.3443	0.0109	0.0097	5.9	5.87
129	1290	0.0040	0.0110	2.5850	1.0034	0.0080	2.3553	0.0109	0.0097	5.9	5.87
130	1300	0.0040	0.0110	2.5960	1.0114	0.0080	2.3662	0.0109	0.0098	5.9	5.87
131	1310	0.0040	0.0110	2.6070	1.0194	0.0080	2.3771	0.0109	0.0098	5.9	5.87
132	1320	0.0040	0.0110	2.6180	1.0274	0.0080	2.3881	0.0109	0.0098	5.9	5.87
133	1330	0.0040	0.0110	2.6290	1.0354	0.0080	2.3990	0.0109	0.0098	5.9	5.87
134	1340	0.0040	0.0110	2.6400	1.0434	0.0080	2.4100	0.0109	0.0098	5.9	5.88
135	1350	0.0040	0.0110	2.6510	1.0515	0.0080	2.4209	0.0109	0.0098	5.9	5.88
136	1360	0.0040	0.0110	2.6620	1.0595	0.0081	2.4318	0.0109	0.0098	5.9	5.88
137	1370	0.0040	0.0110	2.6730	1.0676	0.0081	2.4428	0.0109	0.0098	5.9	5.88
138	1380	0.0040	0.0110	2.6840	1.0757	0.0081	2.4537	0.0109	0.0098	5.9	5.89
139	1390	0.0040	0.0110	2.6950	1.0838	0.0081	2.4647	0.0109	0.0098	5.9	5.89
140	1400	0.0040	0.0110	2.7060	1.0919	0.0081	2.4756	0.0109	0.0098	5.9	5.89
141	1410	0.0040	0.0110	2.7170	1.1000	0.0081	2.4866	0.0109	0.0098	5.9	5.89
142	1420	0.0040	0.0110	2.7280	1.1081	0.0081	2.4975	0.0109	0.0098	5.9	5.90
143	1430	0.0040	0.0110	2.7390	1.1163	0.0082	2.5085	0.0109	0.0098	5.9	5.90
144	1440	0.0040	0.0110	2.7500	1.1245	0.0082	2.5194	0.0109	0.0098	5.9	5.90

Total Volume of Runoff[1] = 684,575 cu. ft.

Notes:

1. Total Runoff Volume is found by summing column (12) and multiplying by the time step, dt as follows:

   V = SumQ x dt
   V(cu.ft.) = SumQ(cu.ft/s) x dt(min.) x (60 s/min.)

SANTA BARBARA URBAN HYDROGRAPH (SBUH) METHOD
RUNOFF VOLUME CALCULATION

Project: City of Arlington - Edgecomb
Basin: West
Storm Event: 25-YEAR, 24-HOUR
Given:

Area = 99.59 acres
Pt = 3.20 inches
dt = 10 min.
Tc = 69.1 min.

PERVIOUS AREA (Interim Final Cover Area)		IMPERVIOUS AREA (Roads)	
Area =	39.84 acres	Area =	59.75 acres
CN =	81	CN =	98
S =	2.35	S =	0.20
0.2S =	0.47	0.2S =	0.04

SUMMARY
T_{pk} (hrs) = 7.83
T_c (min) = 69.1
Q_{pk} (cfs) = 29.75
Vol (cf) = 826,993

Compute: Runoff Hydrograph

Column (3) = SCS Type IA Rainfall Distribution
Column (4) = Col. (3) x Pt
Column (5) = Accumulated Sum of Col. (4)
Column (6) = [If P <= 0.2S] = 0; Note, use PERVIOUS Area "S" value.
[If P > 0.2S] = (Col.(5) - 0.2S)^2/(Col.(5) + 0.8S); Using the PERVIOUS Area "S" value.
Column (7) = Col.(6) of Present Time Step - Col.(6) of Previous Time Step
Column (8) = Same method as for Col.(6), except use the IMPERVIOUS Area "S" value.
Column (9) = Col.(8) of the present time step - Col.(8) of the previous time step.
Column (10) = ((PERVIOUS area / Total area) x Col.(7)) + ((IMPERVIOUS area / Total area) x Col.(9))
Column (11) = (60.5 x Col.(10) x Total Area) / 10 (dt = 10 minutes)
Routing Constant, w = dt / (2Tc + dt) = 0.0675
Column (12) = Col.(12) of Previous Time Step + (w x [Col.(11) of Previous Time Step + Col.(11) of Present Time Step - (2 x Col.(12) of Previous Time Step)])

					Pervious Area		Impervious Area					
(1) Time Increment	(2) Time	(3) Rainfall distri-bution	(4) Incre-mental Rainfall	(5) Accumu-lated Rainfall	(6) Accumu-lated Runoff	(7) Incre-mental Runoff	(8) Accumu-lated Runoff	(9) Incre-mental Runoff	(10) Total Runoff	(11) Instant hydro-graph	(12) design hydro-graph	
	min.	% of Pt	in.	in.	in.	in.	in.	in.	in.	cfs	cfs	
1	10	0.0040	0.0128	0.0128	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.00	
2	20	0.0040	0.0128	0.0256	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.00	
3	30	0.0040	0.0128	0.0384	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.00	
4	40	0.0040	0.0128	0.0512	0.0000	0.0000	0.0005	0.0005	0.0003	0.2	0.01	
5	50	0.0040	0.0128	0.0640	0.0000	0.0000	0.0024	0.0019	0.0011	0.7	0.07	
6	60	0.0040	0.0128	0.0768	0.0000	0.0000	0.0054	0.0030	0.0018	1.1	0.18	
7	70	0.0040	0.0128	0.0896	0.0000	0.0000	0.0094	0.0040	0.0024	1.5	0.33	
8	80	0.0040	0.0128	0.1024	0.0000	0.0000	0.0143	0.0049	0.0029	1.8	0.50	
9	90	0.0040	0.0128	0.1152	0.0000	0.0000	0.0199	0.0056	0.0034	2.0	0.69	
10	100	0.0040	0.0128	0.1280	0.0000	0.0000	0.0261	0.0062	0.0037	2.3	0.88	
11	110	0.0050	0.0160	0.1440	0.0000	0.0000	0.0347	0.0086	0.0051	3.1	1.12	
12	120	0.0050	0.0160	0.1600	0.0000	0.0000	0.0439	0.0093	0.0056	3.4	1.41	
13	130	0.0050	0.0160	0.1760	0.0000	0.0000	0.0539	0.0099	0.0060	3.6	1.69	
14	140	0.0050	0.0160	0.1920	0.0000	0.0000	0.0643	0.0105	0.0063	3.8	1.96	
15	150	0.0050	0.0160	0.2080	0.0000	0.0000	0.0753	0.0109	0.0066	4.0	2.21	
16	160	0.0050	0.0160	0.2240	0.0000	0.0000	0.0866	0.0114	0.0068	4.1	2.46	
17	170	0.0060	0.0192	0.2432	0.0000	0.0000	0.1008	0.0141	0.0085	5.1	2.75	
18	180	0.0060	0.0192	0.2624	0.0000	0.0000	0.1153	0.0146	0.0087	5.3	3.08	
19	190	0.0060	0.0192	0.2816	0.0000	0.0000	0.1303	0.0150	0.0090	5.4	3.38	
20	200	0.0060	0.0192	0.3008	0.0000	0.0000	0.1457	0.0153	0.0092	5.5	3.67	
21	210	0.0060	0.0192	0.3200	0.0000	0.0000	0.1613	0.0156	0.0094	5.7	3.93	
22	220	0.0060	0.0192	0.3392	0.0000	0.0000	0.1772	0.0159	0.0095	5.8	4.17	
23	230	0.0070	0.0224	0.3616	0.0000	0.0000	0.1961	0.0189	0.0113	6.8	4.45	
24	240	0.0070	0.0224	0.3840	0.0000	0.0000	0.2152	0.0192	0.0115	6.9	4.78	
25	250	0.0070	0.0224	0.4064	0.0000	0.0000	0.2346	0.0194	0.0116	7.0	5.07	
26	260	0.0070	0.0224	0.4288	0.0000	0.0000	0.2542	0.0196	0.0118	7.1	5.34	
27	270	0.0070	0.0224	0.4512	0.0000	0.0000	0.2741	0.0198	0.0119	7.2	5.58	
28	280	0.0070	0.0224	0.4736	0.0000	0.0000	0.2941	0.0200	0.0120	7.2	5.80	
29	290	0.0082	0.0262	0.4998	0.0004	0.0004	0.3178	0.0237	0.0143	8.6	6.09	
30	300	0.0082	0.0262	0.5261	0.0013	0.0010	0.3416	0.0238	0.0147	8.9	6.45	
31	310	0.0082	0.0262	0.5523	0.0028	0.0015	0.3656	0.0240	0.0150	9.0	6.79	
32	320	0.0082	0.0262	0.5786	0.0049	0.0020	0.3898	0.0242	0.0153	9.2	7.10	
33	330	0.0082	0.0262	0.6048	0.0074	0.0025	0.4141	0.0243	0.0156	9.4	7.40	
34	340	0.0082	0.0262	0.6310	0.0105	0.0030	0.4386	0.0244	0.0159	9.6	7.68	
35	350	0.0095	0.0304	0.6614	0.0146	0.0041	0.4670	0.0285	0.0187	11.3	8.05	
36	360	0.0095	0.0304	0.6918	0.0193	0.0047	0.4956	0.0286	0.0191	11.5	8.50	
37	370	0.0095	0.0304	0.7222	0.0247	0.0053	0.5244	0.0287	0.0194	11.7	8.92	
38	380	0.0095	0.0304	0.7526	0.0306	0.0059	0.5532	0.0288	0.0197	11.9	9.30	
39	390	0.0095	0.0304	0.7830	0.0370	0.0065	0.5822	0.0289	0.0200	12.0	9.66	
40	400	0.0095	0.0304	0.8134	0.0441	0.0070	0.6112	0.0290	0.0202	12.2	9.99	
41	410	0.0134	0.0429	0.8563	0.0549	0.0108	0.6523	0.0411	0.0290	17.5	10.64	
42	420	0.0134	0.0429	0.8992	0.0666	0.0118	0.6935	0.0412	0.0294	17.7	11.58	
43	430	0.0134	0.0429	0.9421	0.0794	0.0127	0.7349	0.0414	0.0299	18.0	12.43	
44	440	0.0180	0.0576	0.9997	0.0979	0.0185	0.7906	0.0557	0.0408	24.6	13.63	
45	450	0.0180	0.0576	1.0573	0.1179	0.0200	0.8465	0.0559	0.0416	25.0	15.14	
46	460	0.0340	0.1088	1.1661	0.1596	0.0417	0.9525	0.1060	0.0803	48.4	18.05	
47	470	0.0540	0.1728	1.3389	0.2353	0.0756	1.1217	0.1692	0.1318	79.4	24.24	
48	480	0.0270	0.0864	1.4253	0.2769	0.0416	1.2066	0.0849	0.0676	40.7	29.07	Q peak
49	490	0.0180	0.0576	1.4829	0.3059	0.0290	1.2633	0.0567	0.0456	27.5	29.75	
50	500	0.0134	0.0429	1.5258	0.3281	0.0222	1.3055	0.0422	0.0342	20.6	28.98	
51	510	0.0134	0.0429	1.5686	0.3509	0.0228	1.3478	0.0423	0.0345	20.8	27.86	
52	520	0.0134	0.0429	1.6115	0.3741	0.0232	1.3901	0.0423	0.0347	20.9	26.91	
53	530	0.0088	0.0282	1.6397	0.3897	0.0155	1.4179	0.0278	0.0229	13.8	25.62	
54	540	0.0088	0.0282	1.6678	0.4054	0.0157	1.4457	0.0278	0.0230	13.8	24.03	
55	550	0.0088	0.0282	1.6960	0.4213	0.0159	1.4735	0.0278	0.0231	13.9	22.66	
56	560	0.0088	0.0282	1.7242	0.4374	0.0161	1.5013	0.0278	0.0231	13.9	21.48	
57	570	0.0088	0.0282	1.7523	0.4537	0.0163	1.5292	0.0278	0.0232	14.0	20.46	
58	580	0.0088	0.0282	1.7805	0.4702	0.0165	1.5570	0.0278	0.0233	14.0	19.59	
59	590	0.0088	0.0282	1.8086	0.4869	0.0167	1.5849	0.0279	0.0234	14.1	18.85	
60	600	0.0088	0.0282	1.8368	0.5037	0.0168	1.6127	0.0279	0.0235	14.1	18.21	
61	610	0.0088	0.0282	1.8650	0.5207	0.0170	1.6406	0.0279	0.0235	14.2	17.66	
62	620	0.0088	0.0282	1.8931	0.5379	0.0172	1.6685	0.0279	0.0236	14.2	17.19	
63	630	0.0088	0.0282	1.9213	0.5552	0.0173	1.6964	0.0279	0.0237	14.3	16.79	
64	640	0.0088	0.0282	1.9494	0.5727	0.0175	1.7243	0.0279	0.0237	14.3	16.45	
65	650	0.0072	0.0230	1.9725	0.5872	0.0144	1.7471	0.0228	0.0195	11.7	15.99	
66	660	0.0072	0.0230	1.9955	0.6017	0.0145	1.7699	0.0228	0.0195	11.8	15.42	
67	670	0.0072	0.0230	2.0186	0.6163	0.0146	1.7928	0.0228	0.0196	11.8	14.93	

