STORM WATER CALCULATIONS

For:

GRETEMAN WETLAND

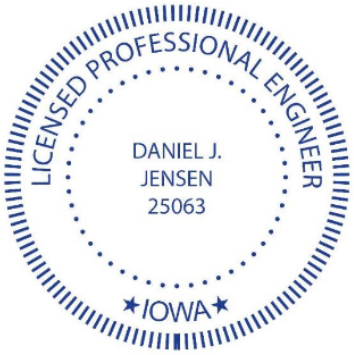
GUT813130A

Iowa Department of Agriculture and Land Stewardship

Bayard, Iowa

S-H PROJECT # 4213850

May 24, 2023



I hereby certify that the portion of this engineering document was prepared by me or under my direct personal supervision. I am a duly licensed Professional Engineer under the laws of the State of Iowa.

Signature: Dan Jensen

Name: Dan Jensen, P.E.

Date: 05/24/2023

My license renewal date is December 31, 2023.

Pages, sheets, or divisions covered by this certification:
All Sheets; excluding geotechnical report

Prepared by:

SHIVEHATTERY
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PROJECT SUMMARY

GENERAL

The proposed work includes construction of a wetland to the southeast of Bayard, IA. The location can be more specifically described as the NE ¼ of Section 30, Township 81 North, Range 31 West of the Fifth Principal meridian, Guthrie County, Iowa. A dam and sheet pile weir structure will be constructed to impound water for the wetland. A drawdown structure on the dam will allow for pool elevation control.

DESIGN STANDARDS, ANALYSIS, AND ASSUMPTIONS

The design procedures and guidelines were obtained from the following resources:

1. "National Engineering Handbook 4 – Hydrology"
2. "Technical Release No. 60 – Earth Dams and Reservoirs" (United States Soil Conservation Service)
3. "Iowa Administrative Code Chapter 73"
4. "NRCS Practice Standard 378"

DESIGN CRITERIA AND GUIDELINES

HAZARD CLASSIFICATION

Structures located in areas where damages from a failure would be limited to loss of the dam, loss of livestock, damages to farm out-buildings, agricultural lands, and lesser used roads, and where loss of human life is considered unlikely. Therefore, the structure shall be classified as low hazard.

STRUCTURE CLASSIFICATION

The height of the top of dam measured above the elevation of the channel bottom at the centerline of the dam (in feet) multiplied by the total storage volume (in acre-feet) is 521 (9 ft. x 53.8 acre-feet = 482) which is considerably less than the threshold of 30,000 required for a low hazard dam to be classified as a major structure. Therefore, the structure shall be classified as a minor structure.

WATER CONTROL STRUCTURE

The water control structure is a 48" diameter CMP riser equipped with stop logs for water elevation control. 18'' CMP will enter the structure from the pool area and 18'' CMP will exit the manhole structure and daylight downstream of the principal spillway sheet pile structure within the grouted plunge pool.

PRINCIPAL SPILLWAY

The principal spillway consists of a 65' wide steel sheet pile structure in the embankment at an elevation of 1145.00'. Since the structure is low hazard with a drainage area greater than 250 acres (292 acres), the principal spillway must pass the 10-year, 24-hour storm according to IAC Chapter 73. In lieu of the 10-year, 24-hour storm, the spillway was sized to pass the 25-year, 24-hour storm to meet NRCS 378 requirements. This equates to a storm producing a rainfall depth of 5.6". The 25-year, 24-hour storm will produce a discharge of 582 cfs through the principal spillway and a peak water surface elevation of 1146.99. The auxiliary spillway elevation is set at 1147.00.

FREEBOARD DESIGN

Based on IAC 567, the freeboard design storm for a low hazard structure shall be the 100-year, 24-hour storm. This equates to a storm producing a rainfall depth of 7.7". The 100-year, 24-hour storm will produce a discharge of 929 cfs through the principal spillway and a peak water surface elevation of 1147.55. The top of dam elevation is set at 1149.00.

IMPOUNDMENT LIFE

The Impoundment life was calculated using estimated sediment delivery and NRCS standard total erosion rate estimates. The erosion rates are based on the Average Annual Soil Erosion by Water on Cropland and CRP Land, 1982, published by USDA and revised in December 2000. This indicated that the erosion rates for the area ranged from 3 to 5 tons per acre per year. Furthermore, sediment delivery was based on NRCS FOTG "Erosion & Sediment Delivery", (Chart I: Estimated sediment delivery for landform regions). The chart indicated a sediment delivery percentage of approximately 8% for a 291

acre drainage area located in the Des Moines Lobe. Finally, the estimated sediment storage is based on the forebay capacity (0.47 ac-ft) and the normal pool storage volume of 7.40 ac-ft).

Based on the assumed soil erosion rate (5 T/Ac/yr), delivery ratio (8%), a sediment unit weight of 100 PCF, and sediment capture rate of 70% of delivered sediment, approximately 81.5 tons of sediment per year (1630 CF) is anticipated to be retained in the wetland. With a total sediment capacity of 7.87 ac-ft, this equates to an expected impoundment life of 210 years.

GEOTECHNICAL INVESTIGATION AND EVALUATION

A geotechnical investigation has been completed by Allender Butzke Engineers for the proposed wetland. A report compiling the findings and associated recommendations is included in Section 5 of this report.

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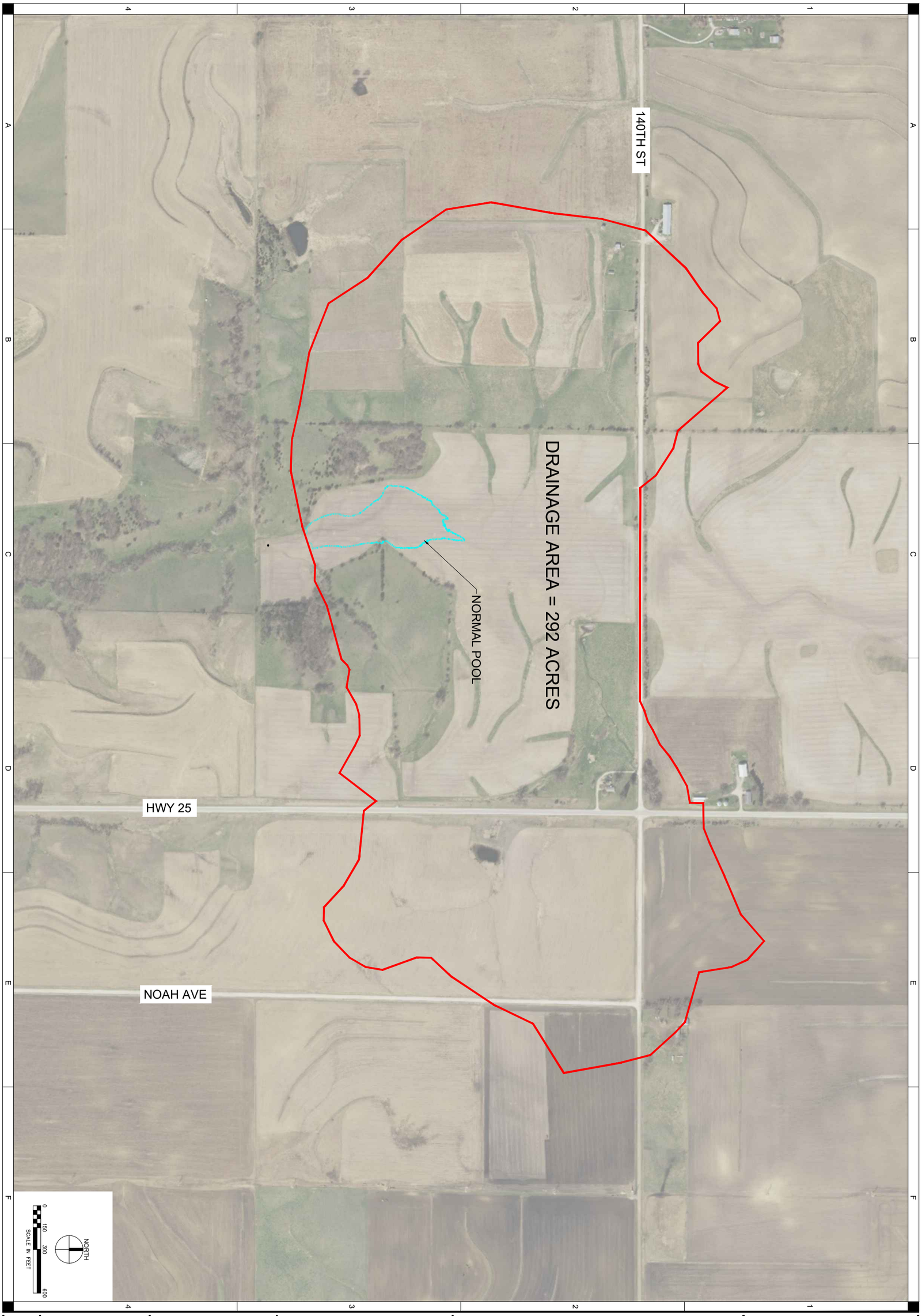

EX01

DRAINAGE AREA

DRAWN:	GHK
APPROVED:	DJJ
ISSUED FOR:	CONSTUCTION
DATE:	9-13-2022
PROJECT NO:	4213850
FIELD BOOK:	---
CLIENT NO:	GUT813130A

GUT813130A BREAKPOINT WETLAND

IOWA DEPARTMENT OF AGRICULTURE AND LAND STEWARDSHIP

GUTHRIE COUNTY, IA

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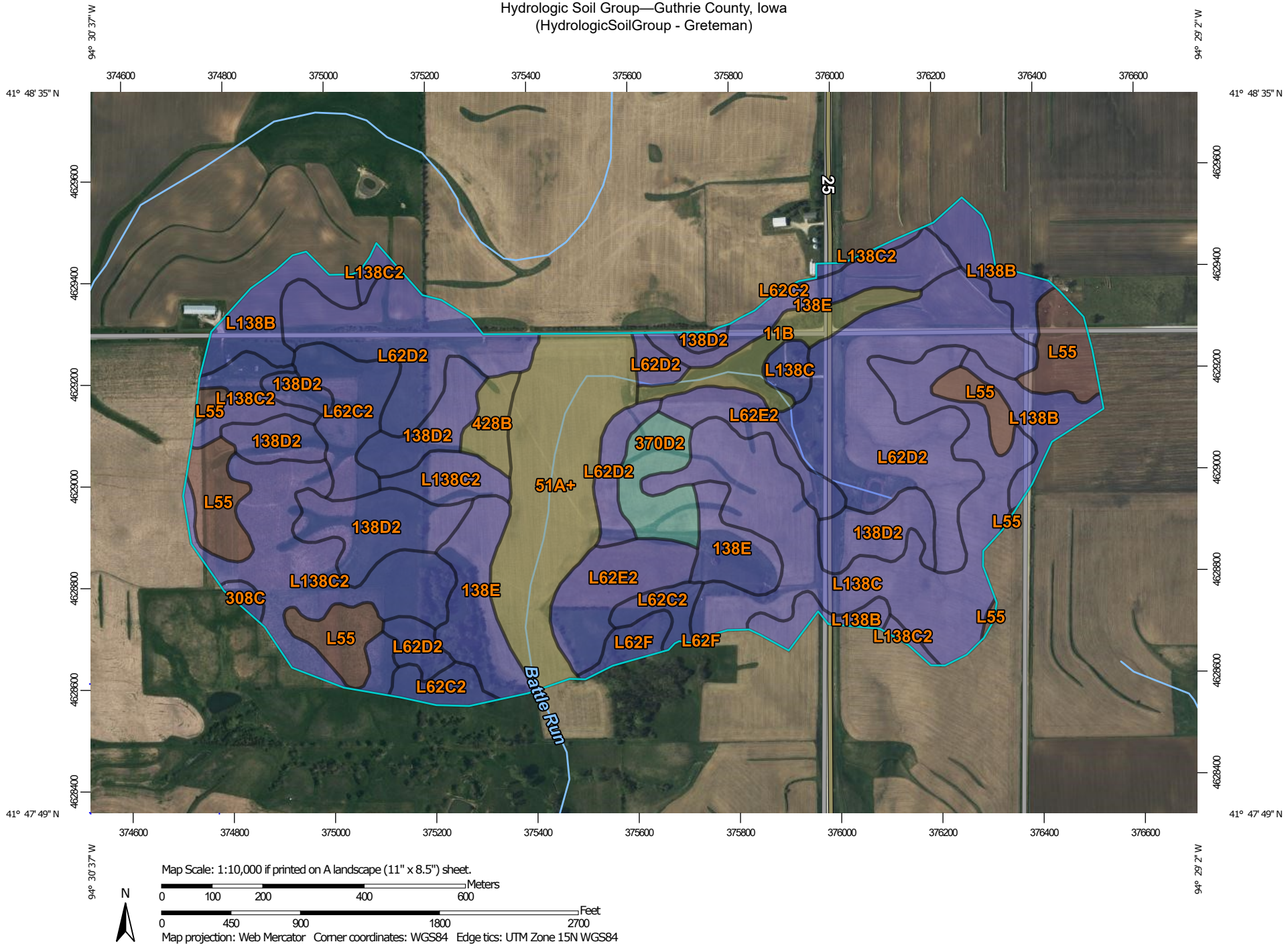
Hydrologic Soil Group—Guthrie County, Iowa
(HydrologicSoilGroup - Greteman)



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils

Soil Rating Polygons
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Guthrie County, Iowa
Survey Area Data: Version 30, Sep 14, 2021

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: May 4, 2021—Jun 4, 2021

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
11B	Colo-Judson silty clay loams, 0 to 5 percent slopes, occasionally flooded	C/D	7.5	2.5%
51A+	Vesser silt loam, 0 to 2 percent slopes, overwash, occasionally flooded	C/D	28.5	9.5%
138D2	Clarion loam, 9 to 14 percent slopes, moderately eroded	B	27.1	9.0%
138E	Clarion loam, 14 to 18 percent slopes	B	24.1	8.0%
308C	Wadena loam, 6 to 12 percent slopes	B	0.9	0.3%
370D2	Sharpsburg silty clay loam, 9 to 14 percent slopes, eroded	C	7.1	2.4%
428B	Ely silty clay loam, dissected till plain, 2 to 5 percent slopes	C/D	3.4	1.1%
L55	Nicollet loam, 1 to 3 percent slopes	B/D	18.8	6.3%
L62C2	Storden loam, Bemis moraine, 6 to 10 percent slopes, moderately eroded	B	14.4	4.8%
L62D2	Storden loam, Bemis moraine, 10 to 16 percent slopes, moderately eroded	B	56.6	18.9%
L62E2	Storden loam, Bemis moraine, 10 to 22 percent slopes, moderately eroded	B	15.5	5.2%
L62F	Belview loam, Bemis moraine, 16 to 30 percent slopes	B	2.6	0.9%
L138B	Clarion loam, Bemis moraine, 2 to 6 percent slopes	B	20.7	6.9%
L138C	Clarion loam, Bemis moraine, 6 to 10 percent slopes	B	38.9	13.0%

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
L138C2	Clarion loam, Bemis moraine, 6 to 10 percent slopes, moderately eroded	B	34.0	11.3%
Totals for Area of Interest			**300.0**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

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Subsection: Master Network Summary

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)
OverlandFlow	Post-Development 25 year	25	85.079	12.500	722.08
OverlandFlow	Post-Development 50 year	50	106.983	12.500	905.09
OverlandFlow	Post-Development 100 year	100	131.603	12.500	1,108.01
Combined Tile Flow	Post-Development 25 year	25	99.174	0.000	12.00
Combined Tile Flow	Post-Development 50 year	50	99.174	0.000	12.00
Combined Tile Flow	Post-Development 100 year	100	99.174	0.000	12.00

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)
FES-1.2	Post-Development 25 year	25	107.976	12.750	582.07
FES-1.2	Post-Development 50 year	50	129.811	12.750	747.52
FES-1.2	Post-Development 100 year	100	154.355	12.700	929.53

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ac-ft)
Wetland Basin (IN)	Post-Development 25 year	25	108.881	12.500	734.08	(N/A)	(N/A)
Wetland Basin (OUT)	Post-Development 25 year	25	107.976	12.750	582.07	1,146.99	24.269
Wetland Basin (IN)	Post-Development 50 year	50	130.785	12.500	917.09	(N/A)	(N/A)
Wetland Basin (OUT)	Post-Development 50 year	50	129.811	12.750	747.52	1,147.27	27.568

IDALS - GUT813130A

Subsection: Master Network Summary

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft^3/s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ac-ft)
Wetland Basin (IN)	Post-Development 100 year	100	155.405	12.500	1,120.01	(N/A)	(N/A)
Wetland Basin (OUT)	Post-Development 100 year	100	154.355	12.700	929.53	1,147.55	31.234

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Subsection: Time-Depth Curve
Label: MSE3
Scenario: Post-Development 100 year

Return Event: 100 years
Storm Event: 100 year

Time-Depth Curve: 100 year	
Label	100 year
Start Time	0.000 hours
Increment	0.100 hours
End Time	24.000 hours
Return Event	100 years

CUMULATIVE RAINFALL (in)
Output Time Increment = 0.100 hours
Time on left represents time for first value in each row.

