CERTIFICATE OF AUTHENTICITY

THIS IS TO CERTIFY THAT THE FOLLOWING ELECTRONIC RECORDS ARE TRUE AND ACCURATE REPRODUCTIONS OF THE ORIGINAL RECORDS OF JAMES CITY COUNTY GENERAL SERVICES DEPARTMENT- STORMW ATER DIVISION; WERE SCANNED IN THE REGULAR COURSE OF BUSINESS PURSUANT TO GUIDELINES ESTABLISHED BY THE LIBRARY OF VIRGINIA AND ARCHIVES; AND HAVE BEEN VERIFIED IN THE CUSTODY OF THE INDIVIDUAL LISTED BELOW.

BMP NUMBER: **88049**

DATE VERIFIED: **December 2, 2021**

QUALITY ASSURANCE TECHNICIAN: **Charles E. Lovett II**

Charles E. Lovett II

LOCATION: WILLIAMSBURG, VIRGINIA

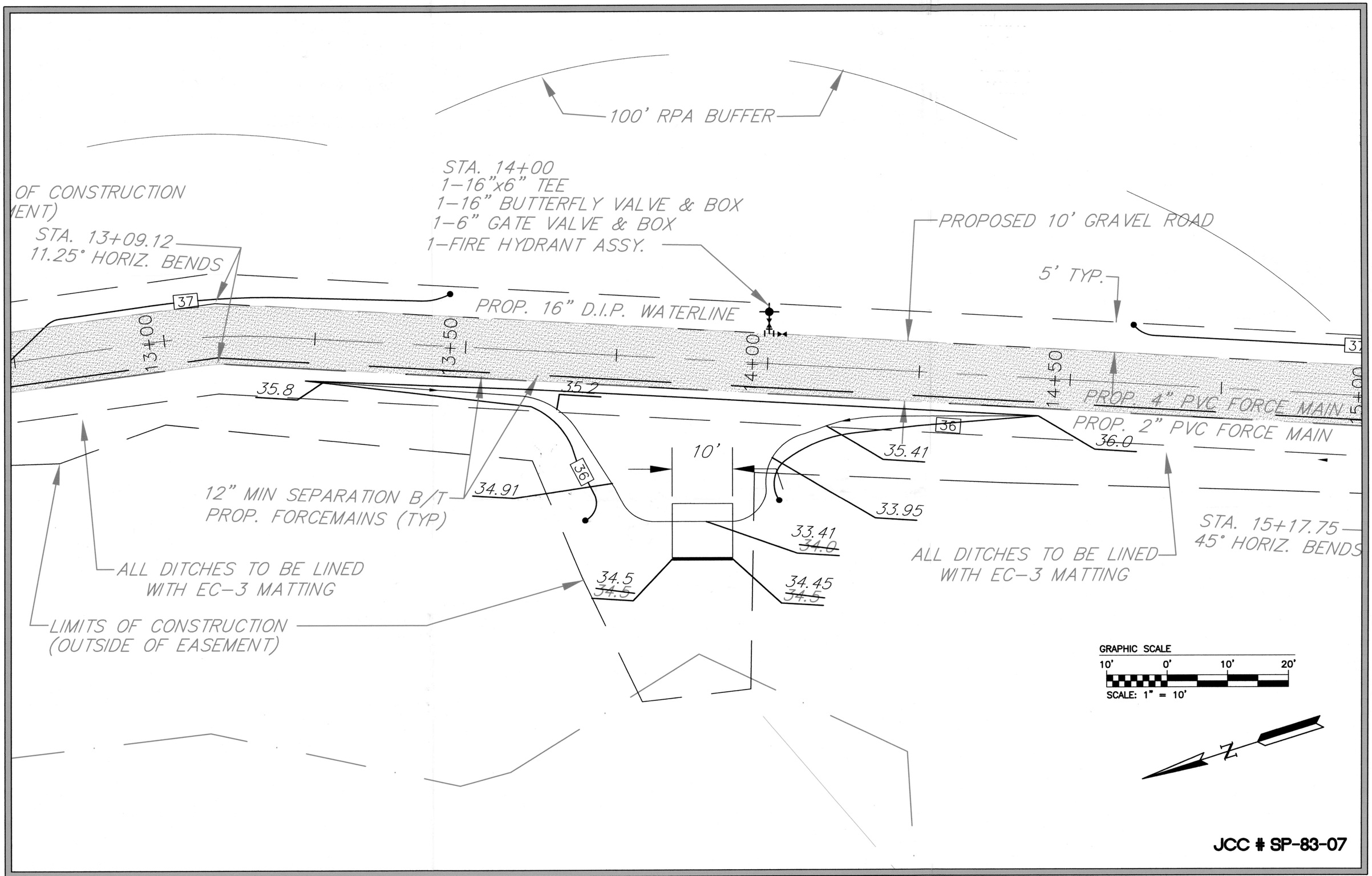
NOTES: CERTIFY & UPLOAD

1. Maintenance Agreement

2. Deeds/Easements/ Agreements/Property Records

3. Construction Certificate

4. Record Drawings (As Builts)



JCC # SP-83-07

Jamestown
MANAGEMENT COMPANY, LLC
DEVELOPMENT PLANNING, MANAGEMENT AND ENGINEERING
213 INGRAM ROAD WILLIAMSBURG, VIRGINIA 23188
(757) 220-0856 OFFICE (757) 220-0916 FAX

LEVEL SPREADER ASBUILT

FORMERLY TRUSWOOD 16" WATERLINE

FOR

COLONIAL PENNIMAN, LLC

ROBERTS DISTRICT JAMES CITY COUNTY VIRGINIA

COMMONWEALTH OF VIRGINIA
ROBERT M. OLIVER
No. 032176
PROFESSIONAL ENGINEER
4/7/17

NO.	REVISION	DATE

DESIGNED: RMO
DRAWN: RMO
SCALE: 1"=10'

PROJECT NUMBER
0000-00

DRAWING NUMBER
03

5. Construction Drawings

6. Design Calculations

RUNOFF CALCULATION
FOR
CULVERT N-1, TRUSWOOD WATERLINE EXTENSION

LMDG File No. 2002031-000.00

- Drainage area to culvert N-1 is 2.502 acres.

- Calculate the weighted runoff coefficient, c, for the drainage area.

Total Area = 2.502 acres
Total Pavement = 0.058 acres
Total Grass = 2.444 acres

$$c = \frac{\text{Pavement Area} * 0.9 + \text{Grass Area} * 0.3}{\text{Total Area}}$$

$$c = \frac{0.058 * 0.9 + 2.444 * 0.3}{2.502}$$

$$c = 0.31$$

- Calculate the time of concentration using the Kinematic Wave Formula:

$$t_c = 0.93 * \frac{L^{0.6} * n^{0.6}}{I^{0.4} * S^{0.3}}$$

where t_c is the time of concentration
L is the longest travel length of the runoff
n is the Manning's coefficient for the runoff surface.
I is the rainfall intensity, and
S is the slope of the travel length.

- For our drainage area, the longest overland travel length is 300 feet at a slope of 4.162%. As the overland distance is wooded area, a "n" value of 0.35 will be used for the drainage area.

- Since the rainfall intensity, I, is a factor of the time of concentration, we will assume that the time of concentration is 20 minutes. Using the Steel Formula for a 10-year storm event ($I = 185.06/(t_c + 20.81)$), this gives us an intensity of 4.53 inches per hour. We can now solve for the t_c.

$$t_c = 0.93 * \frac{300^{0.6} * 0.35^{0.6}}{4.53^{0.4} * 0.04162^{0.3}} = 21.53 \text{ minutes}$$

- As the calculated t_c is different from the assumed t_c, recalculate the time of concentration. A t_c of 21.53 minutes would have an Intensity of 4.37 inches per hour.

  Recalculating the t_c gives us a time of concentration of 21.84 minutes.

- As the calculated t_c is different from the assumed t_c, recalculate the time of concentration. A t_c of 21.84 minutes would have an Intensity of 4.34 inches per hour.

  Recalculating the t_c gives us a time of concentration of 21.90 minutes.

- As the calculated t_c is different from the assumed t_c, recalculate the time of concentration. A t_c of 21.90 minutes would have an Intensity of 4.33 inches per hour.

  Recalculating the t_c gives us a time of concentration of 21.92 minutes

- As the calculated t_c is different from the assumed t_c, recalculate the time of concentration. A t_c of 21.92 minutes would have an Intensity of 4.33 inches per hour.

  As the intensity calculated equals the previous intensity, the overland time of concentration for the basin is 21.92 minutes.

- Calculate the shallow concentrated flow from the end of the overland flow to the new culvert. The length of the shallow concentrated flow is 380 feet and has a longitudinal slope of 4.162%.

  Per attached Plate 5-2, the velocity of the shallow concentrated flow is 3.20 feet per second. The time of concentration for the shallow concentrated flow is 118.75 seconds, or 1.98 minutes.

- The total time of concentration is the overland time plus the shallow concentrated flow time. The total time of concentration is 23.90 minutes. The 10-year storm intensity is 4.14 inches per hour.

- Calculate the runoff.

  $Q = c * I * A = 0.31 * 4.14 * 2.502$

  $Q = 3.21$ cfs.

- Using Manning's Equation, we can calculate that a 15-inch reinforced concrete pipe at 1.00% will have a capacity of 6.46 cfs with a velocity of 5.26 feet per second (See attached *Flowmaster* calculation).

- From the *Virginia Erosion and Sediment Control Handbook*, we can calculate the amount of outlet protection required for the pipe outfall (See attached chart).

- Prove the adequacy of the roadside ditch approaching Culvert N-1.

  - The roadside ditch approaching Culvert N-1 is a v-shaped swale with a longitudinal slope of 2.33%. The side slopes of the swale are 3:1 and the minimum depth of the ditch is 1-foot.
  - Using Manning's Equation, and assuming all of the flow to Culvert N-1 is within the swale, we can calculate that the runoff would have a velocity of 3.17 feet per second and a depth of 0.58 feet.

  - Provide EC-3 matting on side slopes of swale due to velocity of 3.19 feet per second. Ditch is adequate with EC-3 matting.

- Prove the adequacy of the downstream channel from Culvert N-1.

  - The downstream channel from Culvert N-1 is a v-shaped ditch with a longitudinal slope of 1.11%. The side slopes of the ditch are 6:1 and the minimum depth of the ditch is 1.5-feet.
  - Using Manning's Equation, we can calculate that the runoff from Culvert N-1 will have a velocity of 1.85 feet per second and a depth of 0.54 feet.

  - The downstream channel is adequate for the flow and velocity from the Culvert.

Worksheet
Worksheet for Triangular Channel

Project Description	
Worksheet	Ditch to Culvert N-1
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	
Slope	0.023300	ft/ft
Left Side Slope	3.00	H : V
Right Side Slope	3.00	H : V
Discharge	3.21	cfs

Results		
Depth	0.58	ft
Flow Area	1.0	ft²
Wetted Perimeter	3.66	ft
Top Width	3.47	ft
Critical Depth	0.59	ft
Critical Slope	0.021141	ft/ft
Velocity	3.19	ft/s
Velocity Head	0.16	ft
Specific Energy	0.74	ft
Froude Number	1.05	
Flow Type	Supercritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	Culvert N-1 (Full Flow)
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Full Flow Capacity

Input Data		
Mannings Coefficient	0.013	
Slope	0.010000	ft/ft
Diameter	15	in

Results		
Depth	1.25	ft
Discharge	6.46	cfs
Flow Area	1.2	ft²
Wetted Perimeter	3.93	ft
Top Width	0.00	ft
Critical Depth	1.02	ft
Percent Full	100.0	%
Critical Slope	0.010004	ft/ft
Velocity	5.26	ft/s
Velocity Head	0.43	ft
Specific Energy	1.68	ft
Froude Number	0.00	
Maximum Discharg	6.95	cfs
Discharge Full	6.46	cfs
Slope Full	0.010000	ft/ft
Flow Type	N/A	

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Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	Culvert N-1 (Actual Flow)
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.010000	ft/ft
Diameter	15	in
Discharge	3.21	cfs

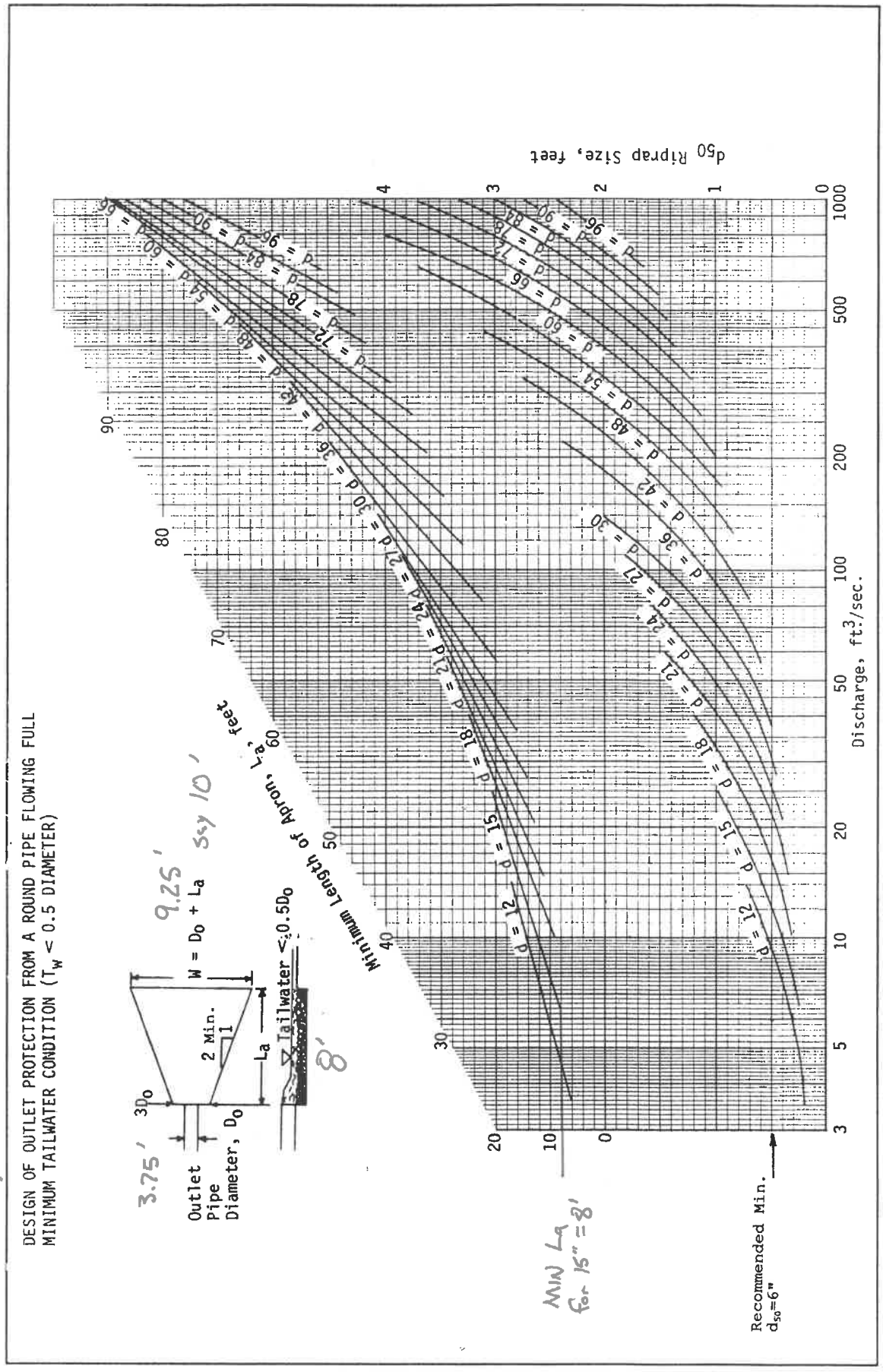
Results		
Depth	0.62	ft
Flow Area	0.6	ft²
Wetted Perimeter	1.96	ft
Top Width	1.25	ft
Critical Depth	0.72	ft
Percent Full	49.8	%
Critical Slope	0.006166	ft/ft
Velocity	5.26	ft/s
Velocity Head	0.43	ft
Specific Energy	1.05	ft
Froude Number	1.33	
Maximum Discharg	6.95	cfs
Discharge Full	6.46	cfs
Slope Full	0.002470	ft/ft
Flow Type	Supercritical	

Worksheet
Worksheet for Triangular Channel

Project Description	
Worksheet	Downstream Channel - Culvert N·
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.035	
Slope	0.011100	ft/ft
Left Side Slope	6.00	H : V
Right Side Slope	6.00	H : V
Discharge	3.21	cfs

Results		
Depth	0.54	ft
Flow Area	1.7	ft²
Wetted Perimeter	6.55	ft
Top Width	6.46	ft
Critical Depth	0.45	ft
Critical Slope	0.029962	ft/ft
Velocity	1.85	ft/s
Velocity Head	0.05	ft
Specific Energy	0.59	ft
Froude Number	0.63	
Flow Type	Subcritical	



Source: USDA-SCS

Plate 3.18-3

RUNOFF CALCULATION
FOR
CHANNEL R-1, TRUSWOOD WATERLINE EXTENSION

LMDG File No. 2002031-000.00

- Drainage area to channel R-1 is 2.999 acres.

- Calculate the weighted runoff coefficient, c, for the drainage area.

