OhioEPA State of Ohio Environmental Protection Agency
Division of Surface Water
Division of Environmental & Financial Assistance

Form A

Permit-to-Install/Plan Approval Application

FOR AGENCY USE ONLY

Date Received: 5/ 6/ 19	Application/Revenue ID: 1289642	Organization ID: 20126482
Document ID: 544462	Place ID: 20126482	Check ID: 807744
Check Date: 5/5/19	Check Number: 3872	Check Amount: $6700.00

1. Project Name: Dovetail Energy – Storage Ponds

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2. Applicant (see note after signature)

Name: Dovetail Energy, LLC.
Mailing Address: 1156 Herr Road
City: Fairborn State: OH Zip: 45324
Contact Name: W. Michael Oberfield
Title: CFO
Phone: 602-321-0750 Fax: ( ) - E-mail : wmoberfield@renergy.com

3. Application/Plans Prepared by:

Name: North Point Engineering Corp.
Mailing Address: 6657 Frank Avenue NW, Suite 200
City: North Canton State: OH Zip: 44720
Contact Name: David Gerdeman, P.E.
Title: Principal Engineer
Phone: 330-494-8888 Fax: ( ) - E-mail : dgerdeman@npecorp.com

4. Billing Address (if different than Applicant)

Name:
Mailing Address:
City: State: Zip:
Contact Name:
Title:
Phone: ( ) - Fax: ( ) - E-mail :

5. Future Owner (if different than Applicant)

Name:
Mailing Address:
City: State: Zip:
Contact Name:
Title:
Phone: ( ) - Fax: ( ) - E-mail :

6. Project Location

Street Address or Location Description: +/- 0.20 miles East of Byron Rd. & +/- 0.30 miles North of Herr Rd.

County: Greene Township: Bath

Municipality: Fairborn Latitude: 39°48'50.26"N Longitude: 83°58'33.73"W

Method of Determination: Google Earth

7. Brief Project Description: Two (2) synthetic lined storage ponds for storage of approximately 24 million gallons of anaerobically digested biosolids. This material will be beneficially used on OEPA approved land application sites at agronomic rates.

8. Will one or more acres be disturbed during construction of this project? ☒ Yes ☐ No

If **Yes**, enter the date the NOI for coverage under the construction storm water NPDES permit was submitted: ________ and the date coverage was granted: ________

9. Will wetlands be disturbed during construction of this project? ☐ Yes ☒ No

If **Yes**, enter the date the 401/404 permit application was submitted: ________

10 a. Is this application part of a combined permit-to-install application? (for example air + water) ☐ Yes ☒ No

b. Has an application for a Class V injection well permit been submitted? ☐ Yes ☐ No ☒ N/A

If **Yes**, date submitted: / /

11. Compliance Status

a. Will this project connect to a collection/treatment system that has a NPDES permit? ☐ Yes ☒ No

If **Yes**, list federal and state permit numbers:

OH

b. Is this application filed in compliance with findings and orders, a consent decree, and/or NPDES permit schedule? ☐ Yes ☒ No

If **Yes**, effective date of the document containing the schedule: / /

12. Compliance with 208 plan

Does the project conform to the 208/201 plan for the area? ☐ Yes ☐ No ☒ N/A

If **Yes**, has the engineer submitted supporting documentation? ☐ Yes ☐ No

13. Designated Ohio, Wild, Scenic, & Recreational Rivers

Is this project located within 1000 feet of a designated wild, scenic, and recreational river? ☐ Yes ☒ No

See http://watercraft.ohiodnr.gov/scenicriversmap for additional information

14. Estimated Project Schedule:

Beginning construction date: 6/15/19 Ending construction date: 9/15/19 Beginning operation date: **9/15/19**

15. Project Cost:

*Installation/Construction Cost: $ 1,000,000 (Mark one): ☐ Actual ☐ Bid ☒ Estimate

Annual Operation/Maintenance Cost (if applicable - this project only): $

Are Water Pollution Control Loan Funds going to be used for this project? ☐ Yes ☒ No

If **No**, Funding Source: private

**This is costs of the treatment/dispersal/collection system that will serve the project*

16. Attachments

The following are included in this application package (check appropriate box(es) and indicate how many copies of each are provided):

☒ Detail Plans 4
☐ Soil Evaluation Form
☒ Hydrogeologic Site Investigation Report w/ engineering report
☐ Site Evaluation Form
☐ Other (describe):
☐ Narrative Plans

☐ Management Plan
☒ Engineering Report 2
☒ Engineering Specifications Included on plans and in report
☐ Sewer Authority Letter
☐ Antidegradation Addendum

17. Form B / C Submission (check all that apply):

☐ Sewer and Pump Station Construction – Form B1
☐ Onsite Sewage Treatment Systems – Form B2
☐ Wastewater Treatment Plants Less Than 100,000 GPD – Form B3
☒ Wastewater Treatment Plants Greater Than or Equal to 100,000 GPD and all Pond Systems – Form B4
☐ Industrial Direct Discharge Facility – Form B5
☐ Industrial Indirect Discharge Facility – Form B6
☐ Underground Storage Tank Remediation – Form B7
☐ Holding Tanks – Form B8
☐ Industrial Impoundment Ponds – Form B9
☐ Land Application Management Plan for Sludge or Waste other than Treated Sewage – Form C1
☐ Treated Sewage Land Application Management Plan – Form C2
☐ Sewage Holding Tank Management Plan – Form C3

18. Fee Calculations:

Permit-to-Install (maximum total fee $15,100)	
a. Application fee:	$ 100.00
b. Plan review fee:	$ 100.00
c. Plan review fee (installation/construction cost x .0065):	$ 6,500
d. Total Fee (a + b + c):	$ 6,700
Sludge Management Plan Approval*	
a. Application fee:	$ 100.00
b. Plan review fee:	$ 100.00
c. Total fee (a + b):	$ 200.00

** No separate fee is needed for land application*

19. Antidegradation

Is this project subject to the Antidegradation Rule (OAC 3745-1-05)? ☐ Yes ☒ No

*If **Yes**, an antidegradation addendum must be submitted (Note: It applies even if an exclusion and/or waiver is met)*

*If **No**, check all that apply:*

☒ Application with no direct surface water discharge (Projects that do not meet the applicability section of 3745-1-05 (B)1, i.e., onsite sewage treatment systems, sanitary sewer extensions, indirect discharger to POTW, etc.).

☐ Renewal NPDES application or PTI application with no requested increase in loading of currently permitted pollutants.

☐ Narrative Plans (Examples: Land Application, General Plans, etc.)

20. Submittals:

To be considered complete, this application must include the following unless otherwise directed by Ohio EPA:

☒ Four copies of the detail plans including profile and plan views of all sewers (shown on the same sheet), existing (as applicable) and proposed pump station facilities, incorporating all of the details outlined in Section 20.1, 20.2 and 20.3 of *Recommended Standards for Wastewater Facilities*.

☒ Two copies of complete technical specifications.

☒ Two copies of the Permit-to-Install Application including Form A, pertinent B & C form(s), and the antidegradation addendum *(if applicable)*

☒ Fee check payable to "Treasurer, State of Ohio."

21. Signature of the Applicant: (see Ohio Administrative Code 3745-42-03)

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision and that all the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are substantial penalties for submitting false information, including the possibility of fines and imprisonment for knowing violations.

Typed name: W. Michael Oberfield

Title: CFO

Signature:

Date: 05/06/2019

NOTE (Who Must Sign):
The person signing as Applicant is not the applicant's engineer or architect or any other person submitting the Permit-to-Install Application on behalf of the owner. The Applicant should be owner of the facility, business, corporation, company, etc. or the legal responsibly entity. It is not the engineer who prepared the plans.

State of Ohio Environmental Protection Agency
Division of Surface Water
Division of Environmental & Financial Assistance

Supplement to Form A – B4

Permit-to-Install/Plan Approval Application

WWTPs Greater Than or Equal to 100,000 GPD and All Pond Systems

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Application Number:	Date Received: / /

Applicant: Dovetail Energy, LLC.
Facility Owner: Dovetail Energy, LLC.
Application/Plans Prepared by: North Point Engineering, Corporation
Project Name: Dovetail Energy - Storage Ponds

This form has eight attachments. Complete only the attachments necessary. Check those included with this application.

☐ I. WWTP Pumping Stations ☐ II. Preliminary Treatment ☐ III. Biological Treatment ☐ IV. Settling
☐ V. Filtration ☐ VI. Disinfection ☒ VII. Sludge Treatment and Disposal ☒ VIII. Ponds

1. Plant Location

Receiving Stream: no discharge

2. Flood Protection

a. 100-Year Flood Elevation: N/A MSL b. 25-Year Flood Elevation: ______ MSL

3. Design Type and Loads

a. Design Period: N/A years b. Design Service Area Population: N/A
c. Treatment Type: N/A

4. Influent Loads

a. Minimum Flow: ______ MGD b. Average Flow: 0.045 MGD
c. Maximum Flow: ______ MGD d. Peak Hourly Flow: ______ MGD
e. Design BOD Load: N/A lb/day f. Design SS Load: N/A lb/day
g. Design Ammonia-Nitrogen Load: N/A lb/day
h. Others:

5. Effluent Loads and Concentration (30-day avg.) N/A

	Summer		Winter	
a. $CBOD_5$	mg/l	lb/day	mg/l	lb/day
b. Suspended Solids	mg/l	lb/day	mg/l	lb/day
c. Ammonia-Nitrogen	mg/l	lb/day	mg/l	lb/day
d. Fecal Coliform	/100 ml		/100 ml	
e. Dissolved Oxygen (minimum)	mg/l		mg/l	
f. Residual Chlorine	mg/l		mg/l	
g. Others:				

6. Submittals:

This application must include the following unless otherwise directed by Ohio EPA:

☒ Four sets of detailed plans which include a site plan, vicinity map, schematic diagrams, hydraulic profiles, plan views, elevation views, municipality approval, and cross-sectional views necessary to evaluate the processes.

☒ Two copies of the Application including Form A, pertinent B & C form(s), and antidegradation addendum (if applicable)

☒ Either the design engineer's or Ohio EPA's basis of design attachments should be submitted with this application. The basis of design should include, at a minimum, dimensions, sizes, hydraulic and organic loading under average and critical flow conditions, etc.

7. The foregoing data is a true statement of facts pertaining to this proposed sanitary system installation.

Date: 5 / 3 / 2019 Signed: ____________________ P.E.

Plans prepared by: North Point Engineering Corporation

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Division of Environmental & Financial Assistance

Supplement to Form A – B4
Attachment VII

Permit-to-Install/Plan Approval Application

Attachment VII: Sludge Treatment and Disposal

Sludge Thickening, Stabilization, Conditioning, Dewatering, Reduction, Disposal and Storage

1. Sludge Thickening ☒ N/A	New	Existing
a. Thickening type		
b. Number of thickeners		
c. Surface area dimensions (feet, each)		
d. Side water depth or height (feet, each)		
e. Detention time (hrs & min, total)		
f. Surface overflow rate (gpd/ft^2)		
g. Solid surface loading		
h. Thickened sludge concentration (%)		
i. Others:		
j. If air flotation is the thickening process:		
i. Air-to-solids ratio		
ii. Air pressure		
iii. Tank operating pressure		
iv. Recycling ratio (%)		
v. Others:		
vi. Will air flotation thickening be aided by polymer addition?	☐ Yes	☐ No
k. If centrifugal thickening is the thickening process:		
i. Centrifuge type		
ii. Number		
iii. Rate		
iv. Others:		
v. Will centrifugal thickening be aided by polymer addition?	☐ Yes	☐ No

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2. Sludge Stabilization ☐ N/A	New	Existing
a. Number of sludge stabilization tanks		3
b. Surface area dimensions (feet, each)		693/2773
c. Retention time (hrs & min, total)		76.6 hrs. min.
d. Side water depth (feet, each)		44.5
e. If aerobic digestion is the stabilization process:		
i. Number of aerators		
ii. Type		
iii. Oxygen supplied (with largest blower out of service)	CFM at PSI	CFM at PSI
	lb oxygen/day	lb oxygen/day
iv. Others:		

2. Sludge Stabilization (cont.)	New	Existing
f. If anaerobic digestion is the stabilization process:		
i. Solids loading (lb vss/cu ft/day)		0.43 (total)
ii. Solid retention time (hours & minutes)		76.6 min
Influent Solids Content (% dry basis)		12
Effluent Solids Content (% dry basis)		5-7
iii. Digestor cover type		fixed
iv. Digestion temperature		mes ~~therm~~ophilic
v. Sludge heating type		heat exchanger
vi. Sludge heating rate (BTU/hr)		3.5 MMBTU/HR
vii. Sludge mixing type		Complete
viii. Number of withdrawal levels		2 min.
ix. Sludge withdrawal pipe size		8" tyo 12"
x. Gas withdrawal pipe size		6" to m12"
xi. Others:		

3. Other Sludge Stabilization ☐ N/A ☐ Yes ☒ No

a. Describe:

b. Design Criteria:

4. Sludge Dewatering ☐ N/A ☐ Yes ☒ No

a. Describe:

b. Design Criteria:

5. Sludge Reduction ☐ N/A ☒ Yes ☐ No

a. Describe: Anaerobic Digestion

b. Design criteria: Minimum of 38% volitile Solids reduction

6. Sludge Disposal ☐ N/A	New	Existing
a. Sludge dry solids content (%)	5 to 10	5 to 10
b. Method of disposal	land aplication	land aplication
c. Estimated sludge production (tons of dry solids/year)	86,700	86,700

7. Sludge Storage Tanks ☐ N/A	New	Existing
a. Location	adjacent land	AD facility
b. Number	2	1
c. Surface area dimensions (feet, each)	453x330,621x482	38,013
d. Storage time (days, total)	717	17.51
e. Side water depth (feet, each)	15.4 and 18	
f. Sludge removal method	pumping	pumping

g. Will mixing be provided? ☐ Yes ☒ No

If **Yes**,

Mixing type:

Describe:

h. Will aeration be employed? ☐ Yes ☒ No

If **Yes**,

Number of blowers:

Type:

Capacity:

i. Will chemicals be used to control odors? ☐ Yes ☒ No

If **Yes**,

Chemical type:

Describe:

8. Sludge Management Plan

Has plan been approved? ☒ Yes ☐ No

If **Yes**, date of approval: 4/16/2016 If **No**, date to be submitted: / /

State of Ohio Environmental Protection Agency
Division of Surface Water
Division of Environmental & Financial Assistance

Supplement to Form A – B4
Attachment VIII

Permit-to-Install/Plan Approval Application

Attachment VIII: Ponds

Pond Type *(check one - if more than one type is proposed, submit a separate copy of this attachment for each type)*

☐ Controlled discharge facultative ☐ Equalization ☐ Flow through facultative ☐ Evaporation
☐ Aerated ☐ Sludge treatment ☐ Polishing ☒ Sludge storage

1. Pond Characteristics

Number of ponds (1): 2

2. Pond 1	New	Existing
a. Capacity (mgd)	23,961,556 gal	N/A
b. Surface area dimensions (feet)	482' x 621'	N/A
c. Detention time (hrs & min)	N/A	N/A
d. Side water depth (feet)	18.0 max op.	N/A
e. BOD_5 loading rate (lb/acre/day)	N/A	N/A
f. Minimum DO maintained (mg/l)	N/A	N/A

3. Pond 2	New	Existing
a. Capacity (mgd)	8,302,610 gal	N/A
b. Surface area dimensions (feet)	453' x 330	N/A
c. Detention time (hrs & min)	N/A	N/A
d. Side water depth (feet)	15.4 max op.	N/A
e. BOD_5 loading rate (lb/acre/day)	N/A	N/A
f. Minimum DO maintained (mg/l)	N/A	

4. Pond 3	New	Existing
a. Capacity (mgd)		
b. Surface area dimensions (feet)		
c. Detention time (hrs & min)		
d. Side water depth (feet)		
e. BOD_5 loading rate (lb/acre/day)		
f. Minimum DO maintained (mg/l)		

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(1): If more than three ponds are proposed, repeat page as needed.

5. Distance between bottom of ponds and maximum ground water elevation: 3' min. feet

6. Distance between bottom of ponds and bedrock formation: greater than 15 feet

7. Is aeration provided to ponds? ☐ Yes ☒ No

If **Yes**, please state the aeration method:

8. Dike Construction

a. Soil type: CL, SC,
b. Compaction density: 95%
c. Top width (feet): 8' minimum
d. Inner slope: 3:1
e. Outer slope: 3:1
f. Free board (feet): 1.0' and 2.6'
g. Will borrow material be needed for construction? ☐ Yes ☒ No
h. Will anti-seep collars be used on all pipes that penetrate the dike? ☒ Yes ☐ No ☐ N/A

9. Ground Water Protection

a. Soil type[(2)]: CL, SC,
b. Compaction density[(2)]: 95% min.
c. Liner Type: ☒ Synthetic ☐ Bentonite ☐ Clay ☒ Other: dual syn and 1' soil
d. Liner thickness: 12" plus synthetic
e. Liner coefficient of permeability (cm/s): 1 x 10^-10
f. Has a hydrogeological study been prepared for the pond/ponds site? ☐ Yes ☒ No
g. Has the hydrogeological study been approved by Ohio EPA, Division of Drinking and Ground Waters? ☐ Yes ☒ No
h. Will monitoring wells be installed around the pond/ponds site? ☐ Yes ☒ No

10. Erosion Control

Explain what method(s) will be used to control erosion: Standard erosion and sedimentation control measures as specified in the Stormwater Pollution Prevention Plan to be provided as part of the General Construction NPDES permit.

---

(2): If the liner soil material is the same as the material used for the dike construction, please fill in "Same as above".

ENGINEERING REPORT

STORAGE PONDS PERMIT-TO-INSTALL

FOR

DOVETAIL ENERGY, LLC

BATH TOWNSHIP
GREENE COUNTY

MAY 3RD, 2019
REV 6-7-19

APPLICANT/ FACILITY LOCATION:
DOVETAIL ENERGY, LLC
1156 HERR ROAD
FAIRBORN, OH 45324

PREPARED BY:
NORTH POINT ENGINEERING CORP.
6657 FRANK AVE. NW, SUITE 200
NORTH CANTON, OHIO 44720

Engineering Report
Dovetail Energy, LLC – Fairborn, OH
Waste Storage Ponds
Permit-to-Install Application
May 2019

TABLE OF CONTENTS

Appendices

1.0 INTRODUCTION

1.1 Purpose

This Engineering Design Report was prepared by North Point Engineering Corporation under contract by Dovetail Energy, LLC. This report includes background siting and subsurface information, containment system design, construction quality control and quality assurance, and Operation and Maintenance Guidance related to two proposed waste water storage ponds to store treated effluent from the Dovetail Energy Anaerobic Digester facility.

Referenced with this report are the Engineering Design Plans prepared by North Point Engineering Corporation.

2.0 SITE LOCATION

2.1 Site Location and Description

The proposed Dovetail Energy storage ponds are located near Fairborn, Ohio in the NW quarter of Section 8-3-8 in Bath Township, Greene County, Ohio. This site is situated north of Herr Road, east of Byron Road, south of Yellow Springs Fairfield Road and approximately 15 miles north east of Dayton, Ohio. See the USGS map in Appendix A that shows the property boundary and the location of the proposed ponds.

3.0 BACKGROUND SITING INFORMATION

Background siting information was collected to demonstrate compliance with OEPA regulations. This information includes:

3.1 Water Wells

The following sites were used to obtain available water well logs: ODNR Well GIS Map; ODNR Well Log search by County & Township, then by roads; Custom Data search using County, Township, road names, portion of names and different variation of names.

Copies of the available well logs within at least 2000 ft. of the proposed ponds and a location map are presented in Appendix B.

There are an estimated 28 occupied structures within 2000 feet of the proposed ponds, see Appendix B. Not all of the occupied structures within the 2000 feet of the ponds had a water well log publicly available.

3.2 Sole Source Aquifer

The proposed storage pond is located above a Sole Source Aquifer. See the OEPA Division of Drinking and Ground Waters information in Appendix C.

3.3 Public Water Systems

There are no class V injection wells, public water system wells, drinking water source protection areas, and inner management zones for public water systems using ground water public water supply intakes located within two thousand feet of the proposed storage ponds. See the OEPA Division of Drinking and Ground Waters information in Appendix C.

The property is located in the upper reaches of the City of Dayton's Surface Water Source Water Protection Area.

3.4 Karst Areas

A map of Ohio Karst Areas published by ODNR, Division of Geological Survey (see Appendix E) shows the site is not located in an area with known Karst features. Also, the area around, but not including the site is identified as a "potential" karst area, but additional information was obtained from the Ohio Department of Natural Resources and does not show any known karst at the site.

Soil borings conducted in the area of the ponds, as well as a visual inspection of the ground surface at the site, gave no indication of a karst formation.

3.5 Underground Mines Map

According to information obtained from the Ohio Department of Natural Resources website (Abandoned Underground Mine Locator), there are no areas of abandoned underground mines known to be present at the site. A map obtained from the website is provided in Appendix F.

In addition to the regulatory siting information, additional background information was collected as part of the facility review and includes the following:

3.6 Floodplains

No portion of the site falls within a designated Federal Emergency Management Agency (FEMA) floodplain. A copy of the relevant portion of the FEMA Flood Insurance Rate Map (FIRM) number 39117C0250E eff. 6/2/2009 is presented in Appendix D.

3.7 Ground Water Pollution Potential

According to information provided on the Ground Water Pollution Potential Map for Greene County, the hydrogeologic setting for the proposed pond site is given as 7Af49, which is described as sand and gravel interbedded in primarily clay glacial till. The site has a GWPP index of 129. A copy of the map obtained from the ODNR website is provided in Appendix G.

3.8 Ground Water Resources

A copy of the Ground Water Resources Map for Greene County obtained from the ODNR website is provided in Appendix H.

3.9 USDA Soil Survey

According to published soil survey data, on-site surface soils consist of Eldean silt loam, Miamian-Casco complex and Miamian-Eldean silt loams as shown on the soil survey map included in Appendix I.

3.10 Wetlands

The proposed storage pond is not located within a wetland. See the National Wetlands Inventory performed by U.S. Fish and Wildlife Services information in Appendix J.

A site-specific wetland delineation was also conducted to determine the limits of a small wetland area along the west central property line. This is also included in Appendix J.

3.11 Oil and Gas Wells

There are no identified oil and gas wells located at the site. See Appendix K.

4.0 SUBSURFACE INFORMATION

Subsurface investigation consisting of background literature research, geotechnical soil borings, test pits and soil testing was conducted to provide background information to guide in the design of the ponds. This information is included in Appendices L and M and are shown on Sheet 2 of the Engineering Plans.

Field investigation work included 2 rounds of soil borings and 2 rounds of soil test pits. The soil borings were focused on determining the general soil types and ground water conditions at the site and the test pits were characterizing the upper soils for potential use as liner material.

Although, due to the liner system proposed for the ponds, a detailed hydrogeologic study was not conducted at the site, the hydrogeologic setting observed in the soil borings fits the description included in the Ground Water Pollution Potential Study for Greene county (see Appendix G) as follows:

"7Af Sand and Gravel Interbedded in Glacial Till

This hydrogeologic setting is characterized by low to moderate relief and sand and gravel deposit interbedded in glacial till. The till is composed primarily of clay with varying amounts of unsorted silt, sand and gravel. The sand and gravel may be relatively thin and discontinuous, lens-shaped bodies, or thick layers which cover a large area. The thick units are usually confined to common horizons within the till. Ground water occurs in both the till and the sand and gravel; however, the sand and gravel serve as the principal aquifer. Recharge to the sand and gravel is primarily die to infiltration of precipitation through the till. Depth to water is highly variable. But on average ranges from 5 to 50 feet. Soils are typically described as clay loams."

5.0 ENGINEERING DESIGN

5.1 Forcemain to Ponds

Effluent from the existing Anaerobic Digester will be conveyed to the new ponds via a 6" diameter PVC forcemain; see plan sheets 6A, 6B, 6C and 6D for location, details and specifications. The new forcemain will tie into the existing conveyance forcemain that flows to the existing storage tank and will include appropriate valving. The forcemain will be buried a minimum of three-feet below ground and will include appropriate mechanical joints and fittings, thrust blocks, construction inspection and leak testing.

5.2 Storage Ponds

5.2.1 Pond Configuration

The ponds are configured to best fit the topography and stay below the ODNR dam regulation threshold. A site-specific wetland delineation was also conducted to determine the limits of a small wetland area along the west central property line. This delineation is included in Appendix J.

There is a ten-foot elevation difference between the two ponds, with a connector pipe allowing gravity transfer from Pond 1 to Pond 2.

5.2.2 Pond Stability

The pond, as designed, has a minimum 8' top width and 3:1 inside and outside slopes. This meets or exceeds ODA and NRCS minimum design standards. Since the ODA and NRCS design standards were established to set a minimum stable embankment configuration for ponds, this proposed design will be stable. Additional quality control testing during construction is also proposed.

In addition to the engineered structural fill soil component of the embankment, excess soil cut from the pond excavation will be placed on the outsides of the berm. This extra will be placed in accordance with NRCS earthfill specifications. The final top of the berm will be at least 20' wide. This additional fill will provide additional stability to the berm.

The various layers of the proposed liner system are commonly used in the landfill industry and the proposed 3:1 inside slopes have been demonstrated to be stable in such applications.

5.2.3 Liner Design

To provide enhanced protection of surface and subsurface resources, an extensive containment and monitoring system is being proposed for the 2 storage ponds. This system, starting from the top going down, is described as follows:

A. **Primary Synthetic Liner** – textured 60 mil HDPE synthetic containment liner covering the entire floor and inside slopes of the ponds.

B. **Primary Witness/Leak Detective Zone** – a geocomposite drainage layer directly beneath the entire primary synthetic liner draining to a sump and sideslope riser pipe.

C. **Secondary Synthetic Liner** – 60 mil HDPE synthetic containment liner covering the entire floor and inside slopes of the ponds.

D. **Secondary Witness Zone/Leak Detection, Drainage and Venting Layer** – strip of geocomposite drainage layer draining to a sump and sideslope riser pump. This will act as a secondary leak detection system and serve to collect, drain and vent any water or gases collected under the liner.

E. **Subbase Soil Containment Layer** – A 12" thick soil barrier to act as a confining layer beneath the secondary leak detection/venting layer. This layer will also serve as a cushion layer for the geomembrane.

F. **Dewatering System** – consisting of separate perimeter drains around each pond flowing to a gravity outlet to the north-west of Pond #2. The perimeter drain will be set a minimum of 3-feet below the final floor grade and lateral drains can also be installed, if needed, for further dewatering of the pond area. In addition to construction dewatering, any contaminants leaving the pond would be detected in the drain system. This in essence, after the primary and secondary witness/detection zones, is a third detection system.

The design of the pond minimizes the number of penetrations through the liner.

5.2.4 Construction Specifications

In addition to the information included in the Engineering Plans, Construction Specifications for the following components are included in Appendix P.

- Fencing, Earthfill, Concrete and Subsurface Drains.

6.0 CONSTRUCTION QUALITY ASSURANCE/ QUALITY CONTROL PLAN

6.1 QA-QC Plan

A Construction Quality Assurance/Quality Control Plan will be implemented during construction of the ponds. This plan will cover both earthwork and synthetic components of the liner and leak detection system as well as the system forcemain piping. QA/QC for geosynthetic components is included in Appendix N. QA/QC for the soils and forcemain piping is included in the Engineering Plans.

7.0 POST CONSTRUCTION

7.1 Operation and Maintenance Plan

A final Operation and Maintenance Plan will be prepared at completion of construction and provided to the owner for use for long-term management of the ponds. Initial drafts of the various O & M plans are included in Appendix O.

7.2 Site Monitoring Plan

Ponds 1 and 2 at the Dovetail Site will be constructed in accordance with the permit to install that includes engineered design drawings. The design incorporates the ability to implement a detection monitoring program to monitor the performance of the system and to identify if contingencies may be required. From bottom to top, the dual-synthetic composite liner consists of 12" recompacted soil, a geocomposite venting layer system, a textured 60 mil HDPE secondary liner, dual sided 160 mil geocomposite witness zone where monitoring will occur, and a textured 60 mil HDPE primary liner.

7.3 Detection Monitoring Program

Data from the detection monitoring program serve to collect ongoing records of any liquids collected in the primary or secondary witness zones as well as serve as a basis for if/when a contingency plan may need to be implemented. The Detection Monitoring Program will consist of the following:

Monitoring Location

The primary and secondary witness zones will be monitored at the top of the sideslope riser pipes, one for each zone for each pond. The location for these monitoring locations is shown on plan sheet 3B. The location of the perimeter drain outlets is also shown on sheet 5A.

Inspections

Visual inspections will be conducted on a weekly basis to assess the occurrence and volume of liquids that may be present in the primary and secondary witness zones. If liquids are present, a water level indictor will be used to determine liquid levels and these levels will be used to calculate estimated volumes within the witness zone based on the engineered design. If measurable liquids are identified, a pump will be placed down the slope riser and will be used to dewater the sump and the volume of liquid evacuated and pumped to the ponds will be recorded. Liquid from the primary and secondary witness zone will be pumped back into the pond unless there is no primary zone liquid, in which the secondary zone liquid can be surface outletted.

Staged Action Leakage Rate (ALR)

A staged Action Leakage Rate (ALR) program will be used during the Detection Monitoring Program. The ALR will be calculated using the Quality Based Action Leakage (QBAL) Method [1] with the following equations:

$$Q = C_b \times a \times \sqrt{2g \times h_w}$$

where,

$Q = leakage\ through\ a\ geomembrane\ defect$
$C_B = dimensionless\ coefficent = 0.6$
$a = area\ of\ a\ geomembrane\ defect$
$g = acceleration\ of\ gravity$
$h_w = head\ of\ water\ on\ the\ defect$

and,

$$ALR = N \times Q$$

where,

$N = the\ number\ of\ defects\ representing\ a\ substandard\ geomembrane\ performance$

Or the Environmental Protection Agency (EPA) Method [1] with the following equation:

$$Q = k \times h \times \tan \alpha \times B_{avg}$$

where,

$Q = flow\ rate\ in\ the\ witness\ zone$
$k = hydraulic\ conductivity\ of\ the\ drainage\ medium$
$h = head\ on\ the\ primary\ geomembrane$
$\alpha = slow\ of\ the\ leak\ detection\ system$
$B_{avg} = average\ width\ of\ the\ flow\ in\ the\ witness\ zone$

and,

$$ALR = \frac{Q}{S.F.}$$

where,

$S.F. = Safety\ Factor = 2$

ALR Analysis and Reporting

Volumetric data will be collected on a monthly basis. Data will be evaluated on a quarterly basis using the appropriate ALR equations. A report summarizing the analysis will be kept on file, and, if an exceedance of the acceptable ALR is identified, the report will be sent to Ohio EPA. The results of the ALR analyses and chemical testing shall be reported to the Ohio EPA on a semi- annual basis. In addition, if an exceedance of the acceptable ALR is identified, a report shall be sent to Ohio EPA within 5 days of the volumetric data collection that exceeded the ALR.

Chemical Testing

Samples of liquids (if present) will be collected on a quarterly basis and analyzed by a qualified testing laboratory. Samples will be collected in general accordance with standard operating procedures, and commonly accepted sampling practices. Samples will be analyzed for: field indicator parameters (i.e., temperature, pH, specific conductance, dissolved oxygen, oxidation reduction potential, turbidity), total dissolved solids, total phosphorous, nitrogen (ammonia, TKN, nitrate, nitrite), major ions (i.e., calcium, sodium, magnesium, manganese, , potassium, iron, chloride, sulfate, bicarbonate, dissolved methane and alkalinity), E. coli, and BOD/COD.

Reporting

The results of the ALR analyses and chemical testing shall be reported to the Ohio EPA on a semi- annual basis. In addition, if an exceedance of the acceptable ALR is identified, a report shall be sent to Ohio EPA within 5 days of the volumetric data collection that exceeded the ALR. The results of the baseline monitoring program shall be detailed in the baseline monitoring report which shall be submitted to the Ohio EPA on a quarterly basis.

7.4 Contingency Program

If the ALR identified in the detection monitoring plan is exceeded, the following data analyses will be conducted to verify or negate the supposition that the integrity of the liner system may have failed:

- A review of sources for ALR exceedance other than the ponds.
- An evaluation of water quality data variations (spatially and temporally) relative to the characteristics of the pond contents.
- Sample the liquids in the witness zone and pond perimeter drain (for the parameters described in baseline monitoring) within 15 days of volumetric sampling that exceeded the ALR and report the

results to the Ohio EPA within 5 business days of receipt of laboratory results.

- Other appropriate methods, as specified by Ohio EPA and/or facility.

A report will be completed and submitted to Ohio EPA summarizing observations and recommendations relative to ALR evaluation. The report shall be submitted within 5 business days following receipt of laboratory results.

If the ALR exceedance is verified, and if a technical evaluation does not support that a breach in the primary liner system has not occurred, then the following contingencies will be applied:

- Contact Ohio EPA within 48 hours of confirming a suspected leak of the primary liner.
- Evaluate the results of the perimeter drain monitoring and determine if contaminants from the ponds are reaching the perimeter drain dewatering monitoring system. If no contaminants are present, continue monitoring while liner repair is being performed. If contaminants are present in the perimeter drain, then the following actions will be taken:
    - Evaluate the quantity and quality of liquid observed in the secondary witness/venting zone and determine whether a breach of the secondary liner has occurred. If no breach has occurred, continue dewatering the primary witness zone and monitor the secondary witness/venting zone as originally done for the upper zone.
    - If leakage is observed into the witness zone beneath the primary liner of Pond 1 exceeds 40 gallons per acre per day (gpad), a pump will be installed in the sump and the quantity and flow rate of water pump will be recorded. Ohio EPA will be notified within 7 days of initial exceedance.
    - If leakage is observed into the witness zone beneath the primary liner of Pond 1 exceeds 350 gpad the area of the leak(s) should be sought, and a written action plan initiated. Ohio EPA will be notified within 7 days of initial exceedance.
    - If leakage is observed into the witness zone beneath the primary liner of Pond 1 exceeds 500 gpad the leak(s) should be located, and a formal action plan submitted. The liquid in the pond being removed and either 1) moved to other onsite storage structures or 2) land applied in accordance with the facilities LAMP or 3) taken to other authorized offsite facilities or land application locations. Leak(s) must be repaired within sixty days or as soon as practically possible.
    - Leakage within the witness zone of Pond 2 will be monitoring similar to as described in Pond 1; however, Pond 2 will have an ALR and IRLR dependent on the liquid levels as it is filled via overflow from Pond 1. The QBAL method will be used to calculate the ALR and IRLR and it will be assumed that installation of the liner system will be good to excellent. Weekly inspections of liquid levels will be collected and evaluated to determine appropriate ALR.

The primary liner will be repaired if the action leakage rate is exceeded and it is determined to be a leak, including, but not limited to, draining/drawing down the pond and repairing the ponds primary liner.

If a breach in the secondary geomembrane liner system has occurred, then the following contingencies will be implemented within 15 days of the of determining the secondary geomembrane has been breached:

- Contact Ohio EPA (by telephone and in writing) within 48 hours of confirming a suspected leak through the secondary liner system.

- Perform a hydrogeologic site investigation to evaluate potential impact to the saturated zones beneath the ponds in compliance with current Ohio EPA rules, regulations and guidance.

- Implement an Ohio EPA-authorized groundwater monitoring program (including the submittal of a groundwater monitoring plan and the initiation of groundwater monitoring).

- Sample drinking water wells within 1,000 feet upgradient of ponds and within 2,000 feet side gradient and/or downgradient of ponds for impact. A report summarizing the sampling results will be submitted to the Ohio EPA within 30 days of the first sample collection.

- Monitor perimeter drain for the same parameters specified in detection monitoring for the witness zone.

- o Submit a preliminary assessment including estimated amounts of liquids, likely sources, possible location, size and any potential causes and sort-term actions planned.

- o Evacuate liquids from the sump and pump into ponds.

- o Monitor perimeter drain.

- o Establish open line of communication with Ohio EPA and begin evaluation of proposed corrective actions. The operator will Ohio EPA (by telephone and in writing) within 48 hours of confirming a suspected leak through the secondary liner system.

After each effort to repair the liner system, the leak collection system shall be sampled on a daily basis for pH, specific conductance and water levels for a minimum of 15 days to evaluate the status of each repair.

References

1. Jordan, C.S. & Ruhl, C.H. “Action Leakage Rate Calculation.” 2017 World of Coal Ash Conference, 9-11 May 2017, Lexington, KY.

8.0 ODOR MANAGEMENT/MITIGATION PLAN

8.1 Design and Operation of the Ponds

The following measures have been incorporated into the design and operation of the ponds:

1. Only Ohio EPA authorized materials will be accepted into the Dovetail Storage Pond.
2. Wherever possible, the embankment of the pond is above ground, allowing better dispersion of any odor into the air, which reduces odor downwind.
3. The overall depth of the pond (below and above grade) has been made as large as possible, reducing the surface area of the pond, which result in less odor generated.
4. Waste material will enter into the storage pond via the submerged inlet forcemain pipe. Water, as needed for initial partial filling, will use the Camlock fitting. Both pipes discharge beneath the normal liquids level of the storage pond. Discharging the material beneath the liquids level will prevent the surface of the storage pond from being agitated and will better allow a solids crust to form.
5. The storage ponds are located outside the OEPA residential setback distance.

8.2 Odor Complaint Documentation Forms

In addition to the above items, regular odor observations will be conducted by site personnel daily, and ad hoc, as needed, if odor complaints are received from the surrounding neighbors. Odor Complaint Documentation forms will be used to rate the type of odors present and the monitoring points/strategy. Example forms are included at the end of this section.

8.3 Windbreak Shelterbelt

Windbreaks or shelterbelts will also be established as part of the Odor Mitigation Plan. The establishment of a windbreak/shelterbelt will help improve air quality by reducing and intercepting any air borne particulate matter or odors that may exist.

Plant species used will be adapted to the soils, climate and site conditions. Sizing and spacing of the plant will be dependent on the type of plant species used. Tree or shrub species selected will have leaf and structural characteristics to optimize interception, adsorption and absorption of airborne odors.

The windbreak will be oriented downwind of the prevailing wind direction and as close to perpendicular to the ponds as possible where wind related issues are the concern. West and southwest winds are the predominant winds in Ohio. However, property lines, other windbreaks, tillage operations, field layout and natural features on the landscape will be taken into account in the design. NRCS Conservation Practice Standard Code 380, Windbreak/Shelterbelt Establishment, will be used as a general guide on the construction of these measures.

8.4 Surface Agitation

In the case where the site has evidence of increased odors (i.e. related to Spring and Fall pond turn-over) we will use surface agitation via a boat as part of our odor mitigation plan. Surface agitation is an option to reduce odor in the ponds, but only if a confirmed problem exists and a mutual agreement with EPA had been discuss prior.

The top three (3) to four (4) feet of the ponds will contain digestate that is more diluted compared to a traditional storage pond. It is expected that the percentage of solids in the top of the ponds will be less than 1% (0.25% - 0.75% total solids) compared to the 5% - 7% total solids in typical storage ponds. This is expected to result in less odor from the new ponds.

Renergy Odor Complaint Documentation

Date and Time of Complaint:	
Name of Complainant:	
Address of Complainant:	

Date and Time of Complaint Investigation:	
Inspector Name:	
Wind Direction and Speed:	
Temperature and other Weather Obs.:	

Site Observations (circle answers). **Site #1 should always be the last site visited to avoid olfactory fatigue by any odors at the facility. Site location may vary. Plan will be updated accordingly.**

Site #1 Odor Present	No Odor – Slight Odor – Strong Odor
Site #1 Type of Odor	Ammonia – Hog Manure – Decaying Food – N/A
Site #2 Odor Present	No Odor – Slight Odor – Nuisance Odor
Site #2 Type of Odor	Ammonia – Hog Manure – Decaying Food – N/A
Site #3 Odor Present	No Odor – Slight Odor – Nuisance Odor
Site #3 Type of Odor	Ammonia – Hog Manure – Decaying Food – N/A
Site #4 Odor Present	No Odor – Slight Odor – Nuisance Odor
Site #4 Type of Odor	Ammonia – Hog Manure – Decaying Food – N/A
Site #5 Odor Present	No Odor – Slight Odor – Nuisance Odor
Site #5 Type of Odor	Ammonia – Hog Manure – Decaying Food – N/A
Site #6 Odor Present	No Odor – Slight Odor – Nuisance Odor
Site #6 Type of Odor	Ammonia – Hog Manure – Decaying Food – N/A

* Nuisance odor" means an emission of any gas, vapor, aerosol or combination thereof from the management of sewage sludge or biosolids, in whatever quantities, that causes, either alone or in reaction with other air contaminants, injurious effects to public health or the environment **or unreasonable interference with the comfortable enjoyment of life or property**.

Other observations:

____

____

____

____


Teilhet Studios
Yellow Springs Fairfield Rd
Site 5
Yellow Springs Fairfield Rd
Yellow Springs Fairfield Rd
Site 4
Yellow Springs Fairfield Rd
Yellow Sp
Site 6
W Enon Rd
Site 3
W Enon Rd
W Enon Rd
W Enon Rd
Pitstick Pork Farms
Site 1
E Xenia Dr
Fairborn Studebaker
Site 2
Google

APPENDIX A
USGS Map

USGS science for a changing world

U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

The National Map
US Topo

YELLOW SPRINGS QUADRANGLE
OHIO
7.5-MINUTE SERIES

Produced by the United States Geological Survey
North American Datum of 1983 (NAD83)
World Geodetic System of 1984 (WGS84). Projection and
1 000-meter grid: Universal Transverse Mercator, Zone 17S
10 000-foot ticks: Ohio Coordinate System of 1983 (south zone)

This map is not a legal document. Boundaries may be generalized for this map scale. Private lands within government reservations may not be shown. Obtain permission before entering private lands.

Imagery..NAIP, October 2015
Roads........................U.S. Census Bureau, 2015 - 2016
Names..GNIS, 2016
Hydrography....................National Hydrography Dataset, 2015
Contours.......................National Elevation Dataset, 2010
Boundaries..........Multiple sources; see metadata file 1972 - 2016
Public Land Survey System..BLM, 2013
Wetlands..........FWS National Wetlands Inventory 1977 - 2014

UTM GRID AND 2016 MAGNETIC NORTH
DECLINATION AT CENTER OF SHEET

U.S. National Grid
100,000-m Square ID
BE
Grid Zone Designation
17S

SCALE 1:24 000

KILOMETERS 1 0.5 0 1 2
METERS 1000 500 0 1000 2000
MILES 1 0.5 0 1
FEET 1000 0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000

CONTOUR INTERVAL 10 FEET
NORTH AMERICAN VERTICAL DATUM OF 1988

This map was produced to conform with the
National Geospatial Program US Topo Product Standard, 2011.
A metadata file associated with this product is draft version 0.6.19

1 New Carlisle
2 Donnelsville
3 Springfield
4 Fairborn
5 Clifton
6 Bellbrook
7 Xenia
8 Cedarville

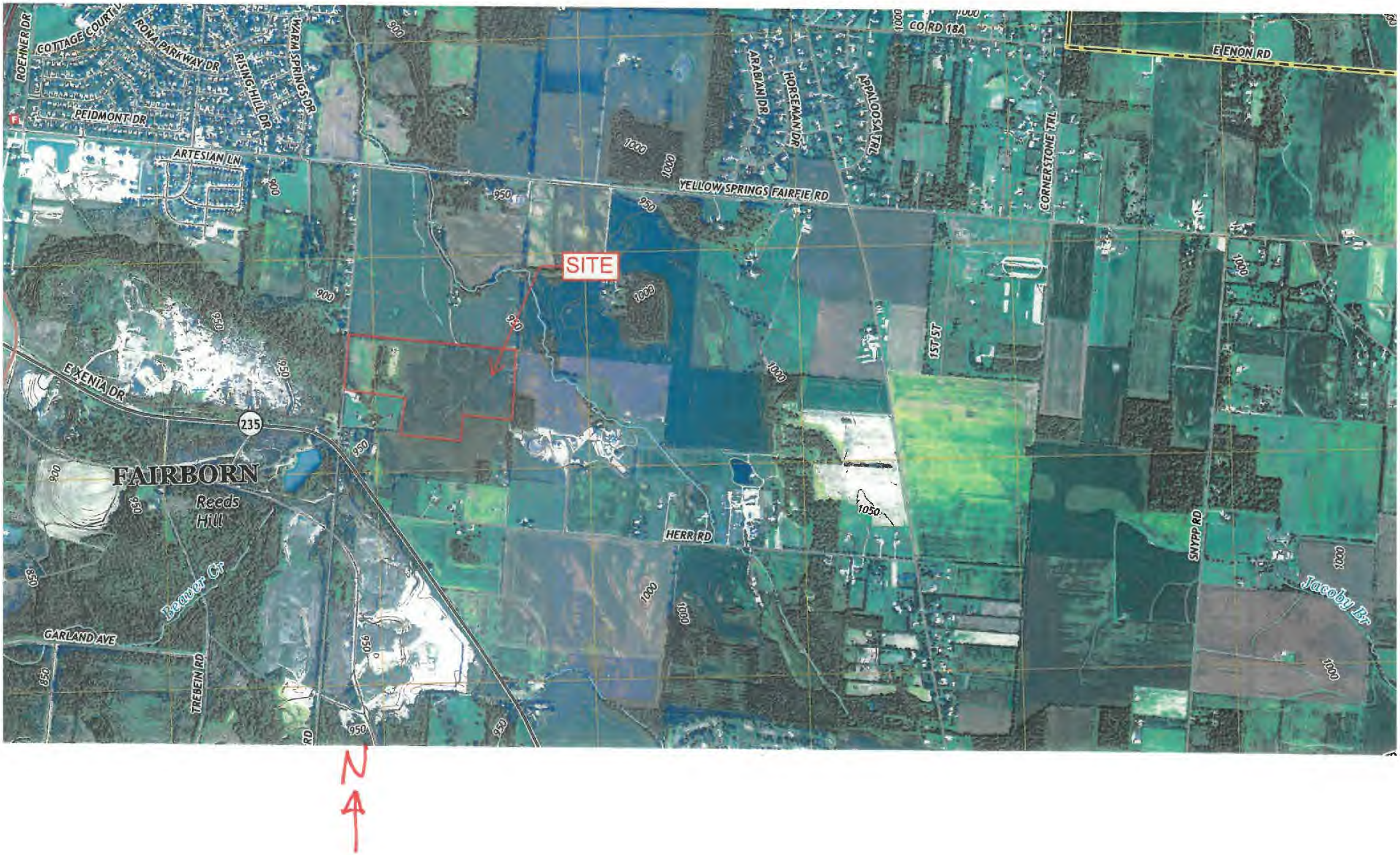
ADJOINING QUADRANGLES

ROAD CLASSIFICATION

Expressway	Local Connector
Secondary Hwy	Local Road
Ramp	4WD
Interstate Route	US Route
State Route	

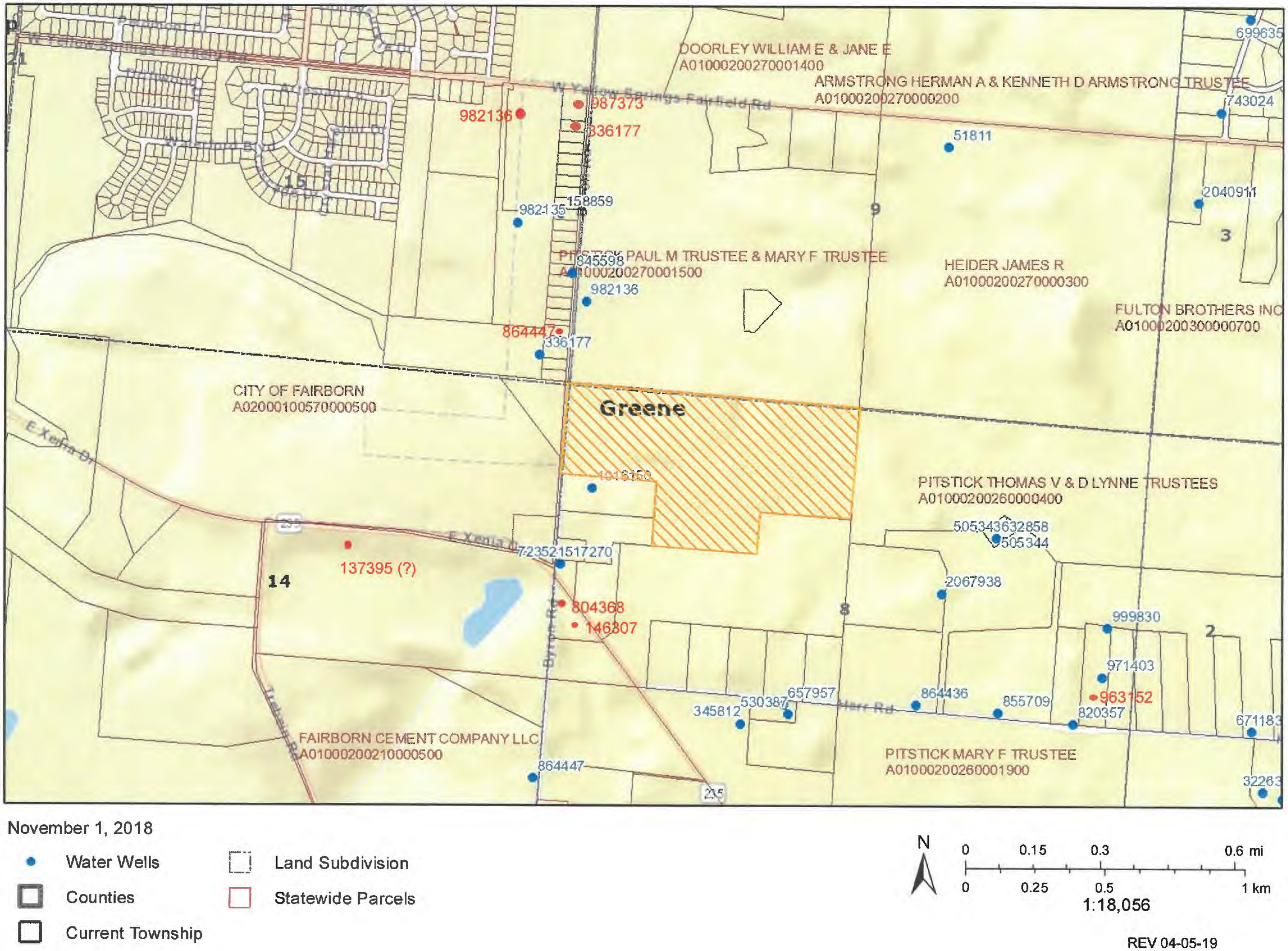
YELLOW SPRINGS, OH
2016

NSN
NGA REF NO. USGSX24K50087


SITE
FAIRBORN
Reeds Hill
ROEHNER DR
COTTAGE COURT
RONA PARKWAY DR
RISING HILL DR
WARM SPRINGS DR
PEIDMONT DR
ARTESIAN LN
YELLOW SPRINGS FAIRFIE RD
CO RD 18A
E ENON RD
ARABIAN DR
HORSEMAN DR
APPALOOSA TRL
CORNERSTONE TRL
1ST ST
E XENIA DR
235
HERR RD
SNYPP RD
Jacoby Br
Beaver Cr
GARLAND AVE
TREBEN RD
RD
900
950
1000
1050
850
N

APPENDIX B
Water Well Logs

Ohio Water Wells



REV 04-05-19

DNR 7802.10

TYPE OR USE PEN
SELF TRANSCRIBING
PRESS HARD

WELL LOG AND DRILLING REPORT

Ohio Department of Natural Resources
Divison of Soil and Water Resources, 2045 Morse Road Building B
Columbus, Ohio 43229-6693 Voice (614) 265-6740 Fax (614) 265-6767

1016150

WELL LOCATION

County GREENE Township Bath

[✓ Owner]/Builder (Circle One or Both) KaR Aggriculture (First / Last)

Address of Well Location 4412 (Number) Byron RD 45324 (Street Name)

City FAIRBORN Zip Code +4 45324

Permit No. Aggriculture Section/Lot No. (Circle One or Both)

Location of Well in State Plane coordinates, if available: Use of Well Aggriculture

N ☐ X . +/- ft. or m

S ☐ Y . +/- ft. or m

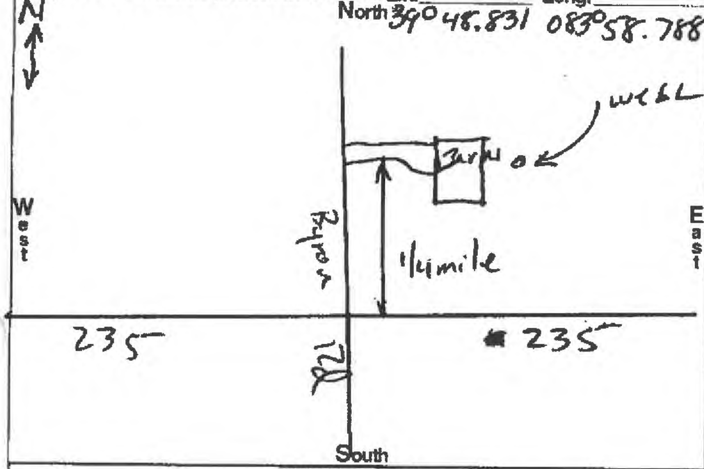
Elevation of Well 910 . 19 +/- 19 [✓ ft] or m

Datum Plain: ☑ NAD27 ☐ NAD83 Elevation Source

Source of Coordinates: ☑ GPS ☐ Survey ☐ Other

Sketch a map showing distance well lies from numbered state highways, street intersections, county roads, buildings or other notable landmarks. If latitude and longitude are available please include here: Lat: Long:

North 39° 48.831 083° 58.788



CONSTRUCTION DETAILS

☐ Rotary ☑ Cable ☐ Augered ☐ Driven ☐ Other

BOREHOLE/CASING (measured from ground surface)

1 ☐ Borehole Diameter 5 5/8 inches Depth 32 ft.

Casing Diameter 6" OD in. Length 29 ft. Thickness .188 in.

2 ☐ Borehole Diameter inches Depth ft.

Casing Diameter in. Length ft. Thickness in.

Casing Height Above Ground 18" ft.

Type: 1 ☐ 2 ☐ Steel; 1 ☐ 2 ☑ Galv.; 1 ☐ 2 ☐ PVC; 1 ☐ 2 ☐ Other

Joints: 1 ☐ 2 ☐ Threaded; 1 ☐ 2 ☑ Welded; 1 ☐ 2 ☐ Solvent; 1 ☐ 2 ☐ Other

SCREEN

Diameter 4" Slot Size .030 Screen Length 3 [✓ ft]

Type Continuous WIRE Material S. STEEL

Set Between 29 ft. and 32 ft.

GRAVEL PACK (Filter Pack)

Material/Size NATURAL Volume/Weight Used

Method of Installation

Depth: Placed FROM 29 ft. TO 32 ft.

GROUT

Material Bentonite Volume/Weight Used 50 lb.

Method of Installation Dry Driven

Depth: Placed FROM 0 ft. TO 32 ft.

DRILLING LOG*

INDICATE DEPTH(S) AT WHICH WATER IS ENCOUNTERED.

Show color, texture, hardness, and formation: sandstone, shale, limestone, gravel, clay, sand, etc.	From	To
BROWN CLAY	0	9
Gravel & CLAY	9	25
Sand & Gravel	25	31
CLAY	31	32

WATER @ 25-31

*(If more space is needed to complete drilling log, use next consecutively numbered form.)

Date of Well Completion 5/21/12 Total Depth of Well 32 ft.

WELL TEST*

Pre-Pumping Static Level 19 ft. Date 5/18/12

Measured from: ☒ Top of Casing ☐ Ground Level ☐ Other

☐ Air ☒ Bailing ☒ Pumping* ☐ Other

Test Rate 14 gpm Duration of Test 4 hrs.

Feet of Drawdown 2 ft. Sustainable Yield 14 gpm

*(Attach a copy of the pumping test record, per section 1521.05, ORC)

Is Copy Attached? ☐ Yes ☑ No Flowing Well? ☐ Yes ☑ No

Quality CLEAR

PUMP/PITLESS

Type of pump 1/2 hp Submersible Capacity 12 gpm

Pump set at 28 ft. Pitless Type JRS10

Pump installed by HALL + JENKINS WELL Drilling

I hereby certify the information given is accurate and correct to the best of my knowledge.

Drilling Firm HALL + JENKINS WELL DRILLING

Address 5120 Dayton-Brandt Rd.

City, State, Zip New Carlise, OH 45344

Signed CWD Date 5/18/12

ODH Registration Number 2340

Completion of this form is required by section 1521.05, Ohio Revised Code - file within 30 days after completion of drilling.

RIGINAL COPY TO - ODNR, DIVISION OF SOIL AND WATER RESOURCES, 2045 MORSE ROAD BLD. B, COLS., OHIO 43229-6693

Blue - Customer's copy Pink - Driller's copy Green - Local Health Dept. copy

TYPE OR USE PEN
SELF TRANSCRIBING
PRESS HARD

WELL LOG AND DRILLING REPORT

723521

Ohio Department of Natural Resources, Divison of Water
1939 Fountain Square Drive, Columbus, Ohio 43224 Phone (614) 265-6739

Permit Number 662-663

COUNTY Greene TOWNSHIP Bath SECTION/LOT No. (CIRCLE ONE)

[✓ OWNER]/BUILDER (CIRCLE ONE OR BOTH) Phil Harris PROPERTY ADDRESS 4350 Byron Rd. (ADDRESS OF WELL LOCATION A)

LOCATION OF PROPERTY

CONSTRUCTION DETAILS

CASING

Borehole Diameter in.

1 Diameter 6 in. Length 28 ft. Wall Thickness in.

2 Diameter in. Length ft. Wall Thickness in.

Type: 1 2 Steel 1 2 Galv. 1 2 [✓ PVC] 1 2 Other

Joints: 1 2 Threaded 1 2 Welded 1 2 [✓ Solvent] 1 2 Other

Liner: Length Type Wall Thickness in.

SCREEN

Type (wire wrapped, louvered, etc.) Material

Length ft. Diameter in.

Set between ft. and ft. Slot

GROUT

Material Bentonite37 gals Volume used 37 gals.

Method of installation Tremie pressure

Depth: placed from 28 ft. to surface ft.

GRAVEL PACK (Filter Pack)

Material Volume used

Method of installation

Depth: placed from ft. to ft.

Pitless Device ☐ Adapter ☐ Preassembled unit

Use of Well Residential

☒ Rotary ☐ Cable ☐ Augered ☐ Driven ☐ Dug ☐ Other

Date of Completion 7-30-91

WELL LOG*

INDICATE DEPTH(S) AT WHICH WATER IS ENCOUNTERED.

Show color, texture, hardness, and formation: sandstone, shale, limestone, gravel, clay, sand, etc.	From	To
Clay	0	3
Clay & Gravel	3	26
Limestone	26	70
Shale	70	105

WELL TEST

☐ Bailing ☒ Pumping* ☐ Other

Test rate less than 1 gpm Duration of test 2 hrs.

Drawdown Total ft.

Measured from: ☐ top of casing ☒ ground level ☐ Other

Static Level (depth to water) ft. Date:

Quality (clear, cloudy, taste, odor)

*(Attach a copy of the pumping test record, per section 1521.05, ORC)

PUMP

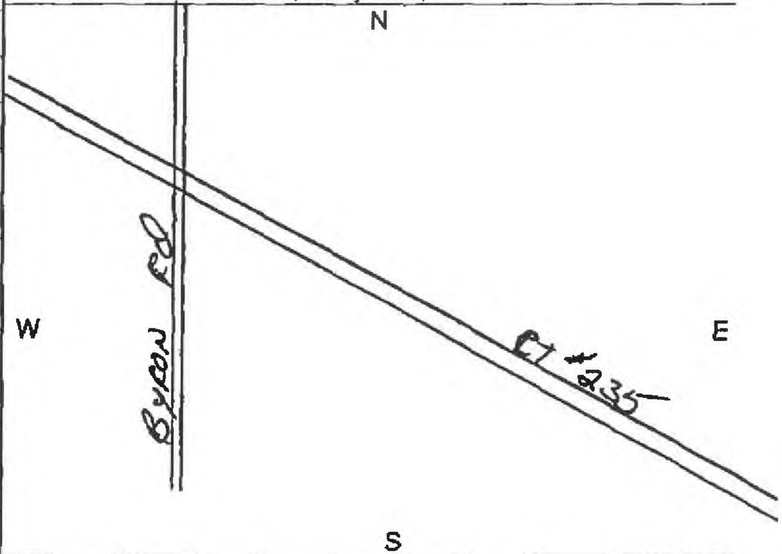
Type of pump Capacity gpm

Pump set at ft.

Pump installed by

SKETCH SHOWING WELL LOCATION

Show distances well lies from numbered state highways, street intersections, county roads, etc.



*If additional space is needed to complete well log, use next consecutively numbered form.

DNR 7802.90

Drilling Firm C. E. HAMILTON WELL DRILLING

Signed Shirley Hamilton

Ad 9449 Milton Carlisle Rd.

Date 7-30-91

WELL LOG AND DRILLING REPORT

ORIGINAL

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
Fountain Square
Columbus, Ohio 43224

NO CARBON PAPER
NECESSARY-
SELF-TRANSCRIBING

517270
Permit # 197

COUNTY Greene TOWNSHIP Bath SECTION OF TOWNSHIP

OWNER Sherry Krug ADDRESS 4350 Byron Rd.

LOCATION OF PROPERTY N/E Corner of Rt 235 and Byron Rd

CONSTRUCTION DETAILS

Casing diameter 5 5/8 Length of casing 30

Type of screen Length of screen

Type of pump Sta-Rite

Capacity of pump 4 GPM

Depth of pump setting 100 Ft.

Date of completion 11-4-1977

[✓ BAILING] OR PUMPING TEST
(specify one by circling)

Test rate 20 gallon gpm Pr Hour Duration of test 24 hrs

Drawdown 80 ft Date 10-27 1977

Static level (depth to water) 24 ft

Quality (clear, cloudy, taste, odor) Clear

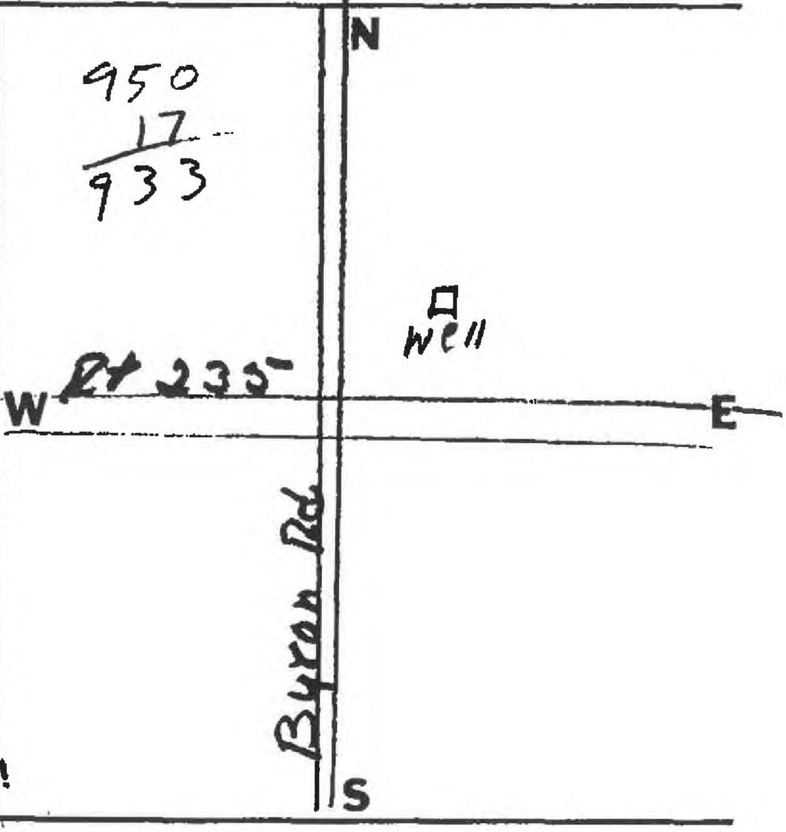
Pump installed by Homer Hall

WELL LOG*

Formations: sandstone, shale, limestone, gravel, clay	From	To
Clay	0 ft	17 ft
Shale	17	110
20 gallon Per Hour		

SKETCH SHOWING LOCATION

Locate in reference to numbered state highways, street intersections, county roads, etc.



950
17
933

DRILLING FIRM Hall's Well Drilling DATE 10-4-1977

ADDRESS 4449 Derwent Dr SIGNED Homer Hall

RB

*If additional space is needed to complete well log, use next consecutive numbered form.

ORIGINAL

WELL LOG AND DRILLING REPORT

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
1562 W. First Avenue
Columbus, Ohio 43212

PLEASE USE PENCIL
OR TYPEWRITER
DO NOT USE INK.

Nº 336177

County Green Township Bath Section of Township Beyon Rd

Owner Johann J Wilke Address 510 lexington Ave

Location of property 4520 Byeen Rd

CONSTRUCTION DETAILS

Casing diameter 5 5/8 Length of casing 32

Type of screen Length of screen

Type of pump

Capacity of pump

Depth of pump setting

Date of completion

BAILING OR PUMPING TEST

Pumping Rate 12 G.P.M. Duration of test hrs.

Drawdown 7 ft. Date

Static level-depth to water 0 ft.

Quality (clear, cloudy, taste, odor) Bailee only

Pump installed by

WELL LOG*

Formations Sandstone, shale, limestone, gravel and clay	From	To
Top Soil	0 Feet	2 Ft.
yellow clay	2	18
Blue clay	18	33
Water Gravel	33	35

SKETCH SHOWING LOCATION

Locate in reference to numbered
State Highways, St. Intersections, County roads, etc.

N.

W. E.

S.

See reverse side for instructions

Drilling Firm A. E Letts & Son

Address 2413 Valley st

Date Oct 15 - 1965

Signed W. L Letts

*If additional space is needed to complete well log, use next consecutive numbered form.

5

LOCATED

Water Well Log and Drilling Report

Ohio Department of Natural Resources
Division of Soil and Water
Phone: 614-265-6740 Fax: 614-265-6767

Well Log Number: 864447

View Image of Original Well Log

ORIGINAL OWNER AND LOCATION

Original Owner Name: *BOBBY HAWKINS*
County: *GREENE* **Township:** *BATH* **Section Number:**
Address: *4535 BYRON RD* **Lot Number:**
City: **State:** *OH* **Zip Code:** *45324*
Location Number: **Location Map Year:** **Location Area:**
Latitude: *39.806640* **Longitude:** *-83.9817*

CONSTRUCTION DETAILS

Borehole Diameter: 1: *6 in.* **Borehole Depth: 1:** *102 ft.* **Depth to Bedrock:**
2: **2:**
Casing Diameter: 1: *5.63 in.* **Casing Length: 1:** *60 ft.* **Casing Thickness: 1:** *0.188 in.*
2: **2:** **2:**
Casing Height Above Ground: **Aquifer Type:** *LIMESTONE*
Date of Completion: *11/29/2002* **Total Depth:** *102 ft.* **Well Use:** *DOMESTIC*
Driller's Name: *PHILLIPS WELL DRILLING*
Screen Diameter: **Slot Size:** **Screen Length:**
Type: **Material:**
Set Between:
Gravel Pack Material/Size: **Vol/Wt Used:**
Method of Installation: **Placed:**
Grout Material/Size: **Vol/Wt Used:**
Method of Installation: **Placed**

WELL TEST DETAILS

Static Water Level: *5 ft.* **Test Rate:** *10 gpm* **Associated Reports**
Drawdown: *30 ft.* **Test Duration:** *1 hrs.*

COMMENTS:

WELL LOG

Formations	From	To
TOP SOIL	0	2
CLAY	2	21
SAND & GRAVEL	21	34
CLAY	34	60
LIMESTONE	60	102

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Well log questions - Web site questions - Web policies

DNR 7802.94
TYPE OR USE PEN
SELF TRANSCRIBING
PRESS HARD

WELL LOG AND DRILLING REPORT

Ohio Department of Natural Resources
Divison of Water, 1939 Fountain Square Drive
Columbus, Ohio 43224 Phone (614) 265-6739

804368

Permit Number 12 98 · 1299

COUNTY Greene TOWNSHIP . Bath SECTION/LOT No. (Circle One)

[✓ OWNER]/BUILDER (Circle One or Both) Paul (First) Clevenger (Last) PROPERTY ADDRESS (Address of well location) 4297 (Number) State Rt 235 (Street) City Zip Code + 4

LOCATION OF PROPERTY 2nd well North west of House

CONSTRUCTION DETAILS

CASING *(Length below grade) Borehole Diameter 8 3/4 in.
1 Diameter 6 in. Length* 25 ft. Wall Thickness SDR21 in.
2 Diameter in. Length* ft. Wall Thickness in.
Type: 1 2 Steel 1 2 Galv. [✓ 1] 2 PVC 1 2 Other
Joints: 1 2 Threaded 1 2 Welded [✓ 1] 2 Solvent 1 2 Other
Liner: Length Type Wall Thickness in.

SCREEN
Type (wire wrapped, louvered, etc.) — Material
Length — ft. Diameter in.
Set between ft. and ft. Slot

GROUT
Material Benseal Volume used 50#
Method of installation grout pump
Depth: placed from 25 ft. to 0 ft.

GRAVEL PACK (Filter Pack)
Material Volume used
Method of installation
Depth: placed from ft. to ft.

Pitless Device ☐ Adapter ☐ Preassembled unit
Use of Well
☑ Rotary ☐ Cable ☐ Augered ☐ Driven ☐ Dug ☐ Other
Date of Completion 9-95

WELL LOG*

INDICATE DEPTH(S) AT WHICH WATER IS ENCOUNTERED.

Show color, texture, hardness, and formation: sandstone, shale, limestone, gravel, clay, sand, etc.	From	To
Clay & Limestone	0	7
Limestone	7	28
Shale - Blue	28	40
Shale - Red	40	57
Shale - Blue	57	158

*(If additional space is needed to complete well log, use next consecutively numbered form.)

WELL TEST

☐ Bailing ☐ Pumping* ☑ Other Air
Test rate 2 gpm Duration of test hrs.
Drawdown ft.
Measured from: ☐ top of casing ☑ ground level ☐ Other
Static Level (depth to water) 22 ft. Date:
Quality (clear, cloudy, taste, odor)

*(Attach a copy of the pumping test record, per section 1521.05, ORC)

PUMP

Type of pump Capacity gpm
Pump set at ft.
Pump installed by

WELL LOCATION

Location of well in State Plane coordinates, if available:
Zone x y
Elevation of well ft./m. Datum plain: ☐ NAD27 ☐ NAD83
Source of coordinates: ☐ GPS ☐ Survey ☐ Other

Sketch a map showing distance well lies from numbered state highways, street intersections, county roads, buildings or other notable landmarks.

North

West East

South

I hereby certify the information given is accurate and correct to the best of my knowledge.

Drilling Firm White's Well Drilling
Address 460 Kinsey Rd.
City, State, Zip Xenia Ohio 45385

Signed John E. White
Date 9-95
ODH Registration Number 15

Completion of this form is required by section 1521.05, Ohio Revised Code - file within 30 days after completion of drilling.

ORIGINAL COPY TO - ODNR, DIVISION OF WATER, 1939 FOUNTAIN SQ. DRIVE, COLS., OHIO 43224
Blue - Customer's copy Pink - Driller's copy Green - Local Health Dept. copy

564

X = 1,580,000 ±3,000
Y = 663,500S

LL LOG AND DRILLING REPORT

ORIGINAL

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
Columbus, Ohio

Nº 146307

County Greene Township Bath ????? Section of Township or Lot Number State Route 235

Owner Edward Linsmayer Address Xenia Pike Fairborn, Ohio

Location of property 2 Mile S.E. Fairborn, Ohio on state Route 235

CONSTRUCTION DETAILS

Casing diameter 6" Length of casing 16'
Type of screen Length of screen
Type of pump
Capacity of pump
Depth of pump setting

PUMPING TEST

Pumping rate G.P.M. Duration of test hrs.
Drawdown ft. Date
Developed capacity
Static level—depth to water 10' ft.
Pump installed by

WELL LOG

Formations Sandstone, shale, limestone, gravel and clay	From	To
Clay and Gravel	0 Feet	12 Ft.
Limestone, Brown	12	18
Water, about 8 G.P,M.	15	
Limestone, White	18	20
Limestone, Red	20	24
Limestone, Light Tan	24	28
Limestone, White	28	34
Limestone, Red	34	40
Water, Dip test about 10 G.P.M. no D.D.	40'	
Limestone, White	40	45
Shale, Gray	45	50

Water at 15' Cased off. The static level of this water is 6'

SKETCH SHOWING LOCATION

Locate in reference to numbered State Highways, St. Intersections, County roads, etc.

N.

968
12
956

W. E.

S.

See reverse side for instructions

Drilling Firm EARL HOLLANDSWORTH, INC
5872 Shull Road
Address Dayton 4, Ohio

Date May 19 1955

Signed Mallie V. Hollandsworth, Secy.

✓

120

X= 1,578,300
Y= 665,500

LL LOG AND DRILLING REPORT

ORIGINAL

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
Columbus, Ohio

Nº 137395

County Greene Township Bath Section of Township or Lot Number

Owner Universal Atlas Cement Co Address Fairborn Ohio

Location of property On Route 235 - 1½ miles east of Fairborn at farm house

CONSTRUCTION DETAILS

Casing diameter 6 Length of casing 71

Type of screen None Length of screen

Type of pump None

Capacity of pump

Depth of pump setting

PUMPING TEST

Pumping rate G.P.M. Duration of test hrs.

Drawdown ft. Date

Developed capacity Not pumped

Static level—depth to water 71 ft.

Pump installed by

WELL LOG

Formations Sandstone, shale, limestone, gravel and clay	From	To
Top Soil	0 Feet	3 Ft.
Clay	3	15
Lime stone	15	75

Greene Bath

maps [illegible]

1 3

Location #129

SKETCH SHOWING LOCATION

Locate in reference to numbered State Highways, St. Intersections, County roads, etc.

N.

W.

E.

S.

See reverse side for instructions

Drilling Firm G. M. Baker & Son Inc Date 4/2/55

Address Cols Ohio Signed Will Boyer

(129)

Water Well Log and Drilling Report

Ohio Department of Natural Resources
Division of Soil and Water
Phone: 614-265-6740 Fax: 614-265-6767

Well Log Number: 2067938

View Image of Original Well Log

ORIGINAL OWNER AND LOCATION

Original Owner Name: *RENERGY INC.*

County: *GREENE*

Township: *BATH*

Section Number:

Address: *1143 HERR RD*

Lot Number:

City:

State: *OH*

Zip Code: *45324*

Location Number:

Location Map Year:

Location Area:

Latitude: *39.811244*

Longitude: *-83.968525*

CONSTRUCTION DETAILS

Borehole Diameter: 1: *9 in.*
2:

Borehole Depth: 1: *120 ft.*
2:

Depth to Bedrock:

Casing Diameter: 1: *5 in.*
2:

Casing Length: 1: *114 ft.*
2:

Casing Thickness: 1: *0.265 in.*
2:

Casing Height Above Ground: *1*

Aquifer Type: *GRAVEL*

Date of Completion: *5/17/2018*

Total Depth: *120 ft.*

Well Use: *INDUSTRIAL*

Driller's Name: *HAMILTON & SONS WELL DRILLING*

Screen Diameter: *5 in.*

Slot Size: *0.08 in.*

Screen Length: *5 ft.*

Type: *CONTINOUS WIRE WOUND*

Material: *STAINLESS STEEL*

Set Between: *From: 60 ft. To: 65 ft.*

Gravel Pack Material/Size: *PEA GRAVEL*

Vol/Wt Used: *300 LBS.*

Method of Installation: *Tremie*

Placed: *FROM: 58 ft. TO: 65 ft.*

Grout Material/Size: *Bentonite slurry*

Vol/Wt Used: *120 GALS. / 330 LBS.*

Method of Installation: *Pumped w/Tremie pipe*

Placed *FROM: 58 ft.*

WELL TEST DETAILS

Static Water Level: *51 ft.*

Test Rate: *5 gpm*

Associated Reports

Drawdown: *9 ft.*

Test Duration: *2 hrs.*

COMMENTS:

WELL LOG

Formations	From	To
CLAY	0	6
CLAY/SAND/GRAVEL	6	59
GRAVEL	59	65
CLAY & GRAVEL	65	82
CLAY	82	112
SHALE	112	120
WATER AT	60	65

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Well log questions - Web site questions - Web policies

WELL LOG AND DRILLING REPORT

ORIGINAL

NO CARBON PAPER
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SELF-TRANSCRIBING

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
Fountain Square
Columbus, Ohio 43224

505344

COUNTY GREENE TOWNSHIP MIAMI SECTION OF TOWNSHIP

OWNER PAUL PITSTICK ADDRESS 1134 HERR RD.

LOCATION OF PROPERTY SAME ↗

CONSTRUCTION DETAILS

Casing diameter 5 5/8 Length of casing 88

Type of screen Length of screen

Type of pump SUB

Capacity of pump 15 GPM

Depth of pump setting 75'

Date of completion MAY 7, 1977

BAILING OR PUMPING TEST
(specify one by circling)

Test rate 15 gpm Duration of test 5 hrs

Drawdown 15 ft Date 5-7-77

Static level (depth to water) 37 ft

Quality (clear, cloudy, taste, odor) CLEAR

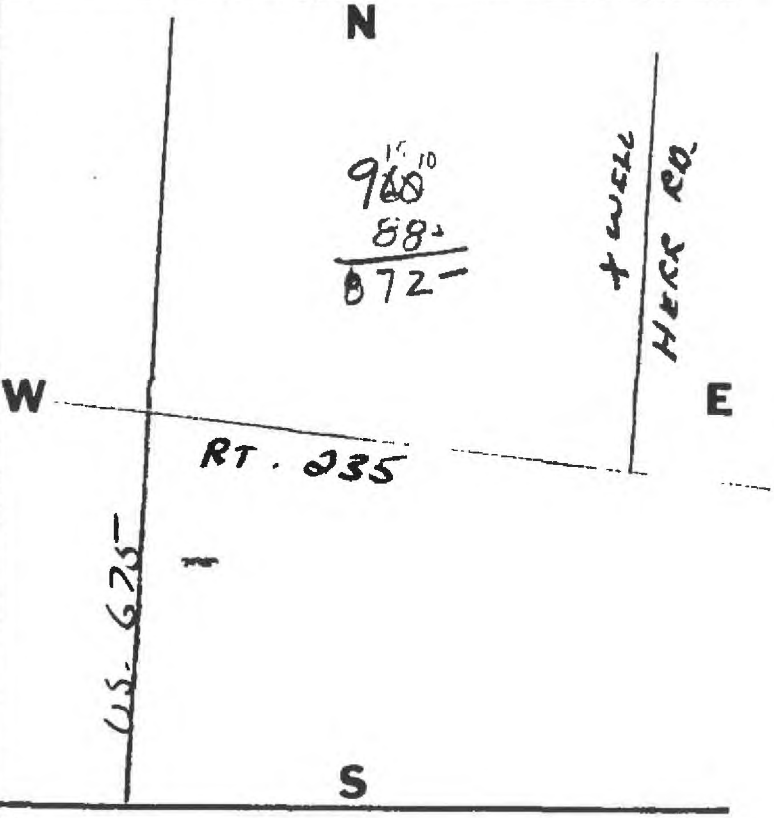
Pump installed by CHAS. E. HAMILTON

WELL LOG*

Formations: sandstone, shale, limestone, gravel, clay	From	To
CLAY	0 ft	70 ft
AND + GRAVEL	70	88
88' OVERALL		

SKETCH SHOWING LOCATION

Locate in reference to numbered state highways, street intersections, county roads, etc.



DRILLING FIRM CHAS. E. HAMILTON DATE 5-7-77

ADDRESS 616 WANETA AVE
DAYTON OHIO 45404

SIGNED Charles E Hamilton

*If additional space is needed to complete well log, use next consecutive numbered form.

125B

Water Well Log and Drilling Report

Ohio Department of Natural Resources
Division of Soil and Water
Phone: 614-265-6740 Fax: 614-265-6767

Well Log Number: 505344

View Image of Original Well Log

ORIGINAL OWNER AND LOCATION

Original Owner Name: *PAUL PITSTICK*
County: *GREENE*
Township: *BATH*
Section Number:
Address: *1134 HERR RD*
Lot Number:
City:
State: *OH*
Zip Code: *45324*
Location Number: *125*
Location Map Year: *1989*
Location Area:
Latitude: *39.812627*
Longitude: *-83.966753*

CONSTRUCTION DETAILS

Borehole Diameter: 1:
2:
Borehole Depth: 1: *88 ft.*
2:
Depth to Bedrock:
Casing Diameter: 1: *5.63 in.*
2:
Casing Length: 1: *88 ft.*
2:
Casing Thickness: 1:
2:
Casing Height Above Ground:
Aquifer Type: *SAND & GRAVEL*
Date of Completion: *5/7/1977*
Total Depth: *88 ft.*
Well Use:
Driller's Name: *HAMILTON HARRY S & SONS*
Screen Diameter:
Slot Size:
Screen Length:
Type:
Material:
Set Between:
Gravel Pack Material/Size:
Vol/Wt Used:
Method of Installation:
Placed:
Grout Material/Size:
Vol/Wt Used:
Method of Installation:
Placed

WELL TEST DETAILS

Static Water Level: *37 ft.*
Test Rate: *15 gpm*
Associated Reports
Drawdown: *15 ft.*
Test Duration: *5 hrs.*

COMMENTS:

WELL LOG

Formations	From	To
CLAY	0	70
SAND & GRAVEL	70	88

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Well log questions - Web site questions - Web policies

ORIGINAL

WELL LOG AND DRILLING REPORT

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
Fountain Square
Columbus, Ohio 43224

NO CARBON PAPER
NECESSARY–
SELF-TRANSCRIBING

505343

COUNTY GREENE TOWNSHIP MIAMI SECTION OF TOWNSHIP

OWNER PAUL PITSTICK ADDRESS 1134 HERR RD

LOCATION OF PROPERTY SAME

CONSTRUCTION DETAILS

Casing diameter 5 5/8 Length of casing 26'

Type of screen Length of screen

Type of pump —

Capacity of pump —

Depth of pump setting —

Date of completion MAY 1, 1977

[✓ BAILING] OR PUMPING TEST (specify one by circling)

Test rate 2 1/2 gpm Duration of test 2 hrs

Drawdown TOTAL ft Date 5-1-77

Static level (depth to water) 20 ft

Quality (clear, cloudy, taste, odor) CLEAR

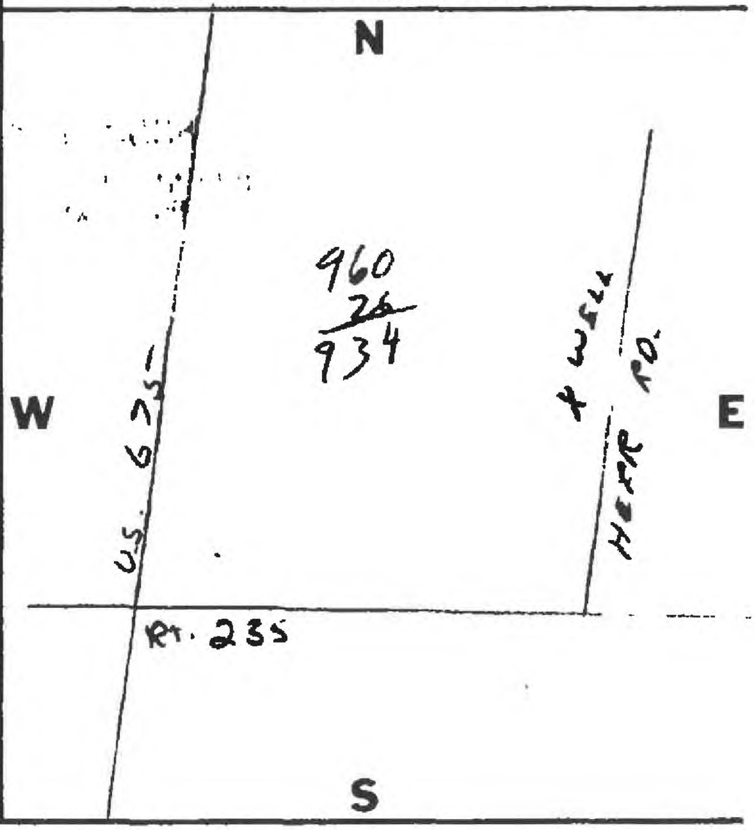
Pump installed by —

WELL LOG*

Formations: sandstone, shale, limestone, gravel, clay	From	To
CLAY	0 ft	26 ft
ROCK	26	150
150' OVERALL		

SKETCH SHOWING LOCATION

Locate in reference to numbered state highways, street intersections, county roads, etc.



DRILLING FIRM CHARLES E. HAMILTON DATE 5-1-77

ADDRESS 616 WANETA AVE SIGNED Charles E Hamilton

DAYTON, OHIO 45404

125A

*If additional space is needed to complete well log, use next consecutive numbered form.

Water Well Log and Drilling Report

Ohio Department of Natural Resources
Division of Soil and Water
Phone: 614-265-6740 Fax: 614-265-6767

Well Log Number: 505343

View Image of Original Well Log

ORIGINAL OWNER AND LOCATION

Original Owner Name: *PAUL PITSTICK*

County: *GREENE*
Township: *BATH*
Section Number:
Address: *1134 HERR RD*
Lot Number:
City:
State: *OH*
Zip Code: *45324*
Location Number: *125*
Location Map Year: *1989*
Location Area:
Latitude: *39.812627*
Longitude: *-83.966753*

CONSTRUCTION DETAILS

Borehole Diameter: 1:
2:
Borehole Depth: 1: *150 ft.*
2:
Depth to Bedrock:
Casing Diameter: 1: *5.63 in.*
2:
Casing Length: 1: *26 ft.*
2:
Casing Thickness: 1:
2:
Casing Height Above Ground:
Aquifer Type: *ROCK*
Date of Completion: *5/1/1977*
Total Depth: *150 ft.*
Well Use:
Driller's Name: *HAMILTON HARRY S & SONS*
Screen Diameter:
Slot Size:
Screen Length:
Type:
Material:
Set Between:
Gravel Pack Material/Size:
Vol/Wt Used:
Method of Installation:
Placed:
Grout Material/Size:
Vol/Wt Used:
Method of Installation:
Placed

WELL TEST DETAILS

Static Water Level: *20 ft.*
Test Rate: *3 gpm*
Associated Reports
Drawdown: *130 ft.*
Test Duration: *2 hrs.*

COMMENTS:

WELL LOG

Formations	From	To
CLAY	0	26
ROCK	26	150

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Well log questions - Web site questions - Web policies

WELL LOG AND DRILLING REPORT

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
Fountain Square
Columbus, Ohio 43224

NO CARBON PAPER
NECESSARY-
SELF-TRANSCRIBING

632858

COUNTY Greene TOWNSHIP Bath SECTION OF TOWNSHIP

OWNER Petstick & Pork Farms ADDRESS 1134 Hen Rd

LOCATION OF PROPERTY Same

CONSTRUCTION DETAILS

Casing diameter 5 5/8 Length of casing 85' approx

Type of screen SS screen No 20 slot Length of screen 9'

Type of pump Sub

Capacity of pump 20 gpm

Depth of pump setting 83'

Date of completion 10-10-85

BAILING OR [✓ PUMPING TEST]
(specify ~~one by circling~~)

Test rate 20 gpm Duration of test 4 hrs

Drawdown 4 ft Date 10-1-85

Static level (depth to water) 43 ft

Quality ([✓ clear], cloudy, taste, odor)

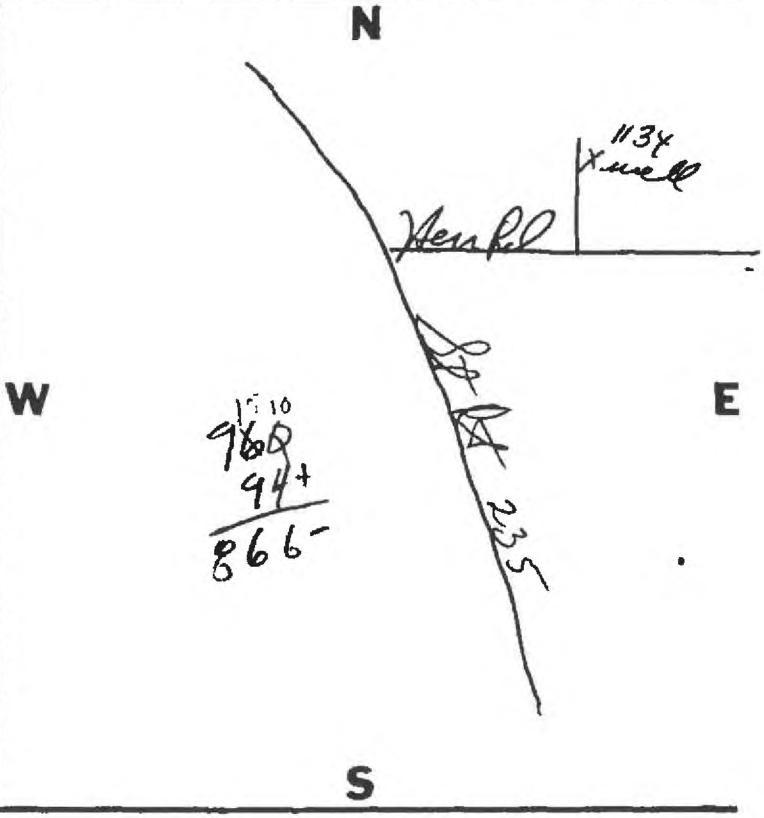
Pump installed by Jenkins Pump Service

WELL LOG*

Formations: sandstone, shale, limestone, gravel, clay	From	To
Drilled	0 ft	83 ft
Sand & Gravel	85	94

SKETCH SHOWING LOCATION

Locate in reference to numbered state highways, street intersections, county roads, etc.



DRILLING FIRM Jenkins Pump Service DATE 11-2-85

ADDRESS 1908 Turnbull Rd SIGNED John B Jenkins

*If additional space is needed to complete well log, use next consecutive numbered form.

125

ORIGINAL COPY - ODNR, DIVISION OF WATER, FOUNTAIN SQ., COLS., OHIO 43224

Water Well Log and Drilling Report

Ohio Department of Natural Resources
Division of Soil and Water
Phone: 614-265-6740 Fax: 614-265-6767

Well Log Number: 632858

View Image of Original Well Log

ORIGINAL OWNER AND LOCATION

Original Owner Name: *PIPSTICK PORK FARMS*

County: *GREENE* **Township:** *BATH* **Section Number:**

Address: *1134 HERR RD* **Lot Number:**

City: **State:** *OH* **Zip Code:** *45324*

Location Number: *125* **Location Map Year:** *1989* **Location Area:**

Latitude: *39.812627* **Longitude:** *-83.966753*

CONSTRUCTION DETAILS

Borehole Diameter: 1: **Borehole Depth: 1:** *94 ft.* **Depth to Bedrock:**

2: **2:**

Casing Diameter: 1: *5.63 in.* **Casing Length: 1:** *81 ft.* **Casing Thickness: 1:**

2: **2:** **2:**

Casing Height Above Ground: **Aquifer Type:** *SAND & GRAVEL*

Date of Completion: *11/2/1985* **Total Depth:** *94 ft.* **Well Use:**

Driller's Name: *JENKINS PUMP SALES & SERV.*

Screen Diameter: **Slot Size:** **Screen Length:**

Type: **Material:**

Set Between:

Gravel Pack Material/Size: **Vol/Wt Used:**

Method of Installation: **Placed:**

Grout Material/Size: **Vol/Wt Used:**

Method of Installation: **Placed**

WELL TEST DETAILS

Static Water Level: *43 ft.* **Test Rate:** *20 gpm* **Associated Reports**

Drawdown: *4 ft.* **Test Duration:** *4 hrs.*

COMMENTS:

WELL LOG

Formations	**From**	**To**
OLD WELL	0	83
SAND & GRAVEL	83	94

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Well log questions - Web site questions - Web policies

Water Well Log and Drilling Report

Ohio Department of Natural Resources
Division of Soil and Water
Phone: 614-265-6740 Fax: 614-265-6767

Well Log Number: 51811

View Image of Original Well Log

ORIGINAL OWNER AND LOCATION

Original Owner Name: *SAM HORNER*
County: *GREENE*
Township: *BATH*
Section Number: *9*
Address: *YELLOW SPRINGS-OSBOR RD*
Lot Number:
City:
State: *OH*
Zip Code:
Location Number: *55*
Location Map Year: *1945*
Location Area:
Latitude: *39.822284*
Longitude: *-83.968314*

CONSTRUCTION DETAILS

Borehole Diameter: 1:
2:
Borehole Depth: 1: *30 ft.*
2:
Depth to Bedrock:
Casing Diameter: 1: *6 in.*
2:
Casing Length: 1: *18 ft.*
2:
Casing Thickness: 1:
2:
Casing Height Above Ground:
Aquifer Type: *LIMESTONE*
Date of Completion: *2/10/1948*
Total Depth: *30 ft.*
Well Use:
Driller's Name: *WEAVER DON*
Screen Diameter:
Slot Size:
Screen Length:
Type:
Material:
Set Between:
Gravel Pack Material/Size:
Vol/Wt Used:
Method of Installation:
Placed:
Grout Material/Size:
Vol/Wt Used:
Method of Installation:
Placed

WELL TEST DETAILS

Static Water Level: *18 ft.*
Test Rate: *4 gpm*
Associated Reports
Drawdown: *4 ft.*
Test Duration: *2 hrs.*

COMMENTS:

WELL LOG

Formations	From	To
TOP SOIL	0	4
YELLOW CLAY	4	12
BLUE SAND & CLAY	12	19
LIMESTONE	19	30

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Well log questions - Web site questions - Web policies

Water Well Log and Drilling Report

Ohio Department of Natural Resources
Division of Soil and Water
Phone: 614-265-6740 Fax: 614-265-6767

Well Log Number: 158859

View Image of Original Well Log

ORIGINAL OWNER AND LOCATION

Original Owner Name: *ED HAMILTON*

County: *GREENE*
Township: *BATH*
Section Number: *4*
Address: *BYRON RD*
Lot Number:
City:
State: *OH*
Zip Code:
Location Number: *4*
Location Map Year: *1965*
Location Area:
Latitude: *39.820627*
Longitude: *-83.980805*

CONSTRUCTION DETAILS

Borehole Diameter: 1:
2:
Borehole Depth: 1: *40 ft.*
2:
Depth to Bedrock:
Casing Diameter: 1: *5.63 in.*
2:
Casing Length: 1: *40 ft.*
2:
Casing Thickness: 1:
2:
Casing Height Above Ground:
Aquifer Type: *GRAVEL*
Date of Completion: *10/13/1955*
Total Depth: *40 ft.*
Well Use:
Driller's Name:
Screen Diameter:
Slot Size:
Screen Length:
Type:
Material:
Set Between:
Gravel Pack Material/Size:
Vol/Wt Used:
Method of Installation:
Placed:
Grout Material/Size:
Vol/Wt Used:
Method of Installation:
Placed

WELL TEST DETAILS

Static Water Level: *8 ft.*
Test Rate: *14 gpm*
Associated Reports
Drawdown: *2 ft.*
Test Duration: *0.5 hrs.*

COMMENTS:

WELL LOG

Formations	**From**	**To**
SAND & CLAY	0	25
GRAVEL & CLAY	25	36
GRAVEL	36	40
WATER AT		36
WATER AT		40

Printing Tips (opens in new window)

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Well log questions - Web site questions - Web policies

Water Well Log and Drilling Report

Ohio Department of Natural Resources
Division of Soil and Water
Phone: 614-265-6740 Fax: 614-265-6767

Well Log Number: 345812

View Image of Original Well Log

ORIGINAL OWNER AND LOCATION

Original Owner Name: *DENNIS DARNER*
County: *GREENE*
Township: *BATH*
Section Number:
Address: *HERR RD*
Lot Number:
City:
State: *OH*
Zip Code:
Location Number: *8*
Location Map Year: *1965*
Location Area:
Latitude: *39.808019*
Longitude: *-83.975*

CONSTRUCTION DETAILS

Borehole Diameter: 1:
2:
Borehole Depth: 1: *50 ft.*
2:
Depth to Bedrock:
Casing Diameter: 1: *5.63 in.*
2:
Casing Length: 1: *30 ft.*
2:
Casing Thickness: 1:
2:
Casing Height Above Ground:
Aquifer Type: *ROCK*
Date of Completion: *5/3/1966*
Total Depth: *50 ft.*
Well Use:
Driller's Name: *LOTTS A E & SON*
Screen Diameter:
Slot Size:
Screen Length:
Type:
Material:
Set Between:
Gravel Pack Material/Size:
Vol/Wt Used:
Method of Installation:
Placed:
Grout Material/Size:
Vol/Wt Used:
Method of Installation:
Placed

WELL TEST DETAILS

Static Water Level:
Test Rate: *4 gpm*
Associated Reports
Drawdown:
Test Duration:
COMMENTS:

WELL LOG

Formations	From	To
TOP SOIL	0	2
YELLOW CLAY	2	11
BLUE SHALE	11	17
BLUE ROCK	17	50

Printing Tips (opens in new window)

Print This Page | Return to County Search

Well log questions - Web site questions - Web policies

Water Well Log and Drilling Report

Ohio Department of Natural Resources
Division of Soil and Water
Phone: 614-265-6740 Fax: 614-265-6767

Well Log Number: 864447

View Image of Original Well Log

ORIGINAL OWNER AND LOCATION

Original Owner Name: *BOBBY HAWKINS*

County: *GREENE*
Township: *BATH*
Section Number:
Address: *4535 BYRON RD*
Lot Number:
City:
State: *OH*
Zip Code: *45324*
Location Number:
Location Map Year:
Location Area:
Latitude: *39.806640*
Longitude: *-83.9817*

CONSTRUCTION DETAILS

Borehole Diameter: 1: *6 in.* **2:**
Borehole Depth: 1: *102 ft.* **2:**
Depth to Bedrock:
Casing Diameter: 1: *5.63 in.* **2:**
Casing Length: 1: *60 ft.* **2:**
Casing Thickness: 1: *0.188 in.* **2:**
Casing Height Above Ground:
Aquifer Type: *LIMESTONE*
Date of Completion: *11/29/2002*
Total Depth: *102 ft.*
Well Use: *DOMESTIC*
Driller's Name: *PHILLIPS WELL DRILLING*
Screen Diameter:
Slot Size:
Screen Length:
Type:
Material:
Set Between:
Gravel Pack Material/Size:
Vol/Wt Used:
Method of Installation:
Placed:
Grout Material/Size:
Vol/Wt Used:
Method of Installation:
Placed

WELL TEST DETAILS

Static Water Level: *5 ft.*
Test Rate: *10 gpm*
Associated Reports
Drawdown: *30 ft.*
Test Duration: *1 hrs.*

COMMENTS:

WELL LOG

Formations	From	To
TOP SOIL	0	2
CLAY	2	21
SAND & GRAVEL	21	34
CLAY	34	60
LIMESTONE	60	102

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Well log questions - Web site questions - Web policies

Water Well Log and Drilling Report

Ohio Department of Natural Resources
Division of Soil and Water
Phone: 614-265-6740 Fax: 614-265-6767

Well Log Number: 530387

View Image of Original Well Log

ORIGINAL OWNER AND LOCATION

Original Owner Name: *DENNIS DARNER*

County: *GREENE*
Township: *BATH*
Section Number:
Address: *SR 235*
Lot Number:
City:
State: *OH*
Zip Code:
Location Number: *30*
Location Map Year: *1986*
Location Area:
Latitude: *39.808253*
Longitude: *-83.973457*

CONSTRUCTION DETAILS

Borehole Diameter: 1:
2:
Borehole Depth: 1: *60 ft.*
2:
Depth to Bedrock:
Casing Diameter: 1: *5.63 in.*
2:
Casing Length: 1:
2:
Casing Thickness: 1:
2:
Casing Height Above Ground:
Aquifer Type: *ROCK*
Date of Completion: *8/31/1978*
Total Depth: *60 ft.*
Well Use:
Driller's Name: *GARRISON CLAY P*
Screen Diameter:
Slot Size:
Screen Length:
Type:
Material:
Set Between:
Gravel Pack Material/Size:
Vol/Wt Used:
Method of Installation:
Placed:
Grout Material/Size:
Vol/Wt Used:
Method of Installation:
Placed

WELL TEST DETAILS

Static Water Level: *20 ft.*
Test Rate: *6 gpm*
Associated Reports
Drawdown: *35 ft.*
Test Duration: *2 hrs.*

COMMENTS:

WELL LOG

Formations	From	To
CLAY	0	10
ROCK	10	60

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Well log questions - Web site questions - Web policies

Water Well Log and Drilling Report

Ohio Department of Natural Resources
Division of Soil and Water
Phone: 614-265-6740 Fax: 614-265-6767

Well Log Number: 657957

View Image of Original Well Log

ORIGINAL OWNER AND LOCATION

Original Owner Name: *DENNIS DARNER*

County: *GREENE*
Township: *BATH*
Section Number:
Address: *1313 HERR RD*
Lot Number:
City:
State: *OH*
Zip Code: *45324*
Location Number: *127*
Location Map Year: *1989*
Location Area:
Latitude: *39.808493*
Longitude: *-83.973599*

CONSTRUCTION DETAILS

Borehole Diameter: 1:
2:
Borehole Depth: 1: *70 ft.*
2:
Depth to Bedrock:
Casing Diameter: 1: *6 in.*
2:
Casing Length: 1: *25 ft.*
2:
Casing Thickness: 1:
2:
Casing Height Above Ground:
Aquifer Type: *SHALE*
Date of Completion: *11/7/1987*
Total Depth: *70 ft.*
Well Use:
Driller's Name: *DARBYS WELL DRILLING*
Screen Diameter:
Slot Size:
Screen Length:
Type:
Material:
Set Between:
Gravel Pack Material/Size:
Vol/Wt Used:
Method of Installation:
Placed:
Grout Material/Size:
Vol/Wt Used:
Method of Installation:
Placed

WELL TEST DETAILS

Static Water Level: *20 ft.*
Test Rate: *8 gpm*
Associated Reports
Drawdown: *45 ft.*
Test Duration: *5 hrs.*

COMMENTS:

WELL LOG

Formations	From	To
TOP SOIL	0	3
GRAVEL & CLAY	3	10
GRAVEL	10	15
GRAVEL & CLAY	15	21
BROWN LIMESTONE	21	30
SHALE & SANDSTONE	30	53
BROWN LIMESTONE	53	60
SHALE	60	70
SHALE & SANDSTONE	60	70

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Well log questions - Web site questions - Web policies

Water Well Log and Drilling Report

Ohio Department of Natural Resources
Division of Soil and Water
Phone: 614-265-6740 Fax: 614-265-6767

Well Log Number: 743024

View Image of Original Well Log

ORIGINAL OWNER AND LOCATION

Original Owner Name: *BILL BUCKEY*

County: *GREENE*
Township: *BATH*
Section Number:
Address: *4743 ARABIAN DR*
Lot Number:
City:
State: *OH*
Zip Code: *45324*
Location Number:
Location Map Year:
Location Area:
Latitude: *39.823166*
Longitude: *-83.959563*

CONSTRUCTION DETAILS

Borehole Diameter: 1:
2:
Borehole Depth: 1: *70 ft.*
2:
Depth to Bedrock:
Casing Diameter: 1: *5.63 in.*
2:
Casing Length: 1: *70 ft.*
2:
Casing Thickness: 1:
2:
Casing Height Above Ground:
Aquifer Type: *SAND & GRAVEL*
Date of Completion: *2/27/1992*
Total Depth: *70 ft.*
Well Use: *DOMESTIC*
Driller's Name: *BARKER'S WELL DRILLING, INC.*

Screen Diameter:
Slot Size:
Screen Length:
Type:
Material:
Set Between:
Gravel Pack Material/Size:
Vol/Wt Used:
Method of Installation:
Placed:
Grout Material/Size:
Vol/Wt Used:
Method of Installation:
Placed

WELL TEST DETAILS

Static Water Level: *55 ft.*
Test Rate: *10 gpm*
Associated Reports
Drawdown:
Test Duration: *1 hrs.*

COMMENTS:

WELL LOG

Formations	From	To
CLAY	0	3
DRY GRAVEL	3	55
WET SAND & GRAVEL	55	70

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Well log questions - Web site questions - Web policies

Water Well Log and Drilling Report

Ohio Department of Natural Resources
Division of Soil and Water
Phone: 614-265-6740 Fax: 614-265-6767

Well Log Number: 845598

View Image of Original Well Log

ORIGINAL OWNER AND LOCATION

Original Owner Name: *SEAN COLLEY*

County: *GREENE*

Township: *BATH*

Section Number:

Address: *4597 BYRON RD*

Lot Number:

City:

State: *OH*

Zip Code: *45324*

Location Number:

Location Map Year:

Location Area:

Latitude: *39.819140*

Longitude: *-83.980473*

CONSTRUCTION DETAILS

Borehole Diameter: 1:
2:

Borehole Depth: 1: *45 ft.*
2:

Depth to Bedrock:

Casing Diameter: 1: *5.63 in.*
2:

Casing Length: 1: *45 ft.*
2:

Casing Thickness: 1:
2:

Casing Height Above Ground:

Aquifer Type: *SAND & GRAVEL*

Date of Completion: *4/7/1997*

Total Depth: *45 ft.*

Well Use: *DOMESTIC*

Driller's Name: *BARKER'S WELL DRILLING, INC.*

Screen Diameter:

Slot Size:

Screen Length:

Type:

Material:

Set Between:

Gravel Pack Material/Size:

Vol/Wt Used:

Method of Installation:

Placed:

Grout Material/Size:

Vol/Wt Used:

Method of Installation:

Placed

WELL TEST DETAILS

Static Water Level: *15 ft.*

Test Rate: *10 gpm*

Associated Reports

Drawdown:

Test Duration: *1 hrs.*

COMMENTS:

WELL LOG

Formations	From	To
TOP SOIL	0	2
YELLOW CLAY	2	6
DRY GRAVEL	6	9
GRAY CLAY	9	41
WET SAND & GRAVEL	41	45
WATER AT		10

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Well log questions - Web site questions - Web policies

Water Well Log and Drilling Report

Ohio Department of Natural Resources
Division of Soil and Water
Phone: 614-265-6740 Fax: 614-265-6767

Well Log Number: 855709

View Image of Original Well Log

ORIGINAL OWNER AND LOCATION

Original Owner Name: *ARLIE CHILDERS*

County: *GREENE*
Township: *BATH*
Section Number:
Address: *918 HERR RD*
Lot Number:
City:
State: *OH*
Zip Code: *45324*
Location Number:
Location Map Year:
Location Area:
Latitude: *39.808310*
Longitude: *-83.9667*

CONSTRUCTION DETAILS

Borehole Diameter: 1:
2:
Borehole Depth: 1: *55 ft.*
2:
Depth to Bedrock:
Casing Diameter: 1: *5.63 in.*
2:
Casing Length: 1: *25 ft.*
2:
Casing Thickness: 1: *0.032 in.*
2:
Casing Height Above Ground:
Aquifer Type: *LIMESTONE*
Date of Completion: *11/6/1997*
Total Depth: *55 ft.*
Well Use: *DOMESTIC*
Driller's Name: *BARKER'S WELL DRILLING, INC.*
Screen Diameter:
Slot Size:
Screen Length:
Type:
Material:
Set Between:
Gravel Pack Material/Size:
Vol/Wt Used:
Method of Installation:
Placed:
Grout Material/Size:
Vol/Wt Used:
Method of Installation:
Placed

WELL TEST DETAILS

Static Water Level: *20 ft.*
Test Rate: *10 gpm*
Associated Reports
Drawdown:
Test Duration: *1 hrs.*

COMMENTS:

WELL LOG

Formations	From	To
TOP SOIL	0	1
YELLOW CLAY	1	6
DRY GRAVEL	6	25
LIMESTONE	25	55

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Well log questions - Web site questions - Web policies

Water Well Log and Drilling Report

Ohio Department of Natural Resources
Division of Soil and Water
Phone: 614-265-6740 Fax: 614-265-6767

Well Log Number: 820357

View Image of Original Well Log

ORIGINAL OWNER AND LOCATION

Original Owner Name: *JIM DOWNS*

County: *GREENE* **Township:** *BATH* **Section Number:**

Address: *1052 HERR RD* **Lot Number:**

City: **State:** *OH* **Zip Code:** *45324*

Location Number: **Location Map Year:** **Location Area:**

Latitude: *39.808034* **Longitude:** *-83.964283*

CONSTRUCTION DETAILS

Borehole Diameter: 1: **Borehole Depth: 1:** *90 ft.* **Depth to Bedrock:**

2: **2:**

Casing Diameter: 1: *6 in.* **Casing Length: 1:** *64 ft.* **Casing Thickness: 1:**

2: **2:** **2:**

Casing Height Above Ground: **Aquifer Type:** *SHALE*

Date of Completion: *9/15/1995* **Total Depth:** *90 ft.* **Well Use:** *DOMESTIC*

Driller's Name: *JENKINS PUMP SALES & SERV.*

Screen Diameter: **Slot Size:** **Screen Length:**

Type: **Material:**

Set Between:

Gravel Pack Material/Size: **Vol/Wt Used:**

Method of Installation: **Placed:**

Grout Material/Size: **Vol/Wt Used:**

Method of Installation: **Placed**

WELL TEST DETAILS

Static Water Level: *31 ft.* **Test Rate:** *10 gpm* **Associated Reports**

Drawdown: *59 ft.* **Test Duration:** *2 hrs.*

COMMENTS:

WELL LOG

Formations	From	To
CLAY	0	5
BROWN SANDY CLAY	5	30
BLUE CLAY	30	64
LIMESTONE	64	80
SHALE	80	90

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Well log questions - Web site questions - Web policies

Water Well Log and Drilling Report

Ohio Department of Natural Resources
Division of Soil and Water
Phone: 614-265-6740 Fax: 614-265-6767

Well Log Number: 963152

View Image of Original Well Log

ORIGINAL OWNER AND LOCATION

Original Owner Name: *STEVE PAULUS*
County: *GREENE*
Township: *BATH*
Section Number:
Address: *1010 HERR RD*
Lot Number:
City:
State: *OH*
Zip Code: *45324*
Location Number:
Location Map Year:
Location Area:
Latitude: *39.806150*
Longitude: *-83.95756*

CONSTRUCTION DETAILS

Borehole Diameter: 1: *8.75 in.*
2:
Borehole Depth: 1: *27 ft.*
2:
Depth to Bedrock:
Casing Diameter: 1: *6 in.*
2:
Casing Length: 1: *27.5 ft.*
2:
Casing Thickness: 1: *0.316 in.*
2:
Casing Height Above Ground: *1*
Aquifer Type: *LIMESTONE & SHALE*
Date of Completion: *8/18/2005*
Total Depth: *81 ft.*
Well Use: *DOMESTIC*
Driller's Name: *JENKINS PUMP SALES & SERV.*
Screen Diameter:
Slot Size:
Screen Length:
Type:
Material:
Set Between:
Gravel Pack Material/Size:
Vol/Wt Used:
Method of Installation:
Placed:
Grout Material/Size:
Vol/Wt Used:
Method of Installation:
Placed

WELL TEST DETAILS

Static Water Level: *19 ft.*
Test Rate: *15 gpm*
Associated Reports
Drawdown: *15 ft.*
Test Duration: *1 hrs.*

COMMENTS:

WELL LOG

Formations	From	To
CLAY	0	25
LIMESTONE	25	65
SHALE	65	81
WATER AT	48	48
WATER AT	65	65

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Well log questions - Web site questions - Web policies

DNR 7802.96

TYPE OR USE PEN
SELF TRANSCRIBING
PRESS HARD

WELL LOG AND DRILLING REPORT

Ohio Department of Natural Resources
Divison of Water, 1939 Fountain Square Drive
Columbus, Ohio 43224-9971 Voice (614) 265-6739 Fax (614) 447-9503

971403

WELL LOCATION

unty GREENE Township BATH

[✓ Owner]/Builder (Circle One or Both) JAMES (First) CHILDRESS (Last)

Address of Well Location 1038 (Number) HERR RD. (Street Name)

City FAIRBORN Zip Code +4 45324

Permit No. 31449-31450 Section/Lot No. (Circle One or Both)

Location of Well in State Plane coordinates, if available: Use of Well RESIDENTIAL

☐ N X ______ . ______ +/- ______ ft. or m

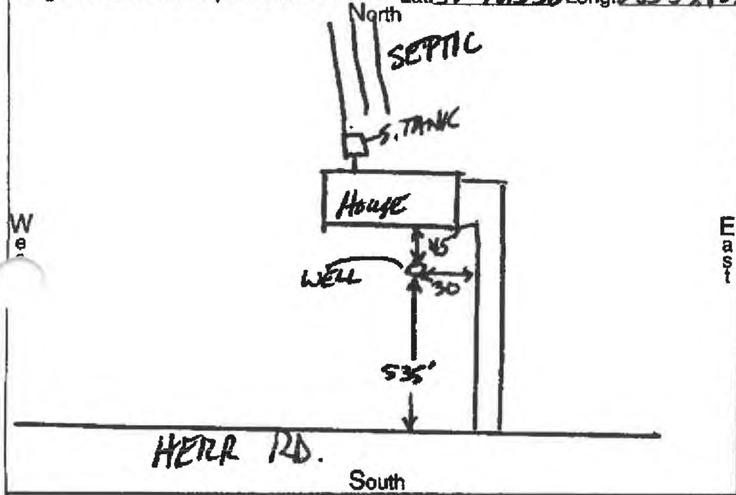
☐ S Y ______ . ______ +/- ______ ft. or m

Elevation of Well ______ . ______ +/- 1163 ft. or m

Datum Plain: ☑ NAD27 ☐ NAD83 Elevation Source GPS

Source of Coordinates: ☒ GPS ☐ Survey ☐ Other

Sketch a map showing distance well lies from numbered state highways, street intersections, county roads, buildings or other notable landmarks. If latitude and longitude are available please include here: Lat: 39°48.552 Long: 083°57.80



WELL TEST*

Pre-Pumping Static Level 18 ft. Date 1-31-05

Measured from ☒ Top of Casing ☐ Ground Level ☐ Other

☐ Air ☒ Bailing ☐ Pumping* ☐ Other

Test Rate 1.5 gpm Duration of Test 6 hrs.

