Water Management Ponds Hydrology and Hydraulic Analysis

Saunders Demonstration Mine

May 2022

Twin Pines Minerals, LLC

wood.

Autodesk® Storm and Sanitary Analysis is a comprehensive hydrology and hydraulic analysis application.

For the purposes of this evaluation, the referenced software was used to model the integration of both the internal process water entering the water management ponds as well as the rainfall events for both the 25-yr/24-hr and 100-yr/24-hr and the pumped discharge water returning to the process system.

Exhibits

Exhibit A

Water Management Pond Plan

Exhibit B

Pond Analysis Output Report for the 25-yr/24-hr Event

Exhibit C

Output Graph for the 25-yr/24-hr event

Exhibit D

Pond Analysis Output Report for the 100-yr/24-hr Event

Exhibit E

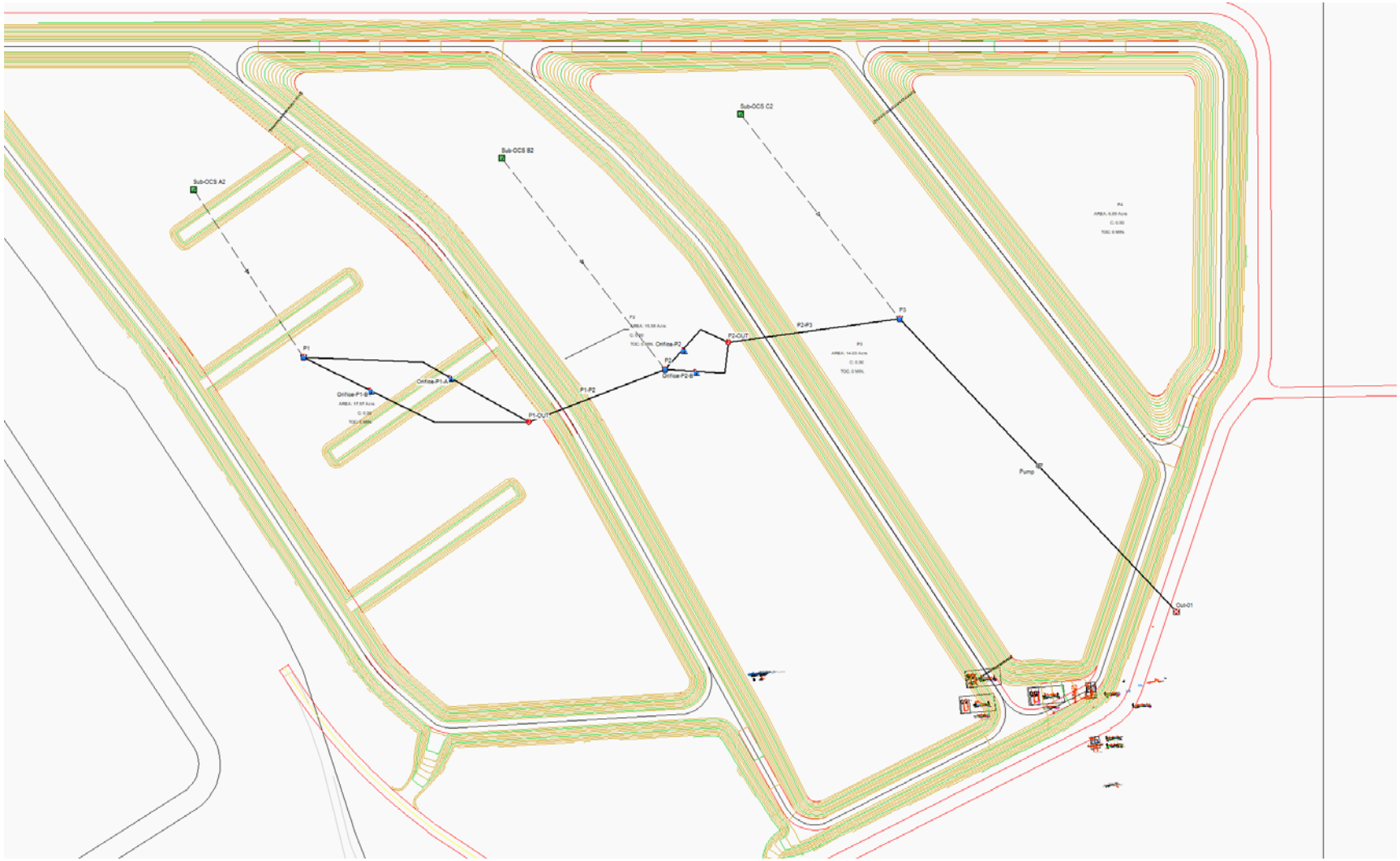
Output Graph for the 100-yr/24-hr event

Exhibit F

Precipitation Frequency Data from NOAA

Exhibit A

Water Management Pond Plan



Autodesk Storm and Sanitary Analysis

Exhibit B

Pond Analysis Output Report for the 25-yr/24-hr Event

Autodesk® Storm and Sanitary Analysis 2016 - Version 13.3.206 (Build 0)

****
Project Description
****
File Name TPM4.SPF

****
Analysis Options
****
Flow Units ..... GPM
Subbasin Hydrograph Method. Modified Rational
Time of Concentration..... SCS TR-55
Return Period..... 25 years
Storm Duration..... 1440 min
Link Routing Method ..... Kinematic Wave
Storage Node Exfiltration.. None
Starting Date APR-22-2022 00:00:00
Ending Date MAY-06-2022 00:00:00
Report Time Step 00:00:10