Total Area = 2.999 acres
Total Pavement = 0.070 acres
Total Grass = 2.929 acres

$$c = \frac{\text{Pavement Area} * 0.9 + \text{Grass Area} * 0.3}{\text{Total Area}}$$

$$c = \frac{0.070 * 0.9 + 2.929 * 0.3}{2.999}$$

$$c = 0.31$$

- Calculate the time of concentration using the Kinematic Wave Formula:

$$t_c = 0.93 * \frac{L^{0.6} * n^{0.6}}{I^{0.4} * S^{0.3}}$$

where t_c is the time of concentration
L is the longest travel length of the runoff
n is the Manning's coefficient for the runoff surface.
I is the rainfall intensity, and
S is the slope of the travel length.

- For our drainage area, the longest overland travel length is 300 feet at a slope of 3.497%. As the overland distance is wooded area, a "n" value of 0.35 will be used for the drainage area.

- Since the rainfall intensity, I, is a factor of the time of concentration, we will assume that the time of concentration is 20 minutes. Using the Steel Formula for a 10-year storm event ($I = 185.06/(t_c + 20.81)$), this gives us an intensity of 4.53 inches per hour. We can now solve for the t_c.

$$t_c = 0.93 * \frac{300^{0.6} * 0.35^{0.6}}{4.53^{0.4} * 0.03497^{0.3}} = 22.68 \text{ minutes}$$

- As the calculated t_c is different from the assumed t_c, recalculate the time of concentration. A t_c of 22.68 minutes would have an Intensity of 4.26 inches per hour.

  Recalculating the t_c gives us a time of concentration of 23.24 minutes.

- As the calculated t_c is different from the assumed t_c, recalculate the time of concentration. A t_c of 23.24 minutes would have an Intensity of 4.20 inches per hour.

  Recalculating the t_c gives us a time of concentration of 23.38 minutes.

- As the calculated t_c is different from the assumed t_c, recalculate the time of concentration. A t_c of 23.38 minutes would have an Intensity of 4.18 inches per hour.

  Recalculating the t_c gives us a time of concentration of 23.42 minutes.

- As the calculated t_c is different from the assumed t_c, recalculate the time of concentration. A t_c of 23.42 minutes would have an Intensity of 4.18 inches per hour.

  As the Intensity equals the previous, the overland time of concentration is 23.42 minutes.

- Calculate the shallow concentrated flow from the end of the overland flow to the new culvert. The length of the shallow concentrated flow is 535 feet and has a longitudinal slope of 3.497%

  Per attached Plate 5-2, the velocity of the shallow concentrated flow is 3.00 feet per second. The time of concentration for the shallow concentrated flow is 178.33 seconds, or 2.97 minutes.

- The total time of concentration is the overland time plus the shallow concentrated flow time. The total time of concentration is 26.39 minutes. The 10-year storm intensity is 3.92 inches per hour.

- Calculate the runoff.

  $Q = c * I * A = 0.31 * 3.92 * 2.999$

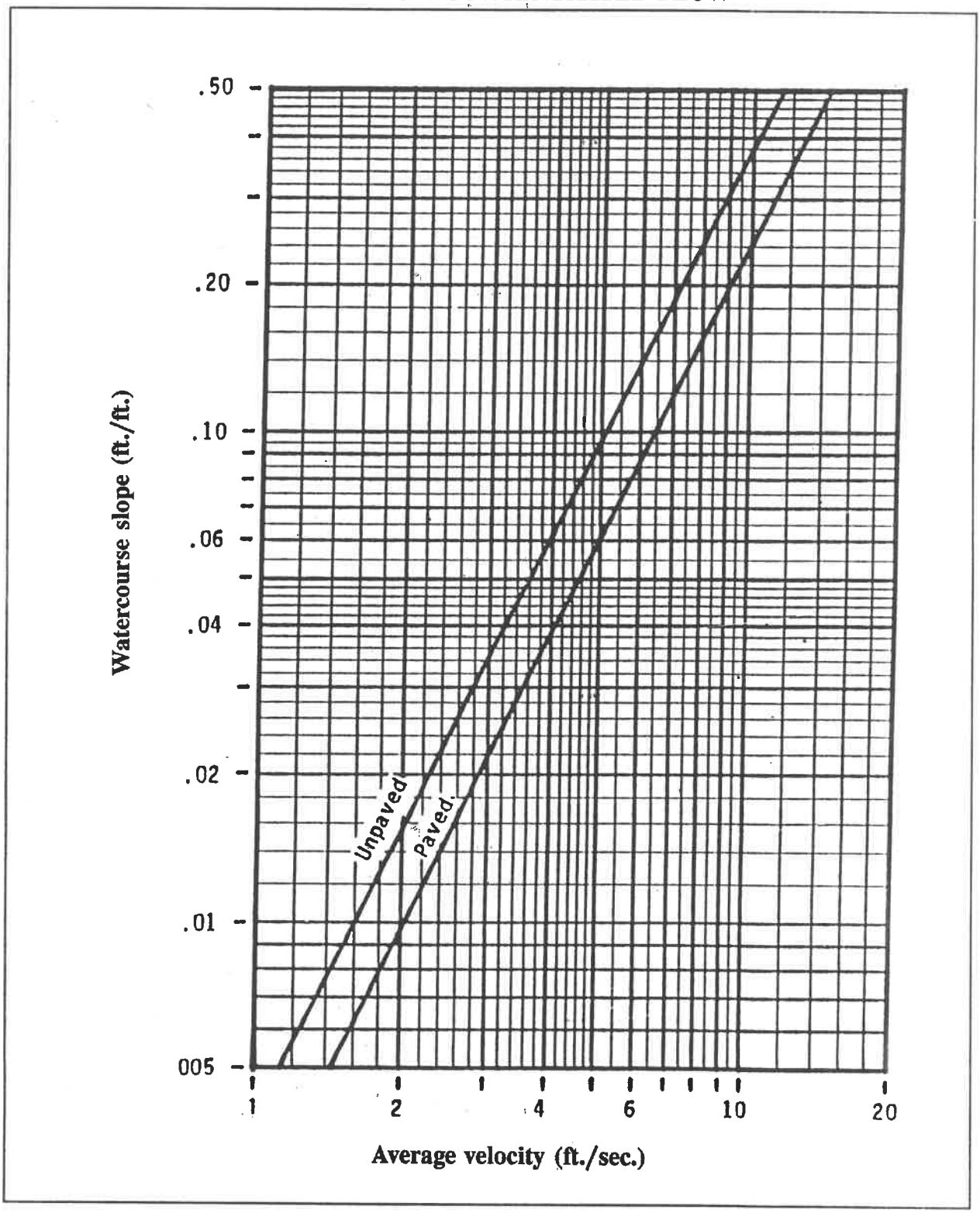
  $Q = 3.64$ cfs.

- Prove the adequacy of the channel R-1.

  - Channel R-1 has an 8-foot wide bottom with a longitudinal slope of 3.90%. The side slopes of the swale are 5:1.
  - Using Manning's Equation, we can calculate that the runoff would have a velocity of 2.42 feet per second and a depth of 0.17 feet.

  - Cut in channel from end of R-1 to bank of existing drainage channel as shown on plans. Provide EC-3 matting on channel as a precaution due to velocity of 2.42 feet per second. Channel is adequate with EC-3 matting.

AVERAGE VELOCITIES FOR ESTIMATING TRAVEL TIME FOR SHALLOW CONCENTRATED FLOW



Source: USDA-SCS

Plate 5-2

Worksheet
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Channel R-1
Flow Element	Trapezoidal Channe
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.035	
Slope	0.039000	ft/ft
Left Side Slope	5.00	H : V
Right Side Slope	5.00	H : V
Bottom Width	8.00	ft
Discharge	3.64	cfs

Results		
Depth	0.17	ft
Flow Area	1.5	ft²
Wetted Perimeter	9.74	ft
Top Width	9.70	ft
Critical Depth	0.18	ft
Critical Slope	0.032864	ft/ft
Velocity	2.42	ft/s
Velocity Head	0.09	ft
Specific Energy	0.26	ft
Froude Number	1.08	
Flow Type	Supercritical	

RUNOFF CALCULATION
FOR
CULVERT S-1, TRUSWOOD WATERLINE EXTENSION

LMDG File No. 2002031-000.00

- Drainage area to culvert S-1 is 5.726 acres.

- Calculate the weighted runoff coefficient, c, for the drainage area.

Total Area = 5.726 acres
Total Pavement = 0.224 acres
Total Grass = 5.502 acres

$$c = \frac{\text{Pavement Area} * 0.9 + \text{Grass Area} * 0.3}{\text{Total Area}}$$

$$c = \frac{0.224 * 0.9 + 5.502 * 0.3}{5.726}$$

$$c = 0.32$$

- Calculate the time of concentration using the Kinematic Wave Formula:

$$t_c = 0.93 * \frac{L^{0.6} * n^{0.6}}{I^{0.4} * S^{0.3}}$$

where t_c is the time of concentration
L is the longest travel length of the runoff
n is the Manning's coefficient for the runoff surface.
I is the rainfall intensity, and
S is the slope of the travel length.

- For our drainage area, the longest overland travel length is 300 feet at a slope of 1.295%. As the overland distance is wooded area, a n value of 0.35 will be used for the drainage area.

- Since the rainfall intensity, I, is a factor of the time of concentration, we will assume that the time of concentration is 30 minutes. Using the Steel Formula for a 10-year storm event ($I = 185.06/(t_c + 20.81)$), this gives us an intensity of 3.64 inches per hour. We can now solve for the t_c.

$$t_c = 0.93 * \frac{300^{0.6} * 0.35^{0.6}}{3.64^{0.4} * 0.01295^{0.3}} = 33.35 \text{ minutes}$$

- As the calculated t_c is different from the assumed t_c, recalculate the time of concentration. A t_c of 33.35 minutes would have an Intensity of 3.42 inches per hour.

  Recalculating the t_c gives us a time of concentration of 34.19 minutes.

- As the calculated t_c is different from the assumed t_c, recalculate the time of concentration. A t_c of 34.19 minutes would have an Intensity of 3.36 inches per hour.

  Recalculating the t_c gives us a time of concentration of 34.43 minutes.

- As the calculated t_c is different from the assumed t_c, recalculate the time of concentration. A t_c of 34.43 minutes would have an Intensity of 3.35 inches per hour.

  Recalculating the t_c gives us a time of concentration of 34.47 minutes.

- As the calculated t_c is different from the assumed t_c, recalculate the time of concentration. A t_c of 34.47 minutes would have an Intensity of 3.35 inches per hour.

  As the intensity calculated equals the previous intensity, the overland time of concentration for the basin is 34.47 minutes.

- Calculate the shallow concentrated flow from the end of the overland flow to the new culvert. The length of the shallow concentrated flow is 762 feet and has a longitudinal slope of 1.295%.

  Per attached Plate 5-2, the velocity of the shallow concentrated flow is 1.80 feet per second. The time of concentration for the shallow concentrated flow is 423.33 seconds, or 7.06 minutes.

- The total time of concentration is the overland time plus the shallow concentrated flow time. The total time of concentration is 41.53 minutes. The 10-year storm intensity is 2.96 inches per hour.

- Calculate the runoff.

  $Q = c * I * A = 0.32 * 2.96 * 5.726$

  $Q = 5.42$ cfs.

- Using Manning's Equation, we can calculate that an 18-inch reinforced concrete pipe at 2.25% will have a capacity of 15.76 cfs with a velocity of 8.09 feet per second (See attached *Flowmaster* calculation).

- From the *Virginia Erosion and Sediment Control Handbook*, we can calculate the amount of outlet protection required for the pipe outfall (See attached chart).

- Prove the adequacy of the roadside ditch approaching Culvert S-1.

  - The roadside ditch approaching Culvert S-1 is a v-shaped swale with a longitudinal slope of 5.05%. The side slopes of the swale are 3:1 and the minimum depth of the swale is 1-foot.
  - Using Manning's Equation, and assuming all of the flow to Culvert S-1 is within the swale, we can calculate that the runoff would have a velocity of 4.87 feet per second and a depth of 0.61 feet.

  - Provide EC-3 matting on side slopes of swale due to velocity of 4.87 feet per second. Ditch is adequate with EC-3 matting.

- Prove the adequacy of the ditch downstream of Culvert S-1.

  - The ditch downstream of Culvert S-1 is a v-shaped swale with a longitudinal slope of 11.11%. The side slopes of the swale are 3:1 and the minimum depth of the swale is 2-feet.
  - Using Manning's Equation, we can calculate that the runoff would have a velocity of 5.83 feet per second and a depth of 0.56 feet.

  - Downstream Channel shall receive rip-rap to elevation 26 to prevent erosion to the existing slope due to the velocity of the runoff.

Worksheet
Worksheet for Triangular Channel

Project Description	
Worksheet	Ditch to Culvert S-1
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	
Slope	0.050500	ft/ft
Left Side Slope	3.00	H : V
Right Side Slope	3.00	H : V
Discharge	5.42	cfs

Results		
Depth	0.61	ft
Flow Area	1.1	ft²
Wetted Perimeter	3.85	ft
Top Width	3.66	ft
Critical Depth	0.73	ft
Critical Slope	0.019715	ft/ft
Velocity	4.87	ft/s
Velocity Head	0.37	ft
Specific Energy	0.98	ft
Froude Number	1.55	
Flow Type	Supercritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	Culvert S-1 (Actual Flow)
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.022500	ft/ft
Diameter	18	in
Discharge	5.42	cfs

Results		
Depth	0.61	ft
Flow Area	0.7	ft²
Wetted Perimeter	2.07	ft
Top Width	1.47	ft
Critical Depth	0.90	ft
Percent Full	40.5	%
Critical Slope	0.005955	ft/ft
Velocity	8.09	ft/s
Velocity Head	1.02	ft
Specific Energy	1.62	ft
Froude Number	2.11	
Maximum Discharg	16.95	cfs
Discharge Full	15.76	cfs
Slope Full	0.002663	ft/ft
Flow Type	Supercritical	

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Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	Culvert S-1 (Full Flow)
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Full Flow Capacity

Input Data		
Mannings Coefficient	0.013	
Slope	0.022500	ft/ft
Diameter	18	in

Results		
Depth	1.50	ft
Discharge	15.76	cfs
Flow Area	1.8	ft²
Wetted Perimeter	4.71	ft
Top Width	0.00	ft
Critical Depth	1.42	ft
Percent Full	100.0	%
Critical Slope	0.019468	ft/ft
Velocity	8.92	ft/s
Velocity Head	1.24	ft
Specific Energy	2.74	ft
Froude Number	0.00	
Maximum Discharg	16.95	cfs
Discharge Full	15.76	cfs
Slope Full	0.022500	ft/ft
Flow Type	N/A	

Worksheet
Worksheet for Triangular Channel

Project Description	
Worksheet	Downstream Channel - Culvert S-
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.035	
Slope	0.111100	ft/ft
Left Side Slope	3.00	H : V
Right Side Slope	3.00	H : V
Discharge	5.42	cfs

Results		
Depth	0.56	ft
Flow Area	0.9	ft²
Wetted Perimeter	3.52	ft
Top Width	3.34	ft
Critical Depth	0.73	ft
Critical Slope	0.026834	ft/ft
Velocity	5.83	ft/s
Velocity Head	0.53	ft
Specific Energy	1.08	ft
Froude Number	1.95	
Flow Type	Supercritical	

Time span=6.00-54.00 hrs, dt=0.05 hrs, 961 points
Runoff by SCS TR-20 method, UH=SCS, Type II 24-hr Rainfall=3.50"
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Undeveloped Site Parcel 7
Tc=50.6 min CN=66 Area=7.500 ac Runoff= 2.96 cfs 0.500 af

Reach 1R: Diversion ditch Inflow= 2.96 cfs 0.500 af
Length= 345.0' Max Vel= 1.7 fps Capacity= 37.45 cfs Outflow= 2.93 cfs 0.500 af

Reach 2R: Road ditch Inflow= 2.93 cfs 0.500 af
Length= 215.0' Max Vel= 2.4 fps Capacity= 60.48 cfs Outflow= 2.92 cfs 0.500 af

Reach 3R: Culvert E-1 Inflow= 2.92 cfs 0.500 af
Length= 101.0' Max Vel= 7.9 fps Capacity= 11.63 cfs Outflow= 2.92 cfs 0.500 af

Runoff Area = 7.500 ac Volume = 0.500 af Average Depth = 0.80"