Feet of Drawdown 160 ft. Sustainable Yield 1.5 gpm

*(Attach a copy of the pumping test record, per section 1521.05, ORC)

Is Copy Attached? ☐ Yes ☒ No Flowing Well? ☐ Yes ☒ No

Quality CLEAR

PUMP/PITLESS

Type of pump ½ HP Submersible Capacity 5 gpm

Pump set at 155 ft. Pitless Type LDS10

Pump Installed by HALL + JENKINS

I hereby certify the information given is accurate and correct to the best of my knowledge.

Drilling Firm HALL + JENKINS WELL DRILLING

Address 5120 DAYTON-BRANDT RD.

City, State, Zip NEW CARLISE OH 45344

ed CWD Date 1-31-05

H Registration Number 2392

CONSTRUCTION DETAILS

☐ Rotary ☒ Cable ☐ Augered ☐ Driven ☐ Other

BOREHOLE/CASING (measured from ground surface)

1☐ Borehole Diameter 5.5 inches, Depth 160 ft.

Casing Diameter 6" OD in. Length 72' ft. Thickness .188 in.

2☐ Borehole Diameter 5.5 inches, Depth 60-160 ft.

Casing Diameter 4" Liner PVC in. Length 100' ft. Thickness .260 in.

Casing Height Above Ground 20" ft.

Type 1 ☒ 2 ☒ Steel 1 ☒ 2 ☒ Galv. 1 ☐ 2 ☐ PVC 1 ☐ 2 ☐ Other

Joints 1 ☐ 2 ☐ Threaded 1 ☒ 2 ☒ Welded 1 ☐ 2 ☐ Solvent 1 ☐ 2 ☐ Other

SCREEN N/A

Diameter Slot Size Screen Length ft.

Type Material

Set Between ft. and ft.

GRAVEL PACK (Filter Pack) N/A

Material/Size Volume/Weight Used

Method of Installation

Depth: Placed FROM ft. TO ft.

GROUT

Material BENSEAL Volume/Weight Used 160 lb.

Method of Installation DRY DRIVEN

Depth: Placed FROM 0 ft. TO 72 ft.

DRILLING LOG*

INDICATE DEPTH(S) AT WHICH WATER IS ENCOUNTERED. Show color, texture, hardness, and formation: sandstone, shale, limestone, gravel, clay, sand, etc.	From	To
BROWN CLAY	0	8
DRY GRAVEL	8	27
GREY CLAY + GRAVEL	27	69
BLUE SHALE	69	73
RED SHALE WB	73	78
BLUE SHALE	78	160
WATER @ 78		

*(If more space is needed to complete drilling log, use next consecutively numbered form.)

Date of Well Completion 1-31-05 Total Depth of Well 160 ft.

Completion of this form is required by section 1521.05, Ohio Revised Code - file within 30 days after completion of drilling.

ORIGINAL COPY TO - ODNR, DIVISION OF WATER, 1939 FOUNTAIN SQ. DRIVE, COLS., OHIO 43224-9971

Blue - Customer's copy Pink - Driller's copy Green - Local Health Dept. copy

DNR 7802.05

TYPE OR USE PEN
SELF TRANSCRIBING
PRESS HARD

WELL LOG AND DRILLING REPORT

Ohio Department of Natural Resources
Division of Water, 2045 Morse Road
Columbus, Ohio 43229-6605 Voice (614) 265-6740 Fax (614) 265-6767

0999830

WELL LOCATION

County GREENE Township BATH

Owner/Builder (Circle One or Both) JAMES B. CHILDRESS (First / Last)

Address of Well Location 1038 (Number) HERR Rd. (Street Name)

City FAIRBORN Zip Code +4 45324

Permit No. 988331 Section/Lot No. (Circle One or Both) ____

Location of Well in State Plane coordinates, if available: Use of Well RESIDENTIAL

N ☐ X ____ . ____ +/- ____ ft. or m

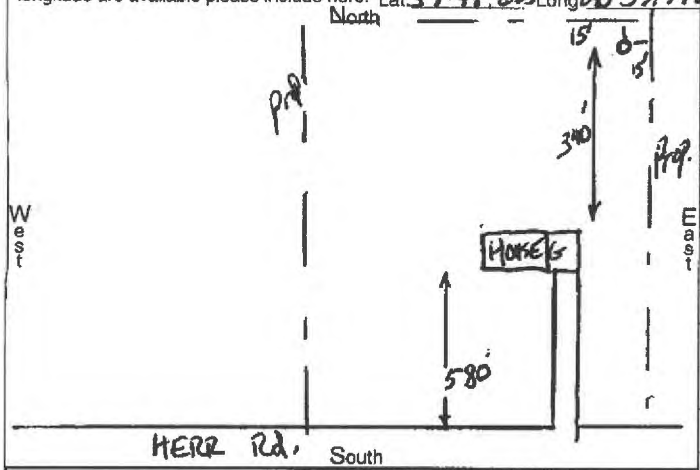
S ☐ Y ____ . ____ +/- ____ ft. or m

Elevation of Well ____ . ____ +/- 1064 ft. or m

Datum Plain: ☑ NAD27 ☐ NAD83 Elevation Source GPS

Source of Coordinates: ☑ GPS ☐ Survey ☐ Other ____

Sketch a map showing distance well lies from numbered state highways, street intersections, county roads, buildings or other notable landmarks. If latitude and longitude are available please include here: Lat: 39°48.65 Long 08°57.790



WELL TEST*

Pre-Pumping Static Level 13 ft. Date 3-22-06

Measured from: ☒ Top of Casing ☐ Ground Level ☐ Other ____

☐ Air ☒ Bailing ☒ Pumping* ☐ Other

Test Rate 30 gpm Duration of Test 2 hrs.

Feet of Drawdown 25 ft. Sustainable Yield 20+ gpm

*(Attach a copy of the pumping test record, per section 1521.05, ORC)

Is Copy Attached? ☐ Yes ☒ No Flowing Well? ☐ Yes ☒ No

Quality CLEAR

PUMP/PITLESS

Type of pump Submersible Capacity 8 gpm

Pump set at 60 ft. Pitless Type JR510

Pump installed by HALL + JENKINS

I hereby certify the information given is accurate and correct to the best of my knowledge.

Drilling Firm HALL & JENKINS WELL DRILLING

Address 5120 DAYTON-BRANDT Rd.

City, State, Zip NEW CARLISE, OH 45344

Signed CWD Date 3-22-06

ODH Registration Number 2392

CONSTRUCTION DETAILS

☐ Rotary ☑ Cable ☐ Augered ☐ Driven ☐ Other ____

BOREHOLE/CASING (measured from ground surface)

1 ☐ Borehole Diameter 5 5/8 inches Depth 74 ft.

Casing Diameter 6" OD in. Length 26.5 ft. Thickness .188 in.

2 ☐ Borehole Diameter ____ inches Depth ____ ft.

Casing Diameter 4" PVC LINER in. Length 60 ft. Thickness .260 in.

Casing Height Above Ground 18" ft.

Type 1 ☒ 2 ☒ Steel 1 ☒ 2 ☒ Galv. 1 ☐ 2 ☐ PVC 1 ☐ 2 ☐ Other ____

Joints 1 ☐ 2 ☐ Threaded 1 ☒ 2 ☒ Welded 1 ☐ 2 ☐ Solvent 1 ☐ 2 ☐ Other ____

SCREEN N/A

Diameter ____ Slot Size ____ Screen Length ____ ft.

Type ____ Material ____

Set Between ____ ft. and ____ ft.

GRAVEL PACK (Filter Pack) N/A

Material/Size ____ Volume/Weight Used ____

Method of Installation ____

Depth: Placed FROM ____ ft. TO ____ ft.

GROUT

Material BENSEAL Volume/Weight Used 40 lb.

Method of Installation DRY DRIVEN

Depth: Placed FROM 0 ft. TO 25 ft.

DRILLING LOG*

INDICATE DEPTH(S) AT WHICH WATER IS ENCOUNTERED. Show color, texture, hardness, and formation: sandstone, shale, limestone, gravel, clay, sand, etc.	From	To
BROWN CLAY	0	6
GRAVEL	6	13
CLAY + GRAVEL	13	25
LIMESTONE	25	54
BLUE SHALE	54	69
RED SHALE	69	71
BLUE SHALE	71	74
WATER AT 31		
54		
71		

*(If more space is needed to complete drilling log, use next consecutively numbered form.)

Date of Well Completion ____ Total Depth of Well ____ ft.

Completion of this form is required by section 1521.05, Ohio Revised Code - file within 30 days after completion of drilling.

ORIGINAL COPY TO - ODNR, DIVISION OF WATER, 2045 MORSE ROAD, COLS., OHIO 43229-6605

Blue - Customer's copy Pink - Driller's copy Green - Local Health Dept. copy

Water Well Log and Drilling Report

Ohio Department of Natural Resources
Division of Soil and Water
Phone: 614-265-6740 Fax: 614-265-6767

Well Log Number: 864436

View Image of Original Well Log

ORIGINAL OWNER AND LOCATION

Original Owner Name: *JOE HOLLIDAY*

County: *GREENE* **Township:** *BATH* **Section Number:**

Address: *850 HERR RD* **Lot Number:**

City: **State:** *OH* **Zip Code:** *45324*

Location Number: **Location Map Year:** **Location Area:**

Latitude: *39.808490* **Longitude:** *-83.96934*

CONSTRUCTION DETAILS

Borehole Diameter: 1: *5 in.* **2:** **Borehole Depth: 1:** *120 ft.* **2:** **Depth to Bedrock:**

Casing Diameter: 1: *6 in.* **2:** **Casing Length: 1:** *43 ft.* **2:** **Casing Thickness: 1:** *0.188 in.* **2:**

Casing Height Above Ground: **Aquifer Type:** *LIMESTONE*

Date of Completion: *6/28/2002* **Total Depth:** *120 ft.* **Well Use:**

Driller's Name: *PHILLIPS WELL DRILLING*

Screen Diameter: **Slot Size:** **Screen Length:**

Type: **Material:**

Set Between:

Gravel Pack Material/Size: **Vol/Wt Used:**

Method of Installation: **Placed:**

Grout Material/Size: **Vol/Wt Used:**

Method of Installation: **Placed**

WELL TEST DETAILS

Static Water Level: *26 ft.* **Test Rate:** *20 gpm* Associated Reports

Drawdown: *8 ft.* **Test Duration:** *1 hrs.*

COMMENTS:

WELL LOG

Formations	From	To
CLAY	0	17
DRY GRAVEL	17	26
GRAVEL & CLAY	26	43
LIMESTONE	43	120

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Well log questions - Web site questions - Web policies

Water Well Log and Drilling Report

Ohio Department of Natural Resources
Division of Soil and Water
Phone: 614-265-6740 Fax: 614-265-6767

Well Log Number: 982135

View Image of Original Well Log

ORIGINAL OWNER AND LOCATION

Original Owner Name: *GARY BAKER*

County: *GREENE* **Township:** *BATH* **Section Number:**

Address: *1577 YELLOW SPRINGS* **Lot Number:**

City: **State:** *OH* **Zip Code:** *45324*

Location Number: **Location Map Year:** **Location Area:**

Latitude: *39.8204* **Longitude:** *-83.982217*

CONSTRUCTION DETAILS

Borehole Diameter: 1: *6 in.* **Borehole Depth: 1:** *130 ft.* **Depth to Bedrock:**

2: **2:**

Casing Diameter: 1: *5 in.* **Casing Length: 1:** *67 ft.* **Casing Thickness: 1:** *0.18 in.*

2: **2:** **2:**

Casing Height Above Ground: *1* **Aquifer Type:** *LIMESTONE*

Date of Completion: *5/28/2006* **Total Depth:** *130 ft.* **Well Use:** *DOMESTIC*

Driller's Name: *PHILLIPS WELL DRILLING*

Screen Diameter: **Slot Size:** **Screen Length:**

Type: **Material:**

Set Between:

Gravel Pack Material/Size: **Vol/Wt Used:**

Method of Installation: **Placed:**

Grout Material/Size: **Vol/Wt Used:**

Method of Installation: **Placed**

WELL TEST DETAILS

Static Water Level: *65 ft.* **Test Rate:** *15 gpm* **Associated Reports**

Drawdown: *8 ft.* **Test Duration:** *1 hrs.*

COMMENTS:

WELL LOG

Formations	From	To
CLAY	0	38
GRAVEL & CLAY	38	51
CLAY	51	57
SHALE	57	121
LIMESTONE	121	130
WATER AT	121	121

Printing Tips (opens in new window)

Print This Page | Return to County Search

Well log questions - Web site questions - Web policies

Water Well Log and Drilling Report

Ohio Department of Natural Resources
Division of Soil and Water
Phone: 614-265-6740 Fax: 614-265-6767

Well Log Number: 982136

View Image of Original Well Log

ORIGINAL OWNER AND LOCATION

Original Owner Name: *CURTIS BROWN*

County: *GREENE* **Township:** *BATH* **Section Number:**

Address: *1567 YELLOW SPRINGS RD* **Lot Number:**

City: **State:** *OH* **Zip Code:** *45324*

Location Number: **Location Map Year:** **Location Area:**

Latitude: *39.818450* **Longitude:** *-83.98*

CONSTRUCTION DETAILS

Borehole Diameter: 1: *6 in.* **2:** **Borehole Depth: 1:** *130 ft.* **2:** **Depth to Bedrock:**

Casing Diameter: 1: *5 in.* **2:** **Casing Length: 1:** *67 ft.* **2:** **Casing Thickness: 1:** *0.18 in.* **2:**

Casing Height Above Ground: *1* **Aquifer Type:** *LIMESTONE*

Date of Completion: *6/2/2006* **Total Depth:** *130 ft.* **Well Use:** *DOMESTIC*

Driller's Name: *PHILLIPS WELL DRILLING*

Screen Diameter: **Slot Size:** **Screen Length:**

Type: **Material:**

Set Between:

Gravel Pack Material/Size: **Vol/Wt Used:**

Method of Installation: **Placed:**

Grout Material/Size: **Vol/Wt Used:**

Method of Installation: **Placed**

WELL TEST DETAILS

Static Water Level: *24 ft.* **Test Rate:** *15 gpm* **Associated Reports**

Drawdown: *12 ft.* **Test Duration:** *1 hrs.*

COMMENTS:

WELL LOG

Formations	From	To
TOP SOIL	0	3
CLAY	3	34
GRAVEL & CLAY	34	67
SHALE	67	121
LIMESTONE	121	130
WATER AT	121	121

Printing Tips (opens in new window)

Print This Page Return to County Search

Well log questions - Web site questions - Web policies

~~W~~ELL LOG AND DRILLING REPORT

ORIGINAL

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
1562 W. First Avenue
Columbus, Ohio 43212

PLEASE USE PENCIL OR TYPEWRITER
DO NOT USE INK.

Nº 336177

County Green Township Bath Section of Township Beyon Rd

Owner Johann J Wilke Address 510 lexington Ave

Location of property 4520 Byreen Rd

CONSTRUCTION DETAILS

Casing diameter 5 5/8 Length of casing 33

Type of screen Length of screen

Type of pump

Capacity of pump

Depth of pump setting

Date of completion

BAILING OR PUMPING TEST

Pumping Rate 12 G.P.M. Duration of test hrs.

Drawdown 7 ft. Date

Static level-depth to water 0 ft.

Quality (clear, [✓ cloudy], taste, odor) Bailer ONLY

Pump installed by

WELL LOG*

Formations Sandstone, shale, limestone, gravel and clay	From	To
Top Soil	0 Feet	2 Ft.
yellow clay	2	18
Blue clay	18	33
Water Gravel	33	35

SKETCH SHOWING LOCATION

Locate in reference to numbered State Highways, St. Intersections, County roads, etc.

N.

W. E.

S.

See reverse side for instructions

Drilling Firm A. E Letts & Son Date Oct 15 - 1965

Address 2413 Valley st Signed N L Letts

*If additional space is needed to complete well log, use next consecutive numbered form.

5
LOCATED

DNR 7802.03

TYPE OR USE PEN
SELF TRANSCRIBING
PRESS HARD

WELL LOG AND DRILLING REPORT

Ohio Department of Natural Resources
Divison of Water, 1939 Fountain Square Drive
Columbus, Ohio 43224-9971 Voice (614) 265-6740 Fax (614) 265-6767

987373

WELL LOCATION

County Greene Township BAth

Owner/Builder (Circle One or Both) Arlie (First) Childers (Last)

Address of Well Location 4739 (Number) Byron Rd. (Street Name)

City FAIRBORN Zip Code +4 45324

Permit No. 30099/30100 Section/Lot No. (Circle One or Both)

Location of Well in State Plane coordinates, if available: Use of Well domestic

N ☑ X 39° 44.843 +/- ft. or m

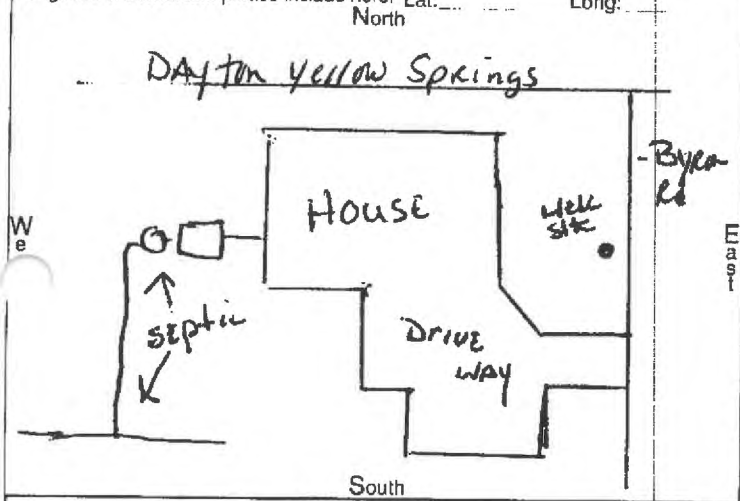
S ☐ Y 083° 58.803 +/- ft. or m

Elevation of Well +/- ft. or m

Datum Plain: ☐ NAD27 ☐ NAD83 Elevation Source

Source of Coordinates: ☑ GPS ☐ Survey ☐ Other

Sketch a map showing distance well lies from numbered state highways, street intersections, county roads, buildings or other notable landmarks. If latitude and longitude are available please include here: Lat: Long:



WELL TEST*

Pre-Pumping Static Level 0 ft. Date 6-13-05

Measured from: ☑ Top of Casing ☐ Ground Level ☐ Other

☐ Air ☐ Bailing ☑ Pumping* ☐ Other

Test Rate 10 gpm Duration of Test 6 hrs.

Feet of Drawdown 60 ft. Sustainable Yield 10 gpm

*(Attach a copy of the pumping test record, per section 1521.05, ORC)

Is Copy Attached? ☐ Yes ☐ No Flowing Well? ☐ Yes ☐ No

Quality Clear

PUMP/PITLESS

Type of pump Submersible Capacity 10 gpm

Pump set at 70 ft. Pitless Type JRS-10

Pump installed by Rick Streatton

I hereby certify the information given is accurate and correct to the best of my knowledge.

Drilling Firm Area Wide Well Drilling

Address 129 W. Plum St.

City, State, Zip Tipp City Oh 45371

Signed Rick Stratton Date

ODH Registration Number 1598

CONSTRUCTION DETAILS

☐ Rotary ☑ Cable ☐ Augered ☐ Driven ☐ Other

BOREHOLE/CASING (measured from ground surface)

1 ☑ Borehole Diameter 5 5/8 inches Depth 79 ft.

Casing Diameter 6 in. Length 79 ft. Thickness .188 in.

2 ☐ Borehole Diameter inches Depth ft.

Casing Diameter in. Length ft. Thickness in.

Casing Height Above Ground 2' ft.

Type 1 ☐ 2 ☐ Steel 1 ☑ 2 ☐ Galv. 1 ☐ 2 ☐ PVC 1 ☐ 2 ☐ Other

Joints 1 ☐ 2 ☐ Threaded 1 ☑ 2 ☐ Welded 1 ☐ 2 ☐ Solvent 1 ☐ 2 ☐ Other

SCREEN

Diameter Slot Size Screen Length ft.

Type Material

Set Between ft. and ft.

GRAVEL PACK (Filter Pack)

Material/Size Volume/Weight Used

Method of Installation

Depth: Placed FROM ft. TO ft.

GROUT

Material Bentonite Volume/Weight Used 100 lbs

Method of Installation dry pour

Depth: Placed FROM 79 ft. TO surface ft.

DRILLING LOG*

INDICATE DEPTH(S) AT WHICH WATER IS ENCOUNTERED.

Show color, texture, hardness, and formation: sandstone, shale, limestone, gravel, clay, sand, etc.	From	To
Top Soil	0	3'
SAND + gravel	3'	15'
ClAy	15'	31'
SAND + gravel - WAter Flowing	31'	39'
ClAy	39'	74'
SAnd + gRAvel	74'	79'

*(If more space is needed to complete drilling log, use next consecutively numbered form.)

Date of Well Completion 6-13-05 Total Depth of Well 79 ft.

Completion of this form is required by section 1521.05, Ohio Revised Code - file within 30 days after completion of drilling.

ORIGINAL COPY TO - ODNR, DIVISION OF WATER, 1939 FOUNTAIN SQ. DRIVE, COLS., OHIO 43224-9971

Blue - Customer's copy Pink - Driller's copy Green - Local Health Dept. copy

DNR 7802.03

TYPE OR USE PEN
SELF TRANSCRIBING
PRESS HARD

WELL LOG AND DRILLING REPORT

Ohio Department of Natural Resources
Divison of Water, 1939 Fountain Square Drive
Columbus, Ohio 43224-9971 Voice (614) 265-6740 Fax (614) 265-6767

982136

WELL LOCATION

County Green Township Bath

(Owner)/Builder (Circle One or Both) Curtis W. Brown (First / Last)

Address of Well Location 1567 (Number) Yellow Springs / Fairfield Rd (Street Name)

City Fairborn Zip Code +4 5324

Permit No. 988340 Section/Lot No. (Circle One or Both)

Location of Well in State Plane coordinates, if available: Use of Well Domestic

N X . +/- ft. or m

S Y . +/- ft. or m

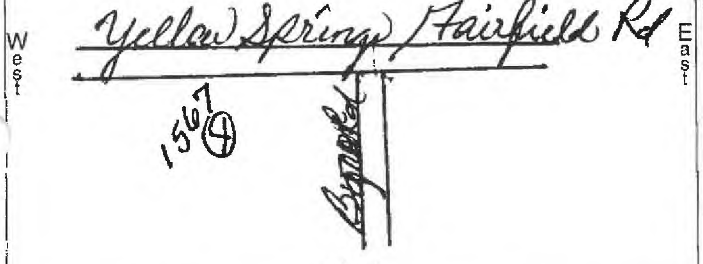
Elevation of Well . (+)- 993 (ft.) or m

Datum Plain: ☐ NAD27 ☑ NAD83 Elevation Source G.P.S.

Source of Coordinates: ☑ GPS ☐ Survey ☐ Other

Sketch a map showing distance well lies from numbered state highways, street intersections, county roads, buildings or other notable landmarks. If latitude and longitude are available please include here: Lat: N39° .49.107' Long: W083° .58.800'

North



WELL TEST*

Pre-Pumping Static Level 24 ft. Date 6/2/06

Measured from: ☑ Top of Casing ☐ Ground Level ☐ Other

☐ Air ☑ Bailing ☐ Pumping* ☐ Other

Test Rate 15 gpm Duration of Test 1 hrs.

Feet of Drawdown 12 ft. Sustainable Yield 15 gpm

*(Attach a copy of the pumping test record, per section 1521.05, ORC)

Is Copy Attached? ☐ Yes ☑ No Flowing Well? ☐ Yes ☑ No

Quality Clear

PUMP/PITLESS

Type of pump Sub Capacity 10 gpm

Pump set at 100 ft. Pitless Type Clearway

Pump installed by Driller

I hereby certify the information given is accurate and correct to the best of my knowledge.

Drilling Firm Phillips Well Drilling 6/10/06

Address 4843 Pyrmont Rd

City, State, Zip Lewisburg, Ohio 45338

Signed Edward C. Phillips Date

ODH Registration Number 313

CONSTRUCTION DETAILS

☐ Rotary ☑ Cable ☐ Augered ☐ Driven ☐ Other

BOREHOLE/CASING (measured from ground surface)

1 Borehole Diameter 6 inches Depth 130 ft.

Casing Diameter 5 5/8 in. Length 67 ft. Thickness .188 in.

2 Borehole Diameter inches Depth ft.

Casing Diameter in. Length ft. Thickness in.

Casing Height Above Ground 16"

Type 1 ☑ 2 ☐ Steel 1 ☐ 2 ☐ Galv. 1 ☐ 2 ☐ PVC 1 ☐ 2 ☐ Other

Joints 1 ☐ 2 ☐ Threaded 1 ☑ 2 ☐ Welded 1 ☐ 2 ☐ Solvent 1 ☐ 2 ☐ Other

SCREEN N/A

Diameter Slot Size Screen Length ft.

Type Material

Set Between ft. and ft.

GRAVEL PACK (Filter Pack) N/A

Material/Size Volume/Weight Used

Method of Installation

Depth: Placed FROM ft. TO ft.

GROUT

Material Bentonite Volume/Weight Used 300lbs

Method of Installation Poured

Depth: Placed FROM Surface ft. TO 67 ft.

DRILLING LOG*

INDICATE DEPTH(S) AT WHICH WATER IS ENCOUNTERED.

Show color, texture, hardness, and formation: sandstone, shale, limestone, gravel, clay, sand, etc.	From	To
Top Soil	0	3
Clay	3	34
Clay & Gravel	34	67
Shale	67	121
Limestone	121	130

Water @ 121'

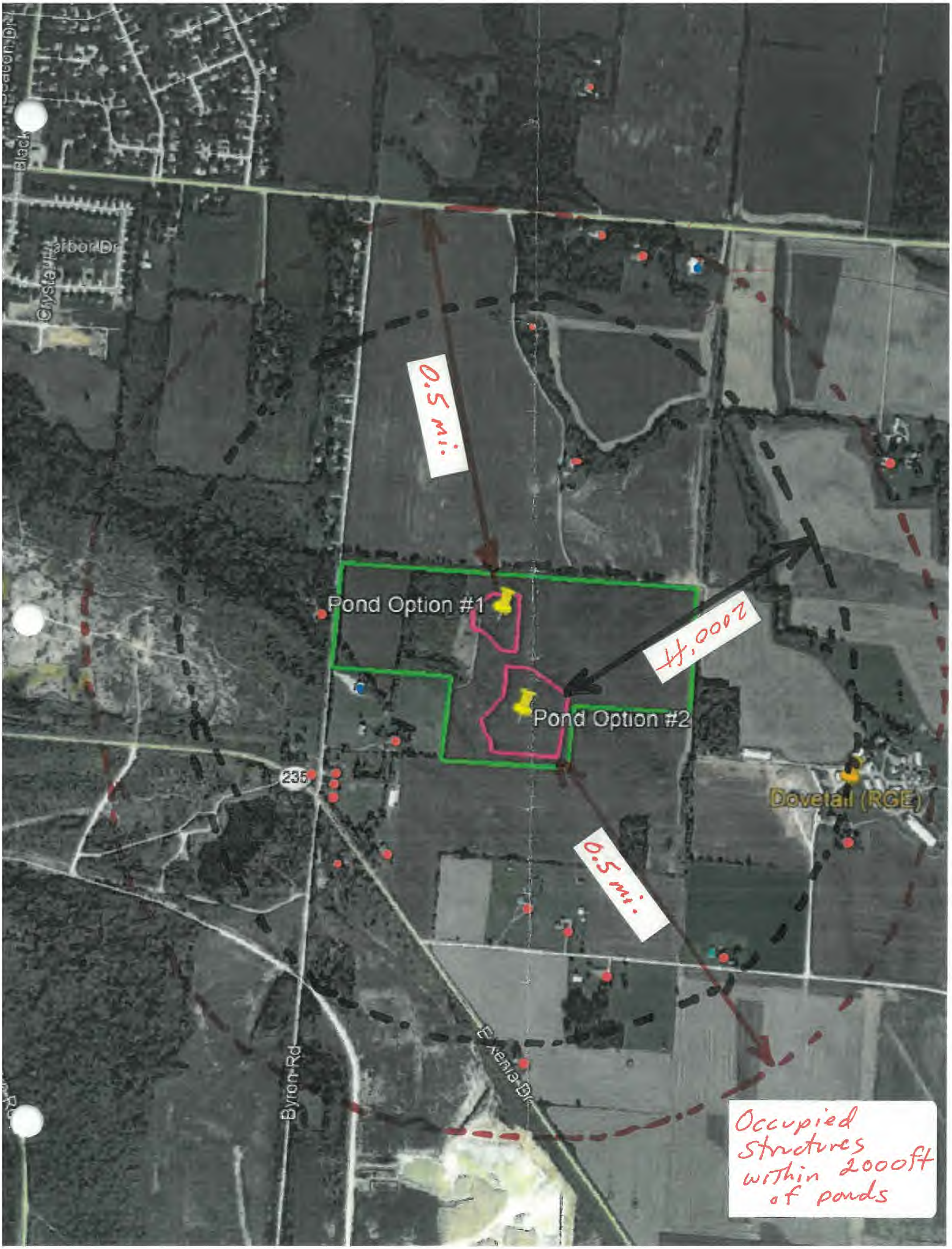
*(If more space is needed to complete drilling log, use next consecutively numbered form.)

Date of Well Completion 6/2/06 Total Depth of Well 130 ft.

Completion of this form is required by section 1521.05, Ohio Revised Code - file within 30 days after completion of drilling.

ORIGINAL COPY TO - ODNR, DIVISION OF WATER, 1939 FOUNTAIN SQ. DRIVE, COLS., OHIO 43224-9971

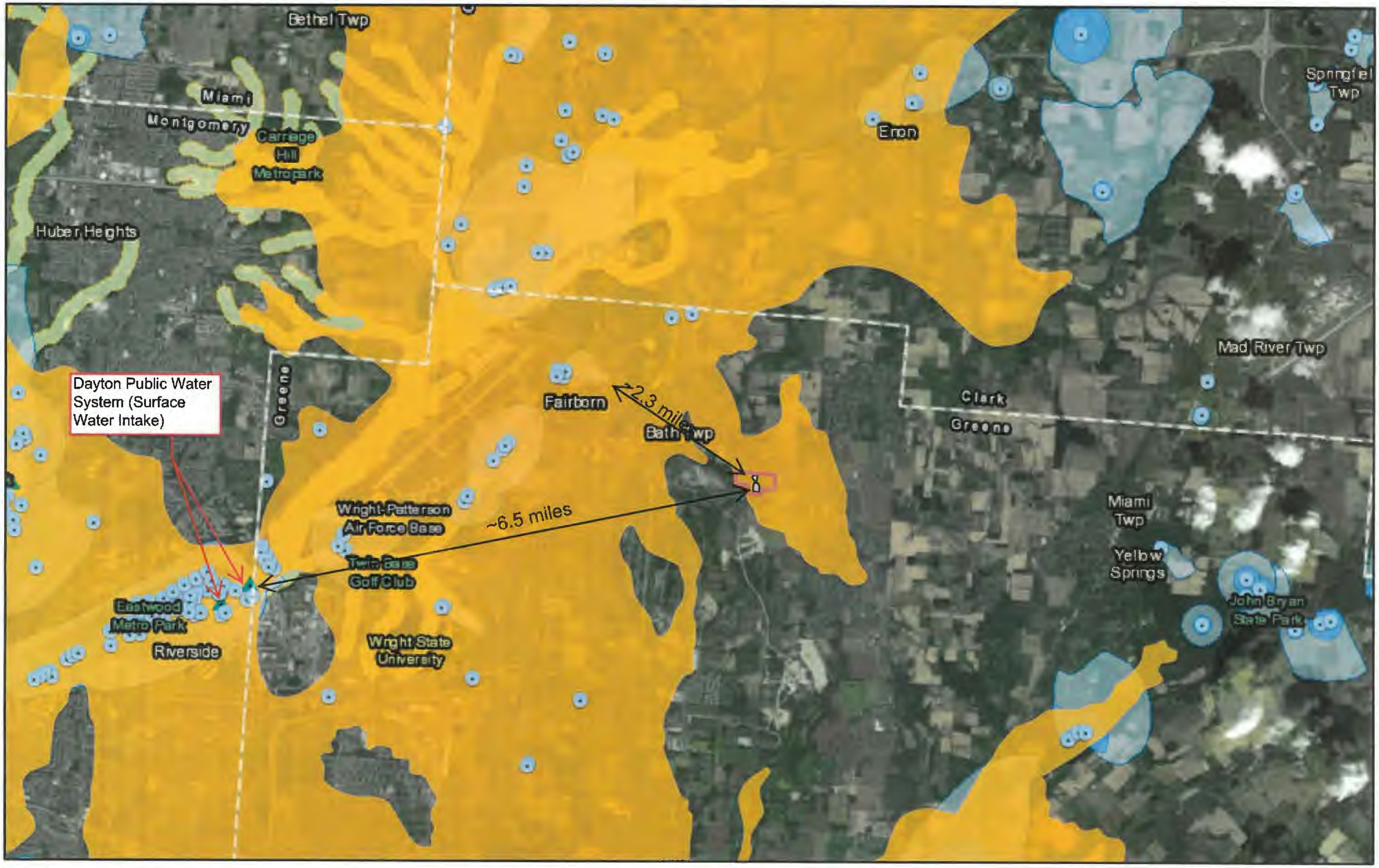
Blue - Customer's copy Pink - Driller's copy Green - Local Health Dept. copy



Occupied structures within 2000ft of ponds

APPENDIX C
Public Water Systems Listing
Drinking Water Source Protection Area Map

Drinking Water Sou e Protection Areas



4/5/2019, 11:29:09 AM

- ● Public Water System Wells
- ▲ Public Water System Intakes
- 🟧 Sole Source Aquifers
- 🟩 Ohio River-Zone of High Concern
- ☐ Ohio River-Zone of Critical Concern
- ☐ Lake Erie-Potential Influence Zone
- 🟪 Lake Erie-Critical Assessment Zone
- 🟨 Corridor Management Zone
- 🟥 Emergency Management Zone

1:144,448

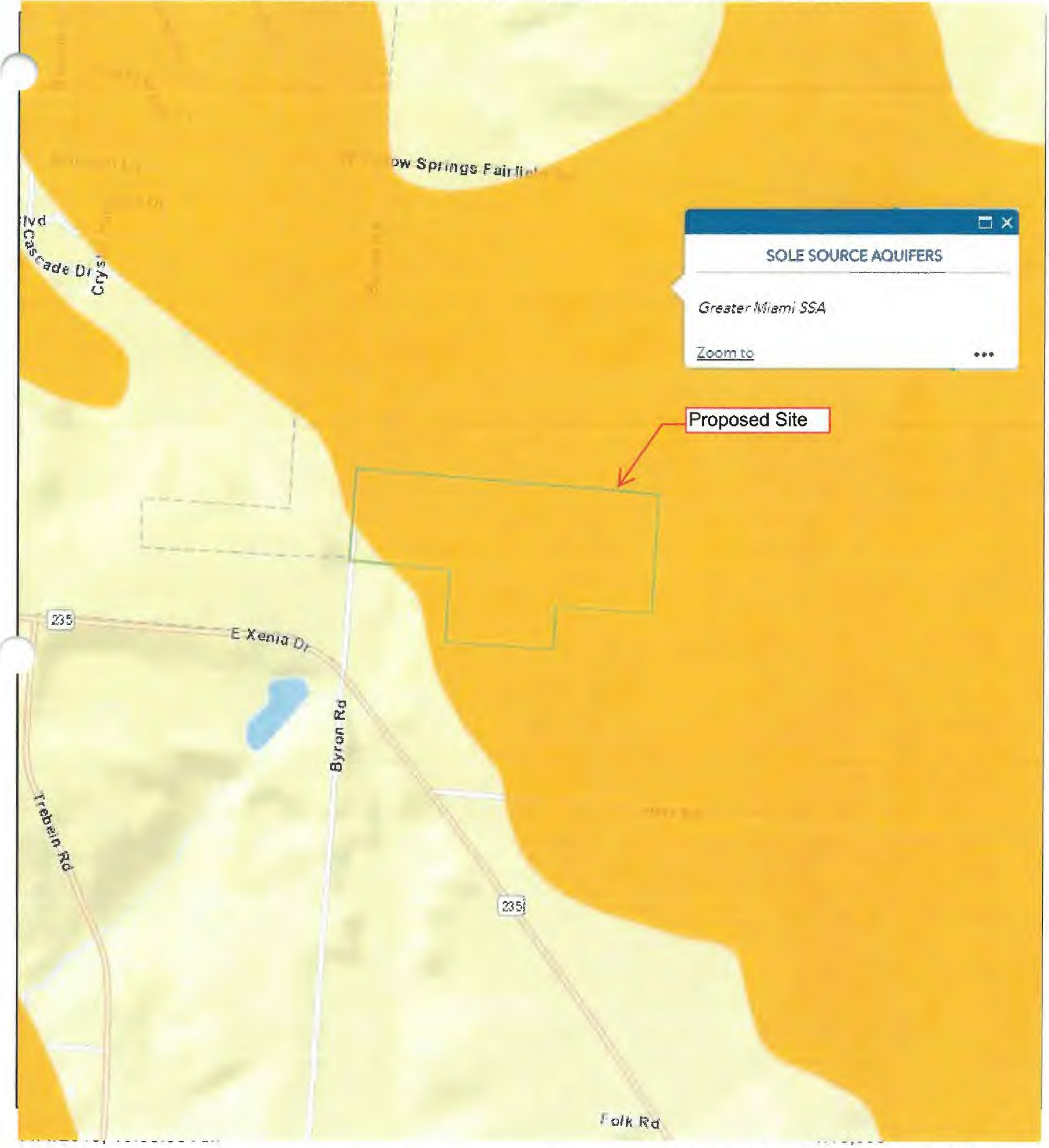
0 0.75 1.5 3 mi

0 1.5 3 6 km

Ohio EPA Division of Drinking and Groundwaters, Esri, HERE, Garmin, ©

Ohio EPA
Division of Drinking and Ground Waters

Drinking Water Source Protection Areas



🟩 Ohio River-Zone of High Concern

☐ Ohio River-Zone of Critical Concern

☐ Lake Erie-Potential Influence Zone

🟪 Lake Erie-Critical Assessment Zone

🟨 Corridor Management Zone

🟥 Emergency Management Zone

🟦 Source Water Protection Area

🟦 Inner Management Zone

0 0.1 0.2 0.4 mi

0 0.17 0.35 0.7 km

Ohio EPA Division of Drinking and Groundwaters, Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, © OpenStreetMap contributors, and the GIS User Community

APPENDIX D
Flood Insurance Rate Map (FIRM)

National Flood Hazard Layer FIRMette

FEMA

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS	🟦	Without Base Flood Elevation (BFE) *Zone A, V, A99*
		With BFE or Depth *Zone AE, AO, AH, VE, AR*
	▨	Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD	🟧	0.2% Annual Chance Flood Hazard, Are of 1% annual chance flood with averag depth less than one foot or with draina areas of less than one square mile *Zone*
	▨	Future Conditions 1% Annual Chance Flood Hazard *Zone X*
	▨	Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
	▨	Area with Flood Risk due to Levee *Zone*
OTHER AREAS	NO SCREEN	Area of Minimal Flood Hazard *Zone X*
	▭	Effective LOMRs
	▭	Area of Undetermined Flood Hazard *Zo*
GENERAL STRUCTURES	- - - -	Channel, Culvert, or Storm Sewer
	IIIIIII	Levee, Dike, or Floodwall
OTHER FEATURES	Ⓑ 20.2 / 17.5	Cross Sections with 1% Annual Chance Water Surface Elevation
	Ⓑ - - -	Coastal Transect
	~~ 513 ~~~	Base Flood Elevation Line (BFE)
	—	Limit of Study
	—	Jurisdiction Boundary
	--- ---	Coastal Transect Baseline
	- —	Profile Baseline
	—	Hydrographic Feature
MAP PANELS	☐	Digital Data Available
	⊡	No Digital Data Available
	☒	Unmapped

N

📍 The pin displayed on the map is an approxima point selected by the user and does not repres an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

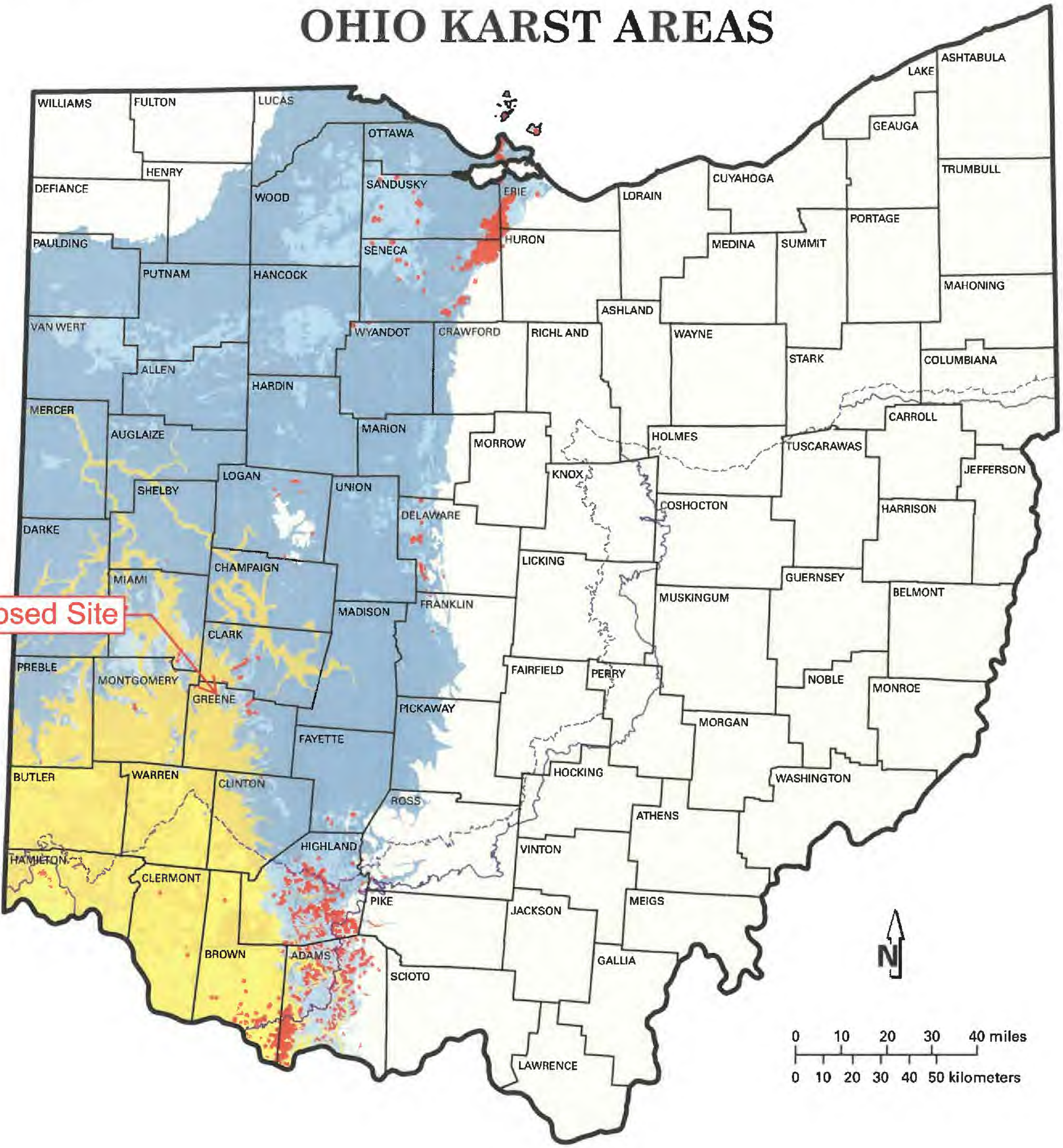
The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 11/1/2018 at 11:01:07 AM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

APPENDIX E
Ohio Karst Area

STATE OF OHIO • DEPARTMENT OF NATURAL RESOURCES • DIVISION OF GEOLOGICAL SURVEY

OHIO KARST AREAS



EXPLANATION

🟦 Silurian- and Devonian-age carbonate bedrock overlain by less than 20 feet of glacial drift and/or alluvium

🟦 Silurian- and Devonian-age carbonate bedrock overlain by more than 20 feet of glacial drift and/or alluvium

🟨 Interbedded Ordovician-age limestone and shale overlain by less than 20 feet of glacial drift and/or alluvium

🟨 Interbedded Ordovician-age limestone and shale overlain by more than 20 feet of glacial drift and/or alluvium

🟥 Probable karst areas

⬜ Area not known to contain karst features

〰 Wisconsinan Glacial Margin

〰 Illinoian Glacial Margin

Recommended citation: Ohio Division of Geological Survey, 1999 (rev. 2002, 2006), Known and probable karst in Ohio: Ohio Department of Natural Resources, Division of Geological Survey Map EG-1, generalized page-size version with text, 2 p., scale 1:2,000,000.

OHIO KARST AREAS

Karst is a landform that develops on or in limestone, dolomite, or gypsum by dissolution and that is characterized by the presence of characteristic features such as sinkholes, underground (or internal) drainage through solution-enlarged fractures (joints), and caves. While karst landforms and features are commonly striking in appearance and host to some of Ohio's rarest fauna, they also can be a significant geologic hazard. Sudden collapse of an underground cavern or opening of a sinkhole can cause surface subsidence that can severely damage or destroy any overlying structure such as a building, bridge, or highway. Improperly backfilled sinkholes are prone to both gradual and sudden subsidence, and similarly threaten overlying structures. Sewage, animal wastes, and agricultural, industrial, and ice-control chemicals entering sinkholes as surface drainage are conducted directly and quickly into the ground-water system, thereby posing a severe threat to potable water supplies. Because of such risks, many of the nation's state geological surveys, and the U.S. Geological Survey, are actively mapping and characterizing the nation's karst regions.

The five most significant Ohio karst regions are described below.

BELLEVUE-CASTALIA KARST PLAIN

The Bellevue-Castalia Karst Plain occupies portions of northeastern Seneca County, northwestern Huron County, southeastern Sandusky County, and western Erie County. Adjacent karst terrain in portions of Ottawa County, including the Marblehead Peninsula, Catawba Island, and the Bass Islands, is related in geologic origin to the Bellevue-Castalia Karst Plain. The area is underlain by up to 175 feet of Devonian carbonates (Delaware Limestone, Columbus Limestone, Lucas Dolomite, and Amherstburg Dolomite) overlying Silurian dolomite, anhydrite, and gypsum of the Bass Islands Dolomite and Salina Group.

The Bellevue-Castalia Karst Plain is believed to contain more sinkholes than any of Ohio's other karst regions. Huge, irregularly shaped, closed depressions up to 270 acres in size and commonly enclosing smaller, circular-closed depressions 5 to 80 feet in diameter pockmark the land between the village of Flat Rock in northeastern Seneca County and Castalia in western Erie County. Surface drainage on the plain is very limited, and many of the streams which are present disappear into sinkholes called swallow holes.

Karst in the Bellevue-Castalia and Lake Erie islands region is due to collapse of overlying carbonate rocks into voids created by the dissolution and removal of underlying gypsum beds. According to Verber and Stansbery (1953, Ohio Journal of Science), ground water is introduced into Salina Group anhydrite ($CaSO_4$) through pores and fractures in the overlying carbonates. The anhydrite chemically reacts with the water to form gypsum ($CaSO_4 \cdot 2H_2O$), undergoing a 33 to 62 percent increase in volume in the process. This swelling lifts overlying strata, thereby opening fractures and creating massive passageways for conduction of greater volumes of ground water through the Silurian Bass Islands Dolomite and into underlying Salina Group strata. Gypsum, being readily soluble in water, is dissolved, creating huge voids. Overlying carbonates then collapse or break down, leaving surface depressions similar to those resulting from roof failure of an underground mine.

DISSECTED NIAGARA ESCARPMENT

The dissected Niagara Escarpment of southwestern Ohio includes the largest single area of karst terrain in the state and the greatest number of surveyed caves. It also is estimated to include the second-largest number of sinkholes in the state. The area is underlain by Silurian rocks of the Peebles Dolomite, Lilley Formation, Bisher Formation, Estill Shale, and Noland Formation in Adams, Highland, and Clinton Counties and the Cedarville Dolomite, Springfield Dolomite, Euphemia Dolomite, Massie Shale, Laurel Dolomite, Osgood Shale, and Dayton Formation in Greene, Clark, Miami, Montgomery, and Preble Counties. The Peebles-Lilley-Bisher sequence and the Cedarville-Springfield-Euphemia sequence constitute the Lockport Group.

Most karst features along the Niagara Escarpment in southwestern Ohio are developed in Lockport Group strata. More than 100 sinkholes and caves developed in the Lockport have been documented in the field, and more than 1,000 probable sinkholes in the Lockport have been identified on aerial photographs, soils maps, and topographic maps. As with most karst terrain, sinkholes developed on the Niagara Escarpment commonly show linear orientations aligned with prevailing joint trends in the area. The greatest concentration of sinkholes on the escarpment is south of the Wisconsinan glacial border in southern Highland and Adams Counties, where highly dissected ridges capped by Silurian carbonate rocks rise 150 to 200 feet above surrounding drainage. Illinoian till in these areas is thin to absent, and soils are completely leached with respect to calcium and calcium-magnesium carbonate. Such geologic settings are ideal for active karst processes, as downward-percolating, naturally acidic rain water is not buffered until it has dissolved some of the underlying carbonate bedrock. Other significant karst features of the Niagara Escarpment include small caves in escarpment re-entrants created by the valleys of the Great Miami and Stillwater Rivers in Miami County.

BELLEFONTAINE OUTLIER

The Bellefontaine Outlier in Logan and northern Champaign Counties is an erosionally resistant "island" of Devonian carbonates capped by Ohio Shale and surrounded by a "sea" of Silurian strata. Though completely glaciated, the outlier was such an impediment to Ice Age glaciers that it repeatedly separated advancing ice sheets into two glacial lobes—the Miami Lobe on the west and the Scioto Lobe on the east. Most Ohioans recognize the outlier as the location of Campbell Hill—the highest point in the state at an elevation of 1,549 feet above mean sea level.

Although it is not known for having an especially well-developed karst terrain, the outlier is the location of Ohio's largest known cave, Ohio Caverns. The greatest sinkhole concentrations are present in McArthur and Rushcreek Townships of Logan County, where the density of sinkholes in some areas approaches 30 per square mile. Sinkholes here typically occur in upland areas of Devonian Lucas Dolomite or Columbus Limestone that are 30 to 50 feet or more above surrounding drainage and are covered by less than 20 feet of glacial drift and/or Ohio Shale.

SCIOTO AND OLENTANGY RIVER GORGES

The uplands adjacent to the gorges of the Scioto and Olentangy Rivers in northern Franklin and southern Delaware Counties include areas of well-developed, active karst terrain. These uplands also are among the most rapidly developing areas of the state, which means karst should be a consideration in site assessments for commercial and residential construction projects.

The Scioto River in this area has been incised to a depth of 50 to 100 feet into underlying bedrock, creating a shallow gorge. The floor, walls, and adjacent uplands of the gorge consist of Devonian Delaware and Columbus Limestones mantled by up to 20 feet of Wisconsinan till. Sinkhole concentrations up to 1 sinkhole per acre are not uncommon in Concord, Scioto, and Radnor Townships of Delaware County. The sinkholes range in diameter from about 10 to 100 feet and commonly are aligned linearly along major joint systems.

The Olentangy River is approximately 5 miles east of the Scioto River in southern Delaware County and occupies a gorge that is narrower and up to 50 feet deeper than the Scioto River gorge. The floor and the lower half of the walls along the Olentangy gorge are composed of Delaware and Columbus Limestones, the upper half of the walls is composed of Devonian Ohio and Olentangy Shales mantled by a thin veneer of glacial drift. Karst terrain has developed along portions of the gorge in a manner similar to karst terrain along the Scioto River.

ORDOVICIAN UPLANDS

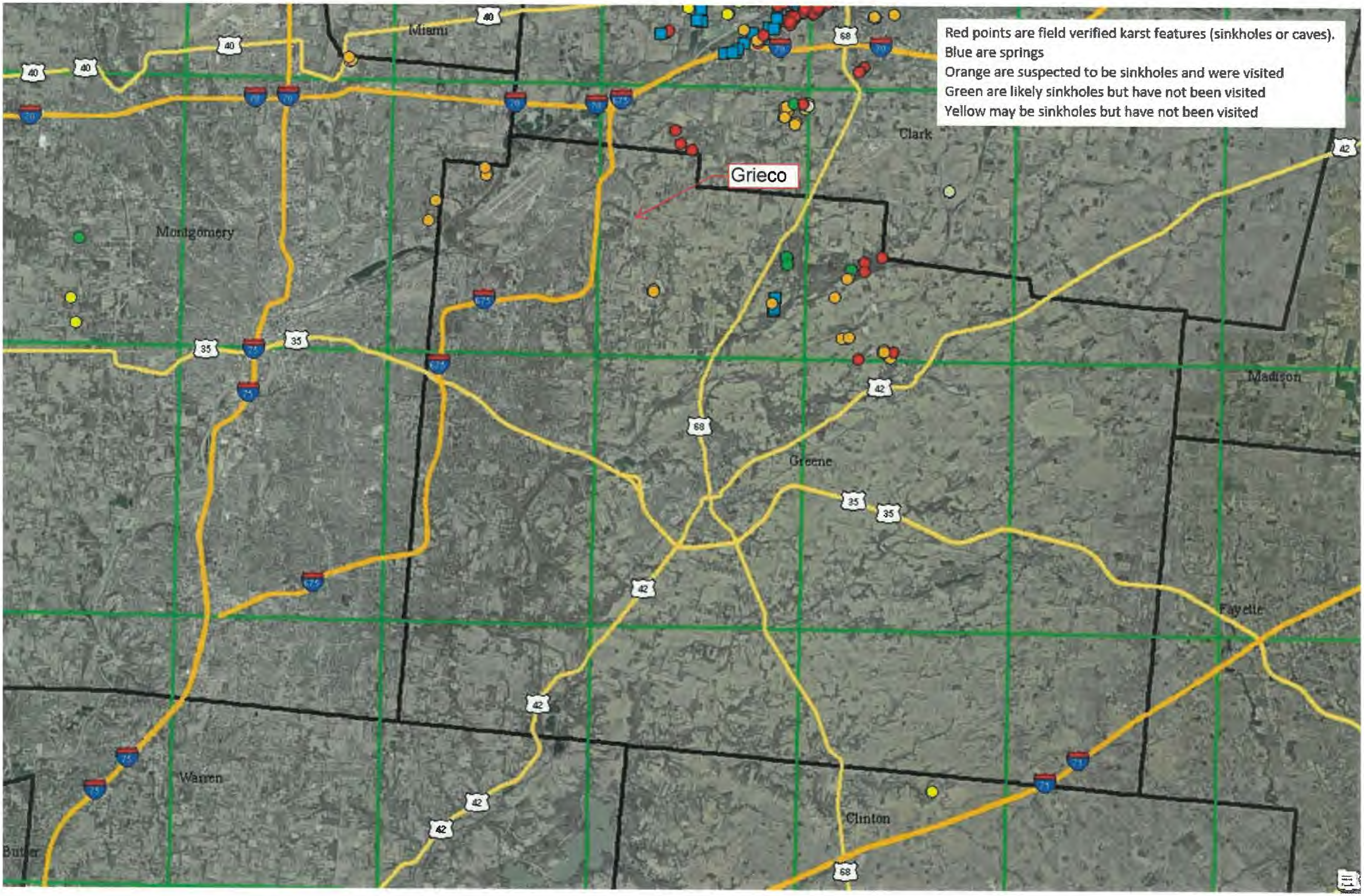
The Ordovician uplands of southwestern Ohio are the location of surprisingly well-developed karst terrain despite the large component of shale in local bedrock. Numerous sinkholes are present in Ordovician rocks of Adams, Brown, Clermont, and Hamilton Counties.

The carbonate-rich members of the Grant Lake Formation (Bellevue and Mount Auburn), Grant Lake Limestone (Bellevue and Straight Creek), and the upper portion of the Arnheim formation are the Ordovician units most prone to karstification; however, the shale-rich (70 percent shale, 30 percent limestone) Waynesville Formation also has been subjected to a surprising amount of karst development in southeastern Brown and southwestern Adams Counties, just north of the Ohio River.

ACKNOWLEDGMENT

The Division of Geological Survey gratefully acknowledges the Ohio Low-Level Radioactive-Waste Facility Development Authority for its financial support for mapping Ohio karst terrain.

GREENE COUNTY, OHIO



Obtained 2/27/2019 from Douglas Aden, ODNR Geological Survey

APPENDIX F
Underground Mines Map

Mines of Ohio

November 1, 2018

Current

- Air Shaft
- Drift Entry
- Vertical Mine Shaft
- Slope Entry

Past

- Air Shaft
- Drift Entry
- Vertical Mine Shaft
- Slope Entry
- Locations

N

0 0.075 0.15 0.3 mi

0 0.1 0.2 0.4 km

1:9,028

Ohio Dept. of Natural Resources

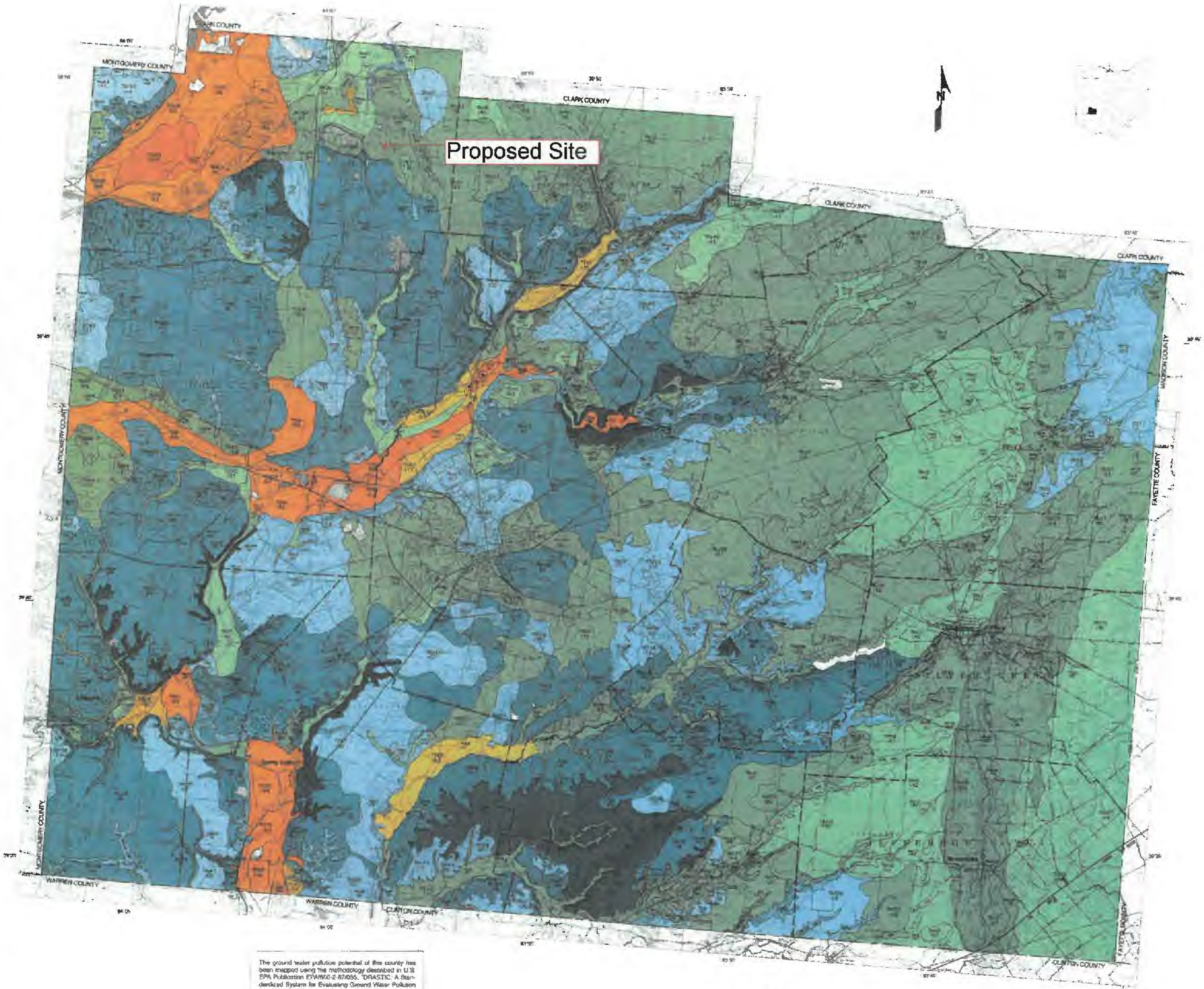
APPENDIX G

Ground Water Pollution Potential Report and Map

Ground Water Pollution Potential of GREENE COUNTY

by

Wayne Jones



2 Miles

2 Kilometers

CONTOUR INTERVAL 5 OR 10 FEET

County Line

Township Line

Incorporated City Limit

Description of Map Symbols

Hydrogeologic Region

Hydrogeologic Setting

7Ad6

98 - Relative Pollution Potential

▣ Observation Well Site *

Gravel Pit / Quarry

*Observation well sites indicate the location of wells used to collect ground water level information. These wells are part of the state observation well network. Hydrographs of the water levels recorded in these and other State observation wells can be obtained through ODNR-Division of Water.

Pollution Potential Index Range

Higher	🟧	200+
	🟧	180 - 199
	🟨	160 - 179
	🟩	140 - 159
to	🟩	120 - 139
	🟦	100 - 119
	🟦	80 - 99
Lower	⬛	< 79

Hydrogeologic Settings

7Aa – Glacial Till Over Bedded Sedimentary Rocks
7Ac – Glacial Till Over Limestone
7Af – Sand and Gravel Interbedded in Glacial Till
7Ba – Outwash
7Bb – Outwash Over Bedded Sedimentary Rock
7D – Buried Valley
7Ec – Alluvium Over Bedded Sedimentary Rocks
7Ed – Alluvium Over Glacial Till
7Ee – Alluvium Over Outwash

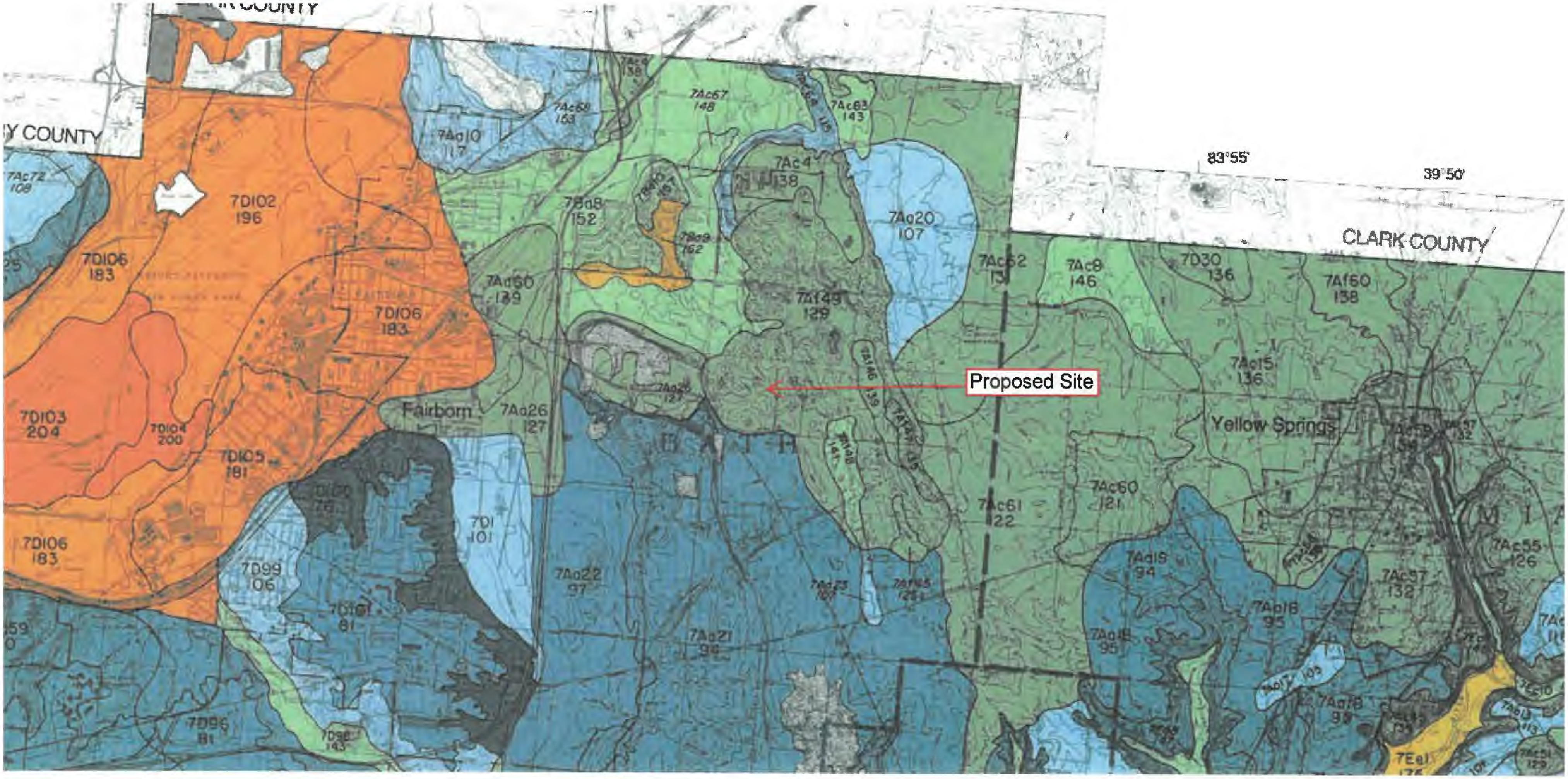
A more detailed description of the hydrogeologic settings and the evaluation of the pollution potential may be found in the publication "Ground Water Pollution Potential of Greene County," GWPP Report No. 30, Ohio Department of Natural Resources, Division of Water

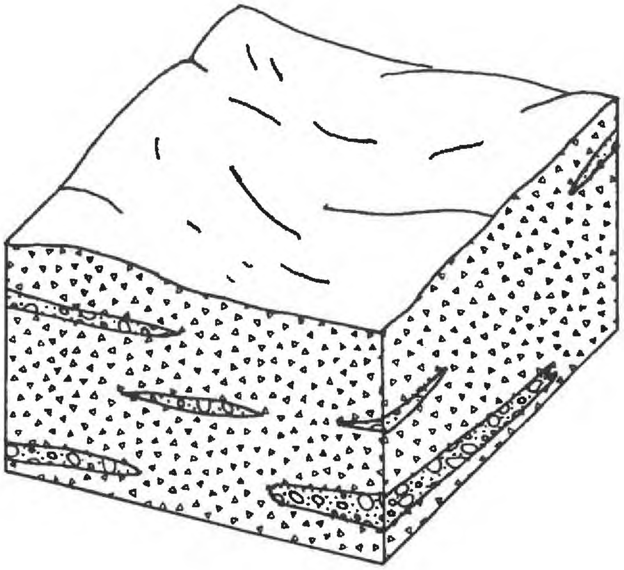
The ground water pollution potential of this county has been mapped using the methodology described in U.S. EPA Publication EPA/600-2-87/035, "DRASTIC: A Standardized System for Evaluating Ground Water Pollution Potential Using Hydrogeologic Settings" (Aller et al., 1987).

Published 1995
Ohio Department of Natural Resources
Water Resources Section
1939 Fountain Square
Columbus, Ohio 43224

J. Gerrie McCall, Cartographer

George V. Voinovich
Governor
Donald C. Anderson
Director


Proposed Site
Fairborn
Yellow Springs
CLARK COUNTY
83°55'
39°50'
7Ac67
148
7Ac68
153
7Aa10
117
7Ac4
138
7Ac83
143
7Aa20
107
7Ba8
152
7Ba9
162
7D102
196
7D106
183
7D103
204
7D104
200
7D105
181
7Ad60
139
7Af49
129
7Aa26
127
7Ac62
7Ac8
146
7D30
136
7Af60
138
7Ac15
136
7Ac60
121
7Ac61
122
7Ac72
109
7D1
101
7D99
106
7D101
81
7D96
81
7Aa22
97
7Aa21
96
7Aa19
94
7Aa16
95
7Aa18
95
7Ac57
132
7Ac55
126
7Ee1



7Af Sand and Gravel Interbedded in Glacial Till

This hydrogeologic setting is characterized by low to moderate relief and sand and gravel deposits interbedded in glacial till. The till is composed primarily of clay with varying amounts of unsorted silt, sand, and gravel. The sand and gravel may be relatively thin and discontinuous, lens-shaped bodies, or thick layers which cover a large area. The thick units are usually confined to common horizons within the till. Ground water occurs in both the till and the sand and gravel; however, the sand and gravel serves as the principal aquifer. Recharge to the sand and gravel is primarily due to infiltration of precipitation through the till. Depth to water is highly variable, but on average ranges from 5 to 50 feet. Soils are typically described as clay loams.

The GWPP index values for the hydrogeologic setting of Sand and Gravel Interbedded in Glacial Till range from 76 to 145 with the total number of GWPP index calculations equaling 61.

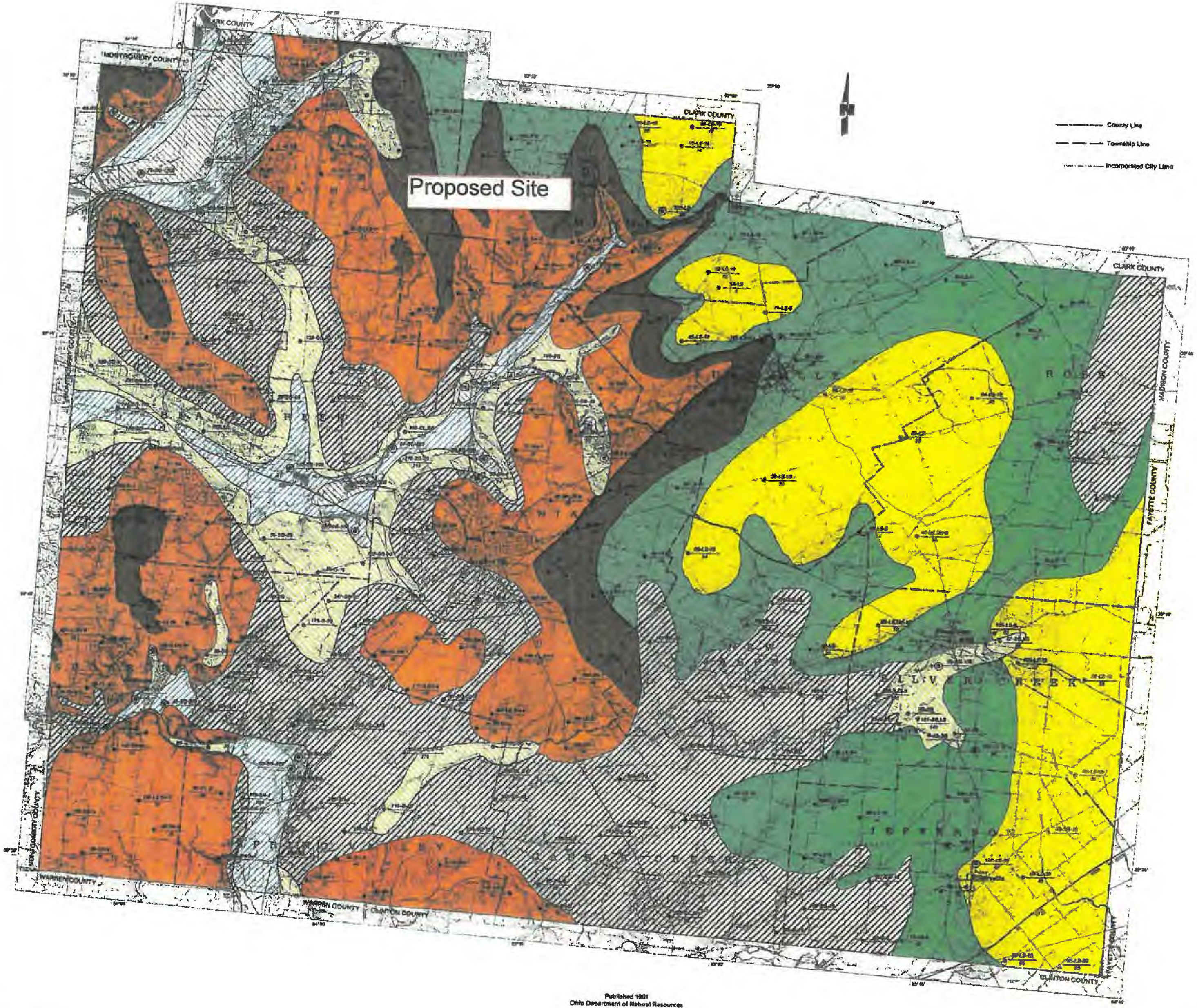
Setting	Depth to Water (feet)	Recharge (In/Yr)	Aquifer Media	Soil Media	Topography	Vadose Zone Media	Hydraulic Conductivity	Rating	Pest Rating
7Af1	15-30	4-7	Sand and Grave	Loam	0-2	Till	300-700	129	156
7Af2	15-30	2-4	Sand and Grave	Clay Loam	0-2	Till	300-700	107	128
7Af3	15-30	2-4	Sand and Grave	Clay Loam	2-6	Till	100-300	100	121
7Af4	15-30	4-7	Sand and Grave	Silty Loam	0-2	Sand & Gravel w/Silt & Clay	300-700	132	155
7Af5	15-30	4-7	Sand and Grave	Clay Loam	0-2	Sand & Gravel w/Silt & Clay	300-700	130	150
7Af6	5-15	4-7	Sand and Grave	Clay Loam	0-2	Sand & Gravel w/Silt & Clay	300-700	140	160
7Af7	15-30	2-4	Sand and Grave	Clay Loam	0-2	Till	100-300	101	124
7Af8	15-30	2-4	Sand and Grave	Clay Loam	0-2	Till	300-700	107	128
7Af9	5-15	4-7	Sand and Grave	Clay Loam	0-2	Till	300-700	140	160
7Af10	5-15	2-4	Sand and Grave	Clay Loam	0-2	Till	300-700	122	142

Setting	Depth to Water (feet)	Recharge (In/Yr)	Aquifer Media	Soil Media	Topography	Vadose Zone Media	Hydraulic Conductivity	Rating	Pest Rating
7Af11	15-30	2-4	Sand and Grave	Clay Loam	0-2	Sand & Gravel w/Silt & Clay	300-700	107	128
7Af12	15-30	2-4	Sand and Grave	Clay Loam	2-6	Till	300-700	106	125
7Af13	15-30	4-7	Sand and Grave	Clay Loam	2-6	Sand & Gravel w/Silt & Clay	300-700	124	143
7Af14	15-30	4-7	Sand and Grave	Clay Loam	0-2	Sand & Gravel w/Silt & Clay	300-700	125	146
7Af15	15-30	4-7	Sand and Grave	Sand	0-2	Sand & Gravel w/Silt & Clay	300-700	137	176
7Af16	15-30	4-7	Sand and Grave	Clay Loam	2-6	Sand & Gravel w/Silt & Clay	300-700	129	147
7Af17	15-30	4-7	Sand and Grave	Silty Loam	0-2	Sand & Gravel w/Silt & Clay	300-700	132	155
7Af18	5-15	4-7	Sand and Grave	Silty Loam	0-2	Sand & Gravel w/Silt & Clay	300-700	142	165
7Af19	5-15	4-7	Sand and Grave	Clay Loam	0-2	Sand & Gravel w/Silt & Clay	100-300	128	150
7Af20	5-15	4-7	Sand and Grave	Clay Loam	0-2	Silt and Clay	100-300	118	142
7Af21	5-15	4-7	Sand and Grave	Clay Loam	2-6	Silt and Clay	100-300	117	139
7Af22	5-15	4-7	Sand and Grave	Silty Loam	2-6	Silt and Clay	100-300	119	144
7Af23	5-15	4-7	Sand and Grave	Silty Loam	0-2	Silt and Clay	100-300	120	147
7Af24	5-15	4-7	Sand and Grave	Loam	2-6	Silt and Clay	100-300	121	149
7Af25	0-5	2-4	Sand and Grave	Silty Loam	0-2	Till	100-300	113	140
7Af26	15-30	4-7	Sand and Grave	Loam	2-6	Sand & Gravel w/Silt & Clay	100-300	121	147
7Af27	15-30	4-7	Sand and Grave	Clay Loam	2-6	Sand & Gravel w/Silt & Clay	100-300	117	137
7Af29	50-75	2-4	Sand and Grave	Clay Loam	0-2	Silt and Clay	100-300	76	100
7Af30	15-30	2-4	Sand and Grave	Clay Loam	0-2	Silt and Clay	100-300	96	120
7Af31	15-30	2-4	Sand and Grave	Silty Loam	18+	Sand & Gravel w/Silt & Clay	300-700	105	110
7Af32	30-50	2-4	Sand and Grave	Clay Loam	0-2	Silt and Clay	100-300	86	110
7Af33	15-30	2-4	Sand and Grave	Loam	2-6	Silt and Clay	100-300	99	127
7Af34	15-30	2-4	Sand and Grave	Clay Loam	2-6	Silt and Clay	100-300	95	117
7Af35	5-15	2-4	Sand and Grave	Silty Loam	0-2	Sand & Gravel w/Silt & Clay	100-300	118	143
7Af36	0-5	4-7	Sand and Grave	Loam	2-6	Sand & Gravel w/Silt & Clay	300-700	145	168
7Af37	0-5	4-7	Sand and Grave	Silty Loam	2-6	Sand & Gravel w/Silt & Clay	300-700	143	163
7Af38	15-30	2-4	Sand and Grave	Clay Loam	0-2	Silt and Clay	300-700	102	124
7Af39	15-30	2-4	Sand and Grave	Clay Loam	2-6	Silt and Clay	300-700	101	121
7Af40	30-50	2-4	Sand and Grave	Silty Loam	0-2	Sand & Gravel w/Silt & Clay	300-700	104	127
7Af41	15-30	4-7	Sand and Grave	Sand	18+	Sand & Gravel w/Silt & Clay	300-700	133	153
7Af42	30-50	2-4	Sand and Grave	Clay Loam	0-2	Sand & Gravel w/Silt & Clay	300-700	97	118
7Af43	30-50	4-7	Sand and Grave	Clay Loam	6-12	Sand & Gravel w/Silt & Clay	300-700	115	125
7Af44	15-30	4-7	Sand and Grave	Clay Loam	12-18	Sand & Gravel w/Silt & Clay	300-700	123	129
7Af45	15-30	4-7	Sand and Grave	Clay Loam	0-2	Till	300-700	125	146
7Af46	15-30	4-7	Sand and Grave	Peat	2-6	Sand & Gravel w/Silt & Clay	300-700	139	172
7Af47	15-30	4-7	Sand and Grave	Sandy Loam	2-6	Sand & Gravel w/Silt & Clay	300-700	135	162
7Af48	15-30	4-7	Sand and Grave	Sand	2-6	Sand & Gravel w/Silt & Clay	300-700	141	177
7Af49	15-30	4-7	Sand and Grave	Clay Loam	2-6	Sand & Gravel w/Silt & Clay	300-700	129	147
7Af50	15-30	4-7	Sand and Grave	Silty Loam	0-2	Till	300-700	121	145
7Af51	15-30	4-7	Sand and Grave	Silty Loam	2-6	Sand & Gravel w/Silt & Clay	300-700	131	152
7Af54	15-30	4-7	Sand and Grave	Silty Loam	2-6	Till	300-700	120	142
7Af55	30-50	2-4	Sand and Grave	Sand	12-18	Till	300-700	102	127
7Af56	15-30	4-7	Sand and Grave	Sand	0-2	Sand and Gravel	300-700	141	178
7Af57	30-50	2-4	Sand and Grave	Sand	6-12	Till	300-700	104	133
7Af58	15-30	2-4	Sand and Grave	Clay Loam	0-2	Sand & Gravel w/Silt & Clay	100-300	111	132
7Af59	15-30	4-7	Sand and Grave	Clay Loam	0-2	Till	100-300	114	138
7Af60	15-30	4-7	Sand and Grave	Silty Loam	0-2	Sand & Gravel w/Silt & Clay	700-1000	138	159
7Af61	30-50	4-7	Sand and Grave	Sandy Loam	18+	Sand & Gravel w/Silt & Clay	300-700	117	128

APPENDIX H
Ground Water Resources Map

Ground Water Resources
of
GREENE COUNTY

by
James J. Schmidt



Miles
Kilometers

CONTOUR INTERVAL 20 FEET

Well Yields

AREAS IN WHICH YIELDS OF 500 TO 1,000 OR MORE GALLONS PER MINUTE MAY BE DEVELOPED.

▨ Best ground water areas in Greene County. Permeable sand and gravel deposits beneath the floodplain of the Little Miami and Mad Rivers. Properly constructed, large diameter drilled wells may yield industrial and municipal supplies at depths ranging from 56 to 135 feet.

AREAS IN WHICH YIELDS OF 100 TO 500 GALLONS PER MINUTE MAY BE DEVELOPED.

▨ Regionally extensive, thick, permeable deposits of sand and gravel at depths of about 80 feet. Exploratory test drilling may be necessary to locate coarse deposits at depths ranging from 30 to 150 feet.

AREAS IN WHICH YIELDS OF AS MUCH AS 75 GALLONS PER MINUTE MAY BE DEVELOPED.

🟨 Niagaran limestone beneath glacial drift. Wells range in depth from 35 to 150 feet, although average well depth is less than 75 feet deep.

▭ Water-bearing deposits of sand, sand and gravel interbedded with thick layers of clayey till. Although glacial deposits may be as much as 235 feet thick, wells are often developed at depths of less than 125 feet.

AREAS IN WHICH YIELDS OF 10 TO 20 GALLONS PER MINUTE MAY BE DEVELOPED.

🟩 Relatively shallow basal Niagaran limestone aquifer yields as much as 15 gallons per minute at depths of less than 95 feet. Deeper drilling into the underlying non-water-bearing Ordovician shaly limestone is not advisable.

AREAS IN WHICH YIELDS OF 3 TO 10 GALLONS PER MINUTE MAY BE DEVELOPED.

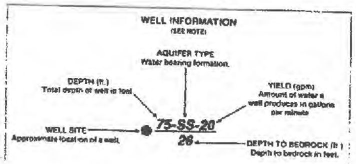
⬛ Average yields for wells developed in basal Silurian limestone bedrock ranges from 3 to 8 gallons per minute. Drilling deeper than 135 feet is not advisable owing to the presence of the non-water-bearing Ordovician bedrock. Cisterns and/or storage may be necessary for peak periods of domestic water demand.

▨ Relatively thick, unconsolidated glacial deposits of silty sand, gravel, and clayey till. Water-bearing deposits may be encountered at depths ranging from 35 to more than 300 feet. Cautious drilling advisable to attempt the development of relatively meager supplies, although potential yields greater than 100 gallons per minute may be developed from properly drilled and screened wells.

AREAS IN WHICH YIELDS OF LESS THAN 3 GALLONS PER MINUTE MAY BE DEVELOPED.

🟧 Clayey till less than 70 feet thick and overlying the non-water-bearing Ordovician shaly limestone. However, if water is present in the Ordovician strata, it usually occurs in the upper few feet where the rock is weathered and broken. Deep wells are not recommended, and daily water supply may require development of cisterns and/or storage. Occasional lenses of sand and gravel will supply small yields.

Well Site Symbols



WELL TYPES

- ● Well Site
- ○ Municipal-Industrial Well
- ☐ Observation Well**

AQUIFER TYPES

S - Sand
G - Gravel
SG - Sand and Gravel
SH - Shale
LS - Limestone
FS - Fine Sand
CL - Clay

Note

The ground water characteristics have been mapped regionally, based upon interpretations of water well records and the area's geology and hydrology. Well sites mapped were selected as typical for the areas shown.

Information regarding specific sites may be obtained from the Division of Water.

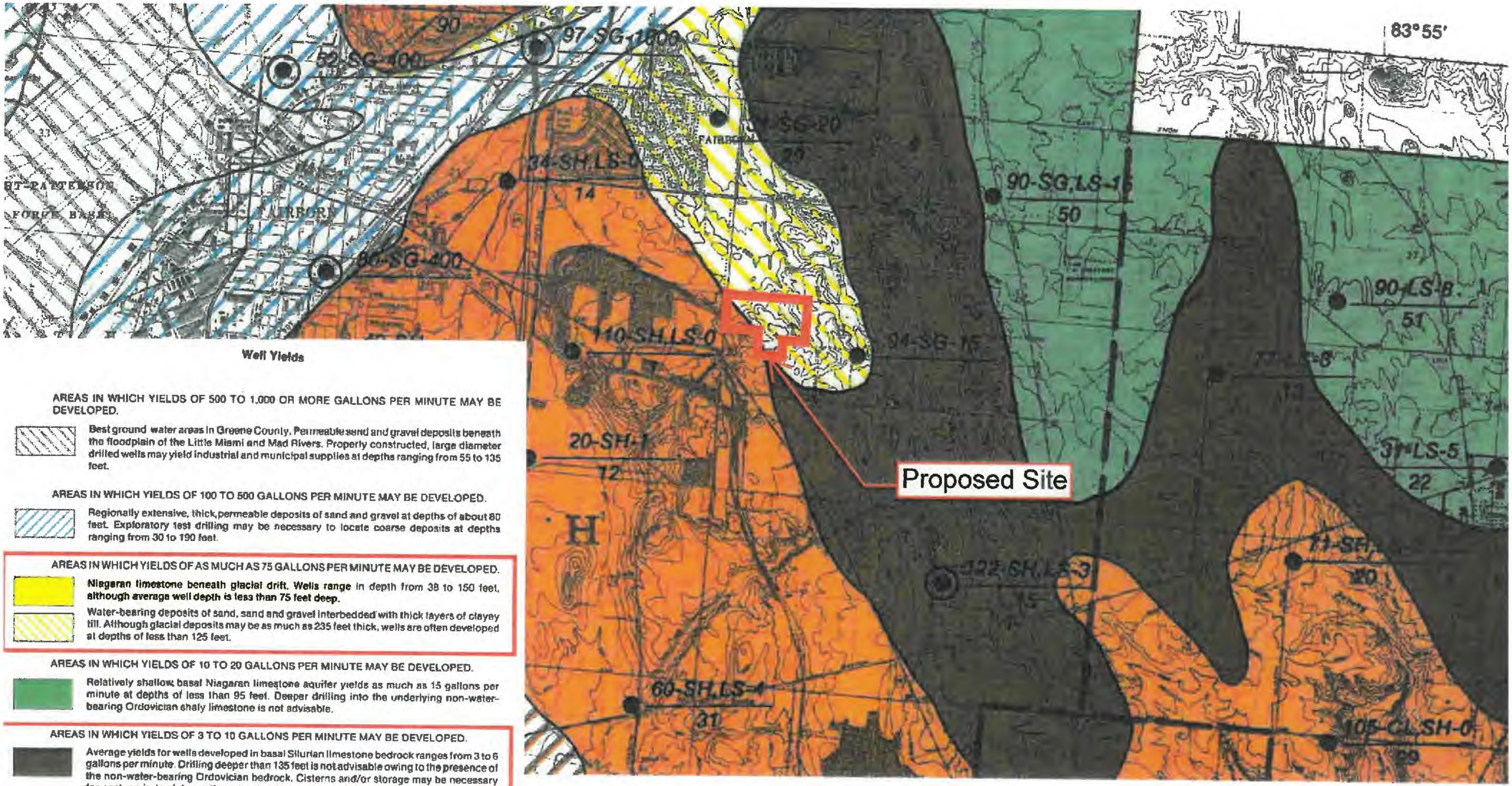
Robert L. Stewart, Cartographer

Published 1991
Ohio Department of Natural Resources
Division of Water
Ground Water Resources Section
1939 Fountain Square
Columbus, Ohio 43224

** Observation well sites indicate the location of wells used to collect ground water level information. These wells are part of the State observation well network. Hydrographs of the water levels recorded in these and other State observation wells can be obtained through ODNR-Division of Water.

ODNR

George V. Voinovich
Governor
Frances S. Buchholzer
Director



Well Yields

AREAS IN WHICH YIELDS OF 500 TO 1,000 OR MORE GALLONS PER MINUTE MAY BE DEVELOPED.

▨ Best ground water areas in Greene County. Permeable sand and gravel deposits beneath the floodplain of the Little Miami and Mad Rivers. Properly constructed, large diameter drilled wells may yield industrial and municipal supplies at depths ranging from 55 to 135 feet.

AREAS IN WHICH YIELDS OF 100 TO 500 GALLONS PER MINUTE MAY BE DEVELOPED.

▨ Regionally extensive, thick, permeable deposits of sand and gravel at depths of about 80 feet. Exploratory test drilling may be necessary to locate coarse deposits at depths ranging from 30 to 190 feet.

AREAS IN WHICH YIELDS OF AS MUCH AS 75 GALLONS PER MINUTE MAY BE DEVELOPED.

🟨 **Niagaran limestone beneath glacial drift. Wells range in depth from 38 to 150 feet, although average well depth is less than 75 feet deep.**

▨ Water-bearing deposits of sand, sand and gravel interbedded with thick layers of clayey till. Although glacial deposits may be as much as 235 feet thick, wells are often developed at depths of less than 125 feet.

AREAS IN WHICH YIELDS OF 10 TO 20 GALLONS PER MINUTE MAY BE DEVELOPED.

🟩 Relatively shallow, basal Niagaran limestone aquifer yields as much as 15 gallons per minute at depths of less than 95 feet. Deeper drilling into the underlying non-water-bearing Ordovician shaly limestone is not advisable.

AREAS IN WHICH YIELDS OF 3 TO 10 GALLONS PER MINUTE MAY BE DEVELOPED.

⬛ Average yields for wells developed in basal Silurian limestone bedrock ranges from 3 to 6 gallons per minute. Drilling deeper than 135 feet is not advisable owing to the presence of the non-water-bearing Ordovician bedrock. Cisterns and/or storage may be necessary for peak periods of domestic water demand.

▨ Relatively thick, unconsolidated glacial deposits of silty sand, gravel, and clayey till. Water-bearing deposits may be encountered at depths ranging from 35 to more than 300 feet. Cautious drilling advisable to attempt the development of relatively meager supplies, although potential yields greater than 100 gallons per minute may be developed from properly drilled and screened wells.

AREAS IN WHICH YIELDS OF LESS THAN 3 GALLONS PER MINUTE MAY BE DEVELOPED.

🟧 Clayey till less than 70 feet thick and overlying the non-water-bearing Ordovician shaly limestone. However, if water is present in the Ordovician strata, it usually occurs in the upper few feet where the rock is weathered and broken. Deep wells are not recommended, and daily water supply may require development of cisterns and/or storage. Occasional lenses of sand and gravel will supply small yields.

APPENDIX I
Soil Survey

Soil Map—Greene County, Ohio
(Dovetail Energy)

Map Scale: 1:4,400 if printed on A landscape (11" x 8.5") sheet.

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 17N WGS84

MAP LEGEND

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

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

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.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

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: Greene County, Ohio
Survey Area Data: Version 16, Jan 30, 2019

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

Date(s) aerial images were photographed: Oct 14, 2015—Mar 28, 2017

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.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
Ag	Algiers silt loam	8.9	17.7%
Bs	Brookston silty clay loam, fine texture, 0 to 2 percent slopes	1.7	3.3%
EmB2	Eldean silt loam, 2 to 6 percent slopes, moderately eroded	10.1	19.9%
MmD2	Miamian-Casco complex, 12 to 18 percent slopes, moderately eroded	6.0	11.8%
MoB2	Miamian-Eldean silt loams, 2 to 6 percent slopes, moderately eroded	6.1	12.0%
MoC2	Miamian-Eldean silt loams, 6 to 12 percent slopes, moderately eroded	15.5	30.6%
MtB	Milton silt loam, 2 to 6 percent slopes	0.5	1.0%
MtC2	Milton silt loam, 6 to 12 percent slopes, moderately eroded	0.3	0.5%
Ws	Westland silty clay loam, Southern Ohio Till Plain, 0 to 2 percent slopes	1.6	3.2%
Totals for Area of Interest		**50.6**	**100.0%**

APPENDIX J
Wetlands Map

U.S. Fish and Wildlife Service

National Wetlands Inventory

Renergy, Inc. - Grieco Site

November 1, 2018

Wetlands

- 🟦 Estuarine and Marine Deepwater
- 🟦 Estuarine and Marine Wetland
- 🟩 Freshwater Emergent Wetland
- 🟩 Freshwater Forested/Shrub Wetland
- 🟦 Freshwater Pond
- 🟦 Lake
- 🟫 Other
- 🟦 Riverine

This map is for general reference only. The US Fish and Wildlife Service is not responsible for the accuracy or currentness of the base data shown on this map. All wetlands related data should be used in accordance with the layer metadata found on the Wetlands Mapper web site.

National Wetlands Inventory (NWI)
This page was produced by the NWI mapper

MAD SCIENTIST ASSOCIATES LLC

Memorandum: Grieco Property Wetland Delineation & Assessment Results

Summary of Observations		
☒ Jurisdictional Waters (Wetlands/Streams)	☐ Isolated Wetlands	☐ T&E Species/Habitat
Recommended Actions		
If impacts to the wetland features are anticipated, then permits through the Ohio Environmental Protection Agency (Ohio EPA) and/or U.S. Army Corps of Engineers (USACE) may be required.		

Date: 2/19/2019

To: Logan Randles, Renergy, Inc.

From: Jenna Odegard and Mark Dilley, MAD Scientist Associates, LLC

RE: Wetland Delineation and Assessment for Grieco Property near Byron Road in Fairborn, OH

Introduction

On behalf of Renergy Inc., North Point Engineering hired MAD Scientist Associates, LLC (MAD) to provide wetland consulting services for an approximately 0.5-acre area on the Grieco Property near Byron Road in Fairborn, Greene County, Ohio (Figure 1). To determine the potential location for a pond that is planned to be installed with a required 300-foot buffer separating it from any wetlands, MAD performed a field-based wetland determination and delineation of the National Wetland Inventory-mapped wetlands. Field work was completed on February 15, 2019, while weather conditions were partly sunny with cool temperatures averaging about 38 degrees.

Wetland conditions were confirmed according to the methods presented in the Midwest Regional Supplement (Version 2.0; USACE, 2010) to the 1987 USACE Wetlands Delineation Manual (Environmental Laboratory, 1987). MAD did not assess the quality of these wetlands according to the methods described in the Ohio Rapid Assessment Method for Wetlands v 5.0 (ORAM; Ohio EPA, 2001) as the wetlands are not planned to be impacted.

Observations of channels with a defined bed and bank and discernable ordinary high water mark (OHWM) were used to identify the presence of streams at the Site. The Team looked for evidence of scour, sorting of materials, and typical biological assemblages (fish, macroinvertebrates, amphibians) as additional evidence of stream functioning.

A general description of the Site, summary of wetland and stream findings, and attached figures, photolog and data forms are provided in the following sections.

General Site Description

The survey area to be delineated is centered approximately on the following coordinates: 39.814015°, -83.977484° (WGS 84). It is bordered by Byron Road to the west and active agricultural fields to the north, east and south (Figure 2; Attachment A, Photographs 1-2). The survey area is located in the Huffman Dam-Mad River Hydrologic Unit Code (HUC12 050800011903). According to the Natural Resources Conservation Service (NRCS), the soil is composed of the somewhat poorly drained Algiers silt loam (USDA, 2018; Attachment B). The site immediately surrounding the survey area has 2 to 16 percent slopes. Land use and habitat in and around the survey area includes unvegetated fields, emergent wetlands, and upland forests (Attachment A, Photograph 3).

Site Findings

Through field observations, one (1) wetland was confirmed to exist at the Site. Wetland A is a small depressional wetland that covers approximately 0.13 acres. It consists of hydrophytic vegetation dominated by hybrid cattail *(Typha x glauca)* with lesser portions of silky dogwood (*Cornus amomum*) and reed canary grass (*Phalaris arundinacea)* also present (Attachment A, Photographs 4-6). Wetland hydrology was confirmed by the presence of surface water, a high water table, and saturation, in addition to the wetland's geomorphic position and saturation visible on aerial imagery. Depth of the pond-like feature likely surpassed two feet in the center (Attachment A, Photographs 7-8). A depleted matrix confirmed hydric soil conditions (Attachment A, Photographs 9-10).

Wetland A appears to have been formed by an earthen berm along its western perimeter. A spillway controls the wetland's maximum water level and directs water through an ephemeral channel downgradient to the northwest. Identified as Stream 1, it appears to flow with enough regularity to have formed a stream with a defined bed and bank and ordinary high water mark (Attachment A, Photographs 11-14). Stream 1 disappears belowground, presumably into a subsurface drainage tile, before resurfacing roughly 50 feet downgradient (Figure 2; Attachment A, Photograph 15).

Groundwater was observed to be actively discharging into Wetland A along its eastern edge (Attachment A, Photograph 16). It is unclear how significant groundwater is in the supply of water to this wetland, as precipitation and direct surface runoff also likely contribute a significant volume of water.

Conclusion

The noteworthy features within the survey area include the 0.13-acre depressional emergent wetland and 85-foot ephemeral stream. Although we understand there are no planned impacts to these features; if impacts are intended in the future, permitting through either the Ohio EPA or the U.S. Army Corps of Engineers may be necessary. The 300-foot buffer setback requirements should be calculated from the provided shapefiles (Ohio State Plane South CRS), the accompanying figure, and the on-site "Wetland Delineation" pin flags.

If you have any questions regarding this memorandum, please feel free to call us at (614) 818-9156. Thank you for this opportunity to provide wetland consulting services.

Best Regards,

Mark A. Dilley

Jenna Odegard
Environmental Scientist I, Wildlife Specialist
Trained Wetland Delineator

Mark Dilley
Chief Scientist
Professional Wetland Scientist

Figures

Attachments

Literature Cited:

Environmental Laboratory. 1987. Corps of Engineers Wetlands Delineation Manual, Technical Report. Y-87-1. U.S. Army Engineers Waterways Experiment Station. Vicksburg, MS.

Ohio EPA. 2001. Ohio Rapid Assessment Method for Wetlands. Version 5.0 Final. Ohio Environmental Protection Agency. Columbus, Ohio.

USDA. 2018. Web Soil Survey 3.1. Soil Conservation Service http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx. Accessed February 10, 2019.

USACE. 2010. Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Midwest (Version 2.0). J. S. Wakeley, R. W. Lichvar, C. V. Noble, and J.F. Berkowitz. ERDC/EL TR-10-16. Vicksburg, MS: U.S. Army Engineer Research and Development Center.

Figures

MAD SCIENTIST
ASSOCIATES LLC

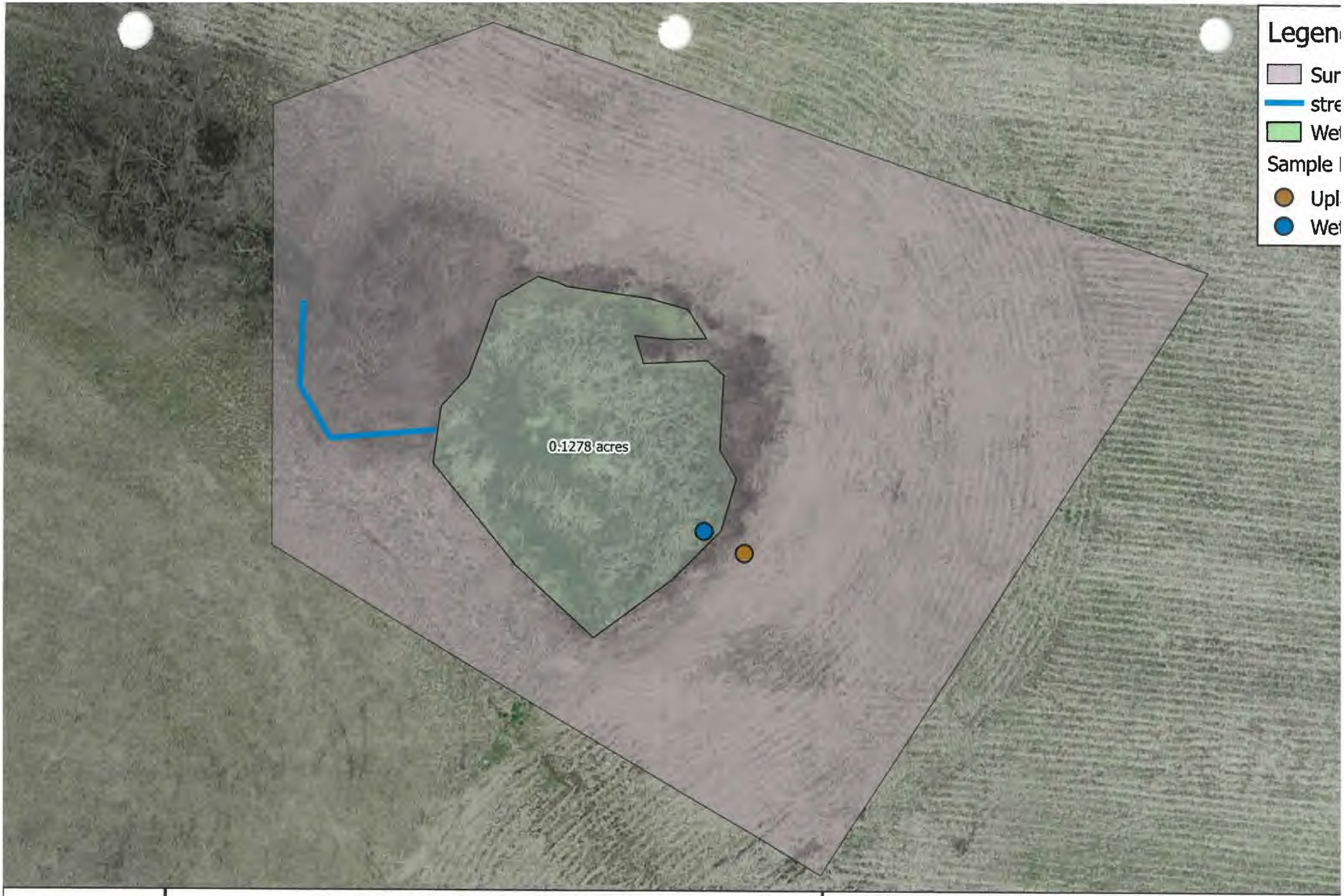
Figure 1. Survey Area Aerial Map
Grieco Property
Fairborn, OH

Sources: USGS Orthoimagery (2013)

Date: February 19, 2019

0 250 500 750 1000 ft

Created By: Jenna Odegard



MAD SCIENTIST ASSOCIATES LLC

Figure 2. Wetland Delineation Summary Map
Grieco Property
Fairborn, OH

Sources: USGS Orthoimagery (2013)

Date: February 19, 2019

0 25 50 75 100 125 150 ft

Created By: Jenna Odegard

Attachment A

Photolog

Photograph 1. General view of the plowed soy field on the east side the survey area. Photograph taken facing east.

