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August 15, 2025

Hauber Wetland Design Report
Site No. WINN981024D
Winneshiek County, Iowa

This wetland project is planned to provide nutrient reduction benefits to a part of the watershed of Ten Mile Creek in Winneshiek County, Iowa. Nitrates will be converted to nitrogen gas through natural processes as the water passes through the wetland. Sediment with phosphorus will also be captured but will need to be removed from time to time.

The project location is on the property of Alan Hauber west of Ridgeway, Iowa. An embankment will be built over the existing stream, and existing drain tiles will be re-laid at a flatter slope to daylight into the pool. Water from the existing stream and drain tiles will feed the wetland. Diversion berms are proposed within the permanent pool to encourage mixing and reduce short-cutting of water out of the wetland. Tile flows and storm flows will be released through the primary spillway which is a full-flow chute structure reinforced with tied concrete block mat.

This site was deemed viable because of the size of its watershed (655 acres) and its topography. The slopes are gentle enough to allow the impounding of a large wetland pool without an excessively large berm or a deep pool. 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 silt loam, with shallow bedrock on the property. Geotechnical investigation was performed by Chosen Valley testing to determine the depth of bedrock in the area of the dam and to determine the suitability of soils for dam construction. The geotechnical report is attached. Because of the shallow bedrock in the vicinity of the dam, it was decided to use a chute outlet structure rather than sheet pile. Additionally, a compacted liner is specified for the wetland pool in order to prevent dissolution of any karst bedrock or draining of the wetland pool through the bedrock. The core trench of the dam is designed to be 7 feet deep or to the existing bedrock. If bedrock is encountered in the core trench, it will be scraped to remove any loose material and cohesive soil will be compacted into the dam core. These measures will minimize the potential for leakage through the bedrock or formation of sinkholes.

The wetland watersheds were analyzed using LiDAR data, with land uses delineated and existing ponds and culverts accounted for. A map of the contributing watersheds is included with this report. Curve number calculations and runoff analysis are provided in the attached hydrology outputs.

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.

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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 and auxiliary spillways and the embankment. The project is NRCS Job Class IV under CPS 656 because the watershed is between 300 and 1000 acres. The auxiliary spillway is placed above the 25-year storm elevation of 1164.70. The primary and auxiliary spillways together are designed to convey the 100-year storm flow with one foot of freeboard to the top of embankment. This exceeds the minimum requirements of CPS 378. The spillway performance is shown in the HydroCAD output.

A permanent pool elevation and embankment location were selected based on the ability to maximize pool area while minimizing the deep (greater than three feet) pool area and embankment height. The watershed information and rainfall data were used to develop hydrographs in HydroCAD. The storm distribution used was MSE 4, with rainfall depths from the National Engineering Handbook. These hydrographs and the proposed stage-storage information were used to size primary and auxiliary spillways for the wetland. Exceeding the minimum design standards of NRCS CPS 378, the auxiliary spillway is placed above the 10-year storm, and the spillways and embankment are designed to provide at least one foot of freeboard during the 100-year storm. HydroCAD outputs are provided in the appendix.

Several known and assumed tiles are planned to be re-laid into the wetland pool. Pipe sizing calculations are provided in the appendix.

The embankment is a low-hazard dam because: its failure will not result in loss of life, damage to homes, commercial or industrial buildings, main highways, or railroads, or interruption of the use or service of public utilities; the product of the storage times the effective height of the dam is less than 3,000 acre-feet²; and the effective height is less than 35 feet.

The permanent easement for this project will be on the Hauber property. 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 was obtained by the Iowa Department of Agriculture and Land Stewardship (IDALS). A floodplain permit application will also be obtained by IDALS if necessary.

Sincerely,

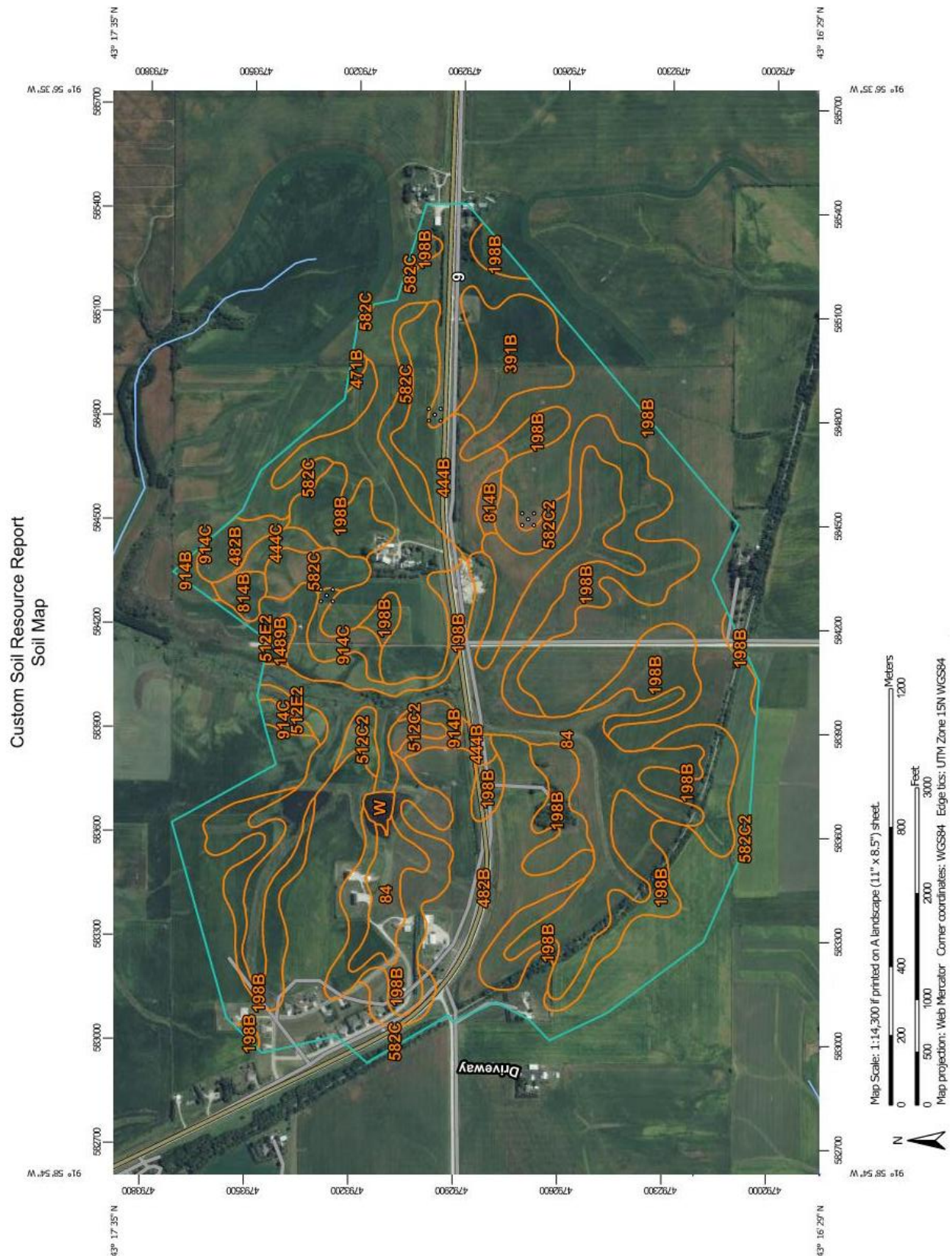
Brandon C. Short, PE

Water Resources Project Engineer

Bolton & Menk, Inc.

Appendices: Soil Survey Map
 Watershed and Land Use Map
 Hydrology Report
 HydroCAD Output
 Geotechnical Report
 Stilling Basin Calculations

Web Soil Survey Map

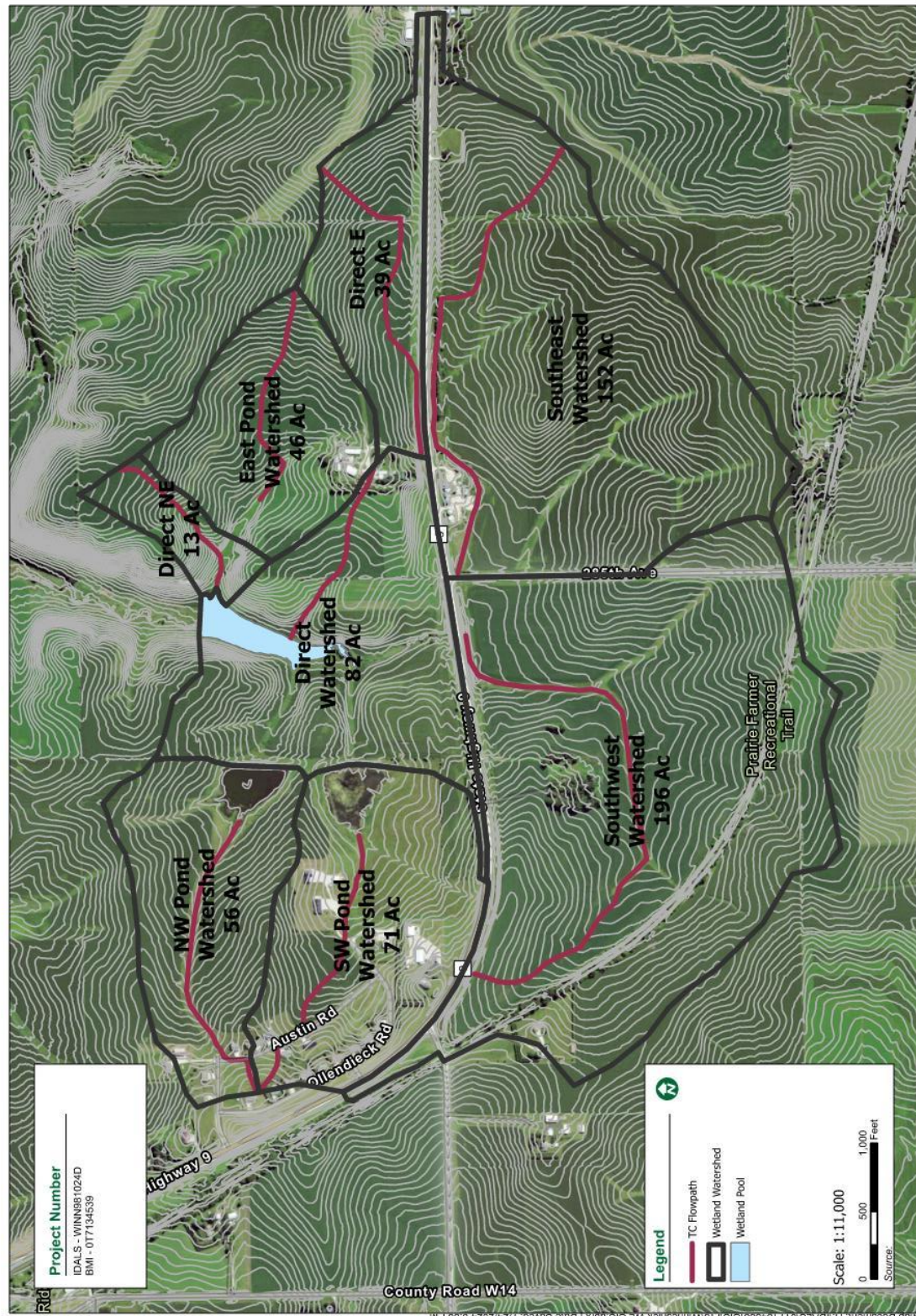


Watersheds and Land Use



Watershed Map
July 2024

Hauber Wetland
Iowa Department of Agriculture



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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 and depression areas were found. Hydrologic data was compiled, sediment calculations were made, the structure was flood routed using the SCS method in HydroCAD, and all the output was reviewed.

Rainfall events used for this site were MSE 4, 24-hour, 5-, 10-, 25-, and 100-year events. The primary spillway is a full-flow tied concrete block mat reinforced chute spillway. The auxiliary spillway is an earthen spillway excavated through the dam.

Hydrology Analysis Summary

- 25-year Event: 5.60" 100-year Event: 7.6"**
- * Hydrologic Soil Groups: B, C
 - * Runoff Curve Number: 83.0 (based on Land use shown in this report)
 - * Primary Spillway Weir Coefficient = Varies with depth (modeled as broad-crested)
 - * Tc = 1.4 hours determined by the sum of sheet, shallow concentrated and channel flow times.

Additional Site Analysis Data

- * Normal Pool area is 3.61 ac; surface watershed area is approx. 655 ac or 1.02 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		
				1163.00	1164.00	1164.50
5-year	449.00	431.00	1164.00	2.1	0.6	-
10-year	547.00	523.00	1164.34	2.6	1.3	-
25-year	699.00	688.00	1164.76	3.7	1.9	1.3
100-year	1067.00	1053.00	1165.48	4.9	2.7	2.2

Rainfall Data

Surface-Drained DA = 655 ac
 = 1.02 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: Winneshiek
 Storm Distribution: MSE 4
 Iowa Climactic Section (SUDAS): 3

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	3.04	3.02
5	3.38	3.78	3.77
10	4.50	4.48	4.48
25	5.60	5.56	5.58
50	6.50	6.48	6.52
100	7.60	7.48	7.55



Tributary Watershed Data

Watershed	Area (ac)	Area (sq. mi.)	Tile/Surface Drained	Time of Concentration (min)	Curve Number
Direct Watershed	82	0.13	Surface & Tile	23.9	84
Direct NE	13	0.02	Surface & Tile	22.4	85
East Pond Watershed	46	0.07	Surface & Tile	22.2	84
NW Pond Watershed	56	0.09	Surface & Tile	35.4	83
SW Pond Watershed	71	0.11	Surface & Tile	33.2	81
Direct E Watershed	39	0.06	Surface & Tile	39.6	83
Southwest Watershed	196	0.31	Surface & Tile	57.4	83
Southeast Watershed	152	0.24	Surface & Tile	48.2	83
Surface Total	655	1.02	Average TC (min)		83
Tile Total	655	1.02	Average TC (hr)		1.38

Runoff Curve Number

Surface-Drained DA = 655 ac
 = 1.02 sq mi

See HydroCAD output for curve number calculations

Soil Name ¹	HSG ¹	Typical Cover Type and Hyd. Condition	Portion of W/S percent	CN ²
Example: Marlean Loam	B	Straight Row Crops, Good	1.2%	78
Example: Floyd Loam	B/D	Straight Row Crops, Good	26.3%	78
Example: Racine Loam	C	Straight Row Crops, Good	50.5%	85
Example: Clyde Silt Loam	C/D	Straight Row Crops, Good	21.7%	89

Weighted Curve Number 83.0

References

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

² USDA - NRCS Technical Release 55, Chapter 2, June 1986. Based on typical cover



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IDALS ID Number: WINN981024D

Job: Hauber

BMI Project Number: OT7.134539

Designed By: BCS Date: 8/15/2025

Stage-Storage

Surface-Drained DA = 655 ac

= 1.02 sq mi

Contour Elevation	Area (sq ft)	Area (Acres)	Incremental Volume (Ac-ft)	Cumulative Volume (Ac-ft)	Volume Above Weir (Ac-ft)
1157.00	1400	0.03	0.00	0.00	
1159.00	25500	0.59	0.62	0.62	
1161.00	134400	3.09	3.67	4.29	
1162.00	157300	3.61	3.35	7.64	0.00
1163.00	181000	4.16	3.88	11.52	3.88
1164.00	213500	4.90	4.53	16.05	8.41
1165.00	249200	5.72	5.31	21.36	13.72
1166.00	310700	7.13	6.43	27.79	20.15

Storage at Normal Pool	7.64 Acre-feet
Elevation of weir =	1162.00
Storage at Overflow	21.36 Acre-feet
Elevation =	1165.00

Average Depth = $\frac{\text{storage at normal pool}}{\text{area at normal pool}}$
Average Depth = 2.11 feet

Notes:

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

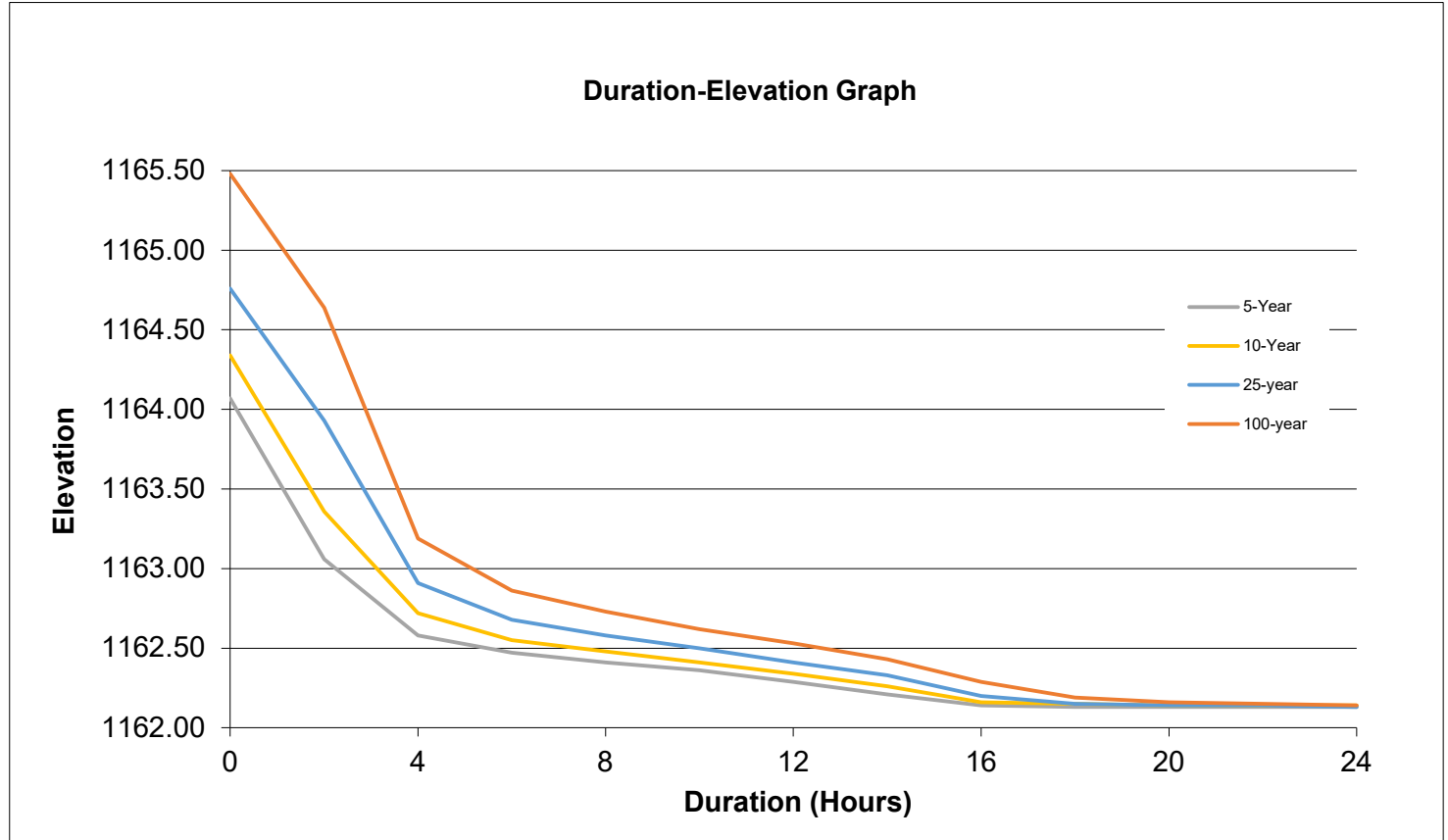
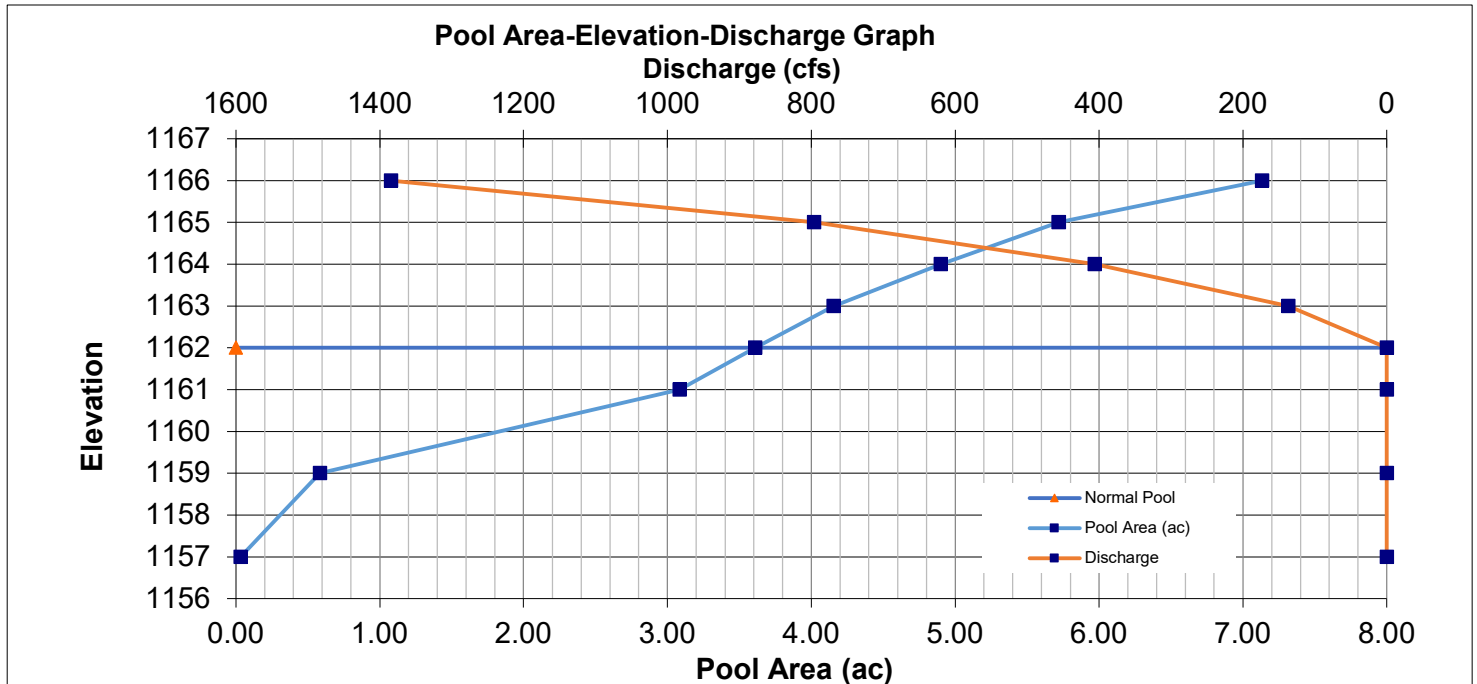


Results

Surface-Drained DA = 655 ac

= 1.02 sq mi

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



Results

Surface-Drained DA = 655 ac

= 1.02 sq mi

The Elevation-Discharge table below shows outflows from the wetland for various elevations.

Elevation	Pool Area (ac)	Chute
1157.00	0.03	0
1159.00	0.59	0
1161.00	3.09	0
1162.00	3.61	0
1163.00	4.16	137
1164.00	4.90	406
1165.00	5.72	796
1166.00	7.13	1384

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

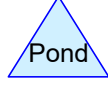
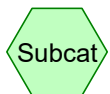
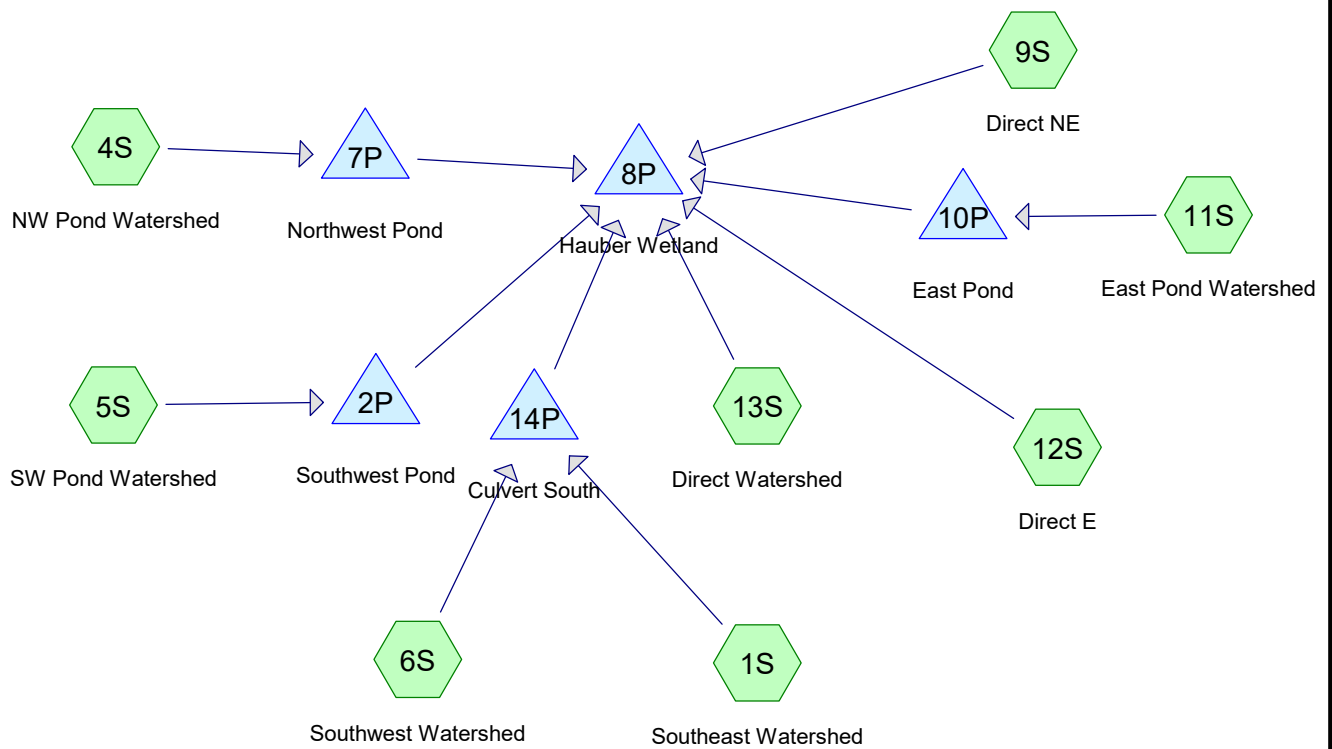
5-year		10-year		25-year		100-year	
Duration	Elevation	Duration	Elevation	Duration	Elevation	Duration	Elevation
0	1164.07	0	1164.34	0	1164.76	0	1165.48
2	1163.06	2	1163.36	2	1163.93	2	1164.64
4	1162.58	4	1162.72	4	1162.91	4	1163.19
6	1162.47	6	1162.55	6	1162.68	6	1162.86
8	1162.41	8	1162.48	8	1162.58	8	1162.73
10	1162.36	10	1162.41	10	1162.50	10	1162.62
12	1162.29	12	1162.34	12	1162.41	12	1162.53
14	1162.21	14	1162.26	14	1162.33	14	1162.43
16	1162.14	16	1162.16	16	1162.20	16	1162.29
18	1162.13	18	1162.15	18	1162.15	18	1162.19
20	1162.13	20	1162.14	20	1162.14	20	1162.16
22	1162.13	22	1162.14	22	1162.14	22	1162.15
24	1162.13	24	1162.14	24	1162.13	24	1162.14

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HydroCAD Output



Routing Diagram for Hauber Chute HydroCAD
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Hauber Chute HydroCAD

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Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	5 Yr	MSE 24-hr	4	Default	24.00	1	3.80	2
2	10 Yr	MSE 24-hr	4	Default	24.00	1	4.50	2
3	25 Yr	MSE 24-hr	4	Default	24.00	1	5.60	2
4	100 Yr	MSE 24-hr	4	Default	24.00	1	7.60	2

Hauber Chute HydroCAD

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Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
6.000	79	1 acre lots, 20% imp, HSG C (4S)
34.000	80	1/2 acre lots, 25% imp, HSG C (5S)
7.000	100	Pond (4S, 5S, 11S)
172.000	78	Row crops, straight row, Good, HSG B (1S, 4S, 5S, 6S, 11S, 12S, 13S)
425.000	85	Row crops, straight row, Good, HSG C (1S, 4S, 5S, 6S, 9S, 11S, 12S, 13S)
5.000	91	Urban industrial, 72% imp, HSG C (11S)
6.000	100	Wetland (13S)
655.000	83	TOTAL AREA

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Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
172.000	HSG B	1S, 4S, 5S, 6S, 11S, 12S, 13S
470.000	HSG C	1S, 4S, 5S, 6S, 9S, 11S, 12S, 13S
0.000	HSG D	
13.000	Other	4S, 5S, 11S, 13S
655.000		TOTAL AREA

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Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	6.000	0.000	0.000	6.000	1 acre lots, 20% imp	4S
0.000	0.000	34.000	0.000	0.000	34.000	1/2 acre lots, 25% imp	5S
0.000	0.000	0.000	0.000	7.000	7.000	Pond	4S, 5S, 11S
0.000	172.000	425.000	0.000	0.000	597.000	Row crops, straight row, Good	1S, 4S, 5S, 6S, 9S, 11S , 12S , 13S
0.000	0.000	5.000	0.000	0.000	5.000	Urban industrial, 72% imp	11S
0.000	0.000	0.000	0.000	6.000	6.000	Wetland	13S
0.000	172.000	470.000	0.000	13.000	655.000	TOTAL AREA	

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Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)	Node Name
1	2P	1,180.00	1,177.00	70.0	0.0429	0.013	0.0	10.0	0.0	
2	7P	1,177.70	1,177.50	62.0	0.0032	0.013	0.0	6.0	0.0	
3	8P	1,155.50	1,154.00	41.0	0.0366	0.013	0.0	12.0	0.0	
4	10P	1,178.10	1,173.00	75.0	0.0680	0.013	0.0	8.0	0.0	
5	14P	1,168.00	1,167.00	103.0	0.0097	0.016	96.0	96.0	0.0	

Hauber Chute HydroCAD

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MSE 24-hr 4 5 Yr Rainfall=3.80"

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Time span=0.00-50.00 hrs, dt=0.05 hrs, 1001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Southeast Watershed Runoff Area=152.000 ac 0.00% Impervious Runoff Depth=2.11"
Flow Length=3,750' Tc=48.2 min CN=83 Runoff=195.62 cfs 26.771 af

Subcatchment 4S: NW Pond Watershed Runoff Area=56.000 ac 7.50% Impervious Runoff Depth=2.11"
Flow Length=2,320' Tc=35.4 min CN=83 Runoff=86.47 cfs 9.863 af

Subcatchment 5S: SW Pond Watershed Runoff Area=71.000 ac 16.20% Impervious Runoff Depth=1.95"
Flow Length=2,100' Tc=33.2 min CN=81 Runoff=105.08 cfs 11.564 af

Subcatchment 6S: Southwest Watershed Runoff Area=196.000 ac 0.00% Impervious Runoff Depth=2.11"
Flow Length=4,140' Tc=57.4 min CN=83 Runoff=225.57 cfs 34.521 af

Subcatchment 9S: Direct NE Runoff Area=13.000 ac 0.00% Impervious Runoff Depth=2.28"
Flow Length=1,245' Tc=22.4 min CN=85 Runoff=27.90 cfs 2.470 af

Subcatchment 11S: East Pond Watershed Runoff Area=46.000 ac 10.00% Impervious Runoff Depth=2.20"
Flow Length=1,600' Tc=22.2 min CN=84 Runoff=95.16 cfs 8.417 af

Subcatchment 12S: Direct E Runoff Area=39.000 ac 0.00% Impervious Runoff Depth=2.11"
Flow Length=2,540' Tc=39.6 min CN=83 Runoff=56.41 cfs 6.869 af

Subcatchment 13S: Direct Watershed Runoff Area=82.000 ac 7.32% Impervious Runoff Depth=2.20"
Flow Length=1,400' Tc=23.9 min CN=84 Runoff=163.68 cfs 15.004 af

Pond 2P: Southwest Pond Peak Elev=1,181.68' Storage=8.718 af Inflow=105.08 cfs 11.564 af
Outflow=4.04 cfs 8.115 af

Pond 7P: Northwest Pond Peak Elev=1,180.51' Storage=7.077 af Inflow=86.47 cfs 9.863 af
Outflow=5.89 cfs 5.484 af

Pond 8P: Hauber Wetland Peak Elev=1,164.07' Storage=15.662 af Inflow=449.17 cfs 106.659 af
Outflow=431.13 cfs 106.337 af

Pond 10P: East Pond Peak Elev=1,181.60' Storage=6.150 af Inflow=95.16 cfs 8.417 af
Outflow=2.99 cfs 7.424 af

Pond 14P: Culvert South Peak Elev=1,174.02' Storage=5.229 af Inflow=416.35 cfs 61.292 af
96.0" x 96.0" Box Culvert n=0.016 L=103.0' S=0.0097 '/' Outflow=343.90 cfs 61.292 af

Total Runoff Area = 655.000 ac Runoff Volume = 115.480 af Average Runoff Depth = 2.12"
95.98% Pervious = 628.700 ac 4.02% Impervious = 26.300 ac

Hauber Chute HydroCAD

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MSE 24-hr 4 5 Yr Rainfall=3.80"

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Summary for Subcatchment 1S: Southeast Watershed

Runoff = 195.62 cfs @ 12.67 hrs, Volume= 26.771 af, Depth= 2.11"
Routed to Pond 14P : Culvert South

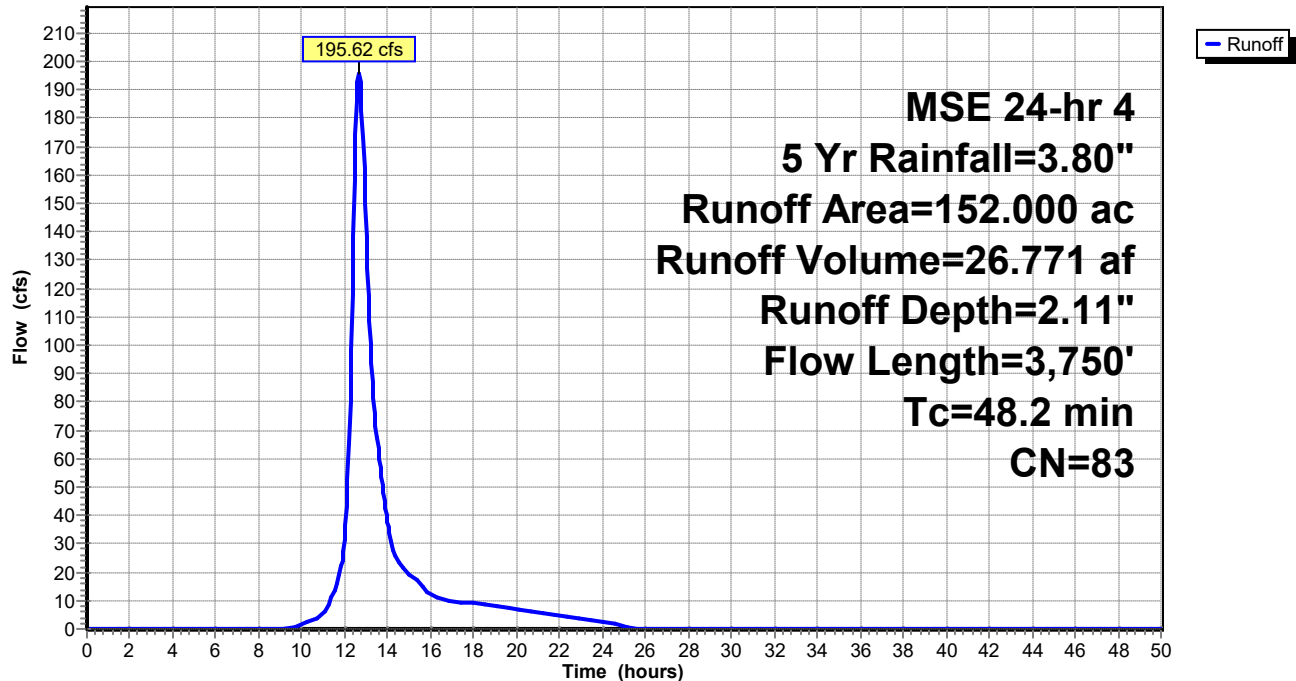
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
MSE 24-hr 4 5 Yr Rainfall=3.80"

Area (ac)	CN	Description
41.000	78	Row crops, straight row, Good, HSG B
111.000	85	Row crops, straight row, Good, HSG C
152.000	83	Weighted Average
152.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.0	100	0.0200	0.15		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 3.10"
7.8	750	0.0320	1.61		Shallow Concentrated Flow, Shallow Crop Cultivated Straight Rows Kv= 9.0 fps
29.4	2,900	0.0120	1.64		Shallow Concentrated Flow, Grassed Grassed Waterway Kv= 15.0 fps
48.2	3,750	Total			

Subcatchment 1S: Southeast Watershed

Hydrograph



Hauber Chute HydroCAD

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MSE 24-hr 4 5 Yr Rainfall=3.80"

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Summary for Subcatchment 4S: NW Pond Watershed

Runoff = 86.47 cfs @ 12.50 hrs, Volume= 9.863 af, Depth= 2.11"
Routed to Pond 7P : Northwest Pond

