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February 26, 2026

Thrills Hills Wetland Design Report
Site No. CAR833409A
Carroll County, Iowa

Project Overview

This wetland improvement is planned to provide nutrient reduction benefits to a part of the watershed of an unnamed tributary of Middle Raccoon River in Carroll County, Iowa. Nitrates will be converted to nitrogen gas through natural processes as the water passes through the wetland.

The project location is on the property of Thrills Hills LLC, roughly four miles southeast of Carroll, Iowa. A wetland pool will be created by a combination of excavation and the construction of an embankment. Water from the stream will be pumped into the wetland to fill the pool. Diversion berms are proposed within the permanent pool to encourage mixing and reduce short-cutting of water out of the wetland. Water will be released from the pool through the rectangular wetland outlet structure and be carried through a 36-inch reinforced concrete pipe, to be discharged into the stream. During large storm events, the pool will rise, and water will flow over the earthen auxiliary spillway, directing the outflow to the stream. Constructing the wetland will not have adverse effects on the hydrology of the neighboring properties.

Site Selection and Analysis

This site was deemed viable because of the size of the stream watershed (2,106 acres) and its topography. Initial payment information was presented to the landowner, who wished to proceed with the project.

Bolton & Menk reviewed the soil survey data for the location and found the soils to be primarily loam. The web soil survey data was confirmed with soil samples from three locations on the site. The wetland watershed was analyzed using LiDAR data. A map of the contributing watersheds is included with this report. Curve number calculations are provided in the attached hydrology report, and runoff analysis is provided in the attached HydroCAD output.

The site was surveyed with survey-grade GPS equipment, and additional topographic information was provided from a publicly available LiDAR database. LiDAR was verified with survey data. Elevations are referenced to NAVD88, and the Iowa State Plane North (Survey Foot) coordinate system was used for horizontal coordinates. Survey data was collected electronically and is available in .csv files.

Design Standards

Iowa NRCS Conservation Practice Standard (CPS) 656, dated December 2023, was used to develop this project. CPS 378 (Pond) was used to design the primary outlet, auxiliary spillway, and the embankment. The project is NRCS Job Class III under CPS 656 because the direct watershed is less than 300 acres.

Project Layout

A permanent pool elevation and embankment location were selected based on the existing topography and the ability to maximize pool area while minimizing excavation and the height of the embankment. The pool was also sited to minimize impacts to the stream it is adjacent to. There is not an established regulatory floodway for the stream, but the embankment is out of the channelized area and its only encroachment into the regulatory floodplain is in a backwater area.

Watersheds were developed using contour and DEM data from a publicly available database. The wetland watershed is that from which surface water directly enters the wetland pool. The gravel pit watershed is that from which surface water enters the adjacent existing gravel pit. The gravel pit was included in the hydraulic analysis but it was shown that it will not overflow into the wetland pool. The stream watershed, which is used for the wetland treated area analysis, was determined from StreamStats. The watershed information and rainfall data were used to develop hydrographs in HydroCAD. The storm distribution used was MSE 3, with rainfall depths from the National Engineering Handbook. These hydrographs and the proposed stage-storage information were used to size the primary outlet and auxiliary spillway for the wetland. Exceeding the minimum design standards of NRCS CPS 378, the auxiliary spillway is placed above the 25-year storm, and the embankment is designed to provide at least one foot of freeboard during the 100-year storm. HydroCAD outputs are provided in the appendix.

Dam Regulation

A dam construction permit is required by the Iowa DNR if it (1) has a height of at least 25 feet and a storage of 15-acre feet at the top of the dam elevation; or (2) has a storage of at least 50 acre-feet at the top of dam and a height of at least 6 feet; or (3) is assigned a hazard potential of high hazard. This dam does not require a dam construction permit because the height is 6.5 feet, the storage at the top of the dam is 15.4 acre-feet, and the hazard potential is low hazard.

The dam is classified as “low hazard” if failure of the dam would result in no probable loss of human life, low economic losses, and low public damages. This dam meets the requirements of a low hazard dam.

Land Rights and Permits

The permanent easement for this project will be on the property of Thrills Hills LLC. IDALS-DSWQ is currently in the process of updating the abstracts and will have a signed easement recorded for the area as shown in the plans. No additional land rights are needed.

The project will be permitted under Army Regional Permit 39. The permit will be obtained by the Iowa Department of Agriculture and Land Stewardship (IDALS). A floodplain permit application will also be obtained by IDALS if necessary. Portions of the project are within the regulatory floodplain; there is no established floodway at this location.

Sincerely,

Bolton & Menk, Inc.

Brandon C. Short, PE

Water Resources Project Engineer

Name: Thrills Hills Wetland Design Report

Date: January 8, 2026

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Appendices:

A: Soil Survey Map

B: Watershed Map

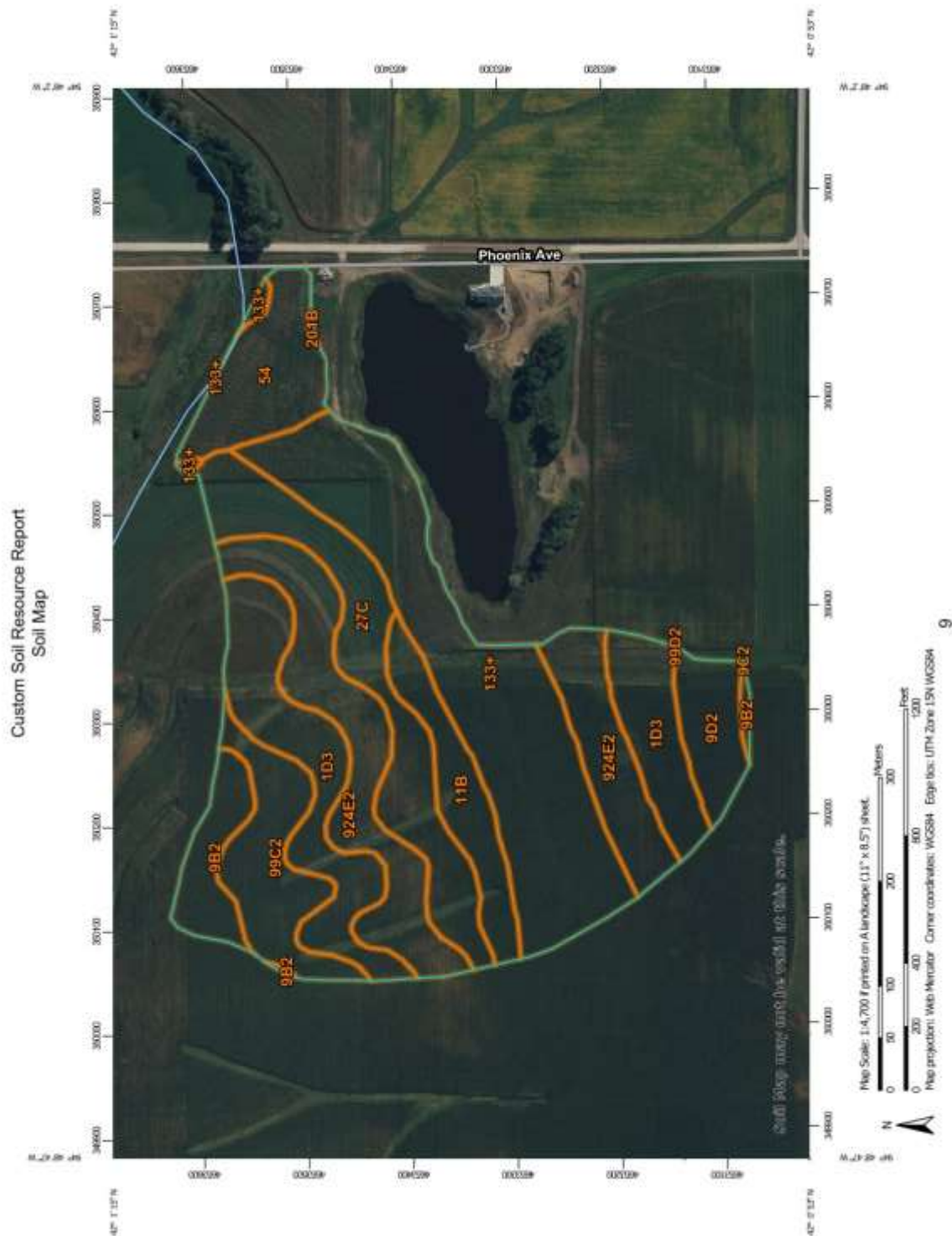
C: Hydrology Report

D: HydroCAD Output

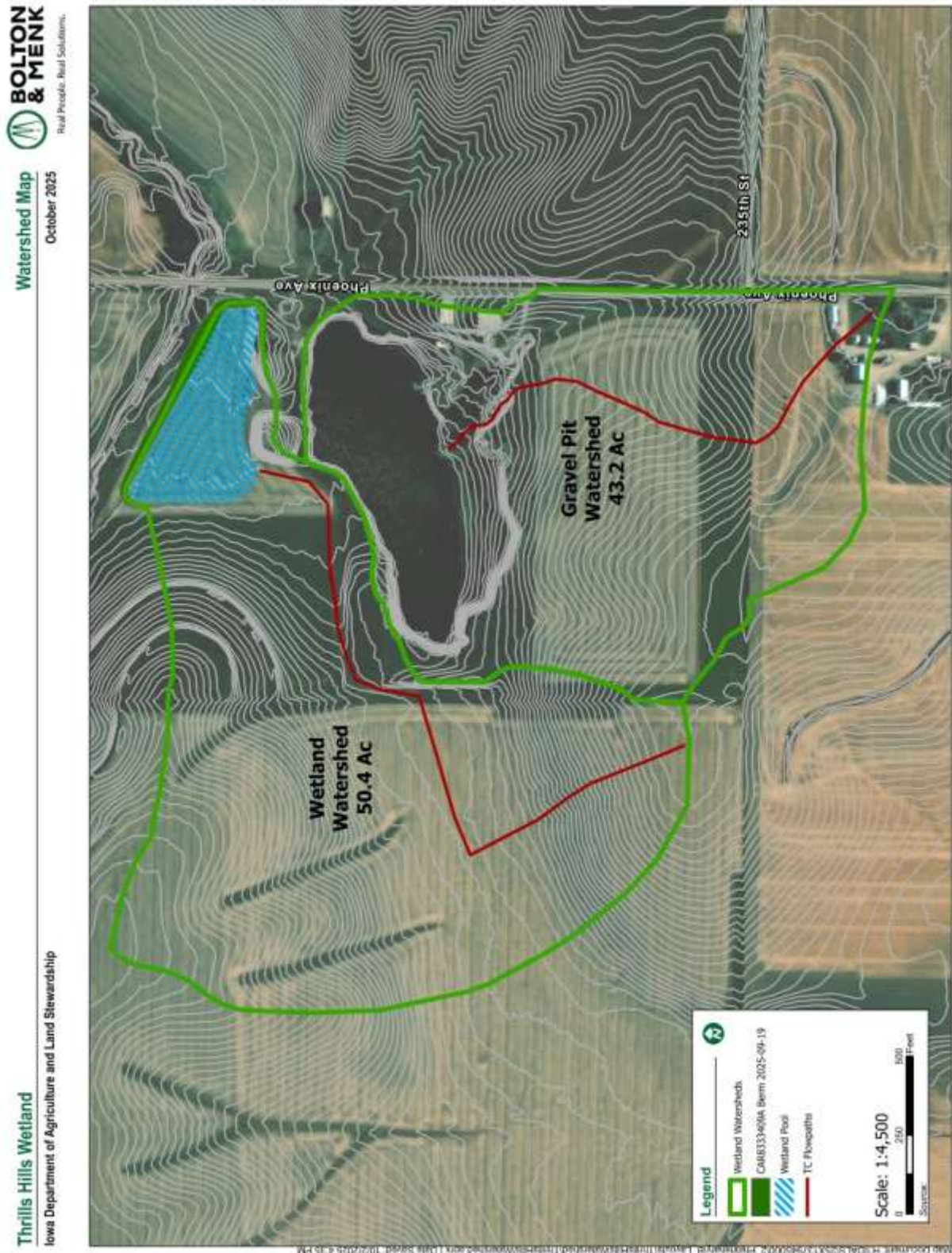
E: Pump Curve

F: Pipe Capacity Calculations

Appendix A: Soil Survey Map



Appendix B: Watershed Map



Name: Thrills Hills Wetland Design Report

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Appendix C: Hydrology Report



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Report Summary

Design Parameters and Procedures:

Design hydrology and hydraulic study of this site was completed. The drainage area was determined and a stage-area-storage curve was developed based on the topographic survey, Lidar data available from the Iowa Department of Natural Resources, and grading design for the wetland. Land use and treatment were determined through a site visit and aerial photo review. Hydrologic data was compiled, the structure was flood routed using the SCS TR-55 method in HydroCAD, and all the output was reviewed.

Rainfall events used for this site were MSE 3 distribution, 24-hour, 5-, 10-, 25-, and 100-year events. The primary spillway is a rectangular outlet structure with six-foot-wide openings on all sides that discharges to the existing stream on site. The auxiliary spillway is a 30-foot earthen spillway placed above the 10-year rainfall event high water level, that also discharges to the stream.

Hydrology Analysis Summary

25-year Event: 5.70"

100-year Event: 7.90"

- * Hydrologic Soil Groups: B, C, C/D
- * Runoff Curve Number: 83.0 (based on Land use shown in this report)
- * Primary Spillway Weir Coefficient ≈ 3.0
- * $T_c = 1.0$ hours determined by the sum of sheet, shallow concentrated and channel flow times.
- * Normal pool area is 3.49 acres.
- * Surface watershed area is approx. 50.4 acres or 0.08 square miles.

Summary Table:

Overflow Elevation: 1235.75 (Data for Surface Flow)

	Q _{max} In (cfs)	Q _{max} Out (cfs)	Max Elev (ft)	Duration - Hours at elevation		
				1217.50	1218.00	1218.25
5-year	61.99	43.80	1217.69	1.3	0.0	0.0
10-year	80.07	59.84	1217.83	1.7	0.0	0.0
25-year	111.78	87.06	1218.06	2.2	0.5	0.0
100-year	170.73	108.89	1218.72	2.7	1.3	0.8

Rainfall Data

Surface-Drained DA = 50 ac
 = .08 sq mi

The following rainfall data was used for the hydrology analysis of the site. Rainfall depths from the NEH Title 210 Figure IA2-25 were used, and two additional sources are shown for reference only.

County: Carroll
 Storm Distribution: MSE 3
 Iowa Climactic Section (SUDAS): West Central

24-hr Rainfall Depths (in)			
Return Period (Years)	Data Source		
	NEH Title 210 (Figure IA2-25)	SUDAS Design Manual 2025 Edition	NOAA Atlas 14
2	3.00	3.01	3.06
5	3.80	3.74	3.79
10	4.50	4.45	4.52
25	5.70	5.59	5.69
50	6.70	6.58	6.73
100	7.90	7.67	7.88



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IDALS ID Number: CAR833409A

Job: Thrills Hills

BMI Project Number: 25X.137945

Designed By: BCS Date: 1/16/2026

Tributary Watershed Data

Watershed	Area (ac)	Area (sq. mi.)	Tile/Surface Drained	Time of Concentration (min)
Direct	50	0.08	Surface	59.6
Stream (Pumped)	2106	3.29	Tile & Surface	



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Runoff Curve Number

Surface-Drained DA = 50 ac
= .08 sq mi

Soil Name ¹	HSG ¹	Cover Type and Hyd. Condition	Portion of W/S percent	CN ²	Product
Ida silt loam; Terril loam	B	Straight Row Crops, Good	28.7%	78	22.386
Colo silt loam; et al.	C	Stright Row Crops, Good	37.7%	85	32.045
Burchard-Adair clay loams; et al.	C/D	Straight Row Crops, Good	33.6%	85	28.560
			Totals:	100.0%	83.0

References

¹ USDA - NRCS Soil Survey of Carroll Co., Iowa.

² USDA - NRCS Technical Release 55, Chapter 2, June 1986.



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IDALS ID Number: CAR833409A

Job: Thrills Hills

BMI Project Number: 25X.137945

Designed By: BCS Date: 1/16/2026

Stage-Storage

Surface-Drained DA = 50 ac

= .08 sq mi

Contour Elev.	Area (sq ft)	Area (Acres)	Average Area (Arces)	Incremental Volume (Ac-ft)	Cumulative Volume (Ac-ft)	Volume Above Weir (Ac-ft)
1215.00	356	0.01	0.01	0.00	0.00	
1215.50	5920	0.14	0.07	0.04	0.04	
1216.00	136041	3.12	1.63	0.81	0.85	
1216.50	139466	3.20	3.16	1.58	2.43	
1217.00	152192	3.49	3.35	1.67	4.11	0.00
1217.50	155747	3.58	3.53	1.77	5.87	1.77
1218.00	159336	3.66	3.62	1.81	7.68	3.58
1218.50	162957	3.74	3.70	1.85	9.53	5.43
1219.00	167469	3.84	3.79	1.90	11.43	7.32
1219.50	171353	3.93	3.89	1.94	13.37	9.27
1220.00	176943	4.06	4.00	2.00	15.37	11.27

Storage at Normal Pool	4.11	Acre-feet
Elevation of weir =	1217.00	
Storage at Overflow	9.53	Acre-feet
Elevation =	1218.50	

Average Depth =	Storage at Normal Pool
	Area at Normal Pool
Average Depth =	1.18 feet

Notes:

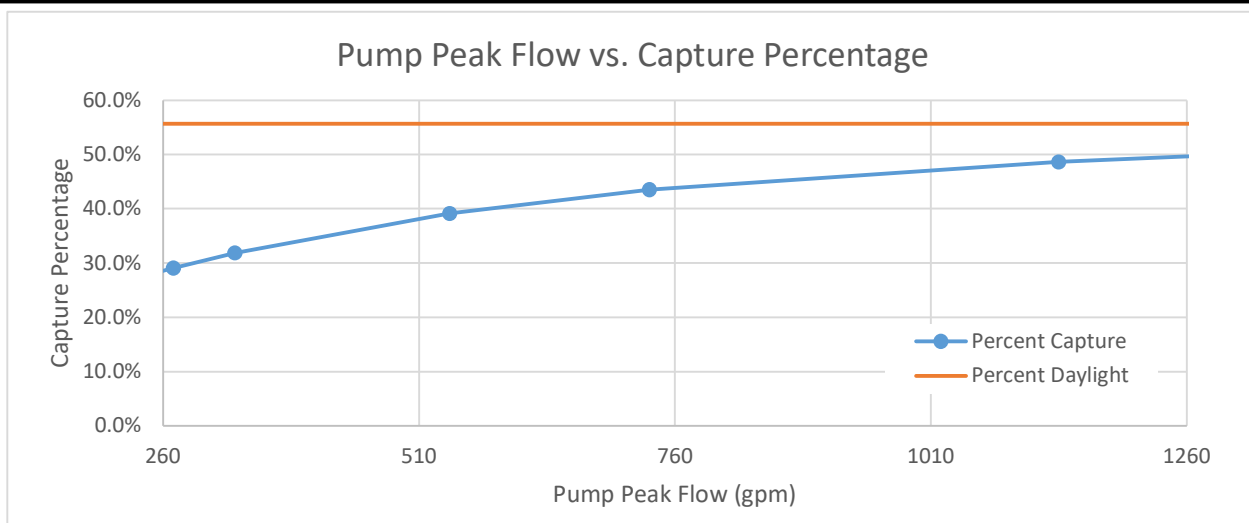
Storage areas include final earthwork borrow in pool area. Contour data is compiled from LiDAR, topographic survey, and proposed grading.



