IDALS Floyd County Wetland

Geotechnical Engineering Report

Cedar Township, Floyd County, Iowa

December 6, 2024 | Terracon Project No. 13245077

Prepared for:

I&S Group, Inc.
335 Cedar Street, Suite 200
Waterloo, Iowa 50701

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

Gregory M. Decker, P.E. — December 6, 2024 (Date)

License Number 28047

My license renewal date is December 31, 2024.

Pages covered by this seal: All pages .

3105 Capital Way, Suite 5
Cedar Falls, IA 50613
P (319) 277-4016
Terracon.com

December 6, 2024

I&S Group, Inc.
335 Cedar Street, Suite 200
Waterloo, Iowa 50701

Attn: Spencer Pech, P.E.
P: (319) 234-1515
E: Spencer.Pech@ISGInc.com

Re: Geotechnical Engineering Report
IDALS Floyd County Wetland
Ocean Avenue
Cedar Township, Floyd County, Iowa
Terracon Project No. 13245077

Dear Mr. Pech:

We have completed the scope of Geotechnical Engineering services for the above referenced project in general accordance with Terracon Proposal No. P13245077 dated August 22, 2024. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork, soil parameters for use in sheet pile design, and geotechnical discussion regarding use of borrow area soils in a dike for the proposed project.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report or if we may be of further service, please contact us.

Sincerely,

Terracon

Gregory M. Decker, P.E.
Staff Engineer

Jason P. Heinz, P.E.
Department Manager
Geotechnical Services

Table of Contents

Figures

Attachments

Note: This report was also delivered in a web-based format. **Blue Bold** text in the report indicates a referenced section heading. The PDF version also includes hyperlinks which direct the reader to that section and clicking on the Terracon logo will bring you back to this page. For more interactive features, please view your project online at **client.terracon.com**.

Refer to each individual Attachment for a listing of contents.

Introduction

This report presents the results of our subsurface exploration and Geotechnical Engineering services performed for the proposed Wetland FLO971628B located east of Ocean Avenue in Cedar Township, Floyd County, Iowa. The purpose of these services was to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil conditions
- Groundwater conditions
- Borrow for dike construction
- Soil parameters for sheet pile design

The geotechnical engineering Scope of Services for this project included the advancement of test borings, laboratory testing, engineering analysis, and preparation of this report. Drawings showing the site and boring locations are shown on the **Site Location** and **Exploration Plan**, respectively. The results of the laboratory testing performed on soil samples obtained from the site during our field exploration are included on the boring logs in the **Exploration and Laboratory Results** section.

Project Description

Item	Description
Proposed Construction	A sheet pile weir is planned about 300 feet east of Ocean Avenue. The sheet pile weir is planned to have a width of about 30 feet. A drop height of 6.86 feet and a maximum water depth of about 6.5 feet is planned for the weir and pool. A forebay with dimensions of 30 feet by 120 feet is also planned. A borrow source is being considered in the eastern area of the site if other areas do not contain enough suitable, fine-grained soil.

Site Conditions

Item	Description
Site Location	The project is located east of Ocean Avenue and south of 110th Street in Cedar Township, Floyd County, Iowa. See **Site Location**
Existing Improvements	Drain tiles are present in the vicinity of the proposed weir.
Current Ground Cover	Various vegetation near the unnamed, intermittent tributary to the Cedar River.
Existing Topography	Based on the topographic site plan provided, surface elevations range from about 1,100 feet in the eastern borrow area to 1,080 feet along the centerline of the proposed weir.

Geotechnical Characterization

Subsurface Profile

We have developed a general characterization of the subsurface conditions based on our review of the subsurface exploration, laboratory data, geologic setting, and our understanding of the project. This characterization, termed GeoModel, forms the basis of our evaluation of the site. Conditions observed at the boring locations are indicated on logs in the **Exploration and Laboratory Results.** The GeoModel can be found in the **Figures** of this report.

As part of our evaluation, we identified the following model layers within the subsurface profile.

