ATTACHMENT E

Stormwater Analyses

ATTACHMENT E

STORMWATER CALCULATIONS

This Attachment presents calculations regarding the project surface water management system. The calculations include the following:

- Establish the exiting conditions and peak flows for each area for the 1, 10, 25 and 100-year storm events, and
- Establish the proposed conditions and peak flows for each area for the 1, 10, 25 and 100-year storm events.

The project consists of two areas, a West Area and an East Area. The existing conditions for the West Area has surface water flows to both Wetlands RG-5 and RG-6 and the existing conditions for the East Area has surface water flows to Wetlands RG-5, RG-6 and RG-7. The peak flows for each area are summarized below:

Existing Conditions
Peak Storm Flows

Drainage Area	Wetland	Q peak–1 yr. (cfs)	Q peak–10 yr. (cfs)	Q peak–25 yr. (cfs)	Q peak–100 yr. (cfs)
1E	RG-6	0.36	3.06	4.21	5.96
2E	RG-5	0.28	2.26	3.11	4.42
3E	RG-7	2.21	17.95	24.76	35.14
4W	RG-5	1.37	11.80	16.15	22.73
5W	RG-6	0.76	6.51	8.92	12.59

Note: Refer to sheet 6 of 87 for a sketch of the drainage areas.

Each borrow area will be developed to include a sedimentation basin, consisting of a forebay and permanent pool. The West Area basin will collect all of the stormwater from drainage areas 4W and 5W and discharge it to Wetland RG-6. The East Area basin will collect all of the stormwater from drainage areas 1E, 2E and 3E and discharge it to Wetland RG-7. The peak flows from each basin is shown below:

Proposed Conditions
Peak Storm Flows

Drainage Area	Wetland	Q peak–1 yr. (cfs)	Q peak–10 yr. (cfs)	Q peak–25 yr. (cfs)	Q peak–100 yr. (cfs)
East	RG-7	2.03	4.50	5.17	5.82
West	RG-6	0.84	1.94	2.25	4.08

Note: Refer to sheet 34 of 87 for a sketch of the drainage areas.

For comparison purposes, we will combine the existing conditions drainage areas based on the wetland it discharges to. This will allow for a comparison of existing and proposed conditions for peak flows. The following table is a summary of existing and proposed conditions for each wetland.

Combined Conditions
Peak Storm Flows

Wetland	Q peak–1 yr. (cfs)		Q peak–10 yr. (cfs)		Q peak–25 yr. (cfs)		Q peak–100 yr. (cfs)	
	Existing	Proposed	Existing	Proposed	Existing	Proposed	Existing	Proposed
RG-5	1.65		14.06		19.26		27.15	
RG-6	1.12	0.84	9.57	1.94	13.13	2.25	18.55	4.08
RG-7	2.21	2.03	17.95	4.50	24.76	5.17	35.14	5.82

SCOPE

THE MILL SEAT FACILITY IS PROPOSING EXCAVATION OF TWO AREAS SOUTH OF THE EXISTING LANDFILL AS CLAY BORROW AREAS. CURRENTLY, THESE AREAS DRAIN INTO NYSDEC WETLANDS RG-5, RG-6, AND RG-7. DURING EXCAVATION OF THE BORROW PITS, STORMWATER WILL BE DIRECTED TO SEDIMENTATION/STORMWATER PONDS, PRIOR TO RELEASE INTO THE NYSDEC WETLANDS. FOLLOWING COMPLETION OF THE EXCAVATION, THE PONDS WILL REMAIN AND CONTINUE TO RETAIN STORMWATER BEFORE IT IS DISCHARGED INTO NYSDEC WETLANDS.

THE STORMWATER ANALYSIS INCLUDES:

1) ESTABLISH EXISTING CONDITIONS FOR DRAINAGE AREAS, FLOW PATHS AND FLOW RATES FOR THE 1-YR, 10-YR, 25-YR AND 100-YR STORM EVENTS.

2) ESTABLISH PROPOSED CONDITIONS FOR DRAINAGE AREAS, FLOW PATHS AND FLOW RATES FOR THE 1-YR, 10-YR, 25-YR AND 100-YR STORM EVENTS.

3) ESTABLISH POND LAYOUTS AND OUTLET STRUCTURES

4) ROUTE STORM FLOWS THROUGH PROPOSED PONDS FOR COMPARISON TO EXISTING CONDITIONS

OBJECTIVE IS TO CONTINUE DISCHARGING WATER TO WETLAND RG-6 AND TO MAINTAIN FLOW RATES EQUAL TO OR LESS THAN DURING THE EXISTING CONDITIONS

THE EAST BORROW AREA CAN BE BROKEN INTO 3 SUBAREAS (SEE PAGE 6)

SUBAREA #1E

- DRAINS TOWARD WETLAND RG-6
- AREA = $172{,}908\ ft^2 \left(\times \frac{1\ ACRE}{43560\ ft^2}\right) = 3.97$ ACRES
- MOST SOIL IS TYPE B (SEE PG. 7-8)
- AREA IS PRIMARILY POOR BRUSH

} CN = 67

SHEET FLOW → L = 150 FT
(A-B)

$S = \frac{677-674}{150\ ft} = 0.02\ ft/ft$

DENSE GRASS → n = 0.24

$P_2 = 2.5''$ (SEE PG. 9)

SHALLOW CONCENTRATED → L = 367 - 150 = 217 ft
(B-C)

$S = \frac{674-672}{217} = 0.0092\ ft/ft$

SHORT GRASS PASTURE

SUBAREA #2E

- DRAINS TO WETLAND RG-5
- AREA = $194053\ ft^2 \left(\times \frac{1\ ACRE}{43560\ ft^2}\right) = 4.45$ ACRES
- CN = 67 (SAME AS ABOVE)

SHEET FLOW → L = 150 FT
(A-B)

$S = \frac{677-674}{150\ ft} = 0.02\ ft/ft$

DENSE GRASS → n = 0.24

$P_2 = 2.5''$

SHALLOW CONCENTRATED → L = 890 - 150 ft = 740 ft
(B-C)

$S = \frac{674'-671'}{740\ ft} = 0.0041\ ft/ft$

SHORT GRASS PASTURE

SUBAREA #3E

- DRAINS TO WETLAND RG-7
- AREA = $1{,}445{,}553\ ft^2 \left(\times \frac{1\ ACRE}{43560\ ft^2}\right) = 33.19$ ACRE

- CN = 67 (SAME AS #1E, #2E)

SHEETFLOW → L = 150 ft
(A-B)

$$S = \frac{677-675}{150} = 0.013\ ft/ft$$

DENSE GRASS → n = 0.24

$P_2 = 2.5''$

SHALLOW CONCENTRATED → L = 1131 − 150 = 981 ft
(B-C)

$$S = \frac{675-660}{981\ ft} = 0.015\ ft/ft$$

SHORT GRASS PASTURE

THE WEST BORROW AREAS CAN BE DIVIDED INTO 2 SUBAREAS (SEE PG. 6)

SUBAREA #4W

- DRAINS TO WETLAND RG-5
- AREA = 542,432 ft² $\left(\times \frac{1 \text{ ACRE}}{43560 \text{ ft}^2}\right)$ = 12.45 ACRE
- SOIL IS PRIMARILY TYPE B
- AREA IS PRIMARILY POOR BRUSH

} CN = 67

SHEET FLOW → L = 150 FT
(A-B)

$$S = \frac{719 - 709}{150 \text{ ft}} = 0.067 \text{ ft/ft}$$

DENSE GRASS → n = 0.24

P_2 = 2.5"

SHALLOW CONCENTRATED

(B-C) LEG 1: 295 - 150 = 145 ft

$$S = \frac{709 - 700}{145} = 0.062 \text{ ft/ft}$$

(C-D) LEG 2: 403 - 295 = 108 ft

$$S = \frac{700 - 688}{108} = 0.111 \text{ ft/ft}$$

(D-E) LEG 3: 765 - 403 = 362 ft

$$S = \frac{688 - 674}{362} = 0.039 \text{ ft/ft}$$

SHORT GRASS PASTURE

SUBAREA #5W

- DRAINS TO WETLAND RG-6
- AREA = 329516 ft² $\left(\times \frac{1 \text{ ACRE}}{43560 \text{ ft}^2}\right)$ = 7.56 ACRES
- CN = 67

SUBAREA #5W

SHEET FLOW → $L = 150$ ft
(A-B)

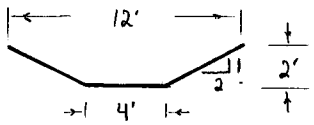
$$S = \frac{715' - 706'}{150 \text{ ft}} = 0.06 \text{ ft/ft}$$

DENSE GRASS → $n = 0.24$

$P = 2.5''$

CHANNEL FLOW → $L = 690 - 150 = 540$ ft
(B-C)

$$S = \frac{706 - 680}{540} = 0.048 \text{ ft/ft}$$



$$a = 2\left(\tfrac{1}{2} \cdot 2' \cdot 4'\right) + (2' \cdot 4') = 16 \text{ ft}^2$$

$$P_w = 4 + 2\left(\sqrt{5}\right) = 8.47 \text{ ft}$$

$$r = \frac{a}{P_w} = 1.89 \text{ ft}$$

DENSE GRASS → $n = 0.24$

SHALLOW CONCENTRATED → $L = 1035 - 690 = 345$ ft
(C-D)

$$S = \frac{680 - 670}{345} = 0.029 \text{ ft/ft}$$

SHORT GRASS PASTURE

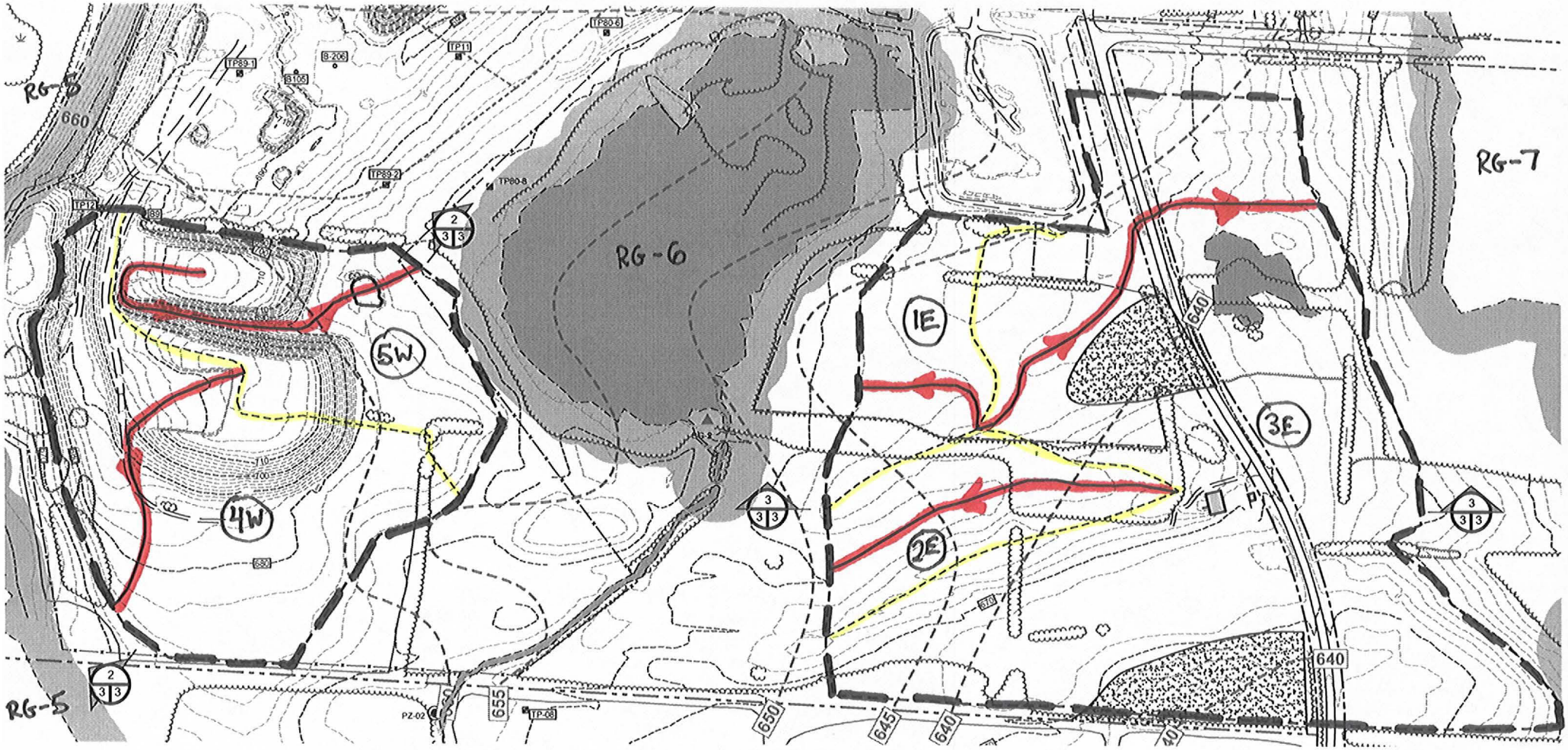
STORM EVENTS

1-YEAR DATA FROM NEW YORK STATE STORMWATER MANAGEMENT DESIGN MANUAL, AUGUST 2003

2, 10, 25, 100-YEAR FROM USDA TR-55 MANUAL, JUNE 1986 (FIGURES ON PG. 9)

EVENT	RAINFALL
1-YR	2.1 IN
2-YR	2.5 IN
10-YR	3.7 IN
25-YR	4.2 IN
100-YR	4.9 IN

N



NOT TO SCALE

DWG. No. 08015-017
8/19/09

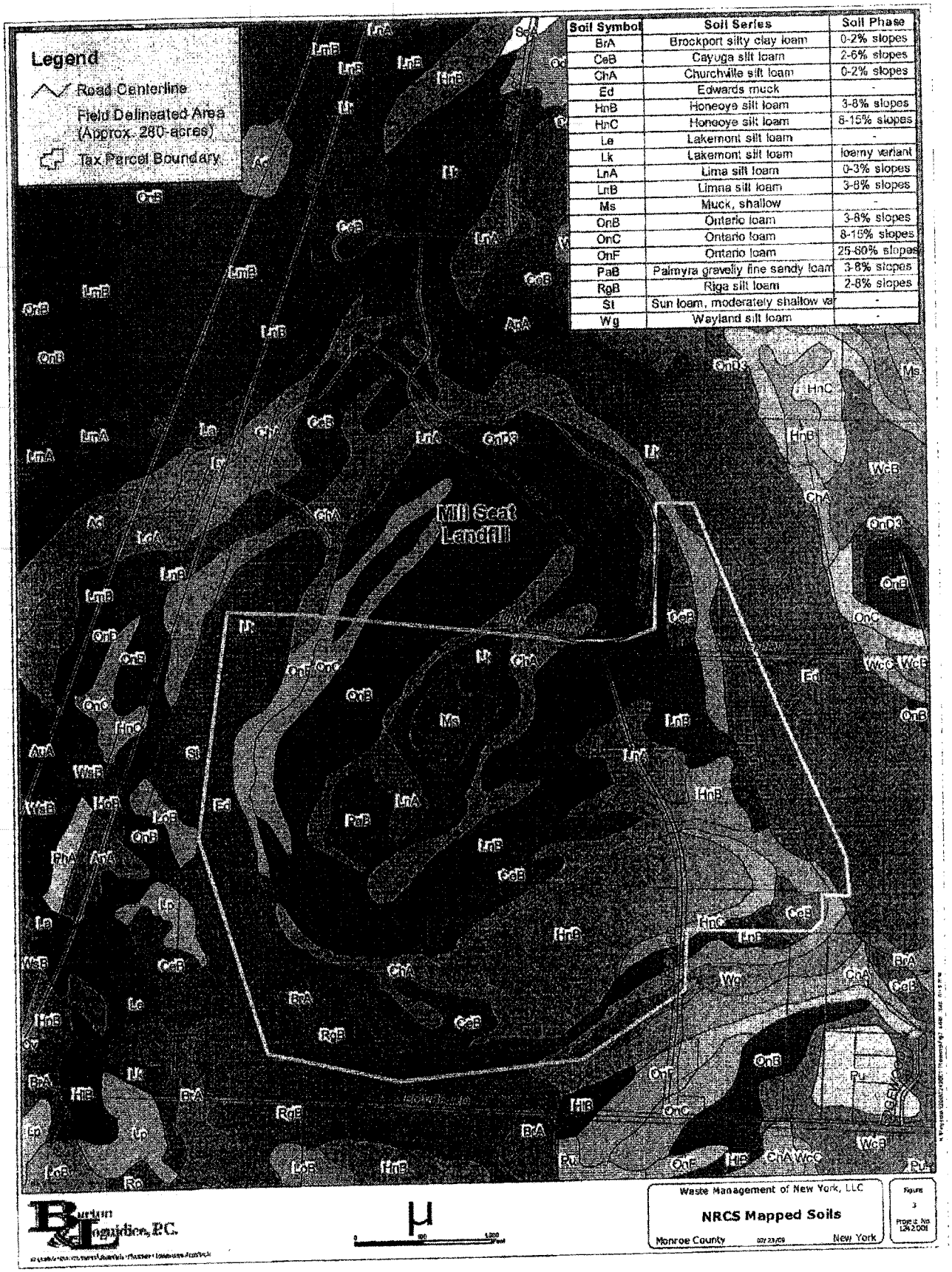
PREDOMINANT SOILS IN PROPOSED BORROW AREA

		TYPE
OnB -	ONTARIO LOAM, 3-8% SLOPES	B
HnB -	HONEOYE SILT LOAM, 3-8% SLOPES	B
LnB -	LIMA SILT LOAM, 3-8% SLOPES	B
LnA -	LIMA SILT LOAM, 0-3% SLOPES	B
PaB -	PALMYRA GRAVELLY FINE SANDY LOAM, 3-8% SLOPES	B
ChA -	CHURCHVILLE SILT LOAM, 0-2% SLOPES	D
CeB -	CAYUGA SILT LOAM, 2-6% SLOPES	C
Lk -	LAKEMONT SILT LOAM, LOAMY VARIANT	D

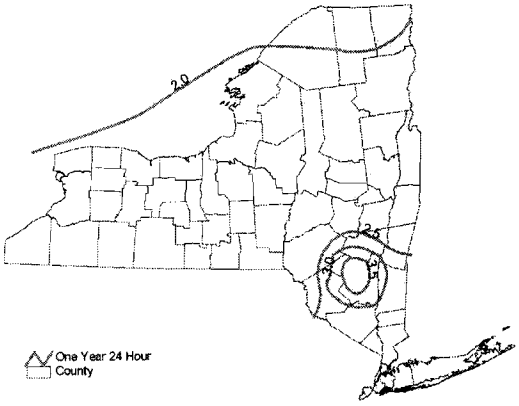
- SOILS FROM WETLAND DELINEATION REPORT FOR THE PROPOSED MILL SEAT LANDFILL SOIL BORROW AREA EXPANSION, AUGUST 2009, BARTON & LOGUIDICE, FIGURE 3 - NRCS MAPPED SOILS (FIGURE ON PG. 8)
- SOIL TYPES FOUND IN USDA TR-55, JUNE 1986, APPENDIX A

McMahon & Mann
Consulting Engineers, P.C.

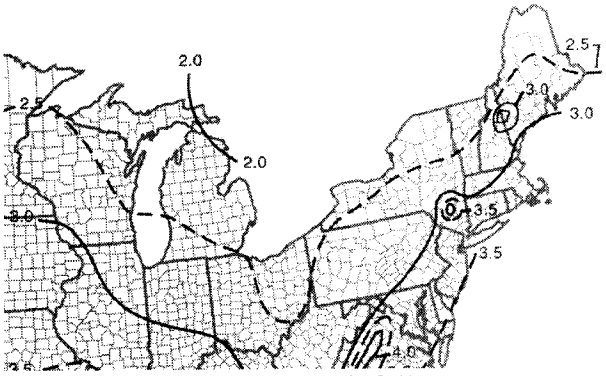
BY AJK DATE 8/24/09 SUBJECT MILL SEAT FACILITY SHT. NO. 8 OF 87
CHKD. BY AJN DATE 9/1/09 BOROW AREA STORMWATER ANALYSIS JOB NO. 08-015
EXISTING CONDITIONS - SOIL TYPES



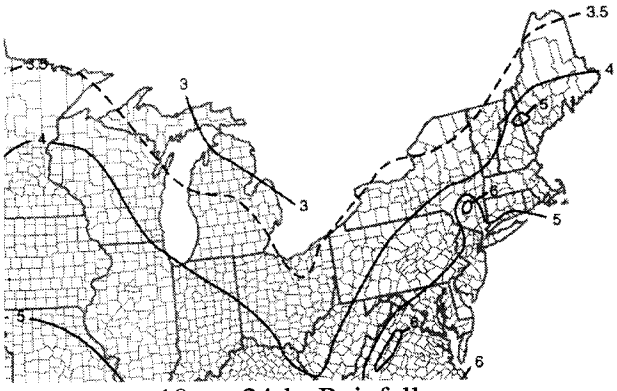
Soil Symbol	Soil Series	Soil Phase
BrA	Brockport silty clay loam	0-2% slopes
CeB	Cayuga silt loam	2-6% slopes
ChA	Churchville silt loam	0-2% slopes
Ed	Edwards muck	-
HnB	Honeoye silt loam	3-8% slopes
HnC	Honeoye silt loam	8-15% slopes
Le	Lakemont silt loam	-
Lk	Lakemont silt loam	loamy variant
LnA	Lima silt loam	0-3% slopes
LnB	Limna silt loam	3-8% slopes
Ms	Muck, shallow	-
OnB	Ontario loam	3-8% slopes
OnC	Ontario loam	8-15% slopes
OnF	Ontario loam	25-60% slopes
PaB	Palmyra gravelly fine sandy loam	3-8% slopes
RgB	Riga silt loam	2-8% slopes
St	Sun loam, moderately shallow va	-
Wg	Wayland silt loam	-



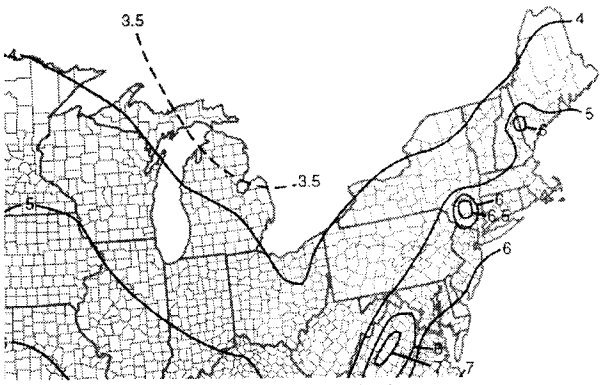
1-yr Design Storm
(NYS Stormwater Management Design Manual, August 2003, Figure 4.4)



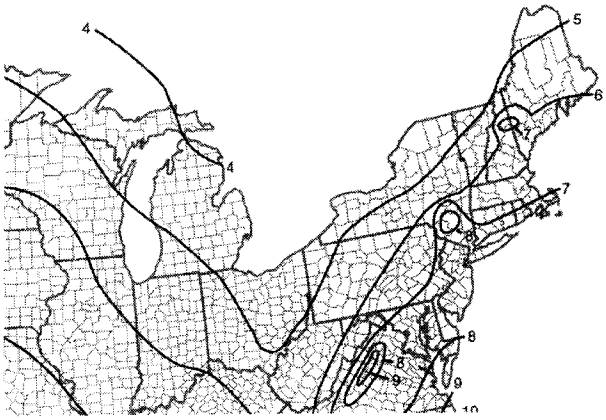
2-yr, 24-hr Rainfall
(USDA TR-55, June 1986, Figure B-3)



10-yr, 24-hr Rainfall
(USDA TR-55, June 1986, Figure B-5)



25-yr, 24-hr Rainfall
(USDA TR-55, June 1986, Figure B-6)



100-yr, 24-hr Rainfall
(USDA TR-55, June 1986, Figure B-8)

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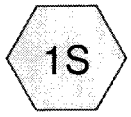
BY AJK DATE 8/19/09 SUBJECT MILLSEAT FACILITY SHT. NO. 10 OF 87
CHKD. BY AJN DATE 9/1/09 BORROW AREA STORMWATER ANALYSIS JOB NO. 08-015
EXISTING CONDITIONS

EXISTING SUMMARY TABLE

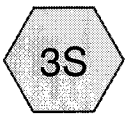
SUBAREA	DISCHARGE WETLAND	1-YR	10-YR	25-YR	100-YR
1E	RG-6	0.36 cfs	3.06 cfs	4.21 cfs	5.96 cfs
2E	RG-5	0.28	2.26	3.11	4.42
3E	RG-7	2.21	17.95	24.76	35.14
4W	RG-5	1.37	11.80	16.15	22.73
5W	RG-6	0.76	6.51	8.92	12.59

* DATA FROM ATTACHED HYDROCAD ANALYSIS

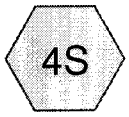


Subarea #1E

Subarea #2E

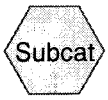


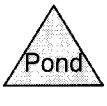
Subarea #3E



Subarea #4W

Subarea #5W





Drainage Diagram for Existing Conditions
Prepared by {enter your company name here} 8/19/2009
HydroCAD® 7.10 s/n 003326 © 2005 HydroCAD Software Solutions LLC

Subcatchment 1S: Subarea #1E

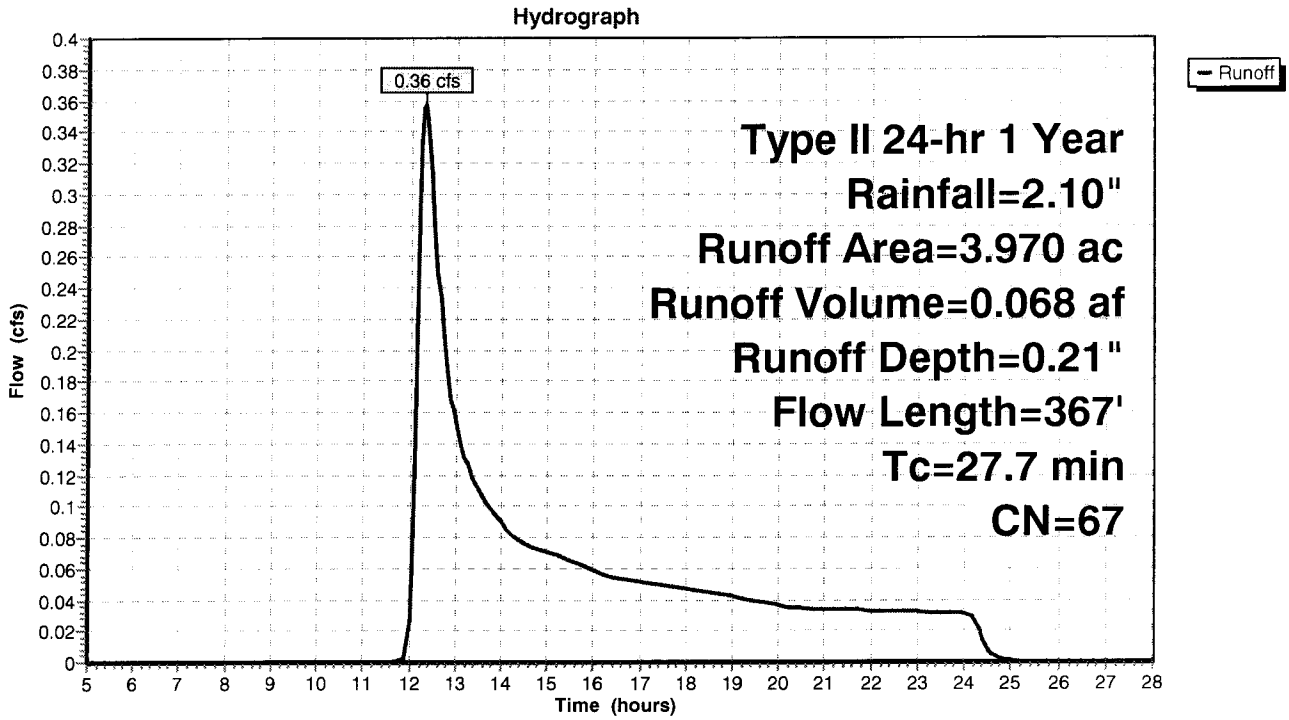
Runoff = 0.36 cfs @ 12.33 hrs, Volume= 0.068 af, Depth= 0.21"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-28.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 Year Rainfall=2.10"

Area (ac)	CN	Description
3.970	67	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.3	150	0.0200	0.1		**Sheet Flow, A to B** Grass: Dense n= 0.240 P2= 2.50"
5.4	217	0.0092	0.7		**Shallow Concentrated Flow, B to C** Short Grass Pasture Kv= 7.0 fps
27.7	367	Total			

Subcatchment 1S: Subarea #1E



Subcatchment 2S: Subarea #2E

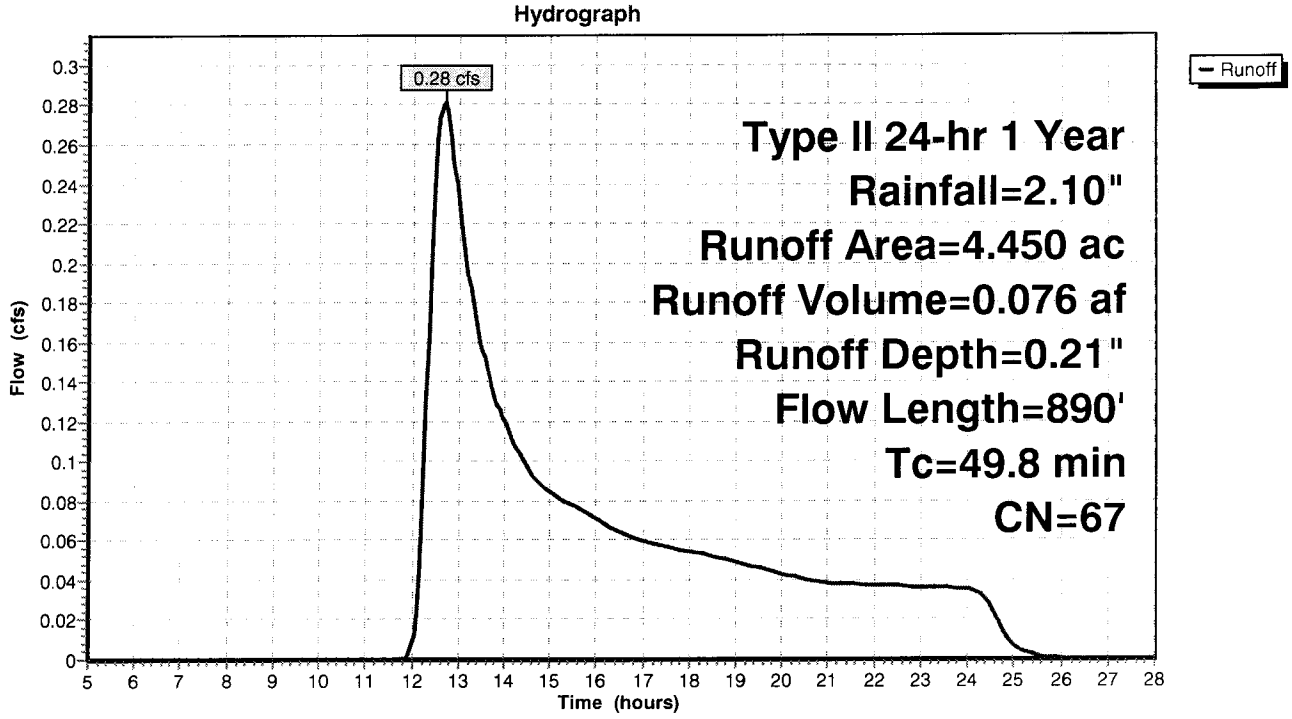
Runoff = 0.28 cfs @ 12.70 hrs, Volume= 0.076 af, Depth= 0.21"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-28.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 Year Rainfall=2.10"