SANTA BARBARA URBAN HYDROGRAPH (SBUH) METHOD
RUNOFF VOLUME CALCULATION

					Pervious Area		Impervious Area				
(1) Time Increment	(2) Time min.	(3) Rainfall distribution % of Pt	(4) Incremental Rainfall in.	(5) Accumulated Rainfall in.	(6) Accumulated Runoff in.	(7) Incremental Runoff in.	(8) Accumulated Runoff in.	(9) Incremental Runoff in.	(10) Total Runoff in.	(11) Instant hydrograph cfs	(12) design hydrograph cfs
68	680	0.0072	0.0230	2.0416	0.6311	0.0147	1.8156	0.0228	0.0196	11.8	14.50
69	690	0.0072	0.0230	2.0646	0.6459	0.0148	1.8384	0.0228	0.0196	11.8	14.14
70	700	0.0072	0.0230	2.0877	0.6608	0.0149	1.8613	0.0228	0.0197	11.9	13.83
71	710	0.0072	0.0230	2.1107	0.6759	0.0150	1.8841	0.0229	0.0197	11.9	13.57
72	720	0.0072	0.0230	2.1338	0.6910	0.0151	1.9070	0.0229	0.0198	11.9	13.34
73	730	0.0072	0.0230	2.1568	0.7062	0.0152	1.9299	0.0229	0.0198	11.9	13.15
74	740	0.0072	0.0230	2.1798	0.7215	0.0153	1.9527	0.0229	0.0198	12.0	12.99
75	750	0.0072	0.0230	2.2029	0.7368	0.0154	1.9756	0.0229	0.0199	12.0	12.85
76	760	0.0072	0.0230	2.2259	0.7523	0.0155	1.9985	0.0229	0.0199	12.0	12.73
77	770	0.0057	0.0182	2.2442	0.7646	0.0123	2.0166	0.0181	0.0158	9.5	12.46
78	780	0.0057	0.0182	2.2624	0.7770	0.0124	2.0347	0.0181	0.0158	9.5	12.07
79	790	0.0057	0.0182	2.2806	0.7894	0.0124	2.0528	0.0181	0.0158	9.5	11.72
80	800	0.0057	0.0182	2.2989	0.8018	0.0125	2.0709	0.0181	0.0159	9.6	11.43
81	810	0.0057	0.0182	2.3171	0.8143	0.0125	2.0890	0.0181	0.0159	9.6	11.18
82	820	0.0057	0.0182	2.3354	0.8269	0.0126	2.1071	0.0181	0.0159	9.6	10.96
83	830	0.0057	0.0182	2.3536	0.8395	0.0126	2.1253	0.0181	0.0159	9.6	10.77
84	840	0.0057	0.0182	2.3718	0.8522	0.0127	2.1434	0.0181	0.0159	9.6	10.62
85	850	0.0057	0.0182	2.3901	0.8649	0.0127	2.1615	0.0181	0.0160	9.6	10.48
86	860	0.0057	0.0182	2.4083	0.8776	0.0128	2.1796	0.0181	0.0160	9.6	10.36
87	870	0.0057	0.0182	2.4266	0.8904	0.0128	2.1977	0.0181	0.0160	9.6	10.26
88	880	0.0057	0.0182	2.4448	0.9032	0.0128	2.2159	0.0181	0.0160	9.6	10.18
89	890	0.0050	0.0160	2.4608	0.9146	0.0113	2.2318	0.0159	0.0141	8.5	10.03
90	900	0.0050	0.0160	2.4768	0.9259	0.0113	2.2477	0.0159	0.0141	8.5	9.82
91	910	0.0050	0.0160	2.4928	0.9373	0.0114	2.2636	0.0159	0.0141	8.5	9.64
92	920	0.0050	0.0160	2.5088	0.9487	0.0114	2.2795	0.0159	0.0141	8.5	9.49
93	930	0.0050	0.0160	2.5248	0.9601	0.0114	2.2954	0.0159	0.0141	8.5	9.35
94	940	0.0050	0.0160	2.5408	0.9716	0.0115	2.3113	0.0159	0.0141	8.5	9.24
95	950	0.0050	0.0160	2.5568	0.9831	0.0115	2.3272	0.0159	0.0141	8.5	9.14
96	960	0.0050	0.0160	2.5728	0.9946	0.0115	2.3431	0.0159	0.0142	8.5	9.06
97	970	0.0050	0.0160	2.5888	1.0062	0.0116	2.3590	0.0159	0.0142	8.5	8.99
98	980	0.0050	0.0160	2.6048	1.0178	0.0116	2.3749	0.0159	0.0142	8.5	8.93
99	990	0.0050	0.0160	2.6208	1.0294	0.0116	2.3909	0.0159	0.0142	8.6	8.88
100	1000	0.0050	0.0160	2.6368	1.0411	0.0117	2.4068	0.0159	0.0142	8.6	8.84
101	1010	0.0040	0.0128	2.6496	1.0504	0.0094	2.4195	0.0127	0.0114	6.9	8.68
102	1020	0.0040	0.0128	2.6624	1.0598	0.0094	2.4322	0.0127	0.0114	6.9	8.44
103	1030	0.0040	0.0128	2.6752	1.0692	0.0094	2.4450	0.0127	0.0114	6.9	8.22
104	1040	0.0040	0.0128	2.6880	1.0786	0.0094	2.4577	0.0127	0.0114	6.9	8.04
105	1050	0.0040	0.0128	2.7008	1.0880	0.0094	2.4704	0.0127	0.0114	6.9	7.88
106	1060	0.0040	0.0128	2.7136	1.0975	0.0094	2.4832	0.0127	0.0114	6.9	7.75
107	1070	0.0040	0.0128	2.7264	1.1070	0.0095	2.4959	0.0127	0.0114	6.9	7.63
108	1080	0.0040	0.0128	2.7392	1.1164	0.0095	2.5087	0.0127	0.0114	6.9	7.53
109	1090	0.0040	0.0128	2.7520	1.1259	0.0095	2.5214	0.0127	0.0114	6.9	7.45
110	1100	0.0040	0.0128	2.7648	1.1355	0.0095	2.5341	0.0127	0.0115	6.9	7.37
111	1110	0.0040	0.0128	2.7776	1.1450	0.0095	2.5469	0.0127	0.0115	6.9	7.31
112	1120	0.0040	0.0128	2.7904	1.1546	0.0096	2.5596	0.0127	0.0115	6.9	7.25
113	1130	0.0040	0.0128	2.8032	1.1641	0.0096	2.5723	0.0127	0.0115	6.9	7.21
114	1140	0.0040	0.0128	2.8160	1.1737	0.0096	2.5851	0.0127	0.0115	6.9	7.17
115	1150	0.0040	0.0128	2.8288	1.1833	0.0096	2.5978	0.0127	0.0115	6.9	7.13
116	1160	0.0040	0.0128	2.8416	1.1930	0.0096	2.6106	0.0127	0.0115	6.9	7.11
117	1170	0.0040	0.0128	2.8544	1.2026	0.0096	2.6233	0.0127	0.0115	6.9	7.08
118	1180	0.0040	0.0128	2.8672	1.2123	0.0097	2.6360	0.0127	0.0115	6.9	7.06
119	1190	0.0040	0.0128	2.8800	1.2220	0.0097	2.6488	0.0127	0.0115	6.9	7.05
120	1200	0.0040	0.0128	2.8928	1.2316	0.0097	2.6615	0.0127	0.0115	6.9	7.03
121	1210	0.0040	0.0128	2.9056	1.2414	0.0097	2.6743	0.0127	0.0115	6.9	7.02
122	1220	0.0040	0.0128	2.9184	1.2511	0.0097	2.6870	0.0127	0.0115	7.0	7.01
123	1230	0.0040	0.0128	2.9312	1.2608	0.0097	2.6998	0.0127	0.0115	7.0	7.00
124	1240	0.0040	0.0128	2.9440	1.2706	0.0098	2.7125	0.0127	0.0116	7.0	7.00
125	1250	0.0040	0.0128	2.9568	1.2804	0.0098	2.7253	0.0127	0.0116	7.0	6.99
126	1260	0.0040	0.0128	2.9696	1.2902	0.0098	2.7380	0.0127	0.0116	7.0	6.99
127	1270	0.0040	0.0128	2.9824	1.3000	0.0098	2.7507	0.0127	0.0116	7.0	6.99
128	1280	0.0040	0.0128	2.9952	1.3098	0.0098	2.7635	0.0127	0.0116	7.0	6.98
129	1290	0.0040	0.0128	3.0080	1.3196	0.0098	2.7762	0.0127	0.0116	7.0	6.98
130	1300	0.0040	0.0128	3.0208	1.3295	0.0099	2.7890	0.0127	0.0116	7.0	6.98
131	1310	0.0040	0.0128	3.0336	1.3394	0.0099	2.8017	0.0127	0.0116	7.0	6.98
132	1320	0.0040	0.0128	3.0464	1.3493	0.0099	2.8145	0.0127	0.0116	7.0	6.98
133	1330	0.0040	0.0128	3.0592	1.3592	0.0099	2.8272	0.0127	0.0116	7.0	6.99
134	1340	0.0040	0.0128	3.0720	1.3691	0.0099	2.8400	0.0127	0.0116	7.0	6.99
135	1350	0.0040	0.0128	3.0848	1.3790	0.0099	2.8527	0.0127	0.0116	7.0	6.99
136	1360	0.0040	0.0128	3.0976	1.3889	0.0099	2.8655	0.0127	0.0116	7.0	6.99
137	1370	0.0040	0.0128	3.1104	1.3989	0.0100	2.8782	0.0128	0.0116	7.0	6.99
138	1380	0.0040	0.0128	3.1232	1.4089	0.0100	2.8910	0.0128	0.0116	7.0	7.00
139	1390	0.0040	0.0128	3.1360	1.4189	0.0100	2.9037	0.0128	0.0116	7.0	7.00
140	1400	0.0040	0.0128	3.1488	1.4289	0.0100	2.9165	0.0128	0.0117	7.0	7.00
141	1410	0.0040	0.0128	3.1616	1.4389	0.0100	2.9292	0.0128	0.0117	7.0	7.00
142	1420	0.0040	0.0128	3.1744	1.4489	0.0100	2.9420	0.0128	0.0117	7.0	7.01
143	1430	0.0040	0.0128	3.1872	1.4590	0.0100	2.9547	0.0128	0.0117	7.0	7.01
144	1440	0.0040	0.0128	3.2000	1.4690	0.0101	2.9675	0.0128	0.0117	7.0	7.01

Total Volume of Runoff[1] = 826,993 cu. ft.

Notes:

1. Total Runoff Volume is found by summing column (12) and multiplying by the time step, dt as follows:

   V = SumQ x dt
   V(cu.ft.) = SumQ(cu.ft/s) x dt(min.) x (60 s/min.)

SANTA BARBARA URBAN HYDROGRAPH (SBUH) METHOD
RUNOFF VOLUME CALCULATION

Project: City of Arlington - Edgecomb
Basin: West
Storm Event: 100-YEAR, 24-HOUR
Given:

Area = 99.59 acres
Pt = 3.75 inches
dt = 10 min.
Tc = 69.1 min.

PERVIOUS AREA (Interim Final Cover Area)			IMPERVIOUS AREA (Roads)		
Area =	39.84	acres	Area =	59.75	acres
CN =	81		CN =	98	
S =	2.35		S =	0.20	
0.2S =	0.47		0.2S =	0.04	

SUMMARY
T_{pk} (hrs) = 7.83
T_c (min) = 69.1
Q_{pk} (cfs) = 36.40
Vol (cf) = 1,004,492

Compute: Runoff Hydrograph

Column (3) = SCS Type IA Rainfall Distribution
Column (4) = Col. (3) x Pt
Column (5) = Accumulated Sum of Col. (4)
Column (6) = [If P <= 0.2S] = 0; Note, use PERVIOUS Area "S" value.
[If P > 0.2S] = (Col.(5) - 0.2S)^2/(Col.(5) + 0.8S); Using the PERVIOUS Area "S" value.
Column (7) = Col.(6) of Present Time Step - Col.(6) of Previous Time Step
Column (8) = Same method as for Col.(6), except use the IMPERVIOUS Area "S" value.
Column (9) = Col.(8) of the present time step - Col.(8) of the previous time step.
Column (10) = ((PERVIOUS area / Total area) x Col.(7)) + ((IMPERVIOUS area / Total area) x Col.(9))
Column (11) = (60.5 x Col.(10) x Total Area) / 10 (dt = 10 minutes)
Routing Constant, w = dt / (2Tc + dt) = 0.0675
Column (12) = Col.(12) of Previous Time Step + (w x [Col.(11) of Previous Time Step + Col.(11) of Present Time Step - (2 x Col.(12) of Previous Time Step)])