Solar Pump Capture Calculations

Average Daylight Hours: 55.7%

Pump Comparison								
	Pump	Outlet Dia. (in)	TDH (ft)	Peak Pumping Rate (gpm)	Peak Pumping Rate (cfs)	9-Month Percent Capture	Capture Without Storage	Effective Pumped Watershed (ac)
	1.5 HP	6	11.00	225	0.50	26.9%	26.9%	566
	2 HP	6	11.00	270	0.60	29.1%	29.1%	613
Selected:	3 HP	6	11.00	330	0.74	31.9%	31.9%	672
Not Practicable with Solar	2 HP Duplex	6	11.00	540	1.20	39.2%	39.2%	825
	5 HP	6	13.00	735	1.64	43.6%	43.6%	917
	10 HP	8	12.00	1135	2.53	48.6%	48.6%	1024
	15 HP	8	12.25	1275	2.84	49.8%	49.8%	1048



Pump Analysis (Selected Pump)							
Watershed	Drainage Area (ac)	9-Month Mean Tile Flow (cfs) ¹	Peak Pumping Rate (cfs) ²	Adjusted Pumping Capacity (cfs) ³	% of 1/2" Dc	% of 9-Month Mean Tile Flow	Total 9-Month Percent Capture ⁴
Stream	2105.6	2.64	0.73	0.23	0.5%	8.8%	31.9%

Notes:

¹ Calculated from USGS StreamStats flow-duration data. Estimates flows from March through November.

² Maximum capacity of 3 HP pump assuming 11 ft total dynamic head.

³ Adjusts for average daylight hours and cloud cover for March through November.

⁴ Average capture was calculated for each month based on expected tile flow, daylight hours, and cloud cover. This percentage is the average of months March through November.



Total Capture Calculations

Wetland Normal Pool Volume = 178851 cf

Watershed	Area (ac)	Percent Capture	Effective Capture Area (ac)	Average Flow Captured (cf/d) ¹	Full Flow Captured (cf/d) ²	Average Residence Time (d) ³	Full Flow Residence Time (d) ⁴
Stream	2105.6	31.9%	672	16248	35362	11.0	5.1

Notes:

¹ 9-month average capture for pumped inlets.

² Average full-sun day for pumped inlets.

³ Based on normal pool volume and average flow capture.

⁴ Based on normal pool volume and full flow capture.

Weir Flow Hydraulics

DA = 50 ac

= .08 sq mi

Input

$$Q = CLH^{1.5}$$

Use C = 3.1

Output

Normal Pool Elev. = 1217.00

Weir Length	15	20	24	30	35
W.S. Elev.	Q - cfs	Q - cfs	Q - cfs	Q - cfs	Q - cfs
1217.00	0.0	0.0	0.0	0.0	0.0
1217.19	3.8	5.0	6.0	7.6	8.8
1217.38	10.7	14.2	17.1	21.4	24.9
1217.56	19.6	26.2	31.4	39.2	45.8
1217.75	30.2	40.3	48.3	60.4	70.5
1217.94	42.2	56.3	67.5	84.4	98.5
1218.13	55.5	74.0	88.8	111.0	129.5
1218.31	69.9	93.2	111.9	139.8	163.1
1218.50	85.4	113.9	136.7	170.9	199.3
1218.69	101.9	135.9	163.1	203.9	237.8
1218.88	119.4	159.2	191.0	238.8	278.6
1219.06	137.7	183.6	220.4	275.5	321.4
1219.25	156.9	209.3	251.1	313.9	366.2
1219.44	177.0	235.9	283.1	353.9	412.9
1219.63	197.8	263.7	316.4	395.5	461.4
1219.81	219.3	292.4	350.9	438.7	511.8
MAX POOL 1220.00	241.6	322.2	386.6	483.2	563.8

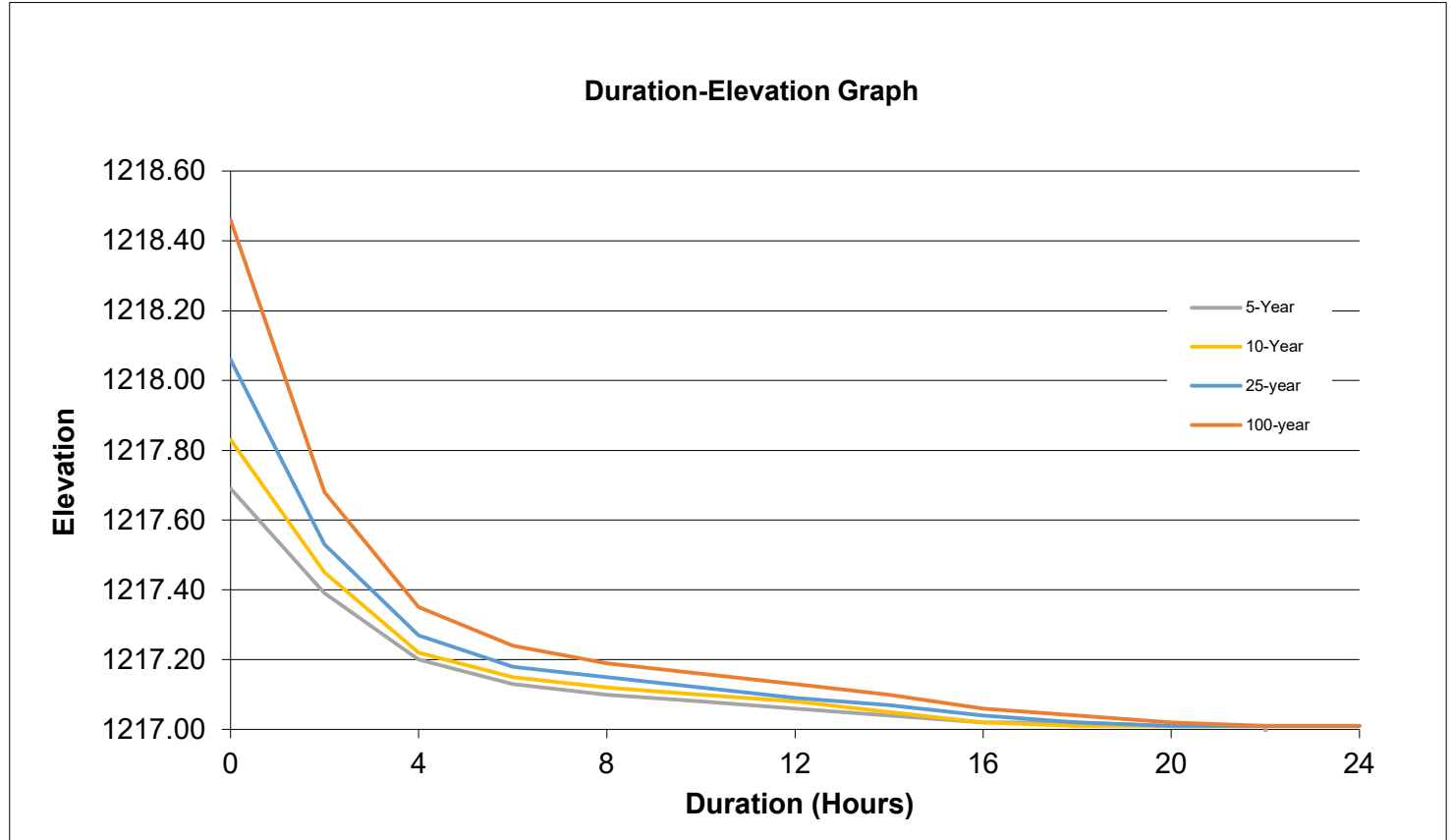
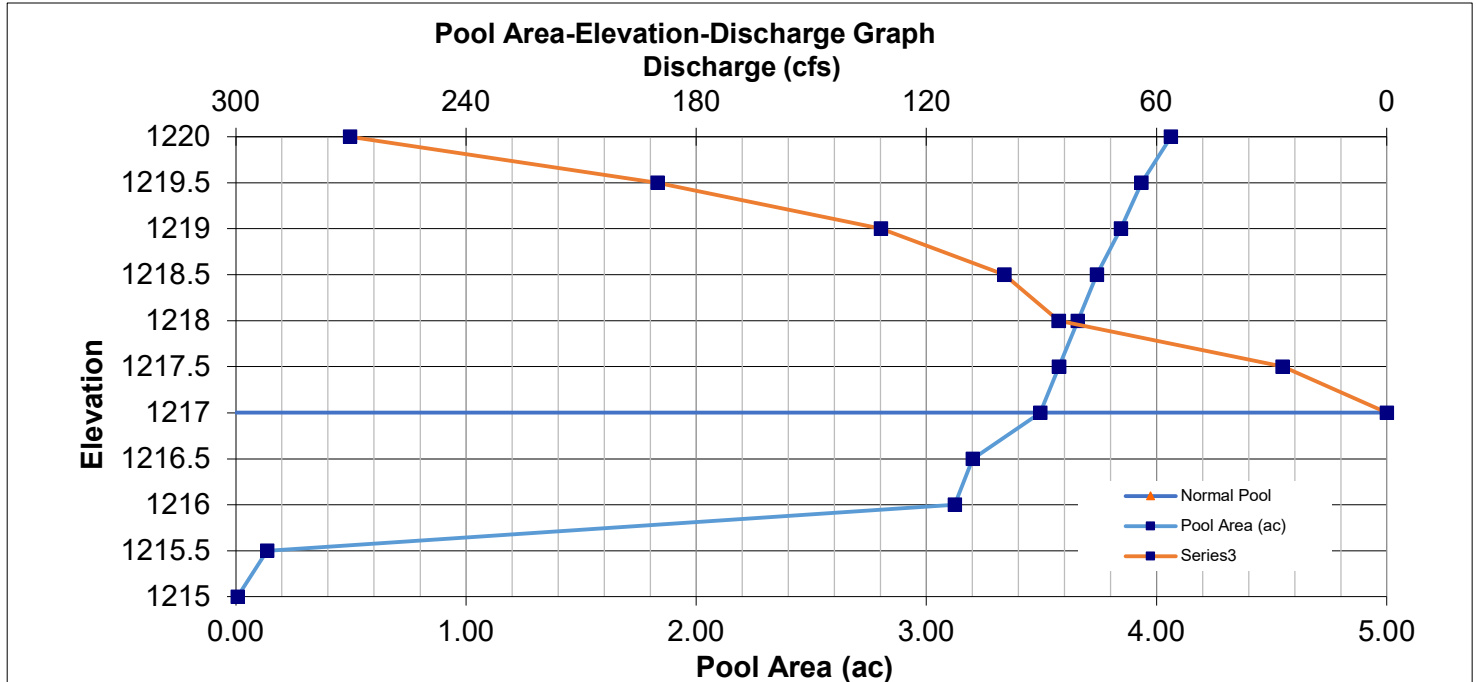
USED



Results

Surface-Drained DA = 50 ac = .08 sq mi

The following are based on surface flows and storm response. Discharge includes tile flow and overland flow.



Results

Surface-Drained DA = 50 ac

= .08 sq mi

The Elevation-Discharge table below shows tile and surface outflows from the wetland for various elevations. The tile discharge is very small compared to the surface discharge at higher elevations.

Elevation	Pool Area (ac)	Outlet Pipe Discharge (cfs)	Aux Spillway Discharge (cfs)	Total Discharge (cfs)
1215.00	0.01			
1215.50	0.14			
1216.00	3.12			
1216.50	3.20			
1217.00	3.49	0	0	0
1217.50	3.58	27.17	0	27.17
1218.00	3.66	85.56	0	85.56
1218.50	3.74	99.33	0.32	99.65
1219.00	3.84	102.11	29.78	131.89
1219.50	3.93	104.9	85.21	190.11
1220.00	4.06	107.63	162.65	270.28

The Duration-Elevation table below shows the duration that the pool is at each listed elevation during the design storms. This is based on surface inflows during the design storms listed. The design for the wetland is based on tile flows, but the entire watershed is analyzed, including surface flows, to show that the proposed wetland does not have adverse impacts on surrounding properties during rainfall events.

Duration-Elevation Table

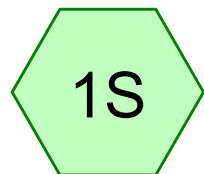
5-year		10-year		25-year		100-year	
Duration	Elevation	Duration	Elevation	Duration	Elevation	Duration	Elevation
0	1217.69	0	1217.83	0	1218.06	0	1218.46
2	1217.39	2	1217.45	2	1217.53	2	1217.68
4	1217.20	4	1217.22	4	1217.27	4	1217.35
6	1217.13	6	1217.15	6	1217.18	6	1217.24
8	1217.10	8	1217.12	8	1217.15	8	1217.19
10	1217.08	10	1217.10	10	1217.12	10	1217.16
12	1217.06	12	1217.08	12	1217.09	12	1217.13
14	1217.04	14	1217.05	14	1217.07	14	1217.10
16	1217.02	16	1217.02	16	1217.04	16	1217.06
18	1217.02	18	1217.01	18	1217.02	18	1217.04
20	1217.01	20	1217.01	20	1217.01	20	1217.02
22	1217.01	22	1217.01	22	1217.01	22	1217.01
24	1207.01	24	1217.01	24	1217.01	24	1217.01

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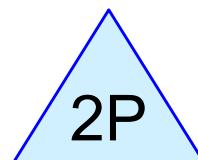
Date: January 8, 2026

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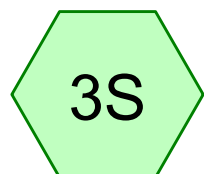
Appendix D: HydroCAD Output



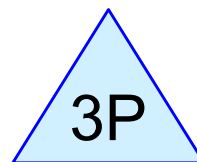
Direct Watershed



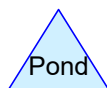
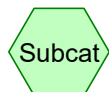
Wetland Pool



Gravel Pit Watershed



Gravel Pit



Thrills Hills HydroCad

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Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	5-Year	MSE 24-hr	3	Default	24.00	1	3.80	2
2	10-Year	MSE 24-hr	3	Default	24.00	1	4.50	2
3	25-Year	MSE 24-hr	3	Default	24.00	1	5.70	2
4	100-Year	MSE 24-hr	3	Default	24.00	1	7.90	2

Thrills Hills HydroCad

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Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
93.600	83	(1S, 3S)
93.600	83	TOTAL AREA

Thrills Hills HydroCad

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MSE 24-hr 3 5-Year Rainfall=3.80"

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Time span=5.00-96.00 hrs, dt=0.05 hrs, 1821 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1S: Direct Watershed Runoff Area=50.400 ac 0.00% Impervious Runoff Depth=2.11"
Flow Length=2,323' Tc=59.6 min CN=83 Runoff=61.99 cfs 8.877 af

Subcatchment 3S: Gravel Pit Watershed Runoff Area=43.200 ac 0.00% Impervious Runoff Depth=2.11"
Flow Length=1,659' Tc=27.6 min CN=83 Runoff=85.61 cfs 7.609 af

Pond 2P: Wetland Pool Peak Elev=1,217.69' Storage=6.641 af Inflow=61.99 cfs 8.877 af
Outflow=43.80 cfs 8.877 af

Pond 3P: Gravel Pit Peak Elev=1,215.09' Storage=7.609 af Inflow=85.61 cfs 7.609 af
Outflow=0.00 cfs 0.000 af

Total Runoff Area = 93.600 ac Runoff Volume = 16.486 af Average Runoff Depth = 2.11"
100.00% Pervious = 93.600 ac 0.00% Impervious = 0.000 ac

Thrills Hills HydroCad

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MSE 24-hr 3 5-Year Rainfall=3.80"

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Summary for Subcatchment 1S: Direct Watershed

Runoff = 61.99 cfs @ 12.81 hrs, Volume= 8.877 af, Depth= 2.11"
Routed to Pond 2P : Wetland Pool

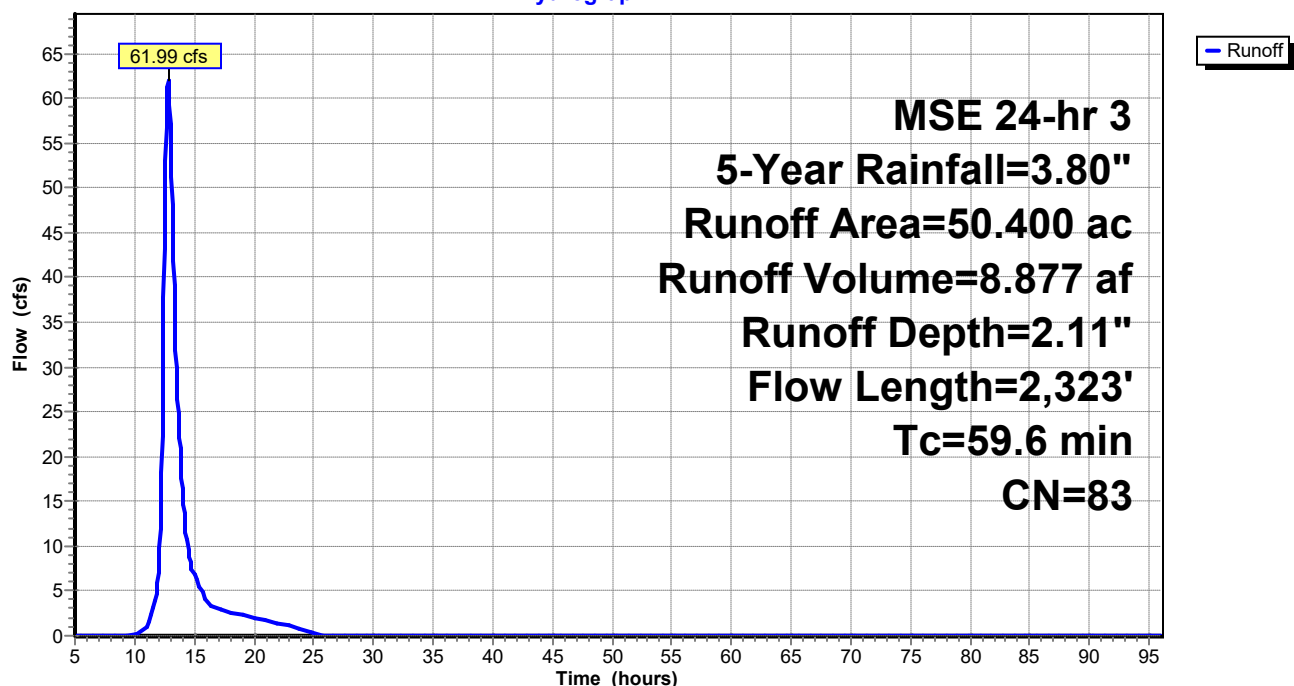
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-96.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 5-Year Rainfall=3.80"

Area (ac)	CN	Description
* 50.400	83	
50.400		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.2	100	0.0200	0.15		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 3.00"
4.3	664	0.0828	2.59		Shallow Concentrated Flow, SR Steep Cultivated Straight Rows Kv= 9.0 fps
21.0	507	0.0020	0.40		Shallow Concentrated Flow, SR Flat Cultivated Straight Rows Kv= 9.0 fps
18.0	770	0.0104	0.71		Shallow Concentrated Flow, Pasture Short Grass Pasture Kv= 7.0 fps
5.1	282	0.0106	0.93		Shallow Concentrated Flow, SR Cultivated Straight Rows Kv= 9.0 fps
59.6	2,323	Total			