Area (ac)	CN	Description
4.450	67	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.3	150	0.0200	0.1		**Sheet Flow, A to B** Grass: Dense n= 0.240 P2= 2.50"
27.5	740	0.0041	0.4		**Shallow Concentrated Flow, B to C** Short Grass Pasture Kv= 7.0 fps
49.8	890	Total			

Subcatchment 2S: Subarea #2E



Subcatchment 3S: Subarea #3E

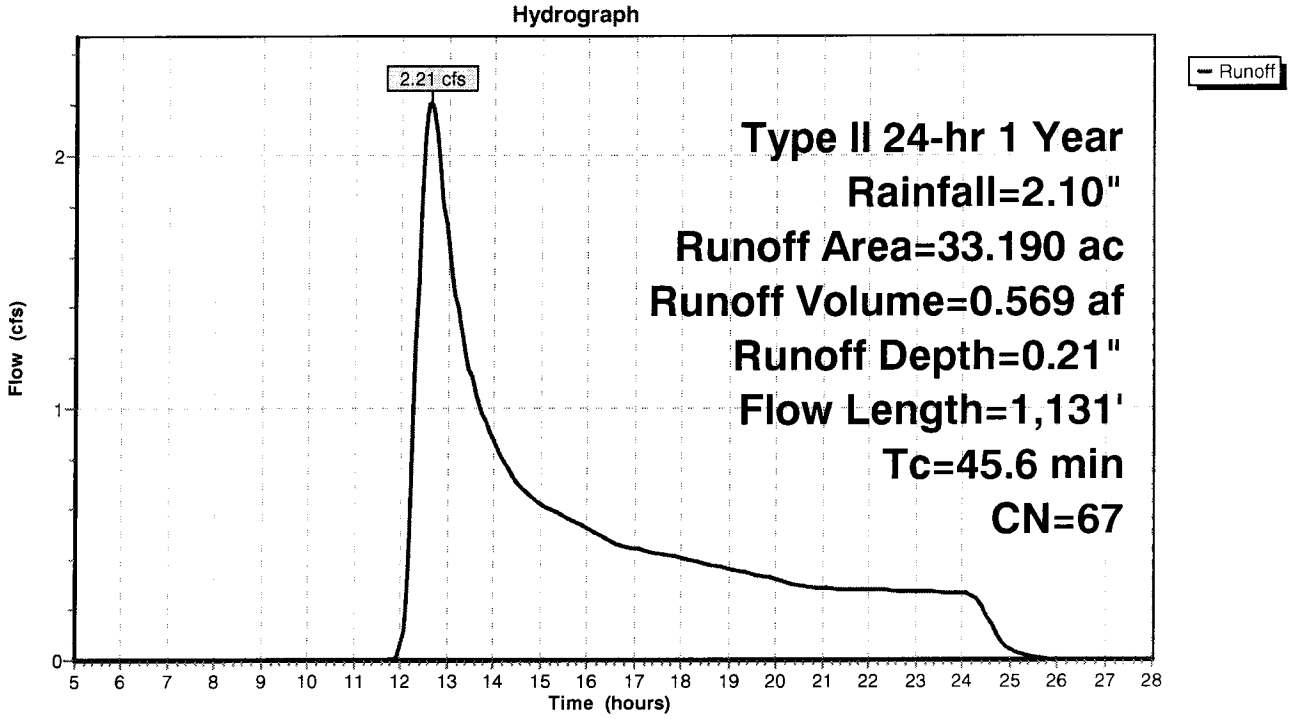
Runoff = 2.21 cfs @ 12.63 hrs, Volume= 0.569 af, Depth= 0.21"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-28.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 Year Rainfall=2.10"

Area (ac)	CN	Description
33.190	67	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
26.5	150	0.0130	0.1		**Sheet Flow, A to B** Grass: Dense n= 0.240 P2= 2.50"
19.1	981	0.0150	0.9		**Shallow Concentrated Flow, B to C** Short Grass Pasture Kv= 7.0 fps
45.6	1,131	Total			

Subcatchment 3S: Subarea #3E



Subcatchment 4S: Subarea #4W

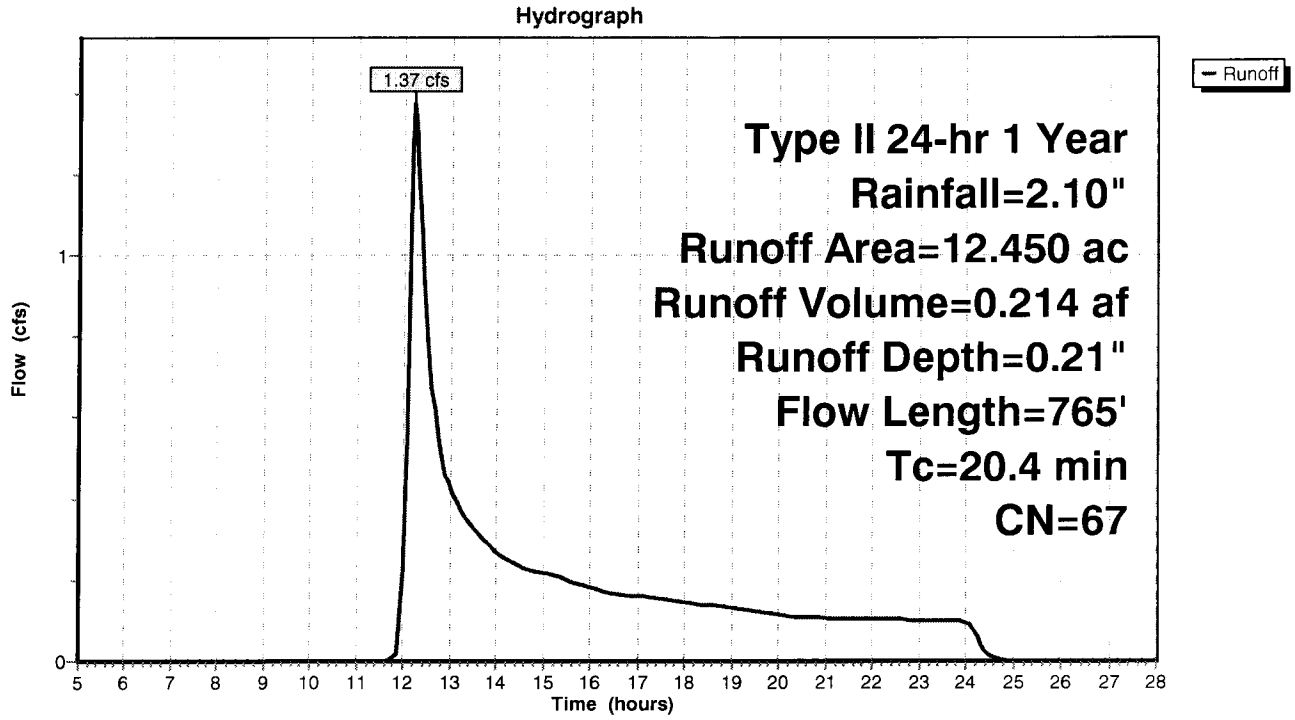
Runoff = 1.37 cfs @ 12.21 hrs, Volume= 0.214 af, Depth= 0.21"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-28.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 Year Rainfall=2.10"

Area (ac)	CN	Description
12.450	67	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.8	150	0.0670	0.2		**Sheet Flow, A to B** Grass: Dense n= 0.240 P2= 2.50"
1.4	145	0.0620	1.7		**Shallow Concentrated Flow, B to C** Short Grass Pasture Kv= 7.0 fps
0.8	108	0.1110	2.3		**Shallow Concentrated Flow, C to D** Short Grass Pasture Kv= 7.0 fps
4.4	362	0.0390	1.4		**Shallow Concentrated Flow, D to E** Short Grass Pasture Kv= 7.0 fps
20.4	765	Total			

Subcatchment 4S: Subarea #4W



Subcatchment 5S: Subarea #5W

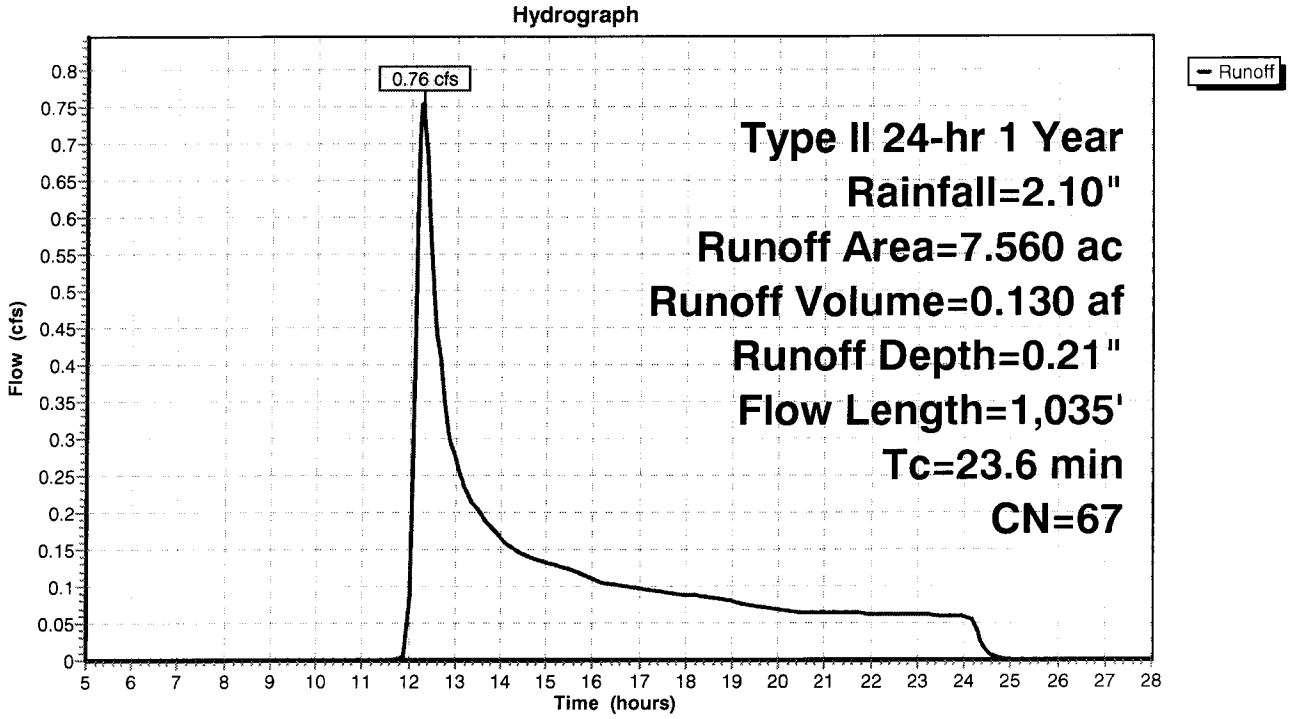
Runoff = 0.76 cfs @ 12.26 hrs, Volume= 0.130 af, Depth= 0.21"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-28.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 Year Rainfall=2.10"

Area (ac)	CN	Description
7.560	67	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.4	150	0.0600	0.2		**Sheet Flow, A to B** Grass: Dense n= 0.240 P2= 2.50"
4.4	540	0.0480	2.1	33.09	**Channel Flow, B to C** Area= 16.0 sf Perim= 8.5' r= 1.88' n= 0.240 Sheet flow over Dense Grass
4.8	345	0.0290	1.2		**Shallow Concentrated Flow, C to D** Short Grass Pasture Kv= 7.0 fps
23.6	1,035	Total			

Subcatchment 5S: Subarea #5W



Subcatchment 1S: Subarea #1E

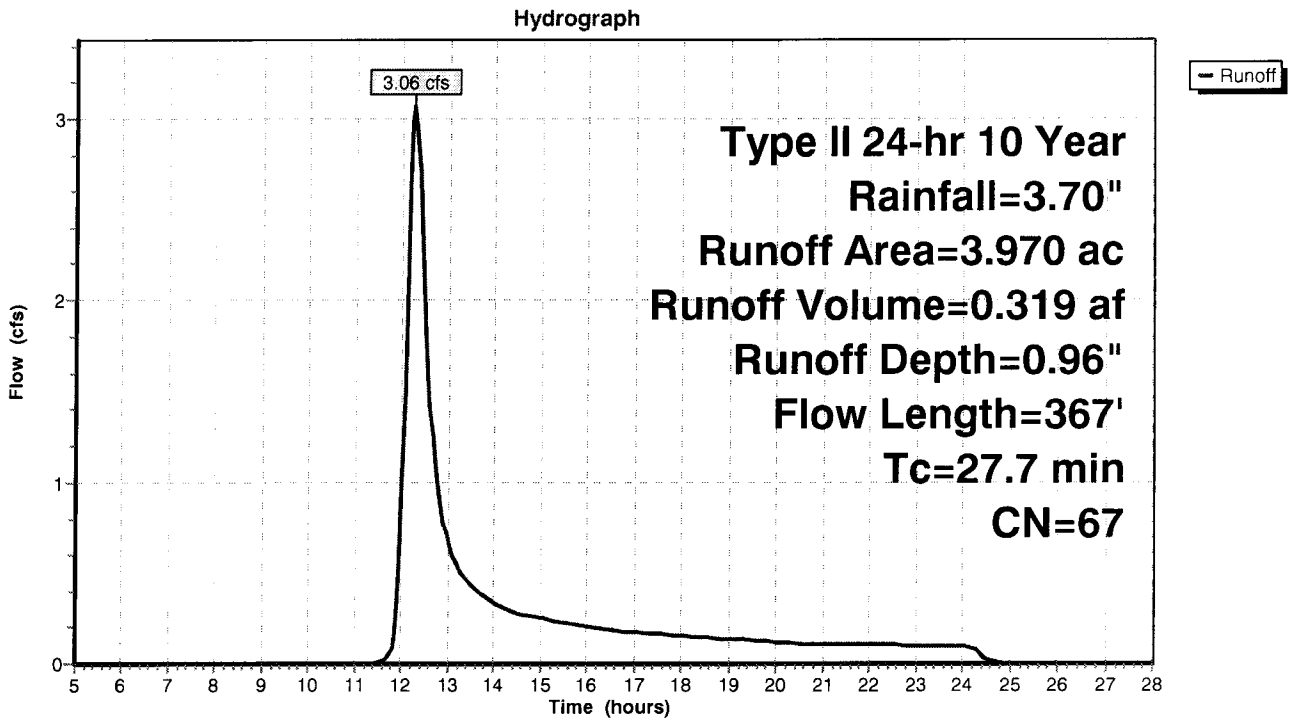
Runoff = 3.06 cfs @ 12.25 hrs, Volume= 0.319 af, Depth= 0.96"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-28.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 Year Rainfall=3.70"

Area (ac)	CN	Description
3.970	67	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.3	150	0.0200	0.1		**Sheet Flow, A to B** Grass: Dense n= 0.240 P2= 2.50"
5.4	217	0.0092	0.7		**Shallow Concentrated Flow, B to C** Short Grass Pasture Kv= 7.0 fps
27.7	367	Total			

Subcatchment 1S: Subarea #1E



Subcatchment 2S: Subarea #2E

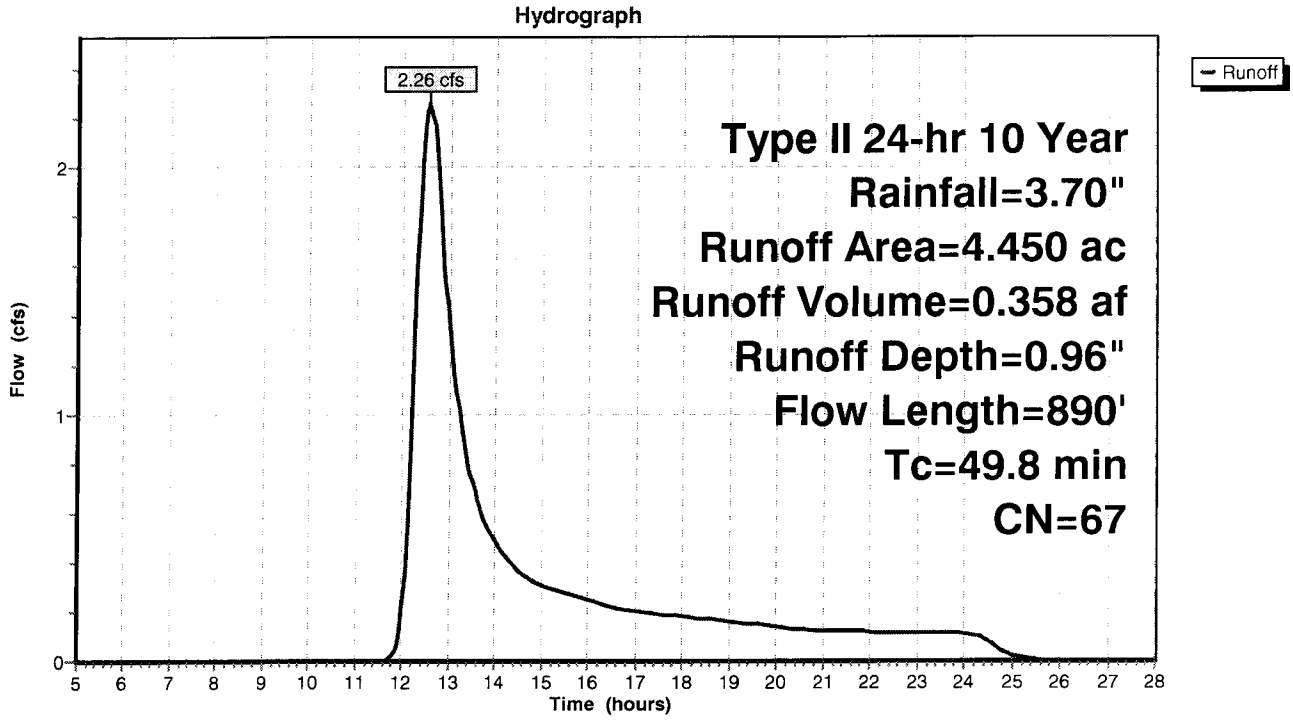
Runoff = 2.26 cfs @ 12.55 hrs, Volume= 0.358 af, Depth= 0.96"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-28.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 Year Rainfall=3.70"

Area (ac)	CN	Description
4.450	67	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.3	150	0.0200	0.1		**Sheet Flow, A to B** Grass: Dense n= 0.240 P2= 2.50"
27.5	740	0.0041	0.4		**Shallow Concentrated Flow, B to C** Short Grass Pasture Kv= 7.0 fps
49.8	890	Total			

Subcatchment 2S: Subarea #2E



Subcatchment 3S: Subarea #3E

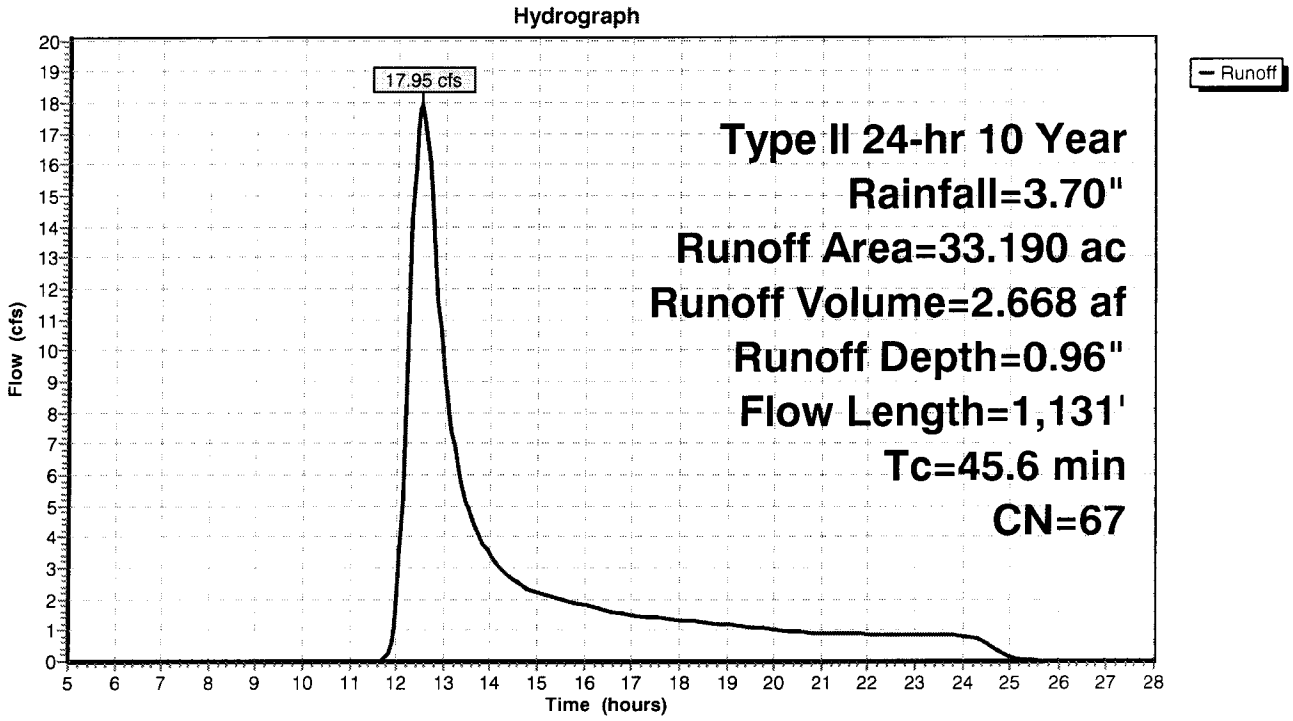
Runoff = 17.95 cfs @ 12.49 hrs, Volume= 2.668 af, Depth= 0.96"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-28.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 Year Rainfall=3.70"

Area (ac)	CN	Description
33.190	67	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
26.5	150	0.0130	0.1		**Sheet Flow, A to B** Grass: Dense n= 0.240 P2= 2.50"
19.1	981	0.0150	0.9		**Shallow Concentrated Flow, B to C** Short Grass Pasture Kv= 7.0 fps
45.6	1,131	Total			

Subcatchment 3S: Subarea #3E



Subcatchment 4S: Subarea #4W

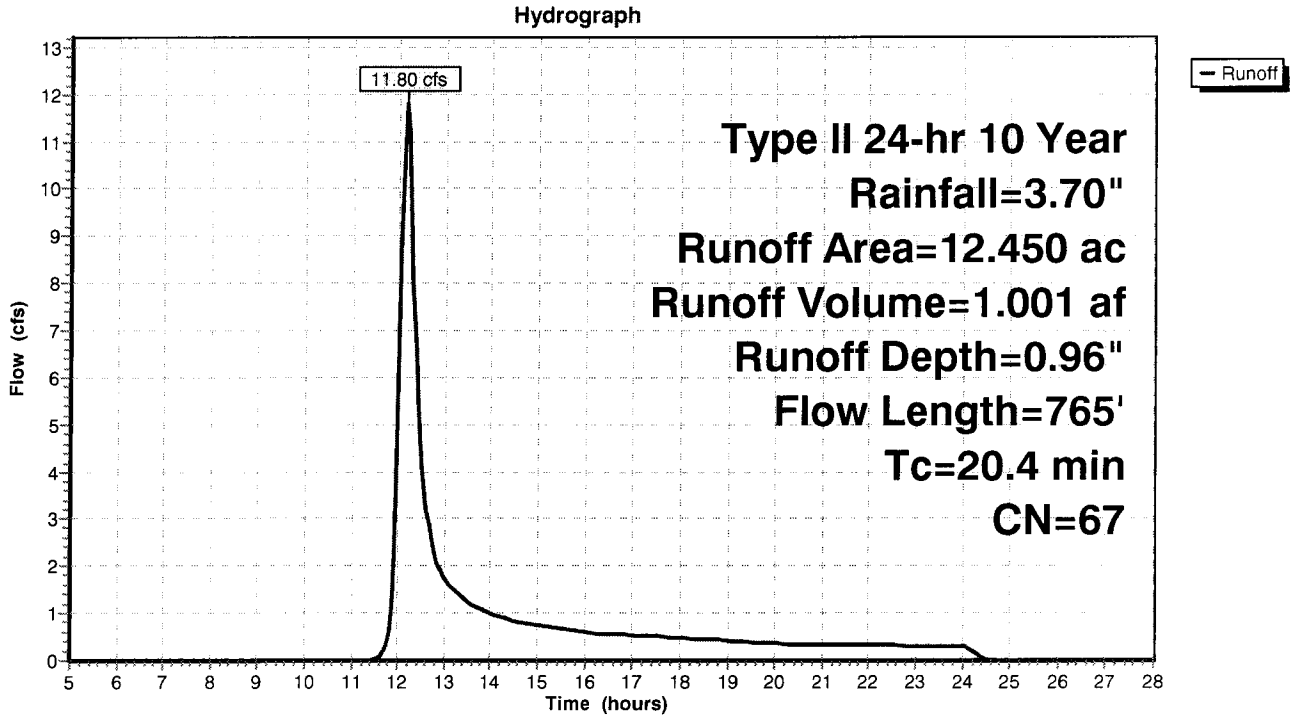
Runoff = 11.80 cfs @ 12.15 hrs, Volume= 1.001 af, Depth= 0.96"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-28.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 Year Rainfall=3.70"

Area (ac)	CN	Description
12.450	67	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.8	150	0.0670	0.2		**Sheet Flow, A to B** Grass: Dense n= 0.240 P2= 2.50"
1.4	145	0.0620	1.7		**Shallow Concentrated Flow, B to C** Short Grass Pasture Kv= 7.0 fps
0.8	108	0.1110	2.3		**Shallow Concentrated Flow, C to D** Short Grass Pasture Kv= 7.0 fps
4.4	362	0.0390	1.4		**Shallow Concentrated Flow, D to E** Short Grass Pasture Kv= 7.0 fps
20.4	765	Total			

Subcatchment 4S: Subarea #4W



Subcatchment 5S: Subarea #5W

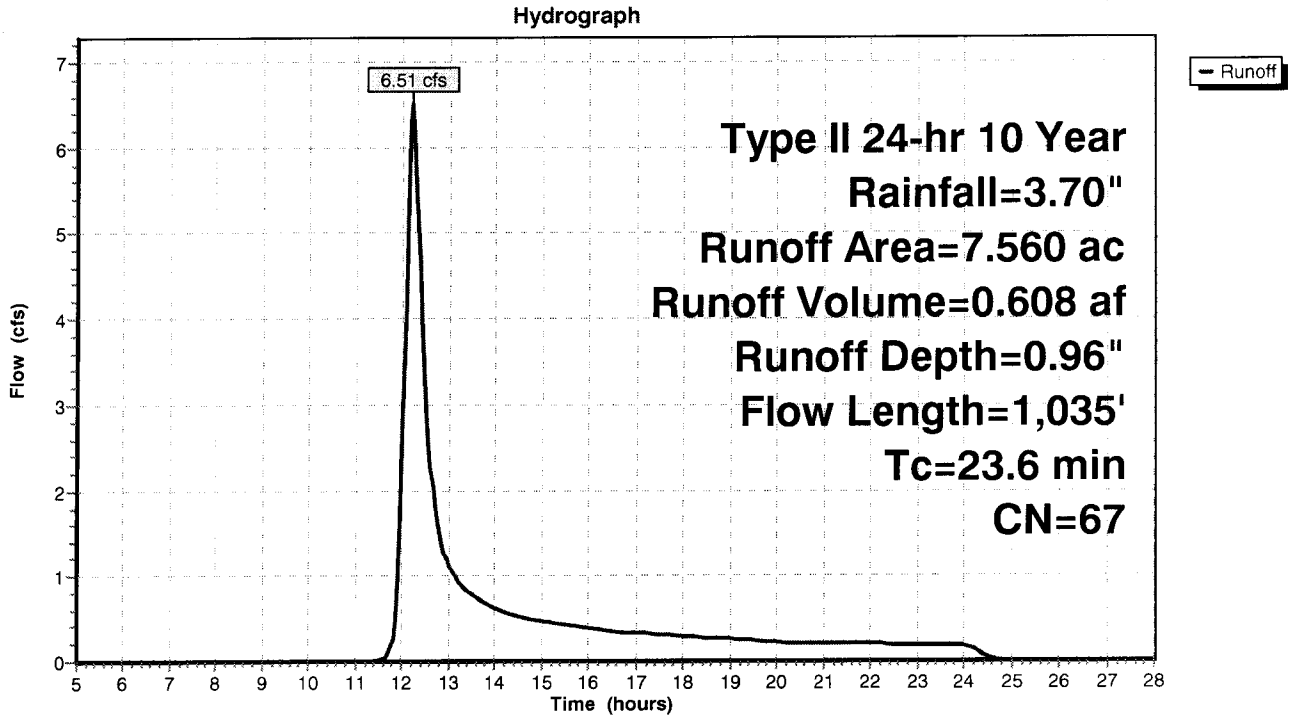
Runoff = 6.51 cfs @ 12.20 hrs, Volume= 0.608 af, Depth= 0.96"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-28.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 Year Rainfall=3.70"

Area (ac)	CN	Description
7.560	67	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.4	150	0.0600	0.2		**Sheet Flow, A to B** Grass: Dense n= 0.240 P2= 2.50"
4.4	540	0.0480	2.1	33.09	**Channel Flow, B to C** Area= 16.0 sf Perim= 8.5' r= 1.88' n= 0.240 Sheet flow over Dense Grass
4.8	345	0.0290	1.2		**Shallow Concentrated Flow, C to D** Short Grass Pasture Kv= 7.0 fps
23.6	1,035	Total			