Time (hours)	Depth (in)	Depth (in)	Depth (in)	Depth (in)	Depth (in)
0.000	0.0	0.0	0.0	0.0	0.0
0.500	0.0	0.0	0.0	0.0	0.0
1.000	0.0	0.0	0.0	0.0	0.0
1.500	0.0	0.1	0.1	0.1	0.1
2.000	0.1	0.1	0.1	0.1	0.1
2.500	0.1	0.1	0.1	0.1	0.1
3.000	0.1	0.1	0.1	0.1	0.2
3.500	0.2	0.2	0.2	0.2	0.2
4.000	0.2	0.2	0.2	0.2	0.2
4.500	0.2	0.3	0.3	0.3	0.3
5.000	0.3	0.3	0.3	0.3	0.3
5.500	0.3	0.3	0.4	0.4	0.4
6.000	0.4	0.4	0.4	0.4	0.4
6.500	0.4	0.5	0.5	0.5	0.5
7.000	0.5	0.5	0.5	0.5	0.6
7.500	0.6	0.6	0.6	0.6	0.6
8.000	0.6	0.7	0.7	0.7	0.7
8.500	0.7	0.7	0.7	0.8	0.8
9.000	0.8	0.8	0.8	0.9	0.9
9.500	0.9	0.9	1.0	1.0	1.0
10.000	1.1	1.1	1.1	1.1	1.2
10.500	1.2	1.2	1.3	1.3	1.4
11.000	1.5	1.6	1.6	1.7	1.8
11.500	1.9	2.0	2.2	2.5	2.9
12.000	3.6	4.8	5.2	5.4	5.6
12.500	5.8	5.9	6.0	6.0	6.1
13.000	6.2	6.3	6.3	6.4	6.4
13.500	6.5	6.5	6.5	6.6	6.6
14.000	6.6	6.6	6.7	6.7	6.7
14.500	6.8	6.8	6.8	6.8	6.9
15.000	6.9	6.9	6.9	6.9	6.9
15.500	7.0	7.0	7.0	7.0	7.0
16.000	7.0	7.0	7.1	7.1	7.1
16.500	7.1	7.1	7.1	7.1	7.1

IDALS - GUT813130A

Subsection: Time-Depth Curve
Label: MSE3
Scenario: Post-Development 100 year

Return Event: 100 years
Storm Event: 100 year

CUMULATIVE RAINFALL (in)
Output Time Increment = 0.100 hours
Time on left represents time for first value in each row.

Time (hours)	Depth (in)	Depth (in)	Depth (in)	Depth (in)	Depth (in)
17.000	7.2	7.2	7.2	7.2	7.2
17.500	7.2	7.2	7.2	7.3	7.3
18.000	7.3	7.3	7.3	7.3	7.3
18.500	7.3	7.3	7.4	7.4	7.4
19.000	7.4	7.4	7.4	7.4	7.4
19.500	7.4	7.4	7.4	7.5	7.5
20.000	7.5	7.5	7.5	7.5	7.5
20.500	7.5	7.5	7.5	7.5	7.5
21.000	7.5	7.5	7.6	7.6	7.6
21.500	7.6	7.6	7.6	7.6	7.6
22.000	7.6	7.6	7.6	7.6	7.6
22.500	7.6	7.6	7.6	7.6	7.6
23.000	7.6	7.6	7.6	7.7	7.7
23.500	7.7	7.7	7.7	7.7	7.7
24.000	7.7	(N/A)	(N/A)	(N/A)	(N/A)

IDALS - GUT813130A

Subsection: Time-Depth Curve
Label: MSE3
Scenario: Post-Development 25 year

Return Event: 25 years
Storm Event: 25 year

Time-Depth Curve: 25 year	
Label	25 year
Start Time	0.000 hours
Increment	0.100 hours
End Time	24.000 hours
Return Event	25 years

CUMULATIVE RAINFALL (in)
Output Time Increment = 0.100 hours
Time on left represents time for first value in each row.

Time (hours)	Depth (in)	Depth (in)	Depth (in)	Depth (in)	Depth (in)
0.000	0.0	0.0	0.0	0.0	0.0
0.500	0.0	0.0	0.0	0.0	0.0
1.000	0.0	0.0	0.0	0.0	0.0
1.500	0.0	0.0	0.0	0.0	0.0
2.000	0.1	0.1	0.1	0.1	0.1
2.500	0.1	0.1	0.1	0.1	0.1
3.000	0.1	0.1	0.1	0.1	0.1
3.500	0.1	0.1	0.1	0.1	0.1
4.000	0.1	0.2	0.2	0.2	0.2
4.500	0.2	0.2	0.2	0.2	0.2
5.000	0.2	0.2	0.2	0.2	0.2
5.500	0.2	0.3	0.3	0.3	0.3
6.000	0.3	0.3	0.3	0.3	0.3
6.500	0.3	0.3	0.3	0.4	0.4
7.000	0.4	0.4	0.4	0.4	0.4
7.500	0.4	0.4	0.4	0.4	0.5
8.000	0.5	0.5	0.5	0.5	0.5
8.500	0.5	0.5	0.5	0.6	0.6
9.000	0.6	0.6	0.6	0.6	0.6
9.500	0.7	0.7	0.7	0.7	0.7
10.000	0.8	0.8	0.8	0.8	0.9
10.500	0.9	0.9	0.9	1.0	1.0
11.000	1.1	1.1	1.2	1.3	1.3
11.500	1.4	1.5	1.6	1.8	2.1
12.000	2.6	3.5	3.8	4.0	4.1
12.500	4.2	4.3	4.3	4.4	4.5
13.000	4.5	4.6	4.6	4.6	4.7
13.500	4.7	4.7	4.8	4.8	4.8
14.000	4.8	4.8	4.9	4.9	4.9
14.500	4.9	4.9	5.0	5.0	5.0
15.000	5.0	5.0	5.0	5.0	5.1
15.500	5.1	5.1	5.1	5.1	5.1
16.000	5.1	5.1	5.1	5.2	5.2
16.500	5.2	5.2	5.2	5.2	5.2

IDALS - GUT813130A

Subsection: Time-Depth Curve
Label: MSE3
Scenario: Post-Development 25 year

Return Event: 25 years
Storm Event: 25 year

CUMULATIVE RAINFALL (in)
Output Time Increment = 0.100 hours
Time on left represents time for first value in each row.

Time (hours)	Depth (in)	Depth (in)	Depth (in)	Depth (in)	Depth (in)
17.000	5.2	5.2	5.2	5.2	5.3
17.500	5.3	5.3	5.3	5.3	5.3
18.000	5.3	5.3	5.3	5.3	5.3
18.500	5.3	5.4	5.4	5.4	5.4
19.000	5.4	5.4	5.4	5.4	5.4
19.500	5.4	5.4	5.4	5.4	5.4
20.000	5.4	5.5	5.5	5.5	5.5
20.500	5.5	5.5	5.5	5.5	5.5
21.000	5.5	5.5	5.5	5.5	5.5
21.500	5.5	5.5	5.5	5.5	5.5
22.000	5.5	5.5	5.5	5.5	5.6
22.500	5.6	5.6	5.6	5.6	5.6
23.000	5.6	5.6	5.6	5.6	5.6
23.500	5.6	5.6	5.6	5.6	5.6
24.000	5.6	(N/A)	(N/A)	(N/A)	(N/A)

IDALS - GUT813130A

Subsection: Time-Depth Curve
Label: MSE3
Scenario: Post-Development 50 year

Return Event: 50 years
Storm Event: 50 year

Time-Depth Curve: 50 year	
Label	50 year
Start Time	0.000 hours
Increment	0.100 hours
End Time	24.000 hours
Return Event	50 years

CUMULATIVE RAINFALL (in)
Output Time Increment = 0.100 hours
Time on left represents time for first value in each row.

Time (hours)	Depth (in)	Depth (in)	Depth (in)	Depth (in)	Depth (in)
0.000	0.0	0.0	0.0	0.0	0.0
0.500	0.0	0.0	0.0	0.0	0.0
1.000	0.0	0.0	0.0	0.0	0.0
1.500	0.0	0.0	0.0	0.1	0.1
2.000	0.1	0.1	0.1	0.1	0.1
2.500	0.1	0.1	0.1	0.1	0.1
3.000	0.1	0.1	0.1	0.1	0.1
3.500	0.1	0.1	0.2	0.2	0.2
4.000	0.2	0.2	0.2	0.2	0.2
4.500	0.2	0.2	0.2	0.2	0.2
5.000	0.2	0.3	0.3	0.3	0.3
5.500	0.3	0.3	0.3	0.3	0.3
6.000	0.3	0.3	0.4	0.4	0.4
6.500	0.4	0.4	0.4	0.4	0.4
7.000	0.4	0.4	0.5	0.5	0.5
7.500	0.5	0.5	0.5	0.5	0.5
8.000	0.6	0.6	0.6	0.6	0.6
8.500	0.6	0.6	0.6	0.7	0.7
9.000	0.7	0.7	0.7	0.7	0.8
9.500	0.8	0.8	0.8	0.9	0.9
10.000	0.9	0.9	1.0	1.0	1.0
10.500	1.0	1.1	1.1	1.2	1.2
11.000	1.3	1.3	1.4	1.5	1.5
11.500	1.6	1.8	1.9	2.1	2.5
12.000	3.0	4.1	4.4	4.7	4.8
12.500	4.9	5.0	5.1	5.2	5.2
13.000	5.3	5.4	5.4	5.5	5.5
13.500	5.6	5.6	5.6	5.6	5.7
14.000	5.7	5.7	5.7	5.7	5.8
14.500	5.8	5.8	5.8	5.9	5.9
15.000	5.9	5.9	5.9	5.9	6.0
15.500	6.0	6.0	6.0	6.0	6.0
16.000	6.0	6.0	6.1	6.1	6.1
16.500	6.1	6.1	6.1	6.1	6.1

IDALS - GUT813130A

Subsection: Time-Depth Curve
Label: MSE3
Scenario: Post-Development 50 year

Return Event: 50 years
Storm Event: 50 year

CUMULATIVE RAINFALL (in)
Output Time Increment = 0.100 hours
Time on left represents time for first value in each row.

Time (hours)	Depth (in)	Depth (in)	Depth (in)	Depth (in)	Depth (in)
17.000	6.1	6.2	6.2	6.2	6.2
17.500	6.2	6.2	6.2	6.2	6.2
18.000	6.2	6.3	6.3	6.3	6.3
18.500	6.3	6.3	6.3	6.3	6.3
19.000	6.3	6.3	6.3	6.4	6.4
19.500	6.4	6.4	6.4	6.4	6.4
20.000	6.4	6.4	6.4	6.4	6.4
20.500	6.4	6.4	6.5	6.5	6.5
21.000	6.5	6.5	6.5	6.5	6.5
21.500	6.5	6.5	6.5	6.5	6.5
22.000	6.5	6.5	6.5	6.5	6.5
22.500	6.5	6.5	6.5	6.6	6.6
23.000	6.6	6.6	6.6	6.6	6.6
23.500	6.6	6.6	6.6	6.6	6.6
24.000	6.6	(N/A)	(N/A)	(N/A)	(N/A)

IDALS - GUT813130A

Subsection: Time of Concentration Calculations
Label: OverlandFlow
Scenario: Post-Development 25 year

Return Event: 25 years
Storm Event: 25 year

Time of Concentration Results

Segment #1: SCS Lag	
Hydraulic Length	6,012.00 ft
CN	81.000
Slope	0.087 ft/ft
Average Velocity	2.29 ft/s
Segment Time of Concentration	0.730 hours

Time of Concentration (Composite)	
Time of Concentration (Composite)	0.730 hours

==== SCS Lag

Tc =	0.000877 * (Lf**0.8) * ((1000/CN)-9)**0.7) * (Sf**-0.5)
Where:	Tc= Time of concentration, hours Lf= Flow length, feet CN= SCS Curve Number Sf= Slope, ft/ft

IDALS - GUT813130A

Subsection: Time of Concentration Calculations
Label: OverlandFlow
Scenario: Post-Development 50 year

Return Event: 50 years
Storm Event: 50 year

Time of Concentration Results

Segment #1: SCS Lag	
Hydraulic Length	6,012.00 ft
CN	81.000
Slope	0.087 ft/ft
Average Velocity	2.29 ft/s
Segment Time of Concentration	0.730 hours

Time of Concentration (Composite)	
Time of Concentration (Composite)	0.730 hours

==== SCS Lag

Tc =	0.000877 * (Lf**0.8) * ((1000/CN)-9)**0.7) * (Sf**-0.5)
Where:	Tc= Time of concentration, hours Lf= Flow length, feet CN= SCS Curve Number Sf= Slope, ft/ft

IDALS - GUT813130A

Subsection: Time of Concentration Calculations
Label: OverlandFlow
Scenario: Post-Development 100 year

Return Event: 100 years
Storm Event: 100 year

Time of Concentration Results

Segment #1: SCS Lag	
Hydraulic Length	6,012.00 ft
CN	81.000
Slope	0.087 ft/ft
Average Velocity	2.29 ft/s
Segment Time of Concentration	0.730 hours

Time of Concentration (Composite)	
Time of Concentration (Composite)	0.730 hours

==== SCS Lag

Tc =	0.000877 * (Lf**0.8) * ((1000/CN)-9)**0.7) * (Sf**-0.5)
Where:	Tc= Time of concentration, hours Lf= Flow length, feet CN= SCS Curve Number Sf= Slope, ft/ft

IDALS - GUT813130A

Subsection: Unit Hydrograph Summary
Label: OverlandFlow
Scenario: Post-Development 25 year

Return Event: 25 years
Storm Event: 25 year

Storm Event	25 year
Return Event	25 years
Duration	24.000 hours
Depth	5.6 in
Time of Concentration (Composite)	0.730 hours
Area (User Defined)	291.531 acres

Computational Time Increment	0.097 hours
Time to Peak (Computed)	12.466 hours
Flow (Peak, Computed)	724.71 ft³/s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	12.500 hours
Flow (Peak Interpolated Output)	722.08 ft³/s

Drainage Area	
SCS CN (Composite)	81.000
Area (User Defined)	291.531 acres
Maximum Retention (Pervious)	2.3 in
Maximum Retention (Pervious, 20 percent)	0.5 in

Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	3.5 in
Runoff Volume (Pervious)	85.324 ac-ft

Hydrograph Volume (Area under Hydrograph curve)	
Volume	85.079 ac-ft

SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.730 hours
Computational Time Increment	0.097 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670

IDALS - GUT813130A

Subsection: Unit Hydrograph Summary
Label: OverlandFlow
Scenario: Post-Development 25 year

Return Event: 25 years
Storm Event: 25 year

SCS Unit Hydrograph Parameters	
Unit peak, qp	452.21 ft³/s
Unit peak time, Tp	0.487 hours
Unit receding limb, Tr	1.948 hours
Total unit time, Tb	2.435 hours

IDALS - GUT813130A

Subsection: Unit Hydrograph Summary
Label: OverlandFlow
Scenario: Post-Development 50 year

Return Event: 50 years
Storm Event: 50 year

Storm Event	50 year
Return Event	50 years
Duration	24.000 hours
Depth	6.6 in
Time of Concentration (Composite)	0.730 hours
Area (User Defined)	291.531 acres

Computational Time Increment	0.097 hours
Time to Peak (Computed)	12.466 hours
Flow (Peak, Computed)	909.69 ft³/s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	12.500 hours
Flow (Peak Interpolated Output)	905.09 ft³/s

Drainage Area	
SCS CN (Composite)	81.000
Area (User Defined)	291.531 acres
Maximum Retention (Pervious)	2.3 in
Maximum Retention (Pervious, 20 percent)	0.5 in

Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	4.4 in
Runoff Volume (Pervious)	107.279 ac-ft

Hydrograph Volume (Area under Hydrograph curve)	
Volume	106.983 ac-ft

SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.730 hours
Computational Time Increment	0.097 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670

IDALS - GUT813130A

Subsection: Unit Hydrograph Summary
Label: OverlandFlow
Scenario: Post-Development 50 year

Return Event: 50 years
Storm Event: 50 year

SCS Unit Hydrograph Parameters	
Unit peak, qp	452.21 ft³/s
Unit peak time, Tp	0.487 hours
Unit receding limb, Tr	1.948 hours
Total unit time, Tb	2.435 hours

IDALS - GUT813130A

Subsection: Unit Hydrograph Summary
Label: OverlandFlow
Scenario: Post-Development 100 year

Return Event: 100 years
Storm Event: 100 year

Storm Event	100 year
Return Event	100 years
Duration	24.000 hours
Depth	7.7 in
Time of Concentration (Composite)	0.730 hours
Area (User Defined)	291.531 acres

Computational Time Increment	0.097 hours
Time to Peak (Computed)	12.466 hours
Flow (Peak, Computed)	1,114.91 ft³/s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	12.500 hours
Flow (Peak Interpolated Output)	1,108.01 ft³/s

Drainage Area	
SCS CN (Composite)	81.000
Area (User Defined)	291.531 acres
Maximum Retention (Pervious)	2.3 in
Maximum Retention (Pervious, 20 percent)	0.5 in

Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	5.4 in
Runoff Volume (Pervious)	131.955 ac-ft

Hydrograph Volume (Area under Hydrograph curve)	
Volume	131.603 ac-ft

SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.730 hours
Computational Time Increment	0.097 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670

IDALS - GUT813130A

Subsection: Unit Hydrograph Summary
Label: OverlandFlow
Scenario: Post-Development 100 year

Return Event: 100 years
Storm Event: 100 year

SCS Unit Hydrograph Parameters	
Unit peak, qp	452.21 ft³/s
Unit peak time, Tp	0.487 hours
Unit receding limb, Tr	1.948 hours
Total unit time, Tb	2.435 hours

Summary for Hydrograph Addition at 'FES-1.2'

Upstream Link	Upstream Node
Outlet-2	Wetland Basin

Node Inflows

Inflow Type	Element	Volume (ac-ft)	Time to Peak (hours)	Flow (Peak) (ft^3/s)
Flow (From)	Outlet-2	107.976	12.750	582.07
Flow (In)	FES-1.2	107.976	12.750	582.07

Subsection: Addition Summary
Label: FES-1.2
Scenario: Post-Development 50 year

Return Event: 50 years
Storm Event: 50 year

Summary for Hydrograph Addition at 'FES-1.2'

Upstream Link	Upstream Node
Outlet-2	Wetland Basin

Node Inflows

Inflow Type	Element	Volume (ac-ft)	Time to Peak (hours)	Flow (Peak) (ft^3/s)
Flow (From)	Outlet-2	129.811	12.750	747.52
Flow (In)	FES-1.2	129.811	12.750	747.52

Subsection: Addition Summary
Label: FES-1.2
Scenario: Post-Development 100 year

Return Event: 100 years
Storm Event: 100 year

Summary for Hydrograph Addition at 'FES-1.2'

Upstream Link	Upstream Node
Outlet-2	Wetland Basin

Node Inflows

Inflow Type	Element	Volume (ac-ft)	Time to Peak (hours)	Flow (Peak) (ft^3/s)
Flow (From)	Outlet-2	154.355	12.700	929.53
Flow (In)	FES-1.2	154.355	12.700	929.53

IDALS - GUT813130A

Subsection: Time vs. Elevation
Label: Wetland Basin (OUT)
Scenario: Post-Development 25 year

Return Event: 25 years
Storm Event: 25 year

Time vs. Elevation (ft)

Output Time increment = 0.050 hours
Time on left represents time for first value in each row.