****
Element Count
****
Number of subbasins 3
Number of nodes 6
Number of links 7

****
Subbasin Summary
****

Subbasin ID	Total Area acres
Sub-OCS A2	17.97
Sub-OCS B2	15.58
Sub-OCS C2	14.03

****
Node Summary
****

Node ID	Element Type	Invert Elevation ft	Maximum Elev. ft	Ponded Area ft²	External Inflow
P1-OUT	JUNCTION	171.00	178.50	0.00	
P2-OUT	JUNCTION	167.00	174.00	0.00	
Out-01	OUTFALL	157.00	157.00	0.00	
P1	STORAGE	166.00	176.00	0.00	Yes
P2	STORAGE	162.00	172.00	0.00	
P3	STORAGE	157.00	167.00	0.00	

****
Link Summary
****

Link ID	From Node	To Node	Element Type	Length ft	Slope %	Manning's Roughness
P1-P2	P1-OUT	P2	CONDUIT	50.0	6.0000	0.0150
P2-P3	P2-OUT	P3	CONDUIT	50.0	10.0000	0.0150
Pump	P3	Out-01	TYPE1 PUMP			
Orifice-P1-A	P1	P1-OUT	ORIFICE			
Orifice-P1-B	P1	P1-OUT	ORIFICE			
Orifice-P2	P2	P2-OUT	ORIFICE			
Orifice-P2-B	P2	P2-OUT	ORIFICE			

****
Cross Section Summary
****

Link ID	Shape	Depth/ Diameter ft	Width ft	No. of Barrels	Cross Sectional Area ft²	Full Flow Hydraulic Radius ft	Design Flow Capacity GPM
P1-P2	CIRCULAR	1.50	1.50	2	1.77	0.38	10008.74
P2-P3	CIRCULAR	1.50	1.50	2	1.77	0.38	12921.22

Runoff Quantity Continuity	Volume acre-ft	Depth inches
Total Precipitation	65.485	16.518
Continuity Error (%)	1.000	

Flow Routing Continuity	Volume acre-ft	Volume Mgallons
External Inflow	123.733	40.320
External Outflow	154.666	50.400
Initial Stored Volume	182.405	59.439
Final Stored Volume	216.413	70.521
Continuity Error (%)	-0.000	

****
Runoff Coefficient Computations Report
****

Subbasin Sub-OCS A2

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	17.97	-	1.00
Composite Area & Weighted Runoff Coeff.	17.97		1.00

Subbasin Sub-OCS B2

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	15.58	-	1.00
Composite Area & Weighted Runoff Coeff.	15.58		1.00

Subbasin Sub-OCS C2

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	14.03	-	1.00
Composite Area & Weighted Runoff Coeff.	14.03		1.00

****
SCS TR-55 Time of Concentration Computations Report
****

Sheet Flow Equation

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where:

Tc = Time of Concentration (hrs)
n = Manning's Roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hrs)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hrs)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft^2)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

n = Manning's Roughness

Subbasin Sub-OCS A2

User-Defined TOC override (minutes): 15.00

Subbasin Sub-OCS B2

User-Defined TOC override (minutes): 15.00

Subbasin Sub-OCS C2

User-Defined TOC override (minutes): 15.00

****
Subbasin Runoff Summary
****

Subbasin ID	Accumulated Precip in	Rainfall Intensity in/hr	Total Runoff in	Peak Runoff GPM	Weighted Runoff Coeff	Time of Concentration days	Time of Concentration hh:mm:ss
Sub-OCS A2	16.52	0.69	16.52	5550.69	1.000	0	00:15:00
Sub-OCS B2	16.52	0.69	16.52	4811.98	1.000	0	00:15:00
Sub-OCS C2	16.52	0.69	16.52	4333.07	1.000	0	00:15:00

****
Node Depth Summary
****

Node ID	Average Depth Attained ft	Maximum Depth Attained ft	Maximum HGL Attained ft	Time of Max Occurrence days	Time of Max Occurrence hh:mm	Total Flooded Volume acre-in	Total Time Flooded minutes	Retention Time hh:mm:ss
P1-OUT	0.33	0.38	171.38	1	00:13	0	0	0:00:00
P2-OUT	0.30	0.33	167.33	1	00:15	0	0	0:00:00
Out-01	0.00	0.00	157.00	0	00:00	0	0	0:00:00
P1	6.16	6.66	172.66	1	00:13	0	0	0:00:00
P2	6.27	6.69	168.69	1	00:15	0	0	0:00:00
P3	6.12	6.49	163.49	4	05:26	0	0	0:00:00

****
Node Flow Summary
****

Node ID	Element Type	Maximum Lateral Inflow GPM	Peak Inflow GPM	Time of Peak Inflow Occurrence days	Time of Peak Inflow Occurrence hh:mm	Maximum Flooding Overflow GPM	Time of Maximum Flooding Occurrence days	Time of Maximum Flooding Occurrence hh:mm

P1-OUT	JUNCTION	0.00	2750.29	1	00:13	0.00
P2-OUT	JUNCTION	0.00	2751.45	1	00:15	0.00
Out-01	OUTFALL	0.00	2500.00	0	00:00	0.00
P1	STORAGE	7550.69	7550.69	0	00:15	0.00
P2	STORAGE	4811.98	7552.22	1	00:00	0.00
P3	STORAGE	4333.07	7073.12	1	00:00	0.00

****
Storage Node Summary
****

Storage Node ID	Maximum Ponded Volume	Maximum Ponded Volume	Time of Max Ponded	Average Ponded Volume	Average Ponded Volume	Average Storage Node Outflow	Maximum Exfiltration Rate	Maximum Exfiltration Rate	Time of Max.	Total Exfiltrated Volume
	1000 ft³	(%)	days hh:mm	1000 ft³	(%)	GPM	cfm	hh:mm:ss		1000 ft³
P1	4166.080	63	1 00:13	3820.071	58	2750.29	0.00	0:00:00		0.000
P2	3539.008	64	1 00:15	3304.465	60	2751.45	0.00	0:00:00		0.000
P3	3058.945	63	4 05:26	2874.342	59	2500.00	0.00	0:00:00		0.000