Subcatchment 1S: Undevelopped Site Parcel 7

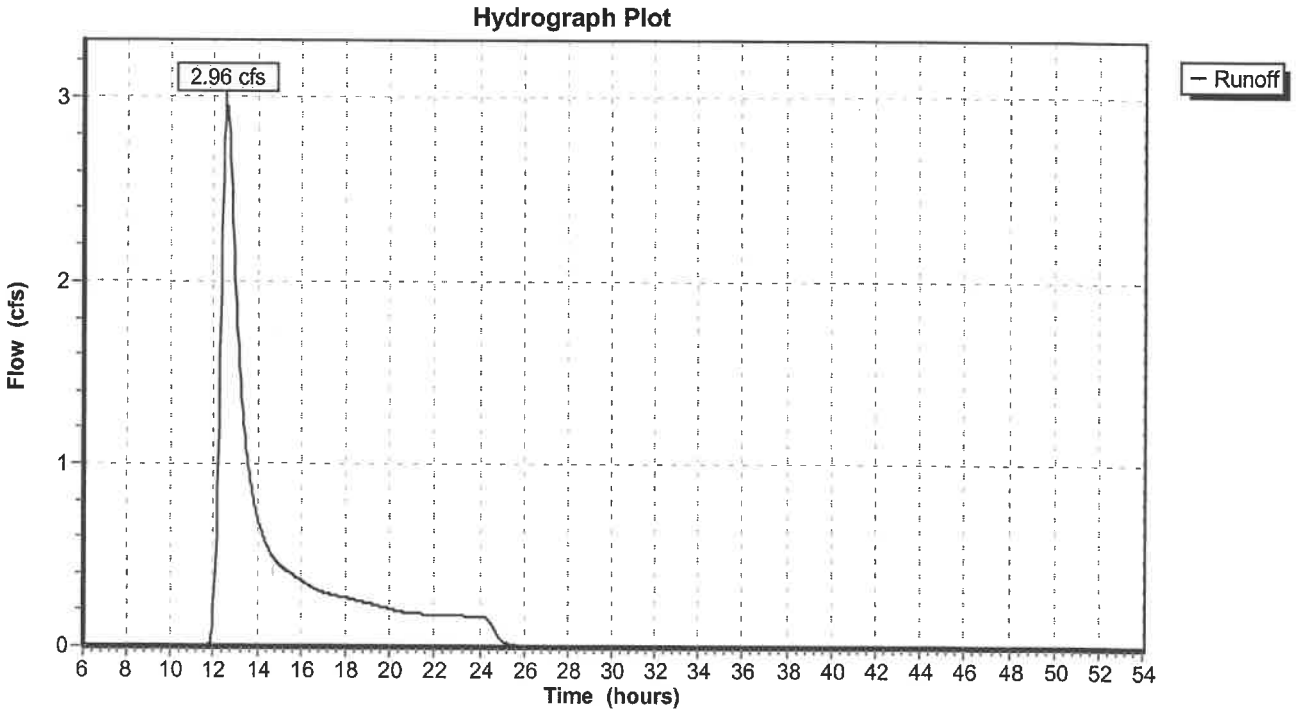
Runoff = 2.96 cfs @ 12.57 hrs, Volume= 0.500 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 6.00-54.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=3.50"

Area (ac)	CN	Description
7.500	66	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
41.0	300	0.0320	0.1		**Sheet Flow, Woods** Woods: Light underbrush n= 0.400 P2= 3.50"
9.6	514	0.0320	0.9		**Shallow Concentrated Flow, Woods** Woodland Kv= 5.0 fps
50.6	814	Total			

Subcatchment 1S: Undevelopped Site Parcel 7



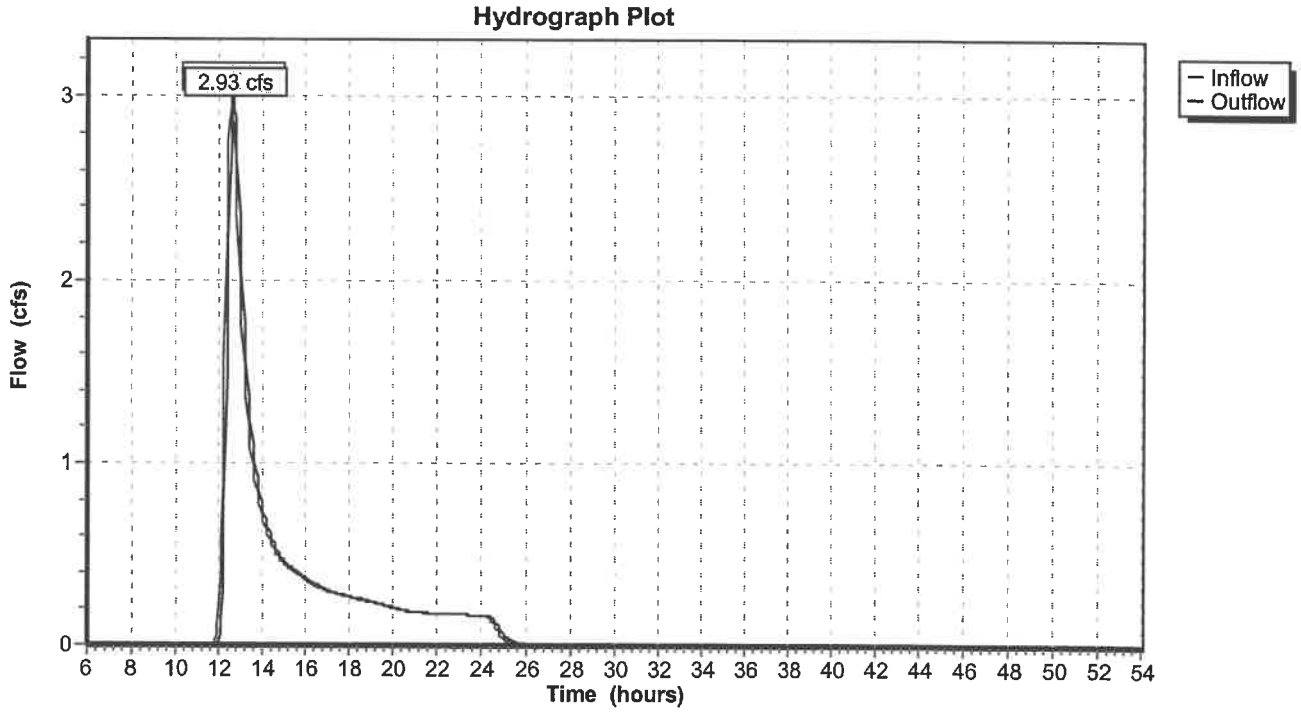
Reach 1R: Diversion ditch

Inflow	=	2.96 cfs @	12.57 hrs, Volume=	0.500 af
Outflow	=	2.93 cfs @	12.68 hrs, Volume=	0.500 af, Atten= 1%, Lag= 6.7 min

Routing by Stor-Ind+Trans method, Time Span= 6.00-54.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.7 fps, Min. Travel Time= 3.5 min
Avg. Velocity = 0.8 fps, Avg. Travel Time= 7.3 min

Peak Depth= 0.77'
Capacity at bank full= 37.45 cfs
Inlet Invert= 41.00', Outlet Invert= 39.00'
0.00' x 2.00' deep channel, n= 0.035 Length= 345.0' Slope= 0.0058 '/'
Side Slope Z-value= 3.0 '/'

Reach 1R: Diversion ditch



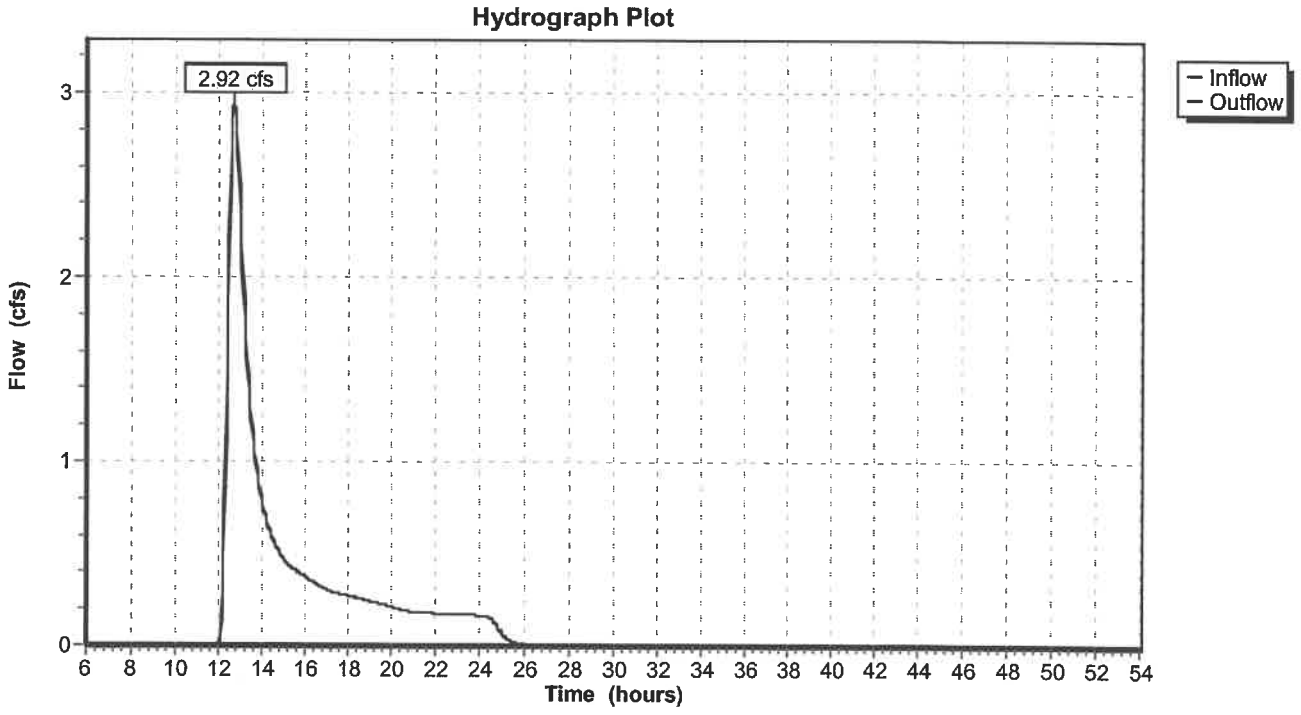
Reach 2R: Road ditch

Inflow = 2.93 cfs @ 12.68 hrs, Volume= 0.500 af
Outflow = 2.92 cfs @ 12.73 hrs, Volume= 0.500 af, Atten= 0%, Lag= 2.8 min

Routing by Stor-Ind+Trans method, Time Span= 6.00-54.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.4 fps, Min. Travel Time= 1.5 min
Avg. Velocity = 1.1 fps, Avg. Travel Time= 3.1 min

Peak Depth= 0.64'
Capacity at bank full= 60.48 cfs
Inlet Invert= 39.00', Outlet Invert= 35.75'
0.00' x 2.00' deep channel, n= 0.035 Length= 215.0' Slope= 0.0151 '/'
Side Slope Z-value= 3.0 '/'

Reach 2R: Road ditch



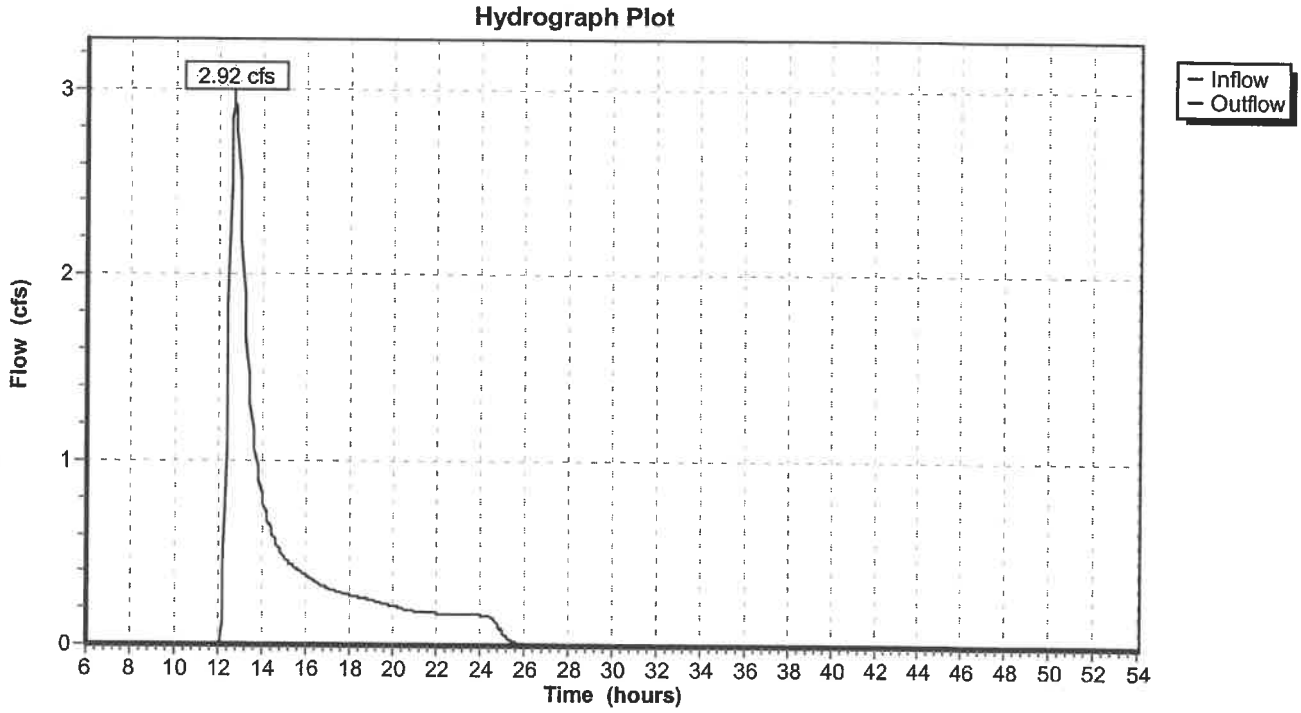
Reach 3R: Culvert E-1

Inflow	=	2.92 cfs @	12.73 hrs, Volume=	0.500 af
Outflow	=	2.92 cfs @	12.73 hrs, Volume=	0.500 af, Atten= 0%, Lag= 0.4 min

Routing by Stor-Ind+Trans method, Time Span= 6.00-54.00 hrs, dt= 0.05 hrs
Max. Velocity= 7.9 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 3.6 fps, Avg. Travel Time= 0.5 min

Peak Depth= 0.43'
Capacity at bank full= 11.63 cfs
Inlet Invert= 35.75', Outlet Invert= 32.96'
15.0" Diameter Pipe n= 0.012 Length= 101.0' Slope= 0.0276 '/'

Reach 3R: Culvert E-1



Time span=6.00-54.00 hrs, dt=0.05 hrs, 961 points
Runoff by SCS TR-20 method, UH=SCS, Type II 24-hr Rainfall=5.80"
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Undevelopped Site Parcel 7
Tc=50.6 min CN=66 Area=7.500 ac Runoff= 9.96 cfs 1.433 af

Reach 1R: Diversion ditch Inflow= 9.96 cfs 1.433 af
Length= 345.0' Max Vel= 2.2 fps Capacity= 37.45 cfs Outflow= 9.90 cfs 1.433 af

Reach 2R: Road ditch Inflow= 9.90 cfs 1.433 af
Length= 215.0' Max Vel= 3.2 fps Capacity= 60.48 cfs Outflow= 9.86 cfs 1.433 af

Reach 3R: Culvert E-1 Inflow= 9.86 cfs 1.433 af
Length= 101.0' Max Vel= 10.6 fps Capacity= 11.63 cfs Outflow= 9.86 cfs 1.433 af

Runoff Area = 7.500 ac Volume = 1.433 af Average Depth = 2.29"

Subcatchment 1S: Undevelopped Site Parcel 7

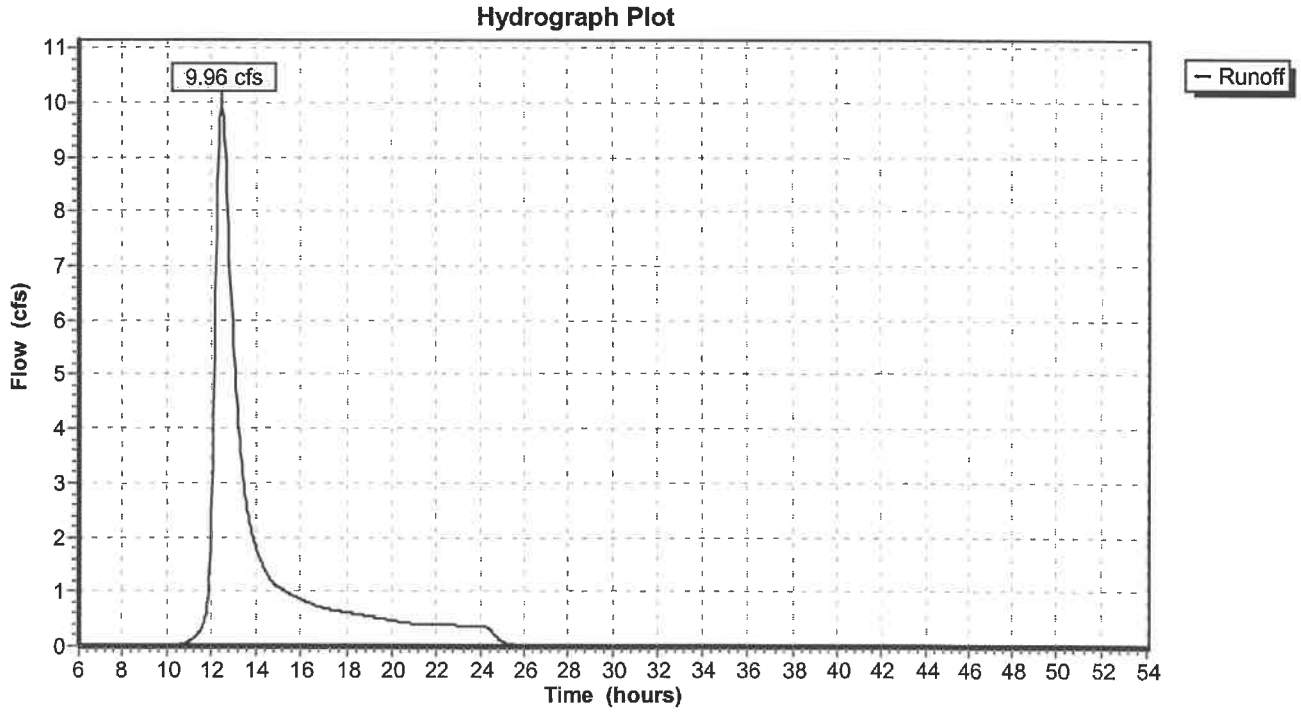
Runoff = 9.96 cfs @ 12.53 hrs, Volume= 1.433 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 6.00-54.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=5.80"