Time (hours)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)
0.000	1,145.00	1,145.01	1,145.01	1,145.02	1,145.03
0.250	1,145.03	1,145.04	1,145.04	1,145.04	1,145.05
0.500	1,145.05	1,145.05	1,145.06	1,145.06	1,145.06
0.750	1,145.06	1,145.06	1,145.07	1,145.07	1,145.07
1.000	1,145.07	1,145.07	1,145.07	1,145.07	1,145.08
1.250	1,145.08	1,145.08	1,145.08	1,145.08	1,145.08
1.500	1,145.08	1,145.08	1,145.08	1,145.08	1,145.08
1.750	1,145.08	1,145.08	1,145.08	1,145.08	1,145.08
2.000	1,145.08	1,145.08	1,145.08	1,145.08	1,145.08
2.250	1,145.08	1,145.08	1,145.08	1,145.08	1,145.08
2.500	1,145.08	1,145.08	1,145.08	1,145.08	1,145.08
2.750	1,145.08	1,145.08	1,145.09	1,145.09	1,145.09
3.000	1,145.09	1,145.09	1,145.09	1,145.09	1,145.09
3.250	1,145.09	1,145.09	1,145.09	1,145.09	1,145.09
3.500	1,145.09	1,145.09	1,145.09	1,145.09	1,145.09
3.750	1,145.09	1,145.09	1,145.09	1,145.09	1,145.09
4.000	1,145.09	1,145.09	1,145.09	1,145.09	1,145.09
4.250	1,145.09	1,145.09	1,145.09	1,145.09	1,145.09
4.500	1,145.09	1,145.09	1,145.09	1,145.09	1,145.09
4.750	1,145.09	1,145.09	1,145.09	1,145.09	1,145.09
5.000	1,145.09	1,145.09	1,145.09	1,145.09	1,145.09
5.250	1,145.09	1,145.09	1,145.09	1,145.09	1,145.09
5.500	1,145.09	1,145.09	1,145.09	1,145.09	1,145.09
5.750	1,145.09	1,145.09	1,145.09	1,145.09	1,145.09
6.000	1,145.09	1,145.09	1,145.09	1,145.09	1,145.09
6.250	1,145.09	1,145.09	1,145.09	1,145.09	1,145.09
6.500	1,145.09	1,145.09	1,145.09	1,145.09	1,145.09
6.750	1,145.09	1,145.09	1,145.09	1,145.09	1,145.09
7.000	1,145.09	1,145.09	1,145.09	1,145.09	1,145.09
7.250	1,145.09	1,145.09	1,145.09	1,145.09	1,145.09
7.500	1,145.09	1,145.09	1,145.09	1,145.09	1,145.09
7.750	1,145.09	1,145.09	1,145.09	1,145.09	1,145.09
8.000	1,145.09	1,145.09	1,145.09	1,145.09	1,145.09
8.250	1,145.09	1,145.09	1,145.09	1,145.09	1,145.09
8.500	1,145.09	1,145.09	1,145.09	1,145.09	1,145.09
8.750	1,145.09	1,145.09	1,145.09	1,145.09	1,145.09
9.000	1,145.09	1,145.09	1,145.09	1,145.09	1,145.09
9.250	1,145.09	1,145.09	1,145.09	1,145.09	1,145.10
9.500	1,145.10	1,145.10	1,145.10	1,145.10	1,145.10
9.750	1,145.11	1,145.11	1,145.11	1,145.11	1,145.11

IDALS - GUT813130A

Subsection: Time vs. Elevation
Label: Wetland Basin (OUT)
Scenario: Post-Development 25 year

Return Event: 25 years
Storm Event: 25 year

Time vs. Elevation (ft)

Output Time increment = 0.050 hours
Time on left represents time for first value in each row.

Time (hours)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)
10.000	1,145.12	1,145.12	1,145.12	1,145.12	1,145.13
10.250	1,145.13	1,145.13	1,145.13	1,145.14	1,145.14
10.500	1,145.14	1,145.14	1,145.15	1,145.15	1,145.15
10.750	1,145.16	1,145.16	1,145.16	1,145.17	1,145.17
11.000	1,145.18	1,145.19	1,145.20	1,145.20	1,145.21
11.250	1,145.22	1,145.23	1,145.25	1,145.26	1,145.27
11.500	1,145.29	1,145.30	1,145.32	1,145.34	1,145.36
11.750	1,145.38	1,145.41	1,145.44	1,145.48	1,145.52
12.000	1,145.57	1,145.63	1,145.70	1,145.80	1,145.92
12.250	1,146.05	1,146.19	1,146.34	1,146.48	1,146.61
12.500	1,146.72	1,146.81	1,146.89	1,146.94	1,146.98
12.750	1,146.99	1,146.98	1,146.95	1,146.92	1,146.87
13.000	1,146.82	1,146.76	1,146.71	1,146.65	1,146.59
13.250	1,146.54	1,146.48	1,146.42	1,146.36	1,146.31
13.500	1,146.26	1,146.21	1,146.16	1,146.12	1,146.08
13.750	1,146.04	1,146.01	1,145.97	1,145.93	1,145.90
14.000	1,145.86	1,145.83	1,145.80	1,145.77	1,145.74
14.250	1,145.72	1,145.69	1,145.67	1,145.65	1,145.63
14.500	1,145.62	1,145.60	1,145.59	1,145.58	1,145.56
14.750	1,145.55	1,145.54	1,145.54	1,145.53	1,145.52
15.000	1,145.52	1,145.51	1,145.50	1,145.50	1,145.49
15.250	1,145.49	1,145.48	1,145.48	1,145.47	1,145.46
15.500	1,145.45	1,145.45	1,145.44	1,145.43	1,145.42
15.750	1,145.41	1,145.41	1,145.40	1,145.39	1,145.38
16.000	1,145.38	1,145.37	1,145.36	1,145.36	1,145.35
16.250	1,145.35	1,145.34	1,145.34	1,145.33	1,145.33
16.500	1,145.33	1,145.32	1,145.32	1,145.31	1,145.31
16.750	1,145.31	1,145.31	1,145.30	1,145.30	1,145.30
17.000	1,145.30	1,145.29	1,145.29	1,145.29	1,145.29
17.250	1,145.28	1,145.28	1,145.28	1,145.28	1,145.28
17.500	1,145.28	1,145.27	1,145.27	1,145.27	1,145.27
17.750	1,145.27	1,145.27	1,145.27	1,145.26	1,145.26
18.000	1,145.26	1,145.26	1,145.26	1,145.26	1,145.26
18.250	1,145.26	1,145.26	1,145.25	1,145.25	1,145.25
18.500	1,145.25	1,145.25	1,145.25	1,145.25	1,145.25
18.750	1,145.25	1,145.24	1,145.24	1,145.24	1,145.24
19.000	1,145.24	1,145.24	1,145.24	1,145.24	1,145.24
19.250	1,145.23	1,145.23	1,145.23	1,145.23	1,145.23
19.500	1,145.23	1,145.23	1,145.23	1,145.23	1,145.23
19.750	1,145.22	1,145.22	1,145.22	1,145.22	1,145.22
20.000	1,145.22	1,145.22	1,145.22	1,145.22	1,145.22

IDALS - GUT813130A

Subsection: Time vs. Elevation
Label: Wetland Basin (OUT)
Scenario: Post-Development 25 year

Return Event: 25 years
Storm Event: 25 year

Time vs. Elevation (ft)

Output Time increment = 0.050 hours
Time on left represents time for first value in each row.

Time (hours)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)
20.250	1,145.21	1,145.21	1,145.21	1,145.21	1,145.21
20.500	1,145.21	1,145.21	1,145.21	1,145.21	1,145.20
20.750	1,145.20	1,145.20	1,145.20	1,145.20	1,145.20
21.000	1,145.20	1,145.20	1,145.20	1,145.20	1,145.19
21.250	1,145.19	1,145.19	1,145.19	1,145.19	1,145.19
21.500	1,145.19	1,145.19	1,145.19	1,145.19	1,145.18
21.750	1,145.18	1,145.18	1,145.18	1,145.18	1,145.18
22.000	1,145.18	1,145.18	1,145.18	1,145.18	1,145.17
22.250	1,145.17	1,145.17	1,145.17	1,145.17	1,145.17
22.500	1,145.17	1,145.17	1,145.17	1,145.16	1,145.16
22.750	1,145.16	1,145.16	1,145.16	1,145.16	1,145.16
23.000	1,145.16	1,145.16	1,145.16	1,145.15	1,145.15
23.250	1,145.15	1,145.15	1,145.15	1,145.15	1,145.15
23.500	1,145.15	1,145.15	1,145.15	1,145.14	1,145.14
23.750	1,145.14	1,145.14	1,145.14	1,145.14	1,145.14
24.000	1,145.14	(N/A)	(N/A)	(N/A)	(N/A)

IDALS - GUT813130A

Subsection: Time vs. Elevation
Label: Wetland Basin (OUT)
Scenario: Post-Development 50 year

Return Event: 50 years
Storm Event: 50 year

Time vs. Elevation (ft)

Output Time increment = 0.050 hours
Time on left represents time for first value in each row.

Time (hours)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)
0.000	1,145.00	1,145.01	1,145.01	1,145.02	1,145.03
0.250	1,145.03	1,145.04	1,145.04	1,145.04	1,145.05
0.500	1,145.05	1,145.05	1,145.06	1,145.06	1,145.06
0.750	1,145.06	1,145.06	1,145.07	1,145.07	1,145.07
1.000	1,145.07	1,145.07	1,145.07	1,145.07	1,145.08
1.250	1,145.08	1,145.08	1,145.08	1,145.08	1,145.08
1.500	1,145.08	1,145.08	1,145.08	1,145.08	1,145.08
1.750	1,145.08	1,145.08	1,145.08	1,145.08	1,145.08
2.000	1,145.08	1,145.08	1,145.08	1,145.08	1,145.08
2.250	1,145.08	1,145.08	1,145.08	1,145.08	1,145.08
2.500	1,145.08	1,145.08	1,145.08	1,145.08	1,145.08
2.750	1,145.08	1,145.08	1,145.09	1,145.09	1,145.09
3.000	1,145.09	1,145.09	1,145.09	1,145.09	1,145.09
3.250	1,145.09	1,145.09	1,145.09	1,145.09	1,145.09
3.500	1,145.09	1,145.09	1,145.09	1,145.09	1,145.09
3.750	1,145.09	1,145.09	1,145.09	1,145.09	1,145.09
4.000	1,145.09	1,145.09	1,145.09	1,145.09	1,145.09
4.250	1,145.09	1,145.09	1,145.09	1,145.09	1,145.09
4.500	1,145.09	1,145.09	1,145.09	1,145.09	1,145.09
4.750	1,145.09	1,145.09	1,145.09	1,145.09	1,145.09
5.000	1,145.09	1,145.09	1,145.09	1,145.09	1,145.09
5.250	1,145.09	1,145.09	1,145.09	1,145.09	1,145.09
5.500	1,145.09	1,145.09	1,145.09	1,145.09	1,145.09
5.750	1,145.09	1,145.09	1,145.09	1,145.09	1,145.09
6.000	1,145.09	1,145.09	1,145.09	1,145.09	1,145.09
6.250	1,145.09	1,145.09	1,145.09	1,145.09	1,145.09
6.500	1,145.09	1,145.09	1,145.09	1,145.09	1,145.09
6.750	1,145.09	1,145.09	1,145.09	1,145.09	1,145.09
7.000	1,145.09	1,145.09	1,145.09	1,145.09	1,145.09
7.250	1,145.09	1,145.09	1,145.09	1,145.09	1,145.09
7.500	1,145.09	1,145.09	1,145.09	1,145.09	1,145.09
7.750	1,145.09	1,145.09	1,145.09	1,145.09	1,145.09
8.000	1,145.09	1,145.09	1,145.09	1,145.09	1,145.09
8.250	1,145.09	1,145.09	1,145.09	1,145.09	1,145.09
8.500	1,145.09	1,145.09	1,145.09	1,145.09	1,145.10
8.750	1,145.10	1,145.10	1,145.10	1,145.10	1,145.10
9.000	1,145.10	1,145.10	1,145.10	1,145.10	1,145.11
9.250	1,145.11	1,145.11	1,145.11	1,145.11	1,145.11
9.500	1,145.12	1,145.12	1,145.12	1,145.12	1,145.13
9.750	1,145.13	1,145.13	1,145.14	1,145.14	1,145.14

IDALS - GUT813130A

Subsection: Time vs. Elevation
Label: Wetland Basin (OUT)
Scenario: Post-Development 50 year

Return Event: 50 years
Storm Event: 50 year

Time vs. Elevation (ft)

Output Time increment = 0.050 hours
Time on left represents time for first value in each row.

Time (hours)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)
10.000	1,145.15	1,145.15	1,145.15	1,145.16	1,145.16
10.250	1,145.16	1,145.17	1,145.17	1,145.18	1,145.18
10.500	1,145.18	1,145.19	1,145.19	1,145.19	1,145.20
10.750	1,145.20	1,145.21	1,145.21	1,145.22	1,145.23
11.000	1,145.24	1,145.25	1,145.26	1,145.27	1,145.28
11.250	1,145.29	1,145.31	1,145.33	1,145.34	1,145.36
11.500	1,145.38	1,145.40	1,145.43	1,145.45	1,145.48
11.750	1,145.51	1,145.54	1,145.57	1,145.61	1,145.65
12.000	1,145.71	1,145.78	1,145.87	1,145.99	1,146.12
12.250	1,146.27	1,146.43	1,146.59	1,146.75	1,146.90
12.500	1,147.02	1,147.12	1,147.19	1,147.24	1,147.26
12.750	1,147.27	1,147.25	1,147.22	1,147.17	1,147.12
13.000	1,147.06	1,147.01	1,146.94	1,146.87	1,146.80
13.250	1,146.73	1,146.67	1,146.61	1,146.55	1,146.49
13.500	1,146.43	1,146.37	1,146.32	1,146.27	1,146.22
13.750	1,146.17	1,146.13	1,146.09	1,146.05	1,146.01
14.000	1,145.98	1,145.94	1,145.90	1,145.87	1,145.84
14.250	1,145.81	1,145.78	1,145.75	1,145.73	1,145.71
14.500	1,145.69	1,145.67	1,145.65	1,145.64	1,145.62
14.750	1,145.61	1,145.60	1,145.59	1,145.58	1,145.57
15.000	1,145.57	1,145.56	1,145.55	1,145.55	1,145.54
15.250	1,145.54	1,145.53	1,145.52	1,145.52	1,145.51
15.500	1,145.51	1,145.50	1,145.49	1,145.48	1,145.48
15.750	1,145.47	1,145.46	1,145.45	1,145.44	1,145.44
16.000	1,145.43	1,145.42	1,145.41	1,145.41	1,145.40
16.250	1,145.40	1,145.39	1,145.39	1,145.38	1,145.38
16.500	1,145.37	1,145.37	1,145.36	1,145.36	1,145.36
16.750	1,145.35	1,145.35	1,145.35	1,145.34	1,145.34
17.000	1,145.34	1,145.33	1,145.33	1,145.33	1,145.33
17.250	1,145.33	1,145.32	1,145.32	1,145.32	1,145.32
17.500	1,145.32	1,145.31	1,145.31	1,145.31	1,145.31
17.750	1,145.31	1,145.31	1,145.30	1,145.30	1,145.30
18.000	1,145.30	1,145.30	1,145.30	1,145.29	1,145.29
18.250	1,145.29	1,145.29	1,145.29	1,145.29	1,145.29
18.500	1,145.29	1,145.28	1,145.28	1,145.28	1,145.28
18.750	1,145.28	1,145.28	1,145.28	1,145.27	1,145.27
19.000	1,145.27	1,145.27	1,145.27	1,145.27	1,145.27
19.250	1,145.27	1,145.26	1,145.26	1,145.26	1,145.26
19.500	1,145.26	1,145.26	1,145.26	1,145.26	1,145.25
19.750	1,145.25	1,145.25	1,145.25	1,145.25	1,145.25
20.000	1,145.25	1,145.25	1,145.24	1,145.24	1,145.24

IDALS - GUT813130A

Subsection: Time vs. Elevation
Label: Wetland Basin (OUT)
Scenario: Post-Development 50 year

Return Event: 50 years
Storm Event: 50 year

Time vs. Elevation (ft)

Output Time increment = 0.050 hours
Time on left represents time for first value in each row.

Time (hours)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)
20.250	1,145.24	1,145.24	1,145.24	1,145.24	1,145.24
20.500	1,145.23	1,145.23	1,145.23	1,145.23	1,145.23
20.750	1,145.23	1,145.23	1,145.23	1,145.22	1,145.22
21.000	1,145.22	1,145.22	1,145.22	1,145.22	1,145.22
21.250	1,145.22	1,145.21	1,145.21	1,145.21	1,145.21
21.500	1,145.21	1,145.21	1,145.21	1,145.21	1,145.20
21.750	1,145.20	1,145.20	1,145.20	1,145.20	1,145.20
22.000	1,145.20	1,145.20	1,145.19	1,145.19	1,145.19
22.250	1,145.19	1,145.19	1,145.19	1,145.19	1,145.19
22.500	1,145.18	1,145.18	1,145.18	1,145.18	1,145.18
22.750	1,145.18	1,145.18	1,145.18	1,145.17	1,145.17
23.000	1,145.17	1,145.17	1,145.17	1,145.17	1,145.17
23.250	1,145.17	1,145.16	1,145.16	1,145.16	1,145.16
23.500	1,145.16	1,145.16	1,145.16	1,145.16	1,145.15
23.750	1,145.15	1,145.15	1,145.15	1,145.15	1,145.15
24.000	1,145.15	(N/A)	(N/A)	(N/A)	(N/A)

IDALS - GUT813130A

Subsection: Time vs. Elevation
Label: Wetland Basin (OUT)
Scenario: Post-Development 100 year

Return Event: 100 years
Storm Event: 100 year

Time vs. Elevation (ft)

Output Time increment = 0.050 hours
Time on left represents time for first value in each row.