****
Outfall Loading Summary
****

Outfall Node ID	Flow Frequency (%)	Average Flow GPM	Peak Inflow GPM
Out-01	100.00	2500.00	2500.00
System	100.00	2500.00	2500.00

****
Link Flow Summary
****

Link ID	Element Type	Time of Peak Flow Occurrence days hh:mm	Maximum Velocity Attained ft/sec	Length Factor	Peak Flow during Analysis GPM	Design Flow Capacity GPM	Ratio of Maximum /Design Flow	Ratio of Maximum Flow Depth	Total Time Surcharged minutes	Reported Condition
P1-P2	CONDUIT	1 00:13	8.85	1.00	2750.29	20017.47	0.14	0.25	0	Calculated
P2-P3	CONDUIT	1 00:15	10.61	1.00	2751.45	25842.45	0.11	0.22	0	Calculated
Pump	PUMP	0 00:00			2500.00	1.00		20160		
Orifice-P1-A	ORIFICE	1 00:13			2674.17		0.00			
Orifice-P1-B	ORIFICE	1 00:13			76.13		0.00			
Orifice-P2	ORIFICE	1 00:15			2702.12		0.00			
Orifice-P2-B	ORIFICE	1 00:15			49.33		0.00			

****
Highest Flow Instability Indexes

****
All links are stable.

Analysis began on: Wed Apr 27 13:20:35 2022
Analysis ended on: Wed Apr 27 13:20:55 2022
Total elapsed time: 00:00:20

Exhibit C

Pond Analysis Output Report for the 100-yr/24-hr Event

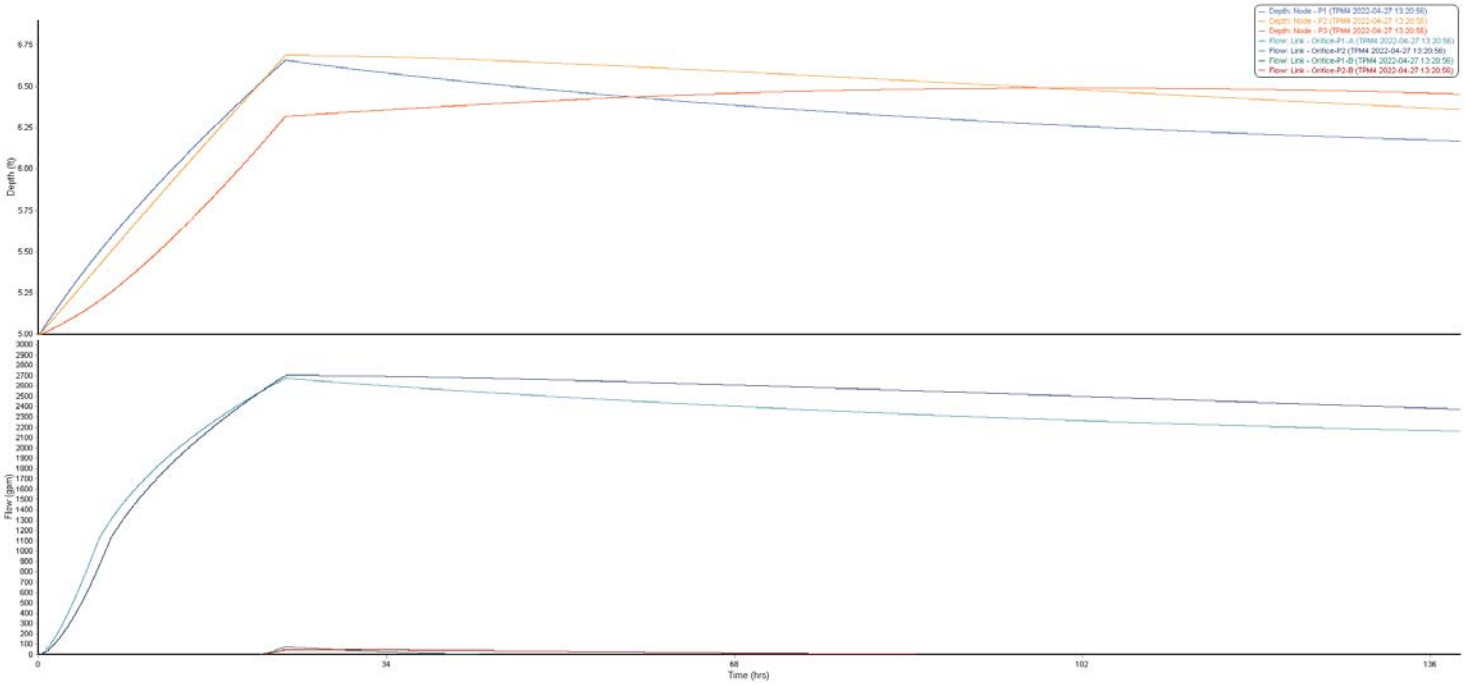

Depth: Node - P1 (TPM4 2022-04-27 13:20:56)
Depth: Node - P2 (TPM4 2022-04-27 13:20:56)
Depth: Node - P3 (TPM4 2022-04-27 13:20:56)
Flow: Link - Orifice-P1-A (TPM4 2022-04-27 13:20:56)
Flow: Link - Orifice-P2 (TPM4 2022-04-27 13:20:56)
Flow: Link - Orifice-P1-B (TPM4 2022-04-27 13:20:56)
Flow: Link - Orifice-P3-B (TPM4 2022-04-27 13:20:56)
Depth (ft)
6.75
6.50
6.25
6.00
5.75
5.50
5.25
5.00
Flow (gpm)
3000
2900
2800
2700
2600
2500
2400
2300
2200
2100
2000
1900
1800
1700
1600
1500
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
0
34
68
102
136
Time (hrs)

Exhibit D

Pond Analysis Output Report for the 100-yr/24-hr Event

Autodesk® Storm and Sanitary Analysis 2016 - Version 13.3.206 (Build 0)