Subcatchment 1S: Direct Watershed

Hydrograph



Summary for Subcatchment 3S: Gravel Pit Watershed

Runoff = 85.61 cfs @ 12.40 hrs, Volume= 7.609 af, Depth= 2.11"
 Routed to Pond 3P : Gravel Pit

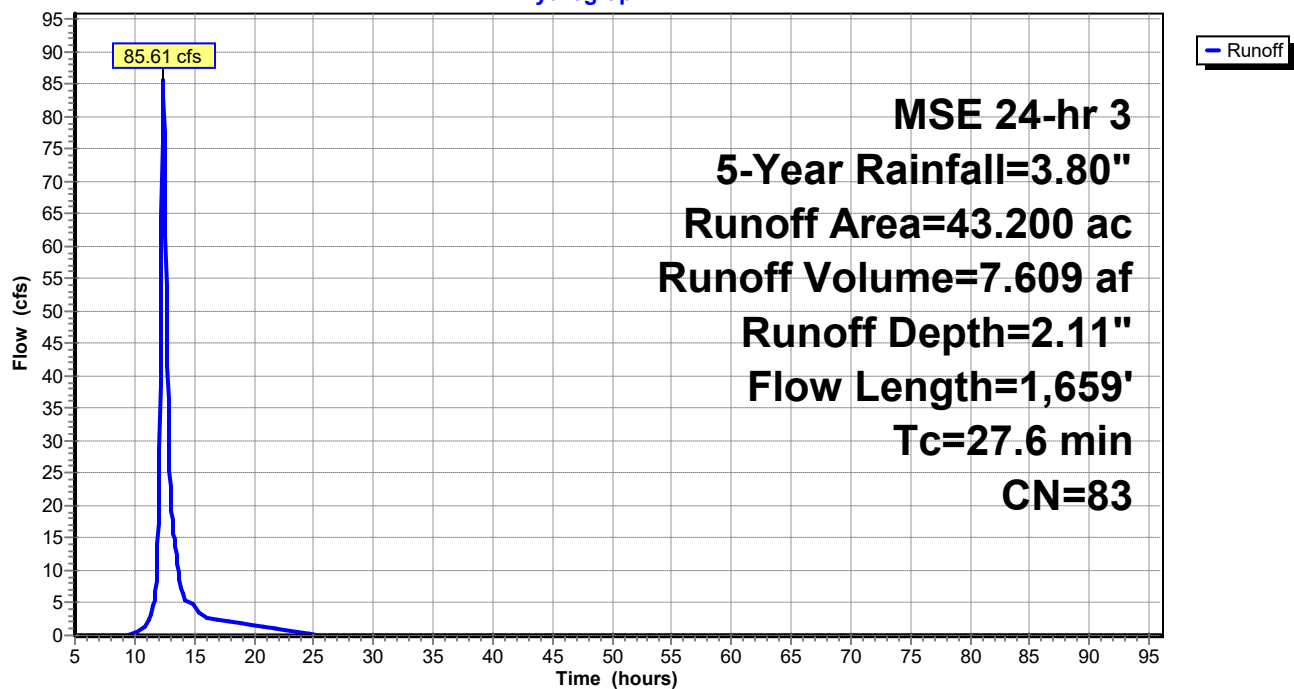
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-96.00 hrs, dt= 0.05 hrs
 MSE 24-hr 3 5-Year Rainfall=3.80"

Area (ac)	CN	Description
* 43.200	83	
43.200		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.4	100	0.0100	0.12		Sheet Flow, Grass: Short n= 0.150 P2= 3.00"
0.8	108	0.0185	2.19		Shallow Concentrated Flow, Unpaved Unpaved Kv= 16.1 fps
3.2	365	0.0438	1.88		Shallow Concentrated Flow, SR Cultivated Straight Rows Kv= 9.0 fps
1.7	173	0.0578	1.68		Shallow Concentrated Flow, Pasture Short Grass Pasture Kv= 7.0 fps
5.2	543	0.0368	1.73		Shallow Concentrated Flow, SR Cultivated Straight Rows Kv= 9.0 fps
3.3	370	0.0730	1.89		Shallow Concentrated Flow, Pasture Short Grass Pasture Kv= 7.0 fps
27.6	1,659	Total			

Subcatchment 3S: Gravel Pit Watershed

Hydrograph



Summary for Pond 2P: Wetland Pool

Inflow Area = 50.400 ac, 0.00% Impervious, Inflow Depth = 2.11" for 5-Year event
 Inflow = 61.99 cfs @ 12.81 hrs, Volume= 8.877 af
 Outflow = 43.80 cfs @ 13.22 hrs, Volume= 8.877 af, Atten= 29%, Lag= 24.5 min
 Primary = 43.80 cfs @ 13.22 hrs, Volume= 8.877 af

Routing by Stor-Ind method, Time Span= 5.00-96.00 hrs, dt= 0.05 hrs
 Starting Elev= 1,217.00' Surf.Area= 3.493 ac Storage= 4.190 af
 Peak Elev= 1,217.69' @ 13.22 hrs Surf.Area= 3.606 ac Storage= 6.641 af (2.451 af above start)

Plug-Flow detention time= 267.8 min calculated for 4.684 af (53% of inflow)
 Center-of-Mass det. time= 67.1 min (918.7 - 851.5)

Volume	Invert	Avail.Storage	Storage Description
#1	1,215.00'	15.437 af	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,215.00	0.238	0.000	0.000
1,215.50	0.380	0.155	0.155
1,216.00	3.013	0.848	1.003
1,216.50	3.122	1.534	2.536
1,217.00	3.493	1.654	4.190
1,217.50	3.575	1.767	5.957
1,218.00	3.657	1.808	7.765
1,218.50	3.740	1.849	9.614
1,219.00	3.845	1.896	11.511
1,219.50	3.914	1.940	13.451
1,220.00	4.030	1.986	15.437

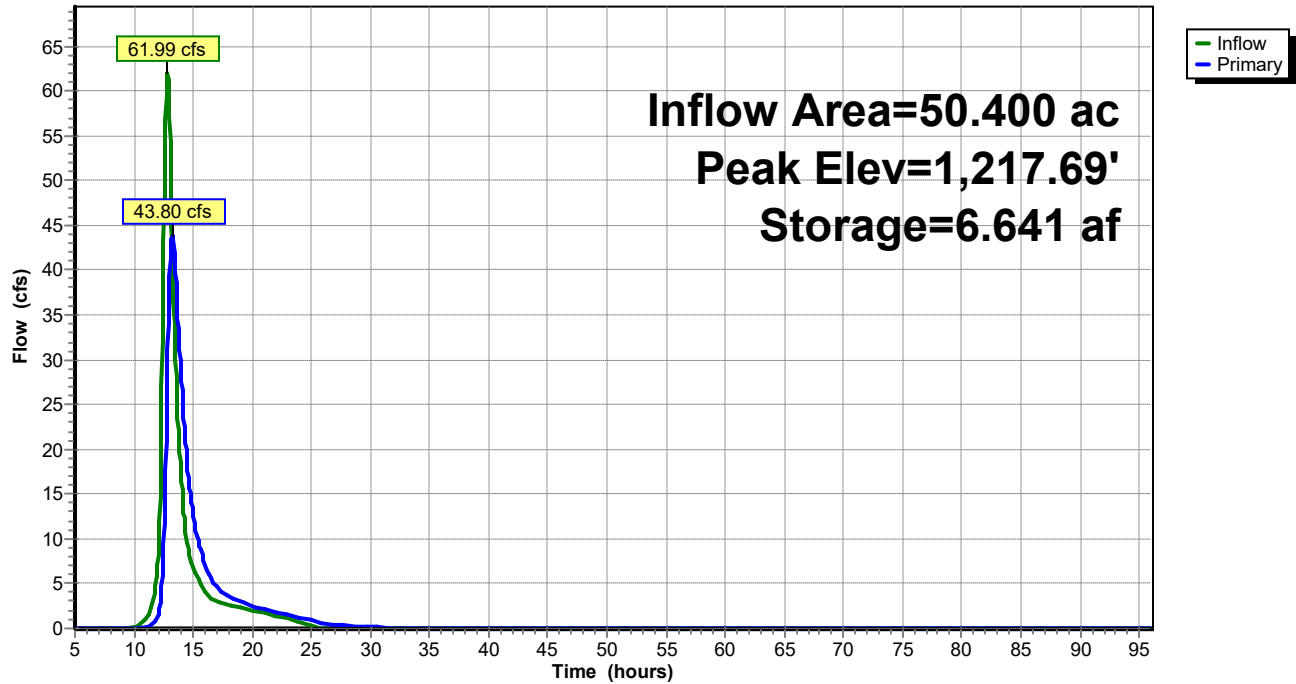
Device	Routing	Invert	Outlet Devices
#1	Primary	1,208.00'	36.0" Round Culvert L= 128.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 1,208.00' / 1,207.50' S= 0.0039 ' / Cc= 0.900 n= 0.013, Flow Area= 7.07 sf
#2	Device 1	1,217.00'	6.0' long x 0.5' breadth Broad-Crested Rectangular Weir X 4.00 Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#3	Primary	1,218.50'	30.0' long + 3.0 ' SideZ x 30.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=43.72 cfs @ 13.22 hrs HW=1,217.69' TW=1,210.00' (Fixed TW Elev= 1,210.00')

1=Culvert (Passes 43.72 cfs of 94.38 cfs potential flow)
 2=Broad-Crested Rectangular Weir (Weir Controls 43.72 cfs @ 2.64 fps)
 3=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

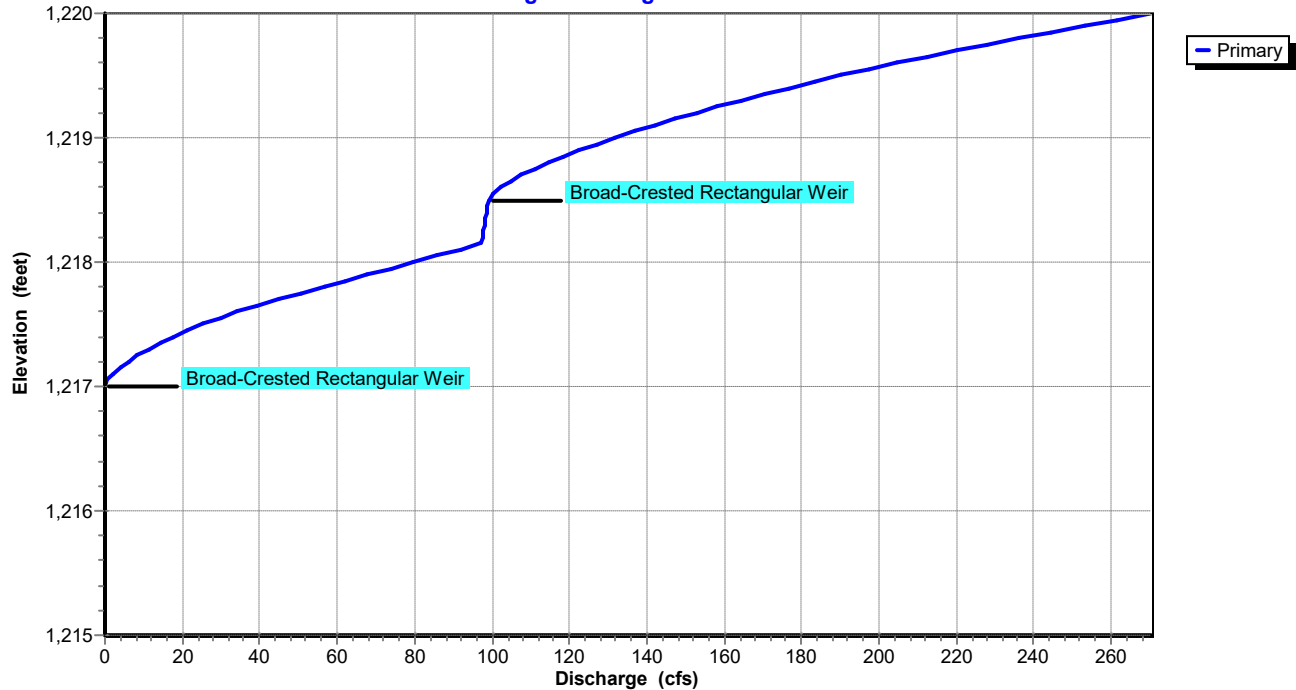
Pond 2P: Wetland Pool

Hydrograph



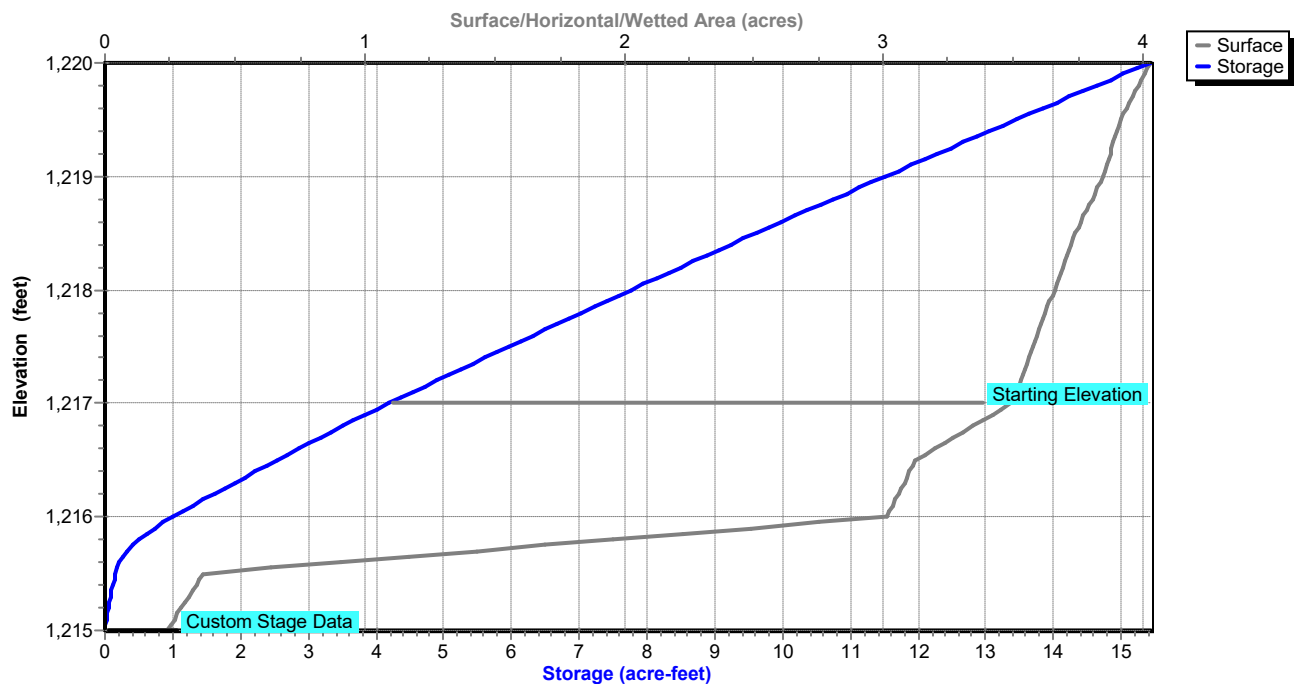
Pond 2P: Wetland Pool

Stage-Discharge



Pond 2P: Wetland Pool

Stage-Area-Storage



Summary for Pond 3P: Gravel Pit

Inflow Area = 43.200 ac, 0.00% Impervious, Inflow Depth = 2.11" for 5-Year event
 Inflow = 85.61 cfs @ 12.40 hrs, Volume= 7.609 af
 Outflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 5.00-96.00 hrs, dt= 0.05 hrs
 Peak Elev= 1,215.09' @ 25.65 hrs Surf.Area= 7.010 ac Storage= 7.609 af

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)

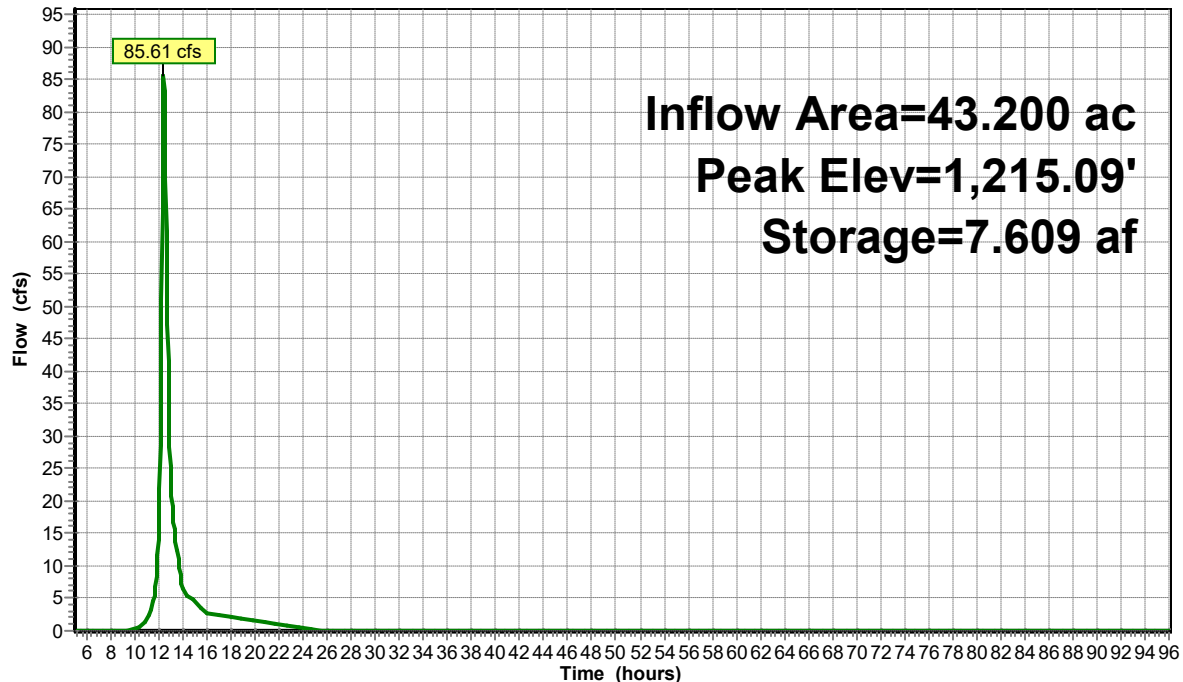
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	1,214.00'	28.755 af	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,214.00	6.900	0.000	0.000
1,216.00	7.102	14.002	14.002
1,218.00	7.651	14.753	28.755