Area (ac)	CN	Description
7.500	66	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
41.0	300	0.0320	0.1		**Sheet Flow, Woods** Woods: Light underbrush n= 0.400 P2= 3.50"
9.6	514	0.0320	0.9		**Shallow Concentrated Flow, Woods** Woodland Kv= 5.0 fps
50.6	814	Total			

Subcatchment 1S: Undevelopped Site Parcel 7



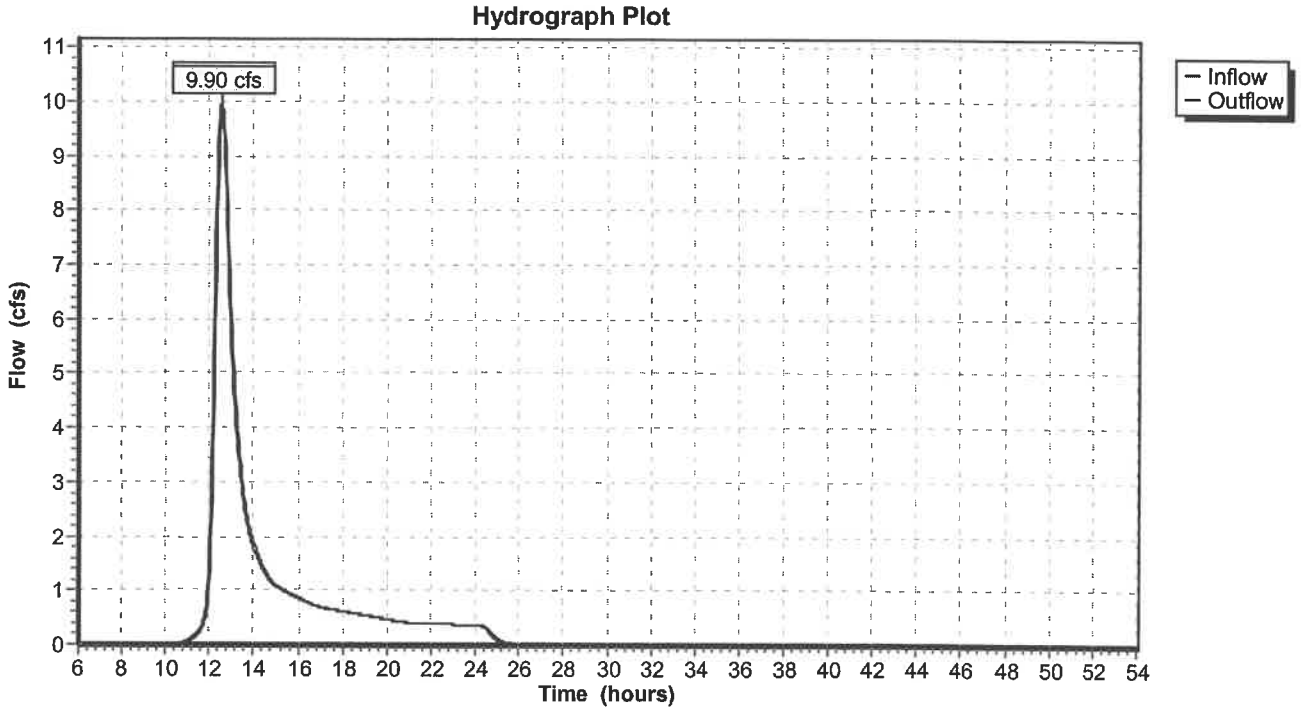
Reach 1R: Diversion ditch

Inflow	=	9.96 cfs @	12.53 hrs, Volume=	1.433 af
Outflow	=	9.90 cfs @	12.60 hrs, Volume=	1.433 af, Atten= 1%, Lag= 4.5 min

Routing by Stor-Ind+Trans method, Time Span= 6.00-54.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.2 fps, Min. Travel Time= 2.6 min
Avg. Velocity = 1.0 fps, Avg. Travel Time= 6.0 min

Peak Depth= 1.21'
Capacity at bank full= 37.45 cfs
Inlet Invert= 41.00', Outlet Invert= 39.00'
0.00' x 2.00' deep channel, n= 0.035 Length= 345.0' Slope= 0.0058 '/'
Side Slope Z-value= 3.0 '/'

Reach 1R: Diversion ditch



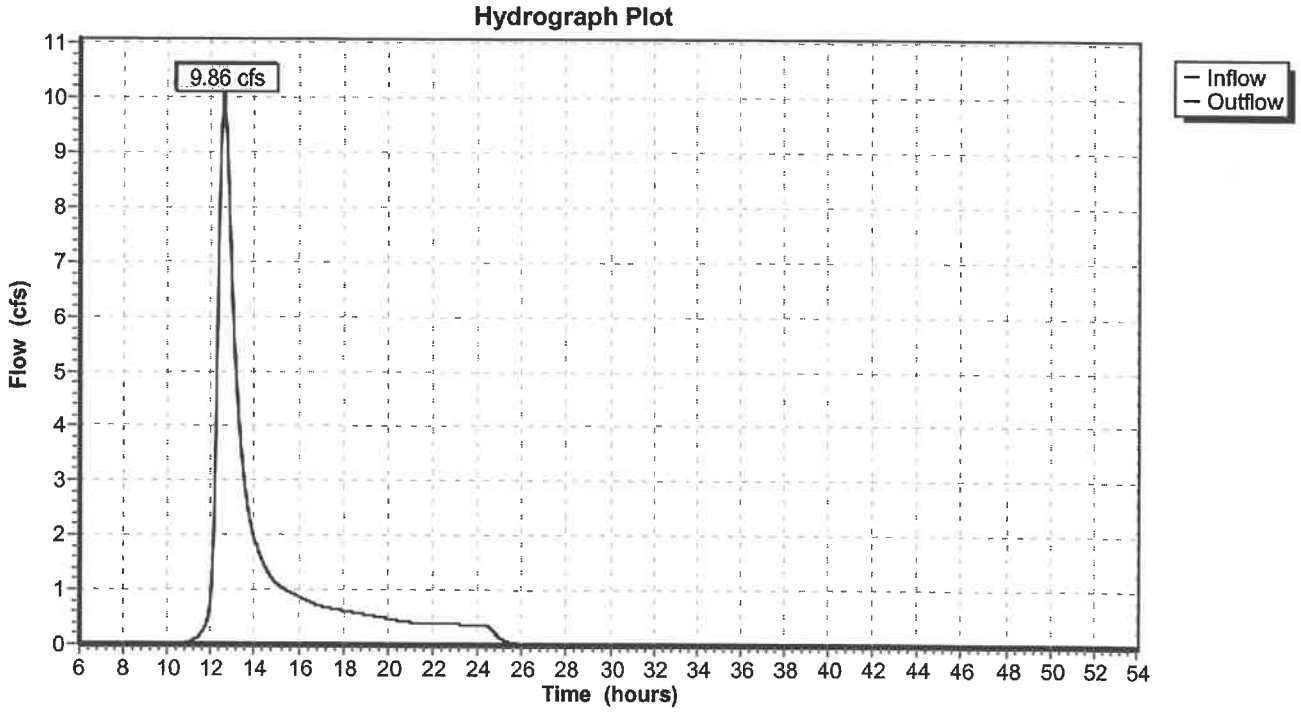
Reach 2R: Road ditch

Inflow	=	9.90 cfs @	12.60 hrs, Volume=	1.433 af
Outflow	=	9.86 cfs @	12.64 hrs, Volume=	1.433 af, Atten= 0%, Lag= 2.0 min

Routing by Stor-Ind+Trans method, Time Span= 6.00-54.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.2 fps, Min. Travel Time= 1.1 min
Avg. Velocity = 1.4 fps, Avg. Travel Time= 2.6 min

Peak Depth= 1.01'
Capacity at bank full= 60.48 cfs
Inlet Invert= 39.00', Outlet Invert= 35.75'
0.00' x 2.00' deep channel, n= 0.035 Length= 215.0' Slope= 0.0151 '/'
Side Slope Z-value= 3.0 '/'

Reach 2R: Road ditch



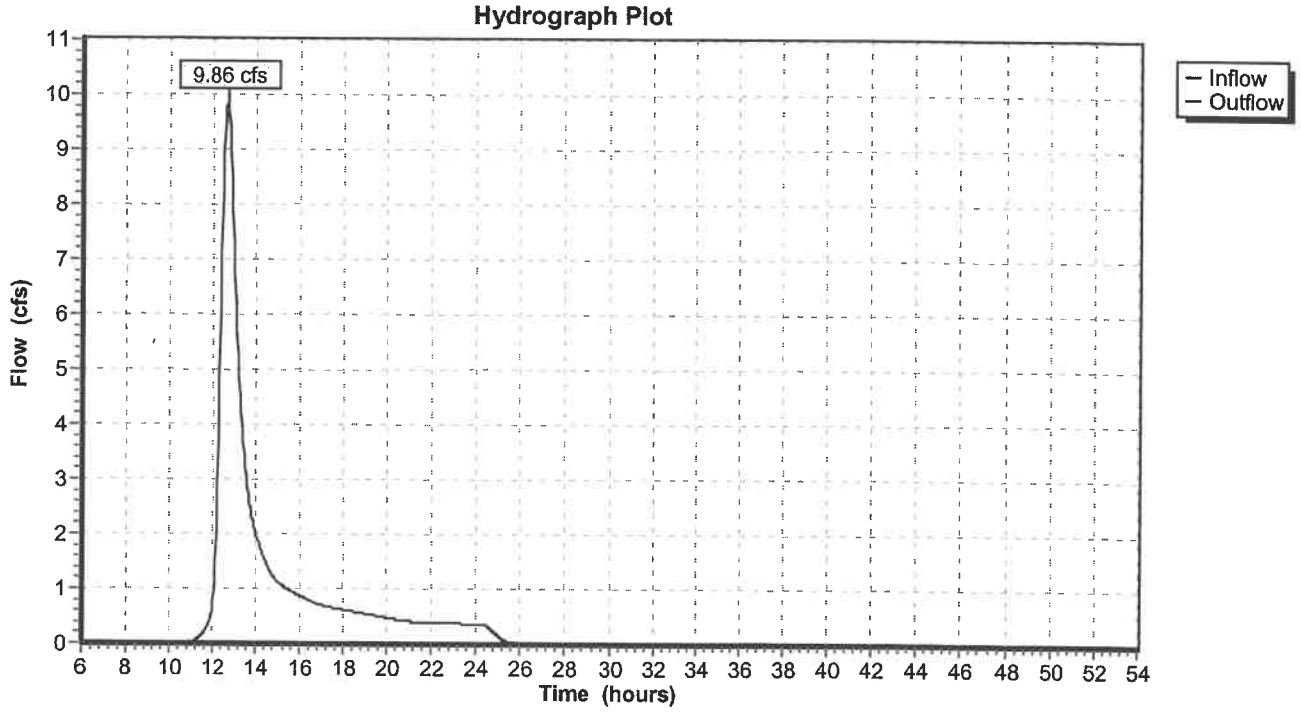
Reach 3R: Culvert E-1

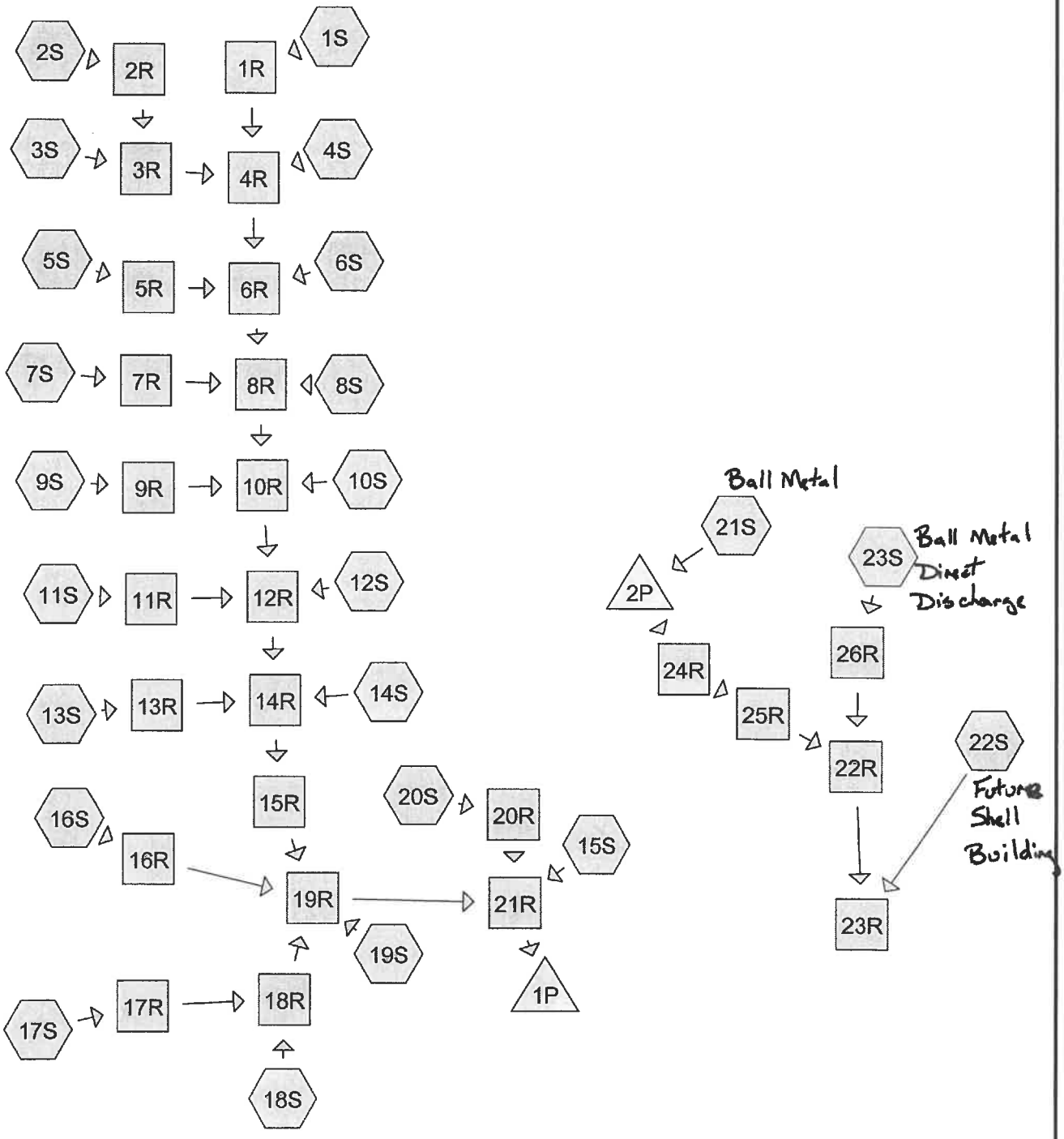
Inflow = 9.86 cfs @ 12.64 hrs, Volume= 1.433 af
Outflow = 9.86 cfs @ 12.64 hrs, Volume= 1.433 af, Atten= 0%, Lag= 0.3 min

Routing by Stor-Ind+Trans method, Time Span= 6.00-54.00 hrs, dt= 0.05 hrs
Max. Velocity= 10.6 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 4.5 fps, Avg. Travel Time= 0.4 min

Peak Depth= 0.88'
Capacity at bank full= 11.63 cfs
Inlet Invert= 35.75', Outlet Invert= 32.96'
15.0" Diameter Pipe n= 0.012 Length= 101.0' Slope= 0.0276 '/'

Reach 3R: Culvert E-1





Drainage Diagram for James River Commerce Center
Prepared by LandMark Design Group, Inc. 12/12/2002

Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Type II 24-hr Rainfall=3.50"
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 21S: Ball Metal Expansion
Tc=9.6 min CN=91 Area=16.710 ac Runoff= 63.82 cfs 3.539 af

Subcatchment 22S: Future Shell Bldg. Undeveloped site
Tc=45.0 min CN=66 Area=7.000 ac Runoff= 3.01 cfs 0.467 af

Subcatchment 23S: Ball Metal Original Site
Tc=5.0 min CN=75 Area=8.440 ac Runoff= 20.44 cfs 0.916 af

Reach 22R: Existing Ball Metal outfall Inflow= 20.99 cfs 4.296 af
Length= 440.0' Max Vel= 7.8 fps Capacity= 93.25 cfs Outflow= 20.66 cfs 4.294 af

Reach 23R: Temporary Road Culvert Inflow= 20.93 cfs 4.761 af
Length= 43.0' Max Vel= 7.7 fps Capacity= 91.04 cfs Outflow= 20.90 cfs 4.761 af