					Pervious Area		Impervious Area					
(1) Time Increment	(2) Time	(3) Rainfall distribution	(4) Incremental Rainfall	(5) Accumulated Rainfall	(6) Accumulated Runoff	(7) Incremental Runoff	(8) Accumulated Runoff	(9) Incremental Runoff	(10) Total Runoff	(11) Instant hydrograph	(12) design hydrograph	
	min.	% of Pt	in.	in.	in.	in.	in.	in.	in.	cfs	cfs	
1	10	0.0040	0.0150	0.0150	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.00	
2	20	0.0040	0.0150	0.0300	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.00	
3	30	0.0040	0.0150	0.0450	0.0000	0.0000	0.0001	0.0001	0.0001	0.0	0.00	
4	40	0.0040	0.0150	0.0600	0.0000	0.0000	0.0016	0.0016	0.0009	0.6	0.04	
5	50	0.0040	0.0150	0.0750	0.0000	0.0000	0.0049	0.0033	0.0020	1.2	0.15	
6	60	0.0040	0.0150	0.0900	0.0000	0.0000	0.0096	0.0046	0.0028	1.7	0.33	
7	70	0.0040	0.0150	0.1050	0.0000	0.0000	0.0154	0.0058	0.0035	2.1	0.54	
8	80	0.0040	0.0150	0.1200	0.0000	0.0000	0.0221	0.0068	0.0041	2.5	0.77	
9	90	0.0040	0.0150	0.1350	0.0000	0.0000	0.0297	0.0076	0.0046	2.7	1.02	
10	100	0.0040	0.0150	0.1500	0.0000	0.0000	0.0381	0.0083	0.0050	3.0	1.27	
11	110	0.0050	0.0188	0.1688	0.0000	0.0000	0.0493	0.0112	0.0067	4.1	1.57	
12	120	0.0050	0.0188	0.1875	0.0000	0.0000	0.0613	0.0120	0.0072	4.4	1.93	
13	130	0.0050	0.0188	0.2063	0.0000	0.0000	0.0741	0.0127	0.0076	4.6	2.27	
14	140	0.0050	0.0188	0.2250	0.0000	0.0000	0.0874	0.0133	0.0080	4.8	2.60	
15	150	0.0050	0.0188	0.2438	0.0000	0.0000	0.1012	0.0138	0.0083	5.0	2.91	
16	160	0.0050	0.0188	0.2625	0.0000	0.0000	0.1154	0.0142	0.0085	5.1	3.20	
17	170	0.0060	0.0225	0.2850	0.0000	0.0000	0.1330	0.0176	0.0106	6.4	3.55	
18	180	0.0060	0.0225	0.3075	0.0000	0.0000	0.1511	0.0181	0.0108	6.5	3.94	
19	190	0.0060	0.0225	0.3300	0.0000	0.0000	0.1695	0.0185	0.0111	6.7	4.30	
20	200	0.0060	0.0225	0.3525	0.0000	0.0000	0.1884	0.0188	0.0113	6.8	4.63	
21	210	0.0060	0.0225	0.3750	0.0000	0.0000	0.2075	0.0191	0.0115	6.9	4.93	
22	220	0.0060	0.0225	0.3975	0.0000	0.0000	0.2269	0.0194	0.0116	7.0	5.20	
23	230	0.0070	0.0263	0.4238	0.0000	0.0000	0.2498	0.0229	0.0138	8.3	5.53	
24	240	0.0070	0.0263	0.4500	0.0000	0.0000	0.2730	0.0232	0.0139	8.4	5.91	
25	250	0.0070	0.0263	0.4763	0.0000	0.0000	0.2965	0.0235	0.0141	8.5	6.25	
26	260	0.0070	0.0263	0.5025	0.0005	0.0004	0.3202	0.0237	0.0144	8.7	6.57	
27	270	0.0070	0.0263	0.5288	0.0015	0.0010	0.3440	0.0239	0.0147	8.9	6.86	
28	280	0.0070	0.0263	0.5550	0.0030	0.0016	0.3681	0.0241	0.0151	9.1	7.15	
29	290	0.0082	0.0308	0.5858	0.0055	0.0025	0.3965	0.0284	0.0180	10.9	7.53	
30	300	0.0082	0.0308	0.6165	0.0087	0.0032	0.4250	0.0286	0.0184	11.1	7.99	
31	310	0.0082	0.0308	0.6473	0.0126	0.0039	0.4537	0.0287	0.0188	11.3	8.43	
32	320	0.0082	0.0308	0.6780	0.0171	0.0045	0.4826	0.0289	0.0191	11.5	8.83	
33	330	0.0082	0.0308	0.7088	0.0222	0.0051	0.5116	0.0290	0.0195	11.7	9.21	
34	340	0.0082	0.0308	0.7395	0.0279	0.0057	0.5407	0.0291	0.0198	11.9	9.56	
35	350	0.0095	0.0356	0.7751	0.0353	0.0074	0.5746	0.0339	0.0233	14.0	10.02	
36	360	0.0095	0.0356	0.8108	0.0434	0.0081	0.6086	0.0340	0.0236	14.2	10.57	
37	370	0.0095	0.0356	0.8464	0.0523	0.0088	0.6427	0.0341	0.0240	14.5	11.08	
38	380	0.0095	0.0356	0.8820	0.0618	0.0095	0.6769	0.0342	0.0243	14.7	11.55	
39	390	0.0095	0.0356	0.9176	0.0720	0.0102	0.7113	0.0343	0.0247	14.9	11.99	
40	400	0.0095	0.0356	0.9533	0.0828	0.0108	0.7457	0.0344	0.0250	15.0	12.39	
41	410	0.0134	0.0503	1.0035	0.0991	0.0163	0.7943	0.0486	0.0357	21.5	13.18	
42	420	0.0134	0.0503	1.0538	0.1166	0.0175	0.8431	0.0488	0.0363	21.8	14.33	
43	430	0.0134	0.0503	1.1040	0.1352	0.0186	0.8920	0.0489	0.0368	22.2	15.37	
44	440	0.0180	0.0675	1.1715	0.1618	0.0266	0.9578	0.0658	0.0501	30.2	16.83	
45	450	0.0180	0.0675	1.2390	0.1902	0.0284	1.0238	0.0660	0.0510	30.7	18.67	
46	460	0.0340	0.1275	1.3665	0.2483	0.0581	1.1488	0.1250	0.0982	59.2	22.21	
47	470	0.0540	0.2025	1.5690	0.3511	0.1028	1.3481	0.1993	0.1607	96.8	29.74	
48	480	0.0270	0.1013	1.6703	0.4068	0.0557	1.4481	0.0999	0.0822	49.5	35.60	Q peak
49	490	0.0180	0.0675	1.7378	0.4453	0.0385	1.5148	0.0667	0.0554	33.4	36.40	
50	500	0.0134	0.0503	1.7880	0.4747	0.0294	1.5644	0.0497	0.0416	25.0	35.43	
51	510	0.0134	0.0503	1.8383	0.5046	0.0299	1.6142	0.0497	0.0418	25.2	34.03	
52	520	0.0134	0.0503	1.8885	0.5351	0.0305	1.6639	0.0497	0.0420	25.3	32.85	
53	530	0.0088	0.0330	1.9215	0.5554	0.0203	1.6966	0.0327	0.0277	16.7	31.25	
54	540	0.0088	0.0330	1.9545	0.5759	0.0205	1.7293	0.0327	0.0278	16.8	29.29	
55	550	0.0088	0.0330	1.9875	0.5966	0.0207	1.7620	0.0327	0.0279	16.8	27.61	
56	560	0.0088	0.0330	2.0205	0.6176	0.0209	1.7947	0.0327	0.0280	16.9	26.15	
57	570	0.0088	0.0330	2.0535	0.6387	0.0211	1.8274	0.0327	0.0281	16.9	24.90	
58	580	0.0088	0.0330	2.0865	0.6601	0.0213	1.8601	0.0327	0.0282	17.0	23.83	
59	590	0.0088	0.0330	2.1195	0.6816	0.0215	1.8928	0.0327	0.0283	17.0	22.91	
60	600	0.0088	0.0330	2.1525	0.7033	0.0217	1.9256	0.0327	0.0283	17.1	22.12	
61	610	0.0088	0.0330	2.1855	0.7252	0.0219	1.9583	0.0327	0.0284	17.1	21.44	
62	620	0.0088	0.0330	2.2185	0.7473	0.0221	1.9911	0.0328	0.0285	17.2	20.86	
63	630	0.0088	0.0330	2.2515	0.7696	0.0223	2.0238	0.0328	0.0286	17.2	20.36	
64	640	0.0088	0.0330	2.2845	0.7920	0.0224	2.0566	0.0328	0.0286	17.3	19.94	
65	650	0.0072	0.0270	2.3115	0.8105	0.0185	2.0834	0.0268	0.0235	14.1	19.37	
66	660	0.0072	0.0270	2.3385	0.8291	0.0186	2.1103	0.0268	0.0235	14.2	18.67	
67	670	0.0072	0.0270	2.3655	0.8478	0.0187	2.1371	0.0268	0.0236	14.2	18.06	

SANTA BARBARA URBAN HYDROGRAPH (SBUH) METHOD
RUNOFF VOLUME CALCULATION

					Pervious Area		Impervious Area				
(1) Time Increment	(2) Time min.	(3) Rainfall distri-bution % of Pt	(4) Incre-mental Rainfall in.	(5) Accumu-lated Rainfall in.	(6) Accumu-lated Runoff in.	(7) Incre-mental Runoff in.	(8) Accumu-lated Runoff in.	(9) Incre-mental Runoff in.	(10) Total Runoff in.	(11) Instant hydro-graph cfs	(12) design hydro-graph cfs
68	680	0.0072	0.0270	2.3925	0.8665	0.0188	2.1639	0.0268	0.0236	14.2	17.54
69	690	0.0072	0.0270	2.4195	0.8854	0.0189	2.1907	0.0268	0.0237	14.3	17.10
70	700	0.0072	0.0270	2.4465	0.9044	0.0190	2.2176	0.0268	0.0237	14.3	16.71
71	710	0.0072	0.0270	2.4735	0.9235	0.0191	2.2444	0.0268	0.0237	14.3	16.39
72	720	0.0072	0.0270	2.5005	0.9427	0.0192	2.2712	0.0268	0.0238	14.3	16.11
73	730	0.0072	0.0270	2.5275	0.9620	0.0193	2.2981	0.0268	0.0238	14.4	15.87
74	740	0.0072	0.0270	2.5545	0.9814	0.0194	2.3249	0.0268	0.0239	14.4	15.67
75	750	0.0072	0.0270	2.5815	1.0009	0.0195	2.3518	0.0268	0.0239	14.4	15.49
76	760	0.0072	0.0270	2.6085	1.0205	0.0196	2.3786	0.0269	0.0239	14.4	15.35
77	770	0.0057	0.0214	2.6299	1.0360	0.0156	2.3999	0.0213	0.0190	11.4	15.02
78	780	0.0057	0.0214	2.6513	1.0516	0.0156	2.4212	0.0213	0.0190	11.4	14.54
79	790	0.0057	0.0214	2.6726	1.0673	0.0157	2.4424	0.0213	0.0190	11.5	14.12
80	800	0.0057	0.0214	2.6940	1.0830	0.0157	2.4637	0.0213	0.0190	11.5	13.76
81	810	0.0057	0.0214	2.7154	1.0988	0.0158	2.4849	0.0213	0.0191	11.5	13.46
82	820	0.0057	0.0214	2.7368	1.1146	0.0158	2.5062	0.0213	0.0191	11.5	13.19
83	830	0.0057	0.0214	2.7581	1.1305	0.0159	2.5275	0.0213	0.0191	11.5	12.96
84	840	0.0057	0.0214	2.7795	1.1464	0.0159	2.5488	0.0213	0.0191	11.5	12.77
85	850	0.0057	0.0214	2.8009	1.1624	0.0160	2.5700	0.0213	0.0192	11.5	12.60
86	860	0.0057	0.0214	2.8223	1.1784	0.0160	2.5913	0.0213	0.0192	11.6	12.46
87	870	0.0057	0.0214	2.8436	1.1945	0.0161	2.6126	0.0213	0.0192	11.6	12.34
88	880	0.0057	0.0214	2.8650	1.2106	0.0161	2.6339	0.0213	0.0192	11.6	12.24
89	890	0.0050	0.0188	2.8838	1.2248	0.0142	2.6525	0.0187	0.0169	10.2	12.05
90	900	0.0050	0.0188	2.9025	1.2390	0.0142	2.6712	0.0187	0.0169	10.2	11.80
91	910	0.0050	0.0188	2.9213	1.2533	0.0143	2.6899	0.0187	0.0169	10.2	11.58
92	920	0.0050	0.0188	2.9400	1.2675	0.0143	2.7085	0.0187	0.0169	10.2	11.39
93	930	0.0050	0.0188	2.9588	1.2819	0.0143	2.7272	0.0187	0.0169	10.2	11.23
94	940	0.0050	0.0188	2.9775	1.2962	0.0144	2.7459	0.0187	0.0169	10.2	11.09
95	950	0.0050	0.0188	2.9963	1.3106	0.0144	2.7645	0.0187	0.0170	10.2	10.97
96	960	0.0050	0.0188	3.0150	1.3250	0.0144	2.7832	0.0187	0.0170	10.2	10.87
97	970	0.0050	0.0188	3.0338	1.3395	0.0145	2.8019	0.0187	0.0170	10.2	10.78
98	980	0.0050	0.0188	3.0525	1.3540	0.0145	2.8206	0.0187	0.0170	10.2	10.71
99	990	0.0050	0.0188	3.0713	1.3685	0.0145	2.8392	0.0187	0.0170	10.3	10.65
100	1000	0.0050	0.0188	3.0900	1.3830	0.0146	2.8579	0.0187	0.0170	10.3	10.60
101	1010	0.0040	0.0150	3.1050	1.3947	0.0117	2.8728	0.0149	0.0136	8.2	10.41
102	1020	0.0040	0.0150	3.1200	1.4064	0.0117	2.8878	0.0149	0.0136	8.2	10.12
103	1030	0.0040	0.0150	3.1350	1.4181	0.0117	2.9027	0.0149	0.0136	8.2	9.86
104	1040	0.0040	0.0150	3.1500	1.4298	0.0117	2.9177	0.0149	0.0137	8.2	9.64
105	1050	0.0040	0.0150	3.1650	1.4416	0.0117	2.9326	0.0149	0.0137	8.2	9.45
106	1060	0.0040	0.0150	3.1800	1.4533	0.0118	2.9476	0.0149	0.0137	8.2	9.28
107	1070	0.0040	0.0150	3.1950	1.4651	0.0118	2.9625	0.0149	0.0137	8.2	9.14
108	1080	0.0040	0.0150	3.2100	1.4769	0.0118	2.9774	0.0149	0.0137	8.2	9.02
109	1090	0.0040	0.0150	3.2250	1.4887	0.0118	2.9924	0.0149	0.0137	8.3	8.92
110	1100	0.0040	0.0150	3.2400	1.5006	0.0118	3.0073	0.0149	0.0137	8.3	8.83
111	1110	0.0040	0.0150	3.2550	1.5124	0.0119	3.0223	0.0149	0.0137	8.3	8.75
112	1120	0.0040	0.0150	3.2700	1.5243	0.0119	3.0372	0.0149	0.0137	8.3	8.69
113	1130	0.0040	0.0150	3.2850	1.5362	0.0119	3.0522	0.0149	0.0137	8.3	8.63
114	1140	0.0040	0.0150	3.3000	1.5481	0.0119	3.0671	0.0149	0.0137	8.3	8.58
115	1150	0.0040	0.0150	3.3150	1.5600	0.0119	3.0821	0.0149	0.0137	8.3	8.54
116	1160	0.0040	0.0150	3.3300	1.5720	0.0119	3.0970	0.0149	0.0137	8.3	8.50
117	1170	0.0040	0.0150	3.3450	1.5839	0.0120	3.1120	0.0149	0.0138	8.3	8.48
118	1180	0.0040	0.0150	3.3600	1.5959	0.0120	3.1269	0.0149	0.0138	8.3	8.45
119	1190	0.0040	0.0150	3.3750	1.6079	0.0120	3.1419	0.0149	0.0138	8.3	8.43
120	1200	0.0040	0.0150	3.3900	1.6199	0.0120	3.1568	0.0150	0.0138	8.3	8.41
121	1210	0.0040	0.0150	3.4050	1.6320	0.0120	3.1718	0.0150	0.0138	8.3	8.40
122	1220	0.0040	0.0150	3.4200	1.6440	0.0120	3.1867	0.0150	0.0138	8.3	8.38
123	1230	0.0040	0.0150	3.4350	1.6561	0.0121	3.2017	0.0150	0.0138	8.3	8.37
124	1240	0.0040	0.0150	3.4500	1.6682	0.0121	3.2166	0.0150	0.0138	8.3	8.37
125	1250	0.0040	0.0150	3.4650	1.6803	0.0121	3.2316	0.0150	0.0138	8.3	8.36
126	1260	0.0040	0.0150	3.4800	1.6924	0.0121	3.2465	0.0150	0.0138	8.3	8.36
127	1270	0.0040	0.0150	3.4950	1.7045	0.0121	3.2615	0.0150	0.0138	8.3	8.35
128	1280	0.0040	0.0150	3.5100	1.7167	0.0121	3.2764	0.0150	0.0138	8.3	8.35
129	1290	0.0040	0.0150	3.5250	1.7288	0.0122	3.2914	0.0150	0.0138	8.3	8.35
130	1300	0.0040	0.0150	3.5400	1.7410	0.0122	3.3063	0.0150	0.0138	8.3	8.35
131	1310	0.0040	0.0150	3.5550	1.7532	0.0122	3.3213	0.0150	0.0139	8.3	8.35
132	1320	0.0040	0.0150	3.5700	1.7654	0.0122	3.3363	0.0150	0.0139	8.3	8.35
133	1330	0.0040	0.0150	3.5850	1.7776	0.0122	3.3512	0.0150	0.0139	8.4	8.35
134	1340	0.0040	0.0150	3.6000	1.7899	0.0122	3.3662	0.0150	0.0139	8.4	8.35
135	1350	0.0040	0.0150	3.6150	1.8021	0.0123	3.3811	0.0150	0.0139	8.4	8.35
136	1360	0.0040	0.0150	3.6300	1.8144	0.0123	3.3961	0.0150	0.0139	8.4	8.35
137	1370	0.0040	0.0150	3.6450	1.8267	0.0123	3.4110	0.0150	0.0139	8.4	8.35
138	1380	0.0040	0.0150	3.6600	1.8390	0.0123	3.4260	0.0150	0.0139	8.4	8.36
139	1390	0.0040	0.0150	3.6750	1.8513	0.0123	3.4410	0.0150	0.0139	8.4	8.36
140	1400	0.0040	0.0150	3.6900	1.8636	0.0123	3.4559	0.0150	0.0139	8.4	8.36
141	1410	0.0040	0.0150	3.7050	1.8760	0.0123	3.4709	0.0150	0.0139	8.4	8.36
142	1420	0.0040	0.0150	3.7200	1.8883	0.0124	3.4858	0.0150	0.0139	8.4	8.37
143	1430	0.0040	0.0150	3.7350	1.9007	0.0124	3.5008	0.0150	0.0139	8.4	8.37
144	1440	0.0040	0.0150	3.7500	1.9131	0.0124	3.5157	0.0150	0.0139	8.4	8.37