****
Project Description
****
File Name TPM4.SPF

****
Analysis Options
****
Flow Units ..... GPM
Subbasin Hydrograph Method. Modified Rational
Time of Concentration..... SCS TR-55
Return Period..... 100 years
Storm Duration..... 1440 min
Link Routing Method ..... Kinematic Wave
Storage Node Exfiltration.. None
Starting Date MAY-02-2022 00:00:00
Ending Date MAY-16-2022 00:00:00
Report Time Step 00:00:10

****
Element Count
****
Number of subbasins 3
Number of nodes 7
Number of links 8

****
Subbasin Summary
****

Subbasin ID	Total Area acres
Sub-OCS A2	17.97
Sub-OCS B2	15.58
Sub-OCS C2	14.03

****
Node Summary
****

Node ID	Element Type	Invert Elevation ft	Maximum Elev. ft	Ponded Area ft²	External Inflow
P1-OUT	JUNCTION	171.00	178.50	0.00	
P2-OUT	JUNCTION	167.00	174.00	0.00	
P3-OUT	JUNCTION	161.00	168.00	0.00	
Out-01	OUTFALL	157.00	157.00	0.00	
P1	STORAGE	166.00	176.00	0.00	Yes
P2	STORAGE	162.00	172.00	0.00	
P3	STORAGE	157.00	167.00	0.00	

****
Link Summary

****

Link ID	From Node	To Node	Element Type	Length ft	Slope %	Manning's Roughness
P1-P2	P1-OUT	P2	CONDUIT	50.0	6.0000	0.0150
P2-P3	P2-OUT	P3	CONDUIT	50.0	10.0000	0.0150
Pump	P3-OUT	Out-01	TYPE1 PUMP			
Orifice-P1-A	P1	P1-OUT	ORIFICE			
Orifice-P1-B	P1	P1-OUT	ORIFICE			
Orifice-P2	P2	P2-OUT	ORIFICE			
Orifice-P2-B	P2	P2-OUT	ORIFICE			
Weir-01	P3	P3-OUT	WEIR			

****
Cross Section Summary
****

Link ID	Shape	Depth/ Diameter ft	Width ft	No. of Barrels	Cross Sectional Area ft²	Full Flow Hydraulic Radius ft	Design Flow Capacity GPM
P1-P2	CIRCULAR	1.50	1.50	2	1.77	0.38	10008.74
P2-P3	CIRCULAR	1.50	1.50	2	1.77	0.38	12921.22

********** Runoff Quantity Continuity	Volume acre-ft	Depth inches
Total Precipitation	77.424	19.530
Continuity Error (%)	1.000	

********** Flow Routing Continuity	Volume acre-ft	Volume Mgallons
External Inflow	123.733	40.320
External Outflow	143.826	46.868
Initial Stored Volume	182.421	59.445
Final Stored Volume	214.629	69.940
Continuity Error (%)	-0.000	

****
Runoff Coefficient Computations Report
****

Subbasin Sub-OCS A2

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	17.97	-	1.00
Composite Area & Weighted Runoff Coeff.	17.97		1.00

Subbasin Sub-OCS B2

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	15.58	-	1.00

Composite Area & Weighted Runoff Coeff.	15.58		1.00

Subbasin Sub-OCS C2

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	14.03	-	1.00
Composite Area & Weighted Runoff Coeff.	14.03		1.00

****
SCS TR-55 Time of Concentration Computations Report
****

Sheet Flow Equation

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where:

Tc = Time of Concentration (hrs)
n = Manning's Roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hrs)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hrs)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft^2)
Wp = Wetted Perimeter (ft)

V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's Roughness

Subbasin Sub-OCS A2

User-Defined TOC override (minutes): 15.00

Subbasin Sub-OCS B2

User-Defined TOC override (minutes): 15.00

Subbasin Sub-OCS C2

User-Defined TOC override (minutes): 15.00

****
Subbasin Runoff Summary
****

Subbasin ID	Accumulated Precip in	Rainfall Intensity in/hr	Total Runoff in	Peak Runoff GPM	Weighted Runoff Coeff	Time of Concentration days	Time of Concentration hh:mm:ss
Sub-OCS A2	19.53	0.81	19.53	6562.76	1.000	0	00:15:00
Sub-OCS B2	19.53	0.81	19.53	5689.36	1.000	0	00:15:00
Sub-OCS C2	19.53	0.81	19.53	5123.13	1.000	0	00:15:00

****
Node Depth Summary
****

Node ID	Average Depth Attained ft	Maximum Depth Attained ft	Maximum HGL Attained ft	Time of Max Occurrence days	Time of Max Occurrence hh:mm	Total Flooded Volume acre-in	Total Time Flooded minutes	Retention Time hh:mm:ss
P1-OUT	0.33	0.40	171.40	1	00:12	0	0	0:00:00
P2-OUT	0.31	0.36	167.36	1	06:25	0	0	0:00:00
P3-OUT	0.00	0.00	161.00	0	00:00	293.78	8141	0:00:00
Out-01	0.00	0.00	157.00	0	00:00	0	0	0:00:00
P1	6.22	6.88	172.88	1	00:12	0	0	0:00:00
P2	6.38	6.97	168.97	1	00:46	0	0	0:00:00
P3	5.23	5.48	162.48	1	00:01	0	0	0:00:00

****
Node Flow Summary
****

Node ID	Element Type	Maximum Lateral Inflow	Peak Inflow	Time of Flooding	Maximum Flooding	Time of Peak

		Inflow GPM	Occurrence GPM	days	hh:mm	Overflow GPM	Occurrence days	hh:mm
P1-OUT	JUNCTION	0.00	3174.19	1	00:12	0.00		
P2-OUT	JUNCTION	0.00	3159.49	1	00:46	0.00		
P3-OUT	JUNCTION	0.00	7990.93	1	00:01	5490.93	1	00:01
Out-01	OUTFALL	0.00	2500.00	0	00:00	0.00		
P1	STORAGE	8562.76	8562.76	0	00:15	0.00		
P2	STORAGE	5689.36	8850.66	1	00:00	0.00		
P3	STORAGE	5123.13	8267.51	1	00:00	0.00		