Model Layer	Layer Name	General Description
1	**Surface**	▪ Topsoil ▪ Sandy Lean Clay, trace gravel and organics
2	**Upper Till**	▪ Sandy Lean Clay and Lean Clay with sand, trace gravel, typically medium stiff to very stiff
3	**Lower Till**	▪ Sandy Lean Clay, trace gravel, with occasional sand seams, typically very stiff to hard

Groundwater Observations

Groundwater was not observed in the boreholes during the relatively short time the boreholes remained open. Groundwater observations made in cohesive soils require a relatively long period for groundwater level to develop and stabilize in a borehole. Long-term observations in piezometers or groundwater observation wells, sealed from the influence of surface water, would be required to provide a better evaluation of groundwater levels in materials of this type. Groundwater level fluctuations should be anticipated during the life of the structure due to variations in the amount of precipitation, the level of the creek, and other potential factors not evident at the time the borings were performed. It should be noted that the exploration was performed during a relatively dry period that included droughts.

A review of the Floyd County, Iowa Soil Survey provided online on the 'Web Soil Survey' by the United States Department of Agriculture/Soil Conservation Service mapped the Clyde Silty Clay Loam (84), Lourdes Loam (781C), Cresco Loam (783B), and Protivin Loam (798B) at the site. The information in the following table for groundwater, drainage class, and flooding frequency was indicated on the Web Soil Survey.

Map Unit Name	Seasonally High Groundwater Depths (feet)	Drainage Class	Flooding Frequency
Clyde Silty Clay Loam (84)	0	Poorly drained	None
Lourdes Loam (781C)	4	Moderately well drained	None
Cresco Loam (783B)	4	Moderately well drained	None
Protivin Loam (798B)	1	Somewhat poorly drained	None

Geotechnical Overview

Based on the results of the subsurface exploration and laboratory testing, construction of a dike and a sheet pile weir appears feasible to impound water at this site. The subsurface conditions primarily consisted sandy lean clay with occasional sand seams with stiffnesses increasing with depth. Zones of unsuitable, partly organic soil are present at the project site. Where partly organic material is encountered in a borrow area, thorough mixing of the material with lean clay or sandy lean clay, or wasting of the material, will be necessary for a suitable borrow source for dike fill. Construction of a relatively uniform dike will require appropriate earthwork operations.

The recommendations contained in this report are based upon the results of field and laboratory testing (presented in the **Exploration Results**), engineering analyses, and our current understanding of the proposed project. The **General Comments** section provides an understanding of the report limitations.

Earthwork

Site Preparation and Subgrade Evaluations

The subgrade for the dike and any berms should be evaluated by Terracon personnel. Unstable, soft, or disturbed subgrade areas for the dike and berms should be undercut or improved in-place prior to fill placement. Excessively wet or dry material should also be undercut or scarified, moisture conditioned, and compacted. Prior to the placement of each lift of fill, the surface should be scarified/disced to a depth of about 4 inches.

We recommend that lifts of fill be placed on slopes no steeper than 5H:1V. The excavation of a maximum 5H:1V slope will help provide a positive bond between the fill and existing soils/materials and reduce the possibility of failure along the interface of existing soil/material and new fill. Faces of slopes should be compacted as construction proceeds. Consideration should be given to overfilling new fill slopes and subsequently cutting the slope to the plan section.

Fill Material Types

For the purposes of this report, fill required to construct the dike and any berms is referred to as structural fill. Requirements for structural fill material types follow.

Reuse of On-Site Soil: Excavated on-site soil may be selectively reused as fill. Due to the presence of partly organic material, sorting of suitable and unsuitable materials should be expected. Some moisture conditioning (e.g., drying) should also be expected to achieve compaction requirements for on-site, fine-grained materials used for the dike

and berm fill. It should be noted that clayey and silty soils (CL, ML, SC, and SM) can be difficult to compact during cool or cold weather, in relatively small areas, and over lower strength/density and marginally stable subgrades.

Borrow Materials: Based on the subsurface conditions encountered below the topsoil and near the site surface in Borings 3 through 5, it appears that suitable clay borrow is present at the site.

Material Property Requirements: Material property requirements for soil/material used as fill to construct the dike and any berms are presented in the following table.