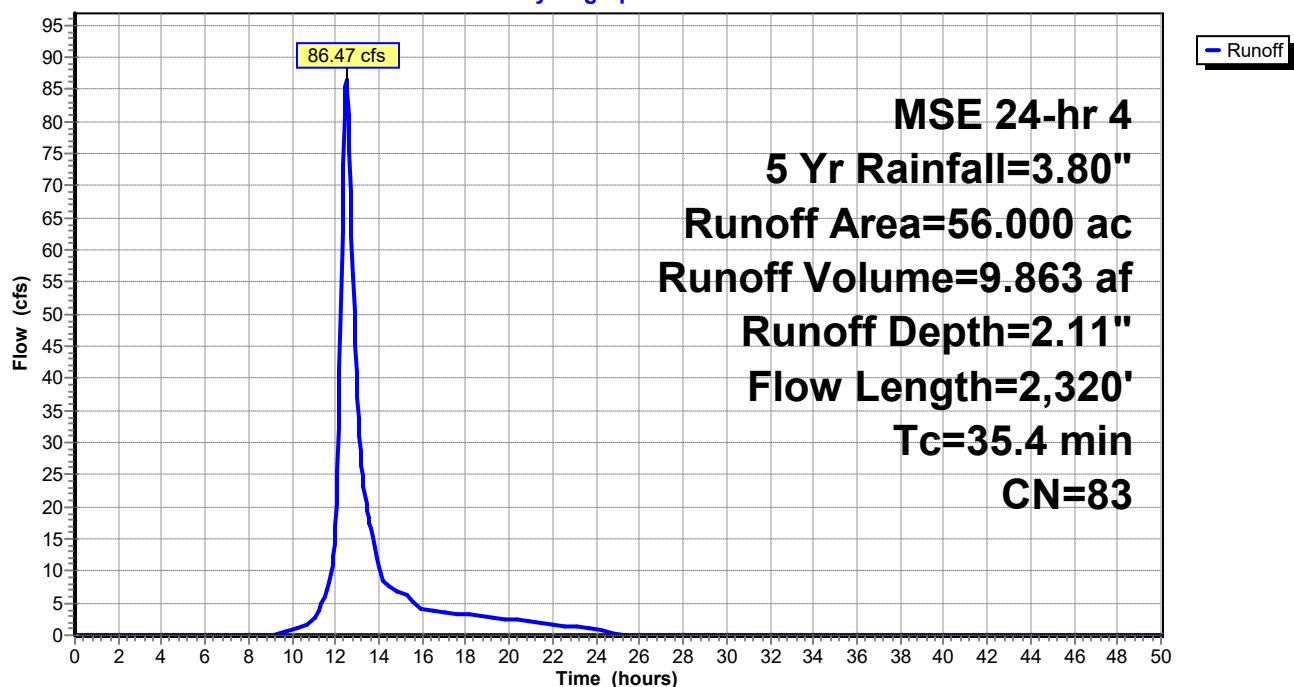
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
MSE 24-hr 4 5 Yr Rainfall=3.80"

Area (ac)	CN	Description
32.000	85	Row crops, straight row, Good, HSG C
15.000	78	Row crops, straight row, Good, HSG B
6.000	79	1 acre lots, 20% imp, HSG C
* 3.000	100	Pond
56.000	83	Weighted Average
51.800		92.50% Pervious Area
4.200		7.50% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.1	100	0.0100	0.09		Sheet Flow, Grass: Dense n= 0.240 P2= 3.10"
16.3	2,220	0.0230	2.27		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
35.4	2,320	Total			

Subcatchment 4S: NW Pond Watershed

Hydrograph



Hauber Chute HydroCAD

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MSE 24-hr 4 5 Yr Rainfall=3.80"

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Summary for Subcatchment 5S: SW Pond Watershed

Runoff = 105.08 cfs @ 12.47 hrs, Volume= 11.564 af, Depth= 1.95"
Routed to Pond 2P : Southwest Pond

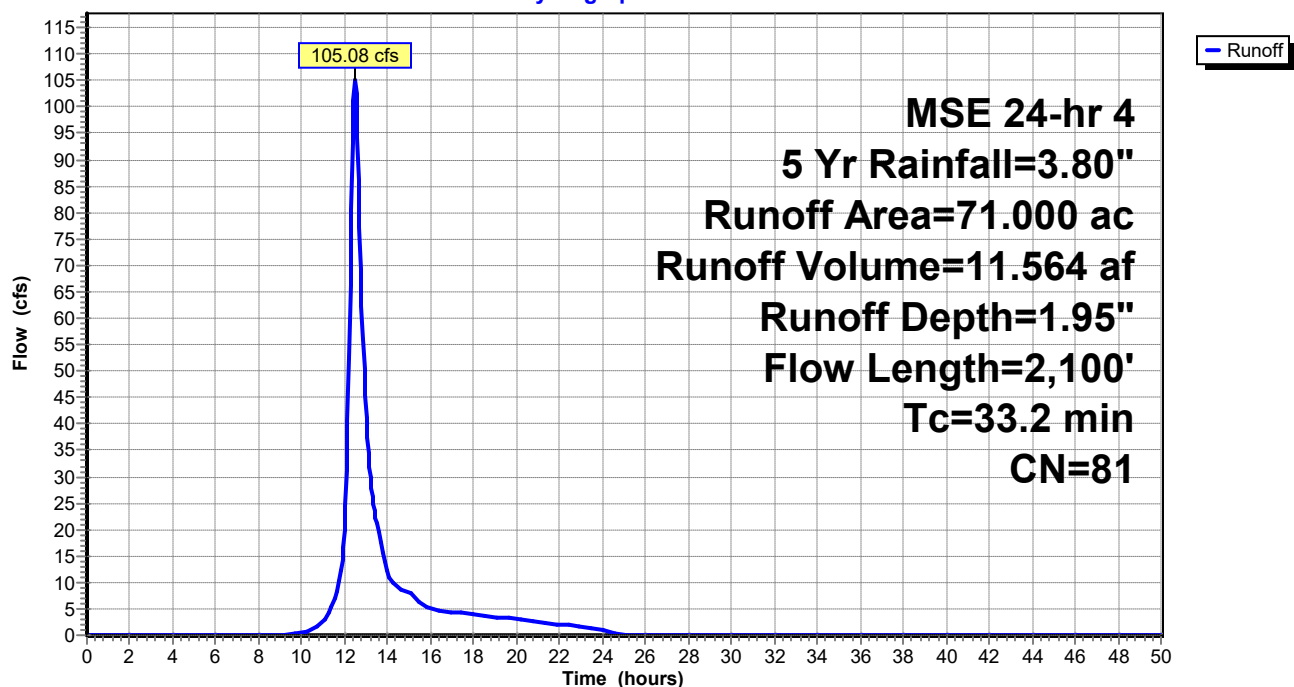
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
MSE 24-hr 4 5 Yr Rainfall=3.80"

Area (ac)	CN	Description
34.000	80	1/2 acre lots, 25% imp, HSG C
19.000	78	Row crops, straight row, Good, HSG B
* 3.000	100	Pond
15.000	85	Row crops, straight row, Good, HSG C
71.000	81	Weighted Average
59.500		83.80% Pervious Area
11.500		16.20% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.1	100	0.0100	0.09		Sheet Flow, Grass: Dense n= 0.240 P2= 3.10"
14.1	2,000	0.0250	2.37		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
33.2	2,100	Total			

Subcatchment 5S: SW Pond Watershed

Hydrograph



Summary for Subcatchment 6S: Southwest Watershed

Runoff = 225.57 cfs @ 12.79 hrs, Volume= 34.521 af, Depth= 2.11"
 Routed to Pond 14P : Culvert South

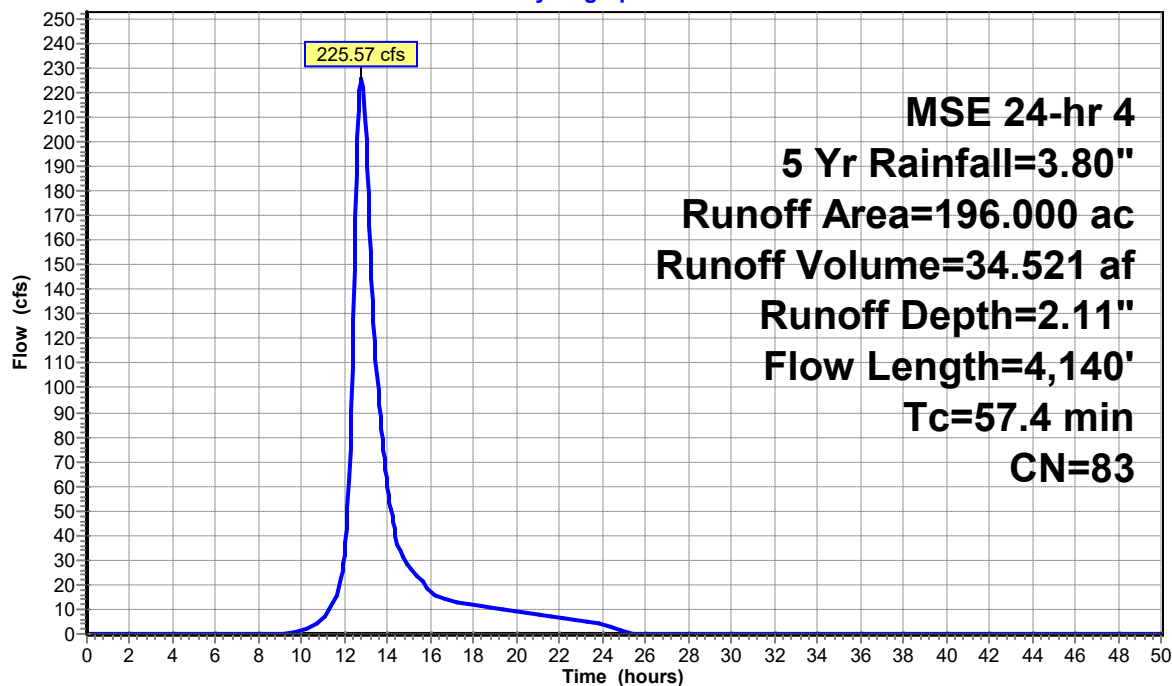
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 MSE 24-hr 4 5 Yr Rainfall=3.80"

Area (ac)	CN	Description
53.000	78	Row crops, straight row, Good, HSG B
143.000	85	Row crops, straight row, Good, HSG C
196.000	83	Weighted Average
196.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.4	100	0.0300	0.18		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 3.10"
18.0	1,340	0.0190	1.24		Shallow Concentrated Flow, Crops Cultivated Straight Rows Kv= 9.0 fps
30.0	2,700	0.0100	1.50		Shallow Concentrated Flow, Grassed Grassed Waterway Kv= 15.0 fps
57.4	4,140	Total			

Subcatchment 6S: Southwest Watershed

Hydrograph



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MSE 24-hr 4 5 Yr Rainfall=3.80"

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Summary for Subcatchment 9S: Direct NE

Runoff = 27.90 cfs @ 12.32 hrs, Volume= 2.470 af, Depth= 2.28"
Routed to Pond 8P : Hauber Wetland

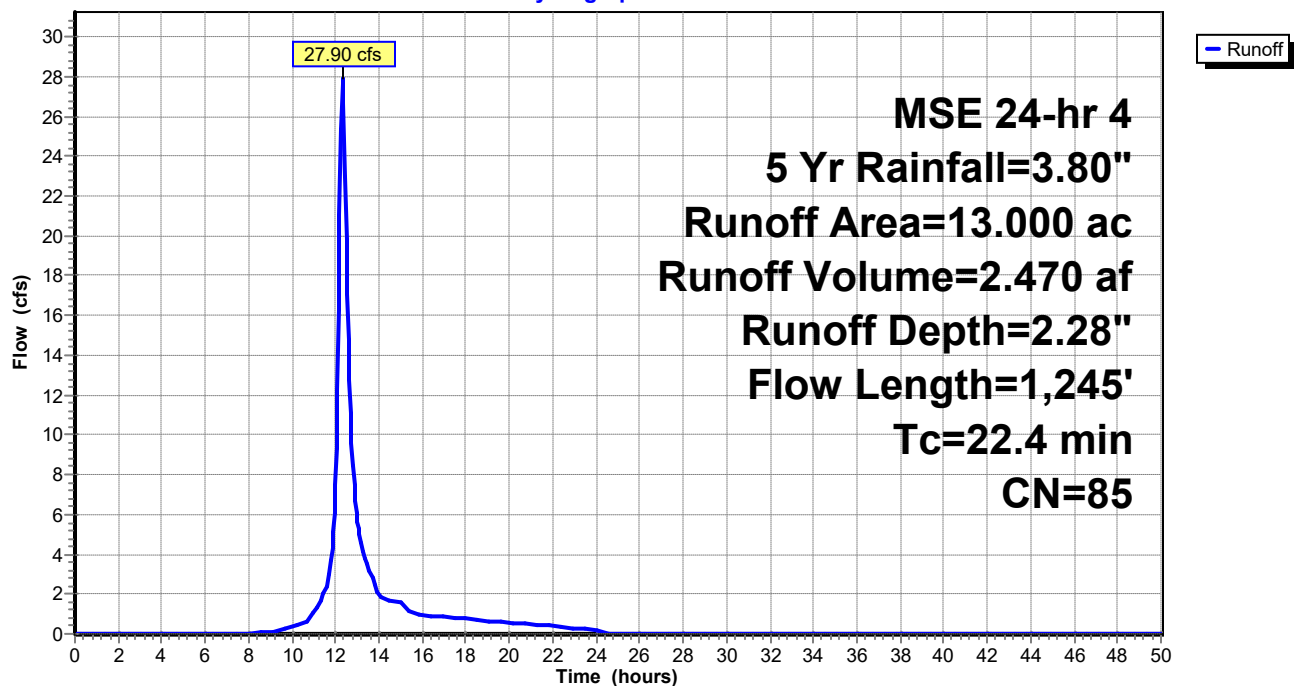
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
MSE 24-hr 4 5 Yr Rainfall=3.80"

Area (ac)	CN	Description
13.000	85	Row crops, straight row, Good, HSG C
13.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.5	100	0.0100	0.11		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 3.10"
5.1	600	0.0467	1.94		Shallow Concentrated Flow, Crop Cultivated Straight Rows Kv= 9.0 fps
2.8	545	0.0470	3.25		Shallow Concentrated Flow, Grass Grassed Waterway Kv= 15.0 fps
22.4	1,245	Total			

Subcatchment 9S: Direct NE

Hydrograph



Summary for Subcatchment 11S: East Pond Watershed

Runoff = 95.16 cfs @ 12.32 hrs, Volume= 8.417 af, Depth= 2.20"
 Routed to Pond 10P : East Pond

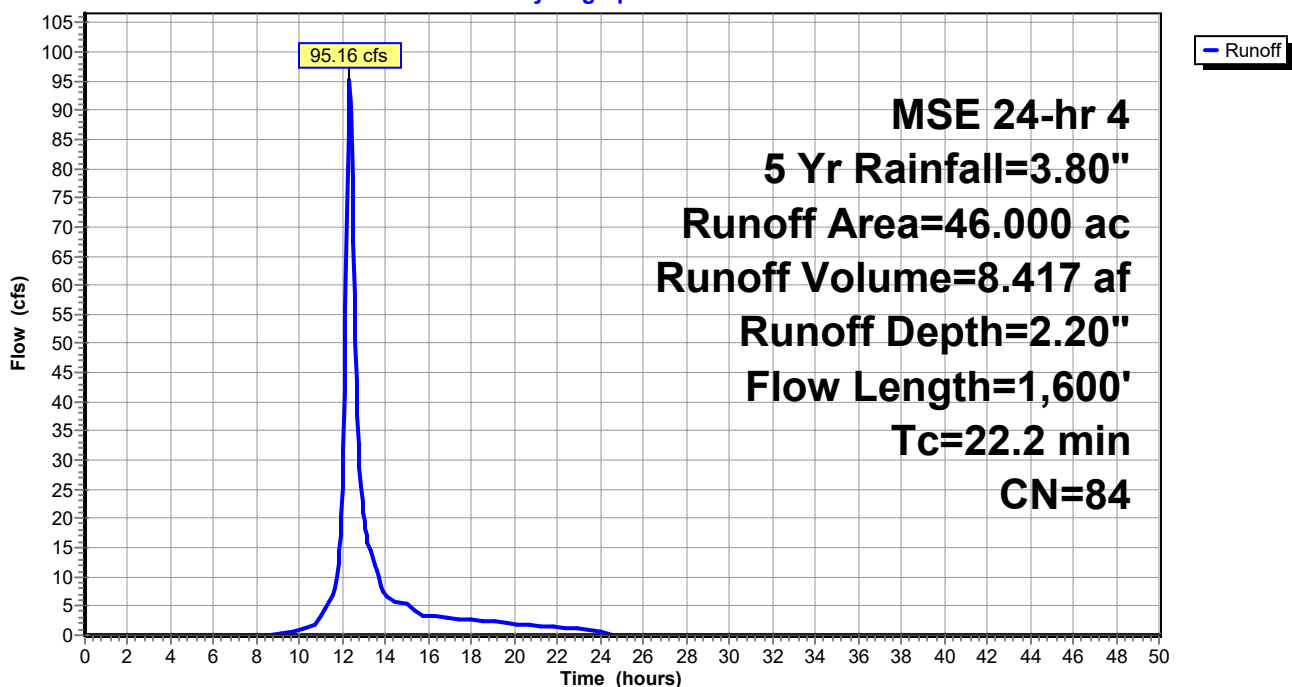
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 MSE 24-hr 4 5 Yr Rainfall=3.80"

Area (ac)	CN	Description
* 1.000	100	Pond
5.000	91	Urban industrial, 72% imp, HSG C
12.000	78	Row crops, straight row, Good, HSG B
28.000	85	Row crops, straight row, Good, HSG C
46.000	84	Weighted Average
41.400		90.00% Pervious Area
4.600		10.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.7	100	0.0700	0.25		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 3.10"
15.5	1,500	0.0320	1.61		Shallow Concentrated Flow, Cultivated Straight Rows Kv= 9.0 fps
22.2	1,600	Total			

Subcatchment 11S: East Pond Watershed

Hydrograph



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MSE 24-hr 4 5 Yr Rainfall=3.80"

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Summary for Subcatchment 12S: Direct E

Runoff = 56.41 cfs @ 12.55 hrs, Volume= 6.869 af, Depth= 2.11"
Routed to Pond 8P : Hauber Wetland

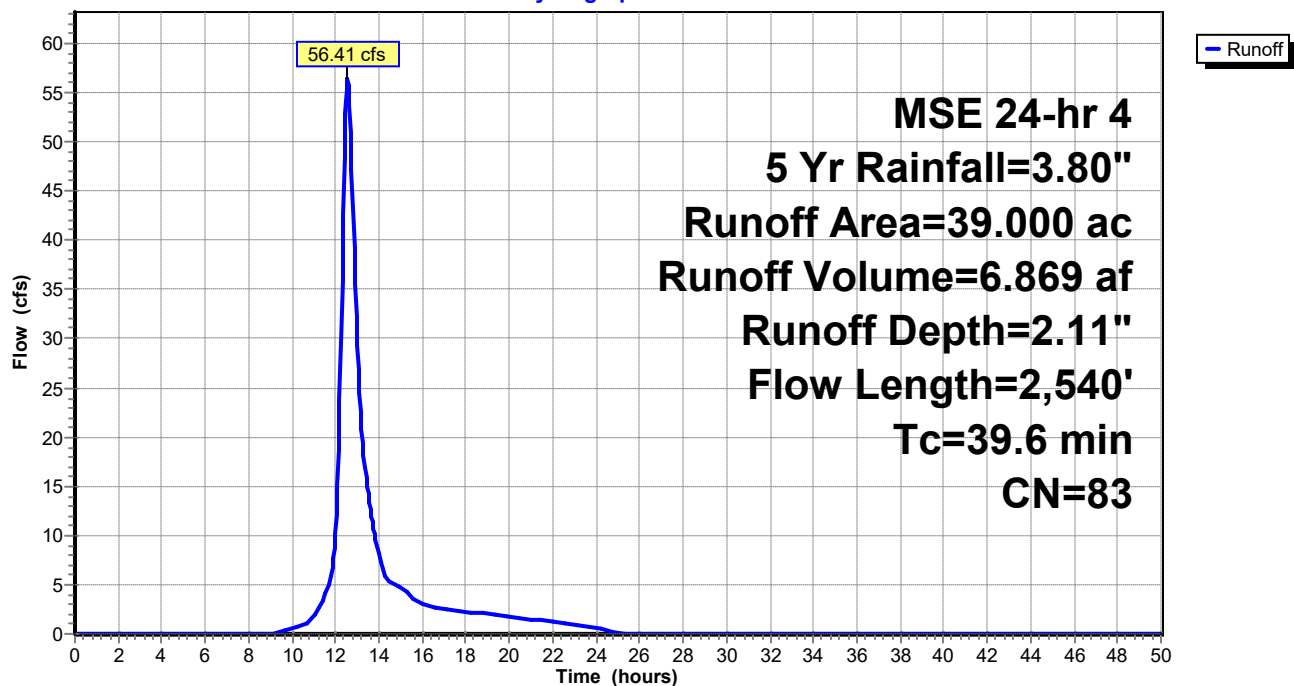
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
MSE 24-hr 4 5 Yr Rainfall=3.80"

Area (ac)	CN	Description
10.000	78	Row crops, straight row, Good, HSG B
29.000	85	Row crops, straight row, Good, HSG C
39.000	83	Weighted Average
39.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.6	100	0.0500	0.22		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 3.10"
32.0	2,440	0.0200	1.27		Shallow Concentrated Flow, Crops Cultivated Straight Rows Kv= 9.0 fps
39.6	2,540	Total			

Subcatchment 12S: Direct E

Hydrograph



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MSE 24-hr 4 5 Yr Rainfall=3.80"

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Summary for Subcatchment 13S: Direct Watershed

Runoff = 163.68 cfs @ 12.35 hrs, Volume= 15.004 af, Depth= 2.20"
Routed to Pond 8P : Hauber Wetland

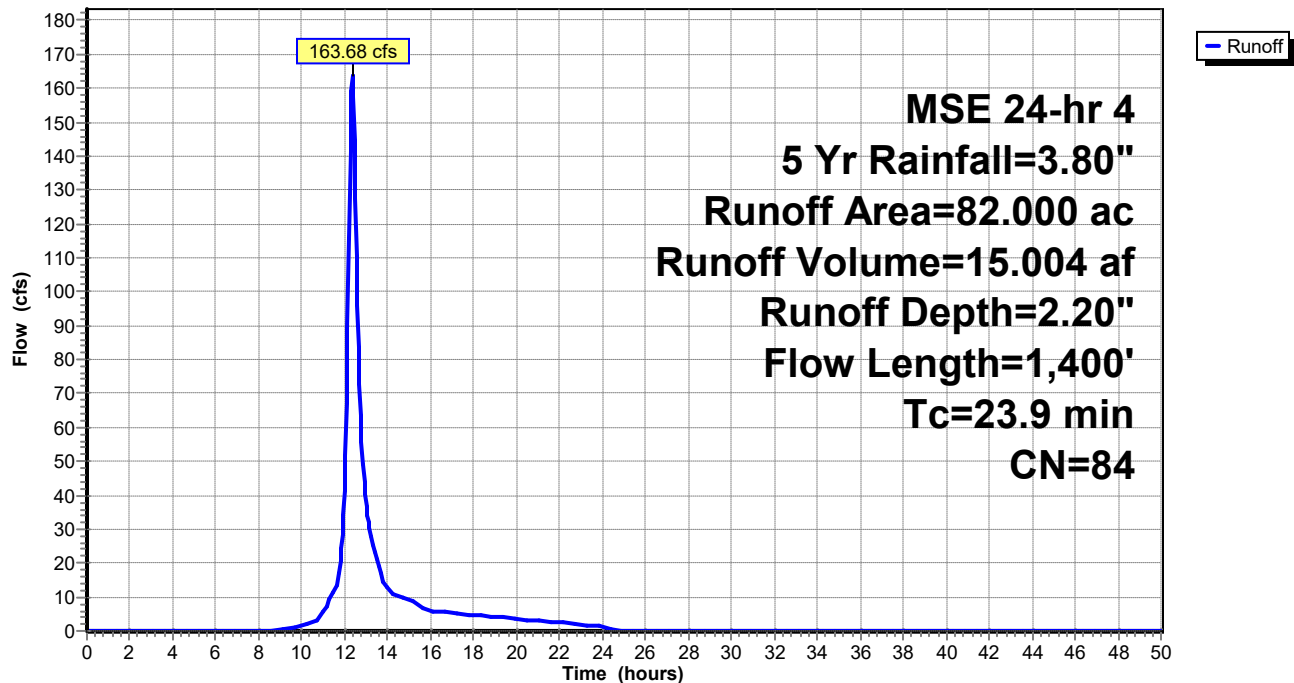
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
MSE 24-hr 4 5 Yr Rainfall=3.80"

Area (ac)	CN	Description
* 6.000	100	Wetland
22.000	78	Row crops, straight row, Good, HSG B
54.000	85	Row crops, straight row, Good, HSG C
82.000	84	Weighted Average
76.000		92.68% Pervious Area
6.000		7.32% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0	100	0.0200	0.17		Sheet Flow, Grass: Short n= 0.150 P2= 3.10"
13.9	1,300	0.0300	1.56		Shallow Concentrated Flow, Cultivated Straight Rows Kv= 9.0 fps
23.9	1,400	Total			

Subcatchment 13S: Direct Watershed

Hydrograph



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MSE 24-hr 4 5 Yr Rainfall=3.80"

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Summary for Pond 2P: Southwest Pond

Inflow Area = 71.000 ac, 16.20% Impervious, Inflow Depth = 1.95" for 5 Yr event
 Inflow = 105.08 cfs @ 12.47 hrs, Volume= 11.564 af
 Outflow = 4.04 cfs @ 17.73 hrs, Volume= 8.115 af, Atten= 96%, Lag= 315.3 min
 Primary = 4.04 cfs @ 17.73 hrs, Volume= 8.115 af
 Routed to Pond 8P : Hauber Wetland

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 1,181.68' @ 17.73 hrs Surf.Area= 6.454 ac Storage= 8.718 af

Plug-Flow detention time= 960.5 min calculated for 8.115 af (70% of inflow)
 Center-of-Mass det. time= 874.4 min (1,716.8 - 842.5)

Volume	Invert	Avail.Storage	Storage Description
#1	1,180.00'	85.805 af	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,180.00	3.980	0.000	0.000
1,181.00	5.410	4.695	4.695
1,182.00	6.950	6.180	10.875
1,183.00	8.600	7.775	18.650
1,184.00	10.360	9.480	28.130
1,185.00	12.270	11.315	39.445
1,186.00	14.340	13.305	52.750
1,187.00	16.520	15.430	68.180
1,188.00	18.730	17.625	85.805

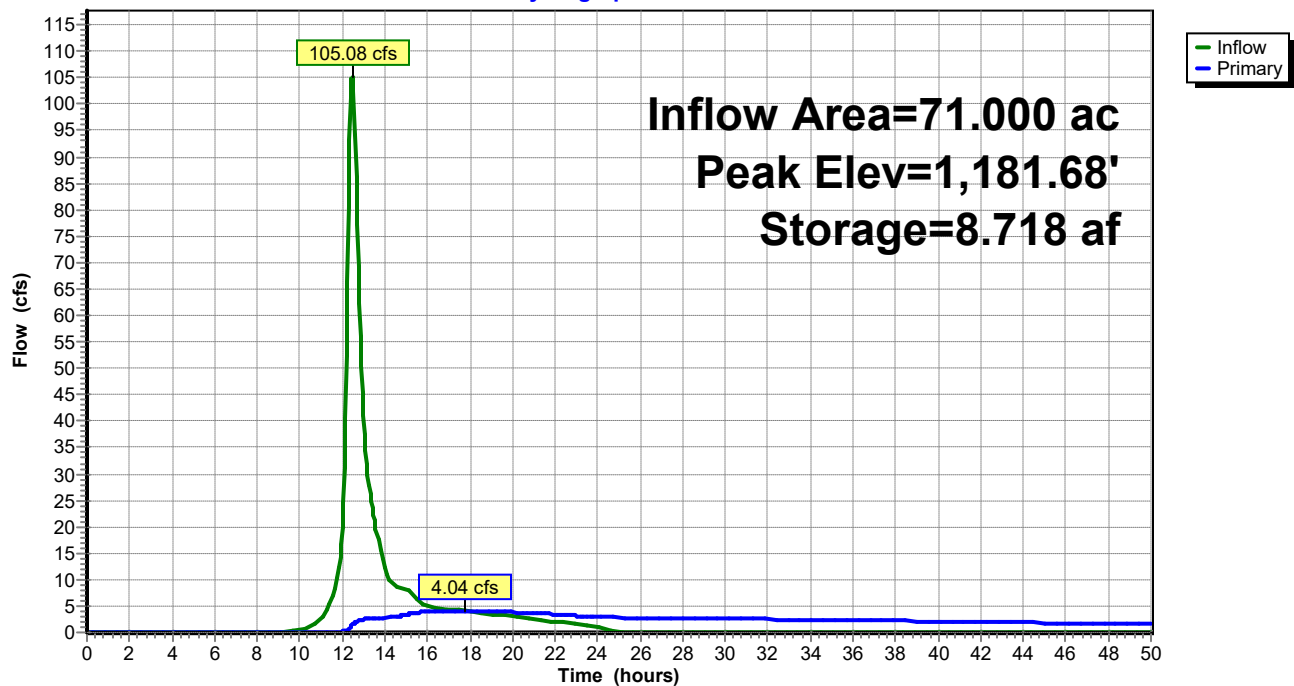
Device	Routing	Invert	Outlet Devices
#1	Primary	1,180.00'	10.0" Round Culvert L= 70.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 1,180.00' / 1,177.00' S= 0.0429 ' / ' Cc= 0.900 n= 0.013, Flow Area= 0.55 sf
#2	Primary	1,181.60'	20.0' long + 4.0 ' / ' SideZ x 3.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32
#3	Primary	1,182.80'	700.0' long + 4.0 ' / ' SideZ x 10.0' 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) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=4.03 cfs @ 17.73 hrs HW=1,181.68' (Free Discharge)

- 1=Culvert (Inlet Controls 2.95 cfs @ 5.41 fps)
 2=Broad-Crested Rectangular Weir (Weir Controls 1.08 cfs @ 0.68 fps)
 3=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Pond 2P: Southwest Pond

Hydrograph



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MSE 24-hr 4 5 Yr Rainfall=3.80"

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Summary for Pond 7P: Northwest Pond

Inflow Area = 56.000 ac, 7.50% Impervious, Inflow Depth = 2.11" for 5 Yr event
Inflow = 86.47 cfs @ 12.50 hrs, Volume= 9.863 af
Outflow = 5.89 cfs @ 15.36 hrs, Volume= 5.484 af, Atten= 93%, Lag= 171.6 min
Primary = 5.89 cfs @ 15.36 hrs, Volume= 5.484 af
Routed to Pond 8P : Hauber Wetland

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 1,180.51' @ 15.36 hrs Surf.Area= 3.692 ac Storage= 7.077 af

Plug-Flow detention time= 724.6 min calculated for 5.484 af (56% of inflow)
Center-of-Mass det. time= 628.2 min (1,467.6 - 839.4)

Volume	Invert	Avail.Storage	Storage Description
#1	1,177.70'	33.835 af	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,177.70	1.420	0.000	0.000
1,178.00	1.650	0.460	0.460
1,179.00	2.410	2.030	2.490
1,180.00	3.220	2.815	5.305
1,181.00	4.140	3.680	8.985
1,182.00	5.130	4.635	13.620
1,183.00	6.240	5.685	19.305
1,184.00	7.270	6.755	26.060
1,185.00	8.280	7.775	33.835

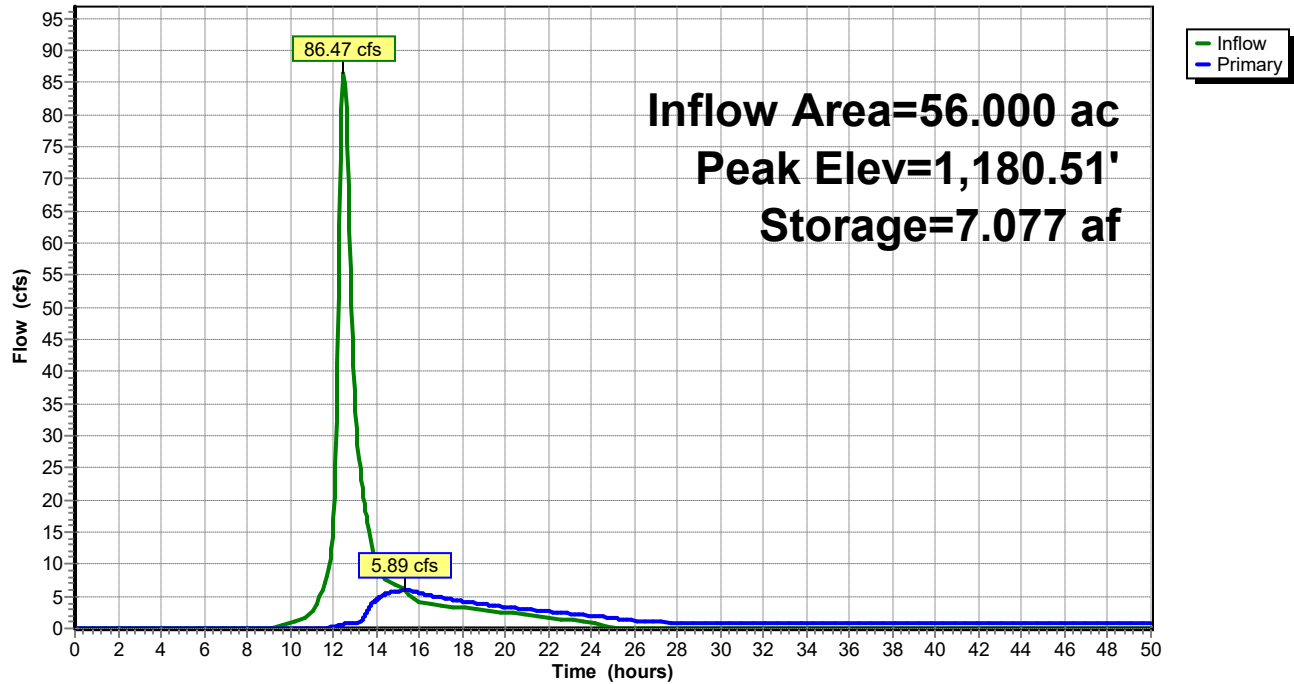
Device	Routing	Invert	Outlet Devices
#1	Primary	1,177.70'	6.0" Round Culvert L= 62.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 1,177.70' / 1,177.50' S= 0.0032 '/' Cc= 0.900 n= 0.013, Flow Area= 0.20 sf
#2	Primary	1,180.20'	10.0' long + 4.0 ' SideZ x 10.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#3	Primary	1,182.20'	550.0' long + 4.0 ' SideZ x 10.0' 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) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=5.85 cfs @ 15.36 hrs HW=1,180.51' (Free Discharge)

- 1=Culvert (Barrel Controls 0.99 cfs @ 5.03 fps)
- 2=Broad-Crested Rectangular Weir (Weir Controls 4.87 cfs @ 1.38 fps)
- 3=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Pond 7P: Northwest Pond

Hydrograph



Summary for Pond 8P: Hauber Wetland

Inflow Area = 655.000 ac, 4.02% Impervious, Inflow Depth > 1.95" for 5 Yr event
 Inflow = 449.17 cfs @ 12.59 hrs, Volume= 106.659 af
 Outflow = 431.13 cfs @ 12.92 hrs, Volume= 106.337 af, Atten= 4%, Lag= 19.8 min
 Primary = 431.13 cfs @ 12.92 hrs, Volume= 106.337 af

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Starting Elev= 1,162.00' Surf.Area= 3.600 ac Storage= 6.845 af
 Peak Elev= 1,164.07' @ 12.92 hrs Surf.Area= 4.960 ac Storage= 15.662 af (8.817 af above start)

Plug-Flow detention time= 141.7 min calculated for 99.392 af (93% of inflow)
 Center-of-Mass det. time= 19.9 min (1,030.1 - 1,010.2)

Volume	Invert	Avail.Storage	Storage Description
#1	1,155.00'	26.995 af	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,155.00	0.000	0.000	0.000
1,156.00	0.020	0.010	0.010
1,158.00	0.130	0.150	0.160
1,159.00	0.660	0.395	0.555
1,160.00	1.060	0.860	1.415
1,161.00	3.100	2.080	3.495
1,162.00	3.600	3.350	6.845
1,163.00	4.200	3.900	10.745
1,164.00	4.900	4.550	15.295
1,165.00	5.700	5.300	20.595
1,166.00	7.100	6.400	26.995

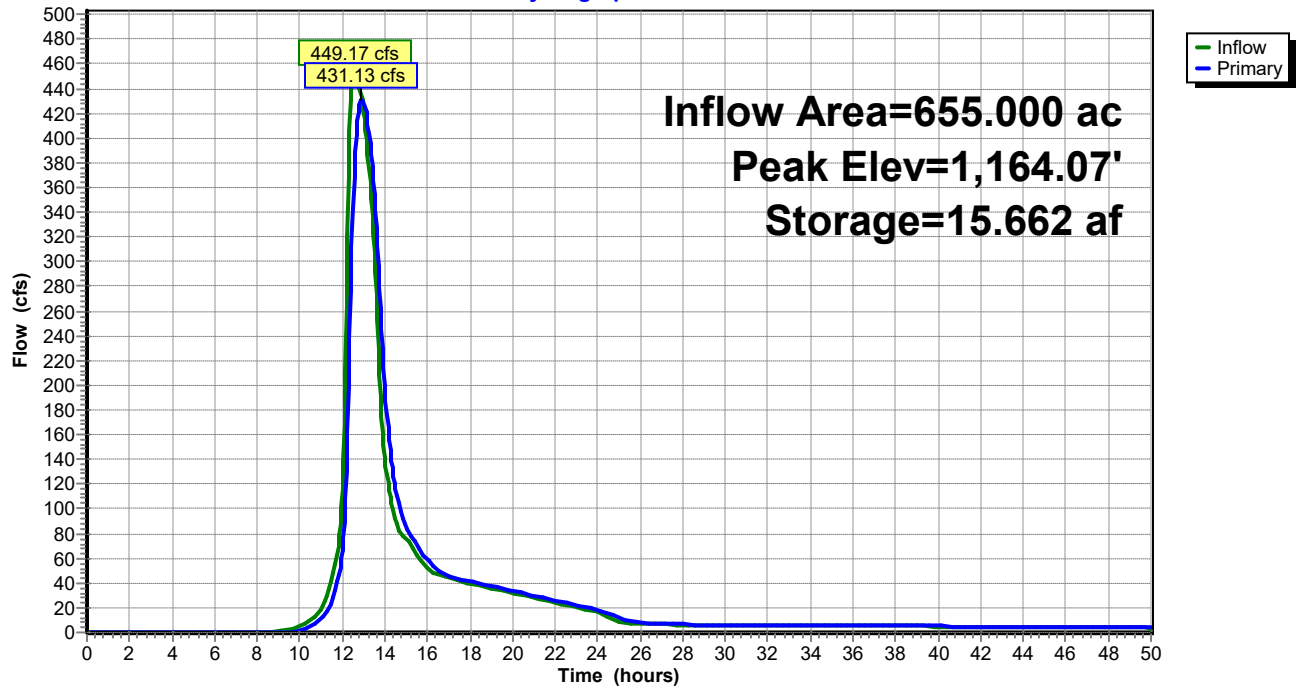
Device	Routing	Invert	Outlet Devices
#1	Primary	1,164.80'	25.0' long + 3.0 ' SideZ x 20.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#2	Primary	1,162.00'	48.0' long + 4.0 ' SideZ x 10.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#3	Primary	1,155.50'	12.0" Round Drawdown Pipe L= 41.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 1,155.50' / 1,154.00' S= 0.0366 ' / ' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#4	Device 3	1,165.50'	3.0' long Sharp-Crested Rectangular Weir 2 End Contraction(s)