Subcatchment 5S: Subarea #5W



Subcatchment 1S: Subarea #1E

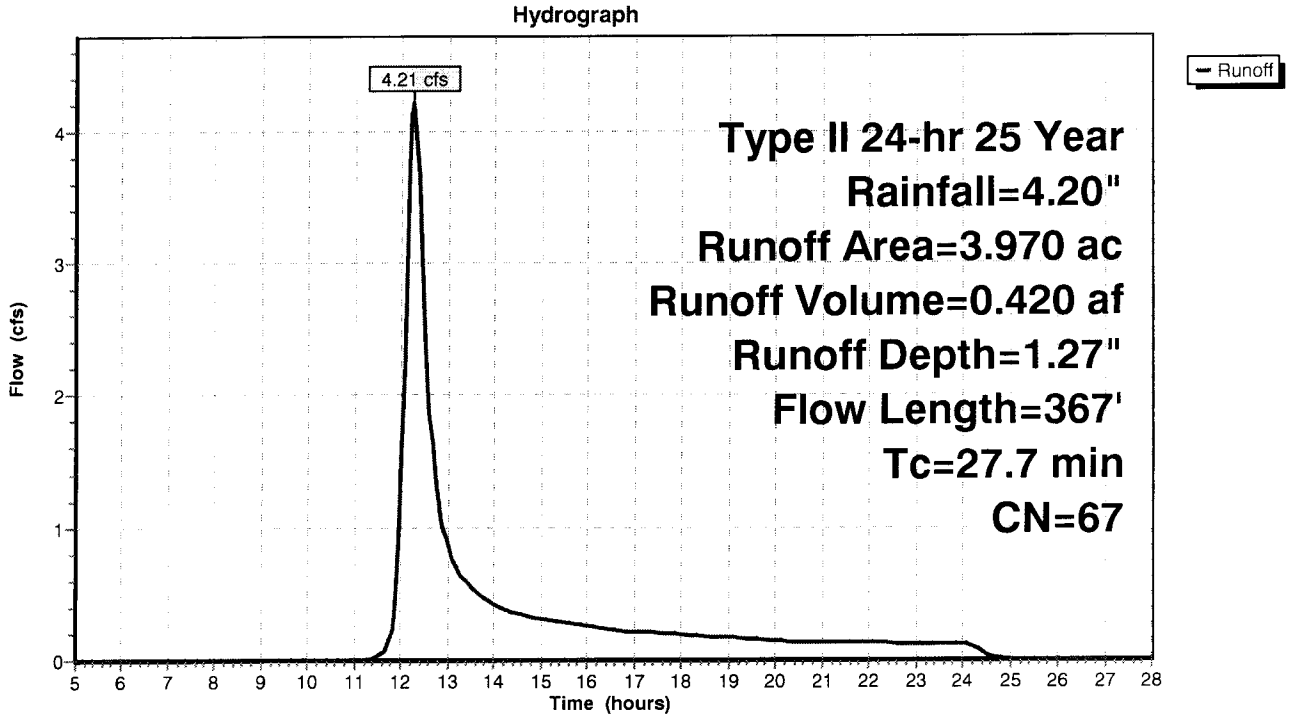
Runoff = 4.21 cfs @ 12.24 hrs, Volume= 0.420 af, Depth= 1.27"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-28.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 Year Rainfall=4.20"

Area (ac)	CN	Description
3.970	67	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.3	150	0.0200	0.1		**Sheet Flow, A to B** Grass: Dense n= 0.240 P2= 2.50"
5.4	217	0.0092	0.7		**Shallow Concentrated Flow, B to C** Short Grass Pasture Kv= 7.0 fps
27.7	367	Total			

Subcatchment 1S: Subarea #1E



Subcatchment 2S: Subarea #2E

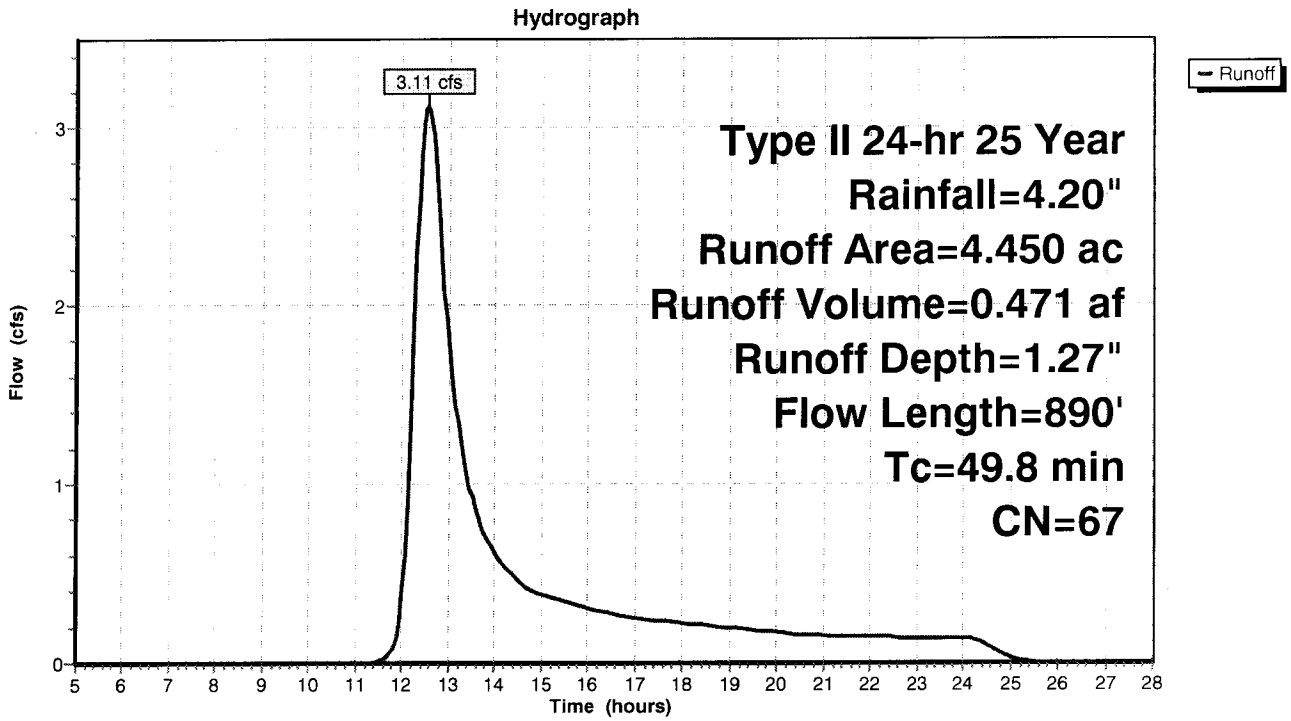
Runoff = 3.11 cfs @ 12.54 hrs, Volume= 0.471 af, Depth= 1.27"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-28.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 Year Rainfall=4.20"

Area (ac)	CN	Description
4.450	67	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.3	150	0.0200	0.1		**Sheet Flow, A to B** Grass: Dense n= 0.240 P2= 2.50"
27.5	740	0.0041	0.4		**Shallow Concentrated Flow, B to C** Short Grass Pasture Kv= 7.0 fps
49.8	890	Total			

Subcatchment 2S: Subarea #2E



Subcatchment 3S: Subarea #3E

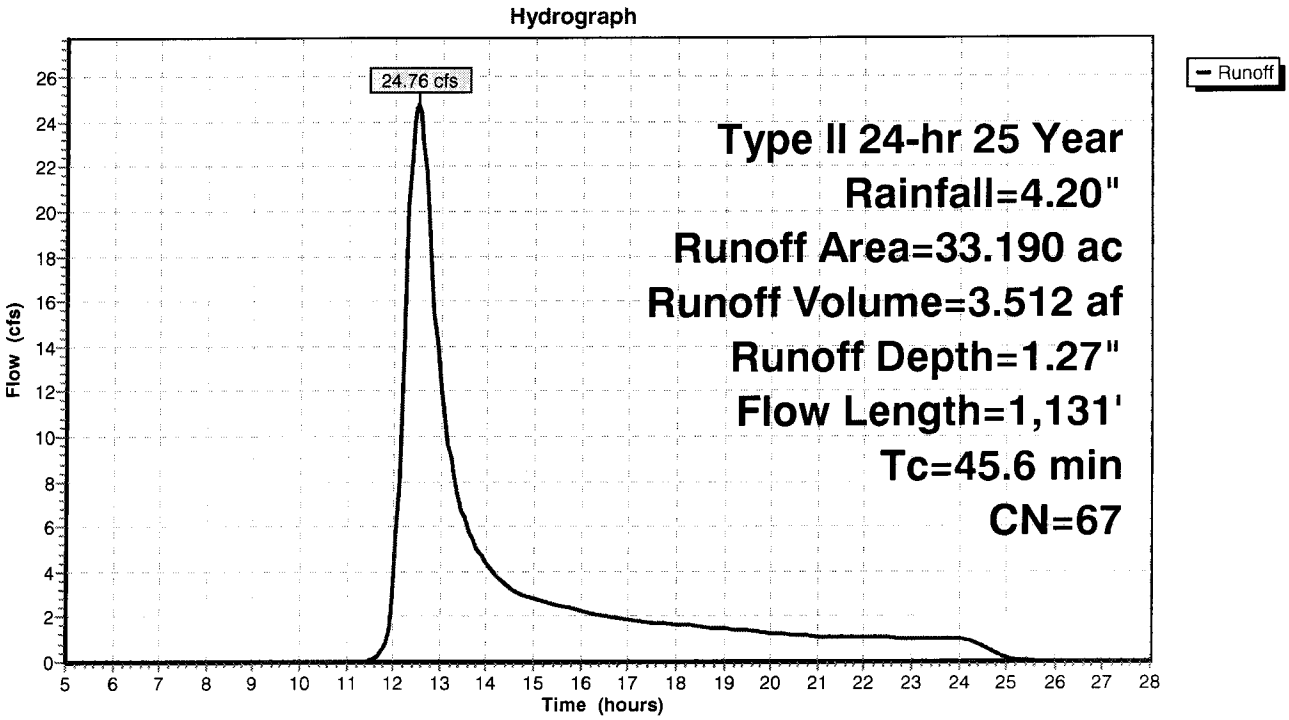
Runoff = 24.76 cfs @ 12.48 hrs, Volume= 3.512 af, Depth= 1.27"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-28.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 Year Rainfall=4.20"

Area (ac)	CN	Description
33.190	67	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
26.5	150	0.0130	0.1		**Sheet Flow, A to B** Grass: Dense n= 0.240 P2= 2.50"
19.1	981	0.0150	0.9		**Shallow Concentrated Flow, B to C** Short Grass Pasture Kv= 7.0 fps
45.6	1,131	Total			

Subcatchment 3S: Subarea #3E



Subcatchment 4S: Subarea #4W

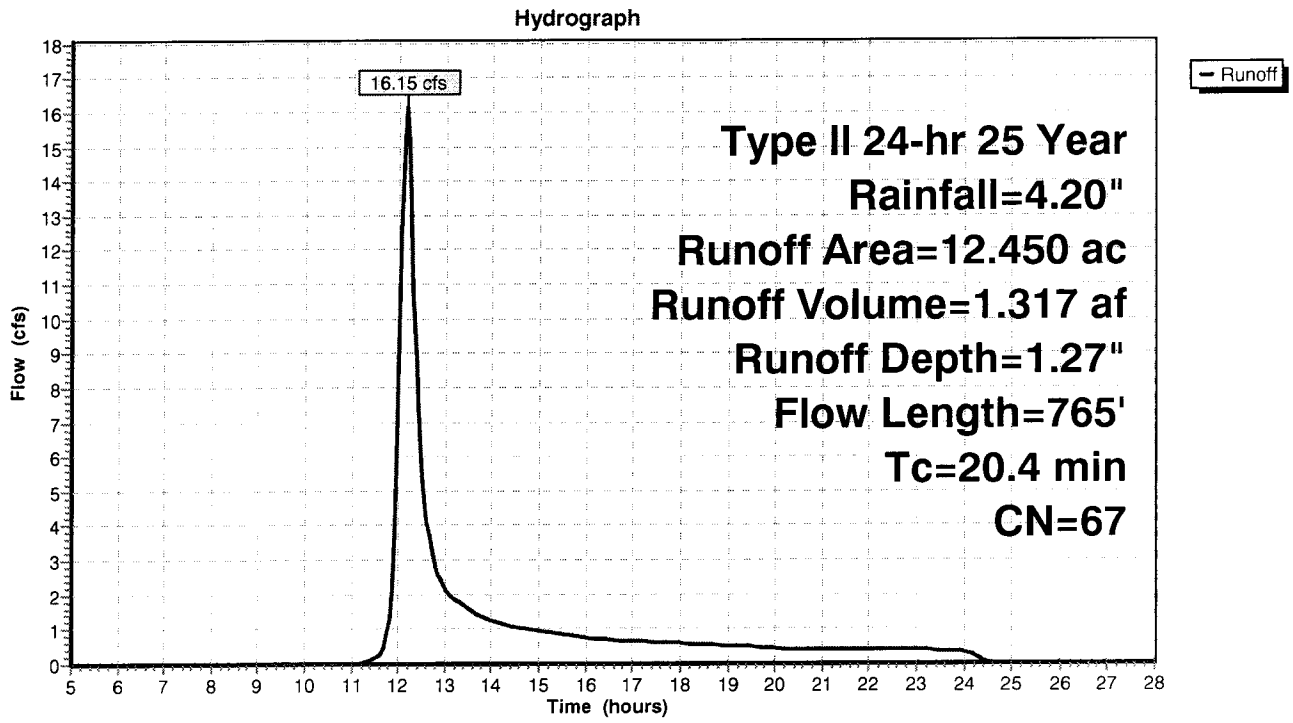
Runoff = 16.15 cfs @ 12.15 hrs, Volume= 1.317 af, Depth= 1.27"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-28.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 Year Rainfall=4.20"

Area (ac)	CN	Description
12.450	67	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.8	150	0.0670	0.2		**Sheet Flow, A to B** Grass: Dense n= 0.240 P2= 2.50"
1.4	145	0.0620	1.7		**Shallow Concentrated Flow, B to C** Short Grass Pasture Kv= 7.0 fps
0.8	108	0.1110	2.3		**Shallow Concentrated Flow, C to D** Short Grass Pasture Kv= 7.0 fps
4.4	362	0.0390	1.4		**Shallow Concentrated Flow, D to E** Short Grass Pasture Kv= 7.0 fps
20.4	765	Total			

Subcatchment 4S: Subarea #4W



Subcatchment 5S: Subarea #5W

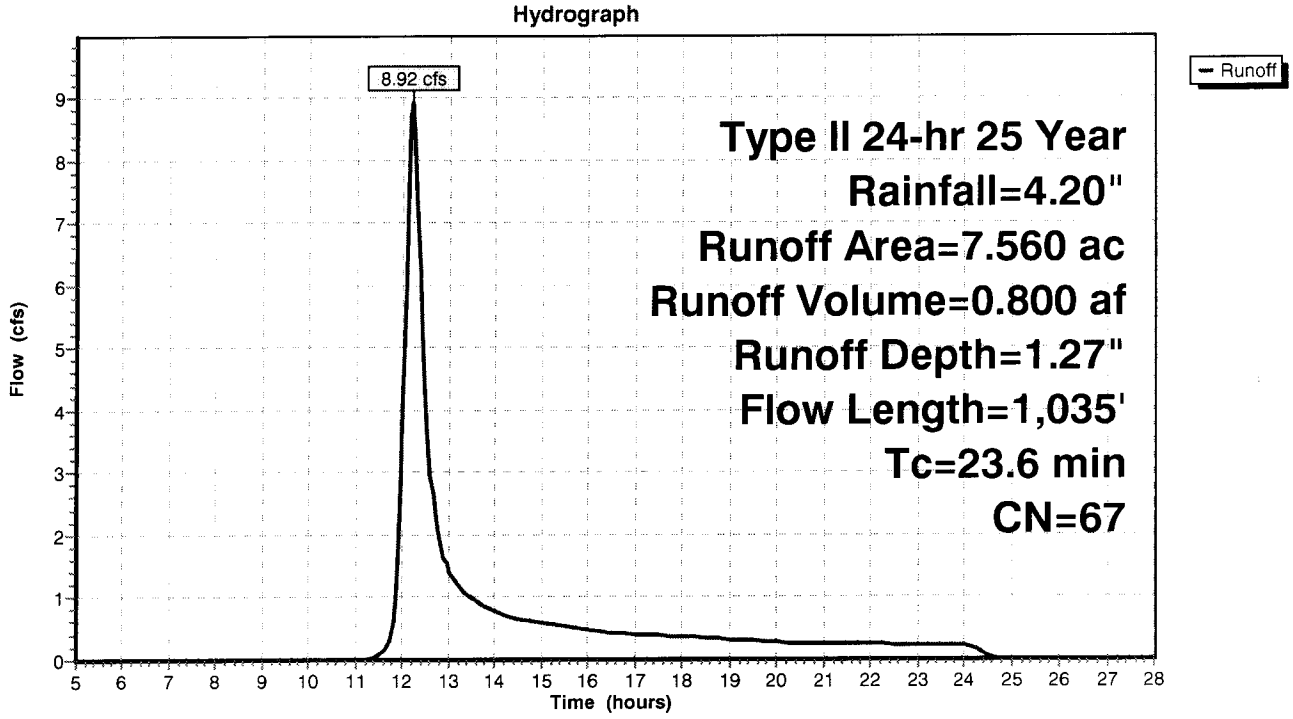
Runoff = 8.92 cfs @ 12.19 hrs, Volume= 0.800 af, Depth= 1.27"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-28.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 Year Rainfall=4.20"

Area (ac)	CN	Description
7.560	67	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.4	150	0.0600	0.2		**Sheet Flow, A to B** Grass: Dense n= 0.240 P2= 2.50"
4.4	540	0.0480	2.1	33.09	**Channel Flow, B to C** Area= 16.0 sf Perim= 8.5' r= 1.88' n= 0.240 Sheet flow over Dense Grass
4.8	345	0.0290	1.2		**Shallow Concentrated Flow, C to D** Short Grass Pasture Kv= 7.0 fps
23.6	1,035	Total			

Subcatchment 5S: Subarea #5W



Subcatchment 1S: Subarea #1E

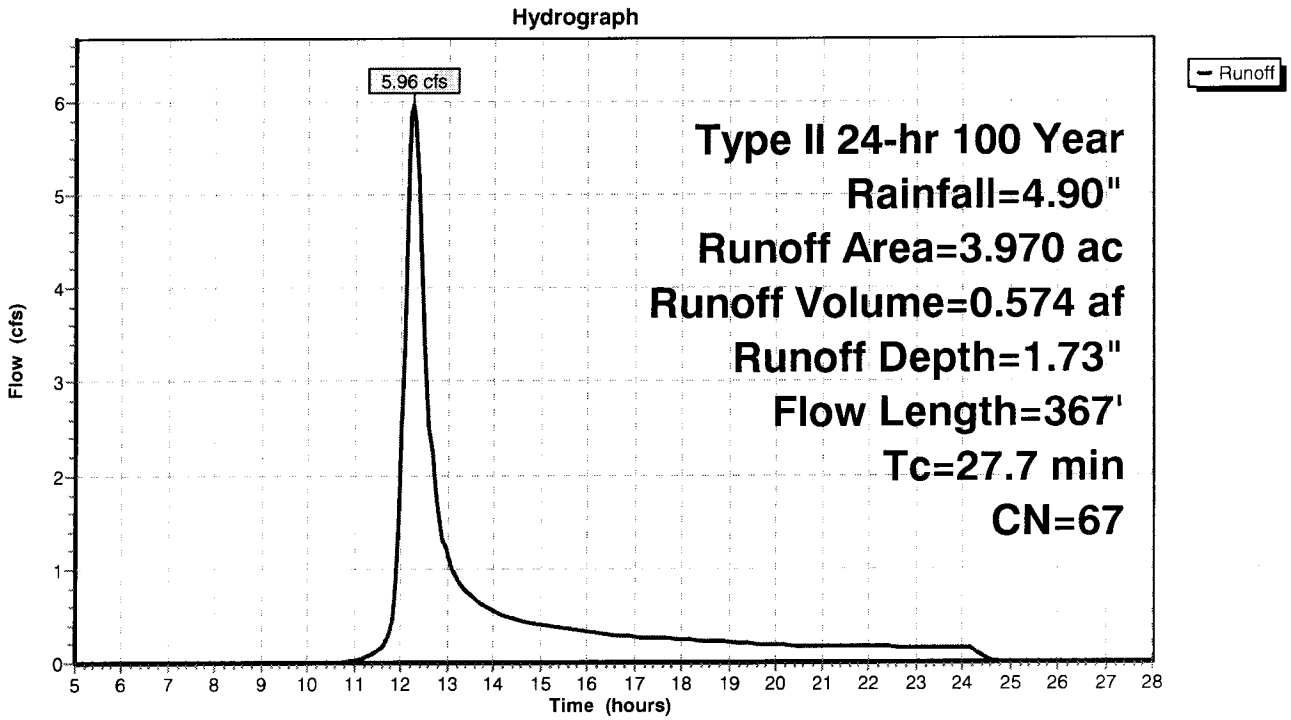
Runoff = 5.96 cfs @ 12.23 hrs, Volume= 0.574 af, Depth= 1.73"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-28.00 hrs, dt= 0.05 hrs
Type II 24-hr 100 Year Rainfall=4.90"

Area (ac)	CN	Description
3.970	67	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.3	150	0.0200	0.1		**Sheet Flow, A to B** Grass: Dense n= 0.240 P2= 2.50"
5.4	217	0.0092	0.7		**Shallow Concentrated Flow, B to C** Short Grass Pasture Kv= 7.0 fps
27.7	367	Total			

Subcatchment 1S: Subarea #1E



Subcatchment 2S: Subarea #2E

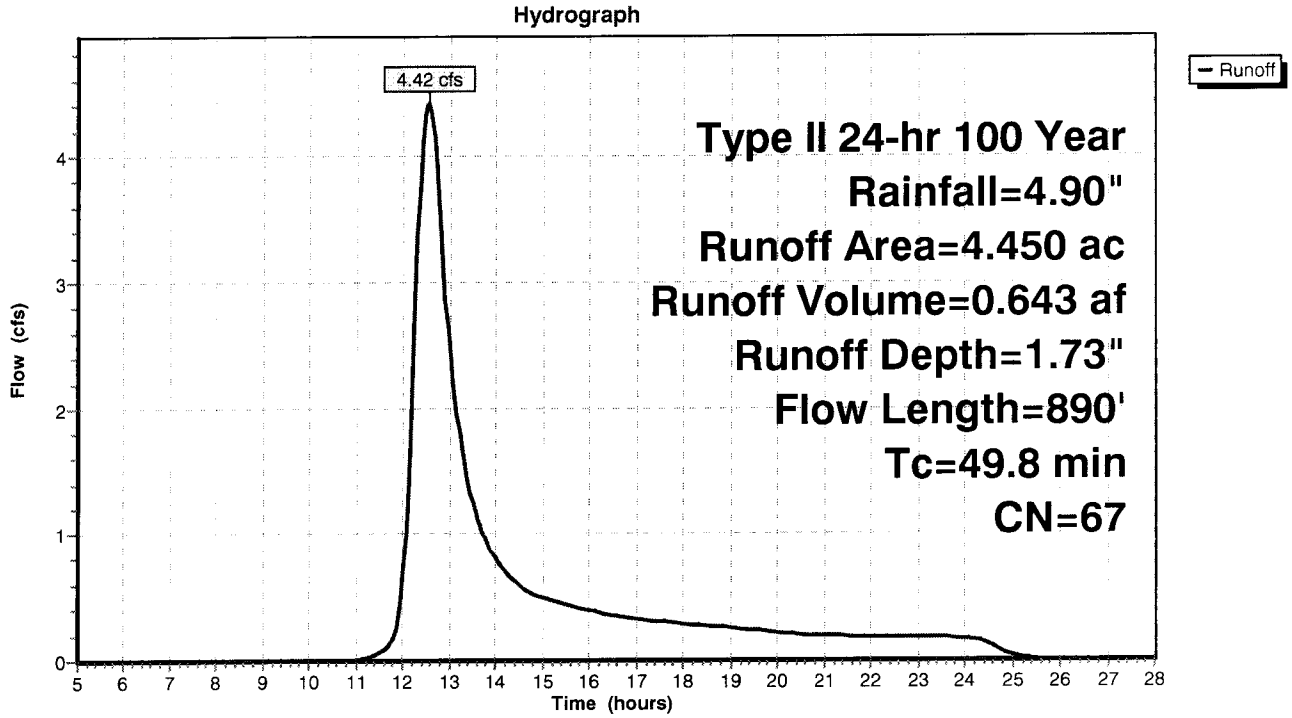
Runoff = 4.42 cfs @ 12.53 hrs, Volume= 0.643 af, Depth= 1.73"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-28.00 hrs, dt= 0.05 hrs
Type II 24-hr 100 Year Rainfall=4.90"

Area (ac)	CN	Description
4.450	67	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.3	150	0.0200	0.1		**Sheet Flow, A to B** Grass: Dense n= 0.240 P2= 2.50"
27.5	740	0.0041	0.4		**Shallow Concentrated Flow, B to C** Short Grass Pasture Kv= 7.0 fps
49.8	890	Total			

Subcatchment 2S: Subarea #2E



Subcatchment 3S: Subarea #3E

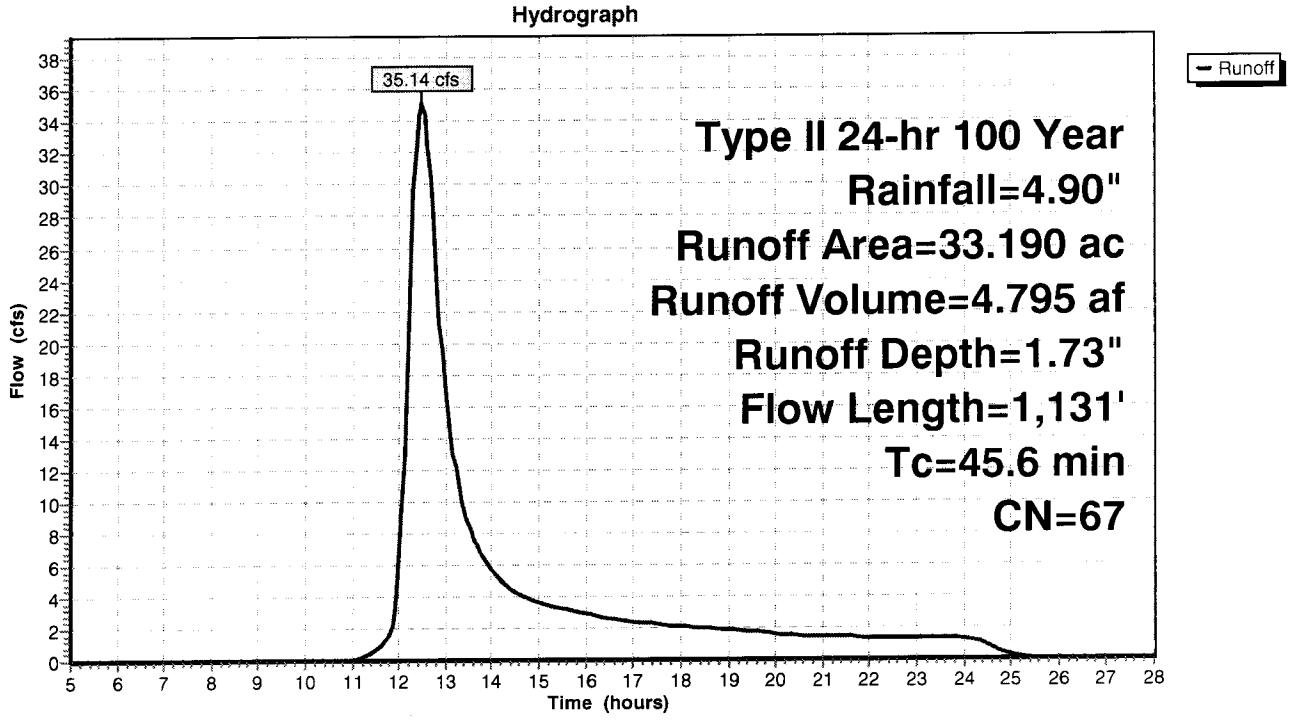
Runoff = 35.14 cfs @ 12.47 hrs, Volume= 4.795 af, Depth= 1.73"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-28.00 hrs, dt= 0.05 hrs
Type II 24-hr 100 Year Rainfall=4.90"

Area (ac)	CN	Description
33.190	67	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
26.5	150	0.0130	0.1		**Sheet Flow, A to B** Grass: Dense n= 0.240 P2= 2.50"
19.1	981	0.0150	0.9		**Shallow Concentrated Flow, B to C** Short Grass Pasture Kv= 7.0 fps
45.6	1,131	Total			

Subcatchment 3S: Subarea #3E



Subcatchment 4S: Subarea #4W

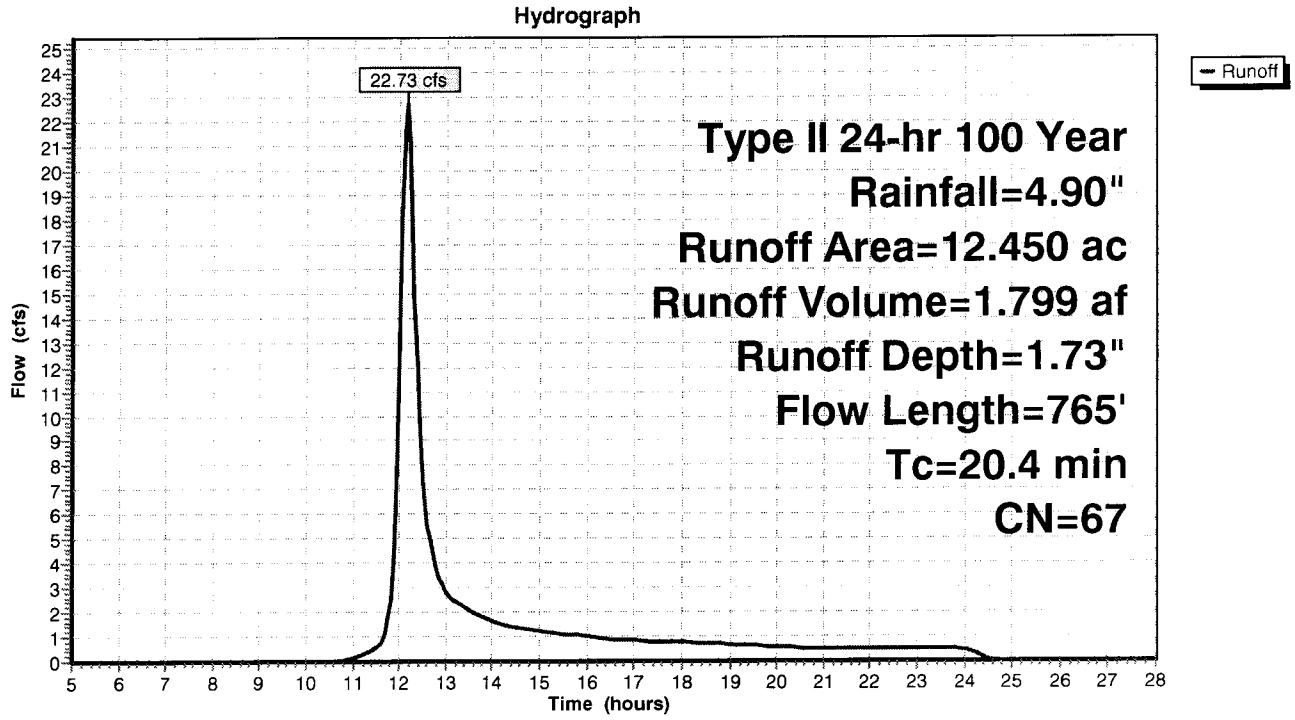
Runoff = 22.73 cfs @ 12.14 hrs, Volume= 1.799 af, Depth= 1.73"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-28.00 hrs, dt= 0.05 hrs
Type II 24-hr 100 Year Rainfall=4.90"

Area (ac)	CN	Description
12.450	67	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.8	150	0.0670	0.2		**Sheet Flow, A to B** Grass: Dense n= 0.240 P2= 2.50"
1.4	145	0.0620	1.7		**Shallow Concentrated Flow, B to C** Short Grass Pasture Kv= 7.0 fps
0.8	108	0.1110	2.3		**Shallow Concentrated Flow, C to D** Short Grass Pasture Kv= 7.0 fps
4.4	362	0.0390	1.4		**Shallow Concentrated Flow, D to E** Short Grass Pasture Kv= 7.0 fps
20.4	765	Total			