****
Storage Node Summary
****

Storage Node ID	Maximum Ponded Volume 1000 ft³	Maximum Ponded Volume (%)	Time of Max Ponded Volume days	hh:mm	Average Ponded Volume 1000 ft³	Average Ponded Volume (%)	Maximum Storage Node Outflow GPM	Maximum Exfiltration Rate cfm	Time of Max Exfiltration Rate hh:mm:ss	Total Exfiltrated Volume 1000 ft³
P1	4326.026	66	1	00:12	3857.786	59	3174.19	0.00	0:00:00	0.000
P2	3703.124	67	1	00:46	3363.845	61	3159.49	0.00	0:00:00	0.000
P3	2555.549	52	1	00:00	2432.346	50	7990.93	0.00	0:00:00	0.000

****
Outfall Loading Summary
****

Outfall Node ID	Flow Frequency (%)	Average Flow GPM	Peak Inflow GPM
Out-01	99.99	2325.01	2500.00
System	99.99	2325.01	2500.00

****
Link Flow Summary
****

Link ID	Element Type	Time of Peak Flow Occurrence days	hh:mm	Maximum Velocity Attained ft/sec	Length Factor	Peak Flow during Analysis GPM	Design Flow Capacity GPM	Ratio of Maximum /Design Flow	Ratio of Maximum Flow Depth	Total Time Surcharged minutes	Reported Condition
P1-P2	CONDUIT	1	00:12	9.22	1.00	3174.19	20017.47	0.16	0.27	0	Calculated
P2-P3	CONDUIT	1	00:04	11.07	1.00	3165.06	25842.45	0.12	0.24	0	Calculated
Pump	PUMP	0	00:00			2500.00		1.00		20158	
Orifice-P1-A	ORIFICE	1	00:12			2882.09		0.00			
Orifice-P1-B	ORIFICE	1	00:12			292.10		0.00			
Orifice-P2	ORIFICE	1	00:46			2959.70		0.00			
Orifice-P2-B	ORIFICE	1	00:46			199.79		0.00			

Weir-01	WEIR	1	00:01	7990.93	0.00

****
Highest Flow Instability Indexes
****
All links are stable.

Access violation at step 0, hour 0 --- execution halted.

Analysis began on: Mon May 2 10:23:42 2022
Analysis ended on: Mon May 2 10:24:04 2022
Total elapsed time: 00:00:22