Primary OutFlow Max=430.79 cfs @ 12.92 hrs HW=1,164.07' (Free Discharge)

- 1=Broad-Crested Rectangular Weir (Controls 0.00 cfs)
- 2=Broad-Crested Rectangular Weir (Weir Controls 430.79 cfs @ 3.69 fps)
- 3=Drawdown Pipe (Passes 0.00 cfs of 10.75 cfs potential flow)
- 4=Sharp-Crested Rectangular Weir (Controls 0.00 cfs)

Pond 8P: Hauber Wetland

Hydrograph



Hauber Chute HydroCAD

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MSE 24-hr 4 5 Yr Rainfall=3.80"

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Summary for Pond 10P: East Pond

Inflow Area = 46.000 ac, 10.00% Impervious, Inflow Depth = 2.20" for 5 Yr event
 Inflow = 95.16 cfs @ 12.32 hrs, Volume= 8.417 af
 Outflow = 2.99 cfs @ 16.84 hrs, Volume= 7.424 af, Atten= 97%, Lag= 270.9 min
 Primary = 2.99 cfs @ 16.84 hrs, Volume= 7.424 af
 Routed to Pond 8P : Hauber Wetland

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 1,181.60' @ 16.84 hrs Surf.Area= 2.626 ac Storage= 6.150 af

Plug-Flow detention time= 938.2 min calculated for 7.417 af (88% of inflow)
 Center-of-Mass det. time= 888.3 min (1,712.9 - 824.6)

Volume	Invert	Avail.Storage	Storage Description
#1	1,178.00'	18.780 af	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,178.00	0.950	0.000	0.000
1,179.00	1.300	1.125	1.125
1,180.00	1.770	1.535	2.660
1,181.00	2.280	2.025	4.685
1,182.00	2.860	2.570	7.255
1,183.00	3.490	3.175	10.430
1,184.00	4.160	3.825	14.255
1,185.00	4.890	4.525	18.780

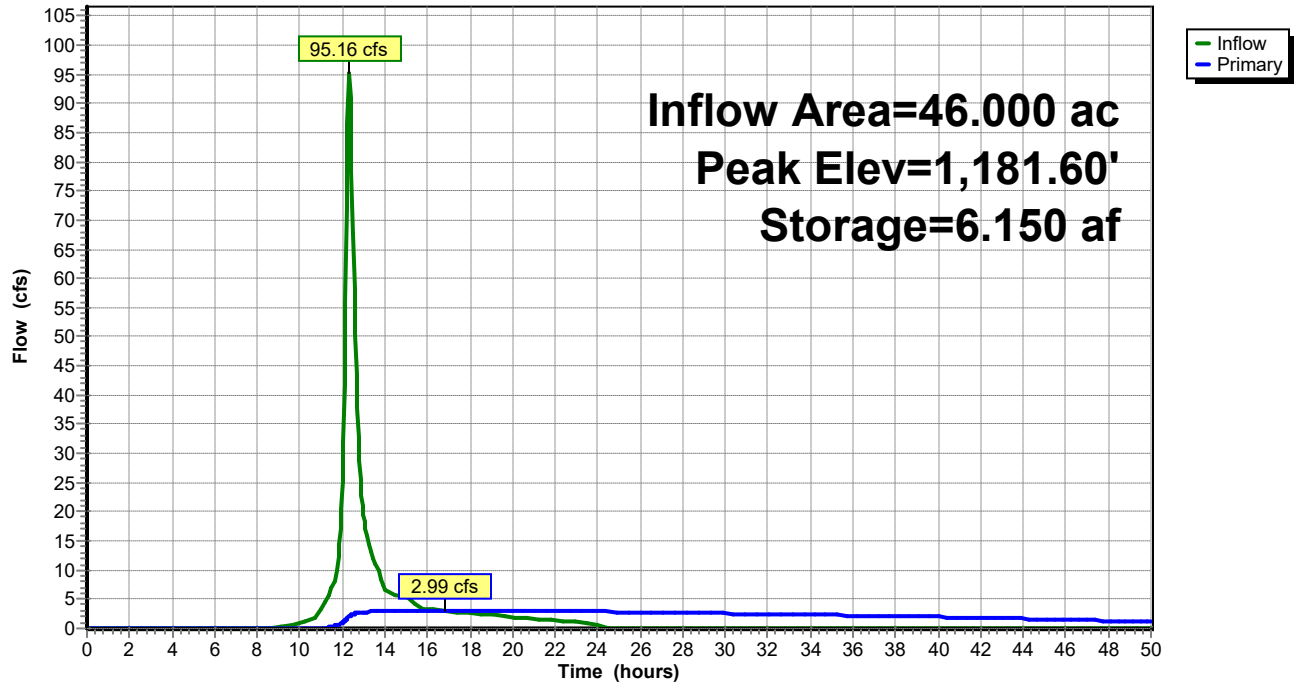
Device	Routing	Invert	Outlet Devices
#1	Primary	1,178.10'	8.0" Round Culvert L= 75.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 1,178.10' / 1,173.00' S= 0.0680 ' / ' Cc= 0.900 n= 0.013, Flow Area= 0.35 sf
#2	Primary	1,182.20'	12.0' long + 4.0 ' / ' SideZ x 10.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=2.99 cfs @ 16.84 hrs HW=1,181.60' (Free Discharge)

1=Culvert (Inlet Controls 2.99 cfs @ 8.56 fps)
 2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Pond 10P: East Pond

Hydrograph



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MSE 24-hr 4 5 Yr Rainfall=3.80"

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Summary for Pond 14P: Culvert South

Inflow Area = 348.000 ac, 0.00% Impervious, Inflow Depth = 2.11" for 5 Yr event
 Inflow = 416.35 cfs @ 12.72 hrs, Volume= 61.292 af
 Outflow = 343.90 cfs @ 12.99 hrs, Volume= 61.292 af, Atten= 17%, Lag= 16.3 min
 Primary = 343.90 cfs @ 12.99 hrs, Volume= 61.292 af
 Routed to Pond 8P : Hauber Wetland

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 1,174.02' @ 12.99 hrs Surf.Area= 3.237 ac Storage= 5.229 af

Plug-Flow detention time= 5.8 min calculated for 61.231 af (100% of inflow)
 Center-of-Mass det. time= 5.8 min (861.9 - 856.1)

Volume	Invert	Avail.Storage	Storage Description
#1	1,168.00'	34.340 af	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,168.00	0.020	0.000	0.000
1,170.00	0.280	0.300	0.300
1,172.00	0.690	0.970	1.270
1,174.00	3.190	3.880	5.150
1,176.00	7.000	10.190	15.340
1,178.00	12.000	19.000	34.340

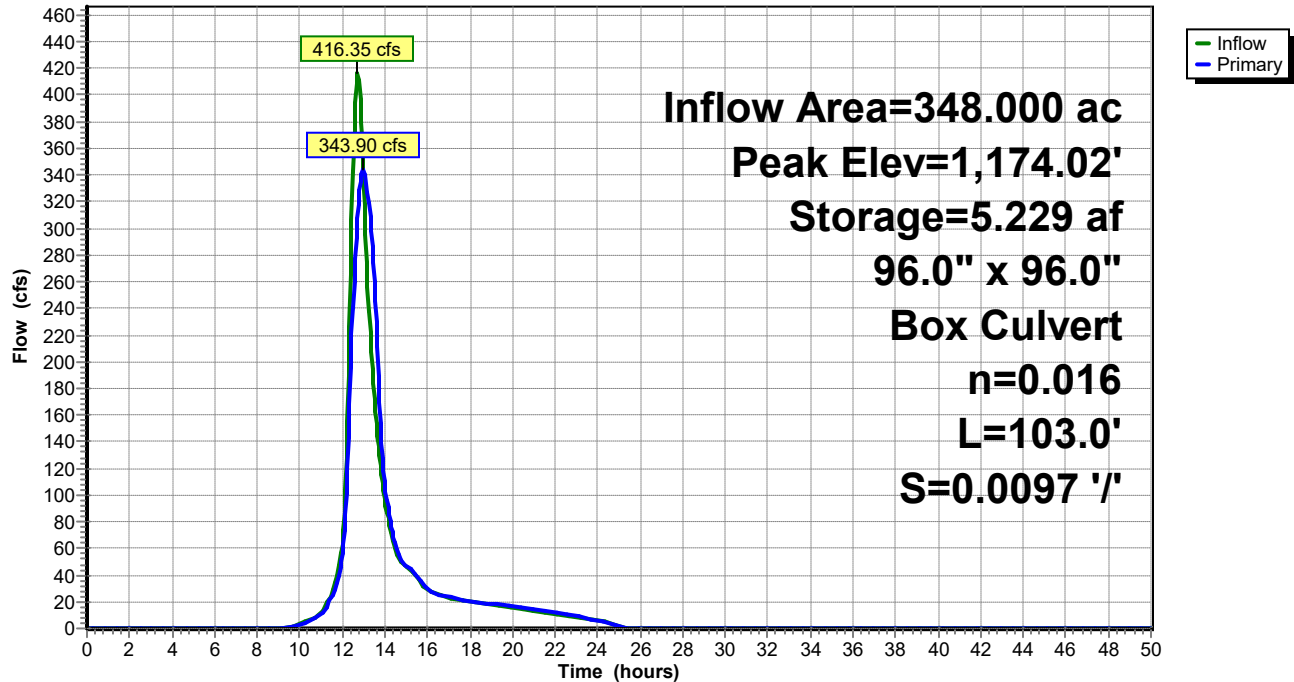
Device	Routing	Invert	Outlet Devices
#1	Primary	1,168.00'	96.0" W x 96.0" H Box Culvert L= 103.0' Box, 10-30° wingwalls, square crown, Ke= 0.500 Inlet / Outlet Invert= 1,168.00' / 1,167.00' S= 0.0097 ' / ' Cc= 0.900 n= 0.016, Flow Area= 64.00 sf

Primary OutFlow Max=343.72 cfs @ 12.99 hrs HW=1,174.02' (Free Discharge)

↑ **1=Culvert** (Barrel Controls 343.72 cfs @ 9.51 fps)

Pond 14P: Culvert South

Hydrograph



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MSE 24-hr 4 10 Yr Rainfall=4.50"

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Time span=0.00-50.00 hrs, dt=0.05 hrs, 1001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Southeast Watershed Runoff Area=152.000 ac 0.00% Impervious Runoff Depth=2.73"
Flow Length=3,750' Tc=48.2 min CN=83 Runoff=252.37 cfs 34.524 af

Subcatchment 4S: NW Pond Watershed Runoff Area=56.000 ac 7.50% Impervious Runoff Depth=2.73"
Flow Length=2,320' Tc=35.4 min CN=83 Runoff=111.47 cfs 12.719 af

Subcatchment 5S: SW Pond Watershed Runoff Area=71.000 ac 16.20% Impervious Runoff Depth=2.55"
Flow Length=2,100' Tc=33.2 min CN=81 Runoff=137.32 cfs 15.076 af

Subcatchment 6S: Southwest Watershed Runoff Area=196.000 ac 0.00% Impervious Runoff Depth=2.73"
Flow Length=4,140' Tc=57.4 min CN=83 Runoff=291.13 cfs 44.518 af

Subcatchment 9S: Direct NE Runoff Area=13.000 ac 0.00% Impervious Runoff Depth=2.91"
Flow Length=1,245' Tc=22.4 min CN=85 Runoff=35.45 cfs 3.152 af

Subcatchment 11S: East Pond Watershed Runoff Area=46.000 ac 10.00% Impervious Runoff Depth=2.82"
Flow Length=1,600' Tc=22.2 min CN=84 Runoff=121.70 cfs 10.797 af

Subcatchment 12S: Direct E Runoff Area=39.000 ac 0.00% Impervious Runoff Depth=2.73"
Flow Length=2,540' Tc=39.6 min CN=83 Runoff=72.72 cfs 8.858 af

Subcatchment 13S: Direct Watershed Runoff Area=82.000 ac 7.32% Impervious Runoff Depth=2.82"
Flow Length=1,400' Tc=23.9 min CN=84 Runoff=209.33 cfs 19.247 af

Pond 2P: Southwest Pond Peak Elev=1,181.90' Storage=10.158 af Inflow=137.32 cfs 15.076 af
Outflow=11.71 cfs 11.485 af

Pond 7P: Northwest Pond Peak Elev=1,180.79' Storage=8.138 af Inflow=111.47 cfs 12.719 af
Outflow=15.55 cfs 8.306 af

Pond 8P: Hauber Wetland Peak Elev=1,164.34' Storage=16.992 af Inflow=546.75 cfs 138.995 af
Outflow=523.33 cfs 138.629 af

Pond 10P: East Pond Peak Elev=1,182.27' Storage=8.044 af Inflow=121.70 cfs 10.797 af
Outflow=3.84 cfs 8.907 af

Pond 14P: Culvert South Peak Elev=1,174.88' Storage=8.695 af Inflow=537.58 cfs 79.042 af
96.0" x 96.0" Box Culvert n=0.016 L=103.0' S=0.0097 '/' Outflow=411.67 cfs 79.042 af

Total Runoff Area = 655.000 ac Runoff Volume = 148.890 af Average Runoff Depth = 2.73"
95.98% Pervious = 628.700 ac 4.02% Impervious = 26.300 ac

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MSE 24-hr 4 10 Yr Rainfall=4.50"

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Summary for Subcatchment 1S: Southeast Watershed

Runoff = 252.37 cfs @ 12.66 hrs, Volume= 34.524 af, Depth= 2.73"
Routed to Pond 14P : Culvert South

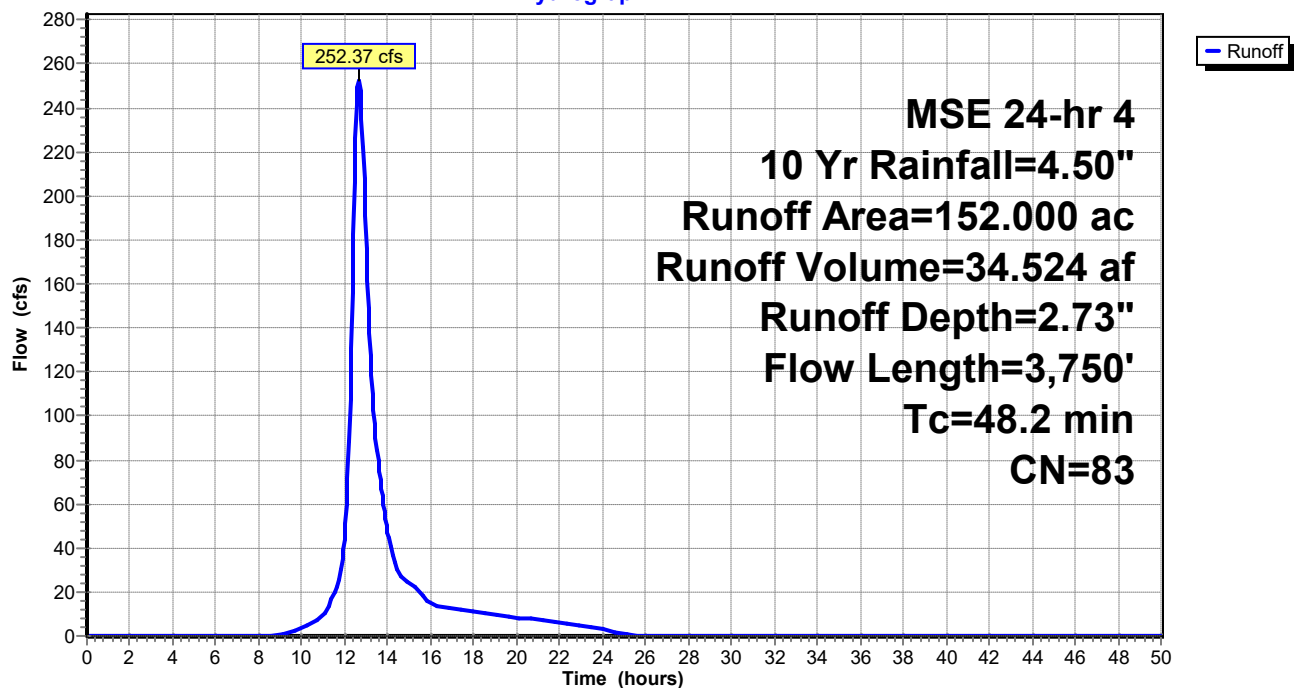
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
MSE 24-hr 4 10 Yr Rainfall=4.50"

Area (ac)	CN	Description
41.000	78	Row crops, straight row, Good, HSG B
111.000	85	Row crops, straight row, Good, HSG C
152.000	83	Weighted Average
152.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.0	100	0.0200	0.15		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 3.10"
7.8	750	0.0320	1.61		Shallow Concentrated Flow, Shallow Crop Cultivated Straight Rows Kv= 9.0 fps
29.4	2,900	0.0120	1.64		Shallow Concentrated Flow, Grassed Grassed Waterway Kv= 15.0 fps
48.2	3,750	Total			

Subcatchment 1S: Southeast Watershed

Hydrograph



Summary for Subcatchment 4S: NW Pond Watershed

Runoff = 111.47 cfs @ 12.49 hrs, Volume= 12.719 af, Depth= 2.73"
 Routed to Pond 7P : Northwest Pond

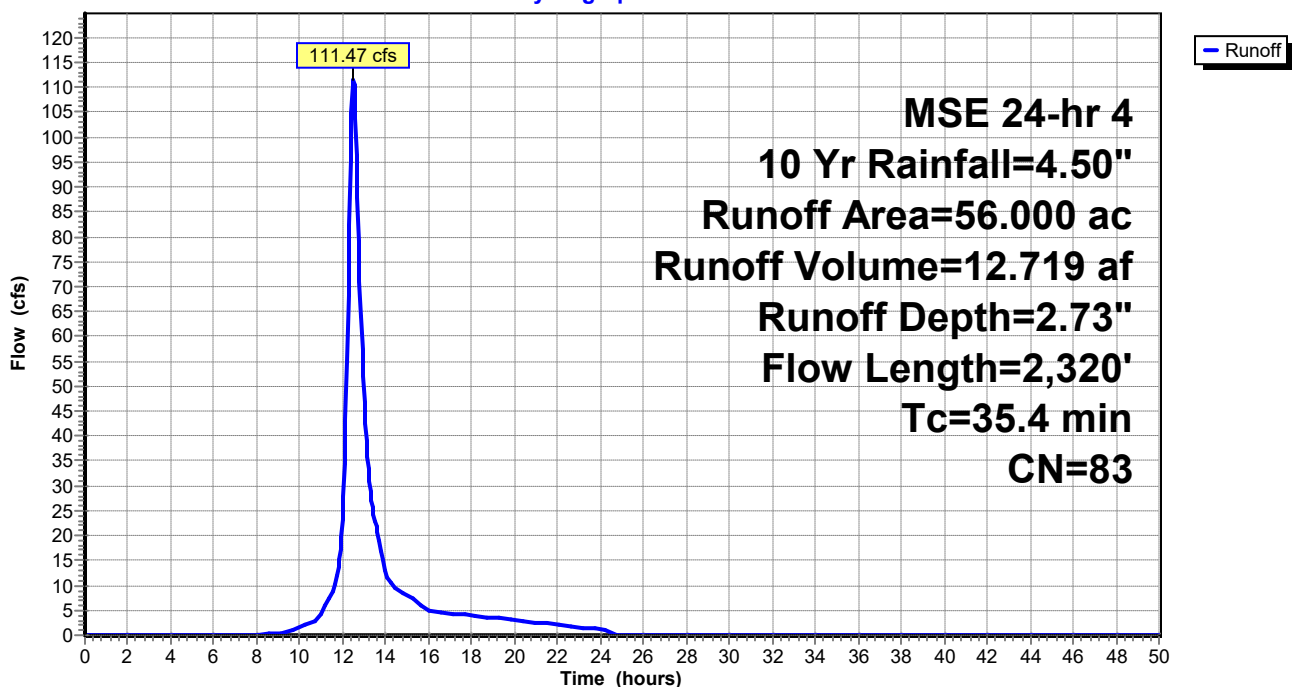
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 MSE 24-hr 4 10 Yr Rainfall=4.50"

Area (ac)	CN	Description
32.000	85	Row crops, straight row, Good, HSG C
15.000	78	Row crops, straight row, Good, HSG B
6.000	79	1 acre lots, 20% imp, HSG C
* 3.000	100	Pond
56.000	83	Weighted Average
51.800		92.50% Pervious Area
4.200		7.50% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.1	100	0.0100	0.09		Sheet Flow, Grass: Dense n= 0.240 P2= 3.10"
16.3	2,220	0.0230	2.27		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
35.4	2,320	Total			

Subcatchment 4S: NW Pond Watershed

Hydrograph



Summary for Subcatchment 5S: SW Pond Watershed

Runoff = 137.32 cfs @ 12.46 hrs, Volume= 15.076 af, Depth= 2.55"
 Routed to Pond 2P : Southwest Pond

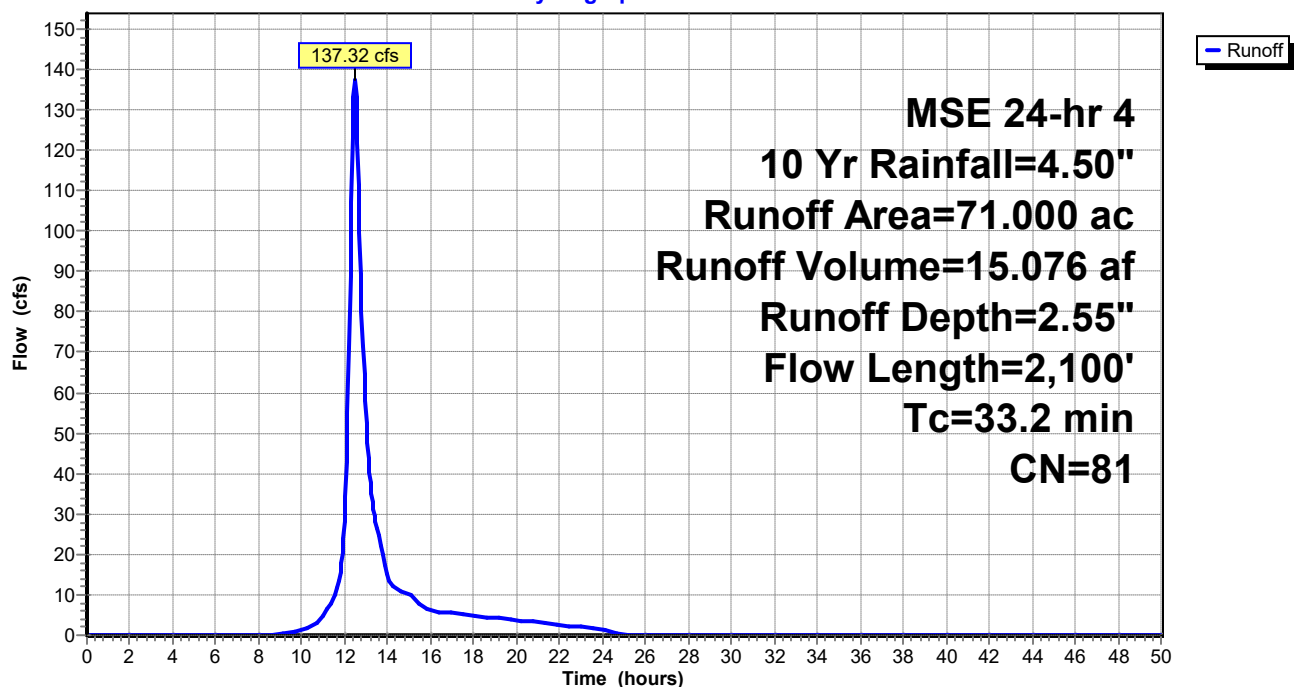
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 MSE 24-hr 4 10 Yr Rainfall=4.50"

Area (ac)	CN	Description
34.000	80	1/2 acre lots, 25% imp, HSG C
19.000	78	Row crops, straight row, Good, HSG B
* 3.000	100	Pond
15.000	85	Row crops, straight row, Good, HSG C
71.000	81	Weighted Average
59.500		83.80% Pervious Area
11.500		16.20% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.1	100	0.0100	0.09		Sheet Flow, Grass: Dense n= 0.240 P2= 3.10"
14.1	2,000	0.0250	2.37		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
33.2	2,100	Total			

Subcatchment 5S: SW Pond Watershed

Hydrograph



Summary for Subcatchment 6S: Southwest Watershed

Runoff = 291.13 cfs @ 12.78 hrs, Volume= 44.518 af, Depth= 2.73"
 Routed to Pond 14P : Culvert South

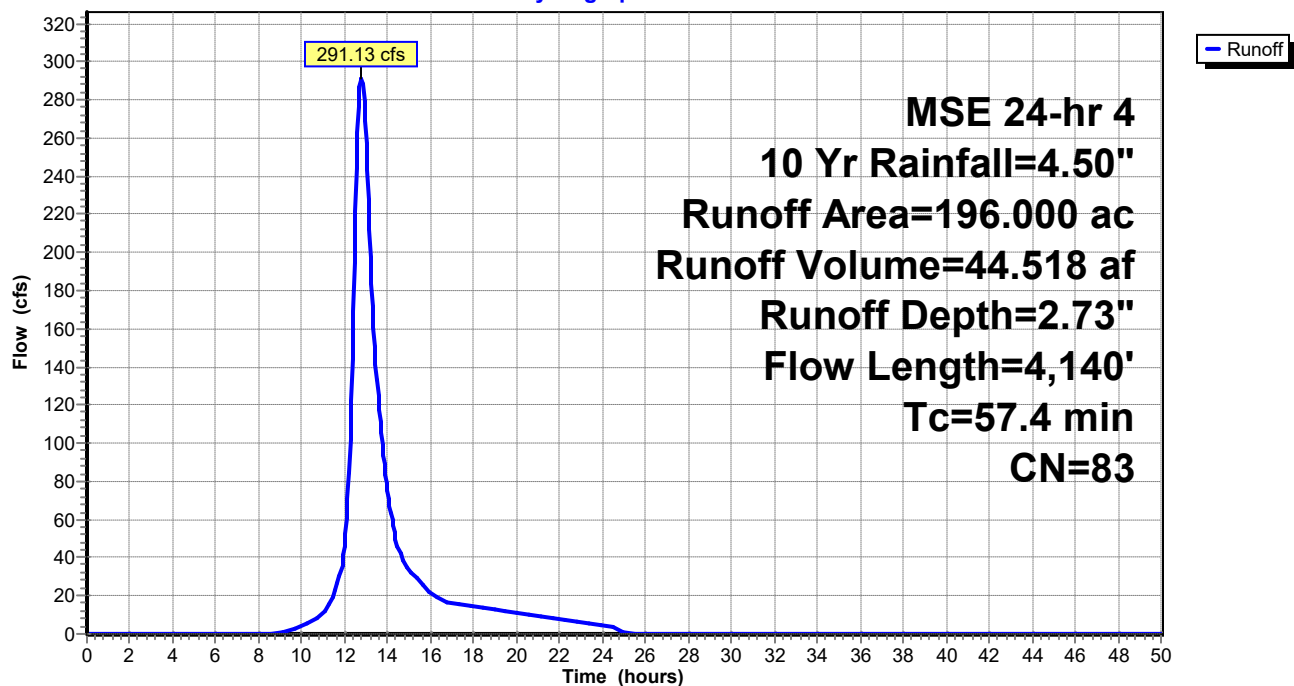
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 MSE 24-hr 4 10 Yr Rainfall=4.50"

Area (ac)	CN	Description
53.000	78	Row crops, straight row, Good, HSG B
143.000	85	Row crops, straight row, Good, HSG C
196.000	83	Weighted Average
196.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.4	100	0.0300	0.18		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 3.10"
18.0	1,340	0.0190	1.24		Shallow Concentrated Flow, Crops Cultivated Straight Rows Kv= 9.0 fps
30.0	2,700	0.0100	1.50		Shallow Concentrated Flow, Grassed Grassed Waterway Kv= 15.0 fps
57.4	4,140	Total			

Subcatchment 6S: Southwest Watershed

Hydrograph



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MSE 24-hr 4 10 Yr Rainfall=4.50"

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Summary for Subcatchment 9S: Direct NE

Runoff = 35.45 cfs @ 12.32 hrs, Volume= 3.152 af, Depth= 2.91"
Routed to Pond 8P : Hauber Wetland

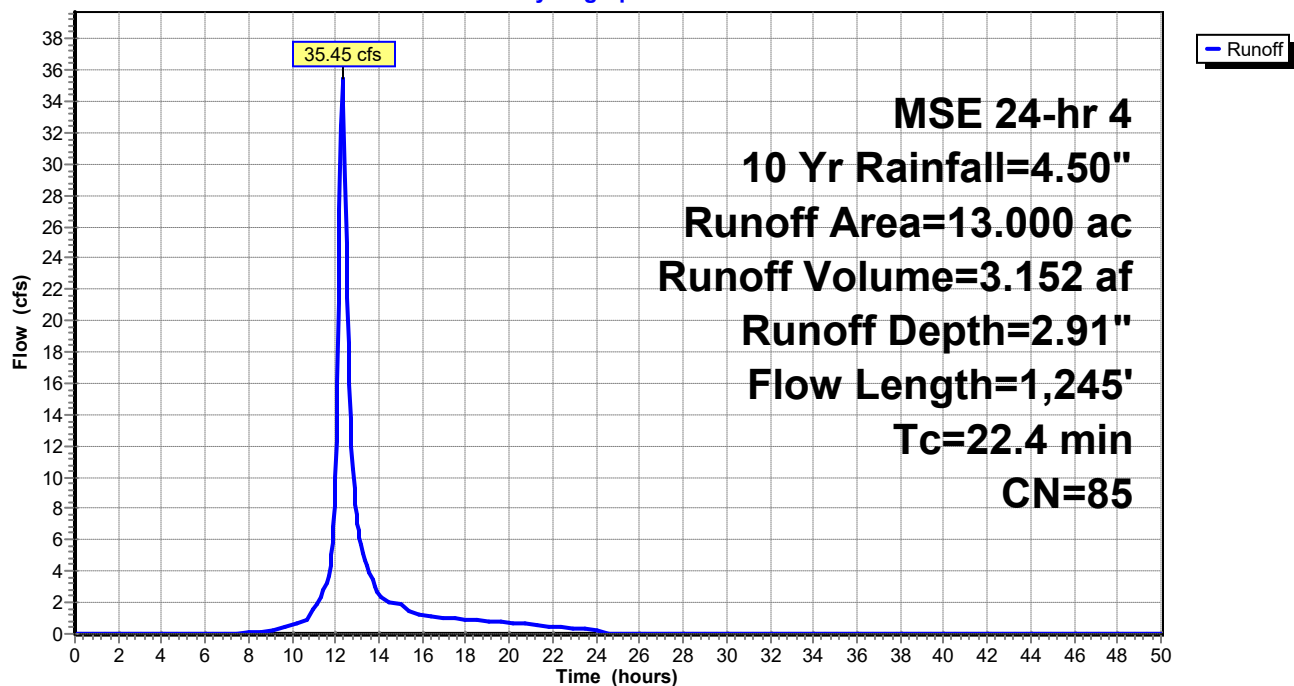
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
MSE 24-hr 4 10 Yr Rainfall=4.50"

Area (ac)	CN	Description
13.000	85	Row crops, straight row, Good, HSG C
13.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.5	100	0.0100	0.11		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 3.10"
5.1	600	0.0467	1.94		Shallow Concentrated Flow, Crop Cultivated Straight Rows Kv= 9.0 fps
2.8	545	0.0470	3.25		Shallow Concentrated Flow, Grass Grassed Waterway Kv= 15.0 fps
22.4	1,245	Total			

Subcatchment 9S: Direct NE

Hydrograph



Summary for Subcatchment 11S: East Pond Watershed

Runoff = 121.70 cfs @ 12.32 hrs, Volume= 10.797 af, Depth= 2.82"
 Routed to Pond 10P : East Pond

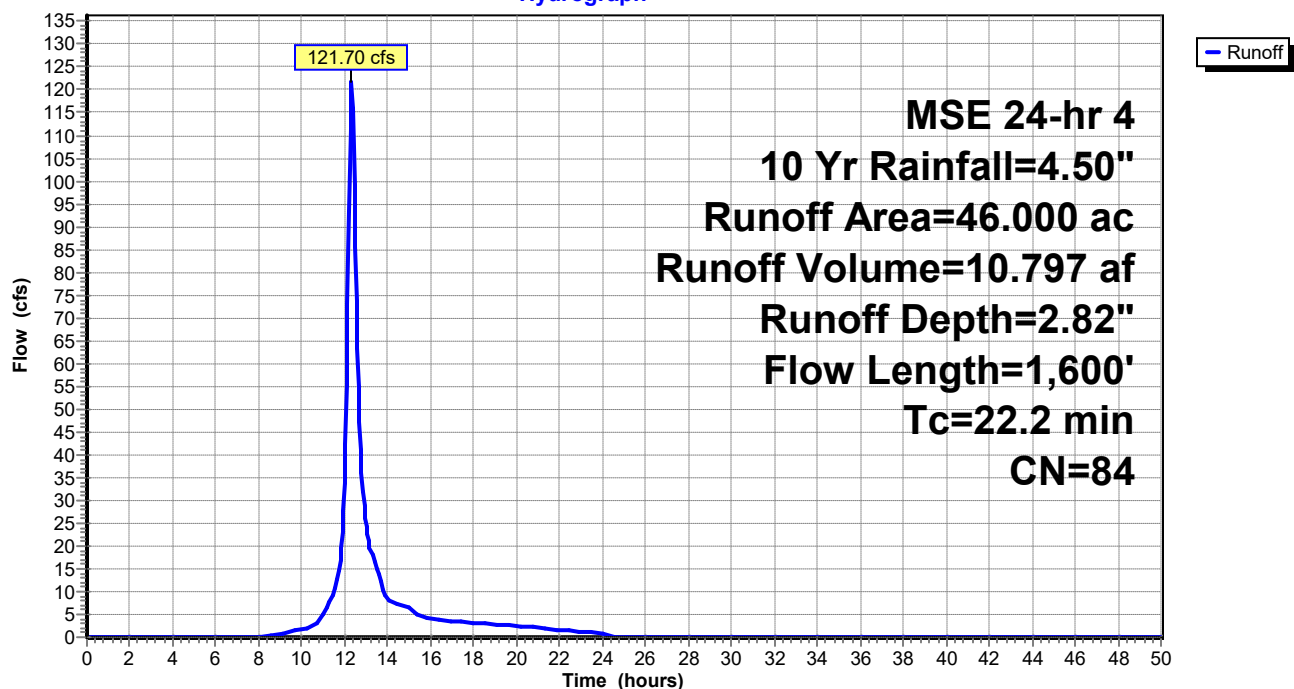
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 MSE 24-hr 4 10 Yr Rainfall=4.50"

Area (ac)	CN	Description
* 1.000	100	Pond
5.000	91	Urban industrial, 72% imp, HSG C
12.000	78	Row crops, straight row, Good, HSG B
28.000	85	Row crops, straight row, Good, HSG C
46.000	84	Weighted Average
41.400		90.00% Pervious Area
4.600		10.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.7	100	0.0700	0.25		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 3.10"
15.5	1,500	0.0320	1.61		Shallow Concentrated Flow, Cultivated Straight Rows Kv= 9.0 fps
22.2	1,600	Total			

Subcatchment 11S: East Pond Watershed

Hydrograph



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MSE 24-hr 4 10 Yr Rainfall=4.50"

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Summary for Subcatchment 12S: Direct E

Runoff = 72.72 cfs @ 12.55 hrs, Volume= 8.858 af, Depth= 2.73"
Routed to Pond 8P : Hauber Wetland

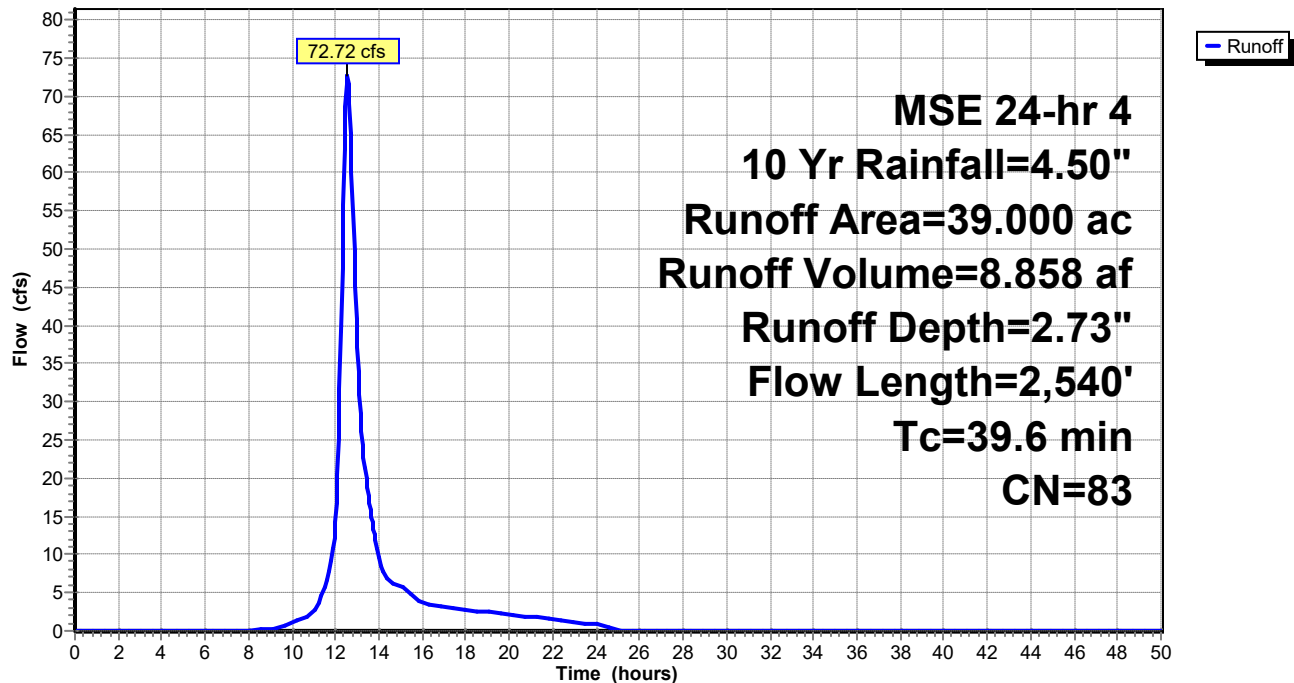
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
MSE 24-hr 4 10 Yr Rainfall=4.50"