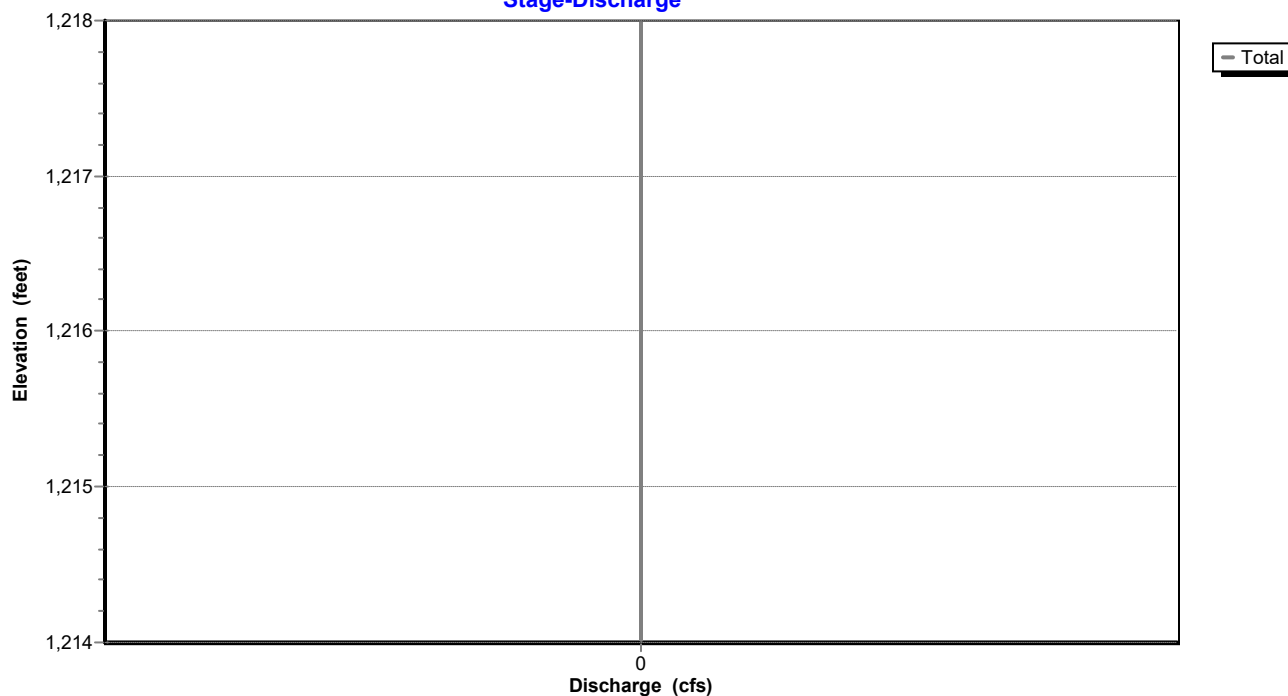
Pond 3P: Gravel Pit

Hydrograph



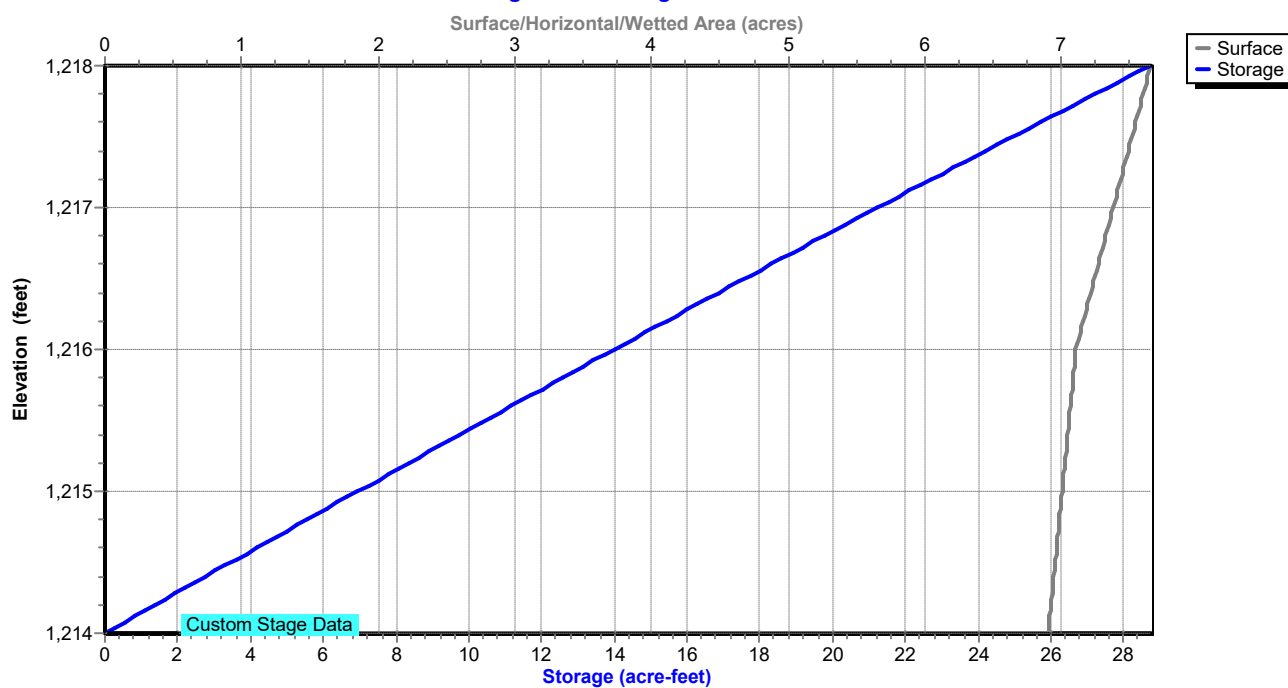
Pond 3P: Gravel Pit

Stage-Discharge



Pond 3P: Gravel Pit

Stage-Area-Storage



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MSE 24-hr 3 10-Year Rainfall=4.50"

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Time span=5.00-96.00 hrs, dt=0.05 hrs, 1821 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1S: Direct Watershed Runoff Area=50.400 ac 0.00% Impervious Runoff Depth=2.73"
Flow Length=2,323' Tc=59.6 min CN=83 Runoff=80.07 cfs 11.447 af

Subcatchment 3S: Gravel Pit Watershed Runoff Area=43.200 ac 0.00% Impervious Runoff Depth=2.73"
Flow Length=1,659' Tc=27.6 min CN=83 Runoff=110.28 cfs 9.812 af

Pond 2P: Wetland Pool Peak Elev=1,217.83' Storage=7.142 af Inflow=80.07 cfs 11.447 af
Outflow=59.84 cfs 11.447 af

Pond 3P: Gravel Pit Peak Elev=1,215.41' Storage=9.812 af Inflow=110.28 cfs 9.812 af
Outflow=0.00 cfs 0.000 af

Total Runoff Area = 93.600 ac Runoff Volume = 21.259 af Average Runoff Depth = 2.73"
100.00% Pervious = 93.600 ac 0.00% Impervious = 0.000 ac

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MSE 24-hr 3 10-Year Rainfall=4.50"

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Summary for Subcatchment 1S: Direct Watershed

Runoff = 80.07 cfs @ 12.81 hrs, Volume= 11.447 af, Depth= 2.73"
Routed to Pond 2P : Wetland Pool

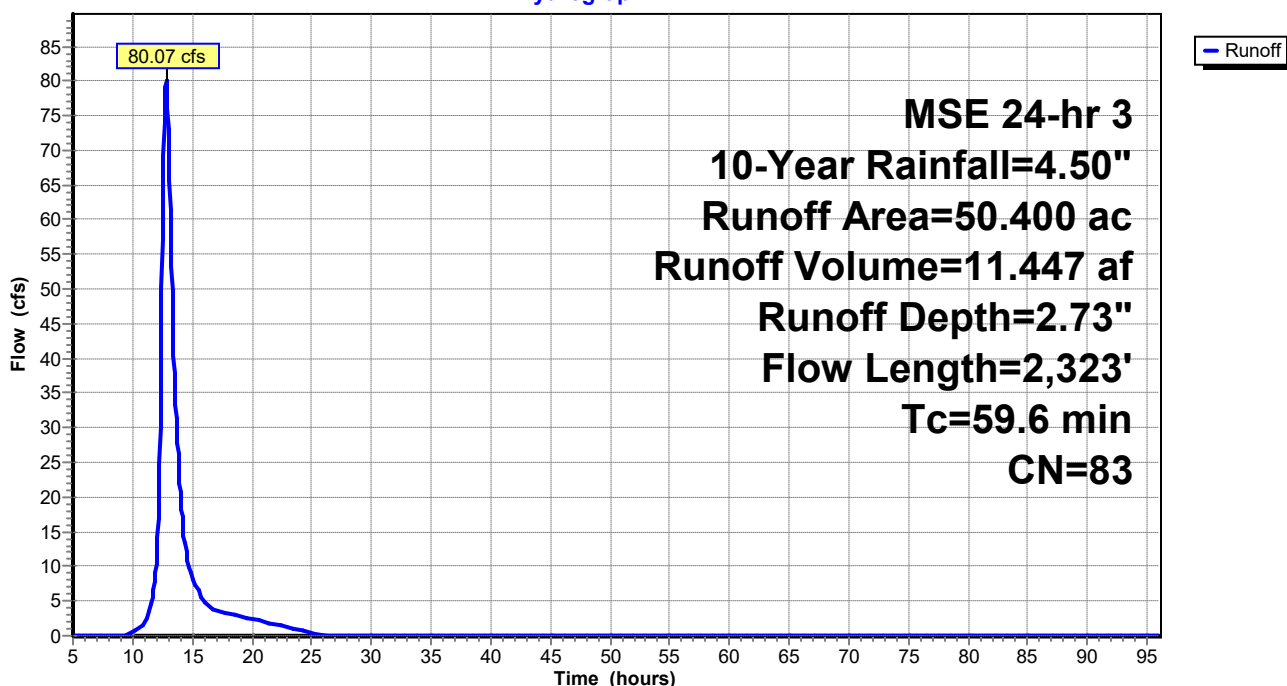
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-96.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 10-Year Rainfall=4.50"

Area (ac)	CN	Description
* 50.400	83	
50.400		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.2	100	0.0200	0.15		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 3.00"
4.3	664	0.0828	2.59		Shallow Concentrated Flow, SR Steep Cultivated Straight Rows Kv= 9.0 fps
21.0	507	0.0020	0.40		Shallow Concentrated Flow, SR Flat Cultivated Straight Rows Kv= 9.0 fps
18.0	770	0.0104	0.71		Shallow Concentrated Flow, Pasture Short Grass Pasture Kv= 7.0 fps
5.1	282	0.0106	0.93		Shallow Concentrated Flow, SR Cultivated Straight Rows Kv= 9.0 fps
59.6	2,323	Total			

Subcatchment 1S: Direct Watershed

Hydrograph



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MSE 24-hr 3 10-Year Rainfall=4.50"

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Summary for Subcatchment 3S: Gravel Pit Watershed

Runoff = 110.28 cfs @ 12.39 hrs, Volume= 9.812 af, Depth= 2.73"
 Routed to Pond 3P : Gravel Pit

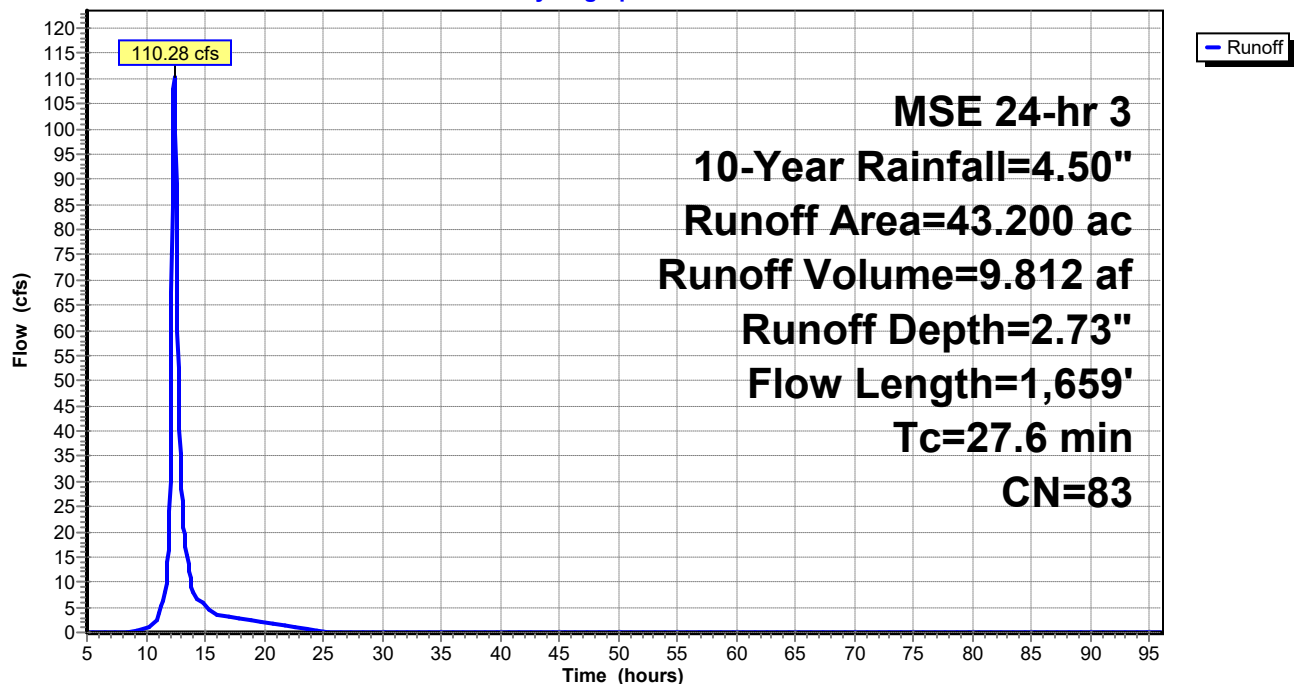
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-96.00 hrs, dt= 0.05 hrs
 MSE 24-hr 3 10-Year Rainfall=4.50"

Area (ac)	CN	Description
* 43.200	83	
43.200		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.4	100	0.0100	0.12		Sheet Flow, Grass: Short n= 0.150 P2= 3.00"
0.8	108	0.0185	2.19		Shallow Concentrated Flow, Unpaved Unpaved Kv= 16.1 fps
3.2	365	0.0438	1.88		Shallow Concentrated Flow, SR Cultivated Straight Rows Kv= 9.0 fps
1.7	173	0.0578	1.68		Shallow Concentrated Flow, Pasture Short Grass Pasture Kv= 7.0 fps
5.2	543	0.0368	1.73		Shallow Concentrated Flow, SR Cultivated Straight Rows Kv= 9.0 fps
3.3	370	0.0730	1.89		Shallow Concentrated Flow, Pasture Short Grass Pasture Kv= 7.0 fps
27.6	1,659	Total			

Subcatchment 3S: Gravel Pit Watershed

Hydrograph



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MSE 24-hr 3 10-Year Rainfall=4.50"

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Summary for Pond 2P: Wetland Pool

Inflow Area = 50.400 ac, 0.00% Impervious, Inflow Depth = 2.73" for 10-Year event
 Inflow = 80.07 cfs @ 12.81 hrs, Volume= 11.447 af
 Outflow = 59.84 cfs @ 13.17 hrs, Volume= 11.447 af, Atten= 25%, Lag= 21.9 min
 Primary = 59.84 cfs @ 13.17 hrs, Volume= 11.447 af

Routing by Stor-Ind method, Time Span= 5.00-96.00 hrs, dt= 0.05 hrs
 Starting Elev= 1,217.00' Surf.Area= 3.493 ac Storage= 4.190 af
 Peak Elev= 1,217.83' @ 13.17 hrs Surf.Area= 3.629 ac Storage= 7.142 af (2.952 af above start)

Plug-Flow detention time= 216.3 min calculated for 7.257 af (63% of inflow)
 Center-of-Mass det. time= 60.9 min (907.3 - 846.4)

Volume	Invert	Avail.Storage	Storage Description
#1	1,215.00'	15.437 af	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,215.00	0.238	0.000	0.000
1,215.50	0.380	0.155	0.155
1,216.00	3.013	0.848	1.003
1,216.50	3.122	1.534	2.536
1,217.00	3.493	1.654	4.190
1,217.50	3.575	1.767	5.957
1,218.00	3.657	1.808	7.765
1,218.50	3.740	1.849	9.614
1,219.00	3.845	1.896	11.511
1,219.50	3.914	1.940	13.451
1,220.00	4.030	1.986	15.437

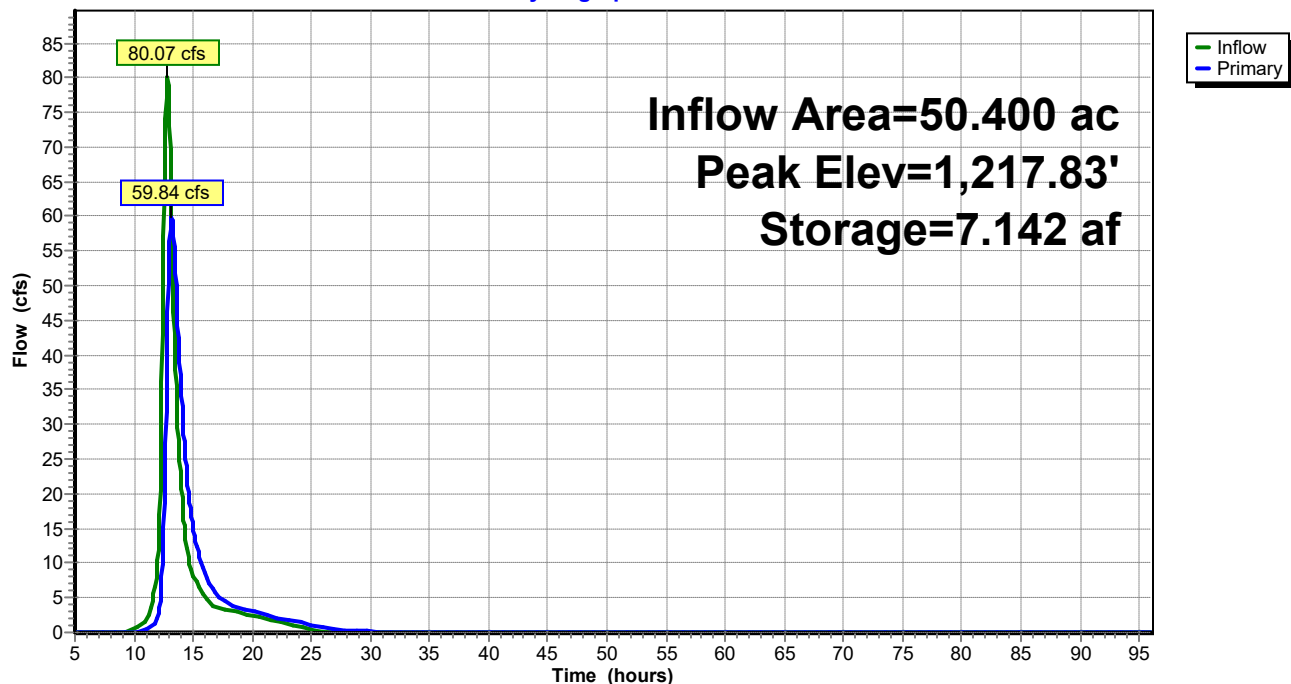
Device	Routing	Invert	Outlet Devices
#1	Primary	1,208.00'	36.0" Round Culvert L= 128.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 1,208.00' / 1,207.50' S= 0.0039 ' / Cc= 0.900 n= 0.013, Flow Area= 7.07 sf
#2	Device 1	1,217.00'	6.0' long x 0.5' breadth Broad-Crested Rectangular Weir X 4.00 Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#3	Primary	1,218.50'	30.0' long + 3.0 ' SideZ x 30.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=59.76 cfs @ 13.17 hrs HW=1,217.83' TW=1,210.00' (Fixed TW Elev= 1,210.00')

- 1=Culvert (Passes 59.76 cfs of 95.23 cfs potential flow)
 2=Broad-Crested Rectangular Weir (Weir Controls 59.76 cfs @ 3.01 fps)
 3=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