Subcatchment 4S: Subarea #4W



Subcatchment 5S: Subarea #5W

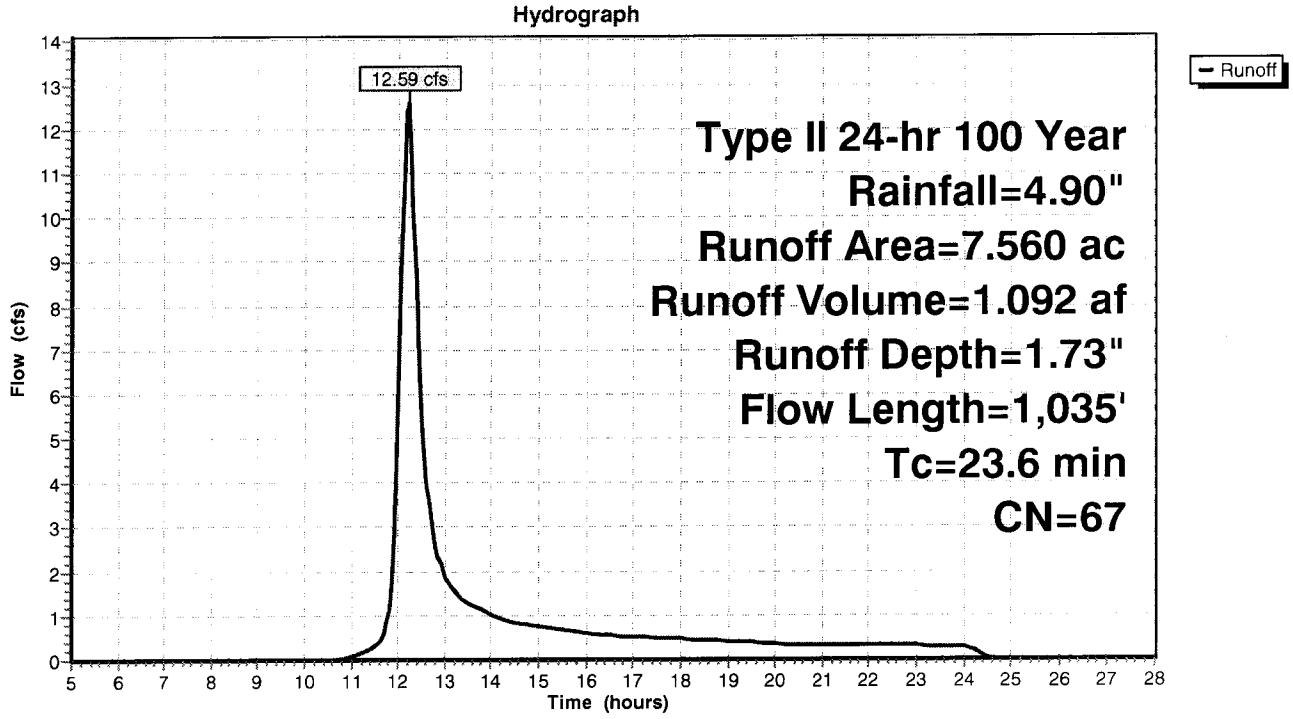
Runoff = 12.59 cfs @ 12.18 hrs, Volume= 1.092 af, Depth= 1.73"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-28.00 hrs, dt= 0.05 hrs
Type II 24-hr 100 Year Rainfall=4.90"

Area (ac)	CN	Description
7.560	67	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.4	150	0.0600	0.2		**Sheet Flow, A to B** Grass: Dense n= 0.240 P2= 2.50"
4.4	540	0.0480	2.1	33.09	**Channel Flow, B to C** Area= 16.0 sf Perim= 8.5' r= 1.88' n= 0.240 Sheet flow over Dense Grass
4.8	345	0.0290	1.2		**Shallow Concentrated Flow, C to D** Short Grass Pasture Kv= 7.0 fps
23.6	1,035	Total			

Subcatchment 5S: Subarea #5W



PROPOSED CONDITIONS

THE PROPOSED BORROW AREAS CAN BE CONSIDERED AS 2 SUBAREAS

SUBAREA #1E

$$\text{AREA} = 1812394\ ft^2 \left(\times \frac{1\ \text{ACRE}}{43560\ ft^2}\right) = 41.61\ \text{ACRE}$$

AREA IS BARE EXPOSED CLAY, PRIMARILY A TYPE D SOIL → CN = 94

- WATER FLOWS AS SHEET AND SHALLOW CONCENTRATED

SHEET FLOW → L = 36 ft
(A-B)
S = 0.333
FALLOW → n = 0.05
P_2 = 2.5"

SHEET FLOW → L = 150 − 36 = 114 FT
(B-C)
S = 0.01
FALLOW → n = 0.05
P_2 = 2.5"

SHALLOW CONCENTRATED → L = 786 ft
(C-D)
S = 0.01
NEARLY BARE & UNTILLED → 10.0

SHALLOW CONCENTRATED → L = 158 ft
(D-E)
S = 0.006
NEARLY BARE & UNTILLED → 10.0

SUBAREA #2W

$$\text{AREA} = 872136\ ft^2 \left(\times \frac{1\ \text{ACRE}}{43560\ ft^2}\right) = 20.02\ \text{ACRE}$$

AREA IS BARE EXPOSED CLAY, PRIMARILY A TYPE D SOIL → CN = 94

- WATER FLOWS AS SHEET AND SHALLOW CONCENTRATED

SHEET FLOW → L = 150 ft
(A-B)
S = 0.005
FALLOW → n = 0.05
P_2 = 2.5"

SHALLOW CONCENTRATED → $L = 801 - 150 = 651$ ft
(B-C) $S = 0.005$
NEARLY BARE AND UNTILLED → 10.0

SHALLOW CONCENTRATED → $L = 43$ ft
(C-D) $S = 0.023$
NEARLY BARE AND UNTILLED → 10.0

SIZE BASIN FOR SUBAREA #1E

USE NYS STORMWATER MANAGEMENT DESIGN MANUAL

ESTIMATE WQ_v, WATER QUALITY VOLUME

$$WQ_v = \frac{P \cdot R_v \cdot A}{12}$$

P – 90% RAINFALL EVENT NUMBER
R_v – $0.05 + 0.009(I)$, I IS % IMPERVIOUS COVER
A – CONTRIBUTING AREA (IN ACRES)

$P = 0.9$ (FIG. 4.1, NYS STORMWATER MGMT. DESIGN MANUAL)

$R_v = 0.05 + 0.009(100)$, ASSUME WORST CASE $I = 100\%$
$= 0.95$ (> 0.2)

$A = 41.61$ ACRE

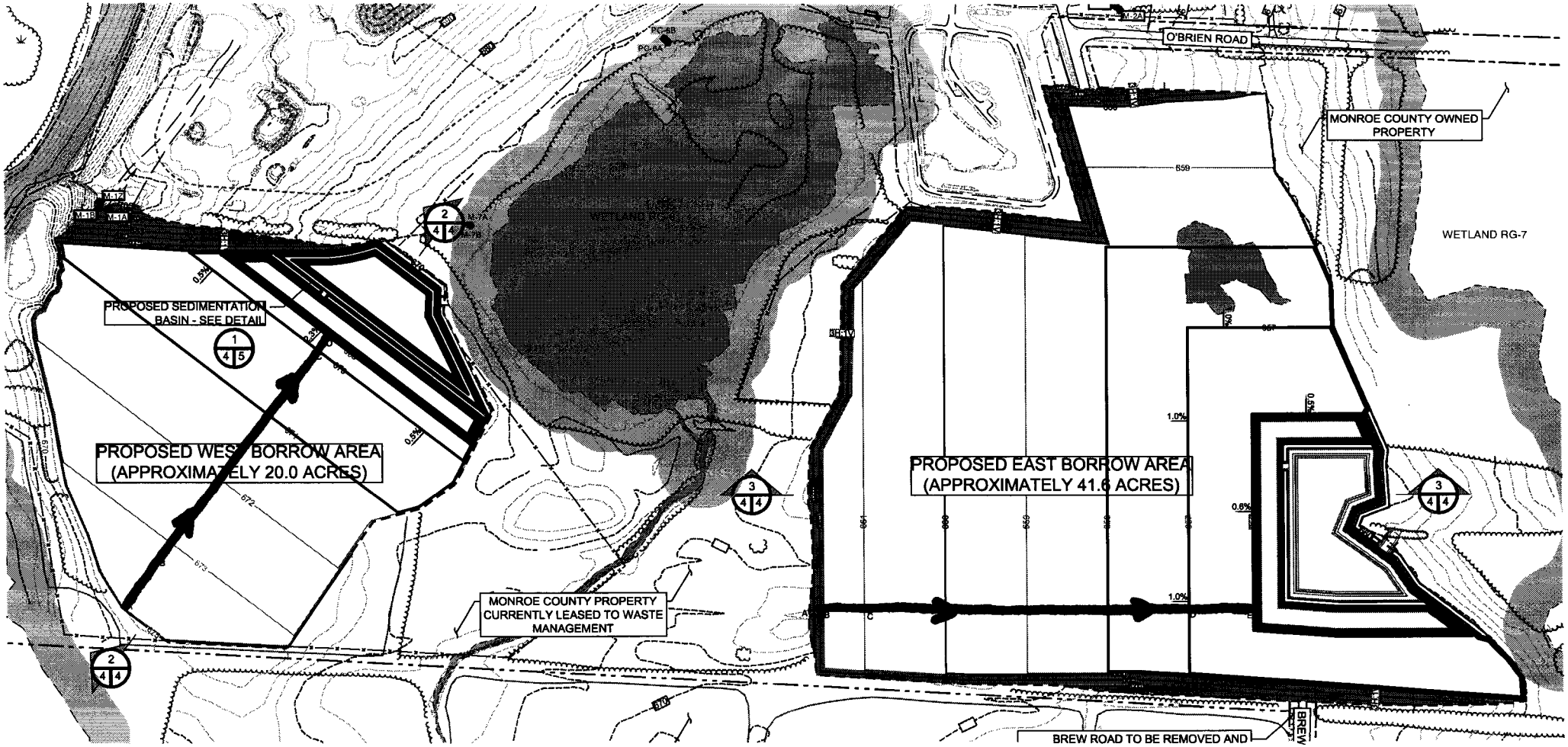
$$WQ_v = \frac{0.9 \cdot 0.95 \cdot 41.61}{12} = 2.96 \text{ ACRE-FT} \left(\times \frac{43560 \text{ ft}^2}{1 \text{ ACRE}}\right) = 129{,}143 \text{ ft}^3$$

- FOREBAY SHALL CONTAIN 10% OF WQ_v

$= 0.10(129{,}143 \text{ ft}^3) = 12914 \text{ ft}^3 < 174{,}771 \text{ ft}^3$ (FOREBAY VOLUME, PG. 31) ✓OK

- EXTENDED DETENTION VOLUME SHALL BE ATLEAST:

$129{,}143 \text{ ft}^3 < 174{,}771 + 184{,}756 = 359{,}527 \text{ ft}^3$ (FOREBAY + PERMANENT POOL VOLUME, PG. 34) ✓OK



DWG. No. 08015-018

8/31/09

SHEET 34 OF 87

Subarea #1E

Use AutoCAD to trace contours and obtain areas and average end method to find volumes of forebay, permanent pool and storage pool for Subarea #1E
(Dwg. No. 08015-018)

Forebay Volume

Contour (ft)	Area (ft^2)	Elevation Change (ft)	Volume (ft^3)	Cumulative Volume (ft^3)
651	44103	-	0	0
652	53442	1	48773	48773
653	62955	1	58199	106971
654	72644	1	67800	174771

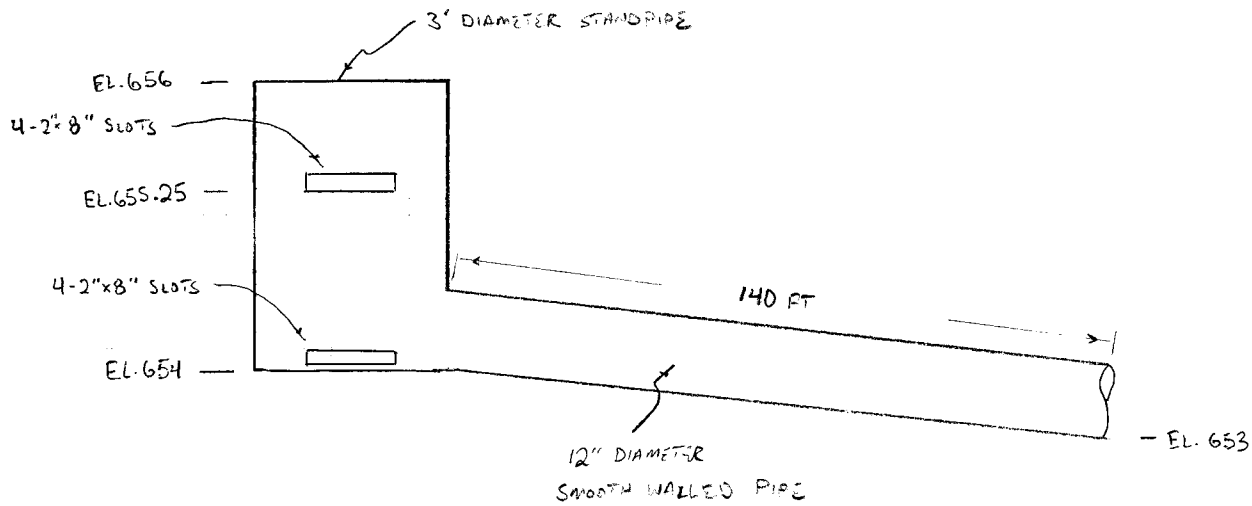
Permanent Pool Volume

Contour (ft)	Area (ft^2)	Elevation Change (ft)	Volume (ft^3)	Cumulative Volume (ft^3)
651	51188	-	0	0
652	56042	1	53615	53615
652.5	58524	0.5	28642	82257
653	64890	0.5	30854	113110
654	78401	1	71646	184756

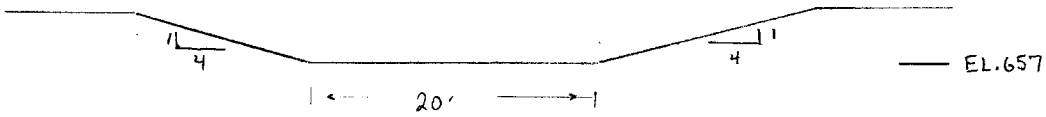
Storage Pool Volume

Contour (ft)	Area (ft^2)	Elevation Change (ft)	Volume (ft^3)	Cumulative Volume (ft^3)
654	151045	-	0	0
655	166728	1	158887	158887
656	184433	1	175581	334467
657	455777	1	320105	654572
658	742877	1	599327	1253899

OUTLET STRUCTURE (#1E)



EMERGENCY SPILLWAY (#1E)



Mill Seat Facility - Proposed Borrow Area Basin Subarea #1E

Evaluate discharge through slotted standpipe
1. Discharge through the 2" x 8" slots
2. Discharge through the 12" pipe
(Reference: Highway Engineering Circular No. 22, Second Edition, "Urban Drainage Design Manual" Publication No. FHWA-NHI-01-021, August 2001)

1. Estimate the Discharge through the 2" x 8" Slots

Discharge through an orifice
$Q = C_oA_o(2gH_o)^{1/2}$ (Eq. 8-17)

C_o = 0.6
A_{oslot} = 0.111
$A_{o4slots}$ = 0.444
g = 32.2

Discharge as a weir
$Q = C_{scw}(L-0.2H)H^{1.5}$ (Eq. 8-20)

Weir Crest =	654	655.25
Channel Bottom =	654	654
L_{4slots} =	2.67	2.67
H_c =	0	1.25

Discharge Elevation (ft)	Q (cfs) - Center of Slot Elevation 654.08	Q (cfs) - Center of Slot Elevation 655.33
654.00	0.000	0.000
654.25	0.882	0.000
654.50	1.387	0.000
654.75	1.752	0.000
655.00	2.053	0.000
655.25	2.315	0.000
655.50	2.550	0.882
655.75	2.765	1.387
656.00	2.965	1.752
656.25	3.152	2.053
656.50	3.329	2.315
656.75	3.497	2.550
657.00	3.657	2.765
657.25	3.810	2.965
657.50	3.958	3.152
657.75	4.100	3.329
658.00	4.237	3.497

Discharge Elevation (ft)	Weir at 655		Weir at 655.25	
	C_{scw}	Q (cfs)	C_{scw}	Q (cfs)
654.00	3.33	0.000	3.330	0.000
654.25	3.33	1.089	3.330	0.000
654.50	3.33	3.022	3.330	0.000
654.75	3.33	5.443	3.330	0.000
655.00	3.33	8.214	3.330	0.000
655.25	3.33	11.247	3.330	0.000
655.50	3.33	14.478	3.330	1.089
655.75	3.33	17.859	3.430	3.113
656.00	3.33	21.349	3.510	5.738
656.25	3.33	24.913	3.590	8.855
656.50	3.33	28.520	3.670	12.395
656.75	3.33	32.144	3.750	16.304
657.00	3.33	35.760	3.830	20.541
657.25	3.33	39.346	3.910	25.067
657.50	3.33	42.882	3.990	29.850
657.75	3.33	46.349	4.070	34.858
658.00	3.33	49.728	4.150	40.059

*Orifice governs for both elevations

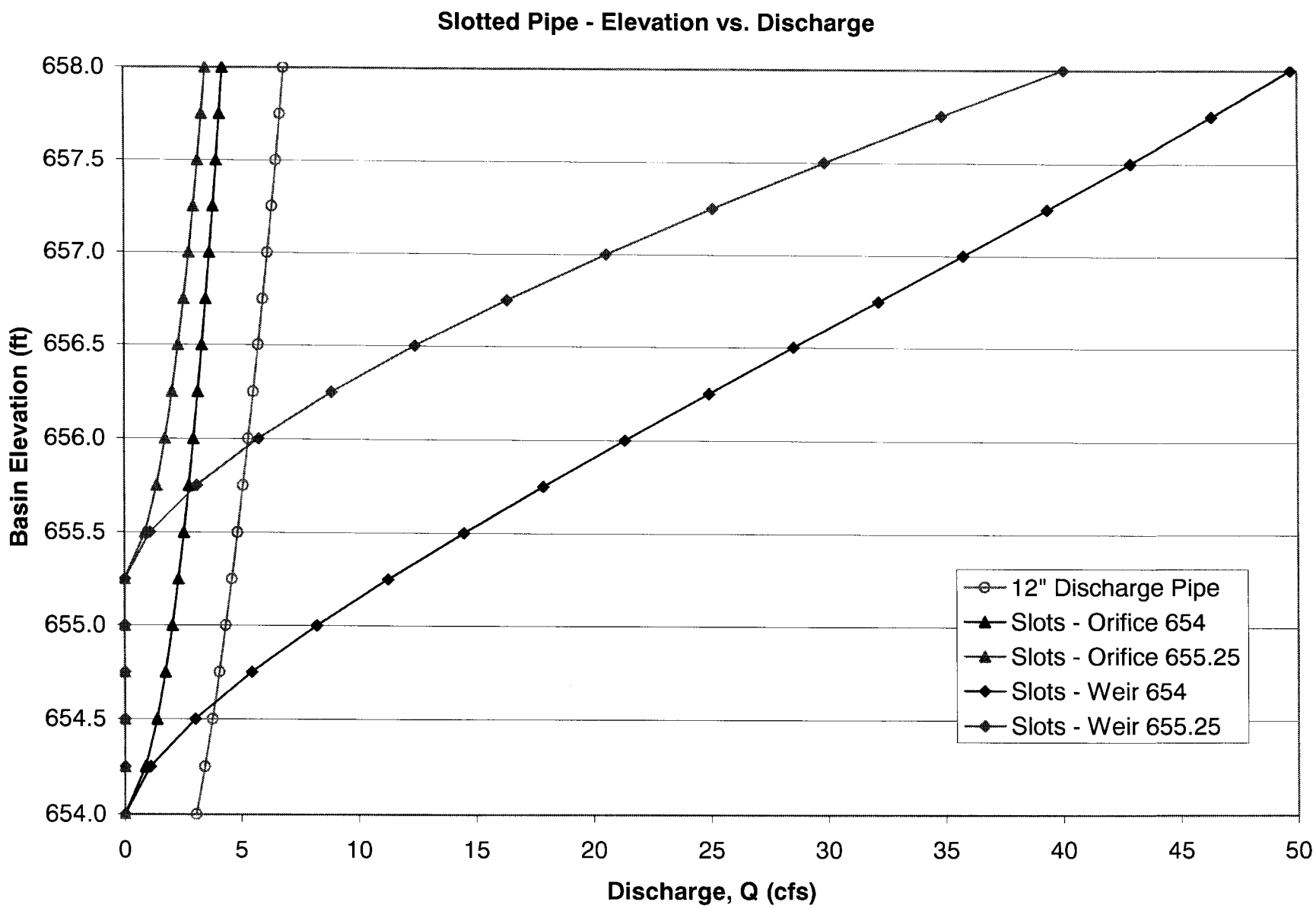
2. Estimate Discharge through the 12" pipe

See Attached Sketch for Layout and Components
$Q = A*((2*g*\Delta H)/(1+k_{entrance}+K_{gate}+(f*L/d)))$

g (ft/sec^2)= 32.2
d_{pipe} (ft) = 1.000
A_{pipe} (ft^2) = 0.785
Pipe Outlet El. = 653.0
Pipe Length (ft) = 140.0
K_e (entrance) = 1.0
K_e (gate valve) = 0.2
f = 0.0145

ν = 1.41E-05
e = 0.000005
e / d = 0.000005

Discharge Elevation (ft)	ΔH (ft)	Q (cfs)	V (fps)	Re
654.00	1.0	3.06	3.9	276728
654.25	1.3	3.43	4.4	309392
654.50	1.5	3.75	4.8	338922
654.75	1.8	4.05	5.2	366077
655.00	2.0	4.33	5.5	391353
655.25	2.3	4.60	5.9	415093
655.50	2.5	4.85	6.2	437546
655.75	2.8	5.08	6.5	458902
656.00	3.0	5.31	6.8	479308
656.25	3.3	5.52	7.0	498879
656.50	3.5	5.73	7.3	517711
656.75	3.8	5.93	7.6	535882
657.00	4.0	6.13	7.8	553457
657.25	4.3	6.32	8.0	570490
657.50	4.5	6.50	8.3	587029
657.75	4.8	6.68	8.5	603115
658.00	5.0	6.85	8.7	618783


Slotted Pipe - Elevation vs. Discharge
Basin Elevation (ft)
658.0
657.5
657.0
656.5
656.0
655.5
655.0
654.5
654.0
0
5
10
15
20
25
30
35
40
45
50
Discharge, Q (cfs)
12" Discharge Pipe
Slots - Orifice 654
Slots - Orifice 655.25
Slots - Weir 654
Slots - Weir 655.25

Mill Seat Facility - Proposed Borrow Area Basin for Subarea #1E

Evaluate Discharge through the Overflow Pipe

Can be governed by:
1) Discharge based on orifice control
2) Discharge based on weir control
3) Discharge based on full pipe flow
(Reference: Highway Engineering Circular No. 22, Second Edition, "Urban Drainage Design Manual" Publication No. FHWA-NHI-01-021, August 2001)

1) Estimate Discharge based on Circular Orifice Control

$Q = C_o A_o (2gH_o)^{1/2}$ (Eq. 8-17)

C_o = 0.6 (circular orifices)
A_o = 7.069
H_o = varies
g = 32.2

2) Estimate the Discharge Based on Sharp Weir Control

$Q = C_{scw} L H^{1.5}$ (Eq. 8-19)

$C_{scw} = 3.27 + 0.4 (H/H_c)$
L = 9.4 (pipe circumference)
H = varies
H_c = 2

Discharge Elevation (ft)	Orifice Flow			Weir Flow		
	H_o (ft)	Q (cfs)		H (ft)	C_{scw}	Q (cfs)
656.00	0.00	0.00		0.00	3.33	0.00
656.25	0.25	17.02		0.25	3.33	3.91
656.50	0.50	24.07		0.50	3.33	11.07
656.75	0.75	29.48		0.75	3.42	20.88
657.00	1.00	34.04		1.00	3.47	32.62
657.25	1.25	38.05		1.25	3.52	46.24
657.50	1.50	41.68		1.50	3.57	61.65
657.75	1.75	45.02		1.75	3.62	78.78
658.00	2.00	48.13		2.00	3.67	97.58

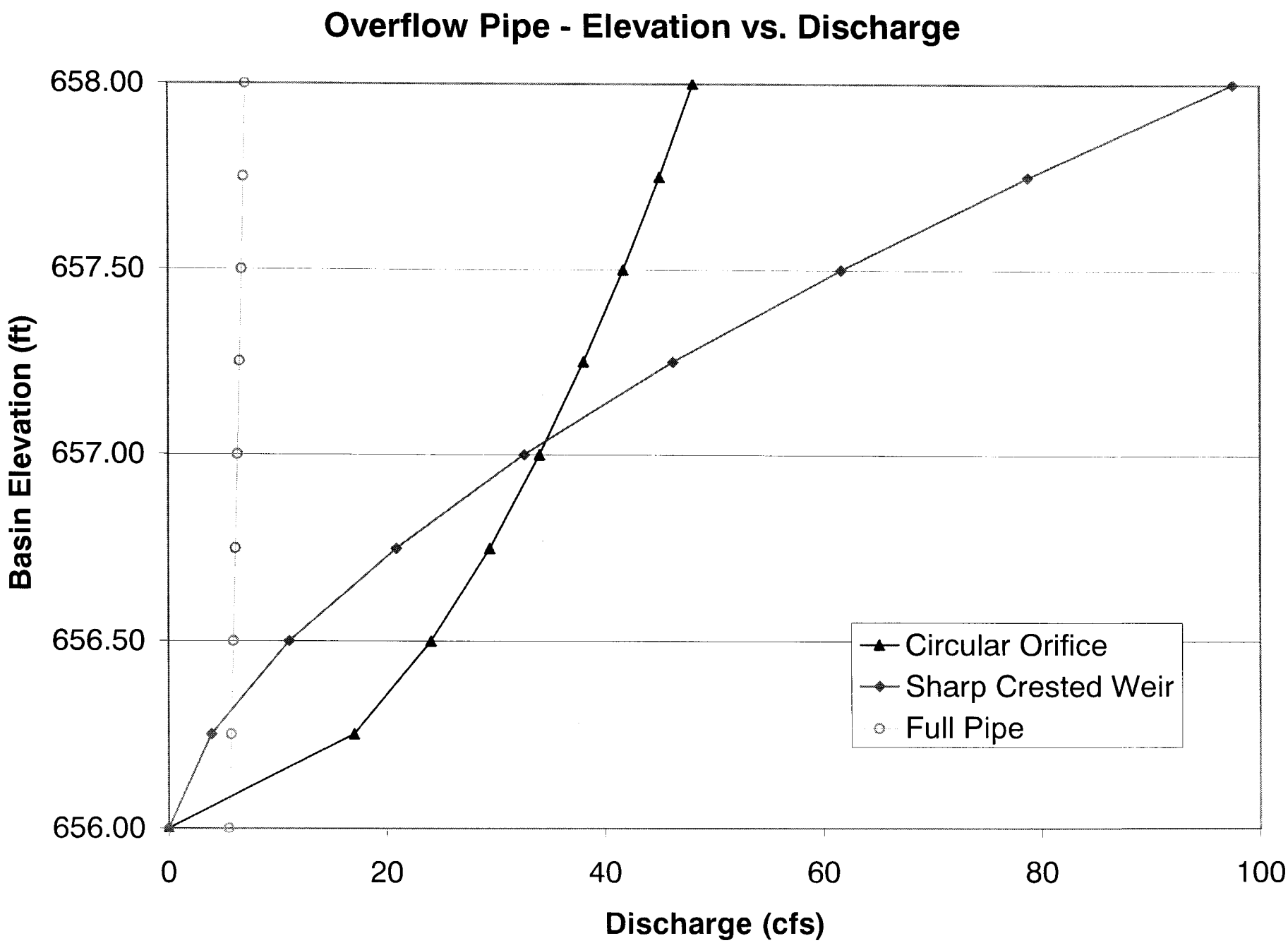
3) Estimate the Discharge Based on Full Pipe Flow

$Q = A*((2*g*\Delta H)/(1+k_{entrance}+K_{gate}+(f*L/d)))$

d_{pipe} = 1
A_{pipe} = 0.785
Pipe Outlet El. = 653
Pipe Length = 140
K (entrance) = 1
K (gate) = 0.2
f = 0.0123

ν = 1.41E-05
ε = 0.000005
ε/d = 0.000005

Discharge Elevation (ft)	ΔH (ft)	Q (cfs)	V (ft/s)	Re
656.00	3.00	5.51	7.02	497772
656.25	3.25	5.74	7.31	518098
656.50	3.50	5.95	7.58	537655
656.75	3.75	6.16	7.85	556526
657.00	4.00	6.37	8.10	574778
657.25	4.25	6.56	8.35	592467
657.50	4.50	6.75	8.60	609644
657.75	4.75	6.94	8.83	626350
658.00	5.00	7.12	9.06	642621


Overflow Pipe - Elevation vs. Discharge
658.00
657.50
657.00
656.50
656.00
Basin Elevation (ft)
0
20
40
60
80
100
Discharge (cfs)
Circular Orifice
Sharp Crested Weir
Full Pipe

Mill Seat Facility - Proposed Borrow Area Basin for Subarea #1E

Determine the Discharge through the Emergency Spillway

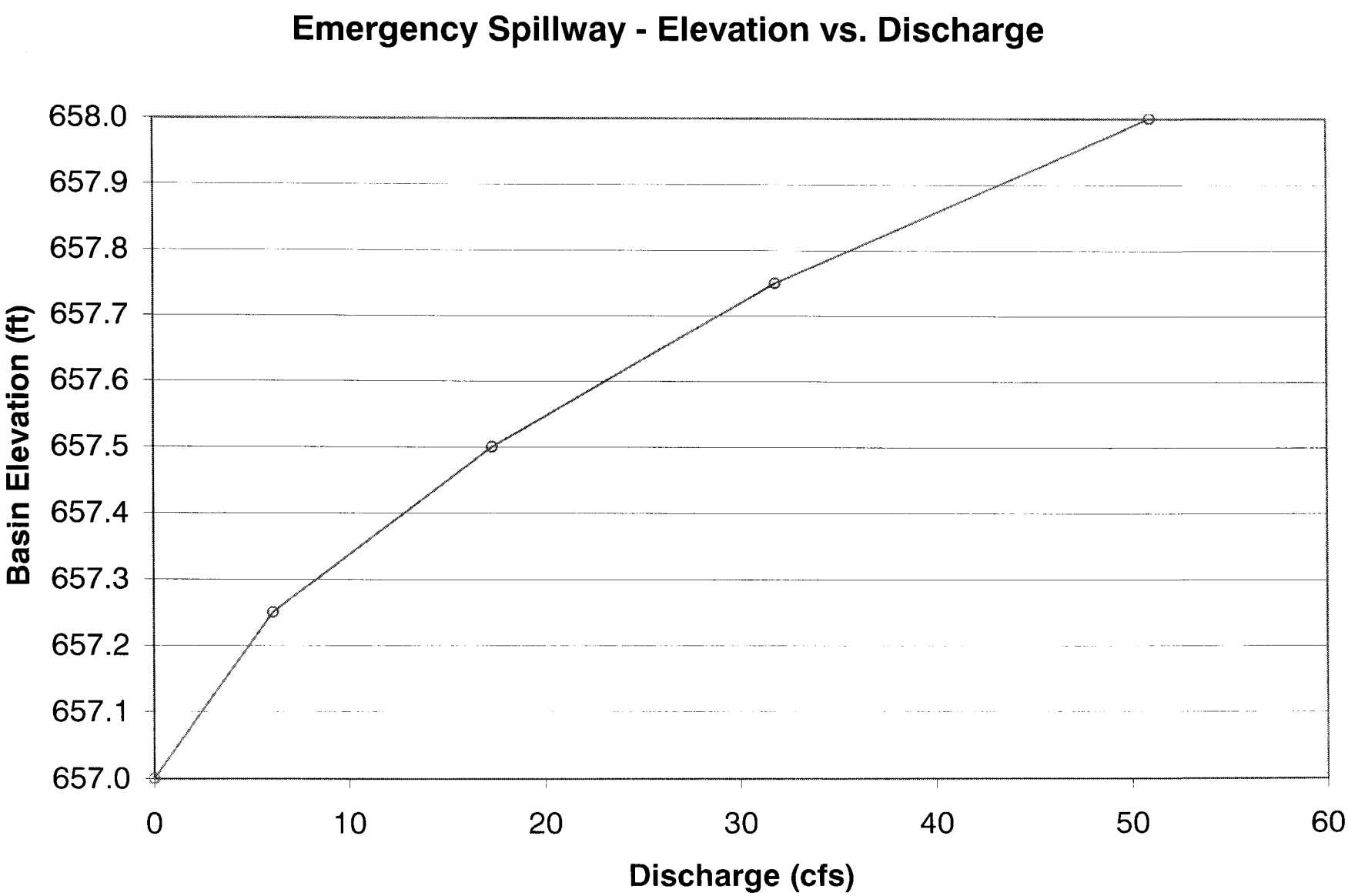
The emergency spillway can be governed by:
1) Discharge based broad-crested weir control
(Reference: Highway Engineering Circular No. 22, Second Edition, "Urban Drainage Design Manual"
Publication No. FHWA-NHI-01-021, August 2001)