Total Volume of Runoff[1] = 1,004,492 cu. ft.

Notes:

1. Total Runoff Volume is found by summing column (12) and multiplying by the time step, dt as follows:

   V = SumQ x dt
   V(cu.ft.) = SumQ(cu.ft/s) x dt(min.) x (60 s/min.)

4-3/74

ATTACHMENT 5
Cascade Survey Data

8/27/7 Nan

CASCADE SURVEYING
& ENGINEERING, INC.
105 E. Division • P.O. Box 326 • Arlington, WA 98223
(360) 435-5551 • fax: (360) 435-4012

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SURVEYORS
ENGINEERS
PLANNERS

FAX COVER SHEET

Date: 8/27/07

To: URS CORP. (CHARLES MANNING)

From: MIKE KRIEGER

Cascade Surveying & Engineering, Inc.
P.O. Box 326, Arlington, WA 98223
Phone: (360) 435-5551
1-800-593-5551
Fax: (360) 435-4012

Message: HERE IS MOST OF THE INFO YOU REQUESTED. I WILL SEND YOU THE LAST OF THE INFORMATION - IF YOU HAVE ANY QUESTIONS PLEASE CONTACT ME.

THANKS MIKE K

Number of pages including this cover sheet: 6

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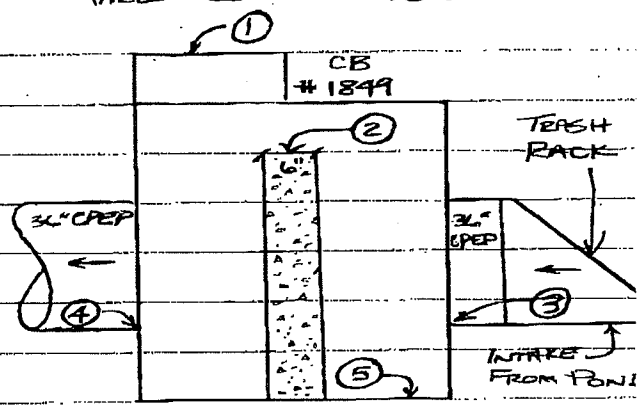
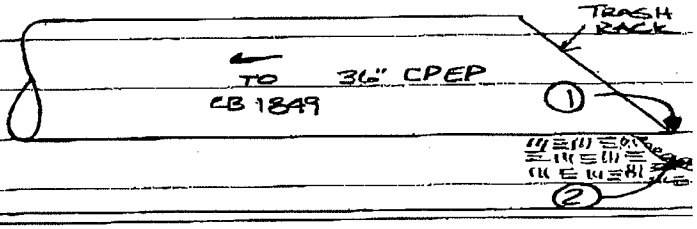
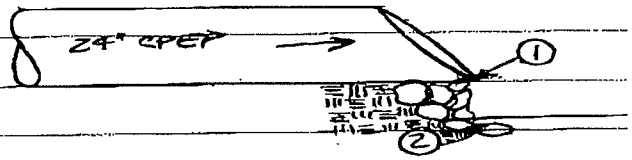
PNT #	DESC.
1849	CONTROL STORM MAN HOLE
1)	RIM = 148.76
2)	TOP SOLID WIER = 146.93
3)	INV SE. 36" CPEP = 143.07
4)	INV N. 36" CPEP = 143.07
5	BOTTOM CB (SUMP) = 141.00



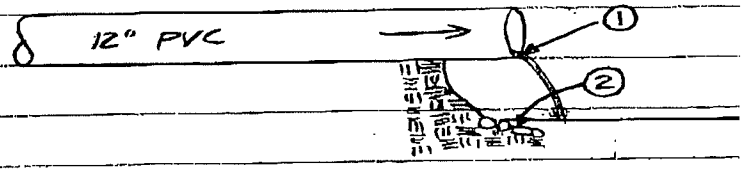
= ?	INTAKE PIPE TO CB # 1849
1)	INV N.W. 36" CPEP = 144.30
2)	GROUND SHOT BELOW INV. = 143.70



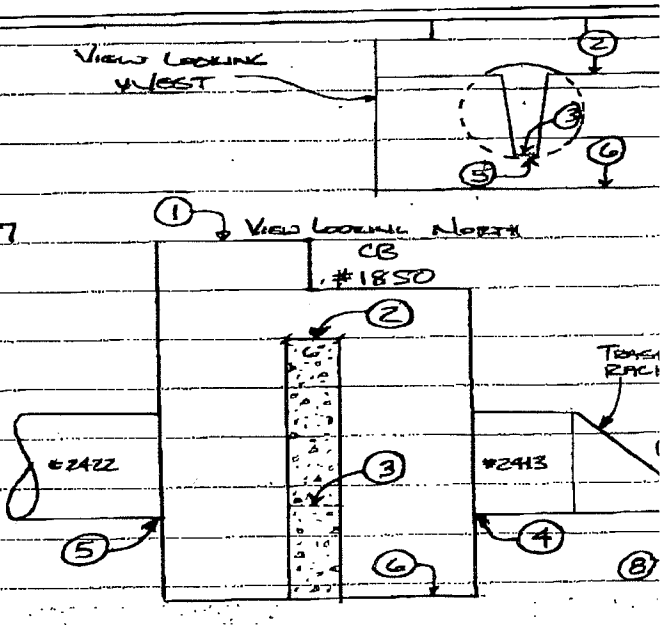
#1683	OUTFALL PIPE @ POND
1)	INV E. 24" CPEP = 144.70
2)	GROUND SHOT BELOW INV = 144.10



# 2285	OUTFALL PIPE @ POND
1)	INV E 12" PVC =
2)	GROUND SHOT BELOW INV =



#1850	CONTROL STORM MAN HOLE
1)	RIM = 149.20
2)	TOP WIER = 147.24
3)	BOTTOM 2" WIDE WIER NOTCH = 144.57
4)	INV E 30" CPEP = 144.51
5)	INV W 30" CPEP = 144.51
6)	BOTTOM CB (SUMP) = 142.55
#2413 7)	INV SW 30" CPEP INTAKE PIPE = 144.45
8)	GROUND SHOT BELOW INV = 144.10



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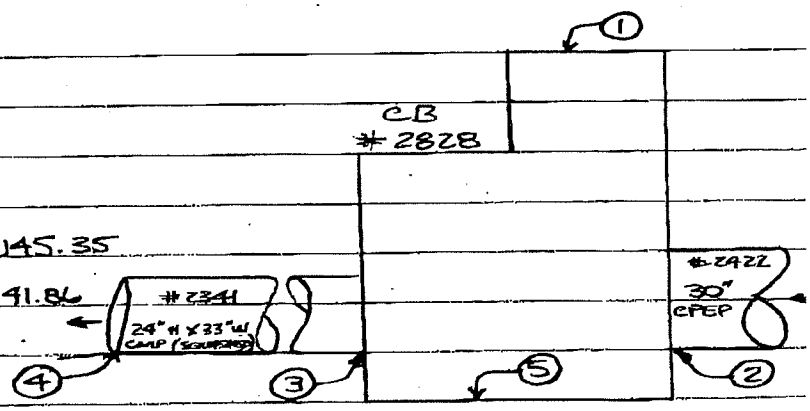
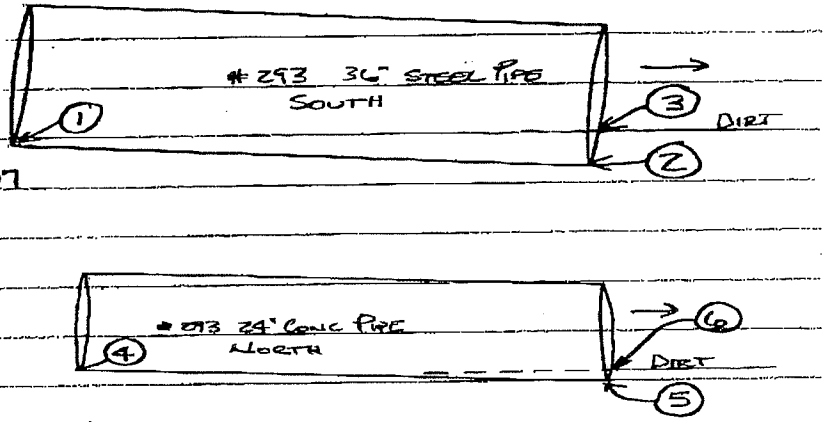
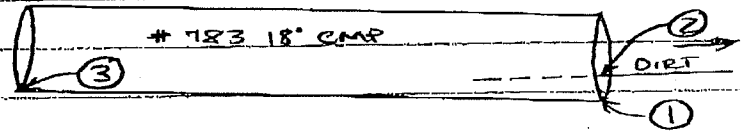
PNT #	DESC
:2828	CATCH BASIN MANHOLE
1)	RIM = 149.80
2)	INV E 30" CPEP = 142.35
3)	INV W 24" x 33" CMP (SQUASHED PIPE) = 145.35
= 2341 4)	INV E 24" x 33" CMP (SQUASHED PIPE) = 141.86
5)	BOTTOM CB SUMP



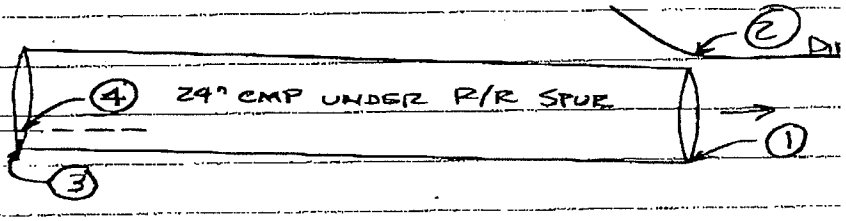
#293	36" STEEL CULVERT
1)	INV E 36" STEEL = 141.07
2)	INV W 36" STEEL = 140.40
3)	GROUND SHOT ABOVE INV = 141.07
4)	INV E 24" CONC = 142.17
5)	INV W 24" CONC = 141.47
6)	GROUND SHOT ABOVE INV = 141.80