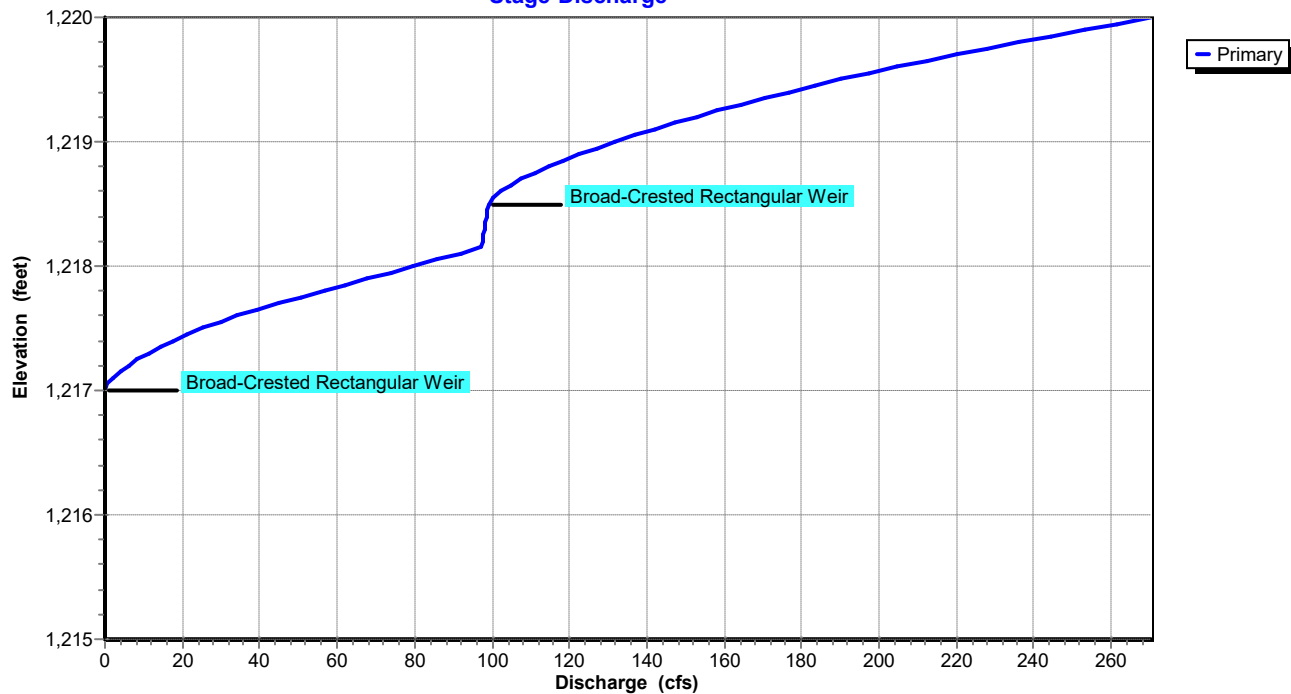
Pond 2P: Wetland Pool

Hydrograph



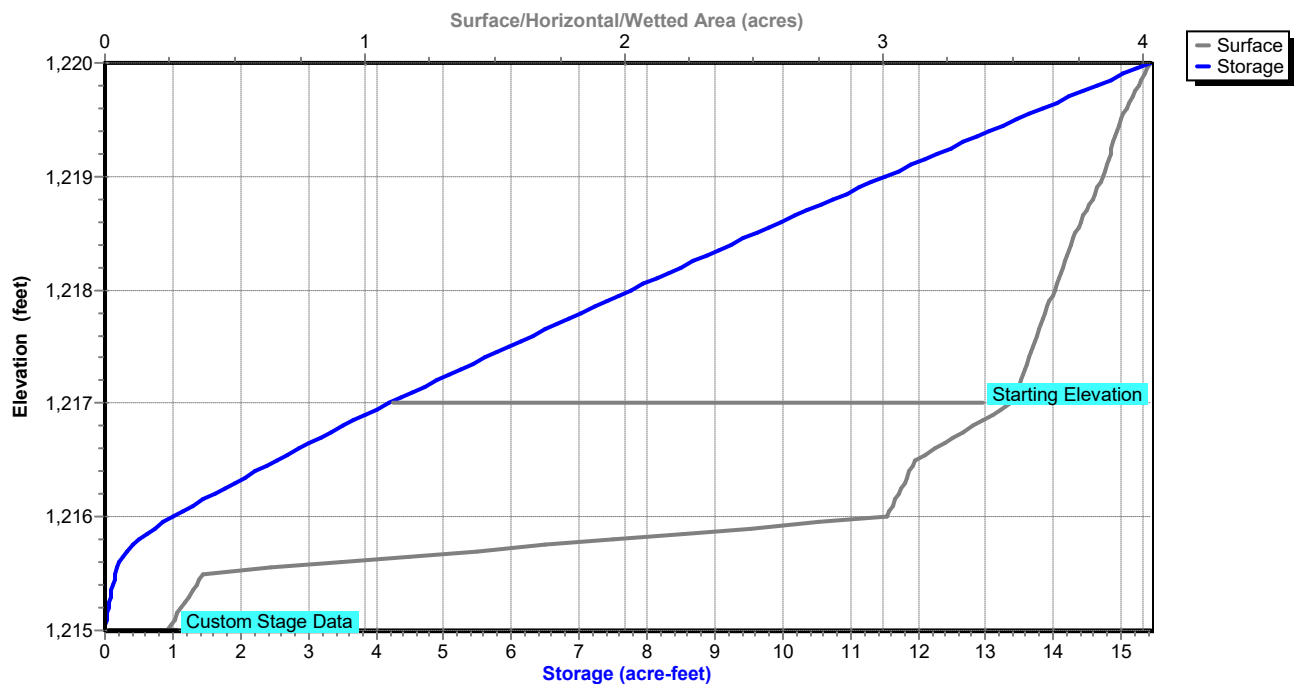
Pond 2P: Wetland Pool

Stage-Discharge



Pond 2P: Wetland Pool

Stage-Area-Storage



Summary for Pond 3P: Gravel Pit

Inflow Area = 43.200 ac, 0.00% Impervious, Inflow Depth = 2.73" for 10-Year event
 Inflow = 110.28 cfs @ 12.39 hrs, Volume= 9.812 af
 Outflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 5.00-96.00 hrs, dt= 0.05 hrs
 Peak Elev= 1,215.41' @ 25.65 hrs Surf.Area= 7.042 ac Storage= 9.812 af

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)

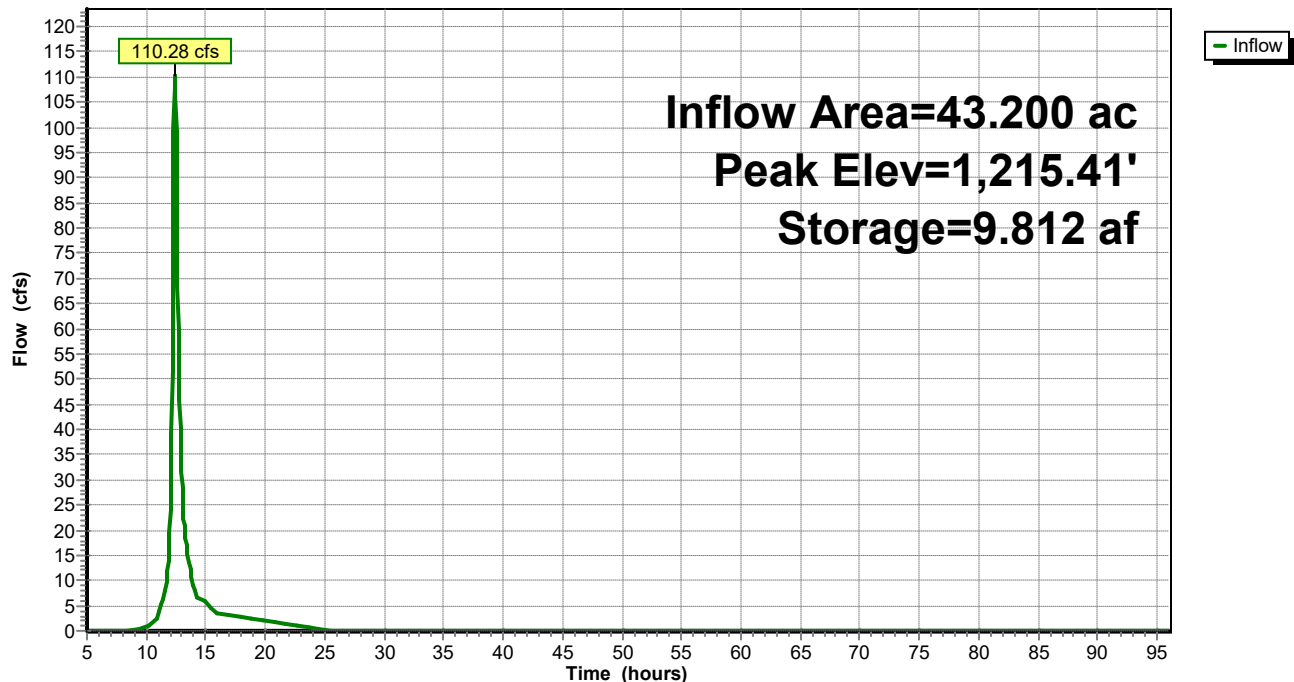
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	1,214.00'	28.755 af	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,214.00	6.900	0.000	0.000
1,216.00	7.102	14.002	14.002
1,218.00	7.651	14.753	28.755

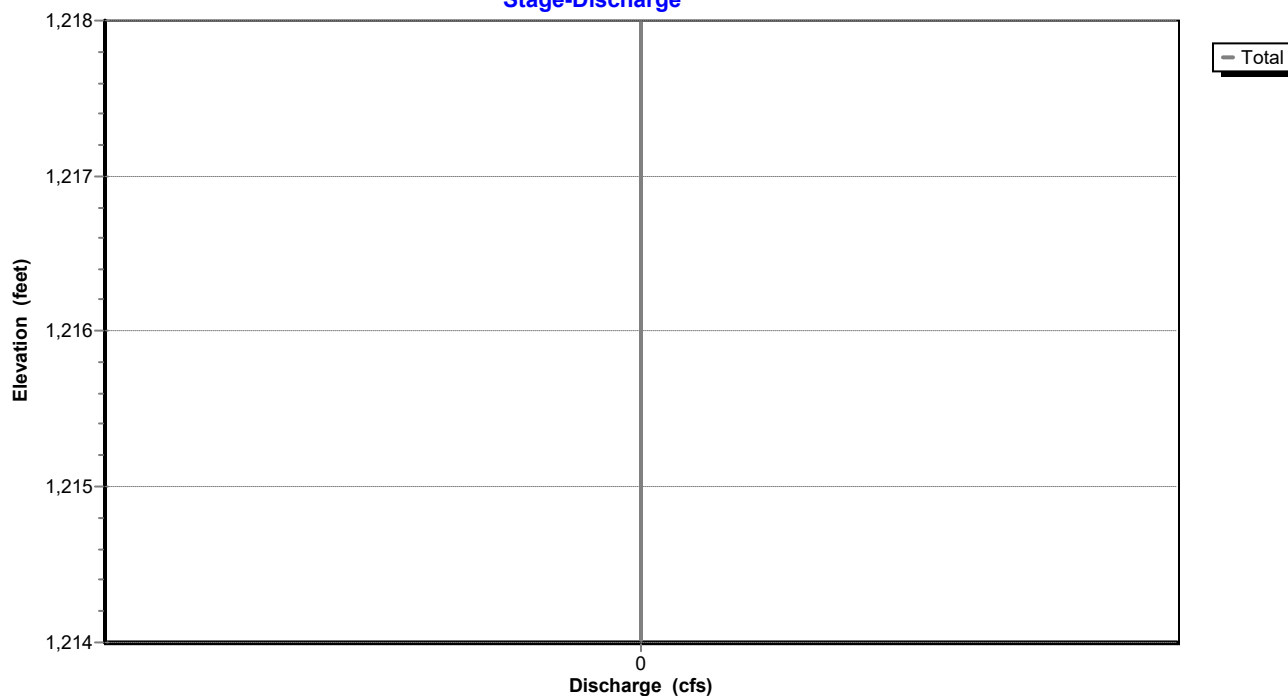
Pond 3P: Gravel Pit

Hydrograph



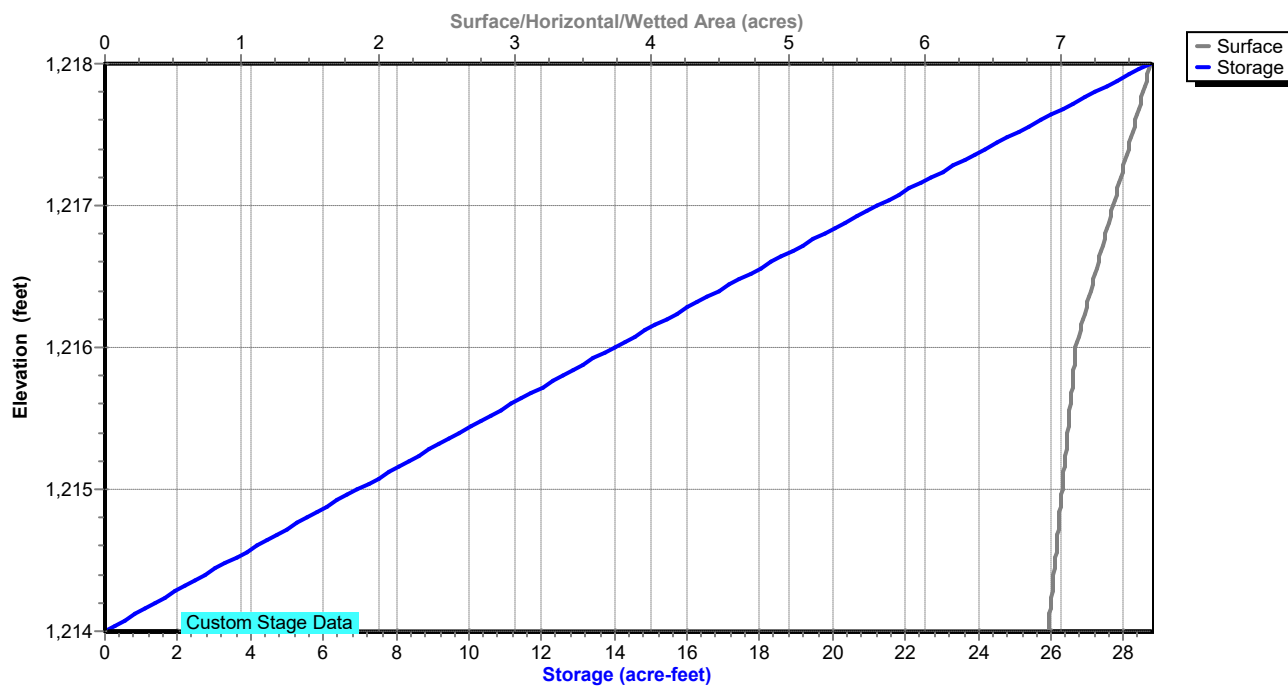
Pond 3P: Gravel Pit

Stage-Discharge



Pond 3P: Gravel Pit

Stage-Area-Storage



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MSE 24-hr 3 25-Year Rainfall=5.70"

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Time span=5.00-96.00 hrs, dt=0.05 hrs, 1821 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1S: Direct Watershed Runoff Area=50.400 ac 0.00% Impervious Runoff Depth=3.81"
Flow Length=2,323' Tc=59.6 min CN=83 Runoff=111.78 cfs 16.018 af

Subcatchment 3S: Gravel Pit Watershed Runoff Area=43.200 ac 0.00% Impervious Runoff Depth=3.81"
Flow Length=1,659' Tc=27.6 min CN=83 Runoff=153.40 cfs 13.730 af

Pond 2P: Wetland Pool Peak Elev=1,218.06' Storage=7.988 af Inflow=111.78 cfs 16.018 af
Outflow=87.06 cfs 16.018 af

Pond 3P: Gravel Pit Peak Elev=1,215.96' Storage=13.730 af Inflow=153.40 cfs 13.730 af
Outflow=0.00 cfs 0.000 af

Total Runoff Area = 93.600 ac Runoff Volume = 29.748 af Average Runoff Depth = 3.81"
100.00% Pervious = 93.600 ac 0.00% Impervious = 0.000 ac

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MSE 24-hr 3 25-Year Rainfall=5.70"

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Summary for Subcatchment 1S: Direct Watershed

Runoff = 111.78 cfs @ 12.80 hrs, Volume= 16.018 af, Depth= 3.81"
Routed to Pond 2P : Wetland Pool

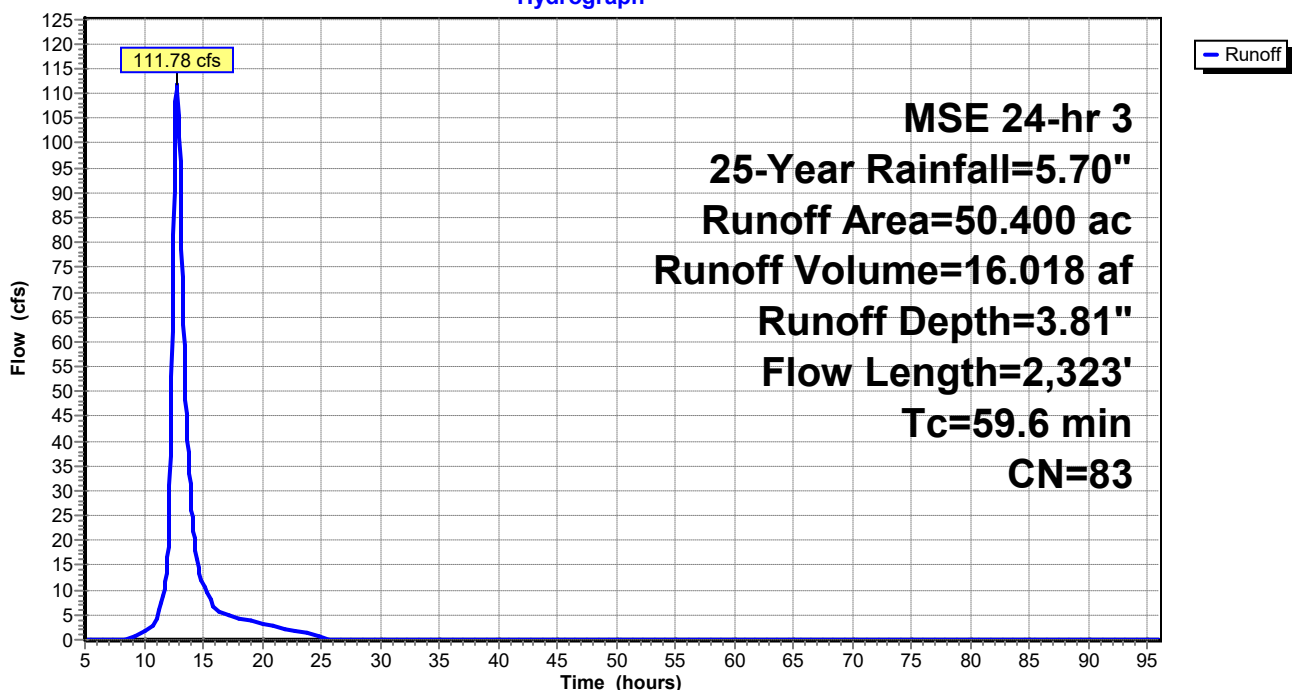
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-96.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 25-Year Rainfall=5.70"