Area (ac)	CN	Description
10.000	78	Row crops, straight row, Good, HSG B
29.000	85	Row crops, straight row, Good, HSG C
39.000	83	Weighted Average
39.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.6	100	0.0500	0.22		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 3.10"
32.0	2,440	0.0200	1.27		Shallow Concentrated Flow, Crops Cultivated Straight Rows Kv= 9.0 fps
39.6	2,540	Total			

Subcatchment 12S: Direct E

Hydrograph



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MSE 24-hr 4 10 Yr Rainfall=4.50"

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Summary for Subcatchment 13S: Direct Watershed

Runoff = 209.33 cfs @ 12.34 hrs, Volume= 19.247 af, Depth= 2.82"
Routed to Pond 8P : Hauber Wetland

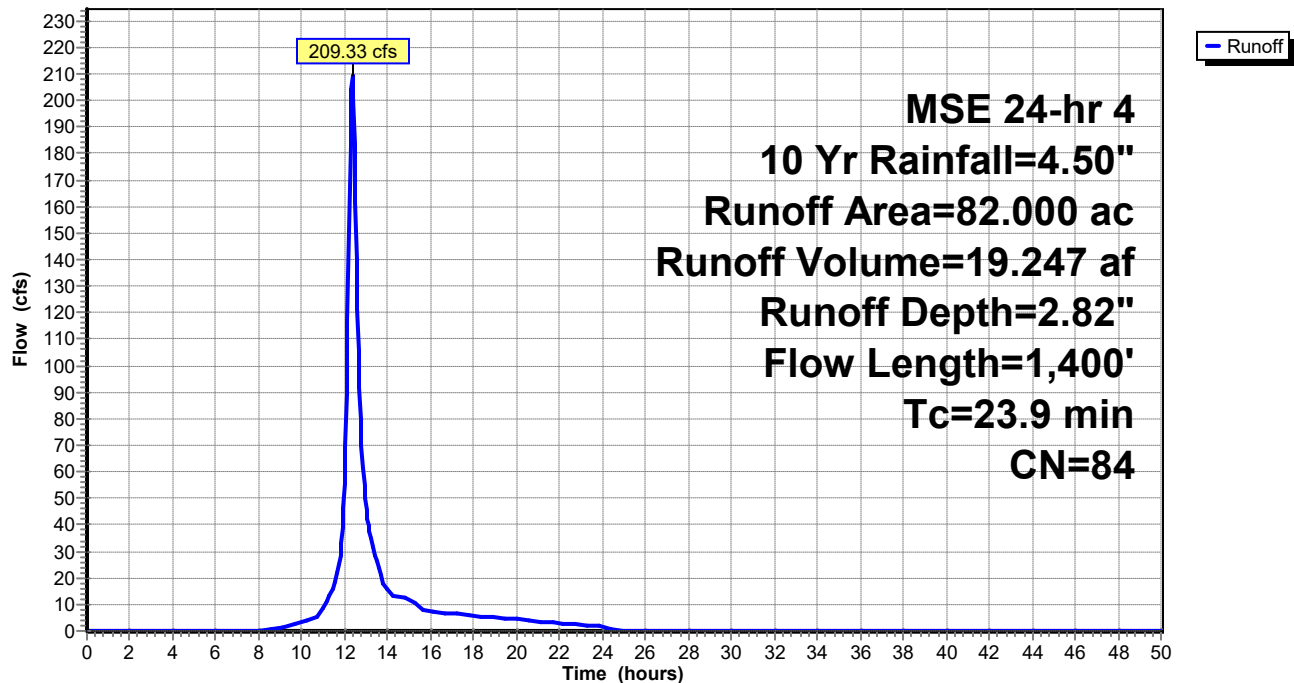
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
MSE 24-hr 4 10 Yr Rainfall=4.50"

Area (ac)	CN	Description
* 6.000	100	Wetland
22.000	78	Row crops, straight row, Good, HSG B
54.000	85	Row crops, straight row, Good, HSG C
82.000	84	Weighted Average
76.000		92.68% Pervious Area
6.000		7.32% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0	100	0.0200	0.17		Sheet Flow, Grass: Short n= 0.150 P2= 3.10"
13.9	1,300	0.0300	1.56		Shallow Concentrated Flow, Cultivated Straight Rows Kv= 9.0 fps
23.9	1,400	Total			

Subcatchment 13S: Direct Watershed

Hydrograph



Summary for Pond 2P: Southwest Pond

Inflow Area = 71.000 ac, 16.20% Impervious, Inflow Depth = 2.55" for 10 Yr event
Inflow = 137.32 cfs @ 12.46 hrs, Volume= 15.076 af
Outflow = 11.71 cfs @ 14.31 hrs, Volume= 11.485 af, Atten= 91%, Lag= 110.7 min
Primary = 11.71 cfs @ 14.31 hrs, Volume= 11.485 af
Routed to Pond 8P : Hauber Wetland

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 1,181.90' @ 14.31 hrs Surf.Area= 6.789 ac Storage= 10.158 af

Plug-Flow detention time= 753.4 min calculated for 11.474 af (76% of inflow)
Center-of-Mass det. time= 677.9 min (1,514.1 - 836.2)

Volume	Invert	Avail.Storage	Storage Description
#1	1,180.00'	85.805 af	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,180.00	3.980	0.000	0.000
1,181.00	5.410	4.695	4.695
1,182.00	6.950	6.180	10.875
1,183.00	8.600	7.775	18.650
1,184.00	10.360	9.480	28.130
1,185.00	12.270	11.315	39.445
1,186.00	14.340	13.305	52.750
1,187.00	16.520	15.430	68.180
1,188.00	18.730	17.625	85.805

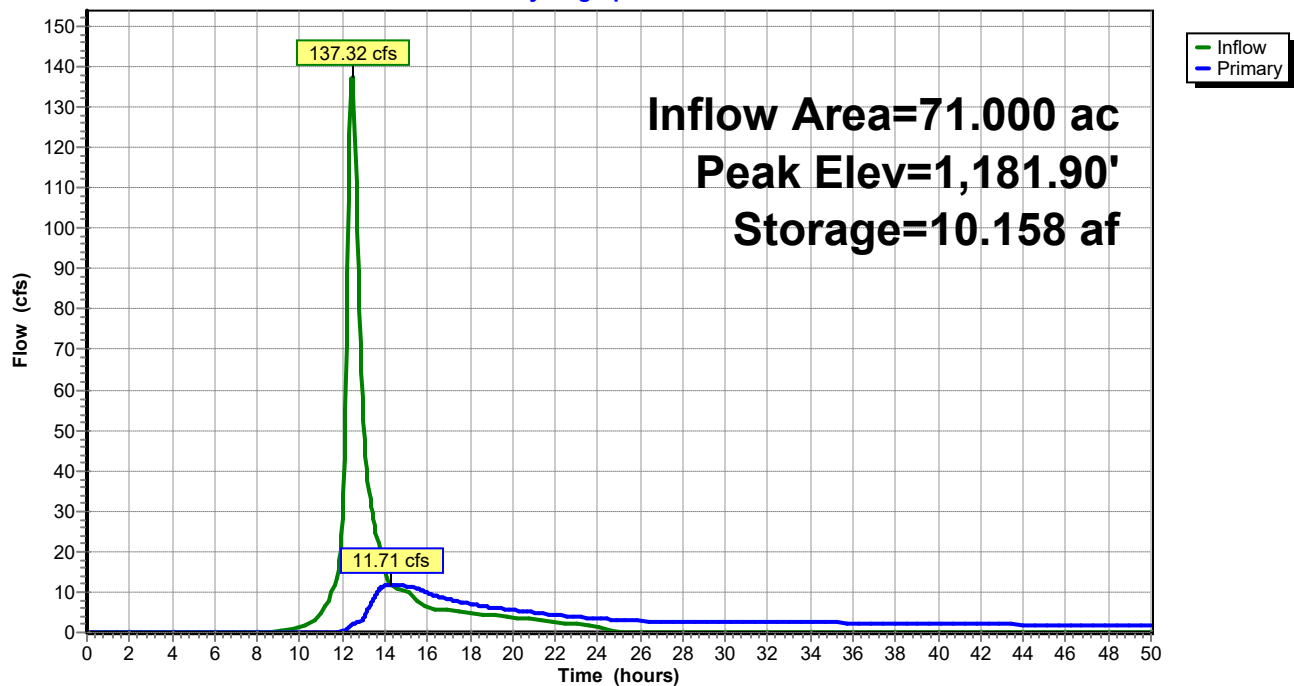
Device	Routing	Invert	Outlet Devices
#1	Primary	1,180.00'	10.0" Round Culvert L= 70.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 1,180.00' / 1,177.00' S= 0.0429 '/' Cc= 0.900 n= 0.013, Flow Area= 0.55 sf
#2	Primary	1,181.60'	20.0' long + 4.0 ' SideZ x 3.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32
#3	Primary	1,182.80'	700.0' long + 4.0 ' SideZ x 10.0' 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) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=11.64 cfs @ 14.31 hrs HW=1,181.90' (Free Discharge)

- 1=Culvert (Inlet Controls 3.19 cfs @ 5.86 fps)
- 2=Broad-Crested Rectangular Weir (Weir Controls 8.44 cfs @ 1.35 fps)
- 3=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Pond 2P: Southwest Pond

Hydrograph



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MSE 24-hr 4 10 Yr Rainfall=4.50"

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Summary for Pond 7P: Northwest Pond

Inflow Area = 56.000 ac, 7.50% Impervious, Inflow Depth = 2.73" for 10 Yr event
 Inflow = 111.47 cfs @ 12.49 hrs, Volume= 12.719 af
 Outflow = 15.55 cfs @ 13.85 hrs, Volume= 8.306 af, Atten= 86%, Lag= 81.3 min
 Primary = 15.55 cfs @ 13.85 hrs, Volume= 8.306 af
 Routed to Pond 8P : Hauber Wetland

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 1,180.79' @ 13.85 hrs Surf.Area= 3.947 ac Storage= 8.138 af

Plug-Flow detention time= 541.0 min calculated for 8.306 af (65% of inflow)
 Center-of-Mass det. time= 453.6 min (1,287.0 - 833.4)

Volume	Invert	Avail.Storage	Storage Description
#1	1,177.70'	33.835 af	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,177.70	1.420	0.000	0.000
1,178.00	1.650	0.460	0.460
1,179.00	2.410	2.030	2.490
1,180.00	3.220	2.815	5.305
1,181.00	4.140	3.680	8.985
1,182.00	5.130	4.635	13.620
1,183.00	6.240	5.685	19.305
1,184.00	7.270	6.755	26.060
1,185.00	8.280	7.775	33.835

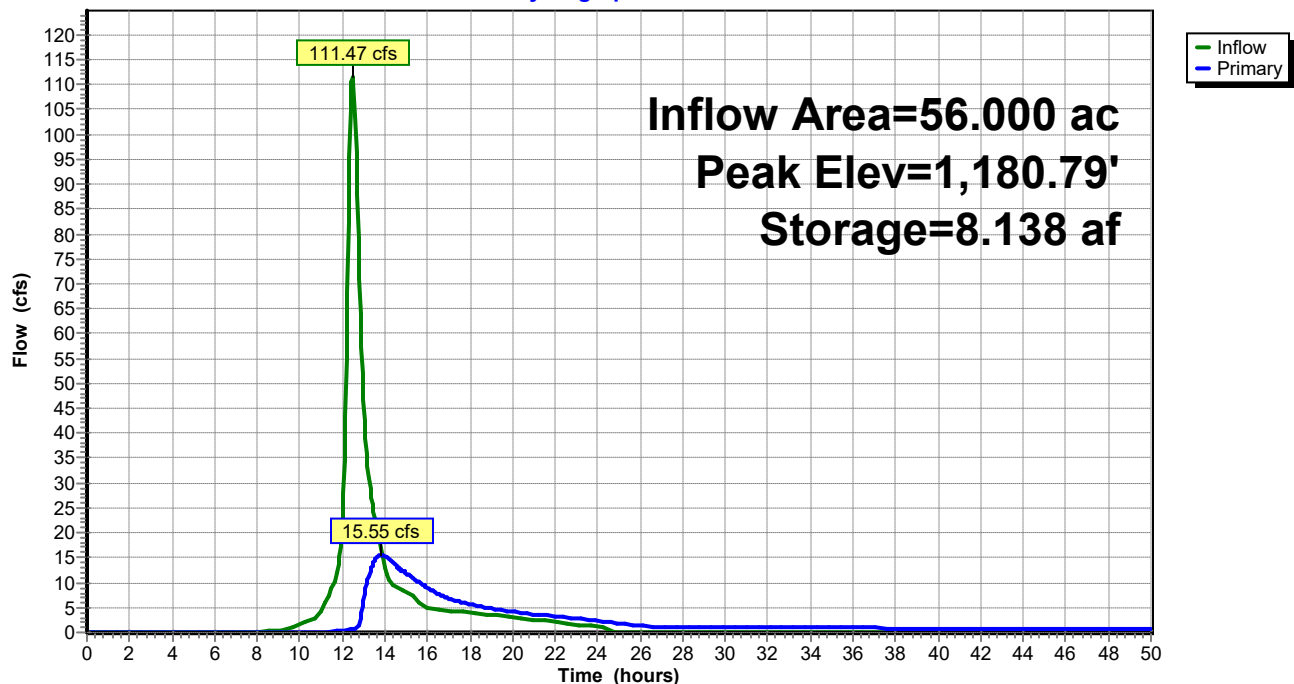
Device	Routing	Invert	Outlet Devices
#1	Primary	1,177.70'	6.0" Round Culvert L= 62.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 1,177.70' / 1,177.50' S= 0.0032 ' / ' Cc= 0.900 n= 0.013, Flow Area= 0.20 sf
#2	Primary	1,180.20'	10.0' long + 4.0 ' / ' SideZ x 10.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#3	Primary	1,182.20'	550.0' long + 4.0 ' / ' SideZ x 10.0' 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) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=15.57 cfs @ 13.85 hrs HW=1,180.79' (Free Discharge)

- 1=Culvert (Barrel Controls 1.04 cfs @ 5.30 fps)
- 2=Broad-Crested Rectangular Weir (Weir Controls 14.53 cfs @ 1.99 fps)
- 3=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Pond 7P: Northwest Pond

Hydrograph



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MSE 24-hr 4 10 Yr Rainfall=4.50"

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Summary for Pond 8P: Hauber Wetland

Inflow Area = 655.000 ac, 4.02% Impervious, Inflow Depth > 2.55" for 10 Yr event
 Inflow = 546.75 cfs @ 12.48 hrs, Volume= 138.995 af
 Outflow = 523.33 cfs @ 12.89 hrs, Volume= 138.629 af, Atten= 4%, Lag= 24.4 min
 Primary = 523.33 cfs @ 12.89 hrs, Volume= 138.629 af

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs

Starting Elev= 1,162.00' Surf.Area= 3.600 ac Storage= 6.845 af

Peak Elev= 1,164.34' @ 12.89 hrs Surf.Area= 5.170 ac Storage= 16.992 af (10.147 af above start)

Plug-Flow detention time= 115.1 min calculated for 131.652 af (95% of inflow)

Center-of-Mass det. time= 18.3 min (1,005.0 - 986.7)

Volume	Invert	Avail.Storage	Storage Description
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#1	1,155.00'	26.995 af	Custom Stage Data (Prismatic) Listed below (Recalc)
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Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,155.00	0.000	0.000	0.000
1,156.00	0.020	0.010	0.010
1,158.00	0.130	0.150	0.160
1,159.00	0.660	0.395	0.555
1,160.00	1.060	0.860	1.415
1,161.00	3.100	2.080	3.495
1,162.00	3.600	3.350	6.845
1,163.00	4.200	3.900	10.745
1,164.00	4.900	4.550	15.295
1,165.00	5.700	5.300	20.595
1,166.00	7.100	6.400	26.995

Device	Routing	Invert	Outlet Devices
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#1	Primary	1,164.80'	25.0' long + 3.0 ' SideZ x 20.0' 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
#2	Primary	1,162.00'	48.0' long + 4.0 ' SideZ x 10.0' 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) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#3	Primary	1,155.50'	12.0" Round Drawdown Pipe L= 41.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 1,155.50' / 1,154.00' S= 0.0366 ' / ' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#4	Device 3	1,165.50'	3.0' long Sharp-Crested Rectangular Weir 2 End Contraction(s)

Primary OutFlow Max=523.15 cfs @ 12.89 hrs HW=1,164.34' (Free Discharge)

1=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

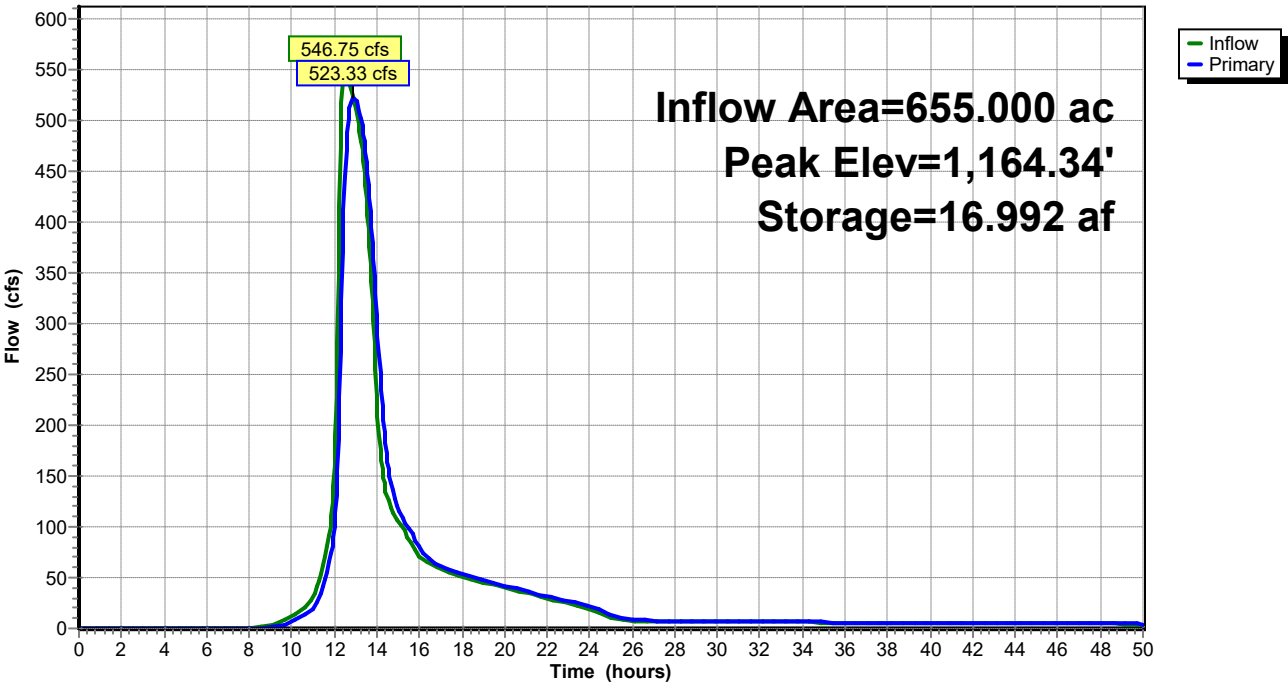
2=Broad-Crested Rectangular Weir (Weir Controls 523.15 cfs @ 3.90 fps)

3=Drawdown Pipe (Passes 0.00 cfs of 10.92 cfs potential flow)

4=Sharp-Crested Rectangular Weir (Controls 0.00 cfs)

Pond 8P: Hauber Wetland

Hydrograph



Hauber Chute HydroCAD

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MSE 24-hr 4 10 Yr Rainfall=4.50"

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Summary for Pond 10P: East Pond

Inflow Area = 46.000 ac, 10.00% Impervious, Inflow Depth = 2.82" for 10 Yr event
 Inflow = 121.70 cfs @ 12.32 hrs, Volume= 10.797 af
 Outflow = 3.84 cfs @ 16.39 hrs, Volume= 8.907 af, Atten= 97%, Lag= 244.2 min
 Primary = 3.84 cfs @ 16.39 hrs, Volume= 8.907 af
 Routed to Pond 8P : Hauber Wetland

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 1,182.27' @ 16.39 hrs Surf.Area= 3.029 ac Storage= 8.044 af

Plug-Flow detention time= 983.5 min calculated for 8.907 af (82% of inflow)
 Center-of-Mass det. time= 918.8 min (1,737.5 - 818.7)

Volume	Invert	Avail.Storage	Storage Description
#1	1,178.00'	18.780 af	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,178.00	0.950	0.000	0.000
1,179.00	1.300	1.125	1.125
1,180.00	1.770	1.535	2.660
1,181.00	2.280	2.025	4.685
1,182.00	2.860	2.570	7.255
1,183.00	3.490	3.175	10.430
1,184.00	4.160	3.825	14.255
1,185.00	4.890	4.525	18.780

Device	Routing	Invert	Outlet Devices
#1	Primary	1,178.10'	8.0" Round Culvert L= 75.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 1,178.10' / 1,173.00' S= 0.0680 '/' Cc= 0.900 n= 0.013, Flow Area= 0.35 sf
#2	Primary	1,182.20'	12.0' long + 4.0 ' SideZ x 10.0' 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) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

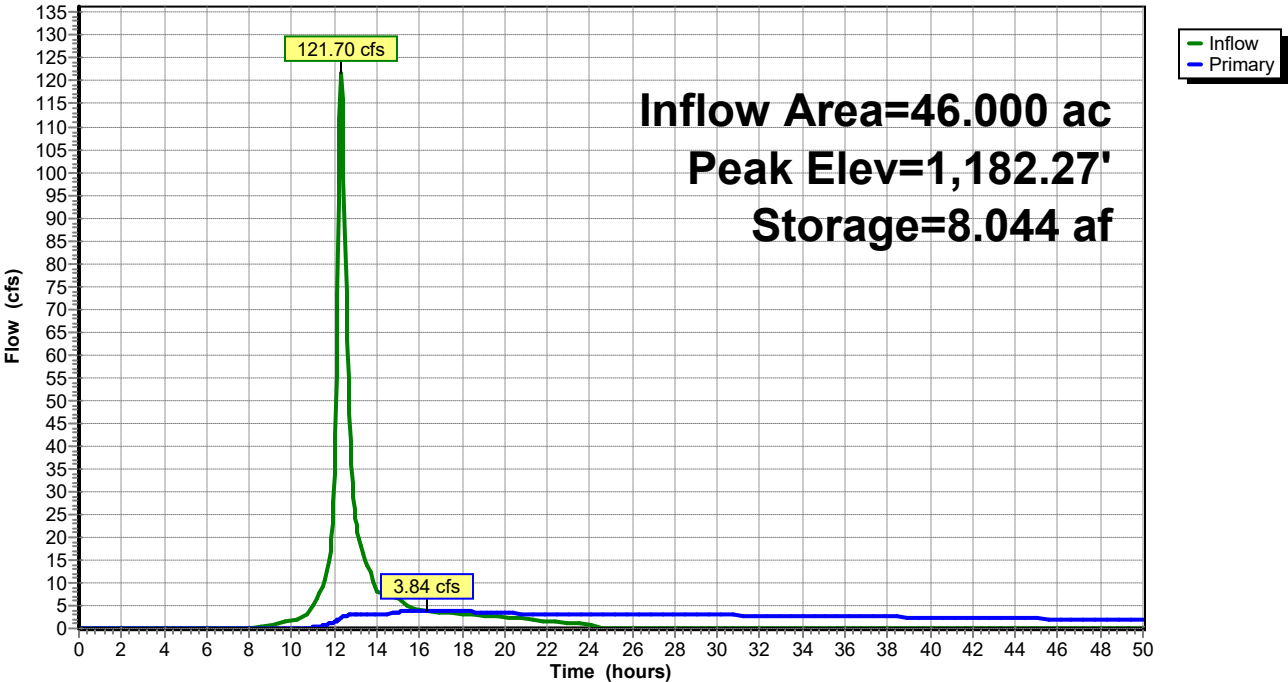
Primary OutFlow Max=3.83 cfs @ 16.39 hrs HW=1,182.27' (Free Discharge)

1=Culvert (Inlet Controls 3.29 cfs @ 9.43 fps)

2=Broad-Crested Rectangular Weir (Weir Controls 0.54 cfs @ 0.65 fps)

Pond 10P: East Pond

Hydrograph



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MSE 24-hr 4 10 Yr Rainfall=4.50"

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Summary for Pond 14P: Culvert South

Inflow Area = 348.000 ac, 0.00% Impervious, Inflow Depth = 2.73" for 10 Yr event
 Inflow = 537.58 cfs @ 12.71 hrs, Volume= 79.042 af
 Outflow = 411.67 cfs @ 13.04 hrs, Volume= 79.042 af, Atten= 23%, Lag= 19.6 min
 Primary = 411.67 cfs @ 13.04 hrs, Volume= 79.042 af
 Routed to Pond 8P : Hauber Wetland

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 1,174.88' @ 13.04 hrs Surf.Area= 4.866 ac Storage= 8.695 af

Plug-Flow detention time= 7.8 min calculated for 78.963 af (100% of inflow)
 Center-of-Mass det. time= 7.8 min (857.9 - 850.1)

Volume	Invert	Avail.Storage	Storage Description
#1	1,168.00'	34.340 af	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,168.00	0.020	0.000	0.000
1,170.00	0.280	0.300	0.300
1,172.00	0.690	0.970	1.270
1,174.00	3.190	3.880	5.150
1,176.00	7.000	10.190	15.340
1,178.00	12.000	19.000	34.340

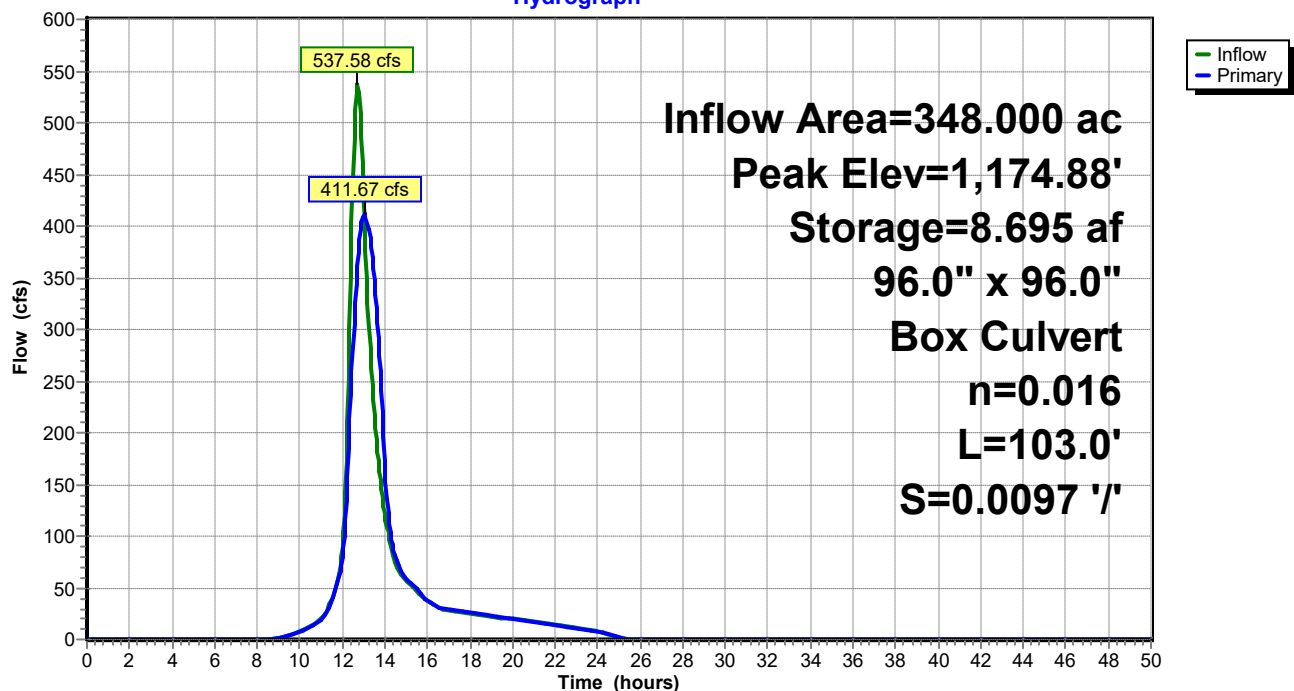
Device	Routing	Invert	Outlet Devices
#1	Primary	1,168.00'	96.0" W x 96.0" H Box Culvert L= 103.0' Box, 10-30° wingwalls, square crown, Ke= 0.500 Inlet / Outlet Invert= 1,168.00' / 1,167.00' S= 0.0097 ' / ' Cc= 0.900 n= 0.016, Flow Area= 64.00 sf

Primary OutFlow Max=411.50 cfs @ 13.04 hrs HW=1,174.88' (Free Discharge)

↑ **1=Culvert** (Barrel Controls 411.50 cfs @ 9.97 fps)

Pond 14P: Culvert South

Hydrograph



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MSE 24-hr 4 25 Yr Rainfall=5.60"

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Time span=0.00-50.00 hrs, dt=0.05 hrs, 1001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Southeast Watershed Runoff Area=152.000 ac 0.00% Impervious Runoff Depth=3.72"
Flow Length=3,750' Tc=48.2 min CN=83 Runoff=343.38 cfs 47.142 af

Subcatchment 4S: NW Pond Watershed Runoff Area=56.000 ac 7.50% Impervious Runoff Depth=3.72"
Flow Length=2,320' Tc=35.4 min CN=83 Runoff=151.51 cfs 17.368 af

Subcatchment 5S: SW Pond Watershed Runoff Area=71.000 ac 16.20% Impervious Runoff Depth=3.52"
Flow Length=2,100' Tc=33.2 min CN=81 Runoff=189.39 cfs 20.833 af

Subcatchment 6S: Southwest Watershed Runoff Area=196.000 ac 0.00% Impervious Runoff Depth=3.72"
Flow Length=4,140' Tc=57.4 min CN=83 Runoff=396.27 cfs 60.788 af

Subcatchment 9S: Direct NE Runoff Area=13.000 ac 0.00% Impervious Runoff Depth=3.93"
Flow Length=1,245' Tc=22.4 min CN=85 Runoff=47.43 cfs 4.254 af

Subcatchment 11S: East Pond Watershed Runoff Area=46.000 ac 10.00% Impervious Runoff Depth=3.82"
Flow Length=1,600' Tc=22.2 min CN=84 Runoff=163.96 cfs 14.657 af

Subcatchment 12S: Direct E Runoff Area=39.000 ac 0.00% Impervious Runoff Depth=3.72"
Flow Length=2,540' Tc=39.6 min CN=83 Runoff=98.86 cfs 12.096 af

Subcatchment 13S: Direct Watershed Runoff Area=82.000 ac 7.32% Impervious Runoff Depth=3.82"
Flow Length=1,400' Tc=23.9 min CN=84 Runoff=282.06 cfs 26.128 af

Pond 2P: Southwest Pond Peak Elev=1,182.23' Storage=12.506 af Inflow=189.39 cfs 20.833 af
Outflow=32.91 cfs 17.140 af

Pond 7P: Northwest Pond Peak Elev=1,181.20' Storage=9.844 af Inflow=151.51 cfs 17.368 af
Outflow=36.65 cfs 12.917 af

Pond 8P: Hauber Wetland Peak Elev=1,164.76' Storage=19.252 af Inflow=699.28 cfs 193.056 af
Outflow=688.21 cfs 192.681 af

Pond 10P: East Pond Peak Elev=1,182.73' Storage=9.496 af Inflow=163.96 cfs 14.657 af
Outflow=17.34 cfs 12.593 af

Pond 14P: Culvert South Peak Elev=1,176.01' Storage=15.444 af Inflow=732.04 cfs 107.930 af
96.0" x 96.0" Box Culvert n=0.016 L=103.0' S=0.0097 ' Outflow=507.03 cfs 107.930 af

Total Runoff Area = 655.000 ac Runoff Volume = 203.265 af Average Runoff Depth = 3.72"
95.98% Pervious = 628.700 ac 4.02% Impervious = 26.300 ac

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MSE 24-hr 4 25 Yr Rainfall=5.60"

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Summary for Subcatchment 1S: Southeast Watershed

Runoff = 343.38 cfs @ 12.65 hrs, Volume= 47.142 af, Depth= 3.72"
Routed to Pond 14P : Culvert South

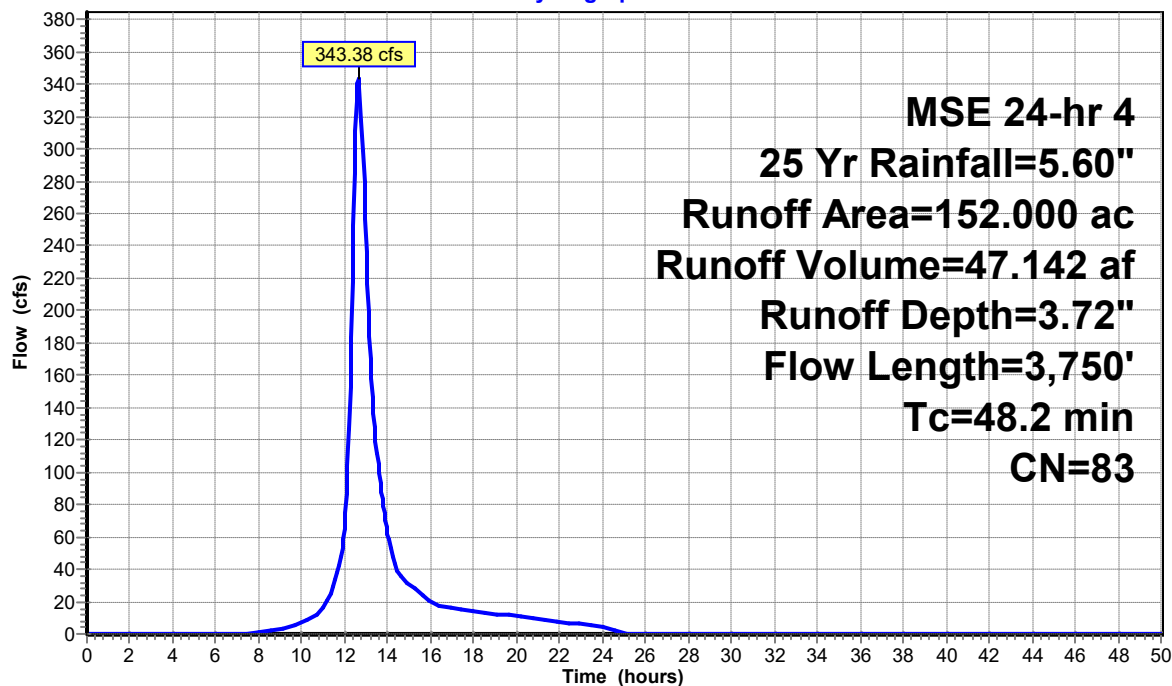
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
MSE 24-hr 4 25 Yr Rainfall=5.60"

Area (ac)	CN	Description
41.000	78	Row crops, straight row, Good, HSG B
111.000	85	Row crops, straight row, Good, HSG C
152.000	83	Weighted Average
152.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.0	100	0.0200	0.15		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 3.10"
7.8	750	0.0320	1.61		Shallow Concentrated Flow, Shallow Crop Cultivated Straight Rows Kv= 9.0 fps
29.4	2,900	0.0120	1.64		Shallow Concentrated Flow, Grassed Grassed Waterway Kv= 15.0 fps
48.2	3,750	Total			

Subcatchment 1S: Southeast Watershed

Hydrograph



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MSE 24-hr 4 25 Yr Rainfall=5.60"

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Summary for Subcatchment 4S: NW Pond Watershed

Runoff = 151.51 cfs @ 12.49 hrs, Volume= 17.368 af, Depth= 3.72"
Routed to Pond 7P : Northwest Pond

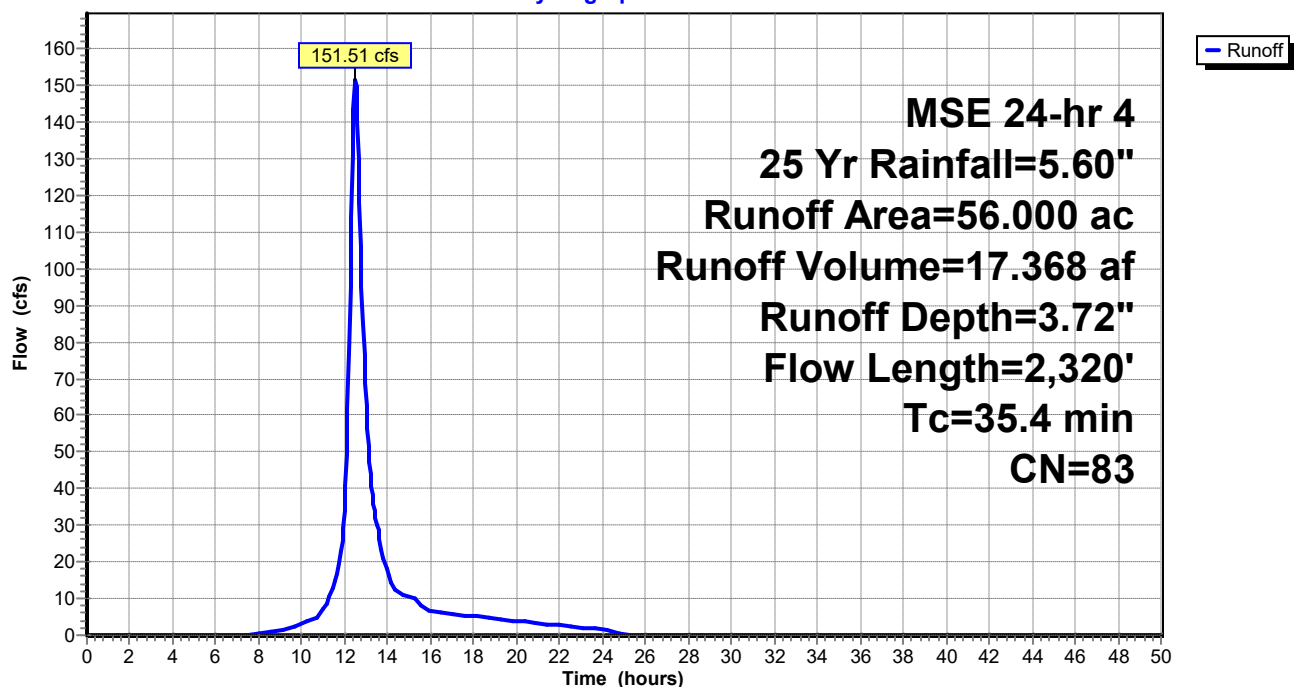
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
MSE 24-hr 4 25 Yr Rainfall=5.60"