Fill Type[1]	USCS Classification	Acceptable Locations for Placement
Imported, Low to Medium Plasticity, Fine-grained Soil	CL, CL/CH, CH 15 < PI < 30 LL <60	Dike, berms, and general site grading
Imported or On-site, Granular[2]	SP, SW, SC, SM, GP, GW, GM	General site grading
On-site, Fine-grained Soil[3]	CL 15 < PI < 30, LL <60	Dike, berms, and general site grading

1. Based on the results of the subsurface exploration and laboratory testing. By our definition, low plasticity material would have a liquid limit (LL) of 45 or less, and a plasticity index (PI) of 23 or less. Low plasticity fill should be used in areas where movements related to shrinking and swelling may adversely impact an improvement. Actual material suitability should be evaluated during construction.
2. Interlayering of fine-grained and coarse-grained materials should be avoided.
3. Based on the construction planned and the results of the borings and laboratory testing, it appears that the non-organic, on-site, fine-grained soils could be reused. Moisture conditioning should be expected to achieve compaction requirements.

Fill Placement and Compaction Requirements

Construction of a relatively uniform dike will require proper fill placement and compaction operations. Fill placement and compaction operations ultimately affect whether the in-place strength and hydraulic conductivity meet the project design requirements. Control of fill moisture content and thorough discing and mixing will be

required during construction. The moisture content of each previous lift must be maintained prior to placement of each subsequent lift of fill. This will require that watering, moisture conditioning, and protection of working subgrades be provided throughout construction. The sizes of the fill material pieces, or clod sizes, affects the hydraulic conductivity of the compacted element. Discing, pulverizing, or tining will therefore be required during construction. The contractor must select appropriate equipment with sufficient weight or force capable of breaking each lift of fill into an acceptable clod size prior to and during moisture conditioning. Each lift of fill should be placed and compacted under strict moisture and compaction/density control and each lift of fill should be tested. In addition to in-place moisture and compaction testing, undisturbed samples of in-place fill should be obtained and tested for hydraulic conductivity throughout dike construction.

Structural fill should be placed and compacted in accordance with the following requirements.

Item	Requirement
Maximum Lift Thickness	▪ 9 inches in loose thickness when heavy, self-propelled compaction equipment is used ▪ 4 inches in loose thickness when hand-guided equipment (i.e., jumping jack or plate compactor) is used
Minimum Compaction Requirements [1, 2]	▪ Granular material: 95% ▪ Fine-grained material: 95%
Water Content Range from Optimum [1, 3]	▪ Fine-grained/Cohesive material: 0% to +4% ▪ Granular material: -3% to +3%

1. The minimum compaction requirements are in reference to the maximum dry density value and optimum water content determined by the 'standard Proctor' test (ASTM D698). Should the results of the in-place density tests indicate the specified water content or compaction limits have not been met, the area represented by the test should be reworked and retested, as required, until the specified water content and compaction requirements are achieved.
2. If the granular material is a coarse sand or gravel, or of a uniform size, or has a low fines content, compaction comparison to relative density may be more appropriate. In this case, granular materials should be compacted to at least 70% relative density (ASTM D4253 and D4254).
3. The gradation of a granular material affects its stability and the water content required for proper compaction. The water content of granular material should be maintained at levels satisfactory for compaction to be achieved without the granular material bulking during placement or pumping when proofrolled.

General Earthwork Considerations

The on-site, fine-grained soils are frost-susceptible and will be sensitive to changes in moisture conditions. Upon completion of filling and grading, care should be taken to maintain the subgrade water content. Construction traffic over completed subgrades should be avoided. If the subgrade freezes or becomes desiccated, saturated, or disturbed, the affected material should be removed, or the materials should be scarified, moisture conditioned, and recompacted.

As a minimum, excavations should be performed in accordance with OSHA 29 CFR, Part 1926, Subpart P, "Excavations" and its appendices, and in accordance with any applicable local, and/or state regulations. Construction site safety is the sole responsibility of the contractor who controls the means, methods, and sequencing of construction operations. Under no circumstances shall the information provided herein be interpreted to mean Terracon is assuming responsibility for construction site safety, or the contractor's activities; such responsibility shall neither be implied nor inferred.

Sheet Pile Design Parameters

The following soil parameters were estimated based on the results of the subsurface exploration and laboratory testing and may be used in the sheet pile design. Please note that recommendations for design and construction of the dike and sheet pile are beyond our scope of services for this project.