Area (ac)	CN	Description
* 50.400	83	
50.400		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.2	100	0.0200	0.15		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 3.00"
4.3	664	0.0828	2.59		Shallow Concentrated Flow, SR Steep Cultivated Straight Rows Kv= 9.0 fps
21.0	507	0.0020	0.40		Shallow Concentrated Flow, SR Flat Cultivated Straight Rows Kv= 9.0 fps
18.0	770	0.0104	0.71		Shallow Concentrated Flow, Pasture Short Grass Pasture Kv= 7.0 fps
5.1	282	0.0106	0.93		Shallow Concentrated Flow, SR Cultivated Straight Rows Kv= 9.0 fps
59.6	2,323	Total			

Subcatchment 1S: Direct Watershed

Hydrograph



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MSE 24-hr 3 25-Year Rainfall=5.70"

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Summary for Subcatchment 3S: Gravel Pit Watershed

Runoff = 153.40 cfs @ 12.39 hrs, Volume= 13.730 af, Depth= 3.81"
 Routed to Pond 3P : Gravel Pit

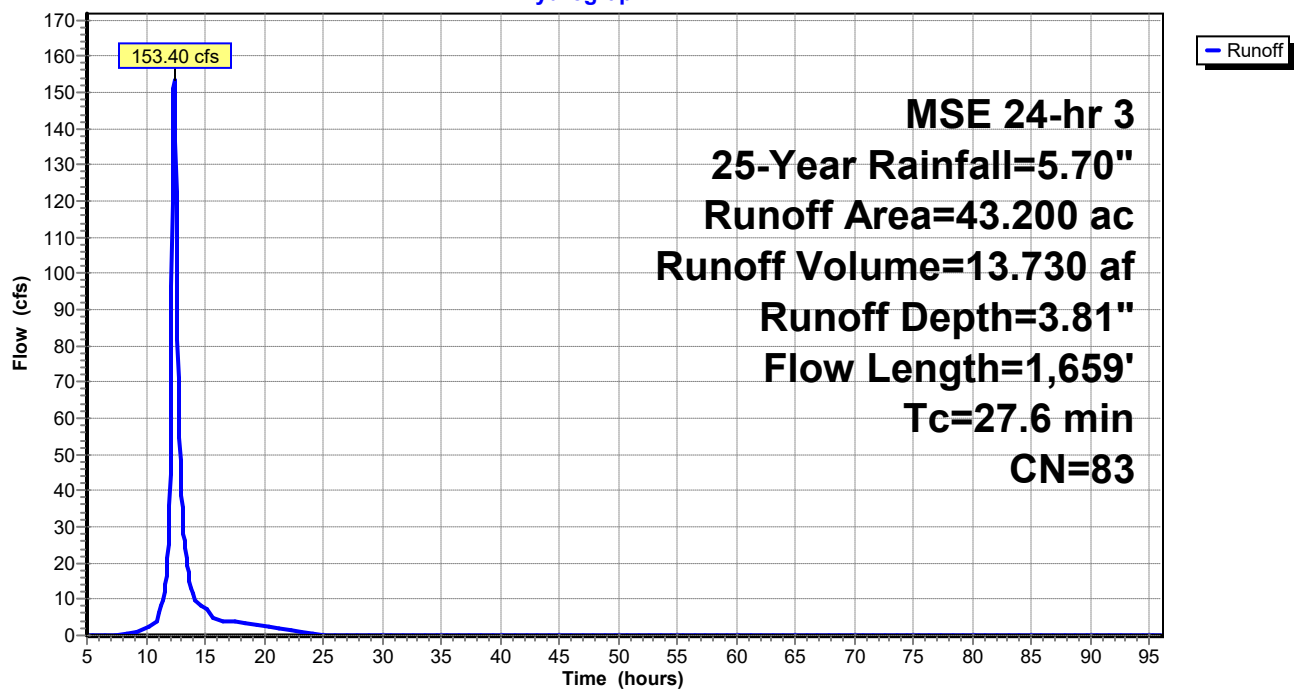
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-96.00 hrs, dt= 0.05 hrs
 MSE 24-hr 3 25-Year Rainfall=5.70"

Area (ac)	CN	Description
* 43.200	83	
43.200		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.4	100	0.0100	0.12		Sheet Flow, Grass: Short n= 0.150 P2= 3.00"
0.8	108	0.0185	2.19		Shallow Concentrated Flow, Unpaved Unpaved Kv= 16.1 fps
3.2	365	0.0438	1.88		Shallow Concentrated Flow, SR Cultivated Straight Rows Kv= 9.0 fps
1.7	173	0.0578	1.68		Shallow Concentrated Flow, Pasture Short Grass Pasture Kv= 7.0 fps
5.2	543	0.0368	1.73		Shallow Concentrated Flow, SR Cultivated Straight Rows Kv= 9.0 fps
3.3	370	0.0730	1.89		Shallow Concentrated Flow, Pasture Short Grass Pasture Kv= 7.0 fps
27.6	1,659	Total			

Subcatchment 3S: Gravel Pit Watershed

Hydrograph



Summary for Pond 2P: Wetland Pool

Inflow Area = 50.400 ac, 0.00% Impervious, Inflow Depth = 3.81" for 25-Year event
 Inflow = 111.78 cfs @ 12.80 hrs, Volume= 16.018 af
 Outflow = 87.06 cfs @ 13.13 hrs, Volume= 16.018 af, Atten= 22%, Lag= 19.8 min
 Primary = 87.06 cfs @ 13.13 hrs, Volume= 16.018 af

Routing by Stor-Ind method, Time Span= 5.00-96.00 hrs, dt= 0.05 hrs
 Starting Elev= 1,217.00' Surf.Area= 3.493 ac Storage= 4.190 af
 Peak Elev= 1,218.06' @ 13.13 hrs Surf.Area= 3.667 ac Storage= 7.988 af (3.797 af above start)

Plug-Flow detention time= 169.2 min calculated for 11.821 af (74% of inflow)
 Center-of-Mass det. time= 54.0 min (893.7 - 839.7)

Volume	Invert	Avail.Storage	Storage Description
#1	1,215.00'	15.437 af	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,215.00	0.238	0.000	0.000
1,215.50	0.380	0.155	0.155
1,216.00	3.013	0.848	1.003
1,216.50	3.122	1.534	2.536
1,217.00	3.493	1.654	4.190
1,217.50	3.575	1.767	5.957
1,218.00	3.657	1.808	7.765
1,218.50	3.740	1.849	9.614
1,219.00	3.845	1.896	11.511
1,219.50	3.914	1.940	13.451
1,220.00	4.030	1.986	15.437

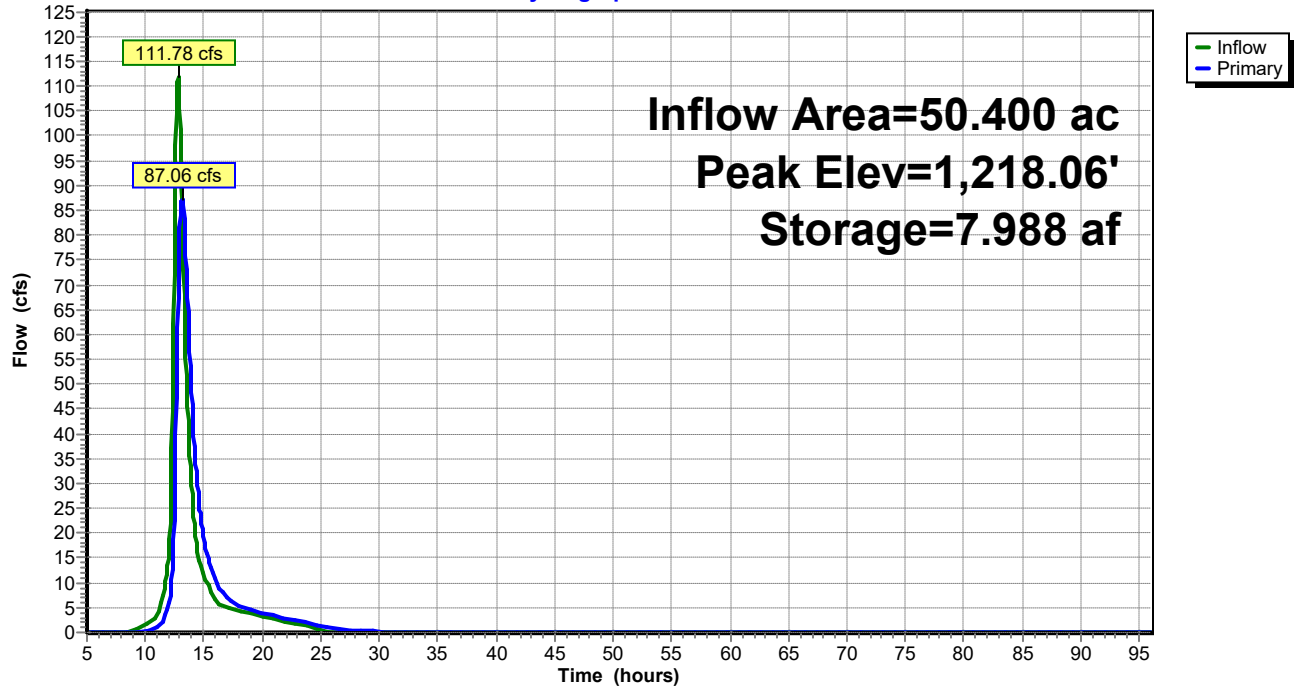
Device	Routing	Invert	Outlet Devices
#1	Primary	1,208.00'	36.0" Round Culvert L= 128.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 1,208.00' / 1,207.50' S= 0.0039 ' / Cc= 0.900 n= 0.013, Flow Area= 7.07 sf
#2	Device 1	1,217.00'	6.0' long x 0.5' breadth Broad-Crested Rectangular Weir X 4.00 Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#3	Primary	1,218.50'	30.0' long + 3.0 ' / SideZ x 30.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=86.96 cfs @ 13.13 hrs HW=1,218.06' TW=1,210.00' (Fixed TW Elev= 1,210.00')

1=Culvert (Passes 86.96 cfs of 96.63 cfs potential flow)
 2=Broad-Crested Rectangular Weir (Weir Controls 86.96 cfs @ 3.42 fps)
 3=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

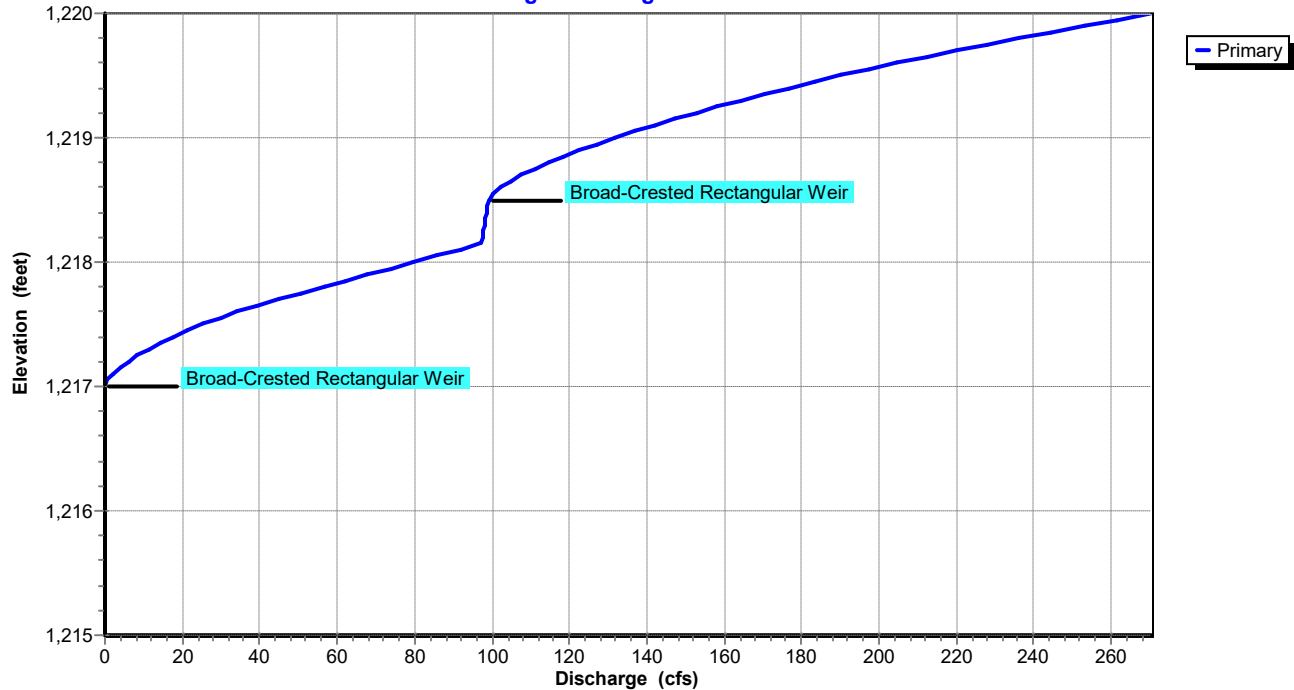
Pond 2P: Wetland Pool

Hydrograph



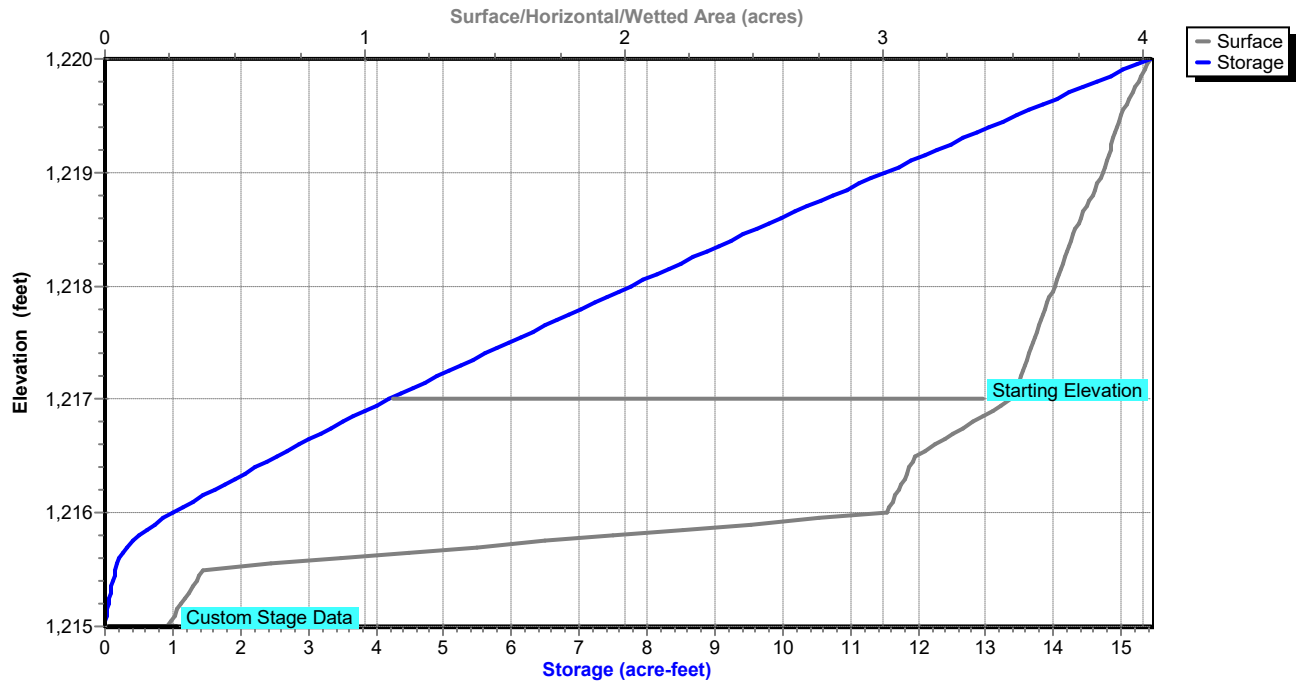
Pond 2P: Wetland Pool

Stage-Discharge



Pond 2P: Wetland Pool

Stage-Area-Storage



Summary for Pond 3P: Gravel Pit

Inflow Area = 43.200 ac, 0.00% Impervious, Inflow Depth = 3.81" for 25-Year event
 Inflow = 153.40 cfs @ 12.39 hrs, Volume= 13.730 af
 Outflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 5.00-96.00 hrs, dt= 0.05 hrs
 Peak Elev= 1,215.96' @ 25.65 hrs Surf.Area= 7.098 ac Storage= 13.730 af

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)

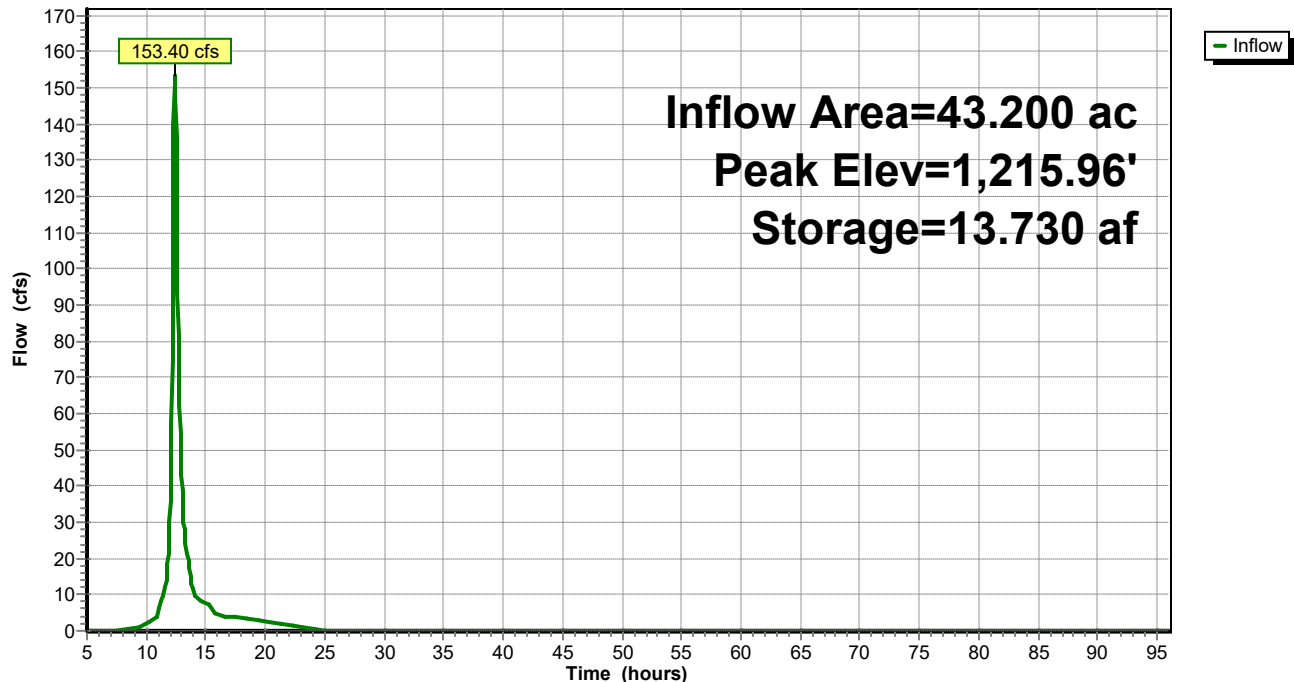
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	1,214.00'	28.755 af	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,214.00	6.900	0.000	0.000
1,216.00	7.102	14.002	14.002
1,218.00	7.651	14.753	28.755