Area (ac)	CN	Description
32.000	85	Row crops, straight row, Good, HSG C
15.000	78	Row crops, straight row, Good, HSG B
6.000	79	1 acre lots, 20% imp, HSG C
* 3.000	100	Pond
56.000	83	Weighted Average
51.800		92.50% Pervious Area
4.200		7.50% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.1	100	0.0100	0.09		Sheet Flow, Grass: Dense n= 0.240 P2= 3.10"
16.3	2,220	0.0230	2.27		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
35.4	2,320	Total			

Subcatchment 4S: NW Pond Watershed

Hydrograph



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MSE 24-hr 4 25 Yr Rainfall=5.60"

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Summary for Subcatchment 5S: SW Pond Watershed

Runoff = 189.39 cfs @ 12.46 hrs, Volume= 20.833 af, Depth= 3.52"
Routed to Pond 2P : Southwest Pond

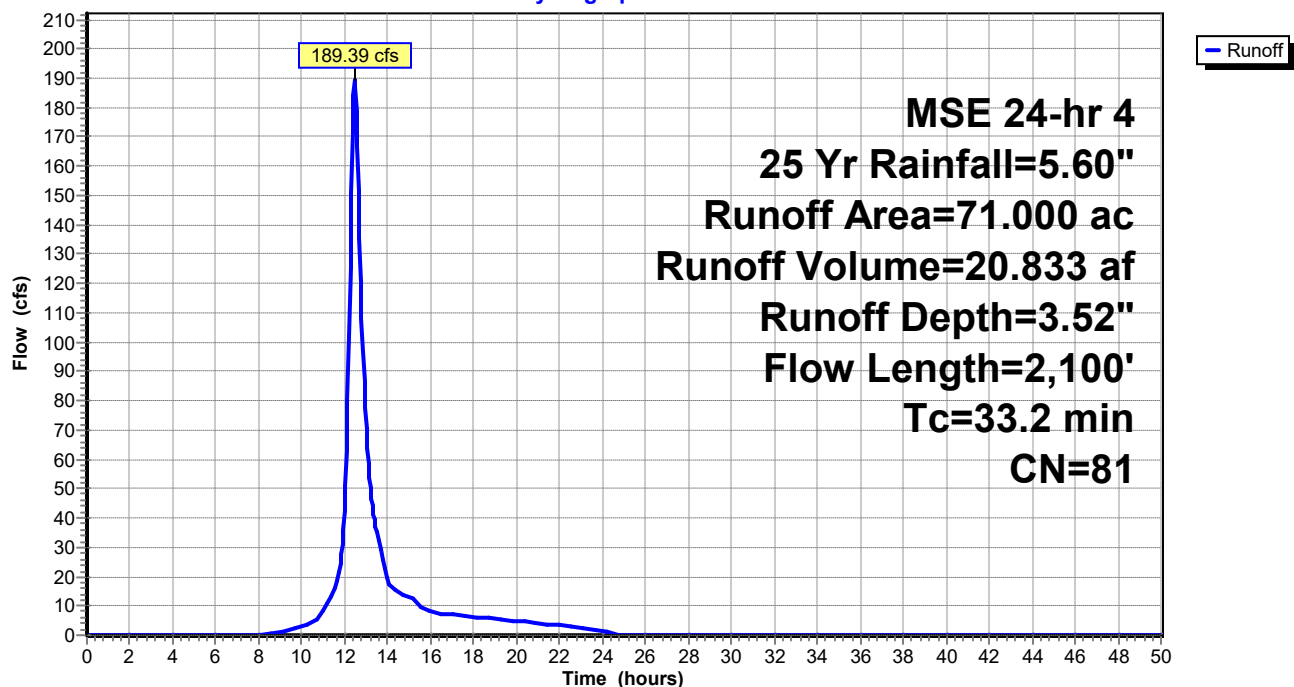
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
MSE 24-hr 4 25 Yr Rainfall=5.60"

Area (ac)	CN	Description
34.000	80	1/2 acre lots, 25% imp, HSG C
19.000	78	Row crops, straight row, Good, HSG B
* 3.000	100	Pond
15.000	85	Row crops, straight row, Good, HSG C
71.000	81	Weighted Average
59.500		83.80% Pervious Area
11.500		16.20% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.1	100	0.0100	0.09		Sheet Flow, Grass: Dense n= 0.240 P2= 3.10"
14.1	2,000	0.0250	2.37		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
33.2	2,100	Total			

Subcatchment 5S: SW Pond Watershed

Hydrograph



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MSE 24-hr 4 25 Yr Rainfall=5.60"

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Summary for Subcatchment 6S: Southwest Watershed

Runoff = 396.27 cfs @ 12.78 hrs, Volume= 60.788 af, Depth= 3.72"
Routed to Pond 14P : Culvert South

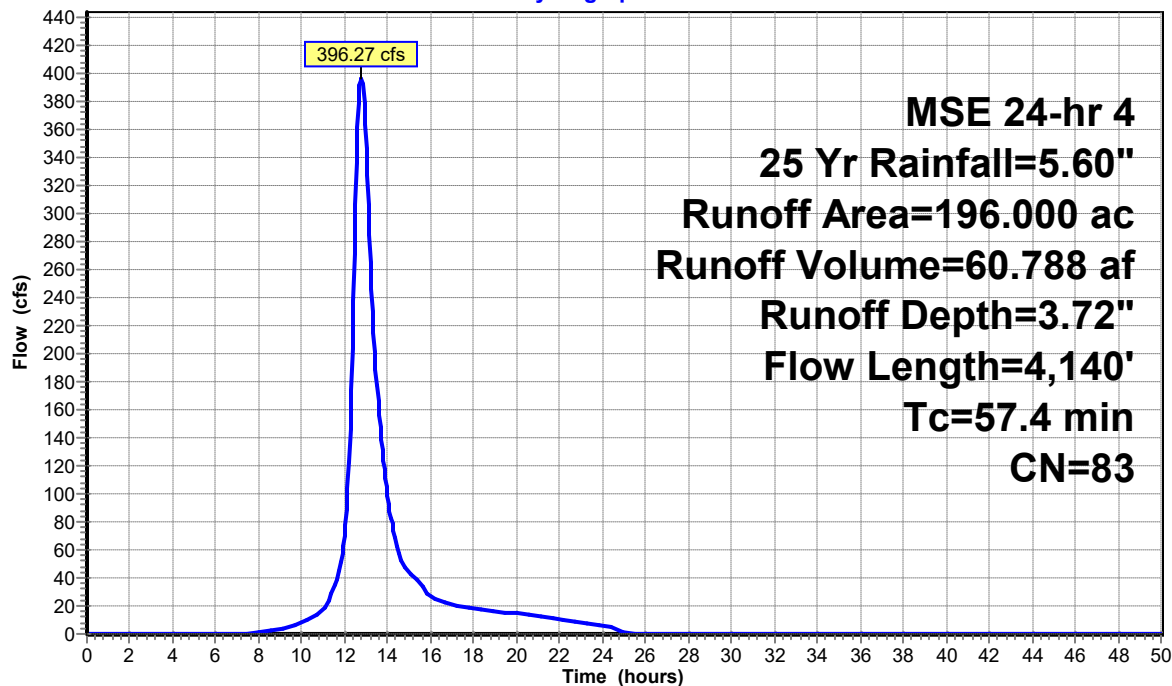
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
MSE 24-hr 4 25 Yr Rainfall=5.60"

Area (ac)	CN	Description
53.000	78	Row crops, straight row, Good, HSG B
143.000	85	Row crops, straight row, Good, HSG C
196.000	83	Weighted Average
196.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.4	100	0.0300	0.18		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 3.10"
18.0	1,340	0.0190	1.24		Shallow Concentrated Flow, Crops Cultivated Straight Rows Kv= 9.0 fps
30.0	2,700	0.0100	1.50		Shallow Concentrated Flow, Grassed Grassed Waterway Kv= 15.0 fps
57.4	4,140	Total			

Subcatchment 6S: Southwest Watershed

Hydrograph



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MSE 24-hr 4 25 Yr Rainfall=5.60"

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Summary for Subcatchment 9S: Direct NE

Runoff = 47.43 cfs @ 12.32 hrs, Volume= 4.254 af, Depth= 3.93"
Routed to Pond 8P : Hauber Wetland

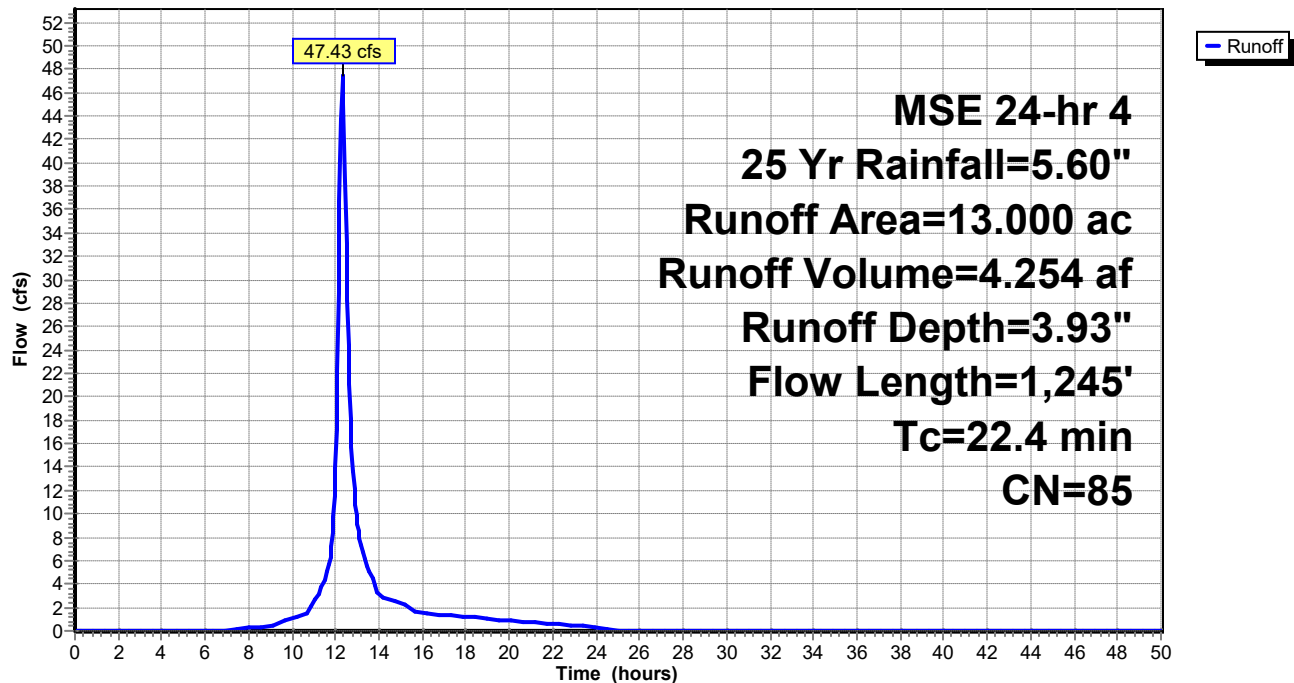
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
MSE 24-hr 4 25 Yr Rainfall=5.60"

Area (ac)	CN	Description
13.000	85	Row crops, straight row, Good, HSG C
13.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.5	100	0.0100	0.11		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 3.10"
5.1	600	0.0467	1.94		Shallow Concentrated Flow, Crop Cultivated Straight Rows Kv= 9.0 fps
2.8	545	0.0470	3.25		Shallow Concentrated Flow, Grass Grassed Waterway Kv= 15.0 fps
22.4	1,245	Total			

Subcatchment 9S: Direct NE

Hydrograph



Summary for Subcatchment 11S: East Pond Watershed

Runoff = 163.96 cfs @ 12.32 hrs, Volume= 14.657 af, Depth= 3.82"
 Routed to Pond 10P : East Pond

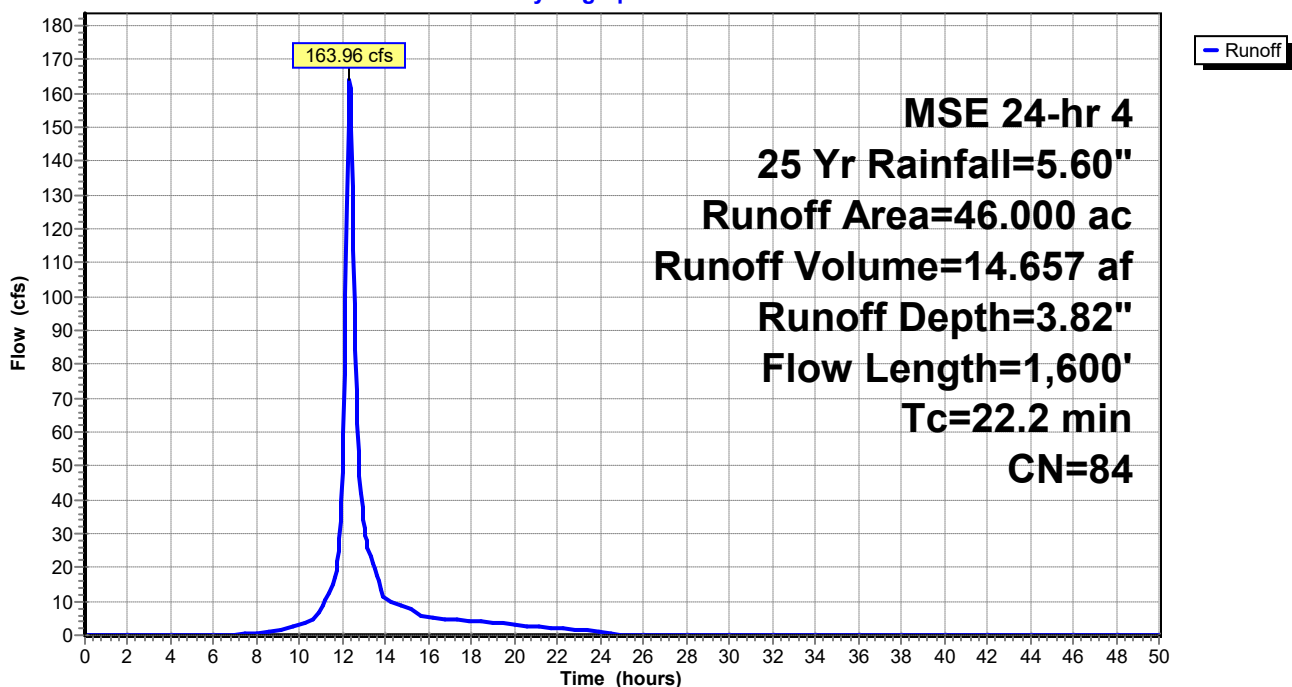
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 MSE 24-hr 4 25 Yr Rainfall=5.60"

Area (ac)	CN	Description
* 1.000	100	Pond
5.000	91	Urban industrial, 72% imp, HSG C
12.000	78	Row crops, straight row, Good, HSG B
28.000	85	Row crops, straight row, Good, HSG C
46.000	84	Weighted Average
41.400		90.00% Pervious Area
4.600		10.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.7	100	0.0700	0.25		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 3.10"
15.5	1,500	0.0320	1.61		Shallow Concentrated Flow, Cultivated Straight Rows Kv= 9.0 fps
22.2	1,600	Total			

Subcatchment 11S: East Pond Watershed

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MSE 24-hr 4 25 Yr Rainfall=5.60"

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Summary for Subcatchment 12S: Direct E

Runoff = 98.86 cfs @ 12.54 hrs, Volume= 12.096 af, Depth= 3.72"
Routed to Pond 8P : Hauber Wetland

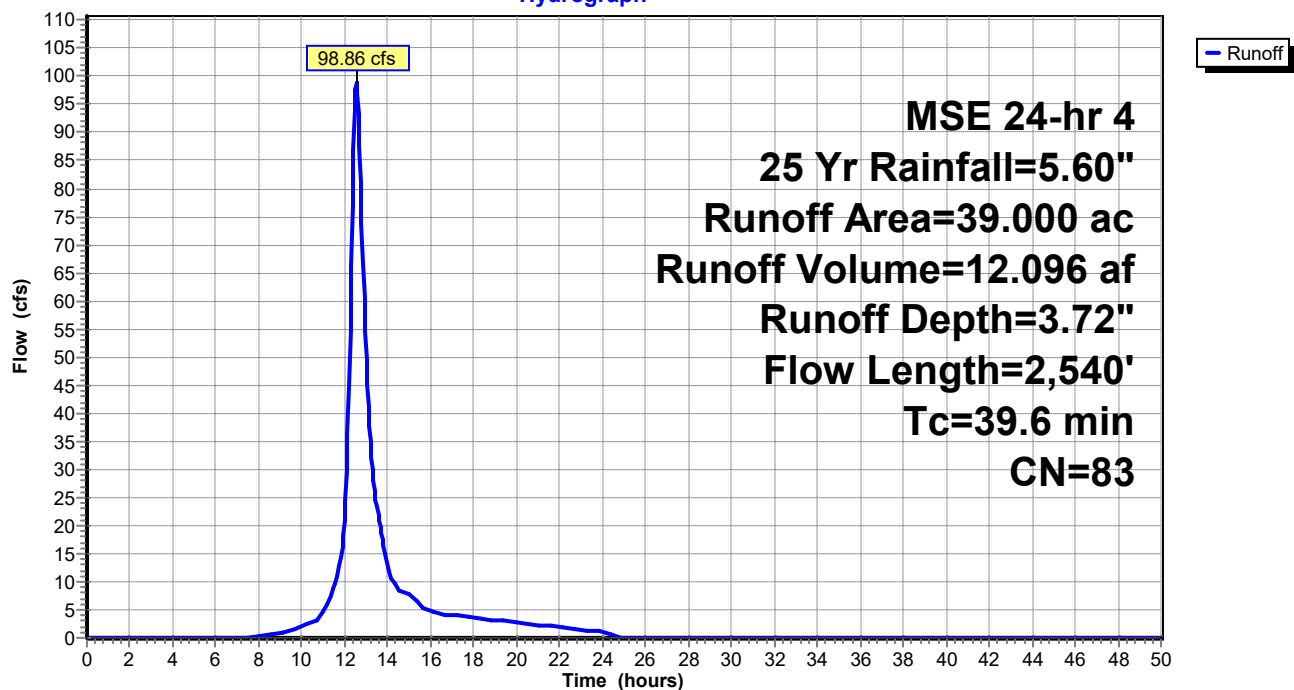
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
MSE 24-hr 4 25 Yr Rainfall=5.60"

Area (ac)	CN	Description
10.000	78	Row crops, straight row, Good, HSG B
29.000	85	Row crops, straight row, Good, HSG C
39.000	83	Weighted Average
39.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.6	100	0.0500	0.22		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 3.10"
32.0	2,440	0.0200	1.27		Shallow Concentrated Flow, Crops Cultivated Straight Rows Kv= 9.0 fps
39.6	2,540	Total			

Subcatchment 12S: Direct E

Hydrograph



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MSE 24-hr 4 25 Yr Rainfall=5.60"

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Summary for Subcatchment 13S: Direct Watershed

Runoff = 282.06 cfs @ 12.34 hrs, Volume= 26.128 af, Depth= 3.82"
Routed to Pond 8P : Hauber Wetland

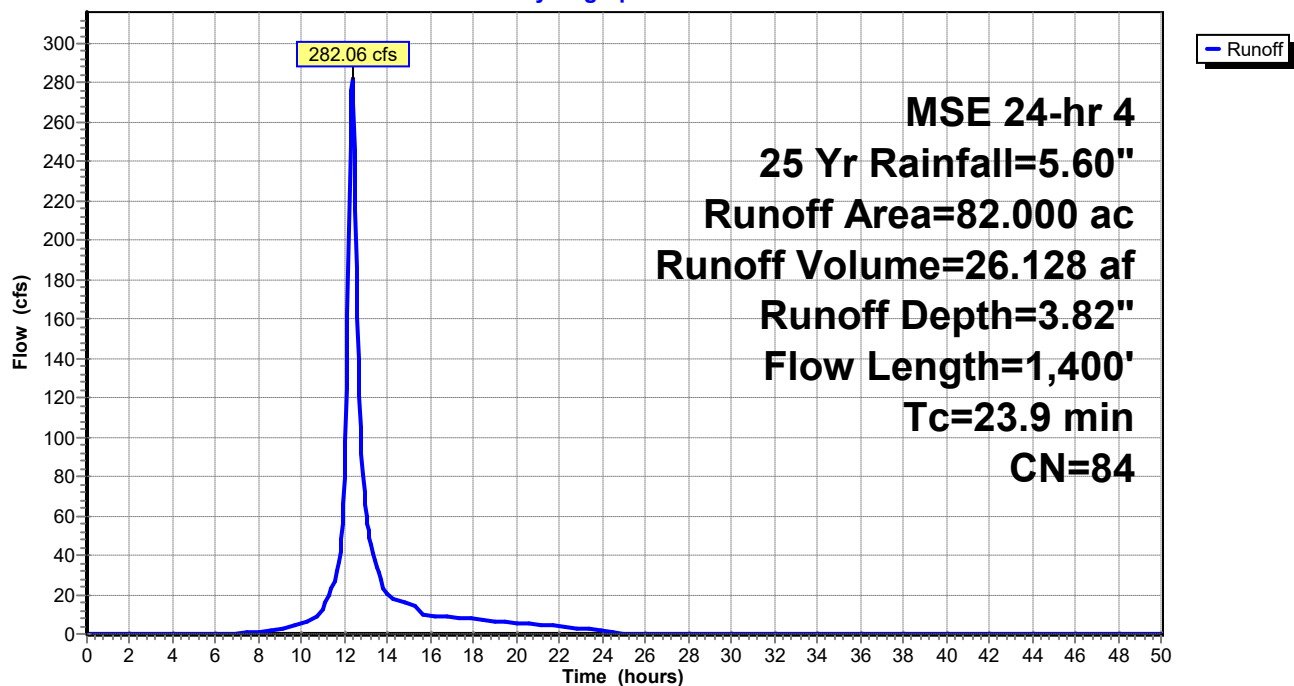
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
MSE 24-hr 4 25 Yr Rainfall=5.60"

Area (ac)	CN	Description
* 6.000	100	Wetland
22.000	78	Row crops, straight row, Good, HSG B
54.000	85	Row crops, straight row, Good, HSG C
82.000	84	Weighted Average
76.000		92.68% Pervious Area
6.000		7.32% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0	100	0.0200	0.17		Sheet Flow, Grass: Short n= 0.150 P2= 3.10"
13.9	1,300	0.0300	1.56		Shallow Concentrated Flow, Cultivated Straight Rows Kv= 9.0 fps
23.9	1,400	Total			

Subcatchment 13S: Direct Watershed

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MSE 24-hr 4 25 Yr Rainfall=5.60"

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Summary for Pond 2P: Southwest Pond

Inflow Area = 71.000 ac, 16.20% Impervious, Inflow Depth = 3.52" for 25 Yr event
 Inflow = 189.39 cfs @ 12.46 hrs, Volume= 20.833 af
 Outflow = 32.91 cfs @ 13.56 hrs, Volume= 17.140 af, Atten= 83%, Lag= 66.3 min
 Primary = 32.91 cfs @ 13.56 hrs, Volume= 17.140 af
 Routed to Pond 8P : Hauber Wetland

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 1,182.23' @ 13.56 hrs Surf.Area= 7.327 ac Storage= 12.506 af

Plug-Flow detention time= 557.3 min calculated for 17.122 af (82% of inflow)
 Center-of-Mass det. time= 493.7 min (1,322.2 - 828.5)

Volume	Invert	Avail.Storage	Storage Description
#1	1,180.00'	85.805 af	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,180.00	3.980	0.000	0.000
1,181.00	5.410	4.695	4.695
1,182.00	6.950	6.180	10.875
1,183.00	8.600	7.775	18.650
1,184.00	10.360	9.480	28.130
1,185.00	12.270	11.315	39.445
1,186.00	14.340	13.305	52.750
1,187.00	16.520	15.430	68.180
1,188.00	18.730	17.625	85.805

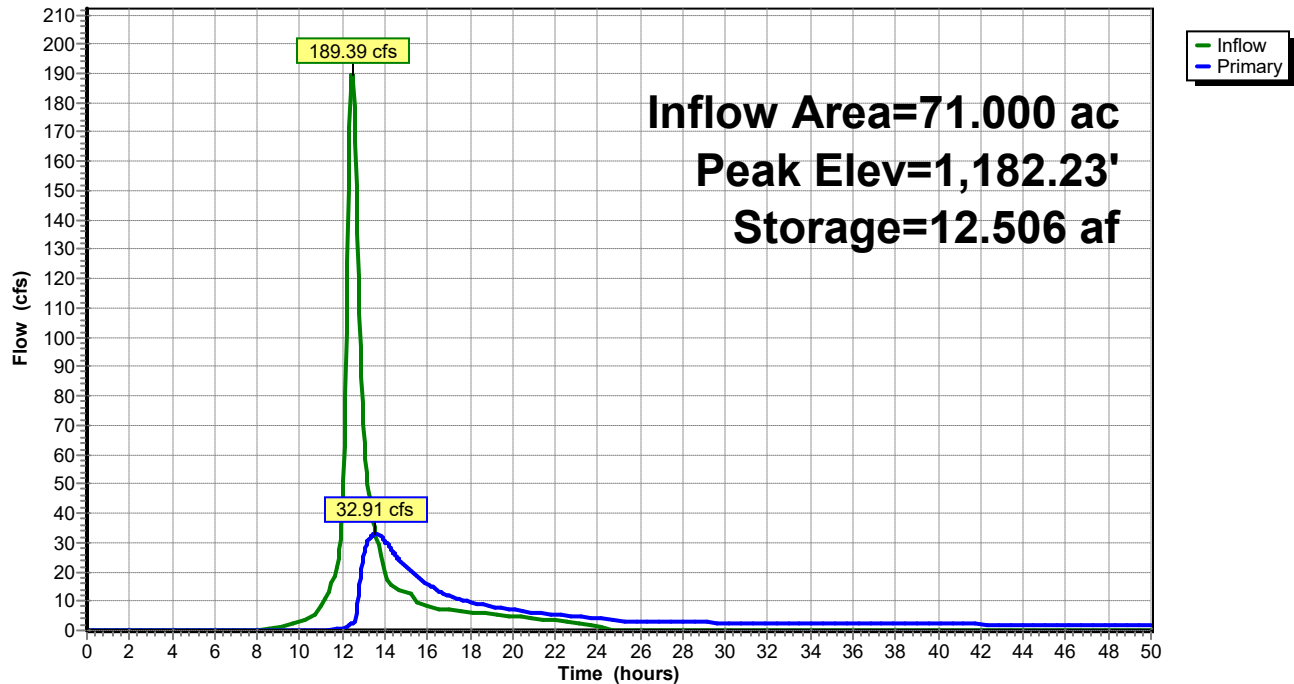
Device	Routing	Invert	Outlet Devices
#1	Primary	1,180.00'	10.0" Round Culvert L= 70.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 1,180.00' / 1,177.00' S= 0.0429 ' /' Cc= 0.900 n= 0.013, Flow Area= 0.55 sf
#2	Primary	1,181.60'	20.0' long + 4.0 ' /' SideZ x 3.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32
#3	Primary	1,182.80'	700.0' long + 4.0 ' /' SideZ x 10.0' 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) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=32.90 cfs @ 13.56 hrs HW=1,182.23' (Free Discharge)

- 1=Culvert (Inlet Controls 3.53 cfs @ 6.48 fps)
 2=Broad-Crested Rectangular Weir (Weir Controls 29.37 cfs @ 2.08 fps)
 3=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Pond 2P: Southwest Pond

Hydrograph



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MSE 24-hr 4 25 Yr Rainfall=5.60"

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Summary for Pond 7P: Northwest Pond

Inflow Area = 56.000 ac, 7.50% Impervious, Inflow Depth = 3.72" for 25 Yr event
Inflow = 151.51 cfs @ 12.49 hrs, Volume= 17.368 af
Outflow = 36.65 cfs @ 13.33 hrs, Volume= 12.917 af, Atten= 76%, Lag= 50.9 min
Primary = 36.65 cfs @ 13.33 hrs, Volume= 12.917 af
Routed to Pond 8P : Hauber Wetland

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 1,181.20' @ 13.33 hrs Surf.Area= 4.340 ac Storage= 9.844 af

Plug-Flow detention time= 398.9 min calculated for 12.917 af (74% of inflow)
Center-of-Mass det. time= 322.2 min (1,148.3 - 826.0)

Volume	Invert	Avail.Storage	Storage Description
#1	1,177.70'	33.835 af	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,177.70	1.420	0.000	0.000
1,178.00	1.650	0.460	0.460
1,179.00	2.410	2.030	2.490
1,180.00	3.220	2.815	5.305
1,181.00	4.140	3.680	8.985
1,182.00	5.130	4.635	13.620
1,183.00	6.240	5.685	19.305
1,184.00	7.270	6.755	26.060
1,185.00	8.280	7.775	33.835

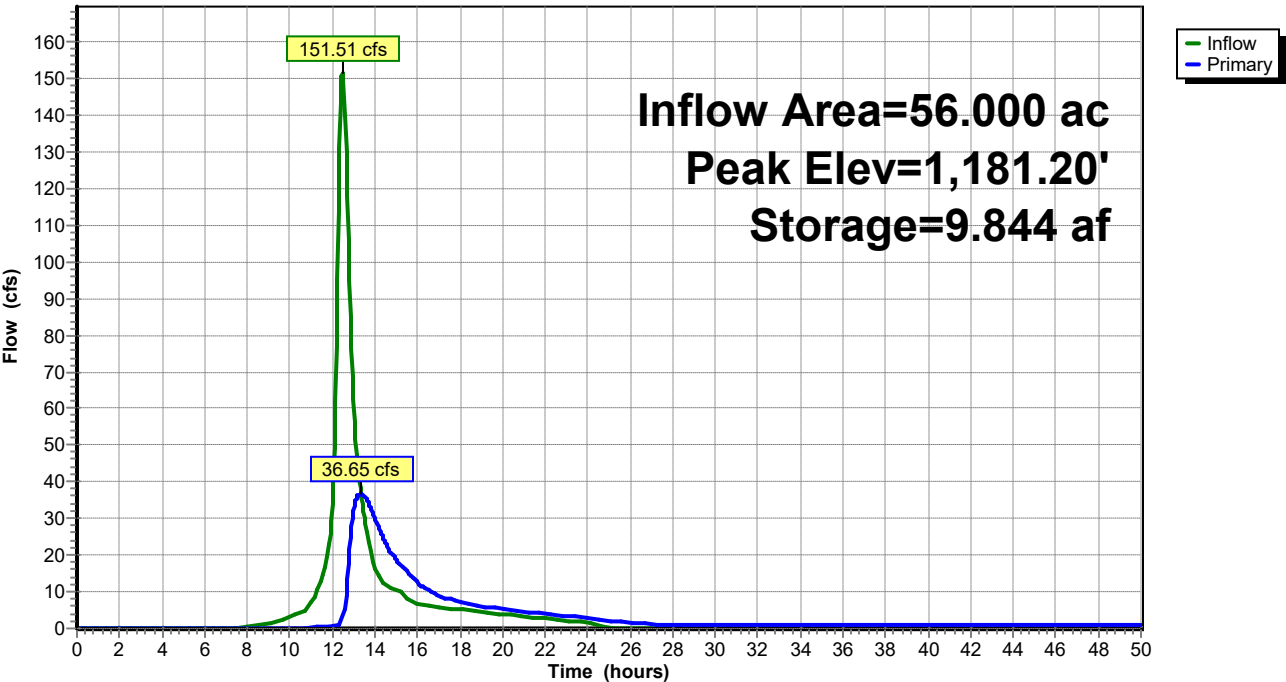
Device	Routing	Invert	Outlet Devices
#1	Primary	1,177.70'	6.0" Round Culvert L= 62.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 1,177.70' / 1,177.50' S= 0.0032 ' / ' Cc= 0.900 n= 0.013, Flow Area= 0.20 sf
#2	Primary	1,180.20'	10.0' long + 4.0 ' / ' SideZ x 10.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#3	Primary	1,182.20'	550.0' long + 4.0 ' / ' SideZ x 10.0' 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) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=36.63 cfs @ 13.33 hrs HW=1,181.20' (Free Discharge)

- 1=Culvert (Barrel Controls 1.11 cfs @ 5.67 fps)
- 2=Broad-Crested Rectangular Weir (Weir Controls 35.52 cfs @ 2.53 fps)
- 3=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Pond 7P: Northwest Pond

Hydrograph



Hauber Chute HydroCAD

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MSE 24-hr 4 25 Yr Rainfall=5.60"

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Summary for Pond 8P: Hauber Wetland

Inflow Area = 655.000 ac, 4.02% Impervious, Inflow Depth > 3.54" for 25 Yr event
 Inflow = 699.28 cfs @ 12.45 hrs, Volume= 193.056 af
 Outflow = 688.21 cfs @ 13.06 hrs, Volume= 192.681 af, Atten= 2%, Lag= 36.6 min
 Primary = 688.21 cfs @ 13.06 hrs, Volume= 192.681 af

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Starting Elev= 1,162.00' Surf.Area= 3.600 ac Storage= 6.845 af
 Peak Elev= 1,164.76' @ 13.06 hrs Surf.Area= 5.508 ac Storage= 19.252 af (12.407 af above start)

Plug-Flow detention time= 88.3 min calculated for 185.836 af (96% of inflow)
 Center-of-Mass det. time= 16.9 min (966.8 - 949.8)

Volume	Invert	Avail.Storage	Storage Description
#1	1,155.00'	26.995 af	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,155.00	0.000	0.000	0.000
1,156.00	0.020	0.010	0.010
1,158.00	0.130	0.150	0.160
1,159.00	0.660	0.395	0.555
1,160.00	1.060	0.860	1.415
1,161.00	3.100	2.080	3.495
1,162.00	3.600	3.350	6.845
1,163.00	4.200	3.900	10.745
1,164.00	4.900	4.550	15.295
1,165.00	5.700	5.300	20.595
1,166.00	7.100	6.400	26.995

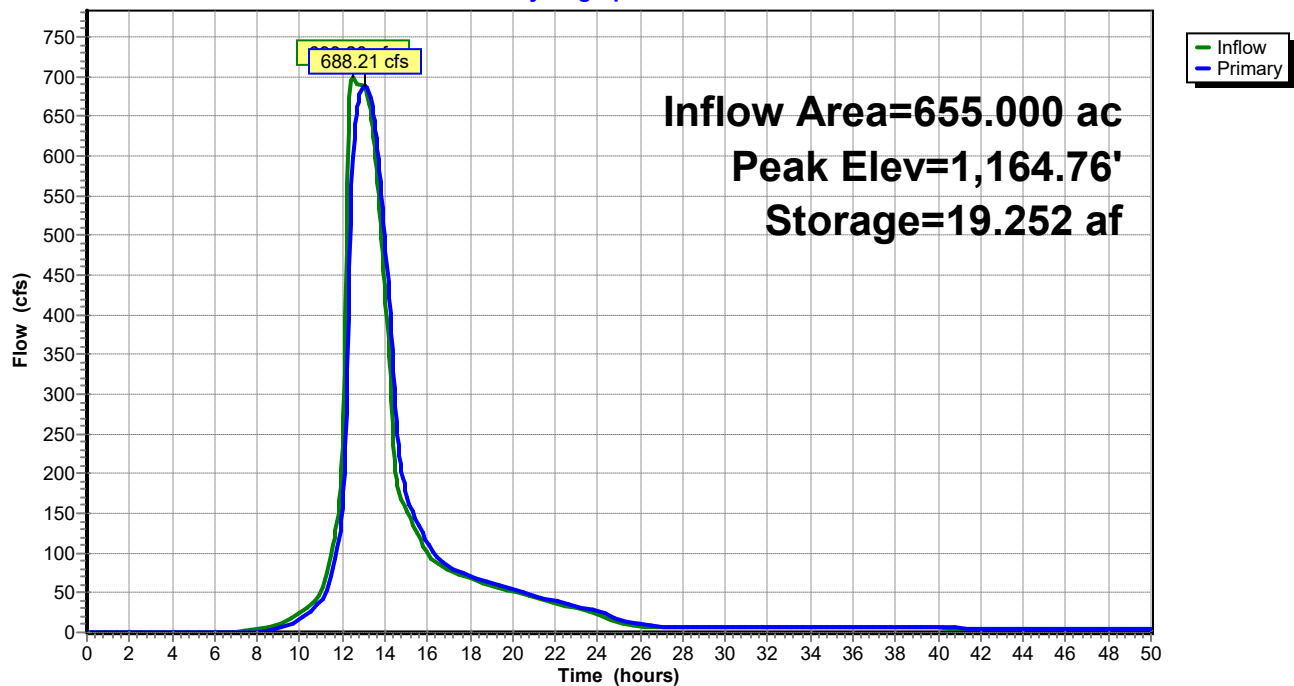
Device	Routing	Invert	Outlet Devices
#1	Primary	1,164.80'	25.0' long + 3.0 ' SideZ x 20.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#2	Primary	1,162.00'	48.0' long + 4.0 ' SideZ x 10.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#3	Primary	1,155.50'	12.0" Round Drawdown Pipe L= 41.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 1,155.50' / 1,154.00' S= 0.0366 ' / ' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#4	Device 3	1,165.50'	3.0' long Sharp-Crested Rectangular Weir 2 End Contraction(s)