Reach 24R: Existing BM 3-2 Inflow= 7.23 cfs 3.382 af
Length= 250.0' Max Vel= 4.6 fps Capacity= 14.31 cfs Outflow= 7.23 cfs 3.381 af

Reach 25R: Existing BM 2-1 Inflow= 7.23 cfs 3.381 af
Length= 240.0' Max Vel= 4.6 fps Capacity= 14.31 cfs Outflow= 7.23 cfs 3.380 af

Reach 26R: Existing BM 5-1 Inflow= 20.44 cfs 0.916 af
Length= 60.0' Max Vel= 16.3 fps Capacity= 263.64 cfs Outflow= 20.41 cfs 0.916 af

Pond 2P: Ball Metal BMP Peak Storage= 83,564 cf Inflow= 63.82 cfs 3.539 af
Primary= 7.23 cfs 3.382 af Outflow= 7.23 cfs 3.382 af

Runoff Area = 32.150 ac Volume = 4.921 af Average Depth = 1.84"

Subcatchment 21S: Ball Metal Expansion

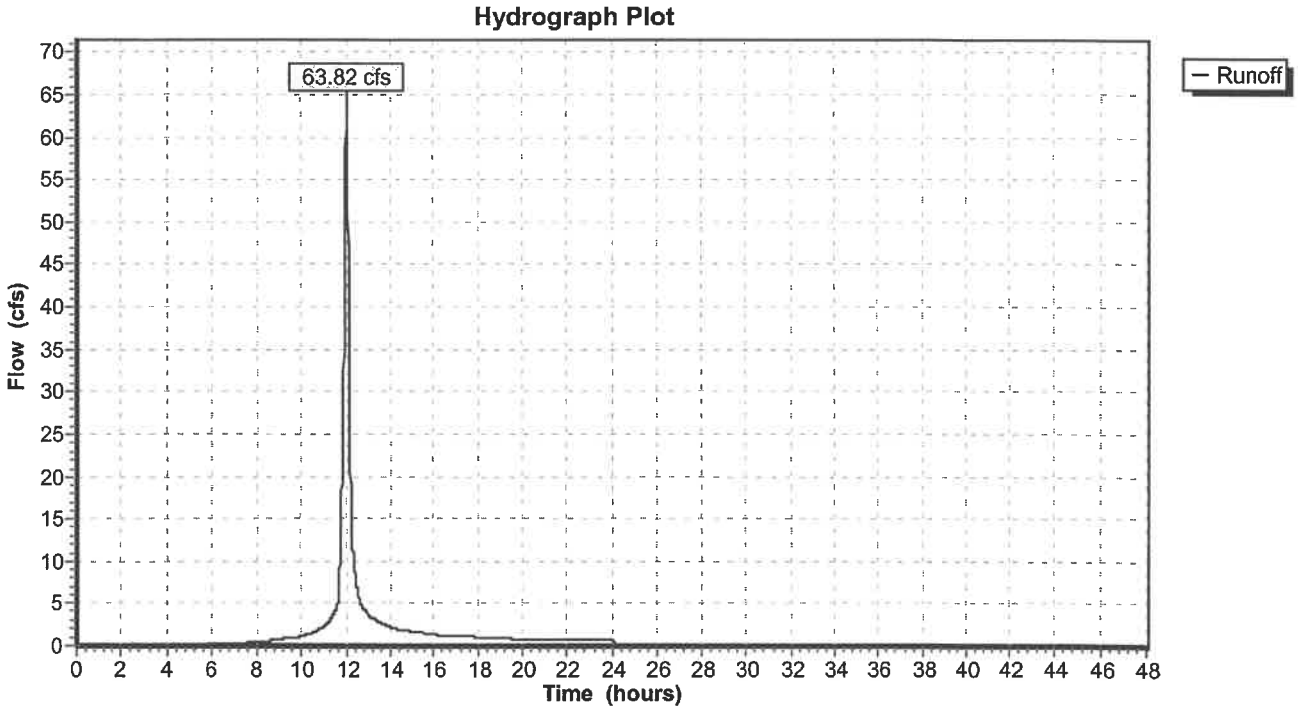
Runoff = 63.82 cfs @ 12.01 hrs, Volume= 3.539 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr Rainfall=3.50"

Area (ac)	CN	Description
16.710	91	Phase 1 developed site

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.6					**Direct Entry, Ball Metal Calcs**

Subcatchment 21S: Ball Metal Expansion



Subcatchment 22S: Future Shell Bldg. Undeveloped site

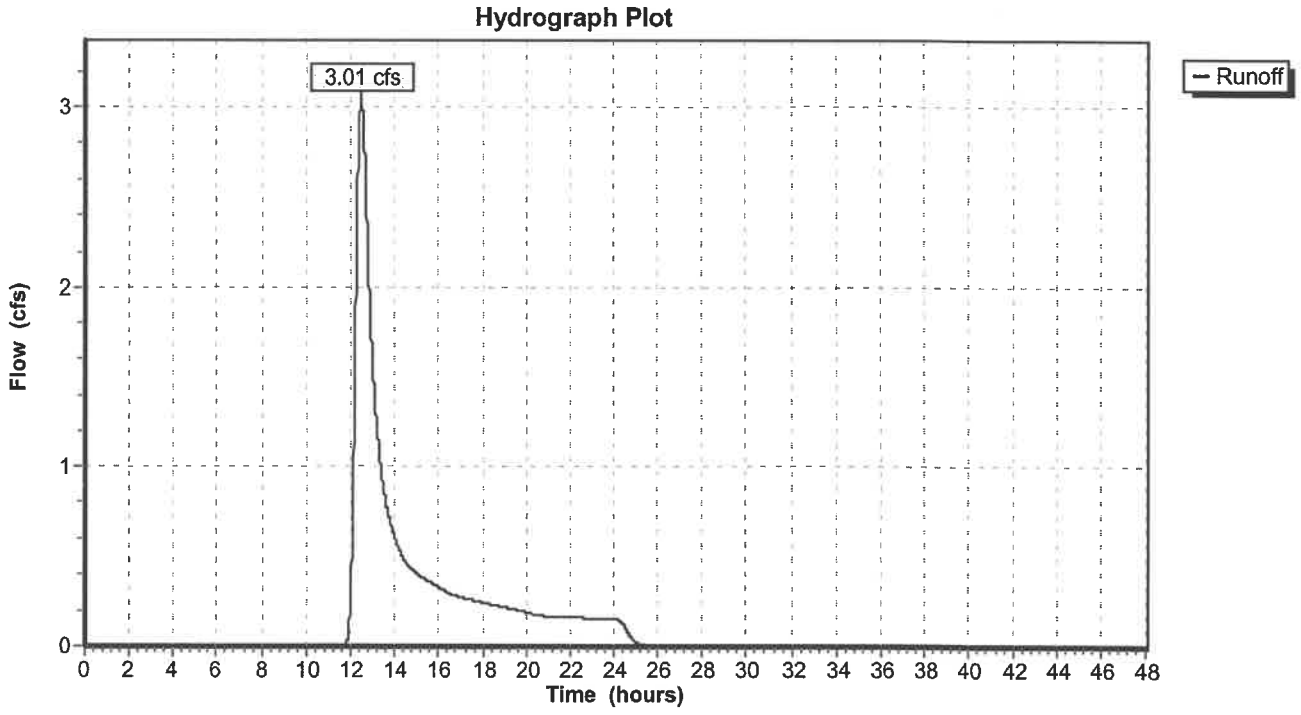
Runoff = 3.01 cfs @ 12.50 hrs, Volume= 0.467 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr Rainfall=3.50"

Area (ac)	CN	Description
7.000	66	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
45.0					**Direct Entry,**

Subcatchment 22S: Future Shell Bldg. Undeveloped site



Subcatchment 23S: Ball Metal Original Site

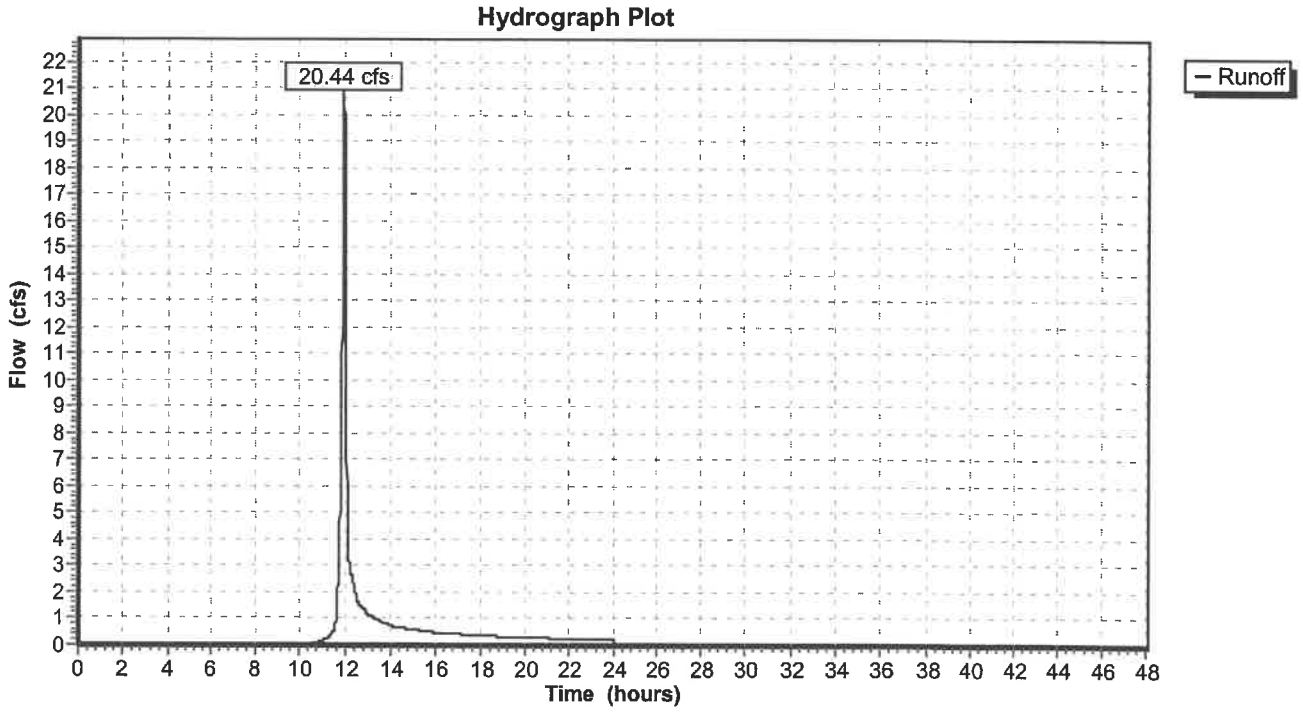
Runoff = 20.44 cfs @ 11.97 hrs, Volume= 0.916 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr Rainfall=3.50"

Area (ac)	CN	Description
8.440	75	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 23S: Ball Metal Original Site



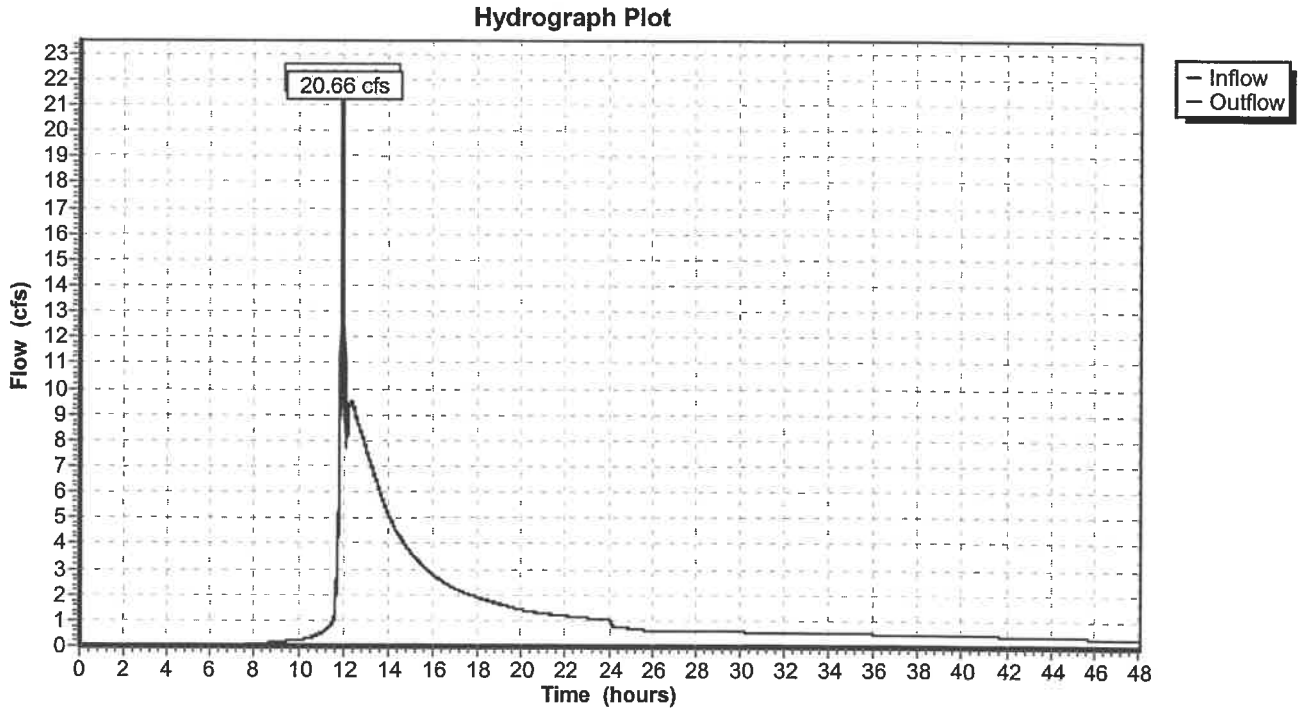
Reach 22R: Existing Ball Metal outfall

Inflow = 20.99 cfs @ 11.97 hrs, Volume= 4.296 af
Outflow = 20.66 cfs @ 11.99 hrs, Volume= 4.294 af, Atten= 2%, Lag= 1.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 7.8 fps, Min. Travel Time= 0.9 min
Avg. Velocity = 2.9 fps, Avg. Travel Time= 2.5 min

Peak Depth= 1.12'
Capacity at bank full= 93.25 cfs
Inlet Invert= 45.78', Outlet Invert= 42.00'
42.0" Diameter Pipe n= 0.013 Length= 440.0' Slope= 0.0086 '/'

Reach 22R: Existing Ball Metal outfall



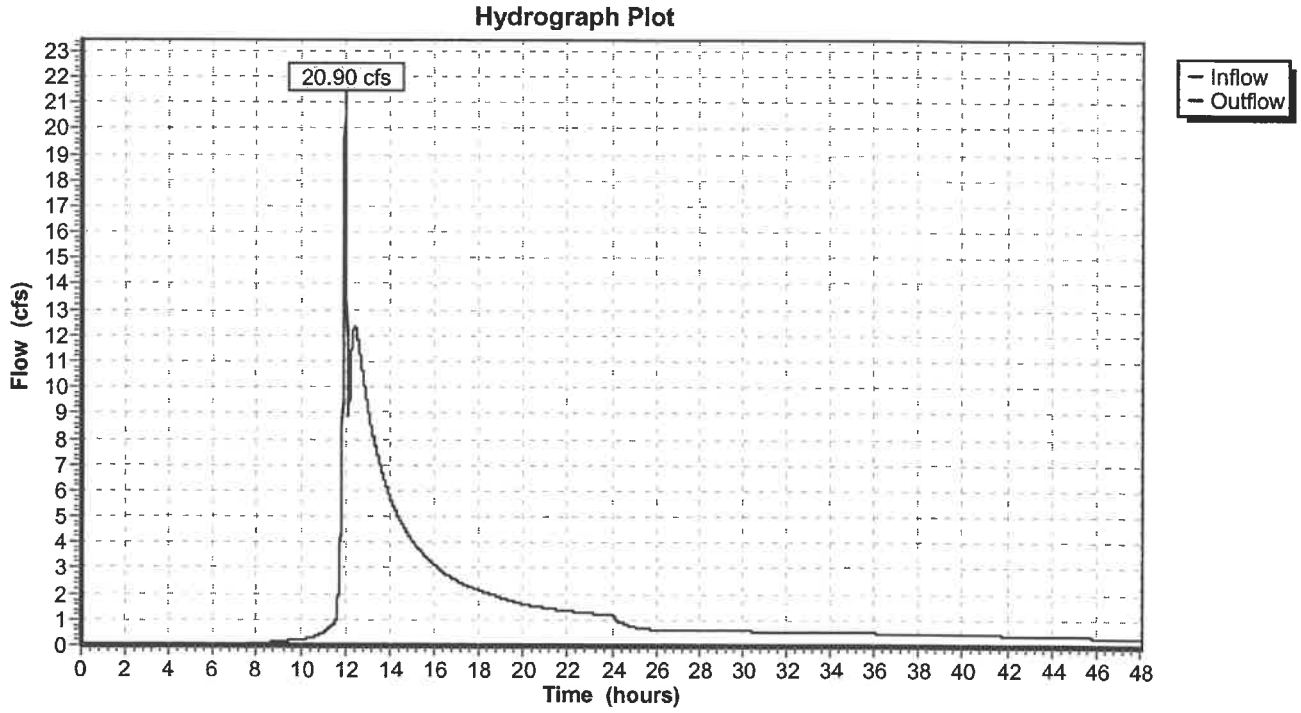
Reach 23R: Temporary Road Culvert

Inflow = 20.93 cfs @ 12.00 hrs, Volume= 4.761 af
Outflow = 20.90 cfs @ 12.00 hrs, Volume= 4.761 af, Atten= 0%, Lag= 0.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 7.7 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 2.9 fps, Avg. Travel Time= 0.2 min