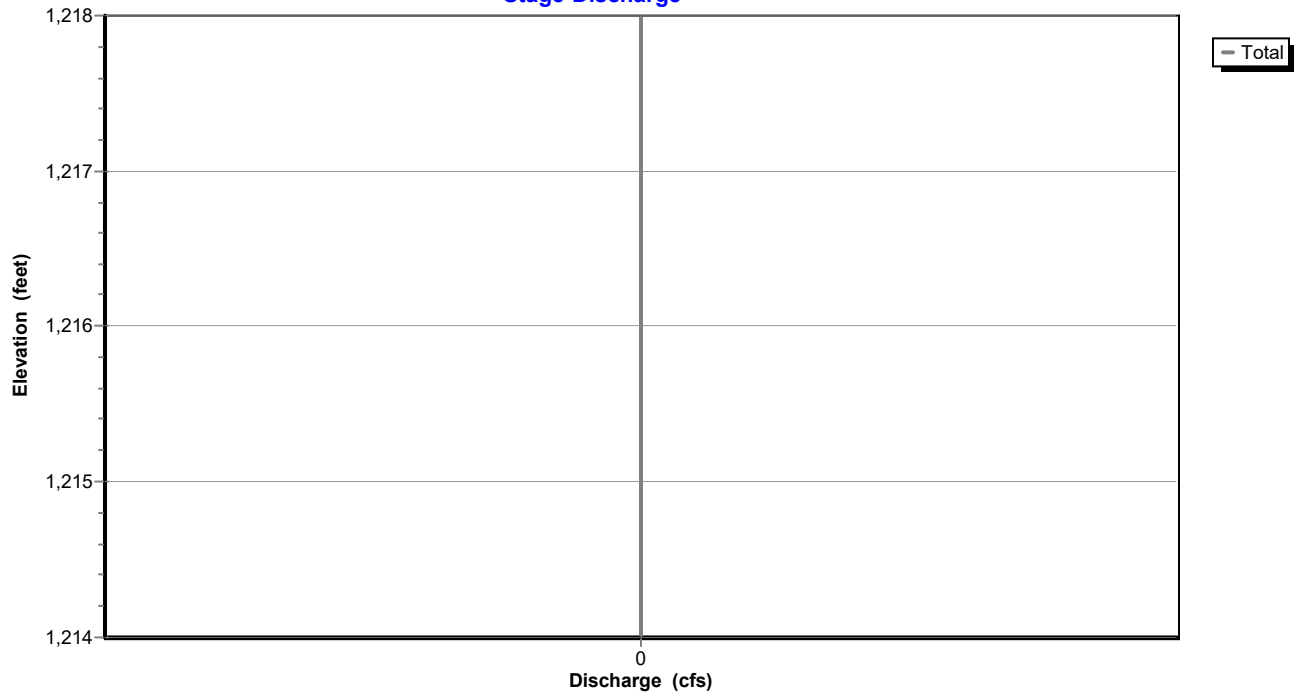
Pond 3P: Gravel Pit

Hydrograph



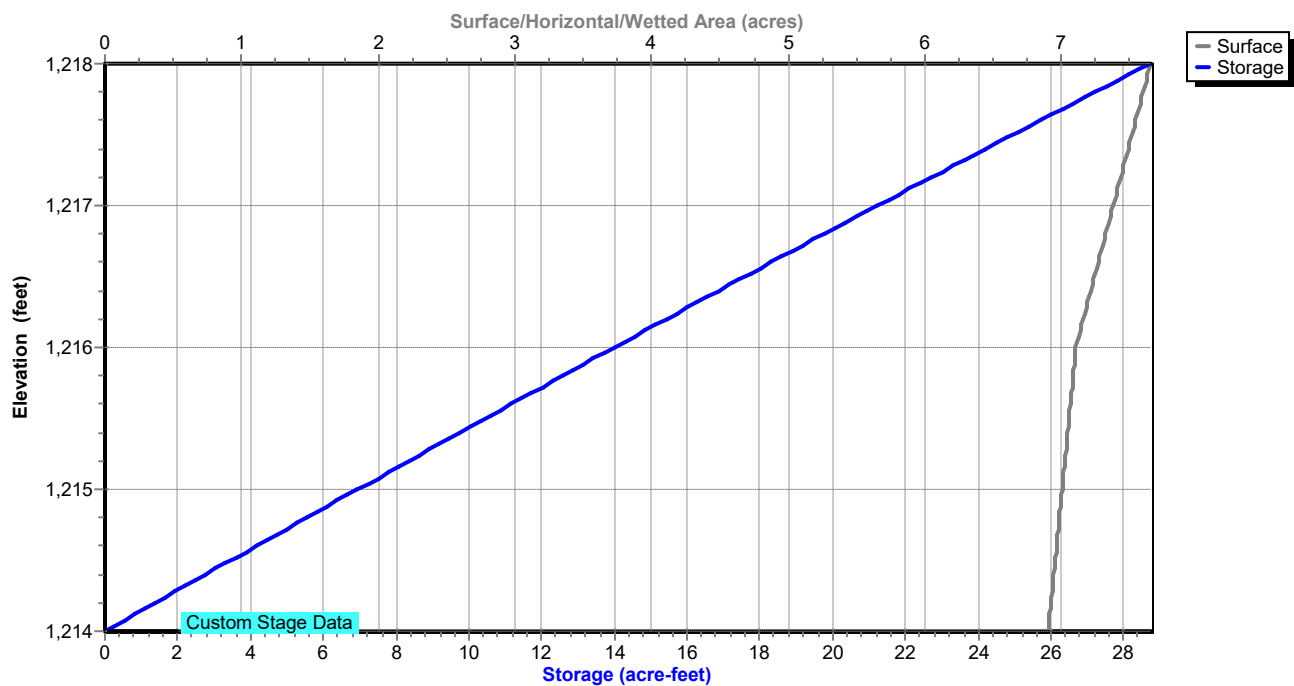
Pond 3P: Gravel Pit

Stage-Discharge



Pond 3P: Gravel Pit

Stage-Area-Storage



Thrills Hills HydroCad

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MSE 24-hr 3 100-Year Rainfall=7.90"

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Time span=5.00-96.00 hrs, dt=0.05 hrs, 1821 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1S: Direct Watershed Runoff Area=50.400 ac 0.00% Impervious Runoff Depth=5.88"
Flow Length=2,323' Tc=59.6 min CN=83 Runoff=170.73 cfs 24.704 af

Subcatchment 3S: Gravel Pit Watershed Runoff Area=43.200 ac 0.00% Impervious Runoff Depth=5.88"
Flow Length=1,659' Tc=27.6 min CN=83 Runoff=233.26 cfs 21.175 af

Pond 2P: Wetland Pool Peak Elev=1,218.72' Storage=10.436 af Inflow=170.73 cfs 24.704 af
Outflow=108.89 cfs 24.704 af

Pond 3P: Gravel Pit Peak Elev=1,216.99' Storage=21.175 af Inflow=233.26 cfs 21.175 af
Outflow=0.00 cfs 0.000 af

Total Runoff Area = 93.600 ac Runoff Volume = 45.879 af Average Runoff Depth = 5.88"
100.00% Pervious = 93.600 ac 0.00% Impervious = 0.000 ac

Thrills Hills HydroCad

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MSE 24-hr 3 100-Year Rainfall=7.90"

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Summary for Subcatchment 1S: Direct Watershed

Runoff = 170.73 cfs @ 12.79 hrs, Volume= 24.704 af, Depth= 5.88"
Routed to Pond 2P : Wetland Pool

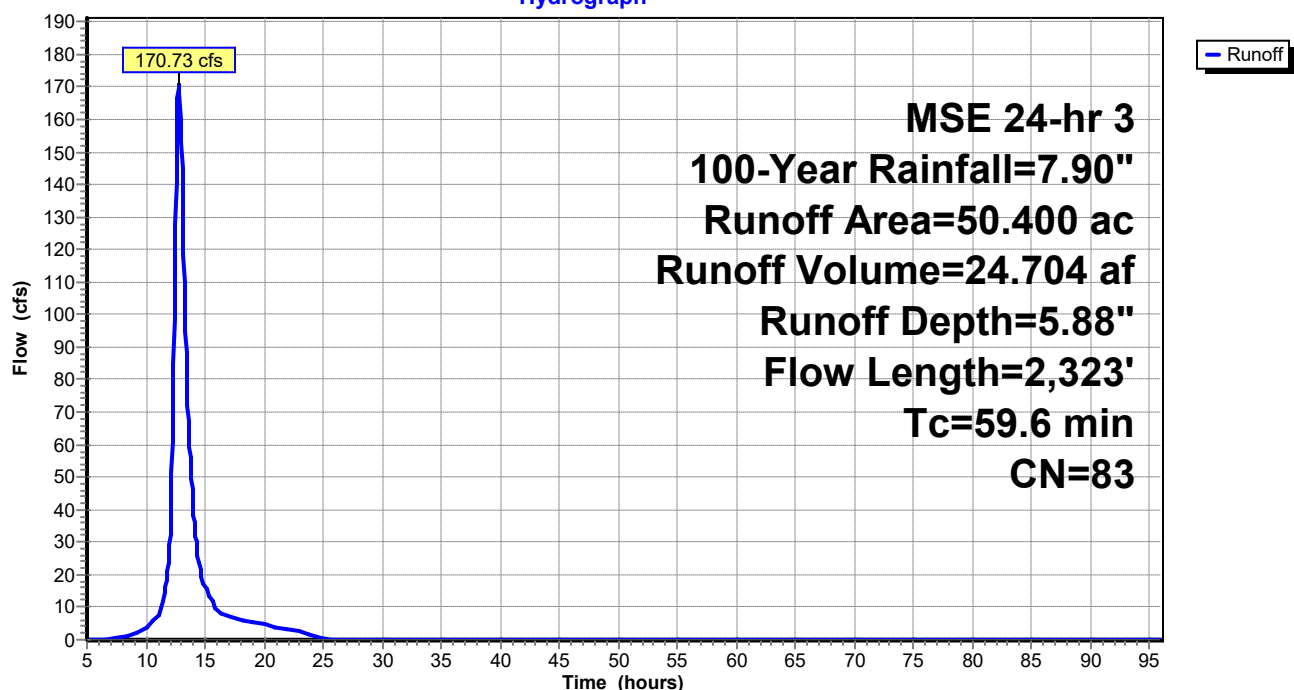
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-96.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 100-Year Rainfall=7.90"

Area (ac)	CN	Description
* 50.400	83	
50.400		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.2	100	0.0200	0.15		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 3.00"
4.3	664	0.0828	2.59		Shallow Concentrated Flow, SR Steep Cultivated Straight Rows Kv= 9.0 fps
21.0	507	0.0020	0.40		Shallow Concentrated Flow, SR Flat Cultivated Straight Rows Kv= 9.0 fps
18.0	770	0.0104	0.71		Shallow Concentrated Flow, Pasture Short Grass Pasture Kv= 7.0 fps
5.1	282	0.0106	0.93		Shallow Concentrated Flow, SR Cultivated Straight Rows Kv= 9.0 fps
59.6	2,323	Total			

Subcatchment 1S: Direct Watershed

Hydrograph



Thrills Hills HydroCad

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MSE 24-hr 3 100-Year Rainfall=7.90"

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Summary for Subcatchment 3S: Gravel Pit Watershed

Runoff = 233.26 cfs @ 12.38 hrs, Volume= 21.175 af, Depth= 5.88"
 Routed to Pond 3P : Gravel Pit

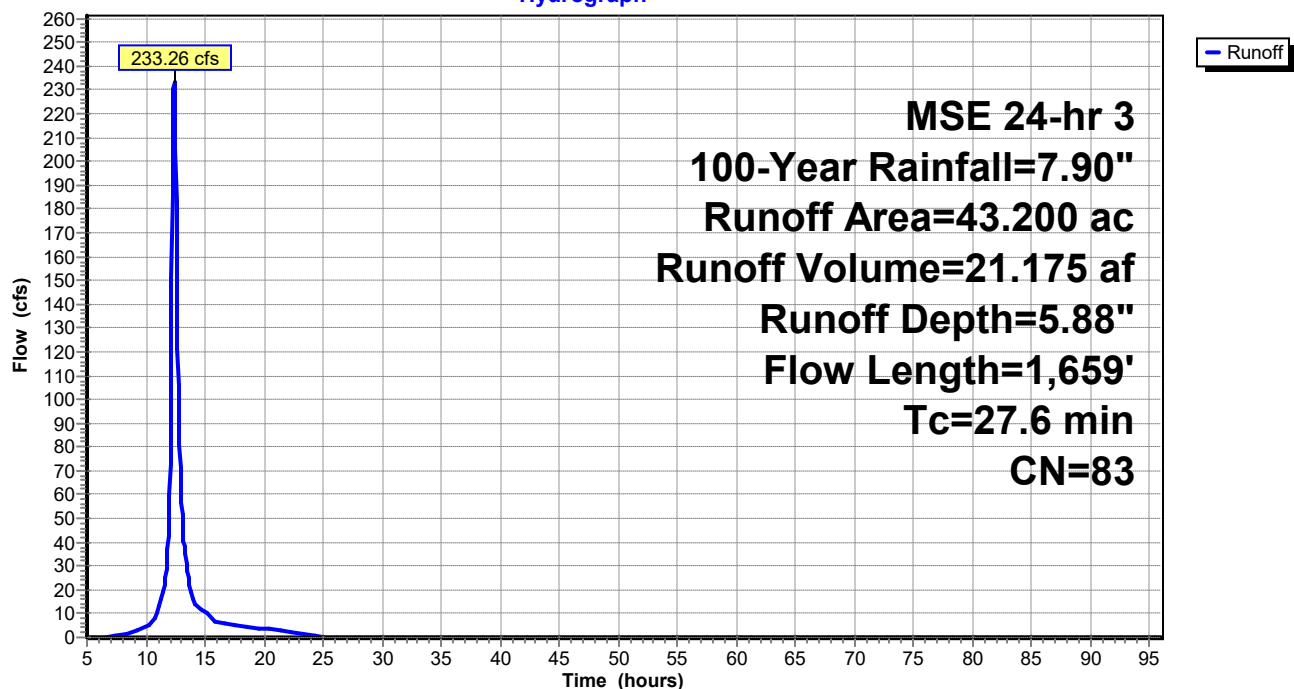
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-96.00 hrs, dt= 0.05 hrs
 MSE 24-hr 3 100-Year Rainfall=7.90"

Area (ac)	CN	Description
* 43.200	83	
43.200		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.4	100	0.0100	0.12		Sheet Flow, Grass: Short n= 0.150 P2= 3.00"
0.8	108	0.0185	2.19		Shallow Concentrated Flow, Unpaved Unpaved Kv= 16.1 fps
3.2	365	0.0438	1.88		Shallow Concentrated Flow, SR Cultivated Straight Rows Kv= 9.0 fps
1.7	173	0.0578	1.68		Shallow Concentrated Flow, Pasture Short Grass Pasture Kv= 7.0 fps
5.2	543	0.0368	1.73		Shallow Concentrated Flow, SR Cultivated Straight Rows Kv= 9.0 fps
3.3	370	0.0730	1.89		Shallow Concentrated Flow, Pasture Short Grass Pasture Kv= 7.0 fps
27.6	1,659	Total			

Subcatchment 3S: Gravel Pit Watershed

Hydrograph



Summary for Pond 2P: Wetland Pool

Inflow Area = 50.400 ac, 0.00% Impervious, Inflow Depth = 5.88" for 100-Year event
 Inflow = 170.73 cfs @ 12.79 hrs, Volume= 24.704 af
 Outflow = 108.89 cfs @ 13.26 hrs, Volume= 24.704 af, Atten= 36%, Lag= 28.0 min
 Primary = 108.89 cfs @ 13.26 hrs, Volume= 24.704 af

Routing by Stor-Ind method, Time Span= 5.00-96.00 hrs, dt= 0.05 hrs
 Starting Elev= 1,217.00' Surf.Area= 3.493 ac Storage= 4.190 af
 Peak Elev= 1,218.72' @ 13.26 hrs Surf.Area= 3.786 ac Storage= 10.436 af (6.246 af above start)

Plug-Flow detention time= 136.4 min calculated for 20.503 af (83% of inflow)
 Center-of-Mass det. time= 50.9 min (882.0 - 831.1)

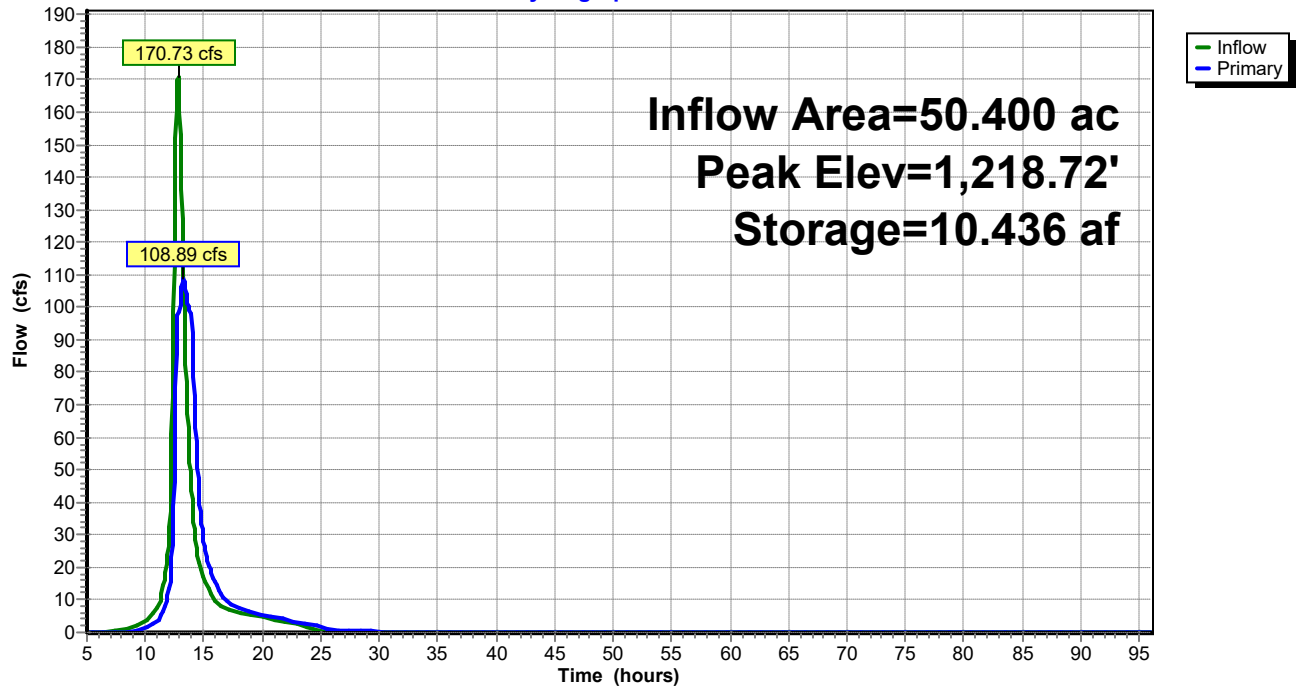
Volume	Invert	Avail.Storage	Storage Description
#1	1,215.00'	15.437 af	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,215.00	0.238	0.000	0.000
1,215.50	0.380	0.155	0.155
1,216.00	3.013	0.848	1.003
1,216.50	3.122	1.534	2.536
1,217.00	3.493	1.654	4.190
1,217.50	3.575	1.767	5.957
1,218.00	3.657	1.808	7.765
1,218.50	3.740	1.849	9.614
1,219.00	3.845	1.896	11.511
1,219.50	3.914	1.940	13.451
1,220.00	4.030	1.986	15.437