$Q = C_{SP}(b)(H_p)^{1.5}$ (Eq. 8-26)

1) Estimate the Discharge for the Emergency Spillway

$b = 20$
$H_o = 657$

Discharge Elevation (ft)	H_p (ft)	C_{SP}	Q (cfs)
657.00	0	0	0
657.25	0.25	2.45	6.13
657.50	0.50	2.45	17.32
657.75	0.75	2.45	31.83
658.00	1.00	2.55	51.00

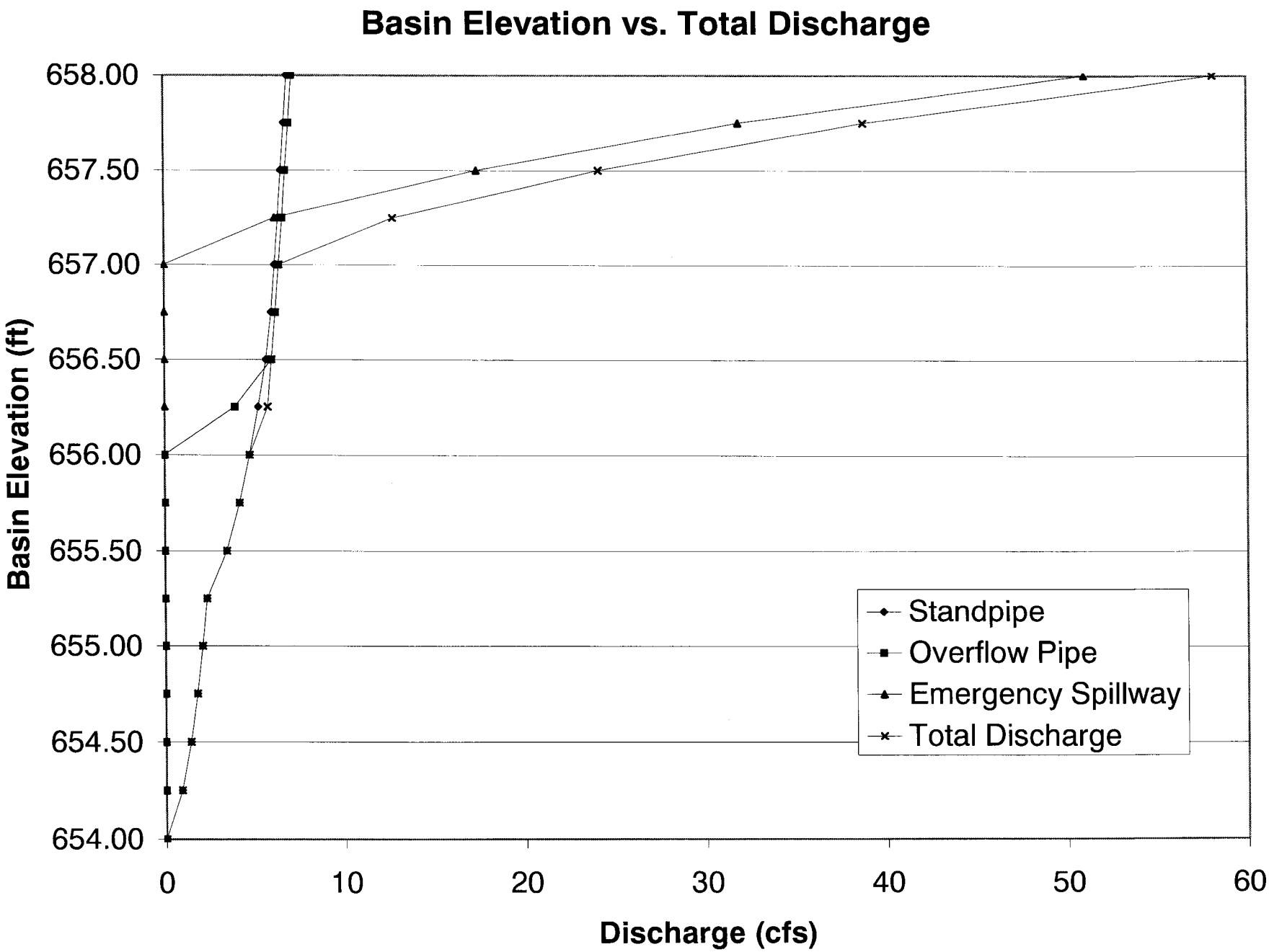

Emergency Spillway - Elevation vs. Discharge
Basin Elevation (ft)
658.0
657.9
657.8
657.7
657.6
657.5
657.4
657.3
657.2
657.1
657.0
0
10
20
30
40
50
60
Discharge (cfs)

9/3/2009
By: ASK
Chk: AJN

Mill Seat Facility - Proposed Borrow Area Basin Subarea #1E

Discharge Summary

Discharge Elevation (ft)	Slotted Standpipe Discharge				Overflow Pipe Discharge				Emergency Spillway Discharge, Q (cfs)	Total Basin Discharge (cfs)
	Q (cfs) - Center of Slot Elevation 654.04	Q (cfs) - Center of Slot Elevation 655.29	Q (cfs) - Full Pipe	**Controlling Discharge**	Q (cfs) - Orifice	Q (cfs) - Weir	Q (cfs) - Full Pipe	**Controlling Discharge**		
654.00	0.00	0.000	3.06	**0.00**	0.00	0.00	0.00	**0.00**	**0.00**	**0.00**
654.25	0.88	0.000	3.43	**0.88**	0.00	0.00	0.00	**0.00**	**0.00**	**0.88**
654.50	1.39	0.000	3.75	**1.39**	0.00	0.00	0.00	**0.00**	**0.00**	**1.39**
654.75	1.75	0.000	4.05	**1.75**	0.00	0.00	0.00	**0.00**	**0.00**	**1.75**
655.00	2.05	0.000	4.33	**2.05**	0.00	0.00	0.00	**0.00**	**0.00**	**2.05**
655.25	2.31	0.000	4.60	**2.31**	0.00	0.00	0.00	**0.00**	**0.00**	**2.31**
655.50	2.55	0.882	4.85	**3.43**	0.00	0.00	0.00	**0.00**	**0.00**	**3.43**
655.75	2.77	1.387	5.08	**4.15**	0.00	0.00	0.00	**0.00**	**0.00**	**4.15**
656.00	2.97	1.752	5.31	**4.72**	0.00	0.00	5.51	**0.00**	**0.00**	**4.72**
656.25	3.15	2.053	5.52	**5.21**	17.02	3.91	5.74	**3.91**	**0.00**	**5.74**
656.50	3.33	2.315	5.73	**5.64**	24.07	11.07	5.95	**5.95**	**0.00**	**5.95**
656.75	3.50	2.550	5.93	**5.93**	29.48	20.88	6.16	**6.16**	**0.00**	**6.16**
657.00	3.66	2.765	6.13	**6.13**	34.04	32.62	6.37	**6.37**	**0.00**	**6.37**
657.25	3.81	2.965	6.32	**6.32**	38.05	46.24	6.56	**6.56**	**6.13**	**12.69**
657.50	3.96	3.152	6.50	**6.50**	41.68	61.65	6.75	**6.75**	**17.32**	**24.08**
657.75	4.10	3.329	6.68	**6.68**	45.02	78.78	6.94	**6.94**	**31.83**	**38.76**
658.00	4.24	3.497	6.85	**6.85**	48.13	97.58	7.12	**7.12**	**51.00**	**58.12**


Basin Elevation vs. Total Discharge
Basin Elevation (ft)
658.00
657.50
657.00
656.50
656.00
655.50
655.00
654.50
654.00
0
10
20
30
40
50
60
Discharge (cfs)
Standpipe
Overflow Pipe
Emergency Spillway
Total Discharge

Mill Seat Facility
08-015

9/1/2009
By: AJK
Chk: AJJ

Mill Seat Facility - Proposed Borrow Area Basin for Subarea #1E

Summary of Elevation vs. Outflow and Storage

Elevation (stage) (ft)	Total Discharge (cfs)	Total Cumulative Storage (ft^3)
654.00	0.00	0
654.25	0.88	39722
654.50	1.39	79444
654.75	1.75	119165
655.00	2.05	158887
655.25	2.31	202780
655.50	3.43	246672
655.75	4.15	290565
656.00	4.72	334457
656.25	5.74	414486
656.50	5.95	494515
656.75	6.16	574543
657.00	6.37	654572
657.25	12.69	804404
657.50	24.08	954236
657.75	38.76	1104067
658.00	58.12	1253899

*Note - Storage volumes were interpolated between 1 foot elevation increments

SIZE BASIN FOR SUBAREA #2W

$$WQ_v = \frac{P \cdot R_v \cdot A}{12}$$

$P = 0.9$ (FIG. 4.1)

$R_v = 0.05 + 0.009(100)$, ASSUME WORST CASE $I = 100\%$

$= 0.95$ (> 0.02)

$A = 20.02$ ACRE

$$WQ_v = \frac{0.9 \cdot 0.95 \; 20.02}{12} = 1.43 \text{ ACRE FT} \left(\times \frac{43560 \text{ ft}^2}{1 \text{ ACRE}}\right) = 62135 \text{ ft}^3$$

- FOREBAY SHALL CONTAIN 10% OF WQ_v

$= 0.10(62135 \text{ ft}^3) = 6214 \text{ ft}^3 < 107773 \text{ ft}^3$ (FOREBAY VOLUME, PG. 47) ✓OK

- EXTENDED DETENTION VOLUME SHALL BE AT LEAST:

$62135 \text{ ft}^3 < 107{,}773 + 133{,}709 \text{ ft}^3 = 241{,}482 \text{ ft}^3$ (FORE BAY + PERMANENT POOL VOLUME, PG. 47) ✓OK

Subarea #2W

Use AutoCAD to trace contours and obtain areas and average end method to find volumes of forebay, permanent pool and storage pool for Subarea #2W
(Dwg. No. 08015-018)

Forebay Volume

Contour (ft)	Area (ft^2)	Elevation Change (ft)	Volume (ft^3)	Cumulative Volume (ft^3)
655	26940	-	0	0
666	32835	1	29888	29888
667	38900	1	35868	65755
668	45135	1	42018	107773

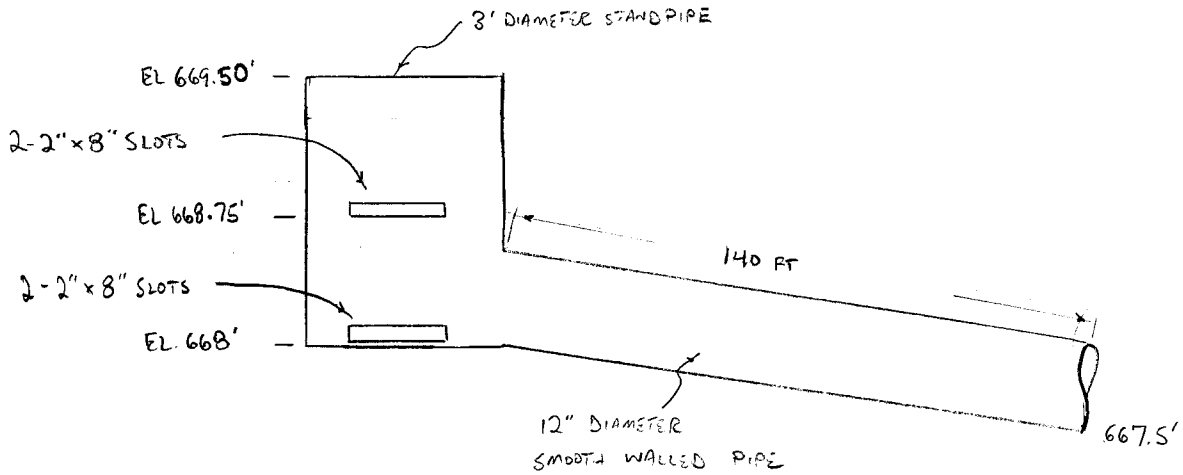
Permanent Pool Volume

Contour (ft)	Area (ft^2)	Elevation Change (ft)	Volume (ft^3)	Cumulative Volume (ft^3)
665	35225	-	0	0
666	39454	1	37340	37340
666.5	41661	0.5	20279	57618
667	47448	0.5	22277	79896
668	60179	1	53814	133709

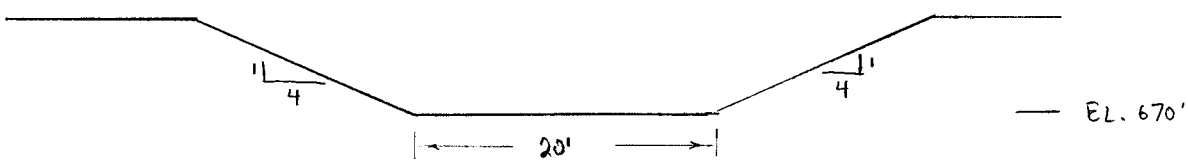
Storage Pool Volume

Contour (ft)	Area (ft^2)	Elevation Change (ft)	Volume (ft^3)	Cumulative Volume (ft^3)
668	105314	-	0	0
669	117443	1	111379	111379
670	162647	1	140045	251424
671	364991	1	263819	515243

OUTLET STRUCTURE (#2W)



EMERGENCY SPILLWAY (#2W)



9/3/2009
By: ASK
Chk: ASW

Mill Seat Facility - Proposed Borrow Area Basin Subarea #2W

Evaluate discharge through slotted standpipe
1. Discharge through the 2" x 8" slots
2. Discharge through the 12" pipe
(Reference: Highway Engineering Circular No. 22, Second Edition, "Urban Drainage Design Manual" Publication No. FHWA-NHI-01-021, August 2001)

1. Estimate the Discharge through the 2" x 8" Slots

Discharge through an orifice
$Q = C_oA_o(2gH_o)^{1/2}$ (Eq. 8-17)

C_o = 0.6
A_{oslot} = 0.111
$A_{o2slots}$ = 0.222
g = 32.2

Discharge as a weir
$Q = C_{scw}(L-0.2H)H^{1.5}$ (Eq. 8-20)

Weir Crest =	668	668.75
Channel Bottom =	668	668
L_{2slots} =	1.33	1.33
H_c =	0	0.75

Discharge Elevation (ft)	Q (cfs) - Center of Slot Elevation 668.08	Q (cfs) - Center of Slot Elevation 668.83
668.00	0.000	0.000
668.25	0.441	0.000
668.50	0.693	0.000
668.75	0.876	0.000
669.00	1.026	0.441
669.25	1.157	0.693
669.50	1.275	0.876
669.75	1.383	1.026
670.00	1.483	1.157
670.25	1.576	1.275
670.50	1.665	1.383
670.75	1.748	1.483
671.00	1.828	1.576

Discharge Elevation (ft)	Weir at 668		Weir at 668.75	
	C_{scw}	Q (cfs)	C_{scw}	Q (cfs)
668.00	3.33	0.000	3.333	0.000
668.25	3.33	0.534	3.333	0.000
668.50	3.33	1.452	3.333	0.000
668.75	3.33	2.559	3.333	0.000
669.00	3.33	3.774	3.403	0.546
669.25	3.33	5.042	3.537	1.542
669.50	3.33	6.322	3.670	2.821
669.75	3.33	7.581	3.803	4.310
670.00	3.33	8.791	3.937	5.960
670.25	3.33	9.928	4.070	7.726
670.50	3.33	10.969	4.203	9.569
670.75	3.33	11.896	4.337	11.448
671.00	3.33	12.689	4.470	13.326

*Orifice governs for both elevations

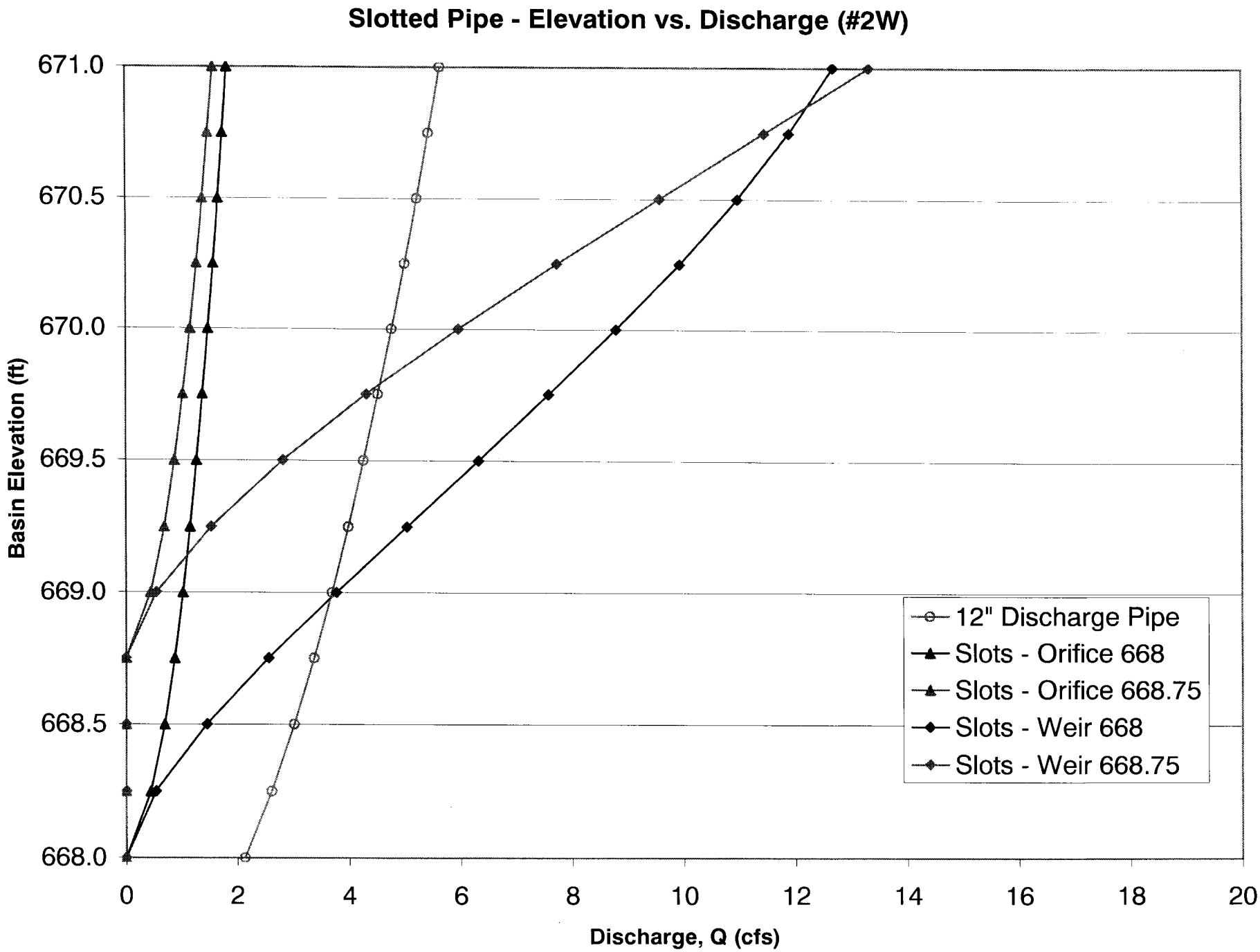
2. Estimate Discharge through the 12" pipe

See Attached Sketch for Layout and Components
$Q = A*((2*g*\Delta H)/(1+k_{entrance}+K_{gate}+(f*L/d)))$

g (ft/sec^2)= 32.2
d_{pipe} (ft) = 1.000
A_{pipe} (ft^2) = 0.785
Pipe Outlet El. = 667.5
Pipe Length (ft) = 140.0
K_e (entrance) = 1.0
K_e (gate valve) = 0.2
f = 0.0155

ν = 1.41E-05
e = 0.000005
e / d = 0.000005

Discharge Elevation (ft)	ΔH (ft)	Q (cfs)	V (fps)	Re
668.00	0.5	2.13	2.7	192517
668.25	0.8	2.61	3.3	235784
668.50	1.0	3.02	3.8	272260
668.75	1.3	3.37	4.3	304395
669.00	1.5	3.69	4.7	333448
669.25	1.8	3.99	5.1	360166
669.50	2.0	4.26	5.4	385033
669.75	2.3	4.52	5.8	408389
670.00	2.5	4.77	6.1	430480
670.25	2.8	5.00	6.4	451491
670.50	3.0	5.22	6.6	471567
670.75	3.3	5.44	6.9	490823
671.00	3.5	5.64	7.2	509351


Slotted Pipe - Elevation vs. Discharge (#2W)
Basin Elevation (ft)
671.0
670.5
670.0
669.5
669.0
668.5
668.0
0
2
4
6
8
10
12
14
16
18
20
Discharge, Q (cfs)
12" Discharge Pipe
Slots - Orifice 668
Slots - Orifice 668.75
Slots - Weir 668
Slots - Weir 668.75

Mill Seat Facility - Proposed Borrow Area Basin for Subarea #2W

Evaluate Discharge through the Overflow Pipe
Can be governed by:
1) Discharge based on orifice control
2) Discharge based on weir control
3) Discharge based on full pipe flow
(Reference: Highway Engineering Circular No. 22, Second Edition, "Urban Drainage Design Manual"
Publication No. FHWA-NHI-01-021, August 2001)

1) Estimate Discharge based on Circular Orifice Control

$Q = C_o A_o (2gH_o)^{1/2}$ (Eq. 8-17)

C_o = 0.6 (circular orifices)
A_o = 7.069
H_o = varies
g = 32.2

2) Estimate the Discharge Based on Sharp Weir Control

$Q = C_{scw} L H^{1.5}$ (Eq. 8-19)

$C_{scw} = 3.27 + 0.4 (H/H_c)$
L = 9.4 (pipe circumference)
H = varies
H_c = 1.5

Discharge Elevation (ft)	Orifice Flow			Weir Flow		
	H_o (ft)	Q (cfs)		H (ft)	C_{scw}	Q (cfs)
669.50	0.00	0.00		0.00	3.33	0.00
669.75	0.25	17.02		0.25	3.33	3.91
670.00	0.50	24.07		0.50	3.40	11.31
670.25	0.75	29.48		0.75	3.47	21.19
670.50	1.00	34.04		1.00	3.54	33.24
670.75	1.25	38.05		1.25	3.60	47.34
671.00	1.50	41.68		1.50	3.67	63.38

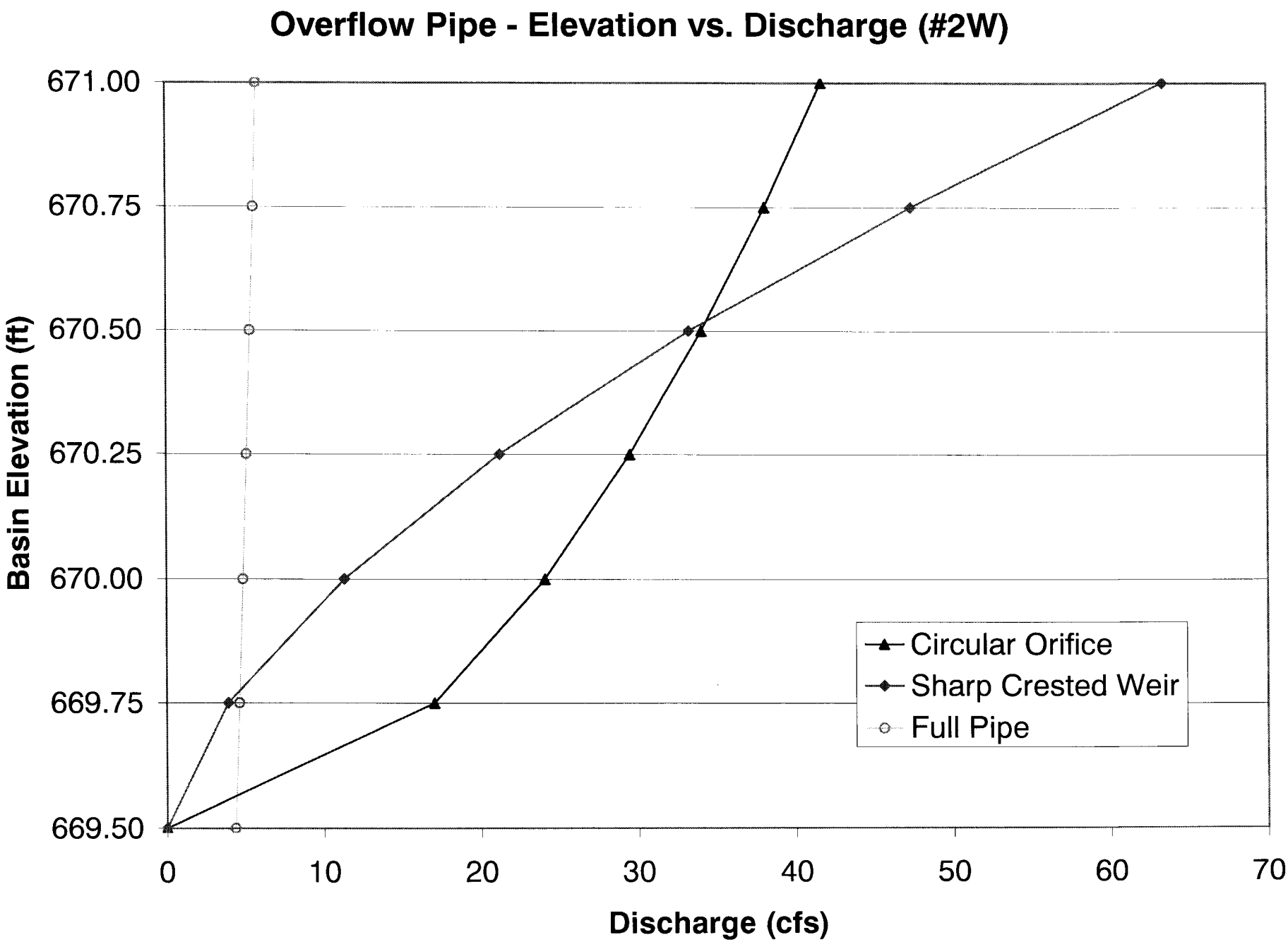
3) Estimate the Discharge Based on Full Pipe Flow

$Q = A*((2*g*\Delta H)/(1+k_{entrance}+K_{gate}+(f*L/d)))$

d_{pipe} = 1
A_{pipe} = 0.785
Pipe Outlet El. = 667.5
Pipe Length = 140
K (entrance) = 1
K (gate) = 0.2
f = 0.014

ν = 1.41E-05
ε = 0.000005
ε/d = 0.000005

Discharge Elevation (ft)	ΔH (ft)	Q (cfs)	V (ft/s)	Re
669.50	2.00	4.37	5.56	394632
669.75	2.25	4.64	5.90	418570
670.00	2.50	4.89	6.22	441212
670.25	2.75	5.12	6.52	462747
670.50	3.00	5.35	6.81	483323
670.75	3.25	5.57	7.09	503059
671.00	3.50	5.78	7.36	522049


Overflow Pipe - Elevation vs. Discharge (#2W)
Basin Elevation (ft)
671.00
670.75
670.50
670.25
670.00
669.75
669.50
0
10
20
30
40
50
60
70
Discharge (cfs)
Circular Orifice
Sharp Crested Weir
Full Pipe

Mill Seat Facility - Proposed Borrow Area Basin for Subarea #2W

Determine the Discharge through the Emergency Spillway

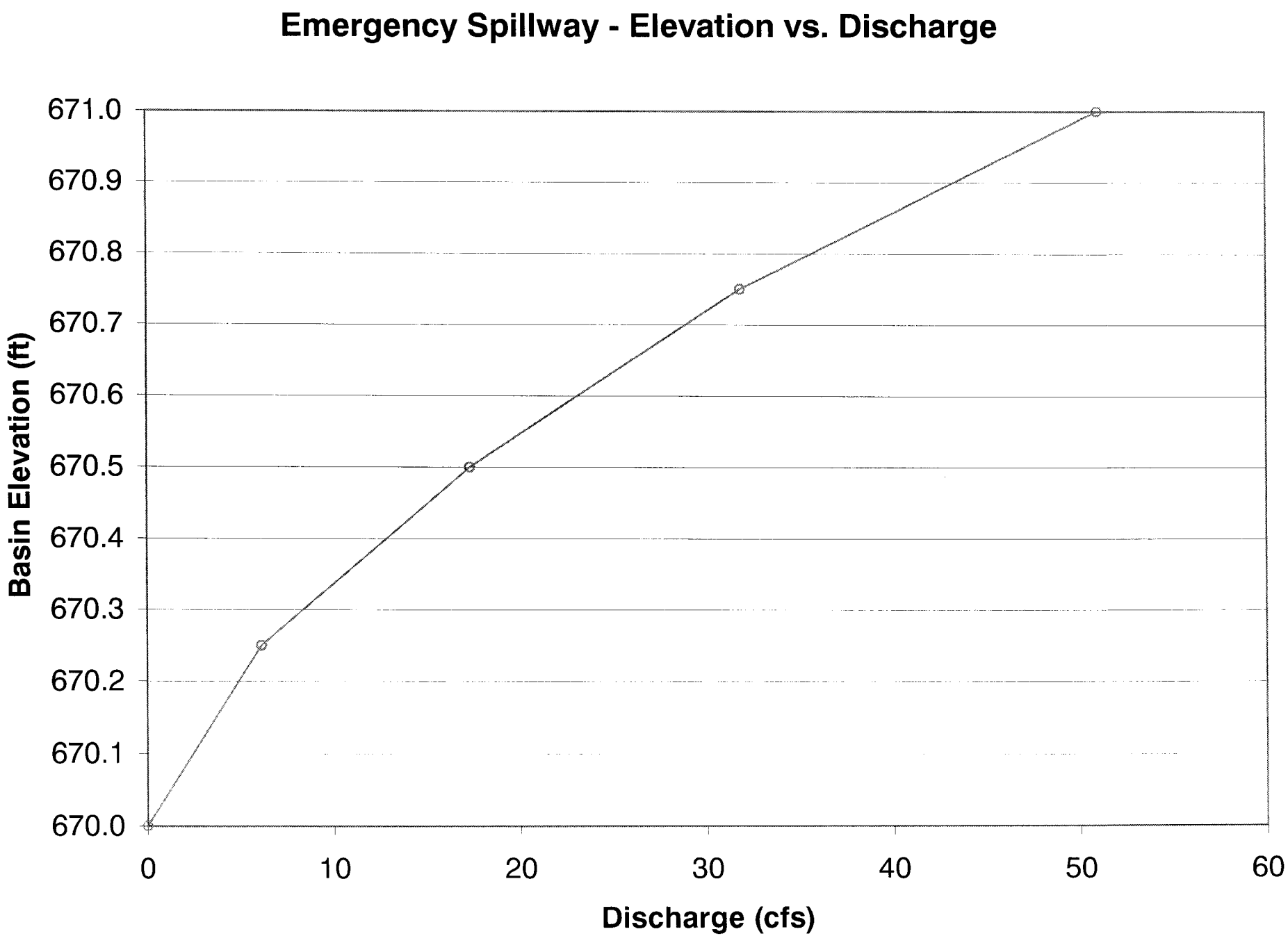
The emergency spillway can be governed by:
1) Discharge based broad-crested weir control
(Reference: Highway Engineering Circular No. 22, Second Edition, "Urban Drainage Design Manual"
Publication No. FHWA-NHI-01-021, August 2001)