Peak Depth= 1.14'
Capacity at bank full= 91.04 cfs
Inlet Invert= 37.30', Outlet Invert= 37.00'
42.0" Diameter Pipe n= 0.012 Length= 43.0' Slope= 0.0070 '/'

Reach 23R: Temporary Road Culvert



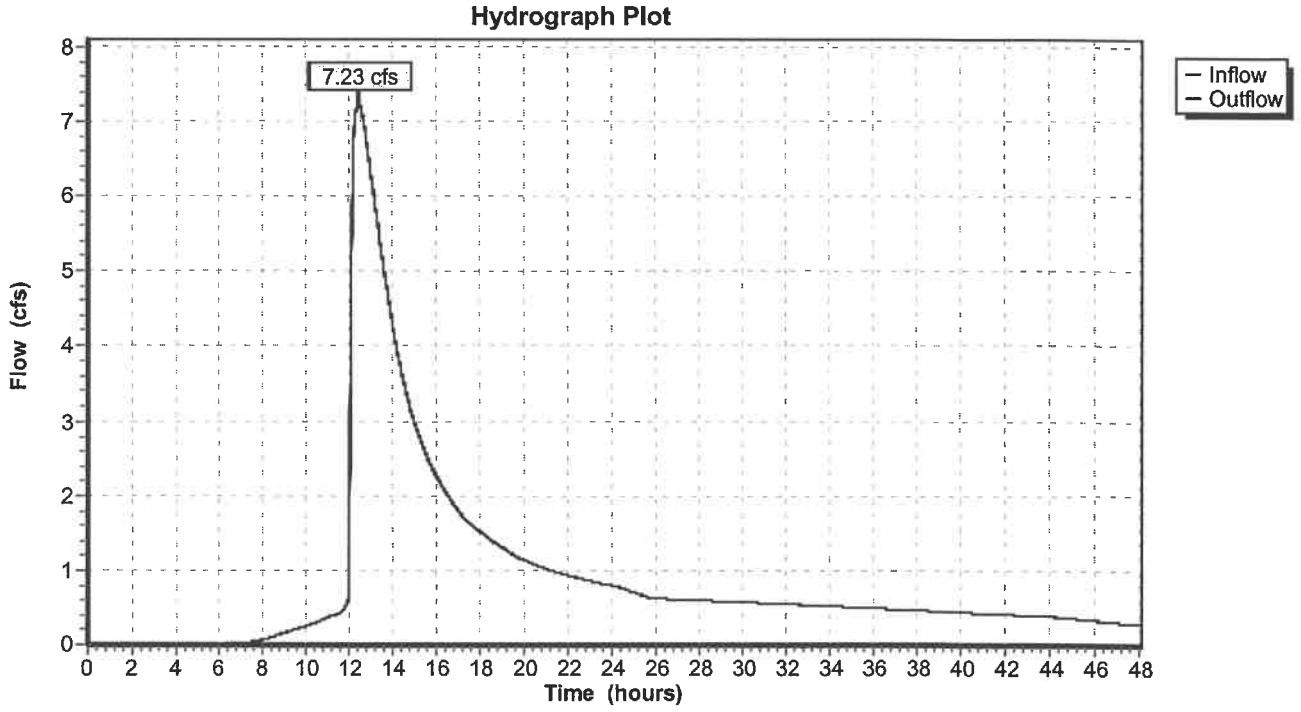
Reach 24R: Existing BM 3-2

Inflow = 7.23 cfs @ 12.44 hrs, Volume= 3.382 af
Outflow = 7.23 cfs @ 12.47 hrs, Volume= 3.381 af, Atten= 0%, Lag= 1.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.6 fps, Min. Travel Time= 0.9 min
Avg. Velocity = 2.3 fps, Avg. Travel Time= 1.8 min

Peak Depth= 1.01'
Capacity at bank full= 14.31 cfs
Inlet Invert= 49.00', Outlet Invert= 48.00'
24.0" Diameter Pipe n= 0.013 Length= 250.0' Slope= 0.0040 '/'

Reach 24R: Existing BM 3-2



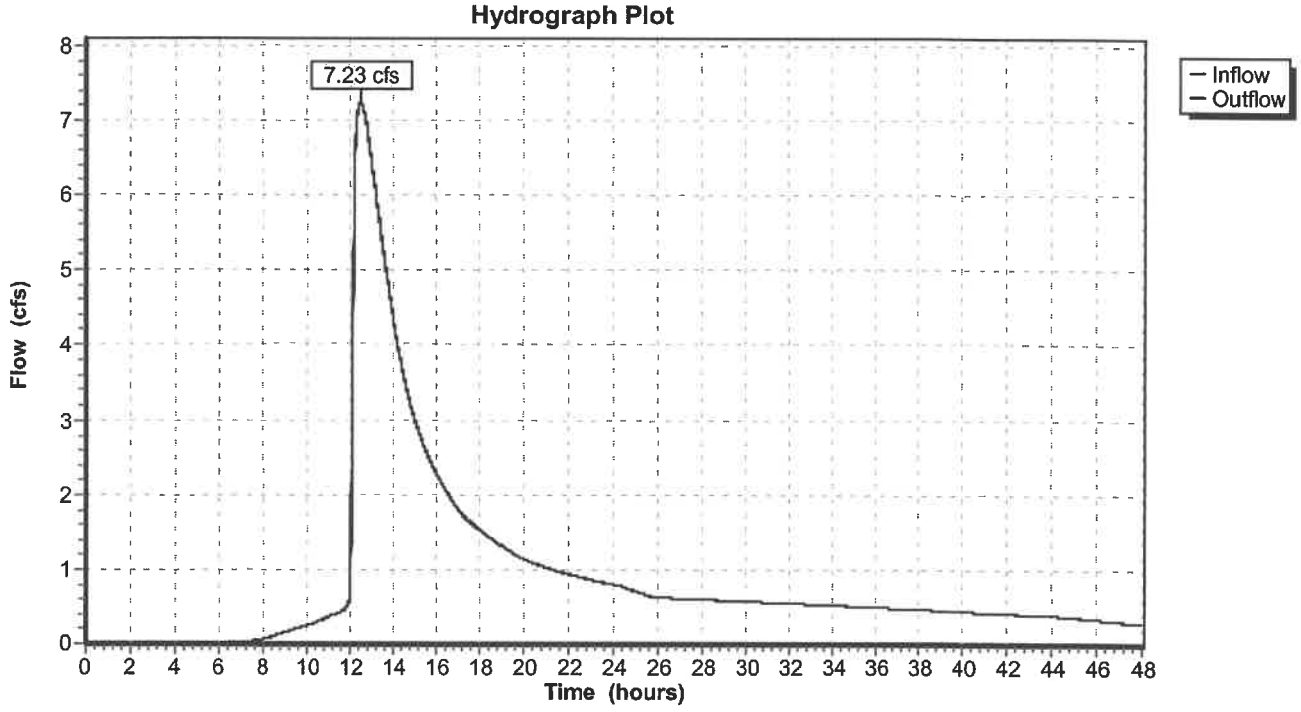
Reach 25R: Existing BM 2-1

Inflow	=	7.23 cfs @	12.47 hrs, Volume=	3.381 af
Outflow	=	7.23 cfs @	12.50 hrs, Volume=	3.380 af, Atten= 0%, Lag= 1.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.6 fps, Min. Travel Time= 0.9 min
Avg. Velocity = 2.3 fps, Avg. Travel Time= 1.8 min

Peak Depth= 1.01'
Capacity at bank full= 14.31 cfs
Inlet Invert= 48.00', Outlet Invert= 47.04'
24.0" Diameter Pipe n= 0.013 Length= 240.0' Slope= 0.0040 '/'

Reach 25R: Existing BM 2-1



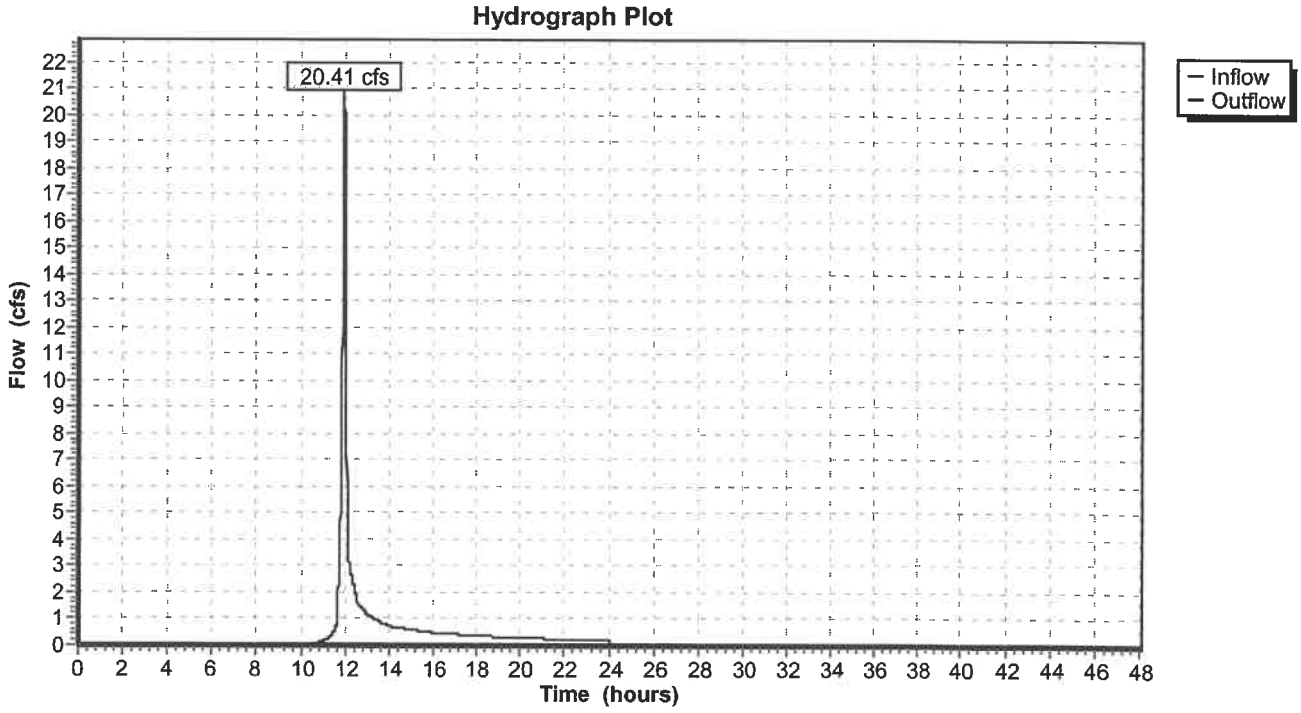
Reach 26R: Existing BM 5-1

Inflow = 20.44 cfs @ 11.97 hrs, Volume= 0.916 af
Outflow = 20.41 cfs @ 11.97 hrs, Volume= 0.916 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 16.3 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 5.3 fps, Avg. Travel Time= 0.2 min

Peak Depth= 0.66'
Capacity at bank full= 263.64 cfs
Inlet Invert= 50.00', Outlet Invert= 45.88'
42.0" Diameter Pipe n= 0.013 Length= 60.0' Slope= 0.0687 '/'

Reach 26R: Existing BM 5-1



Pond 2P: Ball Metal BMP

Inflow = 63.82 cfs @ 12.01 hrs, Volume= 3.539 af
Outflow = 7.23 cfs @ 12.44 hrs, Volume= 3.382 af, Atten= 89%, Lag= 26.2 min
Primary = 7.23 cfs @ 12.44 hrs, Volume= 3.382 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

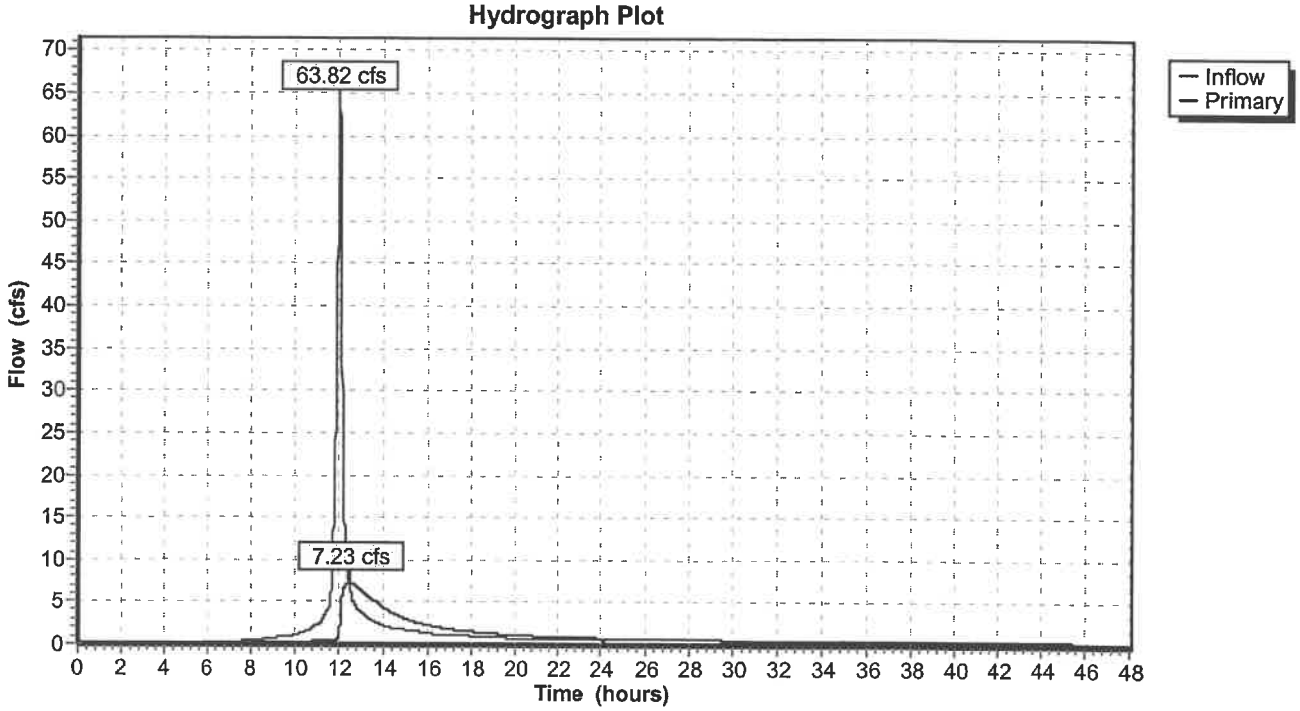
Peak Elev= 53.67' Storage= 83,564 cf
Plug-Flow detention time= 483.7 min calculated for 3.382 af (96% of inflow)
Storage and wetted areas determined by Prismatic sections

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
50.00	0	0	0
51.00	22,738	11,369	11,369
52.00	24,763	23,751	35,120
52.35	26,094	8,900	44,019
56.00	33,669	109,067	153,087
58.00	38,500	72,169	225,256
60.00	43,588	82,088	307,344
62.00	48,919	92,507	399,851
64.00	54,513	103,432	503,283

Primary OutFlow (Free Discharge)
- 1=Culvert
  - 2=Orifice/Grate
  - 3=Orifice/Grate
  - 4=Orifice/Grate

#	Routing	Invert	Outlet Devices
1	Primary	49.50'	**24.0" x 114.0' long Culvert** RCP, square edge headwall, Ke= 0.500 Outlet Invert= 49.04' S= 0.0040 '/' n= 0.013 Cc= 0.900
2	Device 1	50.00'	**4.0" Vert. Orifice/Grate** C= 0.600
3	Device 1	52.35'	**18.0" Vert. Orifice/Grate** C= 0.600
4	Device 1	57.00'	**48.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600

Pond 2P: Ball Metal BMP



Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Type II 24-hr Rainfall=5.80"
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 21S: Ball Metal Expansion
Tc=9.6 min CN=91 Area=16.710 ac Runoff= 115.21 cfs 6.631 af

Subcatchment 22S: Future Shell Bldg. Undeveloped site
Tc=45.0 min CN=66 Area=7.000 ac Runoff= 10.17 cfs 1.338 af

Subcatchment 23S: Ball Metal Original Site
Tc=5.0 min CN=75 Area=8.440 ac Runoff= 48.44 cfs 2.189 af

Reach 22R: Existing Ball Metal outfall Inflow= 55.32 cfs 8.628 af
Length= 440.0' Max Vel= 10.1 fps Capacity= 93.25 cfs Outflow= 54.81 cfs 8.626 af

Reach 23R: Temporary Road Culvert Inflow= 56.82 cfs 9.964 af
Length= 43.0' Max Vel= 10.0 fps Capacity= 91.04 cfs Outflow= 56.77 cfs 9.964 af

Reach 24R: Existing BM 3-2 Inflow= 15.62 cfs 6.442 af
Length= 250.0' Max Vel= 5.2 fps Capacity= 14.31 cfs Outflow= 15.38 cfs 6.440 af