Device	Routing	Invert	Outlet Devices
#1	Primary	1,208.00'	36.0" Round Culvert L= 128.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 1,208.00' / 1,207.50' S= 0.0039 ' / Cc= 0.900 n= 0.013, Flow Area= 7.07 sf
#2	Device 1	1,217.00'	6.0' long x 0.5' breadth Broad-Crested Rectangular Weir X 4.00 Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#3	Primary	1,218.50'	30.0' long + 3.0 ' SideZ x 30.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=108.81 cfs @ 13.26 hrs HW=1,218.72' TW=1,210.00' (Fixed TW Elev= 1,210.00')
 1=Culvert (Inlet Controls 100.49 cfs @ 14.22 fps)
 2=Broad-Crested Rectangular Weir (Passes 100.49 cfs of 179.39 cfs potential flow)
 3=Broad-Crested Rectangular Weir (Weir Controls 8.32 cfs @ 1.25 fps)

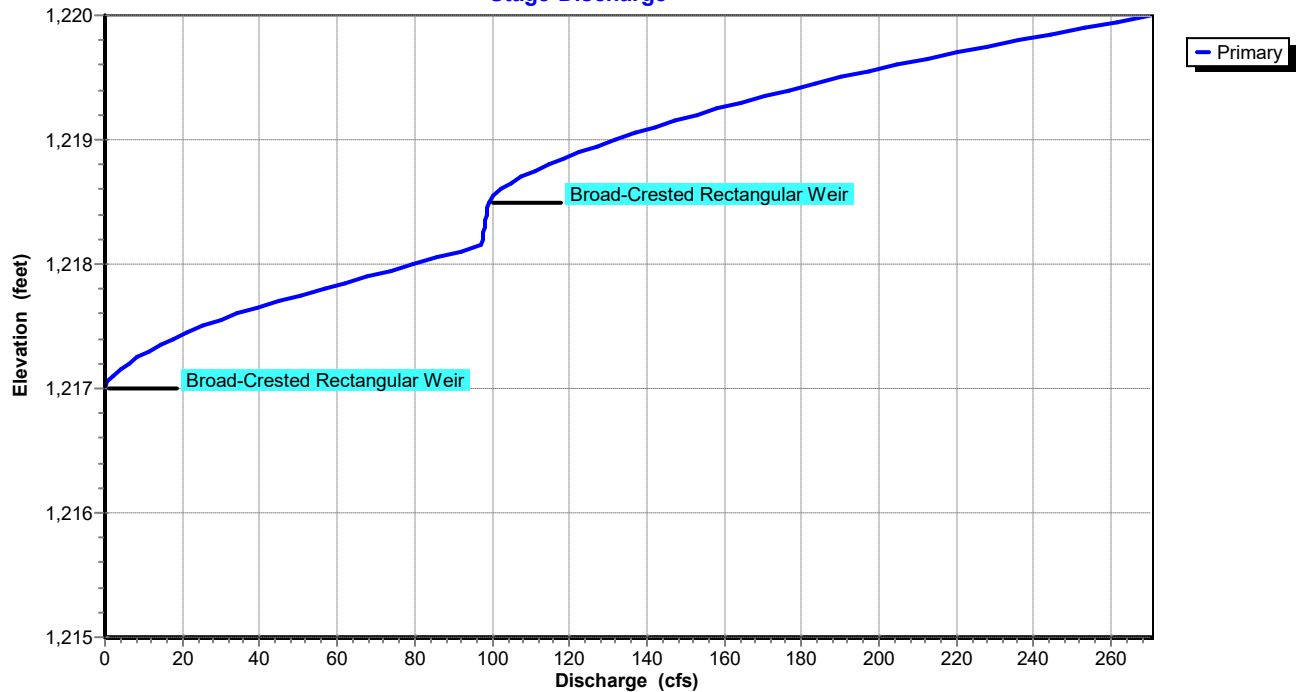
Pond 2P: Wetland Pool

Hydrograph



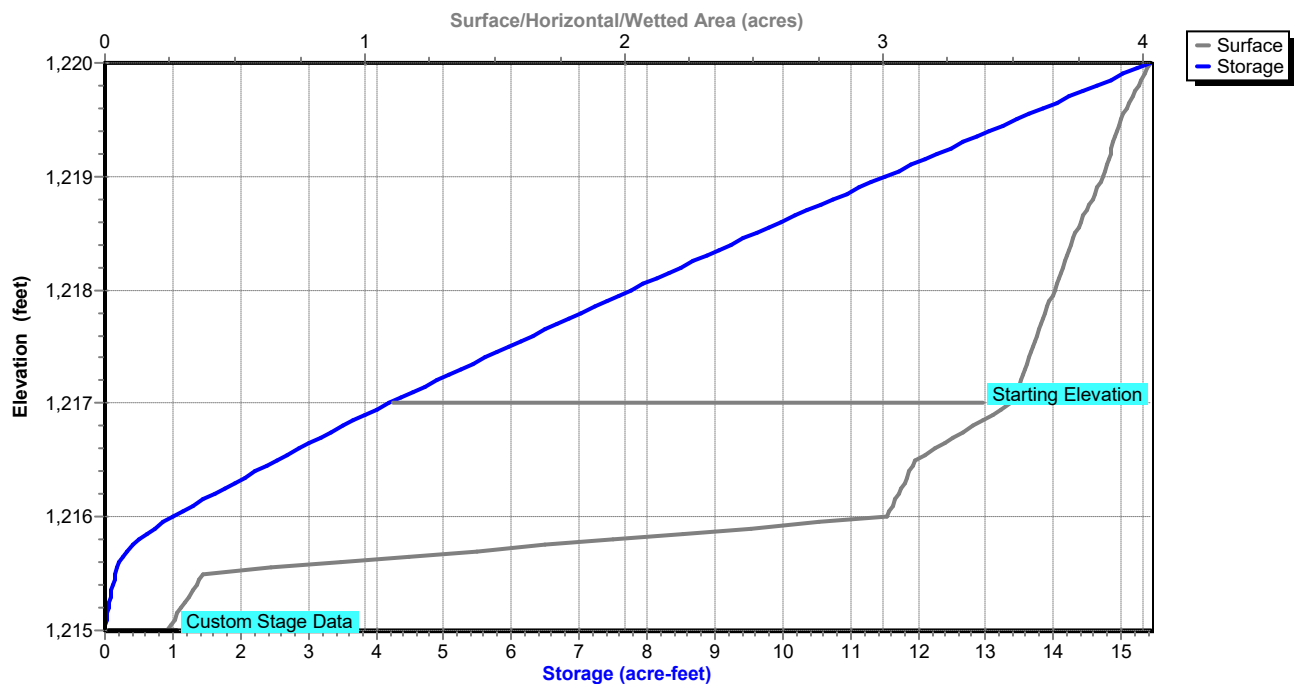
Pond 2P: Wetland Pool

Stage-Discharge



Pond 2P: Wetland Pool

Stage-Area-Storage



Summary for Pond 3P: Gravel Pit

Inflow Area = 43.200 ac, 0.00% Impervious, Inflow Depth = 5.88" for 100-Year event
 Inflow = 233.26 cfs @ 12.38 hrs, Volume= 21.175 af
 Outflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 5.00-96.00 hrs, dt= 0.05 hrs
 Peak Elev= 1,216.99' @ 25.65 hrs Surf.Area= 7.374 ac Storage= 21.175 af

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)

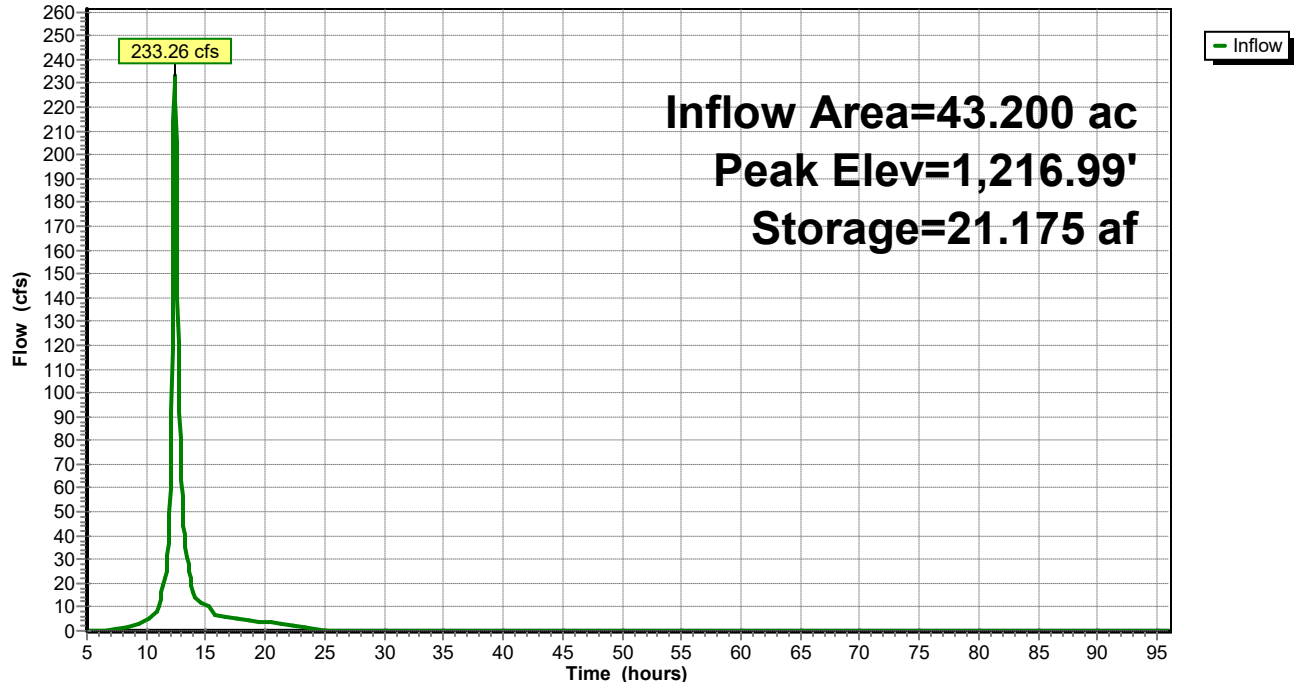
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	1,214.00'	28.755 af	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,214.00	6.900	0.000	0.000
1,216.00	7.102	14.002	14.002
1,218.00	7.651	14.753	28.755

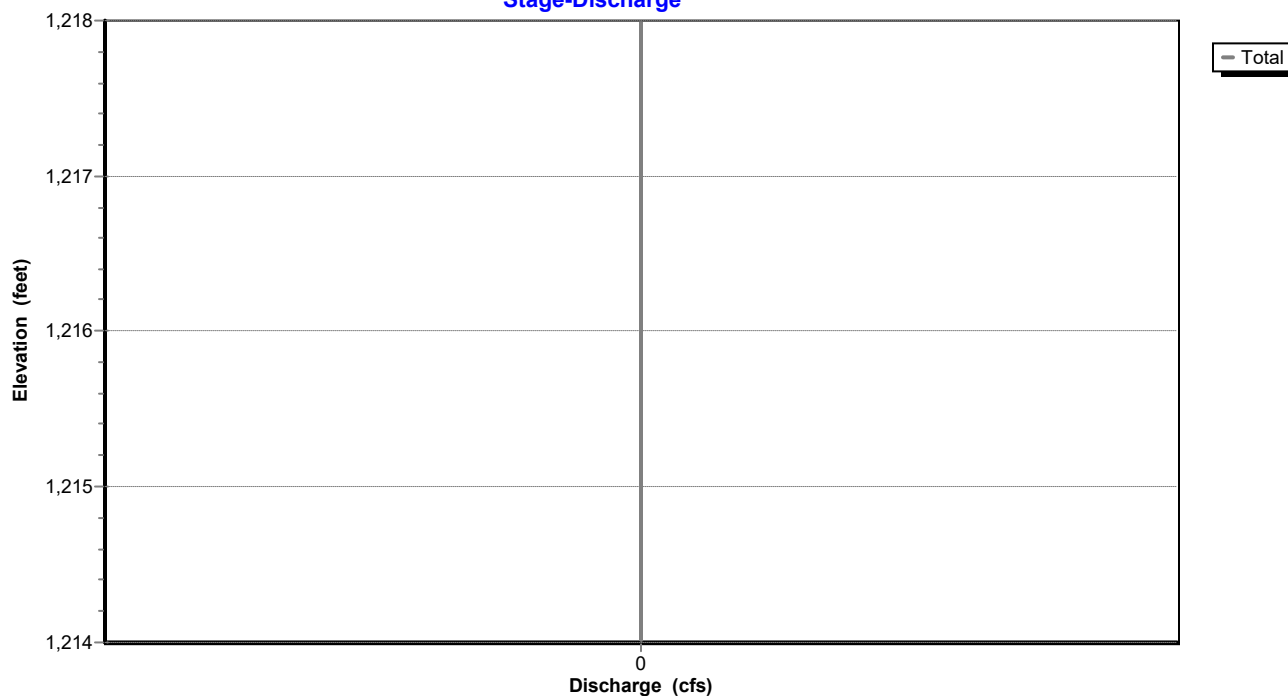
Pond 3P: Gravel Pit

Hydrograph



Pond 3P: Gravel Pit

Stage-Discharge



Pond 3P: Gravel Pit

Stage-Area-Storage

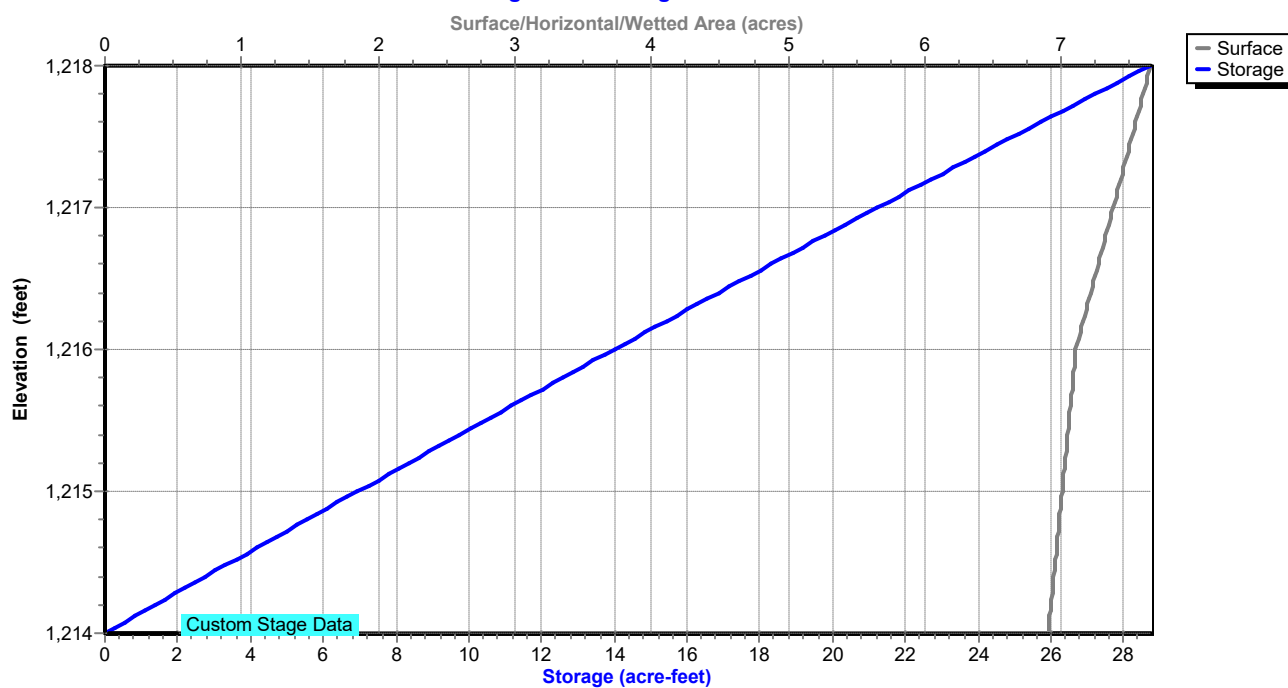


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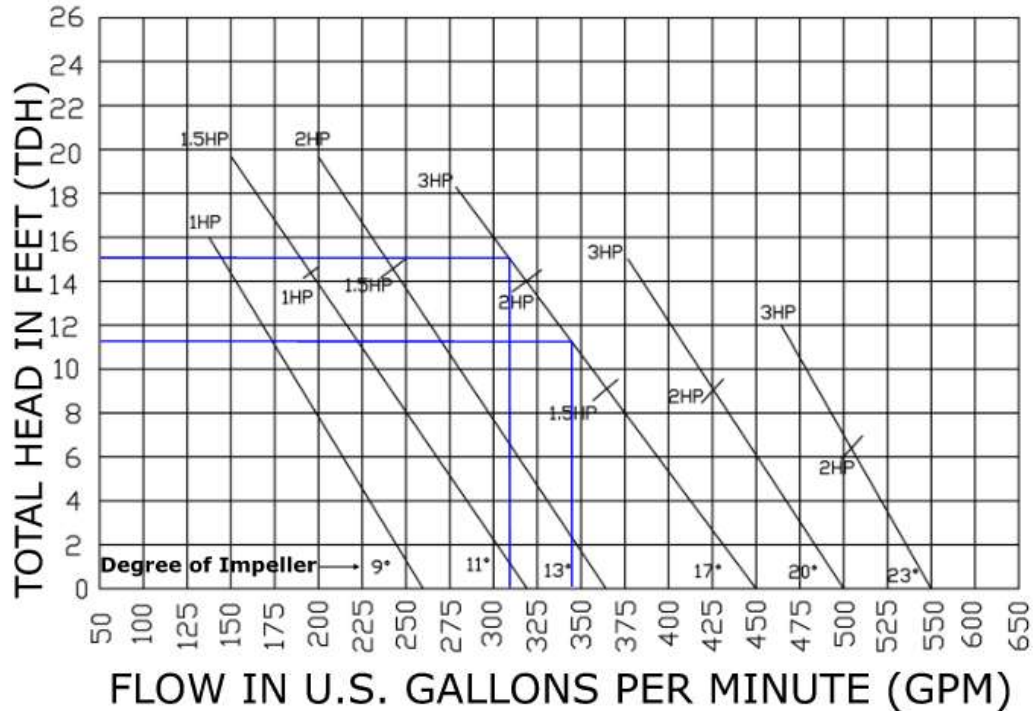
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Appendix E: Pump Curve and Sump Design

CP04 AXIAL-FLOW PUMP CURVES

Pump Basin Sizing Calculations	
Inlet Pipe Elev.	1207.00
Pump Flow Rate	330 gpm
Minimum Working Volume	330 gal
Minimum Working Volume	44.1 cu. ft.
Minimum Working Sump Depth	3.6 ft
On Float Elev.	1207.5
Off Float Elev.	1203.5
Pump Manufacturer Minimum Submergence	22 in
Bottom of Sump Elev.	1201.5

Appendix F: Pipe Capacity Calculations

Pipe Capacity Calculations							
Description	Dia (in)	A (sf)	P (ft)	R _h (ft)	s (%)	n	Q _{max} (cfs)
Pumped Inlet Pipe	18.00	1.77	4.71	0.38	1.30%	0.013	11.98
Existing Pond Outlet	6.00	0.20	1.57	0.13	1.36%	0.020	0.43
Proposed Pond Outlet Re-lay	8.00	0.35	2.09	0.17	0.98%	0.012	1.30
Wetland Outlet Pipe	36.00	7.07	9.42	0.75	0.39%	0.013	41.65