Time (hours)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)
0.000	1,145.00	1,145.01	1,145.01	1,145.02	1,145.03
0.250	1,145.03	1,145.04	1,145.04	1,145.04	1,145.05
0.500	1,145.05	1,145.05	1,145.06	1,145.06	1,145.06
0.750	1,145.06	1,145.06	1,145.07	1,145.07	1,145.07
1.000	1,145.07	1,145.07	1,145.07	1,145.07	1,145.08
1.250	1,145.08	1,145.08	1,145.08	1,145.08	1,145.08
1.500	1,145.08	1,145.08	1,145.08	1,145.08	1,145.08
1.750	1,145.08	1,145.08	1,145.08	1,145.08	1,145.08
2.000	1,145.08	1,145.08	1,145.08	1,145.08	1,145.08
2.250	1,145.08	1,145.08	1,145.08	1,145.08	1,145.08
2.500	1,145.08	1,145.08	1,145.08	1,145.08	1,145.08
2.750	1,145.08	1,145.08	1,145.09	1,145.09	1,145.09
3.000	1,145.09	1,145.09	1,145.09	1,145.09	1,145.09
3.250	1,145.09	1,145.09	1,145.09	1,145.09	1,145.09
3.500	1,145.09	1,145.09	1,145.09	1,145.09	1,145.09
3.750	1,145.09	1,145.09	1,145.09	1,145.09	1,145.09
4.000	1,145.09	1,145.09	1,145.09	1,145.09	1,145.09
4.250	1,145.09	1,145.09	1,145.09	1,145.09	1,145.09
4.500	1,145.09	1,145.09	1,145.09	1,145.09	1,145.09
4.750	1,145.09	1,145.09	1,145.09	1,145.09	1,145.09
5.000	1,145.09	1,145.09	1,145.09	1,145.09	1,145.09
5.250	1,145.09	1,145.09	1,145.09	1,145.09	1,145.09
5.500	1,145.09	1,145.09	1,145.09	1,145.09	1,145.09
5.750	1,145.09	1,145.09	1,145.09	1,145.09	1,145.09
6.000	1,145.09	1,145.09	1,145.09	1,145.09	1,145.09
6.250	1,145.09	1,145.09	1,145.09	1,145.09	1,145.09
6.500	1,145.09	1,145.09	1,145.09	1,145.09	1,145.09
6.750	1,145.09	1,145.09	1,145.09	1,145.09	1,145.09
7.000	1,145.09	1,145.09	1,145.09	1,145.09	1,145.09
7.250	1,145.09	1,145.09	1,145.09	1,145.09	1,145.09
7.500	1,145.09	1,145.09	1,145.09	1,145.09	1,145.09
7.750	1,145.09	1,145.09	1,145.09	1,145.09	1,145.09
8.000	1,145.10	1,145.10	1,145.10	1,145.10	1,145.10
8.250	1,145.10	1,145.10	1,145.10	1,145.10	1,145.11
8.500	1,145.11	1,145.11	1,145.11	1,145.11	1,145.11
8.750	1,145.11	1,145.12	1,145.12	1,145.12	1,145.12
9.000	1,145.12	1,145.12	1,145.12	1,145.13	1,145.13
9.250	1,145.13	1,145.13	1,145.13	1,145.14	1,145.14
9.500	1,145.14	1,145.15	1,145.15	1,145.15	1,145.16
9.750	1,145.16	1,145.17	1,145.17	1,145.18	1,145.18

IDALS - GUT813130A

Subsection: Time vs. Elevation
Label: Wetland Basin (OUT)
Scenario: Post-Development 100 year

Return Event: 100 years
Storm Event: 100 year

Time vs. Elevation (ft)

Output Time increment = 0.050 hours
Time on left represents time for first value in each row.

Time (hours)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)
10.000	1,145.19	1,145.19	1,145.20	1,145.20	1,145.20
10.250	1,145.21	1,145.21	1,145.22	1,145.22	1,145.23
10.500	1,145.23	1,145.24	1,145.24	1,145.25	1,145.25
10.750	1,145.26	1,145.27	1,145.28	1,145.28	1,145.29
11.000	1,145.30	1,145.32	1,145.33	1,145.35	1,145.36
11.250	1,145.38	1,145.40	1,145.42	1,145.44	1,145.47
11.500	1,145.49	1,145.52	1,145.54	1,145.57	1,145.59
11.750	1,145.62	1,145.65	1,145.69	1,145.73	1,145.79
12.000	1,145.86	1,145.94	1,146.05	1,146.17	1,146.32
12.250	1,146.50	1,146.67	1,146.85	1,147.03	1,147.18
12.500	1,147.31	1,147.41	1,147.49	1,147.54	1,147.55
12.750	1,147.55	1,147.53	1,147.48	1,147.43	1,147.36
13.000	1,147.29	1,147.22	1,147.15	1,147.08	1,147.01
13.250	1,146.93	1,146.86	1,146.79	1,146.72	1,146.65
13.500	1,146.59	1,146.53	1,146.48	1,146.42	1,146.36
13.750	1,146.31	1,146.26	1,146.21	1,146.16	1,146.12
14.000	1,146.08	1,146.04	1,146.01	1,145.97	1,145.93
14.250	1,145.90	1,145.87	1,145.84	1,145.81	1,145.78
14.500	1,145.76	1,145.74	1,145.72	1,145.70	1,145.69
14.750	1,145.67	1,145.66	1,145.65	1,145.64	1,145.63
15.000	1,145.62	1,145.61	1,145.60	1,145.60	1,145.59
15.250	1,145.58	1,145.58	1,145.57	1,145.56	1,145.56
15.500	1,145.55	1,145.54	1,145.53	1,145.53	1,145.52
15.750	1,145.51	1,145.50	1,145.50	1,145.49	1,145.48
16.000	1,145.48	1,145.47	1,145.46	1,145.46	1,145.45
16.250	1,145.44	1,145.44	1,145.43	1,145.43	1,145.42
16.500	1,145.42	1,145.41	1,145.41	1,145.41	1,145.40
16.750	1,145.40	1,145.39	1,145.39	1,145.39	1,145.38
17.000	1,145.38	1,145.38	1,145.38	1,145.37	1,145.37
17.250	1,145.37	1,145.37	1,145.36	1,145.36	1,145.36
17.500	1,145.36	1,145.36	1,145.35	1,145.35	1,145.35
17.750	1,145.35	1,145.35	1,145.34	1,145.34	1,145.34
18.000	1,145.34	1,145.34	1,145.34	1,145.33	1,145.33
18.250	1,145.33	1,145.33	1,145.33	1,145.33	1,145.32
18.500	1,145.32	1,145.32	1,145.32	1,145.32	1,145.32
18.750	1,145.31	1,145.31	1,145.31	1,145.31	1,145.31
19.000	1,145.31	1,145.31	1,145.30	1,145.30	1,145.30
19.250	1,145.30	1,145.30	1,145.30	1,145.30	1,145.29
19.500	1,145.29	1,145.29	1,145.29	1,145.29	1,145.29
19.750	1,145.28	1,145.28	1,145.28	1,145.28	1,145.28
20.000	1,145.28	1,145.28	1,145.27	1,145.27	1,145.27

IDALS - GUT813130A

Subsection: Time vs. Elevation
Label: Wetland Basin (OUT)
Scenario: Post-Development 100 year

Return Event: 100 years
Storm Event: 100 year

Time vs. Elevation (ft)

Output Time increment = 0.050 hours
Time on left represents time for first value in each row.

Time (hours)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)
20.250	1,145.27	1,145.27	1,145.27	1,145.27	1,145.26
20.500	1,145.26	1,145.26	1,145.26	1,145.26	1,145.26
20.750	1,145.26	1,145.25	1,145.25	1,145.25	1,145.25
21.000	1,145.25	1,145.25	1,145.24	1,145.24	1,145.24
21.250	1,145.24	1,145.24	1,145.24	1,145.24	1,145.23
21.500	1,145.23	1,145.23	1,145.23	1,145.23	1,145.23
21.750	1,145.23	1,145.22	1,145.22	1,145.22	1,145.22
22.000	1,145.22	1,145.22	1,145.22	1,145.21	1,145.21
22.250	1,145.21	1,145.21	1,145.21	1,145.21	1,145.20
22.500	1,145.20	1,145.20	1,145.20	1,145.20	1,145.20
22.750	1,145.20	1,145.19	1,145.19	1,145.19	1,145.19
23.000	1,145.19	1,145.19	1,145.19	1,145.18	1,145.18
23.250	1,145.18	1,145.18	1,145.18	1,145.18	1,145.18
23.500	1,145.17	1,145.17	1,145.17	1,145.17	1,145.17
23.750	1,145.17	1,145.16	1,145.16	1,145.16	1,145.16
24.000	1,145.16	(N/A)	(N/A)	(N/A)	(N/A)

IDALS - GUT813130A

Subsection: Time vs. Volume
Label: Wetland Basin
Scenario: Post-Development 25 year

Return Event: 25 years
Storm Event: 25 year

Time vs. Volume (ac-ft)

Output Time increment = 0.050 hours
Time on left represents time for first value in each row.

Time (hours)	Volume (ac-ft)	Volume (ac-ft)	Volume (ac-ft)	Volume (ac-ft)	Volume (ac-ft)
0.000	7.404	7.448	7.488	7.525	7.558
0.250	7.589	7.618	7.644	7.668	7.690
0.500	7.710	7.729	7.746	7.761	7.776
0.750	7.789	7.801	7.812	7.822	7.831
1.000	7.839	7.847	7.854	7.861	7.867
1.250	7.872	7.877	7.882	7.886	7.890
1.500	7.893	7.897	7.900	7.902	7.905
1.750	7.907	7.909	7.911	7.913	7.914
2.000	7.916	7.917	7.918	7.920	7.921
2.250	7.922	7.922	7.923	7.924	7.925
2.500	7.925	7.926	7.926	7.927	7.927
2.750	7.928	7.928	7.928	7.929	7.929
3.000	7.929	7.929	7.930	7.930	7.930
3.250	7.930	7.930	7.930	7.931	7.931
3.500	7.931	7.931	7.931	7.931	7.931
3.750	7.931	7.931	7.931	7.931	7.931
4.000	7.931	7.931	7.932	7.932	7.932
4.250	7.932	7.932	7.932	7.932	7.932
4.500	7.932	7.932	7.932	7.932	7.932
4.750	7.932	7.932	7.932	7.932	7.932
5.000	7.932	7.932	7.932	7.932	7.932
5.250	7.932	7.932	7.932	7.932	7.932
5.500	7.932	7.932	7.932	7.932	7.932
5.750	7.932	7.932	7.932	7.932	7.932
6.000	7.932	7.932	7.932	7.932	7.932
6.250	7.932	7.932	7.932	7.932	7.932
6.500	7.932	7.932	7.932	7.932	7.932
6.750	7.932	7.932	7.932	7.932	7.932
7.000	7.932	7.932	7.932	7.932	7.932
7.250	7.932	7.932	7.932	7.932	7.932
7.500	7.932	7.932	7.932	7.932	7.932
7.750	7.932	7.932	7.932	7.932	7.932
8.000	7.932	7.932	7.932	7.932	7.932
8.250	7.932	7.932	7.932	7.933	7.933
8.500	7.934	7.934	7.935	7.937	7.938
8.750	7.940	7.942	7.944	7.946	7.949
9.000	7.952	7.955	7.958	7.962	7.967
9.250	7.971	7.977	7.982	7.989	7.996
9.500	8.005	8.013	8.023	8.033	8.045
9.750	8.056	8.068	8.081	8.095	8.108

IDALS - GUT813130A

Subsection: Time vs. Volume
Label: Wetland Basin
Scenario: Post-Development 25 year

Return Event: 25 years
Storm Event: 25 year

Time vs. Volume (ac-ft)

Output Time increment = 0.050 hours
Time on left represents time for first value in each row.

Time (hours)	Volume (ac-ft)	Volume (ac-ft)	Volume (ac-ft)	Volume (ac-ft)	Volume (ac-ft)
10.000	8.122	8.137	8.152	8.167	8.183
10.250	8.199	8.215	8.232	8.249	8.266
10.500	8.283	8.301	8.320	8.339	8.359
10.750	8.381	8.406	8.433	8.464	8.498
11.000	8.537	8.581	8.631	8.685	8.746
11.250	8.813	8.885	8.964	9.050	9.142
11.500	9.241	9.348	9.463	9.589	9.730
11.750	9.888	10.072	10.290	10.555	10.856
12.000	11.202	11.645	12.220	12.966	13.916
12.250	15.019	16.206	17.539	18.962	20.202
12.500	21.347	22.357	23.180	23.783	24.147
12.750	24.269	24.175	23.900	23.487	22.980
13.000	22.413	21.816	21.210	20.609	20.025
13.250	19.468	18.911	18.331	17.790	17.286
13.500	16.818	16.386	15.986	15.615	15.271
13.750	14.952	14.654	14.339	14.029	13.735
14.000	13.458	13.197	12.953	12.726	12.515
14.250	12.320	12.140	11.975	11.824	11.687
14.500	11.562	11.449	11.347	11.255	11.172
14.750	11.097	11.030	10.969	10.915	10.865
15.000	10.821	10.780	10.743	10.708	10.668
15.250	10.627	10.584	10.538	10.491	10.440
15.500	10.387	10.333	10.277	10.220	10.163
15.750	10.107	10.052	9.998	9.947	9.898
16.000	9.850	9.805	9.762	9.722	9.683
16.250	9.647	9.612	9.580	9.549	9.520
16.500	9.493	9.467	9.443	9.420	9.398
16.750	9.377	9.358	9.339	9.322	9.305
17.000	9.289	9.274	9.259	9.245	9.232
17.250	9.219	9.207	9.195	9.184	9.173
17.500	9.163	9.152	9.142	9.133	9.123
17.750	9.114	9.105	9.096	9.088	9.079
18.000	9.071	9.063	9.055	9.047	9.039
18.250	9.032	9.024	9.017	9.009	9.002
18.500	8.994	8.987	8.980	8.973	8.965
18.750	8.958	8.951	8.944	8.937	8.930
19.000	8.923	8.916	8.910	8.903	8.896
19.250	8.889	8.882	8.875	8.868	8.862
19.500	8.855	8.848	8.841	8.835	8.828
19.750	8.821	8.814	8.808	8.801	8.794
20.000	8.787	8.781	8.774	8.767	8.761

IDALS - GUT813130A

Subsection: Time vs. Volume
Label: Wetland Basin
Scenario: Post-Development 25 year

Return Event: 25 years
Storm Event: 25 year

Time vs. Volume (ac-ft)

Output Time increment = 0.050 hours
Time on left represents time for first value in each row.

Time (hours)	Volume (ac-ft)	Volume (ac-ft)	Volume (ac-ft)	Volume (ac-ft)	Volume (ac-ft)
20.250	8.754	8.747	8.740	8.734	8.727
20.500	8.720	8.714	8.707	8.700	8.694
20.750	8.687	8.680	8.674	8.667	8.660
21.000	8.654	8.647	8.640	8.634	8.627
21.250	8.620	8.614	8.607	8.600	8.594
21.500	8.587	8.580	8.574	8.567	8.560
21.750	8.554	8.547	8.540	8.534	8.527
22.000	8.520	8.514	8.507	8.500	8.494
22.250	8.487	8.480	8.474	8.467	8.460
22.500	8.454	8.447	8.440	8.434	8.427
22.750	8.421	8.414	8.407	8.401	8.394
23.000	8.387	8.381	8.374	8.367	8.361
23.250	8.354	8.348	8.341	8.334	8.328
23.500	8.321	8.314	8.308	8.301	8.294
23.750	8.288	8.281	8.275	8.268	8.261
24.000	8.255	(N/A)	(N/A)	(N/A)	(N/A)

IDALS - GUT813130A

Subsection: Time vs. Volume
Label: Wetland Basin
Scenario: Post-Development 50 year

Return Event: 50 years
Storm Event: 50 year

Time vs. Volume (ac-ft)

Output Time increment = 0.050 hours
Time on left represents time for first value in each row.

Time (hours)	Volume (ac-ft)	Volume (ac-ft)	Volume (ac-ft)	Volume (ac-ft)	Volume (ac-ft)
0.000	7.404	7.448	7.488	7.525	7.558
0.250	7.589	7.618	7.644	7.668	7.690
0.500	7.710	7.729	7.746	7.761	7.776
0.750	7.789	7.801	7.812	7.822	7.831
1.000	7.839	7.847	7.854	7.861	7.867
1.250	7.872	7.877	7.882	7.886	7.890
1.500	7.893	7.897	7.900	7.902	7.905
1.750	7.907	7.909	7.911	7.913	7.914
2.000	7.916	7.917	7.918	7.920	7.921
2.250	7.922	7.922	7.923	7.924	7.925
2.500	7.925	7.926	7.926	7.927	7.927
2.750	7.928	7.928	7.928	7.929	7.929
3.000	7.929	7.929	7.930	7.930	7.930
3.250	7.930	7.930	7.930	7.931	7.931
3.500	7.931	7.931	7.931	7.931	7.931
3.750	7.931	7.931	7.931	7.931	7.931
4.000	7.931	7.931	7.932	7.932	7.932
4.250	7.932	7.932	7.932	7.932	7.932
4.500	7.932	7.932	7.932	7.932	7.932
4.750	7.932	7.932	7.932	7.932	7.932
5.000	7.932	7.932	7.932	7.932	7.932
5.250	7.932	7.932	7.932	7.932	7.932
5.500	7.932	7.932	7.932	7.932	7.932
5.750	7.932	7.932	7.932	7.932	7.932
6.000	7.932	7.932	7.932	7.932	7.932
6.250	7.932	7.932	7.932	7.932	7.932
6.500	7.932	7.932	7.932	7.932	7.932
6.750	7.932	7.932	7.932	7.932	7.932
7.000	7.932	7.932	7.932	7.932	7.932
7.250	7.932	7.932	7.932	7.932	7.932
7.500	7.932	7.932	7.932	7.933	7.933
7.750	7.933	7.934	7.935	7.936	7.938
8.000	7.940	7.942	7.944	7.947	7.950
8.250	7.953	7.956	7.960	7.964	7.969
8.500	7.973	7.978	7.983	7.989	7.994
8.750	8.000	8.006	8.012	8.018	8.025
9.000	8.031	8.038	8.045	8.053	8.061
9.250	8.070	8.079	8.090	8.101	8.114
9.500	8.128	8.143	8.159	8.176	8.194
9.750	8.213	8.233	8.253	8.274	8.295

IDALS - GUT813130A

Subsection: Time vs. Volume
Label: Wetland Basin
Scenario: Post-Development 50 year

Return Event: 50 years
Storm Event: 50 year

Time vs. Volume (ac-ft)

Output Time increment = 0.050 hours
Time on left represents time for first value in each row.