Reach 25R: Existing BM 2-1 Inflow= 15.38 cfs 6.440 af
Length= 240.0' Max Vel= 5.2 fps Capacity= 14.31 cfs Outflow= 15.34 cfs 6.439 af

Reach 26R: Existing BM 5-1 Inflow= 48.44 cfs 2.189 af
Length= 60.0' Max Vel= 20.9 fps Capacity= 263.64 cfs Outflow= 48.40 cfs 2.189 af

Pond 2P: Ball Metal BMP Peak Storage= 154,645 cf Inflow= 115.21 cfs 6.631 af
Primary= 15.62 cfs 6.442 af Outflow= 15.62 cfs 6.442 af

Runoff Area = 32.150 ac Volume = 10.157 af Average Depth = 3.79"

Subcatchment 21S: Ball Metal Expansion

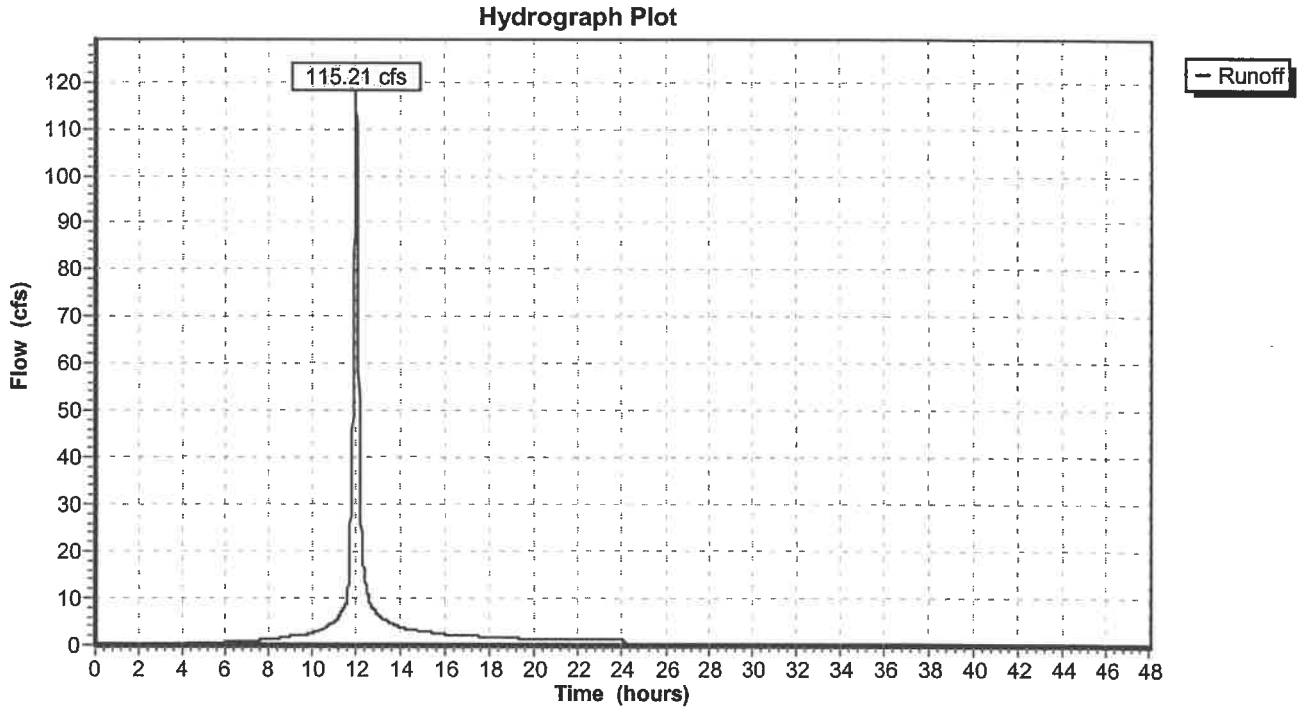
Runoff = 115.21 cfs @ 12.01 hrs, Volume= 6.631 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr Rainfall=5.80"

Area (ac)	CN	Description
16.710	91	Phase 1 developed site

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.6					**Direct Entry, Ball Metal Calcs**

Subcatchment 21S: Ball Metal Expansion



Subcatchment 22S: Future Shell Bldg. Undeveloped site

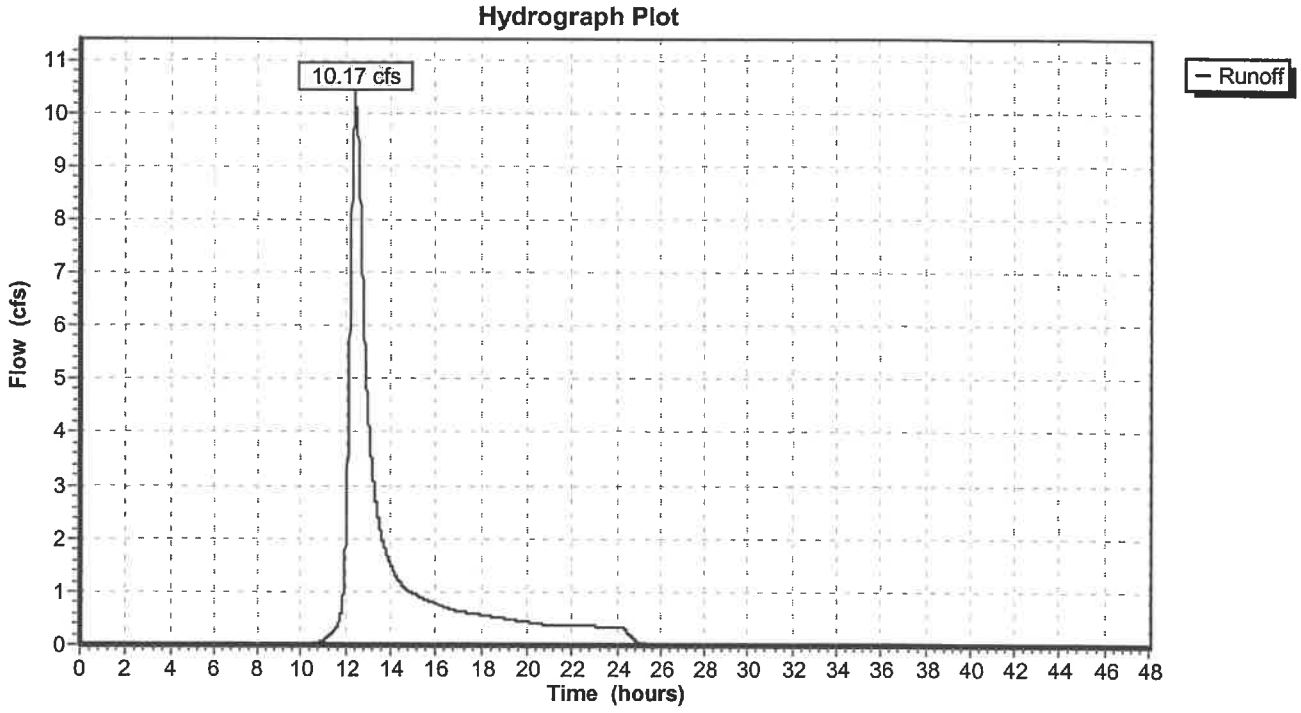
Runoff = 10.17 cfs @ 12.45 hrs, Volume= 1.338 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr Rainfall=5.80"

Area (ac)	CN	Description
7.000	66	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
45.0					**Direct Entry,**

Subcatchment 22S: Future Shell Bldg. Undeveloped site



Subcatchment 23S: Ball Metal Original Site

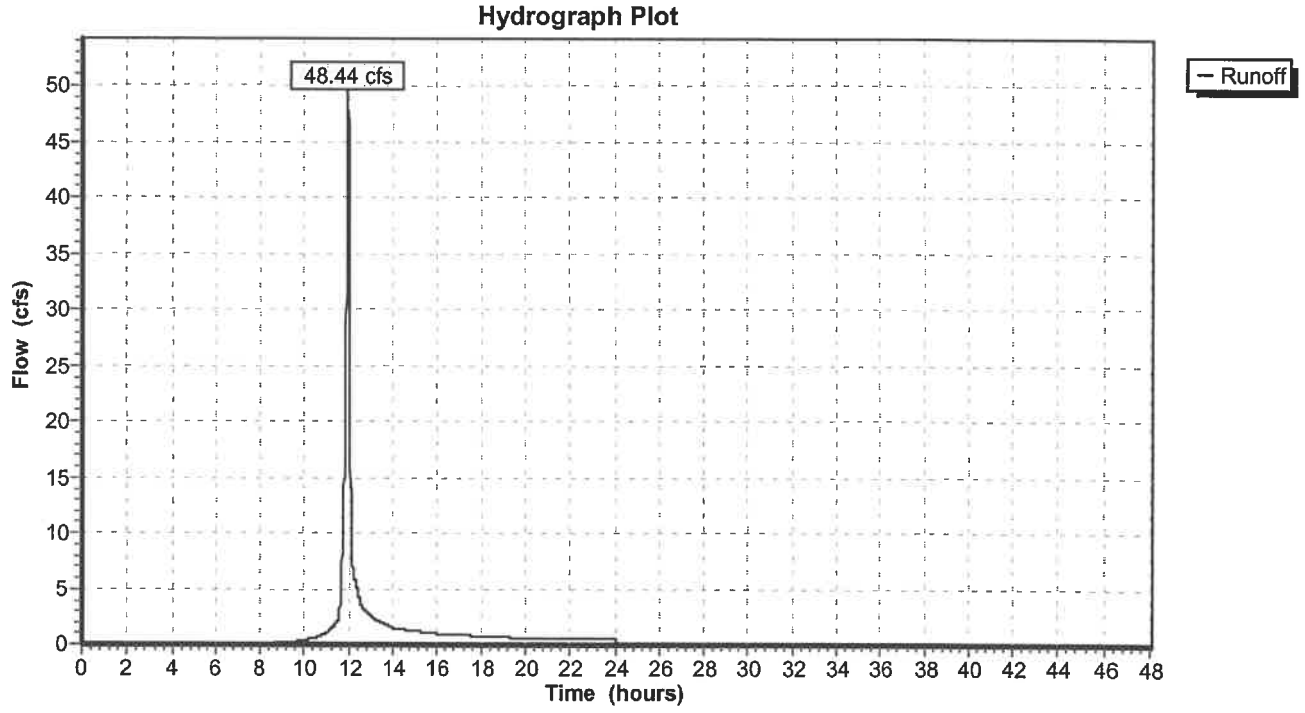
Runoff = 48.44 cfs @ 11.96 hrs, Volume= 2.189 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr Rainfall=5.80"

Area (ac)	CN	Description
8.440	75	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 23S: Ball Metal Original Site



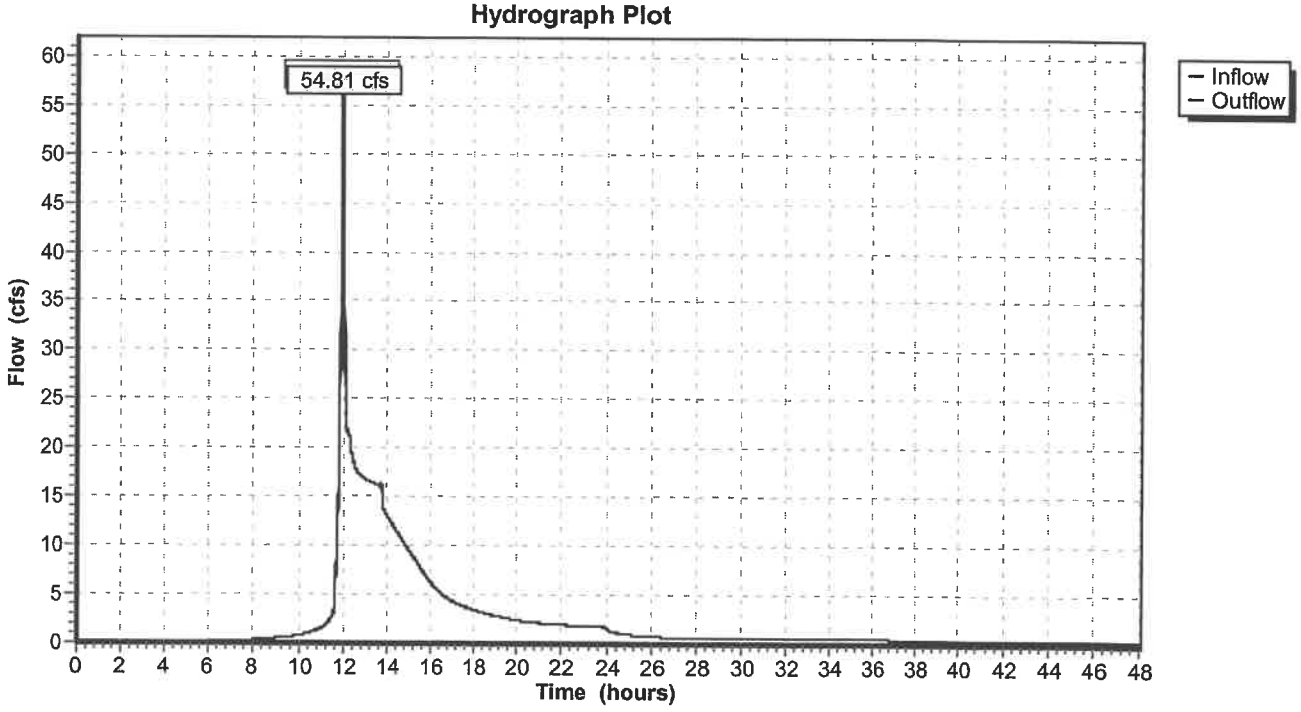
Reach 22R: Existing Ball Metal outfall

Inflow = 55.32 cfs @ 11.97 hrs, Volume= 8.628 af
Outflow = 54.81 cfs @ 11.99 hrs, Volume= 8.626 af, Atten= 1%, Lag= 1.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 10.1 fps, Min. Travel Time= 0.7 min
Avg. Velocity = 3.3 fps, Avg. Travel Time= 2.3 min

Peak Depth= 1.93'
Capacity at bank full= 93.25 cfs
Inlet Invert= 45.78', Outlet Invert= 42.00'
42.0" Diameter Pipe n= 0.013 Length= 440.0' Slope= 0.0086 '/'

Reach 22R: Existing Ball Metal outfall



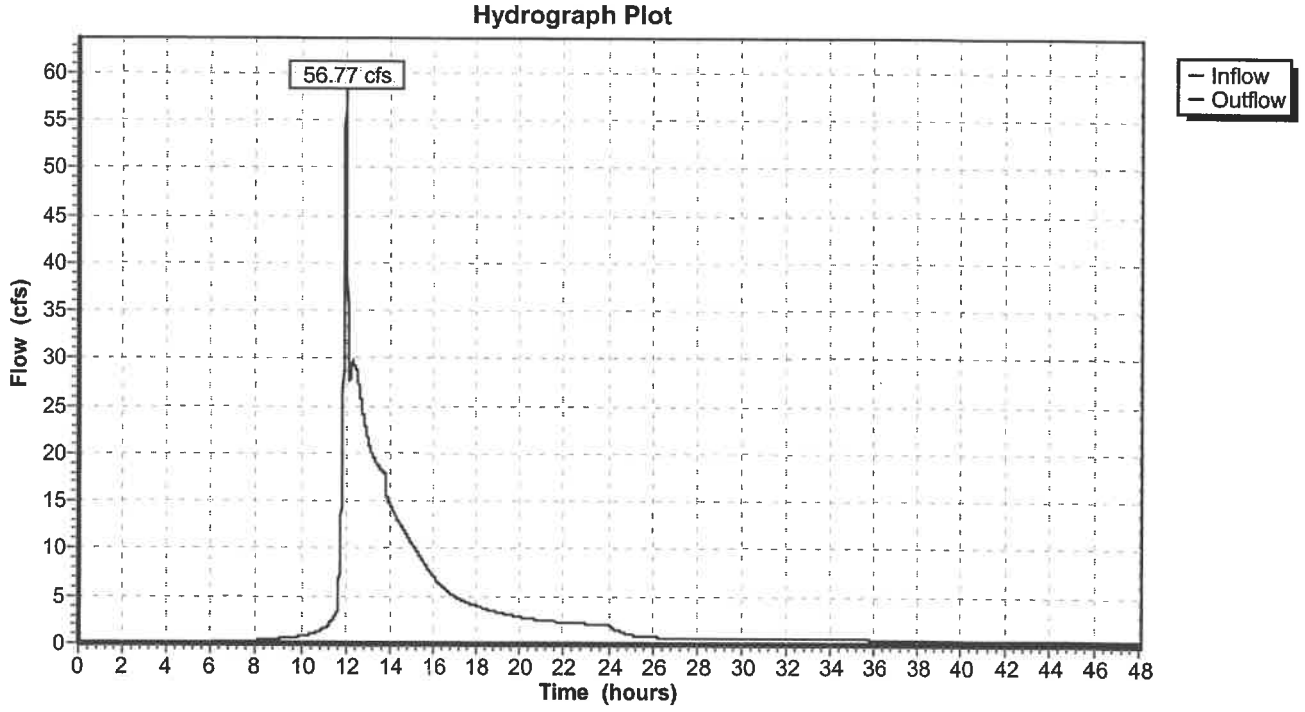
Reach 23R: Temporary Road Culvert

Inflow = 56.82 cfs @ 11.99 hrs, Volume= 9.964 af
Outflow = 56.77 cfs @ 11.99 hrs, Volume= 9.964 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 10.0 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 3.3 fps, Avg. Travel Time= 0.2 min