$Q = C_{SP}(b)(H_p)^{1.5}$ (Eq. 8-26)

1) Estimate the Discharge for the Emergency Spillway

$b = 20$
$H_o = 670$

Discharge Elevation (ft)	H_p (ft)	C_{SP}	Q (cfs)
670.00	0.00	0	0
670.25	0.25	2.45	6.13
670.50	0.50	2.45	17.32
670.75	0.75	2.45	31.83
671.00	1.00	2.55	51.00


Emergency Spillway - Elevation vs. Discharge
Basin Elevation (ft)
671.0
670.9
670.8
670.7
670.6
670.5
670.4
670.3
670.2
670.1
670.0
0
10
20
30
40
50
60
Discharge (cfs)

Mill Seat Facility
08-015

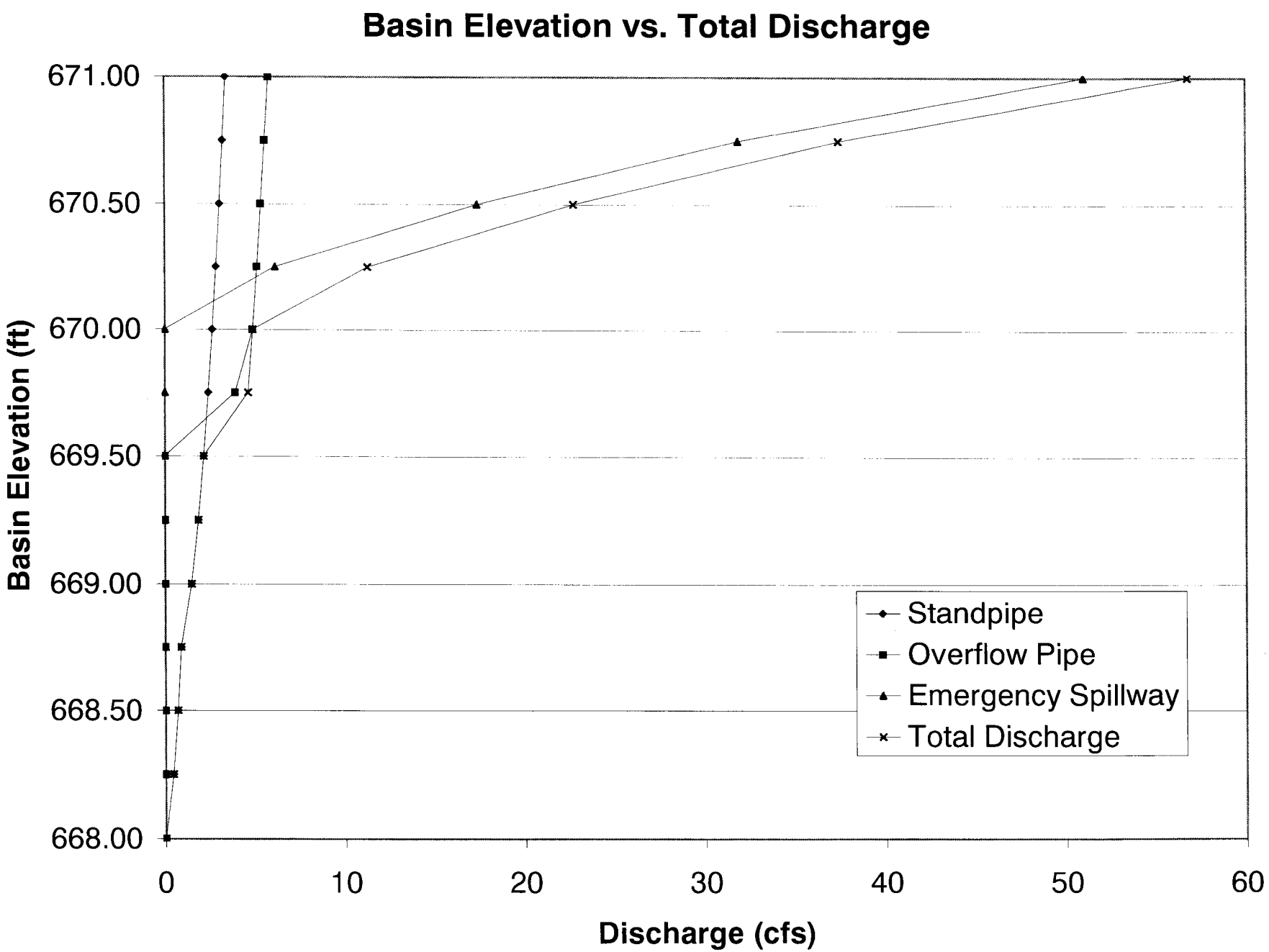
9/3/2009
By: AJK
Chk: AGJ

Mill Seat Facility - Proposed Borrow Area Basin Subarea #2W

Discharge Summary

Discharge Elevation (ft)	Slotted Standpipe Discharge				Overflow Pipe Discharge				Emergency Spillway Discharge, Q (cfs)	Total Basin Discharge (cfs)
	Q (cfs) - Center of Slot Elevation 668.04	Q (cfs) - Center of Slot Elevation 668.79	Q (cfs) - Full Pipe	**Controlling Discharge**	Q (cfs) - Orifice	Q (cfs) - Weir	Q (cfs) - Full Pipe	**Controlling Discharge**		
668.00	0.00	0.00	2.13	**0.00**	0.00	0.00	0.00	**0.00**	**0.00**	**0.00**
668.25	0.44	0.00	2.61	**0.44**	0.00	0.00	0.00	**0.00**	**0.00**	**0.44**
668.50	0.69	0.00	3.02	**0.69**	0.00	0.00	0.00	**0.00**	**0.00**	**0.69**
668.75	0.88	0.00	3.37	**0.88**	0.00	0.00	0.00	**0.00**	**0.00**	**0.88**
669.00	1.03	0.44	3.69	**1.47**	0.00	0.00	0.00	**0.00**	**0.00**	**1.47**
669.25	1.16	0.69	3.99	**1.85**	0.00	0.00	0.00	**0.00**	**0.00**	**1.85**
669.50	1.28	0.88	4.26	**2.15**	0.00	0.00	4.37	**0.00**	**0.00**	**2.15**
669.75	1.38	1.03	4.52	**2.41**	17.02	3.91	4.64	**3.91**	**0.00**	**4.64**
670.00	1.48	1.16	4.77	**2.64**	24.07	11.31	4.89	**4.89**	**0.00**	**4.89**
670.25	1.58	1.28	5.00	**2.85**	29.48	21.19	5.12	**5.12**	**6.13**	**11.25**
670.50	1.66	1.38	5.22	**3.05**	34.04	33.24	5.35	**5.35**	**17.32**	**22.68**
670.75	1.75	1.48	5.44	**3.23**	38.05	47.34	5.57	**5.57**	**31.83**	**37.40**
671.00	1.83	1.58	5.64	**3.40**	41.68	63.38	5.78	**5.78**	**51.00**	**56.78**

SHEET 55 of 87


Basin Elevation vs. Total Discharge
Basin Elevation (ft)
671.00
670.50
670.00
669.50
669.00
668.50
668.00
0
10
20
30
40
50
60
Discharge (cfs)
Standpipe
Overflow Pipe
Emergency Spillway
Total Discharge

Mill Seat Facility
08-015

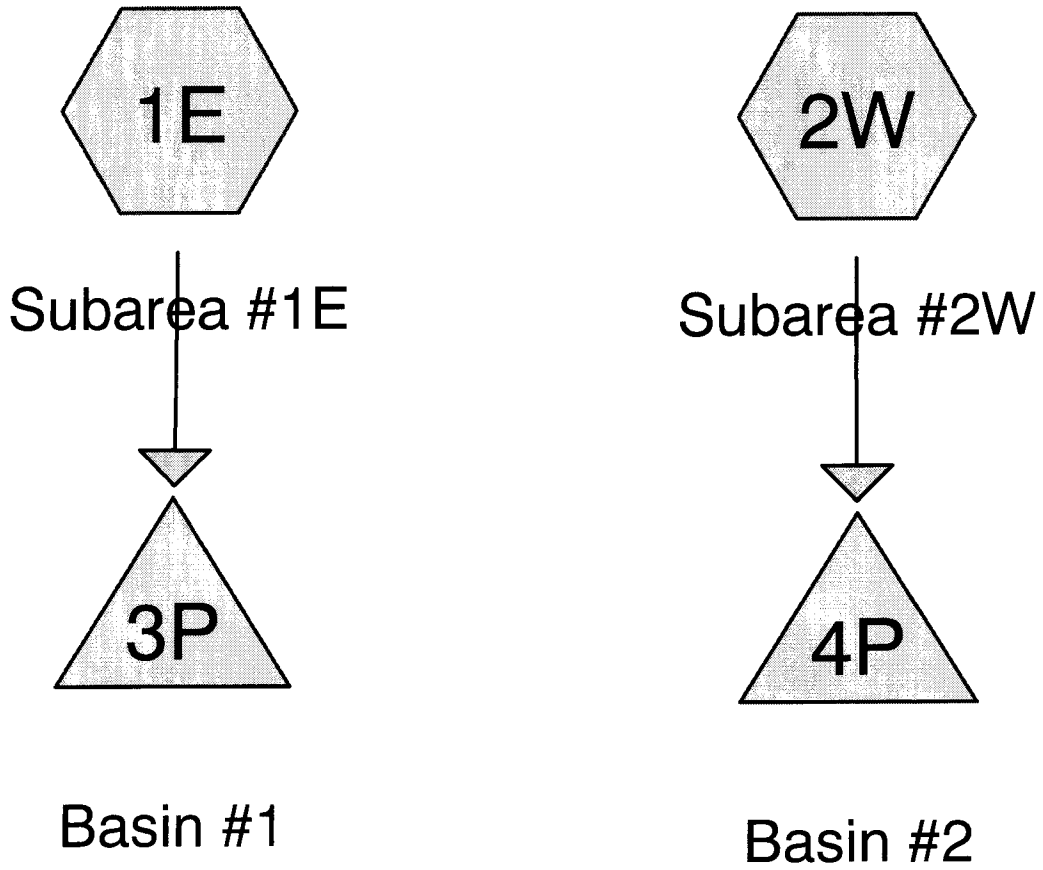
9/3/2009
By: ADK
Chk: AJN
SHEET 57 OF 87

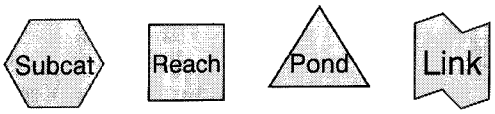
Mill Seat Facility - Proposed Borrow Area Basin for Subarea #2W

Summary of Elevation vs. Outflow and Storage

Elevation (stage) (ft)	Total Discharge (cfs)	Total Cumulative Storage (ft^3)
668.00	0.00	0
668.25	0.44	27845
668.50	0.69	55690
668.75	0.88	83534
669.00	1.47	111379
669.25	1.85	146390
669.50	2.15	181402
669.75	4.64	216413
670.00	4.89	251424
670.25	11.25	317379
670.50	22.68	383334
670.75	37.40	449288
671.00	56.78	515243

*Note - Storage volumes were interpolated between 1 foot elevation increments





Drainage Diagram for Proposed Conditions
Prepared by {enter your company name here}, Printed 9/1/2009
HydroCAD® 8.50 s/n 003326 © 2007 HydroCAD Software Solutions LLC

Subcatchment 1E: Subarea #1E

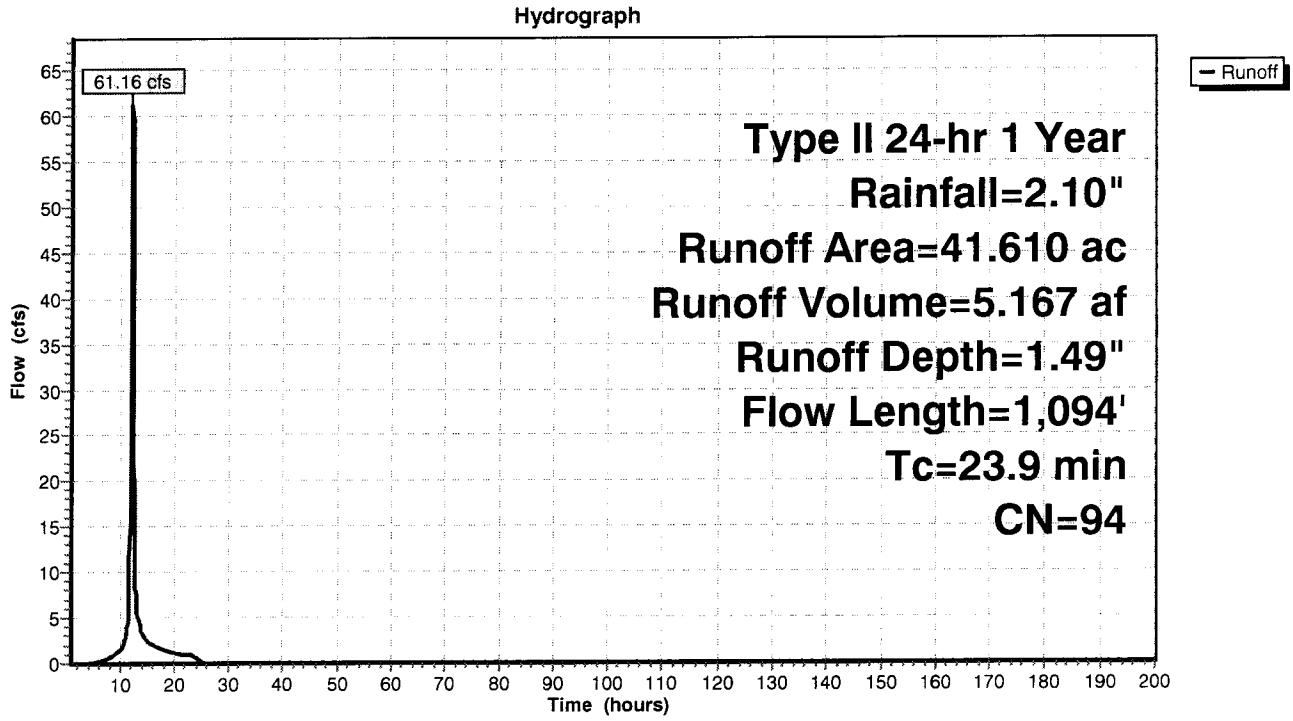
Runoff = 61.16 cfs @ 12.17 hrs, Volume= 5.167 af, Depth= 1.49"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-200.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 Year Rainfall=2.10"

Area (ac)	CN	Description
41.610	94	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	36	0.3333	0.9		**Sheet Flow, A to B** Fallow n= 0.050 P2= 2.50"
6.7	114	0.0100	0.3		**Sheet Flow, B to C** Fallow n= 0.050 P2= 2.50"
13.1	786	0.0100	1.0		**Shallow Concentrated Flow, C to D** Nearly Bare & Untilled Kv= 10.0 fps
3.4	158	0.0060	0.8		**Shallow Concentrated Flow, D to E** Nearly Bare & Untilled Kv= 10.0 fps
23.9	1,094	Total			

Subcatchment 1E: Subarea #1E



Subcatchment 2W: Subarea #2W

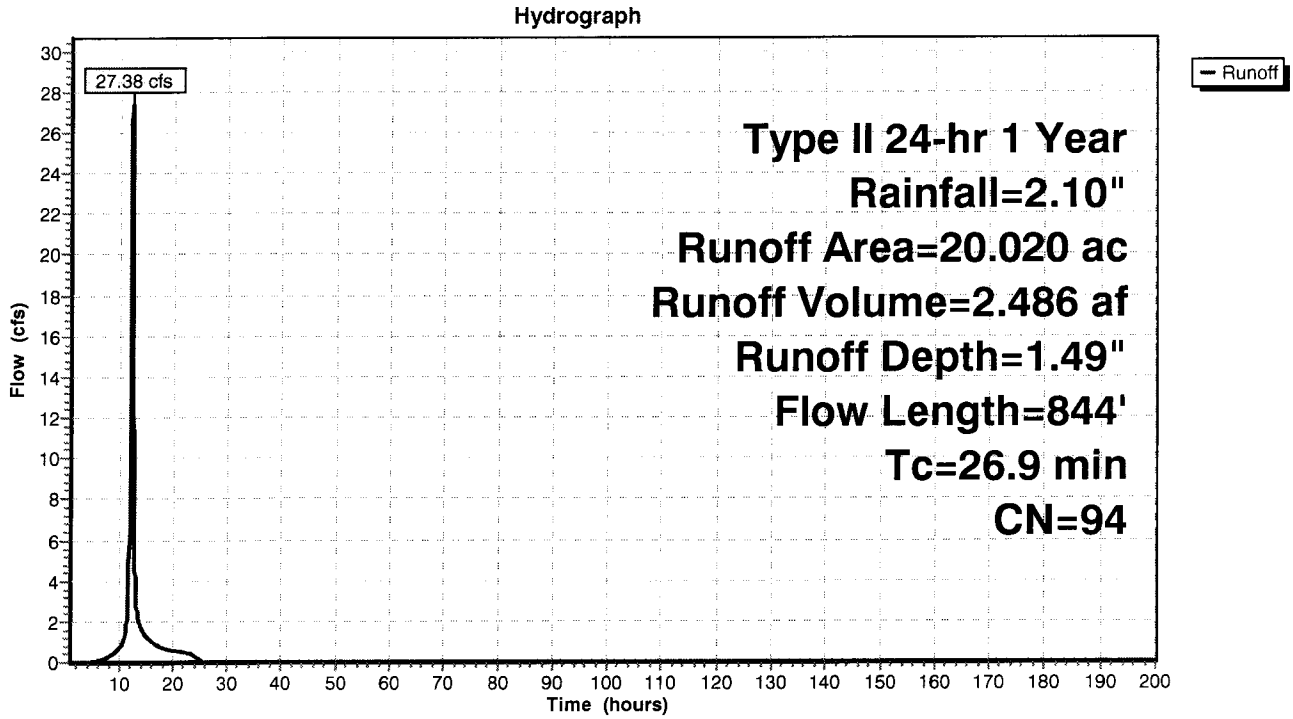
Runoff = 27.38 cfs @ 12.20 hrs, Volume= 2.486 af, Depth= 1.49"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-200.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 Year Rainfall=2.10"

Area (ac)	CN	Description
20.020	94	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.1	150	0.0050	0.2		**Sheet Flow, A to B** Fallow n= 0.050 P2= 2.50"
15.3	651	0.0050	0.7		**Shallow Concentrated Flow, B to C** Nearly Bare & Untilled Kv= 10.0 fps
0.5	43	0.0230	1.5		**Shallow Concentrated Flow, C to D** Nearly Bare & Untilled Kv= 10.0 fps
26.9	844	Total			

Subcatchment 2W: Subarea #2W



Pond 3P: Basin #1

Inflow Area =	41.610 ac,	Inflow Depth =	1.49"	for	1 Year event
Inflow =	61.16 cfs @	12.17 hrs,	Volume=	5.167 af	
Outflow =	2.03 cfs @	16.10 hrs,	Volume=	5.167 af,	Atten= 97%, Lag= 236.4 min
Primary =	2.03 cfs @	16.10 hrs,	Volume=	5.167 af	

Routing by Dyn-Stor-Ind method, Time Span= 1.00-200.00 hrs, dt= 0.05 hrs
Peak Elev= 654.98' @ 16.10 hrs Surf.Area= 0 sf Storage= 155,927 cf
Plug-Flow detention time= 1,045.3 min calculated for 5.167 af (100% of inflow)
Center-of-Mass det. time= 1,045.0 min (1,860.3 - 815.3)

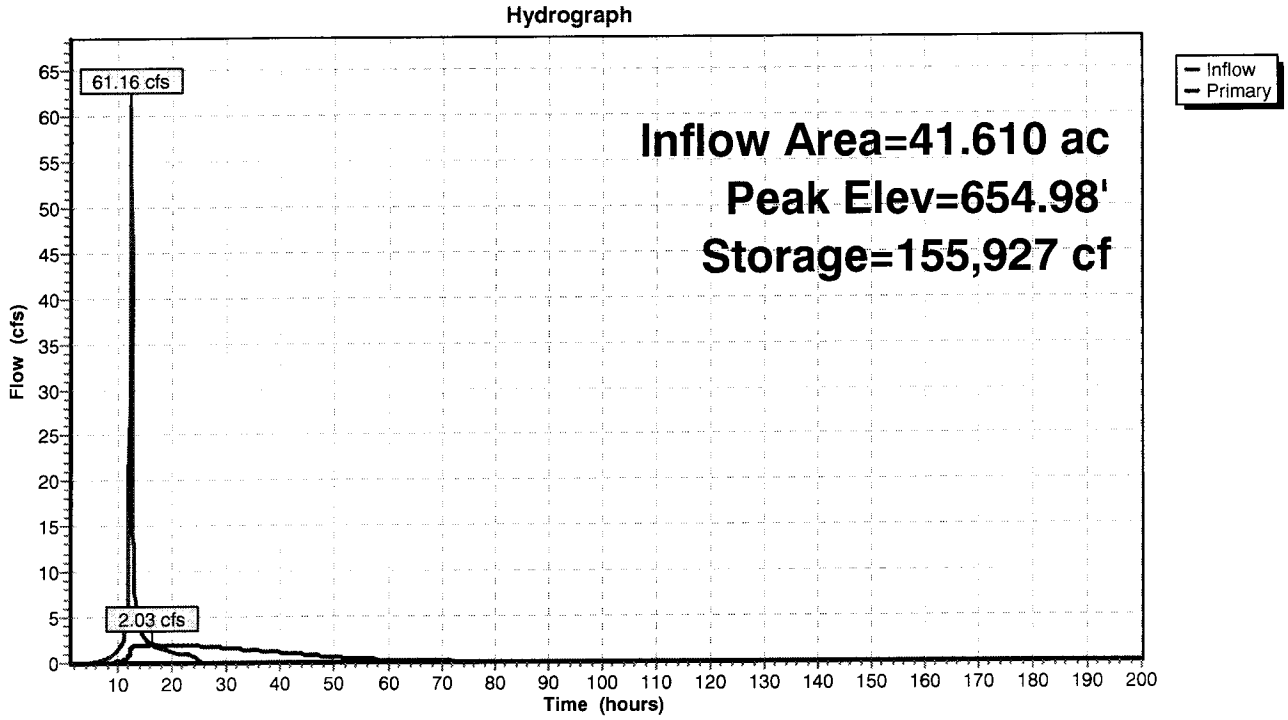
Volume	Invert	Avail.Storage	Storage Description
#1	654.00'	1,253,899 cf	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (cubic-feet)
654.00	0
654.25	39,722
654.50	79,444
654.75	119,165
655.00	158,887
655.25	202,780
655.50	246,672
655.75	290,565
656.00	334,457
656.25	414,486
656.50	494,515
656.75	574,543
657.00	654,572
657.25	804,404
657.50	954,236
657.75	1,104,067
658.00	1,253,899

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**Special & User-Defined** Elev. (feet) 654.00 654.25 654.50 654.75 655.00 655.25 655.50 655.75 656.00 656.25 656.50 656.75 657.00 657.25 657.50 657.75 658.00 Disch. (cfs) 0.000 0.880 1.390 1.750 2.050 2.310 3.430 4.150 4.720 5.740 5.950 6.160 6.370 12.690 24.080 38.760 58.120

Primary OutFlow Max=2.03 cfs @ 16.10 hrs HW=654.98' (Free Discharge)
└─**1=Special & User-Defined** (Custom Controls 2.03 cfs)

Pond 3P: Basin #1



Pond 4P: Basin #2

Inflow Area =	20.020 ac,	Inflow Depth =	1.49"	for	1 Year event
Inflow =	27.38 cfs @	12.20 hrs,	Volume=	2.486 af	
Outflow =	0.84 cfs @	17.08 hrs,	Volume=	2.486 af,	Atten= 97%, Lag= 292.9 min
Primary =	0.84 cfs @	17.08 hrs,	Volume=	2.486 af	

Routing by Dyn-Stor-Ind method, Time Span= 1.00-200.00 hrs, dt= 0.05 hrs
Peak Elev= 668.70' @ 17.08 hrs Surf.Area= 0 sf Storage= 77,683 cf
Plug-Flow detention time= 1,301.2 min calculated for 2.486 af (100% of inflow)
Center-of-Mass det. time= 1,301.1 min (2,119.2 - 818.1)

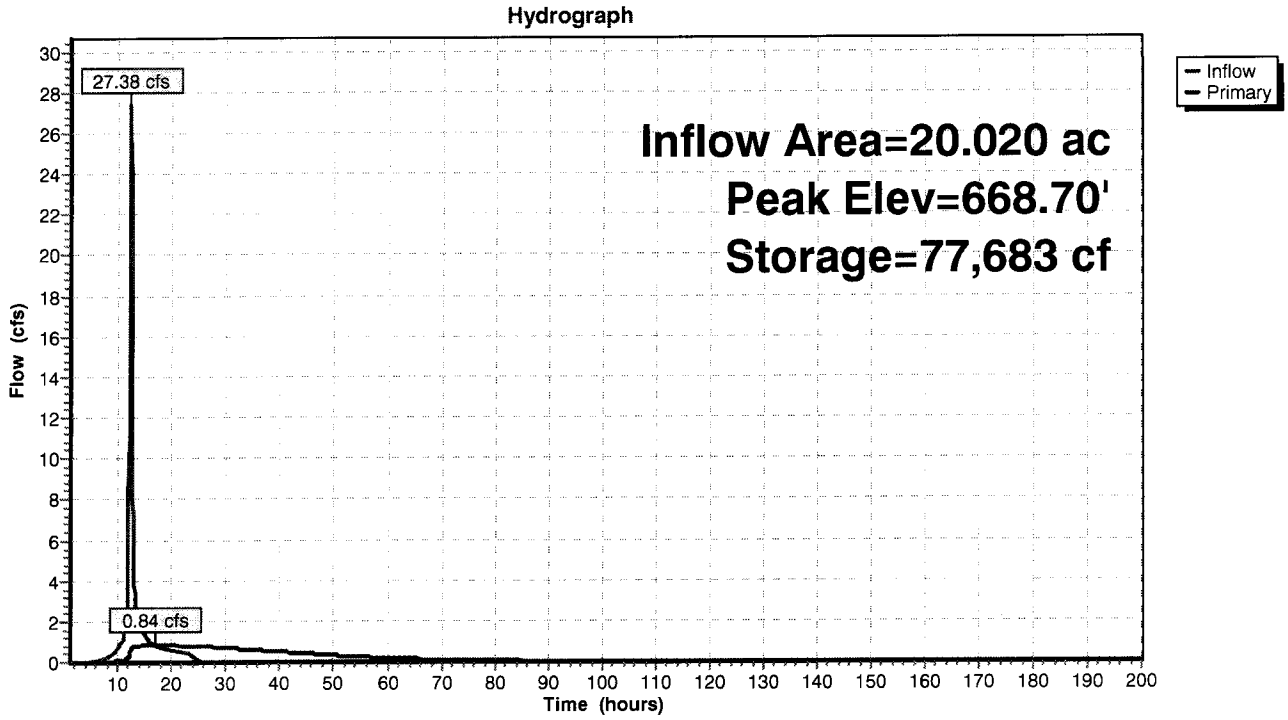
Volume	Invert	Avail.Storage	Storage Description
#1	668.00'	515,243 cf	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (cubic-feet)
668.00	0
668.25	27,845
668.50	55,690
668.75	83,534
669.00	111,379
669.25	146,390
669.50	181,402
669.75	216,413
670.00	251,424
670.25	317,379
670.50	383,334
670.75	449,288
671.00	515,243

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**Special & User-Defined** Elev. (feet) 668.00 668.25 668.50 668.75 669.00 669.25 669.50 669.75 670.00 670.25 670.50 670.75 671.00 Disch. (cfs) 0.000 0.440 0.690 0.880 1.470 1.850 2.150 4.640 4.890 11.250 22.680 37.400 56.780

Primary OutFlow Max=0.84 cfs @ 17.08 hrs HW=668.70' (Free Discharge)
└**1=Special & User-Defined** (Custom Controls 0.84 cfs)

Pond 4P: Basin #2



Subcatchment 1E: Subarea #1E

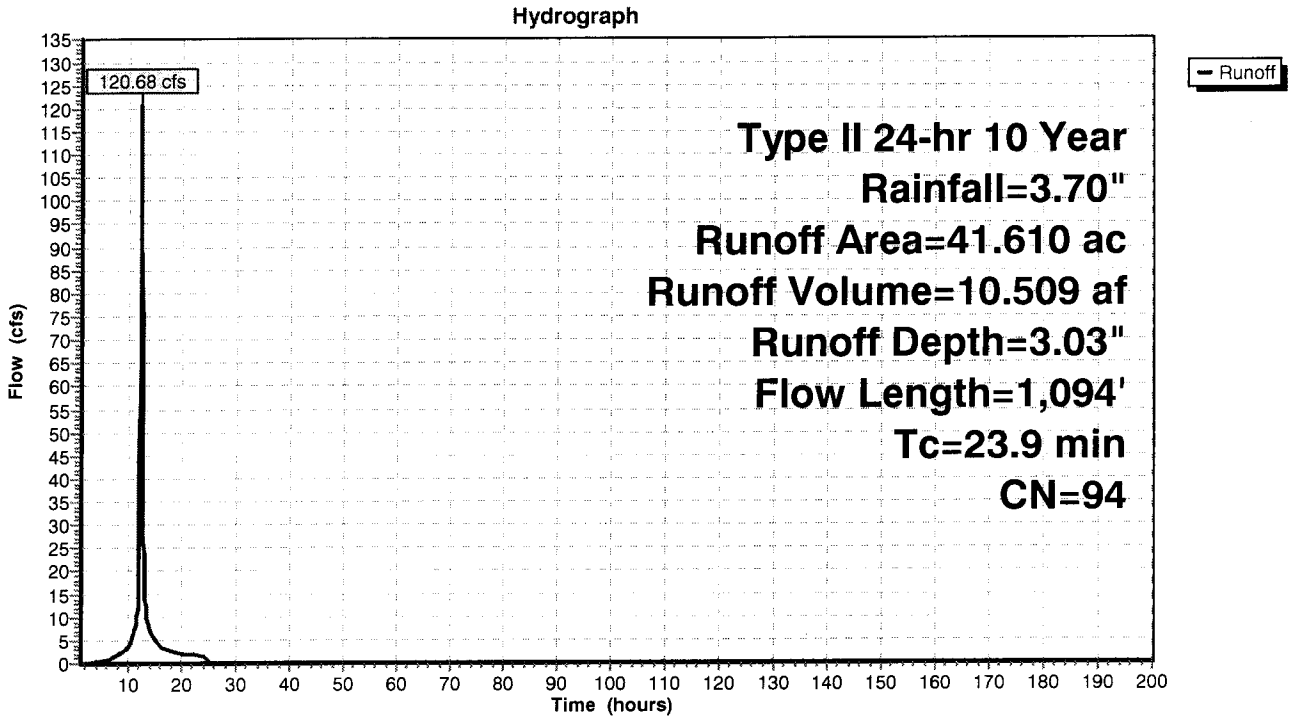
Runoff = 120.68 cfs @ 12.16 hrs, Volume= 10.509 af, Depth= 3.03"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-200.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 Year Rainfall=3.70"