Time (hours)	Volume (ac-ft)	Volume (ac-ft)	Volume (ac-ft)	Volume (ac-ft)	Volume (ac-ft)
10.000	8.316	8.338	8.360	8.383	8.406
10.250	8.429	8.452	8.476	8.500	8.524
10.500	8.548	8.573	8.598	8.624	8.652
10.750	8.683	8.716	8.754	8.797	8.845
11.000	8.900	8.962	9.031	9.108	9.192
11.250	9.286	9.387	9.498	9.617	9.745
11.500	9.882	10.030	10.189	10.363	10.555
11.750	10.762	10.969	11.204	11.481	11.819
12.000	12.247	12.807	13.547	14.518	15.584
12.250	16.893	18.448	20.047	21.642	23.239
12.500	24.695	25.809	26.669	27.249	27.546
12.750	27.568	27.357	26.959	26.430	25.818
13.000	25.163	24.494	23.733	22.965	22.216
13.250	21.500	20.822	20.186	19.594	19.033
13.500	18.437	17.886	17.375	16.903	16.466
13.750	16.060	15.682	15.329	15.001	14.696
14.000	14.382	14.068	13.774	13.499	13.243
14.250	13.006	12.788	12.588	12.404	12.236
14.500	12.084	11.947	11.822	11.710	11.609
14.750	11.518	11.436	11.362	11.295	11.235
15.000	11.181	11.131	11.086	11.043	11.002
15.250	10.962	10.922	10.881	10.839	10.795
15.500	10.751	10.705	10.650	10.593	10.535
15.750	10.477	10.419	10.362	10.307	10.254
16.000	10.202	10.153	10.106	10.062	10.019
16.250	9.978	9.940	9.904	9.869	9.837
16.500	9.806	9.777	9.749	9.723	9.698
16.750	9.674	9.652	9.631	9.610	9.591
17.000	9.573	9.555	9.538	9.522	9.506
17.250	9.492	9.477	9.463	9.450	9.437
17.500	9.424	9.412	9.401	9.389	9.378
17.750	9.367	9.356	9.346	9.335	9.325
18.000	9.315	9.306	9.296	9.286	9.277
18.250	9.267	9.258	9.249	9.240	9.231
18.500	9.222	9.213	9.204	9.196	9.187
18.750	9.178	9.170	9.161	9.153	9.144
19.000	9.136	9.127	9.119	9.110	9.102
19.250	9.094	9.085	9.077	9.069	9.060
19.500	9.052	9.044	9.035	9.027	9.019
19.750	9.011	9.002	8.994	8.986	8.978
20.000	8.970	8.961	8.953	8.945	8.937

IDALS - GUT813130A

Subsection: Time vs. Volume
Label: Wetland Basin
Scenario: Post-Development 50 year

Return Event: 50 years
Storm Event: 50 year

Time vs. Volume (ac-ft)

Output Time increment = 0.050 hours
Time on left represents time for first value in each row.

Time (hours)	Volume (ac-ft)	Volume (ac-ft)	Volume (ac-ft)	Volume (ac-ft)	Volume (ac-ft)
20.250	8.929	8.920	8.912	8.904	8.896
20.500	8.888	8.880	8.871	8.863	8.855
20.750	8.847	8.839	8.831	8.823	8.814
21.000	8.806	8.798	8.790	8.782	8.774
21.250	8.766	8.758	8.749	8.741	8.733
21.500	8.725	8.717	8.709	8.701	8.693
21.750	8.685	8.677	8.669	8.660	8.652
22.000	8.644	8.636	8.628	8.620	8.612
22.250	8.604	8.595	8.587	8.579	8.571
22.500	8.563	8.555	8.547	8.539	8.531
22.750	8.523	8.515	8.507	8.499	8.491
23.000	8.483	8.475	8.467	8.458	8.450
23.250	8.442	8.434	8.426	8.418	8.410
23.500	8.402	8.394	8.386	8.378	8.370
23.750	8.362	8.354	8.346	8.338	8.330
24.000	8.322	(N/A)	(N/A)	(N/A)	(N/A)

IDALS - GUT813130A

Subsection: Time vs. Volume
Label: Wetland Basin
Scenario: Post-Development 100 year

Return Event: 100 years
Storm Event: 100 year

Time vs. Volume (ac-ft)

Output Time increment = 0.050 hours
Time on left represents time for first value in each row.

Time (hours)	Volume (ac-ft)	Volume (ac-ft)	Volume (ac-ft)	Volume (ac-ft)	Volume (ac-ft)
0.000	7.404	7.448	7.488	7.525	7.558
0.250	7.589	7.618	7.644	7.668	7.690
0.500	7.710	7.729	7.746	7.761	7.776
0.750	7.789	7.801	7.812	7.822	7.831
1.000	7.839	7.847	7.854	7.861	7.867
1.250	7.872	7.877	7.882	7.886	7.890
1.500	7.893	7.897	7.900	7.902	7.905
1.750	7.907	7.909	7.911	7.913	7.914
2.000	7.916	7.917	7.918	7.920	7.921
2.250	7.922	7.922	7.923	7.924	7.925
2.500	7.925	7.926	7.926	7.927	7.927
2.750	7.928	7.928	7.928	7.929	7.929
3.000	7.929	7.929	7.930	7.930	7.930
3.250	7.930	7.930	7.930	7.931	7.931
3.500	7.931	7.931	7.931	7.931	7.931
3.750	7.931	7.931	7.931	7.931	7.931
4.000	7.931	7.931	7.932	7.932	7.932
4.250	7.932	7.932	7.932	7.932	7.932
4.500	7.932	7.932	7.932	7.932	7.932
4.750	7.932	7.932	7.932	7.932	7.932
5.000	7.932	7.932	7.932	7.932	7.932
5.250	7.932	7.932	7.932	7.932	7.932
5.500	7.932	7.932	7.932	7.932	7.932
5.750	7.932	7.932	7.932	7.932	7.932
6.000	7.932	7.932	7.932	7.932	7.932
6.250	7.932	7.932	7.932	7.932	7.932
6.500	7.932	7.932	7.932	7.932	7.932
6.750	7.932	7.932	7.932	7.932	7.932
7.000	7.932	7.933	7.933	7.934	7.935
7.250	7.936	7.938	7.940	7.942	7.944
7.500	7.947	7.951	7.954	7.958	7.962
7.750	7.967	7.972	7.977	7.983	7.989
8.000	7.995	8.001	8.008	8.015	8.022
8.250	8.029	8.037	8.044	8.052	8.060
8.500	8.068	8.077	8.085	8.094	8.103
8.750	8.112	8.121	8.130	8.140	8.149
9.000	8.159	8.169	8.179	8.190	8.201
9.250	8.214	8.227	8.243	8.259	8.278
9.500	8.298	8.320	8.344	8.369	8.395
9.750	8.422	8.450	8.479	8.508	8.538

IDALS - GUT813130A

Subsection: Time vs. Volume
Label: Wetland Basin
Scenario: Post-Development 100 year

Return Event: 100 years
Storm Event: 100 year

Time vs. Volume (ac-ft)

Output Time increment = 0.050 hours
Time on left represents time for first value in each row.

Time (hours)	Volume (ac-ft)	Volume (ac-ft)	Volume (ac-ft)	Volume (ac-ft)	Volume (ac-ft)
10.000	8.568	8.598	8.629	8.660	8.691
10.250	8.723	8.754	8.786	8.818	8.850
10.500	8.882	8.915	8.948	8.983	9.020
10.750	9.060	9.105	9.155	9.212	9.276
11.000	9.350	9.433	9.526	9.630	9.744
11.250	9.870	10.007	10.155	10.315	10.487
11.500	10.671	10.842	11.013	11.191	11.382
11.750	11.593	11.832	12.111	12.448	12.868
12.000	13.407	14.120	14.994	16.049	17.398
12.250	19.085	20.805	22.743	24.753	26.503
12.500	28.081	29.402	30.406	30.989	31.234
12.750	31.174	30.862	30.330	29.597	28.766
13.000	27.887	27.000	26.128	25.290	24.497
13.250	23.645	22.824	22.050	21.327	20.654
13.500	20.030	19.454	18.888	18.310	17.774
13.750	17.276	16.812	16.380	15.977	15.602
14.000	15.254	14.932	14.634	14.322	14.021
14.250	13.743	13.485	13.248	13.031	12.832
14.500	12.652	12.488	12.341	12.208	12.087
14.750	11.979	11.881	11.793	11.714	11.642
15.000	11.577	11.518	11.464	11.413	11.364
15.250	11.316	11.268	11.219	11.168	11.116
15.500	11.062	11.007	10.953	10.898	10.845
15.750	10.794	10.744	10.696	10.642	10.590
16.000	10.540	10.491	10.443	10.398	10.354
16.250	10.312	10.273	10.235	10.199	10.164
16.500	10.131	10.100	10.071	10.043	10.016
16.750	9.990	9.966	9.942	9.920	9.899
17.000	9.879	9.859	9.840	9.822	9.805
17.250	9.788	9.772	9.756	9.740	9.726
17.500	9.711	9.697	9.684	9.670	9.657
17.750	9.645	9.632	9.620	9.608	9.596
18.000	9.584	9.573	9.561	9.550	9.539
18.250	9.528	9.517	9.506	9.495	9.484
18.500	9.474	9.463	9.452	9.442	9.432
18.750	9.421	9.411	9.401	9.390	9.380
19.000	9.370	9.360	9.350	9.340	9.330
19.250	9.320	9.310	9.300	9.290	9.280
19.500	9.270	9.260	9.250	9.240	9.230
19.750	9.220	9.210	9.200	9.190	9.181
20.000	9.171	9.161	9.151	9.141	9.131

IDALS - GUT813130A

Subsection: Time vs. Volume
Label: Wetland Basin
Scenario: Post-Development 100 year

Return Event: 100 years
Storm Event: 100 year

Time vs. Volume (ac-ft)

Output Time increment = 0.050 hours
Time on left represents time for first value in each row.

Time (hours)	Volume (ac-ft)	Volume (ac-ft)	Volume (ac-ft)	Volume (ac-ft)	Volume (ac-ft)
20.250	9.121	9.112	9.102	9.092	9.082
20.500	9.072	9.063	9.053	9.043	9.033
20.750	9.024	9.014	9.004	8.994	8.984
21.000	8.975	8.965	8.955	8.945	8.936
21.250	8.926	8.916	8.907	8.897	8.887
21.500	8.878	8.868	8.858	8.848	8.839
21.750	8.829	8.819	8.810	8.800	8.790
22.000	8.780	8.771	8.761	8.751	8.742
22.250	8.732	8.722	8.713	8.703	8.693
22.500	8.684	8.674	8.664	8.655	8.645
22.750	8.635	8.626	8.616	8.607	8.597
23.000	8.587	8.578	8.568	8.558	8.549
23.250	8.539	8.530	8.520	8.510	8.501
23.500	8.491	8.482	8.472	8.462	8.453
23.750	8.443	8.434	8.424	8.415	8.405
24.000	8.396	(N/A)	(N/A)	(N/A)	(N/A)

IDALS - GUT813130A

Subsection: Elevation-Area Volume Curve
Label: Wetland Basin
Scenario: Post-Development 25 year

Return Event: 25 years
Storm Event: 25 year

Elevation (ft)	Planimeter (ft^2)	Area (acres)	A1+A2+sqr (A1*A2) (acres)	Volume (ac-ft)	Volume (Total) (ac-ft)
1,142.00	0.0	0.069	0.000	0.000	0.000
1,143.00	0.0	1.297	1.665	0.555	0.555
1,144.00	0.0	3.308	6.676	2.225	2.781
1,145.00	0.0	6.078	13.870	4.623	7.404
1,146.00	0.0	8.330	21.523	7.174	14.578
1,147.00	0.0	11.428	29.515	9.838	24.417
1,148.00	0.0	14.736	39.141	13.047	37.464
1,149.00	0.0	18.048	49.092	16.364	53.828

IDALS - GUT813130A

Subsection: Elevation-Area Volume Curve
Label: Wetland Basin
Scenario: Post-Development 50 year

Return Event: 50 years
Storm Event: 50 year

Elevation (ft)	Planimeter (ft^2)	Area (acres)	A1+A2+sqr (A1*A2) (acres)	Volume (ac-ft)	Volume (Total) (ac-ft)
1,142.00	0.0	0.069	0.000	0.000	0.000
1,143.00	0.0	1.297	1.665	0.555	0.555
1,144.00	0.0	3.308	6.676	2.225	2.781
1,145.00	0.0	6.078	13.870	4.623	7.404
1,146.00	0.0	8.330	21.523	7.174	14.578
1,147.00	0.0	11.428	29.515	9.838	24.417
1,148.00	0.0	14.736	39.141	13.047	37.464
1,149.00	0.0	18.048	49.092	16.364	53.828

IDALS - GUT813130A

Subsection: Elevation-Area Volume Curve
Label: Wetland Basin
Scenario: Post-Development 100 year

Return Event: 100 years
Storm Event: 100 year

Elevation (ft)	Planimeter (ft^2)	Area (acres)	A1+A2+sqr (A1*A2) (acres)	Volume (ac-ft)	Volume (Total) (ac-ft)
1,142.00	0.0	0.069	0.000	0.000	0.000
1,143.00	0.0	1.297	1.665	0.555	0.555
1,144.00	0.0	3.308	6.676	2.225	2.781
1,145.00	0.0	6.078	13.870	4.623	7.404
1,146.00	0.0	8.330	21.523	7.174	14.578
1,147.00	0.0	11.428	29.515	9.838	24.417
1,148.00	0.0	14.736	39.141	13.047	37.464
1,149.00	0.0	18.048	49.092	16.364	53.828

IDALS - GUT813130A

Subsection: Outlet Input Data
Label: SheetPile
Scenario: Post-Development 25 year

Return Event: 25 years
Storm Event: 25 year

Requested Pond Water Surface Elevations	
Minimum (Headwater)	1,142.00 ft
Increment (Headwater)	0.50 ft
Maximum (Headwater)	1,149.00 ft

Outlet Connectivity

Structure Type	Outlet ID	Direction	Outfall	E1 (ft)	E2 (ft)
Irregular Weir	Sheet Pile	Forward	TW	1,145.00	1,149.00
Irregular Weir	Aux	Forward	TW	1,147.00	1,149.00
Tailwater Settings	Tailwater			(N/A)	(N/A)

Structure ID: Sheet Pile
Structure Type: Irregular Weir

Station (ft)	Elevation (ft)
0.00	4.00
12.00	0.00
77.00	0.00
89.00	4.00

Lowest Elevation	1,145.00 ft
Weir Coefficient	3.00 (ft^0.5)/s

Structure ID: Aux
Structure Type: Irregular Weir

Station (ft)	Elevation (ft)
0.00	2.00
8.00	0.00
58.00	0.00
66.00	2.00

Lowest Elevation	1,147.00 ft
Weir Coefficient	3.00 (ft^0.5)/s

Structure ID: TW
Structure Type: TW Setup, DS Channel

Tailwater Type	Free Outfall

Convergence Tolerances	
Maximum Iterations	30
Tailwater Tolerance (Minimum)	0.01 ft
Tailwater Tolerance (Maximum)	0.50 ft
Headwater Tolerance (Minimum)	0.01 ft
Headwater Tolerance (Maximum)	0.50 ft
Flow Tolerance (Minimum)	0.001 ft³/s
Flow Tolerance (Maximum)	10.000 ft³/s

IDALS - GUT813130A

Subsection: Outlet Input Data
Label: SheetPile
Scenario: Post-Development 50 year

Return Event: 50 years
Storm Event: 50 year

Requested Pond Water Surface Elevations	
Minimum (Headwater)	1,142.00 ft
Increment (Headwater)	0.50 ft
Maximum (Headwater)	1,149.00 ft

Outlet Connectivity

Structure Type	Outlet ID	Direction	Outfall	E1 (ft)	E2 (ft)
Irregular Weir	Sheet Pile	Forward	TW	1,145.00	1,149.00
Irregular Weir	Aux	Forward	TW	1,147.00	1,149.00
Tailwater Settings	Tailwater			(N/A)	(N/A)

Structure ID: Sheet Pile
Structure Type: Irregular Weir

Station (ft)	Elevation (ft)
0.00	4.00
12.00	0.00
77.00	0.00
89.00	4.00

Lowest Elevation	1,145.00 ft
Weir Coefficient	3.00 (ft^0.5)/s

Structure ID: Aux
Structure Type: Irregular Weir

Station (ft)	Elevation (ft)
0.00	2.00
8.00	0.00
58.00	0.00
66.00	2.00

Lowest Elevation	1,147.00 ft
Weir Coefficient	3.00 (ft^0.5)/s

Structure ID: TW
Structure Type: TW Setup, DS Channel

Tailwater Type	Free Outfall

Convergence Tolerances	
Maximum Iterations	30
Tailwater Tolerance (Minimum)	0.01 ft
Tailwater Tolerance (Maximum)	0.50 ft
Headwater Tolerance (Minimum)	0.01 ft
Headwater Tolerance (Maximum)	0.50 ft
Flow Tolerance (Minimum)	0.001 ft³/s
Flow Tolerance (Maximum)	10.000 ft³/s

IDALS - GUT813130A

Subsection: Outlet Input Data
Label: SheetPile
Scenario: Post-Development 100 year

Return Event: 100 years
Storm Event: 100 year

Requested Pond Water Surface Elevations	
Minimum (Headwater)	1,142.00 ft
Increment (Headwater)	0.50 ft
Maximum (Headwater)	1,149.00 ft

Outlet Connectivity

Structure Type	Outlet ID	Direction	Outfall	E1 (ft)	E2 (ft)
Irregular Weir	Sheet Pile	Forward	TW	1,145.00	1,149.00
Irregular Weir	Aux	Forward	TW	1,147.00	1,149.00
Tailwater Settings	Tailwater			(N/A)	(N/A)

IDALS - GUT813130A

Subsection: Outlet Input Data
Label: SheetPile
Scenario: Post-Development 100 year

Return Event: 100 years
Storm Event: 100 year

Structure ID: Sheet Pile
Structure Type: Irregular Weir

Station (ft)	Elevation (ft)
0.00	4.00
12.00	0.00
77.00	0.00
89.00	4.00

Lowest Elevation	1,145.00 ft
Weir Coefficient	3.00 (ft^0.5)/s

Structure ID: Aux
Structure Type: Irregular Weir

Station (ft)	Elevation (ft)
0.00	2.00
8.00	0.00
58.00	0.00
66.00	2.00

Lowest Elevation	1,147.00 ft
Weir Coefficient	3.00 (ft^0.5)/s

Structure ID: TW
Structure Type: TW Setup, DS Channel

Tailwater Type	Free Outfall

Convergence Tolerances	
Maximum Iterations	30
Tailwater Tolerance (Minimum)	0.01 ft
Tailwater Tolerance (Maximum)	0.50 ft
Headwater Tolerance (Minimum)	0.01 ft
Headwater Tolerance (Maximum)	0.50 ft
Flow Tolerance (Minimum)	0.001 ft³/s
Flow Tolerance (Maximum)	10.000 ft³/s

IDALS - GUT813130A

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ALLENDER BUTZKE ENGINEERS INC.
GEOTECHNICAL • ENVIRONMENTAL • CONSTRUCTION Q. C.