Primary OutFlow Max=687.97 cfs @ 13.06 hrs HW=1,164.76' (Free Discharge)

- 1=Broad-Crested Rectangular Weir (Controls 0.00 cfs)
- 2=Broad-Crested Rectangular Weir (Weir Controls 687.97 cfs @ 4.22 fps)
- 3=Drawdown Pipe (Passes 0.00 cfs of 11.19 cfs potential flow)
- 4=Sharp-Crested Rectangular Weir (Controls 0.00 cfs)

Pond 8P: Hauber Wetland

Hydrograph



Hauber Chute HydroCAD

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MSE 24-hr 4 25 Yr Rainfall=5.60"

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Summary for Pond 10P: East Pond

Inflow Area = 46.000 ac, 10.00% Impervious, Inflow Depth = 3.82" for 25 Yr event
 Inflow = 163.96 cfs @ 12.32 hrs, Volume= 14.657 af
 Outflow = 17.34 cfs @ 13.60 hrs, Volume= 12.593 af, Atten= 89%, Lag= 76.9 min
 Primary = 17.34 cfs @ 13.60 hrs, Volume= 12.593 af
 Routed to Pond 8P : Hauber Wetland

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 1,182.73' @ 13.60 hrs Surf.Area= 3.317 ac Storage= 9.496 af

Plug-Flow detention time= 752.9 min calculated for 12.593 af (86% of inflow)
 Center-of-Mass det. time= 696.4 min (1,507.9 - 811.5)

Volume	Invert	Avail.Storage	Storage Description
#1	1,178.00'	18.780 af	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,178.00	0.950	0.000	0.000
1,179.00	1.300	1.125	1.125
1,180.00	1.770	1.535	2.660
1,181.00	2.280	2.025	4.685
1,182.00	2.860	2.570	7.255
1,183.00	3.490	3.175	10.430
1,184.00	4.160	3.825	14.255
1,185.00	4.890	4.525	18.780

Device	Routing	Invert	Outlet Devices
#1	Primary	1,178.10'	8.0" Round Culvert L= 75.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 1,178.10' / 1,173.00' S= 0.0680 ' / ' Cc= 0.900 n= 0.013, Flow Area= 0.35 sf
#2	Primary	1,182.20'	12.0' long + 4.0 ' / ' SideZ x 10.0' 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) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

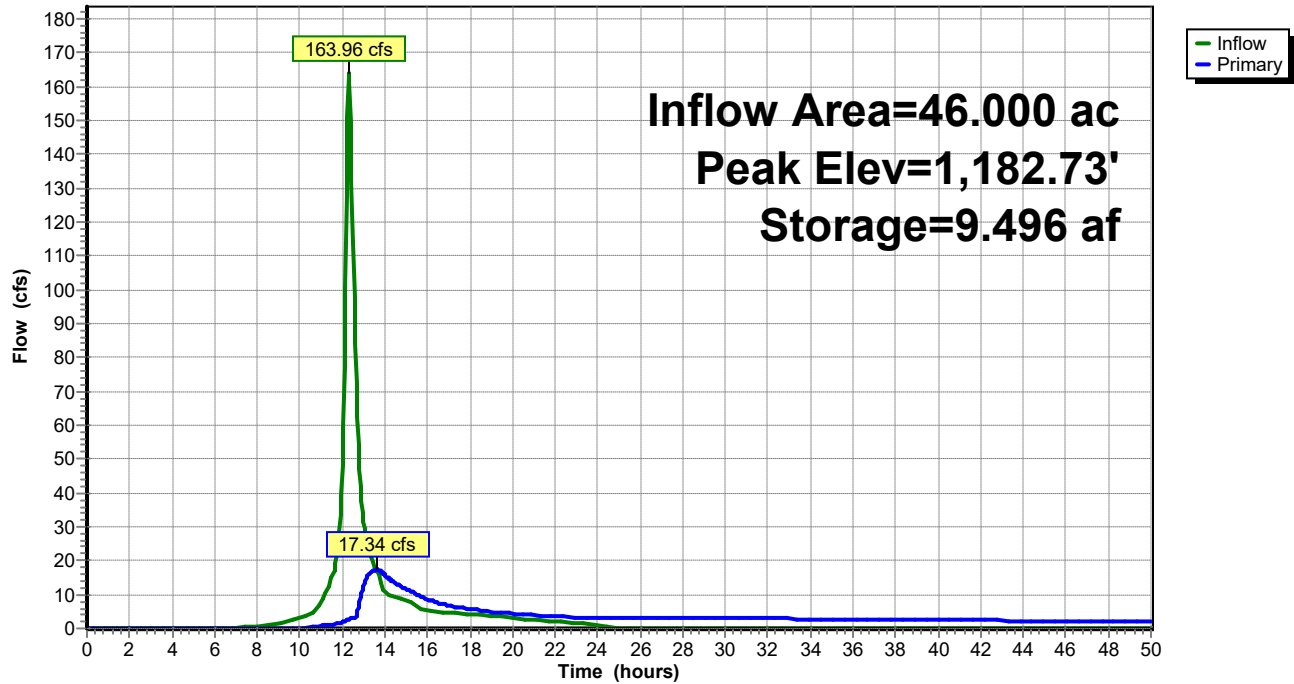
Primary OutFlow Max=17.29 cfs @ 13.60 hrs HW=1,182.73' (Free Discharge)

1=Culvert (Inlet Controls 3.48 cfs @ 9.98 fps)

2=Broad-Crested Rectangular Weir (Weir Controls 13.81 cfs @ 1.86 fps)

Pond 10P: East Pond

Hydrograph



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MSE 24-hr 4 25 Yr Rainfall=5.60"

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Summary for Pond 14P: Culvert South

Inflow Area = 348.000 ac, 0.00% Impervious, Inflow Depth = 3.72" for 25 Yr event
 Inflow = 732.04 cfs @ 12.71 hrs, Volume= 107.930 af
 Outflow = 507.03 cfs @ 13.10 hrs, Volume= 107.930 af, Atten= 31%, Lag= 23.6 min
 Primary = 507.03 cfs @ 13.10 hrs, Volume= 107.930 af
 Routed to Pond 8P : Hauber Wetland

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 1,176.01' @ 13.10 hrs Surf.Area= 7.037 ac Storage= 15.444 af

Plug-Flow detention time= 11.2 min calculated for 107.822 af (100% of inflow)
 Center-of-Mass det. time= 11.2 min (853.9 - 842.7)

Volume	Invert	Avail.Storage	Storage Description
#1	1,168.00'	34.340 af	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,168.00	0.020	0.000	0.000
1,170.00	0.280	0.300	0.300
1,172.00	0.690	0.970	1.270
1,174.00	3.190	3.880	5.150
1,176.00	7.000	10.190	15.340
1,178.00	12.000	19.000	34.340

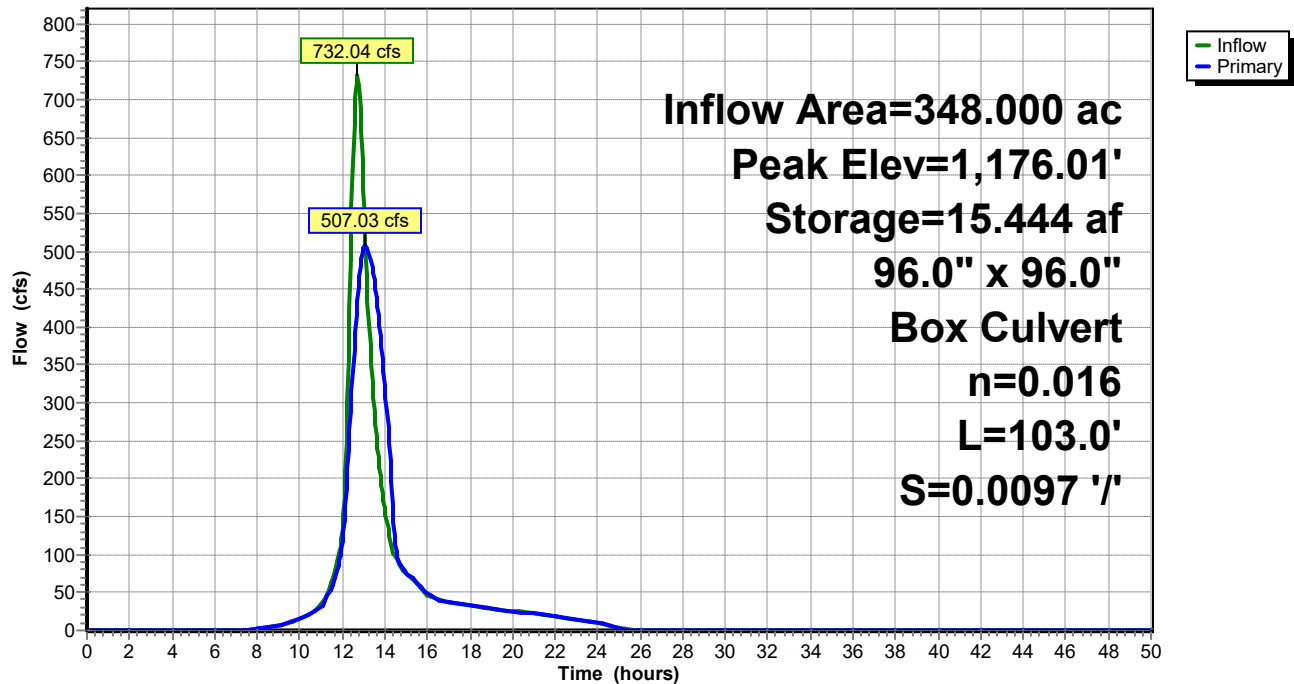
Device	Routing	Invert	Outlet Devices
#1	Primary	1,168.00'	96.0" W x 96.0" H Box Culvert L= 103.0' Box, 10-30° wingwalls, square crown, Ke= 0.500 Inlet / Outlet Invert= 1,168.00' / 1,167.00' S= 0.0097 ' / ' Cc= 0.900 n= 0.016, Flow Area= 64.00 sf

Primary OutFlow Max=507.02 cfs @ 13.10 hrs HW=1,176.01' (Free Discharge)

↑ **1=Culvert** (Barrel Controls 507.02 cfs @ 10.54 fps)

Pond 14P: Culvert South

Hydrograph



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MSE 24-hr 4 100 Yr Rainfall=7.60"

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Time span=0.00-50.00 hrs, dt=0.05 hrs, 1001 points

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Southeast Watershed Runoff Area=152.000 ac 0.00% Impervious Runoff Depth=5.60"
Flow Length=3,750' Tc=48.2 min CN=83 Runoff=510.91 cfs 70.886 af

Subcatchment 4S: NW Pond Watershed Runoff Area=56.000 ac 7.50% Impervious Runoff Depth=5.60"
Flow Length=2,320' Tc=35.4 min CN=83 Runoff=225.13 cfs 26.116 af

Subcatchment 5S: SW Pond Watershed Runoff Area=71.000 ac 16.20% Impervious Runoff Depth=5.37"
Flow Length=2,100' Tc=33.2 min CN=81 Runoff=285.85 cfs 31.748 af

Subcatchment 6S: Southwest Watershed Runoff Area=196.000 ac 0.00% Impervious Runoff Depth=5.60"
Flow Length=4,140' Tc=57.4 min CN=83 Runoff=589.51 cfs 91.405 af

Subcatchment 9S: Direct NE Runoff Area=13.000 ac 0.00% Impervious Runoff Depth=5.83"
Flow Length=1,245' Tc=22.4 min CN=85 Runoff=69.27 cfs 6.314 af

Subcatchment 11S: East Pond Watershed Runoff Area=46.000 ac 10.00% Impervious Runoff Depth=5.71"
Flow Length=1,600' Tc=22.2 min CN=84 Runoff=241.22 cfs 21.896 af

Subcatchment 12S: Direct E Runoff Area=39.000 ac 0.00% Impervious Runoff Depth=5.60"
Flow Length=2,540' Tc=39.6 min CN=83 Runoff=146.92 cfs 18.188 af

Subcatchment 13S: Direct Watershed Runoff Area=82.000 ac 7.32% Impervious Runoff Depth=5.71"
Flow Length=1,400' Tc=23.9 min CN=84 Runoff=415.04 cfs 39.032 af

Pond 2P: Southwest Pond Peak Elev=1,182.78' Storage=16.794 af Inflow=285.85 cfs 31.748 af
Outflow=84.51 cfs 27.940 af

Pond 7P: Northwest Pond Peak Elev=1,181.86' Storage=12.924 af Inflow=225.13 cfs 26.116 af
Outflow=87.92 cfs 21.620 af

Pond 8P: Hauber Wetland Peak Elev=1,165.48' Storage=23.490 af Inflow=1,066.54 cfs 295.077 af
Outflow=1,053.32 cfs 294.694 af

Pond 10P: East Pond Peak Elev=1,183.43' Storage=12.008 af Inflow=241.22 cfs 21.896 af
Outflow=62.49 cfs 19.692 af

Pond 14P: Culvert South Peak Elev=1,177.66' Storage=30.443 af Inflow=1,090.06 cfs 162.291 af
96.0" x 96.0" Box Culvert n=0.016 L=103.0' S=0.0097 ' Outflow=656.01 cfs 162.291 af

Total Runoff Area = 655.000 ac Runoff Volume = 305.584 af Average Runoff Depth = 5.60"
95.98% Pervious = 628.700 ac 4.02% Impervious = 26.300 ac

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MSE 24-hr 4 100 Yr Rainfall=7.60"

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Summary for Subcatchment 1S: Southeast Watershed

Runoff = 510.91 cfs @ 12.64 hrs, Volume= 70.886 af, Depth= 5.60"
Routed to Pond 14P : Culvert South

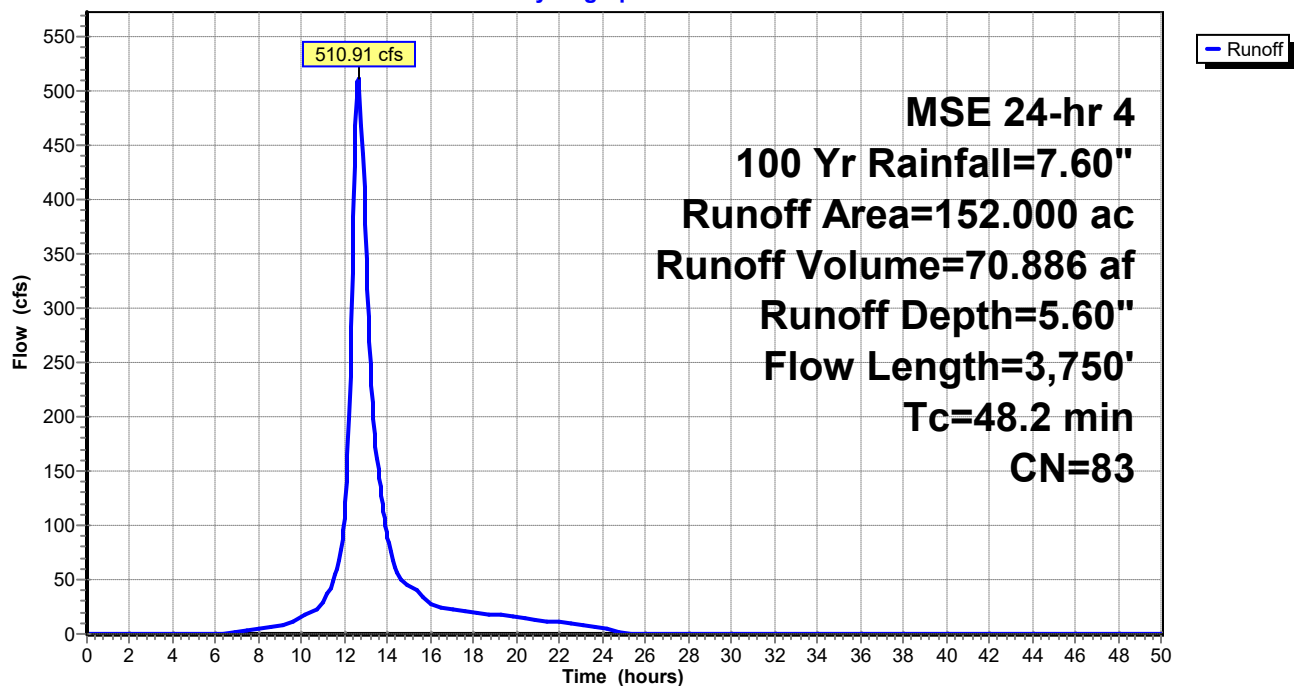
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
MSE 24-hr 4 100 Yr Rainfall=7.60"

Area (ac)	CN	Description
41.000	78	Row crops, straight row, Good, HSG B
111.000	85	Row crops, straight row, Good, HSG C
152.000	83	Weighted Average
152.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.0	100	0.0200	0.15		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 3.10"
7.8	750	0.0320	1.61		Shallow Concentrated Flow, Shallow Crop Cultivated Straight Rows Kv= 9.0 fps
29.4	2,900	0.0120	1.64		Shallow Concentrated Flow, Grassed Grassed Waterway Kv= 15.0 fps
48.2	3,750	Total			

Subcatchment 1S: Southeast Watershed

Hydrograph



Summary for Subcatchment 4S: NW Pond Watershed

Runoff = 225.13 cfs @ 12.48 hrs, Volume= 26.116 af, Depth= 5.60"
 Routed to Pond 7P : Northwest Pond

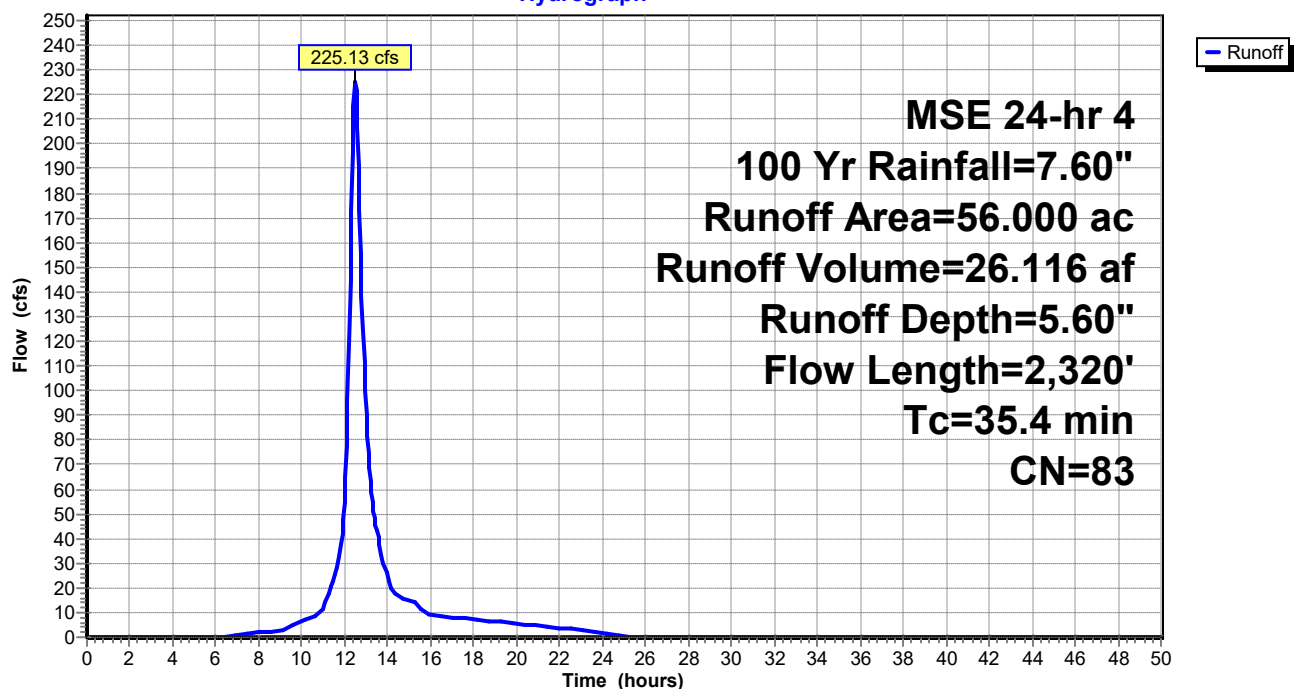
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 MSE 24-hr 4 100 Yr Rainfall=7.60"

Area (ac)	CN	Description
32.000	85	Row crops, straight row, Good, HSG C
15.000	78	Row crops, straight row, Good, HSG B
6.000	79	1 acre lots, 20% imp, HSG C
* 3.000	100	Pond
56.000	83	Weighted Average
51.800		92.50% Pervious Area
4.200		7.50% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.1	100	0.0100	0.09		Sheet Flow, Grass: Dense n= 0.240 P2= 3.10"
16.3	2,220	0.0230	2.27		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
35.4	2,320	Total			

Subcatchment 4S: NW Pond Watershed

Hydrograph



Summary for Subcatchment 5S: SW Pond Watershed

Runoff = 285.85 cfs @ 12.45 hrs, Volume= 31.748 af, Depth= 5.37"
 Routed to Pond 2P : Southwest Pond

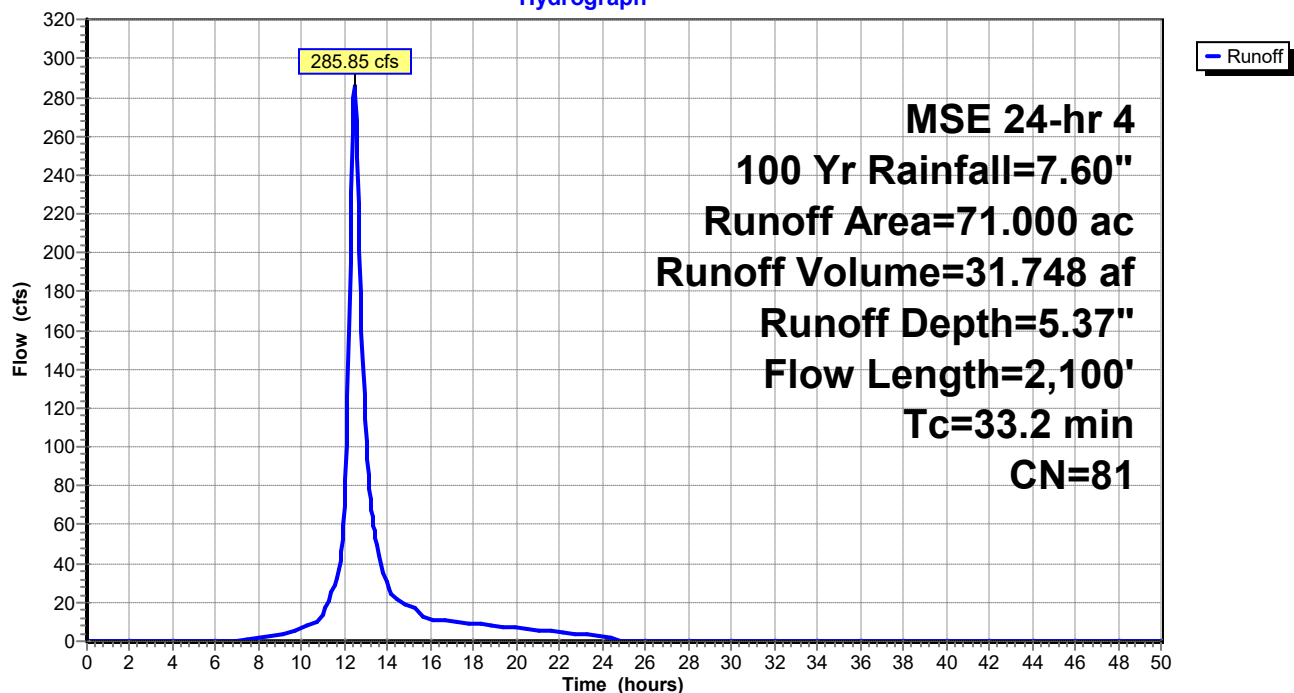
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 MSE 24-hr 4 100 Yr Rainfall=7.60"

Area (ac)	CN	Description
34.000	80	1/2 acre lots, 25% imp, HSG C
19.000	78	Row crops, straight row, Good, HSG B
* 3.000	100	Pond
15.000	85	Row crops, straight row, Good, HSG C
71.000	81	Weighted Average
59.500		83.80% Pervious Area
11.500		16.20% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.1	100	0.0100	0.09		Sheet Flow, Grass: Dense n= 0.240 P2= 3.10"
14.1	2,000	0.0250	2.37		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
33.2	2,100	Total			

Subcatchment 5S: SW Pond Watershed

Hydrograph



Summary for Subcatchment 6S: Southwest Watershed

Runoff = 589.51 cfs @ 12.76 hrs, Volume= 91.405 af, Depth= 5.60"
Routed to Pond 14P : Culvert South

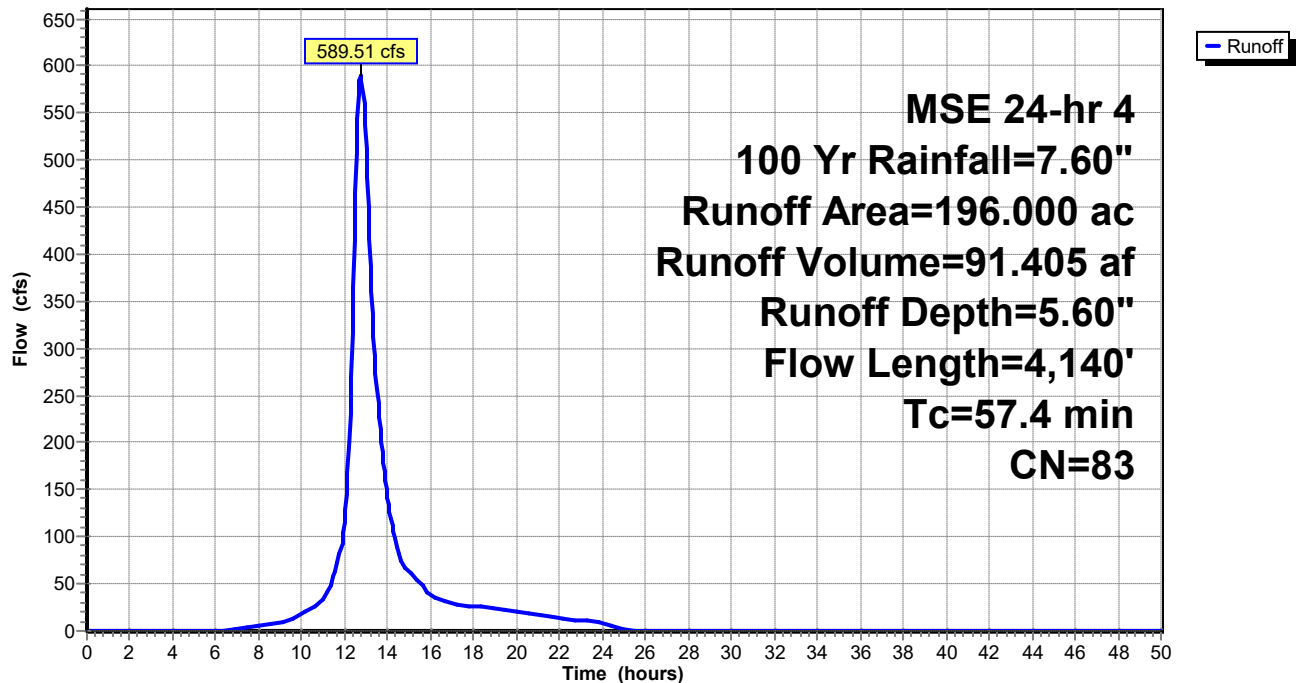
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
MSE 24-hr 4 100 Yr Rainfall=7.60"

Area (ac)	CN	Description
53.000	78	Row crops, straight row, Good, HSG B
143.000	85	Row crops, straight row, Good, HSG C
196.000	83	Weighted Average
196.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.4	100	0.0300	0.18		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 3.10"
18.0	1,340	0.0190	1.24		Shallow Concentrated Flow, Crops Cultivated Straight Rows Kv= 9.0 fps
30.0	2,700	0.0100	1.50		Shallow Concentrated Flow, Grassed Grassed Waterway Kv= 15.0 fps
57.4	4,140	Total			

Subcatchment 6S: Southwest Watershed

Hydrograph



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MSE 24-hr 4 100 Yr Rainfall=7.60"

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Summary for Subcatchment 9S: Direct NE

Runoff = 69.27 cfs @ 12.32 hrs, Volume= 6.314 af, Depth= 5.83"
Routed to Pond 8P : Hauber Wetland

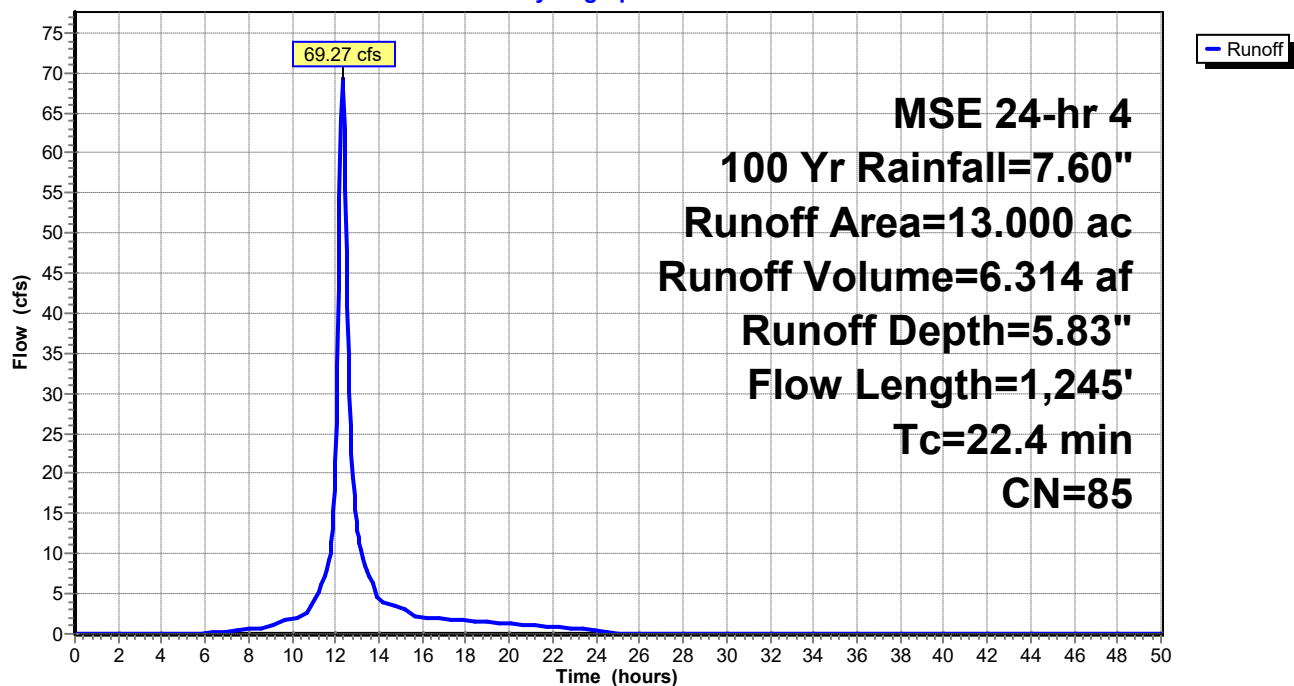
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
MSE 24-hr 4 100 Yr Rainfall=7.60"

Area (ac)	CN	Description
13.000	85	Row crops, straight row, Good, HSG C
13.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.5	100	0.0100	0.11		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 3.10"
5.1	600	0.0467	1.94		Shallow Concentrated Flow, Crop Cultivated Straight Rows Kv= 9.0 fps
2.8	545	0.0470	3.25		Shallow Concentrated Flow, Grass Grassed Waterway Kv= 15.0 fps
22.4	1,245	Total			

Subcatchment 9S: Direct NE

Hydrograph



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MSE 24-hr 4 100 Yr Rainfall=7.60"

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Summary for Subcatchment 11S: East Pond Watershed

Runoff = 241.22 cfs @ 12.32 hrs, Volume= 21.896 af, Depth= 5.71"
Routed to Pond 10P : East Pond

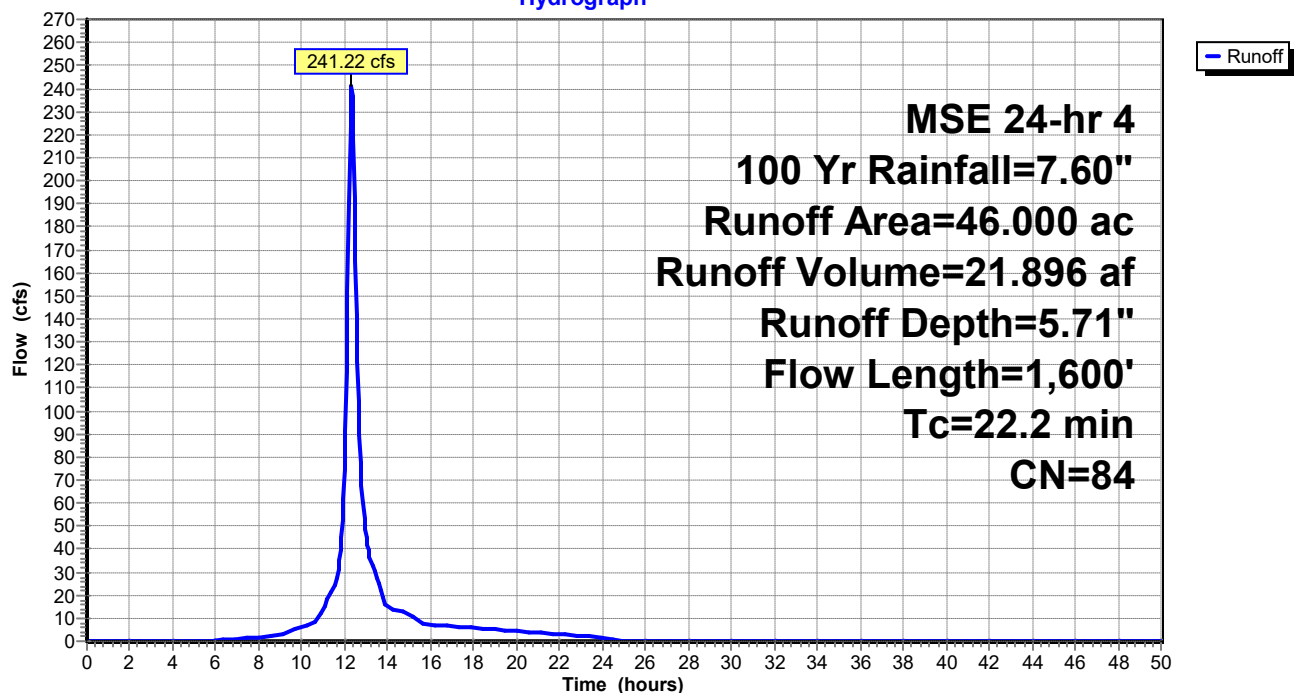
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
MSE 24-hr 4 100 Yr Rainfall=7.60"

Area (ac)	CN	Description
* 1.000	100	Pond
5.000	91	Urban industrial, 72% imp, HSG C
12.000	78	Row crops, straight row, Good, HSG B
28.000	85	Row crops, straight row, Good, HSG C
46.000	84	Weighted Average
41.400		90.00% Pervious Area
4.600		10.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.7	100	0.0700	0.25		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 3.10"
15.5	1,500	0.0320	1.61		Shallow Concentrated Flow, Cultivated Straight Rows Kv= 9.0 fps
22.2	1,600	Total			

Subcatchment 11S: East Pond Watershed

Hydrograph



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MSE 24-hr 4 100 Yr Rainfall=7.60"

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Summary for Subcatchment 12S: Direct E

Runoff = 146.92 cfs @ 12.54 hrs, Volume= 18.188 af, Depth= 5.60"
Routed to Pond 8P : Hauber Wetland

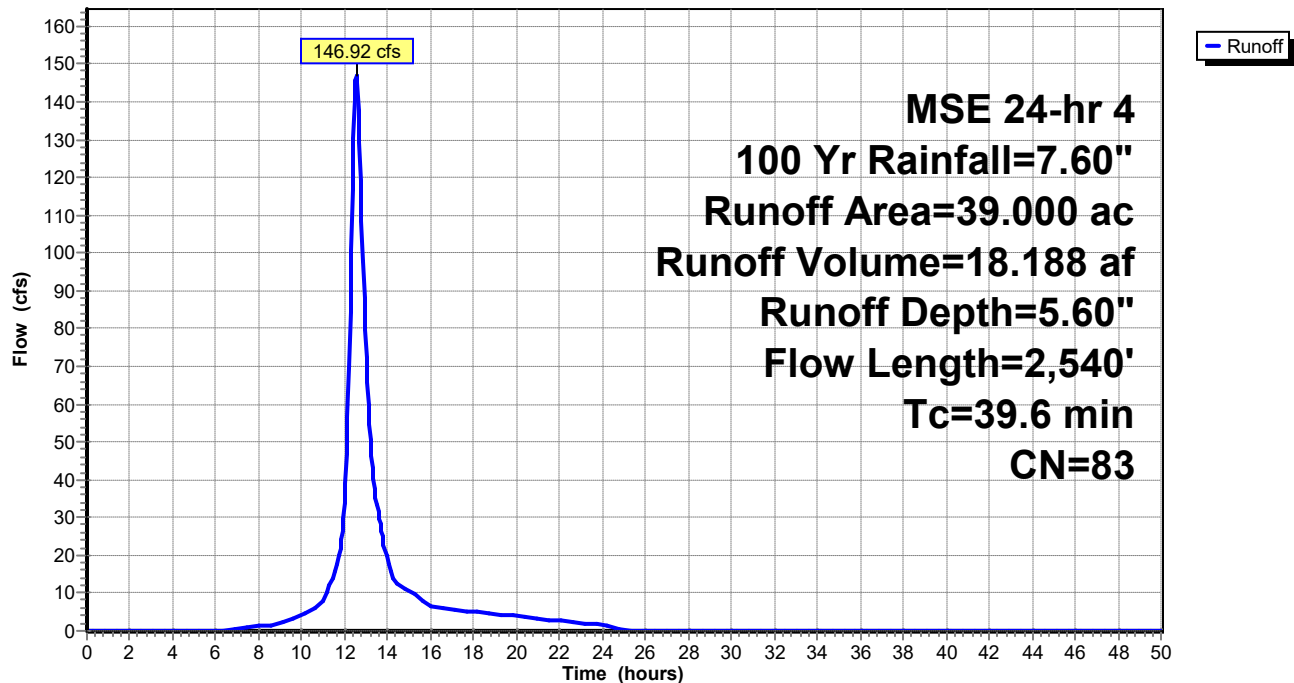
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
MSE 24-hr 4 100 Yr Rainfall=7.60"