Area (ac)	CN	Description
41.610	94	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	36	0.3333	0.9		**Sheet Flow, A to B** Fallow n= 0.050 P2= 2.50"
6.7	114	0.0100	0.3		**Sheet Flow, B to C** Fallow n= 0.050 P2= 2.50"
13.1	786	0.0100	1.0		**Shallow Concentrated Flow, C to D** Nearly Bare & Untilled Kv= 10.0 fps
3.4	158	0.0060	0.8		**Shallow Concentrated Flow, D to E** Nearly Bare & Untilled Kv= 10.0 fps
23.9	1,094	Total			

Subcatchment 1E: Subarea #1E



Subcatchment 2W: Subarea #2W

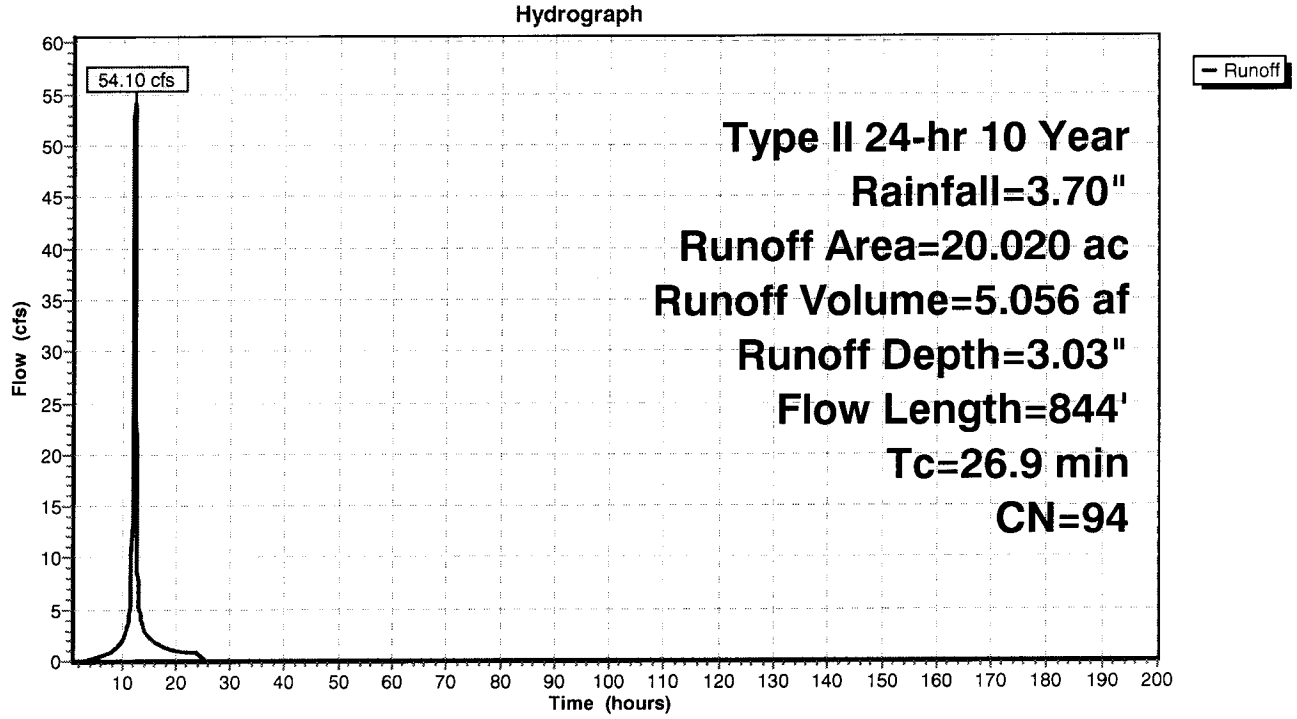
Runoff = 54.10 cfs @ 12.20 hrs, Volume= 5.056 af, Depth= 3.03"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-200.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 Year Rainfall=3.70"

Area (ac)	CN	Description
20.020	94	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.1	150	0.0050	0.2		**Sheet Flow, A to B** Fallow n= 0.050 P2= 2.50"
15.3	651	0.0050	0.7		**Shallow Concentrated Flow, B to C** Nearly Bare & Untilled Kv= 10.0 fps
0.5	43	0.0230	1.5		**Shallow Concentrated Flow, C to D** Nearly Bare & Untilled Kv= 10.0 fps
26.9	844	Total			

Subcatchment 2W: Subarea #2W



Pond 3P: Basin #1

Inflow Area =	41.610 ac,	Inflow Depth =	3.03"	for	10 Year event
Inflow =	120.68 cfs @	12.16 hrs,	Volume=	10.509 af	
Outflow =	4.50 cfs @	15.39 hrs,	Volume=	10.509 af,	Atten= 96%, Lag= 193.6 min
Primary =	4.50 cfs @	15.39 hrs,	Volume=	10.509 af	

Routing by Dyn-Stor-Ind method, Time Span= 1.00-200.00 hrs, dt= 0.05 hrs
Peak Elev= 655.90' @ 15.39 hrs Surf.Area= 0 sf Storage= 317,164 cf
Plug-Flow detention time= 1,129.6 min calculated for 10.509 af (100% of inflow)
Center-of-Mass det. time= 1,129.3 min (1,925.0 - 795.7)

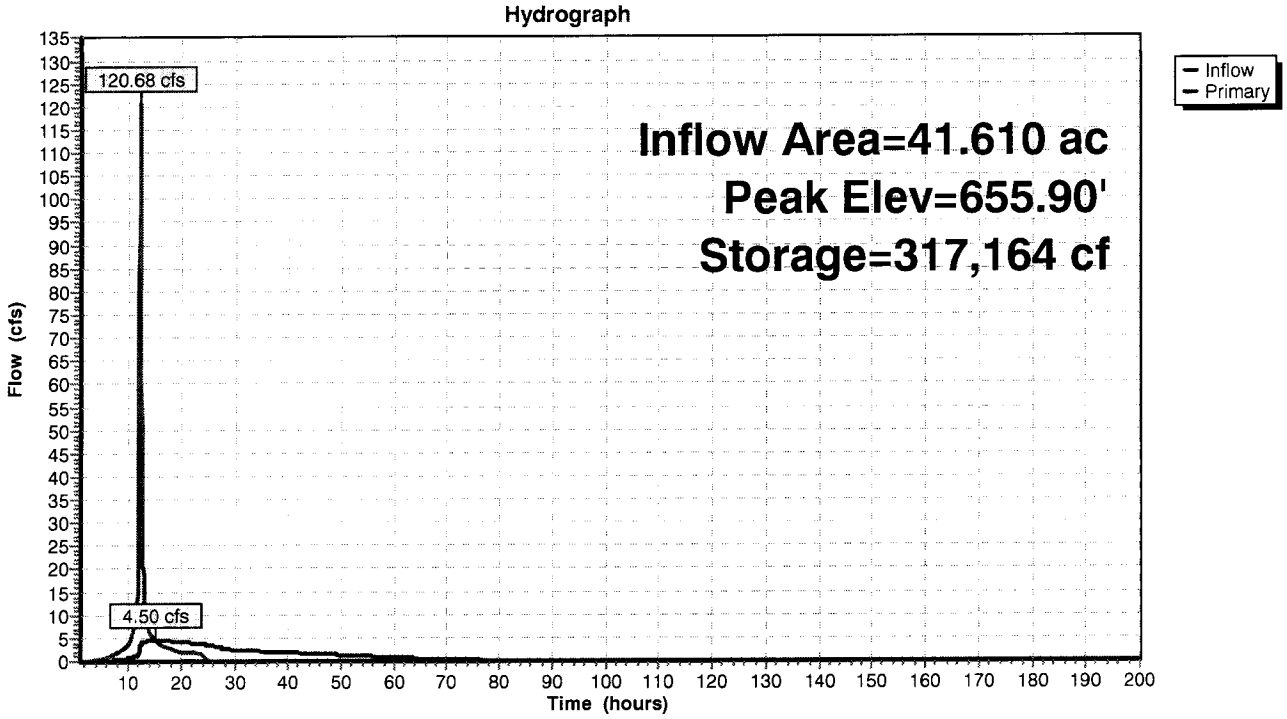
Volume	Invert	Avail.Storage	Storage Description
#1	654.00'	1,253,899 cf	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (cubic-feet)
654.00	0
654.25	39,722
654.50	79,444
654.75	119,165
655.00	158,887
655.25	202,780
655.50	246,672
655.75	290,565
656.00	334,457
656.25	414,486
656.50	494,515
656.75	574,543
657.00	654,572
657.25	804,404
657.50	954,236
657.75	1,104,067
658.00	1,253,899

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**Special & User-Defined** Elev. (feet) 654.00 654.25 654.50 654.75 655.00 655.25 655.50 655.75 656.00 656.25 656.50 656.75 657.00 657.25 657.50 657.75 658.00 Disch. (cfs) 0.000 0.880 1.390 1.750 2.050 2.310 3.430 4.150 4.720 5.740 5.950 6.160 6.370 12.690 24.080 38.760 58.120

Primary OutFlow Max=4.50 cfs @ 15.39 hrs HW=655.90' (Free Discharge)
└─**1=Special & User-Defined** (Custom Controls 4.50 cfs)

Pond 3P: Basin #1



Pond 4P: Basin #2

Inflow Area =	20.020 ac,	Inflow Depth =	3.03"	for	10 Year event
Inflow =	54.10 cfs @	12.20 hrs,	Volume=	5.056 af	
Outflow =	1.94 cfs @	15.89 hrs,	Volume=	5.056 af,	Atten= 96%, Lag= 221.4 min
Primary =	1.94 cfs @	15.89 hrs,	Volume=	5.056 af	

Routing by Dyn-Stor-Ind method, Time Span= 1.00-200.00 hrs, dt= 0.05 hrs
Peak Elev= 669.32' @ 15.89 hrs Surf.Area= 0 sf Storage= 156,413 cf
Plug-Flow detention time= 1,297.5 min calculated for 5.056 af (100% of inflow)
Center-of-Mass det. time= 1,297.3 min (2,095.8 - 798.5)

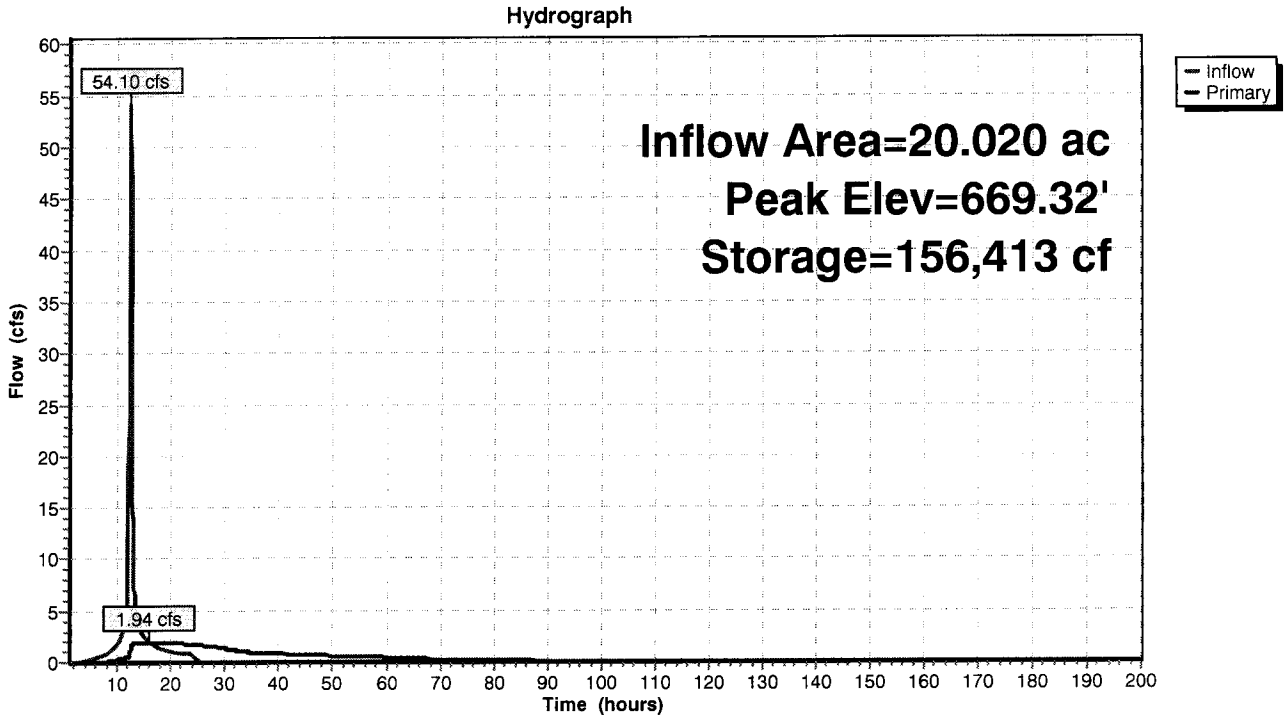
Volume	Invert	Avail.Storage	Storage Description
#1	668.00'	515,243 cf	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (cubic-feet)
668.00	0
668.25	27,845
668.50	55,690
668.75	83,534
669.00	111,379
669.25	146,390
669.50	181,402
669.75	216,413
670.00	251,424
670.25	317,379
670.50	383,334
670.75	449,288
671.00	515,243

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**Special & User-Defined** Elev. (feet) 668.00 668.25 668.50 668.75 669.00 669.25 669.50 669.75 670.00 670.25 670.50 670.75 671.00 Disch. (cfs) 0.000 0.440 0.690 0.880 1.470 1.850 2.150 4.640 4.890 11.250 22.680 37.400 56.780

Primary OutFlow Max=1.94 cfs @ 15.89 hrs HW=669.32' (Free Discharge)
└─**1=Special & User-Defined** (Custom Controls 1.94 cfs)

Pond 4P: Basin #2



Subcatchment 1E: Subarea #1E

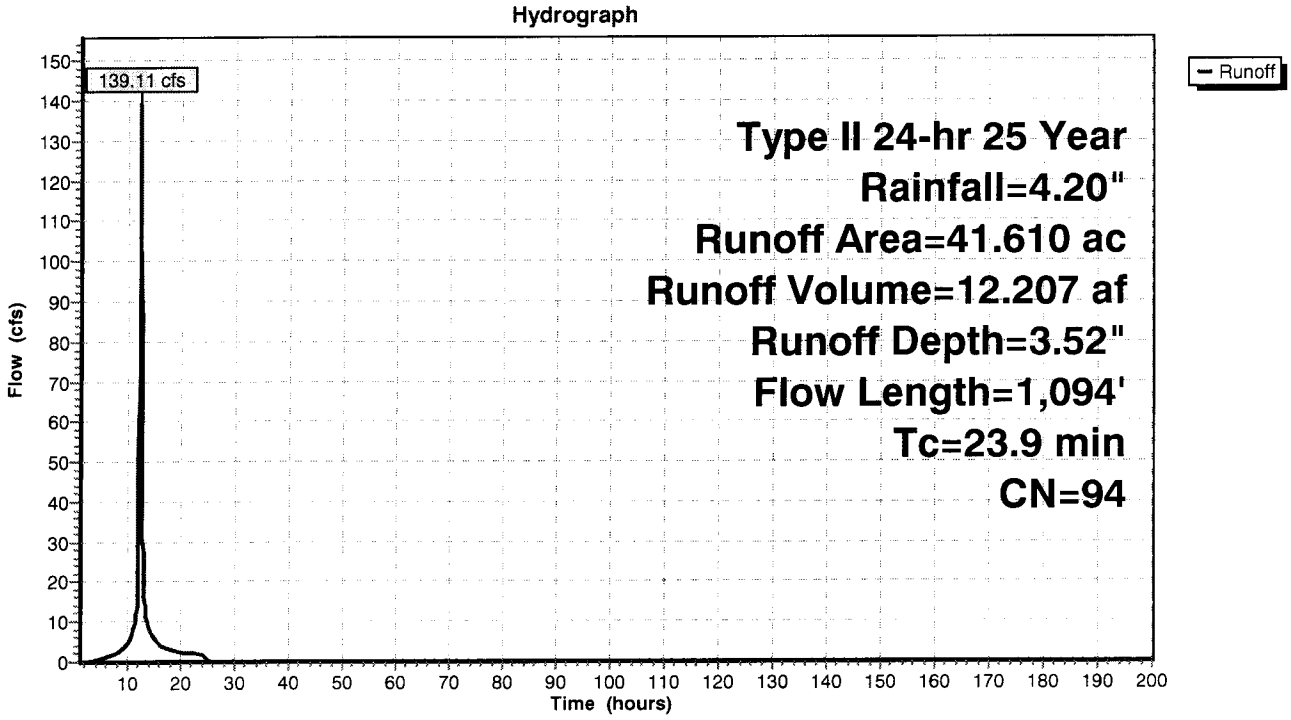
Runoff = 139.11 cfs @ 12.16 hrs, Volume= 12.207 af, Depth= 3.52"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-200.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 Year Rainfall=4.20"

Area (ac)	CN	Description
41.610	94	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	36	0.3333	0.9		**Sheet Flow, A to B** Fallow n= 0.050 P2= 2.50"
6.7	114	0.0100	0.3		**Sheet Flow, B to C** Fallow n= 0.050 P2= 2.50"
13.1	786	0.0100	1.0		**Shallow Concentrated Flow, C to D** Nearly Bare & Untilled Kv= 10.0 fps
3.4	158	0.0060	0.8		**Shallow Concentrated Flow, D to E** Nearly Bare & Untilled Kv= 10.0 fps
23.9	1,094	Total			

Subcatchment 1E: Subarea #1E



Subcatchment 2W: Subarea #2W

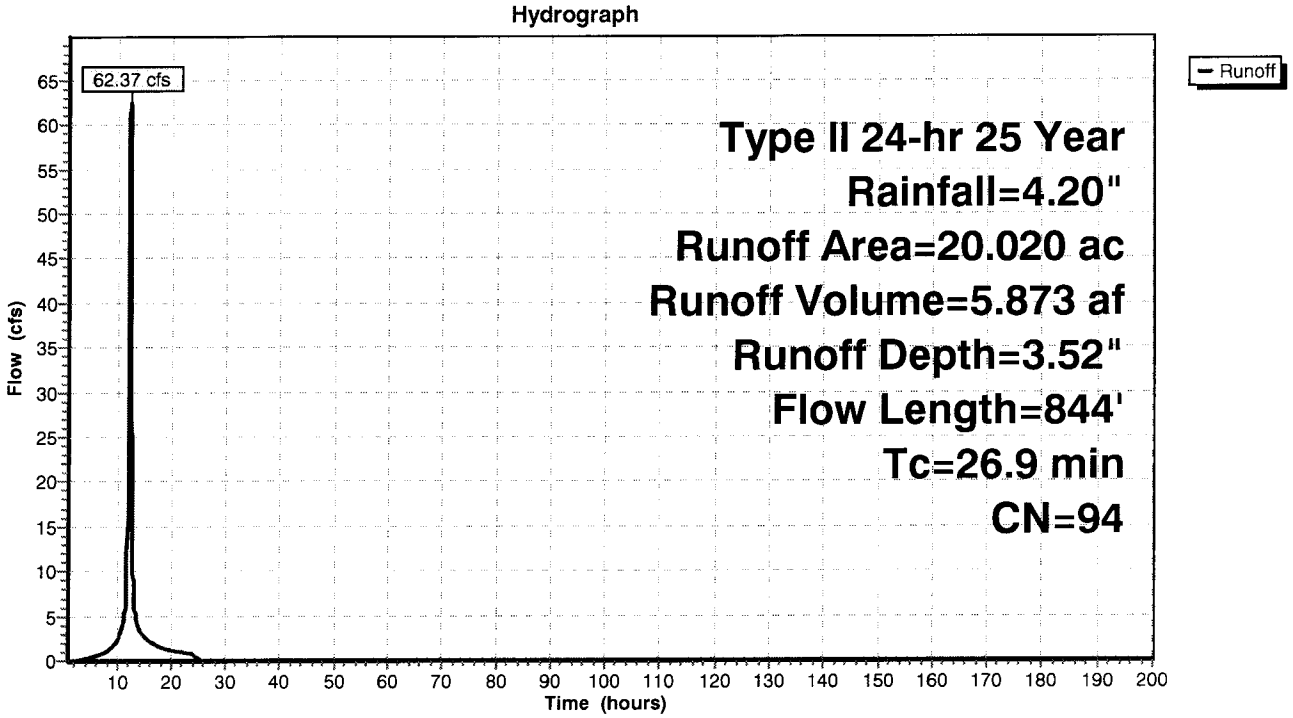
Runoff = 62.37 cfs @ 12.20 hrs, Volume= 5.873 af, Depth= 3.52"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-200.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 Year Rainfall=4.20"

Area (ac)	CN	Description
20.020	94	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.1	150	0.0050	0.2		**Sheet Flow, A to B** Fallow n= 0.050 P2= 2.50"
15.3	651	0.0050	0.7		**Shallow Concentrated Flow, B to C** Nearly Bare & Untilled Kv= 10.0 fps
0.5	43	0.0230	1.5		**Shallow Concentrated Flow, C to D** Nearly Bare & Untilled Kv= 10.0 fps
26.9	844	Total			

Subcatchment 2W: Subarea #2W



Pond 3P: Basin #1

Inflow Area = 41.610 ac, Inflow Depth = 3.52" for 25 Year event
Inflow = 139.11 cfs @ 12.16 hrs, Volume= 12.207 af
Outflow = 5.17 cfs @ 15.36 hrs, Volume= 12.207 af, Atten= 96%, Lag= 192.1 min
Primary = 5.17 cfs @ 15.36 hrs, Volume= 12.207 af

Routing by Dyn-Stor-Ind method, Time Span= 1.00-200.00 hrs, dt= 0.05 hrs
Peak Elev= 656.11' @ 15.36 hrs Surf.Area= 0 sf Storage= 369,435 cf
Plug-Flow detention time= 1,138.8 min calculated for 12.207 af (100% of inflow)
Center-of-Mass det. time= 1,138.5 min (1,930.2 - 791.8)

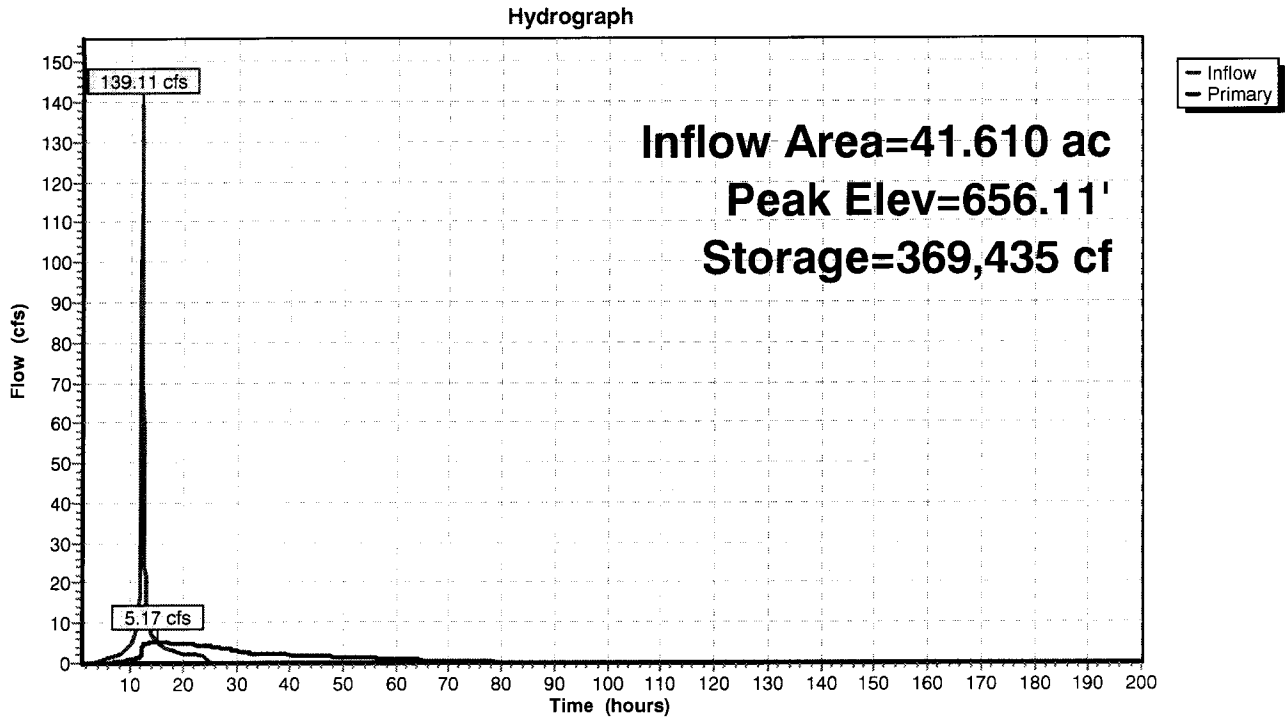
Volume	Invert	Avail.Storage	Storage Description
#1	654.00'	1,253,899 cf	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (cubic-feet)
654.00	0
654.25	39,722
654.50	79,444
654.75	119,165
655.00	158,887
655.25	202,780
655.50	246,672
655.75	290,565
656.00	334,457
656.25	414,486
656.50	494,515
656.75	574,543
657.00	654,572
657.25	804,404
657.50	954,236
657.75	1,104,067
658.00	1,253,899

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**Special & User-Defined** Elev. (feet) 654.00 654.25 654.50 654.75 655.00 655.25 655.50 655.75 656.00 656.25 656.50 656.75 657.00 657.25 657.50 657.75 658.00 Disch. (cfs) 0.000 0.880 1.390 1.750 2.050 2.310 3.430 4.150 4.720 5.740 5.950 6.160 6.370 12.690 24.080 38.760 58.120

Primary OutFlow Max=5.17 cfs @ 15.36 hrs HW=656.11' (Free Discharge)
└─**1=Special & User-Defined** (Custom Controls 5.17 cfs)

Pond 3P: Basin #1



Pond 4P: Basin #2

Inflow Area =	20.020 ac,	Inflow Depth =	3.52"	for	25 Year event
Inflow =	62.37 cfs @	12.20 hrs,	Volume=	5.873 af	
Outflow =	2.25 cfs @	15.83 hrs,	Volume=	5.873 af,	Atten= 96%, Lag= 217.9 min
Primary =	2.25 cfs @	15.83 hrs,	Volume=	5.873 af	

Routing by Dyn-Stor-Ind method, Time Span= 1.00-200.00 hrs, dt= 0.05 hrs
Peak Elev= 669.51' @ 15.83 hrs Surf.Area= 0 sf Storage= 182,743 cf
Plug-Flow detention time= 1,317.4 min calculated for 5.872 af (100% of inflow)
Center-of-Mass det. time= 1,319.3 min (2,113.9 - 794.5)

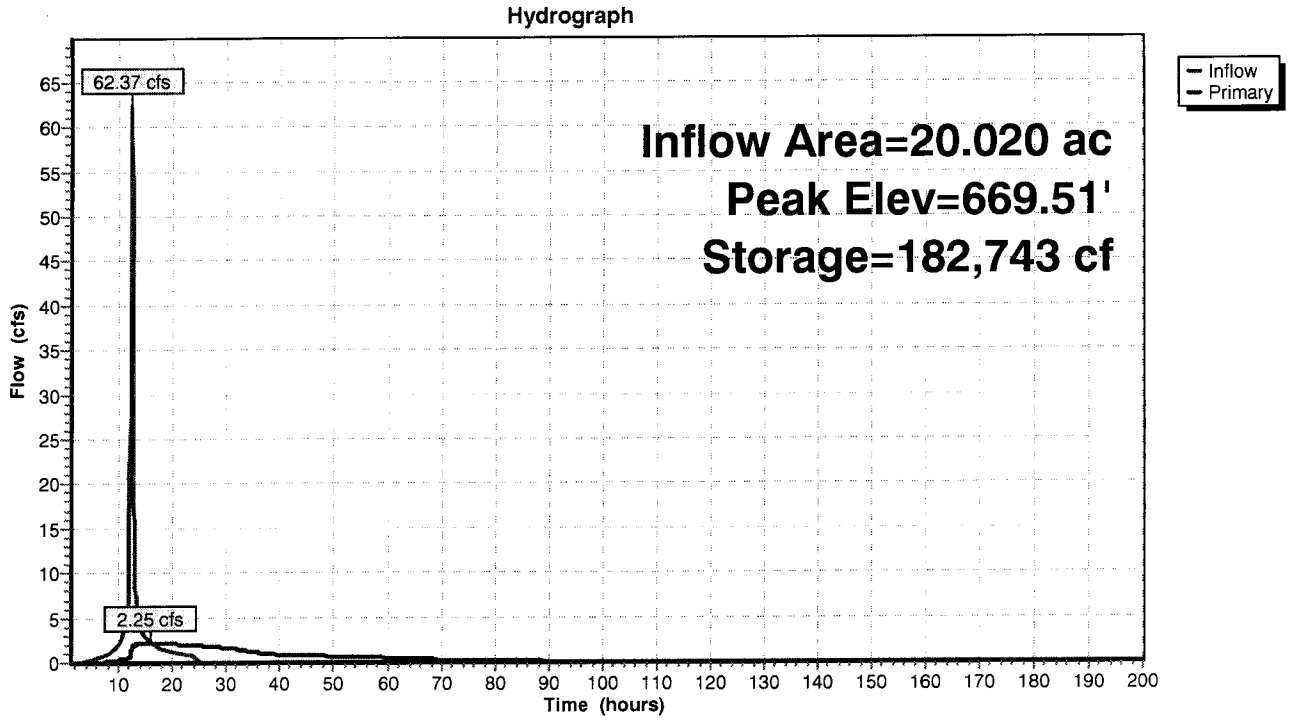
Volume	Invert	Avail.Storage	Storage Description
#1	668.00'	515,243 cf	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (cubic-feet)
668.00	0
668.25	27,845
668.50	55,690
668.75	83,534
669.00	111,379
669.25	146,390
669.50	181,402
669.75	216,413
670.00	251,424
670.25	317,379
670.50	383,334
670.75	449,288
671.00	515,243