MARCH 31, 2022 **PN 221103**

GEOTECHNICAL EXPLORATION

BREAKPOINT WETLAND
140TH STREET AND HWY 25
GUTHRIE COUNTY, IA

PERFORMED FOR

SHIVE-HATTERY
4125 WESTOWN PARKWAY, SUITE 100
WEST DES MOINES, IA 50266

3660 109TH STREET • URBANDALE, IOWA 50322 • PHONE 515-252-1885 • FAX 515-252-1888

ALLENDER BUTZKE ENGINEERS INC.
GEOTECHNICAL • ENVIRONMENTAL • CONSTRUCTION Q. C.

March 31, 2022

Shive-Hattery
4125 Westown Parkway, Suite 100
West Des Moines, IA 50266
Attn: Mr. Daniel Jensen, P.E.

RE: Geotechnical Exploration
Breakpoint Wetland
140th Street and Hwy 25
Guthrie County, IA
PN 221103

Dear Mr. Jensen:

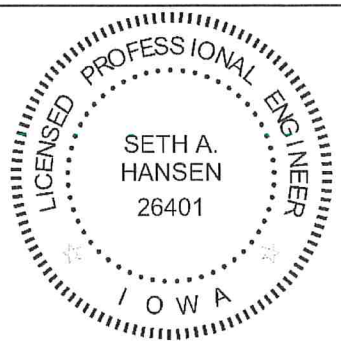
As authorized by you, Allender Butzke Engineers Inc. (ABE) has completed the geotechnical exploration for the above referenced project. The geotechnical exploration was conducted to evaluate physical characteristics of subsurface conditions with respect to design and construction of this project. The enclosed report summarizes the project characteristics as we understand them, presents the findings of the borings and laboratory tests, discusses the observed subsurface conditions, and provides geotechnical engineering recommendations for this project.

We appreciate the opportunity to provide our geotechnical engineering services for this project. If you have any questions or need further assistance, please contact us at your convenience. We are also staffed and equipped to provide construction testing and inspection services on this project as well as environmental site assessments.

Respectfully submitted,
ALLENDER BUTZKE ENGINEERS INC.

Abigail Ellerman, E.I.
Staff Engineer

Seth Hansen, P.E.
Project Engineer



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.

3/31/2022

Seth A. Hansen, P.E. License Number 26401 Date

My license renewal date is December 31, 2023.

Pages covered by this seal: All Pages.

1 PC and Email Above

GEOTECHNICAL EXPLORATION

BREAKPOINT WETLAND
140TH STREET AND HWY 25
GUTHRIE COUNTY, IA

PN 221103

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GEOTECHNICAL EXPLORATION

BREAKPOINT WETLAND
140TH STREET AND HWY 25
GUTHRIE COUNTY, IA

PN 221103

March 31, 2022

PROJECT INFORMATION

Plans are being developed by Shive-Hattery (Shive) for construction of a new wetland located southwest of the intersection of 140th street and Highway 25 in Guthrie County, Iowa. According to preliminary plans provided by Shive, the proposed wetland will be dammed utilizing a soil embankment and a sheet pile weir wall. The top of the dam embankment will be near elevation 1,149 feet and the bottom of the plunge pool will be near elevation 1,140 feet. The proposed embankment will require maximum fill thicknesses of up to 8 feet. Grading for the plunge pool will require excavations on the order of 3 feet or less. The following Figure No. 1 depicts the concept plan for the new wetland.

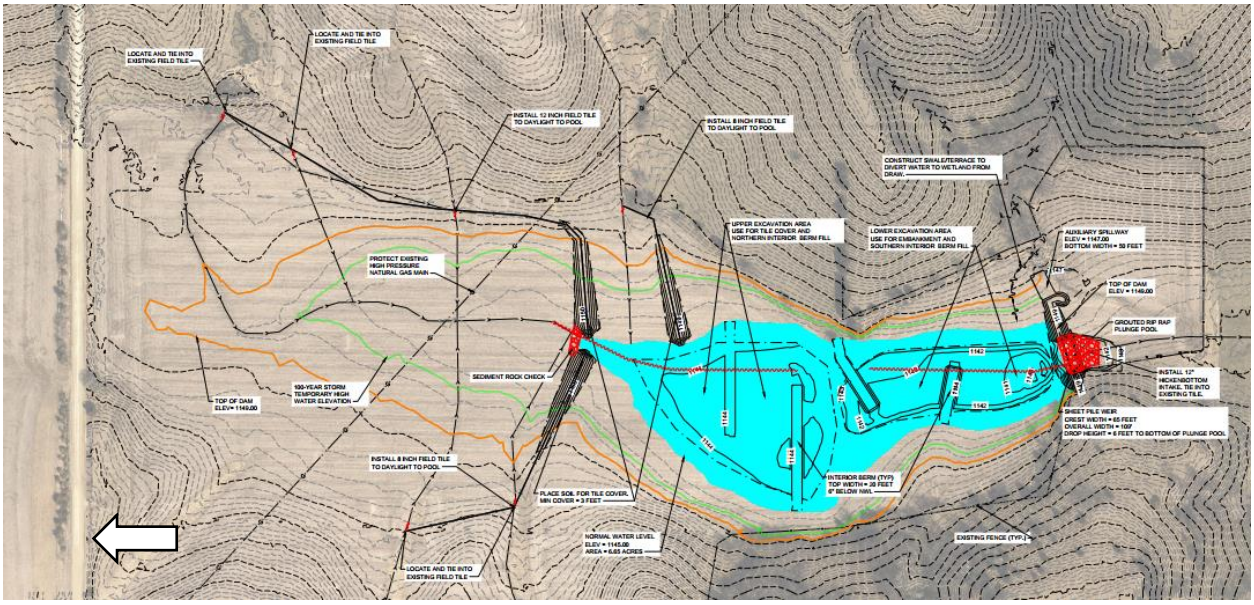


Figure No. 1 – Wetland Site Plan Concept (Shive)

FIELD EXPLORATION

Four borings were conducted at this site to depths between 10 and 20 feet below existing grades on March 3, 2022. Approximate locations of the borings are shown on the enclosed Site Plan. Boring locations and ground surface elevations were determined by ABE using GPS survey equipment. The boring surface elevations, indicated on the enclosed Boring Logs, were Iowa Real-Time Network (RTN) derived. Methods of drilling, sampling, standard laboratory testing, and classifying of subsurface materials are discussed in the Boring Log Description/Legend pages of the Appendix.

SUBSURFACE CONDITIONS

Soil Profile

Detailed descriptions of soils encountered by this exploration are provided on the Boring Logs enclosed in the Appendix. The Profile of Borings (Plate A-1) presented in the Appendix depicts the relative deposit elevations in the borings. Unless otherwise indicated, the depths of soil stratum and groundwater levels are referenced from below the top of existing ground at the individual boring locations at the time of drilling.

Cohesive Alluvium – Very dark gray lean to fat clay (CL-CH) cohesive alluvium with varying amounts of sand was encountered at ground surface in each of the borings. The moist and medium stiff to stiff cohesive alluvium extended to depths of 4 to 18.5 feet in Boring Nos. 1, 2 and 4. Boring No. 3 terminated in the cohesive alluvium near a depth of 10 feet.

Granular Alluvium – Brown-gray clayey sand (SC) granular alluvium underlaid the cohesive alluvium in Boring No. 1. Boring No. 1 terminated in the loose saturated granular alluvium at a depth of 20 feet.

Wisconsinan Glacial Till – Dark brown sandy lean clay (CL) Wisconsinan glacial till was encountered underlying the cohesive alluvium in Boring No. 2. The moist and soft to medium stiff Wisconsinan glacial till extended to a depth of 13.5 feet.

Bedrock – Brown and brown-gray sandstone was encountered in Boring No. 2 underlying the Wisconsinan glacial till and in Boring No. 4 underlying the cohesive alluvium. Boring Nos. 2 and 4 terminated in the damp to moist and hard sandstone bedrock near depths of 15 and 20 feet.

Groundwater Level Observations

The borings were monitored during and shortly after drilling operations to detect moisture seepage and groundwater accumulation. The results of our groundwater level observations are noted on the Boring Logs enclosed in the Appendix.

During drilling operations, moisture seepage was noted near a depth of 11.5 feet below existing grade in Boring No. 2. Groundwater accumulation was observed between depths of 12 and 18.5 feet in Boring Nos. 1 and 2 at the completion of drilling operations while no groundwater accumulation was observed in the remaining borings. These short-term water levels are not necessarily a true indication of the groundwater table. Long-term observations would be necessary to accurately define the groundwater variations at this site. Fluctuation of groundwater levels can occur due to seasonal variations in the amount of rainfall, surface drainage, subsurface drainage, site topography, irrigation practices, and ground cover (pavement or vegetation).

ANALYSES AND RECOMMENDATIONS

Site Preparation

Site grading will include maximum fill thicknesses of up to 8 feet for the proposed embankment and excavations on the order 3 feet or less for the plunge pool. Prior to earthwork construction at this site, including excavations and embankment fill placement, the organic and loose materials in addition to all vegetation must be stripped. We expect that a minimum stripping depth of 6 inches may be required. Stripping depths may vary due to localized variations in vegetation cover and subgrade stability and deeper stripping may be necessary to remove soft accumulated sediment or thicker organic zones. Existing slopes to receive fill should be adequately benched and deeply scarified to integrate the new fill sections with the existing terrain. The subgrade should then be proof-rolled to delineate zones of soft soils present near the surface which may require additional removal or compaction.

Plans indicate field tile is present at this site and is a part of a larger system up-gradient of the site. The concept plan indicates the existing drain tile will be intercepted and re-routed to daylight into the wetland. A map of the field drain tile at this site and adjoining sites may be on file with Guthrie County and would be helpful in determining the extent of field tile at this site and connecting up-gradient sites which could impact construction.

Soft surface soils, easily disturbed by construction traffic, may be encountered near the low lying drainageways on the site and not provide a stable base for compacted fill at the time of construction, especially if groundwater levels are high and soils are wet. On past projects where unstable subgrade soils have created difficulties placing and compacting fill over existing drainageways and wet areas, temporary diversion ditches or subsurface drainlines have improved conditions by lowering groundwater levels and improving support.

Site Grading and Borrow Material

Our laboratory testing program included performing Standard Proctor (ASTM D698) tests of representative soil samples of the cohesive alluvium collected from Boring No. 3 conducted within the proposed wetland area between depths of 1 and 5 feet and between depths of 5 and 10 feet. Results of these soils laboratory tests are provided in Figures PR-1 and PR-2 in the Appendix.

As indicated on Figure PR-1 located in the Appendix, the maximum dry density for the cohesive alluvium between depths of 1 and 5 feet is 93.8 pounds per cubic foot (pcf). Due to this sample's low maximum dry density (less than 95 pcf), this material would be considered unsuitable subgrade material according to the Iowa Department of Transportation (DOT) and Iowa Statewide Urban Design and Specifications (SUDAS) which recommends soils with densities less than 95 pcf not be used within 3 feet of subgrade. The Standard Proctor results indicate the sample collected between depths of 5 and 10 feet (PR-2) has a maximum dry density of 99.9 pcf and would be considered suitable according to the Iowa DOT and Iowa SUDAS specifications.

It is our understanding the dam will not be constructed using Iowa DOT or Iowa SUDAS specifications and may be constructed using NRCS or other construction specifications which don't specify minimum density criteria. Considering the relatively low height of the dam and the proposed slopes of 4:1 (H:V) the lean to fat clay (CL-CH) cohesive alluvium soils encountered in this exploration may be used as compacted fill for the embankment construction. Strippings removed during *Site Preparation* would be unsuitable for compacted fill for the dam and should be wasted in non-critical fill areas. The following Table A lists recommended minimum compaction requirements for cohesive and cohesionless fill materials in specific applications.

TABLE A
RECOMMENDED DEGREE OF COMPACTION GUIDELINES

Construction Application	Standard Proctor (ASTM D698) Cohesive Soil	Standard Proctor (ASTM D698) Cohesionless Soil	*Relative Density (D4253 & D4254) Cohesionless Soil
Class 1	95%	98%	70%
Class 2	90%	93%	45%
Class 3	85%	88%	20%

Class 1 - Subgrade for building foundations, slabs-on-grade, pavements and other critical backfill areas.
Class 2 - Backfill adjacent to structures not supporting other structures - Minor subsidence possible.
Class 3 - Backfill in non-critical areas - Moderate subsidence possible.

*Use Relative Density technique (ASTM D4253 & D4254) where Standard Proctor technique (ASTM D698) does not result in a definable maximum dry density and optimum moisture content.

The on-site soils can be excavated utilizing conventional excavation equipment. Granular soils can generally be suitably compacted with vibratory compaction equipment whereas cohesive soils are more suitable for compaction with sheepsfoot or pneumatic type compactors.

Fill materials for embankments constructed at this site should be placed at moisture contents within a range of 0 to +4 of the material's optimum water content. At the time of this geotechnical exploration, moisture contents of the natural cohesive soil deposits were generally near or above the recommended moisture content range for compaction. Depending on climatic conditions prior to and during construction activities, adjustment of soil moisture content may be required in order to lower or raise the moisture to within the recommended moisture content range for compaction purposes. Discing and aeration is generally the most economical method to lower soil moisture content, if climatic conditions allow. Chemical modification of very moist soils should not be used to dry soils for embankment construction.

Excavation Stability and Dewatering

Boring information indicates that shallow excavations (5 feet or less) at the site will encounter predominately cohesive soils. Interbedded wet sand seams or sand layers are commonly encountered within Wisconsinan glacial till deposits and may be encountered in excavations deeper than 4 feet near and west of Boring No. 2. If excavations encounter only cohesive soils with

no wet sand seams or layers, it is expected that the water seepage can be controlled by permitting it to drain into temporary construction sumps and be pumped outside the perimeter of the excavations. More extensive dewatering such as sand points and wells may be required for excavations which extend down into water bearing sand layers. We recommend that prior to excavating in saturated sand, water levels be lowered and maintained 2 feet or more below the bottom of excavations to prevent upward seepage forces which could reduce subgrade support.

The extent of bracing or sloping of open cut excavations will be dependent upon depth of cut, groundwater conditions, soils encountered, length of time the excavation will be open, area available for excavation and local governing regulations. Predominately cohesive soils may appear to stand nearly vertical in shallow excavations for short periods of time. However, soil creep, surcharge loads, precipitation, subsurface moisture seepage, construction activity vibrations and other factors may cause these soils to cave within an unpredictable period of time. Excavations encountering sand may tend to cave rapidly, especially if water is flowing through the sand. Unstable granular excavation walls may also cause surrounding cohesive soils to become unstable. Temporary shoring, flattening of the excavation slopes or use of trench boxes may be required to maintain a safe condition. Determining the appropriate OSHA classifications of the soil types encountered and implementing the required provisions for sloping, shoring, and bracing of excavations throughout the project during construction are the responsibility of the contractor per OSHA.

Earth Dam Embankment

Grading plans indicate that the dam embankment will be constructed with slopes of 4:1 (H:V). We understand that slopes adjacent to the weir wall will be constructed steeper and will be covered with grouted riprap revetment. In our opinion, embankment fill slopes on the order of 8 feet in total height and constructed at the proposed configurations will remain long-term stable.

Suitable toe support will be important to maintain stability of the proposed 4:1 (H:V) fill slopes. Soft cohesive alluvium, or sediment that may be present at the surface in lower lying areas could pose a concern to long term stability of fill slopes constructed in these areas, especially if the soils become soft and wet at the time of construction. As discussed in the *Site Preparation* section of this report, soft or loose sediment should be over-excavated and stripped during site preparation. If wet conditions are encountered in the drainageway or at the toe of proposed fill slopes at the time of construction, it may be necessary to install temporary diversion ditches or subsurface drain lines to provide a stable base for compacted fill and improve toe support for proposed fill slopes.

We recommend that a key trench be installed below the center of the embankment in order to integrate the embankment into the underlying soils and provide discontinuity for any shallow flow of water below the embankment. The key trench should have a minimum bottom width on the order of 6 feet with side slopes no steeper than 1:1 (horizontal to vertical), extend a minimum of 3 feet below existing grades, and extend up the abutments to 2 feet below the top of the dam elevations or elevation 1147 feet. The key trench should be backfilled with cohesive soils, free of organics and sand seams, such as the onsite lean to fat clay (CL-CH) cohesive alluvium. Cohesive backfill should be compacted to a minimum of 95 percent if the material's maximum dry density at a moisture content of +1 to +4 percent of optimum moisture content. A key trench will not be necessary where the sheet pile weir wall will be established.

The Soil Boring Exhibit provided by Shive indicates an outlet pipe will be installed near the west abutment. Care should be exercised to properly backfill around outlet pipes extending through the embankments, especially pipes that exit the embankment below the high-water level. Also, properly backfilling around weir outlet structures will be required to avoid undesired seepage paths around the structures. If proper compaction cannot be achieved, a bentonite seal should be placed around the structures to reduce the risk of leakage around the pipe.