Photograph 2. General view of the field to the north of the survey area. Photograph taken facing northwest.

Photograph 3. General view of site habitat composed of plowed field, wetland and forest. Photograph taken facing southwest.

Photograph 4. General view of Wetland A dominated with hybrid cattail (*Typha x glauca*). Photograph taken facing west.

Photograph 5. General view of Wetland A facing south toward hybrid cattail in the center and surrounded by eastern red cedar (*Juniperus virginicana*) and silky dogwood (*Cornus amomum*).

Photograph 6. General view of Wetland A dominated with hybrid cattail and reed canary grass (*Phalaris arundinacea*). Photograph taken facing north.

Photograph 7. General view of Wetland A with hybrid cattail and standing water likely greater than two feet in depth. Photograph taken facing east.

Photograph 8. Algal mat observed on top of standing water in Wetland A.

Photograph 9. MAD Scientist Associates environmental scientist, Jim Palus, describing and categorizing hydric soils in Wetland A. Photograph taken facing west.

Photograph 10. Hydric soils in Wetland A displaying a depleted matrix and redoximorphic features.

Photograph 11. Flowing water, identified as Stream 1, was observed on the west side of Wetland A with a channelized bed and bank.

Photograph 12. Stream 1 channel widens as it flowed from east to west with a scoured bed and bank. It also lacked vegetation.

Photograph 13. Sorting of sediments such as gravel and small cobble observed in Stream 1.

Photograph 14. Stream 1 flowed for about 85 feet before it meandered into a grassy area without a defined bed and bank. Photograph taken facing northwest.

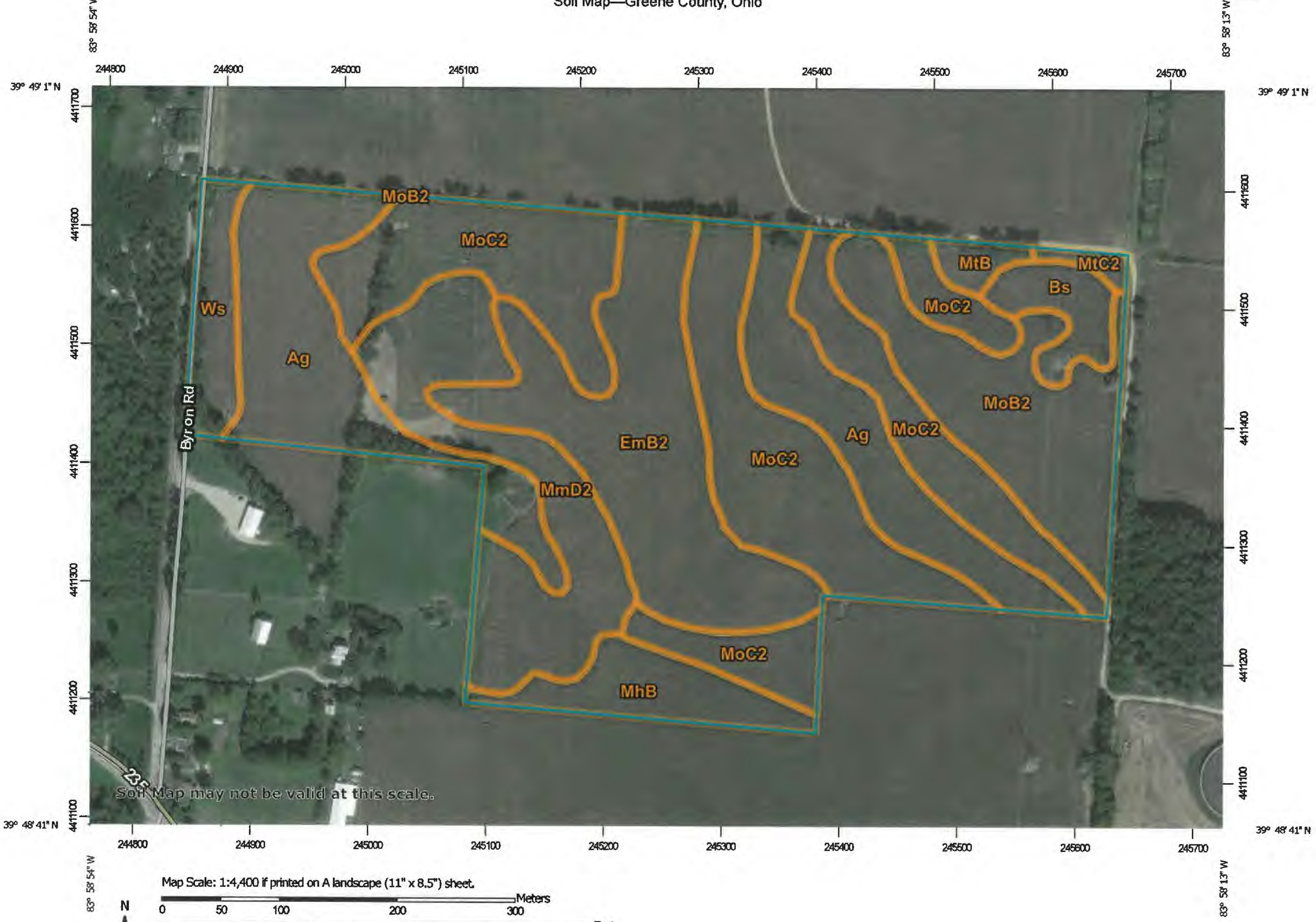
Photograph 15. Stream 1 dried up as it entered the forested area on the west side of the survey area. Photograph taken facing west.

Photograph 16. General view of the eastern edge of Wetland A where a groundwater seep was observed to trickle into Wetland A.

Attachment B

Soil Map

Soil Map—Greene County, Ohio



Map Scale: 1:4,400 if printed on A landscape (11" x 8.5") sheet.

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 17N WGS84

MAP LEGEND

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

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

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.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

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: Greene County, Ohio
Survey Area Data: Version 16, Jan 30, 2019

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

Date(s) aerial images were photographed: Oct 14, 2015—Mar 28, 2017

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.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
Ag	Algiers silt loam	12.0	19.1%
Bs	Brookston silty clay loam, fine texture, 0 to 2 percent slopes	1.7	2.6%
EmB2	Eldean silt loam, 2 to 6 percent slopes, moderately eroded	10.1	16.0%
MhB	Miamian silt loam, 2 to 6 percent slopes	2.8	4.4%
MmD2	Miamian-Casco complex, 12 to 18 percent slopes, moderately eroded	7.7	12.1%
MoB2	Miamian-Eldean silt loams, 2 to 6 percent slopes, moderately eroded	6.9	10.9%
MoC2	Miamian-Eldean silt loams, 6 to 12 percent slopes, moderately eroded	19.1	30.2%
MtB	Milton silt loam, 2 to 6 percent slopes	0.6	1.0%
MtC2	Milton silt loam, 6 to 12 percent slopes, moderately eroded	0.3	0.5%
Ws	Westland silty clay loam, Southern Ohio Till Plain, 0 to 2 percent slopes	2.0	3.1%
Totals for Area of Interest		**63.2**	**100.0%**

Attachment C

Data Forms

WETLAND DETERMINATION DATA FORM – Midwest Region

Project/Site: Northpoint Engineering Grieco Property City/County: Fairborn/Greene Sampling Date: 2/15/19
Applicant/Owner: Renergy State: OH Sampling Point: Wetland A
Investigator(s): Jenna Odegard and Jim Palus Section, Township, Range: ____
Landform (hillside, terrace, etc.): Hillside Local relief (concave, convex, none): Concave
Slope (%): 2-16 Lat: 39.814036 Long: -83.977314 Datum: WGS 84
Soil Map Unit Name: Algiers silt loam NWI classification: PUBGh
Are climatic / hydrologic conditions on the site typical for this time of year? Yes ____ No ____ (If no, explain in Remarks.)
Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes ____ No ____
Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present? Yes X No ____
Hydric Soil Present? Yes X No ____
Wetland Hydrology Present? Yes X No ____

Is the Sampled Area within a Wetland? **Yes** X **No** ____

Remarks:

VEGETATION – Use scientific names of plants.

	Absolute % Cover	Dominant Species?	Indicator Status
Tree Stratum (Plot size: 30 ft)			
1.			
2.			
3.			
4.			
5.			
=Total Cover			
Sapling/Shrub Stratum (Plot size: 15 ft)			
1. *Cornus amomum*	10	Yes	FACW
2.			
3.			
4.			
5.			
=Total Cover	10		
Herb Stratum (Plot size: 5 ft)			
1. *Typha X glauca*	85	Yes	OBL
2. *Phalaris arundinacea*	12	No	FACW
3. *Verbena urticifolia*	1	No	FAC
4. *Carex frankii*	2	No	OBL
5.			
6.			
7.			
8.			
9.			
10.			
=Total Cover	100		
Woody Vine Stratum (Plot size: 30 ft)			
1.			
2.			
=Total Cover			

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)
Total Number of Dominant Species Across All Strata: 2 (B)
Percent of Dominant Species That Are OBL, FACW, or FAC: 100.0% (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species ____	x 1 = ____
FACW species ____	x 2 = ____
FAC species ____	x 3 = ____
FACU species ____	x 4 = ____
UPL species ____	x 5 = ____
Column Totals: ____ (A)	____ (B)

Prevalence Index = B/A = ____

Hydrophytic Vegetation Indicators:

____ 1 - Rapid Test for Hydrophytic Vegetation
X 2 - Dominance Test is >50%
____ 3 - Prevalence Index is ≤3.0[1]
____ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
____ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? **Yes** X **No** ____

Remarks: (Include photo numbers here or on a separate sheet.)
algae, submersed aquatic vegetation

SOIL

Sampling Point: Wetland A

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-7	10YR 3/2	97	10YR 5/8	3	C	PL	Loamy/Clayey	Silty loam
7-13	10YR 3/2	90	10YR 5/8	10	C	PL/M	Loamy/Clayey	Silty loam

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains.

[2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ 2 cm Muck (A10)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ 5 cm Mucky Peat or Peat (S3)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- _X_ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ Coast Prairie Redox (A16)
- ___ Iron-Manganese Masses (F12)
- ___ Red Parent Material (F21)
- ___ Very Shallow Dark Surface (F22)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ___

Depth (inches): 13

Hydric Soil Present? Yes No ___

Remarks:

This data form is revised from Midwest Regional Supplement Version 2.0 to include the NRCS Field Indicators of Hydric Soils, Version 7.0, 2015 Errata. (http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051293.docx)

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- _X_ Surface Water (A1)
- _X_ High Water Table (A2)
- _X_ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- _X_ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- _X_ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- _X_ True Aquatic Plants (B14)
- ___ Hydrogen Sulfide Odor (C1)
- _X_ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Gauge or Well Data (D9)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- _X_ Geomorphic Position (D2)
- _X_ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes X	No ___	Depth (inches): 12
Water Table Present?	Yes X	No ___	Depth (inches): 0
Saturation Present? (includes capillary fringe)	Yes X	No ___	Depth (inches): 0

Wetland Hydrology Present? Yes X No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Midwest Region

Project/Site: Northpoint Engineering Grieco Property City/County: Fairborn/Greene Sampling Date: 2/15/19
Applicant/Owner: Renergy State: OH Sampling Point: Upland A
Investigator(s): Jenna Odegard and Jim Palus Section, Township, Range: ______
Landform (hillside, terrace, etc.): Hillside Local relief (concave, convex, none): Concave
Slope (%): 12-18 Lat: 39.814022 Long: -83.977139 Datum: WGS 84
Soil Map Unit Name: Miamian Caso Complex, moderately eroded NWI classification: N/A
Are climatic / hydrologic conditions on the site typical for this time of year? Yes ___ No ___ (If no, explain in Remarks.)
Are Vegetation ___, Soil ___, or Hydrology ___ significantly disturbed? Are "Normal Circumstances" present? Yes X No ___
Are Vegetation ___, Soil ___, or Hydrology ___ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present? Yes ___ No X
Hydric Soil Present? Yes X No ___
Wetland Hydrology Present? Yes ___ No X

Is the Sampled Area within a Wetland? Yes ___ No X

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 30 ft)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
		=Total Cover	
Sapling/Shrub Stratum (Plot size: 15 ft)			
1. *Juniperus virginiana*	5	Yes	FACU
2.			
3.			
4.			
5.			
	5	=Total Cover	
Herb Stratum (Plot size: 5 ft)			
1. *Setaria viridis*	30	Yes	UPL
2. *Solidago altissima*	10	No	FACU
3. *Glycine max*	60	Yes	UPL
4.			
5.			
6.			
7.			
8.			
9.			
10.			
	100	=Total Cover	
Woody Vine Stratum (Plot size: 30 ft)			
1.			
2.			
		=Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)
Total Number of Dominant Species Across All Strata: 3 (B)
Percent of Dominant Species That Are OBL, FACW, or FAC: 0.0% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	0	x 2 =	0
FAC species	0	x 3 =	0
FACU species	15	x 4 =	60
UPL species	90	x 5 =	450
Column Totals:	105 (A)		510 (B)

Prevalence Index = B/A = 4.86

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation
___ 2 - Dominance Test is >50%
___ 3 - Prevalence Index is ≤3.0[1]
___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
___ Problematic Hydrophytic Vegetation[1] (Explain)

[1] Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ___ No X

Remarks: (Include photo numbers here or on a separate sheet.)
algae, submersed aquatic vegetation

SOIL

Sampling Point: Upland A

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-6	10YR 5/1	85	10YR 5/8	15	C	PL/M	Loamy/Clayey	Silty loam
6-14	10YR 3/2	90	10YR 4/6	10	C	M	Loamy/Clayey	Silty loam

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

___ Histosol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Stratified Layers (A5)
___ 2 cm Muck (A10)
___ Depleted Below Dark Surface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1)
___ 5 cm Mucky Peat or Peat (S3)
___ Sandy Gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Dark Surface (S7)
___ Loamy Mucky Mineral (F1)
___ Loamy Gleyed Matrix (F2)
X Depleted Matrix (F3)
X Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

___ Coast Prairie Redox (A16)
___ Iron-Manganese Masses (F12)
___ Red Parent Material (F21)
___ Very Shallow Dark Surface (F22)
___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ___

Depth (inches): 14

Hydric Soil Present? Yes X No ___

Remarks:
This data form is revised from Midwest Regional Supplement Version 2.0 to include the NRCS Field Indicators of Hydric Soils, Version 7.0, 2015 Errata. (http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051293.docx)

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

___ Surface Water (A1)
___ High Water Table (A2)
___ Saturation (A3)
___ Water Marks (B1)
___ Sediment Deposits (B2)
___ Drift Deposits (B3)
___ Algal Mat or Crust (B4)
___ Iron Deposits (B5)
___ Inundation Visible on Aerial Imagery (B7)
___ Sparsely Vegetated Concave Surface (B8)
___ Water-Stained Leaves (B9)
___ Aquatic Fauna (B13)
___ True Aquatic Plants (B14)
___ Hydrogen Sulfide Odor (C1)
___ Oxidized Rhizospheres on Living Roots (C3)
___ Presence of Reduced Iron (C4)
___ Recent Iron Reduction in Tilled Soils (C6)
___ Thin Muck Surface (C7)
___ Gauge or Well Data (D9)
___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

___ Surface Soil Cracks (B6)
___ Drainage Patterns (B10)
___ Dry-Season Water Table (C2)
___ Crayfish Burrows (C8)
___ Saturation Visible on Aerial Imagery (C9)
___ Stunted or Stressed Plants (D1)
___ Geomorphic Position (D2)
___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ___ No X Depth (inches): ___
Water Table Present? Yes ___ No X Depth (inches): ___
Saturation Present? Yes ___ No X Depth (inches): ___
(includes capillary fringe)

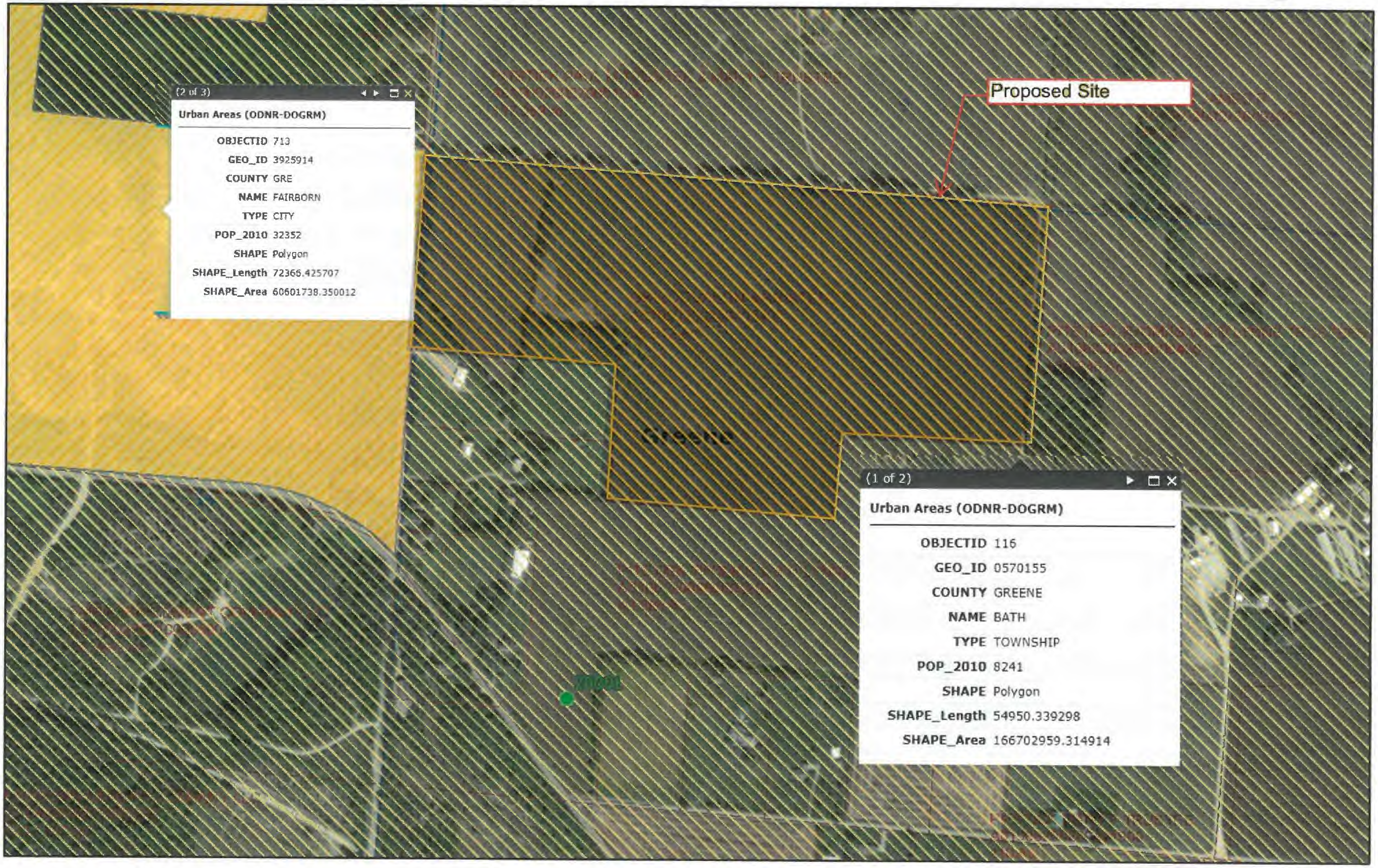
Wetland Hydrology Present? Yes ___ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

APPENDIX K
Oil & Gas Well Map

Ohio Oil & Gas Wells



(2 of 3)

Urban Areas (ODNR-DOGRM)

OBJECTID 713
GEO_ID 3925914
COUNTY GRE
NAME FAIRBORN
TYPE CITY
POP_2010 32352
SHAPE Polygon
SHAPE_Length 72366.425707
SHAPE_Area 60601738.350012

(1 of 2)

Urban Areas (ODNR-DOGRM)

OBJECTID 116
GEO_ID 0570155
COUNTY GREENE
NAME BATH
TYPE TOWNSHIP
POP_2010 8241
SHAPE Polygon
SHAPE_Length 54950.339298
SHAPE_Area 166702959.314914

November 1, 2018

☐ Counties
☐ Current Township
☐ Land Subdivision
☐ Statewide Parcels
▨ Urban Areas (ODNR-DOGRM)

N

0 0.075 0.15 0.3 mi
0 0.1 0.2 0.4 km
1:9,028

ODNR - Division of Oil and Gas Resources Management

APPENDIX L
Soil Boring Logs

SOIL AND BORING LOG

BORING NUMBER : B-1
SHEET 1 of 2

PROJECT NUMBER : RGE-009
PROJECT : Dovetail/Greico
DRILLING METHOD : HSA
DRILLING CONTRACTOR : Envirocore
DRILL DATE: 12/5/2018
STATUS: Borehole
LOGGER : Ken, Joe, Jason

LOCATION : Fairborn, Oh
X COORDINATE: 0
Y COORDINATE: 0
GROUND SURFACE ELEVATION : 939.5
WATER LEVEL: 10 ft.
DATE OF READING: 12/5/18

DEPTH (ft)	WATER LEVEL	SAMPLE					USCS	SYMBOL	DESCRIPTION	ELEVATION (m)	COMMENTS
		NUMBER	TYPE	N-VALUE	RECOVERY	SYMBOL					
1		1	SS	1 1 1 2	22		Topsoil		8" of Topsoil	939	
3		2	SS	1 2 3 2	24		CL		Brown silty clay with trace gravel		
5		3	SS	2 2 2 4	24						
7		4	SS	3 5 5 6	23						
9		5	SS	3 5 6 4	24					930	
10	▼						SP		Brown sand, wet sand and gravel	929	
11		6	SS	1 2 4 7	24		ML - CL		Brown, very silty clay	928	
13		7	SS	4 5 6 9	24		CL - SC		Damp brown silty clay	926	
14	▽										
15		8	SS	4 5 8 8	254		CL		Damp grey / brown silty clay		
17		9	SS	6 10 11 11	24					922	
19		10	SS	14 14 18 15	19		SM		Dry, very fine brown silty sand		
20										920	

SOIL AND BORING LOG

BORING NUMBER : B-1
SHEET 2 of 2

PROJECT NUMBER : RGE-009
PROJECT : Dovetail/Greico
DRILLING METHOD : HSA
DRILLING CONTRACTOR : Envirocore
DRILL DATE: 12/5/2018
STATUS: Borehole
LOGGER : Ken, Joe, Jason

LOCATION : Fairborn, Oh
X COORDINATE: 0
Y COORDINATE: 0
GROUND SURFACE ELEVATION : 939.5
WATER LEVEL: 10 ft.
DATE OF READING: 12/5/18

DEPTH (ft)	WATER LEVEL	SAMPLE					USCS	SYMBOL	DESCRIPTION	ELEVATION (m)	COMMENTS
		NUMBER	TYPE	N-VALUE	RECOVERY	SYMBOL					
21		11	SS	8 14 11 19	18						
22							SM		Dry, very fine brown silty sand		
23		12	SS	8 13 15 19	18						
24										916	
25		13	SS	14 20 21 27	19						
26											
27		14	SS	7 12 15 16	18						
28											
29		15	SS	15 13 11 41	18		GP		Dry, unsorted sand, gravel, and small stone		
30											
31		16	SS	10 11 8 11	16						
32											
33		17	SS	10 10 13 11	15						
34	▼									906	
35		18	SS	8 9 11 11	15		SP		Wet, saturated sand and gravel		
36										904	
37									End of boring at 36 ft. Water found at 10-11' and at 34-35'. Borehole was dry from 14-34'		
38											
39											
40											

SOIL AND BORING LOG

BORING NUMBER : B-2
SHEET 1 of 1

PROJECT NUMBER : RGE-009
PROJECT : Dovetail/Greico
DRILLING METHOD : HSA
DRILLING CONTRACTOR : Envirocore
DRILL DATE: 12/6/2018
STATUS: Borehole
LOGGER : Kenny, Jason

LOCATION : Fairborn, OH
X COORDINATE: 0
Y COORDINATE: 0
GROUND SURFACE ELEVATION : 940.3
WATER LEVEL: Dry
DATE OF READING: 12/6/18

DEPTH (ft)	WATER LEVEL	SAMPLE					USCS	SYMBOL	DESCRIPTION	ELEVATION (m)	COMMENTS
		NUMBER	TYPE	N-VALUE	RECOVERY	SYMBOL					
1 2		1	SS	2 2 4 5			CL		Brown silty clay	938	
3 4		2	SS	- 2 3 4					Brown silty clay with trace gravel		
5 6		3	SS	4 4 4 6						934	
7 8		4	SS	14 17 17 19			SP		Fine brown sand and gravel		
9 10		5	SS	18 20 24 16							
11 12		6	SS	13 13 17 20							
13 14		7	SS	14 16 12 13						926	
15		8	SS	13 14 10 13			CL		Brown silty clay with gravel	925	
16							SP		Brown sand and gravel	924	
17 18		9	SS	13 18 19 12			SW		Fine, well-sorted sand	922	
19 20		10	SS	14 16 18 23			SW - SM		Fine, well-sorted silty sand	920	

End of boring at 20 ft.

SOIL AND BORING LOG

BORING NUMBER : B-3
SHEET 1 of 1

PROJECT NUMBER : RGE-009
PROJECT : Dovetail/Greico
DRILLING METHOD : HSA
DRILLING CONTRACTOR : Envirocore
DRILL DATE: 12/5/2018
STATUS: Borehole
LOGGER : Ken, Joe, Jason

LOCATION : Fairborn, OH
X COORDINATE: 0
Y COORDINATE: 0
GROUND SURFACE ELEVATION : 941.3
WATER LEVEL: Enc. @ 6'; Completion @ 17'
DATE OF READING: 12/5/18

DEPTH (ft)	WATER LEVEL	SAMPLE					USCS	SYMBOL	DESCRIPTION	ELEVATION (m)	COMMENTS
		NUMBER	TYPE	N-VALUE	RECOVERY	SYMBOL					
1		1	SS	2 2 5 7	20		Topsoil		9 Inches of Topsoil	941	
2							CL		Damp Brown clayey sand	937	
3 4		2	SS	5 5 5 6	22						
5 6	∇	3	SS	5 5 6 6	23		ML		Wet brown silt	935	
7 8		4	SS	1 1 2 2	10		SW		Saturated fine sorted sand - very wet, flowing	929	
9 10		5	SS	2 1 1 3	12						
11 12		6	SS	2 1 1 1	12						
13 14		7	SS	4 5 6 8	24		CL		Grey silty clay	924	
15 16		8	SS	1 3 5 13	19						
17 18		9	SS	7 11 18 15	21		SM		Dry, fine brown silty sand	921	
19 20		10	SS	11 13 15 23	21						

End of Boring at 20 ft.

SOIL AND BORING LOG

BORING NUMBER : B-4
SHEET 1 of 2

PROJECT NUMBER : RGE-009
PROJECT : Dovetail/Grieco
DRILLING METHOD : HSA
DRILLING CONTRACTOR : Envirocore
DRILL DATE: 12/6/2018
STATUS: Borehole
LOGGER : Kenny, Jason

LOCATION : Fairborn, OH
X COORDINATE: 0
Y COORDINATE: 0
GROUND SURFACE ELEVATION : 936.5
WATER LEVEL: Dry
DATE OF READING: 12/6/18

DEPTH (ft)	WATER LEVEL	SAMPLE					USCS	SYMBOL	DESCRIPTION	ELEVATION (m)	COMMENTS
		NUMBER	TYPE	N-VALUE	RECOVERY	SYMBOL					
1		1	SS	- 1 2 3			CL		Brown silty clay		
2 3		2	SS	1 3 5 5							
4 5		3	SS	2 2 2 3						931	
6 7		4	SS	2 5 7 8			CL		Wet silty clay		
8 9		5	SS	6 10 12 13						927	
10 11		6	SS	5 9 11 12			ML/CL		Grey silty clay with gravel		
12 13		7	SS	10 12 15 18							
14 15		8	SS	13 12 10 11						921	
16 17		9	SS	5 7 8 10			SC/CL		Grey, wet sandy clay	919	
18 19 20		10	SS	10 14 16 17			SW		Dry, brown fine sand	917	

SOIL AND BORING LOG

BORING NUMBER : B-4
SHEET 2 of 2

PROJECT NUMBER : RGE-009
PROJECT : Dovetail/Grieco
DRILLING METHOD : HSA
DRILLING CONTRACTOR : Envirocore
DRILL DATE: 12/6/2018
STATUS: Borehole
LOGGER : Kenny, Jason

LOCATION : Fairborn, OH
X COORDINATE: 0
Y COORDINATE: 0
GROUND SURFACE ELEVATION : 936.5
WATER LEVEL: Dry
DATE OF READING: 12/6/18

DEPTH (ft)	WATER LEVEL	SAMPLE					USCS	SYMBOL	DESCRIPTION	ELEVATION (m)	COMMENTS
		NUMBER	TYPE	N-VALUE	RECOVERY	SYMBOL					
21		11	SS	6 11 20 23		‖	SM/SW	▒	Well-sorted, brown sand, trace gravel		
22										915	
23		12	SS	17 18 20 24		‖	SW	▒	Fine grey sand, trace gravel		
24										913	
25									End of Boring at 24 ft.		
26											
27											
28											
29											
30											
31											
32											
33											
34											
35											
36											
37											
38											
39											
40											

SOIL AND BORING LOG

BORING NUMBER : B-5
SHEET 1 of 1

PROJECT NUMBER : RGE-009
PROJECT : Dovetail/Grieco
DRILLING METHOD : HSA
DRILLING CONTRACTOR : Envirocore
DRILL DATE: 12/6/2018
STATUS: Borehole
LOGGER : Kenny, Jason

LOCATION : Fairborn, OH
X COORDINATE: 0
Y COORDINATE: 0
GROUND SURFACE ELEVATION : 930.9
WATER LEVEL: Not noted, assumed dry
DATE OF READING: 12/6/18

DEPTH (ft)	WATER LEVEL	SAMPLE					USCS	SYMBOL	DESCRIPTION	ELEVATION (m)	COMMENTS
		NUMBER	TYPE	N-VALUE	RECOVERY	SYMBOL					
1 2		1	SS	1 2 2 4			CL		Brown Silty Clay		
3 4		2	SS	4 5 8 4							
5 6		3	SS	6 7 6 8							
7 8		4	SS	2 4 6 7							
9 10		5	SS	6 8 8 10						921	
11 12		6	SS	2 6 9 10			SC/CL		Brown, sandy clay		
13 14		7	SS	8 10 16 18						917	
15 16		8	SS	7 9 15 21			SW		Fine, well-sorted sand		
17 18		9	SS	15 26 26 30						913	
19 20		10	SS	20 30 34 37			GW		Coarse sand and Gravel	911	

Boring ends at 20

SOIL AND BORING LOG

BORING NUMBER : B-6
SHEET 1 of 1

PROJECT NUMBER : RGE-009
PROJECT : Dovetail/Grieco
DRILLING METHOD : HSA
DRILLING CONTRACTOR : Envirocore
DRILL DATE: 12/6/2018
STATUS: Borehole
LOGGER : Kenny, Jason

LOCATION : Fairborn,OH
X COORDINATE: 0
Y COORDINATE: 0
GROUND SURFACE ELEVATION : 937.6
WATER LEVEL: Dry
DATE OF READING: 12/6/18

DEPTH (ft)	WATER LEVEL	SAMPLE					USCS	SYMBOL	DESCRIPTION	ELEVATION (m)	COMMENTS
		NUMBER	TYPE	N-VALUE	RECOVERY	SYMBOL					
1 2		1	SS	1 2 3 3			CL		Brown silty clay		
3 4		2	SS	5 6 8 8							
5 6		3	SS	7 9 5 8							
7 8		4	SS	7 5 5 8							
9 10		5	SS	6 8 8 10						928	
11 12		6	SS	3 5 8 9			ML/CL		Wet, silty grey clay		
13 14		7	SS	6 8 11 14						924	
15 16		8	SS	8 10 12 13			CL		Grey silty clay		
17 18		9	SS	7 8 13 17						920	
19 20		10	SS	15 18 21 25			SM/SW		Well-sorted Grey clay, transitioning to fine sand	918	

Boring ends at 20

DATE STARTED: 1/18/19
DATE COMPLETED: 1/18/19
COMPLETION DEPTH 25.0 ft
BENCHMARK: N/A
ELEVATION: 938 ft
LATITUDE: 39.815°
LONGITUDE: -83.9769°
STATION: N/A **OFFSET:** N/A
REMARKS: N_{60} denotes the normalization to 60% efficiency as described in ASTM D4633.

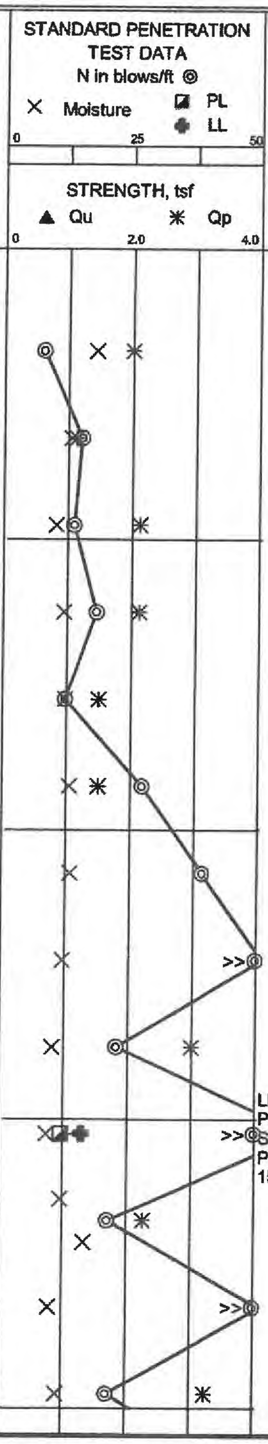
DRILL COMPANY: PSI, Inc.
DRILLER: JE **LOGGED BY:** KP
DRILL RIG: CME 45
DRILLING METHOD: Hollow Stem Auger
SAMPLING METHOD: 2-in SS/SPT (Continuous)
HAMMER TYPE: Automatic
EFFICIENCY 91%
REVIEWED BY: RAS

BORING B-07

Water		
▽	While Drilling	8.4 feet
▼	Upon Completion	5.2 feet
▽	Cave Depth	8.5 feet

BORING LOCATION:
See boring location plan

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	Additional Remarks
	0					TOPSOIL (8")	TOPSOIL			
				1	18	Stiff to Very Stiff, Moist, Brown, **SANDY LEAN CLAY**, (With Gravel at 2.5')	CL	2-2-3 N_{60}=8	18	
935				2	18			3-5-5 N_{60}=15	13	
	5			3	18	Very Stiff, Moist, Brown and Gray, **SANDY LEAN CLAY**	CL	3-4-5 N_{60}=14	10	
				4	18	Very Stiff to Stiff, Moist, Brown, **SANDY LEAN CLAY**	CL	5-5-7 N_{60}=18	12	
930				5	18			3-3-5 N_{60}=12	12	
				6	13	Medium Dense, Wet, Brown, **CLAYEY SAND WITH GRAVEL**	SC	3-6-12 N_{60}=27	13	
	10			7	18	Dense, Wet, Brown, **WELL GRADED SAND WITH CLAY**	SW-SC	5-11-15 N_{60}=39	13	
				8	15	Very Dense, Wet, Brown, **CLAYEY SAND**	SC	9-15-19 N_{60}=51	12	
925				9	18	Very Stiff, Moist, Gray, **SANDY, SILTY CLAY**	CL-ML	9-7-8 N_{60}=23	10	
	15			10	13				9	LL = 16 PL = 12 Shelby Tube Pressure Applied: 1500 psi
				11	18	Medium Dense, Wet, Brown, **WELL GRADED SAND**	SW	5-8-6 N_{60}=21	12 17	
920				12	13	Very Dense, Wet, Brown, **CLAYEY SAND**	SC	7-15-19 N_{60}=51	10	
	20			13	18	Very Stiff, Moist, Gray, **SANDY LEAN CLAY**	CL	6-6-8	11	



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Professional Service Industries, Inc.
5599 Webster Street
Dayton, OH 45414
Telephone: (937) 898-1200

PROJECT NO.: 01051396
PROJECT: Dovetail/Grieco Lagoon
LOCATION: Byron Road nad East Xenia Drive
Fairborn, Ohio
45324

The stratification lines represent approximate boundaries. The transition may be gradual.

DATE STARTED: 1/18/19
DATE COMPLETED: 1/18/19
COMPLETION DEPTH 25.0 ft
BENCHMARK: N/A
ELEVATION: 938 ft
LATITUDE: 39.815°
LONGITUDE: -83.9769°
STATION: N/A **OFFSET:** N/A
REMARKS: N_{60} denotes the normalization to 60% efficiency as described in ASTM D4633.

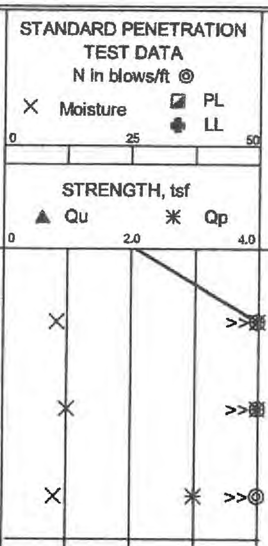
DRILL COMPANY: PSI, Inc.
DRILLER: JE **LOGGED BY:** KP
DRILL RIG: CME 45
DRILLING METHOD: Hollow Stem Auger
SAMPLING METHOD: 2-in SS/SPT (Continuous)
HAMMER TYPE: Automatic
EFFICIENCY 91%
REVIEWED BY: RAS

BORING B-07

Water		
▽	While Drilling	8.4 feet
▼	Upon Completion	5.2 feet
▼	Cave Depth	8.5 feet

BORING LOCATION:
See boring location plan

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	STANDARD PENETRATION TEST DATA	Additional Remarks
	20					Very Stiff, Moist, Gray, **SANDY LEAN CLAY**	CL	N_{60}=21			
				14	18	Very Hard, Moist, Brown, **SANDY LEAN CLAY**	CL	9-14-19 N_{60}=50	10	>>	
915				15	16			9-14-20 N_{60}=51	12	>>	
				16	18	Very Dense, Moist, Brown, **POORLY GRADED SAND**	SP	12-19-19 N_{60}=57	10	>>	
	25										
						End of boring, 25' (Backfilled with 3 bags of hole plug)					



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Professional Service Industries, Inc.
5599 Webster Street
Dayton, OH 45414
Telephone: (937) 898-1200

PROJECT NO.: 01051396
PROJECT: Dovetail/Grieco Lagoon
LOCATION: Byron Road nad East Xenia Drive
Fairborn, Ohio
45324

The stratification lines represent approximate boundaries. The transition may be gradual.

DATE STARTED: 1/22/19
DATE COMPLETED: 1/22/19
COMPLETION DEPTH 25.0 ft
BENCHMARK: N/A
ELEVATION: 934 ft
LATITUDE: 39.8151°
LONGITUDE: -83.9756°
STATION: N/A **OFFSET:** N/A
REMARKS: N_{60} denotes the normalization to 60% efficiency as described in ASTM D4633.

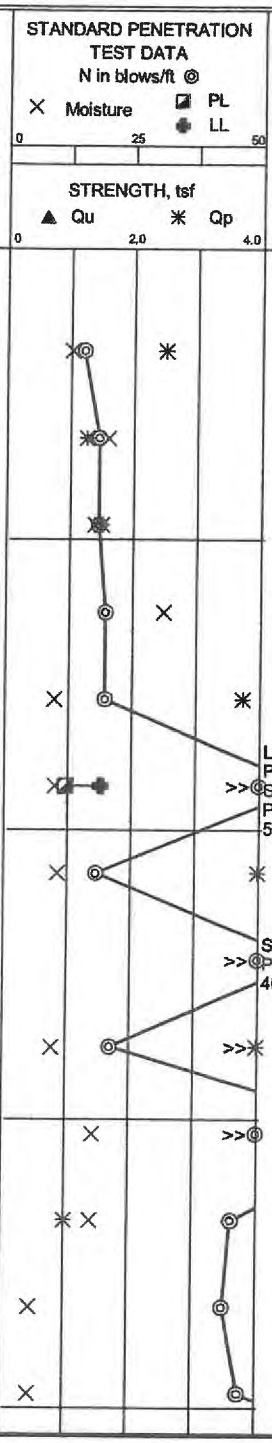
DRILL COMPANY: PSI, Inc.
DRILLER: JE **LOGGED BY:** KP
DRILL RIG: CME 45
DRILLING METHOD: Hollow Stem Auger
SAMPLING METHOD: 2-in SS/SPT (Continuous)
HAMMER TYPE: Automatic
EFFICIENCY 91%
REVIEWED BY: RAS

BORING B-08

Water		
∇	While Drilling	5.5 feet
▼	Upon Completion	N/A feet
∇	Cave Depth	5.5 feet

BORING LOCATION:
See boring location plan

Elevation (feet)	Depth, (feet)	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	Additional Remarks
	0			TOPSOIL (9")	TOPSOIL			
				Very Stiff, Moist, Brown, **SANDY LEAN CLAY**	CL			
		1	18			3-4-6 N_{60}=15	13	
				Very Stiff, Moist, Brown, **SILT WITH SAND**	ML			
		2	18			3-6-6 N_{60}=18	20	
930								
	5	3	18	∇		5-6-6 N_{60}=18	18	
				Medium Dense, Wet, Brown, **SILTY SAND**	SM			
		4	18			2-7-6 N_{60}=20	31	
				Very Stiff, Moist, Gray, **SANDY, SILTY CLAY**	CL-ML			
		5	18			3-6-7 N_{60}=20	10	
925		6	13				10	LL = 19 PL = 12 Shelby Tube Pressure Applied: 500-900 psi
	10							
		7	18			3-5-7 N_{60}=18	11	
		8						Shelby Tube Pressure Applied: 400-1100 psi
920		9	18			5-7-7 N_{60}=21	10	
	15			Very Hard to Hard, Moist, Brown, **SILT WITH SAND**	ML			
		10	18			32-32-20 N_{60}=79	18	
		11	18			10-15-15 N_{60}=45	18	
				Dense, Moist, Brown, **POOLY GRADED SAND**	SP			
		12	18			5-11-18 N_{60}=44	6	
915					SW			
	20	13	18			7-13-18	6	



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Professional Service Industries, Inc.
5599 Webster Street
Dayton, OH 45414
Telephone: (937) 898-1200

PROJECT NO.: 01051396
PROJECT: Dovetail/Grieco Lagoon
LOCATION: Byron Road nad East Xenia Drive
Fairborn, Ohio
45324

The stratification lines represent approximate boundaries. The transition may be gradual.

DATE STARTED: 1/22/19
DATE COMPLETED: 1/22/19
COMPLETION DEPTH 25.0 ft
BENCHMARK: N/A
ELEVATION: 934 ft
LATITUDE: 39.8151°
LONGITUDE: -83.9756°
STATION: N/A **OFFSET:** N/A
REMARKS: N_{60} denotes the normalization to 60% efficiency as described in ASTM D4633.

DRILL COMPANY: PSI, Inc.
DRILLER: JE **LOGGED BY:** KP
DRILL RIG: CME 45
DRILLING METHOD: Hollow Stem Auger
SAMPLING METHOD: 2-in SS/SPT (Continuous)
HAMMER TYPE: Automatic
EFFICIENCY 91%
REVIEWED BY: RAS

BORING B-08

Water		
▽	While Drilling	5.5 feet
▼	Upon Completion	N/A feet
▽	Cave Depth	5.5 feet

BORING LOCATION:
See boring location plan

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	STANDARD PENETRATION TEST DATA N in blows/ft ◎ × Moisture ◪ PL ● LL 0 25 50 STRENGTH, tsf ▲ Qu ✳ Qp 0 2.0 4.0	Additional Remarks
	20							N_{60}=47			
			☒	14	18	Dense to Extremely Dense, Gray, **WELL GRADAED SAND**; Cobble Encountered at 21.8'	SW	8-19-40 N_{60}=89	4	× >>◎	
			☒	15	18	Dense, Damp, Gray, **WELL GRADED SAND WITH CLAY**	SW-SC	10-15-15 N_{60}=45	4	× ◎	
910			☒	16	10	Very Dense, Moist, Brown, **POORLY GRADED SAND WITH CLAY**	SP-SC	7-22-20 N_{60}=63	5	× >>◎	
	25					End of boring, 25' (Backfilled with 5 bags of hole plug)					

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Dayton, OH 45414
Telephone: (937) 898-1200

PROJECT NO.: 01051396
PROJECT: Dovetail/Grieco Lagoon
LOCATION: Byron Road nad East Xenia Drive
Fairborn, Ohio
45324

The stratification lines represent approximate boundaries. The transition may be gradual.

DATE STARTED: 1/18/19
DATE COMPLETED: 1/18/19
COMPLETION DEPTH 25.0 ft
BENCHMARK: N/A
ELEVATION: 940.5 ft
LATITUDE: 39.8128°
LONGITUDE: -83.9764°
STATION: N/A **OFFSET:** N/A
REMARKS: N_{60} denotes the normalization to 60% efficiency as described in ASTM D4633.

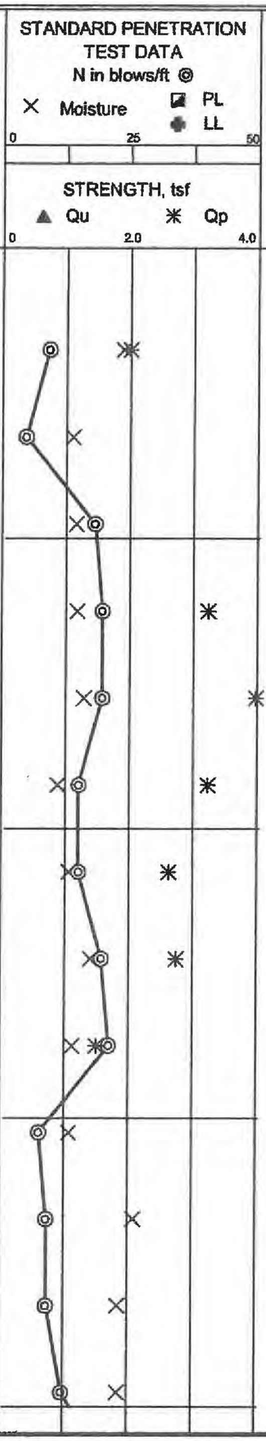
DRILL COMPANY: PSI, Inc.
DRILLER: JE **LOGGED BY:** KP
DRILL RIG: CME 45
DRILLING METHOD: Hollow Stem Auger
SAMPLING METHOD: 2-in SS/SPT (Continuous)
HAMMER TYPE: Automatic
EFFICIENCY 91%
REVIEWED BY: RAS

BORING B-09

Water		
▽	While Drilling	19 feet
▼	Upon Completion	15.2 feet
▽	Cave Depth	16.2 feet

BORING LOCATION:
See boring location plan

Elevation (feet)	Depth, (feet)	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %
	0			TOPSOIL (9")	TOPSOIL		
940				Stiff, Moist, Brown, **LEAN CLAY WITH SAND**	CL		
		1	9			2-3-3 N_{60}=9	24
				Loose, Moist, Brown, **SILTY SAND**	SM		
		2	11			2-2-1 N_{60}=5	14
				Medium Dense, Wet, Brown, **CLAYEY SAND**	SC		
	5	3	0			5-6-6 N_{60}=18	14
935				Very Stiff, Moist, Brown and Gray, **SANDY LEAN CLAY** Grading to **LEAN CLAY**	CL		
		4	10			5-6-7 N_{60}=20	15
		5	11			5-6-7 N_{60}=20	16
		6	13			4-5-5 N_{60}=15	11
	10						
930		7	7			5-5-5 N_{60}=15	13
				Very Stiff, Moist, Brown, **SILT**	ML		
		8	11			5-7-6 N_{60}=20	18
				Very Stiff to Stiff, Moist, Brown, **SANDY LEAN CLAY** Grading to **LEAN CLAY**	CL		
		9	5			5-6-8 N_{60}=21	14
	15						
925		10	7			5-4-1 N_{60}=8	13
				Stiff, Moist, Brown, **SANDY SILT**	ML		
		11	6			1-2-4 N_{60}=9	26
		12	5			2-2-4 N_{60}=9	23
				Medium Dense, Wet, Brown, **POORLY GRADED SAND WITH CLAY**	SP-SC		
	20	13	10			2-4-4	23



Additional Remarks

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Professional Service Industries, Inc.
5599 Webster Street
Dayton, OH 45414
Telephone: (937) 898-1200

PROJECT NO.: 01051396
PROJECT: Dovetail/Grieco Lagoon
LOCATION: Byron Road nad East Xenia Drive
Fairborn, Ohio
45324

The stratification lines represent approximate boundaries. The transition may be gradual.

DATE STARTED: 1/18/19
DATE COMPLETED: 1/18/19
COMPLETION DEPTH 25.0 ft
BENCHMARK: N/A
ELEVATION: 940.5 ft
LATITUDE: 39.8128°
LONGITUDE: -83.9764°
STATION: N/A **OFFSET:** N/A
REMARKS: N_{60} denotes the normalization to 60% efficiency as described in ASTM D4633.

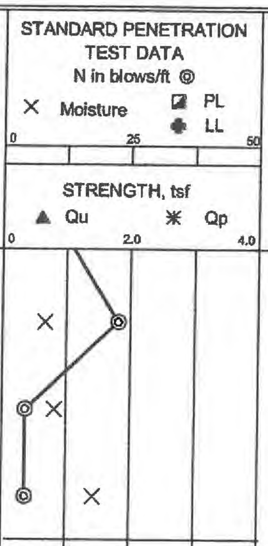
DRILL COMPANY: PSI, Inc.
DRILLER: JE **LOGGED BY:** KP
DRILL RIG: CME 45
DRILLING METHOD: Hollow Stem Auger
SAMPLING METHOD: 2-in SS/SPT (Continuous)
HAMMER TYPE: Automatic
EFFICIENCY 91%
REVIEWED BY: RAS

BORING B-09

Water		
▽	While Drilling	19 feet
▼	Upon Completion	15.2 feet
▼	Cave Depth	16.2 feet

BORING LOCATION:
See boring location plan

Elevation (feet)	Depth, (feet)	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	Additional Remarks
	20				SP-SC	N_{60}=12		
920		14	9	Medium Dense, Wet, Brown, **WELL GRADED SAND WITH CLAY**	SW-SC	3-8-7 N_{60}=23	8	
		15	4	Loose, Wet, Brown, **CLAYEY SAND WITH GRAVEL**	SC	3-2-1 N_{60}=5	10	
		16	5	Loose, Wet, Brown, **WELL GRADED SAND WITH CLAY**	SW-SC	1-2-1 N_{60}=5	18	
	25							
				End of boring, 25' (Backfilled with 5 bags of hole plug)				



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5599 Webster Street
Dayton, OH 45414
Telephone: (937) 898-1200

PROJECT NO.: 01051396
PROJECT: Dovetail/Grieco Lagoon
LOCATION: Byron Road nad East Xenia Drive
Fairborn, Ohio
45324

The stratification lines represent approximate boundaries. The transition may be gradual.

DATE STARTED: 1/18/19
DATE COMPLETED: 1/18/19
COMPLETION DEPTH 30.0 ft
BENCHMARK: N/A
ELEVATION: 950.75 ft
LATITUDE: 39.8128°
LONGITUDE: -83.9748°
STATION: N/A **OFFSET:** N/A
REMARKS: N_{60} denotes the normalization to 60% efficiency as described in ASTM D4633.

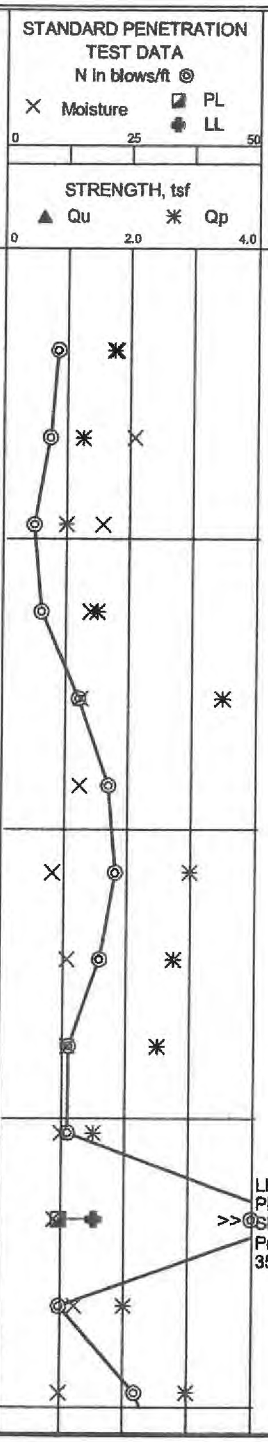
DRILL COMPANY: PSI, Inc.
DRILLER: JE **LOGGED BY:** KP
DRILL RIG: CME 45
DRILLING METHOD: Hollow Stem Auger
SAMPLING METHOD: 2-in SS/SPT (Continuous)
HAMMER TYPE: Automatic
EFFICIENCY 91%
REVIEWED BY: RAS

BORING B-10

Water		
▽	While Drilling	7 feet
▼	Upon Completion	N/A feet
▼	Overnight	14.8 feet

BORING LOCATION:
See boring location plan

Elevation (feet)	Depth, (feet)	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	Additional Remarks
	0			TOPSOIL (11")	TOPSOIL			
950		1	12	Stiff, Moist, Brown, **LEAN CLAY**	CL	1-3-4 N_{60}=11	22	
		2	13			2-3-3 N_{60}=9	26	
	5	3	11	Firm, Moist, Brown, **SANDY SILT**	ML	2-2-2 N_{60}=6	20	
945		4	1	Stiff to Very Stiff, Moist, Brown, **LEAN CLAY WITH SAND**	CL	1-2-3 N_{60}=8	17	
		5	13			3-4-6 N_{60}=15	16	
		6	7	Very Stiff, Moist, Brown, **SANDY LEAN CLAY**	CL	6-7-7 N_{60}=21	15	
940	10	7	14			6-7-8 N_{60}=23	10	
		8	14			4-6-7 N_{60}=20	13	
		9	15			2-3-6 N_{60}=14	13	
935	15	10	15	Very Stiff to Hard, Gray, **SANDY, SILTY CLAY**	CL-ML	2-3-6 N_{60}=14	12	
		11	18				11	LL = 19 PL = 12 >>Shelby Tube Pressure Applied: 350 psi
		12	11			2-3-5 N_{60}=12	15	
	20	13	14			7-9-9	12	



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Professional Service Industries, Inc.
5599 Webster Street
Dayton, OH 45414
Telephone: (937) 898-1200

PROJECT NO.: 01051396
PROJECT: Dovetail/Grieco Lagoon
LOCATION: Byron Road nad East Xenia Drive
Fairborn, Ohio
45324

The stratification lines represent approximate boundaries. The transition may be gradual.

DATE STARTED: 1/18/19
DATE COMPLETED: 1/18/19
COMPLETION DEPTH 30.0 ft
BENCHMARK: N/A
ELEVATION: 950.75 ft
LATITUDE: 39.8128°
LONGITUDE: -83.9748°
STATION: N/A **OFFSET:** N/A
REMARKS: N_{60} denotes the normalization to 60% efficiency as described in ASTM D4633.

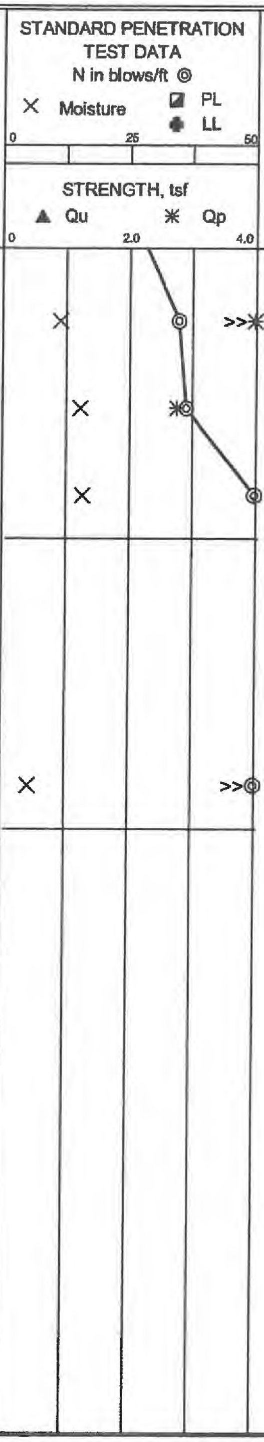
DRILL COMPANY: PSI, Inc.
DRILLER: JE **LOGGED BY:** KP
DRILL RIG: CME 45
DRILLING METHOD: Hollow Stem Auger
SAMPLING METHOD: 2-in SS/SPT (Continuous)
HAMMER TYPE: Automatic
EFFICIENCY 91%
REVIEWED BY: RAS

BORING B-10

Water		
▽	While Drilling	7 feet
▼	Upon Completion	N/A feet
▼	Overnight	14.8 feet

BORING LOCATION:
See boring location plan

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	Additional Remarks
	20					Very Stiff to Hard, Gray, **SANDY, SILTY CLAY**	CL-ML	N_{60}=27		
930				14	13			3-9-14 N_{60}=35	11	
				15	14	Hard, Moist, Brown, **SANDY LEAN CLAY**	CL	5-9-15 N_{60}=36	15	
				16	13	Very Dense, Moist, Brown, **SILTY SAND**	SM	4-12-21 N_{60}=50	16	
925	25									
						Very Dense, Moist, Brown, **POORLY GRADED SAND WITH GRAVEL**	SP			
				17	10			9-14-27 N_{60}=62	5	
	30									
						End of boring, 30' (Backfilled with 5 bags of hole plug)				



Professional Service Industries, Inc.
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PROJECT NO.: 01051396
PROJECT: Dovetail/Grieco Lagoon
LOCATION: Byron Road nad East Xenia Drive
Fairborn, Ohio
45324

The stratification lines represent approximate boundaries. The transition may be gradual.

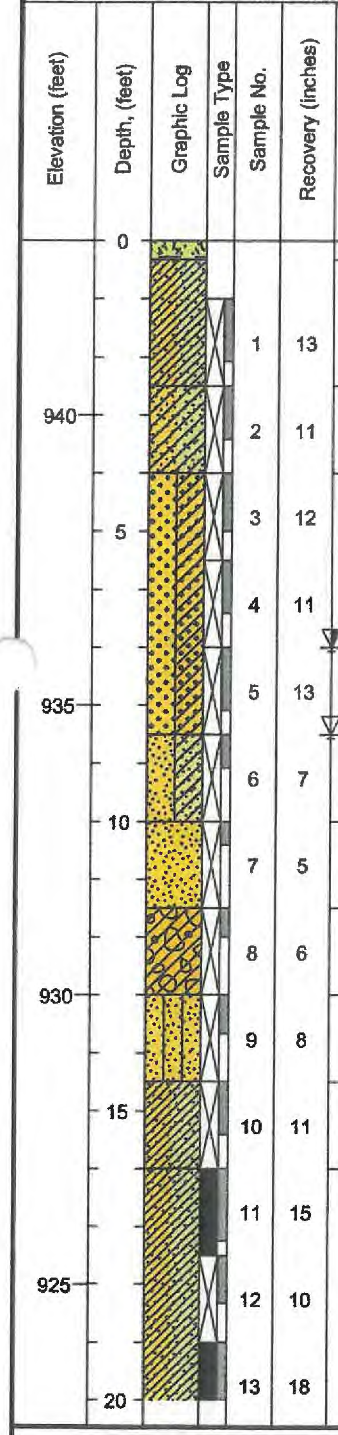
DATE STARTED: 1/18/19
DATE COMPLETED: 1/18/19
COMPLETION DEPTH 25.0 ft
BENCHMARK: N/A
ELEVATION: 943 ft
LATITUDE: 39.8141°
LONGITUDE: -83.9765°
STATION: N/A **OFFSET:** N/A
REMARKS: N_{60} denotes the normalization to 60% efficiency as described in ASTM D4633.

DRILL COMPANY: PSI, Inc.
DRILLER: JE **LOGGED BY:** KP
DRILL RIG: CME 45
DRILLING METHOD: Hollow Stem Auger
SAMPLING METHOD: 2-in SS/SPT (Continuous)
HAMMER TYPE: Automatic
EFFICIENCY 91%
REVIEWED BY: RAS

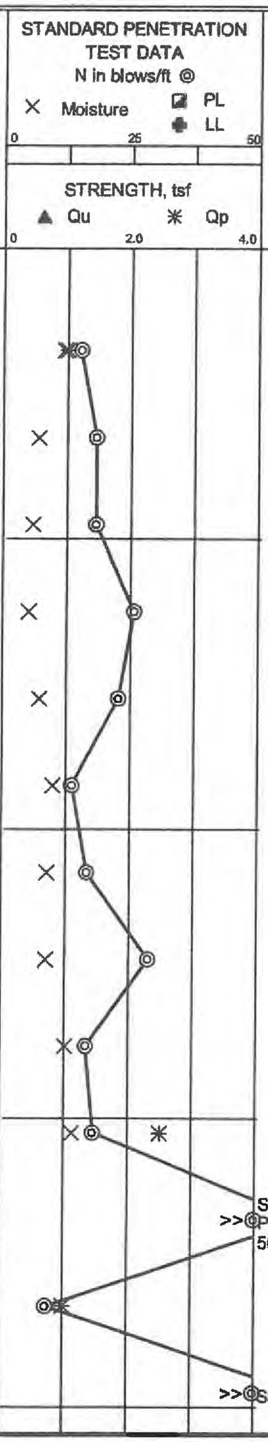
BORING B-11

Water		
▽	While Drilling	8.5 feet
▼	Upon Completion	N/A feet
▼	Cave Depth	7 feet

BORING LOCATION:
See boring location plan



Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	Additional Remarks
		TOPSOIL (4")	TOPSOIL			
1	13	Very Stiff, Moist, Brown, **SANDY LEAN CLAY**	CL	3-5-5 N_{60}=15	12	
2	11	Medium Dense, Moist, Brown, **CLAYEY SAND WITH GRAVEL**	SC	3-5-7 N_{60}=18	7	
3	12	Medium Dense, Moist, Brown, **WELL GRADED SAND WITH CLAY**	SW-SC	3-5-7 N_{60}=18	6	
4	11			4-8-9 N_{60}=26	5	
5	13			7-8-7 N_{60}=23	7	
6	7	Medium Dense, Moist, Brown, **POORLY GRADED SAND WITH CLAY**	SP-SC	6-5-4 N_{60}=14	10	
7	5	Medium Dense, Wet, Brown, **POORLY GRADED SAND**	SP	3-5-6 N_{60}=17	9	
8	6	Medium Dense, Wet, Brown, **CLAYEY GRAVEL WITH SAND**	GC	8-10-9 N_{60}=29	9	
9	8	Medium Dense, Wet, Brown, **SILTY SAND**	SM	6-6-5 N_{60}=17	13	
10	11	Very Stiff, Moist, Brown, **SANDY LEAN CLAY**	CL	3-5-7 N_{60}=18	14	
11	15	Stiff, Moist, Gray, **SANDY LEAN CLAY**	CL			Shelby Tube Pressure Applied: 500-700 psi
12	10			2-2-4 N_{60}=9	12	
13	18					Shelby Tube



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Professional Service Industries, Inc.
5599 Webster Street
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PROJECT NO.: 01051396
PROJECT: Dovetail/Grieco Lagoon
LOCATION: Byron Road nad East Xenia Drive
Fairborn, Ohio
45324

The stratification lines represent approximate boundaries. The transition may be gradual.

DATE STARTED: 1/18/19
DATE COMPLETED: 1/18/19
COMPLETION DEPTH 25.0 ft
BENCHMARK: N/A
ELEVATION: 943 ft
LATITUDE: 39.8141°
LONGITUDE: -83.9765°
STATION: N/A **OFFSET:** N/A
REMARKS: N_{60} denotes the normalization to 60% efficiency as described in ASTM D4633.

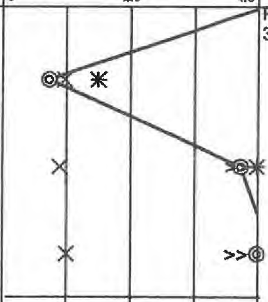
DRILL COMPANY: PSI, Inc.
DRILLER: JE **LOGGED BY:** KP
DRILL RIG: CME 45
DRILLING METHOD: Hollow Stem Auger
SAMPLING METHOD: 2-in SS/SPT (Continuous)
HAMMER TYPE: Automatic
EFFICIENCY 91%
REVIEWED BY: RAS

BORING B-11

Water		
▽	While Drilling	8.5 feet
▼	Upon Completion	N/A feet
▼	Cave Depth	7 feet

BORING LOCATION:
See boring location plan

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	STANDARD PENETRATION TEST DATA N in blows/ft ◎ × Moisture ◪ PL ✚ LL 0 25 50 STRENGTH, tsf ▲ Qu ✳ Qp 0 2.0 4.0	Additional Remarks
	20					Stiff, Moist, Gray, **SANDY LEAN CLAY**					Pressure Applied: 350 psi
				14	4		CL	2-2-4 N_{60}=9	12		
						Hard, Moist, Brown, **SANDY LEAN CLAY**					
920				15	11		CL	4-15-16 N_{60}=47	11		
						Very Dense, Moist, Brown, **SILTY SAND**					
				16	10		SM	9-16-19 N_{60}=53	12		
	25										
						End of boring, 25' (Backfilled with 2 bags of hole plug)					



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Professional Service Industries, Inc.
5599 Webster Street
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PROJECT NO.: 01051396
PROJECT: Dovetail/Grieco Lagoon
LOCATION: Byron Road nad East Xenia Drive
Fairborn, Ohio
45324

The stratification lines represent approximate boundaries. The transition may be gradual.

DATE STARTED: 1/18/19
DATE COMPLETED: 1/22/19
COMPLETION DEPTH 25.0 ft
BENCHMARK: N/A
ELEVATION: 942 ft
LATITUDE: 39.8138°
LONGITUDE: -83.9746°
STATION: N/A **OFFSET:** N/A
REMARKS: N_{60} denotes the normalization to 60% efficiency as described in ASTM D4633.

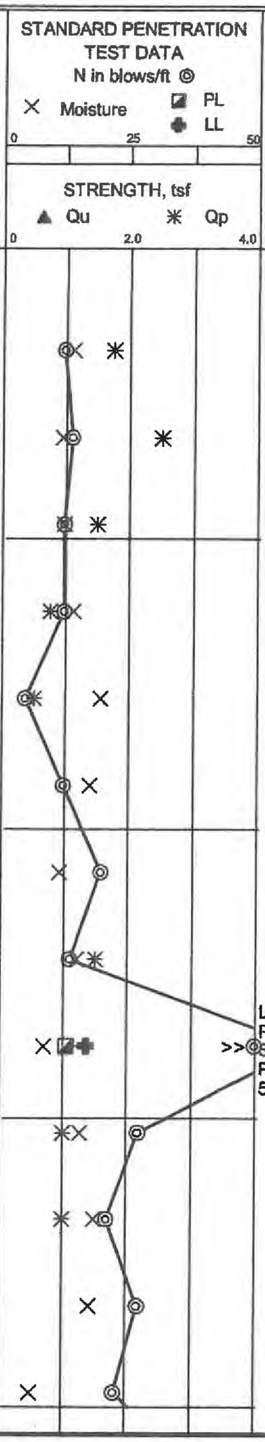
DRILL COMPANY: PSI, Inc.
DRILLER: JE **LOGGED BY:** KP
DRILL RIG: CME 45
DRILLING METHOD: Hollow Stem Auger
SAMPLING METHOD: 2-in SS/SPT (Continuous)
HAMMER TYPE: Automatic
EFFICIENCY 91%
REVIEWED BY: RAS

BORING B-12

Water
▽ While Drilling 17.3 feet
▼ Upon Completion N/A feet
▼ Cave Depth 18.8 feet

BORING LOCATION:
See boring location plan

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	STANDARD PENETRATION TEST DATA	Additional Remarks
	0					TOPSOIL (9")	TOPSOIL				
						Stiff to Very Stiff to Firm, Moist, Brown, **SANDY LEAN CLAY**					
940				1	18			2-3-5 N_{60}=12	14		
				2	18			3-4-5 N_{60}=14	12		
	5			3	16		CL	2-3-5 N_{60}=12	12		
				4	6			3-4-4 N_{60}=12	14		
935				5	4			1-2-1 N_{60}=5	20		
						Medium Dense, Moist, Brown, **SILTY SAND**					
				6	18			1-3-5 N_{60}=12	17		
	10						SM				
				7	18			4-6-7 N_{60}=20	12		
						Stiff, Moist, Brown, **LEAN CLAY**	CL				
930				8	16			7-5-4 N_{60}=14	15		
						Medium Dense, Moist, Brown, **SILTY, CLAYEY SAND WITH GRAVEL**					
				9	18		SC-SM		9		LL = 17 PL = 13 >>Shelby Tube Pressure Applied: 500-800 psi
	15										
				10	18	Medium Dense/Very Stiff, Moist, Brown, **SILTY SAND OR SANDY SILT**		5-10-8 N_{60}=27	16		
925				11	18		SM/ML	7-7-7 N_{60}=21	19		
				12	18			6-8-10 N_{60}=27	18		
						Medium Dense, Moist, Brown, **POORLY GRADED SAND**	SP				
	20			13	17			5-8-7	6		



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The stratification lines represent approximate boundaries. The transition may be gradual.

DATE STARTED: 1/18/19
DATE COMPLETED: 1/22/19
COMPLETION DEPTH 25.0 ft
BENCHMARK: N/A
ELEVATION: 942 ft
LATITUDE: 39.8138°
LONGITUDE: -83.9746°
STATION: N/A **OFFSET:** N/A
REMARKS: N_{60} denotes the normalization to 60% efficiency as described in ASTM D4633.

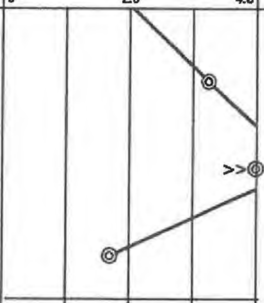
DRILL COMPANY: PSI, Inc.
DRILLER: JE **LOGGED BY:** KP
DRILL RIG: CME 45
DRILLING METHOD: Hollow Stem Auger
SAMPLING METHOD: 2-in SS/SPT (Continuous)
HAMMER TYPE: Automatic
EFFICIENCY 91%
REVIEWED BY: RAS

BORING B-12

Water		
▽ While Drilling	17.3	feet
▼ Upon Completion	N/A	feet
▽ Cave Depth	18.8	feet

BORING LOCATION:
See boring location plan

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	STANDARD PENETRATION TEST DATA N in blows/ft ◎ × Moisture ◪ PL ✚ LL 0 25 50 STRENGTH, tsf ▲ Qu ✳ Qp 0 2.0 4.0	Additional Remarks
	20						SP	N_{60}=23			
				14	18	Dense, Moist, Brown, **CLAYEY SAND WITH GRAVEL**	SC	4-12-15 N_{60}=41			
920				15	18	Very Dense, Moist, Brown, **WELL GRADED SAND WITH CLAY**	SW-SC	9-21-18 N_{60}=59		>>	
				16	9	Medium Dense, Moist, Brown, **WELL GRADED GRAVEL WITH CLAY**	GW-GC	3-6-8 N_{60}=21			
	25					End of boring, 25' (Backfilled with 5 bags of hole plug)					



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Professional Service Industries, Inc.
5599 Webster Street
Dayton, OH 45414
Telephone: (937) 898-1200

PROJECT NO.: 01051396
PROJECT: Dovetail/Grieco Lagoon
LOCATION: Byron Road nad East Xenia Drive
Fairborn, Ohio
45324

The stratification lines represent approximate boundaries. The transition may be gradual.

DATE STARTED: 1/18/19
DATE COMPLETED: 1/18/19
COMPLETION DEPTH 35.5 ft
BENCHMARK: N/A
ELEVATION: 950 ft
LATITUDE: 39.8135°
LONGITUDE: -83.9756°
STATION: N/A **OFFSET:** N/A
REMARKS: N_{60} denotes the normalization to 60% efficiency as described in ASTM D4633.

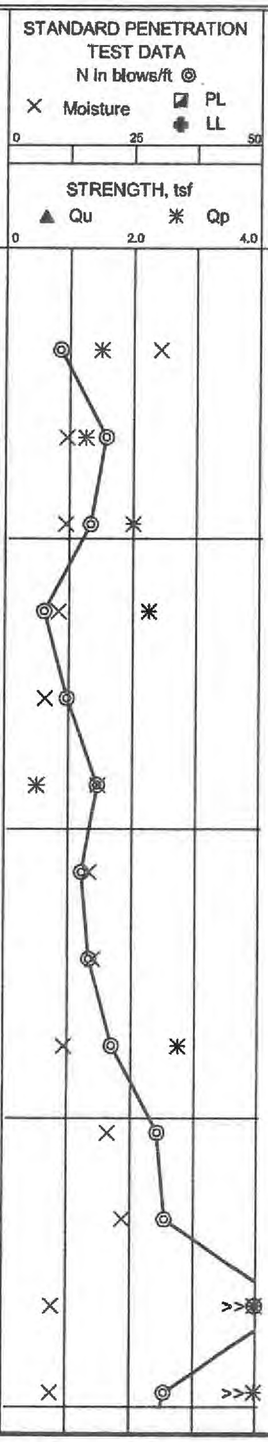
DRILL COMPANY: PSI, Inc.
DRILLER: JE **LOGGED BY:** KP
DRILL RIG: CME 45
DRILLING METHOD: Hollow Stem Auger
SAMPLING METHOD: 2-in SS/SPT (Continuous)
HAMMER TYPE: Automatic
EFFICIENCY 91%
REVIEWED BY: RAS

BORING B-13

Water		
▽	While Drilling	11.5 feet
▼	Upon Completion	10.5 feet
▽	Cave Depth	13 feet

BORING LOCATION:
See boring location plan

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	STANDARD PENETRATION TEST DATA	Additional Remarks
	0					TOPSOIL (9")	TOPSOIL				
				1	10	Stiff to Very Stiff, Moist, Brown, **SANDY LEAN CLAY**	CL	2-3-4 N_{60}=11	30		
				2	14			3-3-10 N_{60}=20	12		
945	5			3	5			10-5-6 N_{60}=17	12		
				4	11			3-3-2 N_{60}=8	10		
				5	12	Medium Dense, Moist to Wet, Brown, **CLAYEY SAND**	SC	2-3-5 N_{60}=12	8		
				6	11			5-6-6 N_{60}=18	18		
940	10										
				7	12	Medium Dense, Wet, Brown, **POORLY GRADED SAND WITH CLAY**	SP-SC	7-5-5 N_{60}=15	17		
				8	9			2-4-7 N_{60}=17	17		
				9	10	Medium Dense to Hard, Moist to Wet, Brown, **SILT WITH SAND**	ML	5-7-7 N_{60}=21	12		
935	15			10	12			4-8-12 N_{60}=30	21		
				11	14	Dense, Wet, Brown, **POORLY GRADED SAND**	SP	3-8-13 N_{60}=32	23		
				12	11	Very Stiff to Hard, Damp, Gray, **SANDY LEAN CLAY**	CL	11-18-20 N_{60}=57	10		
930	20			13	14			8-10-11	10		



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Professional Service Industries, Inc.
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PROJECT NO.: 01051396
PROJECT: Dovetail/Grieco Lagoon
LOCATION: Byron Road nad East Xenia Drive
Fairborn, Ohio
45324

The stratification lines represent approximate boundaries. The transition may be gradual.

DATE STARTED: 1/18/19
DATE COMPLETED: 1/18/19
COMPLETION DEPTH 35.5 ft
BENCHMARK: N/A
ELEVATION: 950 ft
LATITUDE: 39.8135°
LONGITUDE: -83.9756°
STATION: N/A **OFFSET:** N/A
REMARKS: N_{60} denotes the normalization to 60% efficiency as described in ASTM D4633.

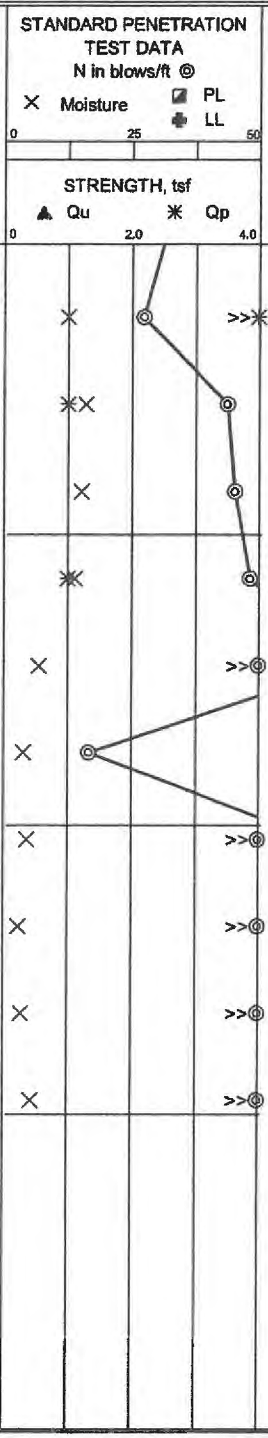
DRILL COMPANY: PSI, Inc.
DRILLER: JE **LOGGED BY:** KP
DRILL RIG: CME 45
DRILLING METHOD: Hollow Stem Auger
SAMPLING METHOD: 2-in SS/SPT (Continuous)
HAMMER TYPE: Automatic
EFFICIENCY 91%
REVIEWED BY: RAS

BORING B-13

Water		
▽	While Drilling	11.5 feet
▼	Upon Completion	10.5 feet
▽	Cave Depth	13 feet

BORING LOCATION:
See boring location plan

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	Additional Remarks
	20						CL	N_{60}=32		
				14	13	Hard, Moist, Brown, **LEAN CLAY WITH SAND**	CL	2-8-10 N_{60}=27	12	
				15	12	Hard, Moist to Damp, Brown, **SANDY SILT**	ML	10-14-15 N_{60}=44	16	
				16	14	Dense to Very Dense, Damp, Brown, **SILTY SAND**		9-13-17 N_{60}=45	15	
925	25			17	12		SM	9-15-17 N_{60}=48	14	
				18	10			9-18-27 N_{60}=68	7	
				19	13	Medium Dense to Very Dense, Damp, Brown, **WELL GRADED SAND WITH CLAY**	SW-SC	9-8-3 N_{60}=17	4	
920	30			20	12			3-19-22 N_{60}=62	5	
				21	11	Very Dense, Damp, Brown, **POORLY GRADED SAND WITH CLAY**	SP-SC	6-19-20 N_{60}=59	3	
				22	12	Very Dense, Damp, Brown, **WELL GRADED SAND**	SW	6-19-26 N_{60}=68	3	
915	35			23	10	Very Dense, Damp, Brown, **WELL GRADED SAND WITH CLAY AND GRAVEL**	SW-SC	13-13-23 N_{60}=54	5	
						End of boring, 35.5' (Backfilled with 5 bags of hole plug)				



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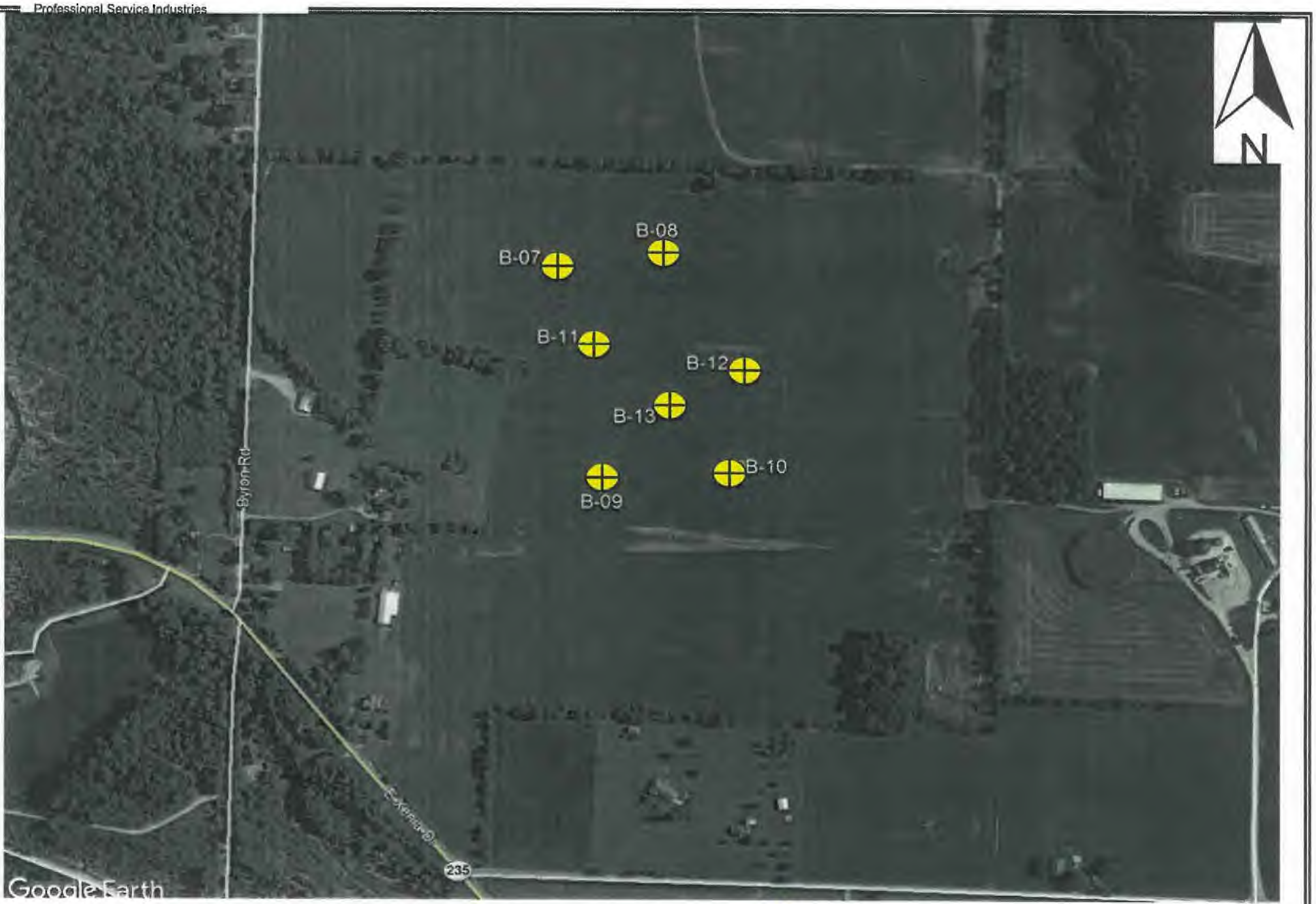
PROJECT NO.: 01051396
PROJECT: Dovetail/Grieco Lagoon
LOCATION: Byron Road nad East Xenia Drive
Fairborn, Ohio
45324

The stratification lines represent approximate boundaries. The transition may be gradual.

Professional Service Industries



⊕ - Indicates Approximate Test Boring Location

intertek psi	**Boring Location Plan** Dovetail/Grieco Lagoon Byron Road Fairborn, Greene County, Ohio	Image Provided By: Google Earth Project No.: 01051396 Date: 02/12/2019

The results of the various test pits are shown on Engineering Plan Sheet 2.

APPENDIX M
Soil Testing

PERMEABILITY TESTING SUMMARY

						STANDARD PROCTOR						
SAMPLE TYPE	SOIL DESCRIPTION	USCS CLASSIFICATION	LOCATION	DEPTH (FEET)	REMOLDED SPECIFICATIONS	MDD (pcf)	OPTIMUM MOISTURE (%)	TESTED PERMEABILITY (cm/sec)	LIQUID LIMIT (%)	PLASTICITY INDEX	PASSING 200 SIEVE (%)	% CLAY
SHELBY TUBE	GREY, SANDY/SILTY CLAY	CL–ML	B–07	14.5'–16'	N/A	N/A	N/A	8.3 X10^{-8}	16	4	52.1	14.8
SHELBY TUBE	GREY, SANDY/SILTY CLAY	CL–ML	B–08	8.5'–10'	N/A	N/A	N/A	6.3 X10^{-8}	19	7	58.1	19.2
SHELBY TUBE	GREY, SANDY/SILTY CLAY	CL–ML	B–10	16'–17.5'	N/A	N/A	N/A	5.9 X10^{-8}	19	7	60.3	18.9
SHELBY TUBE	GREY, SANDY/SILTY CLAY	CL–ML	B–12	13'–14.5'	N/A	N/A	N/A	1.3 X10^{-7}	17	4	38.9	10.9
BULK	BROWN SILTY CLAY W/ SAND	CL–ML	TP–4	0'–2'	N/A	N/A	N/A	N/A	20	6	71.43	12.77
BULK	BROWN SANDY LEAN CLAY	CL	TP–5	0'–1.5'	97.2%, +1.4	113.3	15.0	4.1 X10^{-8}	38	23	67.66	28.19
BULK	SILTY, CLAYEY SAND	SC–SM	TP–7	0'–7'	N/A	N/A	N/A	N/A	18	6	46.95	11.61
BULK	CLAYEY SAND W/ GRAVEL	SC	TP–8	0'–2.5'	95.0%, +3.3	126.4	10.1	2.4 X10^{-8}	26	12	47.72	18.29
BULK	BROWN SANDY LEAN CLAY	CL	TP–10	0'–3.5'	N/A	N/A	N/A	N/A	44	28	65.79	29.77
BULK	BROWN SANDY LEAN CLAY	CL	TP–11	0'–4'	98.1%, +1.8	121.2	13.0	1.9 X10^{-8}	24	11	58.87	21.90

Permeability Test Report

ASTM D 5084 - Method C

Boring: B-07

Press Tube: ST-1

Sample: S-1

Depth: 14.5'-16.0'

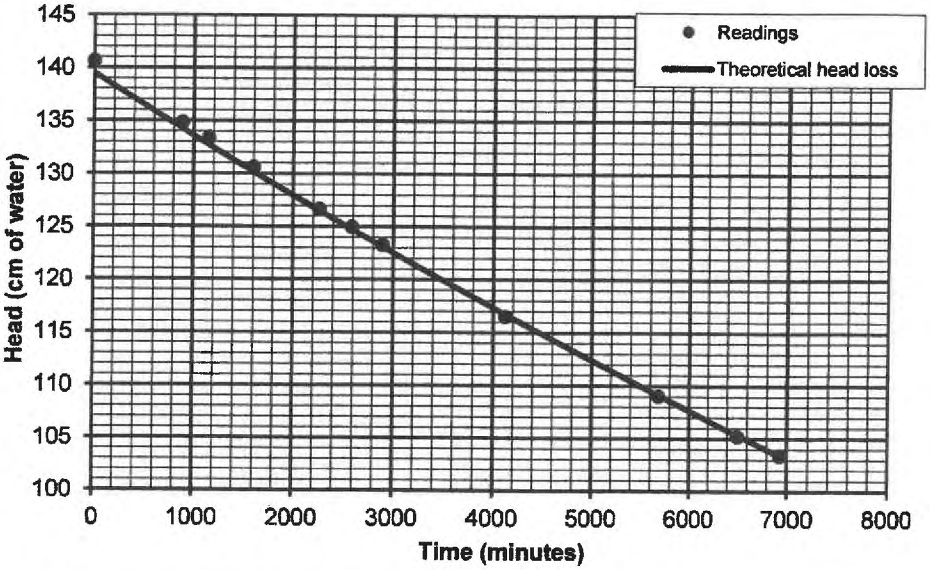
Liquid Limit	16
Plasticity Index	4
Specific Gravity	2.7

Permeant Liquid

De-aired, deionized water

Temp. (°C)

21.0

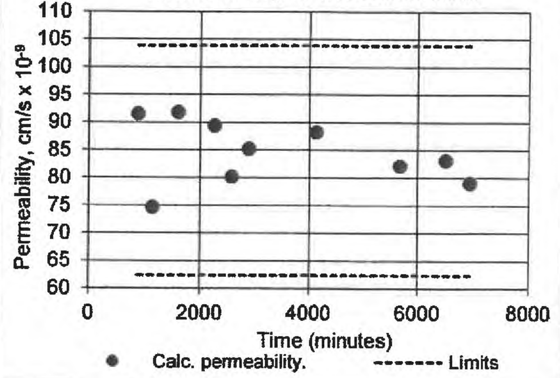


	Diameter (cm)	Area, A (cm^2)	Length, L (cm)	Moisture (%)	Dry Density (pcf)	Saturation (%)
Initial	7.292	41.77	13.871	9.1	132.6	90.7
Final	7.292	41.77	13.871	9.0	132.6	89.9

Chamber Pressure (psi)	Backpressure (psi)		Consolidation Stress (psi)		Hydraulic Gradient (-)		
	Inflow	Outflow	Max.	Min.	Max.	Min.	Avg.
66.0	58.0	56.0	10.0	8.0	10.1	7.5	8.8

Date	Time	Buret Readings		Flow Ratio	Head, h (cm)	$k_{20°C}$ (cm/sec)
		Inflow	Outflow			
1/30/2019	17:52	3.9	19.5	-----	140.6	-----
1/31/2019	8:35	6.0	17.5	0.95	134.9	9.2E-08
1/31/2019	13:06	6.5	17.0	1.00	133.4	7.5E-08
1/31/2019	20:34	7.5	16.0	1.00	130.6	9.2E-08
2/1/2019	7:35	8.9	14.6	1.00	126.7	8.9E-08
2/1/2019	12:58	9.5	14.0	1.00	125.0	8.0E-08
2/1/2019	18:06	10.1	13.4	1.00	123.3	8.5E-08
2/2/2019	14:38	12.5	11.0	1.00	116.5	8.8E-08
2/3/2019	16:32	15.3	8.5	0.89	109.1	8.2E-08
2/4/2019	6:15	16.7	7.2	0.93	105.2	8.3E-08
2/4/2019	13:23	17.4	6.6	0.86	103.4	7.9E-08

Last four readings must be between limits.



$$k_{20°C} = R_T \frac{aL}{2At} \ln\left(\frac{h_1}{h_2}\right) = \textbf{8.3E-08 cm/sec}$$

a - Area of burets (0.71 cm^2)
t - Elapsed time between readings
R_T - Temperature correction factor = (0.980)

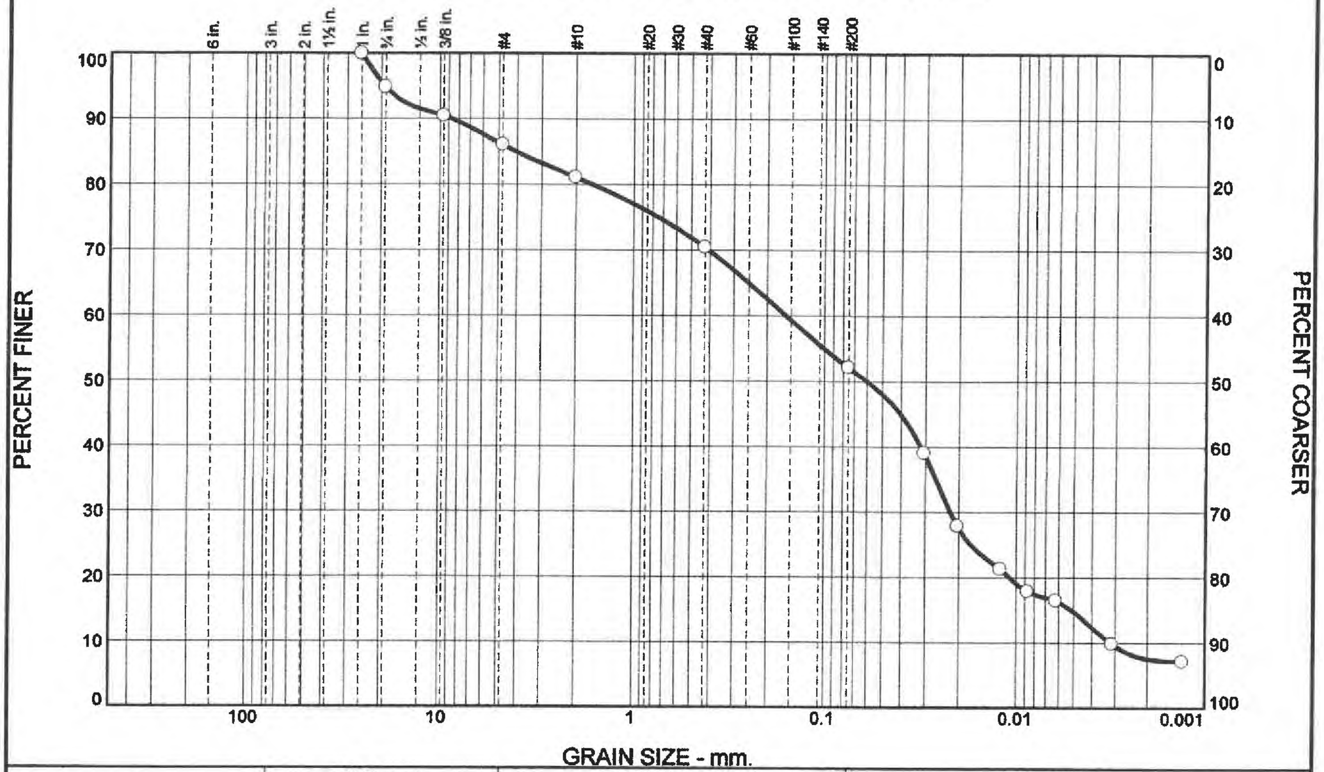
Remarks:

Specific Gravity Value is Assumed

DLZ

Client: PSI
Project: Dovetail/Grieco Lagoon
Job No: 1921-4605.00

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	5.1	8.9	4.9	10.7	18.3	37.3	14.8

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.0	100.0		
0.75	94.9		
0.375	90.5		
#4	86.0		
#10	81.1		
#40	70.4		
#200	52.1		

* (no specification provided)

Material Description

sandy silty clay

Atterberg Limits

PL= 12 LL= 16 PI= 4

Coefficients

D_{90}= 8.6515	D_{85}= 4.0487	D_{60}= 0.1592
D_{50}= 0.0601	D_{30}= 0.0222	D_{15}= 0.0051
D_{10}= 0.0032	C_u= 49.96	C_c= 0.97

Classification

USCS= CL-ML AASHTO= A-4(0)

Remarks

Moisture Content = 9.1%

Source of Sample: B-07 **Depth:** 14.5'-16.0'
Sample Number: ST-1

Date: 1-31-19

DLZ

Client: Intertek-PSI
Project: Dovetail/Grieco Lagoon

Project No: 1921-4605.00 **Figure**

Tested By: Esther Gehring-Anders **Checked By:** Steve Robinson

Permeability Test Report

ASTM D 5084 - Method C

Boring: B-08

Press Tube: ST-1

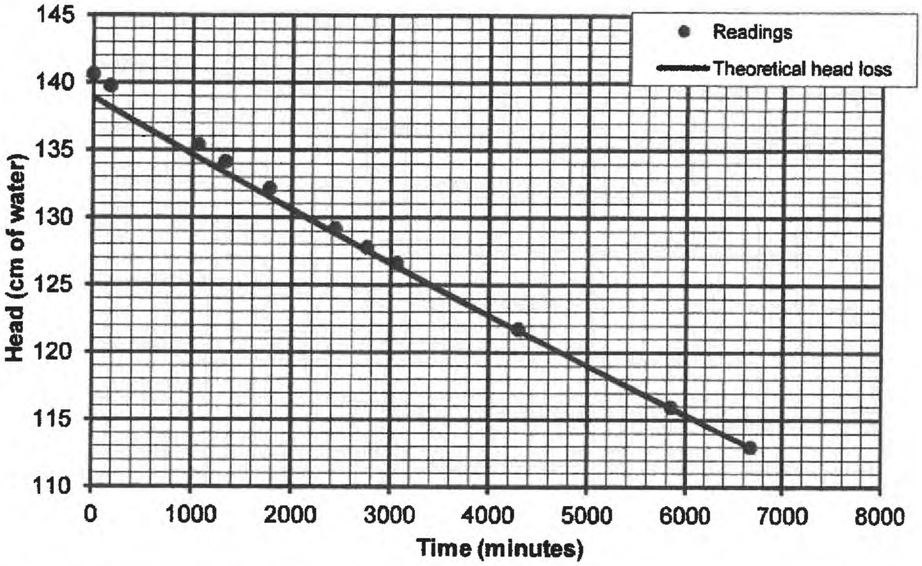
Sample: S-1

Depth: 8.5'-10.0'

Liquid Limit	19
Plasticity Index	7
Specific Gravity	2.733

Permeant Liquid
De-aired, deionized water

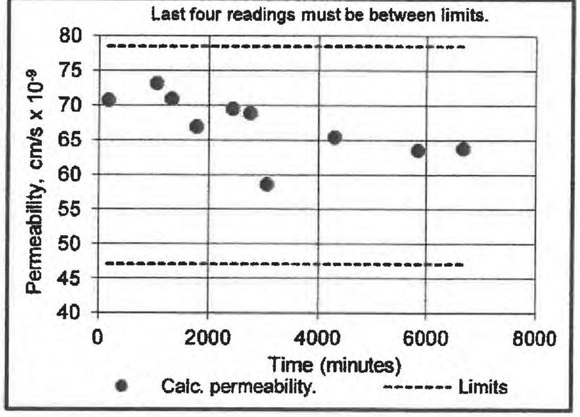
Temp. (°C)
21.0



	Diameter (cm)	Area, A (cm^2)	Length, L (cm)	Moisture (%)	Dry Density (pcf)	Saturation (%)
Initial	7.130	39.92	13.967	9.9	133.9	98.8
Final	7.130	39.92	13.967	10.0	133.9	100.0

Chamber Pressure (psi)	Backpressure (psi)		Consolidation Stress (psi)		Hydraulic Gradient (-)		
	Inflow	Outflow	Max.	Min.	Max.	Min.	Avg.
66.0	58.0	56.0	10.0	8.0	10.1	8.1	9.1

Date	Time	Buret Readings		Flow Ratio	Head, h (cm)	$k_{20°C}$ (cm/sec)
		Inflow	Outflow			
1/30/2019	15:02	1.4	20.7	——	140.6	——
1/30/2019	17:55	1.7	20.4	1.00	139.8	7.1E-08
1/31/2019	8:35	3.2	18.8	1.07	135.4	7.3E-08
1/31/2019	13:04	3.7	18.4	0.80	134.1	7.1E-08
1/31/2019	20:33	4.4	17.7	1.00	132.2	6.7E-08
2/1/2019	7:34	5.4	16.6	1.10	129.2	7.0E-08
2/1/2019	12:57	5.9	16.1	1.00	127.8	6.9E-08
2/1/2019	18:04	6.3	15.7	1.00	126.7	5.9E-08
2/2/2019	14:37	8.1	14.0	0.94	121.7	6.5E-08
2/3/2019	16:31	10.1	11.9	1.05	116.0	6.4E-08
2/4/2019	6:14	11.2	10.9	0.91	113.0	6.4E-08



$$k_{20°C} = R_T \frac{aL}{2At} \ln\left(\frac{h_1}{h_2}\right)$$ = **6.3E-08 cm/sec**

a - Area of burets (0.71 cm^2)
t - Elapsed time between readings
R_T - Temperature correction factor = (0.980)

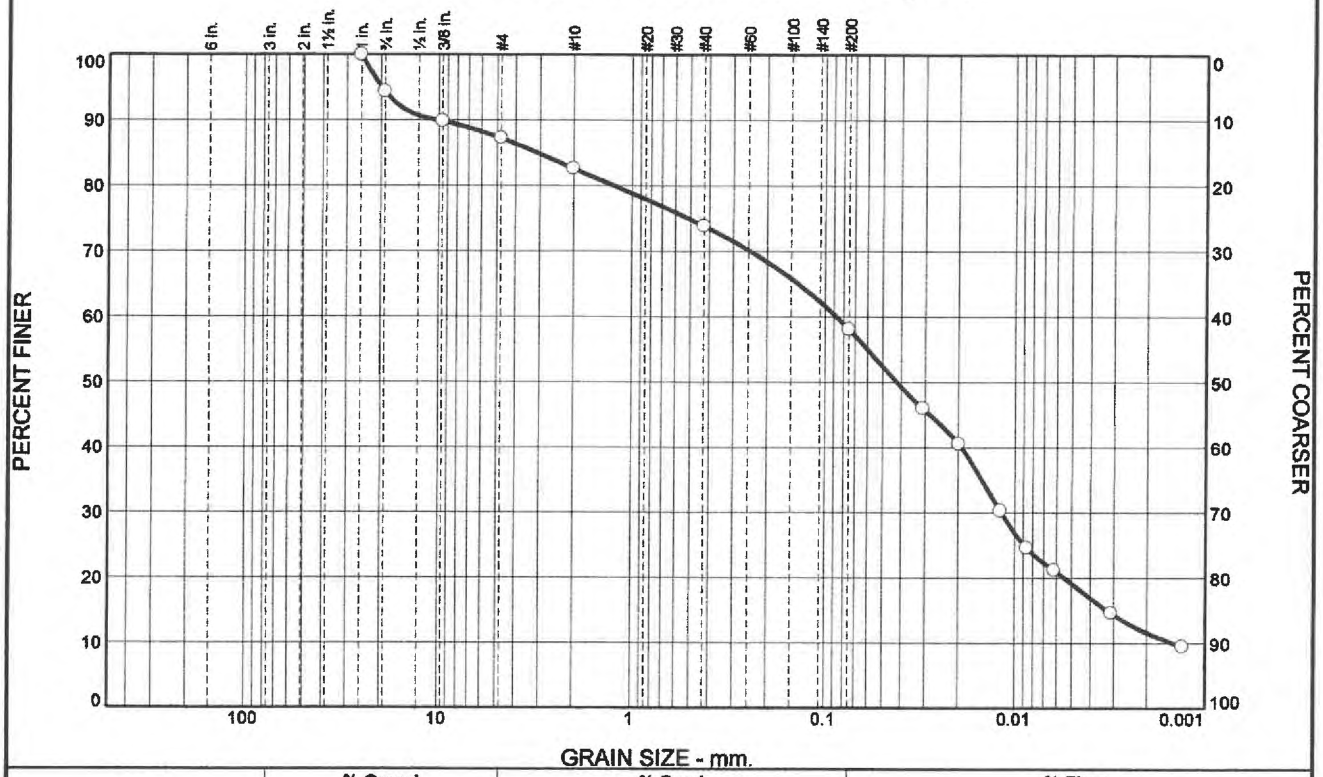
Remarks:

Specific Gravity Value is Assumed

DLZ

Client: PSI
Project: Dovetail/Grieco Lagoon
Job No: 1921-4605.00

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	5.6	7.2	4.6	8.8	15.7	38.9	19.2

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.0	100.0		
0.75	94.4		
0.375	89.8		
#4	87.2		
#10	82.6		
#40	73.8		
#200	58.1		

* (no specification provided)

Material Description

sandy silty clay

Atterberg Limits

PL= 12 LL= 19 PI= 7

Coefficients

D_{90}= 10.1685 D_{85}= 3.0672 D_{60}= 0.0875
D_{50}= 0.0420 D_{30}= 0.0118 D_{15}= 0.0032
D_{10}= 0.0015 C_u= 59.96 C_c= 1.09

Classification

USCS= CL-ML AASHTO= A-4(1)

Remarks

Moisture Content = 10.0%

Source of Sample: B-08 **Depth:** 8.5'-10.0'
Sample Number: ST-1

Date: 1-31-19

DLZ

Client: Intertek-PSI
Project: Dovetail/Grieco Lagoon

Project No: 1921-4605.00 **Figure**

Tested By: Esther Gehring-Anders **Checked By:** Steve Robinson

Permeability Test Report

ASTM D 5084 - Method C

Boring: B-10

Press Tube: ST-1

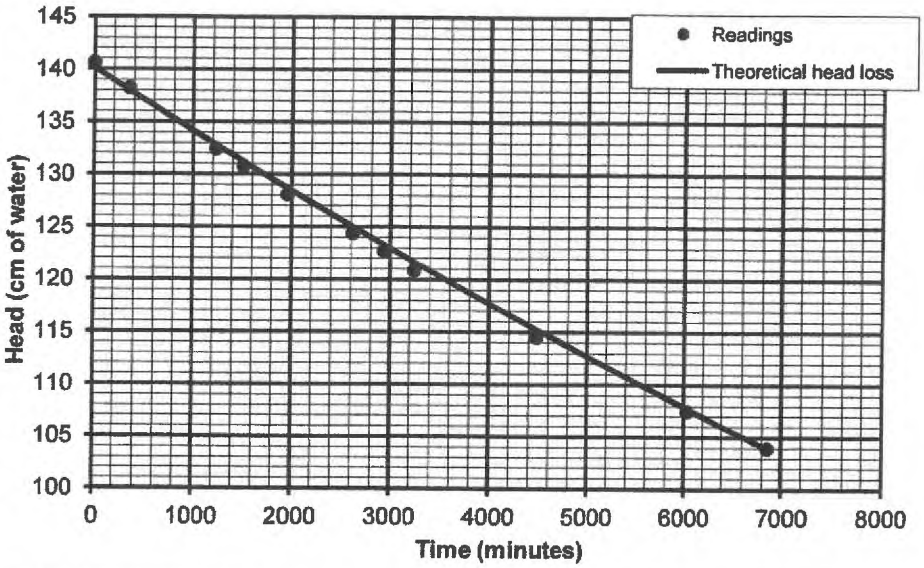
Sample: S-1

Depth: 16.0'-17.5'

Liquid Limit	19
Plasticity Index	7
Specific Gravity	2.723

Permeant Liquid
De-aired, deionized water

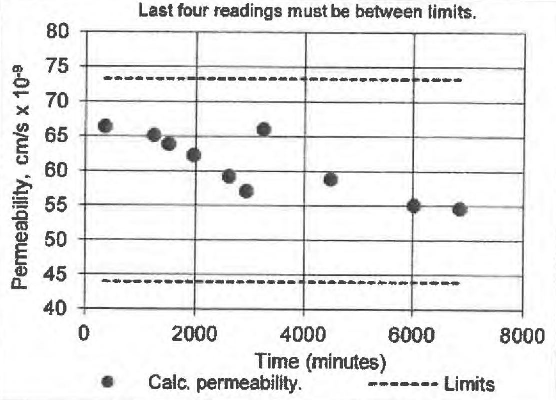
Temp. (°C)
21.0



	Diameter (cm)	Area, A (cm^2)	Length, L (cm)	Moisture (%)	Dry Density (pcf)	Saturation (%)
Initial	7.186	40.55	9.423	10.4	132.4	100.0
Final	7.186	40.55	9.423	10.1	132.4	97.1

Chamber Pressure (psi)	Backpressure (psi)		Consolidation Stress (psi)		Hydraulic Gradient (-)		
	Inflow	Outflow	Max.	Min.	Max.	Min.	Avg.
66.0	58.0	56.0	10.0	8.0	14.9	11.0	13.0

Date	Time	Buret Readings Inflow	Buret Readings Outflow	Flow Ratio	Head, h (cm)	$k_{20^\circ C}$ (cm/sec)
1/30/2019	12:02	1.4	20.2	----	140.6	----
1/30/2019	17:51	2.0	19.1	1.83	138.2	6.6E-08
1/31/2019	8:35	3.5	16.5	1.73	132.5	6.5E-08
1/31/2019	13:06	4.0	15.8	1.40	130.8	6.4E-08
1/31/2019	20:34	4.6	14.5	2.17	128.1	6.2E-08
2/1/2019	7:35	5.6	12.9	1.60	124.4	5.9E-08
2/1/2019	12:58	6.0	12.1	2.00	122.7	5.7E-08
2/1/2019	18:05	6.5	11.3	1.60	120.9	6.6E-08
2/2/2019	14:38	8.1	8.4	1.81	114.5	5.9E-08
2/3/2019	16:32	9.8	5.1	1.94	107.5	5.5E-08
2/4/2019	6:14	10.6	3.4	2.13	104.0	5.5E-08



$$k_{20^\circ C} = R_T \frac{aL}{2At} \ln\left(\frac{h_1}{h_2}\right) = \mathbf{5.9E\text{-}08\ \ cm/sec}$$

a - Area of burets (0.71 cm^2)
t - Elapsed time between readings
R_T - Temperature correction factor = (0.980)

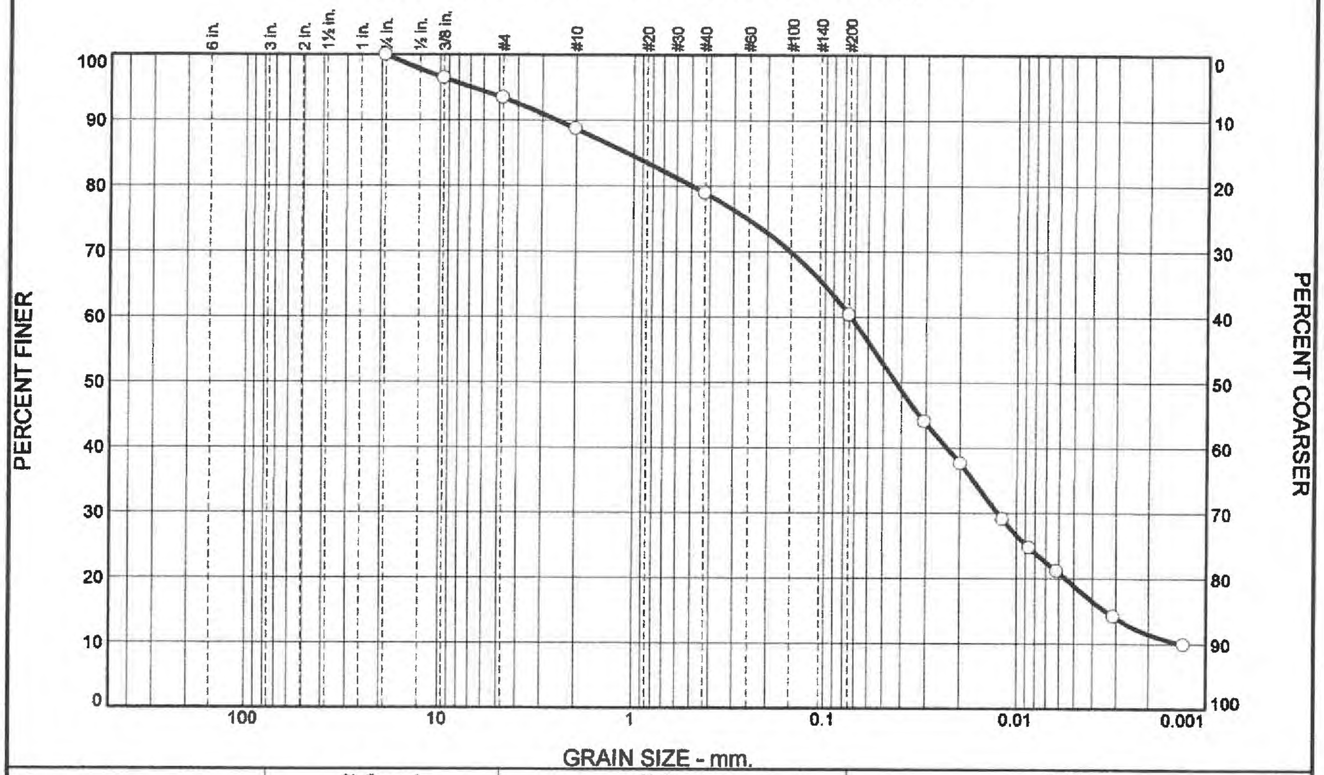
Remarks:

Specific Gravity Value is Assumed

DLZ

Client: PSI
Project: Dovetail/Grieco Lagoon
Job No: 1921-4605.00

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	6.6	4.7	9.8	18.6	41.4	18.9

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.75	100.0		
0.375	96.5		
#4	93.4		
#10	88.7		
#40	78.9		
#200	60.3		

* (no specification provided)

Material Description

sandy silty clay

Atterberg Limits

PL= 12 LL= 19 PI= 7

Coefficients

D_{90}= 2.4967 D_{85}= 1.0795 D_{60}= 0.0736
D_{50}= 0.0428 D_{30}= 0.0126 D_{15}= 0.0034
D_{10}= 0.0014 C_u= 53.86 C_c= 1.58

Classification

USCS= CL-ML AASHTO= A-4(1)

Remarks

Moisture Content = 11.0%

Source of Sample: B-10 **Depth:** 16.0'-17.5'
Sample Number: ST-1

Date: 1-31-19

DLZ

Client: Intertek-PSI
Project: Dovetail/Grieco Lagoon

Project No: 1921-4605.00 **Figure**

Tested By: Esther Gehring-Anders **Checked By:** Steve Robinson

Permeability Test Report

ASTM D 5084 - Method C

Boring: B-12

Press Tube: ST-1

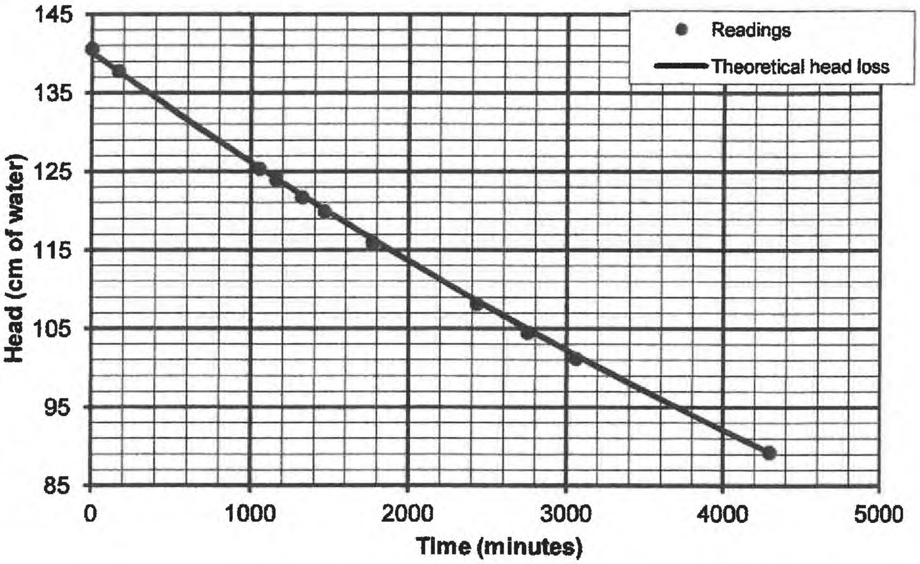
Sample: S-1

Depth: 13.0'-14.5'

Liquid Limit	17
Plasticity Index	4
Specific Gravity	2.725

Permeant Liquid
De-aired, deionized water

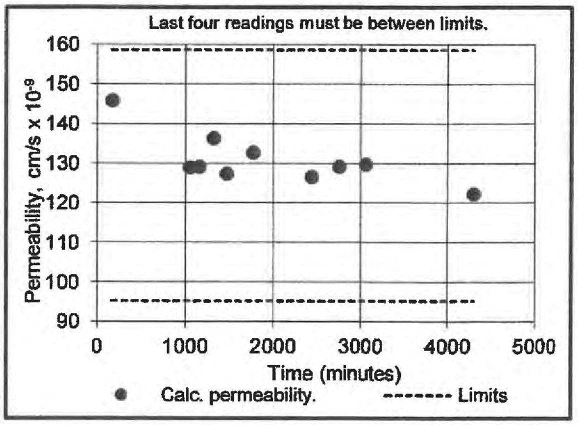
Temp. (°C)
21.0



	Diameter (cm)	Area, A (cm^2)	Length, L (cm)	Moisture (%)	Dry Density (pcf)	Saturation (%)
Initial	7.297	41.82	8.727	11.6	128.4	97.5
Final	7.297	41.82	8.727	11.9	128.4	100.0

Chamber Pressure (psi)	Backpressure (psi)		Consolidation Stress (psi)		Hydraulic Gradient (-)		
	Inflow	Outflow	Max.	Min.	Max.	Min.	Avg.
66.0	58.0	56.0	10.0	8.0	16.1	10.2	13.2

Date	Time	Buret Readings Inflow	Buret Readings Outflow	Flow Ratio	Head, h (cm)	$k_{20°C}$ (cm/sec)
1/30/2019	15:02	1.4	19.1	-----	140.6	-----
1/30/2019	17:50	2.4	18.1	1.00	137.8	1.5E-07
1/31/2019	8:35	7.0	13.9	0.91	125.4	1.3E-07
1/31/2019	10:21	7.5	13.4	1.00	124.0	1.3E-07
1/31/2019	13:04	8.3	12.6	1.00	121.7	1.4E-07
1/31/2019	15:28	9.0	12.0	0.86	119.9	1.3E-07
1/31/2019	20:33	10.5	10.7	0.87	116.0	1.3E-07
2/1/2019	7:34	13.4	8.1	0.90	108.2	1.3E-07
2/1/2019	12:57	14.8	6.9	0.86	104.5	1.3E-07
2/1/2019	18:04	16.0	5.7	1.00	101.2	1.3E-07
2/2/2019	14:37	20.2	1.5	1.00	89.3	1.2E-07



$$k_{20°C} = R_T \frac{aL}{2At} \ln\left(\frac{h_1}{h_2}\right) = \textbf{1.3E-07 cm/sec}$$

a - Area of burets (0.71 cm^2)
t - Elapsed time between readings
R_T - Temperature correction factor = (0.980)

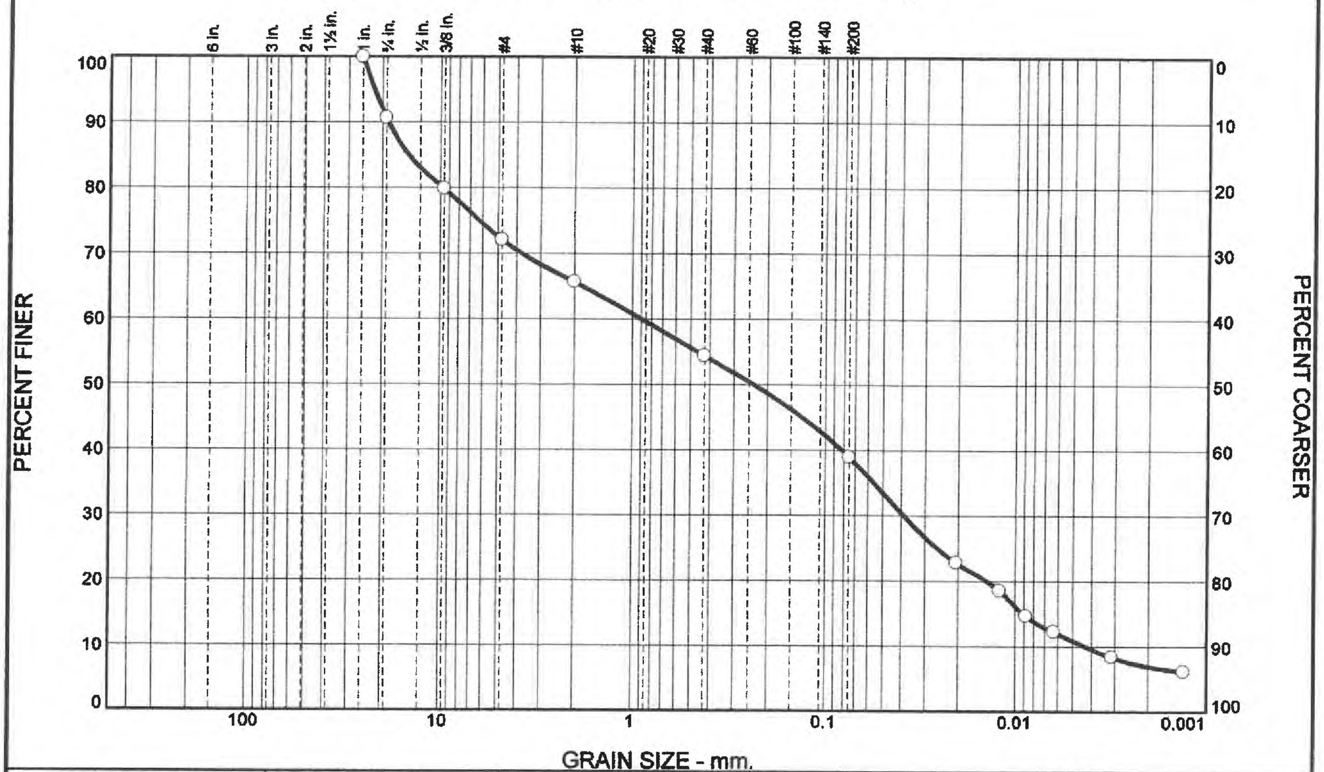
Remarks:

Specific Gravity Value is Assumed

DLZ

Client: PSI
Project: Dovetail/Grieco Lagoon
Job No: 1921-4605.00

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	9.3	18.7	6.4	11.2	15.5	28.0	10.9

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.0	100.0		
0.75	90.7		
0.375	79.9		
#4	72.0		
#10	65.6		
#40	54.4		
#200	38.9		

* (no specification provided)

Material Description

silty, clayey sand with gravel

Atterberg Limits

PL= 13 LL= 17 PI= 4

Coefficients

D_{90}= 18.5779 D_{85}= 14.5620 D_{60}= 0.9003
D_{50}= 0.2359 D_{30}= 0.0387 D_{15}= 0.0090
D_{10}= 0.0043 C_u= 209.35 C_c= 0.39

Classification

USCS= SC-SM AASHTO= A-4(0)

Remarks

Moisture Content = 8.6%

Source of Sample: B-12 **Depth:** 13.0'-14.5'
Sample Number: ST-1

Date: 1-31-19

DLZ

Client: Intertek-PSI
Project: Dovetail/Grieco Lagoon

Project No: 1921-4605.00 **Figure**

Tested By: Esther Gehring-Anders **Checked By:** Steve Robinson

GENERAL NOTES

SAMPLE IDENTIFICATION

The Unified Soil Classification System (USCS), AASHTO 1988 and ASTM designations D2487 and D-2488 are used to identify the encountered materials unless otherwise noted. Coarse-grained soils are defined as having more than 50% of their dry weight retained on a #200 sieve (0.075mm); they are described as: boulders, cobbles, gravel or sand. Fine-grained soils have less than 50% of their dry weight retained on a #200 sieve; they are defined as silts or clay depending on their Atterberg Limit attributes. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size.