Exhibit E

Output Graph for the 100-yr/24-hr event

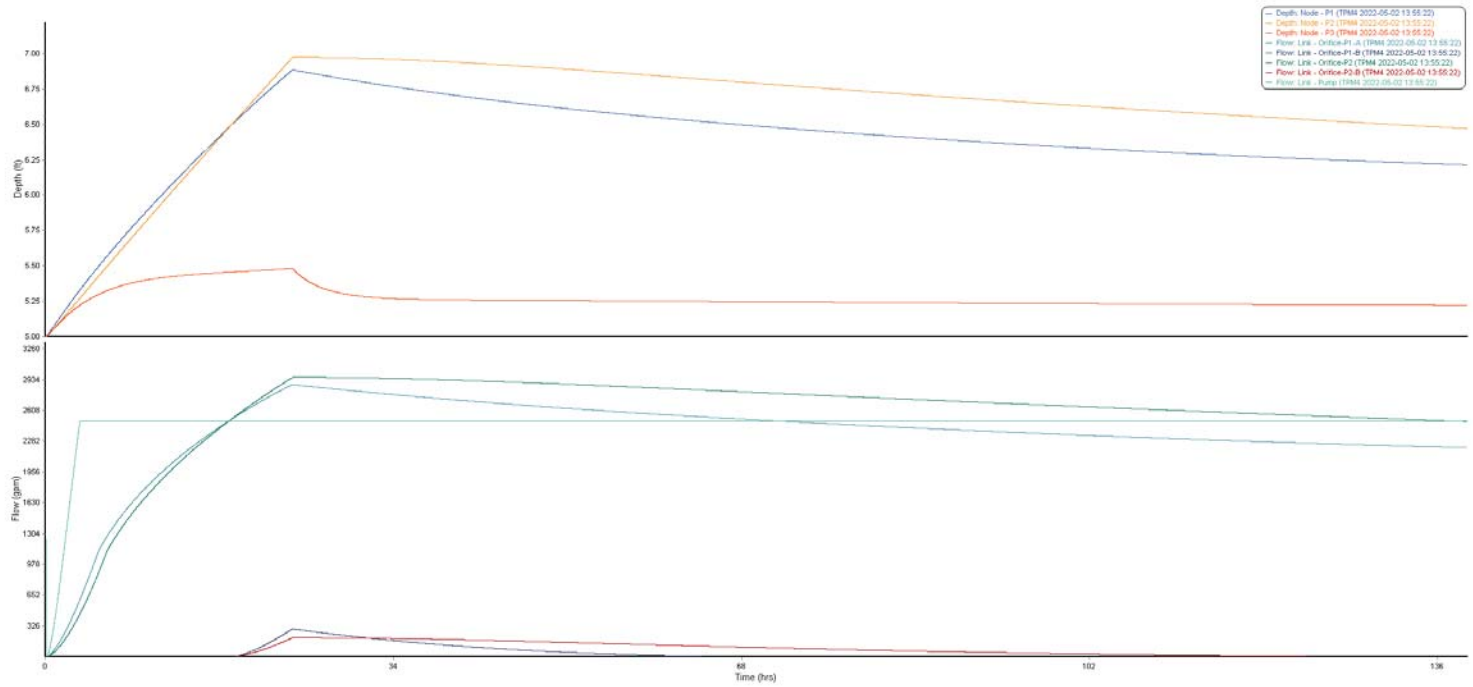

Depth: Node - P1 (TPM4 2022-05-02 13:55:22)
Depth: Node - P2 (TPM4 2022-05-02 13:55:22)
Depth: Node - P3 (TPM4 2022-05-02 13:55:22)
Flow: Link - Orifice-P1-A (TPM4 2022-05-02 13:55:22)
Flow: Link - Orifice-P1-B (TPM4 2022-05-02 13:55:22)
Flow: Link - Orifice-P2 (TPM4 2022-05-02 13:55:22)
Flow: Link - Orifice-P2-B (TPM4 2022-05-02 13:55:22)
Flow: Link - Pump (TPM4 2022-05-02 13:55:22)
Depth (ft)
7.00
6.75
6.50
6.25
6.00
5.75
5.50
5.25
5.00
Flow (gpm)
3260
2934
2608
2282
1956
1630
1304
978
652
326
0
34
68
102
136
Time (hrs)

Exhibit F

Precipitation Frequency Data from NOAA

NOAA Atlas 14, Volume 9, Version 2
Location name: Saint George, Georgia, USA*
Latitude: 30.5194°, Longitude: -82.1079°
Elevation: 172.73 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Deborah Martin, Sandra Pavlovic, Ishani Roy, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Michael Yekta, Geoffery Bonnin