Recommended Sheet Pile Parameters			
Soil Classification	**Topsoil**	**Model Layer 2 Upper Till**	**Model Layer 3 Lower Till**
Total 'Saturated' Density (pcf)	105	115	125
Submerged Density (pcf)	40	50	60
Effective friction angle (degrees)	18	22	24
Cohesion (psf)	0	1,000	2,250
Steel-soil interface friction angle	---	---	---
Active Pressure coefficient (K_a)	0.53	0.46	0.42
Passive Pressure coefficient (K_p)	1.89	2.19	2.37

General Comments

Terracon should be retained to review the final design plans and specifications so comments can be made regarding interpretation and implementation of our geotechnical recommendations in the design and specifications. Terracon also should be retained to provide observation and testing services during grading, excavation, and other earth-related construction phases of the project.

Our analysis and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration. Variations will occur between exploration locations or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. Terracon should be retained as the Geotechnical Engineer, where noted in this report, to provide observation and testing services during pertinent construction phases. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Our Scope of Services does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

Our services and any correspondence are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third-party beneficiaries intended. Any third-party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance upon the services and any work product is limited to our client and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly affect excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety and cost estimating including excavation support and dewatering requirements/design are the responsibility of others. Construction and site development have the potential to affect adjacent properties. Such impacts can include damages due to vibration, modification of groundwater/surface

water flow during construction, foundation movement due to undermining or subsidence from excavation, as well as noise or air quality concerns. Evaluation of these items on nearby properties are commonly associated with contractor means and methods and are not addressed in this report. The owner and contractor should consider a preconstruction/precondition survey of surrounding development. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