DRILLING AND SAMPLING SYMBOLS

SFA: Solid Flight Auger - typically 4" diameter flights, except where noted.
HSA: Hollow Stem Auger - typically 3¼" or 4¼ I.D. openings, except where noted.
M.R.: Mud Rotary - Uses a rotary head with Bentonite or Polymer Slurry
R.C.: Diamond Bit Core Sampler
H.A.: Hand Auger
P.A.: Power Auger - Handheld motorized auger
SS: Split-Spoon - 1 3/8" I.D., 2" O.D., except where noted.
ST: Shelby Tube - 3" O.D., except where noted.
BS: Bulk Sample
PM: Pressuremeter
CPT-U: Cone Penetrometer Testing with Pore-Pressure Readings

SOIL PROPERTY SYMBOLS

N: Standard "N" penetration: Blows per foot of a 140 pound hammer falling 30 inches on a 2-inch O.D. Split-Spoon.
N_{60}: A "N" penetration value corrected to an equivalent 60% hammer energy transfer efficiency (ETR)
Q_u: Unconfined compressive strength, TSF
Q_p: Pocket penetrometer value, unconfined compressive strength, TSF
w%: Moisture/water content, %
LL: Liquid Limit, %
PL: Plastic Limit, %
PI: Plasticity Index = (LL-PL),%
DD: Dry unit weight, pcf
▼,▽,▼ Apparent groundwater level at time noted

RELATIVE DENSITY OF COARSE-GRAINED SOILS

Relative Density	N - Blows/foot
Very Loose	0 - 4
Loose	4 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	50 - 80
Extremely Dense	80+

ANGULARITY OF COARSE-GRAINED PARTICLES

Description	Criteria
Angular:	Particles have sharp edges and relatively plane sides with unpolished surfaces
Subangular:	Particles are similar to angular description, but have rounded edges
Subrounded:	Particles have nearly plane sides, but have well-rounded corners and edges
Rounded:	Particles have smoothly curved sides and no edges

GRAIN-SIZE TERMINOLOGY

Component	Size Range
Boulders:	Over 300 mm (>12 in.)
Cobbles:	75 mm to 300 mm (3 in. to 12 in.)
Coarse-Grained Gravel:	19 mm to 75 mm (¾ in. to 3 in.)
Fine-Grained Gravel:	4.75 mm to 19 mm (No.4 to ¾ in.)
Coarse-Grained Sand:	2 mm to 4.75 mm (No.10 to No.4)
Medium-Grained Sand:	0.42 mm to 2 mm (No.40 to No.10)
Fine-Grained Sand:	0.075 mm to 0.42 mm (No. 200 to No.40)
Silt:	0.002 mm to 0.075 mm
Clay:	<0.002mm to <0.005 mm depending on agency

PARTICLE SHAPE

Description	Criteria
Flat:	Particles with width/thickness ratio > 3
Elongated:	Particles with length/width ratio > 3
Flat & Elongated:	Particles meet criteria for both flat and elongated

RELATIVE PROPORTIONS OF FINES

Descriptive Term	% Dry Weight
Trace:	< 5%
With:	5% to 12%
Modifier:	>12%

GENERAL NOTES
(Continued)

CONSISTENCY OF FINE-GRAINED SOILS

Q_U - TSF	N - Blows/foot	Consistency
0 - 0.25	0 - 2	Very Soft
0.25 - 0.50	2 - 4	Soft
0.50 - 1.00	4 - 8	Firm (Medium Stiff)
1.00 - 2.00	8 - 15	Stiff
2.00 - 4.00	15 - 30	Very Stiff
4.00 - 8.00	30 - 50	Hard
8.00+	50+	Very Hard

MOISTURE CONDITION DESCRIPTION

Description	Criteria
Dry:	Absence of moisture, dusty, dry to the touch
Moist:	Damp but no visible water
Wet:	Visible free water, usually soil is below water table

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term	% Dry Weight
Trace:	< 15%
With:	15% to 30%
Modifier:	>30%

STRUCTURE DESCRIPTION

Description	Criteria
Stratified:	Alternating layers of varying material or color with layers at least ¼-inch (6 mm) thick
Laminated:	Alternating layers of varying material or color with layers less than ¼-inch (6 mm) thick
Fissured:	Breaks along definite planes of fracture with little resistance to fracturing
Slickensided:	Fracture planes appear polished or glossy, sometimes striated

Description	Criteria
Blocky:	Cohesive soil that can be broken down into small angular lumps which resist further breakdown
Lensed:	Inclusion of small pockets of different soils
Layer:	Inclusion greater than 3 inches thick (75 mm)
Seam:	Inclusion 1/8-inch to 3 inches (3 to 75 mm) thick extending through the sample
Parting:	Inclusion less than 1/8-inch (3 mm) thick

SCALE OF RELATIVE ROCK HARDNESS

Q_U - TSF	Consistency
2.5 - 10	Extremely Soft
10 - 50	Very Soft
50 - 250	Soft
250 - 525	Medium Hard
525 - 1,050	Moderately Hard
1,050 - 2,600	Hard
>2,600	Very Hard

ROCK BEDDING THICKNESSES

Description	Criteria
Very Thick Bedded	Greater than 3-foot (>1.0 m)
Thick Bedded	1-foot to 3-foot (0.3 m to 1.0 m)
Medium Bedded	4-inch to 1-foot (0.1 m to 0.3 m)
Thin Bedded	1¼-inch to 4-inch (30 mm to 100 mm)
Very Thin Bedded	½-inch to 1¼-inch (10 mm to 30 mm)
Thickly Laminated	1/8-inch to ½-inch (3 mm to 10 mm)
Thinly Laminated	1/8-inch or less "paper thin" (<3 mm)

ROCK VOIDS

Voids	Void Diameter
Pit	<6 mm (<0.25 in)
Vug	6 mm to 50 mm (0.25 in to 2 in)
Cavity	50 mm to 600 mm (2 in to 24 in)
Cave	>600 mm (>24 in)

GRAIN-SIZED TERMINOLOGY

(Typically Sedimentary Rock)

Component	Size Range
Very Coarse Grained	>4.76 mm
Coarse Grained	2.0 mm - 4.76 mm
Medium Grained	0.42 mm - 2.0 mm
Fine Grained	0.075 mm - 0.42 mm
Very Fine Grained	<0.075 mm

ROCK QUALITY DESCRIPTION

Rock Mass Description	RQD Value
Excellent	90 -100
Good	75 - 90
Fair	50 - 75
Poor	25 -50
Very Poor	Less than 25

DEGREE OF WEATHERING

Slightly Weathered:	Rock generally fresh, joints stained and discoloration extends into rock up to 25 mm (1 in), open joints may contain clay, core rings under hammer impact.
Weathered:	Rock mass is decomposed 50% or less, significant portions of the rock show discoloration and weathering effects, cores cannot be broken by hand or scraped by knife.
Highly Weathered:	Rock mass is more than 50% decomposed, complete discoloration of rock fabric, core may be extremely broken and gives clunk sound when struck by hammer, may be shaved with a knife.

SOIL CLASSIFICATION CHART

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

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March 25, 2019

Project No. 2019-155-001

Mr. David Gerdeman
North Point Engineering
6657 Frank Ave. N.W.
Suite 200
Canton, OH 44720

Transmittal
Laboratory Test Results
Ringler Dovetail

Please find attached the laboratory test results for the above referenced project. The tests were outlined on the Project Verification Form that was transmitted to your firm prior to the testing. The testing was performed in general accordance with the methods listed on the enclosed data sheets. The test results are believed to be representative of the samples that were submitted for testing and are indicative only of the specimens that were evaluated. We have no direct knowledge of the origin of the samples and imply no position with regard to the nature of the test results, i.e. pass/fail and no claims as to the suitability of the material for its intended use.

The test data and all associated project information provided shall be held in strict confidence and disclosed to other parties only with authorization by our Client. The test data submitted herein is considered integral with this report and is not to be reproduced except in whole and only with the authorization of the Client and Geotechnics. The remaining sample materials for this project will be retained for a minimum of 90 days as directed by the Geotechnics' Quality Program.

We are pleased to provide these testing services. Should you have any questions or if we may be of further assistance, please contact our office.

Respectfully submitted,
Geotechnics, Inc.

David R. Backstrom
Laboratory Director

We understand that you have a choice in your laboratory services and we thank you for choosing Geotechnics.

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SIEVE AND HYDROMETER ANALYSIS

ASTM D 422-63 (2007)

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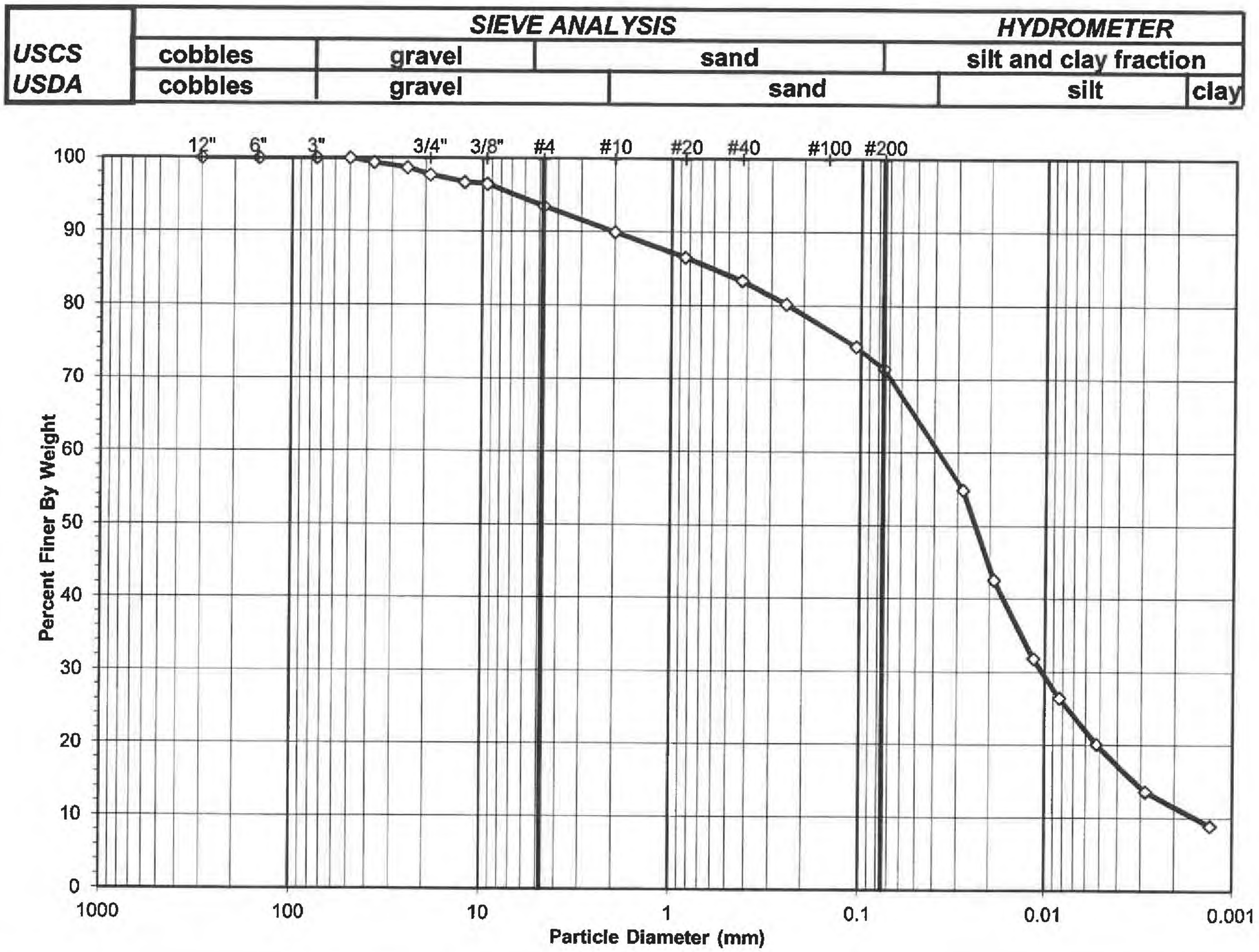
Client: North Point Engineering
Client Reference: Ringler Dovetail
Project No.: 2019-155-001
Lab ID: 2019-155-001-001

Boring No.: NA
Depth (ft): 0-2'
Sample No.: TP-4
Soil Color: Brown



USCS Summary

Sieve Sizes (mm)		Percentage
Greater Than #4	*Gravel*	6.47
#4 To #200	*Sand*	22.10
Finer Than #200	*Silt & Clay*	71.43

USCS Symbol:

CL-ML, TESTED

USCS Classification:

SILTY CLAY WITH SAND

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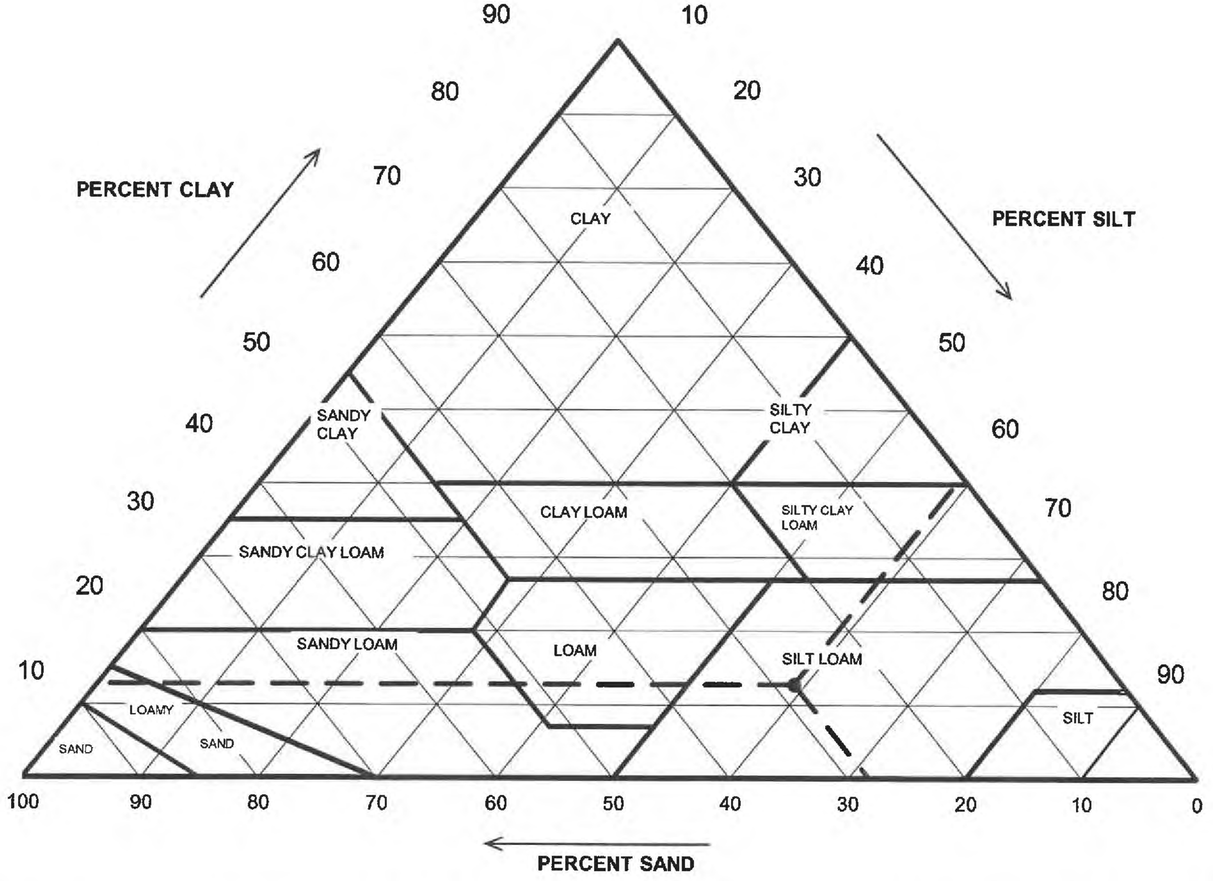
USDA CLASSIFICATION CHART

Client:	North Point Engineering	Boring No.:	NA
Client Reference:	Ringler Dovetail	Depth (ft):	0-2'
Project No.:	2019-155-001	Sample No.:	TP-4
Lab ID:	2019-155-001-001	Soil Color:	Brown



Particle Size (mm)	Percent Finer	USDA SUMMARY	Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classificat.
		Gravel	10.00	**0.00**
2	90.00	*Sand*	25.40	**28.22**
0.05	64.60	*Silt*	53.11	**59.01**
0.002	11.49	*Clay*	11.49	**12.77**

USDA Classification: ***SILT LOAM***

WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

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Client:	North Point Engineering	Boring No.:	NA
Client Reference:	Ringler Dovetail	Depth (ft):	0-2'
Project No.:	2019-155-001	Sample No.:	TP-4
Lab ID:	2019-155-001-001	Soil Color:	Brown

Moisture Content of Passing 3/4" Material		Moisture Content of Retained 3/4" Material	
Tare No.:	37	Tare No.:	909
Wt. of Tare & Wet Sample (g):	1209.44	Weight of Tare & Wet Sample (g):	637.51
Wt. of Tare & Dry Sample (g):	1147.57	Weight of Tare & Dry Sample (g):	629.97
Weight of Tare (g):	203.66	Weight of Tare (g):	108.95
Weight of Water (g):	61.87	Weight of Water (g):	7.54
Weight of Dry Soil (g):	943.91	Weight of Dry Soil (g):	521.02
Moisture Content (%):	**6.6**	**Moisture Content (%):**	**1.4**

Wet Weight of -3/4" Sample (g):	23916	Weight of the Dry Sample (g):	943.91
Dry Weight of - 3/4" Sample (g):	22444.8	Weight of Minus #200 Material (g):	689.84
Wet Weight of +3/4" Sample (g):	528.56	Weight of Plus #200 Material (g):	254.07
Dry Weight of + 3/4" Sample (g):	521.02		
Total Dry Weight of Sample (g):	22965.8	**J - Factor (Percent Finer than 3/4"):**	**0.9773**

Sieve Size	Sieve Opening (mm)	Weight of Soil Retained (g)		Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00		0.00	0.00	100.00	**100.00**
6"	150	0.00		0.00	0.00	100.00	**100.00**
3"	75	0.00		0.00	0.00	100.00	**100.00**
2"	50	0.00	(*)	0.00	0.00	100.00	**100.00**
1 1/2"	37.5	137.72		0.59	0.59	99.41	**99.41**
1"	25.0	160.24		0.69	1.28	98.72	**98.72**
3/4"	19.0	230.60		0.99	2.27	97.73	**97.73**
1/2"	12.5	9.57		1.01	1.01	98.99	**96.74**
3/8"	9.50	2.08		0.22	1.23	98.77	**96.53**
#4	4.75	28.95		3.07	4.30	95.70	**93.53**
#10	2.00	34.07		3.61	7.91	92.09	**90.00**
#20	0.85	32.95	(**)	3.49	11.40	88.60	**86.59**
#40	0.425	30.59		3.24	14.64	85.36	**83.42**
#60	0.250	30.89		3.27	17.91	82.09	**80.22**
#140	0.106	55.96		5.93	23.84	76.16	**74.43**
#200	0.075	29.01		3.07	26.92	73.08	**71.43**
Pan	-	689.84		73.08	100.00	-	-

Notes : *(*) The + 3/4" sieve analysis is based on the Total Dry Weight of the Sample*
*(**) The - 3/4" sieve analysis is based on the Weight of the Dry Sample*

Tested By HL Date 3/22/19 Checked By KC Date 3/25/19

HYDROMETER ANALYSIS

ASTM D 422-63 (2007)

Client:	North Point Engineering	Boring No.:	NA
Client Reference:	Ringler Dovetail	Depth (ft):	0-2'
Project No.:	2019-155-001	Sample No.:	TP-4
Lab ID:	2019-155-001-001	Soil Color:	Brown

Elapsed Time (min)		R Measured	Temp. (°C)	Composite Correction	R Corrected	N (%)	K Factor	Diameter (mm)	N' (%)
0		NA	NA	NA	NA	NA	NA	NA	NA
2		42.0	23.2	6.31	35.7	76.8	0.01294	0.0281	**54.9**
5		34.0	23.2	6.31	27.7	59.6	0.01294	0.0190	**42.6**
15		27.0	23.2	6.31	20.7	44.5	0.01294	0.0115	**31.8**
30		23.5	23.2	6.31	17.2	37.0	0.01294	0.0083	**26.4**
81		19.5	22.9	6.41	13.1	28.2	0.01299	0.0052	**20.1**
291		15.5	22.2	6.64	8.9	19.1	0.01310	0.0028	**13.6**
1440		12.5	22	6.70	5.8	12.5	0.01313	0.0013	**8.9**

Soil Specimen Data		**Other Corrections**	
Tare No.:	700		
Wt. of Tare & Dry Material (g):	138.38	a - Factor:	0.99
Weight of Tare (g):	87.39		
Weight of Deflocculant (g):	5.0	Percent Finer than # 200:	71.43
Weight of Dry Material (g):	45.99		
		Specific Gravity:	2.7 Assumed

Note: *Hydrometer test is performed on - # 200 sieve material.*

Tested By TO Date 3/22/19 Checked By KC Date 3/25/19

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ATTERBERG LIMITS

ASTM D 4318-17

Client:	North Point Engineering	Boring No.:	NA
Client Reference:	Ringler Dovetail	Depth (ft):	0-2'
Project No.:	2019-155-001	Sample No.:	TP-4
Lab ID:	2019-155-001-001	Soil Description:	BROWN SILTY CLAY

(Minus No. 40 sieve material, Air dried)

Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description.

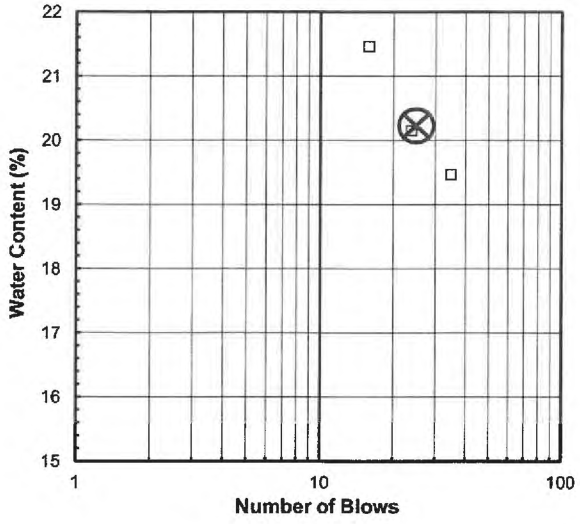
As Received Moisture Content		Liquid Limit Test			
ASTM D2216-10		**1**	**2**	**3**	**M**
Tare Number:	2996	278	203	2289	**U**
Wt. of Tare & Wet Sample (g):	293.21	45.22	44.87	46.70	**L**
Wt. of Tare & Dry Sample (g):	256.36	40.68	40.59	42.06	**T**
Weight of Tare (g):	8.14	17.35	19.34	20.43	**I**
Weight of Water (g):	36.9	4.5	4.3	4.6	**P**
Weight of Dry Sample (g):	248.2	23.3	21.3	21.6	**O**
Was As Received MC Preserved:	**Yes**				**I**
Moisture Content (%):	**14.8**	**19.5**	**20.1**	**21.5**	**N**
Number of Blows:		**35**	**24**	**16**	**T**

Plastic Limit Test	1	2	Range
Tare Number:	405	1265	
Wt. of Tare & Wet Sample (g):	23.77	24.95	
Wt. of Tare & Dry Sample (g):	22.95	24.06	
Weight of Tare (g):	17.43	17.75	
Weight of Water (g):	0.8	0.9	
Weight of Dry Sample (g):	5.5	6.3	
Moisture Content (%):	**14.9**	**14.1**	**0.8**

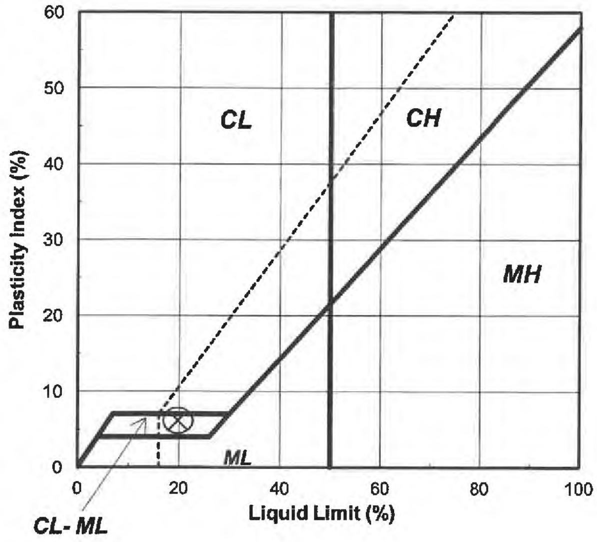
Note: The acceptable range of the two Moisture Contents is ± 0.84

Test Results	
Liquid Limit (%):	**20**
Plastic Limit (%):	**14**
Plasticity Index (%):	**6**
USCS Symbol:	**CL-ML**

Flow Curve



Plasticity Chart



Tested By *RAL* *Date* *3/22/19* *Checked By* *KC* *Date* 3/25/19

SIEVE AND HYDROMETER ANALYSIS

ASTM D 422-63 (2007)

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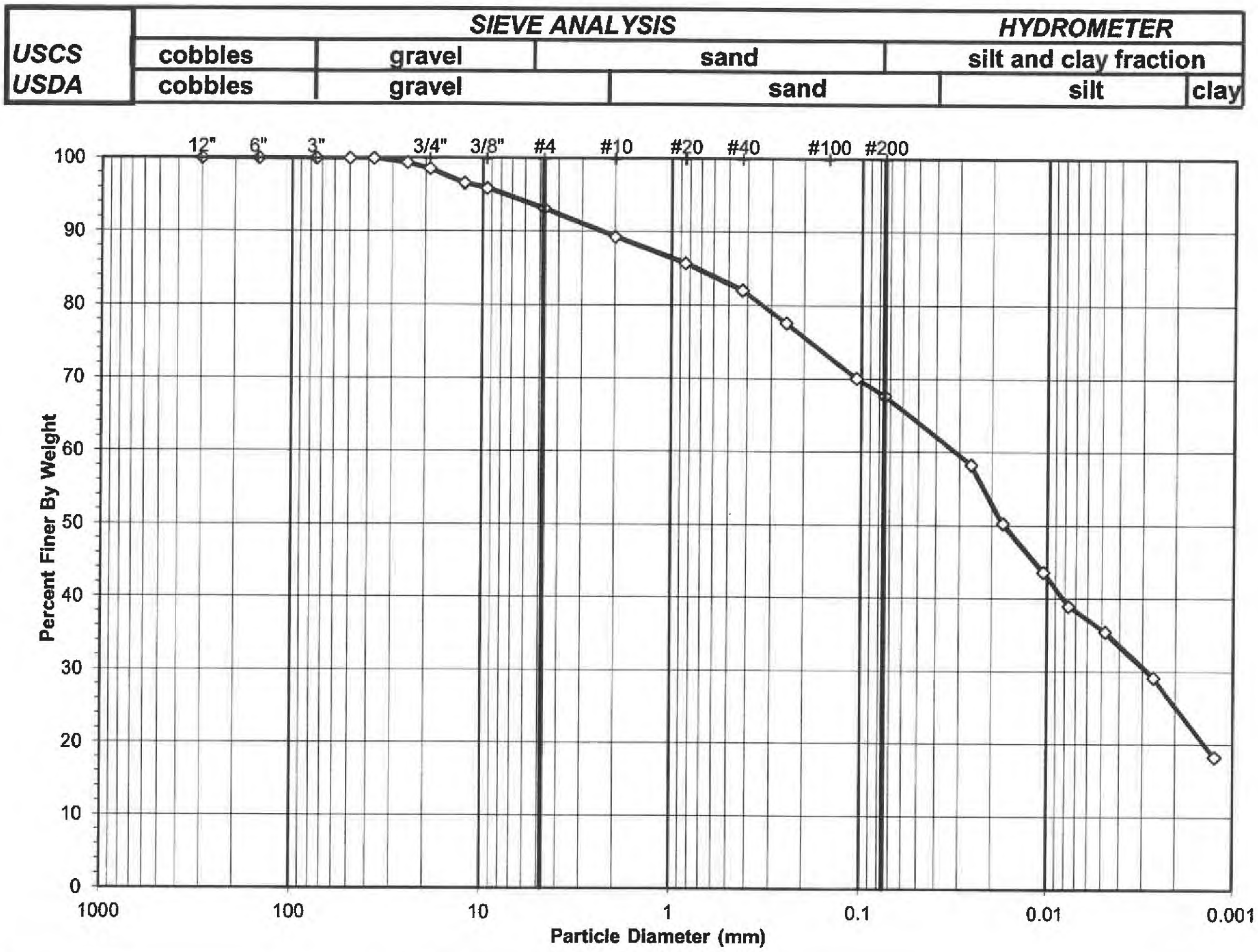
geotechnical & geosynthetic testing

Client:	North Point Engineering	Boring No.:	NA
Client Reference:	Ringler Dovetail	Depth (ft):	0-1.5'
Project No.:	2019-155-001	Sample No.:	TP-5
Lab ID:	2019-155-001-002	Soil Color:	Brown



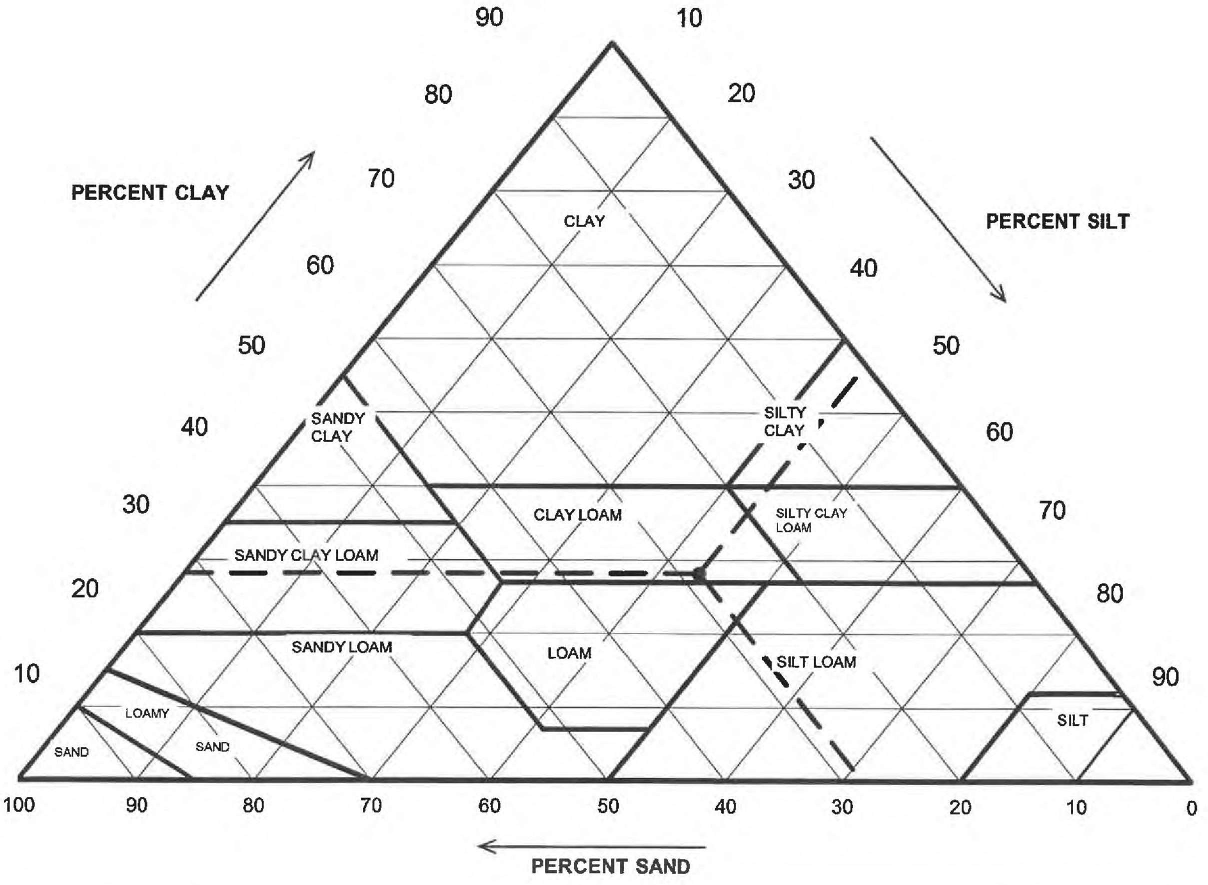
Sieve Sizes (mm)	USCS Summary	Percentage
Greater Than #4	*Gravel*	6.82
#4 To #200	*Sand*	25.52
Finer Than #200	*Silt & Clay*	67.66

USCS Symbol:
CL, TESTED

USCS Classification:
SANDY LEAN CLAY

USDA CLASSIFICATION CHART

Client:	North Point Engineering	Boring No.:	NA
Client Reference:	Ringler Dovetail	Depth (ft):	0-1.5'
Project No.:	2019-155-001	Sample No.:	TP-5
Lab ID:	2019-155-001-002	Soil Color:	Brown



Particle Size (mm)	Percent Finer	USDA SUMMARY	Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classificat.
		Gravel	10.69	**0.00**
2	89.31	*Sand*	25.24	**28.26**
0.05	64.07	*Silt*	38.89	**43.55**
0.002	25.17	*Clay*	25.17	**28.19**

USDA Classification: ***CLAY LOAM***

DCN: CT-S3B DATE: 7/17/17 REVISION: 9e

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WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	North Point Engineering	Boring No.:	NA
Client Reference:	Ringler Dovetail	Depth (ft):	0-1.5'
Project No.:	2019-155-001	Sample No.:	TP-5
Lab ID:	2019-155-001-002	Soil Color:	Brown

Moisture Content of Passing 3/4" Material		Moisture Content of Retained 3/4" Material	
Tare No.:	43	Tare No.:	607
Wt. of Tare & Wet Sample (g):	1262.18	Weight of Tare & Wet Sample (g):	314.53
Wt. of Tare & Dry Sample (g):	1179.47	Weight of Tare & Dry Sample (g):	313.08
Weight of Tare (g):	200.51	Weight of Tare (g):	82.42
Weight of Water (g):	82.71	Weight of Water (g):	1.45
Weight of Dry Soil (g):	978.96	Weight of Dry Soil (g):	230.66
Moisture Content (%):	**8.4**	**Moisture Content (%):**	**0.6**

Wet Weight of -3/4" Sample (g):	17587	Weight of the Dry Sample (g):	978.96
Dry Weight of - 3/4" Sample (g):	16216.9	Weight of Minus #200 Material (g):	671.79
Wet Weight of +3/4" Sample (g):	232.11	Weight of Plus #200 Material (g):	307.17
Dry Weight of + 3/4" Sample (g):	230.66		
Total Dry Weight of Sample (g):	16447.5	**J - Factor (Percent Finer than 3/4"):**	**0.9860**

Sieve Size	Sieve Opening (mm)	Weight of Soil Retained (g)		Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00		0.00	0.00	100.00	**100.00**
6"	150	0.00		0.00	0.00	100.00	**100.00**
3"	75	0.00		0.00	0.00	100.00	**100.00**
2"	50	0.00	(*)	0.00	0.00	100.00	**100.00**
1 1/2"	37.5	0.00		0.00	0.00	100.00	**100.00**
1"	25.0	99.10		0.60	0.60	99.40	**99.40**
3/4"	19.0	133.01		0.80	1.40	98.60	**98.60**
1/2"	12.5	19.37		1.98	1.98	98.02	**96.65**
3/8"	9.50	7.23		0.74	2.72	97.28	**95.92**
#4	4.75	27.21		2.78	5.50	94.50	**93.18**
#10	2.00	38.44		3.93	9.42	90.58	**89.31**
#20	0.85	35.38	(**)	3.61	13.04	86.96	**85.74**
#40	0.425	36.62		3.74	16.78	83.22	**82.05**
#60	0.250	44.10		4.50	21.28	78.72	**77.61**
#140	0.106	74.98		7.66	28.94	71.06	**70.06**
#200	0.075	23.84		2.44	31.38	68.62	**67.66**
Pan	-	671.79		68.62	100.00	-	-

Notes : *(*) The + 3/4" sieve analysis is based on the Total Dry Weight of the Sample*
*(**) The - 3/4" sieve analysis is based on the Weight of the Dry Sample*

Tested By HL Date 3/25/19 Checked By KC Date 3/25/19

HYDROMETER ANALYSIS

ASTM D 422-63 (2007)

Client:	North Point Engineering	Boring No.:	NA
Client Reference:	Ringler Dovetail	Depth (ft):	0-1.5'
Project No.:	2019-155-001	Sample No.:	TP-5
Lab ID:	2019-155-001-002	Soil Color:	Brown

Elapsed Time		R Measured	Temp.	Composite Correction	R Corrected	N	K Factor	Diameter	N'
(min)			(°C)			(%)		(mm)	(%)
0		NA	NA	NA	NA	NA	NA	NA	NA
2		50.0	23.2	6.31	43.7	86.2	0.01294	0.0260	**58.3**
5		44.0	23.2	6.31	37.7	74.3	0.01294	0.0174	**50.3**
15		39.0	23.2	6.31	32.7	64.5	0.01294	0.0105	**43.6**
30		35.5	23.2	6.31	29.2	57.6	0.01294	0.0076	**38.9**
80		33.0	22.9	6.41	26.6	52.4	0.01299	0.0048	**35.5**
288		28.5	22.2	6.64	21.9	43.1	0.01310	0.0026	**29.2**
1440		20.4	22	6.70	13.7	27.0	0.01313	0.0012	**18.3**

Soil Specimen Data		**Other Corrections**	
Tare No.:	961		
Wt. of Tare & Dry Material (g):	155.42	a - Factor:	0.99
Weight of Tare (g):	100.21		
Weight of Deflocculant (g):	5.0	Percent Finer than # 200:	67.66
Weight of Dry Material (g):	50.21		
		Specific Gravity:	2.7 Assumed

Note: *Hydrometer test is performed on - # 200 sieve material.*

Tested By TO Date 3/22/19 Checked By KC Date 3/25/19

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ATTERBERG LIMITS

ASTM D 4318-17

Client: North Point Engineering
Client Reference: Ringler Dovetail
Project No.: 2019-155-001
Lab ID: 2019-155-001-002

Boring No.: NA
Depth (ft): 0-1.5'
Sample No.: TP-5
Soil Description: BROWN LEAN CLAY
(Minus No. 40 sieve material, Air dried)

Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description.

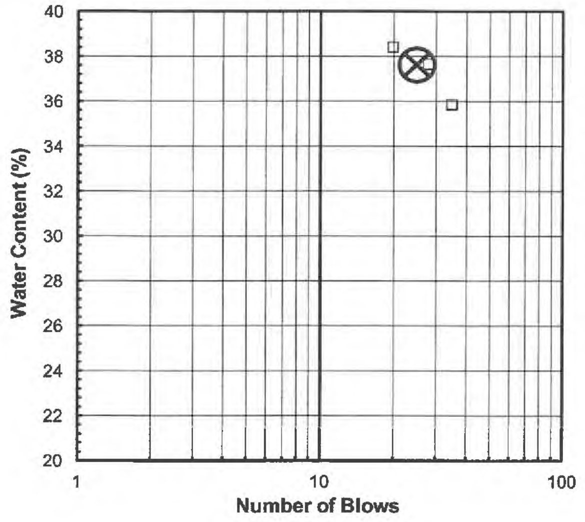
As Received Moisture Content		**Liquid Limit Test**			
ASTM D2216-10		**1**	**2**	**3**	**M**
Tare Number:	3000	13	264	280	**U**
Wt. of Tare & Wet Sample (g):	287.64	32.22	40.93	32.14	**L**
Wt. of Tare & Dry Sample (g):	239.45	26.61	35.46	26.82	**T**
Weight of Tare (g):	8.15	11.99	20.92	11.97	**I**
Weight of Water (g):	48.2	5.6	5.5	5.3	**P**
Weight of Dry Sample (g):	231.3	14.6	14.5	14.9	**O**
Was As Received MC Preserved:	**Yes**				**I**
Moisture Content (%):	**20.8**	**38.4**	**37.6**	**35.8**	**N**
Number of Blows:		**20**	**28**	**35**	**T**

Plastic Limit Test	**1**	**2**	**Range**
Tare Number:	111	169	
Wt. of Tare & Wet Sample (g):	25.53	25.42	
Wt. of Tare & Dry Sample (g):	24.70	24.60	
Weight of Tare (g):	19.26	19.25	
Weight of Water (g):	0.8	0.8	
Weight of Dry Sample (g):	5.4	5.4	
Moisture Content (%):	**15.3**	**15.3**	**-0.1**

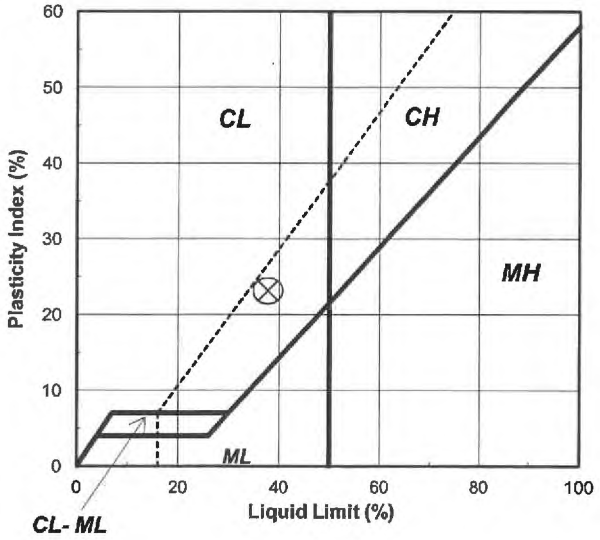
Note: The acceptable range of the two Moisture Contents is ± 1.12

Test Results	
Liquid Limit (%):	**38**
Plastic Limit (%):	**15**
Plasticity Index (%):	**23**
USCS Symbol:	**CL**

Flow Curve



Plasticity Chart



Tested By *RAL* *Date* *3/22/19* *Checked By* *KC* *Date* 3/25/19

page 1 of 1 DCN: CTS4B, REV. 8, 5/22/18 *S:\Excel\Excel QA\Spreadsheets\Limit 3Pt.xls*

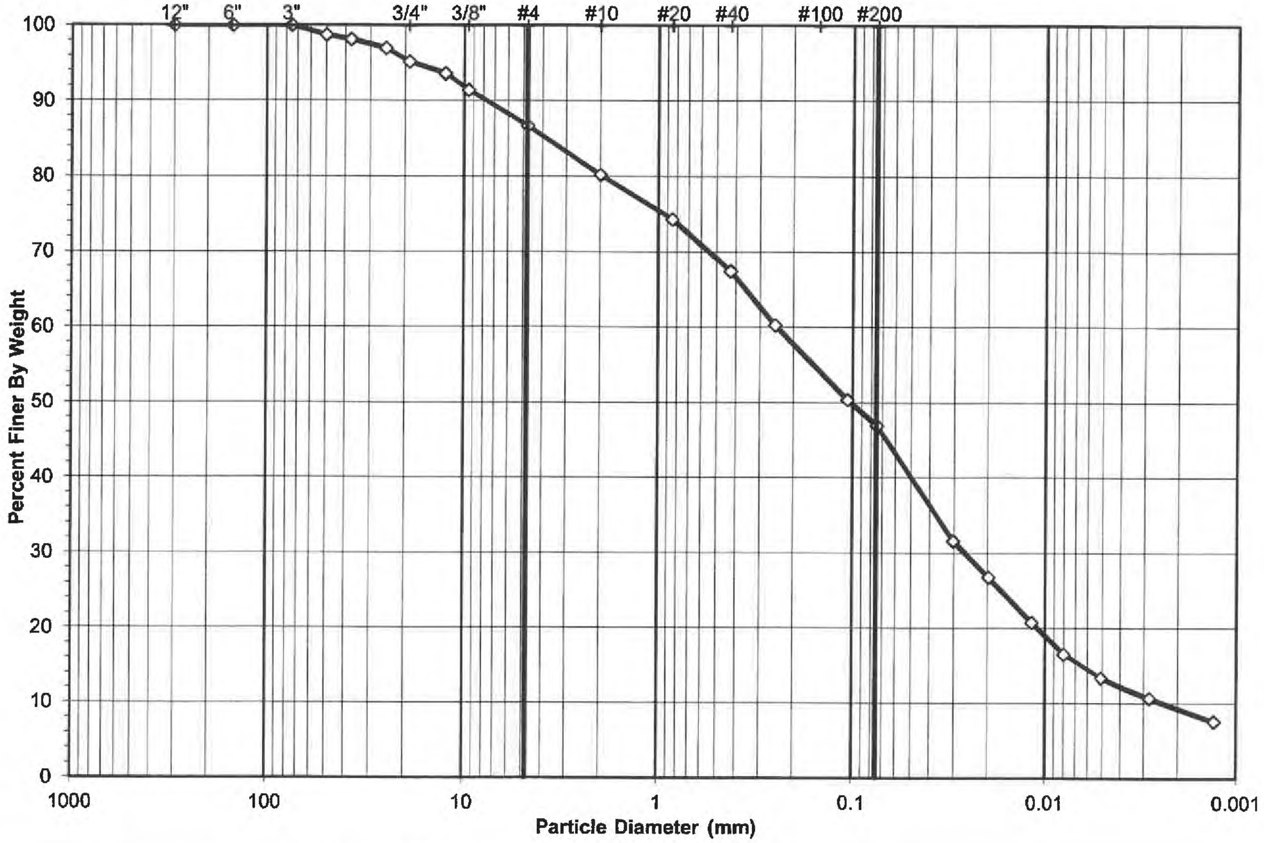
SIEVE AND HYDROMETER ANALYSIS

ASTM D 422-63 (2007)

geotechnics
geotechnical & geosynthetic testing

Client:	North Point Engineering	Boring No.:	NA
Client Reference:	Ringler Dovetail	Depth (ft):	0-7'
Project No.:	2019-155-001	Sample No.:	TP-7
Lab ID:	2019-155-001-003	Soil Color:	Brown

	SIEVE ANALYSIS			***HYDROMETER***	
USCS	**cobbles**	**gravel**	**sand**	**silt and clay fraction**	
USDA	**cobbles**	**gravel**	**sand**	**silt**	**clay**



Sieve Sizes (mm)	**USCS Summary**	**Percentage**
Greater Than #4	*Gravel*	13.28
#4 To #200	*Sand*	39.76
Finer Than #200	*Silt & Clay*	46.95

USCS Symbol:

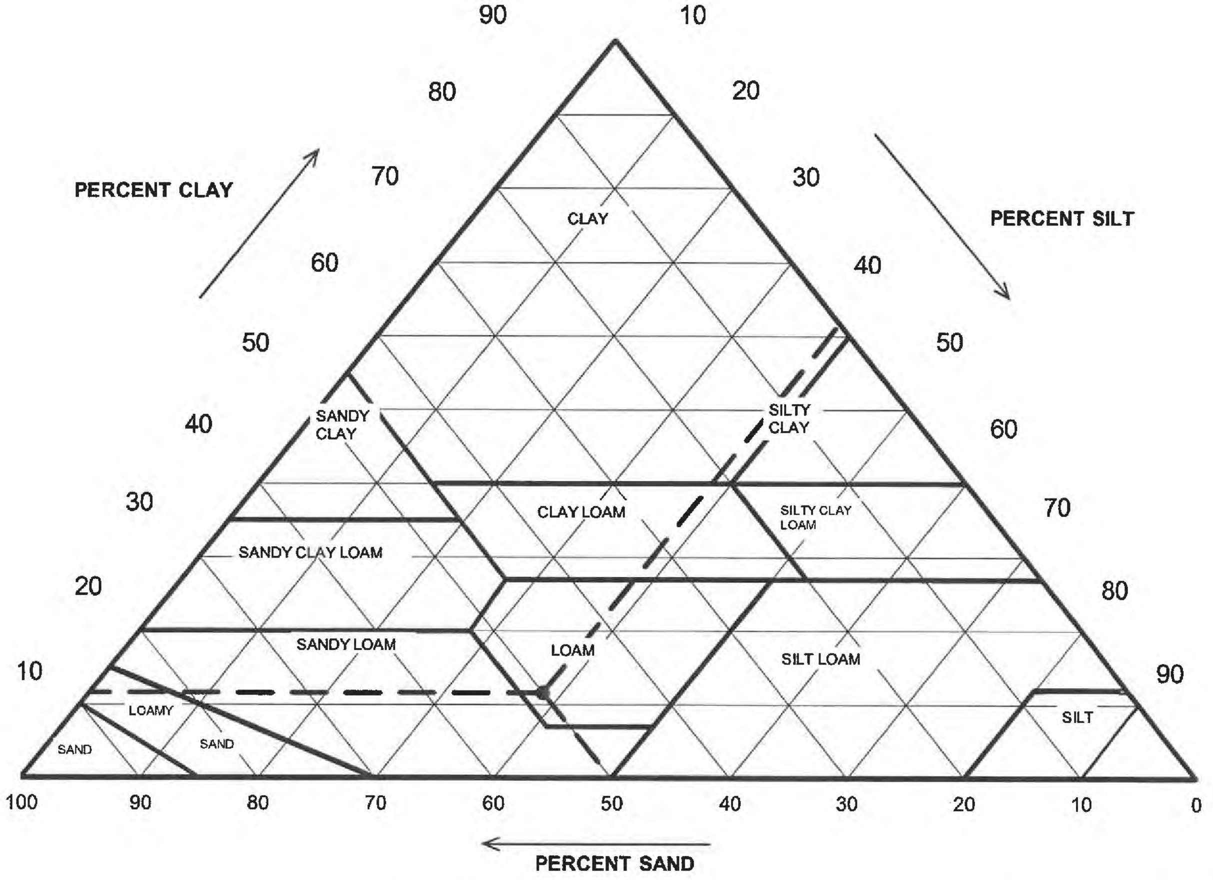
SC-SM, TESTED

USCS Classification:

SILTY, CLAYEY SAND

USDA CLASSIFICATION CHART

Client:	North Point Engineering		Boring No.:	NA
Client Reference:	Ringler Dovetail		Depth (ft):	0-7'
Project No.:	2019-155-001		Sample No.:	TP-7
Lab ID:	2019-155-001-003		Soil Color:	Brown



Particle Size (mm)	Percent Finer	USDA SUMMARY	Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classificat.
		Gravel	19.77	**0.00**
2	80.23	*Sand*	40.15	**50.04**
0.05	40.08	*Silt*	30.77	**38.35**
0.002	9.32	*Clay*	9.32	**11.61**

USDA Classification: ***LOAM***

WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	North Point Engineering	Boring No.:	NA
Client Reference:	Ringler Dovetail	Depth (ft):	0-7'
Project No.:	2019-155-001	Sample No.:	TP-7
Lab ID:	2019-155-001-003	Soil Color:	Brown

Moisture Content of Passing 3/4" Material		Moisture Content of Retained 3/4" Material	
Tare No.:	19	Tare No.:	912
Wt. of Tare & Wet Sample (g):	1148.40	Weight of Tare & Wet Sample (g):	441.68
Wt. of Tare & Dry Sample (g):	1115.55	Weight of Tare & Dry Sample (g):	438.60
Weight of Tare (g):	203.60	Weight of Tare (g):	110.21
Weight of Water (g):	32.85	Weight of Water (g):	3.08
Weight of Dry Soil (g):	911.95	Weight of Dry Soil (g):	328.39
Moisture Content (%):	**3.6**	**Moisture Content (%):**	**0.9**

Wet Weight of -3/4" Sample (g):	26009	Weight of the Dry Sample (g):	911.95
Dry Weight of - 3/4" Sample (g):	25104.7	Weight of Minus #200 Material (g):	449.73
Wet Weight of +3/4" Sample (g):	1275.00	Weight of Plus #200 Material (g):	462.22
Dry Weight of + 3/4" Sample (g):	1263.15		
Total Dry Weight of Sample (g):	26367.8	**J - Factor (Percent Finer than 3/4"):**	**0.9521**

Sieve Size	Sieve Opening (mm)	Weight of Soil Retained (g)		Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00		0.00	0.00	100.00	**100.00**
6"	150	0.00		0.00	0.00	100.00	**100.00**
3"	75	0.00		0.00	0.00	100.00	**100.00**
2"	50	329.00	(*)	1.24	1.24	98.76	**98.76**
1 1/2"	37.5	159.00		0.60	1.83	98.17	**98.17**
1"	25.0	310.00		1.16	3.00	97.00	**97.00**
3/4"	19.0	477.00		1.79	4.79	95.21	**95.21**
1/2"	12.5	14.89		1.63	1.63	98.37	**93.65**
3/8"	9.50	21.26		2.33	3.96	96.04	**91.44**
#4	4.75	45.21		4.96	8.92	91.08	**86.72**
#10	2.00	62.11		6.81	15.73	84.27	**80.23**
#20	0.85	56.80	(**)	6.23	21.96	78.04	**74.30**
#40	0.425	65.70		7.20	29.16	70.84	**67.44**
#60	0.250	68.53		7.51	36.68	63.32	**60.29**
#140	0.106	94.97		10.41	47.09	52.91	**50.37**
#200	0.075	32.75		3.59	50.68	49.32	**46.95**
Pan	-	449.73		49.32	100.00	-	**-**

Notes : *(*) The + 3/4" sieve analysis is based on the Total Dry Weight of the Sample*
*(**) The - 3/4" sieve analysis is based on the Weight of the Dry Sample*

Tested By HL Date 3/25/19 Checked By KC Date 3/25/19

DCN: CT-S3B DATE: 7/17/17 REVISION: 9e

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HYDROMETER ANALYSIS

ASTM D 422-63 (2007)

Client:	North Point Engineering	Boring No.:	NA
Client Reference:	Ringler Dovetail	Depth (ft):	0-7'
Project No.:	2019-155-001	Sample No.:	TP-7
Lab ID:	2019-155-001-003	Soil Color:	Brown

Elapsed Time (min)		R Measured	Temp. (°C)	Composite Correction	R Corrected	N (%)	K Factor	Diameter (mm)	N' (%)
0		NA	NA	NA	NA	NA	NA	NA	NA
2		32.5	23.2	6.31	26.2	67.3	0.01294	0.0303	**31.6**
5		28.5	23.2	6.31	22.2	57.0	0.01294	0.0197	**26.8**
15		23.5	23.2	6.31	17.2	44.2	0.01294	0.0118	**20.7**
34		20.0	23.2	6.31	13.7	35.2	0.01294	0.0080	**16.5**
87		17.5	22.9	6.41	11.1	28.5	0.01299	0.0051	**13.4**
297		15.5	22.2	6.64	8.9	22.8	0.01310	0.0028	**10.7**
1440		13.0	22	6.70	6.3	16.2	0.01313	0.0013	**7.6**

Soil Specimen Data		**Other Corrections**	
Tare No.:	1092		
Wt. of Tare & Dry Material (g):	140.66	a - Factor:	0.99
Weight of Tare (g):	97.13		
Weight of Deflocculant (g):	5.0	Percent Finer than # 200:	46.95
Weight of Dry Material (g):	38.53		
		Specific Gravity:	2.7 Assumed

Note: *Hydrometer test is performed on - # 200 sieve material.*

Tested By TO Date 3/22/19 Checked By KC Date 3/25/19

geotechnics
geotechnical & geosynthetic testing

ATTERBERG LIMITS

ASTM D 4318-17

Client:	North Point Engineering	Boring No.:	NA
Client Reference:	Ringler Dovetail	Depth (ft):	0-7'
Project No.:	2019-155-001	Sample No.:	TP-7
Lab ID:	2019-155-001-003	Soil Description:	BROWN SILTY CLAY

(Minus No. 40 sieve material, Air dried)

Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description.

As Received Moisture Content | Liquid Limit Test

	ASTM D2216-10	1	2	3	M
Tare Number:	3250	326	305	208	U
Wt. of Tare & Wet Sample (g):	470.34	39.97	39.19	39.17	L
Wt. of Tare & Dry Sample (g):	422.11	36.67	36.07	36.17	T
Weight of Tare (g):	8.16	19.09	19.05	19.09	I
Weight of Water (g):	48.2	3.3	3.1	3.0	P
Weight of Dry Sample (g):	414.0	17.6	17.0	17.1	O
Was As Received MC Preserved:	**Yes**				I
Moisture Content (%):	**11.7**	**18.8**	**18.3**	**17.6**	N
Number of Blows:		**17**	**24**	**35**	T

Plastic Limit Test

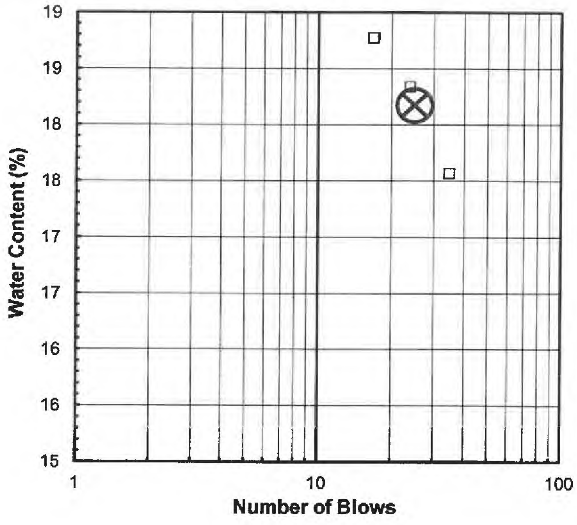
	1	2	Range
Tare Number:	236	139	
Wt. of Tare & Wet Sample (g):	24.86	24.70	
Wt. of Tare & Dry Sample (g):	24.16	24.02	
Weight of Tare (g):	18.49	18.54	
Weight of Water (g):	0.7	0.7	
Weight of Dry Sample (g):	5.7	5.5	
Moisture Content (%):	**12.3**	**12.4**	**-0.1**

Note: The acceptable range of the two Moisture Contents is ± 0.84

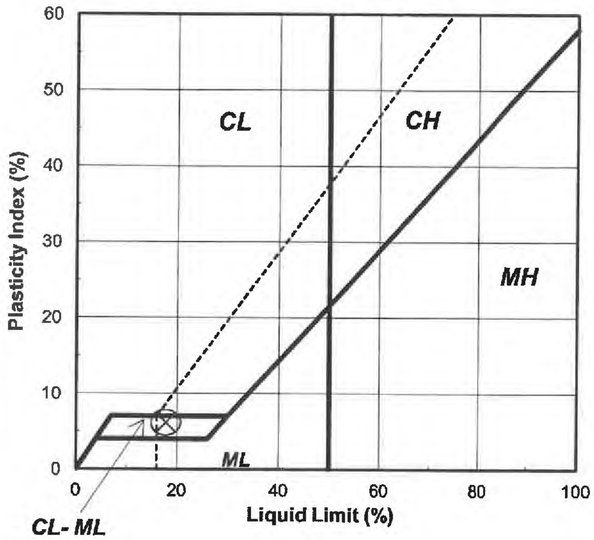
Test Results

Liquid Limit (%):	**18**
Plastic Limit (%):	**12**
Plasticity Index (%):	**6**
USCS Symbol:	**CL-ML**

Flow Curve



Plasticity Chart



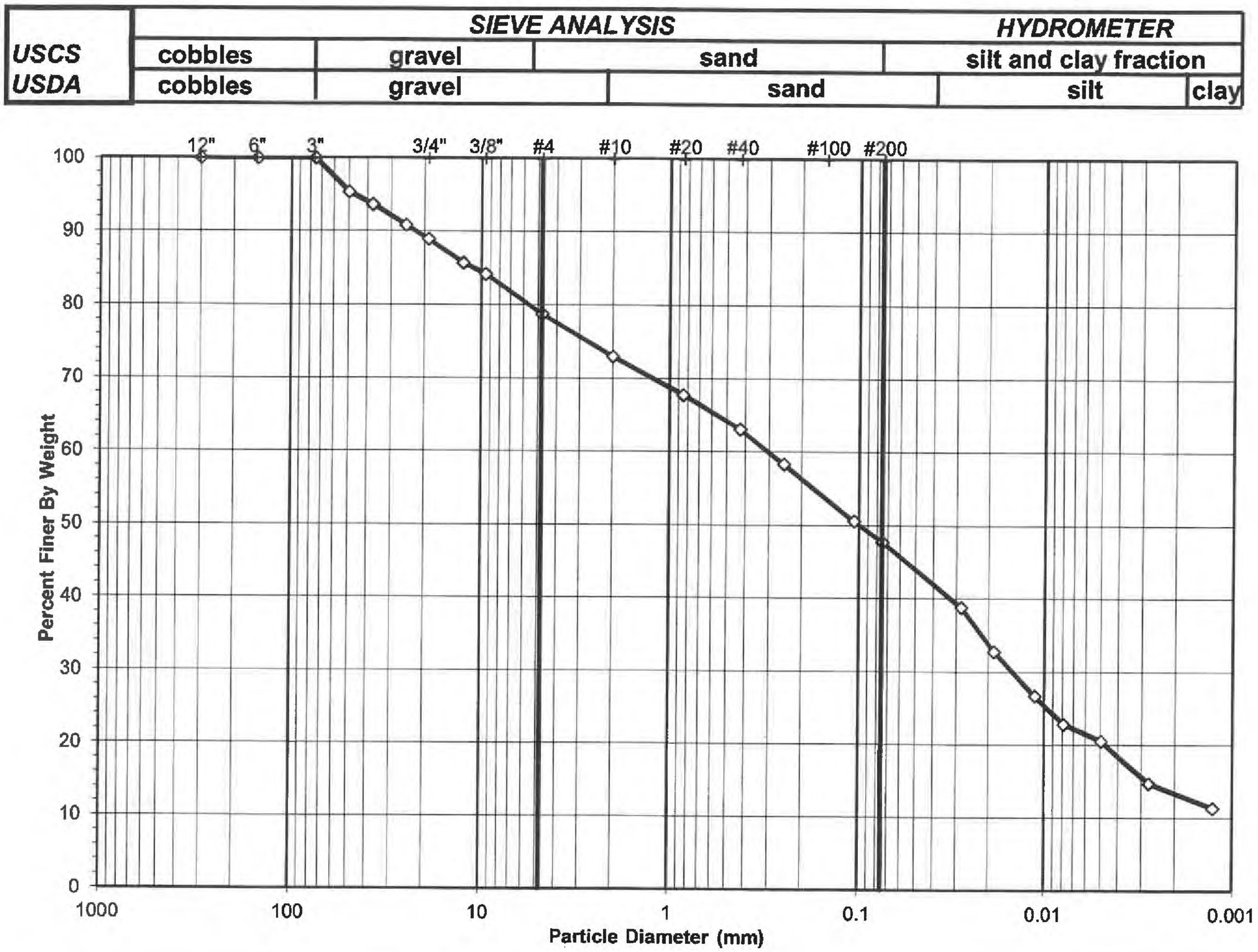
Tested By	*RAL*	*Date*	*3/22/19*	*Checked By*	*KC*	*Date*	*3/25/19*

SIEVE AND HYDROMETER ANALYSIS

ASTM D 422-63 (2007)

geotechnics
geotechnical & geosynthetic testing

Client:	North Point Engineering	Boring No.:	NA
Client Reference:	Ringler Dovetail	Depth (ft):	0-2.5'
Project No.:	2019-155-001	Sample No.:	TP-8
Lab ID:	2019-155-001-004	Soil Color:	Brown



USCS Summary		
Sieve Sizes (mm)		**Percentage**
Greater Than #4	*Gravel*	21.26
#4 To #200	*Sand*	31.02
Finer Than #200	*Silt & Clay*	47.72

USCS Symbol:

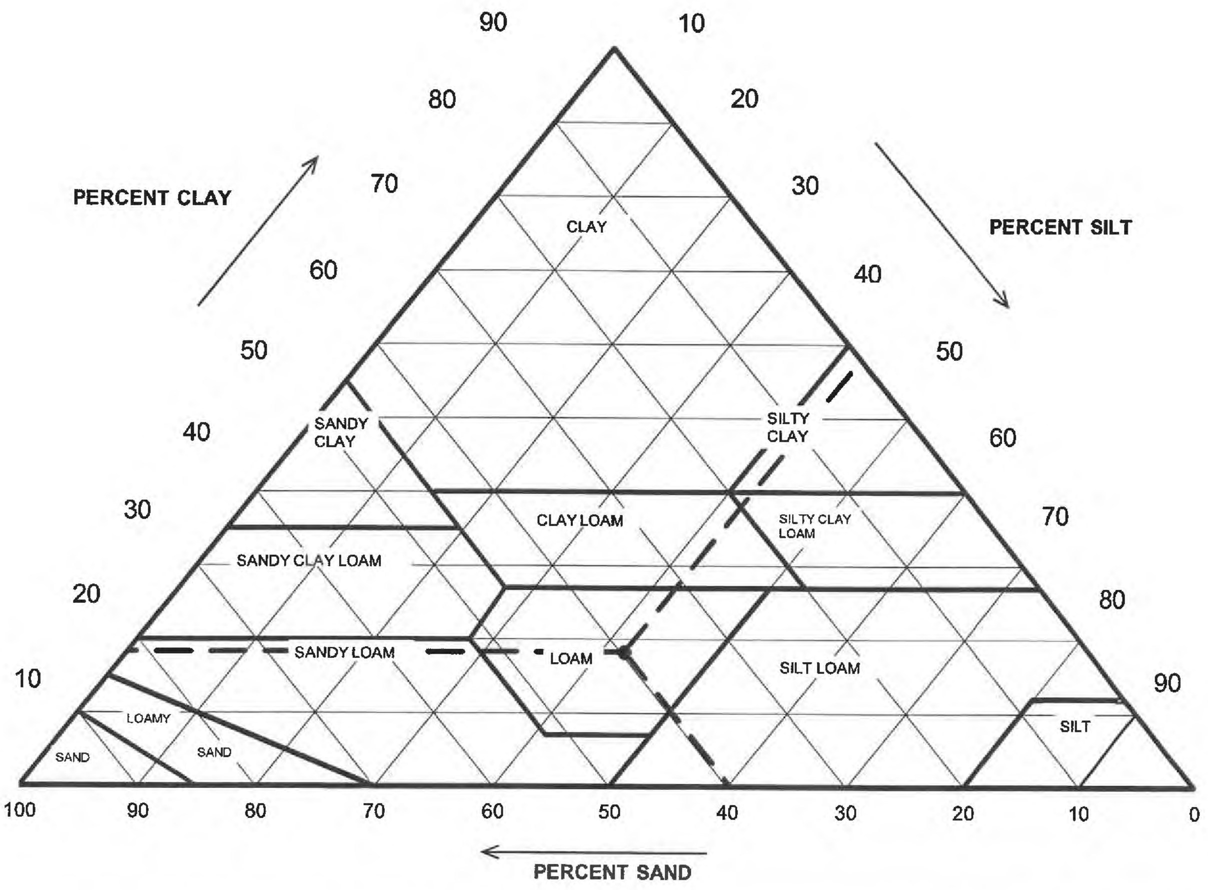
SC, TESTED

USCS Classification:

CLAYEY SAND WITH GRAVEL

USDA CLASSIFICATION CHART

Client:	North Point Engineering	Boring No.:	NA
Client Reference:	Ringler Dovetail	Depth (ft):	0-2.5'
Project No.:	2019-155-001	Sample No.:	TP-8
Lab ID:	2019-155-001-004	Soil Color:	Brown



Particle Size (mm)	Percent Finer	USDA SUMMARY	Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classificat.
		Gravel	27.03	**0.00**
2	72.97	*Sand*	28.93	**39.65**
0.05	44.04	*Silt*	30.69	**42.07**
0.002	13.34	*Clay*	13.34	**18.29**

USDA Classification: ***LOAM***

WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	North Point Engineering	Boring No.:	NA
Client Reference:	Ringler Dovetail	Depth (ft):	0-2.5'
Project No.:	2019-155-001	Sample No.:	TP-8
Lab ID:	2019-155-001-004	Soil Color:	Brown

Moisture Content of Passing 3/4" Material		Moisture Content of Retained 3/4" Material	
Tare No.:	45	Tare No.:	609
Wt. of Tare & Wet Sample (g):	1065.92	Weight of Tare & Wet Sample (g):	565.82
Wt. of Tare & Dry Sample (g):	1016.20	Weight of Tare & Dry Sample (g):	562.66
Weight of Tare (g):	202.42	Weight of Tare (g):	80.92
Weight of Water (g):	49.72	Weight of Water (g):	3.16
Weight of Dry Soil (g):	813.78	Weight of Dry Soil (g):	481.74
Moisture Content (%):	**6.1**	**Moisture Content (%):**	**0.7**

Wet Weight of -3/4" Sample (g):	16070	Weight of the Dry Sample (g):	813.78
Dry Weight of - 3/4" Sample (g):	15144.7	Weight of Minus #200 Material (g):	436.48
Wet Weight of +3/4" Sample (g):	1890.00	Weight of Plus #200 Material (g):	377.30
Dry Weight of + 3/4" Sample (g):	1877.68		
Total Dry Weight of Sample (g):	17022.4	**J - Factor (Percent Finer than 3/4"):**	**0.8897**

Sieve Size	Sieve Opening (mm)	Weight of Soil Retained (g)		Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	Accumulated Percent Finer (%)
12"	300	0.00		0.00	0.00	100.00	**100.00**
6"	150	0.00		0.00	0.00	100.00	**100.00**
3"	75	0.00		0.00	0.00	100.00	**100.00**
2"	50	795.00	(*)	4.64	4.64	95.36	**95.36**
1 1/2"	37.5	289.00		1.69	6.33	93.67	**93.67**
1"	25.0	478.00		2.79	9.12	90.88	**90.88**
3/4"	19.0	328.00		1.91	11.03	88.97	**88.97**
1/2"	12.5	29.75		3.66	3.66	96.34	**85.72**
3/8"	9.50	13.93		1.71	5.37	94.63	**84.19**
#4	4.75	49.91		6.13	11.50	88.50	**78.74**
#10	2.00	52.78		6.49	17.99	82.01	**72.97**
#20	0.85	47.73	(**)	5.87	23.85	76.15	**67.75**
#40	0.425	42.74		5.25	29.10	70.90	**63.08**
#60	0.250	43.09		5.30	34.40	65.60	**58.37**
#140	0.106	71.10		8.74	43.14	56.86	**50.59**
#200	0.075	26.27		3.23	46.36	53.64	**47.72**
Pan	-	436.48		53.64	100.00	-	-

Notes : *(*) The + 3/4" sieve analysis is based on the Total Dry Weight of the Sample*
*(**) The - 3/4" sieve analysis is based on the Weight of the Dry Sample*

Tested By HL Date 3/25/19 Checked By KC Date 3/25/19

HYDROMETER ANALYSIS

ASTM D 422-63 (2007)

Client:	North Point Engineering	Boring No.:	NA
Client Reference:	Ringler Dovetail	Depth (ft):	0-2.5'
Project No.:	2019-155-001	Sample No.:	TP-8
Lab ID:	2019-155-001-004	Soil Color:	Brown

Elapsed Time (min)		R Measured	Temp. (°C)	Composite Correction	R Corrected	N (%)	K Factor	Diameter (mm)	N' (%)
0		NA	NA	NA	NA	NA	NA	NA	NA
2		41.5	23.2	6.31	35.2	81.4	0.01294	0.0282	**38.8**
5		36.0	23.2	6.31	29.7	68.7	0.01294	0.0187	**32.8**
15		30.5	23.2	6.31	24.2	56.0	0.01294	0.0112	**26.7**
32		27.0	23.2	6.31	20.7	47.9	0.01294	0.0079	**22.8**
84		25.0	22.9	6.41	18.6	43.0	0.01299	0.0049	**20.5**
294		20.0	22.2	6.64	13.4	30.9	0.01310	0.0028	**14.7**
1440		17.0	22	6.70	10.3	23.8	0.01313	0.0013	**11.4**

Soil Specimen Data		**Other Corrections**	
Tare No.:	949		
Wt. of Tare & Dry Material (g):	143.67	a - Factor:	0.99
Weight of Tare (g):	95.86		
Weight of Deflocculant (g):	5.0	Percent Finer than # 200:	47.72
Weight of Dry Material (g):	42.81		
		Specific Gravity:	2.7 Assumed

Note: *Hydrometer test is performed on - # 200 sieve material.*

Tested By TO Date 3/22/19 Checked By KC Date 3/25/19

geotechnics
geotechnical & geosynthetic testing

ATTERBERG LIMITS

ASTM D 4318-17

Client:	North Point Engineering	Boring No.:	NA
Client Reference:	Ringler Dovetail	Depth (ft):	0-2.5'
Project No.:	2019-155-001	Sample No.:	TP-8
Lab ID:	2019-155-001-004	Soil Description:	BROWN LEAN CLAY

Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description.

(Minus No. 40 sieve material, Air dried)

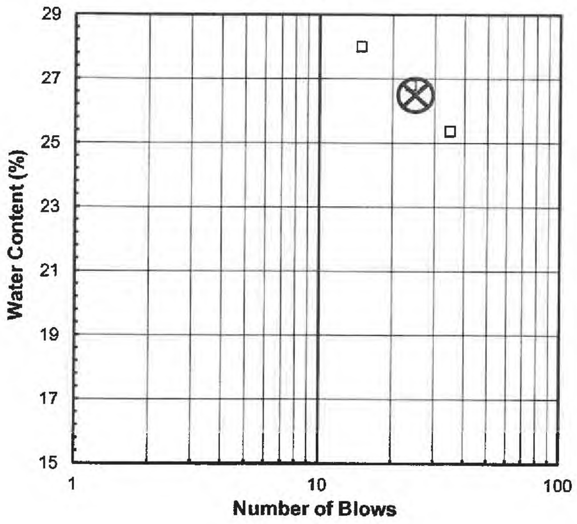
As Received Moisture Content		**Liquid Limit Test**			
ASTM D2216-10		**1**	**2**	**3**	**M**
Tare Number:	3351	260	333	330	**U**
Wt. of Tare & Wet Sample (g):	295.84	39.64	39.81	39.89	**L**
Wt. of Tare & Dry Sample (g):	259.64	35.22	35.51	35.75	**T**
Weight of Tare (g):	8.07	19.43	19.45	19.42	**I**
Weight of Water (g):	36.2	4.4	4.3	4.1	**P**
Weight of Dry Sample (g):	251.6	15.8	16.1	16.3	**O**
Was As Received MC Preserved:	**Yes**				**I**
Moisture Content (%):	**14.4**	**28.0**	**26.8**	**25.4**	**N**
Number of Blows:		**15**	**24**	**35**	**T**

Plastic Limit Test	**1**	**2**	**Range**
Tare Number:	217	219	
Wt. of Tare & Wet Sample (g):	24.77	25.12	
Wt. of Tare & Dry Sample (g):	24.01	24.31	
Weight of Tare (g):	18.66	18.65	
Weight of Water (g):	0.8	0.8	
Weight of Dry Sample (g):	5.4	5.7	
Moisture Content (%):	**14.2**	**14.3**	**-0.1**

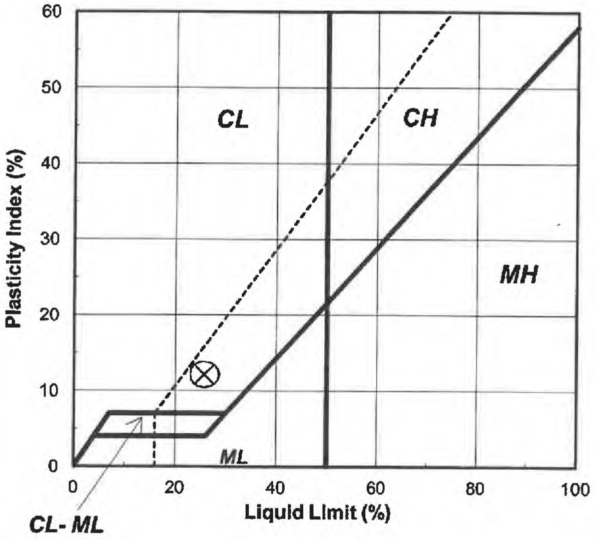
Note: The acceptable range of the two Moisture Contents is ± 1.12

Test Results	
Liquid Limit (%):	**26**
Plastic Limit (%):	**14**
Plasticity Index (%):	**12**
USCS Symbol:	**CL**

Flow Curve



Plasticity Chart



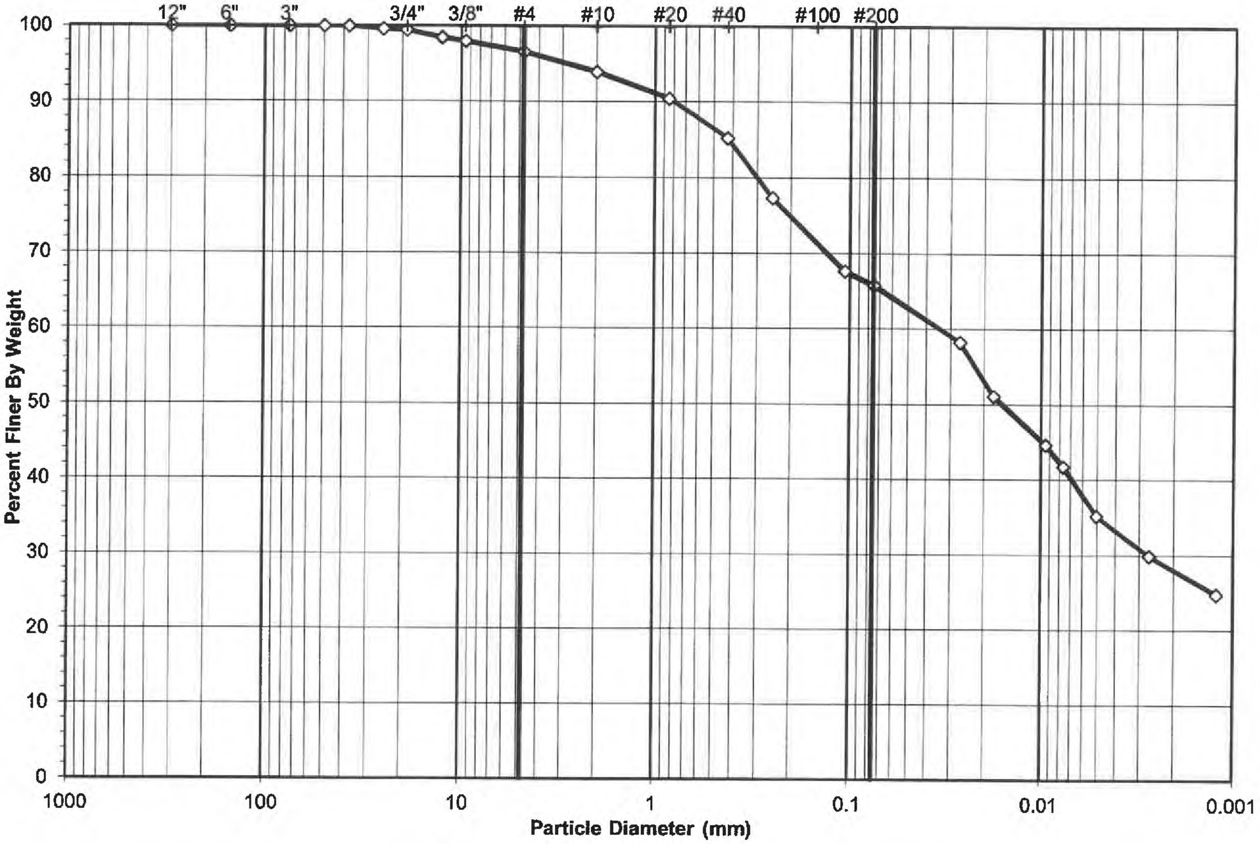
Tested By	RAL	*Date*	3/22/19	*Checked By*	KC	*Date*	3/25/19

SIEVE AND HYDROMETER ANALYSIS

ASTM D 422-63 (2007)

Client:	North Point Engineering	Boring No.:	NA
Client Reference:	Ringler Dovetail	Depth (ft):	0-3.5'
Project No.:	2019-155-001	Sample No.:	TP-10
Lab ID:	2019-155-001-005	Soil Color:	Brown

	SIEVE ANALYSIS			*HYDROMETER*	
USCS	cobbles	gravel	sand	silt and clay fraction	
USDA	cobbles	gravel	sand	silt	clay



USCS Summary

Sieve Sizes (mm)		Percentage
Greater Than #4	*Gravel*	3.40
#4 To #200	*Sand*	30.81
Finer Than #200	*Silt & Clay*	65.79

USCS Symbol:

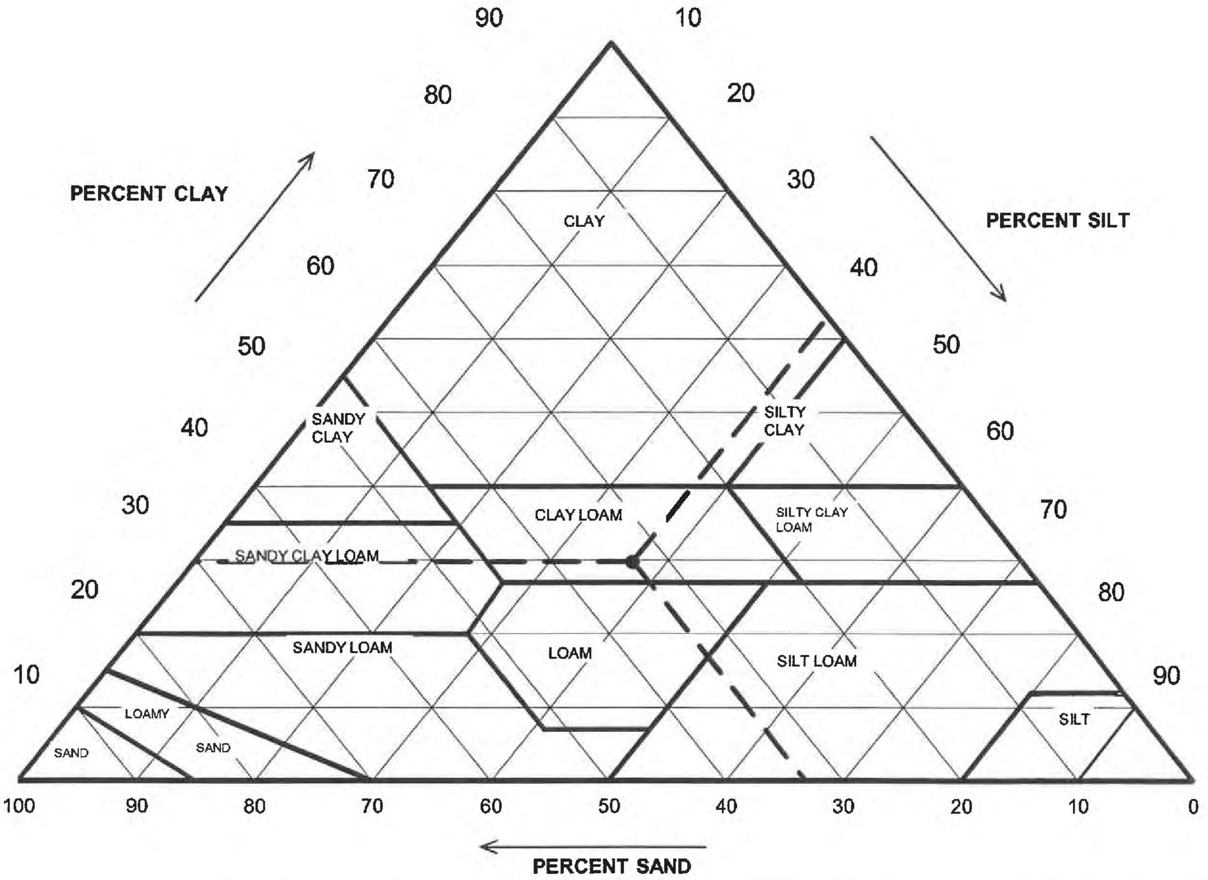
CL, TESTED

USCS Classification:

SANDY LEAN CLAY

USDA CLASSIFICATION CHART

Client:	North Point Engineering	Boring No.:	NA
Client Reference:	Ringler Dovetail	Depth (ft):	0-3.5'
Project No.:	2019-155-001	Sample No.:	TP-10
Lab ID:	2019-155-001-005	Soil Color:	Brown



Particle Size (mm)	Percent Finer	USDA SUMMARY	Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classificat.
		Gravel	6.03	**0.00**
2	93.97	*Sand*	31.15	**33.15**
0.05	62.82	*Silt*	34.84	**37.08**
0.002	27.98	*Clay*	27.98	**29.77**

USDA Classification: ***CLAY LOAM***

geotechnics
geotechnical & geosynthetic testing

WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	North Point Engineering	Boring No.:	NA
Client Reference:	Ringler Dovetail	Depth (ft):	0-3.5'
Project No.:	2019-155-001	Sample No.:	TP-10
Lab ID:	2019-155-001-005	Soil Color:	Brown

Moisture Content of Passing 3/4" Material		Moisture Content of Retained 3/4" Material	
Tare No.:	50	Tare No.:	3
Wt. of Tare & Wet Sample (g):	1090.11	Weight of Tare & Wet Sample (g):	102.29
Wt. of Tare & Dry Sample (g):	984.16	Weight of Tare & Dry Sample (g):	100.50
Weight of Tare (g):	199.34	Weight of Tare (g):	8.27
Weight of Water (g):	105.95	Weight of Water (g):	1.79
Weight of Dry Soil (g):	784.82	Weight of Dry Soil (g):	92.23
Moisture Content (%):	**13.5**	**Moisture Content (%):**	**1.9**

Wet Weight of -3/4" Sample (g):	20006	Weight of the Dry Sample (g):	784.82
Dry Weight of - 3/4" Sample (g):	17626.4	Weight of Minus #200 Material (g):	519.07
Wet Weight of +3/4" Sample (g):	94.02	Weight of Plus #200 Material (g):	265.75
Dry Weight of + 3/4" Sample (g):	92.23		
Total Dry Weight of Sample (g):	17718.7	**J - Factor (Percent Finer than 3/4"):**	**0.9948**

Sieve Size	Sieve Opening (mm)	Weight of Soil Retained (g)		Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00		0.00	0.00	100.00	**100.00**
6"	150	0.00		0.00	0.00	100.00	**100.00**
3"	75	0.00		0.00	0.00	100.00	**100.00**
2"	50	0.00	(*)	0.00	0.00	100.00	**100.00**
1 1/2"	37.5	0.00		0.00	0.00	100.00	**100.00**
1"	25.0	63.02		0.35	0.35	99.65	**99.65**
3/4"	19.0	31.00		0.17	0.52	99.48	**99.48**
1/2"	12.5	7.77		0.99	0.99	99.01	**98.49**
3/8"	9.50	3.67		0.47	1.46	98.54	**98.03**
#4	4.75	11.26		1.43	2.89	97.11	**96.60**
#10	2.00	20.74		2.64	5.54	94.46	**93.97**
#20	0.85	27.69	(**)	3.53	9.06	90.94	**90.46**
#40	0.425	41.27		5.26	14.32	85.68	**85.23**
#60	0.250	62.37		7.95	22.27	77.73	**77.33**
#140	0.106	76.39		9.73	32.00	68.00	**67.64**
#200	0.075	14.59		1.86	33.86	66.14	**65.79**
Pan	-	519.07		66.14	100.00	-	-

Notes : *(*) The + 3/4" sieve analysis is based on the Total Dry Weight of the Sample*
*(**) The - 3/4" sieve analysis is based on the Weight of the Dry Sample*

Tested By	HL	Date	3/25/19	Checked By	KC	Date	3/25/19

HYDROMETER ANALYSIS

ASTM D 422-63 (2007)

Client:	North Point Engineering	Boring No.:	NA
Client Reference:	Ringler Dovetail	Depth (ft):	0-3.5'
Project No.:	2019-155-001	Sample No.:	TP-10
Lab ID:	2019-155-001-005	Soil Color:	Brown

Elapsed Time (min)		R Measured	Temp. (°C)	Composite Correction	R Corrected	N (%)	K Factor	Diameter (mm)	N' (%)
0		NA	NA	NA	NA	NA	NA	NA	NA
2		47.0	23.2	6.31	40.7	88.5	0.01294	0.0268	**58.3**
5		42.0	23.2	6.31	35.7	77.7	0.01294	0.0178	**51.1**
19		37.5	23.2	6.31	31.2	67.9	0.01294	0.0095	**44.7**
30		35.5	23.2	6.31	29.2	63.5	0.01294	0.0076	**41.8**
74		31.0	22.9	6.41	24.6	53.5	0.01299	0.0051	**35.2**
282		27.5	22.2	6.64	20.9	45.4	0.01310	0.0027	**29.9**
1440		24.0	22	6.70	17.3	37.6	0.01313	0.0012	**24.8**

Soil Specimen Data		Other Corrections	
Tare No.:	301		
Wt. of Tare & Dry Material (g):	154.68	a - Factor:	0.99
Weight of Tare (g):	104.18		
Weight of Deflocculant (g):	5.0	Percent Finer than # 200:	65.79
Weight of Dry Material (g):	45.5		
		Specific Gravity:	2.7 Assumed

Note: *Hydrometer test is performed on - # 200 sieve material.*

Tested By TO Date 3/22/19 Checked By KC Date 3/25/19

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ATTERBERG LIMITS

ASTM D 4318-17

Client:	North Point Engineering	Boring No.:	NA
Client Reference:	Ringler Dovetail	Depth (ft):	0-3.5'
Project No.:	2019-155-001	Sample No.:	TP-10
Lab ID:	2019-155-001-005	Soil Description:	BROWN LEAN CLAY

Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description. (Minus No. 40 sieve material, Air dried)

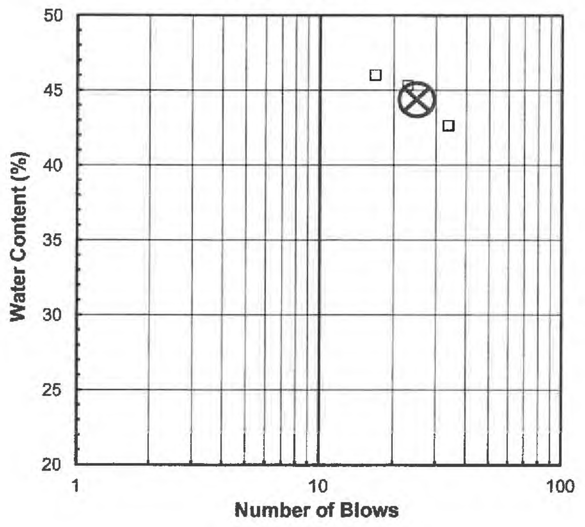
As Received Moisture Content		**Liquid Limit Test**			
ASTM D2216-10		**1**	**2**	**3**	**M**
Tare Number:	3228	334	156	310	**U**
Wt. of Tare & Wet Sample (g):	325.80	39.77	39.03	39.67	**L**
Wt. of Tare & Dry Sample (g):	263.03	33.34	32.75	33.60	**T**
Weight of Tare (g):	8.12	19.36	18.88	19.36	**I**
Weight of Water (g):	62.8	6.4	6.3	6.1	**P**
Weight of Dry Sample (g):	254.9	14.0	13.9	14.2	**O**
Was As Received MC Preserved:	**Yes**				**I**
Moisture Content (%):	**24.6**	**46.0**	**45.3**	**42.6**	**N**
Number of Blows:		**17**	**23**	**34**	**T**

Plastic Limit Test	**1**	**2**	**Range**
Tare Number:	217	219	
Wt. of Tare & Wet Sample (g):	25.30	24.91	
Wt. of Tare & Dry Sample (g):	24.39	24.02	
Weight of Tare (g):	18.66	18.65	
Weight of Water (g):	0.9	0.9	
Weight of Dry Sample (g):	5.7	5.4	
Moisture Content (%):	**15.9**	**16.6**	**-0.7**

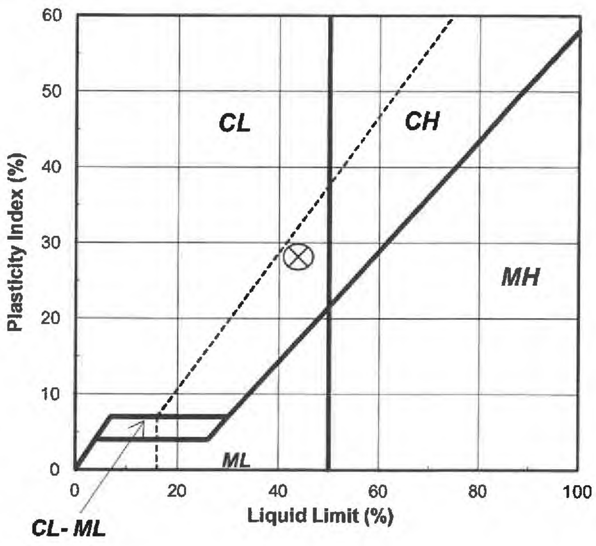
Note: The acceptable range of the two Moisture Contents is ± 1.12

Test Results	
Liquid Limit (%):	**44**
Plastic Limit (%):	**16**
Plasticity Index (%):	**28**
USCS Symbol:	**CL**

Flow Curve



Plasticity Chart



Tested By *RAL* *Date* *3/22/19* *Checked By* *KC* *Date* 3/25/19

SIEVE AND HYDROMETER ANALYSIS

ASTM D 422-63 (2007)

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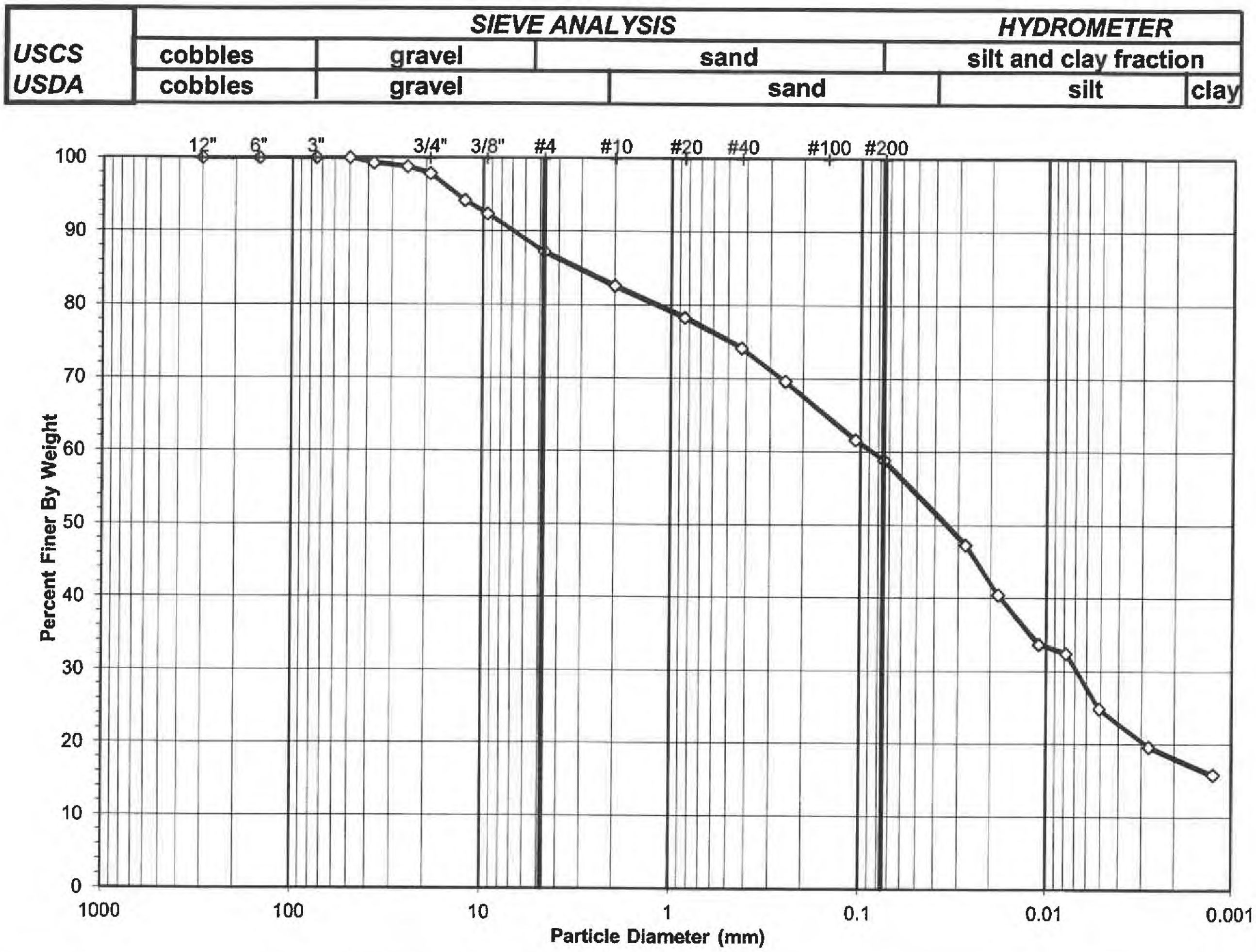
Client: North Point Engineering
Client Reference: Ringler Dovetail
Project No.: 2019-155-001
Lab ID: 2019-155-001-006

Boring No.: NA
Depth (ft): 0-4'
Sample No.: TP-11
Soil Color: Brown



USCS Summary

Sieve Sizes (mm)		Percentage
Greater Than #4	*Gravel*	12.74
#4 To #200	*Sand*	28.40
Finer Than #200	*Silt & Clay*	58.87

USCS Symbol:
CL, TESTED

USCS Classification:
SANDY LEAN CLAY

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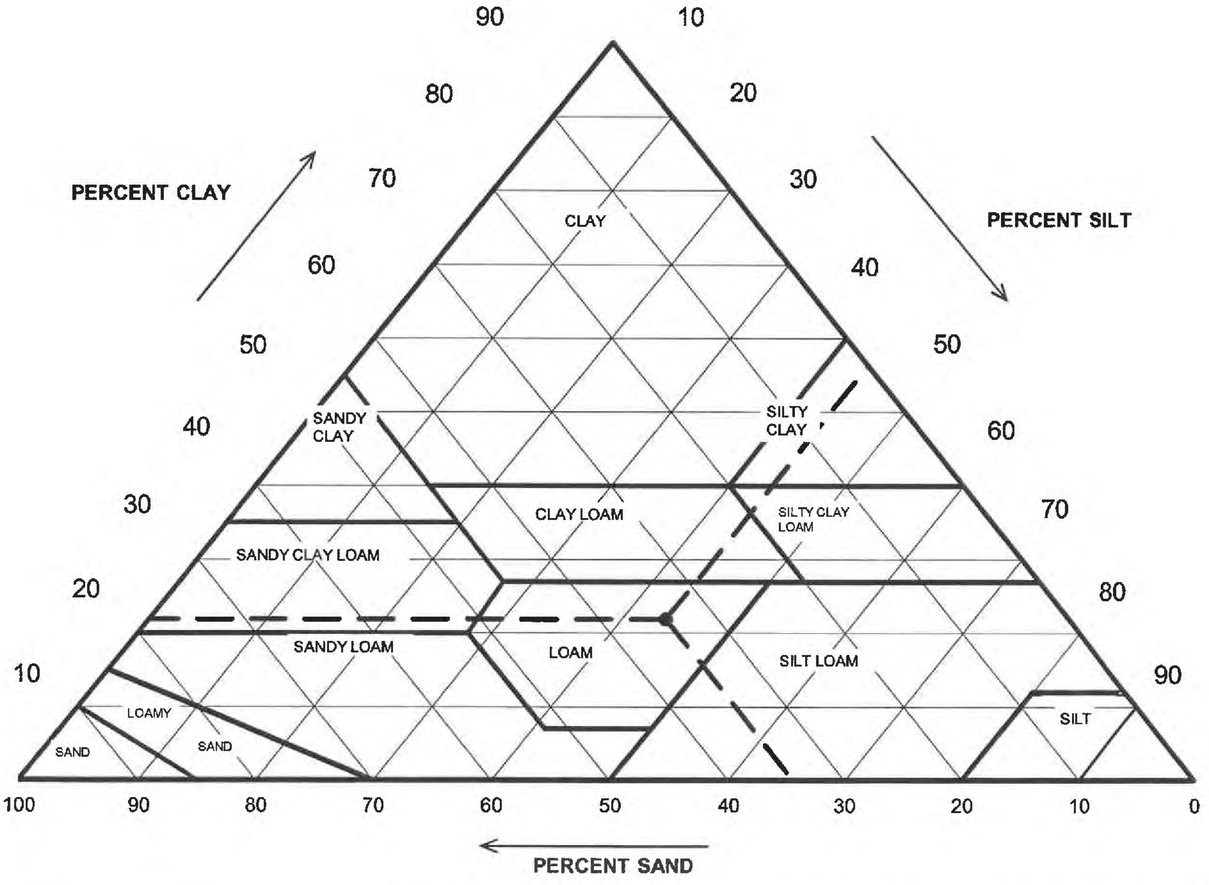
USDA CLASSIFICATION CHART

Client:	North Point Engineering	Boring No.:	NA
Client Reference:	Ringler Dovetail	Depth (ft):	0-4'
Project No.:	2019-155-001	Sample No.:	TP-11
Lab ID:	2019-155-001-006	Soil Color:	Brown



Particle Size (mm)	Percent Finer	USDA SUMMARY	Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classificat.
		Gravel	17.39	**0.00**
2	82.61	*Sand*	28.42	**34.40**
0.05	54.19	*Silt*	36.10	**43.69**
0.002	18.10	*Clay*	18.10	**21.90**

USDA Classification: ***LOAM***

WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

geotechnical & geosynthetic testing

Client: North Point Engineering
Client Reference: Ringler Dovetail
Project No.: 2019-155-001
Lab ID: 2019-155-001-006

Boring No.: NA
Depth (ft): 0-4'
Sample No.: TP-11
Soil Color: Brown

Moisture Content of Passing 3/4" Material		Moisture Content of Retained 3/4" Material	
Tare No.:	28	Tare No.:	1122
Wt. of Tare & Wet Sample (g):	1290.32	Weight of Tare & Wet Sample (g):	543.16
Wt. of Tare & Dry Sample (g):	1223.05	Weight of Tare & Dry Sample (g):	540.77
Weight of Tare (g):	199.30	Weight of Tare (g):	83.94
Weight of Water (g):	67.27	Weight of Water (g):	2.39
Weight of Dry Soil (g):	1023.75	Weight of Dry Soil (g):	456.83
Moisture Content (%):	**6.6**	**Moisture Content (%):**	**0.5**

Wet Weight of -3/4" Sample (g):	22447	Weight of the Dry Sample (g):	1023.75
Dry Weight of - 3/4" Sample (g):	21063.0	Weight of Minus #200 Material (g):	615.71
Wet Weight of +3/4" Sample (g):	459.22	Weight of Plus #200 Material (g):	408.04
Dry Weight of + 3/4" Sample (g):	456.83		
Total Dry Weight of Sample (g):	21519.8	**J - Factor (Percent Finer than 3/4"):**	**0.9788**

Sieve Size	Sieve Opening (mm)	Weight of Soil Retained (g)		Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00		0.00	0.00	100.00	**100.00**
6"	150	0.00		0.00	0.00	100.00	**100.00**
3"	75	0.00		0.00	0.00	100.00	**100.00**
2"	50	0.00	(*)	0.00	0.00	100.00	**100.00**
1 1/2"	37.5	153.40		0.71	0.71	99.29	**99.29**
1"	25.0	99.45		0.46	1.17	98.83	**98.83**
3/4"	19.0	206.37		0.95	2.12	97.88	**97.88**
1/2"	12.5	38.36		3.75	3.75	96.25	**94.21**
3/8"	9.50	18.73		1.83	5.58	94.42	**92.42**
#4	4.75	53.91		5.27	10.84	89.16	**87.26**
#10	2.00	48.69		4.76	15.60	84.40	**82.61**
#20	0.85	45.18	(**)	4.41	20.01	79.99	**78.29**
#40	0.425	43.37		4.24	24.25	75.75	**74.14**
#60	0.250	47.25		4.62	28.86	71.14	**69.63**
#140	0.106	83.58		8.16	37.03	62.97	**61.64**
#200	0.075	28.97		2.83	39.86	60.14	**58.87**
Pan	-	615.71		60.14	100.00	-	-

Notes : *(*) The + 3/4" sieve analysis is based on the Total Dry Weight of the Sample*
*(**) The - 3/4" sieve analysis is based on the Weight of the Dry Sample*

Tested By HL Date 3/25/19 Checked By KC Date 3/25/19

HYDROMETER ANALYSIS

ASTM D 422-63 (2007)

Client:	North Point Engineering	Boring No.:	NA
Client Reference:	Ringler Dovetail	Depth (ft):	0-4'
Project No.:	2019-155-001	Sample No.:	TP-11
Lab ID:	2019-155-001-006	Soil Color:	Brown

Elapsed Time		R Measured	Temp.	Composite Correction	R Corrected	N	K Factor	Diameter	N'
(min)			(°C)			(%)		(mm)	(%)
0		NA	NA	NA	NA	NA	NA	NA	NA
2		44.5	23.2	6.31	38.2	80.3	0.01294	0.0275	**47.3**
5		39.0	23.2	6.31	32.7	68.7	0.01294	0.0182	**40.5**
15		33.5	23.2	6.31	27.2	57.2	0.01294	0.0110	**33.7**
30		32.5	23.2	6.31	26.2	55.1	0.01294	0.0078	**32.4**
77		26.5	22.9	6.41	20.1	42.3	0.01299	0.0051	**24.9**
285		22.5	22.2	6.64	15.9	33.4	0.01310	0.0028	**19.6**
1440		19.5	22	6.70	12.8	26.9	0.01313	0.0013	**15.8**

Soil Specimen Data		**Other Corrections**	
Tare No.:	926		
Wt. of Tare & Dry Material (g):	145.89	a - Factor:	0.99
Weight of Tare (g):	93.81		
Weight of Deflocculant (g):	5.0	Percent Finer than # 200:	58.87
Weight of Dry Material (g):	47.08		
		Specific Gravity:	2.7 Assumed

Note: *Hydrometer test is performed on - # 200 sieve material.*

Tested By TO Date 3/22/19 Checked By KC Date 3/25/19

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ATTERBERG LIMITS

ASTM D 4318-17

Client: North Point Engineering
Client Reference: Ringler Dovetail
Project No.: 2019-155-001
Lab ID: 2019-155-001-006

Boring No.: NA
Depth (ft): 0-4'
Sample No.: TP-11
Soil Description: BROWN LEAN CLAY
(Minus No. 40 sieve material, Air dried)

Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description.