Area (ac)	CN	Description
10.000	78	Row crops, straight row, Good, HSG B
29.000	85	Row crops, straight row, Good, HSG C
39.000	83	Weighted Average
39.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.6	100	0.0500	0.22		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 3.10"
32.0	2,440	0.0200	1.27		Shallow Concentrated Flow, Crops Cultivated Straight Rows Kv= 9.0 fps
39.6	2,540	Total			

Subcatchment 12S: Direct E

Hydrograph



Hauber Chute HydroCAD

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MSE 24-hr 4 100 Yr Rainfall=7.60"

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Summary for Subcatchment 13S: Direct Watershed

Runoff = 415.04 cfs @ 12.34 hrs, Volume= 39.032 af, Depth= 5.71"
Routed to Pond 8P : Hauber Wetland

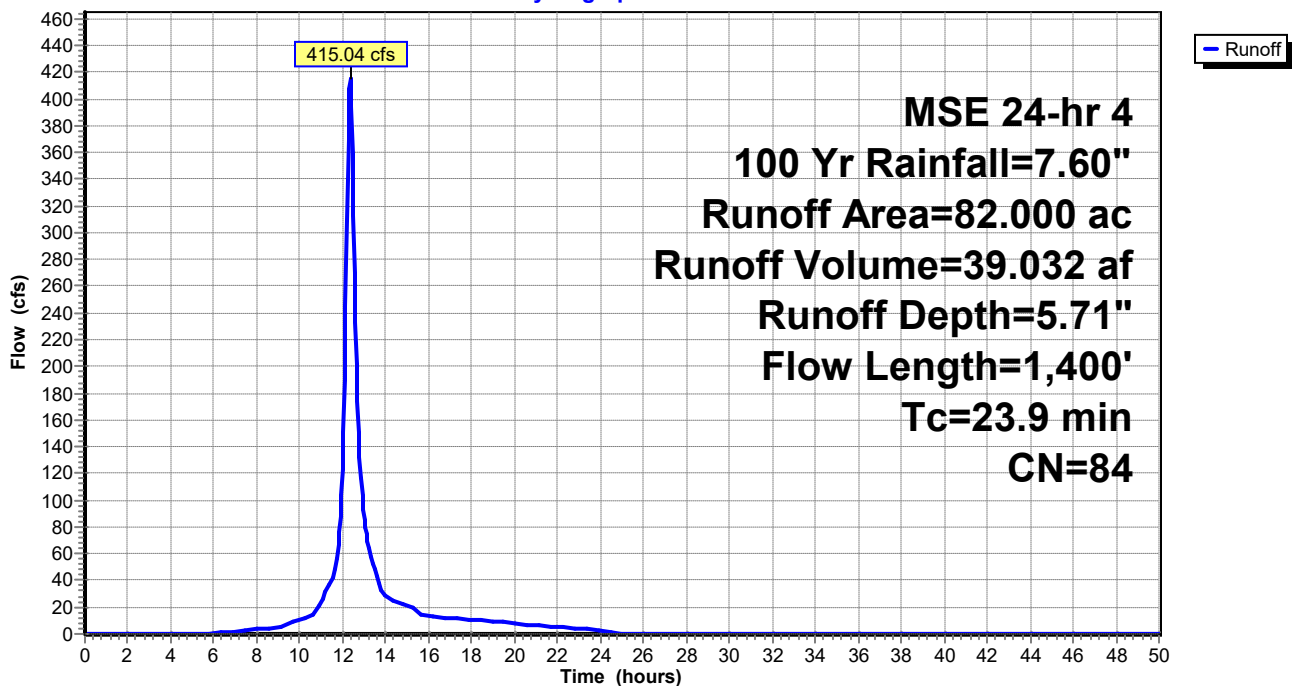
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
MSE 24-hr 4 100 Yr Rainfall=7.60"

Area (ac)	CN	Description
* 6.000	100	Wetland
22.000	78	Row crops, straight row, Good, HSG B
54.000	85	Row crops, straight row, Good, HSG C
82.000	84	Weighted Average
76.000		92.68% Pervious Area
6.000		7.32% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0	100	0.0200	0.17		Sheet Flow, Grass: Short n= 0.150 P2= 3.10"
13.9	1,300	0.0300	1.56		Shallow Concentrated Flow, Cultivated Straight Rows Kv= 9.0 fps
23.9	1,400	Total			

Subcatchment 13S: Direct Watershed

Hydrograph



Hauber Chute HydroCAD

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MSE 24-hr 4 100 Yr Rainfall=7.60"

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Summary for Pond 2P: Southwest Pond

Inflow Area = 71.000 ac, 16.20% Impervious, Inflow Depth = 5.37" for 100 Yr event
 Inflow = 285.85 cfs @ 12.45 hrs, Volume= 31.748 af
 Outflow = 84.51 cfs @ 13.11 hrs, Volume= 27.940 af, Atten= 70%, Lag= 39.3 min
 Primary = 84.51 cfs @ 13.11 hrs, Volume= 27.940 af
 Routed to Pond 8P : Hauber Wetland

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 1,182.78' @ 13.11 hrs Surf.Area= 8.236 ac Storage= 16.794 af

Plug-Flow detention time= 389.5 min calculated for 27.940 af (88% of inflow)
 Center-of-Mass det. time= 338.7 min (1,157.2 - 818.6)

Volume	Invert	Avail.Storage	Storage Description
#1	1,180.00'	85.805 af	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,180.00	3.980	0.000	0.000
1,181.00	5.410	4.695	4.695
1,182.00	6.950	6.180	10.875
1,183.00	8.600	7.775	18.650
1,184.00	10.360	9.480	28.130
1,185.00	12.270	11.315	39.445
1,186.00	14.340	13.305	52.750
1,187.00	16.520	15.430	68.180
1,188.00	18.730	17.625	85.805

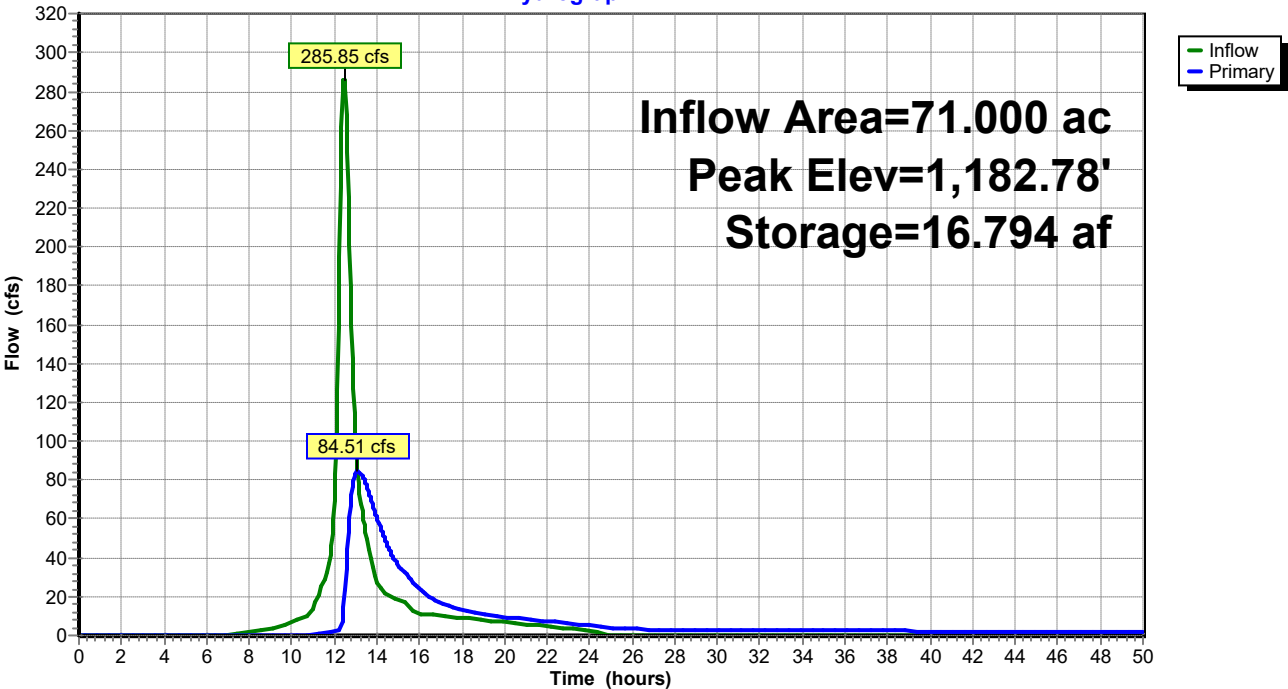
Device	Routing	Invert	Outlet Devices
#1	Primary	1,180.00'	10.0" Round Culvert L= 70.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 1,180.00' / 1,177.00' S= 0.0429 '/' Cc= 0.900 n= 0.013, Flow Area= 0.55 sf
#2	Primary	1,181.60'	20.0' long + 4.0 ' SideZ x 3.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32
#3	Primary	1,182.80'	700.0' long + 4.0 ' SideZ x 10.0' 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) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=84.44 cfs @ 13.11 hrs HW=1,182.78' (Free Discharge)

- 1=Culvert (Inlet Controls 4.04 cfs @ 7.40 fps)
- 2=Broad-Crested Rectangular Weir (Weir Controls 80.40 cfs @ 2.76 fps)
- 3=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Pond 2P: Southwest Pond

Hydrograph



Hauber Chute HydroCAD

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MSE 24-hr 4 100 Yr Rainfall=7.60"

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Summary for Pond 7P: Northwest Pond

Inflow Area = 56.000 ac, 7.50% Impervious, Inflow Depth = 5.60" for 100 Yr event
 Inflow = 225.13 cfs @ 12.48 hrs, Volume= 26.116 af
 Outflow = 87.92 cfs @ 13.02 hrs, Volume= 21.620 af, Atten= 61%, Lag= 32.2 min
 Primary = 87.92 cfs @ 13.02 hrs, Volume= 21.620 af
 Routed to Pond 8P : Hauber Wetland

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 1,181.86' @ 13.02 hrs Surf.Area= 4.994 ac Storage= 12.924 af

Plug-Flow detention time= 284.6 min calculated for 21.620 af (83% of inflow)
 Center-of-Mass det. time= 221.9 min (1,038.3 - 816.4)

Volume	Invert	Avail.Storage	Storage Description
#1	1,177.70'	33.835 af	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,177.70	1.420	0.000	0.000
1,178.00	1.650	0.460	0.460
1,179.00	2.410	2.030	2.490
1,180.00	3.220	2.815	5.305
1,181.00	4.140	3.680	8.985
1,182.00	5.130	4.635	13.620
1,183.00	6.240	5.685	19.305
1,184.00	7.270	6.755	26.060
1,185.00	8.280	7.775	33.835

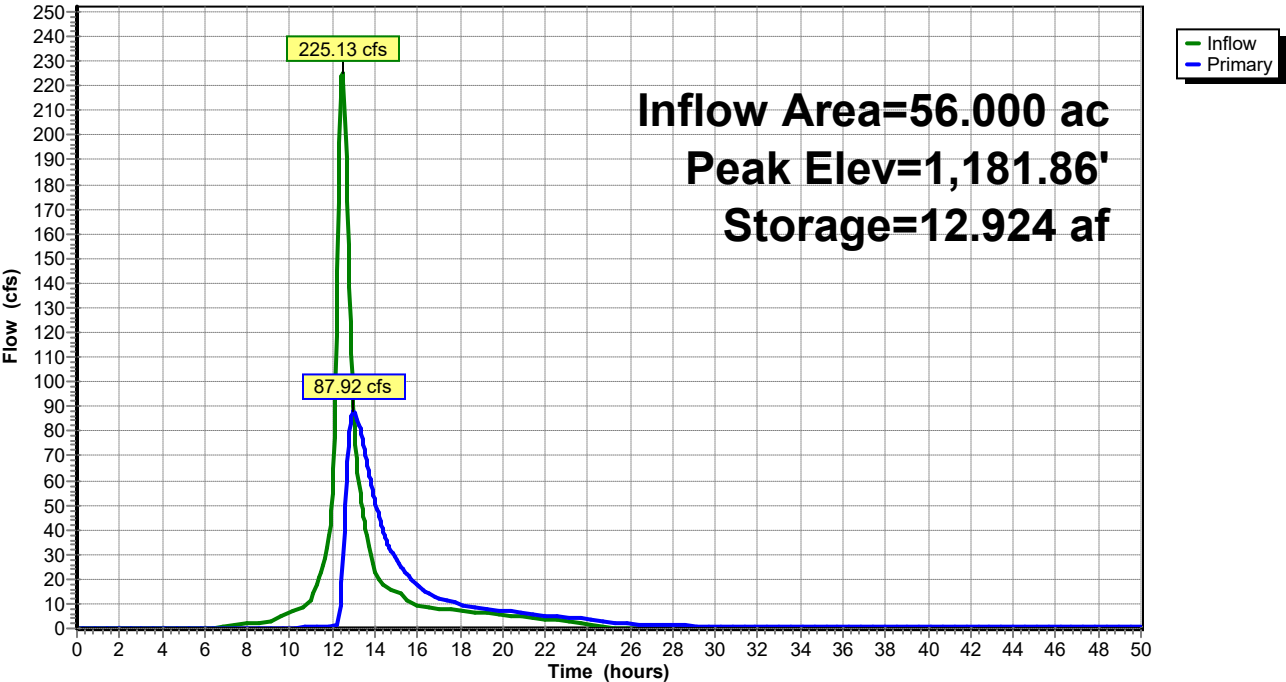
Device	Routing	Invert	Outlet Devices
#1	Primary	1,177.70'	6.0" Round Culvert L= 62.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 1,177.70' / 1,177.50' S= 0.0032 ' / ' Cc= 0.900 n= 0.013, Flow Area= 0.20 sf
#2	Primary	1,180.20'	10.0' long + 4.0 ' / ' SideZ x 10.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#3	Primary	1,182.20'	550.0' long + 4.0 ' / ' SideZ x 10.0' 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) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=87.83 cfs @ 13.02 hrs HW=1,181.86' (Free Discharge)

- 1=Culvert (Barrel Controls 1.22 cfs @ 6.23 fps)
- 2=Broad-Crested Rectangular Weir (Weir Controls 86.61 cfs @ 3.13 fps)
- 3=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Pond 7P: Northwest Pond

Hydrograph



Hauber Chute HydroCAD

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MSE 24-hr 4 100 Yr Rainfall=7.60"

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Summary for Pond 8P: Hauber Wetland

Inflow Area = 655.000 ac, 4.02% Impervious, Inflow Depth > 5.41" for 100 Yr event
 Inflow = 1,066.54 cfs @ 12.74 hrs, Volume= 295.077 af
 Outflow = 1,053.32 cfs @ 12.94 hrs, Volume= 294.694 af, Atten= 1%, Lag= 11.7 min
 Primary = 1,053.32 cfs @ 12.94 hrs, Volume= 294.694 af

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Starting Elev= 1,162.00' Surf.Area= 3.600 ac Storage= 6.845 af
 Peak Elev= 1,165.48' @ 12.94 hrs Surf.Area= 6.372 ac Storage= 23.490 af (16.645 af above start)

Plug-Flow detention time= 62.5 min calculated for 287.562 af (97% of inflow)
 Center-of-Mass det. time= 15.2 min (927.8 - 912.6)

Volume	Invert	Avail.Storage	Storage Description
#1	1,155.00'	26.995 af	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,155.00	0.000	0.000	0.000
1,156.00	0.020	0.010	0.010
1,158.00	0.130	0.150	0.160
1,159.00	0.660	0.395	0.555
1,160.00	1.060	0.860	1.415
1,161.00	3.100	2.080	3.495
1,162.00	3.600	3.350	6.845
1,163.00	4.200	3.900	10.745
1,164.00	4.900	4.550	15.295
1,165.00	5.700	5.300	20.595
1,166.00	7.100	6.400	26.995

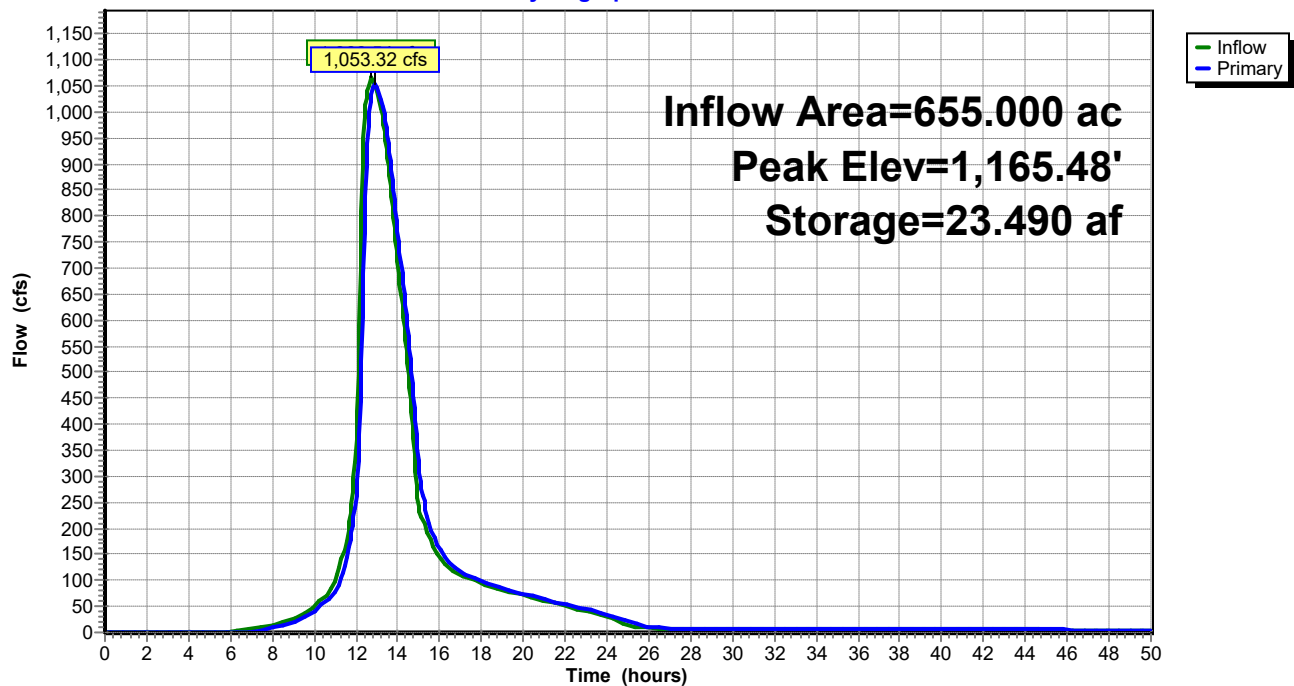
Device	Routing	Invert	Outlet Devices
#1	Primary	1,164.80'	25.0' long + 3.0 ' SideZ x 20.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#2	Primary	1,162.00'	48.0' long + 4.0 ' SideZ x 10.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#3	Primary	1,155.50'	12.0" Round Drawdown Pipe L= 41.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 1,155.50' / 1,154.00' S= 0.0366 ' / ' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#4	Device 3	1,165.50'	3.0' long Sharp-Crested Rectangular Weir 2 End Contraction(s)

Primary OutFlow Max=1,053.07 cfs @ 12.94 hrs HW=1,165.48' (Free Discharge)

- 1=Broad-Crested Rectangular Weir (Weir Controls 39.90 cfs @ 2.17 fps)
- 2=Broad-Crested Rectangular Weir (Weir Controls 1,013.17 cfs @ 4.70 fps)
- 3=Drawdown Pipe (Passes 0.00 cfs of 11.64 cfs potential flow)
- 4=Sharp-Crested Rectangular Weir (Controls 0.00 cfs)

Pond 8P: Hauber Wetland

Hydrograph



Hauber Chute HydroCAD

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MSE 24-hr 4 100 Yr Rainfall=7.60"

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Summary for Pond 10P: East Pond

Inflow Area = 46.000 ac, 10.00% Impervious, Inflow Depth = 5.71" for 100 Yr event
 Inflow = 241.22 cfs @ 12.32 hrs, Volume= 21.896 af
 Outflow = 62.49 cfs @ 12.84 hrs, Volume= 19.692 af, Atten= 74%, Lag= 31.1 min
 Primary = 62.49 cfs @ 12.84 hrs, Volume= 19.692 af
 Routed to Pond 8P : Hauber Wetland

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 1,183.43' @ 12.84 hrs Surf.Area= 3.781 ac Storage= 12.008 af

Plug-Flow detention time= 518.0 min calculated for 19.672 af (90% of inflow)
 Center-of-Mass det. time= 474.5 min (1,276.5 - 802.0)

Volume	Invert	Avail.Storage	Storage Description
#1	1,178.00'	18.780 af	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,178.00	0.950	0.000	0.000
1,179.00	1.300	1.125	1.125
1,180.00	1.770	1.535	2.660
1,181.00	2.280	2.025	4.685
1,182.00	2.860	2.570	7.255
1,183.00	3.490	3.175	10.430
1,184.00	4.160	3.825	14.255
1,185.00	4.890	4.525	18.780

Device	Routing	Invert	Outlet Devices
#1	Primary	1,178.10'	8.0" Round Culvert L= 75.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 1,178.10' / 1,173.00' S= 0.0680 '/' Cc= 0.900 n= 0.013, Flow Area= 0.35 sf
#2	Primary	1,182.20'	12.0' long + 4.0 ' SideZ x 10.0' 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) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

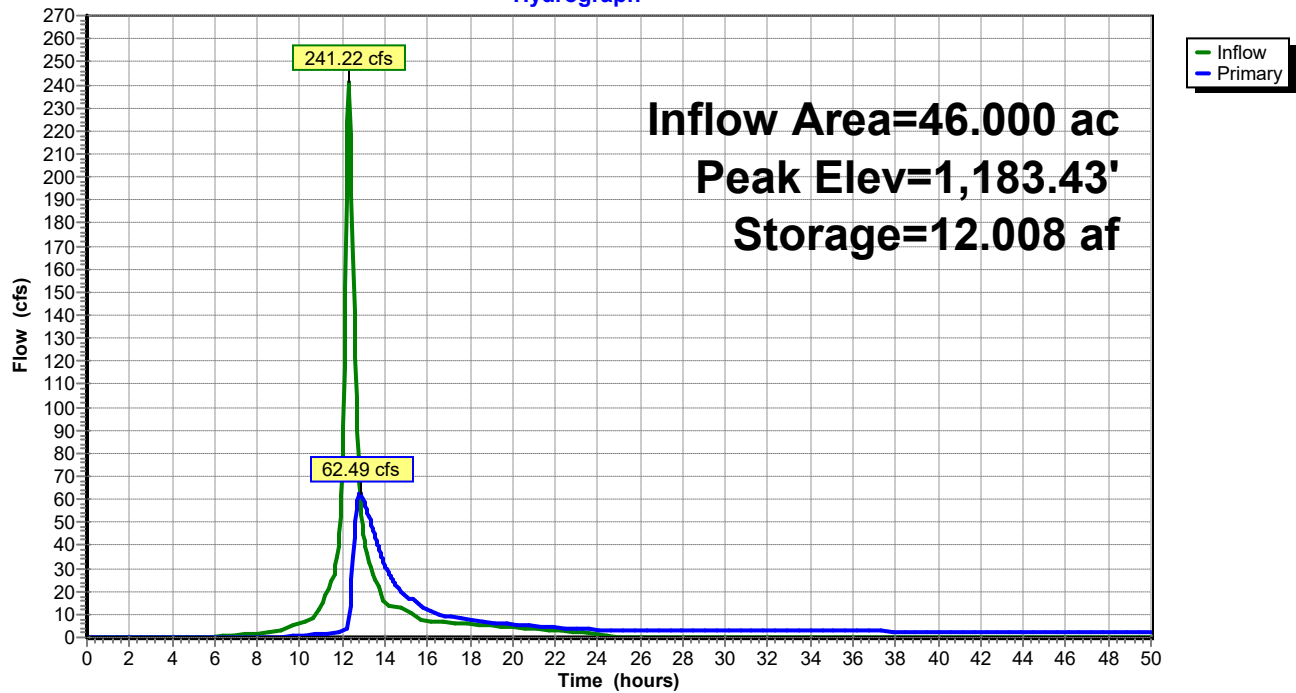
Primary OutFlow Max=62.41 cfs @ 12.84 hrs HW=1,183.43' (Free Discharge)

1=Culvert (Barrel Controls 3.72 cfs @ 10.65 fps)

2=Broad-Crested Rectangular Weir (Weir Controls 58.69 cfs @ 2.81 fps)

Pond 10P: East Pond

Hydrograph



Summary for Pond 14P: Culvert South

Inflow Area = 348.000 ac, 0.00% Impervious, Inflow Depth = 5.60" for 100 Yr event
 Inflow = 1,090.06 cfs @ 12.70 hrs, Volume= 162.291 af
 Outflow = 656.01 cfs @ 13.18 hrs, Volume= 162.291 af, Atten= 40%, Lag= 28.8 min
 Primary = 656.01 cfs @ 13.18 hrs, Volume= 162.291 af
 Routed to Pond 8P : Hauber Wetland

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
 Peak Elev= 1,177.66' @ 13.18 hrs Surf.Area= 11.159 ac Storage= 30.443 af

Plug-Flow detention time= 17.3 min calculated for 162.129 af (100% of inflow)
 Center-of-Mass det. time= 17.3 min (850.4 - 833.1)

Volume	Invert	Avail.Storage	Storage Description
#1	1,168.00'	34.340 af	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,168.00	0.020	0.000	0.000
1,170.00	0.280	0.300	0.300
1,172.00	0.690	0.970	1.270
1,174.00	3.190	3.880	5.150
1,176.00	7.000	10.190	15.340
1,178.00	12.000	19.000	34.340

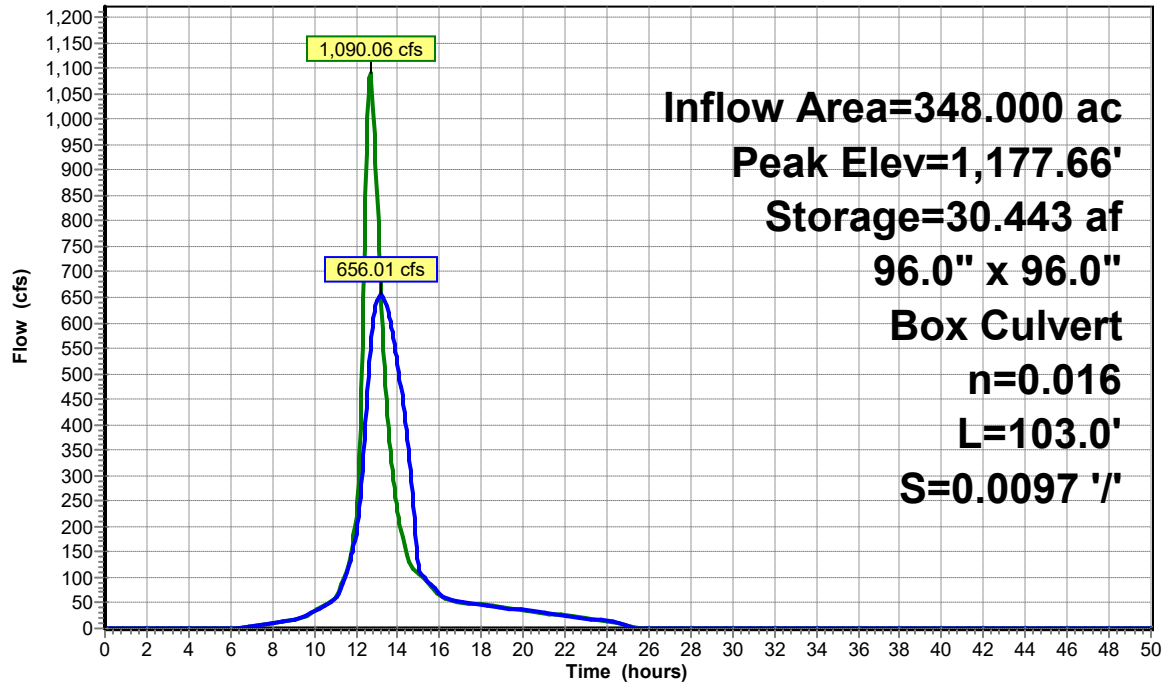
Device	Routing	Invert	Outlet Devices
#1	Primary	1,168.00'	96.0" W x 96.0" H Box Culvert L= 103.0' Box, 10-30° wingwalls, square crown, Ke= 0.500 Inlet / Outlet Invert= 1,168.00' / 1,167.00' S= 0.0097 ' / ' Cc= 0.900 n= 0.016, Flow Area= 64.00 sf

Primary OutFlow Max=655.80 cfs @ 13.18 hrs HW=1,177.66' (Free Discharge)

↑ **1=Culvert** (Barrel Controls 655.80 cfs @ 11.31 fps)

Pond 14P: Culvert South

Hydrograph



Name: Hauber Wetland Design Report

Date: August 15, 2025

Page: 7

Geotechnical Report

Design Phase Geotechnical Report:

Proposed Wetland
SE ¼ Sec. 24 – T98N – R10W
Lincoln Township, Winneshiek County, Iowa
CVT# 24386.24.IAM

Prepared for:

Mr. Brandon Short
Bolton & Menk, Inc.

Certification:

	I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Iowa.
	
	November 25, 2024
	(signature) (date)
	Printed or typed name: <u>Matthew J. Reisdorfer, PE.</u> License number: <u>22234</u> . My license renewal date is <u>December 31, 2025</u> . Pages or sheets covered by this seal:

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Chosen Valley Testing, Inc.

Geotechnical Engineering and Testing • 421 N Georgia Avenue • Mason City, IA 50401 • Telephone (641) 201-1050 • masoncity@cvtesting.com

Mr. Brandon Short
Design Engineer
Bolton & Menk, Inc.
1519 Baltimore Drive
Ames, Iowa 50010
Brandon.short@bolton-menk.com

November 25, 2024

**Re: Factual Geotechnical Evaluation
Proposed Wetland
SE ¼ Sec. 24 – T98N – R10W
Lincoln Township, Winneshiek County, Iowa
CVT Proposal Number: 24386.24.IAM**

Dear Mr. Short:

This factual report was prepared for the proposed wetland located in Lincoln Township, Winneshiek County, Iowa. Our services were authorized by Mr. Brandon Short, Design Engineer for Bolton & Menk, Inc.

A. Introduction

The intent of this report is to present our results to the client in the same logical sequence that led us to arrive at the opinions and recommendations expressed. Since our services must often be completed before the design, assumptions are sometimes needed to prepare a proper evaluation and to analyze the data. A complete and thorough review of this entire document, including the assumptions and the appendices, should be undertaken immediately upon receipt.

A.1. Purpose

This factual report was prepared for the proposed wetland located in Lincoln Township, Winneshiek County, Iowa. Our services were authorized by Mr. Brandon Short, Design Engineer for Bolton & Menk, Inc.

A.2. Scope

To obtain data for analysis, our services included eight penetration test borings. The borings were drilled to auger refusal depths of about 5 to 10 feet below the surface. Our engineering scope consisted of providing a factual discussion of the soils and materials encountered during our exploration.

A.3. Boring Locations and Elevation

The desired boring locations were indicated to Chosen Valley Testing based on on-site staking provided by the client. The Boring Location Sketch in the Appendix shows the approximate location drilled. Elevations at the borings were provided by the client.

A.4. Geologic Background

A geotechnical report is based on subsurface data collected for the specific structure or problem. Available geologic data from the region can help interpretation of the data and is briefly summarized in this section.

Area geologic maps indicate that the natural upper soils are primarily alluvium (water deposited) consisting of clay, silt, sand and gravel mixtures as well as glacial till mixtures of clay, silt, and sand. Bedrock was expected to be within 25 to 50 feet below the surface and consists of limestone, dolomite, and shale of the Maquoketa Formation and limestone and dolomite of the Wapsipinicon Group.

B. Subsurface Data

B.1. Stratification

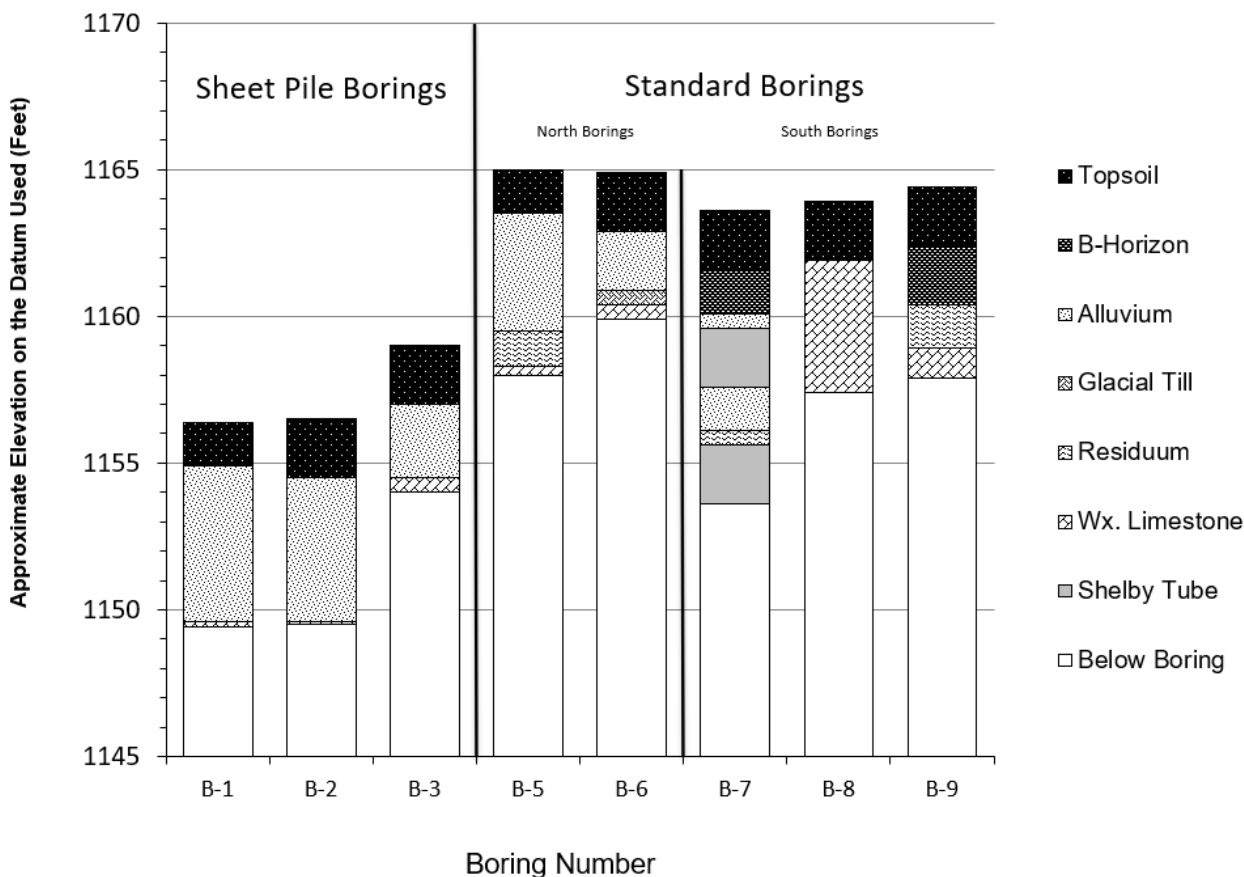
At the surface, the borings met about 1 ½ to 2 feet of slightly organic lean clay topsoil. Below the topsoil in Borings B-7 and B-9, B-Horizon consisting of lean clay and sandy lean clay was met to depths of about 3 ½ to 4 feet below the surface. B-Horizon soils are similar in color and characteristics to that of topsoil but are less organic.

Below the B-Horizon, and below the topsoil in Borings B-1, B-2, B-3, B-5, and B-6, alluvium consisting of lean clay, sandy lean clay, and clayey sand was encountered to depths of about 4 to 7 ½ feet below the surface. Glacial till consisting of mostly sandy lean clay was met below the alluvium in Boring B-6 to a depth of about 4 ½ feet below the surface.

Below the B-Horizon clay in Borings B-7 and B-9 and below the alluvium in Boring B-5, residuum consisting of silty sand with gravel, gravel with silty sand, and lean clay was met to depths of about 5 ½ to 10 feet below the surface.

Weathered limestone was met in all of the borings except for Boring B-7, to about 5 to 7 feet. Termination due to auger refusal, presumably on slightly weathered limestone was met in all borings at depths of about 5 to 10 feet below the surface.

The following simplified cross-section summarizes the boring data. For more detailed information, please refer to the Log of Boring sheets in the Appendix.



B.2. Penetration Test Results

The number of blows needed for the hammer to advance the penetration test sampler is an indicator of soil characteristics. The results tend to be more meaningful for natural mineral soils, than for fill soils. In fill soils, compaction tests are more meaningful.

Penetration resistance values ("N" Values) of 3 to 14 Blows per Foot (BPF) were recorded in the alluvial clays, indicating they were soft to stiff. The alluvial clayey sands returned N-Values of 2 to 3 BPF, indicating they were very loose. The B-Horizon clays returned a N-Value of 6 BPF, indicating they were medium. A N-Value of 18 was recorded in the glacial till clay, indicating it was very stiff.

N-Values of 11 BPF to 50 hammer blows for one to four inches of sampler advancement were recorded in the weathered limestone, indicating it was medium dense to very dense, but was generally very dense.

A pocket penetrometer was used to provide additional data on the compressive strength of cohesive soils. The alluvial clays returned values of $\frac{3}{4}$ to greater than $4 \frac{1}{2}$ tons per square foot (tsf). The B-Horizon clays returned a value of $3 \frac{1}{2}$ tsf. The glacial till clay returned a value of greater than $4 \frac{1}{2}$ tsf.