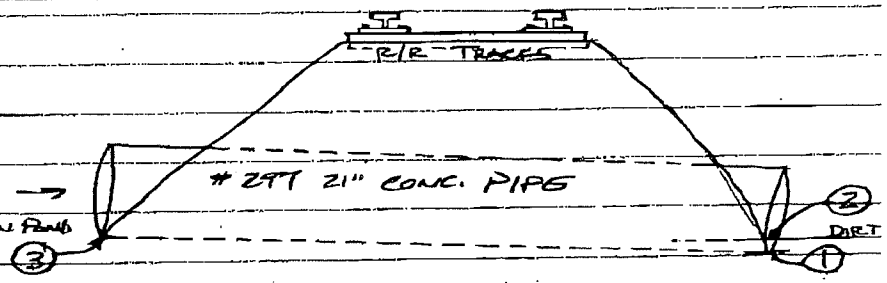
#783	18" CMP CULVERT
1)	INV S. 18" CMP = 139.51
2)	GROUND SHOT ABOVE INV = 140.26
3)	INV N. 18" CMP = 139.90



#	24" CMP UNDER R/R SPUR
1)	INV S. 24" CMP = 135.28
2)	GROUND SHOT ABOVE INV = 137.44
3)	INV N 24" CMP = 137.14
4)	GROUND SHOT ABOVE INV = 137.88



#297	21" CONC CULVERT
1)	INV W. 21" CONC = 129.67
2)	GROUND SHOT ABOVE INV = 130.09
3)	INV E. 21" CONC = 130.67



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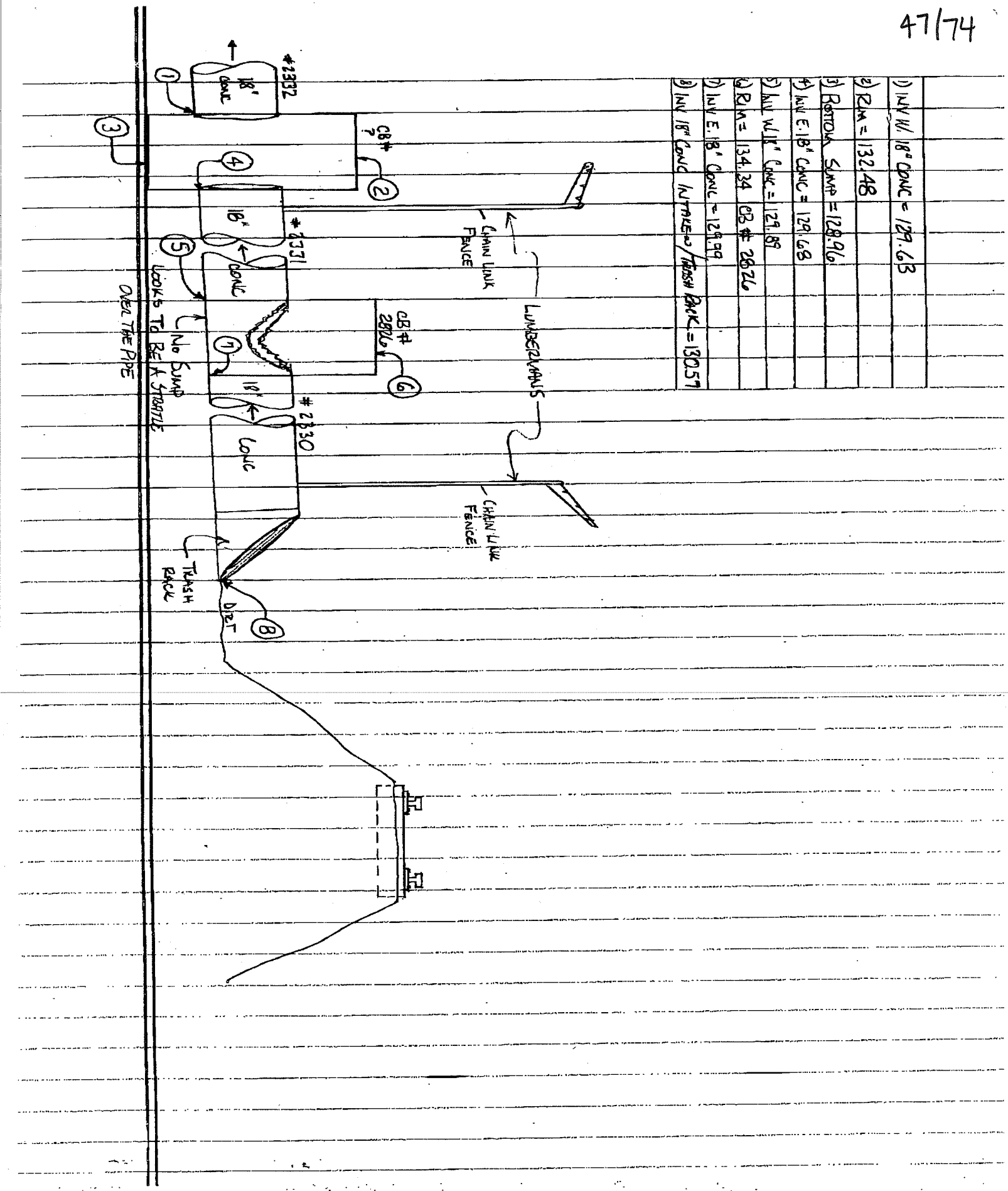
1) INV W. 18" CONC = 129.63
2) RIM = 132.48
3) BOTTOM SUMP = 128.96
4) INV E. 18" CONC = 129.68
5) INV W. 18" CONC = 129.89
6) RIM = 134.24 CB # 2826
7) INV E. 18" CONC = 129.99
8) INV 18" CONC INTAKE = TRASH RACK = 130.57
#2332
18" CONC
CB # ?
18"
#2331
CONC
CB # 2826
#2330
CONC
LUMBERJACKS
CHAIN LINK FENCE
CHAIN LINK FENCE
NO SUMP LOOKS TO BE A STRAIGHT OVER THE PIPE
TRASH RACK
DIRT

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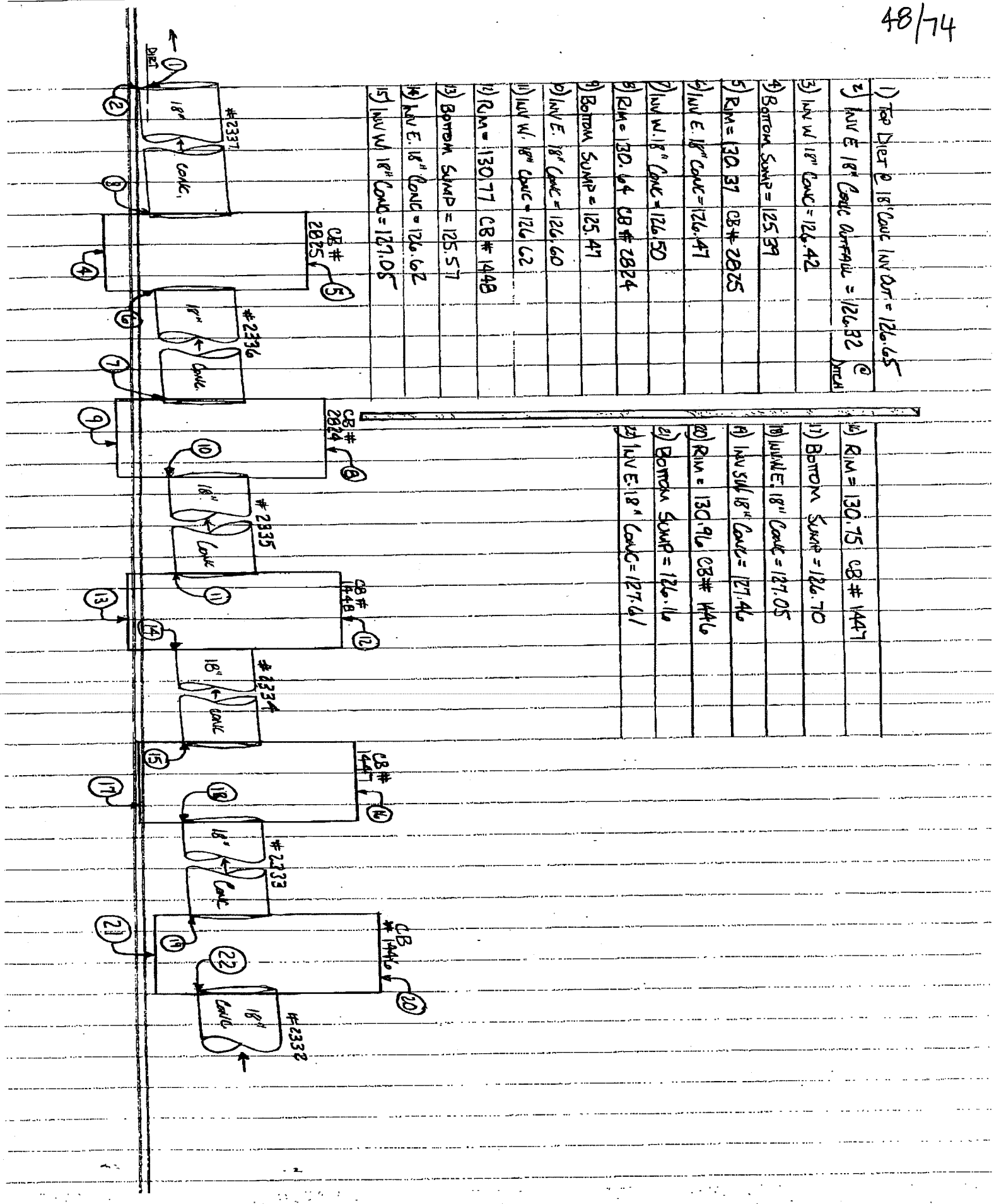
1) Top Dirt @ 18" Conc Inv Out = 126.65
2) Inv E. 18" Conc Available = 126.32 @ Ditch
3) Inv W. 18" Conc = 126.42
4) Bottom Sump = 125.39
5) Rim = 130.37 CB # 2825
6) Inv E. 18" Conc = 126.47
7) Inv W. 18" Conc = 126.50
8) Rim = 130.64 CB # 2824
9) Bottom Sump = 125.47
10) Inv E. 18" Conc = 126.60
11) Inv W. 18" Conc = 126.62
12) Rim = 130.77 CB # 1448
13) Bottom Sump = 125.57
14) Inv E. 18" Conc = 126.62
15) Inv W. 18" Conc = 127.05
16) Rim = 130.75 CB # 1447
17) Bottom Sump = 126.70
18) Inv E. 18" Conc = 127.05
19) Inv Stub 18" Conc = 127.46
20) Rim = 130.96 CB # 1446
21) Bottom Sump = 126.16
22) Inv E. 18" Conc = 127.61
Dirt
18"
Conc.
#2337
#2336
#2335
#2334
#2333
#2332
CB # 2825
CB # 2824
CB # 1448
CB # 1447
CB # 1446

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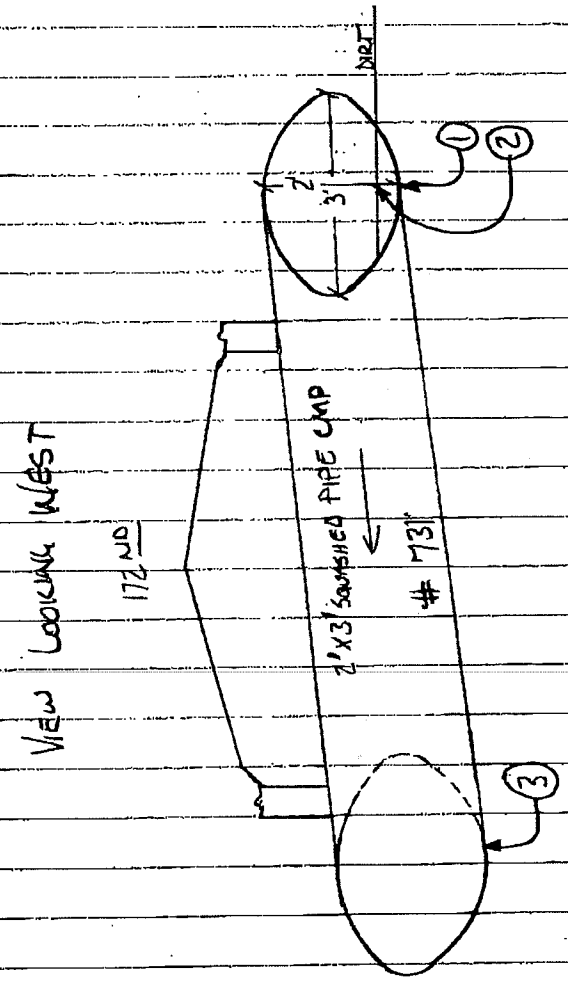


1) INV NE 2'W x 3'H w. (Sawcut Cmp Pipe) = 123.93
2) Ground Shot Above INV = 124.26
3) INV SW 2'W x 3'H w/ (Sawcut Cmp Pipe) = 123.29

8/27/7 2:55p 50/74

CASCADE SURVEYING & ENGINEERING, INC.