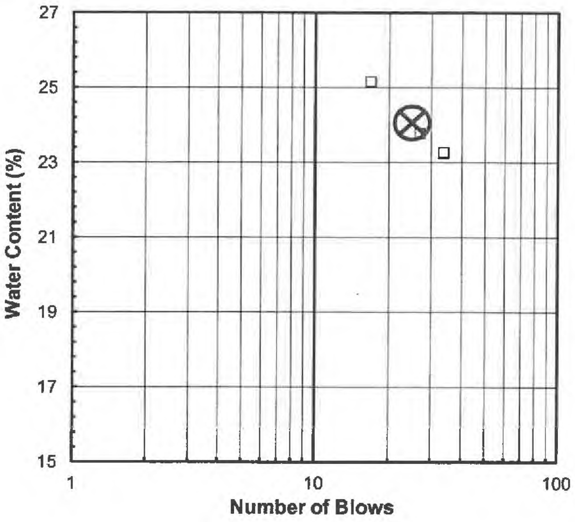
As Received Moisture Content ASTM D2216-10		**Liquid Limit Test** 1	2	3	MULTIPOINT
Tare Number:	3062	303	2101	148	
Wt. of Tare & Wet Sample (g):	312.55	39.67	38.94	40.06	
Wt. of Tare & Dry Sample (g):	257.84	35.64	35.01	36.20	
Weight of Tare (g):	8.12	19.61	18.47	19.60	
Weight of Water (g):	54.7	4.0	3.9	3.9	
Weight of Dry Sample (g):	249.7	16.0	16.5	16.6	
Was As Received MC Preserved:	**Yes**				
Moisture Content (%):	**21.9**	**25.1**	**23.8**	**23.3**	
Number of Blows:		**17**	**27**	**34**	

Plastic Limit Test	**1**	**2**	**Range**
Tare Number:	9	218	
Wt. of Tare & Wet Sample (g):	26.05	25.95	
Wt. of Tare & Dry Sample (g):	25.26	25.16	
Weight of Tare (g):	19.32	19.31	
Weight of Water (g):	0.8	0.8	
Weight of Dry Sample (g):	5.9	5.9	
Moisture Content (%):	**13.3**	**13.5**	**-0.2**

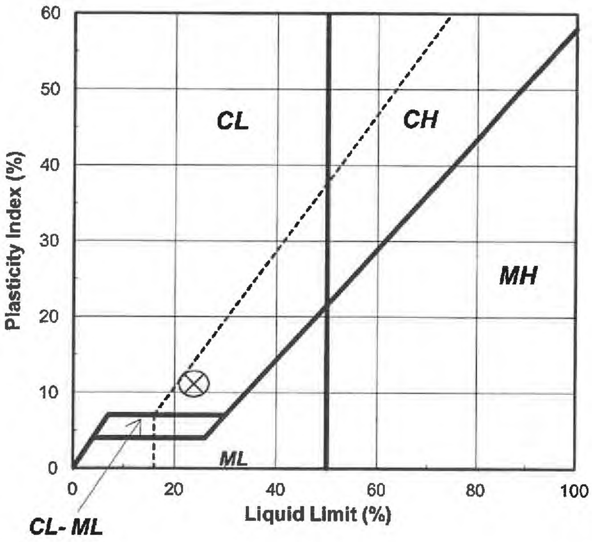
Note: The acceptable range of the two Moisture Contents is ± 1.12

Test Results	
Liquid Limit (%):	**24**
Plastic Limit (%):	**13**
Plasticity Index (%):	**11**
USCS Symbol:	**CL**

Flow Curve



Plasticity Chart



Tested By RAL *Date* 3/22/19 *Checked By* KC *Date* 3/25/19

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April 29, 2019

Project No. 2019-155-002

Mr. David Gerdeman
North Point Engineering
6657 Frank Ave. N.W.
Suite 200
Canton, OH 44720

Transmittal
Laboratory Test Results
Ringler Dovetail

Please find attached the laboratory test results for the above referenced project. The tests were outlined on the Project Verification Form that was transmitted to your firm prior to the testing. The testing was performed in general accordance with the methods listed on the enclosed data sheets. The test results are believed to be representative of the samples that were submitted for testing and are indicative only of the specimens that were evaluated. We have no direct knowledge of the origin of the samples and imply no position with regard to the nature of the test results, i.e. pass/fail and no claims as to the suitability of the material for its intended use.

The test data and all associated project information provided shall be held in strict confidence and disclosed to other parties only with authorization by our Client. The test data submitted herein is considered integral with this report and is not to be reproduced except in whole and only with the authorization of the Client and Geotechnics. The remaining sample materials for this project will be retained for a minimum of 90 days as directed by the Geotechnics' Quality Program.

We are pleased to provide these testing services. Should you have any questions or if we may be of further assistance, please contact our office.

Respectfully submitted,
Geotechnics, Inc.

David R. Backstrom
Laboratory Director

We understand that you have a choice in your laboratory services and we thank you for choosing Geotechnics.

DCN: Data Transmittal Letter Date: 1/28/05 Rev.: 1

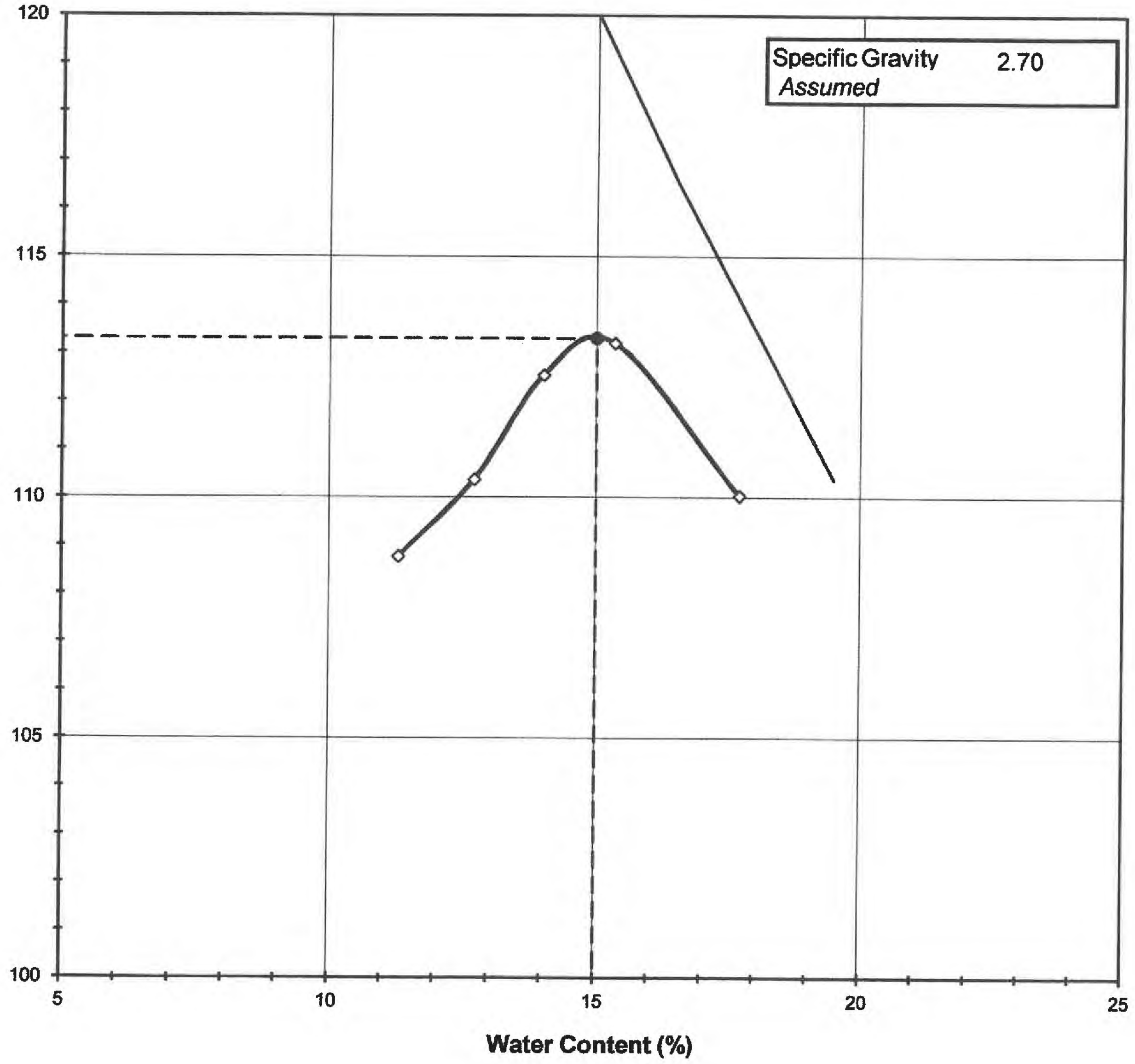
MOISTURE - DENSITY RELATIONSHIP

ASTM D698-12

Client:	North Point Engineering	Boring No.:	NA
Client Reference:	Ringler Dovetail	Depth (ft):	0-1.5'
Project No.:	2019-155-002	Sample No.:	TP-5
Lab ID:	2019-155-002-001	Test Method	**STANDARD**

Visual Description: Brown Clay with Rock

Optimum Water Content (%): **15.0**
Maximum Dry Density (pcf): **113.3**



Tested By PC *Date* 4/11/19 *Checked By* NJM *Date* 4/12/19

MOISTURE - DENSITY RELATIONSHIP

ASTM D698-12

Client: North Point Engineering
Client Reference: Ringler Dovetail
Project No.: 2019-155-002
Lab ID: 2019-155-002-001

Boring No.: NA
Depth (ft): 0-1.5'
Sample No.: TP-5

Visual Description: Brown Clay with Rock

Total Weight of the Sample (g):	NA
As Received Water Content (%):	NA
Assumed Specific Gravity:	2.70
Percent Retained on 3/4":	NA
Percent Retained on 3/8":	NA
Percent Retained on #4:	NA
Oversize Material:	Not included
Procedure Used:	C

Test Type:	**STANDARD**
Rammer Weight (lb):	5.5
Rammer Drop (in):	12
Rammer Type:	MECHANICAL
Machine ID:	G774
Mold ID:	G1775
Mold diameter:	6"
Weight of the Mold (g):	5705
Volume of the Mold (cm³):	2130

Mold / Specimen

Point No.	**1**	**2**	**3**	**4**	**5**
Weight of Mold & Wet Sample (g):	9838	9952	10085	10162	10126
Weight of Mold (g):	5705	5705	5705	5705	5705
Weight of Wet Sample (g):	4133	4247	4380	4457	4421
Mold Volume (cm^3):	2130	2130	2130	2130	2130

Moisture Content / Density

Tare Number:	903	560	546	629	581
Weight of Tare & Wet Sample (g):	470.16	491.94	546.43	459.58	480.07
Weight of Tare & Dry Sample (g):	433.49	445.67	489.68	409.88	420.35
Weight of Tare (g):	109.30	82.11	84.80	85.90	83.03
Weight of Water (g):	36.67	46.27	56.75	49.70	59.72
Weight of Dry Sample (g):	324.19	363.56	404.88	323.98	337.32

Wet Density (g/cm^3):	1.94	1.99	2.06	2.09	2.08
Wet Density (pcf):	121.1	124.4	128.3	130.6	129.5
Moisture Content (%):	**11.3**	**12.7**	**14.0**	**15.3**	**17.7**
Dry Density (pcf):	**108.8**	**110.4**	**112.5**	**113.2**	**110.0**

Zero Air Voids

Moisture Content (%):	13.5	16.5	19.5
Dry Unit Weight (pcf):	123.5	116.6	110.4

Tested By PC *Date* 4/11/19 *Checked By* NJM *Date* 4/12/19

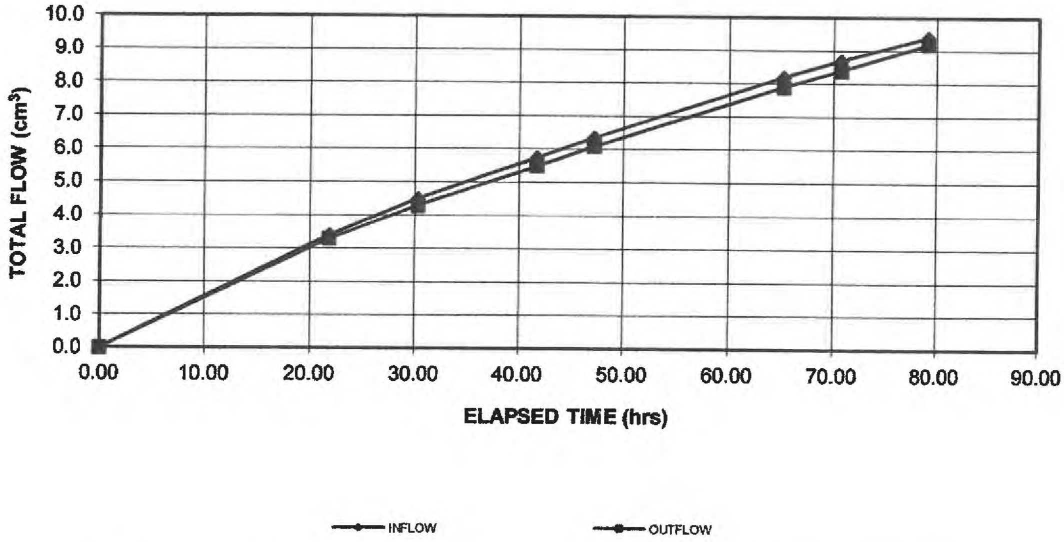
PERMEABILITY TEST

ASTM D 5084-16a

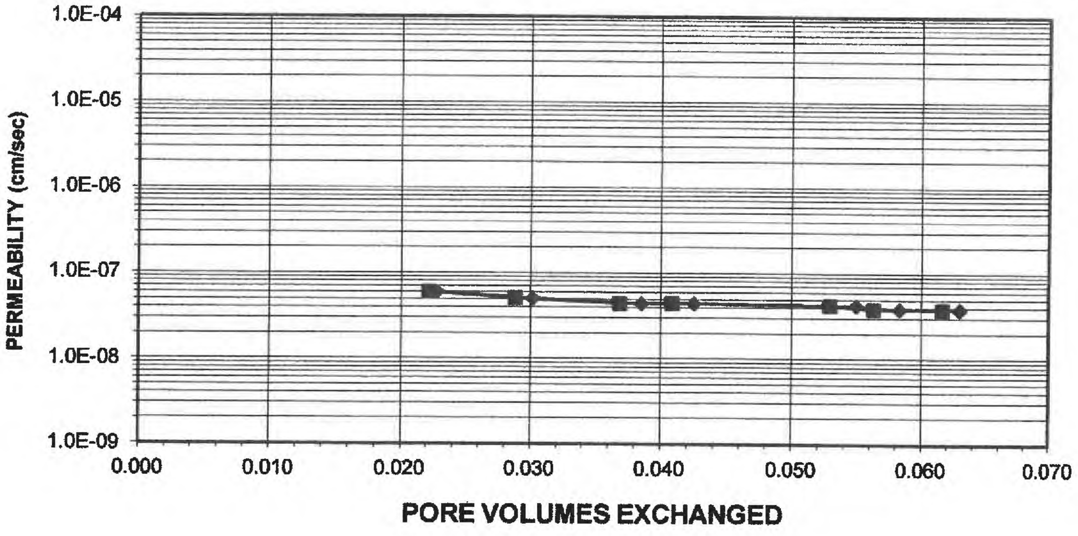
Client:	North Point Engineering	Boring No.:	N/A
Client Project:	Ringler Dovetail	Depth (ft):	0-1.5'
Project No.:	2019-155-002	Sample No.:	TP-5
Lab ID No.:	2019-155-002-001	Avg. Conf. Pressure (psi):	10

AVERAGE PERMEABILITY = 4.1E-08 cm/sec @ 20°C
AVERAGE PERMEABILITY = 4.1E-10 m/sec @ 20°C

TOTAL FLOW vs. ELAPSED TIME



PORE VOLUMES EXCHANGED vs. PERMEABILITY



Tested By:	RPE	Date:	4/17/19	Checked By:	KC	Date:	4/25/19

PERMEABILITY TEST

ASTM D 5084-16a

Client:	North Point Engineering	Boring No.:	N/A
Client Project:	Ringler Dovetail	Depth (ft):	0-1.5'
Project No.:	2019-155-002	Sample No.:	TP-5
Lab ID No.:	2019-155-002-001	Avg. Conf. Pressure (psi):	10

Specific Gravity:	2.70	Assumed
Sample Condition:		Remolded

Visual Description: Brown Clay

Permeant Type: Deaired Water

MOISTURE CONTENT:	BEFORE TEST	AFTER TEST
Tare Number	1699	545
Weight of Tare & Wet Sample (g)	293.12	972.89
Weight of Tare & Dry Sample (g)	263.54	824.20
Weight of Tare (g)	83.36	82.74
Weight of Water (g)	29.58	148.69
Weight of Dry Sample (g)	180.18	741.46
Moisture Content (%)	**16.4**	**20.1**

SPECIMEN:	BEFORE TEST	AFTER TEST
Weight of Tube & Wet Sample (g)	2192.80	NA
Weight of Tube (g)	1323.90	NA
Weight of Wet Sample (g)	868.90	896.04
Length 1 (in)	3.973	3.952
Length 2 (in)	3.973	3.974
Length 3 (in)	3.973	3.944
Top Diameter (in)	2.877	2.889
Middle Diameter (in)	2.877	2.893
Bottom Diameter (in)	2.877	2.892
Average Length (in)	3.97	3.96
Average Area (in^2)	6.50	6.57
Sample Volume (cm^3)	423.24	425.71
Unit Wet Weight (g/cm^3)	2.05	2.10
Unit Wet Weight (pcf)	128.1	131.4
Unit Dry Weight (pcf)	110.1	109.4
Unit Dry Weight (g/cm^3)	1.76	1.75
Void Ratio, e	0.53	0.54
Porosity, n	0.35	0.35
Pore Volume (cm^3)	146.8	149.3
Total Weight of Sample After Test (g)		890.46

Tested By: RPE Date: 4/17/19 Checked By: KC Date: 4/25/19

PERMEABILITY TEST

ASTM D 5084-16a

Client:	North Point Engineering	Boring No.:	N/A
Client Project:	Ringler Dovetail	Depth (ft):	0-1.5'
Project No.:	2019-155-002	Sample No.:	TP-5
Lab ID No.:	2019-155-002-001	Avg. Conf. Pressure (psi):	10

Pressure Heads (Constant)	
Top Cap (psi)	64.0
Bottom Cap (psi)	66.0
Cell (psi)	75.0
Total Pressure Head (cm)	140.6
Hydraulic Gradient	13.99

Final Sample Dimensions	
Sample Length (cm), L	10.05
Sample Diameter (cm)	7.34
Sample Area (cm^2), A	42.36
Inflow Burette Area (cm^2), a-in	0.870
Outflow Burette Area (cm^2), a-out	0.891
B Parameter (%)	96

AVERAGE PERMEABILITY = 4.1E-08 cm/sec @ 20°C
AVERAGE PERMEABILITY = 4.1E-10 m/sec @ 20°C

DATE (mm/dd/yy)	TIME (hr)	(min)	ELAPSED TIME t (hr)	TOTAL INFLOW (cm^3)	TOTAL OUTFLOW (cm^3)	TOTAL HEAD h (cm)	FLOW (0 flow) (1 stop)	TEMP. (°C)	INCREMENTAL PERMEABILITY @ 20°C (cm/sec)
4/20/19	14	10	0.000	0.0	0.0	168.5	0	21.3	NA
4/21/19	11	59	21.817	3.4	3.3	160.9	0	20.8	6.0E-08
4/21/19	20	25	30.250	4.5	4.3	158.5	0	20.4	5.1E-08
4/22/19	7	51	41.683	5.8	5.5	155.7	0	20.5	4.4E-08
4/22/19	13	20	47.167	6.4	6.1	154.3	0	21.6	4.5E-08
4/23/19	7	22	65.200	8.2	7.9	150.2	0	21.1	4.3E-08
4/23/19	12	51	70.683	8.7	8.4	149.0	0	21.6	3.9E-08
4/23/19	21	19	79.150	9.4	9.2	147.3	1	21.1	3.8E-08

Tested By: RPE Date: 4/17/19 Checked By: KC Date: 4/25/19

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MOISTURE - DENSITY RELATIONSHIP

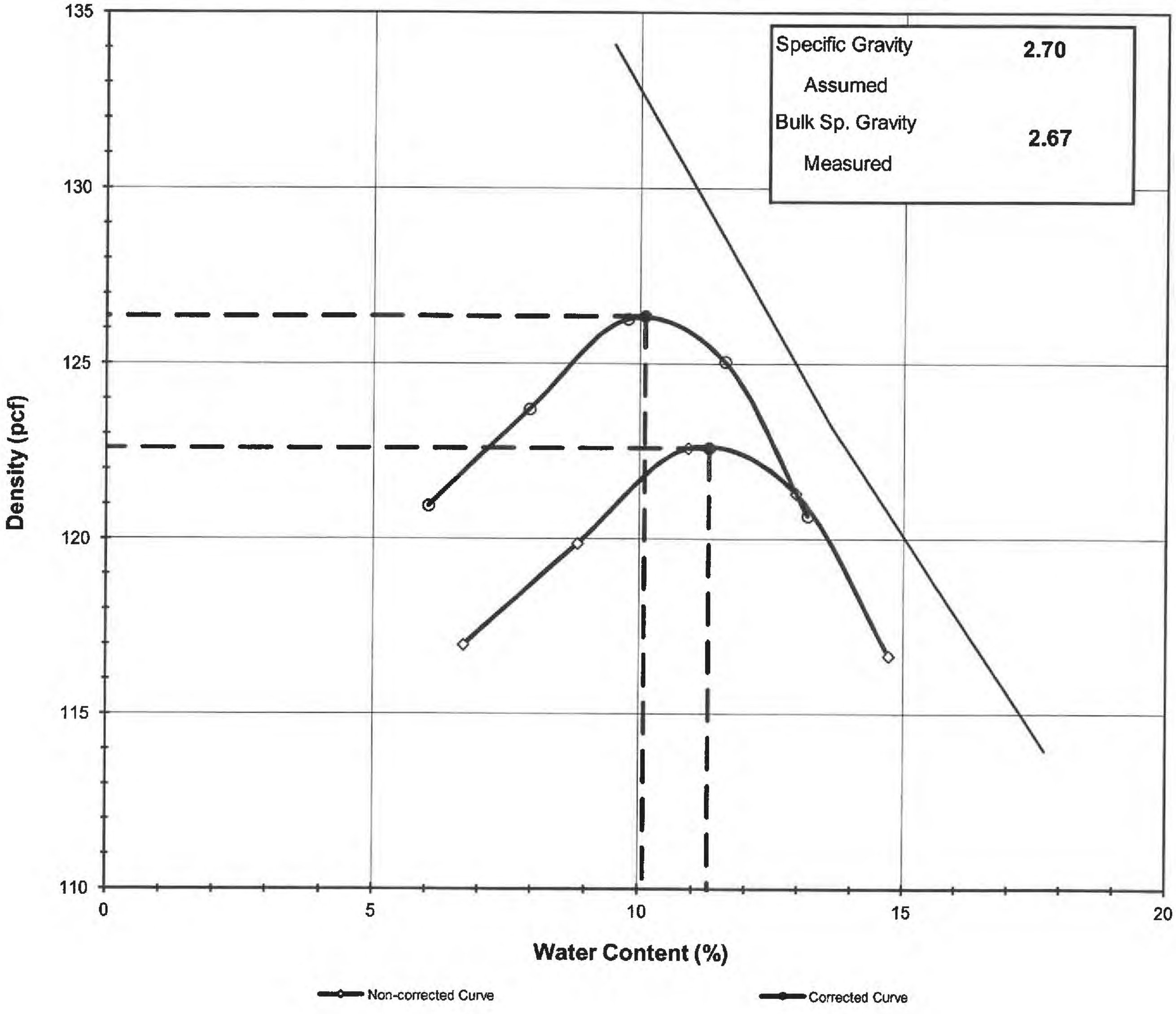
(Corrected for Oversize Particles)

ASTM D 4718-15, D 698-12e2 (SOP-S12,S39)

Client:	North Point Engineering	Boring No.:	NA
Client Reference:	Ringler Dovetail	Depth (ft):	0-2.5'
Project No.:	2019-155-001	Sample No.:	TP-8
Lab ID:	2019-155-001-004	Test Method	STANDARD

Visual Description: Brown Sandy Clay with Rock

Optimum Water Content (%):	**11.3**	**Corrected Water Content (%):**	**10.1**
Maximum Dry Density (pcf):	**122.6**	**Corrected Dry Density (pcf):**	**126.4**



Tested By *MF* *Date* *3/28/19* *Checked By* *KC* *Date* *3/29/19*

MOISTURE - DENSITY RELATIONSHIP

(Corrected for Oversize Particles) *ASTM D 4718-15, D698-12e2 (SOP-S12,S39)*

Client:	North Point Engineering	Boring No.:	NA
Client Reference:	Ringler Dovetail	Depth (ft):	0-2.5'
Project No.:	2019-155-001	Sample No.:	TP-8
Lab ID:	2019-155-001-004		

Visual Description: Brown Sandy Clay with Rock

Total Weight of the Sample (g):	NA
As Received Water Content (%):	NA
Assumed Specific Gravity	2.70

Percent Retained on 3/4" (Dry):	11.03
Percent Retained on 3/8" (Dry):	NA
Percent Retained on #4 (Dry):	NA
Oversize Material:	Not included
Procedure Used:	C

TestType:	**STANDARD**
Rammer Weight (lb):	5.5
Rammer Drop (in):	12
Rammer Type:	MECHANICAL
Machine ID:	G774
Mold ID:	G1775
Mold diameter (in):	6"
Weight of the Mold (g):	5705
Volume Of the Mold (cm^3):	2130

Mold/Specimen

Point No.	**1**	**2**	**3**	**4**	**5**
Weight of Mold & Wet Sample (g):	9966	10159	10346	10382	10274
Weight of Mold (g):	5705	5705	5705	5705	5705
Weight of Wet Sample (g):	4261	4454	4641	4677	4569
Mold Volume (cm^3):	2130	2130	2130	2130	2130

Moisture Content/Density

Tare Number:	562	561	590	1718	545
Weight of Tare & Wet Sample (g):	415.23	414.10	422.98	416.34	428.73
Weight of Tare & Dry Sample (g):	394.39	387.42	389.42	377.98	384.31
Weight of Tare (g):	84.08	86.03	81.71	81.77	82.65
Weight of Water (g):	20.84	26.68	33.56	38.36	44.42
Weight of Dry Sample (g):	310.31	301.39	307.71	296.21	301.66

Wet Density (g/cm^3):	2.00	2.09	2.18	2.20	2.15
Wet Density (pcf):	124.8	130.5	136.0	137.0	133.9
Moisture Content (%):	**6.7**	**8.9**	**10.9**	**13.0**	**14.7**
Dry Density (pcf):	**117.0**	**119.9**	**122.6**	**121.3**	**116.7**

Zero Air Voids

Moisture Content (%):		9.5	13.6	17.7	
Dry Unit Weight (pcf):		134.1	123.2	113.9	

Calculated Oversize Corrected Moisture & Density

Moisture Content (%):	**6.0**	**7.9**	**9.8**	**11.6**	**13.2**
Dry Density (pcf):	**121.0**	**123.7**	**126.3**	**125.1**	**120.7**

Tested By *MF* *Date* 3/28/19 *Checked By* KC *Date* 3/29/19

Correction of Unit Weight and Water Content for Soils Containing Oversize Particles by Specific Gravity

ASTM D4718/D4718M-15

Client:	North Point Engineering	Boring No.:	NA
Client Reference:	Ringler Dovetail	Depth (ft):	0-2.5'
Project No.:	2019-155-001	Sample No.:	TP-8
Lab ID:	2019-155-001-004		

Visual Description:	Brown Sandy Clay

Total Dry Weight of Sample (g): **17022.4**

COARSE PORTION		*FINE PORTION*	
Total Wet Weight of + 3/4" Portion (g):	1890.0	Total Wet Weight of - 3/4" Portion (g):	16070.0
Total Dry Weight of + 3/4" Portion (g):	1877.7	Total Dry Weight of - 3/4" Portion (g):	15144.7
Percent + 3/4" By Dry Weight (%):	11.03	Percent - 3/4" By Dry Weight (%):	88.97

MOISTURE CONTENT OF +3/4" PORTION		*MOISTURE CONTENT OF -3/4" PORTION*	
Tare Number:	609	Tare Number:	45
Weight of Tare & Wet Sample (g):	565.82	Weight of Tare & Wet Sample (g):	1065.92
Weight of Tare & Dry Sample (g):	562.66	Weight of Tare & Dry Sample (g):	1016.20
Weight of Tare (g):	80.92	Weight of Tare (g):	202.42
Weight of Water (g):	3.16	Weight of Water (g):	49.72
Weight of Dry Sample (g):	481.74	Weight of Dry Sample (g):	813.78
Moisture Content (%):	0.66	**Moisture Content (%):**	6.11

SPECIFIC GRAVITY DETERMINATION

Weight of Basket in Air (g):	1033.0
Weight of Saturated Surface Dry Sample & Basket in Air (g):	2428.3
Weight of Saturated Surface Dry Sample in Air (g):	1395.3
Weight of Basket in Water (g):	901.8
Weight of Saturated Sample & Basket in Water (g):	1780.8
Weight of Saturated Sample in Water (g):	879.0
Tare No.:	1618
Weight of Tare and Dried Sample (g):	1526.0
Weight of Tare (g):	148.0
Weight of Dried Soil (g):	1378.0
Bulk Specific Gravity (+3/4"):	**2.67**

Tested By RAL *Date* 3/27/19 *Checked By* KC *Date* 3/28/19

DCN: CT-S39 DATE: 10/17/17 REVISION: 2e

S:\Excel\Excel QA\Spreadsheets\Oversize Correction.xls

PERMEABILITY TEST

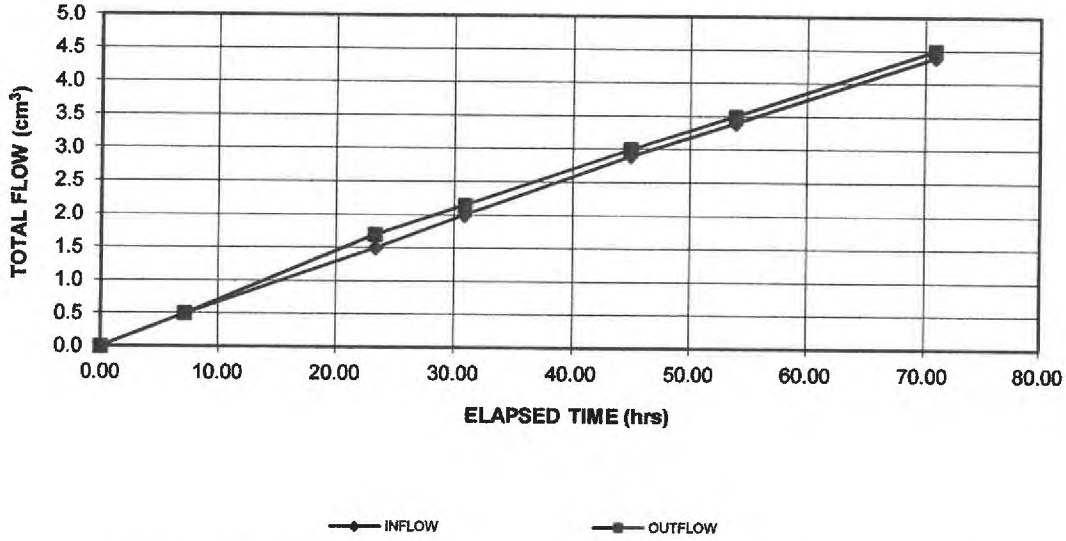
ASTM D 5084-16a

Client: North Point Engineering
Client Project: Ringler Dovetail
Project No.: 2019-155-002
Lab ID No.: 2019-155-002-002

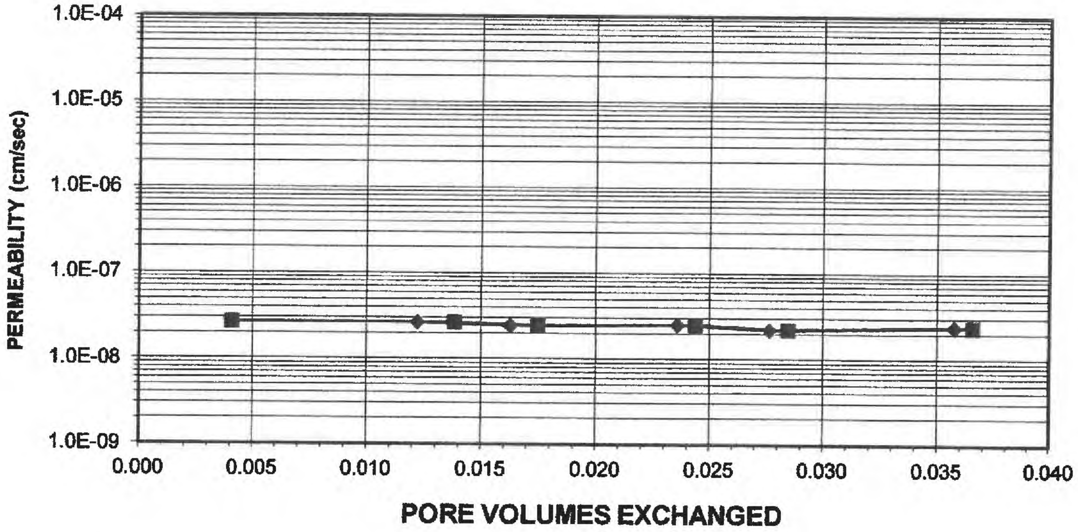
Boring No.: N/A
Depth (ft): 0-2.5'
Sample No.: TP-8
Avg. Conf. Pressure (psi): 10

AVERAGE PERMEABILITY = 2.4E-08 cm/sec @ 20°C
AVERAGE PERMEABILITY = 2.4E-10 m/sec @ 20°C

TOTAL FLOW vs. ELAPSED TIME



PORE VOLUMES EXCHANGED vs. PERMEABILITY



Tested By: RPE Date: 4/19/19 Checked By: KC Date: 4/27/19

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PERMEABILITY TEST

ASTM D 5084-16a

Client: North Point Engineering
Client Project: Ringler Dovetail
Project No.: 2019-155-002
Lab ID No.: 2019-155-002-002

Boring No.: N/A
Depth (ft): 0-2.5'
Sample No.: TP-8
Avg. Conf. Pressure (psi): 10

Specific Gravity: 2.70 Assumed
Sample Condition: Remolded

Visual Description: Brown Sandy Clay with Rock

Permeant Type: Deaired Water

MOISTURE CONTENT:	BEFORE TEST	AFTER TEST
Tare Number	565	880
Weight of Tare & Wet Sample (g)	222.30	982.61
Weight of Tare & Dry Sample (g)	205.76	869.92
Weight of Tare (g)	82.34	108.69
Weight of Water (g)	16.54	112.69
Weight of Dry Sample (g)	123.42	761.23
Moisture Content (%)	**13.4**	**14.8**

SPECIMEN:	BEFORE TEST	AFTER TEST
Weight of Tube & Wet Sample (g)	2247.20	NA
Weight of Tube (g)	1323.90	NA
Weight of Wet Sample (g)	923.30	934.72
Length 1 (in)	3.973	3.973
Length 2 (in)	3.973	3.973
Length 3 (in)	3.973	3.974
Top Diameter (in)	2.877	2.882
Middle Diameter (in)	2.877	2.884
Bottom Diameter (in)	2.877	2.879
Average Length (in)	3.97	3.97
Average Area (in^2)	6.50	6.52
Sample Volume (cm^3)	423.24	424.65
Unit Wet Weight (g/cm^3)	2.18	2.20
Unit Wet Weight (pcf)	136.2	137.4
Unit Dry Weight (pcf)	120.1	119.7
Unit Dry Weight (g/cm^3)	1.92	1.92
Void Ratio, e	0.40	0.41
Porosity, n	0.29	0.29
Pore Volume (cm^3)	121.7	123.1
Total Weight of Sample After Test (g)		933.76

Tested By: RPE Date: 4/19/19 Checked By: KC Date: 4/27/19

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PERMEABILITY TEST

ASTM D 5084-16a

Client:	North Point Engineering	Boring No.:	N/A
Client Project:	Ringler Dovetail	Depth (ft):	0-2.5'
Project No.:	2019-155-002	Sample No.:	TP-8
Lab ID No.:	2019-155-002-002	Avg. Conf. Pressure (psi):	10

Pressure Heads (Constant)	
Top Cap (psi)	64.0
Bottom Cap (psi)	66.0
Cell (psi)	75.0
Total Pressure Head (cm)	140.6
Hydraulic Gradient	13.93

Final Sample Dimensions	
Sample Length (cm), L	10.09
Sample Diameter (cm)	7.32
Sample Area (cm^2), A	42.08
Inflow Burette Area (cm^2), a-in	0.872
Outflow Burette Area (cm^2), a-out	0.886
B Parameter (%)	99

AVERAGE PERMEABILITY = 2.4E-08 cm/sec @ 20°C
AVERAGE PERMEABILITY = 2.4E-10 m/sec @ 20°C

DATE (mm/dd/yy)	TIME (hr)	(min)	ELAPSED TIME t (hr)	TOTAL INFLOW (cm^3)	TOTAL OUTFLOW (cm^3)	TOTAL HEAD h (cm)	FLOW (0 flow) (1 stop)	TEMP. (°C)	INCREMENTAL PERMEABILITY @ 20°C (cm/sec)
4/23/19	8	25	0.000	0.0	0.0	167.5	0	21.2	NA
4/23/19	15	35	7.167	0.5	0.5	166.4	0	21.7	2.7E-08
4/24/19	7	43	23.300	1.5	1.7	163.9	0	21.1	2.7E-08
4/24/19	15	17	30.867	2.0	2.2	162.8	0	21.9	2.5E-08
4/25/19	5	19	44.900	2.9	3.0	160.8	0	21.0	2.5E-08
4/25/19	14	17	53.867	3.4	3.5	159.6	0	21.9	2.2E-08
4/26/19	7	18	70.883	4.4	4.5	157.4	1	21.2	2.4E-08

Tested By: RPE Date: 4/19/19 Checked By: KC Date: 4/27/19

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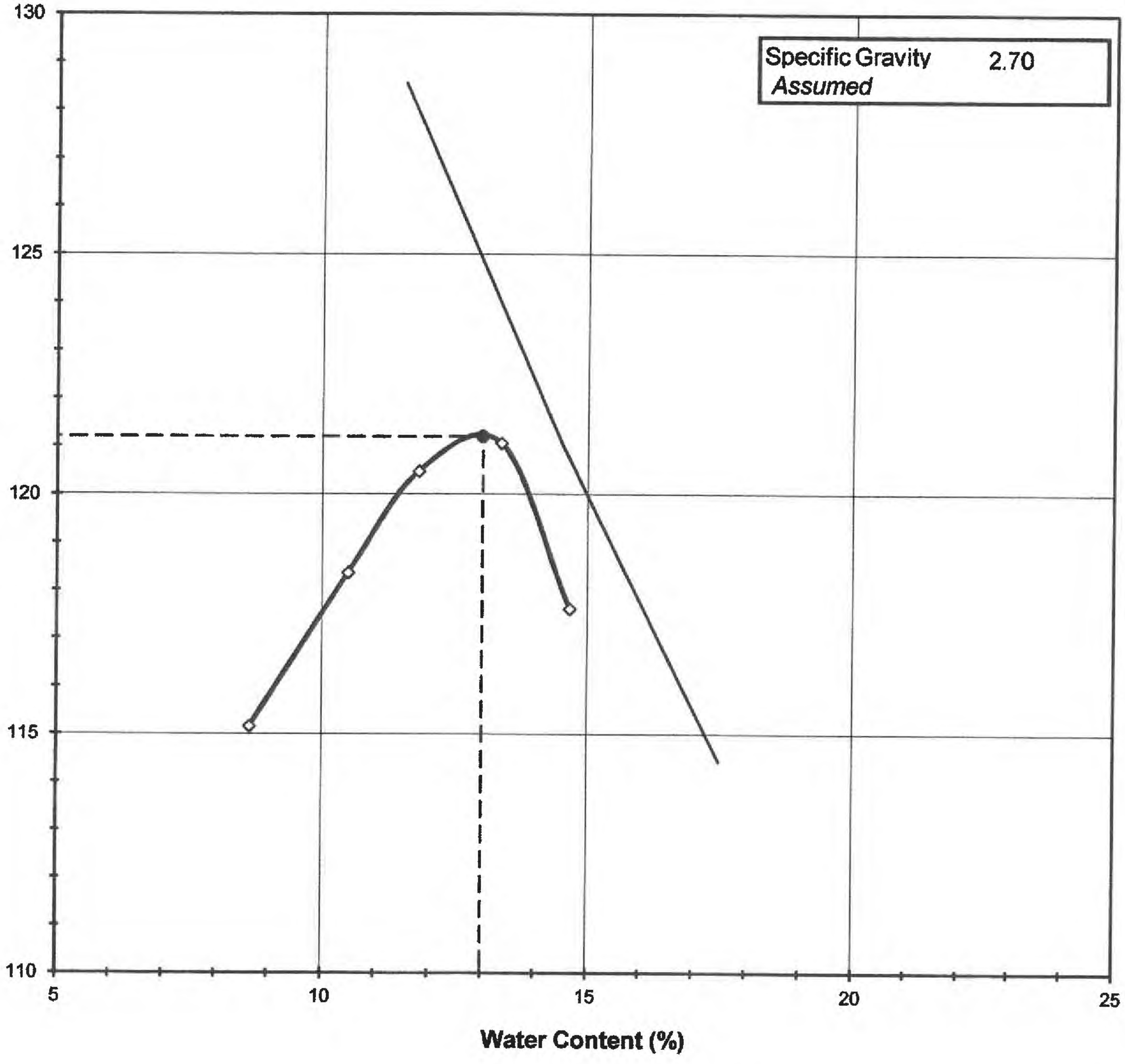
MOISTURE - DENSITY RELATIONSHIP

ASTM D698-12

Client:	North Point Engineering	Boring No.:	NA
Client Reference:	Ringler Dovetail	Depth (ft):	0-4'
Project No.:	2019-155-002	Sample No.:	TP-11
Lab ID:	2019-155-002-003	Test Method	**STANDARD**

Visual Description: Brown Clay with Rock

Optimum Water Content (%): **13.0**
Maximum Dry Density (pcf): **121.2**



Tested By MLF *Date* 4/10/19 *Checked By* NJM *Date* 4/11/19

MOISTURE - DENSITY RELATIONSHIP

ASTM D698-12

Client:	North Point Engineering	Boring No.:	NA
Client Reference:	Ringler Dovetail	Depth (ft):	0-4'
Project No.:	2019-155-002	Sample No.:	TP-11
Lab ID:	2019-155-002-003		

Visual Description: Brown Clay with Rock

Total Weight of the Sample (g):	NA
As Received Water Content (%):	NA
Assumed Specific Gravity:	2.70
Percent Retained on 3/4":	NA
Percent Retained on 3/8":	NA
Percent Retained on #4:	NA
Oversize Material:	Not included
Procedure Used:	C

Test Type:	STANDARD
Rammer Weight (lb):	5.5
Rammer Drop (in):	12
Rammer Type:	MECHANICAL
Machine ID:	G1916
Mold ID:	G1923
Mold diameter:	6"
Weight of the Mold (g):	5765
Volume of the Mold (cm^3):	2134

Mold / Specimen

Point No.	**1**	**2**	**3**	**4**	**5**
Weight of Mold & Wet Sample (g):	10044	10237	10371	10458	10377
Weight of Mold (g):	5765	5765	5765	5765	5765
Weight of Wet Sample (g):	4279	4472	4606	4693	4612
Mold Volume (cm^3):	2134	2134	2134	2134	2134

Moisture Content / Density

Tare Number:	1125	7	590	886	905
Weight of Tare & Wet Sample (g):	493.09	459.70	456.51	454.49	533.38
Weight of Tare & Dry Sample (g):	460.47	423.15	416.97	413.85	479.19
Weight of Tare (g):	83.42	74.39	81.65	109.40	109.58
Weight of Water (g):	32.62	36.55	39.54	40.64	54.19
Weight of Dry Sample (g):	377.05	348.76	335.32	304.45	369.61

Wet Density (g/cm^3):	2.01	2.10	2.16	2.20	2.16
Wet Density (pcf):	125.1	130.8	134.7	137.2	134.9
Moisture Content (%):	**8.7**	**10.5**	**11.8**	**13.3**	**14.7**
Dry Density (pcf):	**115.2**	**118.4**	**120.5**	**121.1**	**117.6**

Zero Air Voids

Moisture Content (%):	11.5	14.5	17.5
Dry Unit Weight (pcf):	128.6	121.1	114.4

Tested By MLF *Date* 4/10/19 *Checked By* NJM *Date* 4/11/19

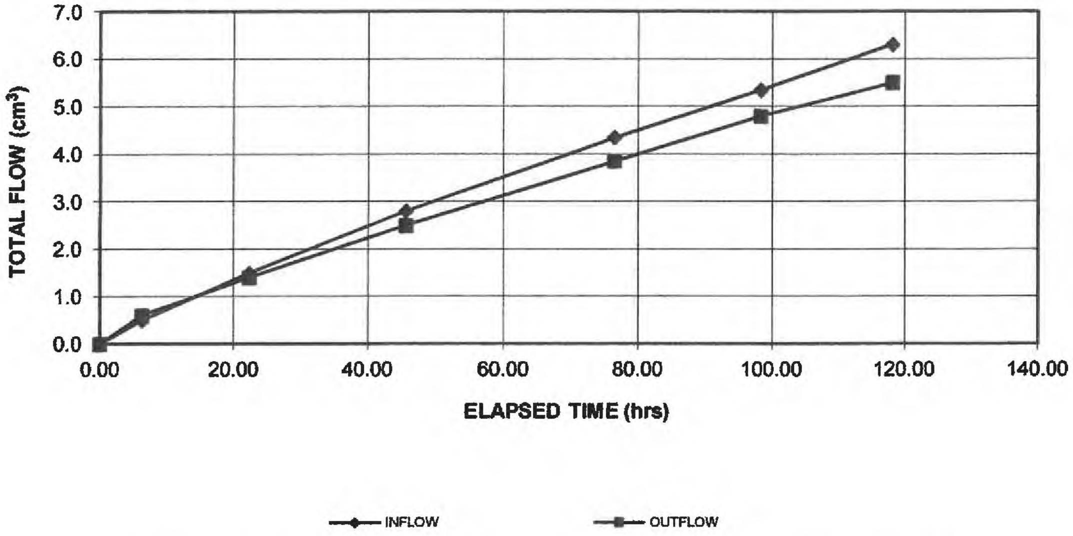
PERMEABILITY TEST

ASTM D 5084-16a

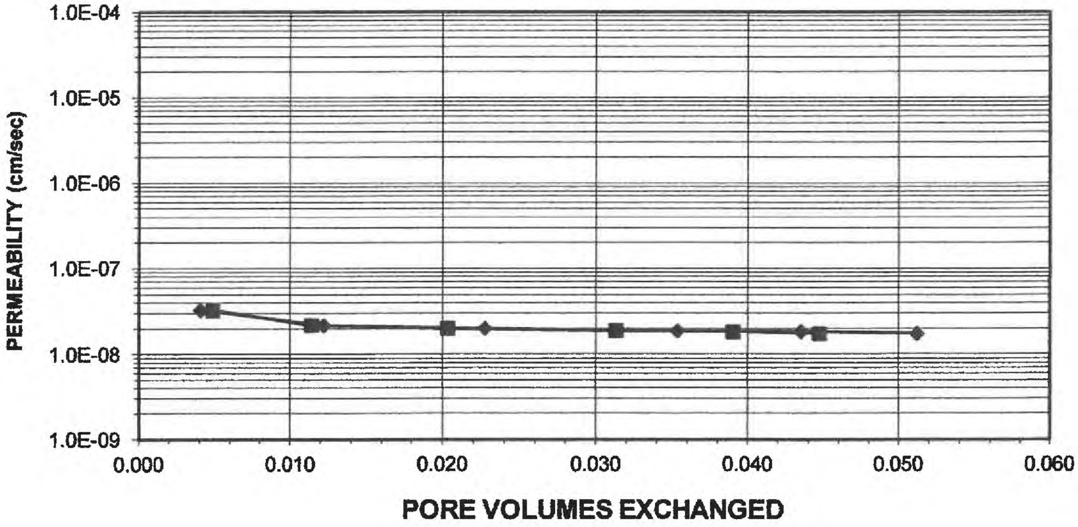
Client:	North Point Engineering	Boring No.:	N/A
Client Project:	Ringler Dovetail	Depth (ft):	0-4'
Project No.:	2019-155-002	Sample No.:	TP-11
Lab ID No.:	2019-155-002-003	Avg. Conf. Pressure (psi):	10

AVERAGE PERMEABILITY = 1.9E-08 cm/sec @ 20°C
AVERAGE PERMEABILITY = 1.9E-10 m/sec @ 20°C

TOTAL FLOW vs. ELAPSED TIME



PORE VOLUMES EXCHANGED vs. PERMEABILITY



Tested By: RPE Date: 4/15/19 Checked By: KC Date: 4/23/19

PERMEABILITY TEST

ASTM D 5084-16a

Client:	North Point Engineering	Boring No.:	N/A
Client Project:	Ringler Dovetail	Depth (ft):	0-4'
Project No.:	2019-155-002	Sample No.:	TP-11
Lab ID No.:	2019-155-002-003	Avg. Conf. Pressure (psi):	10

Specific Gravity:	2.70	Assumed
Sample Condition:		Remolded

Visual Description: Brown Clay

Permeant Type: Deaired Water

MOISTURE CONTENT:	BEFORE TEST	AFTER TEST
Tare Number	589	1741
Weight of Tare & Wet Sample (g)	255.27	1014.18
Weight of Tare & Dry Sample (g)	233.05	888.59
Weight of Tare (g)	82.56	82.74
Weight of Water (g)	22.22	125.59
Weight of Dry Sample (g)	150.49	805.85
Moisture Content (%)	**14.8**	**15.6**

SPECIMEN:	BEFORE TEST	AFTER TEST
Weight of Tube & Wet Sample (g)	2248.80	NA
Weight of Tube (g)	1323.90	NA
Weight of Wet Sample (g)	924.90	931.51
Length 1 (in)	3.973	3.963
Length 2 (in)	3.973	3.931
Length 3 (in)	3.973	3.958
Top Diameter (in)	2.877	2.879
Middle Diameter (in)	2.877	2.878
Bottom Diameter (in)	2.877	2.881
Average Length (in)	3.97	3.95
Average Area (in^2)	6.50	6.51
Sample Volume (cm^3)	423.24	421.55
Unit Wet Weight (g/cm^3)	2.19	2.21
Unit Wet Weight (pcf)	136.4	137.9
Unit Dry Weight (pcf)	118.9	119.3
Unit Dry Weight (g/cm^3)	1.90	1.91
Void Ratio, e	0.42	0.41
Porosity, n	0.29	0.29
Pore Volume (cm^3)	124.8	123.1
Total Weight of Sample After Test (g)		932.08

Tested By: RPE Date: 4/15/19 Checked By: KC Date: 4/23/19

PERMEABILITY TEST

ASTM D 5084-16a

Client:	North Point Engineering	Boring No.:	N/A
Client Project:	Ringler Dovetail	Depth (ft):	0-4'
Project No.:	2019-155-002	Sample No.:	TP-11
Lab ID No.:	2019-155-002-003	Avg. Conf. Pressure (psi):	10

Pressure Heads (Constant)		Final Sample Dimensions	
Top Cap (psi)	64.0	Sample Length (cm), L	10.03
Bottom Cap (psi)	66.0	Sample Diameter (cm)	7.31
Cell (psi)	75.0	Sample Area (cm^2), A	42.01
Total Pressure Head (cm)	140.6	Inflow Burette Area (cm^2), a-in	0.912
Hydraulic Gradient	14.01	Outflow Burette Area (cm^2), a-out	0.861
		B Parameter (%)	100

AVERAGE PERMEABILITY = 1.9E-08 cm/sec @ 20°C
AVERAGE PERMEABILITY = 1.9E-10 m/sec @ 20°C

DATE (mm/dd/yy)	TIME (hr)	TIME (min)	ELAPSED TIME t (hr)	TOTAL INFLOW (cm^3)	TOTAL OUTFLOW (cm^3)	TOTAL HEAD h (cm)	FLOW (0 flow) (1 stop)	TEMP. (°C)	INCREMENTAL PERMEABILITY @ 20°C (cm/sec)
4/17/19	9	41	0.000	0.0	0.0	167.4	0	21.2	NA
4/17/19	15	59	6.300	0.5	0.6	166.2	0	22.1	3.3E-08
4/18/19	7	56	22.250	1.5	1.4	164.1	0	21.2	2.2E-08
4/19/19	7	17	45.600	2.8	2.5	161.5	0	21.4	2.0E-08
4/20/19	14	8	76.450	4.4	3.9	158.2	0	21.3	1.9E-08
4/21/19	11	58	98.283	5.4	4.8	156.0	0	20.8	1.8E-08
4/22/19	7	50	118.150	6.3	5.5	154.2	1	20.5	1.7E-08

Tested By: RPE Date: 4/15/19 Checked By: KC Date: 4/23/19

APPENDIX N
QA/QC Plan

QUALITY ASSURANCE/QUALITY CONTROL (QA/QC) PLAN

DOVETAIL ENERGY, LLC

WASTEWATER STORAGE POND

GREENE COUNTY, OHIO

MAY 2019
REVISED JUNE 7, 2019

Prepared by:

North Point Engineering Corporation
6657 Frank Avenue NW, Suite 200
North Canton, Ohio 44720

Prepared for:

Dovetail Energy, LLC
1156 Herr Road
Fairborn, Ohio 45324

QUALITY ASSURANCE/QUALITY CONTROL PLAN
DOVETAIL ENERGY, LLC
WASTEWATER STORAGE POND
MAY 2019; REVISED JUNE 7, 2019

TABLE OF CONTENTS

List of Tables

SECTION 1.0
GEOMEMBRANES

Preface

The manufacture, shipment, and installation of polyethylene geomembrane shall be in accordance with this section of the QA/QC Plan and the design specifications.

General Manufacturer's installation specifications have been incorporated into the QA/QC Plan as appropriate. After a specific Geomembrane Manufacturer has been contracted, modifications may be made to this section of the QA/QC Plan to incorporate particular requirements of that Manufacturer. The modifications will be submitted for approval by the permitting agency prior to implementation.

The CQA Consultant shall document inventory, testing, and placement of geosynthetics.

Table 1 of the QA/QC plan provides testing parameters and values for Quality Control and Quality Assurance Testing. If the geomembrane manufacturer's specifications for testing are more stringent, then the manufacturer's specifications shall be used.

1.0 Manufacture, Shipment, and Storage

The following addresses the activities associated with the manufacture of the geomembrane; the shipment, handling, and delivery of geomembrane to the site; conformance testing of delivered geomembrane; and the storage of the geomembrane prior to installation.

A. Manufacture of Polyethylene Geomembrane

The Geomembrane manufacturer shall provide documentation that the material meets the requirements of the design specifications and that adequate quality control measures have been implemented during the manufacturing process.

1. Resin Quality

   The raw material shall be new, first quality compounded polyethylene manufactured specifically for producing geomembrane meeting the requirements listed in Table 1.

   Prior to the shipment of polyethylene geomembrane material, the Contractor shall submit the following information to the CQA Consultant:

   - The origin (Resin Supplier's name and resin production plant), identification (brand name, number), and production date of the resin;
   - A copy of the quality control certificates issued by the Resin Supplier;

- Reports on the tests conducted by the Manufacturer to verify the quality of the resin used to manufacture the geomembrane rolls and extrudate rods meet the requirements indicated above; and

At the Owner's discretion and cost, testing may be carried out on the resin by the Geosynthetics CQA Laboratory for purposes of verifying conformance. If the results of the Manufacturer and the Geosynthetics CQA Laboratory testing differ, the testing will be repeated by the Geosynthetics CQA Laboratory, and the Manufacturer will be permitted to monitor this testing. The results of this latter series of tests will prevail, provided that the applicable test methods have been followed.

2. Certification of Property Values
In addition to information regarding the raw material, the Contractor shall submit the following information to the CQA Consultant:

- Properties sheet certification including, at a minimum, guaranteed values for all specified properties presented in Table 1. Additional properties may be requested at the discretion of the Certifying Engineer.

- A list of quantities and descriptions of materials other than the base polymer which comprise the geomembrane.

The CQA Consultant shall verify that the property values certified by the Geomembrane Manufacturer meet the test methods and values as shown in Table 1.

3. Quality Control Certificates
Prior to shipment, the Contractor shall submit the Geomembrane Manufacturer's quality control certificates for the geomembrane provided to the CQA Consultant. The quality control certificate will be signed by a responsible party employed by the Geomembrane Manufacturer. The quality control certificate will include:

- Roll numbers and identification;

- Date of production; and

- Results of quality control tests.

The Manufacturer shall be required to perform, at a minimum, the tests presented in Table 1 on samples taken at the minimum frequency as specified within the most recent versions of Geosynthetics Research Institute (GRI) Test Method GM 13 and GM 17.

The CQA Consultant shall:

- Verify that the quality control certificates have been provided at the specified frequency for all rolls; and

- Review the quality control certificates and verify that the test methods and values meet the requirements presented in Table 1.

B. Shipment and Handling

Shipment of the geomembrane to the site is the responsibility of the Owner, Geomembrane Manufacturer, or Installer depending on the contract documents. Handling on-site is the responsibility of the Installer. Shipments will be accepted by the Owner only if delivered by flatbed trailer.

The CQA Consultant shall observe that:

- Handling equipment used on-site poses minimal risk of damage to the geomembrane; and

- The Geomembrane Installer's personnel handle the geomembranes with care.

Upon delivery at the site, the Installer and the CQA Consultant shall conduct a surface observation of the exposed outer surface rolls for defects, damage, and labeling. This examination shall be conducted without unrolling rolls unless defects or damages are found or suspected. All labels identifying rolls shall be weatherproof. The CQA Consultant will indicate to the Certifying Engineer and Owner:

- Rolls, or portions thereof, that should be rejected and removed from the site because they have severe flaws;

- Rolls that have minor repairable flaws; and

- Rolls without proper identification.

Rolls without proper identification shall be rejected by the Certifying Engineer.

C. Conformance Testing of Geomembrane

Upon, or prior to, delivery of the rolls of geomembrane, the CQA Consultant shall verify that samples are removed and forwarded to the Geosynthetics CQA Laboratory for testing to verify conformance with the test methods and values presented in Table 1. Samples shall be taken and tested at the minimum frequency specified in Table 1 or one sample per lot, whichever results in a greater frequency. The Certifying Engineer may elect to waive the testing for each lot if the construction event results in the use of "inventoried or stocked" rolls (i.e., one or two rolls from each lot and multiple lots used as rolls are shipped from manufacturer inventory and not specifically produced for the project).

1. Sample Collection

   Using the packing list provided by the manufacturer or a sequential inventory list made by the CQA Consultant, rolls shall be selected for sampling at a minimum frequency as specified in Table 1. If the material is shipped in identifiable lots or manufacturing runs, sample selection should be adjusted to assure that the minimum frequency is met and that each different lot or manufacturing run is represented by at least one sample.

   Samples will be taken across the entire width of the roll and should not include the first 3 lineal feet of the roll if it is damaged. Unless otherwise specified, samples will be 3 feet long by the roll width. Conformance testing shall be conducted in accordance Table 1.

2. Test Results

   The results of the conformance testing shall be evaluated in accordance to the following procedure:

   - If the test values for the sample meet the requirements presented in Table 1 and the Manufacturer's guaranteed minimum values, the sample passes.

   - If the test value for the sample does not meet one or more of the required values, additional evaluation procedures will be implemented by the CQA Consultant and Certifying Engineer. Additional tests required for further evaluation shall be at the expense of the Manufacturer. For the failing parameter(s), two additional tests can be performed on the sample. These tests may be performed by another CQA Geosynthetics Laboratory at the discretion of the CQA Consultant, Certifying Engineer, and the Owner.

   - If the test values for each of the two additional tests meet the required values, the roll is acceptable. If one or more of the test values do not meet requirements, reject the roll; collect samples from the closest numerical roll on both sides of the failed roll and test for the failed parameter(s). If one or both of these tests do not meet requirements, those roll(s) will be rejected and the CQA Consultant, Certifying Engineer, and Owner shall determine further testing protocol and criteria for identifying the limits of rejected rolls.

D. Storage

The Contractor shall be responsible for the storage of the geomembrane on site. Storage space should protect the geomembrane from theft, vandalism, passage of vehicles, water, and weather. The CQA Consultant shall document that storage of the geomembrane provides adequate protection against dirt, vehicle impact, and other sources of damage.

2.0 Geomembrane Installation

The installation of the geomembrane involves three primary tasks; earthwork, placement of geomembrane field panels, and seaming the field panels.

A. Earthwork

The earthwork supporting the geomembrane and anchoring it in place is crucial to the performance of the geomembrane. The Earthwork Contractor shall inform the Construction Quality Assurance (CQA) Consultant when the surface on which the geomembrane will be installed is suitable for installation. Geomembrane placement may not commence until both the CQA Inspector and the Installer inspect the subgrade and agree that the area under consideration is acceptable.

It is the Installer's responsibility to protect the supporting soil after it has been accepted. After the supporting soil has been accepted by the Installer, it shall be the responsibility of the Installer and the CQA Consultant to indicate to the Certifying Engineer any change in the supporting soil condition that may require repair work.

B. Geomembrane Placement

The placement of field panels of geomembrane is the responsibility of the Installer and shall be performed in accordance with the approved layout and the following sections. The geomembrane shall be placed in direct and uniform contact with the underlying recompacted soil barrier layer.

1. Panel Layout

At or prior to the Pre-Construction Meeting, the Owner may request that the Contractor submit a proposed panel layout drawing of the facility to be lined. The CQA Consultant shall review the panel layout drawing and verify it is consistent with the accepted state of practice and the QA/QC Plan. The panel layout drawing shall be approved by the Certifying Engineer.

Seams should be oriented parallel to the line of maximum slope, i.e., oriented along, not across, the slope, whenever possible. In corners and odd-shaped geometric locations, the number of seams should be minimized. Horizontal seams should be installed at least 5 feet (1.5 m) from the toe of slopes, or areas of potential stress concentration, unless otherwise authorized. On slopes of 4H:1V or steeper, horizontal or butt seams shall be minimized to the degree possible. Where necessary, the seams shall be staggered and angled at a minimum of 22.5 degrees.

2. Field Panel Identification

The CQA Consultant shall document that the Installer labels each field panel with an "identification code" (number and/or letter) consistent with the layout plan. This identification code shall be agreed upon by the Owner, Installer, Certifying Engineer, and CQA Consultant. It is the responsibility of the Installer and the CQA Consultant to verify that each field panel placed can be tracked to the original roll number. The identification code will be marked at a location agreed upon by the Owner, Installer, and CQA Consultant at the Pre-Construction Meeting.

The CQA Consultant shall establish a table or chart showing correspondence between roll numbers and field panel identification codes. The field panel identification code will be used for all quality assurance records.

3. Location

The CQA Consultant shall verify that field panels are installed at the location indicated in the Installer's layout plan, as approved or modified.

4. Installation Schedule

Field panels shall be placed one at a time unless otherwise approved by the CQA Consultant, and the Certifying Engineer. Each field panel shall be seamed after its placement in order to minimize the number of unseamed field panels exposed to weather.

It is usually beneficial to "shingle" overlaps in the downward direction to facilitate drainage in the event of precipitation. It is also beneficial to proceed in the direction of prevailing winds. Scheduling decisions must be made during installation, in accordance with varying conditions. In any event, the Installer shall be fully responsible for the decision made regarding placement procedures.

The CQA Consultant shall record the identification code, location, date of installation, time of installation, ambient temperature, sheet temperature, and thickness of each field panel.

The CQA Consultant shall evaluate field changes by the Installer which may have affected the original schedule proposed by the Installer and advise the Owner on the acceptability of that change.

5. Weather Conditions

Geomembrane placement shall not proceed when sheet temperature measured by placing a thermometer on the surface of the sheet is below 32°F (0°C) or above 170°F (75°C) for extrusion welding and fusion welding. Deviations from the above temperature criteria shall only occur when authorized by the Certifying Engineer. Geomembrane placement shall not be done during any precipitation, fog, snow, in an area of ponded water, or in the presence of excessive winds.

The CQA Consultant shall verify that the above conditions are fulfilled and shall inform the Owner and Certifying Engineer if the conditions are not fulfilled.

6. Anchorage System

Anchor trenches shall be excavated by the Earthwork Contractor (unless otherwise specified) to the lines and widths shown on the plans prior to geomembrane placement. The CQA Consultant shall verify that anchor trenches have been constructed according to the plans.

Slightly rounded corners will be provided in trenches where the geomembrane adjoins the trench to avoid sharp bends in the geomembrane. Loose soil shall not underlie the geomembrane in the trenches. Seaming shall continue through the anchor trench.

7. Method of Placement

The following is the responsibility of the Geomembrane Installer; the CQA Consultant shall document that these conditions are satisfied:

- Equipment used does not damage the geomembrane by handling, traffic, excessive heat, leakage of liquids, or other means;

- The prepared surface underlying the geomembrane has not deteriorated since previous acceptance, and is still acceptable immediately prior to geomembrane placement;

- Geosynthetic material immediately underlying the geomembrane is clean and free of debris;

- Personnel working on the geomembrane do not smoke, wear damaging shoes, or engage in other activities that could damage the geomembrane;

- The method and equipment used to unroll the panels does not cause scratches or crimps in the geomembrane and does not damage the supporting soil;

- The method used to place the panels minimizes wrinkles (especially differential wrinkles between adjacent panels);

- Adequate temporary loading and/or anchoring (e.g., sand bags), not likely to damage the geomembrane, has been placed to prevent uplift by wind (in case of high winds, continuous loading, e.g., by adjacent sand bags or rolls of geosynthetic materials, is recommended along the edges of panels to minimize the risk of wind flow under the panels); and

- Direct contact with the geomembrane is minimized; i.e., the geomembrane is protected by geotextiles, extra geomembrane, or other suitable materials, in areas where excessive traffic may be expected.

The CQA Consultant shall inform the Owner and Certifying Engineer if the above conditions are not fulfilled.

8. Damage

The CQA Consultant shall visually observe each panel, after placement and prior to seaming, for damage. The CQA Consultant shall advise the Certifying Engineer which panels, or portions of panels, should be rejected, repaired, or accepted. Damaged panels or portions of damaged panels which have been rejected shall be marked and their removal from the work area recorded by the CQA Consultant. Repairs shall be made according to procedures described in within this section. As a minimum, the CQA Consultant shall document that:

- The panel is placed in such a manner that it is unlikely to be further damaged;
- Any tears, punctures, holes, thin spots, etc. are either marked for repair or the panel is rejected.

The party responsible for damaging the geomembrane will be responsible for payment for all repairs or replacements.

C. Field Seaming

Field seaming is the responsibility of the Installer and shall be performed in accordance with the following.

1. Requirements of Personnel

At the Pre-Construction Meeting, the Geomembrane Installer will provide the CQA Consultant with a list of proposed seaming personnel and their professional records. This document will be reviewed and approved by the Certifying Engineer and CQA Consultant.

2. Seaming Equipment and Products

Approved processes for field seaming are extrusion seaming and fusion seaming. Proposed alternate processes shall be documented and submitted to the Owner for approval. Only seaming equipment which has been specifically approved by make and model shall be used. The Installer shall submit seaming equipment documentation to the Certifying Engineer and the CQA Consultant for approval.

The following is the responsibility of the Installer; the CQA Consultant shall verify that these conditions are met:

- The Installer maintains on-site the number of spare operable seaming apparatus decided at the Pre-Construction Meeting;
- Equipment used for seaming is not likely to damage the geomembrane;

- The extruder is purged prior to beginning a seam until heat-degraded extrudate has been removed from the barrel;

- For cross seams, the edge of the cross seam is ground to a smooth incline (top and bottom) prior to seaming;

- The electric generator is placed on a flat smooth base and a rub sheet such that no damage occurs to the geomembrane; and

- A smooth insulating plate, scrub sheet or fabric is placed beneath the hot seaming apparatus after usage.

a. Extrusion Process
The extrusion seaming apparatus shall be equipped with gauges giving the relevant temperatures of the extrudate, nozzle, and preheat. The Installer shall submit documentation regarding the extrudate to the Certifying Engineer, and shall certify that the extrudate is compatible with the design specifications, and is comprised of resin which is compatible with geomembrane sheeting. The CQA Consultant shall log apparatus temperatures, ambient temperatures, extrudate temperatures, and sheet temperatures at appropriate intervals.

b. Fusion Process
The fusion-seaming apparatus must be automated vehicular mounted devices, equipped with gauges giving the applicable temperatures. Pressure settings shall be verified by the Installer prior to each seaming period. The CQA Consultant shall log ambient temperatures, sheet temperatures, seaming apparatus temperatures, speeds, and pressures.

3. Seam Preparation
The following is the responsibility of the Installer; the CQA Consultant shall verify that these conditions are met:

- Prior to seaming, the seam area is clean and free of moisture, dust, dirt, oils, greases, debris of any kind, and foreign material. The material to be joined must be wiped with a clean cloth just prior to seaming;

- A rub sheet must be used to protect the liner while cutting any materials;

- If seam overlap grinding is required, the process is completed according to the Geomembrane Manufacturer's instructions within one hour of the seaming operation, and in a way that does not damage the geomembrane;

- The abrading is not visible when welding is complete;

- Seams are aligned with the fewest possible number of wrinkles and "fish mouths"; and

- No metal objects that could potentially damage the liner are permitted for use on the lined area.

4. Weather Conditions for Seaming
The required weather conditions for seaming are as follows:

- The sheet temperatures shall be measured with the thermometer on the surface of the geomembrane sheet.

- Unless authorized in writing by the Certifying Engineer, no seaming shall be attempted at a sheet temperature below 32° F (0°C) or above 170°F (75°C) for extrusion welding and for fusion welding.

- The geomembrane shall be dry and protected from wind.

If the Installer wishes to use methods which may allow seaming at sheet temperatures below 32°F (0°C), the Installer shall provide cold weather welding procedures which shall be reviewed and approved by the Certifying Engineer, and certify in writing that the installation crew has been trained to perform cold weather welding. The proposed cold weather seaming procedures must be consistent with the most recent version of GRI Test Method GM9; a copy of the current method (2013) is included at the end of this section. The installer shall also demonstrate through trial welding that the overall quality of the geomembrane is not adversely affected.

5. Overlapping and Temporary Bonding
The following shall be the responsibility of the Installer and verified by the CQA Consultant:

- As a general guidance, the panels of geomembrane have a finished overlap of a minimum of 3 inches (75 mm) for extrusion seaming and 4 inches (100 mm) for fusion seaming, but in any event sufficient overlap will be provided to allow peel tests to be performed on the seam;

- No solvent or adhesive is used unless the product is approved in writing by the Owner (samples will be submitted to the Owner for testing and evaluation); and

- The procedure used to temporarily bond adjacent panels together does not damage the geomembrane (in particular, the temperature of hot air at the nozzle of any spot seaming apparatus is controlled such that the geomembrane is not damaged).

The CQA Consultant shall log all appropriate temperatures and conditions, and shall log and report to the Certifying Engineer any deviation.

6. Trial Seams

Trial seams shall be made on fragment pieces of geomembrane liner to verify that seaming conditions are adequate and in accordance with seam strength requirements noted in Table 1. Such trial seams shall be made at the beginning of each seaming period, when a seaming apparatus is started, when operators change, and when a seaming apparatus is re-started. A passing trial seam shall be made for each seaming device and technician. A change in technician or machine on a previously passed trial seam warrants the welding of a new passing trial seam. A trial seam shall also be made in the event that the sheet temperature varies more than 18°F (10°C) since the last passing trial seam. Trial seams shall be made under the same conditions as actual seams. If seaming apparatus is turned off for any reason, a new passing trial seam must be completed for that specific seaming apparatus.

The Installer shall provide the tensiometer required for peel testing of trial seams in the field. Shear testing may be performed at the discretion of the Certifying Engineer. The tensiometer shall be automatic and shall have a direct digital readout. The tensiometer shall be calibrated at the site prior to use. The Installer shall provide the Certifying Engineer with the calibration certification.

The trial seam sample shall be at least 5 feet (1.5 m) long by 1 foot (.3 m) wide (after seaming) with the seam centered lengthwise. Seam overlap will be as indicated in Subsection 2.C.5.

Three specimens, each 1 inch (25 mm) wide shall be cut from the trial seam sample by the Installer and tested in peel using a field tensiometer. For each fusion specimen, both tracks shall be tested. A passing welded seam is achieved in peel when the specimen meets the criteria in Table 1. If shear testing is performed, it shall meet the requirements specified in Table 1.

If a specimen fails, the entire operation shall be repeated. If the additional specimen fails, the seaming apparatus and seamer shall not be accepted and shall not be used for seaming until the deficiencies are corrected and two consecutive successful full trial seams are achieved.

The CQA Consultant shall observe trial seam procedures. The remainder of the successful trial seam sample shall be assigned a number and marked accordingly by the CQA Consultant, who will also log the date, hour, machine settings, ambient temperature, number of seaming unit, name of seamer, and pass or fail description. The remainder of the successful trial seam sample shall be archived by the owner until the Permitting Agency has approved the final documentation.

7. General Seaming Procedure
Unless otherwise specified, the general seaming procedure used by the Installer shall be as follows:

- For fusion seaming, a movable protective layer of plastic may be required to be placed directly below each overlap of geomembrane that is to be seamed. This is to help prevent any moisture build-up between the sheets to be seamed.

- If required, a firm substrate will be provided by using a flat board or similar hard surface directly under the seam overlap to achieve proper support.

- Wrinkles at the seam overlaps will be cut along the ridge of the wrinkle in order to achieve a flat overlap. The cut wrinkles will be seamed and any portion where the overlap is inadequate will then be patched with an oval or round patch of the same geomembrane extending a minimum of 6 inches (150 mm) beyond the cut in all directions.

- Seaming will extend to the outside edge of panels to be placed in the anchor trench.

- No field seaming shall take place without the Master Seamer being present.

The CQA Consultant shall verify that the above seaming procedures are followed and shall inform the Owner and Certifying Engineer if they are not.

8. Non-Destructive Seam Continuity Testing
The Installer shall non-destructively test field seams over their full length using a vacuum test unit (for extrusion seams only), air pressure test, or other approved method. The testing shall be carried out to the accepted standards of the industry. The purpose of non-destructive tests is to check the continuity of seams. It does not provide any information on seam strength. Continuity testing shall be carried out on 100 percent of the seams as the seaming work progresses, not at the completion of all field seaming, unless otherwise approved by the Owner and Certifying Engineer. The Installer shall complete any required repairs in accordance with Subsection 2.D.

a. Air Pressure Testing:
Unless otherwise specified, the general air pressure testing procedure used by the Installer shall be as follows:

- Seal both ends of the test channel with a heat gun or other acceptable clamping method.

- Insert a hollow needle with attached pressure gauge into the test channel.

- Inflate the test channel to 30 to 35 psi, close valve, and observe initial pressure after approximate air temperature and pressure have stabilized. The initial pressure setting shall be between 30 and 35 psi.

- Observe and record the test pressure 5 minutes after reading the initial test pressure. If pressure loss exceeds 3 psi, or if the pressure does not stabilize, locate the faulty area and repair.

- At the conclusion of the pressure test, the end of the seam opposite the pressure gauge shall be cut to verify seam continuity. A decrease in a gauge pressure must be observed or the air channel will be considered "blocked" and the test will have to be repeated after the blockage is corrected.

- Remove needle or other approved pressure feed device and seal the resulting hole.

- Test results will be recorded by the CQA Consultant.

b. Non-Complying Air Pressure Test:
In the event of a non-complying air pressure test, the following procedure shall be followed:

- Check the seam end seals and retest the seams.

- If the seam fails air pressure testing, the Installer may isolate the failing zone, air pressure test the seam outside the failing zone, then repair the failing zone by the methods listed below. Alternatively, the Installer may repair the entire seam by the methods listed below:

    - Cap-strip the suspect area;
    - When sufficient overlap exists (1-1/2 inch (38 mm)), heat tack the overlap and extrusion weld the entire seam; or
    - Further isolate the air pressure failure as agreed upon by the CQA Consultant and the Certifying Engineer.

- Test the entire length of the repaired seam by vacuum testing.

- All sections shall be retested and repaired in accordance with Subsection 2D.

c. Vacuum Testing
Unless otherwise specified, the general vacuum testing procedure used by the Installer shall be as follows:

- Turn on the vacuum pump to reduce the vacuum box to approximately 5 psi (0.35 kg/cm3).

- Apply a generous amount of liquid soap and water solution to the area to be tested.

- Place the vacuum box over the area to be tested and apply sufficient downward pressure to "seat" the seal strip against the liner.

- Close the bleed valve and open the vacuum valve.

- Ensure that a leak tight seal is created.

- For a period of not less than 5 seconds, examine the geomembrane through the viewing window for the presence of soap bubbles.

- If no bubbles appear after 5 seconds, close the vacuum valve and open the bleed valve, move the box over the next adjoining area with a minimum 3 inch (75 mm) overlap, and repeat the process.

d. Non-Complying Vacuum Test
In the event of a non-complying vacuum test, the following procedure shall be followed:

- Mark all areas where soap bubbles appear and repair the marked areas.

- Retest repaired areas.

e. Electrical Leak Location Testing
Electrical Leak Location survey shall be performed for all installed geomembrane using one of the following methods:

- ASTM D7002 – Standard Practices for Locating Leak on Exposed Geomembranes Using the Water Puddle Method

- ASTM D7703 – Standard Practice for Electrical Leak Location on Exposed Geomembranes Using the Water Lance Method

- ASTM D7953 – Standard Practice for Electrical Leak Location on Exposed Geomembranes Using the Arc Testing Method

- ASTM D7240 – Standard Practice for Electrical Leak Location using Geomembranes with an Insulating Layer in Intimate Contact with a Conductive Layer via Electrical Capacitance Technique (Conductive-Backed Geomembrane

f. QA/QC Responsibilities; the CQA Consultant shall:

- Document all continuity testing;

- Record location, date, test unit number, name of tester, and outcome of all testing; and,

- Inform the Installer and Certifying Engineer of any required repairs.

When defects are located, the CQA Consultant shall:

- Observe the repair and retesting of the repair;

- Mark on the geomembrane that the repair has been made;

- Document the results.

g. Non-Testable Areas
The Installer shall use the following procedures at locations where seams cannot be non-destructively tested:

- All such seams shall be cap-stripped with the same geomembrane material.

- If the seam cannot be tested prior to final installation, the seaming and cap-stripping operations shall be observed by the CQA Consultant and Installer for uniformity and completeness.

The seam number, date of observation, name of tester, and outcome of the test or observation shall be recorded by the CQA Consultant.

9. Destructive Testing

Destructive seam tests shall be performed at locations selected by the CQA Consultant. The purpose of these tests is to evaluate seam strength. Seam strength testing will be done as the seaming work progresses and not at the completion of all field seaming, unless otherwise approved by the Owner and Certifying Engineer.

a. Location and Frequency

The CQA Consultant shall select locations where a destructive seam sample will be cut out for peel and shear strength testing. Those locations shall be established as follows:

- A frequency of one test location per 500 feet (150m) or less of seam length per seaming apparatus.
- Test locations will be determined during seaming at the CQA Consultant's discretion. Selection of such locations may be prompted by suspicion of contamination, offset seams, or any other potential cause of imperfect seaming.

The Installer will not be informed in advance of the locations where the seam samples will be taken.

b. Sampling Procedure

Samples shall be cut by the Installer as the seaming progresses in order to have passing test results before the geomembrane is covered by another material. The CQA Consultant shall:

- Observe sample cutting;
- Assign a number to each sample, and mark it accordingly;
- Record the sample location on the layout drawing; and
- Record the reason for taking the sample at this location, if not taken due to statistical routine.

All holes in the geomembrane resulting from destructive seam sampling shall be immediately repaired in accordance with repair procedures described in Subsection 2.D.2 of this Plan. The continuity of the new seams in the repaired area will be tested according to Subsection 2.C.8.

c. Size of Samples

At a given sampling location, samples shall be taken by the Installer. The sample shall be cut into three parts and distributed as follows:

- One portion to the CQA Consultant for archive storage, 12 inches x 12 inches (30 cm x 30 cm);

- One portion for peel testing in the field, 12 inches x 18 inches (30 cm x 45 cm); and

- One portion to the CQA Consultant for shipment to an independent testing laboratory, 12 inches x 12 inches (30 cm x 30 cm) assuming passing field-testing results.

Final determination of the sample sizes shall be made at the Pre-Construction Meeting.

d. Field Testing
One inch (25 mm) wide specimens shall be removed from the field sample and tested in the field with a tensiometer. Three (3) specimens shall be tested in peel. Shear testing will be performed at the discretion of the Certifying Engineer. All specimens shall meet the minimum requirements presented in Table 1. If any field test specimen fails to pass, then the procedures outlined in Subsection 2.C.9.g will be followed.

The CQA Consultant shall witness field tests and mark all samples and portions with their number. The CQA Consultant shall also log the date and time, ambient temperature, number of seaming unit, name of technician, seaming apparatus temperatures and speeds, and pass or fail description.

e. Geosynthetics CQA Laboratory Testing
Destructive test samples shall be packaged and shipped, if necessary, by the CQA Consultant in a manner that will not damage the test sample. The CQA Consultant shall be responsible for storing the archive samples. Destructive seam sample testing shall be performed with a calibrated tensiometer.

Lab testing will be performed as shown in Table 1.

Written results of destructive testing of seam samples shall be made available to the CQA Consultant, Installer, and Certifying Engineer within approximately 24 hours after samples are removed from the liner. The Certifying Engineer shall review laboratory test results as soon as they become available and make appropriate recommendations to the Owner and CQA Consultant. If a sample fails, the procedures given in Subsection 2.C.9.g shall be followed.

f. Installer's Laboratory Testing
If the Installer chooses to perform destructive testing on their portion of the seam samples, their test results shall be presented to the Certifying Engineer and the CQA Consultant for review within approximately 24 hours after samples are removed from the liner.

g. Destructive Test Failure

The following procedures shall apply whenever a seam sample fails destructive testing:

- The Installer can reconstruct the seam between any two passed destructive seam test locations, or

- The Installer can trace the seaming path to an intermediate location (at least 10 ft (3 m) from the point of the failed test in each direction) and take a small sample for an additional field test at each location. If these additional samples pass field tensiometer testing, then destructive laboratory samples are taken. If these samples pass destructive testing, then the seam is reconstructed between these locations (see Subsection 2.D.2 for repair procedures). If the additional testing fails, then the process shall be repeated to establish the zone to be reconstructed.

All acceptable seams must be bounded by two passing destructive tests. In cases exceeding 150 feet of reconstructed seam length, a sample shall be taken from the zone in which the seam has been reconstructed. This sample must pass destructive testing or the procedure outlined here must be repeated. The CQA Consultant shall document all actions taken in conjunction with destructive test failures.

D. Defects and Repairs

Seams and non-seam areas of the geomembrane shall be examined by the CQA Consultant for identification of defects, holes, blisters, undispersed raw materials and any sign of contamination by foreign matter. Because light reflected by the geomembrane helps to detect defects, the surface of the geomembrane will be clean at the time of examination. The geomembrane surface shall be swept or washed by the Installer if the amount of dust or mud inhibits examination.

1. Evaluation

Each suspect location both in seam and non-seam areas shall be non-destructively tested using the methods described in Subsection 2.C.8 as appropriate. Each location that fails the non-destructive testing shall be marked with an identification code by the CQA Consultant and repaired by the Installer. Work shall not proceed with any materials which will cover locations which have been repaired until laboratory test results with passing values are available.

2. Repair Procedures

Any portion of the geomembrane exhibiting a flaw, or failing a destructive test, or non-destructive test, shall be repaired. Several procedures exist for the repair of these areas. The final decision as to the appropriate repair procedure shall be approved by the Certifying Engineer and CQA Consultant. The procedures available include:

- Patching
  - Apply a new piece of geomembrane sheet over, and at least 6 inches (150 mm) beyond the limits of a defect. The patch shall be extrusion seamed to the underlying geomembrane. This method should be used to repair large holes, tears, destructive test locations, undispersed raw materials, and contamination by foreign matter.
- Spot Seaming
  - Apply a "bead" of extrudate, maximum length of 6 inches (150 mm), over a defect. Spot seaming should be used only to repair dents, pinholes, pressure test air holes, or other minor, localized flaws.
- Capping
  - Apply a new strip of geomembrane over a faulty seam. The cap strip shall extend at least 6 inches (150 mm) beyond the limit of the seam and the edges will be extrusion seamed to the underlying geomembrane. This method should be used to repair lengths of extrusion or fusion seams.
- Welding Flap
  - Where an adequate flap exists, (1-1/2 inches (38 mm)) extrusion weld the flap of a fusion seam. At the ends of this repair, the flap shall be cut to allow the extrusion weld to enclose the failed area.
- Replacement
  - The faulty seam is removed and replaced.

In addition, the following provisions shall be satisfied:

- Surfaces of the geomembrane which are to be repaired will be abraded no more than one hour prior to the repair;

- All surfaces must be clean and dry at the time of the repair;

- All seaming equipment used in repairing procedures must pass trial weld testing;

- The repair procedures, materials, and techniques will be approved in advance of the specific repair by the CQA Consultant and Installer; and

- Patches or caps will extend at least 6 inches (150 mm) beyond the edge of the defect, and all corners of patches will be rounded.

3. Verification of Repairs

Each repair shall be numbered and logged by the CQA Consultant and the Installer. Each repair shall be non-destructively tested using the methods described in Subsection 2.C.8 as appropriate. Repairs which pass the non-destructive test will be taken as an indication of an adequate repair. However, if the CQA Consultant suspects a repair to be questionable, although it passes non-destructive testing, a destructive test can be requested. Failed tests will require the repair to be redone and retested until a passing test is achieved. The CQA Consultant shall observe non-destructive testing of repairs and shall record the date of the repair and test outcome.

4. Large Wrinkles

When seaming of the geomembrane is completed (or when seaming of a large area of the geomembrane is completed) and prior to placing overlying materials, the CQA Consultant shall observe the geomembrane wrinkles. The CQA Consultant will indicate to the Certifying Engineer which wrinkles should be cut and re-seamed by the Installer. The seam thus produced will be tested like any other repair.

The following procedures may be implemented, as necessary, to minimize wrinkle development and ensure that wrinkles are not encapsulated (folded over).

- Close CQA inspection during placement activities.
- Placement during cooler and cloudier conditions when liner temperatures are lower and thermal expansion is less of a concern.
- Application of water over the FML to reduce sheet temperature to prevent or remove wrinkles.
- If wrinkles are present, they may be cut out and repaired. There are no specific size criteria that dictates wrinkle cutting/removal. It shall be based upon the discretion of the CQA Consultant and should be done only if the other procedures noted herein are not effective and direct contact between the FML and the RSB cannot be otherwise achieved.
- Avoiding placement of cover material, when wrinkles are present.
- Use of white HDPE liner which is less prone to thermal expansion and wrinkling.

In certain cases, and under careful CQA observation, wrinkles may be carefully “walked out” or forced to a certain location where they can be cut and repaired. This can occur with careful spreading of overlying granular and soil materials adjacent to a wrinkle. Once the wrinkle can no longer be “walked out” it can be removed and repaired. This practice should only be attempted under close CQA observation to ensure the wrinkle is not encapsulated or entombed.

5. Backfilling of Anchor Trench
   Anchor trenches will be adequately drained, to prevent ponding or otherwise softening of the adjacent soils while the trench is open. Anchor trenches shall be backfilled and compacted as soon as possible. Care shall be taken when backfilling the trenches to prevent any damage to the geosynthetics. The CQA Consultant shall observe the backfilling operation and advise the Certifying Engineer of any problems.

6. Liner System Certification/Acceptance
   The Installer and the Manufacturer shall retain ownership and responsibility for the geosynthetics in the facility until acceptance by the Owner. The liner system shall be accepted by the Owner when:

   - The Project is finished;

   - Verification of the adequacy of seams and repairs, including associated testing, is complete;

   - Installer's representative furnishes the Owner and Certifying Engineer with certification that the geomembrane was installed in accordance with the Manufacturer's recommendations as well as the design plans and specifications;

   - All documentation of installation is completed including the Certifying Engineer's final report; and

   The CQA Consultant shall provide certification that installation was performed in accordance with this QA/QC Plan for the project except as noted to the Certifying Engineer or Owner. If material availability allows, the CQA Consultant may collect a material sample for inclusion in the certification report.

7. Materials in Contact with the Geomembranes
   The CQA Consultant shall verify that the additional materials required as part of the overall project construction are done so with extreme care so as not to damage the geomembrane during placement.

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adopted – 1995
Revision 1 (editorial): January 10, 2013

GRI Test Method GM9*

Standard Practice for

"Cold Weather Seaming of Geomembranes"

This specification was developed by the Geosynthetic Research Institute (GRI) with the cooperation of the member organizations for general use by the public. It is completely optional in this regard and can be superseded by other existing or new specifications on the subject matter in whole or in part. Neither GRI, the Geosynthetic Institute, nor any of its related institutes, warrant or indemnifies any materials produced according to this specification either at this time or in the future.

1. Scope

1.1 This standard provides guidelines for the field seaming of geomembranes in cold weather. The applicable temperature range of the geomembrane sheet is from 0° to -15°C (32° to 5°F). This practice, however, is not to be considered as all-encompassing since each material and site specific condition presents its own challenges and special conditions.

1.2 This practice is focused on thermal fusion and extrusion fillet seaming methods for the seaming of thermoplastic geomembranes.

1.3 This practice is intended to be a guide for those monitoring geomembrane installations as well as an aid to installers for the seaming of geomembranes in cold climates and conditions.

1.4 This standard may involve hazardous operations, equipment and climates. This standard does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

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* This GRI standard is developed by the Geosynthetic Research Institute through consultation and review by the member organizations. This specification will be reviewed at least every 2-years, or on an as-required basis. In this regard it is subject to change at any time. The most recent revision date is the effective version.

2. Reference Documents

2.1 ASTM Standards:

2.2 EPA Documents:
EPA/530/SW-91/051, "Inspection Techniques for Fabrication of Geomembrane Field Seams"

EPA/600/R-93/182, "Quality Assurance and Quality Control for Waste Containment Facilities"

3. Terminology

3.1 Definitions of Generic Terms

3.1.1 *geomembrane* - An essentially impermeable geosynthetic composed of one or more synthetic sheets. (ASTM definition)

3.1.2 *destructive tests* - Tests performed on geomembrane samples cut from a field installation or test strip to verify specification performance requirements, e.g., shear and peel tests of geomembrane seams during which the specimens are tested to failure.

3.1.3 *seam shear test* - A destructive test in which two seamed sheets on opposite sides of the seam are pulled in tension placing the seam in a shear mode of stress.

3.1.4 *seam peel test* - A destructive test in which two seamed sheets on the same side of the seam are pulled in tension placing the seam in a tensile mode of stress.

3.1.5 *Construction Quality Control (CQC)* - A planned system of inspections that is used to directly monitor and control the quality of a construction project. Construction quality control is normally performed by the geosynthetics installer and is necessary to achieve quality in the constructed or installed system. Construction quality control (CQC) refers to measures taken by the installer or contractor to determine compliance with the requirements for materials and workmanship as stated in the plans and specifications for the project.

3.1.6 *Construction Quality Assurance (CQA)* - A planned system of activities that provides the owner and permitting agency assurance that the facility was constructed as specified in the design. Construction quality assurance includes inspections, verifications, audits, and evaluations of materials and workmanship necessary to determine and document the quality of the constructed facility. Construction quality assurance (CQA) refers to measures taken by the CQA organization to determine if the installer or contractor is in compliance with the plans and specifications of the project.

3.2 Description of Terms Specific to This Standard

3.2.1 *field seams* - The seaming of geomembrane rolls or panels together in the field making a continuous liner system. Synonymous with *production seams.*

3.2.2 *trial seams* - Trial sections of seamed geomembranes used to establish machine settings of temperature, pressure and travel rate for a specific geomembrane under a specific set of atmospheric conditions for machine-assisted seaming as well as establishing procedures to be correctly used by the installation personnel.

3.2.3 *test strips* - Synonymous with "trial seams".

3.2.4 *test welds* - Synonymous with "trial seams".

3.2.5 *thermal fusion seams* - A seam which involves the temporary, thermally-induced reorganization in the polymer structure at the surface of two opposing geomembrane sheets which, after the application of pressure and the passage of a certain amount of time, results in the two geomembranes being permanently joined together.

3.2.6 *mouse* - Synonymous term for hot wedge, or hot shoe, seaming device.

3.2.7 *extrusion fillet seams* - A seam between two geomembrane sheets achieved by heat-extruding a ribbon of molten polymer over the overlap areas followed by the application of a nominal amount of pressure which results in the two geomembrane sheets being permanently joined together.

3.2.8 *gun* - Synonymous term for hand held extrusion fillet seaming device.

4. Significance and Use

4.1 Most federal and state environmental regulations call for special procedures for field seaming of geomembranes when sheet temperatures are less than 0°C (32°F). This standard practice is meant to give procedural guidance for seaming of geomembranes at sheet temperatures down to -15°C (5°F). Geomembrane seaming at temperatures below -15°C (5°F) is not generally recommended from both material and personnel perspectives.

4.2 The standard is focused on the two main types of thermal seaming methods, thermal fusion and extrusion fillet methods, where trial seam tests and production seam tests can be conducted within minutes after the seam is fabricated.

5. Procedure

5.1 Preparation of the geomembrane surfaces to be seamed:

5.1.1 Seaming is not to take place when it is snowing, sleeting or hailing on the geomembrane in the area to be seamed.

5.1.2 In the area to be seamed, all frost must be removed from the opposing surfaces of the geomembrane sheets in the regions where the actual seaming is to be performed.

5.1.3 The residual moisture left after removing frost must be wiped dry.

> Note 1: Perhaps the most difficult surfaces to prepare in this regard are textured geomembranes where the texturing extends to the roll edges or roll ends.

5.1.4 The application of heat to remove moisture using a hand held hot air device can be used providing care against excessive heat application is taken. An assessment using trial seams is recommended.

5.1.5 The specific area to be seamed must be free of soil particles and other foreign matter.

5.1.6 For thermal fusion welding, such as the hot wedge method, the under side of the lower sheet should be free of frost so that the lower drive wheels of the device can move evenly and do not slip.

> Note 2: It may be necessary to use a rub sheet beneath the area being seamed to separate the geomembrane from frozen soil subgrade. Various materials have been used for rub sheets including smooth membranes, smooth films and even certain types of geotextiles.

5.1.7 For fillet extrusion welding the thermal tacking of the sheets together should proceed as with similar welding at temperatures above freezing.

5.1.8 Preheating of the geomembrane area to be seamed is common but the amount of preheat and its timing preceding the actual production seaming is at the option of the installer based upon past practice and experience. An assessment using trial seams is recommended.

5.2 Thermal fusion seaming (e.g., using a hot wedge welding device):

5.2.1 In general, the rate of seaming, i.e., the speed of the hot wedge device, is usually slower than when seaming at temperatures above 0°C (32°F). Furthermore, the rate should decrease with decreasing sheet temperature.

5.2.2 Cold temperature seaming requires more frequent trial seams than when welding at temperatures above freezing. For example, if the CQA plan calls for two trial seams a day at temperatures above freezing, the number should be increased by one per day for each 7.5°C (13.5°F) less than freezing. Trial seams should be made at the discretion of the CQA Engineer.

5.2.3 Cold temperature seaming may also require more destructive tests on production seams than when welding above freezing. For example, in addition to the CQA plan written around above freezing temperatures, additional destructive seam samples may be taken at the end(s) of each continuous production seams.