A key to descriptors used to qualify the relative density of soil (such as *soft*, *stiff*, *loose*, and *dense*) can be found on the Legend to Soil Description in the Appendix.

B.3. Groundwater Data

During the drilling operation, the drillers may note the presence of moisture on the sampling instrument, in the cuttings, or within the borehole. These observations are recorded on the boring logs. The water level may vary with weather; time of year and other factors and the presence or absence of water during the drilling is subject to interpretation and is not always conclusive.

Water was not encountered the borings during drilling. Groundwater levels at the site are expected to fluctuate seasonally with nearby creeks and rivers, as well as with local weather patterns.

C. Level of Care

The services provided for this project have been conducted in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in this area, under similar budget and time constraints. This is our professional responsibility. No other warranty, expressed or implied, is made.

Appendix

Soil Boring Location Sketch

Log of Boring 1-3 & 5-9

Direct Shear Test Results

Legend to Soil Description



24386.24.IAM

 Boring Location





Boring Location Sketch

Proposed Street and Utility Reconstruction

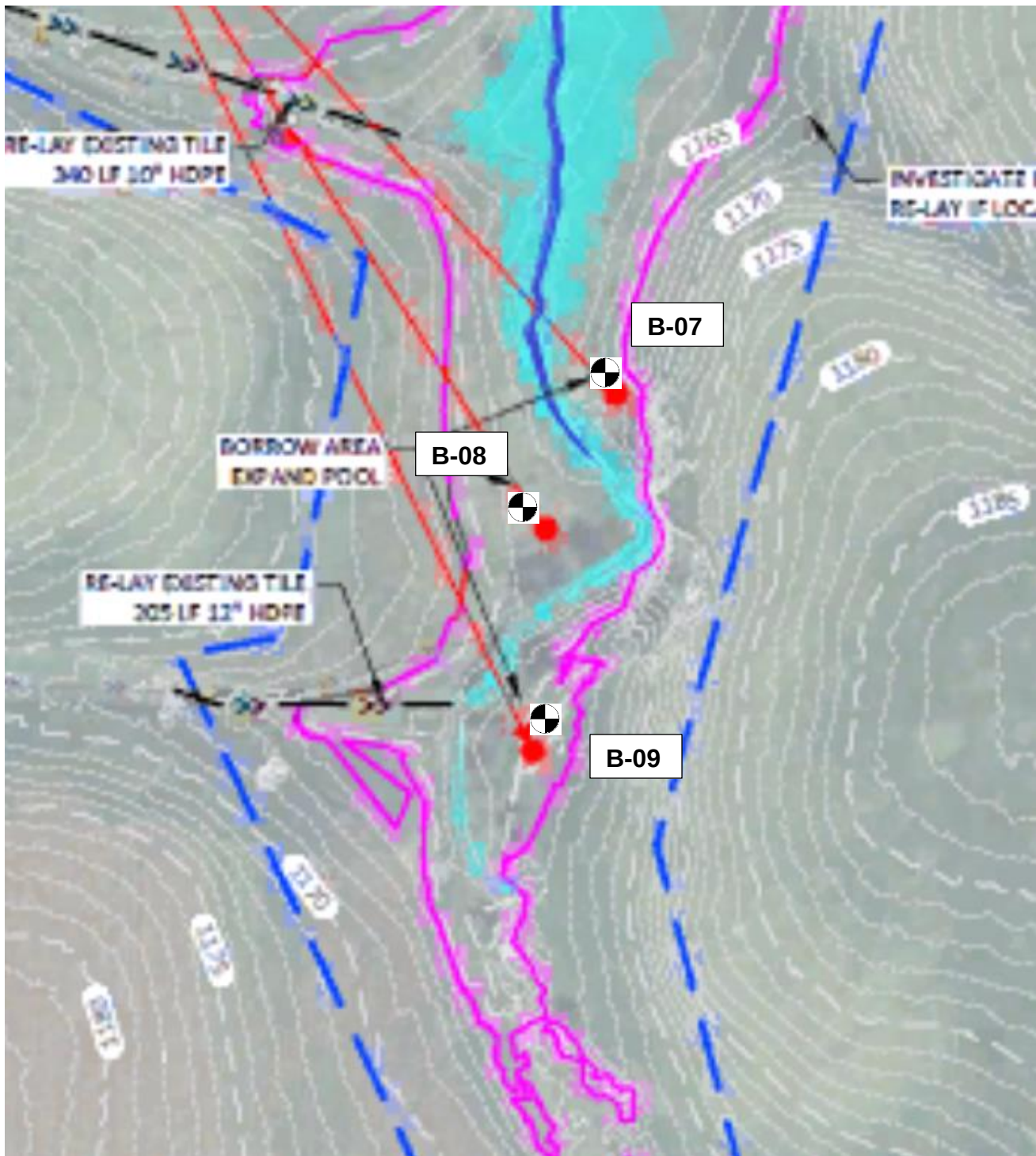
SE ¼ Sec. 24 – T98N – R10W

Lincoln Township, Winneshiek County, Iowa

24386.24.IAM

Legend

 Boring Location



LOG OF BORING

CHOSEN VALLEY TESTING



PROJECT: 24386.24.IAM Design Phase Geotechnical Evaluation Proposed Wetland SE 1/4 Sec. 24 - T98N - R10W Lincoln Township, Winneshiek County, Iowa				BORING: B-01		
				LOCATION: See attached sketch		
				DATE: 11/7/2024		SCALE: 1" = 1'
Elev.	Depth	USCS Symbol	Description of Materials (ASTM D 2487/2488)	BPF	WL	Tests and Notes
1156.4	0.0	CL OL	<u>Slightly Organic LEAN CLAY</u> black, wet. (Topsoil)			Elevations provided by Bolton & Menk, Inc.
1154.9	1.5	SC CL	<u>CLAYEY SAND to SANDY LEAN CLAY</u> mostly medium grained, trace of gravel, dark grey to black, moist, very loose. (Alluvium)	2		
1152.4	4.0	CL	<u>LEAN CLAY</u> trace of organics, trace of sand, black, wet, soft. (Alluvium)	3		
1150.4	6.0	CL	<u>SANDY LEAN CLAY</u> trace of gravel, brown, very wet, rather stiff. (Alluvium)	*		
1149.6	6.8	SM	<u>SILTY SAND with GRAVEL</u> mostly fine grained, light brown, moist, very dense. (Weathered Limestone)			
1149.4	7.0		Auger refusal at about 7 feet during drilling, presumably on bedrock. Boring sealed upon completion.			* 12 / 50 = 2" PP = 0.75 tsf

CVT STANDARD 24386.24.IAM (WINNESHIEK COUNTY WETLAND - RIDGEWAY).GPJ LOG-A GNN06.GDT 11/25/24

LOG OF BORING

CHOSEN VALLEY TESTING



PROJECT: 24386.24.IAM Design Phase Geotechnical Evaluation Proposed Wetland SE 1/4 Sec. 24 - T98N - R10W Lincoln Township, Winneshiek County, Iowa				BORING: B-02		
				LOCATION: See attached sketch		
				DATE: 11/7/2024	SCALE: 1" = 1'	
Elev.	Depth	USCS Symbol	Description of Materials (ASTM D 2487/2488)	BPF	WL	Tests and Notes
1156.5	0.0	CL OL	<u>Slightly Organic LEAN CLAY</u> black, wet. (Topsoil)			Elevations provided by Bolton & Menk, Inc.
1154.5	2.0	SC CL	<u>CLAYEY SAND to SANDY LEAN CLAY</u> mostly medium grained, trace of gravel, grey to brown, moist, very loose. (Alluvium)	3		
1152.5	4.0	CL	<u>SANDY LEAN CLAY</u> trace of gravel, trace of silt to about 6.5 feet, grey to light brown to brown, wet, soft to stiff. (Alluvium)	3		
1149.6	6.9	SM	<u>SILTY SAND with GRAVEL</u> mostly fine grained, light brown, moist, very dense. (Weathered Limestone)	*		MC = 21.6% * 14 / 50 = 2" PP = 2.25 tsf
1149.5	7.0		Auger refusal at about 7 feet during drilling, presumably on bedrock. Boring sealed upon completion.			

CVT STANDARD 24386.24.IAM (WINNESHIEK COUNTY WETLAND - RIDGEWAY).GPJ LOG A GNN06.GDT 11/25/24

LOG OF BORING

CHOSEN VALLEY TESTING



PROJECT: 24386.24.IAM Design Phase Geotechnical Evaluation Proposed Wetland SE 1/4 Sec. 24 - T98N - R10W Lincoln Township, Winneshiek County, Iowa				BORING: B-03		
				LOCATION: See attached sketch		
				DATE: 11/7/2024		SCALE: 1" = 1'
Elev.	Depth	USCS Symbol	Description of Materials (ASTM D 2487/2488)	BPF	WL	Tests and Notes
1159.0	0.0	CL OL	<u>Slightly Organic LEAN CLAY</u> black, wet. (Topsoil)			Elevations provided by Bolton & Menk, Inc.
1157.0	2.0	CL	<u>SANDY LEAN CLAY</u> trace of gravel, brown to black, wet, rather stiff. (Alluvium)	11		MC = 25.9%
1155.0	4.0	CL	<u>LEAN CLAY</u> trace of gravel, trace of roots, black, wet, medium. (Alluvium)			
1154.5	4.5	SP SC	<u>POORLY-GRADED SAND to CLAYEY SAND with GRAVEL</u> mostly medium grained, brown, moist, very dense. (Weathered Limestone)	*		* 4 / 4 / 50 = 2"
1154.0	5.0		Auger refusal at about 5 feet during drilling, presumably on bedrock. Boring sealed upon completion.			

CVT STANDARD 24386.24.IAM (WINNESHIEK COUNTY WETLAND - RIDGEWAY).GPJ LOG-A GNN06.GDT 11/25/24

LOG OF BORING

CHOSEN VALLEY TESTING



PROJECT: 24386.24.IAM Design Phase Geotechnical Evaluation Proposed Wetland SE 1/4 Sec. 24 - T98N - R10W Lincoln Township, Winneshiek County, Iowa				BORING: B-05		
				LOCATION: See attached sketch		
				DATE: 11/7/2024	SCALE: 1" = 1'	
Elev.	Depth	USCS Symbol	Description of Materials (ASTM D 2487/2488)	BPF	WL	Tests and Notes
1165.0	0.0	CL OL	<u>Slightly Organic LEAN CLAY</u> black, wet. (Topsoil)			Elevations provided by Bolton & Menk, Inc.
1163.5	1.5	CL	<u>LEAN CLAY</u> trace of gravel, brown, wet, rather stiff to stiff. (Alluvium)	14		PP = 2.75 tsf, MC = 24.9%
1159.5	5.5	SM	<u>SILTY SAND with GRAVEL</u> mostly fine grained, light brown, moist, loose. (Residuum)	10		PP = 2.5 tsf, MC = 26.2%
1158.5	6.5	CL	<u>LEAN CLAY</u> trace of gravel, brown, wet, hard. (Residuum)	*		* 50 = 4" PP = 3.5 tsf
1158.3	6.7	SM	<u>SILTY SAND with GRAVEL</u> mostly fine grained, light brown, moist, very dense. (Weathered Limestone)			
1158.0	7.0		Auger refusal at about 7 feet during drilling, presumably on bedrock. Boring sealed upon completion.			

CVT STANDARD 24386.24.IAM (WINNESHIEK COUNTY WETLAND - RIDGEWAY).GPJ LOG-A GNN06 GDT 11/25/24

LOG OF BORING

CHOSEN VALLEY TESTING



PROJECT: 24386.24.IAM Design Phase Geotechnical Evaluation Proposed Wetland SE 1/4 Sec. 24 - T98N - R10W Lincoln Township, Winneshiek County, Iowa				BORING: B-06		
				LOCATION: See attached sketch		
				DATE: 11/7/2024	SCALE: 1" = 1'	
Elev.	Depth	USCS Symbol	Description of Materials (ASTM D 2487/2488)	BPF	WL	Tests and Notes
1164.9	0.0	CL OL	<u>Slightly Organic LEAN CLAY</u> black, wet. (Topsoil)			Elevations provided by Bolton & Menk, Inc.
T162.9	2.0	CL	<u>SANDY LEAN CLAY</u> trace of gravel, brown, wet, medium. (Alluvium)	8		PP > 4.5 tsf, MC = 10.5%
T160.9	4.0	CL	<u>SANDY LEAN CLAY</u> trace of gravel, brown, wet, very stiff. (Glacial Till)			
T160.4	4.5	SM	<u>SILTY SAND with GRAVEL</u> mostly fine grained, light brown, moist, very dense. (Weathered Limestone)	*		* 8 / 10 / 50 = 4" PP > 4.5 tsf
T159.9	5.0		Auger refusal at about 5 feet during drilling, presumably on bedrock. Boring sealed upon completion.			

CVT STANDARD 24386.24.IAM (WINNESHIEK COUNTY WETLAND - RIDGEWAY).GPJ LOG A GNN06.GDT 11/25/24

LOG OF BORING

CHOSEN VALLEY TESTING



PROJECT: 24386.24.IAM Design Phase Geotechnical Evaluation Proposed Wetland SE 1/4 Sec. 24 - T98N - R10W Lincoln Township, Winneshiek County, Iowa				BORING: B-07		
				LOCATION: See attached sketch		
				DATE: 11/7/2024		SCALE: 1" = 1'
Elev. 1163.6	Depth 0.0	USCS Symbol	Description of Materials (ASTM D 2487/2488)	BPF	WL	Tests and Notes
		CL OL	<u>Slightly Organic LEAN CLAY</u> black, wet. (Topsoil)			Elevations provided by Bolton & Menk, Inc.
1161.6	2.0	CL	<u>SANDY LEAN CLAY</u> trace of gravel, black, wet, medium. (B-Horizon)	6		PP = 3.5 tsf, MC = 29.2%
1160.1	3.5	CL	<u>LEAN CLAY</u> dark brown, wet, medium. (Alluvium)			
1159.6	4.0	ML	<u>SANDY SILT</u> trace of gravel, light grey and brown, wet. (Alluvium)	*		DD = 115.5 pcf, MC = 14.0% Friction Angle = 39.7 deg. Cohesion = 72 psf
1157.6	6.0	CL	<u>SANDY LEAN CLAY</u> trace of gravel, black, wet, hard. (Alluvium)			* 50 = 1"
1156.1	7.5	GP	<u>POORLY-GRADED GRAVEL with SILTY SAND</u> mostly fine grained, light brown, moist, very dense. (Residuum)	*		
1155.6	8.0	ML	<u>SANDY SILT</u> trace of gravel, light grey and brown, wet. (Residuum)	*		DD = 113.4 pcf, MC = 15.9% Friction Angle = 35.7 deg. Cohesion = 48 psf
1153.6	10.0		Auger refusal at about 10 feet during drilling, presumably on bedrock. Boring sealed upon completion.			

CVT STANDARD 24386.24.IAM (WINNESHIEK COUNTY WETLAND - RIDGEWAY) GPJ LOG-A GNN06.GDT 11/25/24

LOG OF BORING

CHOSEN VALLEY TESTING



PROJECT: 24386.24.IAM Design Phase Geotechnical Evaluation Proposed Wetland SE 1/4 Sec. 24 - T98N - R10W Lincoln Township, Winneshiek County, Iowa				BORING: B-08		
				LOCATION: See attached sketch		
				DATE: 11/7/2024	SCALE: 1" = 1'	
Elev.	Depth	USCS Symbol	Description of Materials (ASTM D 2487/2488)	BPF	WL	Tests and Notes
1163.9	0.0	CL OL	<u>Slightly Organic LEAN CLAY</u> black, wet. (Topsoil) good, but only 2 ft			Elevations provided by Bolton & Menk, Inc.
1161.9	2.0	SM	<u>SILTY SAND with GRAVEL</u> mostly fine grained, trace of clay, light brown, moist, loose to medium dense. (Weathered Limestone)	7		
1157.4	6.5		Auger refusal at about 6.5 feet during drilling, presumably on bedrock. Boring sealed upon completion.			

CVT STANDARD 24386.24.IAM (WINNESHIEK COUNTY WETLAND - RIDGEWAY).GPJ LOG A GNN06.GDT 11/25/24

LOG OF BORING

CHOSEN VALLEY TESTING



PROJECT: 24386.24.IAM Design Phase Geotechnical Evaluation Proposed Wetland SE 1/4 Sec. 24 - T98N - R10W Lincoln Township, Winneshiek County, Iowa				BORING: B-09		
				LOCATION: See attached sketch		
				DATE: 11/7/2024		SCALE: 1" = 1'
Elev. 1164.4	Depth 0.0	USCS Symbol	Description of Materials (ASTM D 2487/2488)	BPF	WL	Tests and Notes
		CL OL	<u>Slightly Organic LEAN CLAY</u> black, wet. (Topsoil)			Elevations provided by Bolton & Menk, Inc. MC = 49.6%
1162.4	2.0	CL	<u>LEAN CLAY with Organics</u> black, wet, medium. (B-Horizon)	6		
1160.4	4.0	SM	<u>SILTY SAND</u> mostly fine grained, white, moist, medium dense. (Residuum)			
1158.9	5.5	SM	<u>SILTY SAND with GRAEVL</u> mostly fine grained, light brown, moist, medium dense. (Weathered Limestone)	11		
1157.9	6.5		Auger refusal at about 6.5 feet during drilling, presumably on bedrock. Boring sealed upon completion.			

CVT STANDARD 24386.24.IAM (WINNESHIEK COUNTY WETLAND - RIDGEWAY).GPJ LOG A GNN06 GDT 11/25/24

Direct Shear Test

ASTM D3080

Job No.: 15509

Project/Client: Winneshiek County Wetland / Chosen Valley Testing, Inc.

Boring No.: B7

Sample No.

Depth: 5

Location:

Sample Type: TWT

Soil Type: Sandy Silt with pieces of hardend Silt, light gray and brown (ML)

Remarks: Specimens trimmed to given sizes; Inundated after applying normal load. Consolidated and sheared to given displacements at constant rate of 0.001 inches/minute.

Test Date: 11/15/2024

Date Reported: 11/21/2024

Shear Rate

0.001 (in/min)

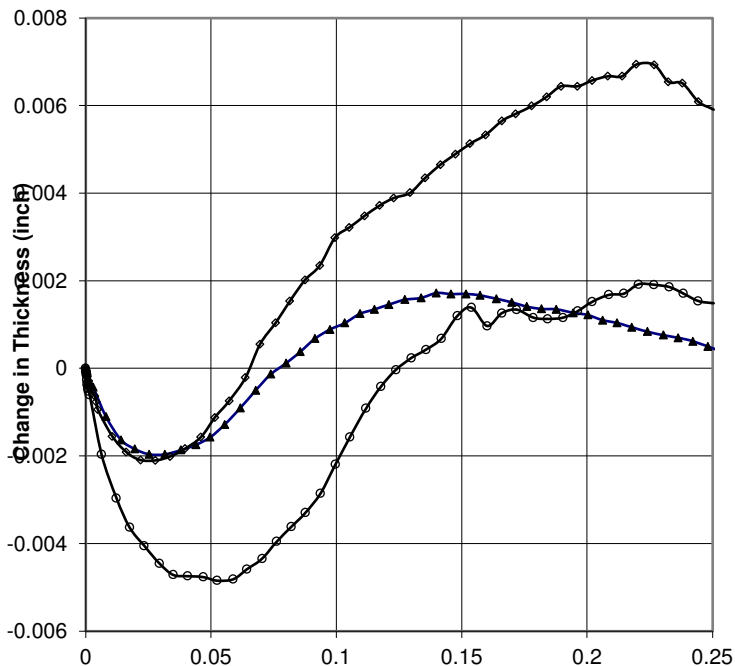
Liquid Limit:

Plastic Limit:

Plasticity Index:

Specific Gravity (*): 2.68

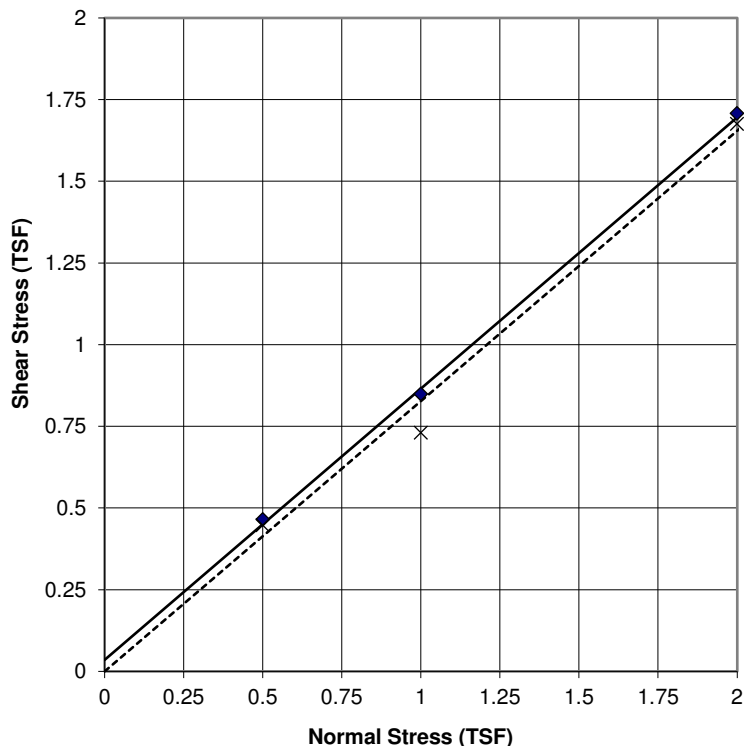
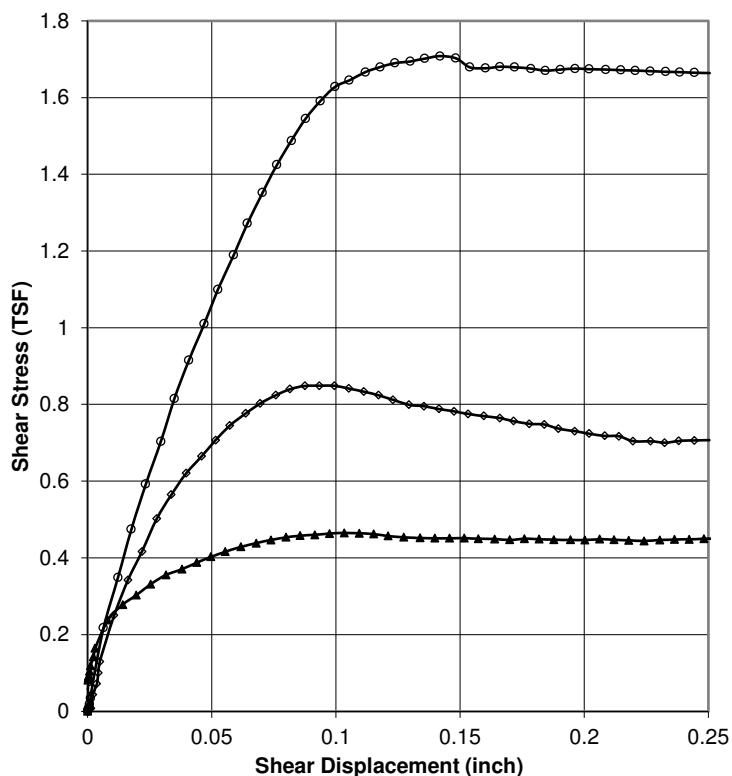
(*) = Assumed Specific Gravity



Failure Criterion:				
Max Stress	A	B	C	D
Initial	▲	◇	○	X
Diameter (In.)	2.50	2.50	2.50	
Thickness (In.)	0.97	0.97	0.97	
Water Content (%)	14.0	16.2	14.5	
Dry Density (pcf)	115.5	112.6	112.1	
Before Shear				
Thickness (In.)	0.95	0.94	0.93	
Water Content (%)	15.5	16.6	16.0	
Dry Density (pcf)	118.1	115.7	117.2	
Normal Stress	0.50	1.00	2.00	
Shear Stress	0.47	0.85	1.71	

"These tests are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design."

Peak Conditions		At Given Shear Disp. Of: 0.2	
Friction Angle:	$\phi = 39.7 \text{ deg.}$	Friction Angle:	$\phi = 39.6 \text{ deg.}$
Apparent Cohesion	0.036 TSF	Apparent Cohesion	0.000 TSF



Direct Shear Test

ASTM D3080

Job No.: 15509

Project/Client: Winneshiek County Wetland / Chosen Valley Testing, Inc.

Boring No.: B8

Sample No.

Depth: 3

Location:

Sample Type: TWT

Soil Type: Sandy Silt with pieces of hardend Silt, light gray and brown (ML)

Remarks: Specimens trimmed to given sizes; Inundated after applying normal load. Consolidated and sheared to given displacements at constant rate of 0.001 inches/minute.

Test Date: 11/15/2024

Date Reported: 11/21/2024

Shear Rate

0.001 (in/min)

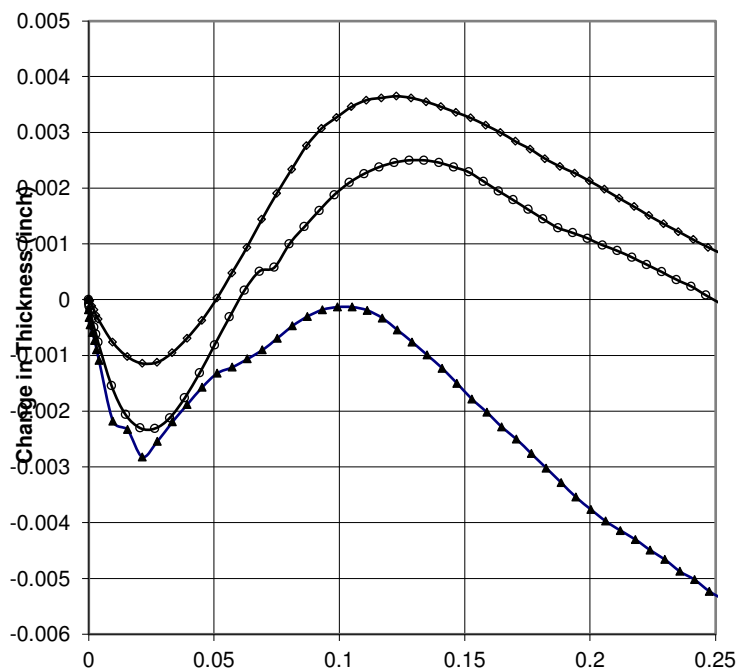
Liquid Limit:

Plastic Limit:

Plasticity Index:

Specific Gravity (*): 2.68

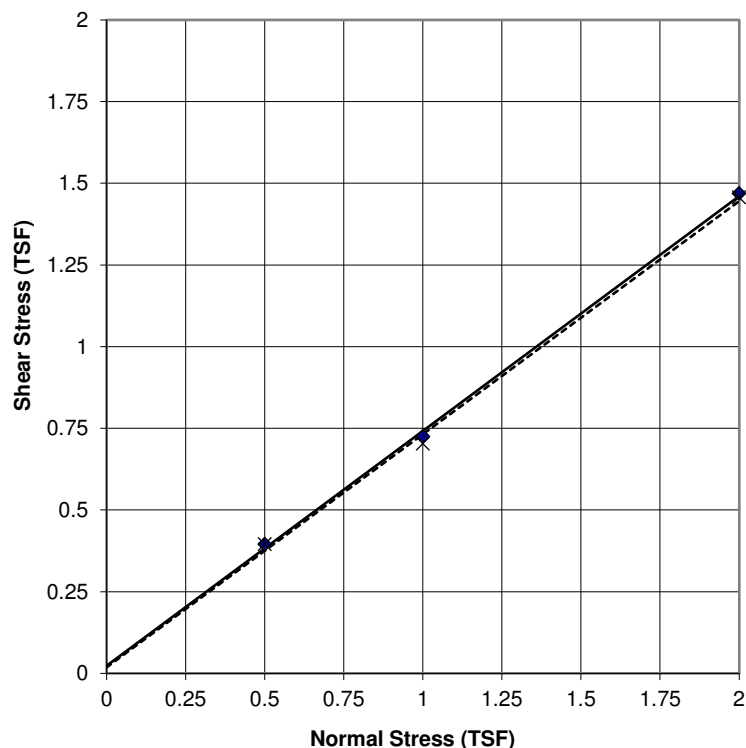
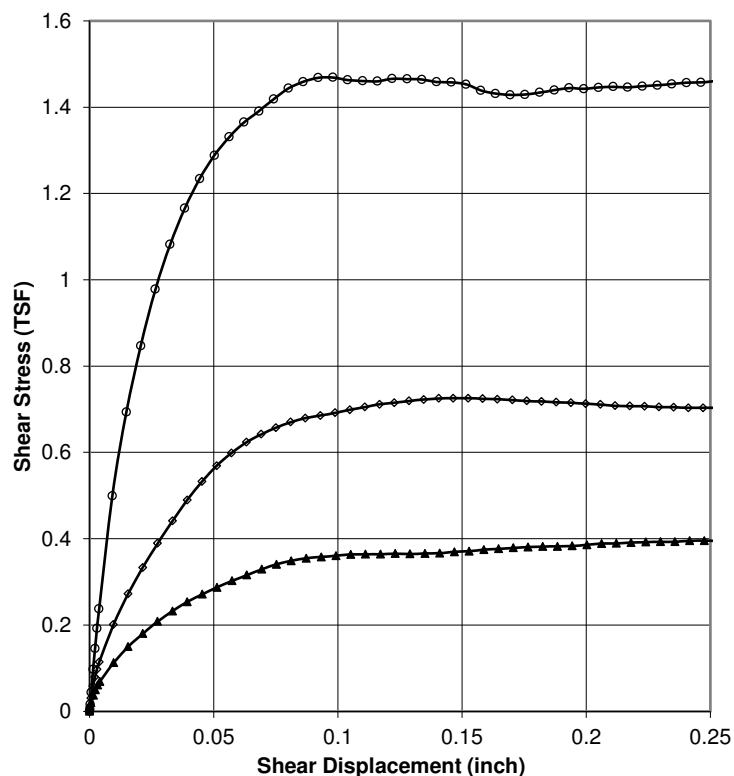
(*) = Assumed Specific Gravity



Failure Criterion:				
Max Stress	A	B	C	D
Initial	▲	◊	○	X
Diameter (In.)	2.50	2.50	2.50	
Thickness (In.)	0.97	0.97	0.97	
Water Content (%)	15.9	17.9	17.8	
Dry Density (pcf)	113.4	111.6	111.4	
Before Shear				
Thickness (In.)	0.95	0.95	0.94	
Water Content (%)	16.7	17.4	17.1	
Dry Density (pcf)	115.5	114.0	114.7	
Normal Stress	0.50	1.00	2.00	
Shear Stress	0.40	0.73	1.47	

"These tests are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design."

Peak Conditions		At Given Shear Disp. Of: 0.25	
Friction Angle:	$\phi = 35.7 \text{ deg.}$	Friction Angle:	$\phi = 35.5 \text{ deg.}$
Apparent Cohesion	0.024 TSF	Apparent Cohesion	0.019 TSF



UNIFIED SOIL CLASSIFICATION (ASTM D-2487/2488)

MATERIAL TYPES	CRITERIA FOR ASSIGNING SOIL GROUP NAMES			GROUP SYMBOL	SOIL GROUP NAMES & LEGEND	
COARSE-GRAINED SOILS >50% RETAINED ON NO. 200 SIEVE	GRAVELS >50% OF COARSE FRACTION RETAINED ON NO 4. SIEVE	CLEAN GRAVELS <5% FINES	Cu>4 AND 1<Cc<3	GW	WELL-GRADED GRAVEL	
			Cu>4 AND 1>Cc>3	GP	POORLY-GRADED GRAVEL	
		GRAVELS WITH FINES >12% FINES	FINES CLASSIFY AS ML OR CL	GM	SILTY GRAVEL	
			FINES CLASSIFY AS CL OR CH	GC	CLAYEY GRAVEL	
	SANDS >50% OF COARSE FRACTION PASSES ON NO 4. SIEVE	CLEAN SANDS <5% FINES	Cu>6 AND 1<Cc<3	SW	WELL-GRADED SAND	
			Cu>6 AND 1>Cc>3	SP	POORLY-GRADED SAND	
		SANDS AND FINES >12% FINES	FINES CLASSIFY AS ML OR CL	SM	SILTY SAND	
			FINES CLASSIFY AS CL OR CH	SC	CLAYEY SAND	
FINE-GRAINED SOILS >50% PASSES NO. 200 SIEVE	SILTS AND CLAYS LIQUID LIMIT<50	INORGANIC	PI>7 AND PLOTS>"A" LINE	CL	LEAN CLAY	
			PI>4 AND PLOTS<"A" LINE	ML	SILT	
		ORGANIC	LL (oven dried)/LL (not dried)<0.75	OL	ORGANIC CLAY OR SILT	
	SILTS AND CLAYS LIQUID LIMIT>50	INORGANIC	PI PLOTS >"A" LINE	CH	FAT CLAY	
			PI PLOTS <"A" LINE	MH	ELASTIC SILT	
		ORGANIC	LL (oven dried)/LL (not dried)<0.75	OH	ORGANIC CLAY OR SILT	
HIGHLY ORGANIC SOILS		PRIMARILY ORGANIC MATTER, DARK IN COLOR, AND ORGANIC ODOR		PT	PEAT	

Relative Proportions of Sand and Gravel	
TERM	PERCENT
Trace	< 15
With	15 - 29
Modifier	> 30
Relative Proportions of Fines	
TERM	PERCENT
Trace	< 5
With	5 - 12
Modifier	> 12
Grain Size Terminology	
TERM	SIZE
Boulder	< 12 in.
Cobble	3 in. - 12 in.
Gravel	#4 sieve to 3 in.
Sand	#200 sieve to #4 sieve
Silt or Clay	Passing #200 sieve

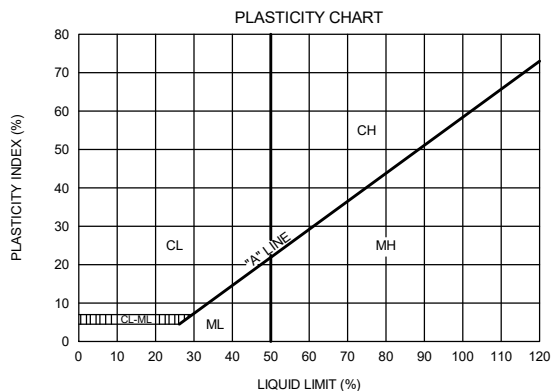
SAMPLE TYPES

- Hollow Stem
- Standard Penetration Test
- Shelby Tube

TEST SYMBOLS

- MC - MOISTURE CONTENT
- OC - ORGANIC CONTENT
- CN - CONSOLIDATION
- DD - DRY DENSITY
- PP - POCKET PENETROMETER
- RV - R-VALUE
- SA - SIEVE ANALYSIS
- P200 - % PASSING #200 SIEVE
- LL - LIQUID LIMIT
- PI - PLASTISITY INDEX
- SW - SWELL TEST
- UU - Unconsolidated Undrained triaxial

- WATER LEVEL (WITH TIME OF MEASUREMENT)



PENETRATION RESISTANCE (RECORDED AS BLOWS / 0.5 FT)				
SAND & GRAVEL		SILT & CLAY		
RELATIVE DENSITY	BLOWS/FOOT*	CONSISTENCY	BLOWS/FOOT*	COMPRESSIVE STRENGTH (TSF)
VERY LOOSE	0 - 4	VERY SOFT	0 - 1	0 - 0.25
LOOSE	4 - 10	SOFT	2 - 3	0.25 - 0.50
MEDIUM DENSE	10 - 30	RATHER SOFT	4 - 5	0.50 - 1.0
DENSE	30 - 50	MEDIUM	6 - 8	
VERY DENSE	OVER 50	RATHER STIFF	9 - 12	1.0 - 2.0
		STIFF	13 - 16	2.0 - 4.0
		VERY STIFF	17 - 30	OVER 4.0
		HARD	OVER 30	

* NUMBER OF BLOWS OF 140 LB HAMMER FALLING 30 INCHES TO DRIVE A 2 INCH O.D. (1-3/8 INCH I.D.) SPLIT-BARREL SAMPLER THE LAST 12 INCHES OF AN 18-INCH DRIVE (ASTM-1586 STANDARD PENETRATION TEST).

Chosen Valley Testing

Job No. 24386.24.IAM

**LEGEND TO SOIL
DESCRIPTIONS**



Name: Hauber Wetland Design Report

Date: August 15, 2025

Page: 8

Stilling Basin Calculations

Item	Variable	Q ₁₀₀	Explanation
Weir Width (ft)	L	48	Hydrology Report
Constructed Weir Height (ft)	h	4.5	Hydrology Report
Peak discharge (cfs)		1053	Hydrology Report
Weir Elev (ft)		1162	Phase 2 Site Plan
Tail Water Elev (ft)		1158.65	Hydrology Report
Transverse Sill Elev (ft)		1153	Determine from Phase 2 Site Plan
Headwater Elev (ft)		1165.48	Pool Elev. Upstream of Weir
Tail water depth (ft)	t	5.65	Tail Water Elev. - Transverse Sill Elev.
Headwater depth (ft)	H	3.48	Headwater Elev. - Weir Elev.
h/t	h/t	0.80	for use in chart to find L_B/F
Unit Flow Rate (cfs/ft)	q	21.94	for use in chart to find d_c
Weir Critical Depth (ft)	d_c	2.47	Use Chart ES-111 on 5-19 for Critical Depth
Tail Water Check		2.29	OK (t/d_c is greater than 1.75)
Calculated Transverse Sill Height (Min ft.)	(s)	1.264	0.4 times d_c
Used Transverse Sill Height (ft)	s	1.5	
Stilling Basin Elev (ft)		1151.5	
Cantilever Height (ft)	F	9	Weir Elev. - Transverse Sill Elev
h/F	h/F	0.50	for use in chart to find L_B/F
L_B/F	L_B/F	2.4	Use Chart ES-111 on 5-21 for L_B/F
Calculated Stilling basin length, (Min ft.)	(L_B)	21.6	$L_B/F * F$
Used Stilling basin length, (ft.)	L_B	24.5	(Create a 20' minimum flat bottom length)
Sheetpile Cantilever Design Height		10.5	Weir Elev. - Stilling Basin Elev.