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**5.90** (4.69-7.38)	**6.70** (5.32-8.39)	**8.04** (6.36-10.1)	**9.18** (7.22-11.6)	**10.8** (8.24-14.0)	**12.1** (9.01-15.9)	**13.4** (9.66-18.0)	**14.8** (10.2-20.3)	**16.7** (11.1-23.4)	**18.2** (11.7-25.8)
10-min	**4.32** (3.43-5.41)	**4.90** (3.89-6.14)	**5.89** (4.66-7.39)	**6.72** (5.29-8.47)	**7.91** (6.04-10.3)	**8.86** (6.60-11.6)	**9.83** (7.07-13.2)	**10.8** (7.48-14.9)	**12.2** (8.11-17.2)	**13.3** (8.58-18.9)
15-min	**3.51** (2.79-4.39)	**3.99** (3.17-4.99)	**4.78** (3.79-6.00)	**5.46** (4.30-6.88)	**6.43** (4.91-8.34)	**7.20** (5.36-9.45)	**7.99** (5.75-10.7)	**8.82** (6.08-12.1)	**9.93** (6.59-14.0)	**10.8** (6.98-15.4)
30-min	**2.74** (2.18-3.42)	**3.10** (2.46-3.88)	**3.72** (2.95-4.67)	**4.26** (3.35-5.37)	**5.03** (3.84-6.53)	**5.64** (4.20-7.41)	**6.27** (4.52-8.41)	**6.94** (4.79-9.52)	**7.84** (5.21-11.0)	**8.56** (5.52-12.2)
60-min	**1.78** (1.42-2.23)	**2.03** (1.61-2.54)	**2.46** (1.95-3.09)	**2.85** (2.24-3.59)	**3.41** (2.61-4.45)	**3.87** (2.89-5.10)	**4.35** (3.14-5.86)	**4.87** (3.37-6.70)	**5.59** (3.71-7.87)	**6.16** (3.98-8.75)
2-hr	**1.10** (0.882-1.36)	**1.26** (1.01-1.56)	**1.53** (1.23-1.90)	**1.78** (1.42-2.22)	**2.15** (1.67-2.79)	**2.46** (1.86-3.22)	**2.78** (2.03-3.72)	**3.13** (2.19-4.29)	**3.63** (2.43-5.08)	**4.02** (2.62-5.68)
3-hr	**0.797** (0.645-0.981)	**0.915** (0.739-1.13)	**1.13** (0.906-1.39)	**1.32** (1.05-1.63)	**1.61** (1.26-2.08)	**1.85** (1.41-2.42)	**2.11** (1.55-2.82)	**2.40** (1.69-3.27)	**2.80** (1.89-3.92)	**3.13** (2.05-4.40)
6-hr	**0.467** (0.381-0.568)	**0.535** (0.437-0.652)	**0.661** (0.538-0.807)	**0.779** (0.630-0.955)	**0.960** (0.760-1.24)	**1.12** (0.859-1.45)	**1.29** (0.954-1.70)	**1.47** (1.05-2.00)	**1.74** (1.19-2.42)	**1.96** (1.29-2.73)
12-hr	**0.275** (0.227-0.331)	**0.313** (0.259-0.378)	**0.385** (0.317-0.466)	**0.454** (0.371-0.551)	**0.560** (0.449-0.716)	**0.653** (0.508-0.840)	**0.754** (0.566-0.992)	**0.866** (0.622-1.17)	**1.03** (0.708-1.42)	**1.16** (0.774-1.61)
24-hr	**0.161** (0.134-0.191)	**0.184** (0.154-0.220)	**0.228** (0.190-0.273)	**0.269** (0.222-0.323)	**0.333** (0.269-0.420)	**0.387** (0.304-0.493)	**0.447** (0.339-0.582)	**0.512** (0.371-0.684)	**0.606** (0.422-0.830)	**0.683** (0.460-0.941)
2-day	**0.092** (0.077-0.108)	**0.107** (0.090-0.126)	**0.134** (0.113-0.158)	**0.159** (0.133-0.189)	**0.197** (0.160-0.245)	**0.229** (0.181-0.288)	**0.263** (0.201-0.339)	**0.300** (0.220-0.397)	**0.353** (0.248-0.479)	**0.396** (0.269-0.542)
3-day	**0.067** (0.057-0.079)	**0.078** (0.066-0.091)	**0.097** (0.082-0.114)	**0.115** (0.096-0.135)	**0.141** (0.116-0.175)	**0.163** (0.130-0.205)	**0.188** (0.144-0.241)	**0.214** (0.157-0.281)	**0.251** (0.177-0.339)	**0.281** (0.192-0.383)
4-day	**0.054** (0.047-0.064)	**0.063** (0.053-0.073)	**0.077** (0.066-0.090)	**0.091** (0.077-0.107)	**0.111** (0.091-0.137)	**0.128** (0.103-0.160)	**0.147** (0.113-0.187)	**0.167** (0.123-0.218)	**0.195** (0.138-0.263)	**0.218** (0.150-0.296)
7-day	**0.037** (0.032-0.043)	**0.042** (0.036-0.048)	**0.051** (0.044-0.059)	**0.059** (0.050-0.068)	**0.071** (0.058-0.086)	**0.080** (0.065-0.099)	**0.091** (0.071-0.115)	**0.102** (0.076-0.133)	**0.118** (0.084-0.158)	**0.131** (0.091-0.177)
10-day	**0.029** (0.025-0.034)	**0.033** (0.029-0.038)	**0.040** (0.034-0.046)	**0.045** (0.039-0.053)	**0.054** (0.045-0.065)	**0.061** (0.049-0.074)	**0.068** (0.053-0.085)	**0.076** (0.056-0.098)	**0.086** (0.062-0.115)	**0.095** (0.066-0.128)
20-day	**0.020** (0.017-0.023)	**0.022** (0.019-0.025)	**0.026** (0.023-0.029)	**0.029** (0.025-0.033)	**0.033** (0.028-0.040)	**0.037** (0.030-0.044)	**0.041** (0.032-0.050)	**0.044** (0.033-0.056)	**0.049** (0.036-0.065)	**0.053** (0.037-0.071)
30-day	**0.016** (0.014-0.018)	**0.018** (0.016-0.020)	**0.021** (0.018-0.024)	**0.023** (0.020-0.026)	**0.026** (0.022-0.031)	**0.029** (0.024-0.035)	**0.031** (0.025-0.038)	**0.034** (0.026-0.043)	**0.037** (0.027-0.048)	**0.040** (0.028-0.053)
45-day	**0.013** (0.012-0.015)	**0.015** (0.013-0.017)	**0.017** (0.015-0.019)	**0.019** (0.017-0.022)	**0.022** (0.018-0.025)	**0.023** (0.019-0.028)	**0.025** (0.020-0.031)	**0.027** (0.021-0.034)	**0.029** (0.021-0.038)	**0.031** (0.022-0.041)
60-day	**0.012** (0.010-0.013)	**0.013** (0.012-0.014)	**0.015** (0.013-0.017)	**0.017** (0.015-0.019)	**0.019** (0.016-0.022)	**0.020** (0.017-0.024)	**0.022** (0.018-0.027)	**0.023** (0.018-0.029)	**0.025** (0.018-0.032)	**0.026** (0.019-0.035)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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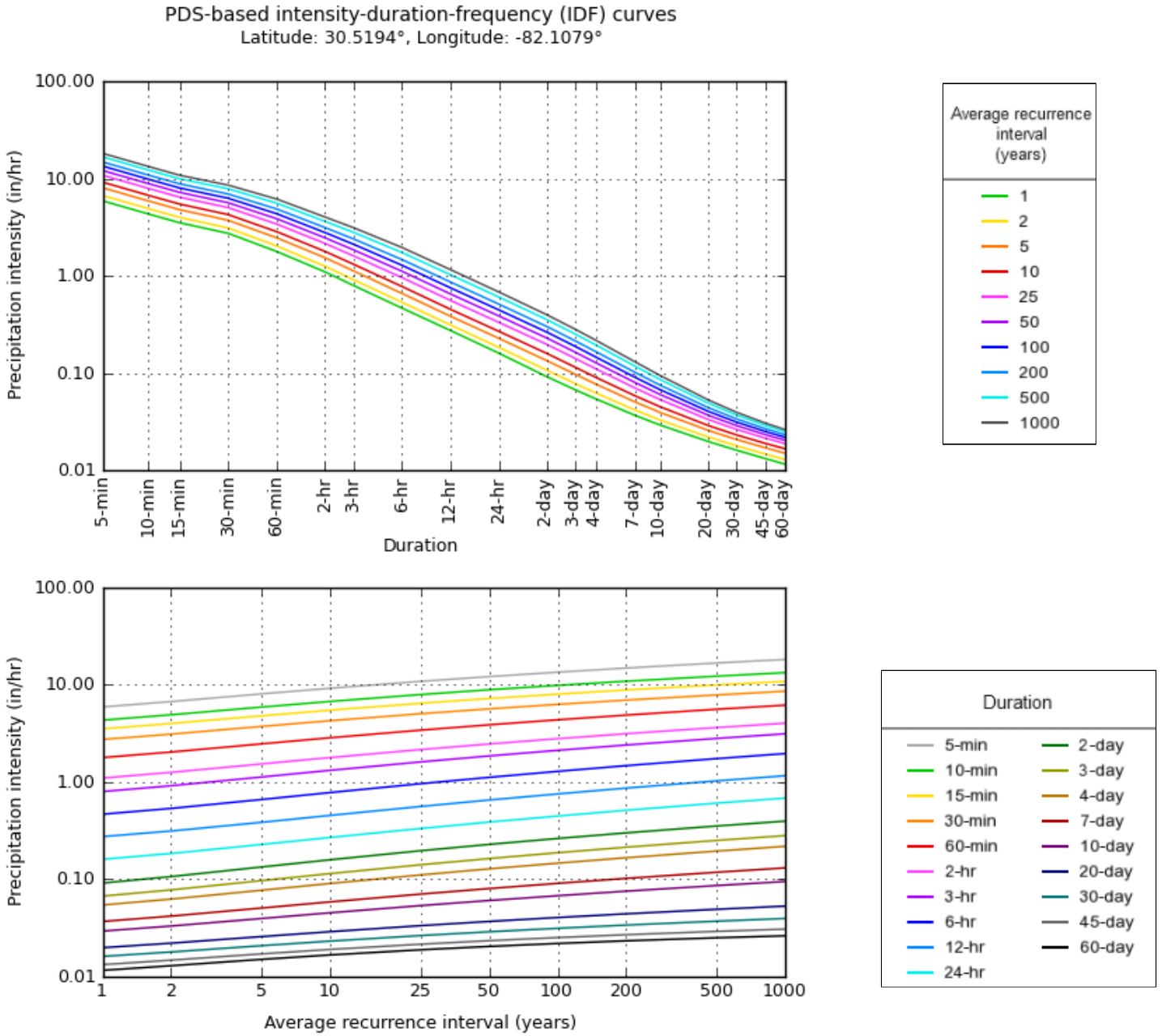
PF graphical