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**Special & User-Defined** Elev. (feet) 668.00 668.25 668.50 668.75 669.00 669.25 669.50 669.75 670.00 670.25 670.50 670.75 671.00 Disch. (cfs) 0.000 0.440 0.690 0.880 1.470 1.850 2.150 4.640 4.890 11.250 22.680 37.400 56.780

Primary OutFlow Max=2.25 cfs @ 15.83 hrs HW=669.51' (Free Discharge)
└**1=Special & User-Defined** (Custom Controls 2.25 cfs)

Pond 4P: Basin #2



Subcatchment 1E: Subarea #1E

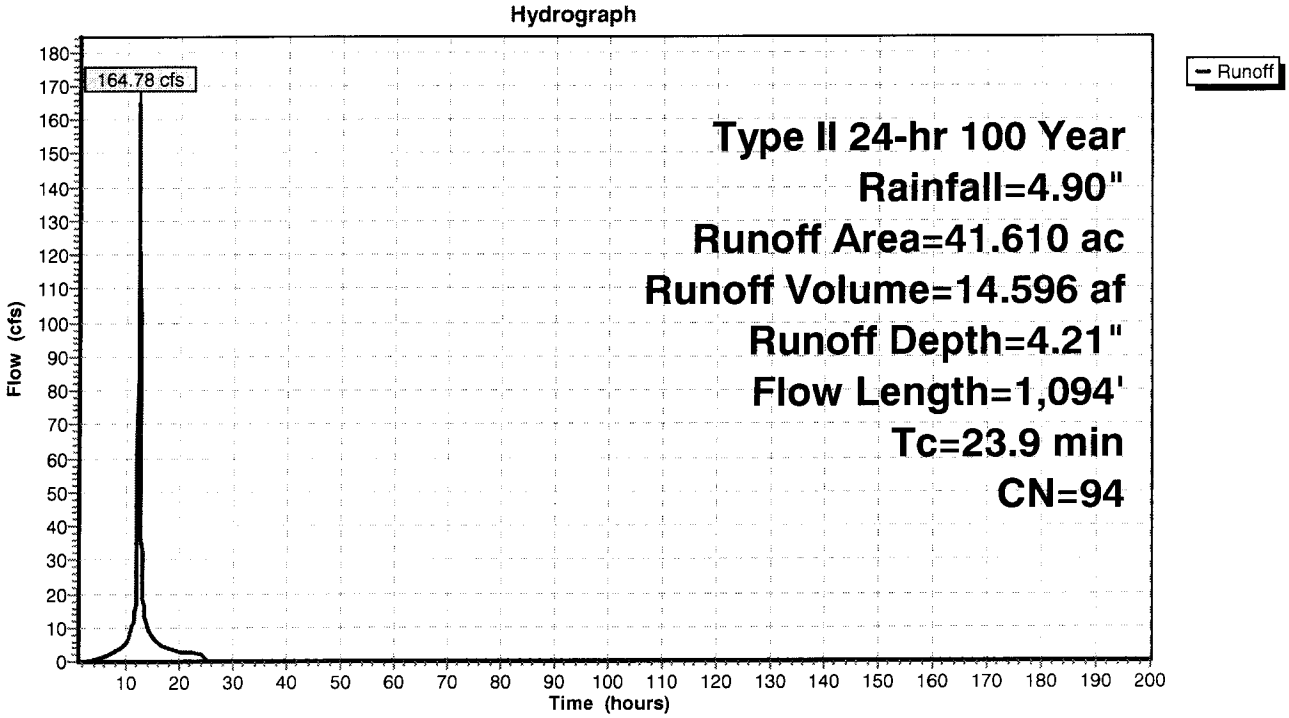
Runoff = 164.78 cfs @ 12.16 hrs, Volume= 14.596 af, Depth= 4.21"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-200.00 hrs, dt= 0.05 hrs
Type II 24-hr 100 Year Rainfall=4.90"

Area (ac)	CN	Description
41.610	94	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	36	0.3333	0.9		**Sheet Flow, A to B** Fallow n= 0.050 P2= 2.50"
6.7	114	0.0100	0.3		**Sheet Flow, B to C** Fallow n= 0.050 P2= 2.50"
13.1	786	0.0100	1.0		**Shallow Concentrated Flow, C to D** Nearly Bare & Untilled Kv= 10.0 fps
3.4	158	0.0060	0.8		**Shallow Concentrated Flow, D to E** Nearly Bare & Untilled Kv= 10.0 fps
23.9	1,094	Total			

Subcatchment 1E: Subarea #1E



Subcatchment 2W: Subarea #2W

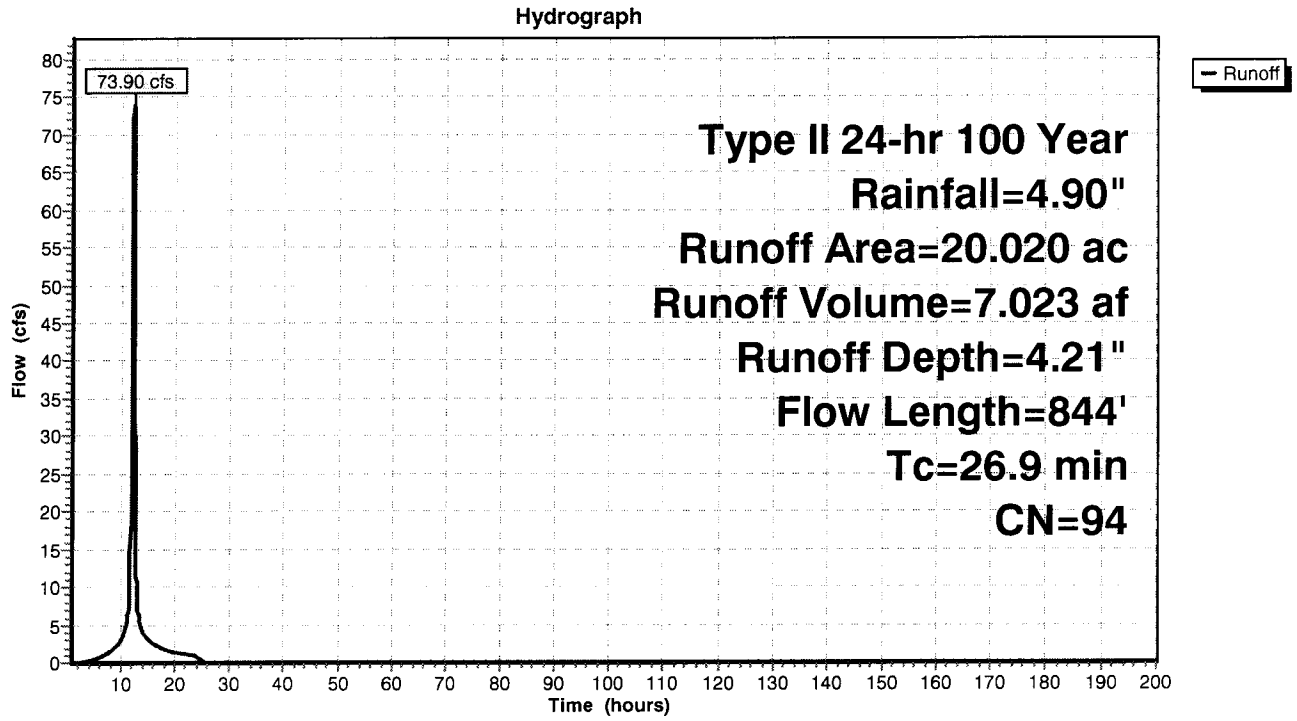
Runoff = 73.90 cfs @ 12.19 hrs, Volume= 7.023 af, Depth= 4.21"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-200.00 hrs, dt= 0.05 hrs
Type II 24-hr 100 Year Rainfall=4.90"

Area (ac)	CN	Description
20.020	94	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.1	150	0.0050	0.2		**Sheet Flow, A to B** Fallow n= 0.050 P2= 2.50"
15.3	651	0.0050	0.7		**Shallow Concentrated Flow, B to C** Nearly Bare & Untilled Kv= 10.0 fps
0.5	43	0.0230	1.5		**Shallow Concentrated Flow, C to D** Nearly Bare & Untilled Kv= 10.0 fps
26.9	844	Total			

Subcatchment 2W: Subarea #2W



Pond 3P: Basin #1

Inflow Area = 41.610 ac, Inflow Depth = 4.21" for 100 Year event
Inflow = 164.78 cfs @ 12.16 hrs, Volume= 14.596 af
Outflow = 5.82 cfs @ 15.53 hrs, Volume= 14.596 af, Atten= 96%, Lag= 202.5 min
Primary = 5.82 cfs @ 15.53 hrs, Volume= 14.596 af

Routing by Dyn-Stor-Ind method, Time Span= 1.00-200.00 hrs, dt= 0.05 hrs
Peak Elev= 656.35' @ 15.53 hrs Surf.Area= 0 sf Storage= 445,269 cf
Plug-Flow detention time= 1,162.6 min calculated for 14.596 af (100% of inflow)
Center-of-Mass det. time= 1,162.3 min (1,949.5 - 787.2)

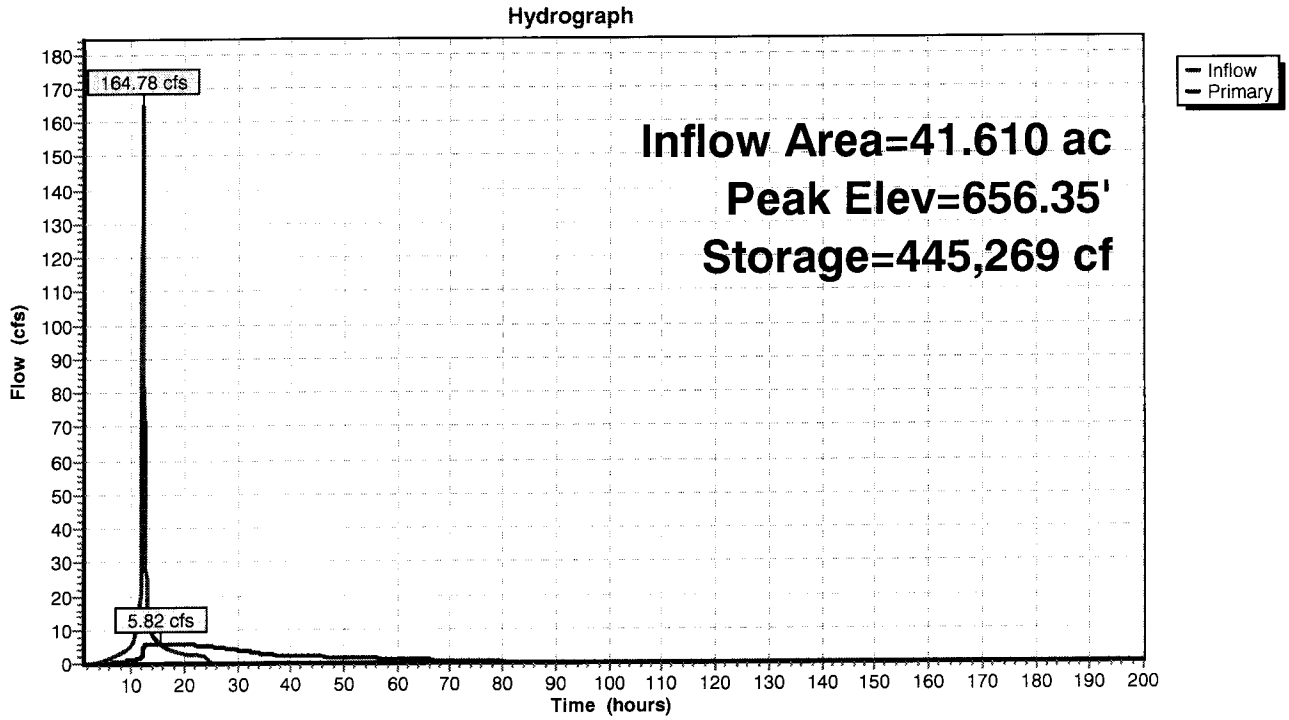
Volume	Invert	Avail.Storage	Storage Description
#1	654.00'	1,253,899 cf	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (cubic-feet)
654.00	0
654.25	39,722
654.50	79,444
654.75	119,165
655.00	158,887
655.25	202,780
655.50	246,672
655.75	290,565
656.00	334,457
656.25	414,486
656.50	494,515
656.75	574,543
657.00	654,572
657.25	804,404
657.50	954,236
657.75	1,104,067
658.00	1,253,899

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**Special & User-Defined** Elev. (feet) 654.00 654.25 654.50 654.75 655.00 655.25 655.50 655.75 656.00 656.25 656.50 656.75 657.00 657.25 657.50 657.75 658.00 Disch. (cfs) 0.000 0.880 1.390 1.750 2.050 2.310 3.430 4.150 4.720 5.740 5.950 6.160 6.370 12.690 24.080 38.760 58.120

Primary OutFlow Max=5.82 cfs @ 15.53 hrs HW=656.35' (Free Discharge)
└─**1=Special & User-Defined** (Custom Controls 5.82 cfs)

Pond 3P: Basin #1



Pond 4P: Basin #2

Inflow Area =	20.020 ac,	Inflow Depth =	4.21"	for	100 Year event
Inflow =	73.90 cfs @	12.19 hrs,	Volume=	7.023 af	
Outflow =	4.08 cfs @	14.17 hrs,	Volume=	7.022 af,	Atten= 94%, Lag= 118.7 min
Primary =	4.08 cfs @	14.17 hrs,	Volume=	7.022 af	

Routing by Dyn-Stor-Ind method, Time Span= 1.00-200.00 hrs, dt= 0.05 hrs
Peak Elev= 669.69' @ 14.17 hrs Surf.Area= 0 sf Storage= 208,486 cf
Plug-Flow detention time= 1,205.7 min calculated for 7.022 af (100% of inflow)
Center-of-Mass det. time= 1,205.6 min (1,995.5 - 789.9)

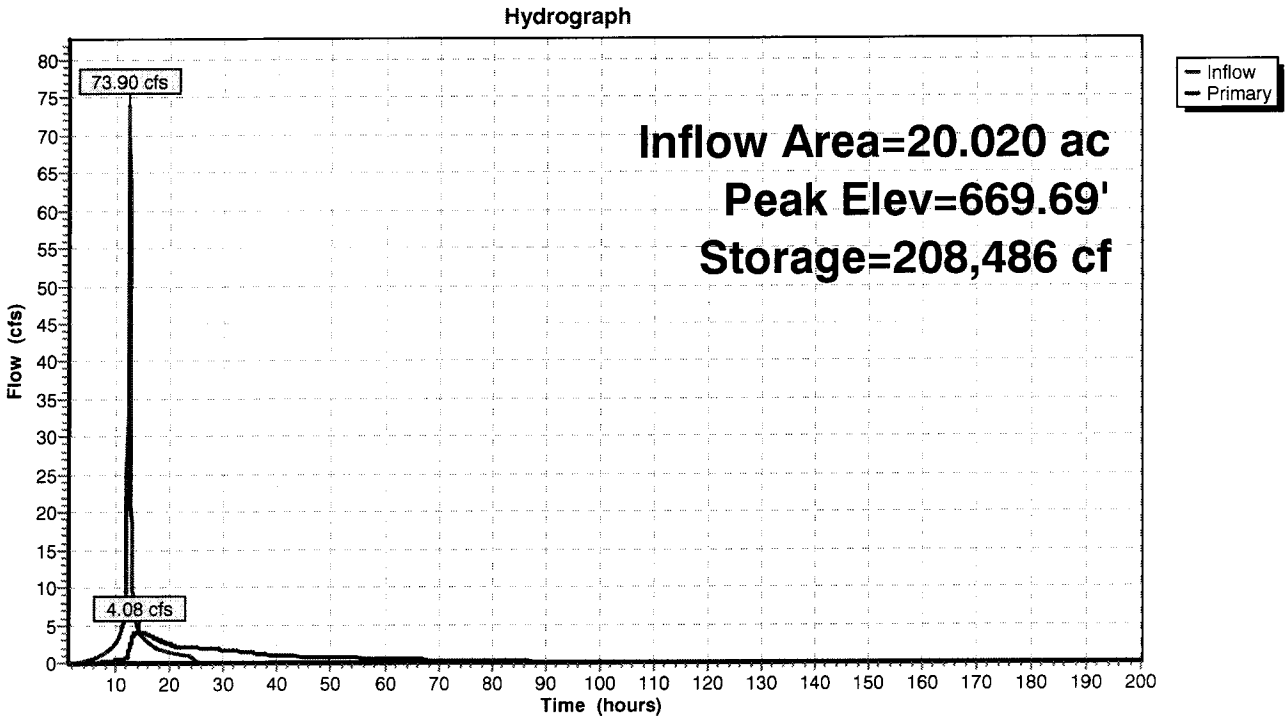
Volume	Invert	Avail.Storage	Storage Description
#1	668.00'	515,243 cf	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (cubic-feet)
668.00	0
668.25	27,845
668.50	55,690
668.75	83,534
669.00	111,379
669.25	146,390
669.50	181,402
669.75	216,413
670.00	251,424
670.25	317,379
670.50	383,334
670.75	449,288
671.00	515,243

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**Special & User-Defined** Elev. (feet) 668.00 668.25 668.50 668.75 669.00 669.25 669.50 669.75 670.00 670.25 670.50 670.75 671.00 Disch. (cfs) 0.000 0.440 0.690 0.880 1.470 1.850 2.150 4.640 4.890 11.250 22.680 37.400 56.780

Primary OutFlow Max=4.08 cfs @ 14.17 hrs HW=669.69' (Free Discharge)
└─**1=Special & User-Defined** (Custom Controls 4.08 cfs)

Pond 4P: Basin #2



THE 1, 10, 25 AND 100 YEAR STORM EVENTS WERE ROUTED THROUGH THE BASINS IN THE PROPOSED CONDITIONS

- COMPARE THE EXISTING CONDITIONS TO THE PROPOSED CONDITIONS

- PROPOSED SUBAREA #1E ALL FLOWS TO BASIN #1 (RG-7): COMPARE TO THE EXISTING SUBAREAS #3E

- PROPOSED SUBAREA #2W ALL FLOWS TO BASIN #2 (RG-6): COMPARE TO THE EXISTING SUBAREAS #1E AND #5W

Q (ft^3/s)

STORM EVENT	RG-5 EXISTING #2E	RG-5 EXISTING #4W	RG-5 EXISTING SUM	RG-5 PROPOSED NONE	RG-6 EXISTING #1E	RG-6 EXISTING #5W	RG-6 EXISTING SUM	RG-6 PROPOSED #2W	RG-7 EXISTING #3E	RG-7 PROPOSED #1E
1	0.28	1.37	1.65	–	0.36	0.76	1.12	0.84	2.21	2.03
10	2.26	11.80	14.06	–	3.06	6.51	9.57	1.94	17.95	4.50
25	3.11	16.15	19.26	–	4.21	8.92	13.13	2.25	24.76	5.17
100	4.42	22.73	27.15	–	5.96	12.59	18.55	4.08	35.14	5.82

- ALL PROPOSED FLOWS ARE LESS THAN THE EXISTING FLOWS

PEAK ELEVATIONS (FT)

STORM EVENT	BASIN #1	BASIN #2
1	654.98'	668.70'
10	655.90'	669.32'
25	656.11'	669.51'
100	656.35'	669.69'

- THE 100-YR STORM EVENT DOES NOT OVERTOP THE SPILLWAY IN EITHER BASIN.

- BASIN #1E PLUG-FLOW DETENTION TIME = 1045.3 MIN = 17.4 HRS FOR 1-YR STORM EVENT

  12 < 17.4 < 24 HRS ✓ OK

- BASIN #2W PLUG-FLOW DETENTION TIME = 1301.7 MIN = 21.7 HRS FOR 1-YR STORM EVENT

  12 HR < 21.7 HRS < 24 HR ✓ OK

BOTH BASINS HAVE A 12" DIAMETER OUTLET PIPE AND EMERGENCY SPILLWAY THAT SHOULD BE PROTECTED AGAINST EROSION.

- SIZE OUTLET PROTECTION FOR THE 12" DIAMETER PIPES
  - USE THE LARGER DISCHARGE OF THE TWO CASES.

$Q = 5.82 \frac{ft^3}{s}$ (IN THE CASE OF A 100-YR STORM EVENT IN BASIN #1E)

$D_o = 12 \text{ IN} = 1 \text{ ft}$

- AT RATE $Q = 5.82 \frac{ft^3}{s}$, PIPE IS FLOWING NEARLY FULL

THE ELEVATION OF THE BASIN IS 656.50' WHEN $Q = 5.95 \frac{ft^3}{s}$ (SHEET 43)

- ASSUME OUTLET IS NOT SUBMERGED

TAILWATER, $T_w < 0.5 \cdot D_o = 0.5$ FT

IF $Q = 5.82 \frac{ft^3}{s}$, $d = 12"$, USING FIGURE 5B.12 (SHEET 86) $\rightarrow D_{50} = 0.3 \text{ ft} = 3.6 \text{ IN}$

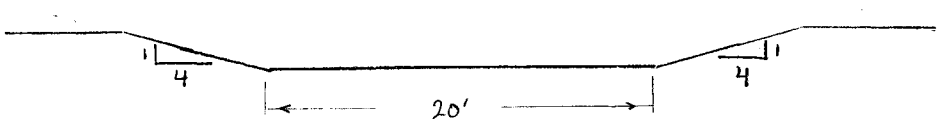
$L_a = 10 \text{ ft}$, $W = D_o + L_a = 1' + 10' = 11'$

$\therefore$ USE A D_{50} OF 4 IN

WHERE $d_{max} = 6$ IN AND MINIMUM BLANKET THICKNESS = 9 IN (SHEET 87)

- THE DISCHARGE PIPE FOR BASIN #1E WILL REQUIRE AN APRON OF 10' × 11' WITH RIP-RAP OF $D_{50} = 4"$
  THE DISCHARGE PIPE FOR BASIN #2W WILL DISCHARGE INTO THE EMERGENCY SPILLWAY.

- SIZE EMERGENCY SPILLWAY PROTECTION



- FROM HYDROCAD ANALYSIS, THE 100-YR STORM EVENT DOES NOT PASS THROUGH EITHER BASIN SPILLWAY. INSTEAD, SIZE THE BASIN SPILLWAY PROTECTION BASED ON 1 FT OF WATER DEPTH FROM EMERGENCY SPILLWAY CALCULATION: $Q = 51.0 \frac{ft^3}{s}$

  - SPILLWAY SLOPES

    BASIN #1E: USE 1% SLOPE

    BASIN #2W: $\frac{(670' - 667.5')}{140 \text{ FT}} = 1.8\%$ SLOPE

SIZE RIPRAP FOR 1 FT OF DEPTH AND 2% SLOPE

$\tau = \gamma \cdot d \cdot s$

τ = SHEAR STRENGTH
$\gamma = 62.4\ lb/ft^3$
d = DEPTH
s = SLOPE

$\tau = 62.4 \frac{lb}{ft^3} \cdot 1 ft \cdot 0.02\ ft/ft$

$= 1.25 \frac{lb}{ft^2}$

TO SIZE RIP-RAP ASSUME $\tau = \tau_p = 4 \cdot D_{50}$

$1.25 = 4 \cdot D_{50}$

$D_{50} = \frac{1.25}{4}$

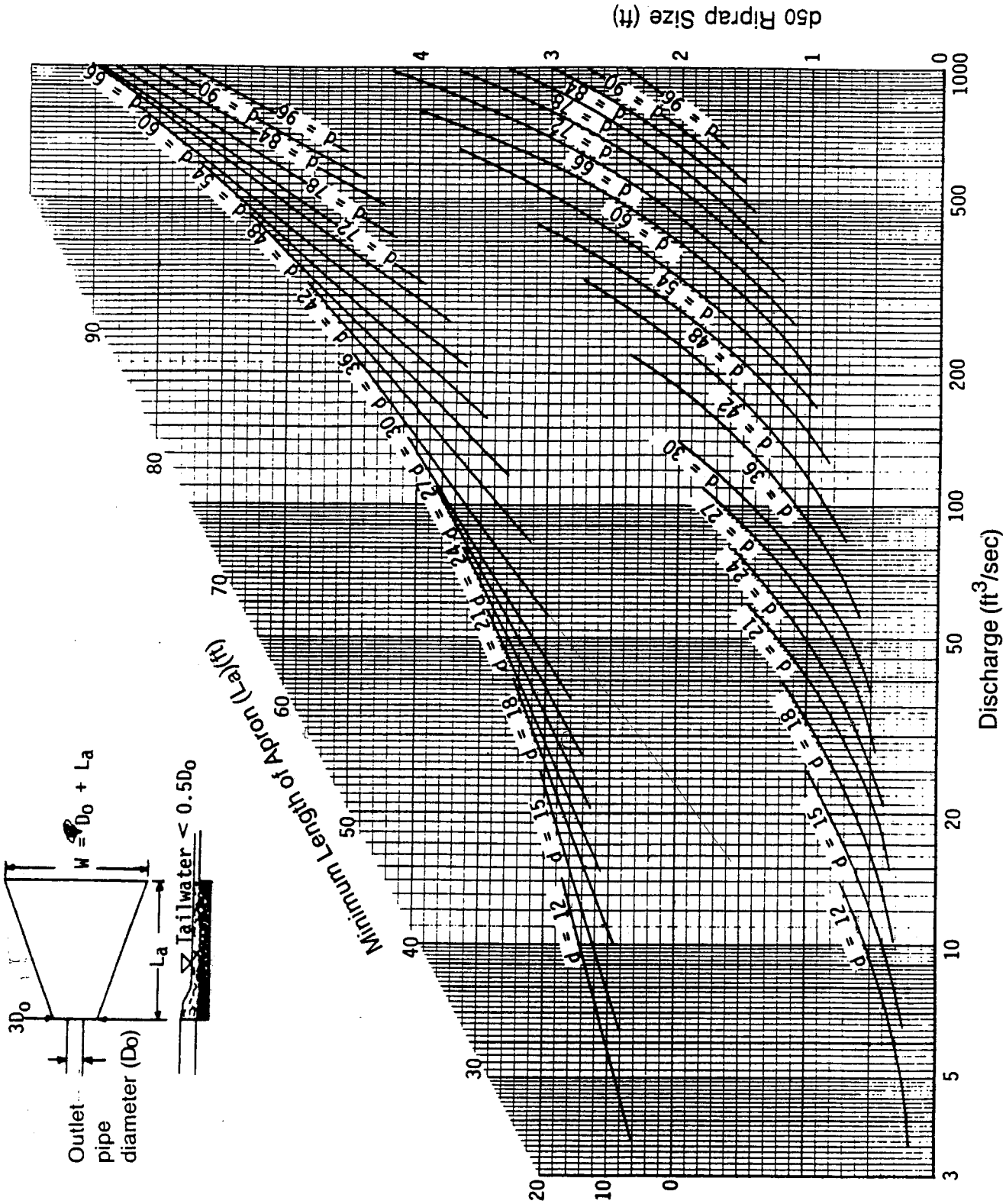
$D_{50} = 0.32\ ft = 3.75\ IN$

$\therefore$ USE RIP-RAP WITH A $D_{50} = 4\ IN$

WHERE $d_{max} = 6\ IN$ AND MINIMUM BLANKET THICKNESS = 9 IN (SHEET 87)

- BOTH SPILLWAYS CAN BE PROTECTED WITH RIPRAP $D_{50} = 4"$, DECIDE TO USE $D_{50} = 6"$ AND THICKNESS OF 15" (NYSDOT MEDIUM STONE FILLING)

Figure 5B.12
Outlet Protection Design - Minimum Tailwater Condition
(Design of Outlet Protection from a Round Pipe Flowing Full, Minimum Tailwater Condition: $T_W < 0.5D_O$)



Thickness

The minimum thickness of the riprap layer shall be 1.5 times the maximum stone diameter for d_{50} of 15 inches or less; and 1.2 times the maximum stone size for d_{50} greater than 15 inches. The following chart lists some examples:

D_{50} (inches)	d_{max} (inches)	Mimimum Blanket Thickness (inches)
4	6	9
6	9	14
9	14	20
12	18	27
15	22	32
18	27	32
21	32	38
24	36	43

Stone Quality

Stone for riprap shall consist of field stone or rough unhewn quarry stone. The stone shall be hard and angular and of a quality that will not disintegrate on exposure to water or weathering. The specific gravity of the individual stones shall be at least 2.5.

Recycled concrete equivalent may be used provided it has a density of at least 150 pounds per cubic foot, and does not have any exposed steel or reinforcing bars.

Filter

A filter is a layer of material placed between the riprap and the underlying soil surface to prevent soil movement into and through the riprap. Riprap shall have a filter placed under it in all cases.

A filter can be of two general forms: A gravel layer or a plastic filter cloth. The plastic filter cloth can be woven or non-woven monofilament yarns, and shall meet these base requirements: thickness 20-60 mils, grab strength 90-120 lbs; and shall conform to ASTM D-1777 and ASTM D-1682.

Gravel filter blanket when used shall be designed by comparing particle sizes of the overlying material and the base material. Design criteria are available in Standard and Specification for Riprap Slope Protection, page 5B.55.

Gabions

Gabions shall be made of hexagonal triple twist mesh with heavily galvanized steel wire. The maximum linear dimension of the mesh opening shall not exceed 4 1/2 inches and the area of the mesh opening shall not exceed 10 square inches.

Gabions shall be fabricated in such a manner that the sides, ends, and lid can be assembled at the construction site into a rectangular basket of the specified sizes. Gabions shall be of single unit construction and shall be installed according to manufacturers recommendations.

The area on which the gabion is to be installed shall be graded as shown on the drawings. Foundation conditions shall be the same as for placing rock riprap and filter cloth shall be placed under all gabions. Where required, a key may be needed to prevent undermining of the main gabion structure.

Maintenance

Once a riprap outlet has been installed, the maintenance needs are very low. It should be inspected after high flows to see if scour beneath the riprap has occurred, or any stones have been dislodged. Repairs should be made immediately.

Design Procedure

1. Investigate the downstream channel to assure that non-erosive velocities can be maintained.
2. Determine the tailwater condition at the outlet to establish which curve to use.
3. Enter the appropriate chart with the ~~depth of flow~~ ok and discharge ~~velocity~~ depth to determine the riprap size and apron length required. It is noted that references to pipe diameters in the charts are based on full flow. For other than full pipe flow, the parameters of depth of flow and velocity must be used.
4. Calculate apron width at the downstream end if a flared section is to be employed.

Examples

Example 1: Pipe Flow (full) with discharge to unconfined section.

Given: A circular conduit flowing full.

Q = 280 cfs, diam. = 66 in., tailwater (surface) is 2 ft. above pipe invert (minimum tailwater condition).

Find: Read d_{50} = 1.2 and apron length (L_a) = 38 ft.

Apron width = diam. + L_a = 5B.5 + 38 = 43.5 ft.

Use: d_{50} = 15", d_{max} = 22", blanket thickness = 32"

Example 2: Box Flow (partial) with high tailwater

Given: A box conduit discharging under partial flow conditions. A concrete box 5.5 ft. x 10 ft. flowing 5.0 ft. deep,

Q = 600 cfs and tailwater surface is 5 ft. above invert (max. tailwater condition).

Since this is not full pipe flow and does not directly fit the nomograph assumptions, it is necessary to compute the