105 E. Division • P.O. Box 326 • Arlington, WA 98223
(360) 435-5551 • fax: (360) 435-4012

SURVEYORS
ENGINEERS
PLANNERS

FAX COVER SHEET

Date: 8/27/07

To: URS CORP (CHARLES MANNING)

From: MIKE KRIEGER

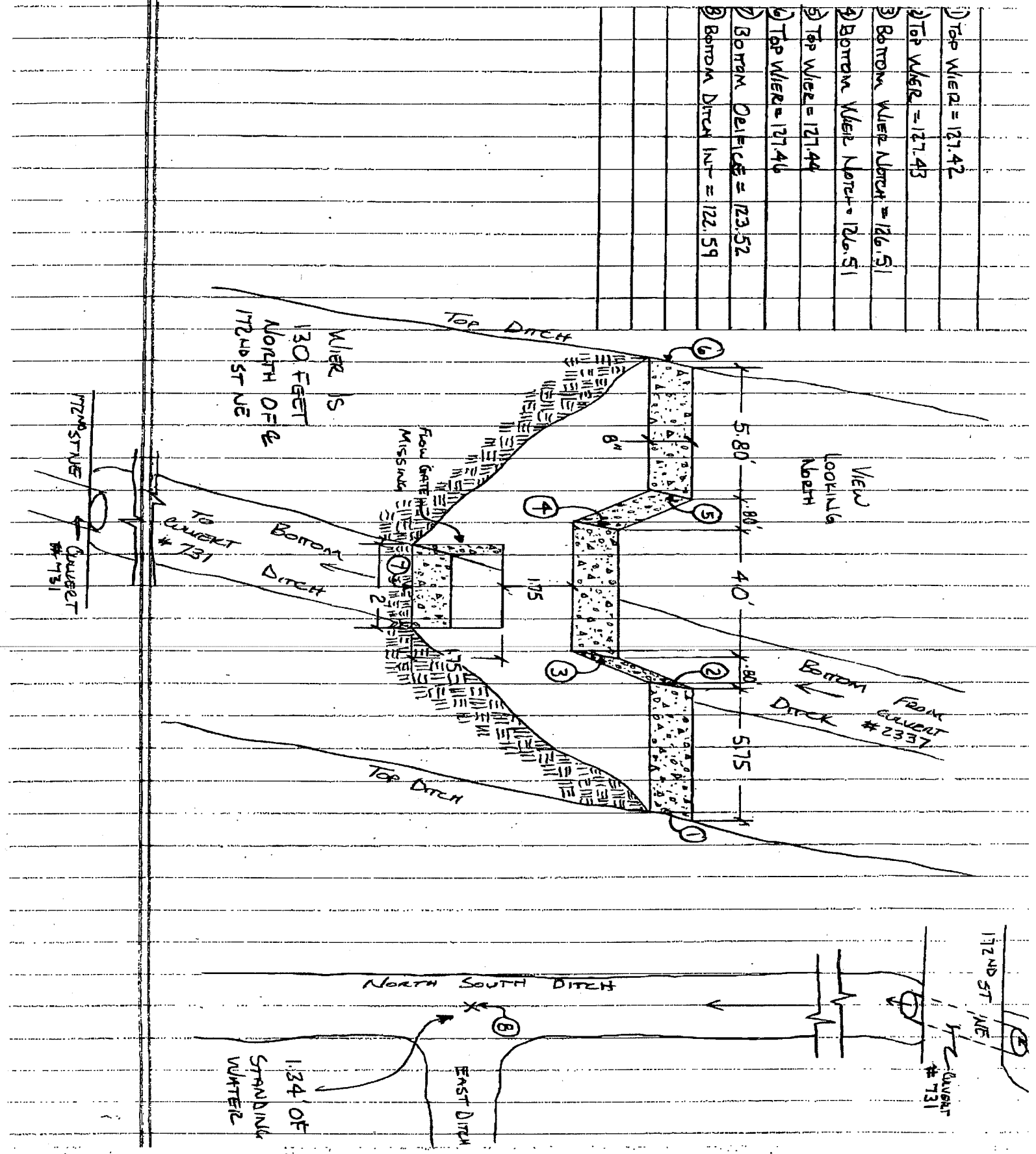
Cascade Surveying & Engineering, Inc.
P.O. Box 326, Arlington, WA 98223
Phone: (360) 435-5551
1-800-593-5551
Fax: (360) 435-4012

Message: THIS IS THE LAST OF THE INFORMATION THAT YOU REQUESTED

Number of pages including this cover sheet: 2

51/74

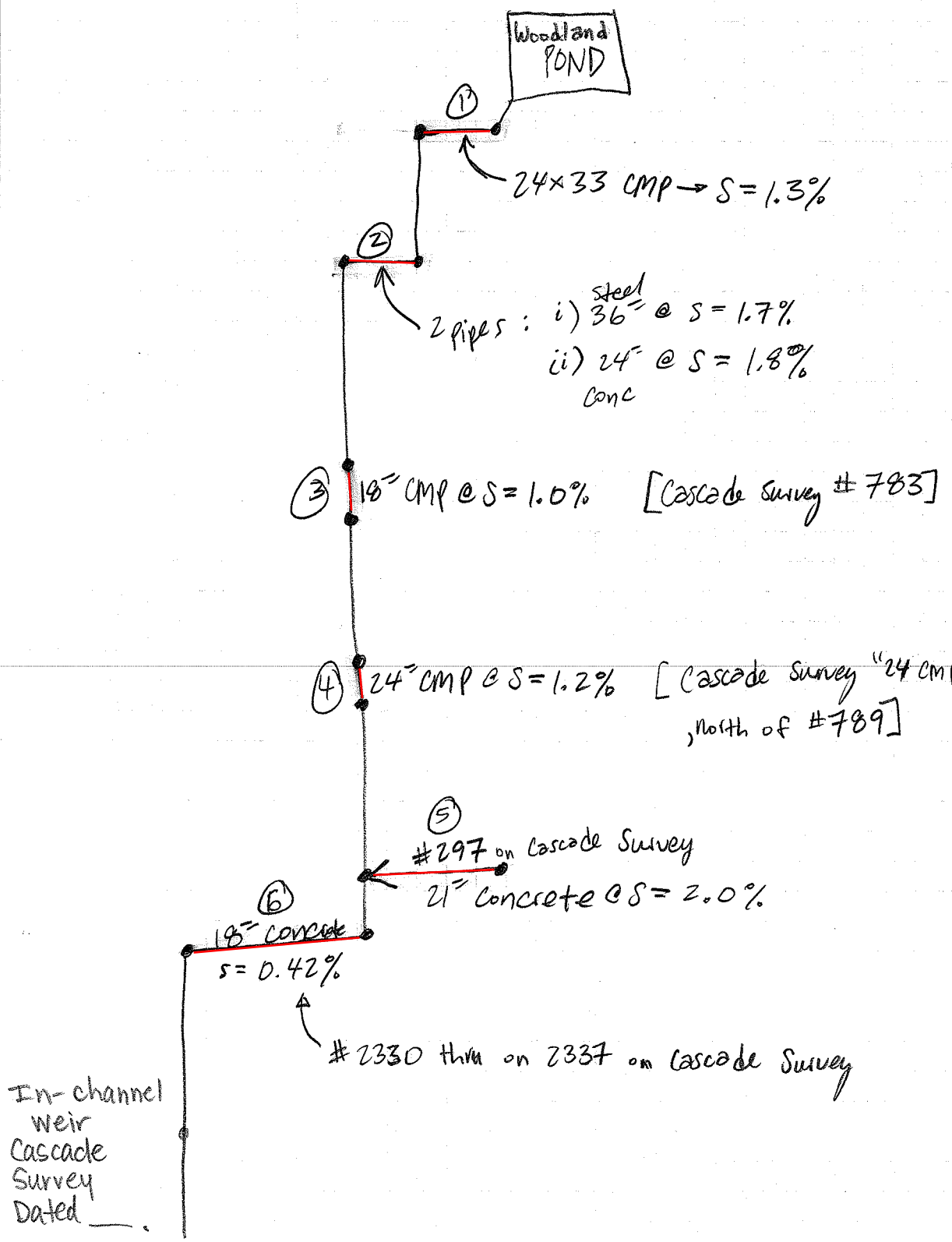
1) Top Weir = 127.42
2) Top Weir = 127.43
3) Bottom Weir North = 126.51
4) Bottom Weir North = 126.51
5) Top Weir = 127.44
6) Top Weir = 127.46
7) Bottom Deflage = 123.52
8) Bottom Ditch Int = 122.59



ATTACHMENT 6
Pipe Sizing Recommendations

6/4/08

53/74



CS → Cascade Survey # System [Existing Conditions: Req'd Headwater] 6/4/08

5A/74

Q_{10} = 44.21 cfs into Pond

Assume Q_{10} is split evenly between north pond outlet & south outlet.

Q_{10} ditch → 44.21 / 2 = 22.11 cfs

(1) [#CS2341]

IE_{up} = 145.35

IE_{dn} = 141.86

L = 270'

S = 1.3%

24" x 33" CMP

$HW_{Req'd}$ = 147.57 − 145.35 = 2.2 ft ⇒ ok.

(2) [#CS693]

36" Steel

IE_{up} =

IE_{dn} =

L =

$HW_{Req'd}$ =

24" concrete

IE_{up} =

IE_{dn} =

L =

$HW_{Req'd}$ =

Nearly the same slope & diameter as (1) but there are 2 culverts therefore the existing conditions are adequate

(3) [#CS783]

IE_{up} = 139.90

IE_{dn} = 139.51

L = 40'

S = 1.0%

18" CMP

$HW_{Req'd}$ = 149.96 − 139.90 = 10.06 ft ⇒ Requires upsized culvert

(4) [culvert under RR spur]

IE_{up} = 137.14

IE_{dn} = 135.28

L = 150

24" CMP

S = 1.24%

$HW_{Req'd}$ = 142.93 − 137.14 = 5.79

(Ditch avg depth = 4 ft per Arlington Memo 6-2-08. ⇒ requires upsized culvert)

(5) $Q_{10} = 24.44$

$IE_{up} = 130.67$ $IE_{dn} = 129.67$ $L = 51$ ft

$S = 1.96\%$ $D = 21"$ concrete

$HW_{Req'd} = 134.61 - 130.67 = 3.9$ ft HW

21" Concrete

(most ditches are between 3-6 feet deep per Arlington 6-2-08 memo)

Assume ⇒ OK. (CLOSE)

(6) Flow from $Q_{10_{North}} = 22.11$ cfs

Flow from (5) ~ 24.44

Q_{10} Combined $= 22.11 + 24.44 = 46.55$

$S = 0.42\%$

$L = 940$ $IE_{up} = 130.59$ $IE_{dn} = 126.65$

$D = 18"$ concrete

$HW_{Req'd} = 325.71 - 130.59 = 195.12$ ft → NOT REALISTIC

EDGECOMB CHECK 18" Ø STORM DRAIN. cgt 6/23/02

SEE ATTACHED NOMOGRAPH FROM KING COUNTY 56/14

18" Ø EXISTING

$Q_{MAX} \approx 47$ cfs.

18" Ø $\Rightarrow \frac{HW}{D}$ off the chart $\Rightarrow$ No Good.

21" Ø $\Rightarrow \frac{HW}{D} = 6$ $HW = 6(21/12) = 10.5'$

DITCH IS 3-4' DEEP $\Rightarrow$ NG

24" Ø $\Rightarrow \frac{HW}{D} = 3.8$ $HW = 7.6' \Rightarrow$ NG

30" Ø $\Rightarrow \frac{HW}{D} = 1.8$ $HW = 4.5' \Rightarrow$ close

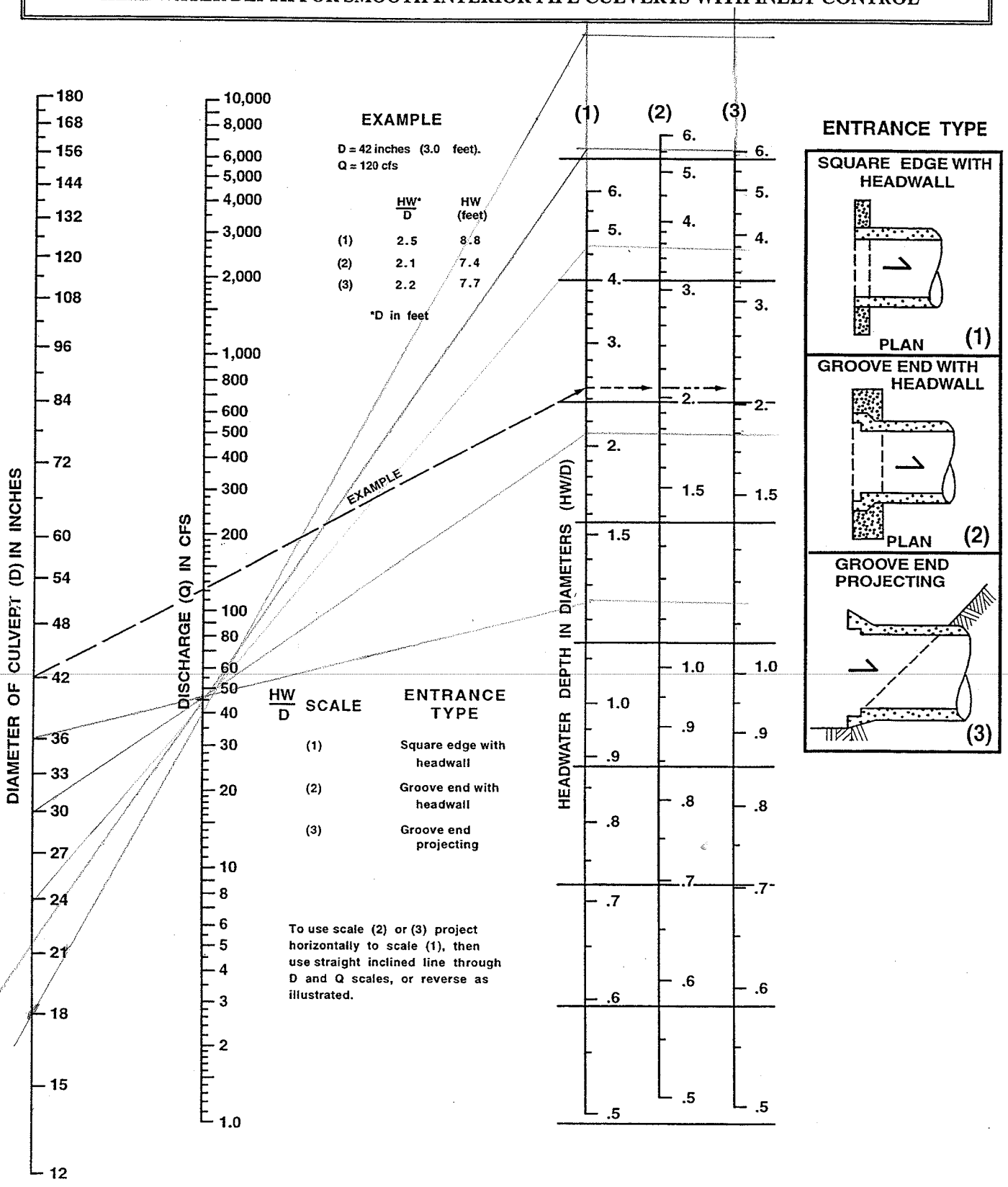
36" Ø $\Rightarrow \frac{HW}{D} = 1.15$ $HW =$ 3.45' ok.