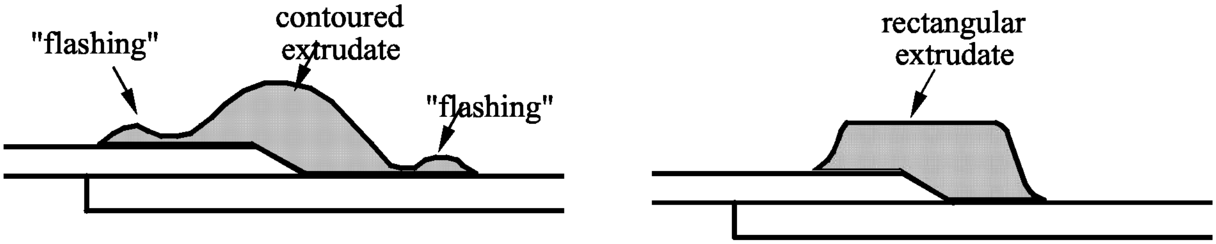
> Note 3: The actual schedule for destructive test samples is at the discretion of the CQA Engineer.

5.2.4 Movable enclosures (i.e., tents) traveling along with the welding device and personnel are particularly effective at sites with high wind. Cold temperature, per se, will not demand the use of protective tents. The decision to use tents is that of the installer and CQC personnel.

5.3 Extrusion fillet seaming:

5.3.1 The necessary grinding of the geomembrane surfaces in preparation of placing extrudate should be no further ahead of the extrusion gun than 10 m (30 ft.), or as stated in the CQA plan.

5.3.2 At the discretion of the parties involved, the profile of the base of the extrusion gun barrel is often shaped more rectangularly than when seaming at temperatures above freezing. The reason for this is to minimize the cooling rate in the thinner extrudate regions, see Figure 1.



(a) Typical Cross Section for Temperatures > 0°C

(b) Alternative Cross Section for Temperatures < 0°C

Figure 1 - Extrusion Fillet Patterns

5.3.3 In general, the rate of seaming, i.e., the speed of travel, is slower than when seaming at temperatures above 0° (32°F). Furthermore, the rate should decrease with decreasing sheet temperatures.

5.3.4 Cold temperature seaming requires more frequent trial seams than when welding at temperatures above freezing. For example, if the CQA plan calls for two trial seams a day at temperatures above freezing, the number should be increased by one per day for each 7.5°C (13.5°F) less than freezing. Trial seams should be made at the discretion of the CQA Engineer.

5.3.5 Cold temperature seaming may also require more destructive tests on production seams than when welding above freezing. For example, in addition to the CQA plan written around above freezing temperatures, additional destructive seam samples may be taken at the end(s) of each continuous production seam.

Note 4: The actual schedule for destructive test samples is at the discretion of the CQA Engineer.

5.3.6 Movable enclosures (i.e., tents) traveling along with the welding device and personnel are particularly effective at sites with high wind. Cold temperature, per se, will not demand the use of protective tents. The decision to use tents is that of the installer and CQC personnel.

5.4 Seam Testing

5.4.1 In general, destructive testing of seams (both shear and peel) made in cold temperatures should follow the same protocol and test methods as for temperatures above freezing.

5.4.2 Destructive seam samples for CQA purposes should be taken as described previously and sent to the laboratory for testing at the designated test method conditions for above freezing temperatures.

5.4.3 Seam tests from trial seams can be taken to a field trailer, allowed to equilibrate to the designated test temperature and tested accordingly. However, seam tests from trial seams which are tested with a tensiometer on-site at temperatures less than freezing cannot be compared to geomembrane sheet strengths at room temperature. Numerous invalid results will occur if this procedure is practiced. Instead, the field tensiometer must be used to determine the strength of the unseamed geomembrane sheets at the same temperature as the seam test. The apparent strength will be higher as the temperature of the test specimen decreases. Acceptance of the trial seam is then based on the percentages of sheet strength as prescribed in the CQA plan, e.g., 90% in shear and 62% in peel for HDPE geomembranes.

> Note 5: This type of testing whereby the seam test specimen results are compared to a single value of sheet strength is contentious since the value of sheet strength is not statistically reliable. Agreement by the parties involved is necessary.

6. CQA Report

6.1 The report should include hourly temperatures during cold weather seaming which includes the actual temperature of the surface of the geomembrane (using a pyrometer) and the ambient air temperature measured approximately 1 m (3 ft.) above the geomembrane.

6.2 The method of removing frost from the area to be seamed (if any is present), as well as drying and cleaning of the surfaces involved, should be described.

6.3 The condition of the subgrade beneath the area being seamed should be assessed. If a rub sheet is used during the seam process it should be noted.

6.4 Complete identification of the field seaming system used, including material, methods, preheat, seaming rate, use of tents or enclosures and other details of the procedure should be documented.

6.5 The type, nature, number, condition and details of trial seams, as well as the results of such tests, should be detailed.

6.6 The type, nature, number and details of destructive samples and disposition of sections of the sample should be described. Proper identification is required to identify results of CQA laboratory testing in the final as-built plans of the project.

6.7 Any unusual condition with respect to personnel, equipment, sampling and/or testing that may be attributable to the cold weather should be described and documented.

SECTION 2.0

GEOCOMPOSITE DRAINAGE LAYER

1.0 General

A. Description

The work covered in this section shall consist of all work required to install geocomposite leak detection and drainage/venting layers.

B. Manufacturing Quality Control

Testing shall be carried out by the Manufacturer(s) and Resin Supplier to demonstrate that the raw material, geonet and geocomposite meet the product specification. The Manufacturers shall provide the following information:

1. Copies of the QC certificates issued by the Resin Supplier, including the origin, identification and production dates of the resin.

2. Copies of the QC certificates issued by the geotextile Manufacturer.

3. A list of guaranteed minimum average roll values for the geotextile used in the production of the geocomposite.

4. Copies of the QC certificates issued by the geonet and geocomposite Manufacturer.

5. A list of the guaranteed minimum physical properties for the geonet and geocomposite to be supplied.

Refer to the QA/QC plan summary table under Table 1 for testing parameters and frequencies for geocomposite drainage layers.

C. Packing and Identification Requirements

Geocomposites shall be provided in rolls with relatively opaque and watertight wrappings. Each roll of geonet and geocomposite shall bear a label, which identifies the following:

1. Manufacturer’s name
2. Product identification
3. Lot and/or roll number
4. Roll dimensions

2.0 Materials

A geocomposite drainage layer used the leak detection and drainage/venting capacity shall meet the following requirements

A. Geocomposites shall consist of HDPE geonet with polyester nonwoven geotextiles heat bonded on both sides. The geonet and geotextile portions of the geocomposite shall meet the requirements set forth within this section and Table 1 of this QA/QC Plan.

B. Conformance Testing

The Contractor or Manufacturer will be directed to remove samples from the geocomposite rolls for conformance testing to supplement the quality control testing noted above. Testing by the Geosynthetic CQA Laboratory will be performed to insure conformance with both the design specifications and the list of guaranteed properties prior to installation. The tests and frequencies are noted under Table 1.

3.0 Execution

A. Transportation, Handling and Inspection

Geocomposites shall be shipped in such a manner that they are protected from any damaging or deleterious conditions. Shipments will only be accepted by the Owner if delivered by flatbed trailer. All personnel shall handle the geocomposites in accordance with the Manufacturer's instructions and shall take all precautions necessary to prevent damaging the material at all times.

Upon delivery of the material to the site, the Contractor in the presence of the CQA Consultant shall conduct a visual inspection of the surface of all rolls for defects and damage. This inspection shall be conducted without unrolling rolls unless defects or damage are found or suspected. All flaws in the materials shall be immediately brought to the attention of the Manufacturer, Owner and the trucking firm (the latter will only be notified if the damage is believed to have occurred during transportation). Rolls that have severe flaws shall be rejected. Rolls that, in the opinion of the CQA Consultant, have minor repairable flaws shall be repaired in accordance with Sections 3.E.3 and 3.F.3. All flawed materials shall be stored in a separate location to insure that they are not inadvertently installed.

Any material damaged during shipment to the site shall be replaced by the Manufacturer at no cost to the Owner. Any material damaged by Contractor's failure to properly handle, store and/or protect the material shall be replaced by the Contractor at no cost to the Owner.

B. Storage

The Owner will provide a storage location for the material as close as possible to the area of deployment. Geocomposite rolls shall be stored in their original, unopened, wrapped covers in a clean, dry area. The rolls shall be unwrapped no more than one hour prior to installation and will not be exposed to ultraviolet light for more than 30 days.

Geocomposites shall also be stored in their original, unopened, wrapped covers such that they are protected from precipitation and ultraviolet light exposure and are free of dirt, dust or cuttings when they are installed. Geocomposite drainage materials shall be adequately pliable to allow for proper deployment.

D. Pre-Installation Inspection
Immediately prior to installation, the CQA Consultant shall verify that the geocomposites are free of dirt and dust. If the materials are judged to be dirty or dusty, they shall be cleaned by the Contractor prior to installation.

E. Installation of Geocomposites

1. The Installation Contractor shall comply with the following:

    a. On slopes, the geocomposites shall be secured at the top of the slope. The geocomposites shall then be rolled down the slope in such a manner as to continually keep the geocomposite sheet in tension to minimize folds and wrinkles.

    b. In the presence of wind, all geocomposites shall be weighted with sandbags or the equivalent. Such sandbags shall be installed during placement and shall remain until replaced with other material.

    c. The Contractor shall take all necessary precautions to prevent damage to underlying layers during placement of the geocomposite.

    d. During placement and joining of geocomposites, care shall be taken not to entrap stones, mud or dirt that could cause clogging of the drainage system and/or damage any adjacent geosynthetic materials.

    e. Geocomposites shall be cut with an approved cutter, i.e., hook blade. Care shall be taken to prevent damage to underlying materials.

2. Joining of Adjacent Geocomposites
As a minimum, the following requirements shall be met for joining of adjacent geocomposites.

    a. Adjacent rolls shall be overlapped such that the geotextile overlap is at least 4 inches and the geonet overlap is at least 4 inches. When rolls are joined end to end, the geotextile and geonet overlap shall be a minimum of 12 inches in a shingle placement fashion.

b. The geonet portion of adjacent geocomposite rolls shall be secured by tying as follows:

   1) Tying shall be achieved by plastic fasteners and shall be white or yellow for easy inspection. Metallic devices are not allowed.

   2) Unless otherwise authorized by the Certifying Engineer, tying shall be every 5 feet along the slope and every 12 inches across the slope, at the top of slope and into the anchor trench (where applicable).

c. The geotextile portion of the adjacent geocomposite rolls shall be seamed as follows:

   1) The bottom layers of geotextile shall be overlapped.

   2) On slopes steeper than 10 horizontal to 1 vertical, the top layers of geotextile shall be continuously sewn. The thread shall be a polymeric material with chemical resistance similar to the geotextile.

   3) On slopes shallower than 10 horizontal to 1 vertical, the top layers of geotextile can either be sewn as described above or thermally bonded.

3. Repairs
The damaged portion of the geocomposite will be inspected by the CQA Consultant. If the damaged area exceeds 3 feet by 3 feet, the roll will be cut, the damaged area removed, and a butt joint formed (where permitted) or the entire roll will be replaced. Unless otherwise approved by the Certifying Engineer, the geocomposite will be repaired as follows if the damaged area is smaller than 3 feet by 3 feet:

a. If the geonet is undamaged, a geotextile patch extending 12 inches beyond the edges of the damaged area shall be thermally bonded in place.

b. If the geonet is damaged, the damaged geonet shall be removed. A section of geonet shall be cut to replace the removed geonet. The geonet patch shall be tied to the existing geonet using plastic fasteners secured at 6-inch intervals, with a staggered double row formation (i.e., the first row of fasteners shall be spaced at 12-inch intervals; the second set of fasteners shall be offset a maximum of 12 inches deep and spaced at 12-inch intervals, staggered in relation to the first row). A geotextile patch extending 12 inches beyond the edges of the damaged area shall be thermally bonded in place.

G. Placement of Cover Materials
The Contractor shall place all cover materials in such a manner to ensure:

1. the geocomposite is not damaged

2. the installed geocomposite is not displaced by placement of overlying materials.

3. no excess tensile stresses develop in the geocomposite.

SECTION 3.0
GEOMEMBRANE ELECTRICAL LEAK LOCATION TESTING – EXPOSED GEOMEMBRANE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. This section includes a description of the leak location testing using the water puddle, water lance, arc testing or spark testing methods on the exposed geomembrane.

1.2 REFERENCES

A. ASTM D6747 – Standard Guide for Selection of Techniques for Electrical Leak Location of Leaks in Geomembranes

B. ASTM D7002 – Standard Practices for Locating Leak on Exposed Geomembranes Using the Water Puddle Method

C. ASTM D7703 – Standard Practice for Electrical Leak Location on Exposed Geomembranes Using the Water Lance Method

C. ASTM D7953 – Standard Practice for Electrical Leak Location on Exposed Geomembranes Using the Arc Testing Method

D. ASTM D7240 – Standard Practice for Electrical Leak Location using Geomembranes with an Insulating Layer in Intimate Contact with a Conductive Layer via Electrical Capacitance Technique (Conductive-Backed Geomembrane Spark Test)

1.3 SUBMITTALS

A. Prior to commencement of the electrical leak location survey, the electrical leak location consultant shall submit a Work Plan to the OWNER. The Electrical Leak Location Survey Work Plan shall include:

1. Qualifications of the proposed electrical leak location consultant including the square footage and number of projects of successful method application the electrical leak location consultant has performed of the proposed survey method.

2. Description of the proposed survey method, procedures, site preparations, estimated duration of survey, and quality control and field sensitivity testing procedures.

3. A Statement of Qualifications meeting the requirements of Section 2.1, Paragraph A.

4. A list of number and types of defects located for the three qualifying projects of the supervising leak location technician or documentation of the ELL operator certification for said technician.

B. If necessary, the electrical leak location consultant shall provide any permanent electrodes, wires, and installation instructions to the OWNER prior to the installation of the geomembrane.

C. The electrical leak location consultant shall report the general results of the survey to the OWNER during the daily progress of the field work.

D. Prior to the demobilization of the survey personnel from the site, the electrical leak location consultant shall submit a list of locations of the leaks detected to the OWNER, CONTRACTOR, and INSTALLER.

E. The electrical leak location consultant shall submit a letter report documenting the field work and results of the surveys to the OWNER within fourteen (14) days after completion of the field work.

PART 2 QUALIFICATIONS

2.1 ELECTRICAL LEAK LOCATION CONSULTANT AND SUPERVISOR QUALIFICATIONS

A. The electrical leak location consultant shall have experience in conducting electrical leak location surveys of the proposed method(s) including having tested a minimum of 2,500,000 square feet of each of the proposed survey method(s) on at least three projects. In addition, the leak location survey shall be supervised by a professional or technician with a minimum of 1,000,000 square feet of electrical leak location testing experience using the proposed method(s) on at least two projects. Alternatively, the field professional or technician may maintain current Level 3 ELL operator certification for the on-site supervisor in lieu of the minimum project and square footage requirement.

PART 3 EXECUTION

3.1 INFORMATION REQUIRED

A. The electrical leak location consultant shall be provided with drawings showing:

1. All layers constituting the lining system and details of all liner penetrations.

2. Plan of the survey area.

3. Peripheral details, including welds to adjacent lining systems.

4. Structures and obstructions above the liner.

5. Electrical equipment above the geomembrane.

3.2 PREPARATION AND SUPPORT

A. The CONTRACTOR is responsible for preparing the survey area for the electrical leak location surveys. The preparation consists of, but is not limited to, the following:

1. Install any necessary electrodes.

2. Provide the electrical leak location consultant the liner installation schedule.

3. Provide a water truck and driver with water as a continuous water source for the electrical leak location testing, if required by electrical leak location consultant.

4. Provide one laborer per electrical leak location equipment operator to assist with the electrical leak location testing, if required by electrical leak location consultant.

5. Remove and dispose of residual water, as needed.

6. Render the geomembrane clean and uncluttered. Remove all standing water from the surface of the geomembrane and provide electrical isolation at the perimeter of the survey area.

7. The survey area must have a low point where water is allowed to collect if the water-based survey methods are used. As the survey progresses, water is sprayed onto the liner. If the water exits the survey area and touches the surrounding ground, the survey cannot be performed. Often features such as rain flaps and berms are required to keep the water restrained to the survey area.

8. The subgrade must contain sufficient moisture to conduct the survey unless conductive-backed geomembrane is being tested. One percent by weight is usually adequate. It may be necessary to wet the subgrade if it has desiccated before deployment of the geomembrane; however, the surface tends to rehydrate after several days by wicking up moisture from the underlying soil. The CONTRACTOR may also wet the installed geomembrane with approximately 0.1 inches of water (2,700 gallons per acre) several days before the performance of the leak location survey. An equivalent recent rainfall would also suffice.

9. Calibration requires drilling holes in the geomembrane. The CONTRACTOR must be prepared to have these holes repaired.

3.3 SURVEY

A. The bare geomembrane survey shall be performed directly after the installation of the geomembrane.

B. The electrical leak location consultant is responsible for calibrating equipment utilized to achieve optimum data quality and sensitivity for the site conditions. This usually involves drilling some holes in the geomembrane which may be required to be repaired by the Contractor.

C. All testing shall be performed in accordance with current industry and ASTM standards.

D. The survey works best when the geomembrane is in intimate contact with the subgrade, unless conductive geomembrane is being tested. Wrinkles are an impediment to conducting a good survey. Defects on wrinkles may not be detected. Therefore, it is usually in the interest of the project to conduct the survey when the liner system is cool and flat, such as in the morning or during the night.

E. Working on slopes with smooth geomembrane can create safety hazards with slippery surfaces and may require additional harnessing and slower production rates.

F. Leak locations shall be logged, visibly marked, and reported for repair.

G. The electrical leak location consultant shall report the general results of the survey to the CQA MONITOR, OWNER and CONTRACTOR during the daily progress of the field work.

H. Prior to the demobilization of the survey personnel from the site, the electrical leak location consultant shall submit a list of locations of the leaks detected to the CQA MONITOR, OWNER and CONTRACTOR

I. The electrical leak location consultant shall submit a letter report documenting the field work and results of the surveys to the OWNER within fourteen (14) days after completion of the field work.

END OF SECTION

TABLE 1
SUMMARY OF QA/QC TESTING REQUIREMENTS

Item/Description	Inspection or Required Tests	Location of Sample/Test	Frequency	Standard Values or Acceptance Criteria	Corrective Action
Geomembrane Dual-sided textured 60 mil HDPE					
QA Conformance Test and Manuf QC Test (MQC)	Thickness (ASTM D 5994)	Roll storage area or factory	Once per 150,000 s.f. (QA) Current GRI-GM 13 (MQC)	60 mil (nominal) 57 mil min avg 54 mil (min 8 of 10) 51 mil lowest individual	select alternate material or manufacturer if necessary
QA Conformance Test and Manuf QC Test (MQC)	Sheet Density (ASTM D1505 or D792)	Roll storage area or factory	Once per 150,000 s.f. (QA) Current GRI-GM13 (MQC)	≥ 0.94 g/cc	Select alternate material or manufacturer if necessary
QA Conformance Test and Manuf QC Test (MQC)	Carbon black content (ASTM D 1603 or D4218)	Roll storage area or factory	Once per 150,000 s.f. (QA) Current GRI-GM13 (MQC)	2% - 3%	select alternate material or manufacturer if necessary
QA Conformance Test and Manuf QC Test (MQC)	Carbon black dispersion (ASTM D5596)	Roll storage area or factory	Once per 150,000 s.f. (QA) Current GRI-GM13 (MQC)	9 of 10 = Cat. 1 or 2; no more than 1 of 10 = Cat. 3	select alternate material or manufacturer if necessary
QA Conformance Test and Manuf QC Test (MQC)	Elongation @ yield/yield strength and Elongation at break/break strength (ASTM D 6693)	Roll storage area or factory	Once per 150,000 s.f. (QA) Current GRI-GM13 (MQC)	Yield Strength ≥ 126 ppi Elong at Yield ≥ 12% Break Strength ≥ 90 ppi Elong at Break ≥ 100%	select alternate material or manufacturer if necessary
QA Conformance Test and Manuf QC Test (MQC)	Asperity Height ((ASTM D7466)	Roll storage area or factory	Once per 150,000 s.f. (QA) Current GRI-GM13 (MQC)	18 mils	select alternate material or manufacturer if necessary

TABLE 1
SUMMARY OF QA/QC TESTING REQUIREMENTS

Item/Description	Inspection or Required Tests	Location of Sample/Test	Frequency	Standard Values or Acceptance Criteria	Corrective Action
QA Conformance Test and Manuf QC Test (MQC)	Tear Resistance (ASTM D1004 Die C)	Roll storage area or factory	Once per 150,000 s.f. (QA) Current GRI-GM13 (MQC)	45 lbs	select alternate material or manufacturer if necessary
QA Conformance Test and Manuf QC Test (MQC)	Puncture Resistance (ASTM D4833)	Roll storage area or factory	Once per 150,000 s.f. (QA) Current GRI-GM13 (MQC)	90 lbs	select alternate material or manufacturer if necessary
Manufacturer Quality Control Test	Oxidative Induction Time (ASTM D3895)	Roll storage area or factory	Current GRI GM13	>100 minutes	select alternate material or manufacturer if necessary
Manufacturer Quality Control Test	Oven Aging with HP OIT (ASTM D5885)	Roll storage area or factory	Current GRI GM13	80% retained after 90 days	select alternate material or manufacturer if necessary

TABLE 1
SUMMARY OF QA/QC TESTING REQUIREMENTS

Item/Description	Inspection or Required Tests	Location of Sample/Test	Frequency	Standard Values or Acceptance Criteria	Corrective Action
Manufacturer Quality Control Test	UV Resistance (ASTM D5885)	Roll storage area or factory	Current GRI GM13	50% retained after 1600 hour	select alternate material or manufacturer if necessary
Manufacturer Quality Control Test	Stress Crack Resistance (ASTM D5397)	Roll storage area or factory	Current GRI GM13	500 hours	select alternate material or manufacturer if necessary
Geomembrane Resin					
Manufacturer Quality Control Test	Density (ASTM D1505/D792)	Roll storage area or factory	Each Resin Batch	0.932 g/cc	select alternate material or manufacturer if necessary
Manufacturer Quality Control Test	Melt Flow Index (ASTM D1238)	Roll storage area or factory	Each Resin Batch	1.0 g/10 minutes, max	select alternate material or manufacturer if necessary
Field Testing	Electrical Leak Location Survey	Entire lined area	After installation	Holes detected to 1 mm diameter size	Refer to QA/QC plan.
Field Testing	Nondestructive seam testing	All seams	Continuous	Vacuum testing: no air leaks permitted. Pressure testing: 3 psi drop within 5 min.	Refer to QA/QC plan.
	Trial Seam Field Testing (Peel Using Calibrated Field Tensiometer) ASTM D 6392	Trial Seam	Beginning of each day, when an apparatus is started, when operators change, an apparatus is restarted and at the beginning of each seaming period Perform peel testing on 3 specimens	Seam peel strength: 91 ppi for fusion and 78 ppi for extrusion welds; Peel incursion ≤ 25%	Refer to QA/QC Plan.
	Field destructive seam testing (Peel ASTM D 6392)	Placed FML (seams)	1 test per 500 feet of seam Perform peel on 3 specimens (both sides of fusion welds)	Seam Peel Strength: 91 ppi for fusion and 78 ppi for extrusion welds; Peel incursion ≤ 25%	Refer to QA/QC Plan

TABLE 1
SUMMARY OF QA/QC TESTING REQUIREMENTS

Item/Description	Inspection or Required Tests	Location of Sample/Test	Frequency	Standard Values or Acceptance Criteria	Corrective Action
	Laboratory destructive seam testing (Peel ASTM D 6392)	Placed FML (seams)	1 test per 500 feet of seam Perform peel on 5 specimens (both sides of fusion welds)	Fusion peel strength: 4 of 5 results ≥ 91 ppi with 5th result≥ 73 ppi; peel incursion ≤ 25% Extrusion peel strength: 4 of 5 results ≥ 78 ppi with 5th result≥ 63 ppi; peel incursion ≤ 25% See Note 1 for additional requirements for locus of break patterns	Refer to QA/QC plan
Geocomposite Leak Detection/Witness Layer					
QA Conformance Test and Manuf QC Test (MQC)	Geonet Component - Thickness (ASTM D 5199)	Roll storage area or factory	250,000 s.f. or one per lot (QA) Manufacturer Standard Frequency (MQC)	160 mil (min)	Select alternate manufacturer or material, if necessary.
QA Conformance Test and Manuf QC Test (MQC)	Geonet Component Carbon Black Content (ASTM D1603 or D4218)	Roll storage area or factory	250,000 s.f. or one per lot (QA) Manufacturer Standard Frequency (MQC)	2.0 – 3.0%	Select alternate manufacturer or material, if necessary.
QA Conformance Test and Manuf QC Test (MQC)	Geonet Component Density (ASTM D1505)	Roll storage area or factory	1,000,000 and at least one per lot (QA) Manufacturer Standard Frequency (MQC)	0.94 g/cc	Select alternate manufacturer or material if necessary
QA Conformance Test and Manuf QC Test (MQC)	Geonet Component Tensile Strength (ASTM D5035)	Roll Storage Area or factory	250,000 s.f. or one per lot (QA) Manufacturer Standard Frequency (MQC)	30 ppi	Select alternate manufacturer or material, if necessary.
Manuf QC Test (MQC)	Geocomposite Transmissivity (ASTM D4716)	Roll Storage Area or factory	Manufacturer Standard Frequency (MQC)	0.4 gpm/ft (normal load = 1,000 psf, gradient = 0.10)	Select alternate manufacturer or material, if necessary.
QA Conformance Test and Manuf QC Test (MQC)	Geocomposite Ply adhesion (ASTM D7005 or GRI GC-7)	Roll storage area or factory	250,000 s.f. or one per lot (QA) Manufacturer Standard Frequency (MQC)	1.0 ppi avg	Select alternate manufacturer or material, if necessary.

TABLE 1
SUMMARY OF QA/QC TESTING REQUIREMENTS

Item/Description	Inspection or Required Tests	Location of Sample/Test	Frequency	Standard Values or Acceptance Criteria	Corrective Action
QA Conformance Test and Manuf QC Test (MQC)	Geotextile Component Mass per unit area (ASTM D 5261)	Roll storage area or factory	250,000 s.f. or one per lot (QA) Manufacturer Standard Frequency (MQC)	6 oz/sy (min)	Select alternate manufacturer or material, if necessary.
QA Conformance Test and Manuf QC Test (MQC)	Geotextile Component Grab Strength (ASTM D 4632)	Roll storage area or factory	250,000 s.f. or one per lot (QA) Manufacturer Standard Frequency (MQC)	Tensile Strength > 160 lbs Grab Elongation > 50%	Select alternate manufacturer or material, if necessary.
QA Conformance Test and Manuf QC Test (MQC)	Geotextile Component CBR Puncture Resistance (ASTM D6241)	Roll storage area or factory	250,000 s.f. and one per lot (QA) Manufacturer Standard Frequency (MQC)	> 435 lbs	Select alternate manufacturer or material, if necessary.
QA Conformance Test and Manuf QC Test (MQC)	Geotextile Component Hydraulic Properties (ASTM D4491) Flow Rate	Roll storage area or factory	250,000 s.f. or one per lot (QA) Manufacturer Standard Frequency (MQC)	Flow Rate: 110 gpm/sf	Select alternate manufacturer or material, if necessary.
QA Conformance Test and Manuf QC Test (MQC)	Geotextile Component Apparent Opening Size (ASTM D 4751)	Roll storage area or factory	250,000 s.f. or one per lot (QA) Manufacturer Standard Frequency (MQC)	70 - 140	Select alternate manufacturer or material, if necessary.

Notes:

1. Regarding the locus-of-break patterns of the different seaming methods in shear and peel, the following are unacceptable break codes per their description in ASTM D6392 (in this regard, SIP is an acceptable break code):

   Fusion seams: AD and AD-Brk > 25%
   Extrusion seams: AD1, AD2, AD-WLD (unless strength is achieved)

APPENDIX O
Operation & Maintenance Plans

OPERATION AND MAINTENANCE
POND AGITATION

As part of operations and in advance of land application of nutrients, the owner/operator may want to agitate the ponds to resuspend settled solids.

The owner/operator is required to prepare and implement a program to agitate the ponds in a manner that will not damage the liner.

The equipment currently planned to be used to agitate the pond is a Nuhn Lagoon Crawler – Amphibious Agitation and Pump Boat, or equal.

The equipment will be controlled by GPS and will have optional equipment specification and safeguards included for use in synthetic lined ponds. The GPS control system will be programmed to vertically and horizontally stay back from the liner a distance at least twice the accuracy of the GPS. As a contingency protection, the agitator will be equipped with inflatable cushions in the event of accidental contact with the liner.

Items to include in the agitation program are as follows:

1. The sludge removal will be accomplished via a pump/agitator system that is on the lagoon crawler and connected to a hose that delivers the solids to be land applied or further processed. The suction line will be below the boat and extend toward the pond floor, also manufactured to prevent damage if accidental contact is made with the liner.

2. Concrete ramps and pad have been included in the design of the ponds to allow the operator access for its agitation equipment.

3. Any agitation will be constantly supervised and done in strict accordance with the equipment manufacturer's operating requirements.

4. Extreme care will be taken to ensure the equipment does not damage the geomembrane layer.

Special Considerations: _

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OPERATION AND MAINTENANCE
FENCING

The owner/operator is responsible for establishing and implementing this plan. Items to inspect and maintain include, but are not limited to the following:

- Routine inspection of fences should be part of an on-going management program.
- Inspect fences after major storm events.
- Maintenance and repairs will be performed as needed to facilitate the intended operation of the installed fence.
- Remove fallen tree limbs, trash, and debris from fence and maintain proper tension on the fence wires.
- Vegetative control can be achieved by herbicide application per manufacturer's recommendations.
- Wire that is overstretched may break and recoil. Eye and hand protection should be worn when repairing fence.
- Inspect and maintain gates. Replace missing chains, hinges, and movable parts as needed.

Special Considerations: ____

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OPERATION AND MAINTENANCE
GRASSED WATERWAY

The waterway capacity and vegetative cover shall be maintained. Items to inspect and maintain include, but are not limited to the following:

- Maintain waterway capacity and outlet elevations especially if high sediment yielding areas are in the drainage area above the waterway. Establish necessary clean-out requirements.
- Spoil grading after construction should be accomplished promptly, fully, uniformly, without gaps, and with attention to tile trenches so that the practice functions as it was intended to function.
- Inspect waterway periodically, after significant storms and at a minimum, inspect annually for damage or deleterious effects such as sedimentation or vegetation beyond what is considered normal and healthy.
- If an erosion control blanket is installed, ensure that it is in-tact periodically and particularly after storms before vegetation is fully established.
- Do not graze waterway during establishment of vegetation and when soil conditions are wet.
- Protect waterway from damage by farm equipment and vehicles. Do not use waterway as a road and practice care when crossing to prevent tillage marks or wheel tracks.
- Avoid farming operations along the waterway, which would hinder water entry. Fill and seed all rills or small gullies that occur in the waterway.
- Maintain effective erosion control on the contributing watershed to prevent sedimentation and the resulting loss of capacity.
- Reestablish vegetative cover immediately where scour erosion has removed established seeding.
- Do not spray the waterway with herbicides intended for adjacent crops. Avoid crossing waterways during spray operations, and then cross only if the spray equipment is completely shut off.
- Fertilize waterways the first spring after seeding and thereafter as necessary to maintain a vigorous stand of grass.
- Mow waterways regularly to maintain a healthy, vigorous sod.
- Do not burn or overgraze the waterway.
- Keep trees and brush from growing in the waterway. Regular mowing will control woody vegetation.
- Where rock checks, chutes or outlets are installed, replace any dislodged rock and fill back to grade if displacement or settlement occurs.
- Promptly repair all broken subsurface drain lines adjacent to or in the waterway and repair or replace any other damaged components as necessary. Ensure that tile outlets are open following storm events.

- Each inlet for underground outlets must be kept clean and sediment buildup redistributed so that the inlet is at the lowest point. Inlets damaged by farm machinery must be replaced or repaired immediately.
- Redistribute sediment as necessary to maintain the capacity of the waterway.
- Vegetation shall be maintained and trees and brush controlled by hand, chemical and/or mechanical means. The waterway shall be kept free of weeds, shrubs, trees and burrowing animals.
- Keep machinery away from steep sloped ridges.
- Keep equipment operators informed of all potential hazards.

Other Considerations: ____

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OPERATION AND MAINTENANCE
LEAK DETECTION SUMPS

The owner/operatpr is responsible for establishing and implementing this plan. Items to inspect and maintain include, but are not limited to the following:

- Both the primary and secondary sumps shall be monitored in accordance with the approved Monitoring, Detection and Contingency Program.
- Pumps will be installed if liquid is observed in the sumps.
- Liquid collected from the primary leak detection sump will be pumped into the storage pond.
- Liquid collected from the secondary leak detection, dewatering and venting sump will be tested, and if there is no sign of contamination, it can be pumped to the surface swale. If contaminated, it will be managed as approved by EPA.

Special Considerations: ____

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OPERATION AND MAINTENANCE
PIPELINE

The owner/operator is responsible to establish and implement an inspection and maintenance program. Items to inspect and maintain include, but are not limited to, the following:

1. Inspect after significant storm events and at least annually to identify repair and maintenance needs.
2. Inspect the entire length of the pipeline system for signs of erosion and pipe settlement. This is particularly important for the first two or three years after installation.
3. Open/close valves in a manner that prevents excessive water hammer.
4. Fill at the specified rate requirements to remove entrapped air and prevent water hammer surges. Appurtenances, such as a flow meter or other means (e.g., number of turns of a gate valve) should be used to determine the rate of flow into the pipeline. If filling at a slow flow rate is not possible, the system shall be open to the atmosphere (outlets open) prior to pressurizing.
5. Inspect and test pipeline, valves, pressure regulators, pumps, switches and other appurtenances.
6. Check and assure proper operation of any backflow protection devices.
7. Check for debris, minerals, algae and other materials which may restrict system flow.
8. Drain and/or provide for cold weather operation of the system.
9. Promptly repair or replace damaged or inoperable components.
10. Perform routine maintenance of all mechanical components in accordance with the manufacturer's recommendations.
11. Prior to retrofitting any electrically powered irrigation equipment, electrical service must be disconnected and the absence of stray electrical current verified.
12. Protect the components from damage by farm equipment and livestock.
13. Maintain erosion protection at outlets.
14. Repair any settlement or erosion that occurs around the pipe with soil and reseed as needed. If this problem persists, evaluate the pipe for leakage and erosion of the fill material into or along the pipe.

OPERATION AND MAINTENANCE
POND SEALING OR LINING-FLEXIBLE MEMBRANE LINER

The owner/operator is responsible for establishing, implementing, and updating this plan.

1. Items to inspect and maintain during the design life of the ponds include, but are not limited to the following:
    - Liquid level markers
    - Sump risers, locking caps and protective ballards
    - Concrete ramps and agitation pads
    - Anchor trench backfill
    - Venting covers
    - Gravity transfer pipe between ponds
    - Ballooning of the liner indicating presence of gas beneath liner

2. Any repair or maintenance item will be promptly done and recorded in the facility operating record.

Special Considerations: ____

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OPERATION AND MAINTENANCE
PUMPING PLANT

The owner/operator is responsible for establishing and implementing this plan. Items to inspect and maintain include, but are not limited to the following:

This pumping plant is designed to pump_____ gallons per minute (GPM) against _______ feet of total dynamic head (TDH). The pump is designed to operate on a cycle time of_____cycles per hour.

1. Inspect the pump, power units, switches, controls, and pressure tank after significant storm events and at least annually to identify repair and maintenance needs.
2. Remove sediment from the sump/storage area to maintain the design storage volume and to ensure proper pump operation.
3. Proper start-up procedures for the operation of the pumping plant shall be in accordance with the manufacturer's recommendations.
4. When applicable, the power unit should be frequently checked for lubricant leaks and repaired as needed.
5. Routinely test and inspect all automation components of the pumping plant to assure they are functioning as designed.
6. Inspect and maintain secondary containment facilities, if applicable.
7. Periodic inspection of all safety features to ensure they are in place and functional.
8. Prior to retrofitting any electrically powered equipment, electrical service must be disconnected and the absence of stray electrical current verified.

Special Considerations: ____

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OPERATION AND MAINTENANCE
SEDIMENT BASIN

The owner/operator is responsible to establish and implement an inspection and maintenance program. Items to inspect and maintain include, but are not limited to the following:

1. Inspect after significant storm events and at least annually to identify repair and maintenance needs.
2. Clean frequently to avoid debris accumulation.
3. Control vehicular traffic, as appropriate.
4. Check areas where unusual settlement has occurred. Determine the cause of settlement and fill or otherwise repair, as appropriate.
5. Promptly repair and re-vegetate bare spots and eroded areas. Apply fertilizer, lime and mulch as appropriate to maintain vigorous vegetation.
6. All complementary appurtenances, e.g. pipes, fences, gates, etc., should be inspected to ensure they are functional, structurally sound and are not a safety hazard. Repair as needed.
7. Spray or chop out undesirable vegetation periodically to prevent large, woody-stemmed weeds and water plants such as cattails or willow trees from growing.
8. Promptly remove any burrowing rodents that may invade area of embankment.
9. Remove sediment from basin when volume of sediment storage becomes depleted.

Special Considerations: ____

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OPERATION AND MAINTENANCE
SUBSURFACE DRAIN

The owner/operator is responsible for establishing and implementing this plan. Items to inspect and maintain during the life of the drains are:

- Settling of fill in the subsurface drain installation trench may occur. Addition of compacted fill material may be needed.
- Remove woody vegetation such as willows, cotton wood, elm, and soft maple trees from the vicinity of subsurface drains.
- Broken subsurface drains are evident from wet areas, holes, or seeps that develop. Repair all broken subsurface drains immediately.
- Inspect and maintain subsurface drain outlets, including animal guards.
- Install a rock riprap splash pad consisting of ODOT Class C rock riprap if erosion occurs at the subsurface drain outlet.
- Check surface inlets, junction boxes, manholes, and other appurtenances. Repair as needed to maintain their intended function.
- Remove woody vegetation within 5 feet of a subsurface drain outlet. The outlet must be fire resistant if burning is used to remove vegetation. Herbicide applications to remove vegetation must be applied according to manufacturer's recommendations.
- If iron ochre and manganese dioxide precipitates plug the lines, a cleanout structure must be installed to provide access for cleaning equipment.

Special considerations: ______________________________

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OPERATION AND MAINTENANCE
UNDERGROUND OUTLET

The owner/operator is responsible for establishing and implementing this plan. Items to inspect and maintain include, but are not limited to the following:

1. Inspect after significant storm events and at least annually to identify repair and maintenance needs.
2. Keep inlets, trash guards, and collection boxes and structures clean and free of materials that can reduce the flow.
3. Repair leaks and broken or crushed pipe to insure proper functioning.
4. Repair any settlement or erosion that occurs around the pipe with soil and reseed as needed. If this problem persists, evaluate the pipe for leakage and erosion of the fill material into or along the pipe.
5. Keep adequate backfill over the conduit.
6. Check outlet pipe and animal guard to ensure proper functioning.
7. Maintain erosion protection at outlets; repair any eroded areas at the outlet.
8. Promptly repair or replace damaged or inoperable components.
9. Protect the components from damage by farm equipment and livestock. Avoid damage to riser inlets by farm equipment. Mark risers so they are visible to prevent damage by equipment.

Special Considerations: _

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OPERATION AND MAINTENANCE
WASTE STORAGE FACILITY– EARTHEN STRUCTURES

Inspections and maintenance are required to achieve the intended function, benefits, and life of the structure. The owner/operator is responsible for establishing and implementing an inspection and maintenance program consistent with safety requirements and in compliance with all local, state, and Federal laws and regulations.

Items to inspect and maintain during the life of the ponds include, but are not limited to the following:

1. Inspect after significant storm events and at least annually to identify repair and maintenance needs. Monitor for seepage, leachate and ensure any outlets are free and flowing clean. Check foundation drain outlets for evidence of leakage, discolored water, manure solids, odor, flow etc.
2. Each time the structure is emptied conduct a thorough inspection of liners, walls, sumps, pits, ramps, floors and other structures for damage, separations and/or cracks and other defects which may indicate potential failure. Defects should be repaired immediately. Cracks in concrete should be treated with Thoroseal or equivalent sealant. Deteriorated concrete should have loose concrete chipped out and repaired with epoxy cement. Inspect all pipes, pumps, valves, etc. for function and soundness. Inspect fasteners for rust and corrosion. Make repairs as needed.
3. Inspect haul roads and approaches to and from the storage facility frequently to determine the need for stone or other stabilizing materials. Do not operate heavy equipment on unprotected liners, or within 10 –feet of tank/concrete walls unless structures are designed for the surcharge loading from heavy equipment. Use caution to avoid damaging liners, concrete or other structures.
4. All appurtenances – pipes, pumps, valves, gates, etc. should be inspected a minimum of twice a year. Inspect for functional and structural soundness. Repair/replace as necessary.
5. Earth embankments/fills should be mowed 2 times per year. A good vegetative cover should be maintained on earth embankments/fills. If the vegetative cover of embankments or other operational areas is damaged the areas should be revegetated as soon as possible.
6. Check frequently for burrowing animals. When found, remove the burrowing animals, replace fill/embankment materials and reseed.
7. Maintain all required fences and gates around the waste storage facility. All fences and gates shall be inspected for damage at least twice a year. Damaged fences and gates should be repaired or replaced as soon as possible. When installed, inspect safety stations twice a year. Replace safety items such as safety chains, barriers, ropes, floatation devices, swim rings, et cetera, as needed.
8. Ensure all waste storage warning signs are posted and clearly visible.
9. Exercise caution near the surface of manure storage ponds due to the potential presence of hazardous or explosive gases. Install and maintain safety stops, and gates at push-off and load-out areas to prevent accidental entry of machinery. Provide and maintain warning signs, ladders, ropes, flotation devices, bars, and rails as appropriate to ensure humans and livestock safety. Provide ventilation systems and warning signs near pumping ports for covered waste-holding structures to avoid inhalation of poisonous gases, asphyxiation, or explosion.

10. Manage the facility to abate odors to the extent practical by minimizing handling and disturbance of waste, during operation and unloading of the structure.

Other Considerations: ____

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APPENDIX P
Construction Specifications

NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

FENCE

(Ft.)

CODE 382

DEFINITION

A constructed barrier to animals or people.

PURPOSE

This practice facilitates the accomplishment of conservation objectives by providing a means to control movement of animals and people, including vehicles.

CONDITIONS WHERE PRACTICE APPLIES

This practice may be applied on any area where management of animal or human movement is needed.

CRITERIA

General Criteria Applicable to All Purposes

Fencing materials, type and design of fence installed shall be of a high quality and durability. The type and design of fence installed will meet the management objectives and site challenges. Based on objectives, fences may be permanent, portable, or temporary.

Fences shall be positioned to facilitate management requirements. Ingress/egress features such as gates and cattle guards shall be planned. The fence design and installation should have the life expectancy appropriate for management objectives and shall follow all federal, state and local laws and regulations.

Height, size, spacing and type of materials used will provide the desired control, life expectancy, and management of animals and people of concern.

Fences shall be designed, located, and installed to meet appropriate local wildlife and land management needs and requirements.

CONSIDERATIONS

The fence design and location should consider: topography, soil properties, livestock management, animal safety, livestock trailing, access to water facilities, development of potential grazing systems, human access and safety, landscape aesthetics, erosion problems, soil moisture conditions, flooding potential, stream crossings, and durability of materials. When appropriate, natural barriers should be utilized instead of fencing.

Where applicable, cleared rights-of-way may be established which would facilitate fence construction and maintenance. Avoid clearing of vegetation during the nesting season for migratory birds.

Where applicable, fences should be marked to enhance visibility as a safety measure for animals or people.

Fences across gullies, canyons or streams may require special bracing, designs or approaches.

Fence design and location should consider ease of access for construction, repair and maintenance.

Fence construction requiring the removal of existing fencing materials should provide for proper disposal to prevent harm to animals, people and equipment.

PLANS AND SPECIFICATIONS

Plans and specifications are to be prepared for all fence types, installations and specific sites. Requirements for applying the practice to achieve all of its intended purposes shall be described.

OPERATION AND MAINTENANCE

Regular inspection of fences should be part of an ongoing maintenance program to ensure continuing proper function of the fence. Operation and Maintenance (O&M) includes the following:

A schedule for regular inspections and after storms and other disturbance events.

Maintenance activities:

- Repair or replacement of loose or broken material, gates and other forms of ingress/egress
- Removal of trees/limbs
- Replacement of water gaps as necessary
- Repair of eroded areas as necessary
- Repair or replacement of markers or other safety and control features as required.

REFERENCES

Bell, H.M. 1973. Rangeland management for livestock production. University of Oklahoma Press.

Heady, H.F. and R.D. Child. 1994. Rangeland ecology and management. Western Press.

Holechek, J.L., R.D. Pieper, and C.H. Herbel. 2001. Range management: principles and practices. Prentice Hall.

Paige, C. 2012. A Landowner's Guide to Fences and Wildlife: Practical Tips to Make Your Fences Wildlife Friendly. Wyoming Land Trust, Pinedale, WY.

Stoddard, L.A., A.D. Smith, and T.W. Box. 1975. Range management. McGraw-Hill Book Company.

United States Department of Interior, Bureau of Land Management and United States Department of Agriculture, Forest Service. 1988. Fences. Missoula Technology and Development Center.

United States Department of Agriculture, Natural Resources Conservation Service. 2005. Electric fencing for serious graziers. Columbia, Mo.

United States Department of Agriculture, Natural Resources Conservation Service. 2003. National range and pasture handbook, revision 1. Washington, DC.

Vallentine, J.F. 1971. Range development and improvement. Brigham Young University Press.

NATURAL RESOURCES CONSERVATION SERVICE
CONSTRUCTION SPECIFICATION

FENCE (Feet)

CODE 382
WOVEN WIRE FENCE (WWF)

This construction specification is for Standard Woven Wire Fence (SWWF), High Tensile Woven Wire Fence (HTWWF), and Specialty High Tensile Woven Wire Fence (SHTWWF).

Standard woven wire fence (SWWF) shall consist of low carbon steel woven wire with a single or multiple strands of either barb wire or electric high tensile smooth wire with a maximum spacing of 4 inches starting at the top of the woven wire no closer then 2 inches to the top of the wooden post or within 1-2 inches of the steel post.

High tensile woven wire fence (HTWWF) shall consist of fixed knot or hinge joint high tensile woven wire with a single or multi strand(s) of electric high tensile wire with a maximum spacing 4 inches or high tensile barb wire place above the top of the woven wire. The top wire shall be no closer then 2 inches to the top of the wooden post or within 1-2 inches of the steel post.

Specialty high tensile woven wire fence (SHTWWF) shall consist of 48 to 72 inch high woven wire with a single strand or multi strands of electric high tensile wire or high tensile barb with a maximum spacing 4 inches above the top of the woven wire. The top wire shall be no closer then 2 inches to the top of the wooden post or within 1-2 inches of the steel post. Posts needed will depend on fence height.

These types of fence can be for all animals or people, including deer, game, livestock, and exotic animals (elk, bison, llama, and ostrich).

The minimum total height of SWWF/HTWWF for cattle, goats, horses, and people is 48 inches; sheep 42 inches; and for swine 36 inches. SHTWWF shall be 49 to 72 inches high. Goats, sheep, and horses needs smaller stay wire spacing (3 inches maximum preferred) between wires for protection of head and hoof entrapment. May use graduated woven wire fence that meets the animals species and protection.

1. Materials

   A. Wire

      SWWF will be made from low carbon steel wire with class 1 galvanizing. The woven wire shall have the top and bottom strands 10 gauge or heavier. The intermediate and stay wires shall be 14.5 gauge or heavier. The stay wires shall be spaced a maximum of 12 inches apart. Select woven wire fence for animal species.

      The barb wire will consist of 2 twisted strands of 12.5 gauge steel wire with class 1 galvanizing or 2 twisted strands of 15.5 or 14 gauge high tensile wire with class 3 galvanizing. Barbs shall be 4 point on 5 inch centers.

      HTWWF will be made from high tensile steel wire with class 3 galvanizing. The woven wire shall have the top and bottom strands be 12.5 gauge or heavier. The intermediate and stay wires shall be 14.5 gauge or heavier. The stay wires shall be spaced a maximum of 12 inches apart. Select woven wire fence for animal species. Do not stretch HTWWF with temperatures under 50 degrees.

      The barb wire will be new and consist of 2 twisted strands of 12.5 gauge steel wire with class 1 galvanizing or 2 twisted strands of 15.5 or 14 gauge high tensile wire with class 3 galvanizing. The barbs shall be 4 point on 5 inch centers. **(Do not electric charge barb wire.)**

      SHTWWF will be made from high tensile smooth steel wire with class 3 galvanizing. The woven wire shall be 48 to 72 inches high with the top and bottom strands 12.5 gauge or heavier. The intermediate and stay wires shall be 14.5 gauge or heavier. The stay wires shall be spaced a maximum of 12 inches apart. Do not stretch SHTWWF with temperatures under 50 degrees.

The high tensile electric wire will be smooth and meet or exceed the following:

Tensile Strength- 170,000 PSI (minimum)
Galvanizing – Class 3
Gauge – 12.5
Breaking Strength – 1,300 lbs. (minimum)

B. Fasteners:

(1) Staples shall be of 9 gauge, class 3, galvanized steel or heavier with a minimum length of1¾ inches for softwoods and a minimum length of 1 inch for close-grained hardwoods.

(2) Manufacturer's clips or 14 gauge, class 3, galvanized wire may be used to fasten wires to steel posts.

2. Posts.

A. Wood.

All wooden posts and brace members (except red cedar, osage orange, or black locust) shall be treated with a minimum of 0.40 lbs/cubic foot of chromated copper arsenate (CCA) Type A, B, or C or ammoniated copper quat (ACQ) preservative by a method to ensure that complete penetration of the sapwood is obtained or have a 20-year warranty. All bark shall be removed from the red cedar, osage orange, and black locust. At least half the diameter of red cedar shall be heartwood. Quality of treated wood shall provide sufficient strength and last for the expected life of the fence. **(NOTE: Do Not Cut or Notch Treated Post)**

All Corners, ends, pull, and gate assembly posts for HTWWF and SWWF shall be wooden with a 6-7 inch diameter or larger at smallest circumference. Assembly brace posts shall be a minimum of 8 feet long for single H-brace (10 feet H-Brace cross member Preferred).

Assemblies post for SHTWWF the length will be dependent upon the height of the fence.

Bend assembly posts shall have a 5-6 inch diameter or larger at the smallest circumference and will be a minimum of 8 feet long.

Wooden line posts shall have a 4-5 inch diameter or larger at the smallest circumference (4 inch for osage orange). Wood line posts shall be a minimum length of 7.5 feet (7 foot posts can be used for fences 42 inches and below). Specialty fences must have a minimum of 4-5 inch diameter or larger at the smallest circumference of the post.

B. Plastic

Plastic line posts for WWF and HTWWF shall be a minimum of 4 inches in diameter, able to accept and hold staples, or insulated for electric fencing, and be durable for the life of the fence. Plastic line posts shall be solid and be a minimum length of 7 feet.

Plastic line posts for SHTWWF woven wire fence shall have a minimum diameter 4 inches.

C. Steel.

Steel line posts shall have the standard "T" section, nominal dimensions of 1 3/8" x 1 3/8" x 1/8" with anchor plate. The post shall weigh at least 1.25 pounds per foot of length and be painted with a weather resistant paint. The post shall be studded to aid in wire attachment. Steel line posts shall be a minimum length of 7 feet.

3. Construction.

A. Use of Trees.

Live trees used for corner, bracing, and line posts shall have a diameter breast height (DBH) equal to or greater than those prescribed for normal wooden posts. Some alignment variation shall be allowed, but caution should be taken to minimize offsets and prevent excess fencing needs. Wire or insulators will not be fastened directly to trees. A board or boards will be placed on the tree to keep the wire from contacting the bark. Wire shall not be wrapped around the tree. A CCA treated 2" x 6" fiberglass strip, plastic strip, or an untreated red or white oak board with a minimum size of 1" x 4" must be securely fastened to the tree with at least three 40 d. pole barn nails. The board must be long enough to accommodate the wire. The fence will be fastened to the board with staples.

B. Corner, End, Pull, and Gate Brace Assemblies.

One of the following assemblies for all corners, ends, pulls, and gates shall be used:

(1) H-brace assembly posts shall be set or driven 3 feet below the ground line using 8 foot posts, a single H-Brace assembly will be used.

(2) Deep soils and sandy soils shall have post driven 4 feet or deeper below the ground line, and will use a single H-Brace with 9 foot assembly posts.

(Post should be 5 feet above ground. NOTE: Do Not Cut or Notch Treated Post.)

Brace assemblies are required at all corners, gates, pulls, and ends. All braces must be set according to the H-Brace Standards. **(NOTE: Do Not Cut or Notch Treated Post)**

The horizontal cross member shall be a 4-5 inch in diameter or larger at the smallest circumference and a minimum of 8 feet in length installed with 10" and 4" galvanized pins (H-Brace Standard) placed 2 feet from top of post or 3 feet from top of the ground to the galvanized pins for SWWF/HTWWF. (SHTWWF H-Brace will be determent on fence heigth.)

SHTWWF/HTWWF shall use tension wire composed of a double loop of a 12.5 gauge high tensile smooth wire with an inline strainer. SWWF shall use 2 complete loops of number 9 gauge smooth wire with a twist stick or HTWWF standard. One end of the tension wire shall be at the height of the horizontal cross brace member galvanized pin and the other end of the tension wire shall be 1-2 inches above the ground line on the other post. Do not staple the tension wire, use a staple assembly.

A corner assembly or a bend assembly shall be used when the horizontal alignment changes more than 15 degrees and a pull assembly when vertical alignment changes more than 15 degrees. A bend assembly will be used only when it will not affect the integrity of the fence. Post spacing for a bend assembly can be determined by placing 3 stakes, each spaced 14 feet apart, along the fence line. A string is then stretched between the first and third stake. A measurement is then taken from the second stake and the string. The spacing of the posts is determined as follows:

0 to 4 inches	14 feet
5 to 7 inches	12 feet
8 to 10 inches	10 feet
11 to 15 inches	8 feet
16 or more inches	6 feet

These bend assembly posts will be wood and set with a 6-inch lean from vertical to the outside of the curve and set or driven 36 inches deep.

Pull assemblies or H-Braces for SWWF shall be installed at intervals not to exceed 660 feet. Pull assemblies or H-Braces for SHTWWF/HTWWF shall be installed at intervals not to exceed 1320 feet.

4. Line Post.

Wooden (Preferred) and plastic line posts shall be set or driven a minimum of 30 inches below ground line at a 90 degree to the ground (Can be set deeper for longer than 7.5ft posts). If soil depth is less than 28 inches, use standard "T" steel posts.

Steel line posts shall be set or driven a minimum of 21 inches below ground line. Post should be 5 feet above the ground for a 7 foot steel post.

Post spacing for line posts shall be a maximum of 16 feet for SWWF and SHTWWF and shall be 18 feet for HTWWF.

If posts are not driven, the backfill around the post shall be thoroughly compacted.

In areas where soil depth restricts the embedment depth or vallies and dips additional fence anchors or deadman support shall be applied against the direction of pull. Especially on steep elevation bottoms.

5. Fastenings.

Staples shall be driven diagonally to the wood's grain and at a slight downward angle (upward if pull is up) to avoid splitting the post and loosening of the staples. Space should be left between the inside crown of the staple and post to permit free movement of high tensile wire. Barbed staples shall be used for pressure treated posts.

The staples, wires, and clips should allow free movement of the high tensile fence wire. The top wire and the bottom wire of the SHTWWF/HTWWF should be stapled or secure, along with ever other wire on each post. All fence wire should be wraped and tied to the end posts (H-Braces).

HTWWF shall be spliced by means of a Figure 8 splicing knot or by suitable splice sleeves applied with a tool designed for the purpose.

Wire shall be spliced by means of a Western Union splice or by suitable splice sleeves applied with a tool designed for the purpose. The Western Union splice shall have not less than 8 wraps at each end about the other. All wraps shall be tightly wound and closely spaced.

6. Grounding.

Fences using wood posts shall be grounded at least every 1,000 feet with ground rods driven not less than 4 feet into the ground. The rods shall be galvanized steel and a minimum of 0.50 inch in diameter. All line wires of the fence must be grounded. Referrer to the permanent electric wire fence standard.

Natural Resources Conservation Service

CONSTRUCTION AND MATERIAL SPECIFICATION

OH-23 EARTHFILL

SCOPE

The work shall consist of the construction of earth embankments, other earthfills, and earth backfill required by the drawings and specifications. The completed work shall conform to the lines, grades, and elevations shown on the drawings or as staked in the field. The term "engineer", used throughout this document, will refer to the NRCS staff person or his/her representative that has construction responsibility for a given construction project. The Engineer may be a NRCS engineer, ODA/SWCD engineer, NRCS technician, or a licensed professional engineer that supplied the design to the landowner.

MATERIALS

All earthfill materials shall be obtained from required excavations and designated borrow areas. Earthfill materials shall contain no frozen soil, sod, brush, roots or other bio-degradable materials. The materials used throughout the earthfill shall be essentially uniform.

Rocks larger than 6 inches in diameter must be removed prior to compaction of the earthfill. For earth backfill around structures, the maximum rock size shall be 3 inches in diameter. Backfill used for backfilling within 2 feet around a pipe must not contain rocks larger than 1.5 inches in diameter.

Backfill shall consist of friable soil material and must have adequate moisture for compaction. The moisture content can generally be considered as satisfactory when the earth backfill material has sufficient moisture to produce a hand-molded ball which holds its shape and not so wet that free water can be squeezed to the surface.

FOUNDATION PREPARATION

Remove all topsoil prior to beginning placement of earthfill. Foundation surfaces must be scarified to a minimum depth of 4 inches prior to placing the initial lift.

Foundation and abutment surfaces must not be sloped steeper than 1 horizontal to 1 vertical unless otherwise shown on the drawings.

PLACEMENT

Earthfill shall not be placed until the required excavation and foundation preparation have been completed and the foundation has been inspected and approved by the engineer. Earthfill must not be placed upon a frozen surface, nor shall snow, ice, or frozen material be incorporated in the earthfill.

If the surface of any layer becomes too hard and smooth for proper bond with the succeeding layer, it must be scarified to a minimum depth of 2 inches before the next layer is placed.

The placing and spreading of the earthfill material shall begin at the lowest point in the foundation area and must be placed in horizontal lifts with thicknesses as specified in the "Compaction" section that follows.

The top surfaces of embankments must be maintained approximately level during construction except that a cross-slope of approximately 2% shall be maintained to ensure effective drainage.

Place earth backfill that is adjacent to structures or pipes in a manner that will prevent damage. The height of the earthfill adjacent to structures or pipes shall be increased at approximately the same rate on all sides. Placement and/or compaction of backfill adjacent to a new concrete wall must meet the requirements shown in NRCS Ohio Design and Construction Specification- Concrete.

Place earth backfill material in a trench in such a manner that displacement of the pipe will not occur. The backfill material, after placement, must meet the requirements as shown on the drawings and as described in the specifications. The pipe must be held in place mechanically while backfill material is placed around and over the pipe to ensure that the proper pipe elevation is maintained. Earth backfill shall extend slightly above ground surface and be well rounded over a pipe trench. The cover over all buried pipe must be at least 2 feet deep unless otherwise specified on the drawings.

Zoned earthfills are not allowed unless they are shown on the construction drawings.

When moving earthfill material from the borrow area(s) to an embankment, the following steps shall be followed:

- Immediately after the borrow material is moved to the embankment, it must be spread in horizontal lifts placed parallel to the centerline of the embankment.
- Compactive effort must then be applied by operating equipment (as specified in the "Compaction" section) parallel to the centerline of the earthfill or embankment.
- Lift thicknesses shall be as specified in the "Compaction" section.

CONTROL OF MOISTURE CONTENT

The moisture content of the earthfill material being placed must be maintained within the limits required to permit satisfactory compaction. If the earthfill material contains sufficient moisture to produce a hand-molded ball which holds its shape and not so wet that free water can be squeezed to the surface, the moisture content is satisfactory for most soil types. If borrow material is dry, water must be added by irrigating the borrow area or by sprinkling each earthfill layer prior to compaction. After adding water, the earthfill material must be mixed to obtain uniform moisture content prior to compaction. Material that is too wet when placed on the earthfill must be removed or dried by scarifying prior to compaction.

If during placement of earthfill the top surface of the preceding layer of compacted earthfill becomes too dry to permit a suitable bond, it must be scarified and moistened by sprinkling to an acceptable moisture content prior to placement of the next layer of earthfill. If the top surface of the earthfill becomes frozen, this material must be removed prior to placement of the next layer of earthfill. If during placement of earthfill the top surface of the preceding layer of compacted earthfill becomes too wet to permit a suitable bond, it must either be- 1) removed or 2) dried by scarifying to an acceptable moisture content prior to placement of the next layer of earthfill.

Earth foundations under and adjacent to concrete structures must be prevented from drying and cracking before concrete and backfill are placed.

COMPACTION

Earthfill shall be compacted by one of the following methods as specified on the drawings. .

- Class A — Each layer of earthfill must be compacted as necessary to provide the density of the earthfill matrix not less than the minimum density specified on the drawings. The earthfill matrix is defined as the portion of the earthfill material finer than the maximum particle size allowed in the reference compaction test method specified (ASTM D698 or ASTM D1557). Earthfill must be compacted to 95% Standard Proctor Density.
- Class B — Each layer of earthfill must be compacted to a mass density not less than the minimum density specified on the drawings.
- Class C — Each layer of earthfill must be compacted with at least four (4) passes of a sheepsfoot roller (200-psi minimum rating) or rubber-wheeled heavy equipment. Each pass shall consist of at least one passage of the sheepsfoot roller or rubber-wheeled equipment over the entire surface of the layer.

The maximum thickness of a lift of earthfill before compaction shall be 9 inches unless otherwise indicated on the drawings.

Heavy equipment must not be operated within 2 feet of any structure or pipe.

Earthfill adjacent to structures, pipe conduits, and appurtenances must be placed and compacted in layers not more than 4 inches thick to a depth of 2 feet above the pipe unless otherwise specified on the plans. Above this backfill level, the sides of the trench shall be sloped no steeper than 1.5 horizontal to 1 vertical with the backfill placed in 9 inch layers and compacted as described above in this section.

Earth backfill adjacent to structures shall be compacted to a density equivalent to that of the surrounding in-place earth material or adjacent required earthfill or earth backfill. Compaction shall be accomplished by hand tamping or manually directed power tampers, plate vibrators, walk-behind or self-propelled rollers. The use of plate vibrators will not be an acceptable method of compaction on fine-grained soils.

Compacting of earthfill adjacent to concrete structures must not be started until the concrete is at least 7 days old.

NATURAL RESOURCES CONSERVATION SERVICE
DESIGN AND CONSTRUCTION SPECIFICATION

CONCRETE

SCOPE

This specification consists of the design and construction requirements for concrete structures for Conservation Operations (CO-01) practices. The term "Engineer", used throughout this document, will refer to the NRCS staff person or his/her representative that has construction responsibility for a given construction project. The Engineer may be a NRCS engineer, ODNR/SWCD engineer, NRCS technician, or a licensed professional engineer that supplied the design to the landowner.

DESIGN REQUIREMENTS

1. DESIGN OF THE CONCRETE MIX

The contractor shall be responsible for the design of the concrete mix and for providing a letter certifying that the concrete materials and mix proportions (including admixtures if used) will provide the required compressive strength and include evidence satisfactory to the Engineer that the materials and proportions (the "job mix") will produce concrete conforming to this specification. After a job mix has been approved, neither the source, character, or grading of the aggregates nor the type or brand of cement or admixture shall be changed without prior notice to the Engineer. The letter certifying the materials and job mix shall be provided to the landowner with a copy to the Engineer at the pre-construction meeting.

The proportions of the aggregates shall be such as to produce a concrete mixture that works readily into the corners and angles of the forms and around reinforcement when consolidated but will not segregate or exude free water during consolidation. The Maximum Size Aggregate (MSA) shall be 1.5 inches with a Nominal Maximum Size Aggregate (NMSA) of 1 inch. A #57 aggregate will meet these requirements.

The maximum water to cement ratio (w/c) shall be 0.50 unless otherwise specified. The concrete mix shall have a 28-day compressive strength of 4,000 psi or greater. The minimum cement content shall be 6 bags (564 lbs.) per cubic yard. Use Type I or Type I A portland cement meeting the requirements of ASTM C150. Water used in mixing and curing concrete shall be clean and free from injurious amounts of oil, salt, acid, alkali, organic matter, or other deleterious substances. Wash water shall not be used as part of the mixing water for succeeding batches.

The following mineral admixtures may be used as partial substitutions for Portland cement:

- Fly ash may be used in an amount not greater than 25 percent by weight of the total required cement in the concrete mix.
- Ground granulated blast furnace slag (GGBFS) may be used in amounts between 25 to 70 percent by weight of the total required cement in the concrete mix.
- Fly ash or GGBFS shall not be used in mixes designed or intended to obtain high early strength.
- The weight of the cement and the combined weight of the cement and fly ash or slag shall be within plus or minus 1 percent of the required weight of the cementitious material.

- Concrete mixes containing fly ash or GGBFS can only be used between April 1 and October 15.

Entrained air shall be used in all concrete that will be exposed to freezing and thawing. The air content by volume shall be 4% to 8% of the volume of the concrete. Air entraining admixtures shall conform to the requirements of ASTM C260.

Unless otherwise specified, the slump shall be within the range of 3 inches minimum to 5 inches (maximum).

Chemical admixtures shall conform to the requirements of ASTM C494 and be of the following types:

- Type A- Water-reducing admixture
- Type B- Retarding admixture
- Type C- Accelerating admixture
- Type D- Water-reducing and retarding admixture
- Type E- Water-reducing and accelerating admixture
- Type F- Water-reducing, high range admixture
- Type G- Water-reducing, high range, and retarding admixture

Superplasticizers (ASTM C494 Types F and G) may be used to increase workability and reduce the water content required to produce a concrete mix within the slump range shown above. The use of superplasticizers will be approved by the Engineer at the pre-construction meeting. Superplasticizers shall be used according to manufacturer's recommendations. The maximum slump before adding superplasticizers shall be within the range of 3 to 5 inches. The maximum slump after adding superplasticizer and prior to placement of the concrete shall be 7 ½ inches.

Fiber-Reinforced Concrete

The addition of synthetic fibers to concrete helps to reduce the bleeding process, reduce segregation of the concrete mix, and helps to control cracking due to plastic shrinkage and to drying shrinkage during the first few hours of curing.

Micro-synthetic fibers or macro-synthetic fibers may be added to the concrete mix. The type of synthetic fibers shall be polypropylene. Micro-synthetic fibers are generally added at low dosage volumes ranging from 0.03% to 0.2% by volume of concrete (0.5 to 3.0 pounds per cubic yard). Macro-synthetic fibers are generally added at dosages of 3.0 to 20 pounds per cubic yard. The dosage rates used should follow the manufacturer's recommendation for the product used.

Synthetic fibers shall not be used as a substitute for steel reinforcement.

2. MATERIAL SPECIFICATIONS

All materials used in concrete construction shall meet the applicable ASTM standards and/or ACI specifications.

3. CONCRETE SLABS

The design of concrete slabs shall take into consideration the required performance and the critical applied loads. Concrete slabs may be used as floors in manure storage structures (excluding those listed in Design Requirements, Sec. 4 "Concrete Manure Storage Tanks"), as heavy use pads, scrape alleys, feed pads, and concrete grade stabilization structures. The in situ subgrade material must be evaluated as to the suitability and denseness. A minimum 4-inch thick layer of AASHTO M43 #57 or #67 crushed gravel or limestone is required under all concrete slabs. Where the in situ subgrade is uniform and dense, a Type S-1 concrete slab is acceptable. A Type S-2 concrete slab shall be used where the in situ subgrade material is non-uniform or has variable density and it is not economical or feasible to improve the subgrade. The in situ subgrade thickness in question is generally 12 inches but could be more depending on the soil profile. A Type S-3 concrete slab shall be used when the contraction (control) joint spacing will be more than 15 feet, when no contraction (control) joints are desired, when reduced seepage is required, or when a watertight slab is required.

Type S-1 Concrete Slab

The Type S-1 slab may be used where the subgrade is uniform and dense. This slab is considered to be manure tight. Vehicles of the following types may be used on this slab (maximum 12 ton Gross Vehicle Weight):

- Light (small) Farm Tractor
- Light (small) Tractor Loader/Backhoe
- Skid Steer
- Light (small) Dump Truck
- Standard pull-type rear-discharge Manure Spreader

Design Requirements:

a. The concrete strength shall be 4,000 pounds per square inch (psi) or greater.

b. The slab thickness shall be 5 inches.

c. Steel reinforcement is not required but may be used if desired. If reinforcement bars are used, the slab thickness shall be increased in an amount needed to provide the required clear covers on the bars (see Construction Requirements, Sec. 5, "Form and Steel Placement", and the list below). Reinforcing bars, if used, shall not extend across contraction (control) joints.

• #3 Bars	5.25" min. slab thickness
• #4 Bars	5.50" min. slab thickness
• #5 Bars	5.75" min. slab thickness
• #6 Bars	6.50" min. slab thickness
• #7 Bars	6.75" min. slab thickness
• #8 Bars	7.00" min. slab thickness

d. Contraction (control) joints shall be used and be placed at a maximum spacing of 15 feet in both directions. The joints shall be continuous and not staggered or offset.

e. An aspect ratio (length to width) of 1 to 1 is preferred for slab panels, with a maximum allowed ratio of 1.5 to 1. L-shaped and T-shaped panels shall be avoided.

CONSTRUCTION REQUIREMENTS

1. CONSTRUCTION DRAWING INFORMATION

The following items are to be included on the construction drawings as a minimum:

Concrete

- Minimum cement content shall be 6 bags/cu.yd.
- Maximum water/cement ratio shall be 0.50 (0.40 for Agrichemical Handling Facility)
- 28-day compressive strength of 4,000 psi or greater (5,000 psi for Agrichemical Handling Facility)
- All concrete to be air entrained with an air content of 4%-8% of the concrete volume
- Slump shall be in the range of 3" to 5"

Reinforcing Steel

- Minimum steel clearances (in notes or labeled on a detail view, or a combination of both)
- Steel Grade 60
- Minimum lap splices for each size of bar used (in notes, tables, or labeled on detail views, or any combination of these)
- Sizes and spacings of bars labeled on detail views (lengths of bars as necessary)
- Joint information for types specified:
  - Contraction Joints- spacing and location
  - Isolation Joints- location; size; type of joint filler
  - Dowels- size; length; spacing

2. REINFORCING STEEL

Reinforcing steel shall be Grade 60 deformed bars manufactured specifically for use as concrete reinforcement. Reinforcing steel shall be free from loose rust, concrete, oil, grease, paint, or other deleterious coatings.

Reinforcing steel shall be cold-bent if bends are required.

Welding of reinforcing steel is not permitted.

Synthetic fibers shall not be used a substitute for steel reinforcement. Refer to Design Requirements, Sec. 1, "Design of the Concrete Mix", for guidance on the use of synthetic fibers as an additive.

Welded wire reinforcement shall not be used as a substitute for steel reinforcement.

3. FORMS

Forms shall be of wood, plywood, steel, or other approved materials and shall be mortar tight. The forms and associated falsework shall be substantial and unyielding and shall be constructed so the finished concrete will conform to the specified dimensions and contours. Formed surfaces shall be smooth and free from holes, dents, sags, or other irregularities.

4. PREPARATION OF SUBGRADE

The subgrade shall be prepared for the type of footer or concrete slab that is to be installed.

The uniformity can be checked with the use of a tile probe. If the subgrade is found to have a soft spot, it should be excavated and backfilled with granular material.

A 4-inch thick layer of AASHTO M43 #57 or #67 crushed gravel or limestone is required under all concrete slabs.

Placement of concrete on mud, dried earth, uncompacted fill, or frozen subgrade will not be permitted.

Unless required or allowed to be used, do not use earth cuts as forms for vertical or sloping surfaces. When allowed, the original construction drawings shall clearly show the locations where earth cuts may be used as forms.

The subgrade shall be inspected and approved by the Engineer prior to the placement of forms, steel (if required), and concrete.

5. FORM AND STEEL PLACEMENT

Forms shall be coated with a non-staining form release agent before being set into place.

Form ties shall have a minimum 2-inch clearance from reinforcing steel.

Items to be embedded in the concrete shall be positioned accurately and anchored firmly.

Weepholes in walls or slabs shall be formed with non-ferrous materials.

Reinforcement shall be accurately placed and secured in position in a manner that will prevent its displacement during the placement of concrete. Reinforcing steel shall be supported by precast concrete bricks or manufactured chairs. Except for dowel rods, placing steel reinforcement into concrete already in place will not be permitted.

Splices of reinforcing bars shall be made only at the locations shown on the drawings unless otherwise approved by the Engineer.

Unless otherwise indicated on the drawings, minimum splice lengths of reinforcing bars shall be as shown in the following list. If two different size bars are to be spliced, the splice length shall be determined by the larger bar to be spliced.

• #4 Bar	16 in.
• #5 Bar	19 in.
• #6 Bar	23 in.
• #7 Bar	33 in.
• #8 Bar	37 in.

The concrete cover on reinforcing bars shall not be less than:

- 3 in. for concrete cast against and permanently exposed to earth surfaces (sides or base) and/or granular base surfaces
- 2 in. for concrete placed in forms
- Concrete with exposed surfaces
  - 1.5 in. for #5 reinforcing bars and smaller
  - 2.0 in. for #6 reinforcing bars and larger
- Placement Tolerances for concrete cover (measured perpendicular to concrete surface)
  - –3/8 in. for member thickness 12 in. or less
  - –1/2 in. for member thickness greater than 12 in.
  - A (-) tolerance decreases the amount to which it applies
- Vertical deviation for slab reinforcement
  - ±3/4 in. (a (+) deviation increases and a (-) deviation decreases the amounts to which they apply)

Maximum variation from the indicated bar spacing is 1/12 of the indicated bar spacing but the required number of bars shall not be reduced.

Steel tying and form construction adjacent to concrete in place shall not be started until the concrete has cured at least 12 hours. Before new concrete is deposited on or against concrete that has hardened, the forms shall be retightened.

6. CONCRETE MIXERS AND MIXING

Concrete may be furnished by ready-mix methods, by volumetric batching and continuous mixing at the site, or by batch mixing at the site. Ready-mixed concrete shall be mixed, transported, and placed in a freshly mixed and unhardened state and meet the requirements as described in ASTM C94 "Standard Specification for Ready-Mixed Concrete". The contractor shall furnish a batch ticket (refer to Construction Requirements, Sec. 7, "Batch Ticket Information") upon the arrival of a load to the construction site.

No mixing water in excess of the amount called for by the job mix shall be added to the concrete during mixing or hauling or after arrival at the delivery point. Withholding some of the water until the concrete arrives on the job and then adding the remaining water and turning the mixer 30 revolutions at mixing speed is allowed to overcome transporting conditions. Water to compensate for up to a 1-inch loss in slump may be added one time prior to discharging any of the load, not to exceed the design maximum water cement (w/c) ratio.

7. BATCH TICKET INFORMATION

A delivery ticket for each batch of concrete shall be provided to the contractor by the concrete supplier prior to the concrete being unloaded at the work site. Upon completion of the placement of all concrete, copies of all batch tickets shall be provided to the landowner.

The following minimum information shall be included on each Batch Ticket:

a. Name of purchaser and the work location (address)
b. Name of the concrete supplier (ready-mix batch plant)
c. Batch plant location
d. Ticket serial number
e. Design mix designation
f. Delivery date
g. Time the concrete was loaded onto the truck at the plant
h. Time the concrete arrived at the site
i. Amount of concrete delivered to the site (batch size)
j. Time the concrete was unloaded at the site
k. Actual weight of Cement (also Fly Ash and/or other mineral admixtures if used)
l. Actual weight of Aggregates (Coarse and Fine)
m. Actual weight of Water added at the plant
n. Actual volume of Admixture(s) – Type(s) and Quantity(s) added at the plant (if used)
o. Actual weight and type of fiber reinforcement (if used)
p. Water/Cement ratio of batch leaving the plant
q. Quantity of water added at the site by the receiver of the concrete
r. Admixture(s) added at the site – type(s), quantity(s), and time admixture(s) added to the concrete

The contractor shall be responsible for any changes to the certified design mix.

8. CONCRETE DELIVERY

Concrete shall be delivered to the site and discharged into the forms within 90 minutes after the introduction of the cement to the aggregates. In hot weather or under conditions contributing to quick stiffening of the concrete or when the temperature of the concrete is 85° F or above, the time between the introduction of the cement to the aggregates and discharge shall not exceed 45 minutes.

Concrete shall be conveyed from the mixer to the forms as rapidly as practicable by methods that will prevent segregation of the aggregates or the loss of mortar.

9. CONCRETE PLACEMENT

Reasonable notice shall be given to the Engineer for the required inspection and approval prior to the time of concrete placement. Such notice shall be far enough in advance to give adequate time to inspect the subgrade, forms, steel reinforcement, and other preparations for compliance with the specifications before the concrete is delivered to the site.

All subgrade surfaces shall be firm and damp prior to placement of concrete.

Prior to the placement of concrete, the forms and reinforcement steel (if required) shall be inspected and approved by the Engineer. The forms shall be free of chips, sawdust, debris, water, ice, snow, extraneous oil, mortar, or other harmful substances or coatings. Any oil on the reinforcing steel or other surfaces required to be bonded to the concrete shall be removed.

The concrete shall be deposited as closely as possible to its final position in the forms and shall be worked into the corners and angles of the forms and around all reinforcement and embedded items in a manner to prevent segregation of aggregates or excessive laitance. The depositing of concrete in either forms or slabs shall be regulated so that the concrete can be consolidated by the use of a vibrator with a minimum of lateral movement.

Slab concrete shall be placed to the design thickness in one continuous layer. Formed concrete shall be placed in horizontal layers not more than 20 inches thick. Hoppers and chutes, concrete pumps, pipes, or "elephant trunks" shall be used when the vertical drop is in excess of 5 feet to prevent splashing of mortar on the forms and reinforcing steel and to prevent segregation.

Slump testing shall meet the requirements of ASTM C143 "Slump of Hydraulic-Cement Concrete" to ensure the quality as specified in Design Requirements, Sec. 1, "Design of the Concrete Mix". The contractor and/or Engineer shall perform an adequate number of slump tests to ensure that the slump for all concrete delivered to the work site is within the ranges specified in Section 1. Samples used for slump testing shall be obtained from the concrete as it is delivered from the mixer as specified in ASTM C172 "Sampling Freshly Mixed Concrete". If concrete is conveyed to the placement location by pumping or conveyor belts, the samples shall be collected at the discharge end.

The minimum number of Slump Tests to perform:

1. on the first load delivered to the site each day
2. on one other load during each work day
3. before the addition of superplasticizer and after it is mixed into the load

The contractor shall keep a record of all Slump Tests performed. At a minimum, the record shall show:

1. date(s) and time(s) of delivery of tested batches and batch number
2. name of person performing the test(s)
3. all slump measurements taken

This record will become part of the as-built documentation to be included with the as-built drawings.

Superplasticizer may be used with the approval of the Engineer (refer to Design Requirements, Sec. 1, "Design of the Concrete Mix"). When superplasticizer is added to the load at the site, a slump test shall be taken before the addition of the superplasticizer and after the superplasticizer is mixed into the load prior to the placement of the concrete. This "retempering" of the load may be performed again if the slump is still testing below the maximum slump allowed (7 ½ in.) prior to the placement of the concrete. The load may also be retempered after a portion of the load has been dispensed and placed. The contractor shall follow the manufacturer's recommendation on the methods to use and the number of times that retempering may be done with the specific product being used. The time requirements for concrete delivery and discharging shall not be exceeded as specified in Construction Requirements, Sec. 8, "Concrete Delivery". At no time shall the maximum allowable slump of 7 ½ inches be exceeded.

Immediately after the concrete is placed, it shall be consolidated by vibrating as necessary to ensure smooth surfaces and dense concrete. Each layer shall be consolidated to ensure a monolithic bond with the preceding layer. If the surface of a layer of concrete in place sets to the degree that it will not flow and merge with the succeeding layer when vibrated, the placement of concrete will be discontinued and a construction joint will be made.

If placing is discontinued when an incomplete horizontal layer is in place, a vertical bulkhead shall form the unfinished end of the layer.

New concrete, whether reinforced or non-reinforced, shall not be placed next to concrete in place until the hardened concrete in place has cured at least 12 hours.

10. CONSTRUCTION JOINTS

Construction joints are stopping places in the process of construction. A true construction joint should bond new concrete to existing concrete and permit no movement. Because extra care is needed to make true construction joints, they are usually designed and built to function as and align with contraction and/or isolation joints.

Construction joints are placed in a slab or wall where concreting operations have concluded for the day, generally in conformity with a predetermined joint layout. If at any time concreting is interrupted long enough for the placed concrete to harden, a construction joint must be used.

Construction joints shall be made at the locations shown on the drawings. If construction joints are needed that are not shown on the drawings, they shall be placed in locations and in a manner approved by the Engineer.

Construction joints on unformed surfaces shall have a roughened surface.

Construction joints shall be moist cured for seven (7) days or until the adjoining concrete is placed.

Surfaces of all construction joints shall be cleaned of all unsatisfactory concrete, laitance, coatings, or debris by washing and scrubbing with a wire brush or wire broom, or by other means approved by the Engineer. The surfaces shall be kept moist for at least one hour prior to placement of the new concrete if the initial curing period has passed.

Keyed construction joints are not recommended for slabs where load transfer is required.

11. ISOLATION (EXPANSION) JOINTS

Isolation joints are often called expansion joints because they are intended to isolate structural units that behave in different ways. They permit both horizontal and vertical differential movements at adjoining parts of a structure. They are used to isolate walls from floors, columns from floors, and slabs from existing structures or slabs. Isolation joints are also used in locations where restraint or transmission of secondary forces is not desired.

An isolation joint requires the use of an expansion joint material which can be as thin as ¼ inch but a commonly used thickness is ½-inch. Preformed expansion joint filler material shall be bituminous, cork, or rubber.

Isolation joints shall be made only at the locations shown or noted on the drawings.

Exposed concrete edges at isolation joints shall be carefully tooled or chamfered and the joints shall be free of mortar and concrete. Joint filler shall be left exposed for its full length with clean true edges.

Preformed expansion joint filler shall be held firmly in the correct position as the concrete is placed.

12. CONTRACTION (CONTROL) JOINTS

Contraction joints are often called control joints because they are intended to control crack location. Contraction (control) joints are purposely made planes of weakness and are designed to regulate cracking caused by drying and thermal shrinkage of the concrete.

The maximum spacing of contraction (control) joints in concrete slabs on ground and concrete walls shall be as specified in Design Requirements, Sec. 3 "Concrete Slabs", Sec. 4 "Concrete Manure Storage Tanks, and Sec. 5 "Concrete for Agrichemical Handling Facilities".

The slab panels created by the joints shall be as square as possible but with a maximum aspect ratio (length to width) of 1.5 to 1. Avoid L- or T-shaped panels. Add a joint at reentrant corners. Contraction (control) joints shall be made only at locations shown or noted on the drawings.

Contraction (control) joints are to be made to a depth of ¼ the thickness of the slab or wall but not less than 1 inch. Sawing is a commonly used method to make contraction (control) joints.

Contraction (control) joints also can be formed in the fresh concrete with hand groovers or by using inserts (strips of plastic, e.g., "zip-strip", or other suitable material) at the joint location. The edges of these open joints shall be finished with an edging tool prior to removal of the joint filler strips. Inserts are not recommended for use on slabs that will be subjected to wheeled traffic.

Contraction (control) joints in concrete walls that are to be liquid-tight shall be caulked as described in Design Requirements, Sec. 4 "Concrete Manure Storage Tanks" and Sec. 5 "Concrete for Agrichemical Handling Facilities". Use an elastomeric sealant with a foam backer rod. A waterstop shall also be used (see the following section).

13. WATERSTOPS

Waterstops shall be held firmly in the correct position as the concrete is placed. Joints in metal waterstops shall be soldered, brazed, or welded. Joints in rubber or plastic waterstops shall be cemented, welded, or vulcanized as recommended by the manufacturer. Hydrophilic strips may be used as waterstops.

Wall pours shall not be continuous past waterstops. Vertical waterstops shall be held firmly in place by a bulkhead attached to the wall forms. Flexible (rubber or PVC) waterstops with center bulbs are preferred and shall be used when required in contraction joints.

14. FINISHING UNFORMED SURFACES

All exposed surfaces of the concrete shall be accurately screeded to grade and then float finished.

Excessive floating or troweling of surface while the concrete is soft will not be permitted.

The addition of dry cement or water to the surface of the screeded concrete to expedite finishing will not be allowed.

Joints and edges on surfaces that will be exposed to view shall be chamfered or finished with molding tools.

15. REMOVAL OF FORMS

Forms for walls and columns shall remain tight and in place for a minimum of 24 hours and a maximum of 48 hours after placing the concrete. Forms for slabs shall not be loosened or removed for at least 12 hours after placing concrete.

Forms that support beams or covers shall not be removed for at least 7 days or as otherwise stated on the drawings. Forms for beams or covers that are to support additional forms or shoring shall not be removed for at least 14 days.

Removal of forms shall be done in a manner that will not damage the concrete surface nor induce sudden or excessive stresses.

16. FINISHING FORMED SURFACES

Immediately after the removal of the forms, the surfaces shall be kept wet until all defects, holes, and other irregularities have been repaired.

All fins and irregular projections shall be removed from exposed surfaces.

Holes produced on all surfaces by the removal of form ties, cone-bolts, she-bolts, and other items shall be cleaned, wetted, and filled with a dry-pack mortar consisting of one part Portland cement, three parts sand that will pass a No. 16 sieve, and sufficient water to produce a consistency such that the filling is at the point of becoming rubbery when the material is solidly packed. The Engineer must approve other patching material and procedures prior to their use.

17. CONCRETE REPAIR

Concrete that is honey combed, damaged, or otherwise defective shall be repaired or removed and replaced.

The Engineer will determine the required extent of removal, replacement, or repair. The plan for implementing the repair must be approved by the Engineer prior to the beginning of the repair work. The contractor shall perform all repair work in the presence of the Engineer or his or her representative. The Engineer will have the final approval of all repair work.

18. CONCRETE CURING

Concrete shall be prevented from drying for a curing period of at least 7 days after it is placed. Exposed surfaces shall be kept continuously moist for the entire period or until curing compound is applied as specified below. Moisture shall be maintained by sprinkling, flooding, fog spraying or by covering with continuously moistened canvas, cloth mats, straw, sand, or other approved materials. Formed surfaces shall be thoroughly wetted immediately after forms are removed and shall be kept wet until patching and repairs are completed. Water or covering shall be applied in such a way that the concrete surface is not eroded or otherwise damaged. Exposed and unformed concrete surfaces, especially flat work placed with large surface areas, shall be kept completely and continuously wet for the duration of the curing period or until curing compound is applied as specified below.

Concrete, except at construction joints, may be coated with an approved curing compound in lieu of continued application of moisture. The compound shall be sprayed on the moist concrete surface as soon as free water has disappeared but shall not be applied to any surface until patching, repairs, and finishing of that surface are completed. The compound shall be applied at a uniform rate of not less than one gallon per 150 square feet of surface (or at the manufacturer's recommended rate) and shall form a continuous adherent membrane over the entire surface. Curing compound shall not be applied to surfaces requiring a bond to subsequently placed concrete, such as construction joints, shear plates, reinforcing steel and other embedded items. If the membrane is damaged during the concrete curing period, the damaged areas shall be re-sprayed at the rate of application specified above.

The use of white curing compound is strongly recommended if curing compound is used.

19. BACKFILLING NEW CONCRETE WALLS

Placement and/or compaction of backfill adjacent to a new concrete wall shall not begin until 14 days have elapsed since the placement of the concrete. Walls that will be backfilled on both sides simultaneously may be backfilled after 7 days.

Heavy equipment shall not be allowed within 3 feet of a new concrete wall. Provide compaction near the wall by means of hand tamping or small, manually directed equipment. Vibrating equipment is not permitted to be used for compacting backfill.

20. CONCRETING IN COLD WEATHER

Cold weather concreting procedures shall be used for all concrete mixed and placed between November 1 and April 1, regardless of weather forecasts.

Cold weather concreting procedures may be required before November 1 and after April 1, when the atmospheric temperature is less than 40° at the time of placement or predicted to fall below 32° in the following 24 hours.

The contractor shall submit a written plan detailing how the concrete is going to be protected from freezing and how the required temperatures of the concrete will be maintained. The written plan shall be approved by the Engineer prior to any work on the project except for earthwork.

In the event that there is no plan or no cold weather provisions available, concrete placement will not be permitted.

Cold weather concreting requirements are:

a. Concrete temperatures (for the required curing period) shall meet the requirements shown in the following table [1/]:

Air Temperature	Section Size (minimum dimension)	
	< 12"	12" – 36"
	Minimum Concrete Temperature as Placed	
All	55° F	50° F
	Maximum Concrete Temperature as Placed	
All	75° F	70° F
	Minimum Concrete Temperature as Mixed	
Above 30° F	60° F	55° F
0° F to 30° F	65° F	60° F
	Max. Allowable Gradual Temp. Drop in First 24 hours After End of Protection	
All	50° F	40° F

1/ From information in ACI 306 Sec. 5.1

b. When the cement is added to the mix, the temperature of the mixing water shall not exceed 140° F nor shall the temperature of the aggregate exceed 150° F.

c. The use of antifreeze compounds and/or calcium chloride is not allowed.

d. The surface temperature of the concrete shall not go below 40° F for seven (7) days following placement of the concrete. The concrete shall be immediately protected after placement. Protection methods to maintain the minimum temperature adjacent to the concrete surface include but are not limited to the following (applies to both walls and slabs):

    1) Using canvas tarpaulins, polyethylene film (plastic sheeting), or waterproof paper as protective covers over at least 3 in. of dry straw or hay; heating may be added if necessary.

2) Using commercial insulating blankets or batt insulation in single or multiple layers; plastic sheeting may also be used as an additional layer with the blankets or batting; heating may be added if necessary.

3) Using heated enclosures made of wood, canvas tarpaulins (tents), or polyethylene to protect the concrete; prefabricated rigid-plastic enclosures may also be used.

e. The contractor or landowner shall record temperatures at least once a day at the same time each day (two sets of readings are preferred) for seven (7) days. A maximum/minimum thermometer shall be used to monitor the temperature at the concrete surface. There should be a sufficient number of temperature measurement locations to show the range of concrete temperatures throughout the structure. The following minimum information is to be recorded for each set of readings:

1) Date and Time
2) Name of person taking readings
3) Outside air temperature
4) Weather conditions
5) Maximum and minimum temperature readings in each 24 hour period using a max/min thermometer at the concrete surface.

f. At the end of the protection period, the concrete shall be allowed to cool gradually. The maximum decrease in temperature at the concrete surface in the first 24 hours shall not exceed the values shown in the above table.

21. CONCRETING IN HOT WEATHER

For the purpose of this specification, hot weather is defined as any combination of the following conditions that may potentially impair the quality of freshly mixed or hardened concrete by accelerating the rate of moisture loss and the rate of cement hydration or otherwise produce detrimental results:

a. High ambient temperature
b. High concrete temperature
c. Low relative humidity
d. Wind velocity
e. Solar radiation

Whenever the above conditions exist or when climatic conditions are such that the temperature of the concrete may reasonably be expected to exceed 90°F at the time of delivery to the work site or during the placement operations, the following provisions shall apply:

a. The contractor shall maintain the temperature of the concrete below 90°F during mixing, conveying, and placing. The usual method of cooling concrete is to lower the temperature of the concrete materials before mixing.

b. Exposed concrete surfaces that tend to dry or set too rapidly, reinforcing steel, and subgrade shall be continuously moistened using fog sprays or other means to maintain adequate moisture during the time between placement and finishing. Water shall not be sprinkled or added directly to the surface of the concrete prior to finishing.

c. Finishing of slabs and other exposed surfaces shall be started as soon as the condition of the concrete allows and shall be completed without delay. Water shall not be sprinkled or added to the surface of the concrete during the darbying, bull floating, or other finishing operations to facilitate finishing.

d. When any single or combination of conditions may result in very rapid setting or drying of the concrete, extreme conditions exist. For flatwork and slab construction, extreme conditions exist when the evaporation rate exceeds 0.2 $lb/ft^2/hr$. The evaporation rate for flatwork and slab construction may be determined by calculating the evaporation rate from a shallow cake pan having a surface area of at least 1 square foot or by other methods approved by the Engineer. Retarding admixtures may be used.

e. The Engineer may (1) restrict placement to the most favorable time of the day, (2) restrict the depth of layers to ensure coverage of the previous layer while it will still respond readily to vibration, (3) suspend placement until conditions improve, and (4) restrict the removal of forms, repair, and patching to small areas which can be protected with curing compound immediately.

f. The need for moist curing is greatest during the first few hours after finishing. Moist curing should commence as soon as the surfaces are finished and continue for a least 24 hours. If moist curing cannot be continued beyond 24 hours, while the surfaces are still damp, the concrete should be protected from drying with curing paper, heat-reflecting plastic sheets, or membrane-forming curing compounds.

g. Application of a curing compound should be preceded by 24 hours of moist curing. If this is not practical, the curing compound should be applied immediately after final finishing. The concrete surfaces should be moist.

h. The contractor shall submit a written plan detailing procedures of mixing, using admixtures, placing, protection, curing, and temperature monitoring during hot weather. The Engineer shall approve the written plan prior to the ordering of the concrete.

i. The contractor or landowner shall maintain a record of the placement of the concrete. The following minimum information is to be recorded for each set of readings:

    a. Date and Time
    b. Name of person taking readings
    c. Outside air temperature
    d. Weather conditions
    e. Concrete temperature at the time of delivery and after the concrete is placed
    f. Protection method(s) used
    g. Initial curing method used
    h. Final curing method used
    i. When curing compound is used, the time and rate of application
    j. The duration and termination of curing

22. LOADING

This section addresses loads being applied to each structure after the construction has been approved.

Slabs- Do not drive on or load slabs before 14 days have elapsed after concrete placement unless specified differently on the drawings.

Walls- No loading shall be applied to new concrete walls before 14 days have elapsed after concrete placement unless specified differently on the drawings. Backfill is considered to be a load condition (refer to Construction Requirements, Sec. 19, "Backfilling New Concrete Walls"). Walls backfilled on both sides simultaneously may be loaded after 7 days have elapsed.

Columns and Beams-

No loading shall be applied to new concrete columns or beams before the concrete obtains a compressive strength of 4,000 psi or before 28 days have elapsed, whichever comes first unless specified differently on the drawings.

23. SAFETY CONCERNS

All work shall be conducted within applicable Federal, State, and local regulations. Utility locations, overhead obstacles, excavation safety, steel placement, impalement protection, and working with fresh concrete are of particular concern. Contractors shall have necessary safety equipment and procedures in place prior to commencement of construction.

24 INFORMATION REQUIRED AT THE END OF THE PROJECT

At the end of the project, the contractor, the landowner's technical representative, or the Engineer shall provide as a minimum the following items to the landowner (to be included with the as-built construction drawings):

☐ Certified Concrete Design Mix (including all admixtures used)
(Design Requirements, Sec. 1)

☐ All concrete Batch Tickets
(Construction Requirements, Sec. 7)

☐ Slump Test results
(Construction Requirements, Sec. 9)

☐ Types and extent of Concrete Repairs made
(Construction Requirements, Sec. 17)

☐ Method used for Concrete Curing; Type/Color of Curing Compound (if used)
(Construction Requirements, Sec. 18)

☐ Cold Weather Concreting Plan
(Construction Requirements, Sec. 20)

☐ Cold Weather Concreting Temperature Readings and Logs for the required seven (7) day period after concrete placement
(Construction Requirements, Sec. 20)

☐ Concreting in Hot Weather Plan
(Construction Requirements, Sec. 21)

☐ Concreting in Hot Weather Readings and Logs
(Construction Requirements, Sec. 21)

☐ As-Built Construction Drawings

NATURAL RESOURCES CONSERVATION SERVICE
CONSTRUCTION SPECIFICATION

SUBSURFACE DRAIN – 606

Scope

The work consists of furnishing and installing conduits and appurtenances for the subsurface drain system as shown on the drawings and specified herein.

Utilities

The landowner and/or contractor are responsible for locating all buried utilities in the project area, including drainage tile and other structural measures.

Inspection and Handling of Materials

Carefully inspect conduit materials before installation. Look for any deficiencies, such as thin spots or cracking, prior to installation. Plastic pipe and tubing shall be protected from hazards that could cause deformation and warping. Where applicable, check clay and concrete tile for damage from freezing and thawing prior to installation. Protect bituminized fiber and plastic pipe and tubing from hazards causing deformation or warping. Materials with physical imperfections shall not be installed.

Materials

Materials for subsurface drains must meet the requirements as shown in the plans and specifications.

The following reference specifications pertain to products currently acceptable for use as subsurface drains:

Pipe Material	Material Specification
Polyethylene (PE) Plastic Pipe	
3" through 24" Corrugated Polyethylene Pipe and Fittings	ASTM F 667
12"– 60" Annular Corrugated Profile-Wall Polyethylene (PE) Pipe and Fittings for Gravity–Flow Storm Sewer and Subsurface Drainage Applications	ASTM F 2306
2"– 60" Annular Corrugated Profile-Wall Polyethylene (PE) Pipe & Fittings for Land Drainage Applications* *(permits the use of Recycled Materials)	ASTM F 2648
Corrugated Polyethylene Drainage Pipe (and Fittings); 3"– 10"	AASHTO M 252
Corrugated Polyethylene Pipe (and Fittings); 12"- 60"	AASHTO M 294
Clay Pipe	
Clay Drain Tile and Perforated Clay Drain Tile	ASTM C-4
Standard Test Methods for Vitrified Clay Pipe	ASTM C-301
Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated (3"- 24")	ASTM C-700
Concrete Pipe	
Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe (4"– 36")	ASTM C 14
Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe (12" and larger)	ASTM C 76
Concrete Pipe for Irrigation or Drainage (4"- 24")	ASTM C 118
Portland cement	ASTM C 150
Concrete Drain Tile (4"– 36")	ASTM C 412
Joints for Concrete Pipe and Manholes, Using Rubber Gaskets	ASTM C 443

Perforated Concrete Pipe (4"- 24")	ASTM C 444
Test Methods for Concrete Pipe, Manhole Sections, or Tile	ASTM C 497

Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe

Styrene-Rubber (SR) Plastic Drain Pipe and Fittings; 2"- 6"	ASTM D 2852

Poly Vinyl Chloride (PVC) Pipe

PVC Plastic Pipe, Schedules 40, 80, and 120; 1/8"- 24"	ASTM D 1785
PVC Pressure-Rated Pipe (SDR Series); 1/8"- 36"	ASTM D 2241
Type PSM PVC Sewer Pipe and Fittings; 3"– 15"	ASTM D 3034
Joints for Drain & Sewer Plastic Pipes Using Flexible Elastomeric Seals	ASTM D 3212
Elastomeric Seals (Gaskets) for Joining Plastic Pipe	ASTM F 477
PVC Large-Diameter Plastic Gravity Sewer Pipe and Fittings; 18"– 48"	ASTM F 679
PVC Corrugated Sewer Pipe with a Smooth Interior and Fittings; 4"– 48"	ASTM F 949

Steel Pipe

Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains	ASTM A 760

Aluminum Pipe

Corrugated Aluminum Pipe for Sewers and Drains	ASTM B 745

Ductile Iron Pipe

Ductile-Iron and Gray-Iron Fittings (3"– 48")	AWWA C 110
Rubber Gasket Joints for Ductile-Iron Pressure Pipe and Fittings	AWWA C 111
Ductile-Iron Pipe, Centrifugally Cast, for Water (3"– 64")	AWWA C 151

Safety

All operations shall be carried out in a safe manner and meet applicable health and safety regulations. Trenches may require a protective system unless the excavation is made entirely in stable rock. A competent person may determine that a protective system is not required. A competent person is an individual working for the contractor who is capable of identifying existing and predictable hazards or working conditions that are hazardous, unsanitary, or dangerous to workers, soil types and protective systems required, and who is authorized to take prompt corrective measures to eliminate these hazards and conditions.

Conduit Perforations Requirement

Where perforated conduit is required, the water inlet area should be at least 1 in.^{2}/ft of conduit length. Round perforations must not exceed 3/16-in. in diameter except where filters, envelopes, or other protection is provided or for organic soils, where a maximum hole diameter of ½ in. may be used. Slotted perforations should not exceed 1/8 in. in width.

Excavation

Trench widths must be adequate for proper installation of the conduit, allow proper joining of sections, and allow proper placement of filter, envelope, or blinding materials. The trench bottom shall be constructed to proper grade before placement of the conduit. The conduit must be placed on a firm foundation to ensure proper alignment. Prevent runoff and surface water from entering the trench.

Where rock is encountered the trench will be over excavated a minimum of 6 inches and refilled to proper grade with a suitable bedding material.

Unless otherwise shown on the drawings, trench width at the top of the conduit should be the minimum required for proper installation of the conduit, allowing proper joining of sections, allowing proper placement of filter, envelope, or blinding materials, and providing bedding conditions suitable to support the load on the conduit. The clearance from the edges of the conduit to the edges of the trench shall not be less than 3 inches on each side. Maximum trench width shall be the conduit diameter plus 12 inches measured at the top of the conduit, unless approved bedding is installed.

Plow installation, a trenchless method for installing plastic pipe, is allowed. Minimum trench width shall be 2 inches wider than the conduit on each side. Grade control and bedding conditions shall be closely inspected during plow installation. Boulders, cobbles, or cemented soils can cause the plow to jump and lose grade. These hard points can also puncture or dimple and deform the pipe.

Installation

The following specifications shall be used for reference to install the different types of pipe required by this standard.

Table A - Pipe Installation Specifications

Installation Specification	Pipe Material							
	Steel/CMP	Aluminum	Clay	PE	ABS	PVC	Ductile Iron	Concrete
ASTM A 798	X							
ASTM A 807	X							
ASTM B 788		X						
ASTM B 789		X						
ASTM C 12			X					
ASTM D 2321				X	X	X		
ASTM D 2774				X	X	X		
ASTM F 449				X				
ASTM F 1668				X	X	X		
AWWA C 600							X	
AWWA C 604	X							
AWWA C 605						X		
AWWA Manual M9								X

All subsurface drains should be laid to line and grade and covered with approved blinding, envelope, or filter material to a depth of not less than 3 inches over the top of the drain. No reversals in grade of the conduit are permitted. Material used for blinding must contain no rocks greater than 1½ inches in diameter for conduits 6 inches or larger in diameter, or ¾ inch for smaller conduits. The cover over all buried conduit lines must be at least 2 feet deep unless otherwise specified on the plans.

Unless otherwise specified in the construction plans, provide a shaped groove with an angle of support of 90 degrees in the bottom of the trench for corrugated plastic tile (CPT) 8 inches diameter or less. For larger CPT, use a semi-circular or trapezoidal shaped groove with support angle of 120 degrees.

Perforated pipe shall be laid with the perforations down and oriented symmetrically about the vertical centerline. Perforations shall be clear of any obstructions when the pipe is laid.

Rigid conduits such as clay or concrete tile will not need the V groove, but all other applicable placement and bedding requirements will be adhered to. Joints between drain tiles must have the closest possible fit. Pipe shall be placed with the bell end upstream, unless otherwise specified. Pipe shall be firmly and uniformly supported through the entire length. The pipe ends and couplings shall be free of foreign material when assembled.

If not connected to a structure, the upper end of the subsurface drain line must be closed with a tight-fitting cap or plug of the same material as the conduit, or other durable materials.

Connections (Drain Tubing)

Joints between concrete and clay drain tile, which serve only to collect and transport drainage water from lateral tile lines shall vary with soil type as follows:

- Peat and muck – ¼ inch preferred (3/8 inch maximum)
- Clay – 1/8 inch preferred (1/4 inch maximum)
- Silt and loam – 1/16 inch preferred (1/8 inch maximum)
- Sand – tightest fit possible

Where joint width exceeds the maximum above, the joint shall be covered with a permanent type material such as treated roofing paper, fiber glass sheet or mat, or plastic sheet.

Lateral connections with drain tubing will be made with manufactured appurtenances (wyses, tees, etc,) compatible in strength and durability with the specified conduit unless otherwise shown on the drawings. Connections with the outlet pipe shall be made watertight.

Connections and Fittings (PVC / PE Pipe)

Pipe shall be installed and joined in accordance with manufacturers recommendations. Joints may be bell and spigot type with elastomeric gaskets, coupling type with elastomeric gaskets on each end, or solvent cemented. Gaskets and joints shall conform to the appropriate ASTM specification for the pipe material used (see Pipe Material list in the Materials section above). When a lubricant is required to facilitate joint assembly, it shall be a type having no detrimental effect on the gasket or pipe material.

Mechanical joints (split couplings and snap couplings) may be used when joining PE pipe and fittings when the pipe is sued for non-pressure flow and a free draining sand or gravel bedding material is provided. Elastomeric-sealed mechanical joints shall be used when joining PE pipe and fittings under pressure flow or where seepage cannot be tolerated. Where non-pressure pipe is specified, the fittings shall be of the same or similar materials as the pipe and shall provide the same durability and strength as the pipe.

Where pressure pipe is specified, fittings shall have a design capacity equal to or exceeding that specified for the pipe to which it is attached. Fittings shall be cast iron, steel, one piece injection molded plastic fitting, or fabricated from plastic pipe and one piece injection molded plastic fittings.

Backfill

Place earth backfill material in the trench in such a manner that displacement of the conduit will not occur and so that the filter and bedding material, after backfilling, will meet the requirements of the drawings and specifications. Backfill within 2 feet of conduit shall have no rock particles larger than 1.5 inches in diameter. All backfill shall contain no stones larger than 6 inches in diameter, frozen material, or large dry clods.

Backfill shall be completed as soon as practical as consistent with soil conditions. Backfill shall extend slightly above ground surface and be well rounded over the trench. The maximum depth of cover for standard duty corrugated plastic tubing shall be 10 feet for trench widths of 2 feet or less (measured at tubing and to 1 foot above top of tubing). Heavy-duty tubing shall be specified for depths greater than 10 feet, trench widths more than 2 feet, or in rocky soils.

Outlet

A continuous section of non-perforated conduit shall be used at the outlet as described in the construction plans, unless a headwall is used. All outlets must have an animal guard, hinged to allow passage of debris.

Unless otherwise specified in the construction plans, acceptable materials for use at the outlet include the following:

- Corrugated metal pipe, galvanized or aluminum, 16-gauge, minimum thickness,
- Smooth steel pipe with 3/16 of an inch minimum wall thickness,
- Smooth plastic pipe, polyvinyl chloride (PVC), with a SDR of 35 or less or schedule 40 or heavier, and
- Corrugated profile wall (dual wall) polyethylene (PE) pipe.

For discharge to streams or channels, the outlet invert shall be located above the elevation of normal flow and at least 1.0 foot above the channel bottom. At least two-thirds of the pipe section shall be buried in the ditch bank, and the cantilever section must extend to the toe of the ditch side slope, or the side slope shall be protected from erosion.

Use plastic pipe for the outlet only where fire will not be used to manage the vegetation. All plastic and polyethylene pipe outlets must include an ultra-violet stabilizer. Conduit ends must be protected from sun damage during installation.

DOVETAIL ENERGY, LLC.