Peak Depth= 2.00'
Capacity at bank full= 91.04 cfs
Inlet Invert= 37.30', Outlet Invert= 37.00'
42.0" Diameter Pipe n= 0.012 Length= 43.0' Slope= 0.0070 '/'

Reach 23R: Temporary Road Culvert



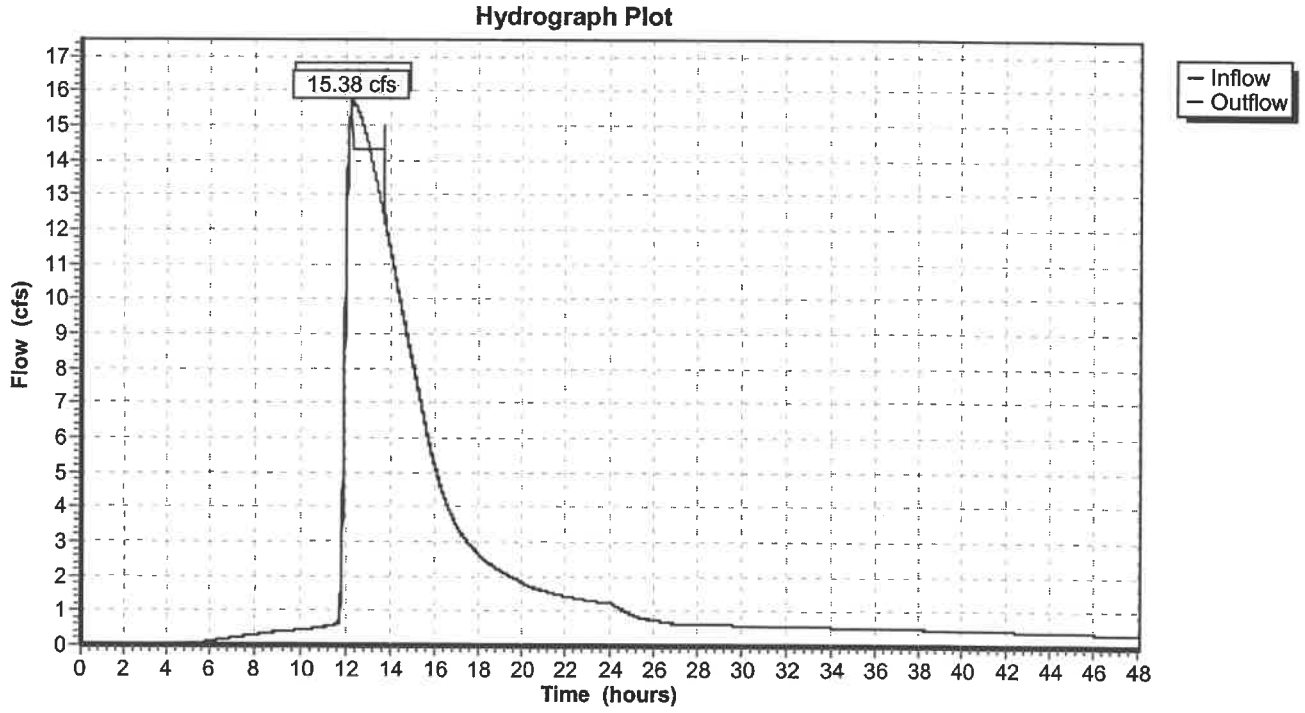
Reach 24R: Existing BM 3-2

Inflow = 15.62 cfs @ 12.35 hrs, Volume= 6.442 af
Outflow = 15.38 cfs @ 12.25 hrs, Volume= 6.440 af, Atten= 1%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 5.2 fps, Min. Travel Time= 0.8 min
Avg. Velocity = 2.5 fps, Avg. Travel Time= 1.7 min

Peak Depth= 2.00'
Capacity at bank full= 14.31 cfs
Inlet Invert= 49.00', Outlet Invert= 48.00'
24.0" Diameter Pipe n= 0.013 Length= 250.0' Slope= 0.0040 '/'

Reach 24R: Existing BM 3-2



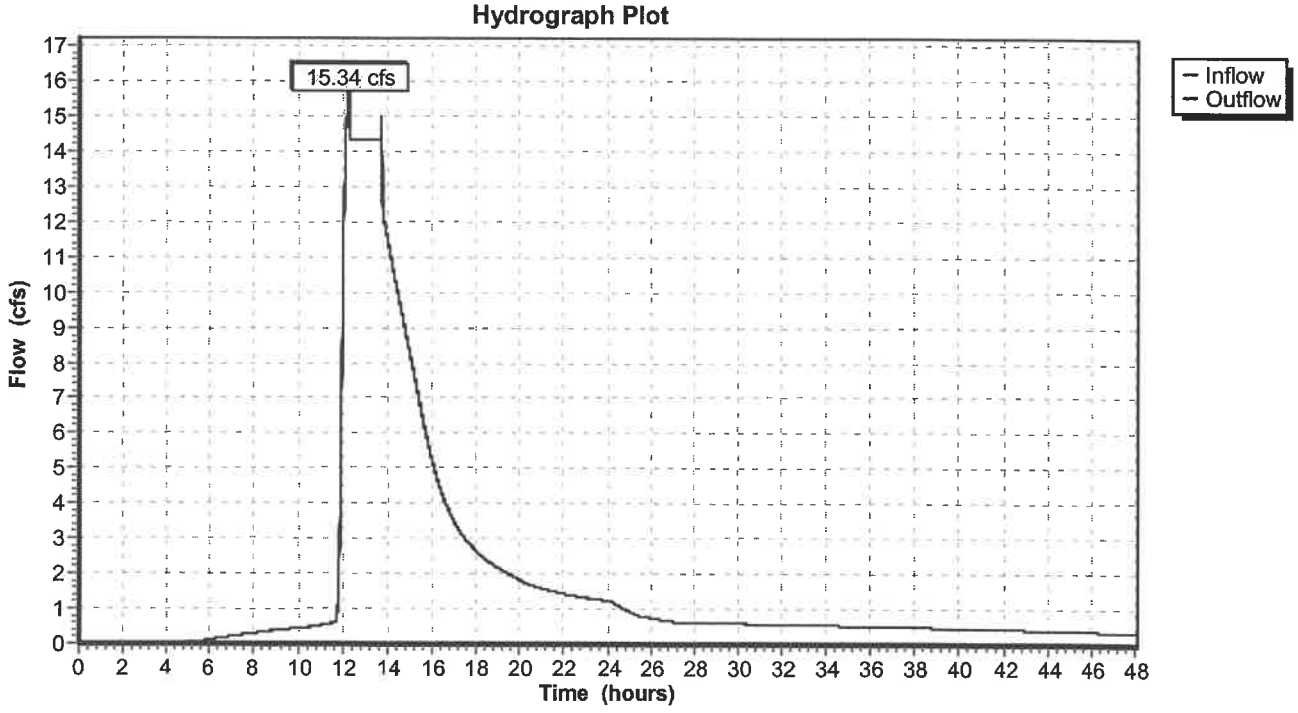
Reach 25R: Existing BM 2-1

Inflow = 15.38 cfs @ 12.25 hrs, Volume= 6.440 af
Outflow = 15.34 cfs @ 12.28 hrs, Volume= 6.439 af, Atten= 0%, Lag= 1.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 5.2 fps, Min. Travel Time= 0.8 min
Avg. Velocity = 2.5 fps, Avg. Travel Time= 1.6 min

Peak Depth= 1.83'
Capacity at bank full= 14.31 cfs
Inlet Invert= 48.00', Outlet Invert= 47.04'
24.0" Diameter Pipe n= 0.013 Length= 240.0' Slope= 0.0040 '/'

Reach 25R: Existing BM 2-1



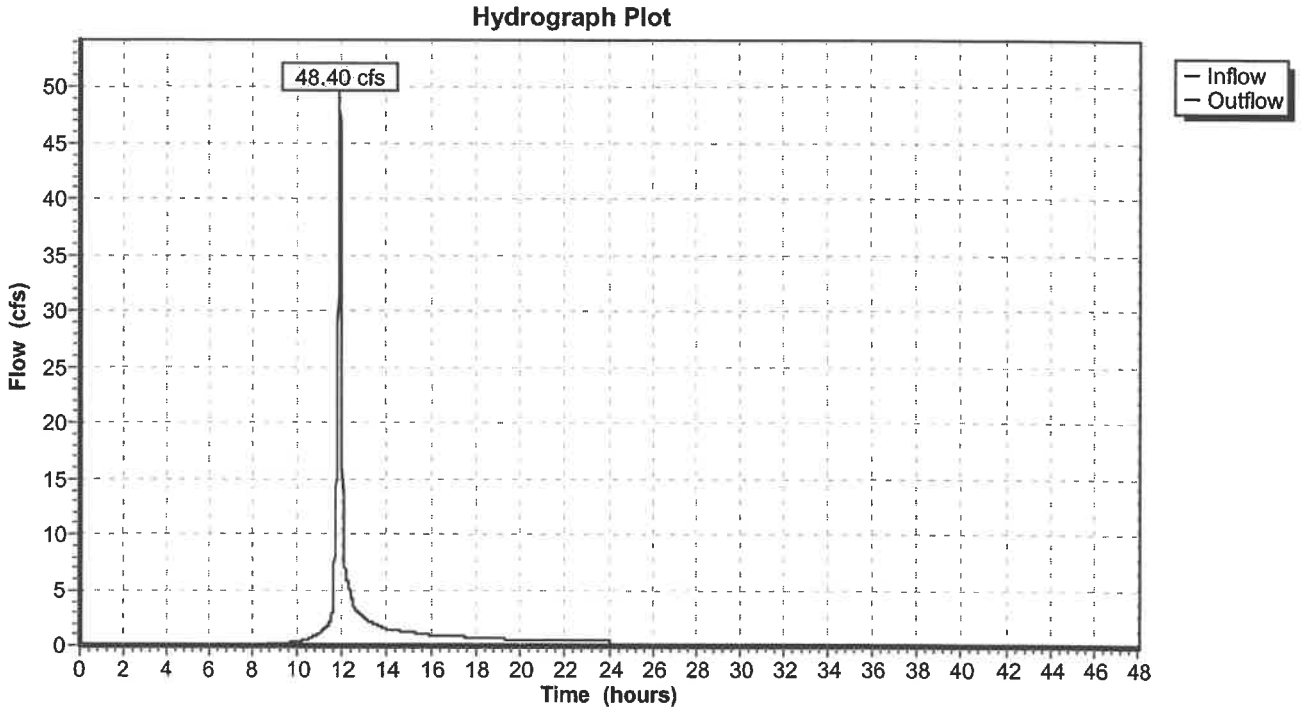
Reach 26R: Existing BM 5-1

Inflow = 48.44 cfs @ 11.96 hrs, Volume= 2.189 af
Outflow = 48.40 cfs @ 11.96 hrs, Volume= 2.189 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 20.9 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 6.3 fps, Avg. Travel Time= 0.2 min

Peak Depth= 1.02'
Capacity at bank full= 263.64 cfs
Inlet Invert= 50.00', Outlet Invert= 45.88'
42.0" Diameter Pipe n= 0.013 Length= 60.0' Slope= 0.0687 '/'

Reach 26R: Existing BM 5-1



Pond 2P: Ball Metal BMP

Inflow	=	115.21 cfs @	12.01 hrs, Volume=	6.631 af
Outflow	=	15.62 cfs @	12.35 hrs, Volume=	6.442 af, Atten= 86%, Lag= 20.7 min
Primary	=	15.62 cfs @	12.35 hrs, Volume=	6.442 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

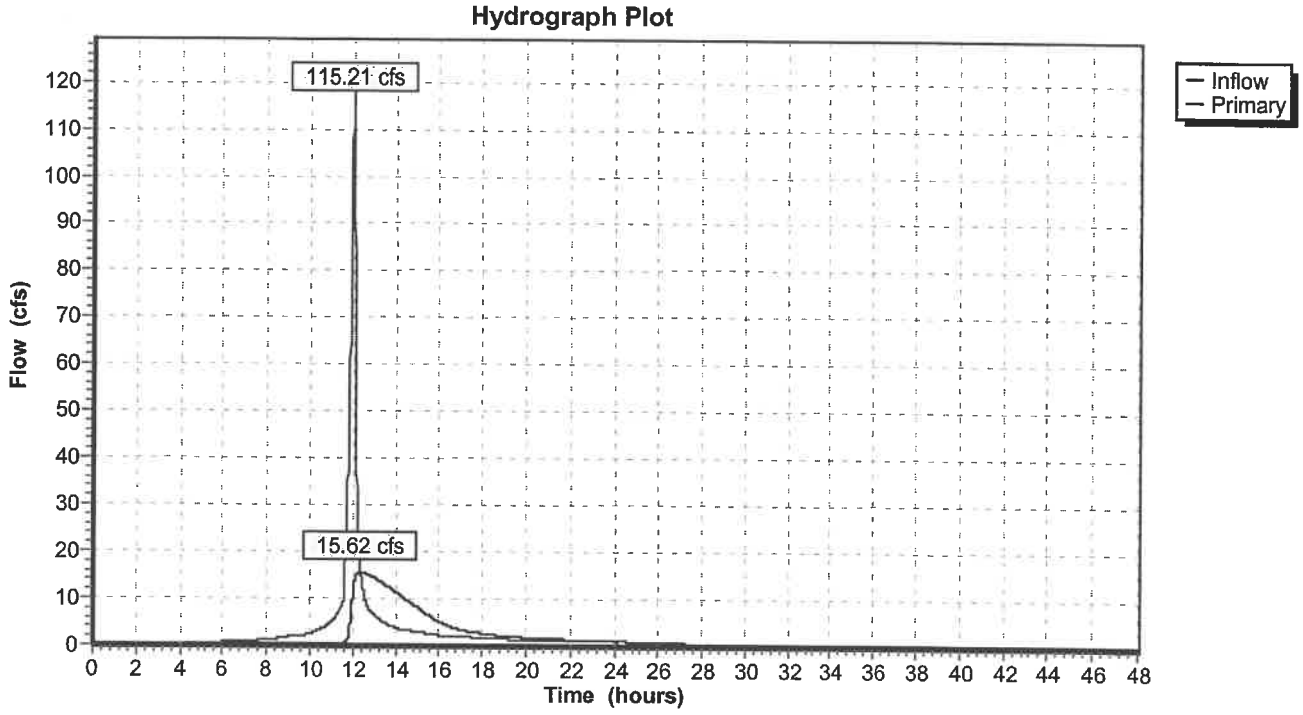
Peak Elev= 56.04' Storage= 154,645 cf
Plug-Flow detention time= 321.3 min calculated for 6.442 af (97% of inflow)
Storage and wetted areas determined by Prismatic sections

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
50.00	0	0	0
51.00	22,738	11,369	11,369
52.00	24,763	23,751	35,120
52.35	26,094	8,900	44,019
56.00	33,669	109,067	153,087
58.00	38,500	72,169	225,256
60.00	43,588	82,088	307,344
62.00	48,919	92,507	399,851
64.00	54,513	103,432	503,283

Primary OutFlow (Free Discharge)
- 1=Culvert
  - 2=Orifice/Grate
  - 3=Orifice/Grate
  - 4=Orifice/Grate

#	Routing	Invert	Outlet Devices
1	Primary	49.50'	**24.0" x 114.0' long Culvert** RCP, square edge headwall, Ke= 0.500 Outlet Invert= 49.04' S= 0.0040 '/' n= 0.013 Cc= 0.900
2	Device 1	50.00'	**4.0" Vert. Orifice/Grate** C= 0.600
3	Device 1	52.35'	**18.0" Vert. Orifice/Grate** C= 0.600
4	Device 1	57.00'	**48.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600

Pond 2P: Ball Metal BMP



7. Reports

8. Correspondence

DEVELOPMENT MANAGEMENT

101-A Mounts Bay Road, P.O. Box 8784, Williamsburg, VA 23187-8784
(757) 253-6671 Fax: (757) 253-6850 E-Mail: devman@james-city.va.us

Environmental Division	Planning	County Engineer	Integrated Pest Management
(757) 253-6670	(757) 253-6685	(757) 253-6671	(757) 259-4116
environ@james-city.va.us	planning@james-city.va.us		

March 25, 2008

Mr. Curt Nordeman
LandMark Design Group
4029 Ironbound Road, Suite 100
Williamsburg, VA 23188

RE: SP-83-07, Colonial Penniman Waterline Extension

Dear Mr. Nordeman:

I am pleased to inform you that your site plan amendment received final approval on March 25, 2008. Enclosed are two copies of the stamped final approval drawing for your files.

Final approval of the original site plan shall expire five years after the date of approval (March 26, 2008): the approval of this amendment does not change that date. During that period all permits shall be obtained or the development shall be put into use. When the permits have been issued, the site plan approval shall run concurrently with the permit's term of validity. All work shall be completed in the manner and location indicated upon the approved plan. Modifications shall be approved in advance by the Zoning Administrator.

Sincerely,

Melissa Brown
Deputy Zoning Administrator

9. Inspections

10. Permitting

11. Miscellaneous (ex. photos)

12. Project Development Documents