NOTE: ① DITCH U/S OF 18" Ø IS WIDE & LIKELY PROVIDES SOME FLOOD STORAGE.

② ASSUMES INLET CONTROL $\Rightarrow$ NO BACKWATER.

③ IF PROJECT 13 IMPLEMENTED THIS EXISTING 18" Ø WOULD NOT NEED UPGRADES.

FIGURE 4.3.1.B
HEADWATER DEPTH FOR SMOOTH INTERIOR PIPE CULVERTS WITH INLET CONTROL



Culvert Calculator Report
Culvert 1

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	0.00	ft	Headwater Depth/Height	1.24	
Computed Headwater Elev	147.57	ft	Discharge	22.11	cfs
Inlet Control HW Elev.	147.56	ft	Tailwater Elevation	0.00	ft
Outlet Control HW Elev.	147.57	ft	Control Type	Outlet Control	

Grades					
Upstream Invert	145.35	ft	Downstream Invert	141.86	ft
Length	270.00	ft	Constructed Slope	0.012926	ft/ft

Hydraulic Profile					
Profile	M2		Depth, Downstream	1.38	ft
Slope Type	Mild		Normal Depth	1.40	ft
Flow Regime	Subcritical		Critical Depth	1.38	ft
Velocity Downstream	6.69	ft/s	Critical Slope	0.013172	ft/ft

Section					
Section Shape	Horizontal Ellipse		Mannings Coefficient	0.020	
Section Material	Concrete		Span	2.83	ft
Section Size	22x34 inch		Rise	1.79	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	147.57	ft	Upstream Velocity Head	0.68	ft
Ke	0.20		Entrance Loss	0.14	ft

Inlet Control Properties					
Inlet Control HW Elev.	147.56	ft	Flow Control	Submerged	
Inlet Type	Groove end with headwall (horizontal ellipse)		Area Full	4.0	ft²
K	0.00180		HDS 5 Chart	29	
M	2.50000		HDS 5 Scale	2	
C	0.02920		Equation Form	1	
Y	0.74000				

Culvert Calculator Report
Culvert 3

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	0.00	ft	Headwater Depth/Height	6.71	
Computed Headwater Elev	149.96	ft	Discharge	22.11	cfs
Inlet Control HW Elev.	144.94	ft	Tailwater Elevation	0.00	ft
Outlet Control HW Elev.	149.96	ft	Control Type	Outlet Control	

Grades					
Upstream Invert	139.90	ft	Downstream Invert	139.51	ft
Length	40.00	ft	Constructed Slope	0.009750	ft/ft

Hydraulic Profile					
Profile	CompositeM2PressureProfile		Depth, Downstream	1.48	ft
Slope Type	Mild		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	1.48	ft
Velocity Downstream	12.55	ft/s	Critical Slope	0.137055	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.024	
Section Material	CMP		Span	1.50	ft
Section Size	18 inch		Rise	1.50	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	149.96	ft	Upstream Velocity Head	2.43	ft
Ke	0.20		Entrance Loss	0.49	ft

Inlet Control Properties					
Inlet Control HW Elev.	144.94	ft	Flow Control	Submerged	
Inlet Type	Beveled ring, 33.7° (1.5:1) bevels		Area Full	1.8	ft²
K	0.00180		HDS 5 Chart	3	
M	2.50000		HDS 5 Scale	B	
C	0.02430		Equation Form	1	
Y	0.83000				

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Culvert Calculator Report
Culvert 4

Solve For: Headwater Elevation

Culvert Summary			
Allowable HW Elevation	0.00 ft	Headwater Depth/Height	2.89
Computed Headwater Elev	142.93 ft	Discharge	22.11 cfs
Inlet Control HW Elev.	139.99 ft	Tailwater Elevation	0.00 ft
Outlet Control HW Elev.	142.93 ft	Control Type	Outlet Control

Grades			
Upstream Invert	137.14 ft	Downstream Invert	135.28 ft
Length	150.00 ft	Constructed Slope	0.012400 ft/ft

Hydraulic Profile			
Profile	CompositeM2PressureProfile	Depth, Downstream	1.68 ft
Slope Type	Mild	Normal Depth	N/A ft
Flow Regime	Subcritical	Critical Depth	1.68 ft
Velocity Downstream	7.85 ft/s	Critical Slope	0.031266 ft/ft

Section			
Section Shape	Circular	Mannings Coefficient	0.024
Section Material	CMP	Span	2.00 ft
Section Size	24 inch	Rise	2.00 ft
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev.	142.93 ft	Upstream Velocity Head	0.77 ft
Ke	0.20	Entrance Loss	0.15 ft

Inlet Control Properties			
Inlet Control HW Elev.	139.99 ft	Flow Control	Submerged
Inlet Type	Beveled ring, 33.7° (1.5:1) bevels	Area Full	3.1 ft²
K	0.00180	HDS 5 Chart	3
M	2.50000	HDS 5 Scale	B
C	0.02430	Equation Form	1
Y	0.83000		

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Culvert Calculator Report
Culvert 5

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	0.00	ft	Headwater Depth/Height	130.08	
Computed Headwater Elev	325.71	ft	Discharge	46.55	cfs
Inlet Control HW Elev.	148.69	ft	Tailwater Elevation	0.00	ft
Outlet Control HW Elev.	325.71	ft	Control Type	Outlet Control	

Grades					
Upstream Invert	130.59	ft	Downstream Invert	126.65	ft
Length	940.00	ft	Constructed Slope	0.004191	ft/ft

Hydraulic Profile					
Profile	CompositeM2PressureProfile		Depth, Downstream	1.50	ft
Slope Type	Mild		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	1.50	ft
Velocity Downstream	26.34	ft/s	Critical Slope	0.191884	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Concrete		Span	1.50	ft
Section Size	18 inch		Rise	1.50	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	325.71	ft	Upstream Velocity Head	10.78	ft
Ke	0.20		Entrance Loss	2.16	ft

Inlet Control Properties					
Inlet Control HW Elev.	148.69	ft	Flow Control	Submerged	
Inlet Type	Beveled ring, 33.7° bevels		Area Full	1.8	ft²
K	0.00180		HDS 5 Chart	3	
M	2.50000		HDS 5 Scale	B	
C	0.02430		Equation Form	1	
Y	0.83000				

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Project Engineer: Chris Dimilanta

#1 6/4/08

Estimate flow rate based on available HW capacity
62/74
- zero tail water assumed

(4) $Q_4 = 18.61$ cfs assuming 4' HW
$Q_4 = 22.49$ cfs assuming 6' HW

(5) $Q_5 = 8.55$ cfs assuming 4' HW
$Q_5 = 9.71$ cfs assuming 6' HW

Culvert Calculator Report
Culvert 3 with 4-ft Headwater, Solving for Pipe Diameter

Solve For: Section Size

Culvert Summary					
Allowable HW Elevation	143.90	ft	Headwater Depth/Height	1.84	
Computed Headwater Elev	143.58	ft	Discharge	22.11	cfs
Inlet Control HW Elev.	142.75	ft	Tailwater Elevation	0.00	ft
Outlet Control HW Elev.	143.58	ft	Control Type	Outlet Control	

Grades					
Upstream Invert	139.90	ft	Downstream Invert	139.51	ft
Length	40.00	ft	Constructed Slope	0.009750	ft/ft

Hydraulic Profile					
Profile	CompositeM2PressureProfile		Depth, Downstream	1.68	ft
Slope Type	Mild		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	1.68	ft
Velocity Downstream	7.85	ft/s	Critical Slope	0.031266	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.024	
Section Material	CMP		Span	2.00	ft
Section Size	24 inch		Rise	2.00	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	143.58	ft	Upstream Velocity Head	0.77	ft
Ke	0.20		Entrance Loss	0.15	ft

Inlet Control Properties				
Inlet Control HW Elev.	142.75	ft	Flow Control	Submerged
Inlet Type	Beveled ring, 33.7° (1.5:1) bevels		Area Full	3.1 ft²
K	0.00180		HDS 5 Chart	3
M	2.50000		HDS 5 Scale	B
C	0.02430		Equation Form	1
Y	0.83000			

Culvert Calculator Report
Culvert 3 with 4-ft Headwater & 2-ft Tailwater, Solving for Pipe Diameter

Solve For: Section Size

Culvert Summary					
Allowable HW Elevation	143.90	ft	Headwater Depth/Height	1.92	
Computed Headwater Elev	143.74	ft	Discharge	22.11	cfs
Inlet Control HW Elev.	142.75	ft	Tailwater Elevation	141.51	ft
Outlet Control HW Elev.	143.74	ft	Control Type	Outlet Control	

Grades					
Upstream Invert	139.90	ft	Downstream Invert	139.51	ft
Length	40.00	ft	Constructed Slope	0.009750	ft/ft

Hydraulic Profile					
Profile	PressureProfile		Depth, Downstream	2.00	ft
Slope Type	N/A		Normal Depth	N/A	ft
Flow Regime	N/A		Critical Depth	1.68	ft
Velocity Downstream	7.04	ft/s	Critical Slope	0.031266	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.024	
Section Material	CMP		Span	2.00	ft
Section Size	24 inch		Rise	2.00	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	143.74	ft	Upstream Velocity Head	0.77	ft
Ke	0.20		Entrance Loss	0.15	ft

Inlet Control Properties					
Inlet Control HW Elev.	142.75	ft	Flow Control	Submerged	
Inlet Type	Beveled ring, 33.7° (1.5:1) bevels		Area Full	3.1	ft²
K	0.00180		HDS 5 Chart	3	
M	2.50000		HDS 5 Scale	B	
C	0.02430		Equation Form	1	
Y	0.83000				

Culvert Calculator Report
Culvert 4 with 4-ft Headwater, Solving for Pipe Diameter

Solve For: Section Size

Culvert Summary					
Allowable HW Elevation	141.14	ft	Headwater Depth/Height	1.41	
Computed Headwater Elev	140.30	ft	Discharge	22.11	cfs
Inlet Control HW Elev.	139.69	ft	Tailwater Elevation	0.00	ft
Outlet Control HW Elev.	140.30	ft	Control Type	Outlet Control	

Grades					
Upstream Invert	137.14	ft	Downstream Invert	135.28	ft
Length	150.00	ft	Constructed Slope	0.012400	ft/ft

Hydraulic Profile					
Profile	CompositeM2PressureProfile		Depth, Downstream	1.65	ft
Slope Type	Mild		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	1.65	ft
Velocity Downstream	7.09	ft/s	Critical Slope	0.022163	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.024	
Section Material	CMP		Span	2.25	ft
Section Size	27 inch		Rise	2.25	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	140.30	ft	Upstream Velocity Head	0.48	ft
Ke	0.20		Entrance Loss	0.10	ft

Inlet Control Properties					
Inlet Control HW Elev.	139.69	ft	Flow Control	Transition	
Inlet Type	Beveled ring, 33.7° (1.5:1) bevels		Area Full	4.0	ft²
K	0.00180		HDS 5 Chart	3	
M	2.50000		HDS 5 Scale	B	
C	0.02430		Equation Form	1	
Y	0.83000				

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Culvert Calculator Report
Culvert 4 with 4-ft Headwater & 2-ft Tailwater, Solving for Pipe Diameter

Solve For: Section Size

Culvert Summary					
Allowable HW Elevation	141.14	ft	Headwater Depth/Height	1.45	
Computed Headwater Elev	140.40	ft	Discharge	22.11	cfs
Inlet Control HW Elev.	139.69	ft	Tailwater Elevation	137.28	ft
Outlet Control HW Elev.	140.40	ft	Control Type	Outlet Control	

Grades					
Upstream Invert	137.14	ft	Downstream Invert	135.28	ft
Length	150.00	ft	Constructed Slope	0.012400	ft/ft

Hydraulic Profile					
Profile	CompositeM2PressureProfile		Depth, Downstream	2.00	ft
Slope Type	Mild		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	1.65	ft
Velocity Downstream	5.92	ft/s	Critical Slope	0.022163	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.024	
Section Material	CMP		Span	2.25	ft
Section Size	27 inch		Rise	2.25	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	140.40	ft	Upstream Velocity Head	0.48	ft
Ke	0.20		Entrance Loss	0.10	ft

Inlet Control Properties					
Inlet Control HW Elev.	139.69	ft	Flow Control	Transition	
Inlet Type	Beveled ring, 33.7° (1.5:1) bevels		Area Full	4.0	ft²
K	0.00180		HDS 5 Chart	3	
M	2.50000		HDS 5 Scale	B	
C	0.02430		Equation Form	1	
Y	0.83000				

Culvert Calculator Report
Culvert 6 with 4-ft Headwater, Solving for Pipe Diameter

Solve For: Section Size

Culvert Summary					
Allowable HW Elevation	134.59	ft	Headwater Depth/Height	1.21	
Computed Headwater Elev	134.22	ft	Discharge	46.55	cfs
Inlet Control HW Elev.	134.08	ft	Tailwater Elevation	0.00	ft
Outlet Control HW Elev.	134.22	ft	Control Type	Outlet Control	