WASTEWATER STORAGE PONDS PTI PLANS

BATH TOWNSHIP, GREENE COUNTY, OHIO

APPLICANT INFORMATION:

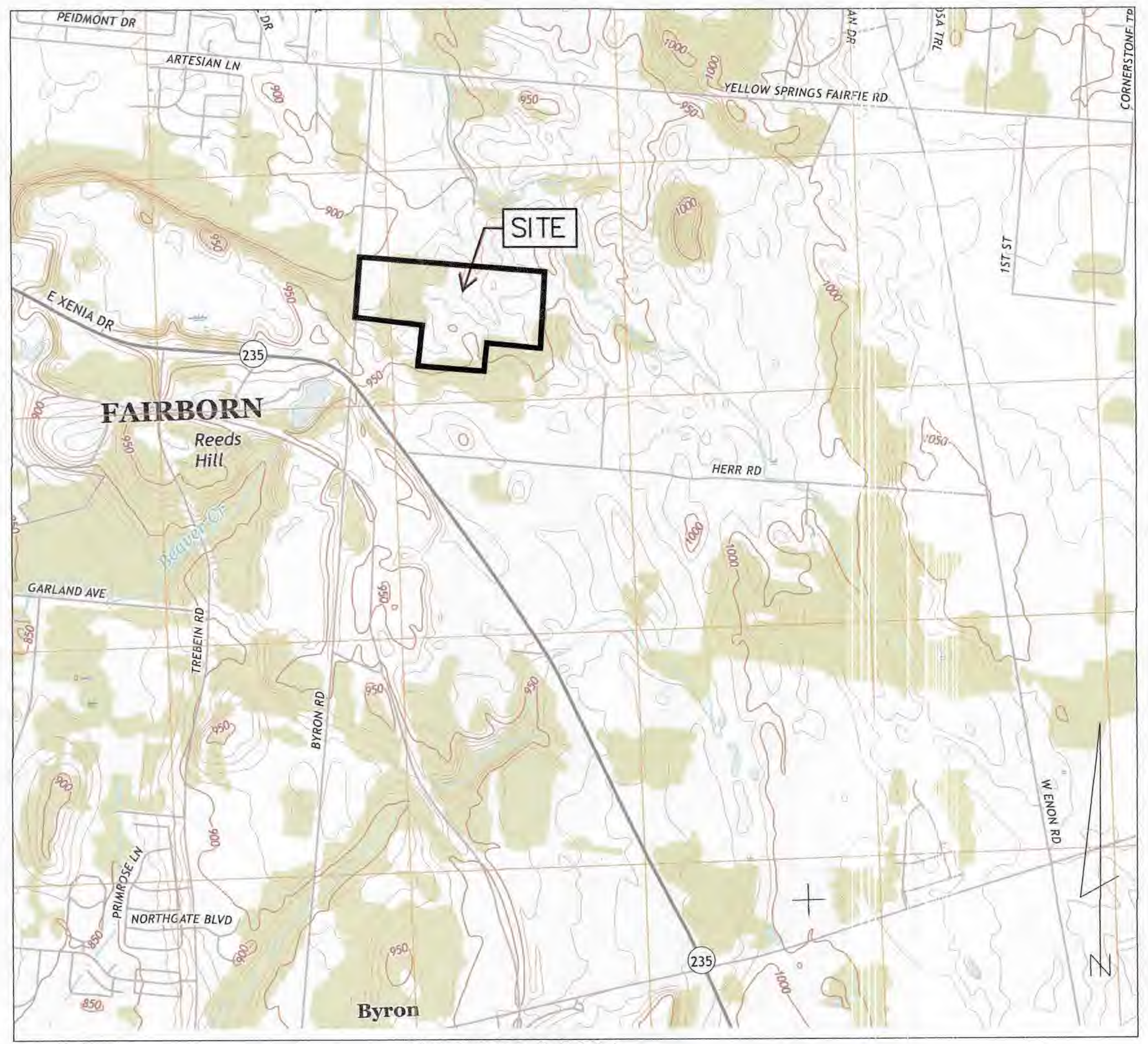
DOVETAIL ENERGY, LLC
1156 HERR ROAD
FAIRBORN, OHIO 45324
PHONE: 602-321-0750
CONTACT: W. MICHAEL OBERFIELD

FACILITY INFORMATION:

DOVETAIL ENERGY, LLC
1156 HERR ROAD
FAIRBORN, OHIO 45324
PHONE: 740-509-0790
CONTACT: ASHLEIGH LEMON

PLANS PREPARED BY:

NORTH POINT ENGINEERING CORPORATION
6657 FRANK AVENUE NW, SUITE 200
NORTH CANTON, OH 44720
PHONE: 330-494-8888
CONTACT: DAVID GERDEMAN, P.E.



USGS MAP
NOT TO SCALE

RECEIVED
OHIO EPA
JUN 10 2019
Southwest District

SUBMITTED
5-3-19
REV. 6-5-19

NOTE:
THE PROPOSED POND IS LOCATED MORE THAN 300 FEET FROM AN OCCUPIED RESIDENCE

SITE PLAN LEGEND:

— - - —	EXIST. PROPERTY BOUNDARY
— —	EXIST. WATERS OF THE STATE
976	EXIST. CONTOURS LIDAR OSIP POINT DATA
△	SURVEY BENCH MARK (TO BE SET PRIOR TO CONSTRUCTION)
— x — x —	PROPOSED FENCE
▬	SUBSURFACE DRAINS EXPLORATORY TRENCH
B-1 (975.17)	SOIL BORINGS BY ENVIROCORE 12-5/6-2018 WITH SURVEYED EXISTING GROUND ELEVATION
B-7 (975.17)	SECOND ROUND OF SOIL BORINGS (BY PSI 1-18, 22, 2019)
● TP	NORTH POINT ENGINEERING TEST PITS
🟧	EXISTING ADJACENT RESIDENCE

DAVID A GERDEMAN E-48568

OEPA MINIMUM SETBACK STANDARDS

300' FROM OCCUPIED STRUCTURES
300' FROM WATERS OF THE STATE
300' FROM PRIVATE WELLS NOT USED BY OWNER
50' FROM PRIVATE WELL USED BY OWNER
50' FROM PROPERTY LINE

0 200' 400'
SCALE: 1"= 200'

N

INDEX OF SHEETS

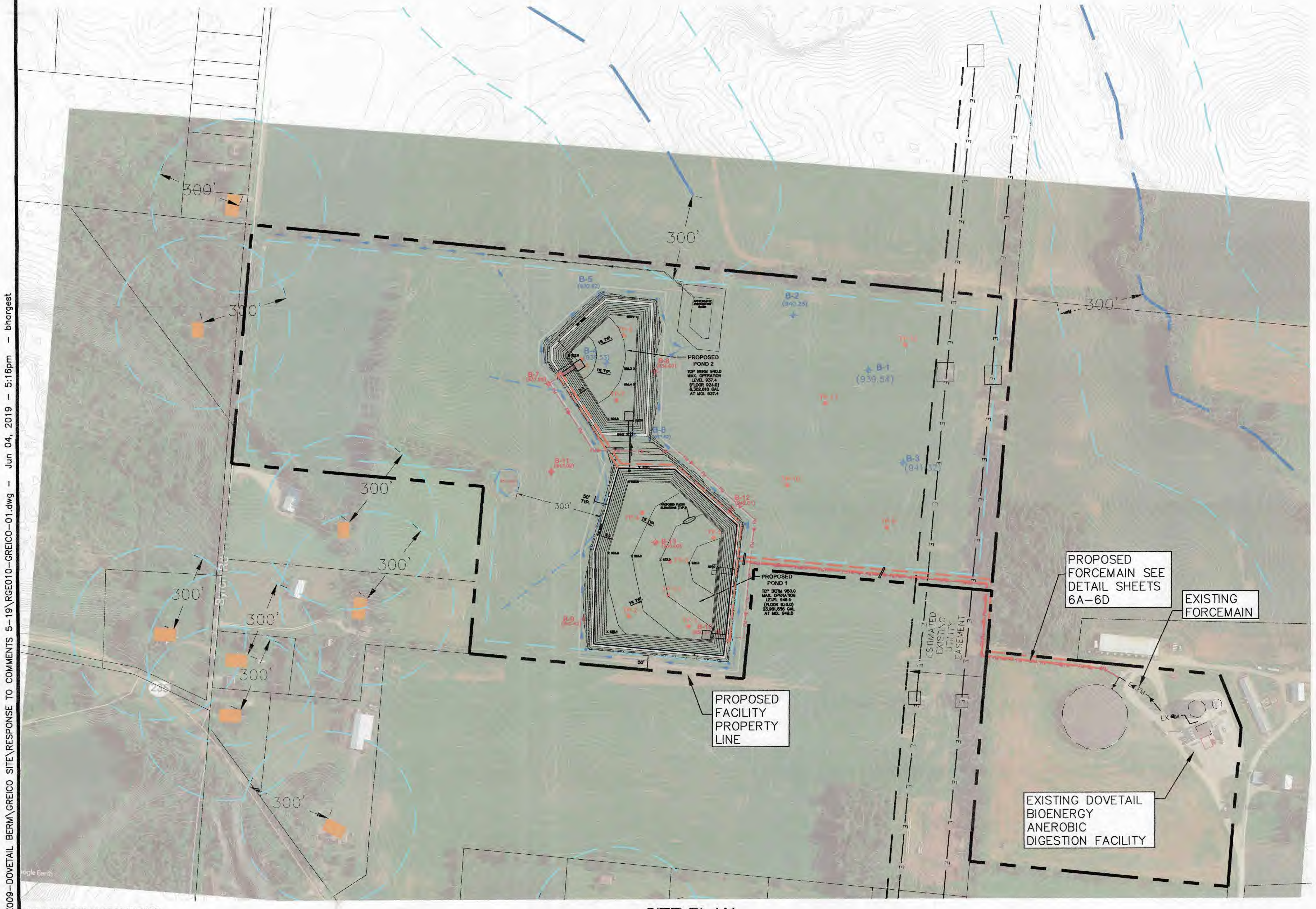
DWG NO.	SHEET NO.	DRAWING TITLE
RGE010-01	1 OF 13	TITLE SHEET AND SITING SETBACK PLAN
RGE010-02	2 OF 13	SUBSURFACE INFORMATION
△1 RGE010-03A	3A OF 13	WASTEWATER EARTHEN EMBANKMENT AND LINER POND PLAN AND SPECIFICATIONS
△1 RGE010-03B	3B OF 13	STORAGE PONDS-ENLARGED VIEW
△1 RGE010-03C	3C OF 13	STORAGE POND #1 CROSS-SECTIONS
△1 RGE010-03D	3D OF 13	STORAGE POND #2 CROSS-SECTIONS
△1 RGE010-04A	4A OF 13	PONDS - FML LINER DETAILS
RGE010-04B	4B OF 13	FML LINER SUMP AND VENTING DETAILS
△1 RGE010-05A	5A OF 13	PERIMETER DRAIN PLAN, PROFILE AND DETAILS
△1 RGE010-06A	6A OF 13	INLET FORCEMAIN PLAN AND PROFILE
△1 RGE010-06B	6B OF 13	PUMPOUT FORCEMAIN PLAN AND PROFILE
△1 RGE010-06C	6C OF 13	FORCEMAIN TIE-IN PIPING DETAILS
RGE010-06D	6D OF 13	FORCEMAIN TIE-IN PIPING DETAILS

NOTICE TO CONTRACTOR

CONTRACTOR MUST NOTIFY ALL UTILITIES AT LEAST 48 HOURS, AND NOT MORE THAN 10 DAYS, PRIOR TO THE PLANNED COMMENCEMENT OF EXCAVATION.

1. MEMBER UTILITIES WILL BE CONTACTED BY CALLING OUPS (1-800-362-2764).
2. THE OIL AND GAS PRODUCER UNDERGROUND PROTECTION SERVICE (1-614-587-0444).
3. EACH LIMITED BASIS PARTICIPANT AND MEMBERS OF THE OHIO OIL AND GAS ASSOCIATION WILL BE CONTACTED BY THE EXCAVATOR USING THE TELEPHONE NUMBER PROVIDED.

2 WORKING DAYS
BEFORE YOU DIG
CALL TOLL FREE 800-362-2764
OHIO UTILITIES PROTECTION SERVICE



MOST CURRENT AS OF PLAN DATE
AERIAL SOURCE: GOOGLE EARTH IMAGE DATED 7-10-2018
TOPOGRAPHY SOURCE: OGRIP LIDAR OSIP I (2007)

SITE PLAN

N:\RGE009–DOVETAIL BERM\GREICO SITE\RESPONSE TO COMMENTS 5-19\RGE010–GREICO–01.dwg – Jun 04, 2019 – 5:16pm – bhargest

REVISIONS	BY	DATE

DATE: 5-21-19
PREPARED BY: DAG
DRAWN BY: LMH
CHECKED BY: DAG
FILE: RGE010-01

NORTH POINT ENGINEERING
6657 Frank Ave. N.W.
Suite 200
North Canton, Ohio 44720
330 - 494 - 8888

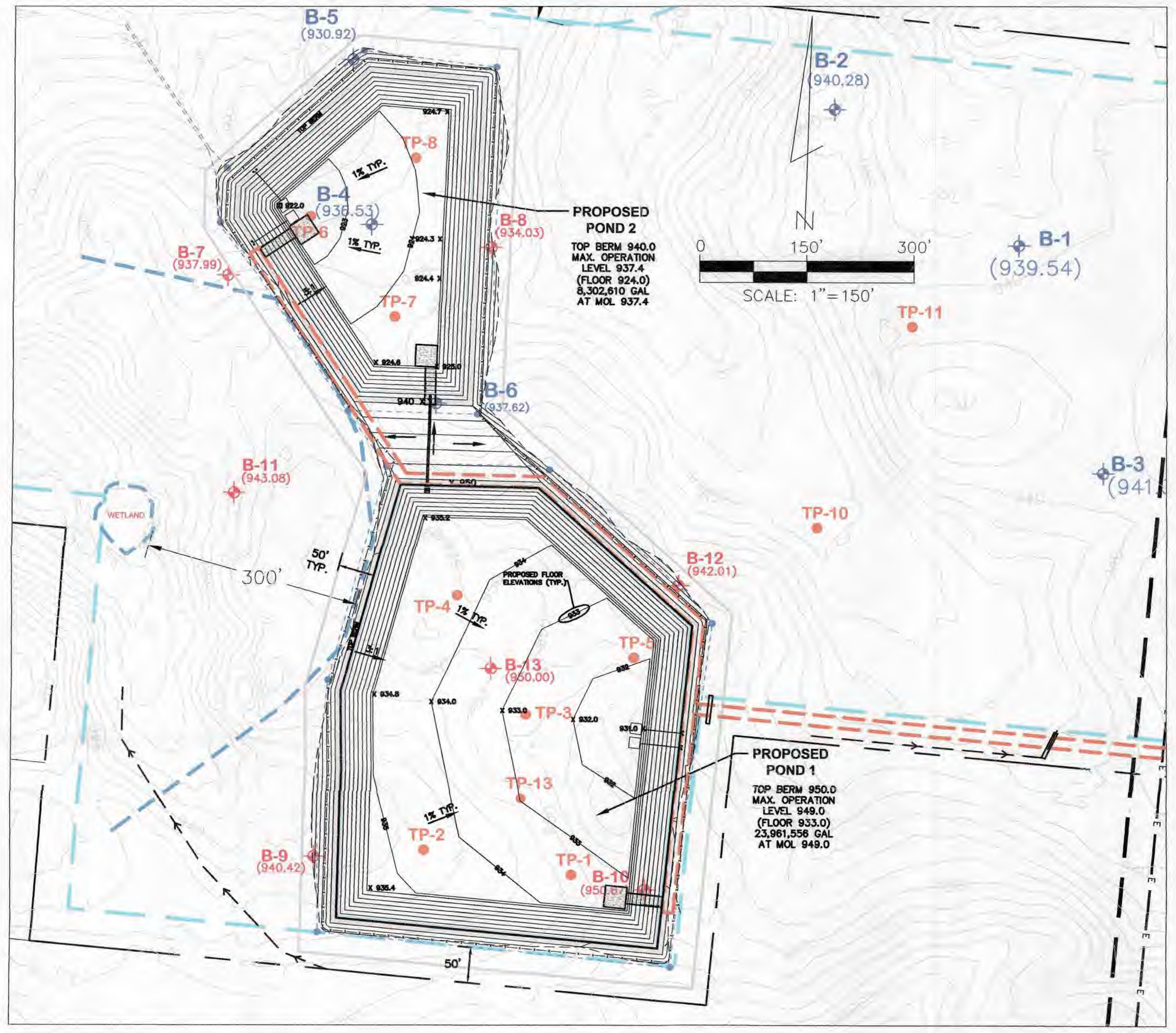
6-5-19
DATE
REG. PROF. ENG. DAVID GERDEMAN, P.E. LICENSE NO. 48568

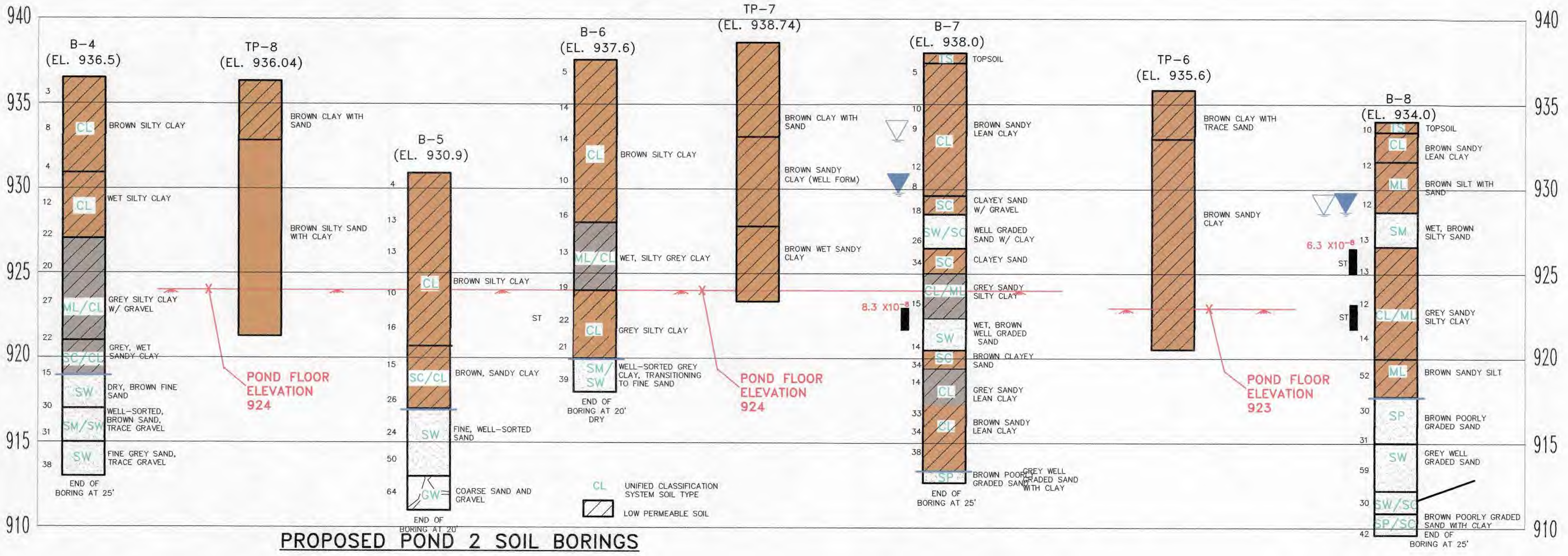
DOVETAIL ENERGY, LLC

TITLE SHEET AND SITING/SETBACK PLAN

BATH TOWNSHIP, GREENE COUNTY, OHIO

1/13

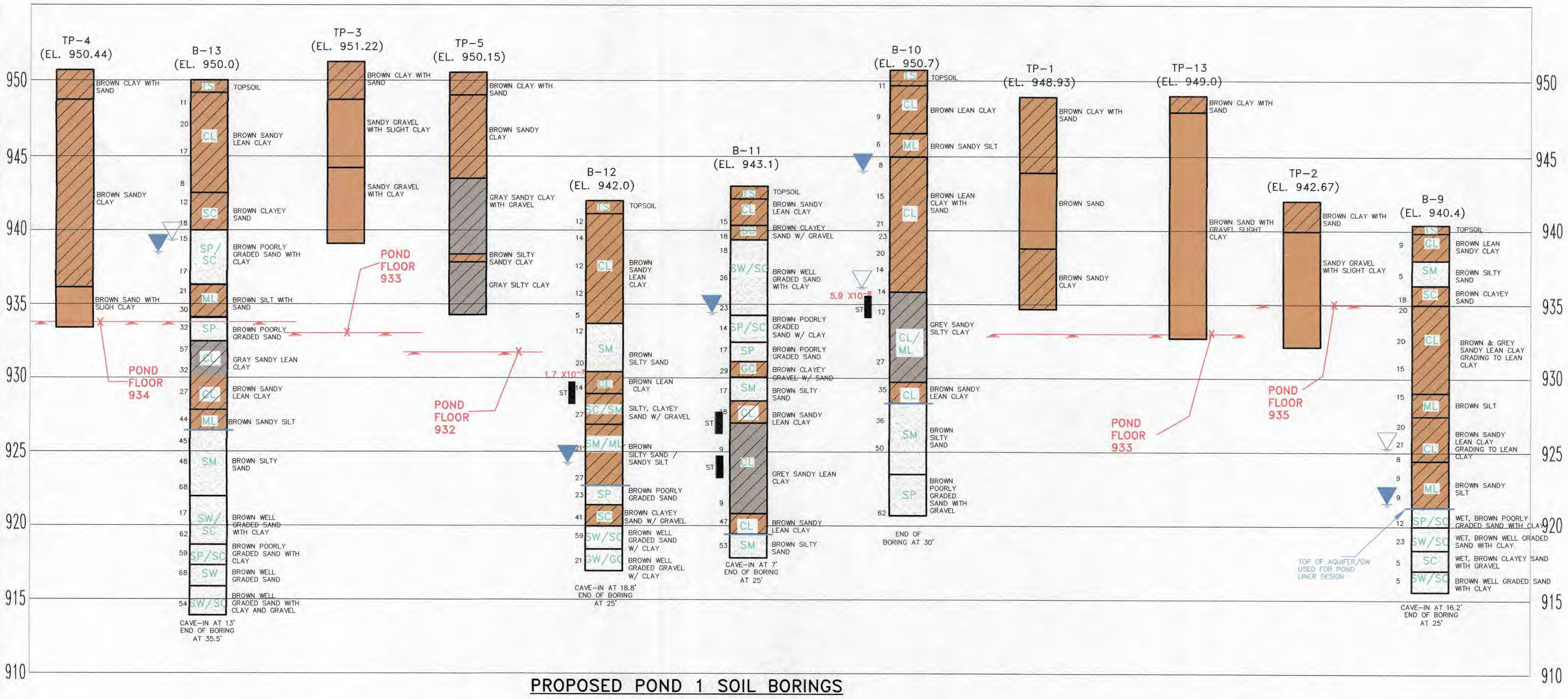




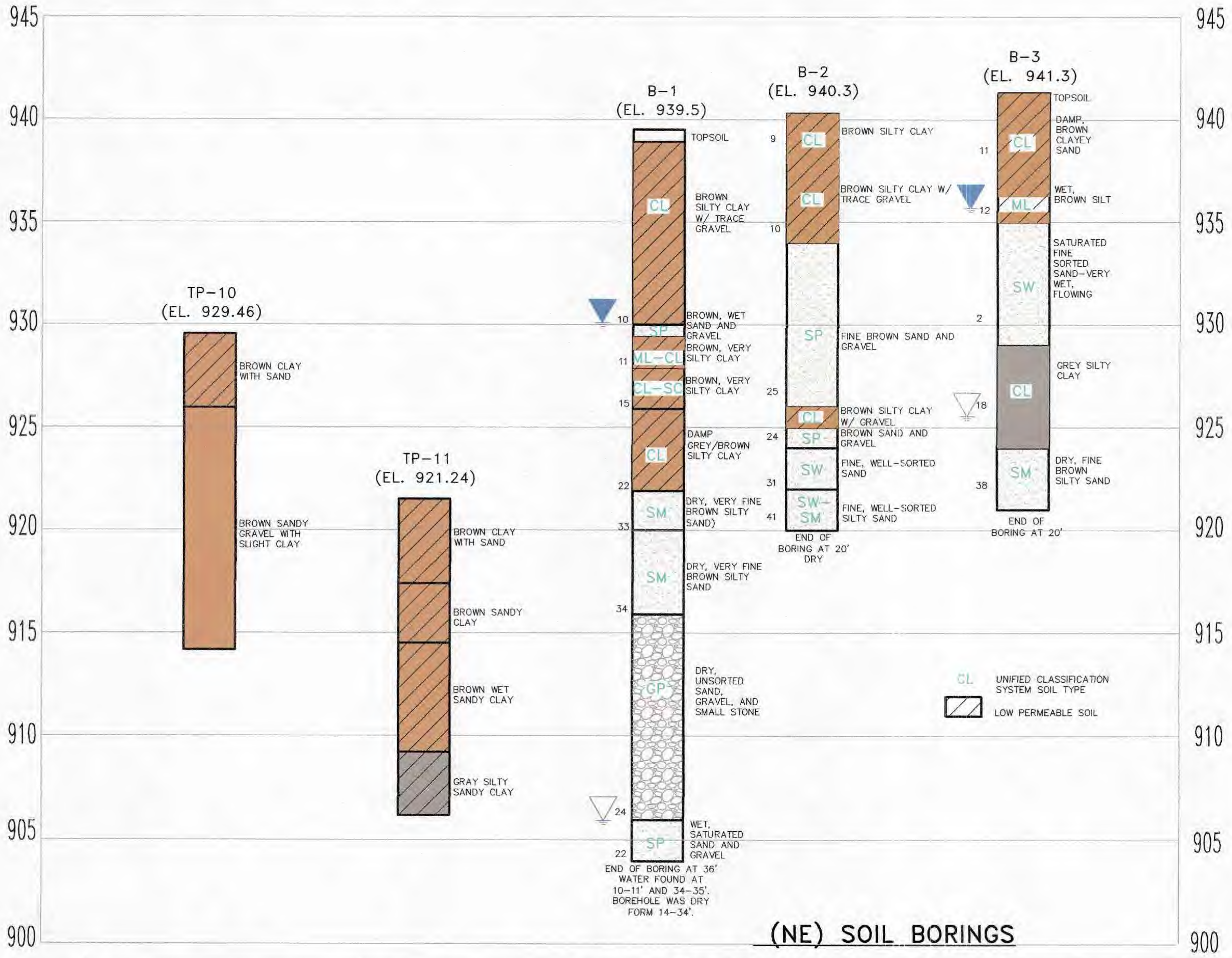
PROPOSED POND 2 SOIL BORINGS

LEGEND

B-1 (975.17)	SOIL BORINGS BY ENVIROCORE 12-5/6-2018 WITH SURVEYED EXISTING GROUND ELEVATION
B-7 (975.17)	SECOND ROUND OF SOIL BORINGS BY PSI 1-18, 22, 2019
	BORING LOCATIONS SURVEYED BY NPE
● TP-1	TEST PITS BY NORTH POINT ENGINEERING
▼	GROUNDWATER ENCOUNTERED
▽	GROUNDWATER AT COMPLETION



PROPOSED POND 1 SOIL BORINGS



(NE) SOIL BORINGS

PERMEABILITY TESTING SUMMARY												
						STANDARD PROCTOR						
SAMPLE TYPE	SOIL DESCRIPTION	USCS CLASSIFICATION	LOCATION	DEPTH (FEET)	REMOLDED SPECIFICATIONS	MDD (pcf)	OPTIMUM MOISTURE (%)	TESTED PERMEABILITY (cm/sec)	LIQUID LIMIT (%)	PLASTICITY INDEX	PASSING 200 SIEVE (%)	% CLAY
SHELBY TUBE	GREY, SANDY/SILTY CLAY	CL-ML	B-07	14.5'-16'	N/A	N/A	N/A	8.3 $\times 10^{-8}$	16	4	52.1	14.8
SHELBY TUBE	GREY, SANDY/SILTY CLAY	CL-ML	B-08	8.5'-10'	N/A	N/A	N/A	6.3 $\times 10^{-8}$	19	7	58.1	19.2
SHELBY TUBE	GREY, SANDY/SILTY CLAY	CL-ML	B-10	16'-17.5'	N/A	N/A	N/A	5.9 $\times 10^{-8}$	19	7	60.3	18.9
SHELBY TUBE	GREY, SANDY/SILTY CLAY	CL-ML	B-12	13'-14.5'	N/A	N/A	N/A	1.3 $\times 10^{-7}$	17	4	38.9	10.9
BULK	BROWN SILTY CLAY W/ SAND	CL-ML	TP-4	0'-2'	N/A	N/A	N/A	N/A	20	6	71.43	12.77
BULK	BROWN SANDY LEAN CLAY	CL	TP-5	0'-1.5'	97.2%, +1.4	113.3	15.0	4.1 $\times 10^{-8}$	38	23	67.66	28.19
BULK	SILTY, CLAYEY SAND	SC-SM	TP-7	0'-7'	N/A	N/A	N/A	N/A	18	6	46.95	11.61
BULK	CLAYEY SAND W/ GRAVEL	SC	TP-8	0'-2.5'	95.0%, +3.3	126.4	10.1	2.4 $\times 10^{-8}$	26	12	47.72	18.29
BULK	BROWN SANDY LEAN CLAY	CL	TP-10	0'-3.5'	N/A	N/A	N/A	N/A	44	28	65.79	29.77
BULK	BROWN SANDY LEAN CLAY	CL	TP-11	0'-4'	98.1%, +1.8	121.2	13.0	1.9 $\times 10^{-8}$	24	11	58.87	21.90

REVISIONS				
NUMBER	DATE	MADE BY	CHECKED BY	DESCRIPTION

DATE: 5-21-19
PREPARED BY: DAG
DRAWN BY: RTS
CHECKED BY: DAG
FILE: RGE010-2A

NORTH POINT ENGINEERING
6657 Frank Ave. N.W.
Suite 200
North Canton, Ohio 44720
330 - 494 - 8888
Fax 330 - 494 - 8889

REG. PROF. ENG. DAVID A GERDEMAN, P.E. LICENSE NO. E-48568
DATE 6-5-19

DOVETAIL ENERGY, LLC

SUBSURFACE INFORMATION

BATH TOWNSHIP, GREENE COUNTY, OHIO

2/13

N:\RGE009-DOVETAIL BERM\GREICO SITE\RESPONSE TO COMMENTS 5-19\RGE010-GREICO-02.dwg - Jun 04, 2019 - 4:54pm - bhargest

SITE PLAN LEGEND:

—— – – ——	EXIST. PROPERTY BOUNDARY
▬ ▬	EXIST. WATERS OF THE STATE
——	EXIST. CONTOURS LIDAR OSIP POINT DATA
△	SURVEY BENCH MARK (TO BE SET PRIOR TO CONSTRUCTION)
—— x ——	PROPOSED FENCE
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B-1 (975.17)	SOIL BORINGS BY ENVIROCORE 12–5/6–2018 WITH SURVEYED EXISTING GROUND ELEVATION
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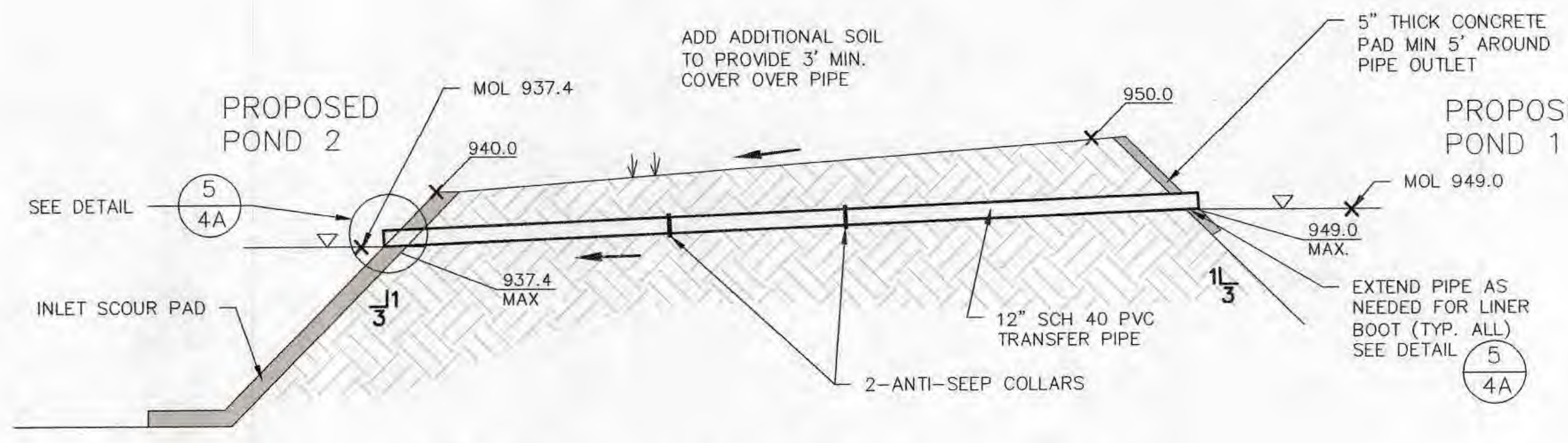
● TP	NORTH POINT ENGINEERING TEST PITS
—▸—▸	PROPOSED SURFACE PERIMETER DITCH
- - - - -	PROPOSED SUBSURFACE PERIMETER DRAIN
▬ ▬ ▬	SET BACKS
▨	PROPOSED CONCRETE
═ ═ ═	ACCESS CORRIDOR △1
⌒⌒⌒	PROPOSED WINDBREAK/SHELTER BELT △1

N

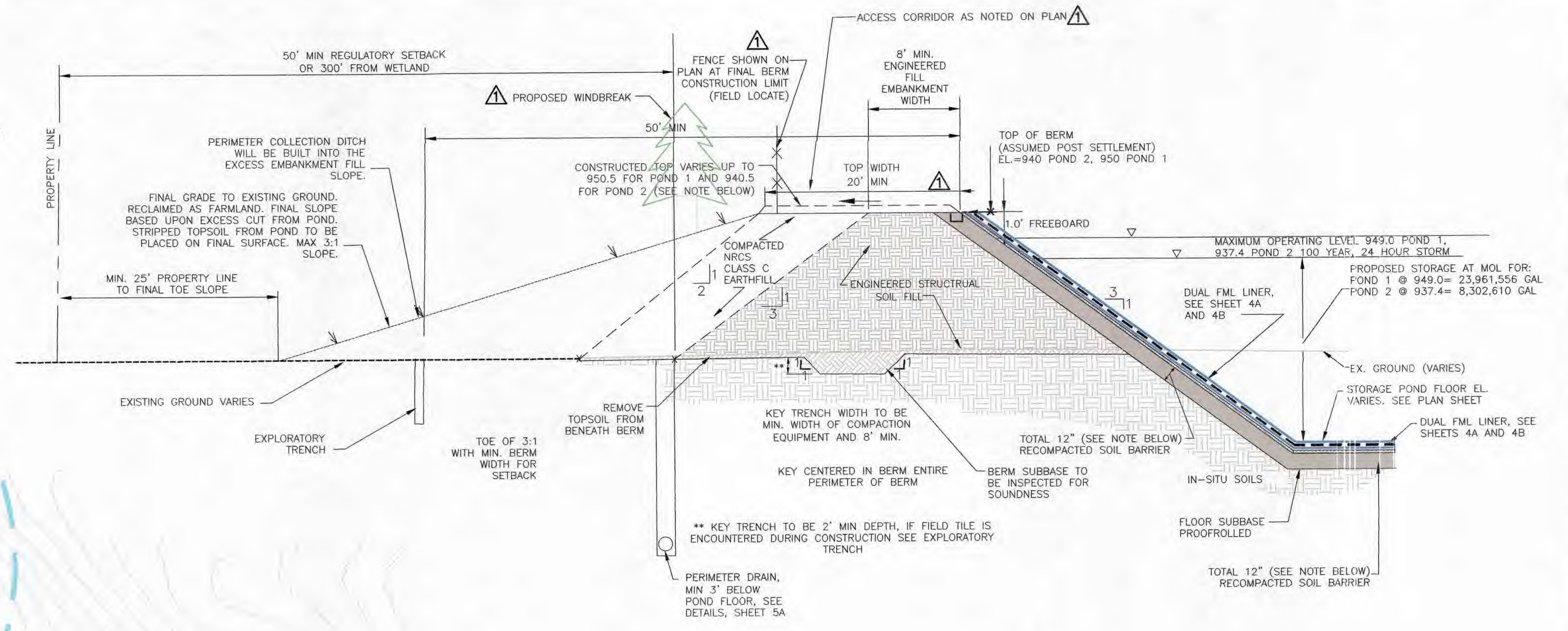
0 100' 200'

SCALE: 1"=100'



1/3A TRANSFER PIPE DETAIL

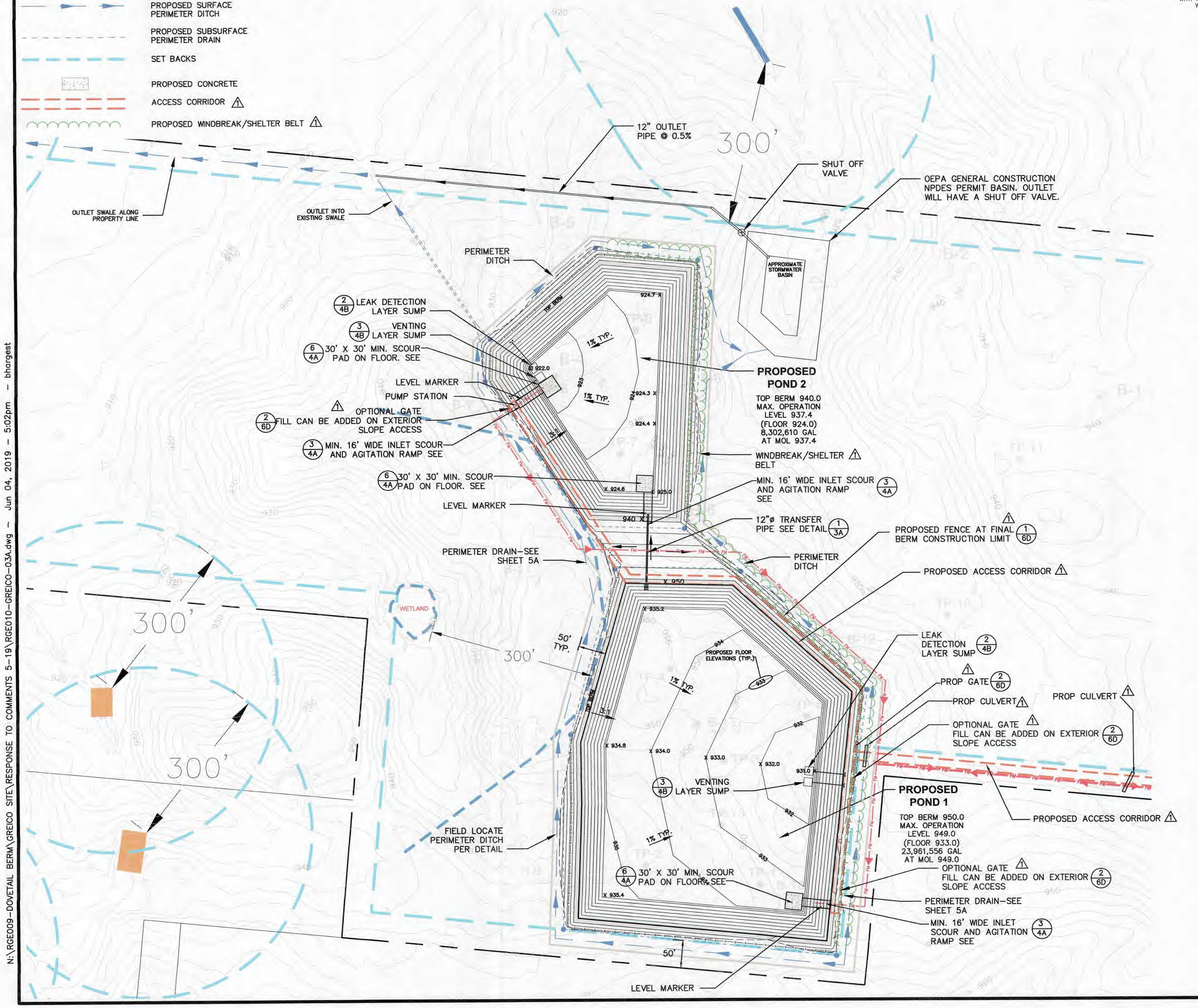
NTS



TYPICAL POND EMBANKMENT SECTION

N.T.S.

CONSTRUCTED BERM TOP NOTE: THE BERM WILL BE OVER CONSTRUCTED 5% OF THE BERM HEIGHT ABOVE EXISTING GROUND. FINAL HEIGHT VARIES 940.5 TO 940 FOR POND 2, 950.5 TO 940.5 FOR POND 1.



WASTEWATER STORAGE POND SOILS CONSTRUCTION SPECIFICATIONS

ENGINEERED STRUCTURAL SOIL FILL

SUBJECT TO THE ENGINEER'S APPROVAL, AREAS TO RECEIVE FILL SHALL BE STRIPPED TO REMOVE ALL VEGETATION, TOPSOIL, ORGANIC MATTER, OVERLY SOFT MATERIAL AND OTHER UNSUITABLE MATERIALS PRIOR TO THE PLACEMENT OF FILL MATERIALS. OVEREXCAVATED AREAS SHALL BE REPLACED WITH COMPACTED FILL.

FILL SHALL CONSIST OF ON–SITE EXCAVATED, SOIL MATERIALS FREE OF FOREIGN MATERIALS, REFUSE, ROOTS OR OTHER DELETERIOUS SUBSTANCES.

IF ENCOUNTERED, THE CONTRACTOR SHOULD BE PREPARED TO REMOVE SURFACE AND GROUND WATER FROM THE CONSTRUCTION AREA.

PLACEMENT OF FILL MATERIALS SHALL BE APPROVED BY THE ENGINEER AND INSPECTED WHEN REQUIRED. WHEN TESTING IS REQUIRED, ALLOW THE ENGINEER'S REPRESENTATIVE TIME TO PERFORM TESTING/INSPECTION AFTER COMPLETION OF EACH LAYER OF FILL IN THE DESIGNATED AREA.

- PRECOMPACTED LIFT THICKNESS: THE LIFT THICKNESS SHALL BE EQUIVALENT TO THE LENGTH OF THE FEET OF THE SHEEPSFOOT ROLLER PLUS 2 INCHES; NOT TO EXCESS 8 INCHES IN TOTAL LOOSE LIFT THICKNESS.
- MAXIMUM ROCK DIAMETER: 3 INCHES.
- MINIMUM MOISTURE CONTENT: THE SOIL MATERIAL SHALL BE OF SUFFICIENT MOISTURE TO EASILY FORM IT INTO A MOIST, SOMEWHAT SOFT, BALL BY HAND AND NOT DEVELOP ANY CRACKS. THIS MOISTURE CONTENT APPROXIMATES OPTIMUM PLUS 2%.
- COMPACTION EQUIPMENT: SHEEPSFOOT ROLLER WITH A MINIMUM 200–PSI FOOT CONTACT PRESSURE, AND A MINIMUM 7"IN PAD LENGTH. ALTERNATE COMPACTION EQUIPMENT CAN BE USED BASED UPON SOIL TYPE AND APPROVED BY THE CERTIFYING ENGINEER.
- COMPACTION EFFORT: A MINIMUM OF 6 PASSES OF THE ROLLER OVER ALL POINTS OF EACH LIFT.
- ANY ADDITIONAL WATER NEEDED FOR PROPER COMPACTION SHALL BE THOROUGHLY MIXED IN WITH A DISK PRIOR TO COMPACTION.
- THE SURFACE OF A COMPACTED LIFT MUST BE SUFFICIENTLY MOIST TO ALLOW BONDING WITH THE NEXT LIFT, OTHERWISE THE SURFACE NEEDS TO BE SCARIFIED, WETTED TO THE MINIMUM MOISTURE CONTENT, AND RECOMPACTED PRIOR TO PLACEMENT OF THE NEXT LIFT.
- IN LIEU OF THE PLACEMENT FILL SPECIFICATIONS ABOVE, THE CONTRACTOR CAN ELECT TO USE ALTERNATE SHEEPSFOOT COMPACTION EQUIPMENT PROVIDED EACH LIFT IS TESTED TO HAVE ACHIEVED A MINIMUM OF 95% OF STANDARD PROCTOR MDD AND AT A MOISTURE OF +0% TO +4% OF OPTIMUM MOISTURE. TESTS SHALL BE DONE AT A MINIMUM OF 1 TEST PER LIFT, MIN 1 TEST PER PRODUCTION DAY.

12" RECOMPACTED SOIL BARRIER LAYER

IN ADDITION TO THE MINIMUM SPECIFICATIONS FOR ENGINEERED COMPACTED SOIL, THE 12" RECOMPACTED SOIL BARRIER LAYER WILL CONSIST OF SELECT CLAYEY SOILS APPROVED FOR USE BY THE CERTIFYING ENGINEER AND WILL BE COMPACTED AT A MINIMUM DENSITY OF 95% OF STANDARD PROCTOR MDD AT A MOISTURE CONTENT AT OR ABOVE OPTIMUM MOISTURE. THIS DENSITY AND MOISTURE CONTENT WILL BE CONFIRMED IN THE FIELD USING THE NUCLEAR GAUGE METHOD AT A RATE OF 1 TEST PER LIFT, MINIMUM 1 TEST PER PRODUCTION DAY BASED ON OAC–3745–42–13.

GENERAL COMPACTED EARTHFILL

THIS SHALL MEET THE REQUIREMENTS OF NRCS CONSTRUCTION SPECIFICATION OH–23, EARTHFILL.

DAVID A GERDEMAN E-48568

OTHER SPECIFICATIONS

MEASURING DEVICE

FOR THE PROPOSED STORAGE PONDS, THE CONTRACTOR WILL INSTALL ONE LEVEL MEASURING DEVICE. THE MEASURING DEVICE WILL BE A 12" HIGH 1/2" MIN. DIAMETER REBAR ANCHORED INTO THE CONCRETE RAMP PORTION OF THE INLET SCOUR PROTECTION AS NOTED IN THE PLANS. THE PINS ARE SET INTO THE TOP OF THE CURB ON THE RAMP AND THE TOP BENT. A SEPARATE ROD WILL BE SET FOR EACH ELEVATION STARTING AT THE MAXIMUM OPERATING ELEVATION AND EVERY EVEN ONE FOOT INCREMENT BELOW THAT DOWN TO AT LEAST HALF WAY DOWN POND SLOPES. A LEVEL MARKER ALSO WILL BE SET AT THE 50% FULL MARK. THE ACTUAL FINAL ELEVATIONS TO BE USED WILL BE DETERMINED AT COMPLETION OF CONSTRUCTION BASED UPON AS–BUILT DIMENSIONS.

SUBBASE PROOF ROLLING

THE SUBBASE GRADE ON BOTH THE BOTTOM OF THE POND AND BELOW GRADE PORTIONS OF THE SIDESLOPES OF THE POND WHICH IS THE BOTTOM OF THE COMPACTED SOIL BARRIER LAYER, WILL BE PROOFROLLED IN THE PRESENCE OF THE CERTIFYING ENGINEER'S REPRESENTATIVE WITH A LOADED RUBBER TIRED TRUCK OR SCRAPER MAKING REPETITIVE OFFSET PASSES OVER THE AREA. IF EXCESSIVE OR IRREGULAR DEFLECTION (IDENTIFIED AS IN EXCESS OF 3 INCHES) AND PUMPING ARE OBSERVED THE DELINEATED AREA SHALL BE OVER EXCAVATED TO A MINIMUM OF 24 INCHES AND INSPECTED FOR WEAK SOILS. IF PRESENT, ANY WEAK SOILS WILL BE OVEREXCAVATED AND REMOVED AS NEEDED TO OBTAIN A FIRM, STABLE BASE FOR PLACEMENT OF THE SOIL BARRIER LAYER. EXCAVATED AREA WILL BE SUBJECTED TO A PROOF ROLL PRIOR TO BACKFILLING WITH COMPACTED ENGINEERED SOIL FILL.

FENCING

FENCING THE POND AND PROVIDING FLOTATION DEVICES FOR PUBLIC SAFETY IS REQUIRED. WARNING SIGNS WITH A ROPE AND SAFETY FLOTATION DEVICE SHALL BE PLACED ON AT LEAST TWO SIDES OF AN POND. LOCATE THE PERMANENT FENCE SO THAT EASY ACCESS IS POSSIBLE FOR THE AGITATING AND PUMPING EQUIPMENT. A 4' HIGH WOVEN WIRE FENCE PER NRCS STANDARD 382 OR EQUAL SHALL BE INSTALLED.

△1 EXPLORATORY TRENCH

AT THE BEGINNING OF CONSTRUCTION, THE CONTRACTOR SHALL EXCAVATE A 48" DEEP FIELD TILE EXPLORATORY TRENCH 50 FEET OUTSIDE THE PROPOSED PONDS AS NOTED IN THE DRAWING. THE CONTRACTOR SHALL PERMANENTLY PLUG ALL ENCOUNTERED FIELD TILE SYSTEMS BY SEALING WITH A PLASTIC CAP IF THE PIPE IS NOT INTACT OR BY PACKING CLAYEY SOILS OR BACKFILLING WITH CONCRETE IF THE PIPE IS BROKEN, (IF DRAINING AWAY) AND/OR REROUTE THE ENCOUNTERED TILE SYSTEM USING SAME TYPE/SIZE TILE WITH FITTINGS IN A MANNER ACCEPTABLE TO THE OWNER. ALL TILES INSIDE OF THE 50' SETBACK SHALL BE COMPLETELY REMOVED. DOCUMENTATION MUST BE PROVIDED TO THE CERTIFYING ENGINEER AND INCLUDED IN THE FINAL DOCUMENT.

AGITATION RAMP AND FLOOR PAD

SCOUR PADS AT RAMPS WILL BE CONSTRUCTED ON TOP OF THE FINISHED LINER SYSTEM AT NUMBERS AND LOCATIONS AROUND THE POND DETERMINED BY THE OWNER. SAND BAGS WILL BE USED TO FORM THE PADS.

CERTIFICATION

CONSTRUCTION OF THE POND WILL BE CERTIFIED BY A PROFESSIONAL ENGINEER REGISTERED IN THE STATE OF OHIO.

PERIMETER DITCH

COLLECT RUNOFF FROM THE DIRECT POND AREA. CONSTRUCT INTO EXCESS EMBANKMENT FILL.

CONCRETE

CONCRETE SHALL BE PLACED IN ACCORDANCE WITH NRCS CONCRETE CONSTRUCTION SPECIFICATIONS.

REVISIONS	BY	DATE
△1 ADD ACCESS CORRIDOR AND MOVED FENCE ON PLAN SECTION		
AND ADDED GATES, UPDATE EMBANKMENT SECTION ADDED FILL		
NOTE FOR ACCESS TO OPTIONAL GATE ACCESS AREAS		

DATE: 5–21–19
PREPARED BY: DAG
DRAWN BY: LMH
CHECKED BY: DAG
FILE: RGE009–03A

NORTH POINT ENGINEERING
6657 Frank Ave. N.W.
Suite 200
North Canton, Ohio 44720
330 – 494 – 8888

REG. PROF. ENG. DAVID GERDEMAN, P.E. LICENSE NO. 48568
6-5-19
DATE

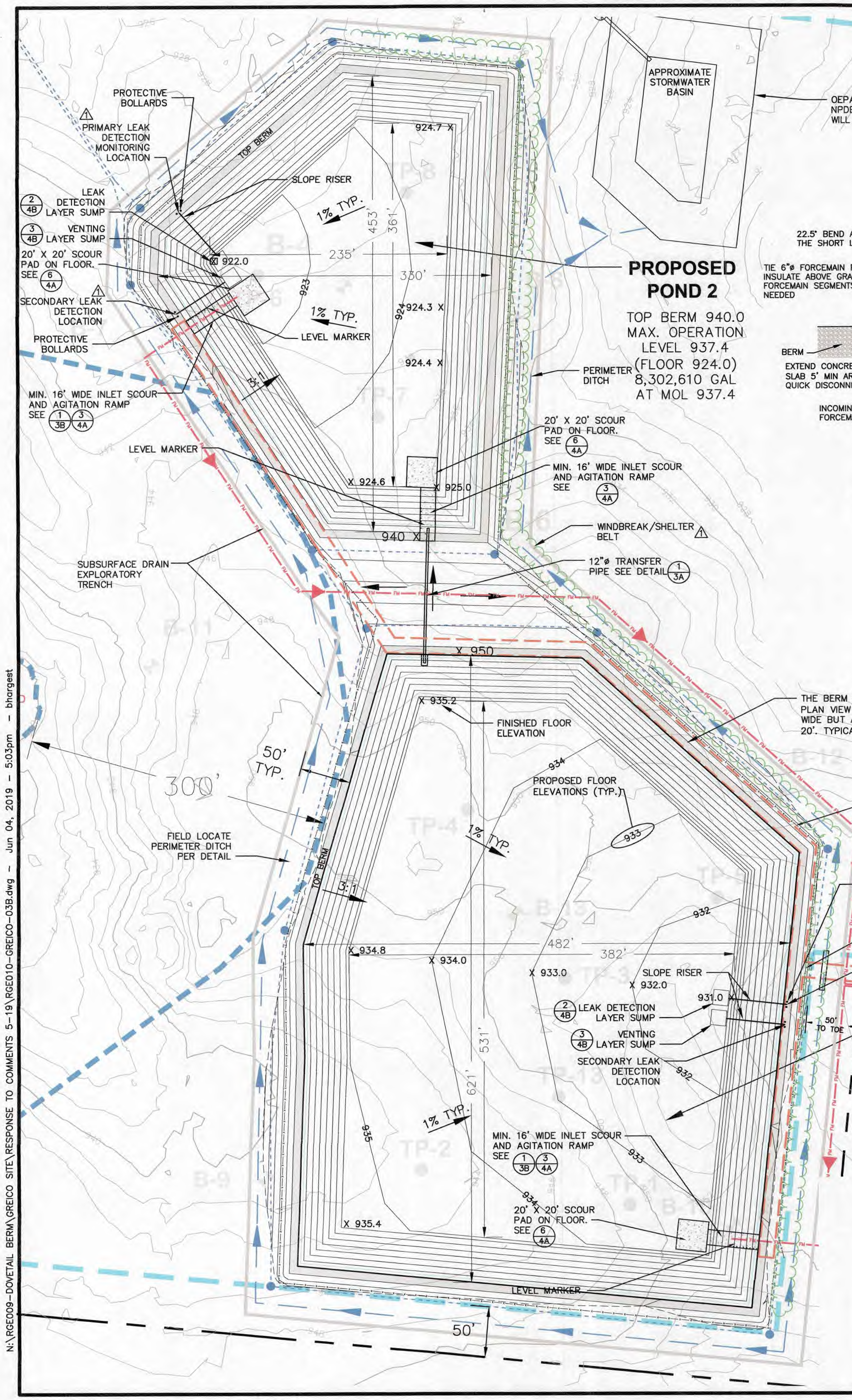
DOVETAIL ENERGY, LLC

WASTEWATER EARTHEN EMBANKMENT AND LINER POND PLAN AND SPECIFICATIONS

BATH TOWNSHIP, GREENE COUNTY, OHIO

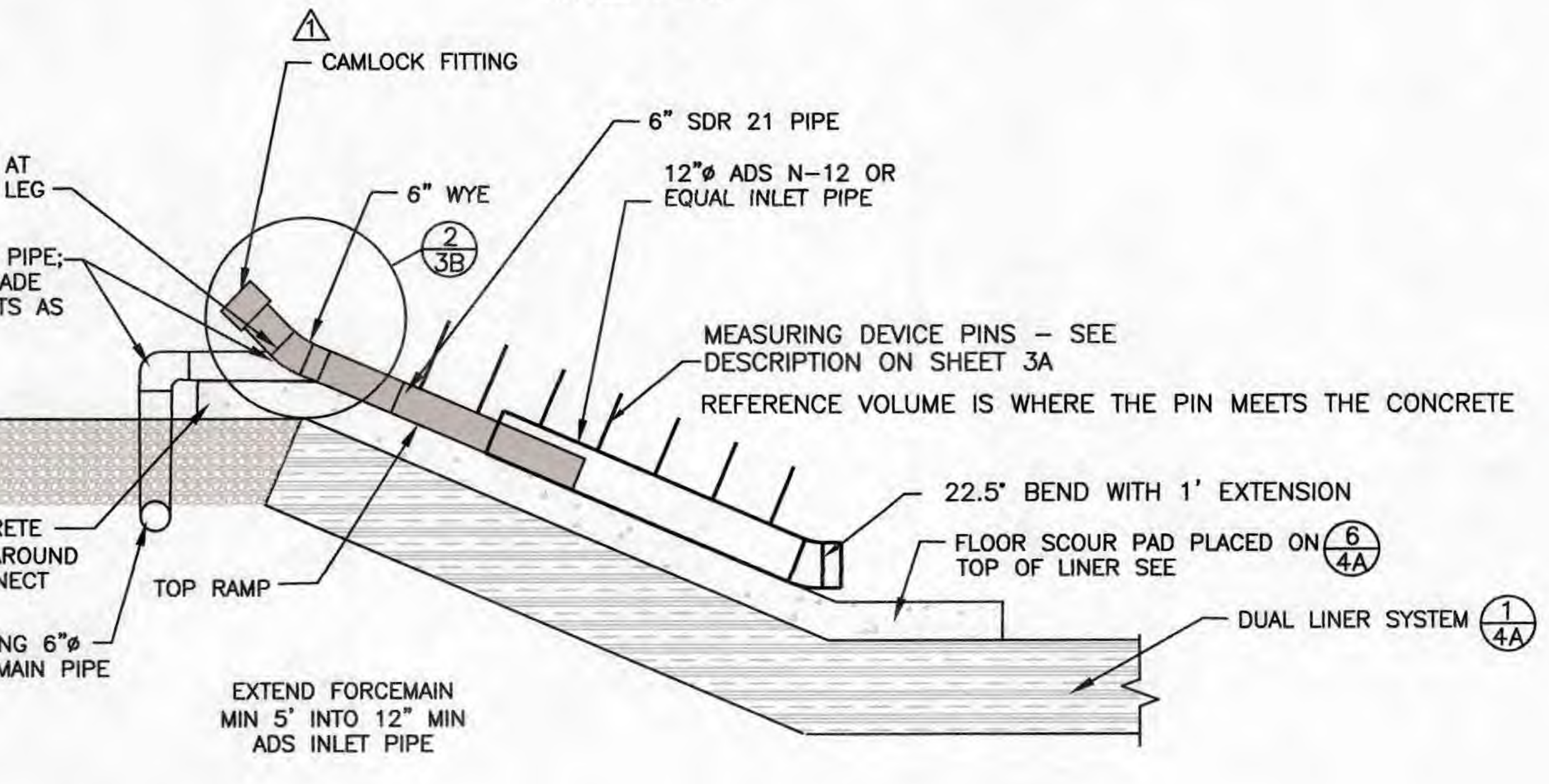
3A/13

N:\RGE009–DOVETAIL BERM\GREICO SITE\RESPONSE TO COMMENTS 5–19\RGED10–GREICO–03A.dwg – Jun 04, 2019 – 5:02pm – bhorgest



N

0 60' 120'
SCALE: 1"=60'

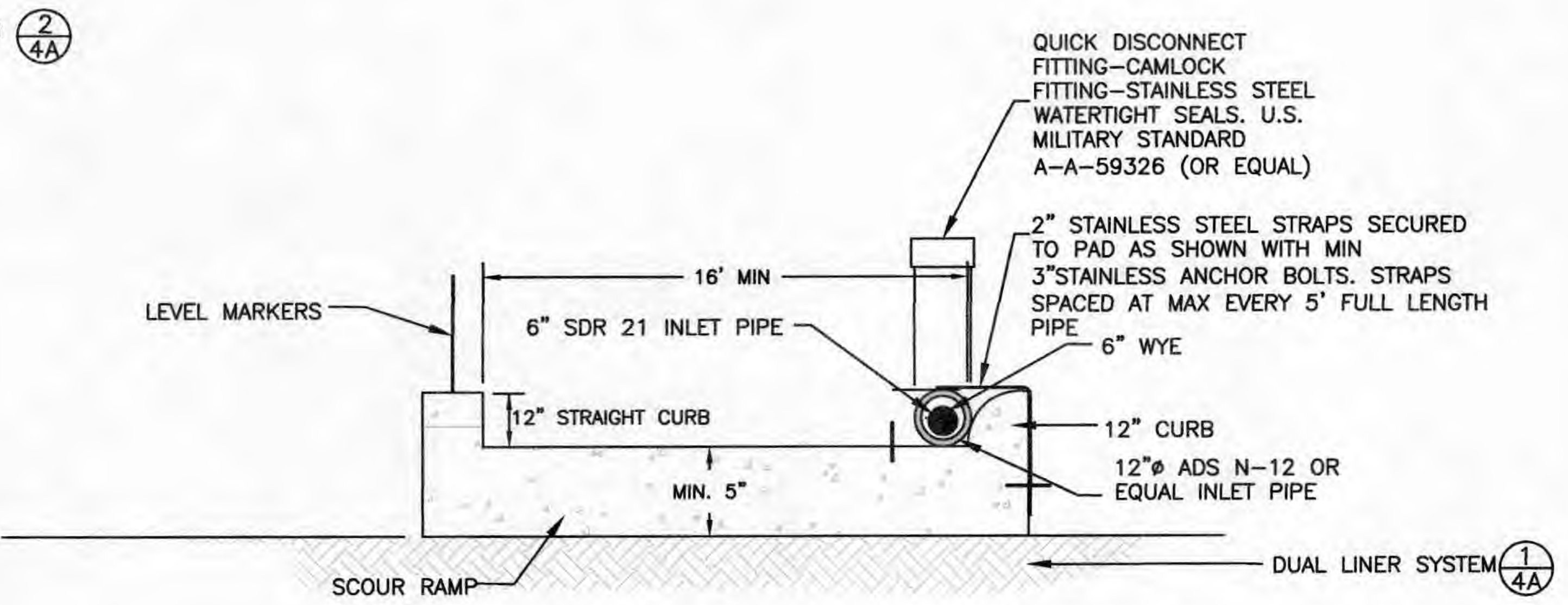


1/3B INLET SCOUR AND AGITATION RAMP PROTECTION

N.T.S.

SEE ALSO 3/4A

SEE SECTION 2/4A



2/3B INLET SCOUR AND AGITATION PROTECTION END VIEW

N.T.S.

SITE PLAN LEGEND:

▬ ▬ ▬	EXIST. PROPERTY BOUNDARY
——976——	EXIST. CONTOURS LIDAR OSIP POINT DATA
△	SURVEY BENCH MARK
—— X —— X ——	PROPOSED FENCE
▬	SUBSURFACE DRAINS EXPLORATORY TRENCH
—— ► —— ►	PROPOSED SURFACE PERIMETER DITCH
- - - - -	PROPOSED SUBSURFACE PERIMETER DRAIN
▬ ▬ ▬	SET BACKS
▨	PROPOSED CONCRETE
▬ ▬ ▬	ACCESS CORRIDOR ⚠1
⌒⌒⌒	PROPOSED WINDBREAK/SHELTER BELT ⚠1
B-3	SOIL BORINGS ON TRICAR, LTD., PLANS, SEPTEMBER 2006
⊕ TP-1	SOIL BORINGS ON TRICAR, LTD., PLANS, SEPTEMBER 2006
C-1 (975.17)	SOIL BORINGS BY ENVIROCORE 10-18/19-2018 WITH SURVEYED EXISTING GROUND ELEVATION
⌖ C-1	PIEZOMETERS BY ENVIROCORE 10-18/19-2018

POND 2 VOLUME TABLE

	ELEVATION CONTOUR	CONTOUR AREA	AVERAGE AREA	HEIGHT BETWEEN	INCREMENTAL STORAGE VOLUME	CUMULATIVE FROM BOTTOM (CUBIC FEET)	CUMULATIVE FROM BOTTOM (GALLONS)
	922	20.0					
			17767	2	35534	35534	265,793
	924	35513.9					
			47946	1	47946	103761	776,135
	925	60378.2					
			68395	5	341975	445737	3,334,109
	930	76411.9					
			89762	7.4	664238	1109975	8,302,610
MOL →	937.4	103111.9					
			108255	2.6	281462	1391437	10,407,949
	940	113397.6					

POND 1 VOLUME TABLE

	ELEVATION CONTOUR	CONTOUR AREA	AVERAGE AREA	HEIGHT BETWEEN	INCREMENTAL STORAGE VOLUME	CUMULATIVE FROM BOTTOM (CUBIC FEET)	CUMULATIVE FROM BOTTOM (GALLONS)
	931	20.0					
			57796	3	173387	173387	1,296,933
	934	115571.2					
			147071	1.25	183838	357225	2,672,044
	935.25	178570.1					
			183059	0.75	137294	310681	2,323,895
	936	187548.2					
			192703	2	385405	696086	5,206,725
	938	197856.9					
			203145	2	406289	1102376	8,245,769
	940	208432.4					
			213854	2	427707	1530083	11,445,020
	942	219274.9					
			224830	2	449659	1979742	14,808,471
	944	230384.3					
			236073	2	472145	2451887	18,340,115
	946	241760.7					
			247582	2	495165	2947052	22,043,947
	948	253404.0					
			256365	1	256365	3203417	23,961,556
MOL →	949	259325.7					
			262320	1	262320	3465736	25,923,709
	950	265314.2					

POND 2 FREEBOARD CALCULATION TABLE

Dovetail Energy, LLC
Storage Pond #2 Maximum Operating Level Calculation Worksheet
May 2, 2019

1. 100 Year/24 Hour Storm Rainfall and Run-off (Max Operating Level calculation)

a. 100-year 24-hour precipitation on pond surface

100-year 24-hour storm from NOAA website		=	5.5	inches			
Pond area		=	381460.60	sf inside top berm both ponds			
Collected precipitation	**SUBTOTAL**	=	**174,836**	ft³	**SUBTOTAL**	(ft³)	**174,836**
Volume 100 year precipitation and runoff		=	174,836	cu ft			
Surface area of Pond 2 at 1' freeboard		=	109,404	sf Pond 2 at elv. 939			
Depth reserved for 100 year storm in Pond 2		=	1.6	ft diff between design (1' freeboard) and operating levels MOL			

REVISIONS	BY	DATE
⚠1 ADD FENCE AND GATE DETAILS		

DATE: 5-21-19
PREPARED BY: DAG
DRAWN BY: LMH
CHECKED BY: DAG
FILE: RGE009-03B

NORTH POINT ENGINEERING
6657 Frank Ave. N.W.
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330 - 494 - 8888

DAVID A GERDEMAN E-48568

6-5-19
DATE

REG. PROF. ENG. DAVID GERDEMAN, P.E. LICENSE NO. 48568

DOVETAIL ENERGY, LLC

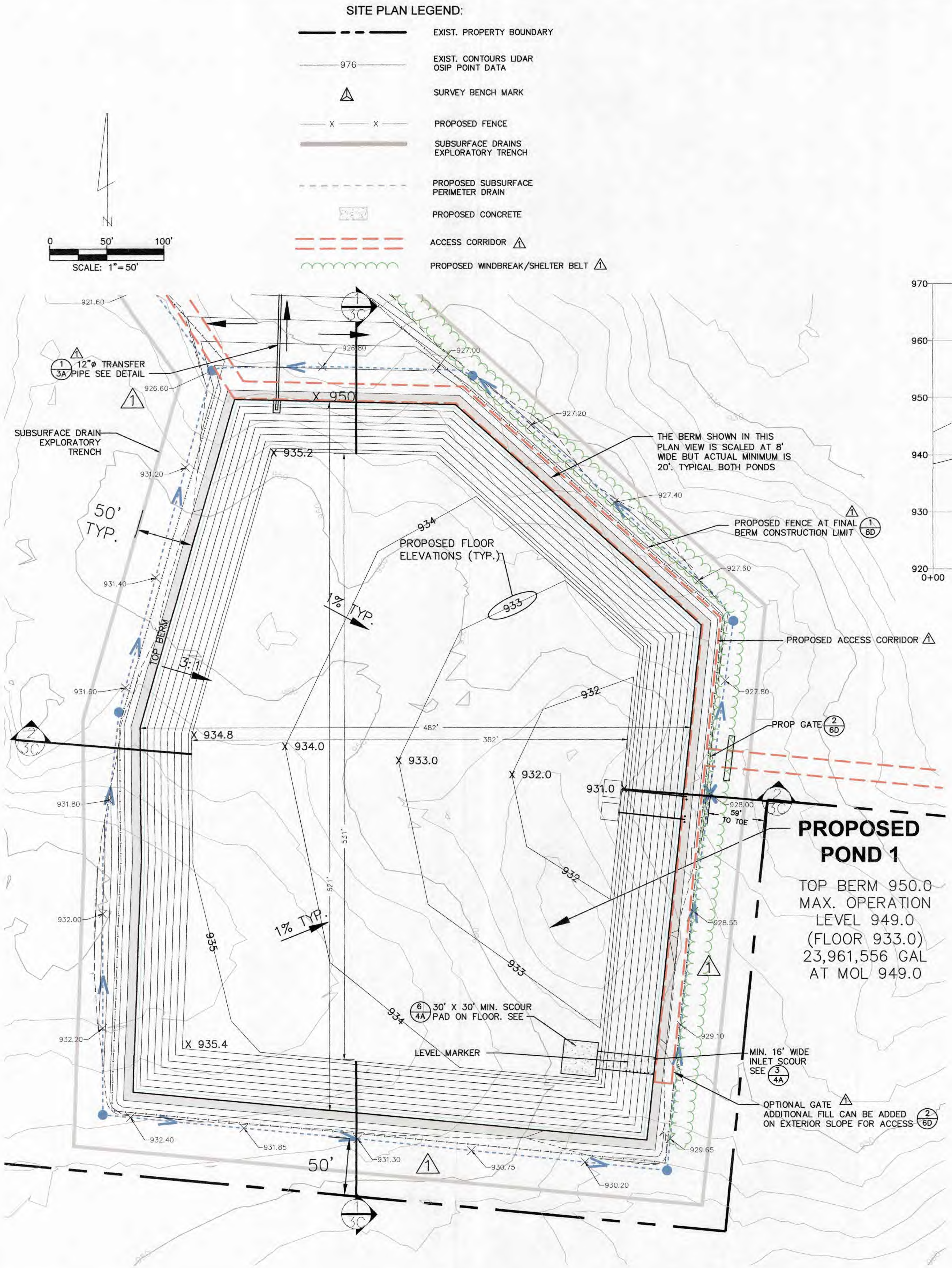
STORAGE PONDS PLAN
ENLARGED VIEW, VOLUMES
AND DETAILS

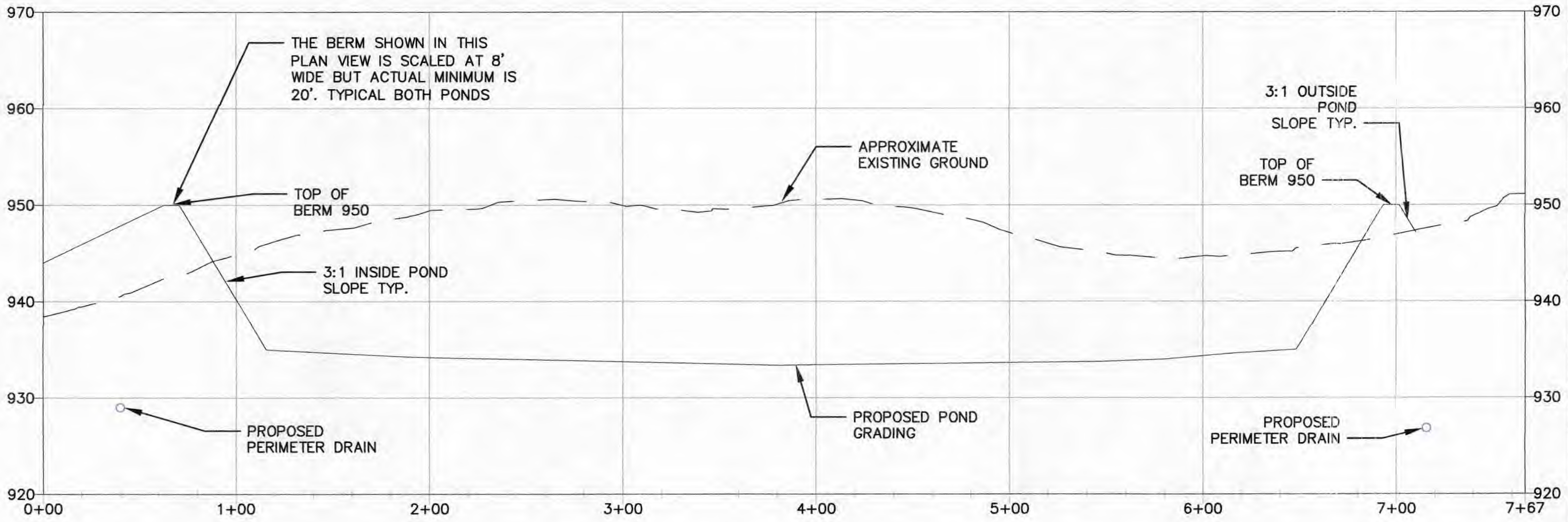
BATH TOWNSHIP, GREENE COUNTY, OHIO

3B/13

N:\RGE009-DOVETAIL BERM\GRECO SITE\RESPONSE TO COMMENTS 5-19\RGE010-GRECO-03B.dwg - Jun 04, 2019 - 5:03pm - bhargest

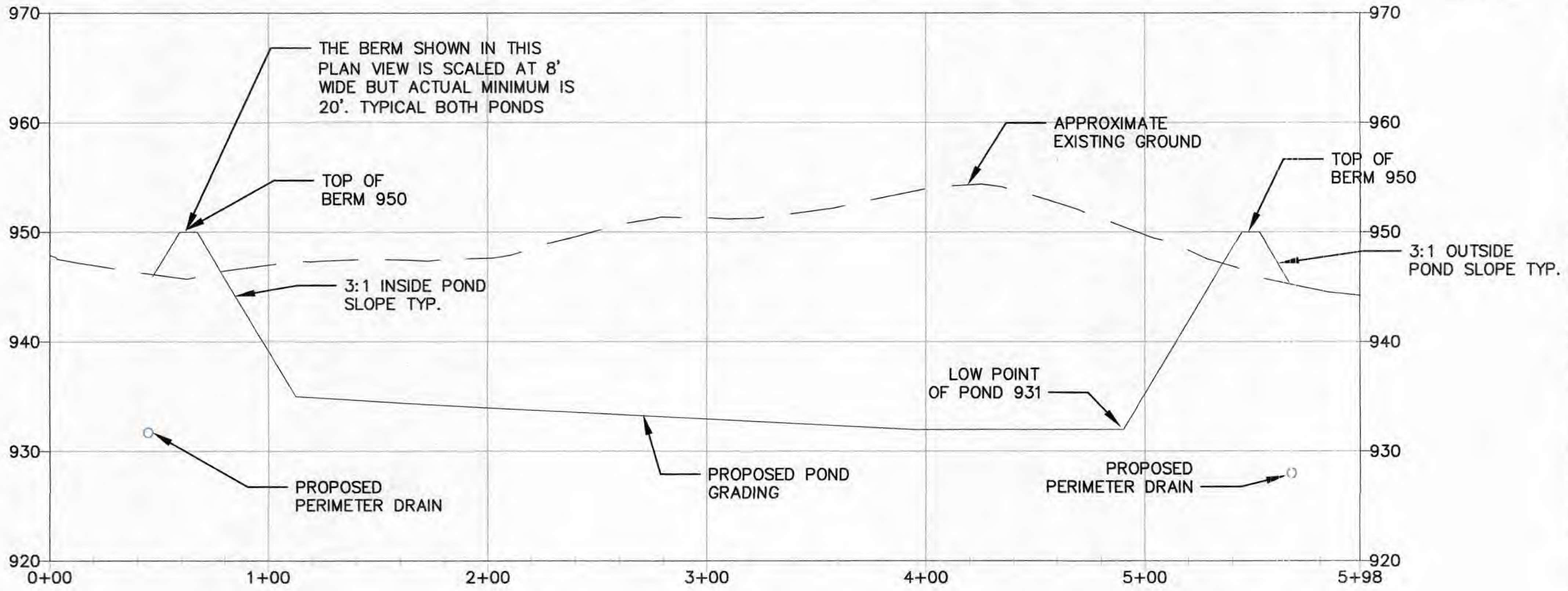
N:\RGE009-DOVETAIL BERM\GREICO SITE\RESPONSE TO COMMENTS 5-19\RGE010-GREICO-03C.dwg - Jun 04, 2019 - 5:04pm - bhargest





1 3C POND 1 CROSS-SECTION NORTH-SOUTH

1"=50H, 1"=10'V



2 3C POND 1 CROSS-SECTION WEST-EAST

1"=50H, 1"=10'V

DAVID A GERDEMAN E-48568

REVISIONS

		BY	DATE
1	REVISED PERIMETER DRAIN ELEVATION AND FLOW ARROWS, CALLOUTS ON GATES AND ACCESS CORRIDOR UPDATE LABEL CALLOUT ON TRANSFER PIPE		

DATE: 5-21-19
PREPARED BY: DAG
DRAWN BY: LMH
CHECKED BY: DAG
FILE: RGE009-03C

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330 - 494 - 8888

6-5-19
DATE

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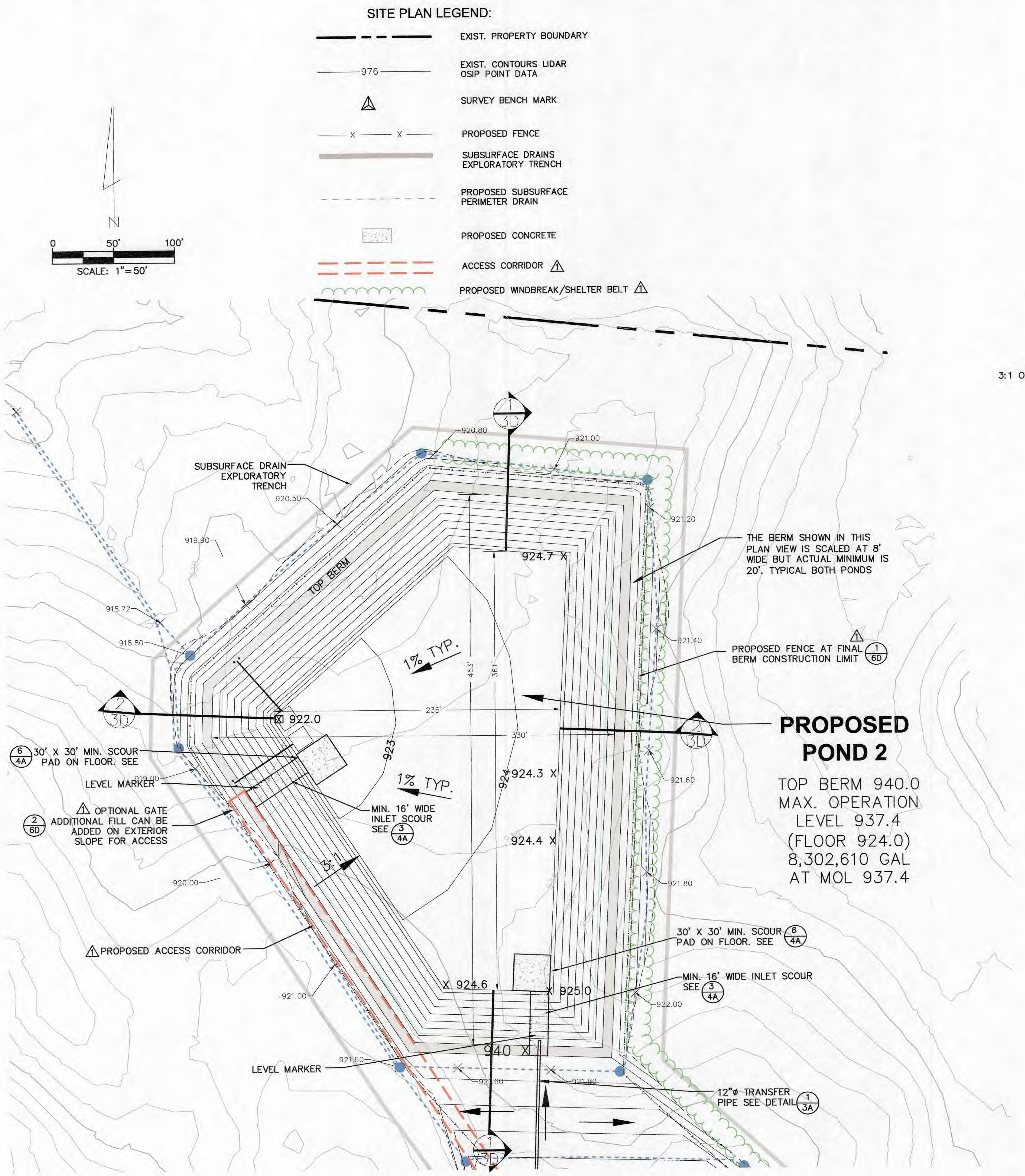
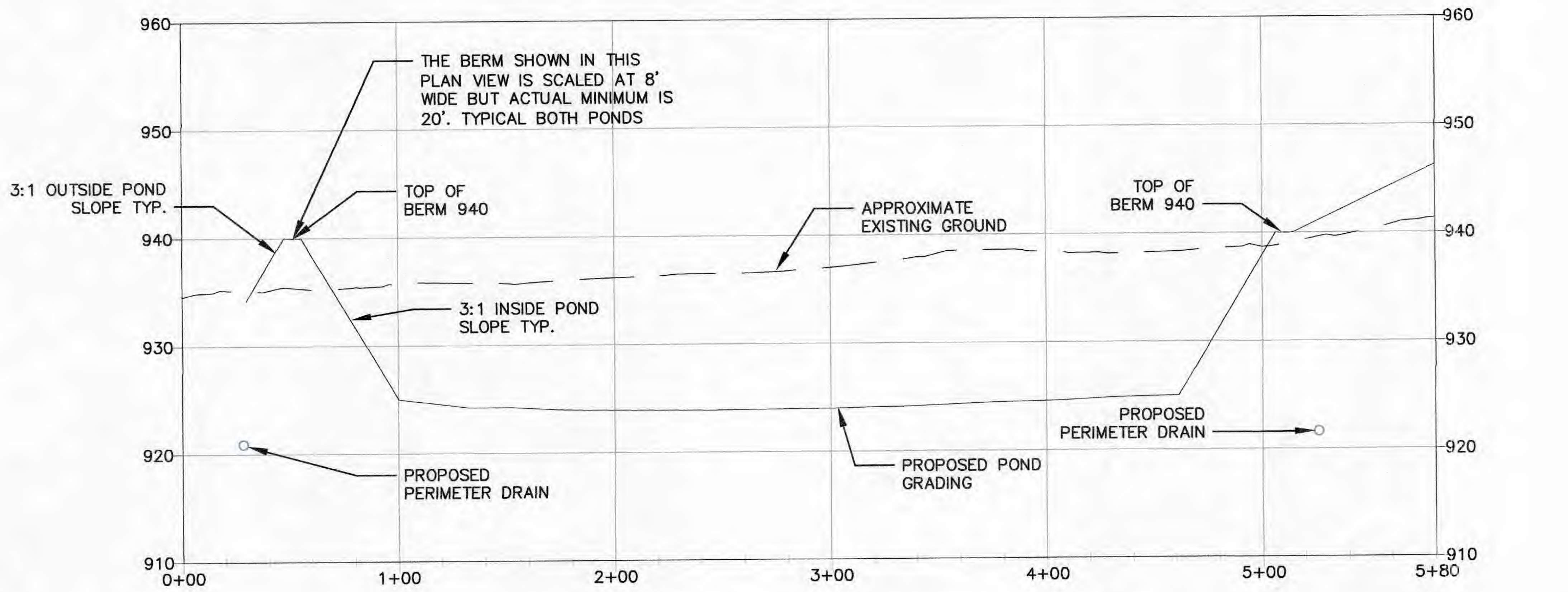
DOVETAIL ENERGY, LLC

STORAGE POND #1
CROSS-SECTION VIEW

BATH TOWNSHIP, GREENE COUNTY, OHIO

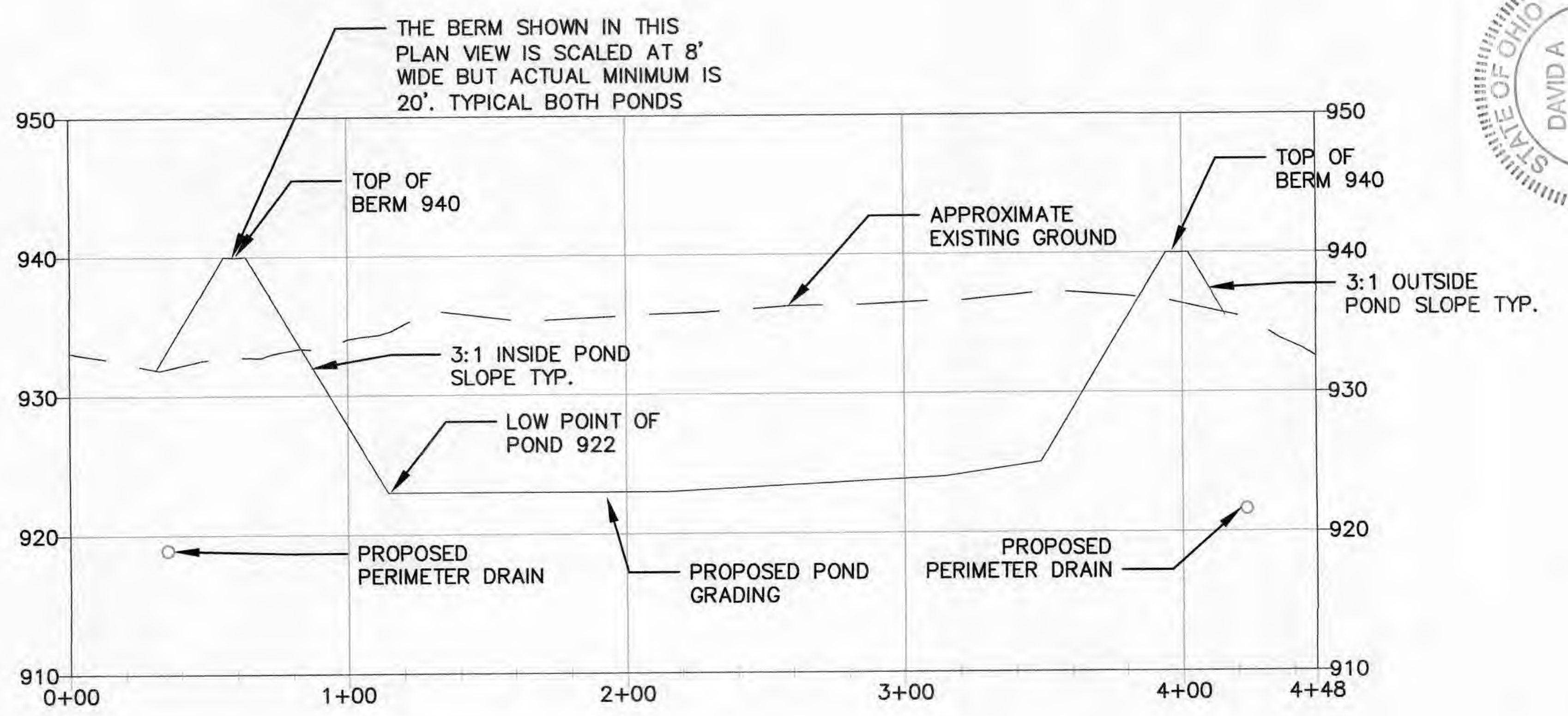
3C
13





1/3D POND 1 CROSS-SECTION NORTH-SOUTH

1"=50H, 1"=10'V



2/3D POND 1 CROSS-SECTION WEST-EAST

1"=50H, 1"=10'V

N:\RGE009-DOVETAIL BERM\GREICO SITE\RESPONSE TO COMMENTS 5-19\RGE010-GREICO-03D.dwg - Jun 04, 2019 - 5:04pm - bhargest

REVISIONS	BY	DATE
1 ADD CALLOUTS FOR GATES AND ACCESS. UPDATED TRANSFER PIPE CALLOUT		

DATE: 5-21-19
PREPARED BY: DAG
DRAWN BY: LMH
CHECKED BY: DAG
FILE: RGE009-03D

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REG. PROF. ENG. DAVID GERDEMAN, P.E. LICENSE NO. 48568

6-5-19
DATE

DOVETAIL ENERGY, LLC

STORAGE POND #1
CROSS-SECTION VIEW

BATH TOWNSHIP, GREENE COUNTY, OHIO

3D
13

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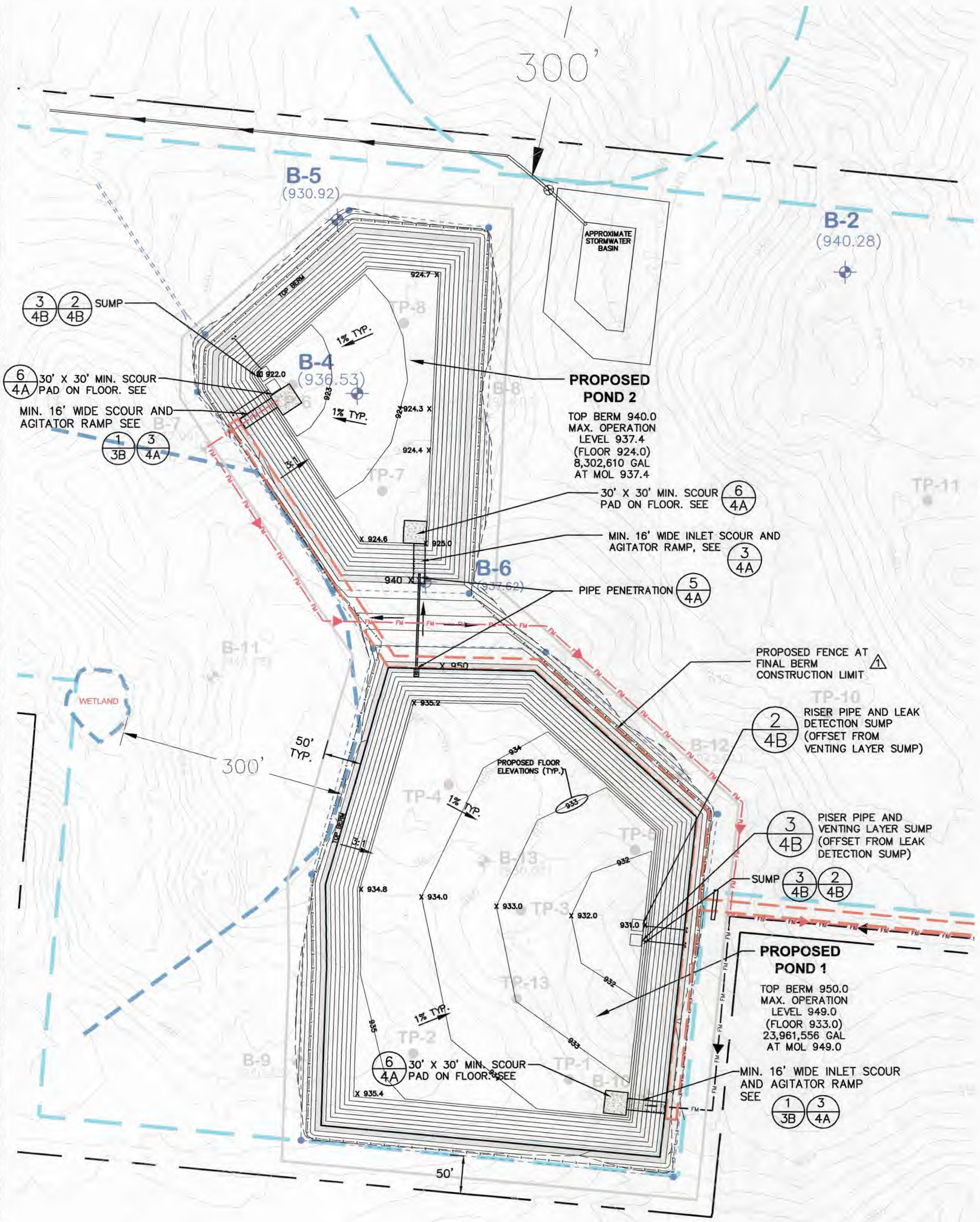
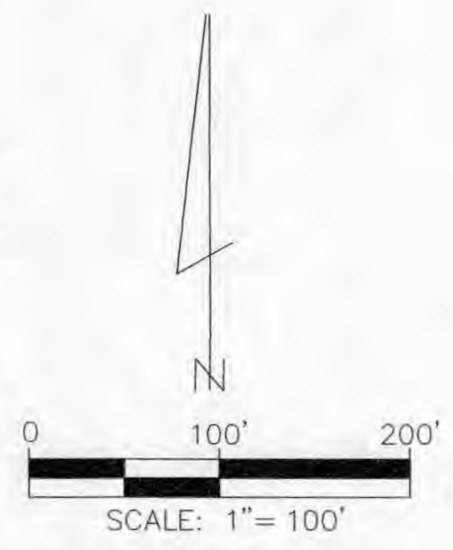
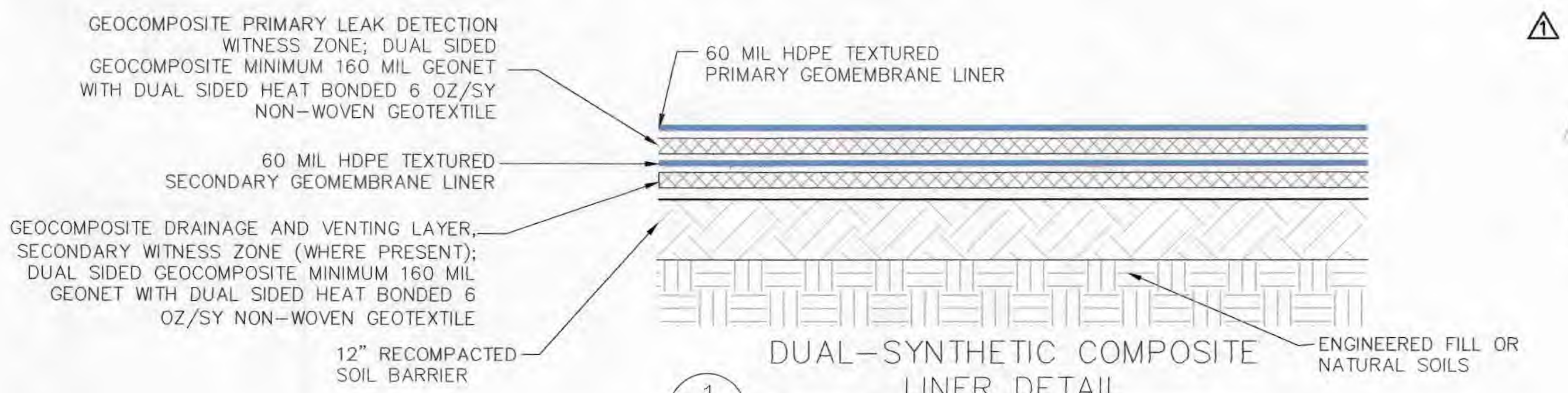


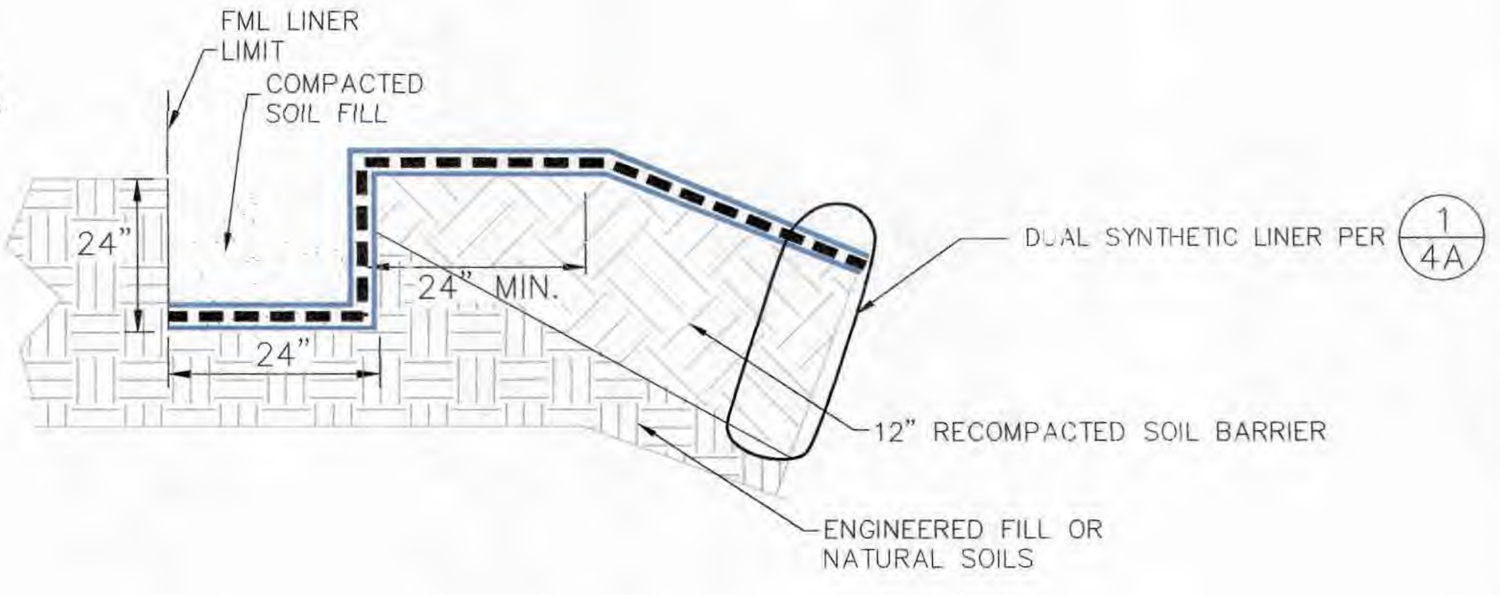




DUAL-SYNTHETIC COMPOSITE LINER DETAIL

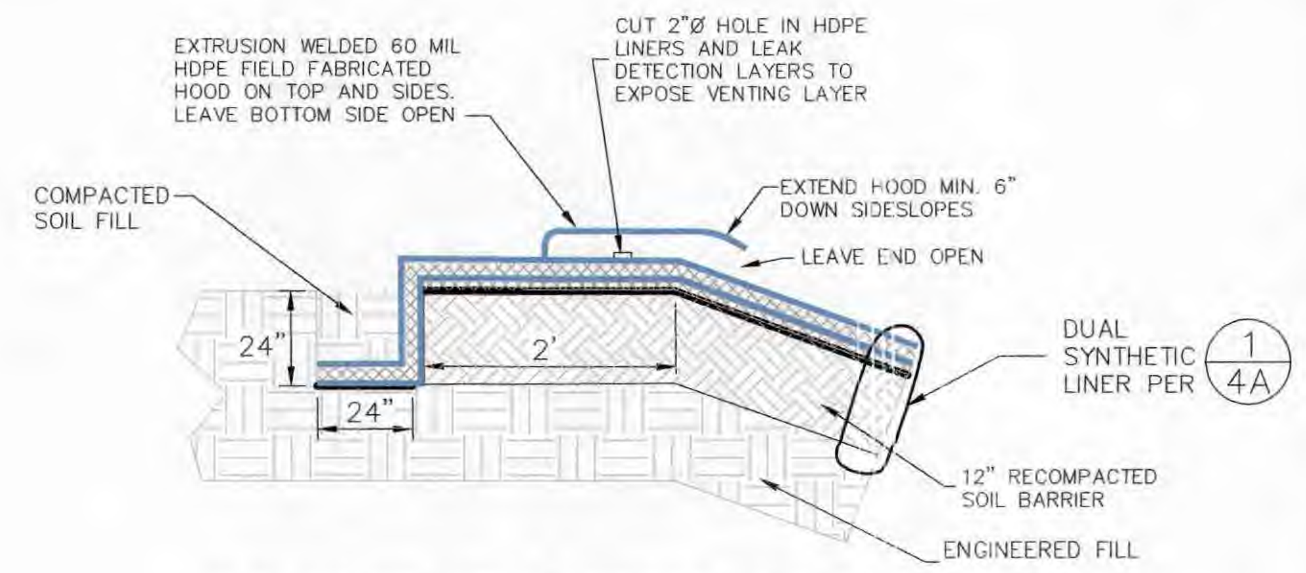
1/4A NOT TO SCALE

NOTE: GEOCOMPOSITE DRAINAGE AND VENTING NOT SHOWN FOR CLARITY.



LINER ANCHOR DETAIL (TYP.)

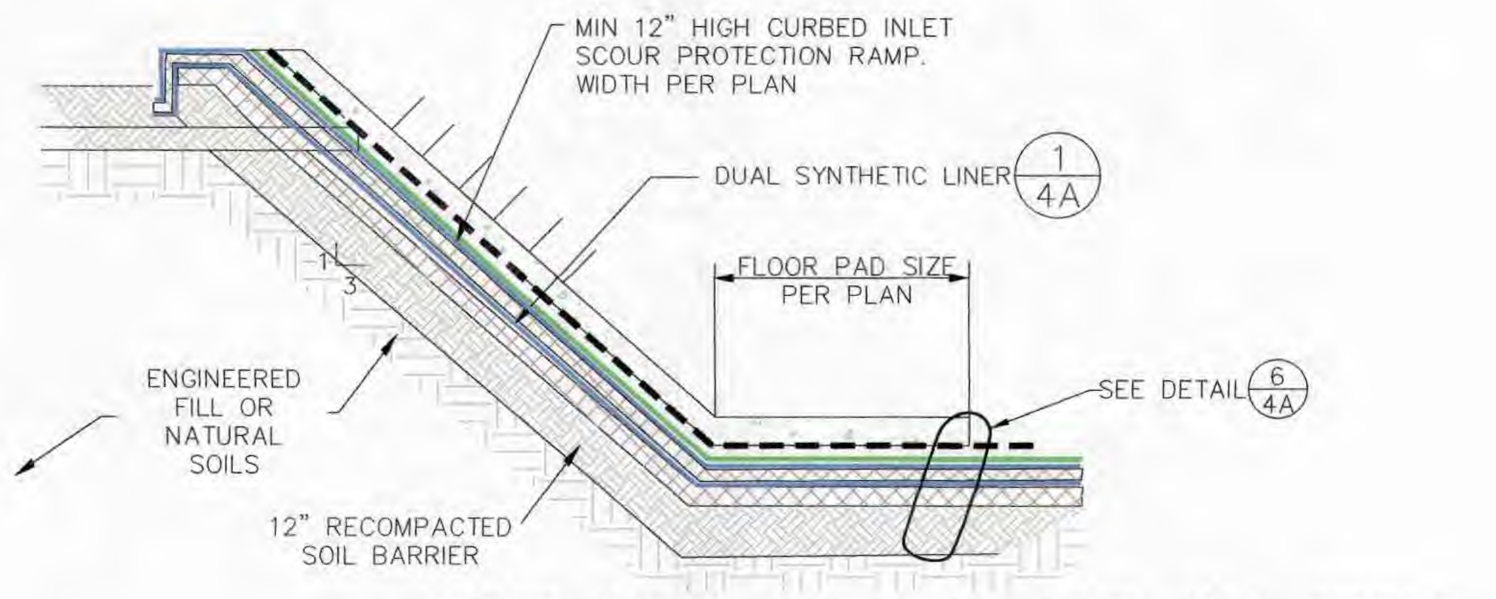
2/4A NOT TO SCALE



LINER VENT DETAIL (TYP.)

4/4A NOT TO SCALE

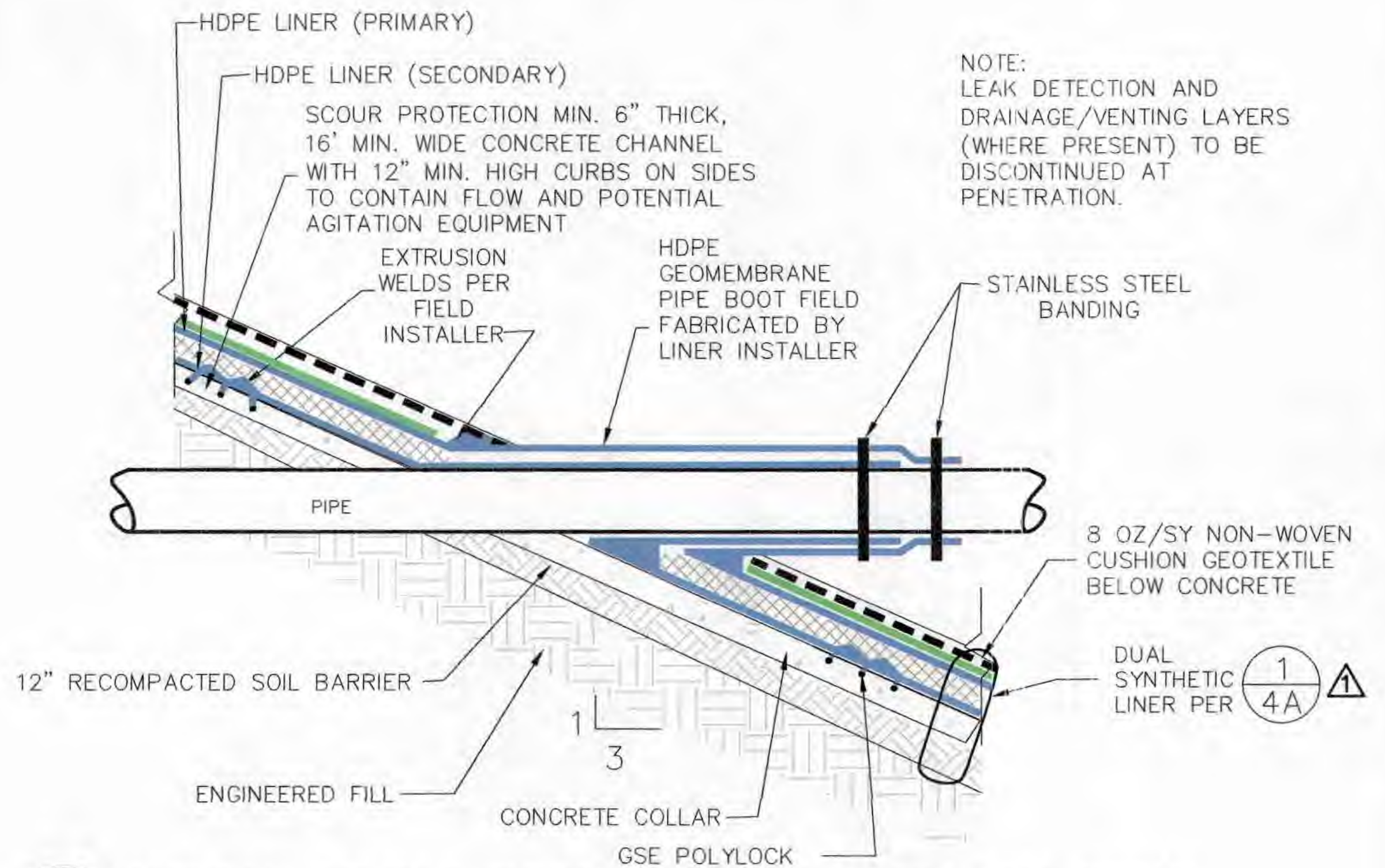
VENTS SPACED 2 PER EACH STRIP OF GEOCOMPOSITE VENTING STRIP MAX 20' C/C



POND INLET AGITATION PAD AND CROSS OVER SCOUR SECTION

3/4A NOT TO SCALE

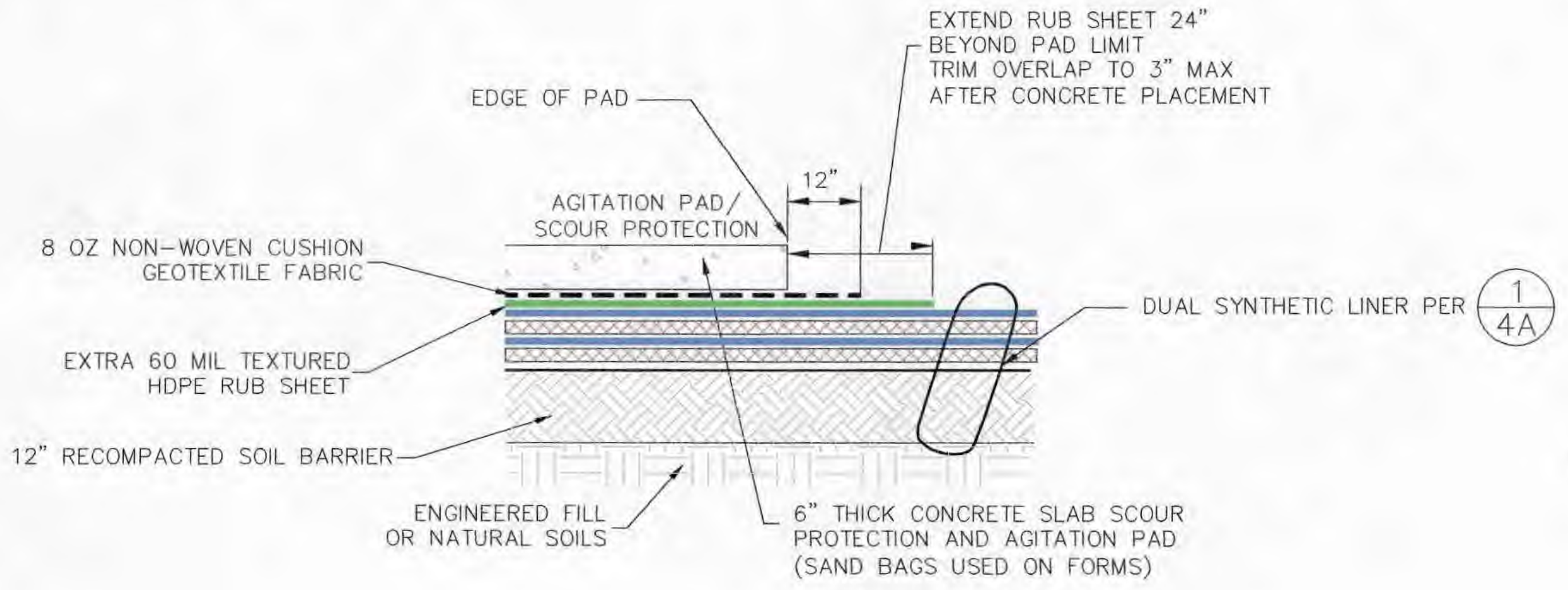
ALSO SEE 1/3B



NOTE:
LEAK DETECTION AND DRAINAGE/VENTING LAYERS (WHERE PRESENT) TO BE DISCONTINUED AT PENETRATION.