Lateral Earth Pressures

In our opinion, the overburden cohesive alluvium and glacial till soils above the sandstone bedrock would be conducive to sheet pile installation; however, the hard sandstone will inhibit sheet pile installation. If the sheet pile cannot generate sufficient toe support from the overburden cohesive soils, then tie backs may be an option. Another option could be to construct a cast-in-place reinforced concrete weir instead of a sheet pile. We are available to provide foundation recommendations for a cast-in-place wall if desired.

Sheet pile walls built to retain soil and water should be designed to accommodate unbalanced lateral earth and hydrostatic pressures. Estimated lateral earth pressures for the soil types encountered in the test borings are presented in the following Table B. We would be available to further discuss specific backfill types and soil parameters as requested if different soil types are encountered.

TABLE B
LATERAL EARTH PRESSURE PARAMETERS

Formation	Friction Angle, φ	Cohesion[1], c (psf)	Wet Unit Weight, γ (pcf)	Saturated Unit Weight[2], γ_{sat} (pcf)	K_{active}[3]	$K_{passive}$[3]
New Fill, Cohesive Alluvium, Glacial Till	18°	400	115	120	0.53	1.89
Clean Sand	30°	0	120	125	0.33	3.00
Clean Crushed Rock	40°	0	120	125	0.22	4.60

1) Ignore cohesion above frost depth
2) Excludes buoyancy due to hydrostatic pressure (water @ 62.4 pounds per cubic foot (pcf))
3) Assumes no safety factor, negligible wall friction, vertical wall, level backfill, zero surcharge loads, and ignores cohesion shear strength.

Based on the subsurface profile encountered near the weir in the borings, we anticipate driven sheet pile wall sections will extend into the cohesive alluvium and the Wisconsinan glacial till. Typically, these natural soils provide an adequate seal to resist water seepage around the sheet pile walls and should remain stable with respect to water seepage forces and piping.

Active earth pressure design assumes that the wall can rotate and deflect at the top. If the wall is rigidly fixed, higher lateral earth pressures will develop against the wall and at-rest pressure parameters should be used for design. Increased earth pressures can also develop from backfill. Expansive materials (CH), either natural or backfill, should not be within 3 feet of below grade walls.

GENERAL

The analyses and recommendations in this report are based in part upon the data obtained from the soil borings performed at the indicated locations and from any other information discussed in this report. This report does not reflect any variations which may occur between borings or across the site. The nature and extent of such variations may not become evident until

construction. If variations then appear evident, it will be necessary to reevaluate the recommendations of this report.

It is recommended that the geotechnical engineer be provided the opportunity to review the plans and specifications so that comments can be made regarding the interpretation and implementation of our geotechnical recommendations in the design and specifications. It is further recommended that the geotechnical engineer be retained for testing and observation during earthwork and foundation construction phases to help determine that the design requirements are fulfilled.

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranty, expressed or implied, is made. In the event that any changes in the nature, design or location of the project as outlined in this report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and the conclusions of this report modified or verified in writing by the geotechnical engineer.

The scope of our service was not intended to include any environmental assessment or exploration for the presence of hazardous or toxic materials in the soil, surface water, groundwater or air on, below or adjacent to this site.

APPENDIX

BORING LOG DESCRIPTION/LEGEND

The material types encountered during the drilling operations were recorded on field logs. The profile represented on the Boring Log is based on final classification performed by a geotechnical engineer using the field logs, laboratory observation and testing. The material stratigraphy demarcation lines shown on the Boring Logs indicate changes in soil characteristics, however, actual soil changes or variations may occur as a gradual transition. Soil profile discussion, Log Boring information, water levels and recommendations presented in this report are based upon measured depths below ground levels existing at time of the field exploration, unless otherwise specified.

DRILLING AND SAMPLING

The borings were conducted with either a truck or all-terrain rotary drill rig using the drilling methods indicated on each Boring Log. Soil sampling and/or in-situ testing such as Shelby Tube (ST), split-spoon (SS), drive cone (DC), or core (C) was conducted at depth intervals which were selected in consideration of the characteristics of the proposed construction. Generally undisturbed soil samples are taken at 5 foot depth intervals or change in soil types. Disturbed soil samples from the auger, either jar size or bulk size samples, may be taken at intermediate intervals for the purpose of soil classification or laboratory testing. Borings conducted for soil classification only, will show no designation of sampling although disturbed sampling is performed. Soil samples obtained in the field were identified and sealed for transportation to the laboratory for performance of pertinent physical testing and engineering classification.

Drilling Methods

CFA - Continuous Flight Auger: 4, 6, or 8-inch diameter (ASTM D1452).
RD - Rotary Drilling: Using drilling fluid in cased or uncased boring (ASTM D2113).
HSA - Hollow Stem Auger: 6 or 8-inch diameter, continuous flight auger remains in boring with soil removed from the hollow stem through which undisturbed sampling is conducted.
HA - Hand Auger: 4-inch or less diameter.

Sample Types

ST - Shelby Tube: Thin-walled tube samples of cohesive soils (ASTM D1587).
SS - Split Spoon with 140 lb. manual hammer: Standard penetration test and split-barrel samples (ASTM D1586).
SSA - Split Spoon with 140 lb. automatic hammer: Standard penetration test and split-barrel samples (ASTM D1586).
DC - Drive Cone: Dynamic in-place testing of soil using a 2-inch diameter cone with a 60 degree point driven into the soil for continuous 1-foot intervals in the same manner as Split Spoon, no sample is obtained.
C - Core: Sampling hard soil or bedrock with a diamond core barrel in a rotary drill boring (ASTM D2113).
SPT - Standard Penetration Test: Number of blows required to drive sampler (split spoon or drive cone) into the soil with a 140-pound weight dropping a distance of 30-inches (ASTM D1586), number of blows recorded for each 6-inch interval in an 18-inch (or more) penetration depth, values shown are for each 6-inch interval (if series of number sets are shown) or a total of the last two 6-inch intervals (if only one number is shown) which is commonly referred to as "N" in blows per foot. High resistance is indicated by a high number of blows for a lesser penetration depth listed in inches.
BS - Bulk Sample: Disturbed.
CPT - Cone Penetration Test: Quasi-static in-place testing of soils using a 60 degree cone and friction sleeve which are steadily pushed into the soil and measure skin friction and end bearing (ASTM D3441).

STANDARD LABORATORY TESTING

Representative undisturbed soil samples obtained by the Shelby Tube sampler were tested for moisture content (ASTM D2216), density (dry) and unconfined compressive strength (ASTM D2166) in the laboratory. Results of these tests appear on the respective Boring Logs. Additional soil testing including particle size analysis (ASTM D422) and Atterberg Limits (ASTM D4318) may be conducted, if necessary, to define in more detail pertinent soil characteristics for classification in accordance with the Unified Soil Classification System. Specialized laboratory tests (if conducted) to determine pertinent soil characteristics are discussed in the "Laboratory Testing" section of the report.

WATER LEVEL MEASUREMENT

Water levels indicated on the Boring Logs are the levels measured in the borings at the times indicated. In pervious soils, the indicated levels may reflect the location of groundwater. In low permeability soils, the accurate determination of groundwater levels is not possible with short term observations.

BORING LOG DESCRIPTION/LEGEND

(page 2 of 3)

DESCRIPTIVE SOIL CLASSIFICATION

Soil description is based on the Unified Classification System as outlined in ASTM Designations D-2487 and D-2488. This classification is primarily based upon visual and apparent physical soil characteristics, comparison with other soil samples, and our experience with the soil. Additional laboratory testing may be conducted, if necessary to define in more detail pertinent soil characteristics. The Unified Soil Classification group symbol shown on the boring logs corresponds with the group names listed below. The description includes soil constituents, moisture conditions, color and any other appropriate descriptive terms.

Group Symbol	Group Name	Group Symbol	Group Name	Group Symbol	Group Name	Group Symbol	Group Name
GW	Well-Graded Gravel	SW	Well-Graded Sand	CL	Lean Clay	CH	Fat Clay
GP	Poorly-Graded Gravel	SP	Poorly-Graded Sand	ML	Silt	MH	Elastic Silt
GM	Silty Gravel	SM	Silty Sand	OL	Organic Clay Organic Silt	OH	Organic Clay Organic Silt
GC	Clayey Gravel	SC	Clayey Sand			PT	Peat

RELATIVE PROPORTIONS			GRAIN SIZE TERMINOLOGY	
Descriptive Term(s) (Of components also present in sample)	Sand and Gravel % of Dry Weight	Fines % of Dry Weight	Major Component of Sample	Size Range
Trace	<15	<5	Cobbles	12 in. to 3 in. (300mm to 75mm)
With	15-30	5-12	Gravel	3 in. to #4 sieve (75mm to 4.75mm)
Modifier	>30	>12	Sand	#4 to #200 sieve (4.75mm to 0.074mm)
			Silt or Clay	Passing #200 sieve (.074 mm)

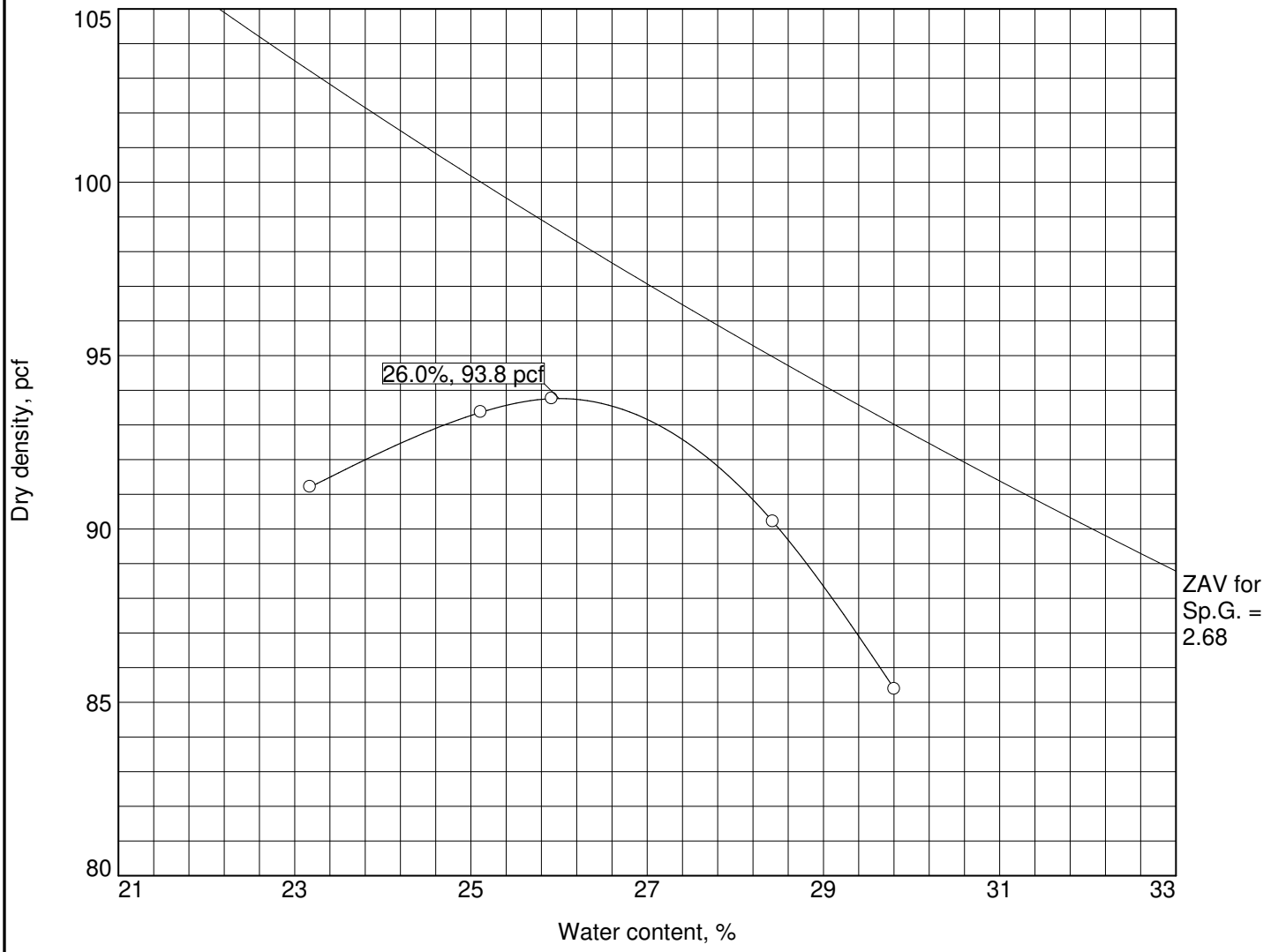
CONSISTENCY OF FINE-GRAINED SOILS			RELATIVE DENSITY OF COARSE-GRAINED SOILS	
Unconfined Compressive Strength, Qu, psf	Consistency	SPT, bpf	SPT, bpf	Relative Density
< 500	Very Soft	0-2	0-4	Very Loose
500-1,000	Soft	2-4	4-10	Loose
1,000-2,000	Medium Stiff	4-8	10-30	Medium Dense
2,000-4,000	Stiff	8-15	30-50	Dense
4,000-8,000	Very Stiff	15-30	50-80	Very Dense
8,000-16,000	Hard	30-100	80+	Extremely Dense
> 16,000	Very Hard	>100		

BORING LOG DESCRIPTION/LEGEND

ABBREVIATIONS

COMMONLY USED ABBREVIATIONS	
ft. or ' - feet	elev. - Elevation
in. or " - inches	% - Percent
psf - pounds per square foot	No. - Number
plf - pound per lineal foot	TB - Test Boring
pcf - pounds per cubic feet	N - blow count (SPT, bpf)
kip - 1000 pounds	USCS - Unified Soil Classification System
ksf - 1000 pounds per square foot	LL - Liquid Limit
klf - 1000 pounds per lineal foot	PL - Plastic Limit
tsf - tons per square foot	PI - Plasticity Index
bpf - blows per foot (SPT, N)	

PROCTOR TEST REPORT



Test specification: ASTM D 698-12 Method A Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > #4	% < No.200
	USCS	AASHTO						
1'-5'	CL-CH							

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 93.8 pcf Optimum moisture = 26.0 %	Very dark gray lean to fat clay

Project No. 221103 **Client:** Shive-Hattery

Project: Breakpoint Wetland - Guthrie County, Iowa

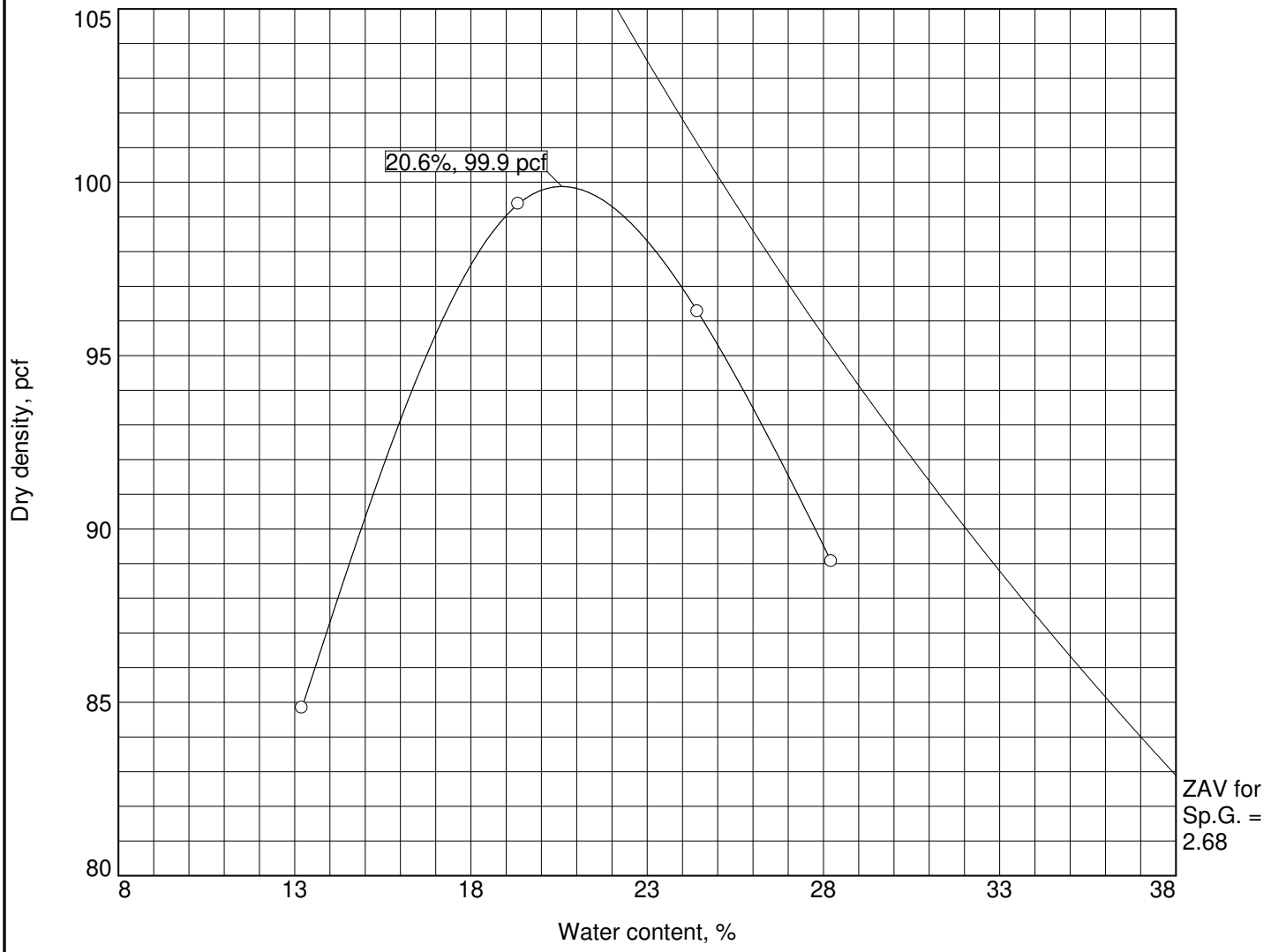
○**Location:** Boring No. 3

Remarks:
Cohesive Alluvium

ALLENDER BUTZKE ENGINEERS, INC.