Grades					
Upstream Invert	130.59	ft	Downstream Invert	126.65	ft
Length	940.00	ft	Constructed Slope	0.004191	ft/ft

Hydraulic Profile					
Profile	M2		Depth, Downstream	2.22	ft
Slope Type	Mild		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	2.22	ft
Velocity Downstream	8.29	ft/s	Critical Slope	0.006030	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Concrete		Span	3.00	ft
Section Size	36 inch		Rise	3.00	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	134.22	ft	Upstream Velocity Head	0.73	ft
Ke	0.20		Entrance Loss	0.15	ft

Inlet Control Properties				
Inlet Control HW Elev.	134.08 ft	Flow Control	Transition	
Inlet Type	Beveled ring, 33.7° bevels	Area Full	7.1	ft²
K	0.00180	HDS 5 Chart	3	
M	2.50000	HDS 5 Scale	B	
C	0.02430	Equation Form	1	
Y	0.83000			

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Culvert Calculator Report
Culvert 6 with 4-ft Headwater & 2-ft Tailwater, Solving for Pipe Diameter

Solve For: Section Size

Culvert Summary			
Allowable HW Elevation	134.59 ft	Headwater Depth/Height	1.21
Computed Headwater Elev	134.22 ft	Discharge	46.55 cfs
Inlet Control HW Elev.	134.08 ft	Tailwater Elevation	128.65 ft
Outlet Control HW Elev.	134.22 ft	Control Type	Outlet Control

Grades			
Upstream Invert	130.59 ft	Downstream Invert	126.65 ft
Length	940.00 ft	Constructed Slope	0.004191 ft/ft

Hydraulic Profile			
Profile	M2	Depth, Downstream	2.22 ft
Slope Type	Mild	Normal Depth	N/A ft
Flow Regime	Subcritical	Critical Depth	2.22 ft
Velocity Downstream	8.29 ft/s	Critical Slope	0.006030 ft/ft

Section			
Section Shape	Circular	Mannings Coefficient	0.013
Section Material	Concrete	Span	3.00 ft
Section Size	36 inch	Rise	3.00 ft
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev.	134.22 ft	Upstream Velocity Head	0.73 ft
Ke	0.20	Entrance Loss	0.15 ft

Inlet Control Properties			
Inlet Control HW Elev.	134.08 ft	Flow Control	Transition
Inlet Type	Beveled ring, 33.7° bevels	Area Full	7.1 ft²
K	0.00180	HDS 5 Chart	3
M	2.50000	HDS 5 Scale	B
C	0.02430	Equation Form	1
Y	0.83000		

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Project Engineer: Chris Dimilanta

ATTACHMENT 7

Existing Project Descriptions and Comments from the City

Middle Fork Basin

Problem Identified:
Listed in the 1995 Stormwater Master Plan, this project is intended to addresses capacity issues along this stretch of the drainage system.

Proposed Project:
Project consists of replacement of an undersized culvert under the BNSF railroad tracks at approximately 182nd Street NE and replacement of a culvert at the intersection of 172nd Street NE and the BNSF railroad tracks. The second project also requires ditching and installation of a new culvert near the property at 172nd Street NE and 67th Avenue NE.

ITEM NO.	ITEM	Quantity	Units	Unit Price	Total Price	2006 Unit Price	2006 Total Price
13	**67th Street Improvements (BNRR Xing @ 182nd)**						
1	Roadway Excavation, w/ Haul*	100	CY	$8.50	$850	$10	$957
2	Arch Culvert (8-feet)	60	LF			$400	$24,000
3	Head Wall (8-feet) & Wing Wall (8-feet)	2	EA			$2,500	$5,000
4	Culvert Backfill & Compaction*	10	CY	$20	$200	$23	$225
5	Aggregate Base & Surfacing Coarse	10	CY	$18	$180	$20	$203
6	Stream Reconstruction	1	LS			$10,000	$10,000
7	Protect Existing Utilities & One Call Services	1	LS	$750	$750	$844	$844
8	Trench Safety	60	LF	$2	$120	$2	$135
9	SPCC Plan, Silt Fence, & TESC Measures	100	LF	$5	$500	$6	$563
10	Roadway Restoration	100	CY			$50	$5,000
11	Traffic Control Labor	100	Hours	$35	$3,500	$39	$3,939
	Subtotal				**$6,100**		**$50,866**
	67th Street Improvements (172nd Storm Reroute @ Corner Property)						
12	Roadway Excavation, w/ Haul*	100	CY	$8.50	$850	$10	$957
13	Arch Culvert (8-feet)	60	LF			$400	$24,000
14	Head Wall (8-feet) & Wing Wall (8-feet)	2	EA			$2,500	$5,000
15	Culvert Backfill & Compaction*	10	CY	$20	$200	$23	$225
16	Aggregate Base & Surfacing Coarse	10	CY	$18	$180	$20	$203
17	Stream Reconstruction	1	LS			$10,000	$10,000
18	Protect Existing Utilities & One Call Services	1	LS	$750	$750	$844	$844
19	Trench Safety	60	LF	$2	$120	$2	$135
20	SPCC Plan, Silt Fence, & TESC Measures	100	LF	$5	$500	$6	$563
21	Roadway Restoration	100	CY			$50	$5,000
22	Traffic Control Labor	100	Hours	$35	$3,500	$39	$3,939
	Subtotal				**$6,100**		**$50,866**
	Subtotal for 67th Street Improvements				**$12,200**		**$101,731**
23	Mobilization/Overhead & Profit	1	LS	10%	$1,220	10%	$10,173
24	Contingency	1	LS	30%	$3,660	30%	$30,519
25	Sales Tax	1	LS	8.5%	$1,452	8.5%	$12,106
	Estimated Construction Cost				**$18,532**		**$154,530**
26	Eng'r, Permitting, Legal, Admin (25%)	1	LS	25%	$4,633	25%	$38,632
27	Geotech Borings & Soil Tests	1	LS			$10,000	$10,000
28	Surveying (Property, Design & Const.)	1	LS	4%	$741	4%	$6,181
29	Construction Management (4%)	1	LS	4%	$741	4%	$6,181
	CITY'S ESTIMATE (2003)				**$216,000**		
	TOTAL 2002 DOLLARS				**$24,647**		
	TOTAL 2006 DOLLARS						**$215,525**

Notes:
1 Quantities based on discussions with City of Arlington staff 12/10/2002.
2 (*) Indicates Unit Prices from 67th Ave. NE Bid Tab opened March 15, 2001.
3 (RSM) Indicates Unit Prices from RS Means.
4 Assumes a single contractor (or City) to perform all projects in the area under one contract.
5 See accompanying text for more detailed description.

Middle Fork Basin

Problem Identified:
Listed in the 1995 Stormwater Master Plan, this project is intended to addresses capacity issues along this stretch of the drainage system.
Proposed Project:
Project includes constructing a regional conveyance system of channels supporting fish passage roughly parallel to 172nd Street NE, and constructing a large water quality wetland in each of the two Quilceda Creek basins on lands south of 172nd Street NE.

ITEM NO.	ITEM	Quantity	Units	Unit Price	Total Price	2006 Unit Price	2006 Total Price
14	**172nd Street Regional Drainage Improvements**						
1	Traffic Safety Control Devices	1	LS	$7,500	$7,500	$8,445	$8,445
2	Storm Sewer Pipe (48-inch)	1,425	LF	$85	$121,125	$96	$136,387
3	Type 2 - 72" Catch Basins*		EA	$3,800	$0	$4,279	$0
4	Type 2 - 96" Catch Basins	11	EA	$7,500	$82,500	$8,445	$92,895
5	Ditch Cleaning & Berming	5,200	LF	$18.50	$96,200	$20.83	$108,321
6	Wetpond Facility Excavation - Area 1*	12,750	CY	$5.50	$70,125	$6.19	$78,961
7	Wetpond Facility Excavation - Area 2*	13,250	CY	$6	$72,875	$6	$82,057
8	Detention Facility Embankment - Area 1	2,420	CY	$13	$32,259	$15	$36,323
9	Detention Facility Embankment - Area 2	2,420	CY	$13	$32,259	$15	$36,323
10	Det. Facility Control Structure/Outlet-Area 1	1	LS	$25,000	$25,000	$28,150	$28,150
11	Det. Facility Control Structure/Outlet-Area 2	1	LS	$25,000	$25,000	$28,150	$28,150
12	Detention Facility Land Acquisition - Area 1	2	Acre	$50,000	$100,000	$56,300	$112,600
13	Detention Facility Land Acquisition - Area 2	2	Acre	$50,000	$100,000	$56,300	$112,600
14	Relocate Existing Utilities	1	LS	$2,500	$2,500	$2,815	$2,815
15	Trench Safety	1,425	LF	$2	$2,850	$2	$3,209
New Items							
16	SPCC Plan, Silt Fence, & TESC Measures	1,425	LF	$5	$7,125	$6	$8,023
17	Traffic Control Labor	600	Hours	$35	$21,000	$39	$23,646
	Subtotal				**$798,317**		**$898,905**
18	Mobilization/Demob/Overhead & Profit	1	LS	10%	$79,832	10%	$89,891
19	Contingency	1	LS	30%	$263,445	30%	$296,639
20	Sales Tax	1	LS	8.5%	$97,035	8.5%	$109,262
	Estimated Construction Cost				**$1,238,629**		**$1,394,696**
21	Eng'r, Permitting, Legal, Admin (25%)	1	LS	25%	$309,657	25%	$348,674
22	Surveying (Design, Const. & As-built)	1	LS	4%	$49,545	4%	$55,788
23	Construction Management (4%)	1	LS	4%	$49,545	4%	$55,788
	CITY'S ESTIMATE (2003)				**$2,036,000**		
	TOTAL 2002 DOLLARS				**$1,647,377**		
	TOTAL 2006 DOLLARS						**$1,854,946**

Notes:
1 Quantities based on previous take-off in 1995 Comprehensive Plan with New Items.
2 (*) Indicates Unit Prices from 67th Ave. NE Bid Tab opened March 15, 2001.
3 (RSM) Indicates Unit Prices from RS Means.
4 Assumes a single contractor to perform all projects in the area under one contract.
5 See accompanying text for more detailed description.

City of Arlington Utilities Division

Memo

To: Carla Talich

From: Mike Wolanek

cc: James Kelly, Skip Grodt

Date: 6/2/2008

Re: Arlington Stormwater Comp Plan Modeling "Punchlist" Responses

---

Carla, here are the responses to selected information needs you presented to us at our meeting on Thursday, May 29, 2008.

1) Flooding in Talcott basin on 4th Street downstream of Clara Ave. at 2 yr event: Local flooding has never been observed (20 year history)

2) Flooding in Talcott basin on Alcazar Ave near Division St at ~10 yr event: Local flooding has never been observed except when inlets were clogged with leaves (20 year history)

3) Edgecomb Creek near Lumberman's (NW of intersection of 172nd St and 67th Ave):

a. Flooding history: >>10 years ago—perhaps >15 yrs ago—during an intense storm event that affected the entire city, an perhaps one other event; but issues in all cases are understood to be related to non-maintenance, not flow restrictions;

b. Jurisdiction: even though the culvert is on/under private property, there are dedicated stormwater easements that maintain city ownership and maintenance responsibility (early non-maintenance issues may have been a combination of wood waste on owner's part and lack of understanding of jurisdiction on city's part);

c. Weir: understood to be installed with development of site BMPs for petroleum uses by second owner of existing facility (west of Lumberman's) that is now Petrocard (previously Thunderbird Lubricants, previously and originally Pacific Densified Fuels [pellets]); function was stormwater detention though cannot find plans and/or design documents; WDFW considers the weir to be the division between non-fish-bearing stream (north) and fish-bearing stream (south); regarding the prospect of weir

removal, it seems to me that evaluation of this effort is in itself a project to be identified (in the SCP) because of complexities associated with multiple other hydraulic influences or potential influences, including developments on the NE and SW corners of this intersection. Carla, does this answer your questions regarding the weir?

d. Cross section data for the channel paralleling 67th Avenue are summarized in the table below. Each record corresponds to a channel or culvert segment in our GIS data which URS should have. Records are in sequential order from north to south:

Feature (From / To)	Segment Length (ft)	Top Width (ft) [or diameter]	Bottom Width (ft)	Average Depth (ft)
First open channel west of 67th and d/s of west-trending culvert (same data for short fork to 2 culverts)	234	14	6	2.5
Two culverts under BNSF RR flowing from east to west	36 42	[24 inch] [36 inch]		
Channel	386	14	4.5	3.5
Channel	364	20	8	8
Channel	287	20	8	6
Culvert under ~182nd Street	41	[Diameter unknown (buried)]		
Channel	1,097	18	4.5	4
Missing info—URS may have improved data for a connection under a RR spur	Approx			
Channel	169	12	1.5	3
Culvert under old channel crossing	39	[Diameter unknown (buried)]		
Channel	982	12	1.5	3
First culvert under Lumberman's trending west	244	[18 inch concrete]		

4) Kruger Creek: I could not find any correspondence to/from Selene other than inquiries about where this basin was. (You will find it easily in our current mapping as a NNW-trending fifth-tier basin that is the first tributary to Upper Portage Creek—parallel to the west; Eagle Creek is the basin to the east.) There are several projects in the Kruger Creek basin in the early drafts of the SCP (which pre-date current Utilities staff). Project

number 206 calls for a culvert replacement of Kruger Creek under Burn Road, and estimates an 8 foot "wide" pipe (arch?) that is 60 ft in length.

5) Projects Map: I am working on a map showing an overview of all currently identified problem areas. So it will actually be a "Problem Areas Map", some of which have proposed projects identified. I hope to have this to you this week.

This memo responds to everything I have in my notes as needed information. Let me know if I've overlooked anything.

Also, the City would like to obtain copies of the Excel file(s) which develop the project cost estimates. We will use them for updating the project numbers and titles, and as a template for developing projects for additional, recently identified problem statements. We will update you with revisions prior to working on updates to proposed costs.