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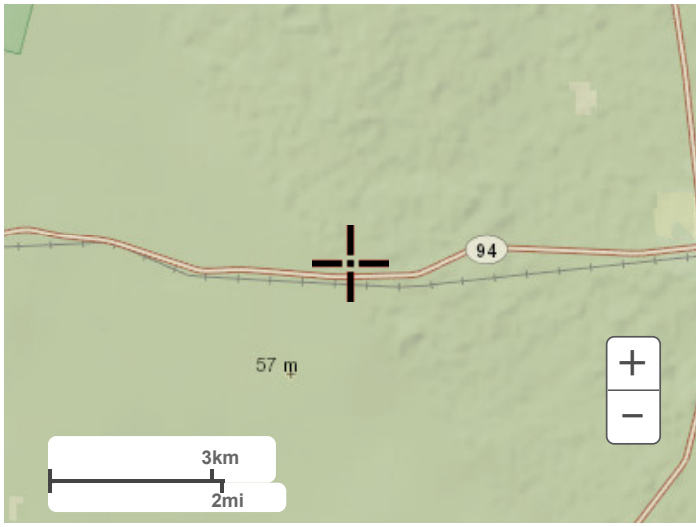
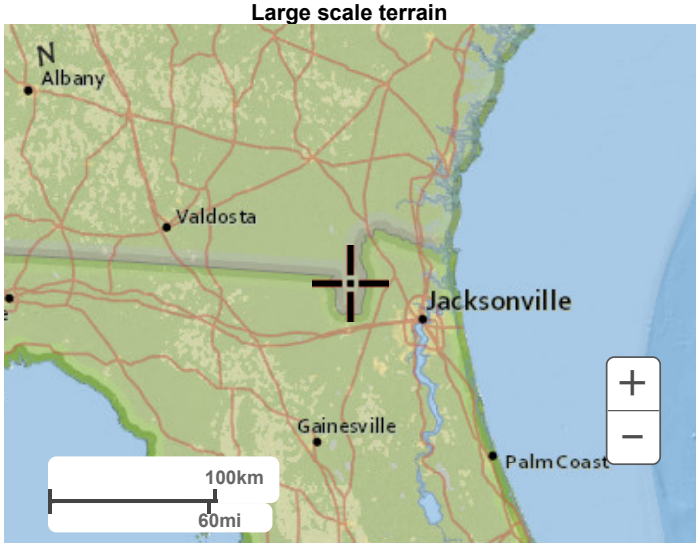
Maps & aerials

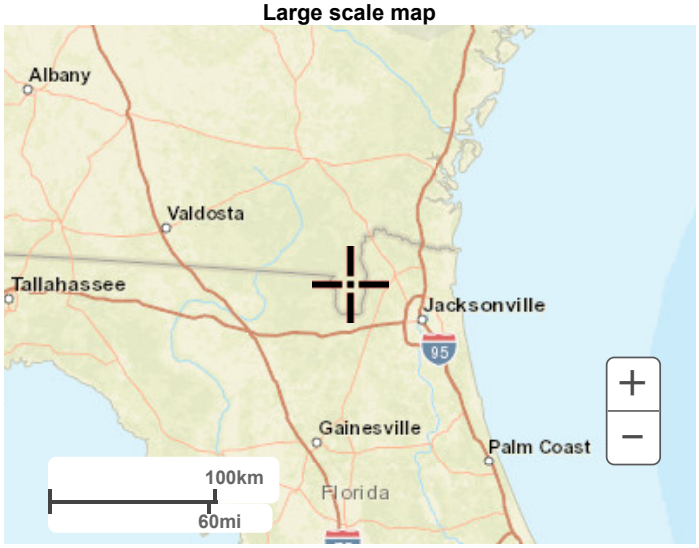
Small scale terrain



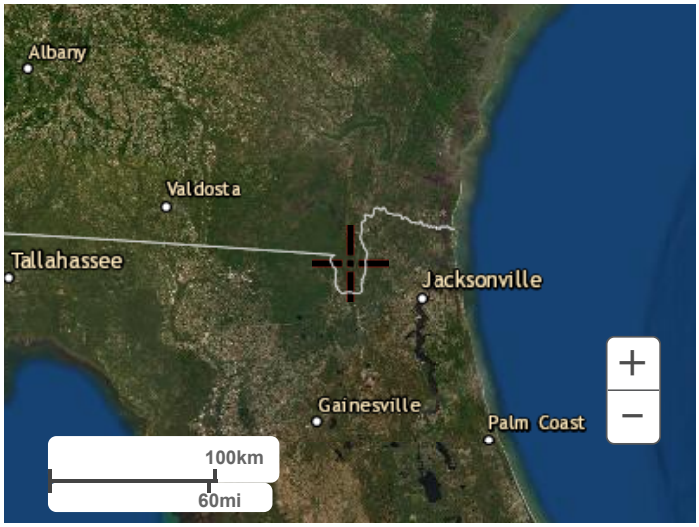
Large scale terrain



Large scale map



Large scale aerial



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