Figure PR-1

PROCTOR TEST REPORT



Test specification: ASTM D 698-12 Method A Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > #4	% < No.200
	USCS	AASHTO						
5'-10'	CL-CH							

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 99.9 pcf Optimum moisture = 20.6 %	Very dark gray lean to fat clay

Project No. 221103 **Client:** Shive-Hattery

Project: Breakpoint Wetland - Guthrie County, Iowa

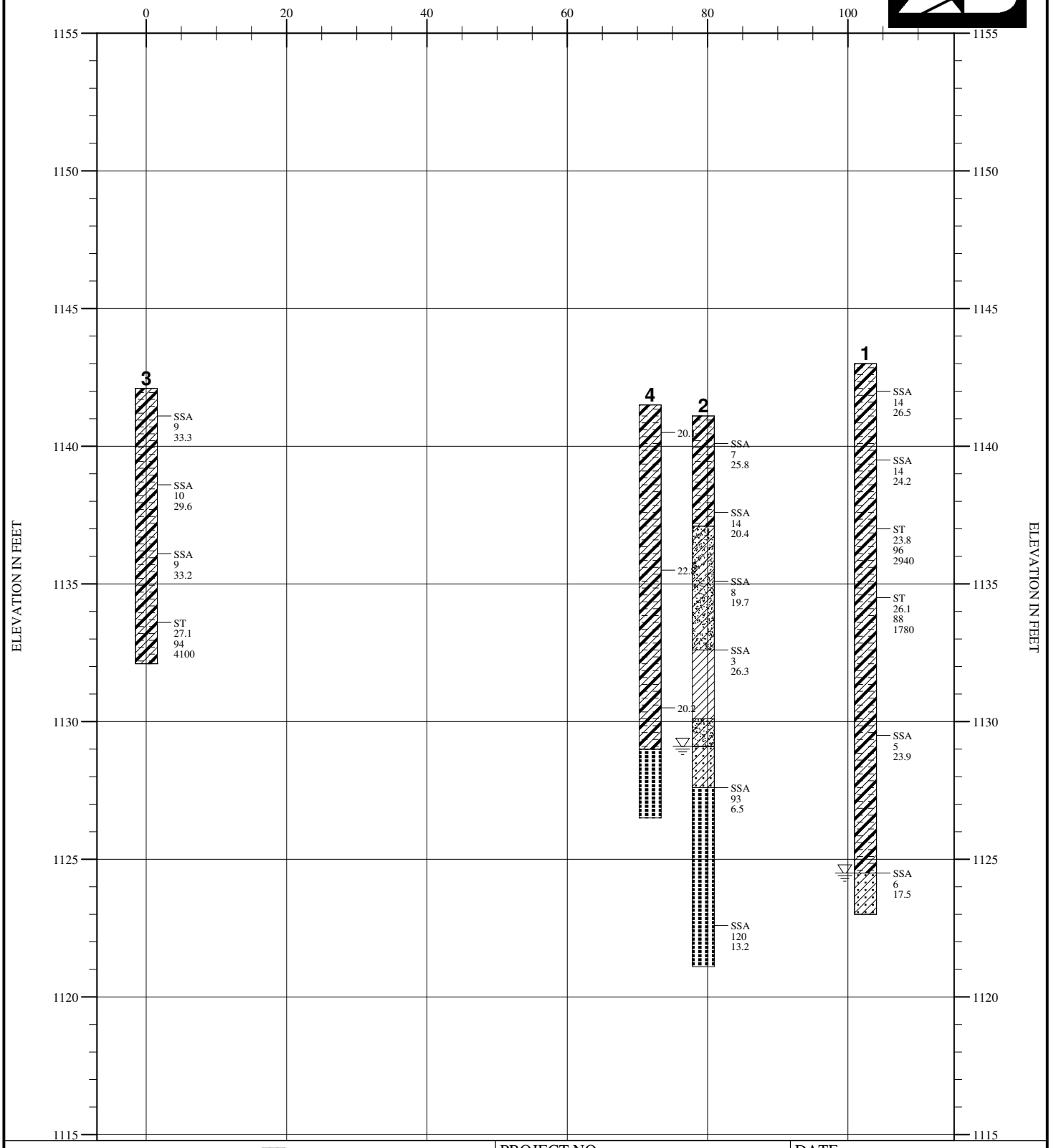
○**Location:** Boring No. 3

Remarks:
Cohesive Alluvium

ALLENDER BUTZKE ENGINEERS, INC.

Figure PR-2

PROFILE OF BORINGS



Strata symbols

- Lean to Fat Clay Alluvium
- Sandstone
- Sandy Lean Clay
- Lean Clay
- Clayey Sand

Misc. Symbols

- Water table at completion

PROJECT NO.: 221103	DATE: 3/9/2022
PROJECT: Breakpoint Wetland 140th Street and Hwy 25 Guthrie County, Iowa	
PLATE: A-1	SCALE: 5 feet/in.

ALLENDER BUTZKE ENGINEERS, INC.

BORING LOG NO. 1

Project No.: 221103

Project: Breakpoint Wetland
140th Street and Hwy 25
Guthrie County, Iowa

Client: Shive-Hattery
4125 Westown Parkway, Suite 100
West Des Moines, Iowa 50266

Surface Elevation: 1143.0'
Datum: Iowa RTN Derived

Date Drilled: 3/3/2022
Drilling Depth, ft.: 20

Drilling Method: 4" CFA
Page: 1 of 1

Elevation ft.	Depth ft.	Sample No.	Type	SPT bpf	Moisture Content, %	Dry Density pcf	Unconfined Compressive Strength psf	Material Description*	Graphic Log	USCS	Water Level	Depth / Elevation ft.
1142	0							Very dark gray lean to fat clay, trace sand, moist		CL-CH		
		1	SSA	14	26.5							
1140												
	4	2	SSA	14	24.2							
1138								Dark gray after 5.5'				
		3	ST		23.8	96	2940					
1136	8											
		4	ST		26.1	88	1780	**COHESIVE ALLUVIUM**				
1134												
1132	12											
1130												
		5	SSA	5	23.9			With sand after 14'				
1128												18.5
	16											
1126												
1124		6	SSA	6	17.5			Brown-gray clayey fine to medium sand, saturated **GRANULAR ALLUVIUM**		SC		1124.5
	20											20
1122								End of Boring				1123
1120												
	24											
1118												
1116												
	28											

*The stratification lines represent the approximate boundary lines between material types: in-situ, the transition may be gradual.

Water Level Observation

Time: at completion _____ hrs. _____ days

Depth to water: 18.5 ft. ▽ _____ ft. ▼ _____ ft. ▼

ALLENDER BUTZKE ENGINEERS, INC.

Geotechnical | Environmental | Construction Q.C.

BORING LOG NO. 2

Project No.: 221103

Project: Breakpoint Wetland
140th Street and Hwy 25
Guthrie County, Iowa

Client: Shive-Hattery
4125 Westown Parkway, Suite 100
West Des Moines, Iowa 50266

Surface Elevation: 1141.1'
Datum: Iowa RTN Derived

Date Drilled: 3/3/2022
Drilling Depth, ft.: 20

Drilling Method: 4" CFA
Page: 1 of 1

Elevation ft.	Depth ft.	Sample No.	Type	SPT bpf	Moisture Content, %	Dry Density pcf	Unconfined Compressive Strength psf	Material Description*	Graphic Log	USCS	Water Level	Depth / Elevation ft.
1140	0	1	SSA	7	25.8			Very dark gray lean to fat clay with sand, moist **COHESIVE ALLUVIUM**		CL-CH		4
1136	4	2	SSA	14	20.4			Dark brown sandy lean clay, trace gravel, moist		CL		1137.1
1134		3	SSA	8	19.7			Brown after 7.5'				
1132	8	4	SSA	3	26.3			Brown lean clay, very moist after 8.5' **WISCONSINAN GLACIAL TILL**		CL		
1130								Very sandy after 11'				
1128	12							Moisture seepage near 11.5' Dark brown clayey fine to medium sand, trace gravel, saturated after 12'		SC	▽	13.5
1126		5	SSA	93	6.5			Brown sandstone, moist **BEDROCK**				1127.6
1124	16											
1122		6	SSA	120	13.2							20
1120	20							End of Boring				1121.1
1118												
1116	24											
1114												
	28											

*The stratification lines represent the approximate boundary lines between material types: in-situ, the transition may be gradual.

Water Level Observation
Time: at completion _____ hrs. _____ days
Depth to water: 12 ft. ▽ _____ ft. ▽ _____ ft. ▽

ALLENDER BUTZKE ENGINEERS, INC.
Geotechnical | Environmental | Construction Q.C.

BORING LOG NO. 3

Project No.: 221103

Project: Breakpoint Wetland
140th Street and Hwy 25
Guthrie County, Iowa

Client: Shive-Hattery
4125 Westown Parkway, Suite 100
West Des Moines, Iowa 50266

Surface Elevation: 1142.1'
Datum: Iowa RTN Derived

Date Drilled: 3/3/2022
Drilling Depth, ft.: 10

Drilling Method: 4" CFA
Page: 1 of 1

Elevation ft.	Depth ft.	Sample No.	Type	SPT bpf	Moisture Content, %	Dry Density pcf	Unconfined Compressive Strength psf	Material Description*	Graphic Log	USCS	Water Level	Depth / Elevation ft.
1142	0							Very dark gray lean to fat clay, moist		CL-CH		
		1	SSA	9	33.3							
1140												
1138	4	2	SSA	10	29.6							
								COHESIVE ALLUVIUM				
1136												
		3	SSA	9	33.2							
1134	8											
		4	ST		27.1	94	4100					10
1132								End of Boring				1132.1
1130	12											
1128												
1126	16											
1124												
1122	20											
1120												
1118	24											
1116												
1114	28											

*The stratification lines represent the approximate boundary lines between material types: in-situ, the transition may be gradual.

Water Level Observation

Time: at completion _____ hrs. _____ days

Depth to water: **Dry** ft. _____ ft. _____ ft.

ALLENDER BUTZKE ENGINEERS, INC.

Geotechnical | Environmental | Construction Q.C.

BORING LOG NO. 4

Project No.: 221103

Project: Breakpoint Wetland
140th Street and Hwy 25
Guthrie County, Iowa

Client: Shive-Hattery
4125 Westown Parkway, Suite 100
West Des Moines, Iowa 50266

Surface Elevation: 1141.5'
Datum: Iowa RTN Derived

Date Drilled: 3/3/2022
Drilling Depth, ft.: 15

Drilling Method: 4" CFA
Page: 1 of 1

Elevation ft.	Depth ft.	Sample No.	Type	SPT bpf	Moisture Content, %	Dry Density pcf	Unconfined Compressive Strength psf	Material Description*	Graphic Log	USCS	Water Level	Depth / Elevation ft.
1140	0				20.1			Very dark gray lean to fat clay, moist		CL-CH		
1138	4											
1136					22.8			**COHESIVE ALLUVIUM**				
1134	8							Sandy after 8'				
1132												
1130	12				20.2			Very sandy after 11'				12.5
1128								Brown-gray sandstone, damp **BEDROCK**				1129 15
1126	16							End of Boring				1126.5
1124												
1122	20											
1120												
1118	24											
1116												
1114	28											

*The stratification lines represent the approximate boundary lines between material types: in-situ, the transition may be gradual.

Water Level Observation
Time: at completion _____ hrs. _____ days
Depth to water: **Dry** ft. _____ ft. _____ ft.

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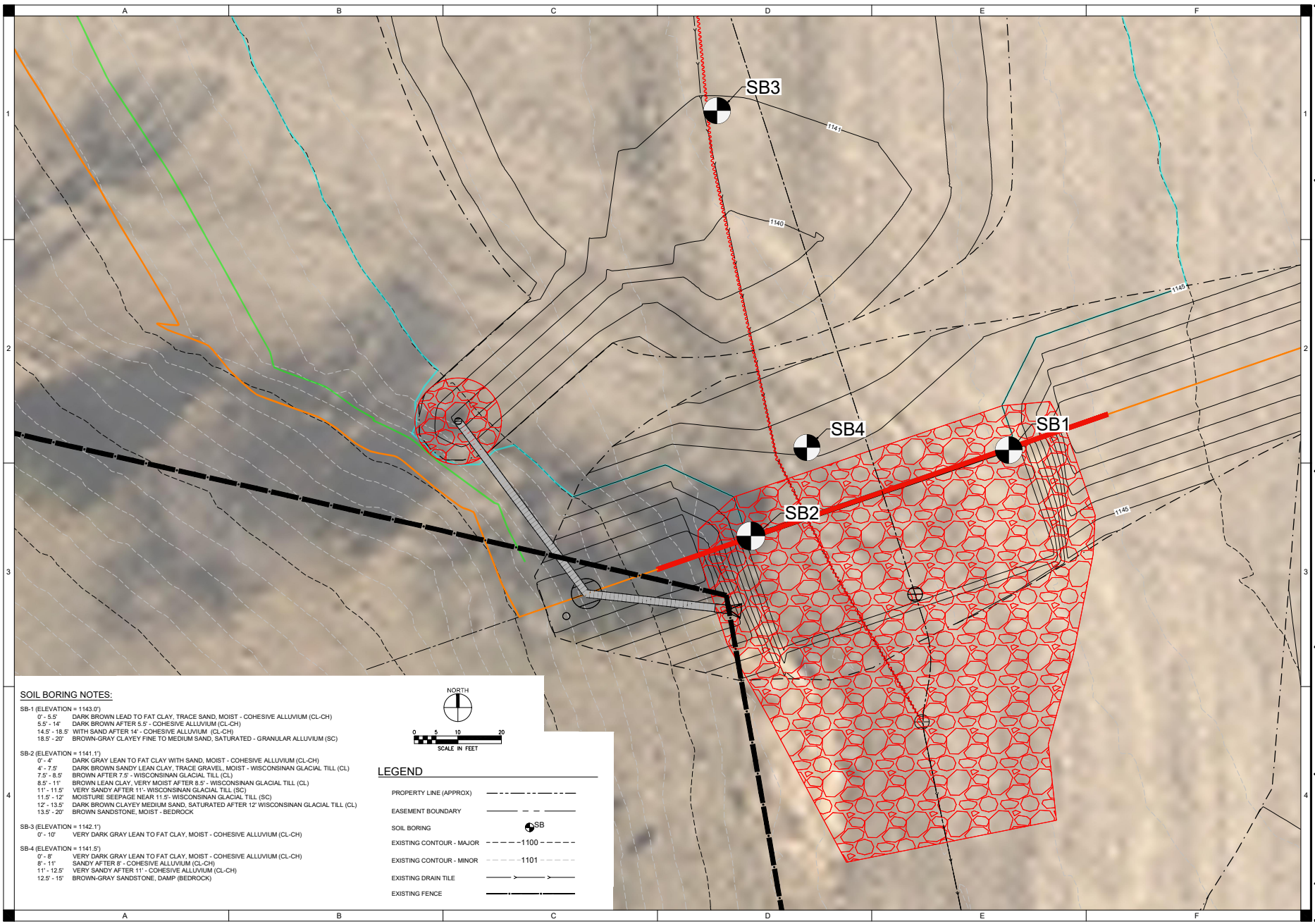
Geotechnical | Environmental | Construction Q.C.



SOIL BORING NOTES:

SB-1 (ELEVATION = 1143.0')
- 0' - 5.5' DARK BROWN LEAD TO FAT CLAY, TRACE SAND, MOIST - COHESIVE ALLUVIUM (CL-CH)
- 5.5' - 14' DARK BROWN AFTER 5.5' - COHESIVE ALLUVIUM (CL-CH)
- 14.5' - 18.5' WITH SAND AFTER 14' - COHESIVE ALLUVIUM (CL-CH)
- 18.5' - 20' BROWN-GRAY CLAYEY FINE TO MEDIUM SAND, SATURATED - GRANULAR ALLUVIUM (SC)

SB-2 (ELEVATION = 1141.1')
- 0' - 4' DARK GRAY LEAN TO FAT CLAY WITH SAND, MOIST - COHESIVE ALLUVIUM (CL-CH)
- 4' - 7.5' DARK BROWN SANDY LEAN CLAY, TRACE GRAVEL, MOIST - WISCONSINAN GLACIAL TILL (CL)
- 7.5' - 8.5' BROWN AFTER 7.5' - WISCONSINAN GLACIAL TILL (CL)
- 8.5' - 11' BROWN LEAN CLAY, VERY MOIST AFTER 8.5'- WISCONSINAN GLACIAL TILL (CL)
- 11' - 11.5' VERY SANDY AFTER 11'- WISCONSINAN GLACIAL TILL (SC)
- 11.5' - 12' MOISTURE SEEPAGE NEAR 11.5'- WISCONSINAN GLACIAL TILL (SC)
- 12' - 13.5' DARK BROWN CLAYEY MEDIUM SAND, SATURATED AFTER 12' WISCONSINAN GLACIAL TILL (CL)
- 13.5' - 20' BROWN SANDSTONE, MOIST - BEDROCK

SB-3 (ELEVATION = 1142.1')
- 0' - 10' VERY DARK GRAY LEAN TO FAT CLAY, MOIST - COHESIVE ALLUVIUM (CL-CH)

SB-4 (ELEVATION = 1141.5')
- 0' - 8' VERY DARK GRAY LEAN TO FAT CLAY, MOIST - COHESIVE ALLUVIUM (CL-CH)
- 8' - 11' SANDY AFTER 8' - COHESIVE ALLUVIUM (CL-CH)
- 11' - 12.5' VERY SANDY AFTER 11' - COHESIVE ALLUVIUM (CL-CH)
- 12.5' - 15' BROWN-GRAY SANDSTONE, DAMP (BEDROCK)

NORTH

0 5 10 20
SCALE IN FEET

LEGEND

- PROPERTY LINE (APPROX)
- EASEMENT BOUNDARY
- SOIL BORING (SB)
- EXISTING CONTOUR - MAJOR (1100)
- EXISTING CONTOUR - MINOR (1101)
- EXISTING DRAIN TILE
- EXISTING FENCE

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GUT813130A BREAKPOINT WETLAND

IOWA DEPARTMENT OF AGRICULTURE AND LAND STEWARDSHIP

GUTHRIE COUNTY, IA

PRELIMINARY - NOT FOR CONSTRUCTION

DRAWN: GHK
APPROVED: DJJ
ISSUED FOR: 90% PLANS
DATE: 03/22/2022
PROJECT NO: 421960
FIELD BOOK: –
CLIENT NO: GUT813130A

SOIL BORING EXHIBIT

EX02

NOTES