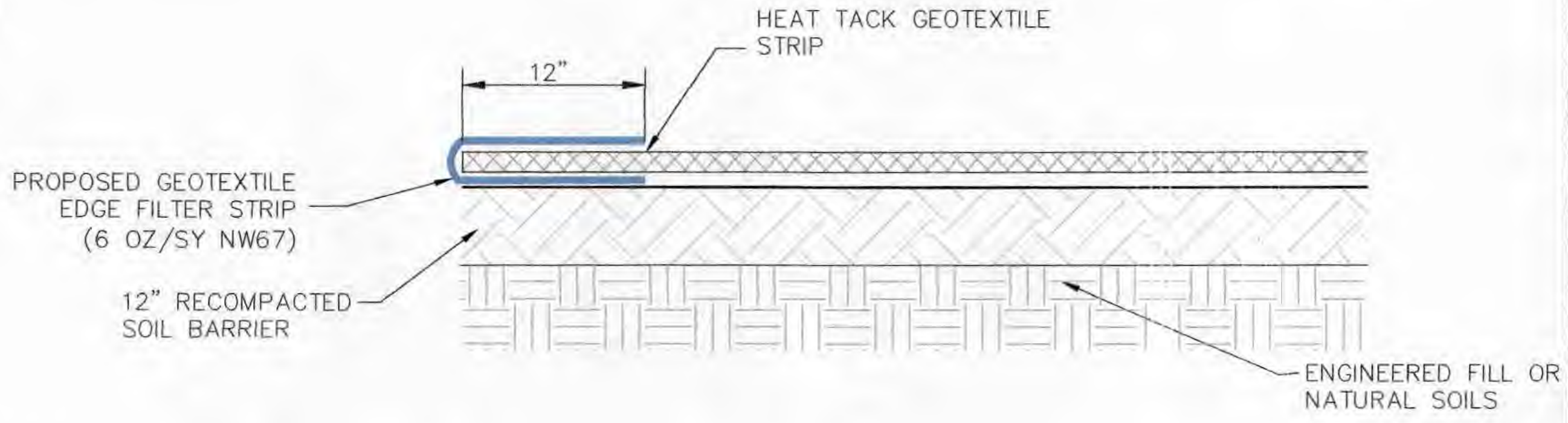
TYPICAL DOUBLE BOOTED PIPE PENETRATION DETAIL

5/4A NOT TO SCALE



CONCRETE PAD LINER PROTECTION DETAIL (INLET SCOUR PROTECTION, AGITATION PADS AND FLOOR PAD)

6/4A NOT TO SCALE



⚠1 GEOCOMPOSITE VENTING LAYER EDGE DETAIL

7/4A NOT TO SCALE

NOTE:
AFTER GEOCOMPOSITE IS DEPLOYED, THE EDGE SHALL BE LIFTED AND A STRIP OF NON-WOVEN GEOTEXTILE SHALL BE INSERTED UNDER AND THEN OVERLAPPED ABOVE THE GEOCOMPOSITE. NEW FILTER STRIP SHALL CONTINUOUSLY BE HEAT TACKED TO THE GEOCOMPOSITE.

REVISIONS	BY	DATE
⚠1 REMOVED FENCE CALLOUT ON 2/4A DETAIL, UPDATE FENCE ON PLAN TO FINAL BERM CONSTRUCTION LIMIT, UPDATE CALLOUT ON DETAIL 5/4A, ADDED DETAIL FOR GEOCOMPOSITE VENTING LAYER EDGE		

DATE: 5-21-19
PREPARED BY: DAG
DRAWN BY: LMH
CHECKED BY: DAG
FILE: RGE010-4A

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REG. PROF. ENG. DAVID GERDEMAN, P.E. LICENSE NO. 48568
6-5-19
DATE

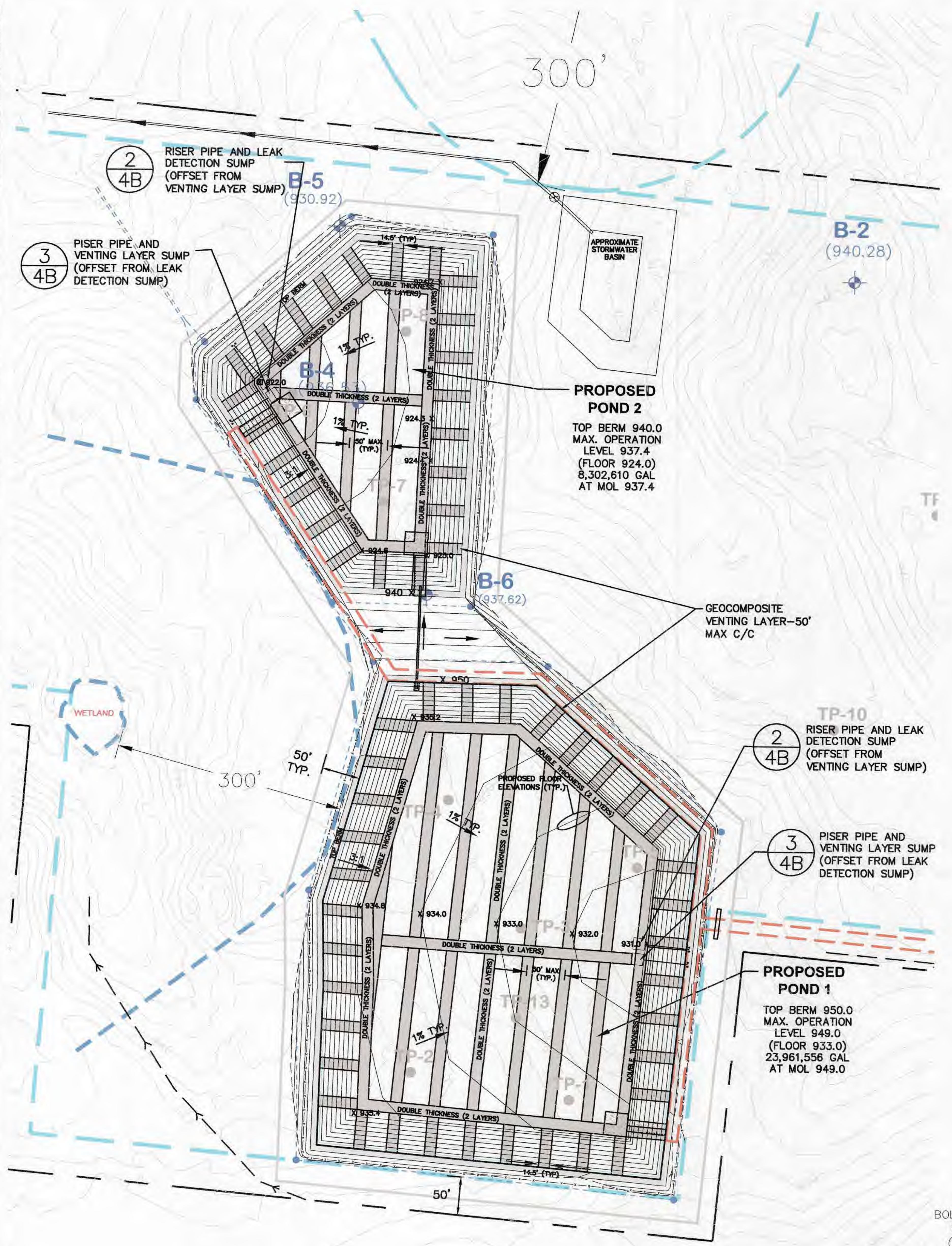
DAVID A GERDEMAN
E-48568

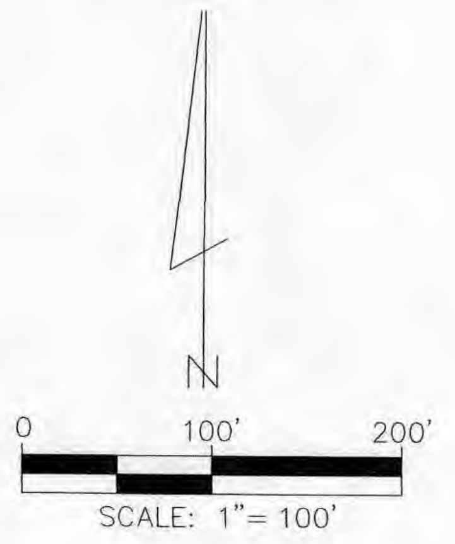
DOVETAIL ENERGY, LLC

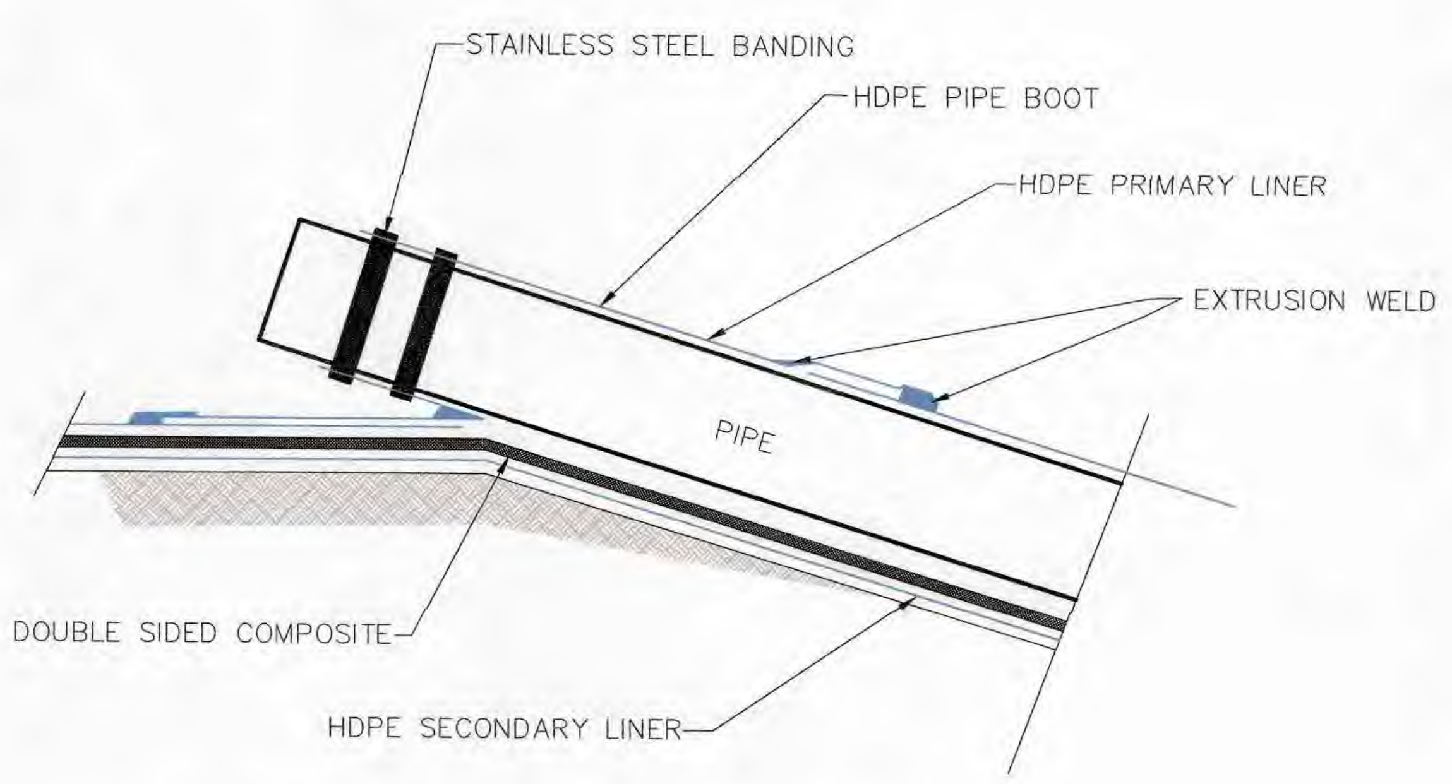
PONDS - FML LINER DETAILS

BATH TOWNSHIP, GREENE COUNTY, OHIO

4A/13

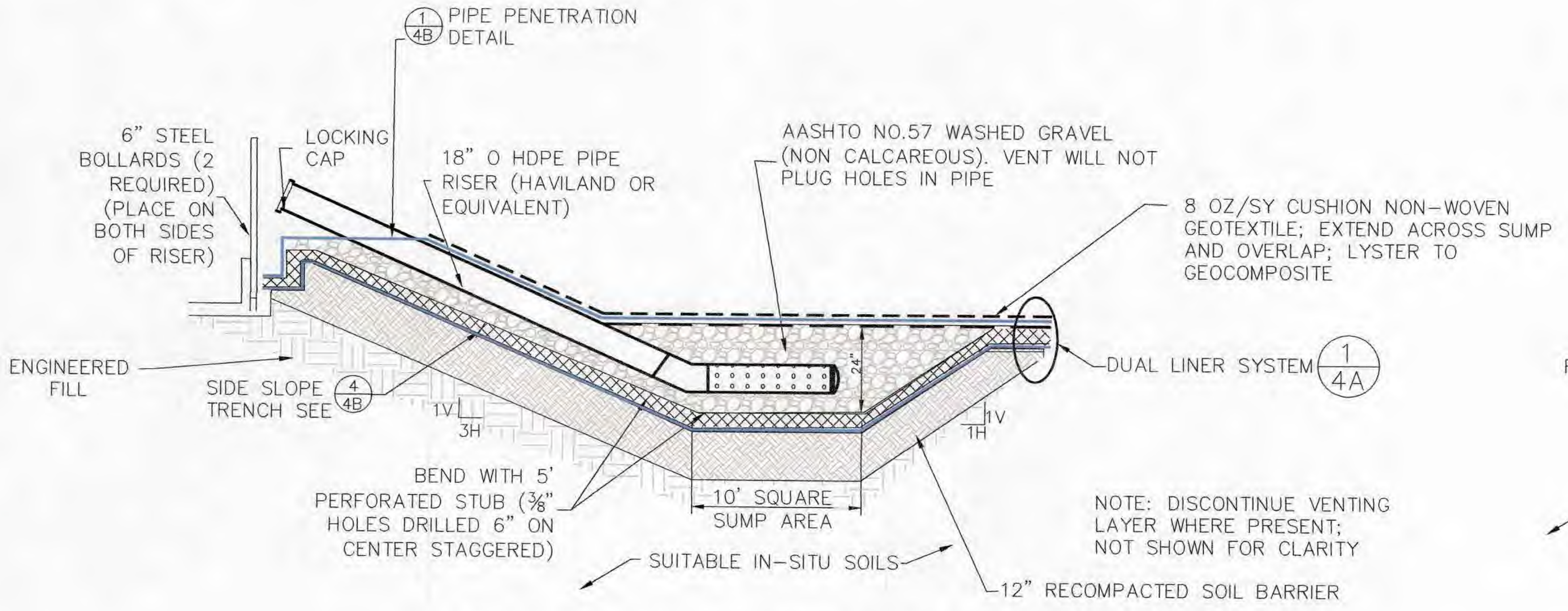






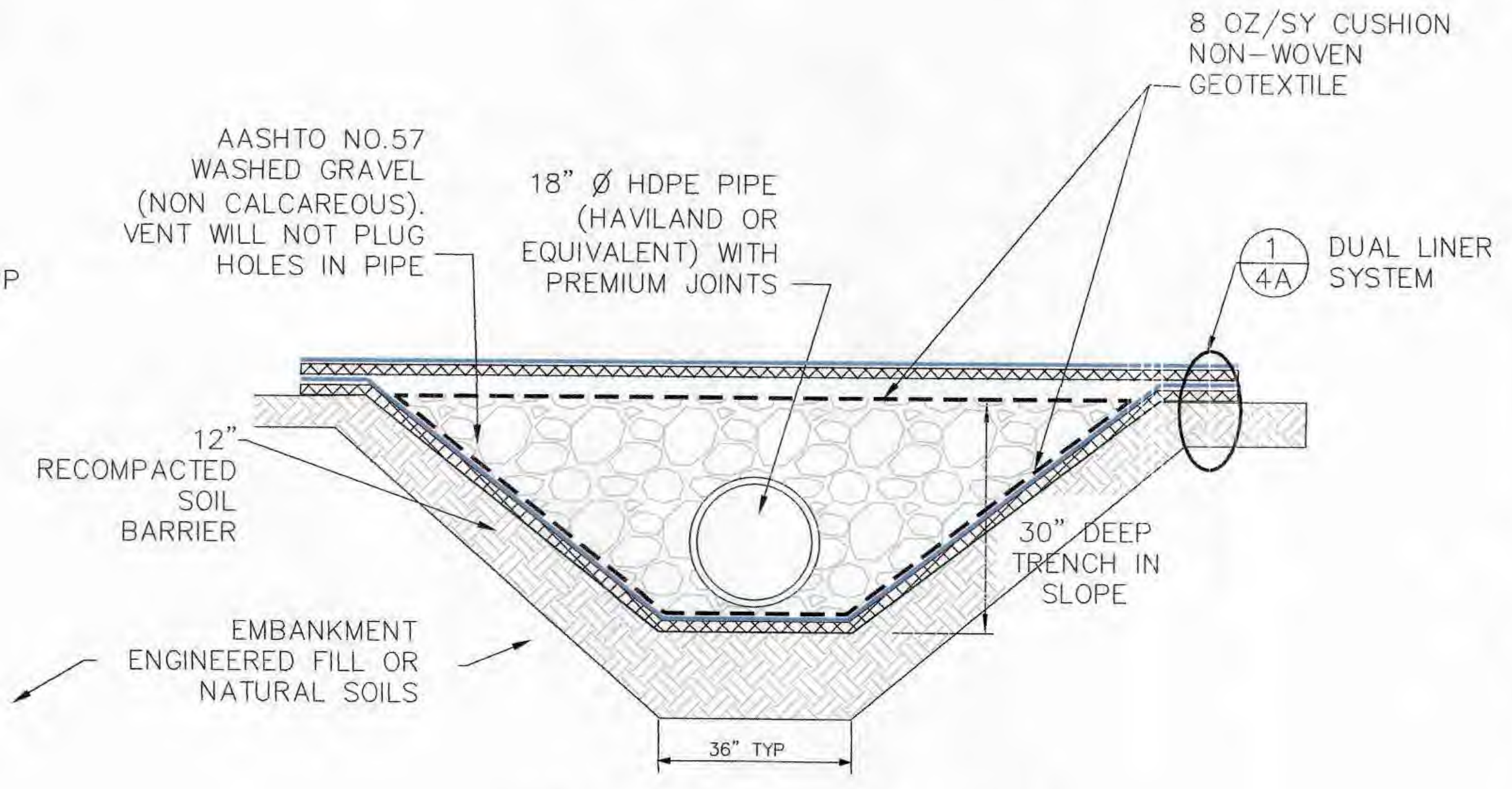
LINER PENETRATION ON SLOPE (PRIMARY WITNESS ZONE RISER)

1/4B NOT TO SCALE



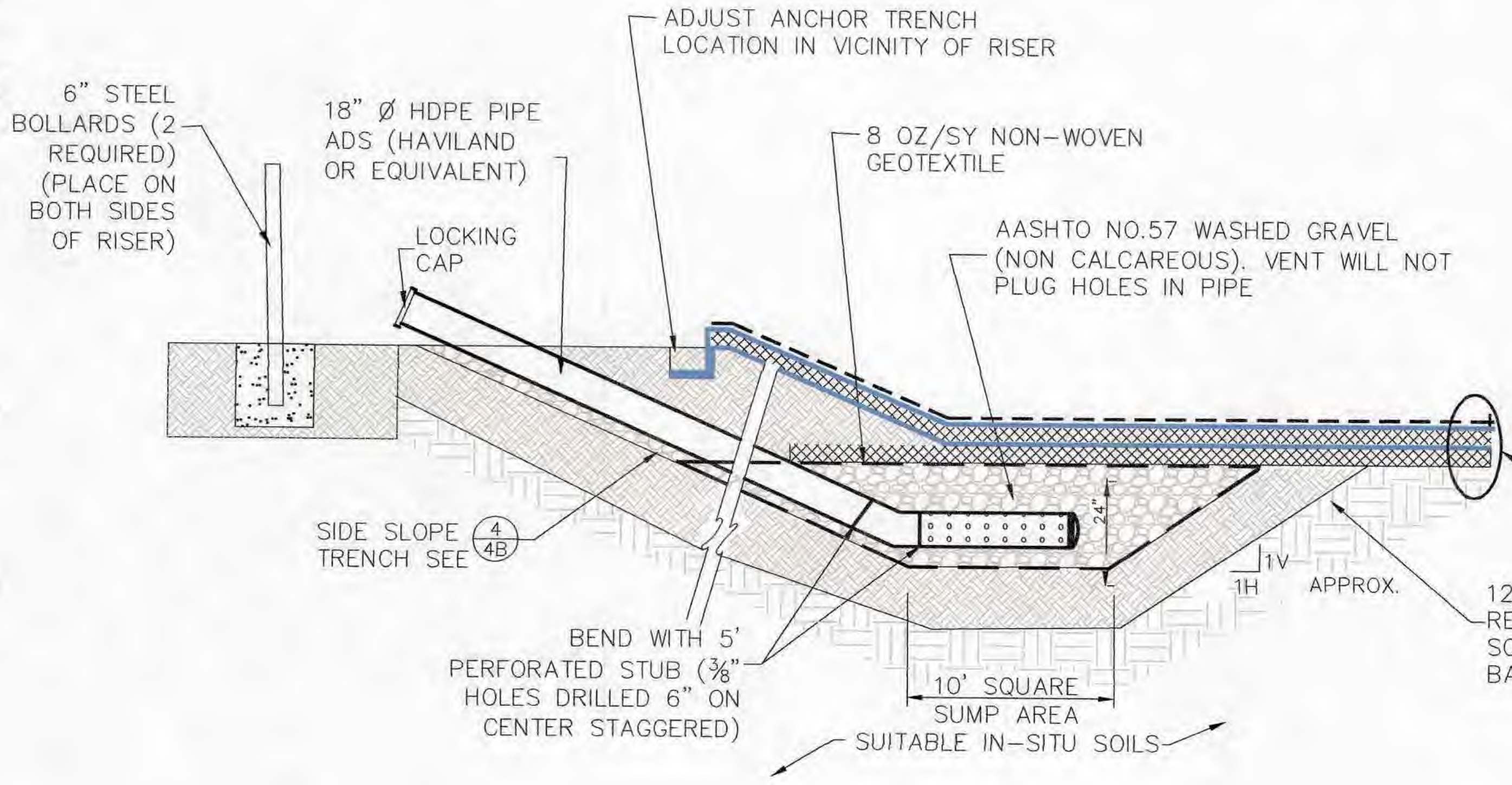
18" RISER PIPE AND PRIMARY LEAK DETECTION LAYER SUMP SECTION

2/4B NOT TO SCALE



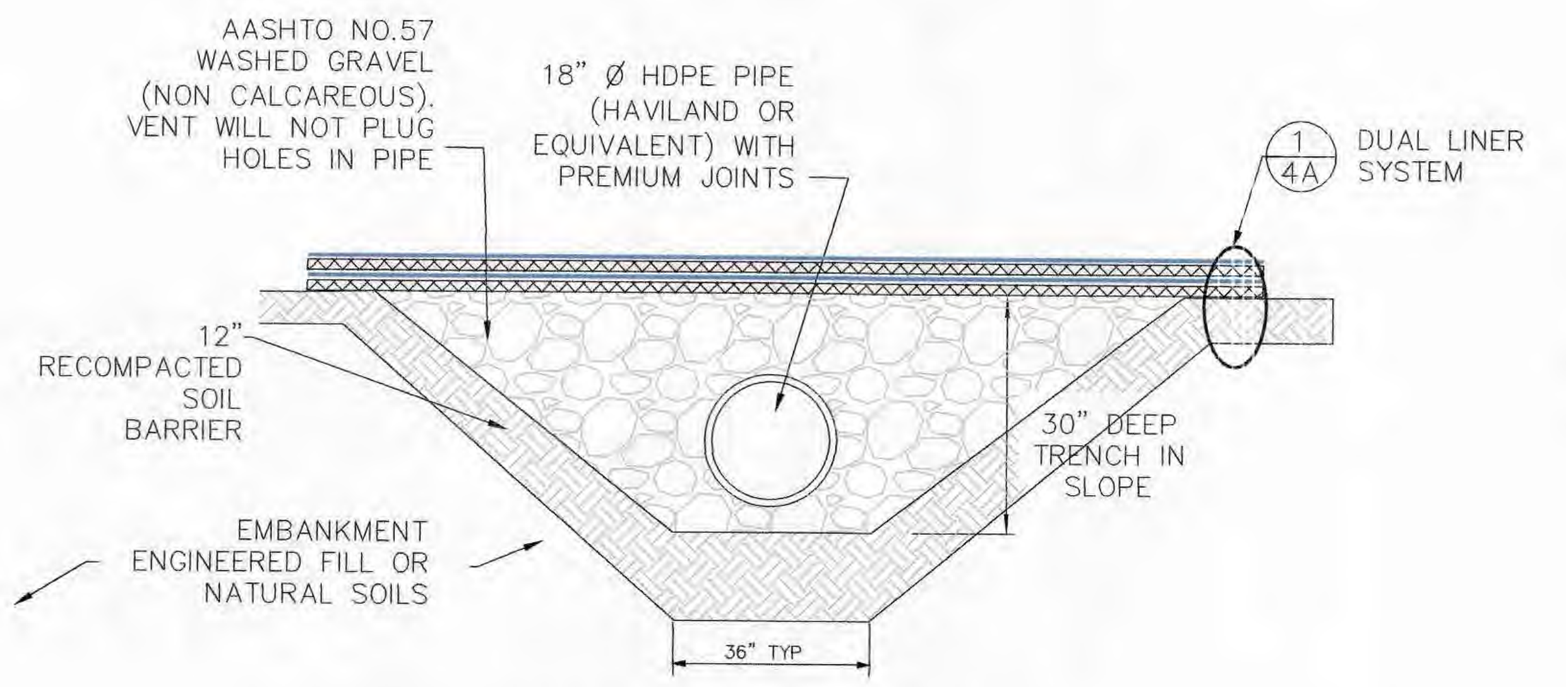
SIDESLOPE TRENCH FOR DRAINAGE/VENTING PRIMARY DETECTION RISER SECTION

4/4B NOT TO SCALE



18" RISER PIPE AND DRAINAGE/VENTING SECONDARY WITNESS LAYER SUMP SECTION

3/4B NOT TO SCALE



SIDESLOPE TRENCH FOR DRAINAGE/VENTING SECONDARY DETECTION RISER SECTION

4/4B NOT TO SCALE

DAVID A GERDEMAN
E-48568

REVISIONS	BY	DATE

DATE: 5-21-19
PREPARED BY: DAG
DRAWN BY: LMH
CHECKED BY: DAG
FILE: RGE010-4A

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REG. PROF. ENG. DAVID GERDEMAN, P.E. LICENSE NO. 48568
6-5-19
DATE

DOVETAIL ENERGY, LLC

FML LINER SUMP AND VENTING DETAILS

BATH TOWNSHIP, GREENE COUNTY, OHIO

4B/13

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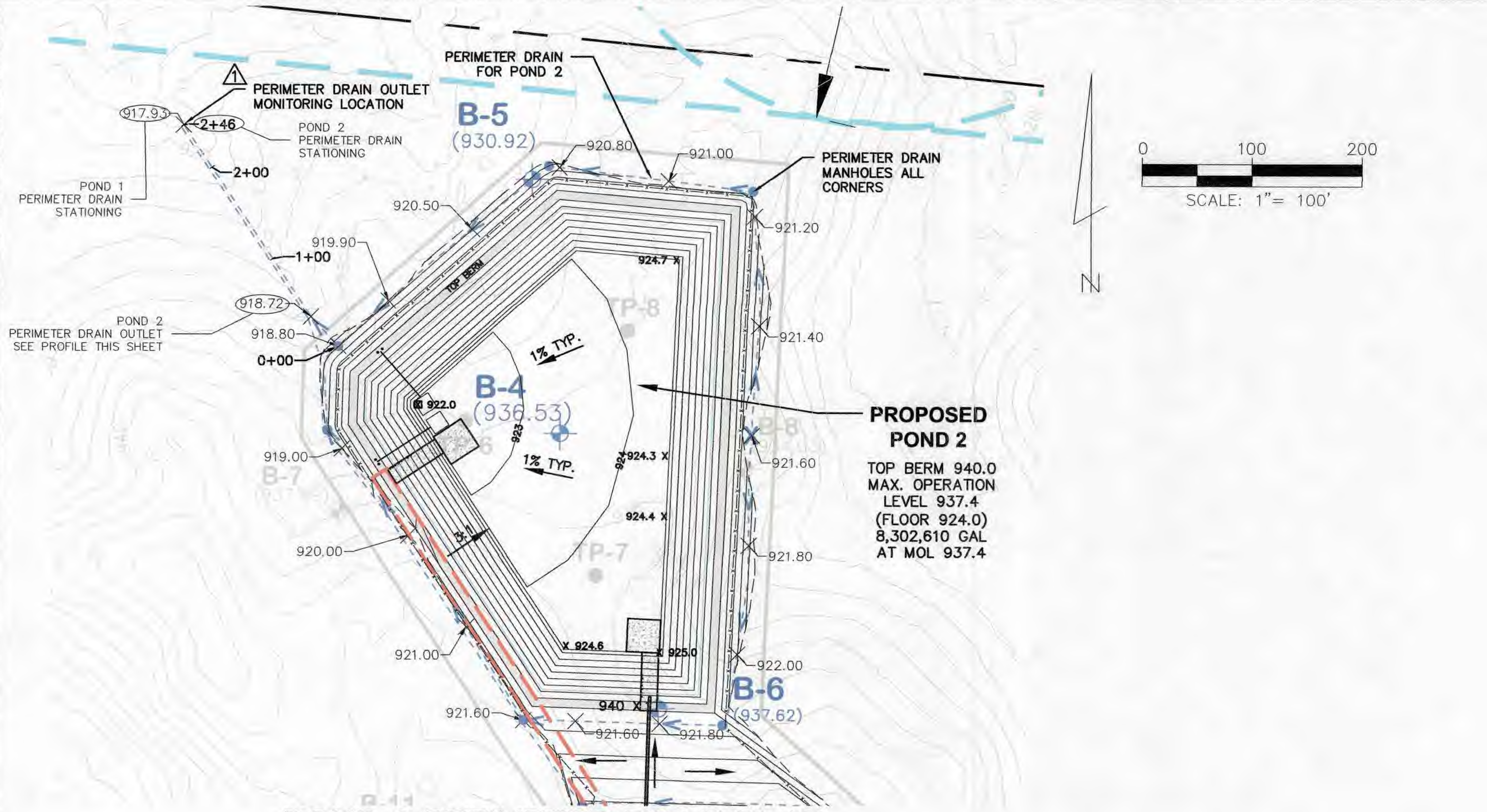
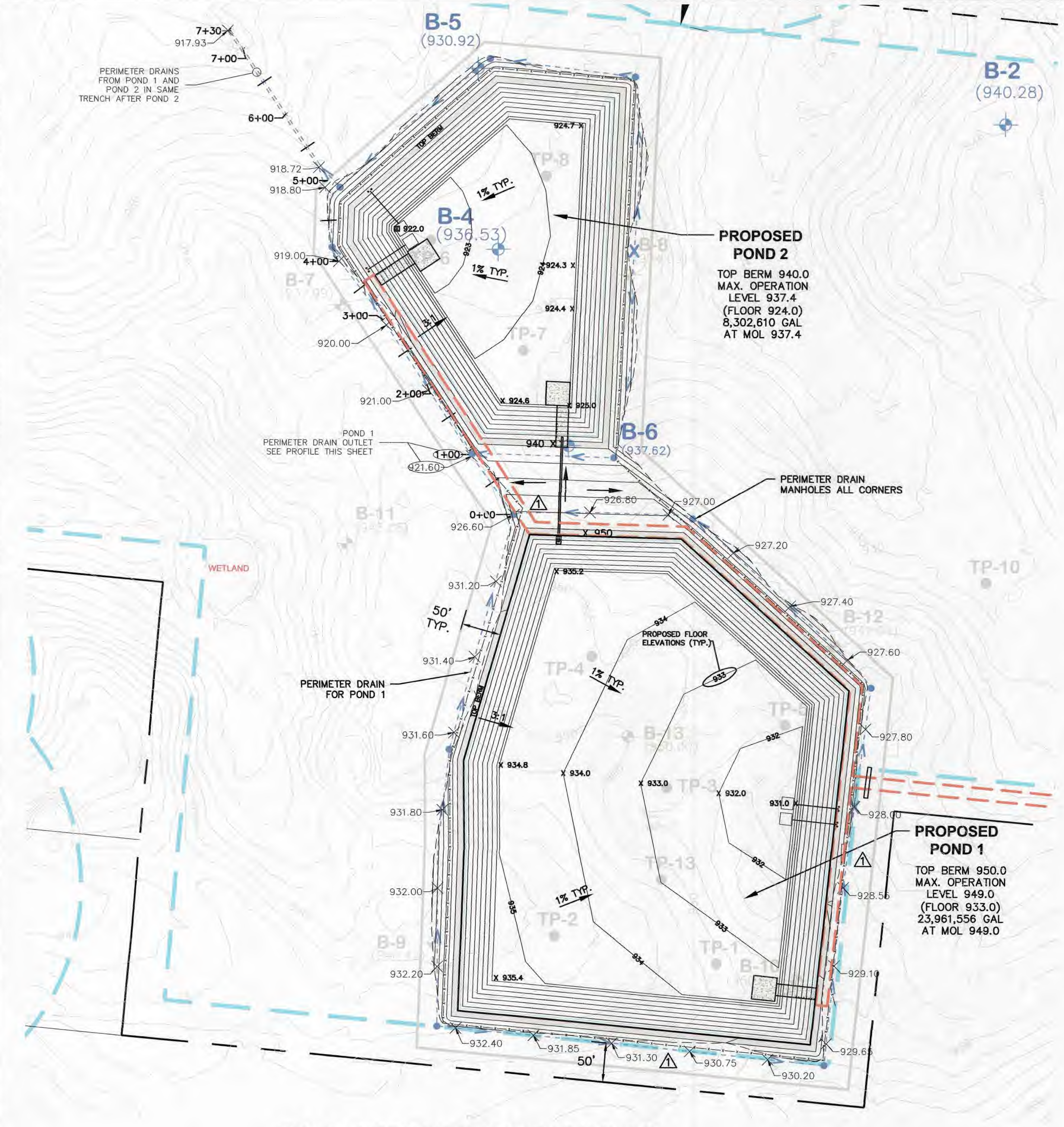
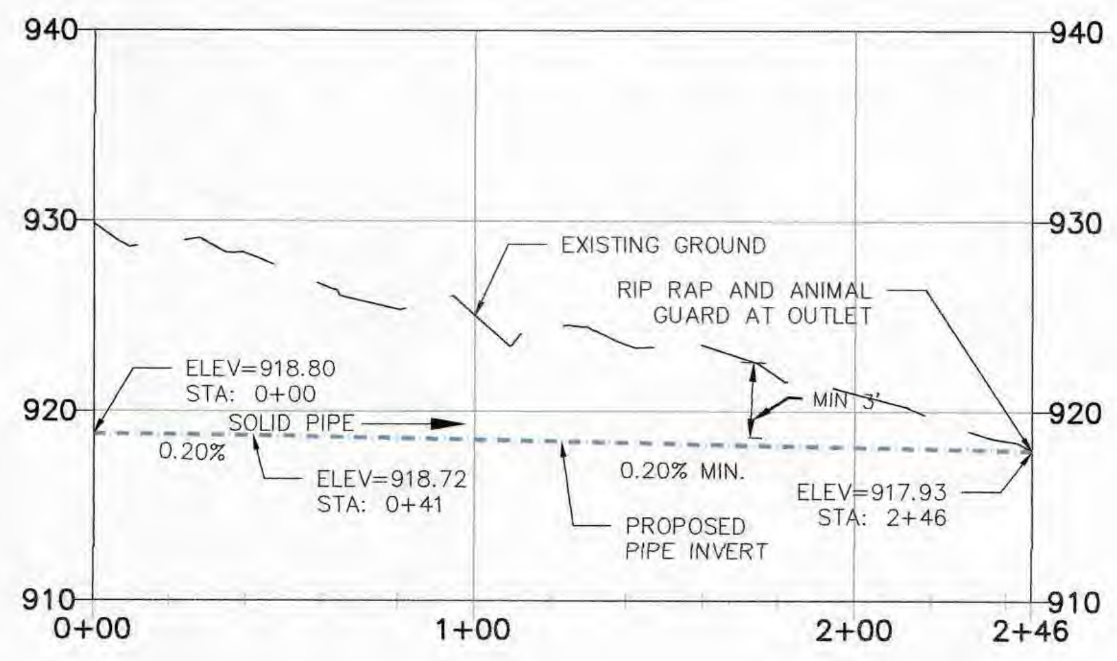


POND 2 PERIMETER DRAIN PLAN



POND 1 PERIMETER DRAIN PLAN

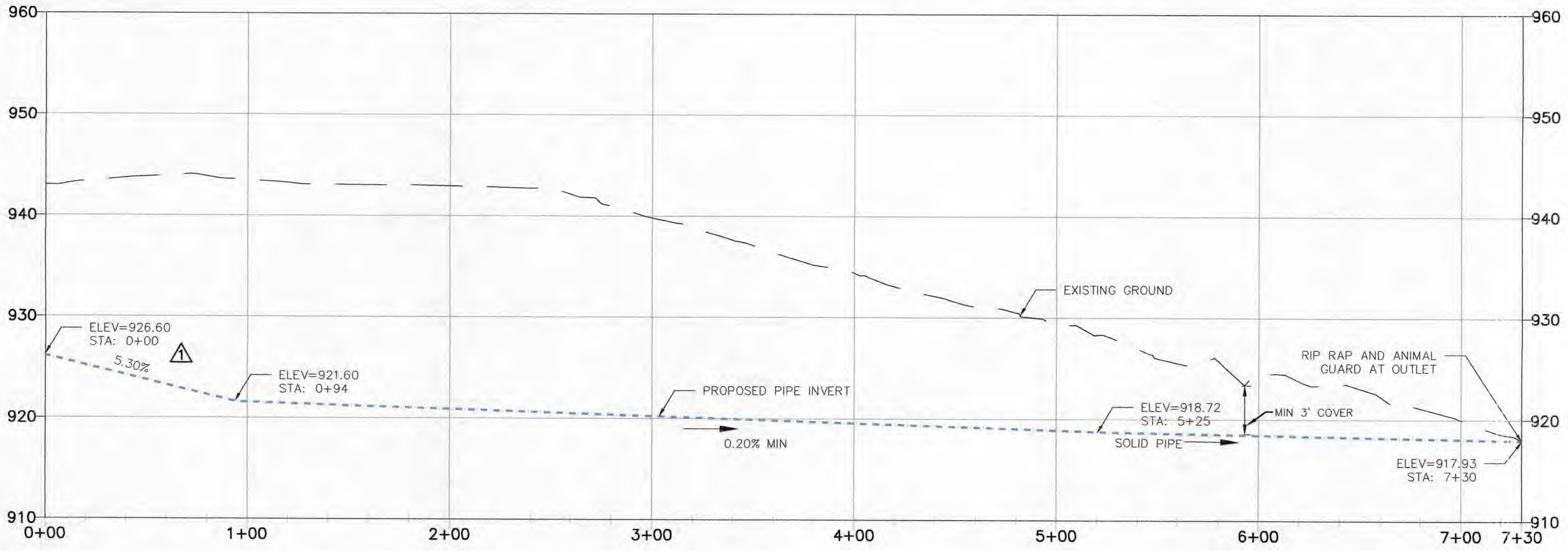


2/5A POND 2 PERIMETER DRAIN OUTLET (FROM POND PERIMETER TO OUTLET)

1"=50H, 1"=10'V

NOTE:

- ADJUST DRAIN TO FIT FIELD CONDITIONS
- OUTLET FROM POND 2 AND POND 1 IN SAME TRENCH

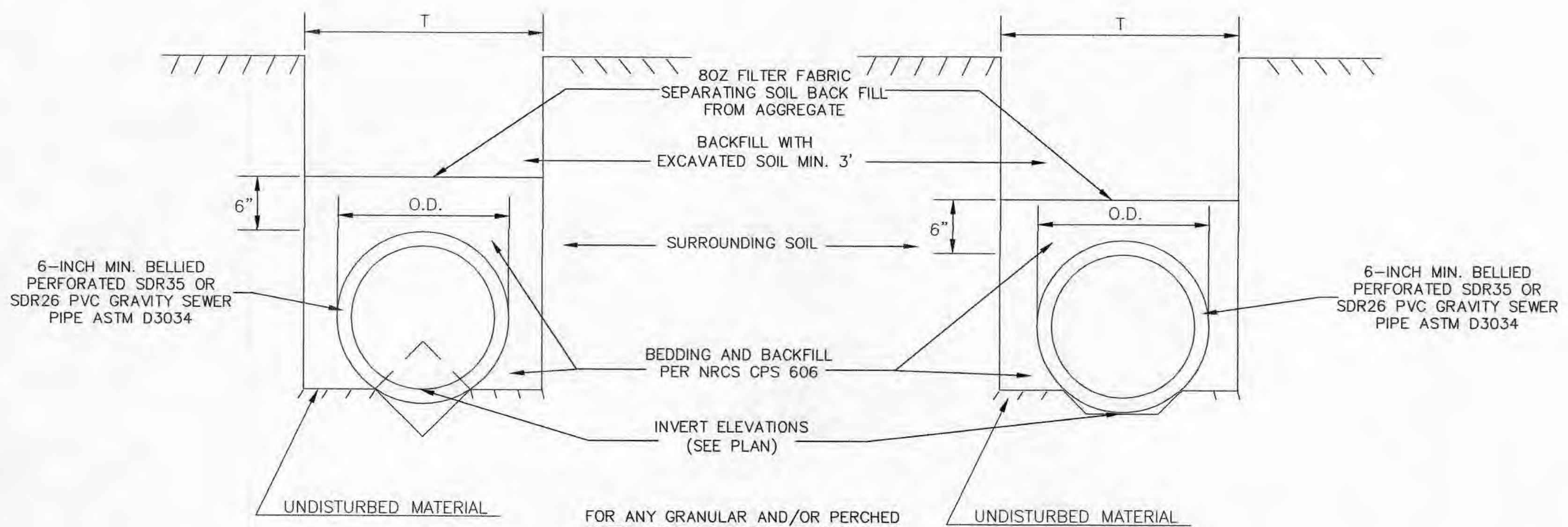


1/5A POND 1 PERIMETER DRAIN OUTLET (FROM POND PERIMETER TO OUTLET)

1"=50H, 1"=10'V

NOTE:

- IN ADDITION TO THE PERIMETER DRAINS SHOWN ON THIS PLAN, LATERAL DRAINS CAN BE PLACED UNDER THE FLOOR OF THE POND AND TIED INTO THE PERIMETER DRAIN AS NEEDED FOR DEWATERING.
- THE PERIMETER DRAIN CAN BE LOWERED AS NEEDED TO PROVIDE ADEQUATE DEWATERING OF THE CONSTRUCTION AREA.
- PERIMETER DRAIN INVERTS CAN BE FIELD ADJUSTED PROVIDED THEY ARE AT LEAST 3' BELOW THE FINISHED FLOOR OF THE POND AND MAINTAIN A MINIMUM 0.2% SLOPE.



3 TO 8 INCH DIAMETER

T = O.D. + 6" 1N FINE GRAINED FRIABLE OR SANDY SOILS

T = O.D. + 12 INCHES IN CLODDY SOILS

FOR ANY GRANULAR AND/OR PERCHED WATER ZONE ENCOUNTERED, CREATE A PATHWAY FOR ANY GROUNDWATER ENCOUNTERED TO DRAIN TO THE DRAIN. THIS APPLIES UP TO WITHIN 3 FEET OF GROUND SURFACES BOTH SIDES OF TRENCH TO DRAIN TO PIPE USING GRANULAR OR MORE PERMEABLE SOIL. GEOCOMPOSITE DRAINAGE LAYER CAN BE USED IN LIEU OF AGGREGATE FOR VERTICAL DRAIN

CONSTRUCTION NOTES:
OEPA IS TO BE NOTIFIED A MINIMUM 48 HOURS BEFORE BEGINNING OF CONSTRUCTION OF THE PERIMETER DRAIN

10 INCH DIAMETER OR LARGER

DRAIN TUBING TO HAVE TRAPEZOIDAL OR SIMI CIRCULAR GROVE

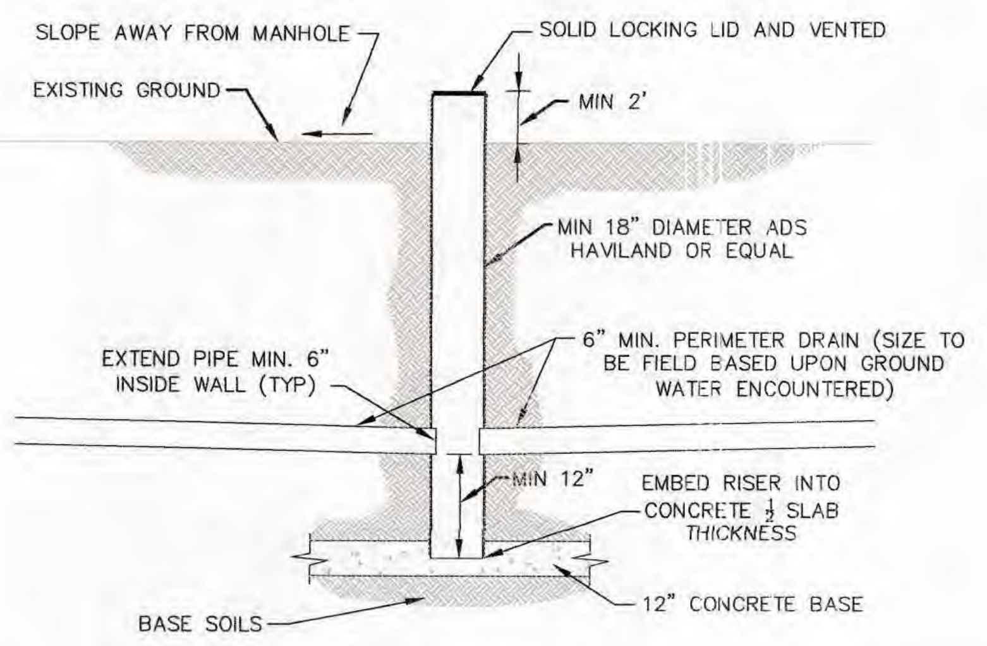
T = O.D. + 6" 1N FINE GRAINED FRIABLE OR SANDY SOILS

T = O.D. + 12 INCHES IN CLODDY SOILS

3/5A TYP. PERIMETER DRAIN TRENCH DETAIL

NOT TO SCALE

SUBSURFACE DRIAN INSTALLED
PER NRCS CPS 606



4/5A POND PERIMETER DRAIN SUMP, MANHOLE DETAIL

NOT TO SCALE (MANHOLES TO BE LOCATED AT ALL CORNERS OF THE PONDS)

DAVID A GERDEMAN E-48568

REVISIONS
⚠ REVISED PERIMETER DRAIN ELEVATION AND FLOW ARROWS IN SOUTH WESTERN AND SOUTH EASTERN AREA OF POND

BY	DATE

DATE: 5-21-19
PREPARED BY: DAG
DRAWN BY: LMH
CHECKED BY: DAG
FILE: RGE010-5A

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6657 Frank Ave. N.W.
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REG. PROF. ENG. DAVID GERDEMAN, P.E. LICENSE NO. 48568
6-5-19
DATE

DOVETAIL ENERGY, LLC

PERIMETER DRAIN PLAN,
PROFILE AND DETAILS

BATH TOWNSHIP, GREENE COUNTY, OHIO

5A
13

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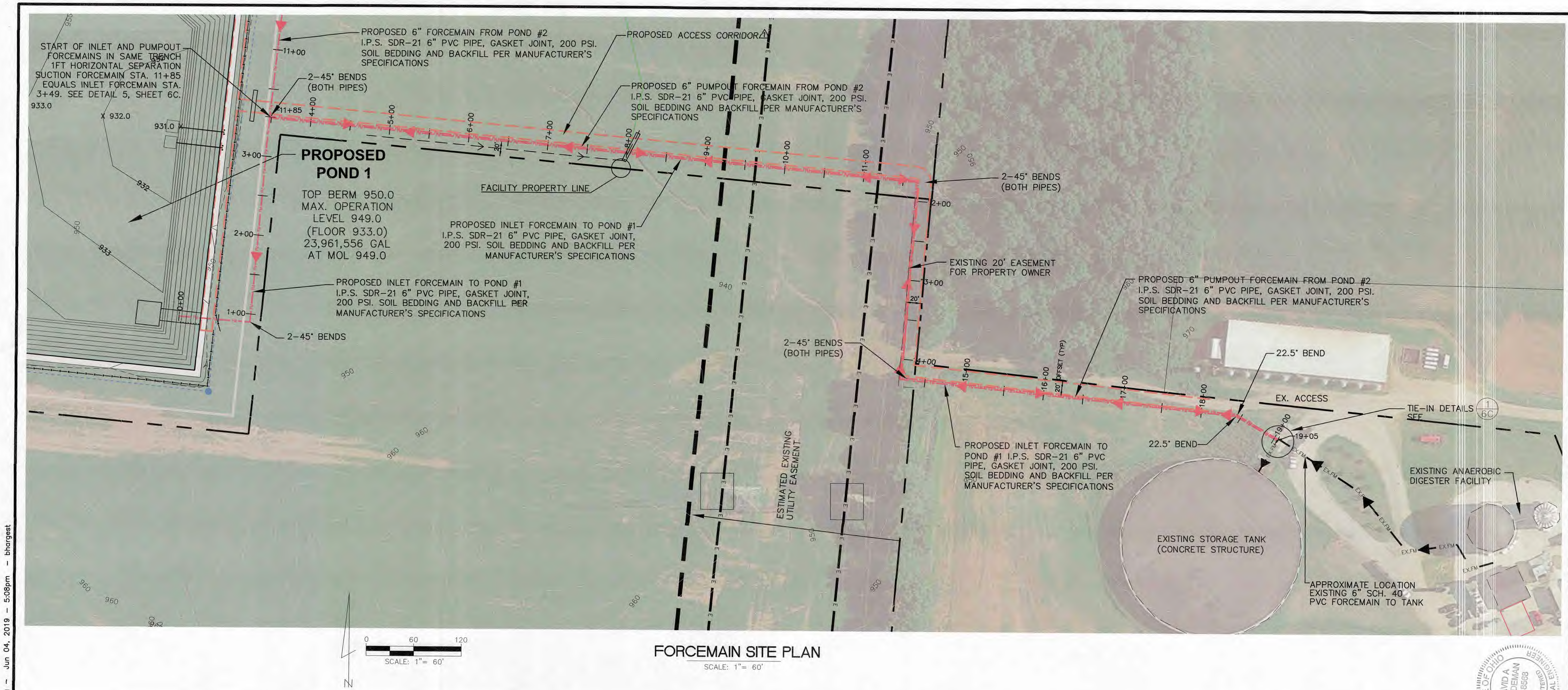
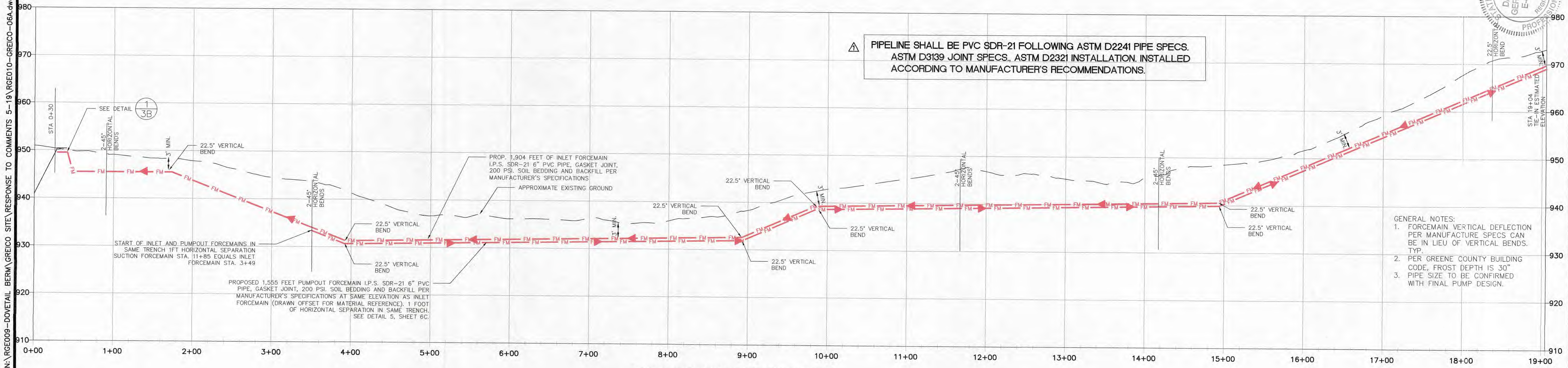


FORCEMAIN SITE PLAN

SCALE: 1"= 60'



⚠1 PIPELINE SHALL BE PVC SDR-21 FOLLOWING ASTM D2241 PIPE SPECS. ASTM D3139 JOINT SPECS., ASTM D2321 INSTALLATION. INSTALLED ACCORDING TO MANUFACTURER'S RECOMMENDATIONS.

GENERAL NOTES:
1. FORCEMAIN VERTICAL DEFLECTION PER MANUFACTURE SPECS CAN BE IN LIEU OF VERTICAL BENDS. TYP.
2. PER GREENE COUNTY BUILDING CODE, FROST DEPTH IS 30"
3. PIPE SIZE TO BE CONFIRMED WITH FINAL PUMP DESIGN.

FORCEMAINS PROFILE VIEW

SCALE: 1"=60' H, 1"=10'V

N:\RGE009-DOVETAIL BERM\GREICO SITE\RESPONSE TO COMMENTS 5-19\RGE010-GREICO-06A.dwg - Jun 04, 2019 - 5:08pm - bhargest

REVISIONS	BY	DATE
⚠1 ADDED PVC FM SPEC. NOTE, ADDED ACCESS CORRIDOR TO EX FACILITY		

DATE: 5-21-19
PREPARED BY: DAG
DRAWN BY: LMH
CHECKED BY: DAG
FILE: RGE010-06A

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DAVID A GERDEMAN E-48568

6-5-19
DATE

REG. PROF. ENG. DAVID GERDEMAN, P.E. LICENSE NO. 48568

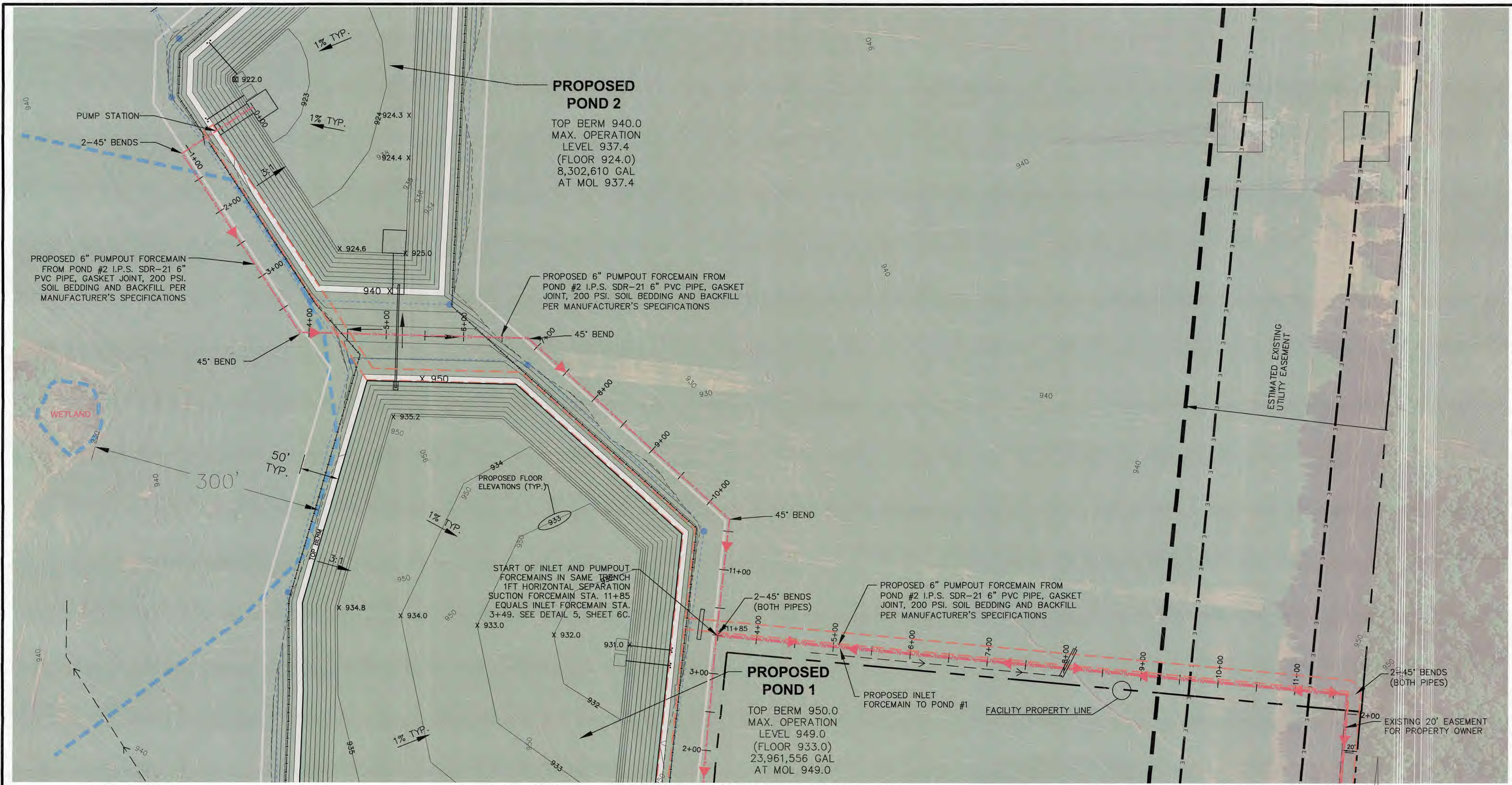
DOVETAIL ENERGY, LLC

INLET FORCEMAIN
PLAN AND PROFILE

BATH TOWNSHIP, GREENE COUNTY, OHIO

6A
13

N:\RGE009-DOVETAIL BERM\GREICO SITE\RESPONSE TO COMMENTS 5-19\RGE010-GREICO-06B.dwg - Jun 04, 2019 - 5:08pm - bhargest

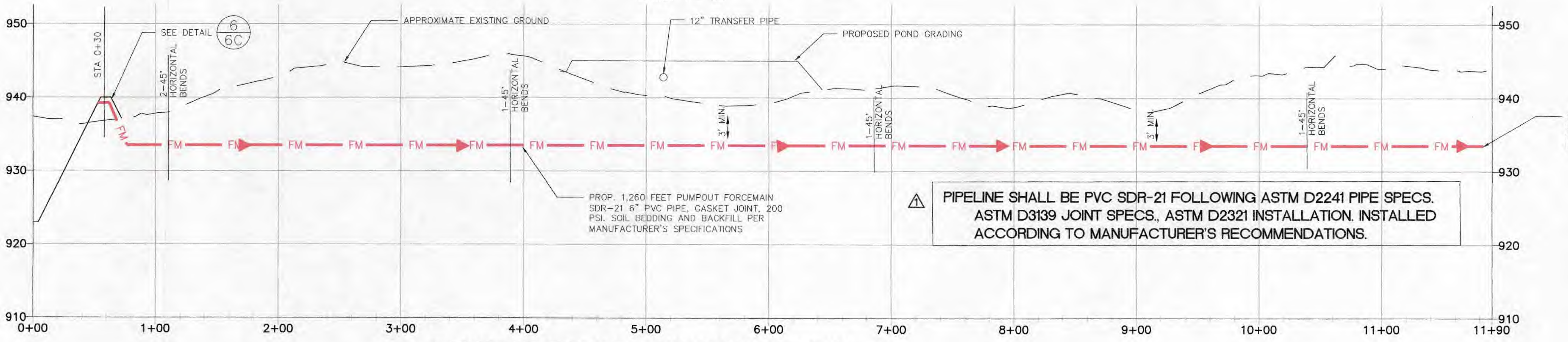


PUMPOUT FORCEMAIN SITE PLAN

SCALE: 1"= 60'

0 60 120

SCALE: 1"= 60'



⚠ PIPELINE SHALL BE PVC SDR-21 FOLLOWING ASTM D2241 PIPE SPECS. ASTM D3139 JOINT SPECS., ASTM D2321 INSTALLATION. INSTALLED ACCORDING TO MANUFACTURER'S RECOMMENDATIONS.

PUMPOUT FORCEMAIN PROFILE VIEW

SCALE: 1"=60' H, 1"=10'V

GENERAL NOTES:
1. FORCEMAIN VERTICAL DEFLECTION PER MANUFACTURE SPECS CAN BE IN LIEU OF VERTICAL BENDS. TYP.
2. PER GREENE COUNTY BUILDING CODE, FROST DEPTH IS 30"
3. PIPE SIZE TO BE CONFIRMED WITH FINAL PUMP DESIGN.

DAVID A. GERDEMAN E-48568

REVISIONS	BY	DATE
⚠ ADDED PVC FM SPEC. NOTE		

DATE: 5-21-19
PREPARED BY: DAG
DRAWN BY: LMH
CHECKED BY: DAG
FILE: RGE010-06B

NORTH POINT ENGINEERING
6657 Frank Ave. N.W.
Suite 200
North Canton, Ohio 44720
330 - 494 - 8888

REG. PROF. ENG. DAVID GERDEMAN, P.E. LICENSE NO. 48568

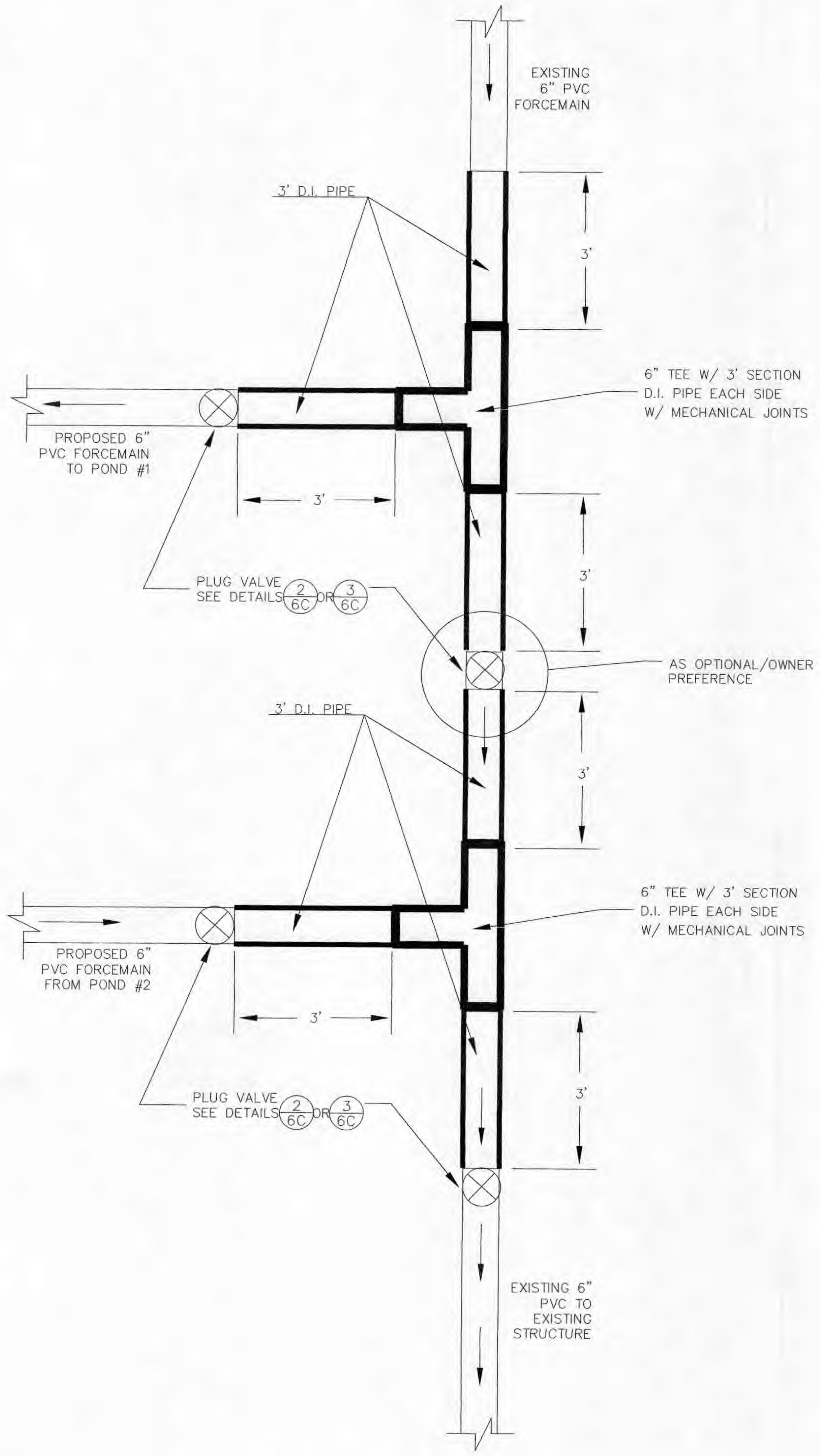
6-5-19
DATE

DOVETAIL ENERGY, LLC

PUMPOUT FORCEMAIN
PLAN AND PROFILE

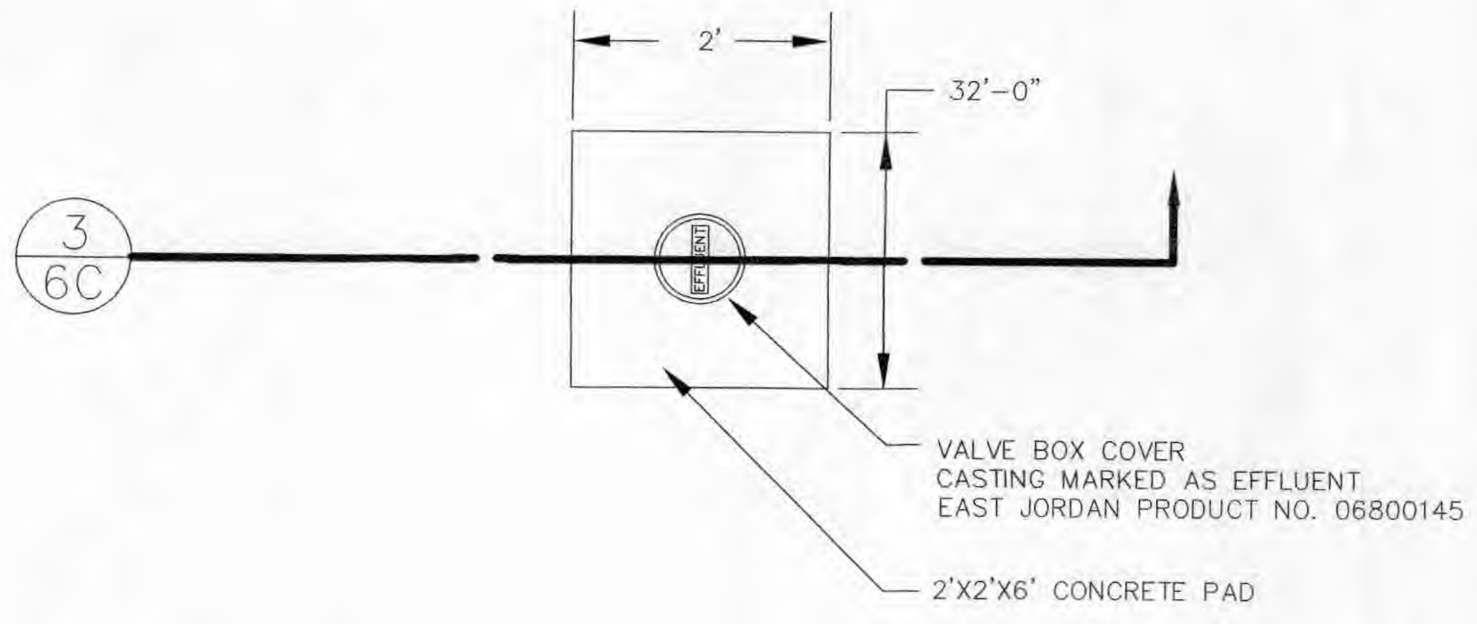
BATH TOWNSHIP, GREENE COUNTY, OHIO

6B
13



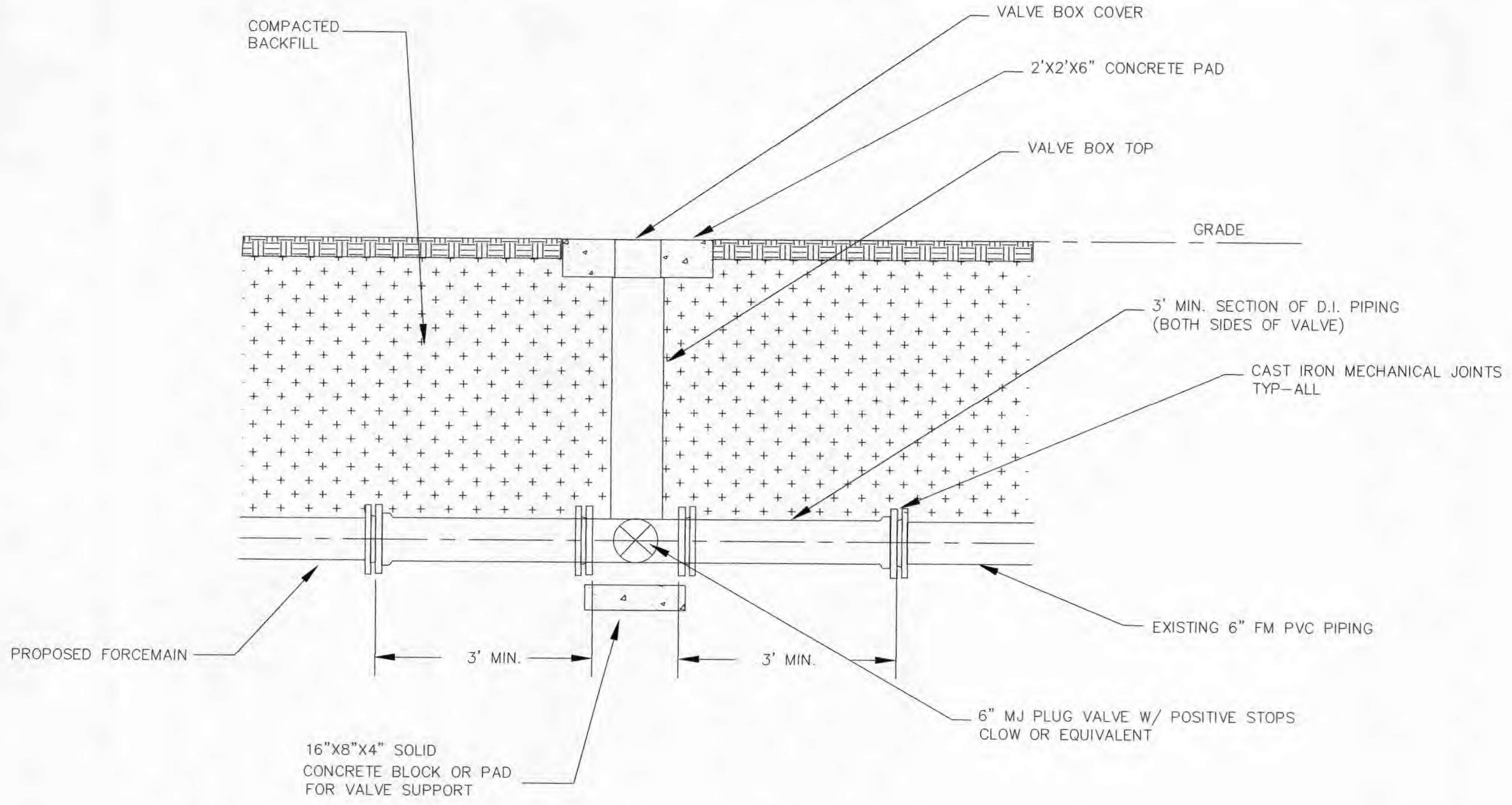
1/6C TIE-IN DETAIL

SCALE: NTS



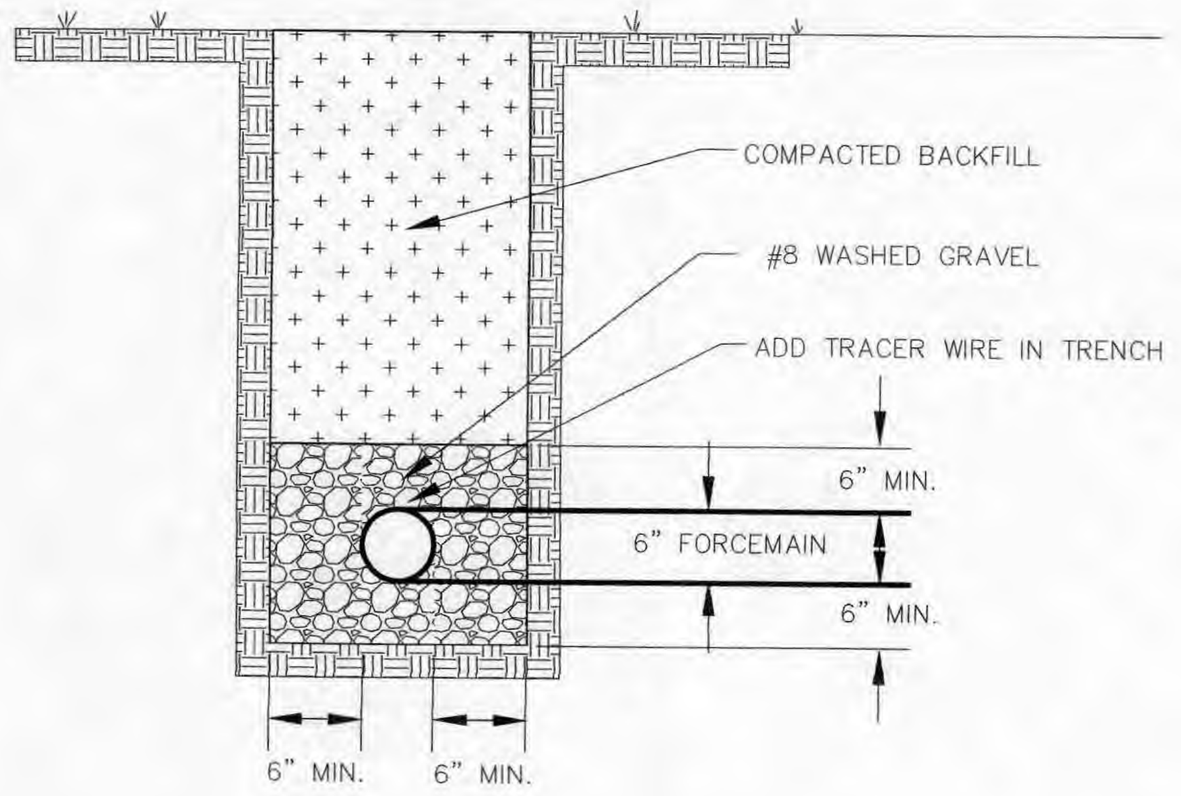
2/6C VALVE BOX TOP VIEW

SCALE: NTS



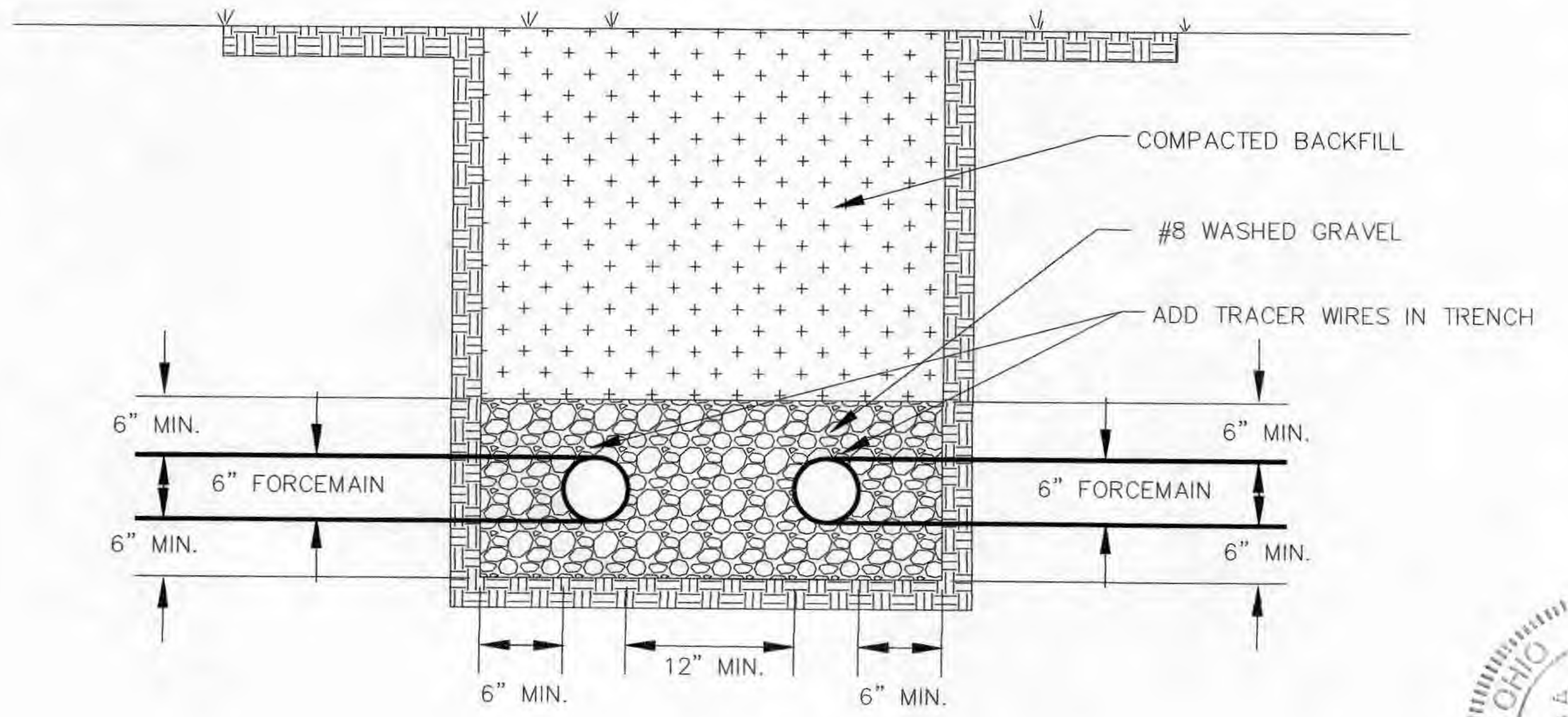
3/6C VALVE BOX SIDE VIEW

SCALE: NTS



4/6C PIPE BEDDING DETAIL

SCALE: NTS

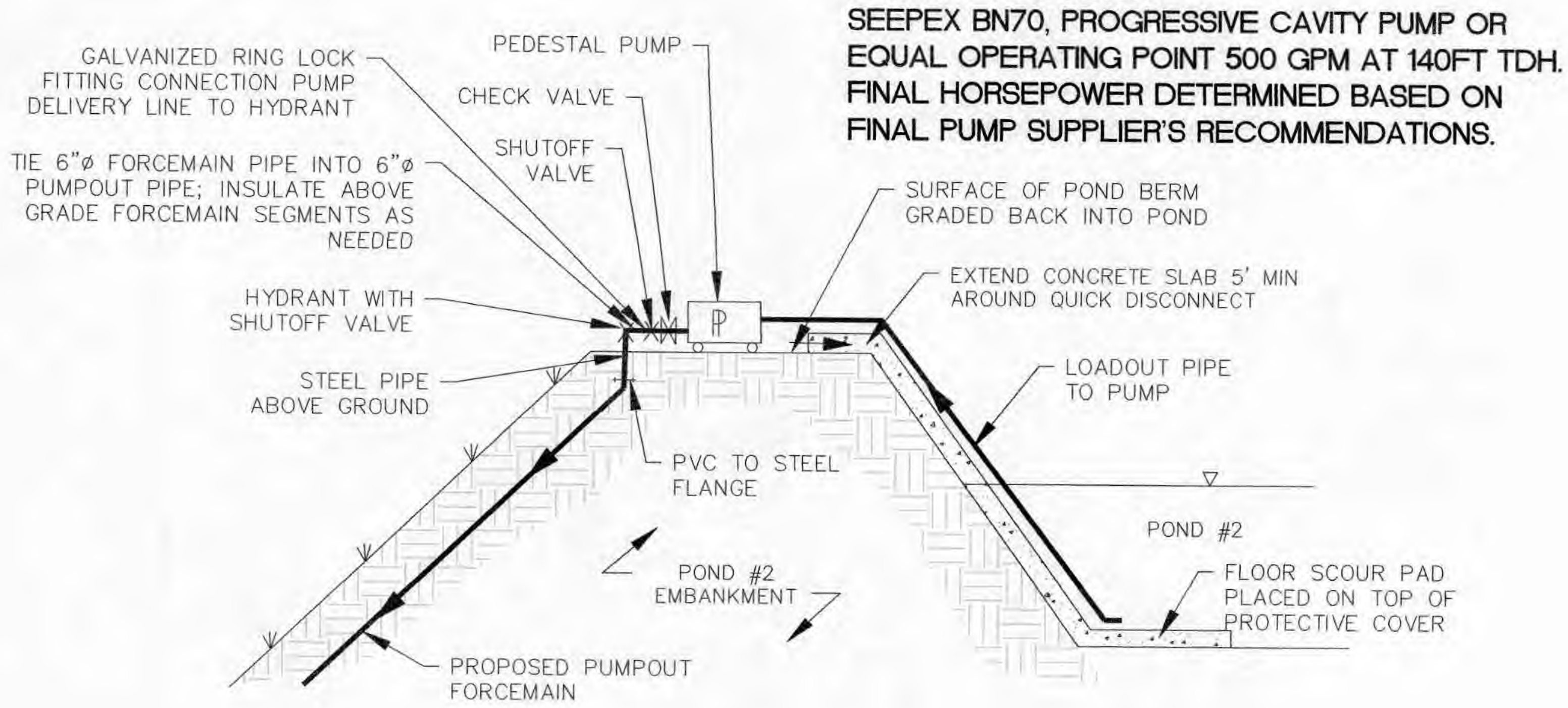


5/6C PIPE BEDDING W/ DUAL FORCEMAIN DETAIL

SCALE: NTS

PUMP SPECIFICATION: ⚠1

SEEPEX BN70, PROGRESSIVE CAVITY PUMP OR EQUAL OPERATING POINT 500 GPM AT 140FT TDH. FINAL HORSEPOWER DETERMINED BASED ON FINAL PUMP SUPPLIER'S RECOMMENDATIONS.



6/6C PUMPOUT LOWER POND #2

SCALE: NTS

CONSTRUCTION NOTES:

⚠ 1. PIPELINE SHALL BE PVC SDR-21 FOLLOWING ASTM D2241 PIPE SPECS. ASTM D3139 JOINT SPECS., ASTM D2321 INSTALLATION. INSTALLED ACCORDING TO MANUFACTURER'S RECOMMENDATIONS.
2. CONCRETE THRUST BLOCKING SHALL BE INSTALLED AT EACH PIPE BEND, TEE, ELBOW, END CAPS, VALVES, AND STEEP INCLINES OR DECLINES. SEE SHEET 6D.
3. A LEAKAGE TEST PER NRCS NATIONAL ENGINEERING HANDBOOK, PART 642, CONSTRUCTION SPECIFICATION 45, SECTION 12, METHOD 2, INCLUDED ON SHEET 6D SHALL BE CONDUCTED ON THE PIPELINE TO DETERMINE ALL JOINTS, FITTINGS, AND OTHER APPURTENANCES DO NOT LEAK PRIOR TO ACCEPTANCE. SEE SHEET 6D.
4. AFTER COMPLETION OF PIPE TRENCH BACKFILL, TOPSOIL IS TO BE PLACED OVER THE TOP OF THE FILLED TRENCH AND ANY BORROW AREA USED. SEEDING SHALL BE MADE AS SPECIFIED AND SEEDED IN OEPA GENERAL CONSTRUCTION PERMIT.

REVISIONS	BY	DATE
⚠1 ADDED PVC FM SPEC. NOTE TO #1 ON CONSTRUCTION NOTES AND PUMP SPECS TO DETAIL 6/6C		

DATE: 5-21-19
PREPARED BY: DAG
DRAWN BY: LMH
CHECKED BY: DAG
FILE: RGE010-06C

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6-5-29

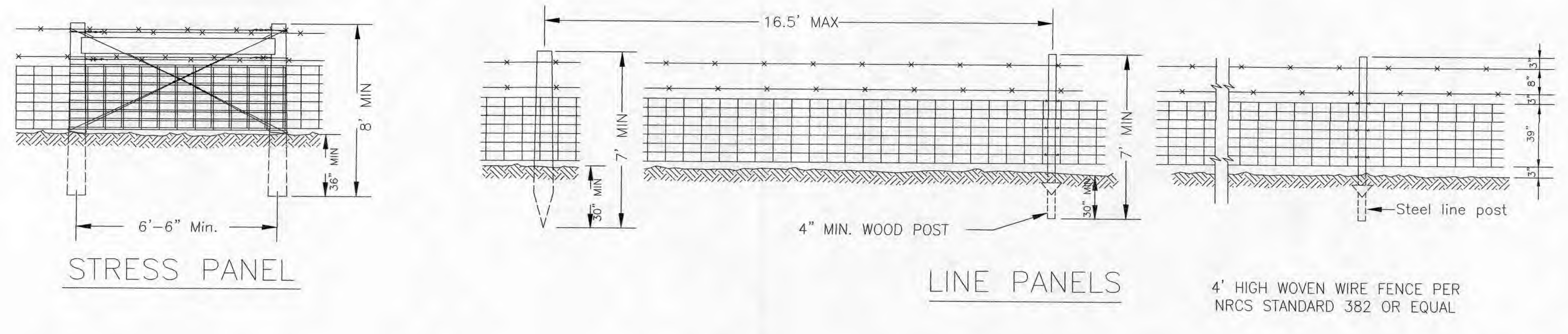
REG. PROF. ENG. DAVID GERDEMAN, P.E. LICENSE NO. 48568 — DATE

DOVETAIL ENERGY, LLC

FORCEMAIN TIE-IN
PIPING DETAILS

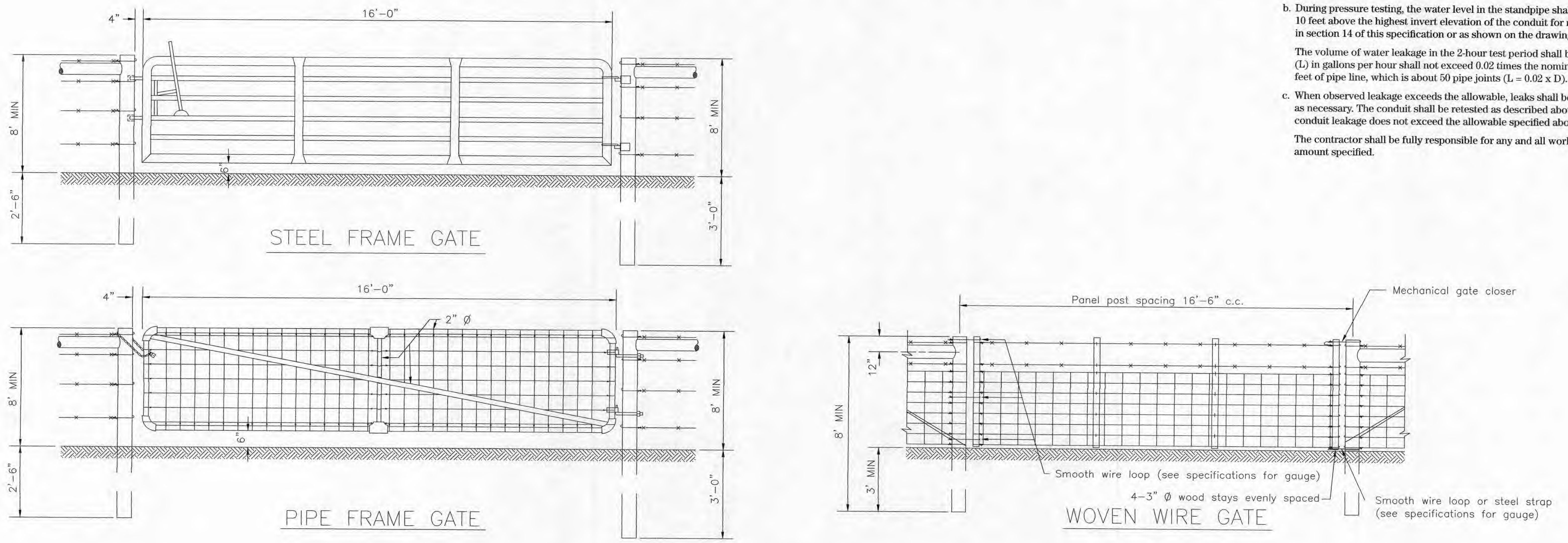
BATH TOWNSHIP, GREENE COUNTY, OHIO

6C/13



⚠ 1 / 6D **FENCE DETAILS**

N.T.S.



⚠ 2 / 6D **GATE DETAILS OPTIONS**

N.T.S.

NRCS NATIONAL ENGINEERING HANDBOOK, PART 642
CONSTRUCTION SPECIFICATION 45

SECTION 12: PRESSURE TESTING

Method 2—The conduit shall be tested for leaks in the following manner:

a. Before pressure testing:

(1) Joints of the assembled pipeline shall be allowed to cure as recommended by the manufacturer.

(2) Pipeline shall be flushed and cleaned.

(3) All concrete anchors and thrust blocks shall be in place and allowed to cure for a minimum of 3 days.

(4) Earth backfill shall be sufficient to anchor the conduit against movement during the pressure testing and shall be compacted as specified in Section 14 of this specification or as shown on the drawings.

(5) The conduit shall be braced, anchored, or both, at each end to restrict all potential pipe movement.

(6) The ends of the conduit shall be plugged. The upstream plug shall have a standpipe installed vertically having a minimum diameter of 2 inches and shall be equipped with a shutoff valve. All high points in the line shall be vented to evacuate air pockets. The conduit and the standpipe shall be slowly filled with water such that no air is entrapped during the filling operation. After filling is complete, all vents shall be closed.

b. During pressure testing, the water level in the standpipe shall be continuously maintained at a minimum of 10 feet above the highest invert elevation of the conduit for no less than 2 hours unless otherwise specified in section 14 of this specification or as shown on the drawings.

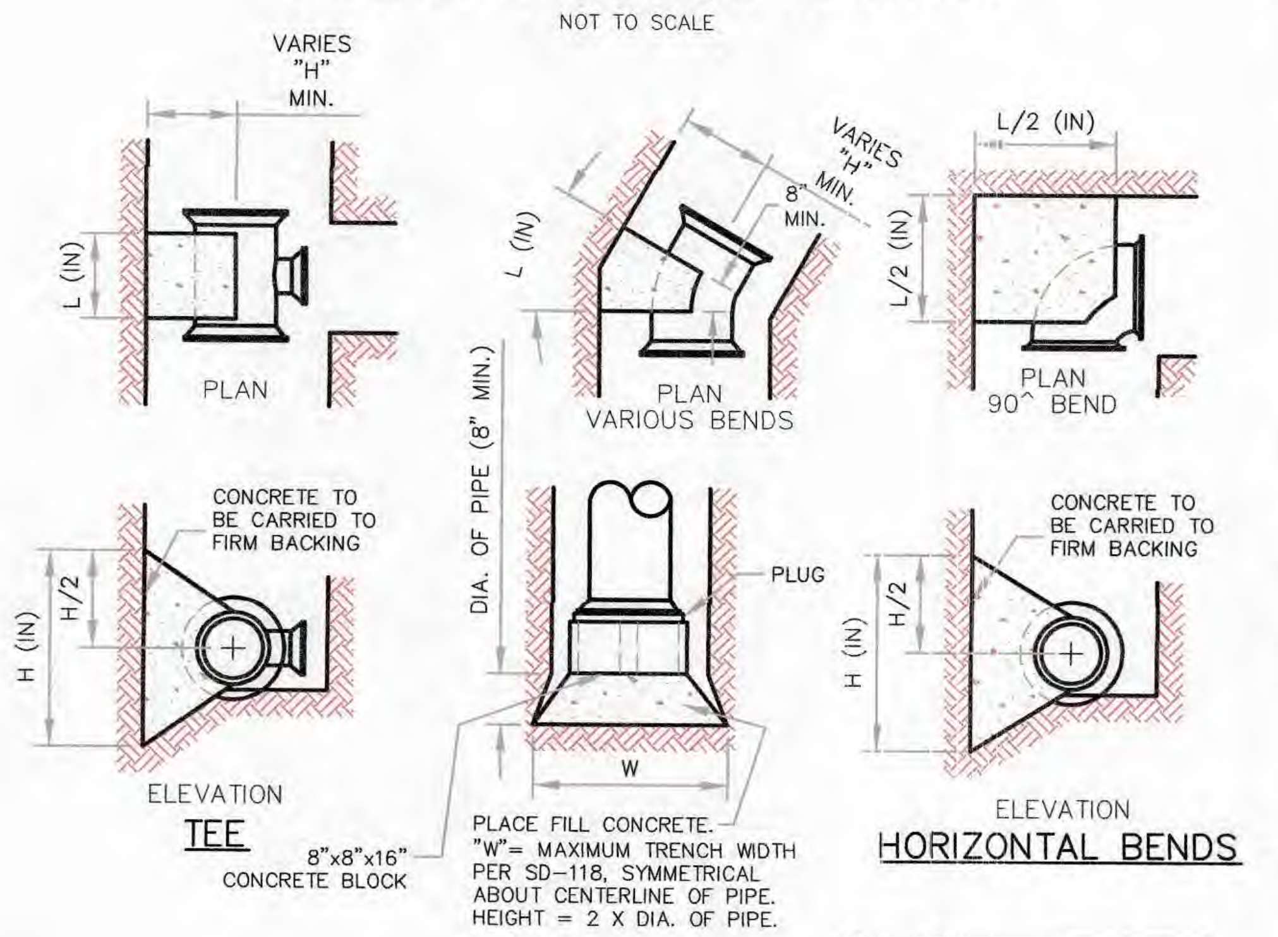
The volume of water leakage in the 2-hour test period shall be recorded. The maximum allowable leakage (L) in gallons per hour shall not exceed 0.02 times the nominal pipe diameter (D) in inches for each 1,000 feet of pipe line, which is about 50 pipe joints (L = 0.02 x D).

c. When observed leakage exceeds the allowable, leaks shall be sealed by replacement of pipe and fittings as necessary. The conduit shall be retested as described above. This procedure shall be repeated until the conduit leakage does not exceed the allowable specified above.

The contractor shall be fully responsible for any and all work required to correct leakage exceeding the amount specified.

THRUST BLOCKING DETAILS

NOT TO SCALE



TEE

8"x8"x16" CONCRETE BLOCK

PLACE FILL CONCRETE.
"W"= MAXIMUM TRENCH WIDTH PER SD-118, SYMMETRICAL ABOUT CENTERLINE OF PIPE.
HEIGHT = 2 X DIA. OF PIPE.

END OF LINE

HORIZONTAL BENDS

L & H DIMENSIONS ARE IN INCHES

RUN	BRANCH 2" L	2" H	3" L	3" H	4" L	4" H	6" L	6" H	8" L	8" H	10" L	10" H	12" L	12" H
2"	6	5												
3"	6	5	8	6										
4"	6	5	8	6	12	7								
6"	6	6	8	6	10	8	15	12						
8"	6	8	6	8	10	8	15	12	18	18				
10"	6	10	6	10	8	10	15	12	18	18	22	22		
12"	6	12	6	12	7	12	15	12	18	18	22	22	24	29
14"	6	14	6	14	6	14	13	14	18	18	22	22	26	27

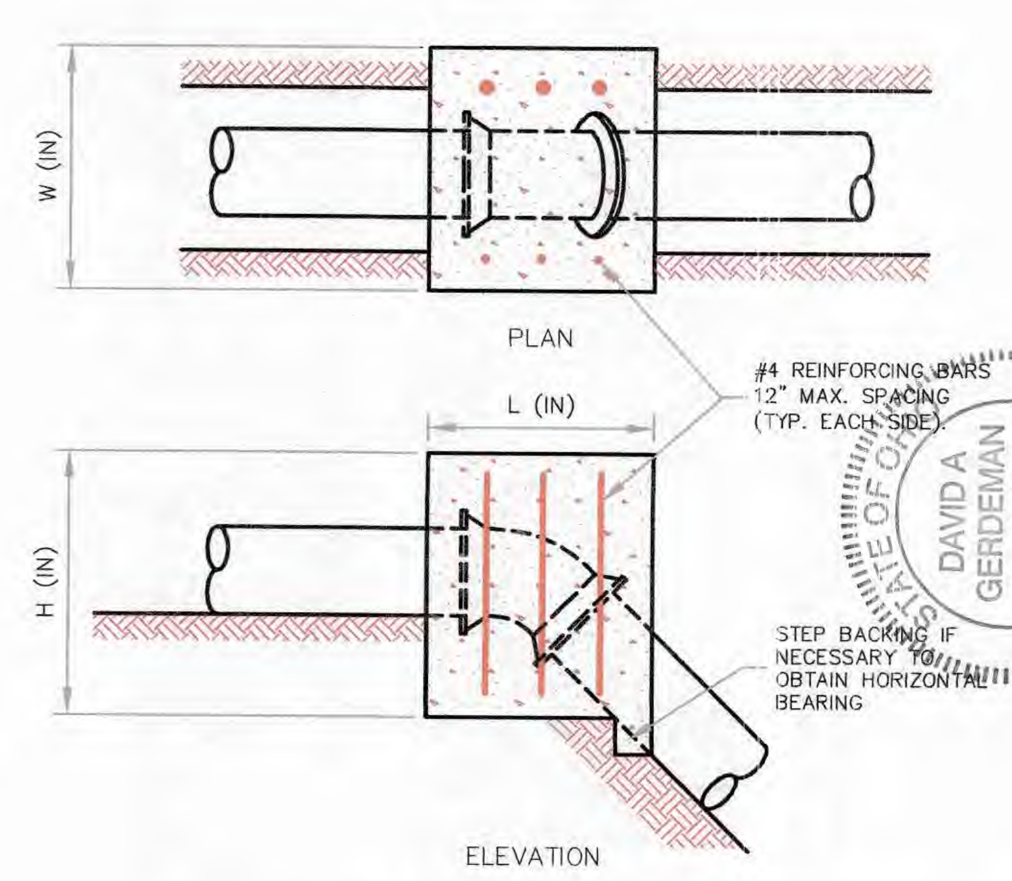
SIZE OF PIPE	DEGREE OF BEND 11¼^ L	11¼^ H	22½^ L	22½^ H	45^ L	45^ H	90^ L	90^ H
2"	4	3	4	4	5	4	10	5
3"	4	3	5	4	7	5	16	6
4"	5	4	7	5	10	6	20	8
6"	6	6	10	7	17	8	30	12
8"	8	8	14	9	19	13	36	18
10"	10	10	17	11	22	17	44	22
12"	12	12	19	15	24	22	48	29
14"	14	14	20	19	25	29	52	36
16"	16	16	20	24	27	35	58	42
18"	18	18	22	28	28	42	62	50
20"	20	20	25	30	32	46	68	56
24"	23	24	29	37	36	58	80	68

SD-100

REV. 4-94

THRUST BLOCKING DETAILS

NOT TO SCALE



VERTICAL BENDS

NOTES:

1. BLOCKING TO BE CENTERED ON BEND HORIZONTALLY.
2. ALL CONCRETE TO BE FILL CONCRETE.
3. L & W & H DIMENSIONS ARE IN INCHES.
4. BLOCKING DESIGN BASED ON A WORKING PRESSURE OF 125 P.S.I. AND A SOIL BEARING OF 3000 LB./SQ. FT.
5. –THE AREA OF THE THRUST BLOCK WILL BE INCREASED PROPORTIONALLY FOR FIELD SOIL BEARING LESS THAN 3,000 PSF.
–FIELD BEARING SHALL BE VERIFIED BY USING A POCKET PENETROMETER OR SIMILAR DEVICE.

SIZE OF PIPE (D)	DEGREE OF BEND 11¼^ L	11¼^ W	11¼^ H	22½^ L	22½^ W	22½^ H	45^ L	45^ W	45^ H	90^ L	90^ W	90^ H
3"	12	18	15	13	24	15	18	30	16	25	30	20
4"	13	24	16	16	30	16	25	30	20	27	40	24
6"	15	36	18	27	36	18	30	44	24	36	45	36
8"	20	40	20	28	48	22	34	50	34	43	58	42
10"	24	44	22	32	54	27	40	55	40	51	64	50
12"	32	48	24	36	60	30	46	60	46	60	66	59

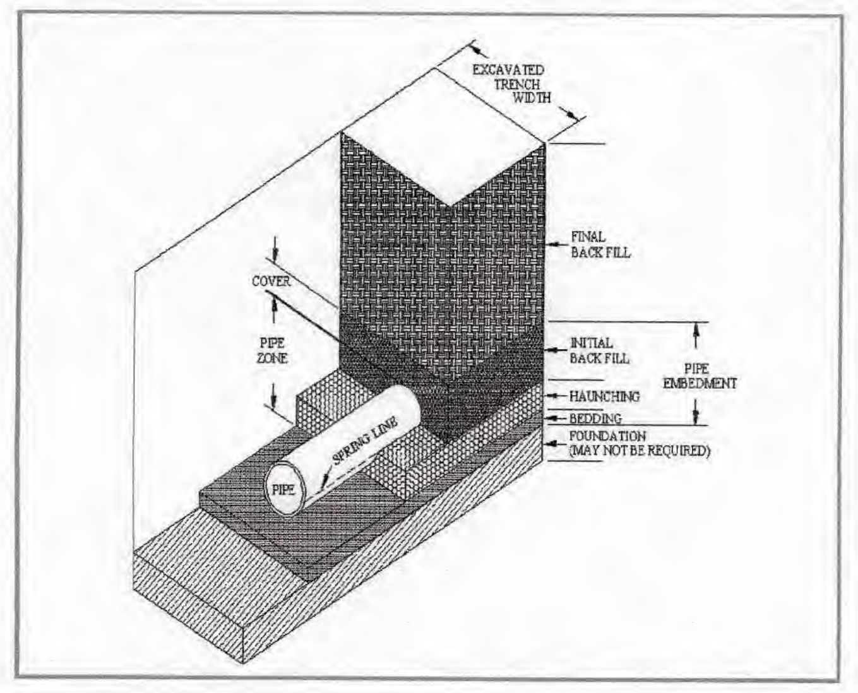
SD-101

REV. 12-2001

PRESSURE PIPE

TRENCH CONSTRUCTION:

Terms used in pipe installation are illustrated in the trench cross-section below. The use of proper embedment materials is very important to minimize trench settlement. For pipe from 4-inch through 12-inch diameter, the particle size of material in contact with the pipe shall not exceed ¾-inch for angular rock and 1½ inches for round rock. For 14-inch diameter and larger pipe, maximum particle size in contact with the pipe is 1½ inches.



FOUNDATION:

A foundation is required when the trench bottom is unstable. The bottom of the trench is over-excavated and brought back up to grade with suitable material. Where over-excavation occurs, ensure that the elevation under the entire length of the pipe is brought up (rather than only at the bells). Proper placement of over-excavated materials will provide proper support of the pipe and will prevent sagging between joints.

PRESSURE PIPE

BEDDING:

Bedding may be used to bring the trench bottom up to grade before the pipe is installed. The purpose of bedding is to provide continuous support under the pipe. Where required (such as when rock is encountered), a minimum depth of 4 to 6 inches is typical.

Holes for pipe bells should be provided at each joint to ensure uniform support for the pipe. Bell holes should be no larger than necessary for pipe assembly.

HAUNCHING:

Proper placement of material in the haunch reduces voids and increases pipe support. If granular materials are used, they may be properly placed using techniques such as shovel slicing. Place material under the haunches and at least halfway up the pipe to provide side support. Make sure material is properly compacted. DO NOT DISTURB SIDE SUPPORT WHEN MOVING SHEETING OR TRENCH BOX.

The pipe stiffness and anticipated loadings will dictate whether or not granular material and/or compaction of the haunch material are necessary.

PRESSURE PIPE

INITIAL BACKFILL:

The material placed over the crown of the pipe to a height of 6 to 12 inches is the initial backfill. The purpose of the initial backfill is to protect the pipe from the final backfill. Where not otherwise specified, the initial backfill may consist of the native material in the trench provided it is not frozen and is free from large stones, debris, and other organic materials.

Machine compaction of initial backfill directly over the pipe is not desirable unless adequate cover has been provided to protect the pipe. The required depth of cover will depend on the type of compaction equipment – consult the project engineer for information.

FINAL BACKFILL:

Final backfill is often specified by the project engineer based on site design. Material selection, placement, and compaction should meet the project requirements. In many cases, the material that was originally excavated can be used for final backfill.

PRESSURE PIPE

COMPACTING THE BACKFILL:

Compact the haunching, initial backfill, and final backfill in accordance with the job drawings. Observe the following precautions:

- When a "self-compacting" material is used (such as crushed stone), ensure that the material does not arch or bridge beneath the haunch of the pipe. Remove such voids by shovel slicing.
- When compacting the material underneath and at either side of the pipe, do not allow the tool or the machine to strike the pipe.

It is not necessary to compact the initial backfill directly over the top of the pipe for the sake of the pipe's structural strength. However, it may be necessary for roadway integrity and for minimizing trench settlement.

DAVID A GERDEMAN E-48568

REVISIONS	BY	DATE
⚠ ADD FENCE AND GATE DETAILS		

DATE: 5-21-19
PREPARED BY: DAG
DRAWN BY: LMH
CHECKED BY: DAG
FILE: RGE010-06D

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PIPING DETAILS

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