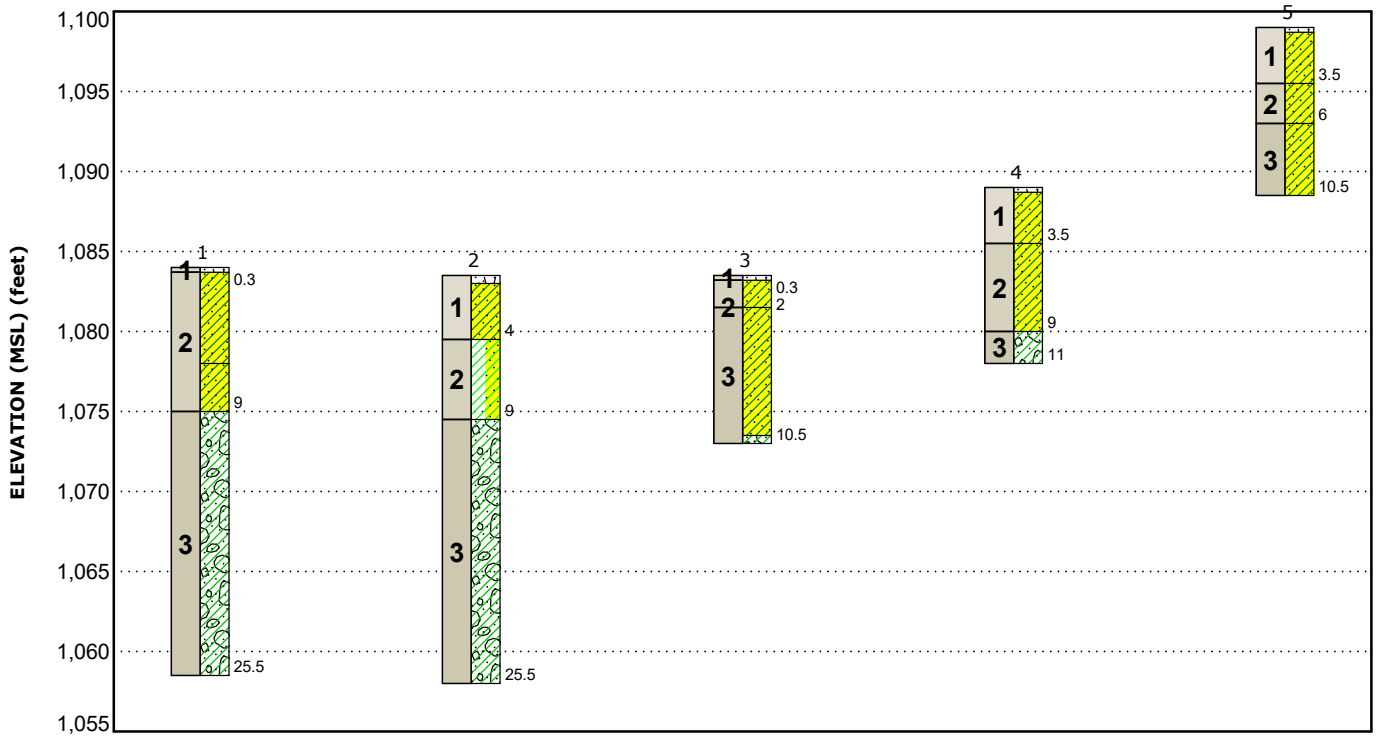
Figures

Contents:

IDALS Floyd County Wetland
Ocean Ave | Floyd, IA
Terracon Project No. 13245077

Terracon
3105 Capital Way, Ste 5
Cedar Falls, IA

GeoModel



This is not a cross section. This is intended to display the Geotechnical Model only. See individual logs for more detailed conditions.

Model Layer	Layer Name	General Description
1	Surface	Topsoil Sandy Lean Clay, trace gravel and organics
2	Upper Till	Sandy Lean Clay and Lean Clay, with sand, trace gravel, typically medium stiff to very stiff
3	Lower Till	Sandy Lean Clay, trace gravel, with occasional sand seams, typically very stiff to hard

Legend

- Topsoil
- Sandy Lean Clay
- Glacial Till
- Lean Clay with Sand

NOTES:
Layering shown on this figure has been developed by the geotechnical engineer for purposes of modeling the subsurface conditions as required for the subsequent geotechnical engineering for this project. Numbers adjacent to soil column indicate depth below ground surface.

Attachments

Exploration and Testing Procedures

Field Exploration

Number of Borings	Approximate Boring Depth (feet)	Location
2	25.5	Sheet Pile Wier
2	10.5 to 11	Planned Borrow Area
1	10.5	Alternate Borrow Area

Boring Layout and Elevations: I&S Group determined the boring locations and staked the locations in the field. Approximate elevations were also determined by I&S Group. The surface elevations of the boring logs were rounded to the nearest ½-foot. The locations and elevations of the borings should be considered accurate only to the degree implied by these methods.

Subsurface Exploration Procedures: We advanced the borings with a track-mounted, rotary drill rig using continuous flight, hollow-stem augers. Soil sampling was performed using split-barrel and thin-walled tube sampling procedures. In the split-barrel sampling procedure, the number of blows required to advance a standard 2-inch O.D. split barrel sampler the last 12 inches of the typical total 18-inch penetration by means of a hammer with a free fall of 30 inches, is the standard penetration resistance value (N). A CME automatic SPT hammer was used to estimate the relative density of granular soils, and to a lesser extent, the consistency of fine-grained soils. In the thin-walled tube sampling procedure a thin-walled, seamless steel tube with a sharp cutting edge was pushed hydraulically into the soil to obtain a relatively undisturbed sample

Our exploration team prepared field boring logs as part of the drilling operations. These field logs include visual classifications of the materials encountered during drilling and the exploration team's interpretation of the subsurface conditions between samples. The sampling interval depths, penetration resistances, recoveries, and other sampling information are recorded on the field boring logs. The samples were containerized and transported to our laboratory for further testing and classification.

Laboratory Testing

The project engineer reviewed the field data and assigned laboratory tests. The laboratory testing program included the following types of tests:

- Moisture Content
- Dry Density Determination

- Unconfined Compressive Strength
- Liquid and Plastic Limits
- Organic Content

The laboratory testing program included examination of soil samples by geologists. Based on the results of our field and laboratory programs, we described and classified the soil samples in general accordance with the Unified Soil Classification System.

Site Location and Exploration Plans

Contents:

Site Location Plan
Exploration Plan

Note: All attachments are one page unless noted above.

Site Location

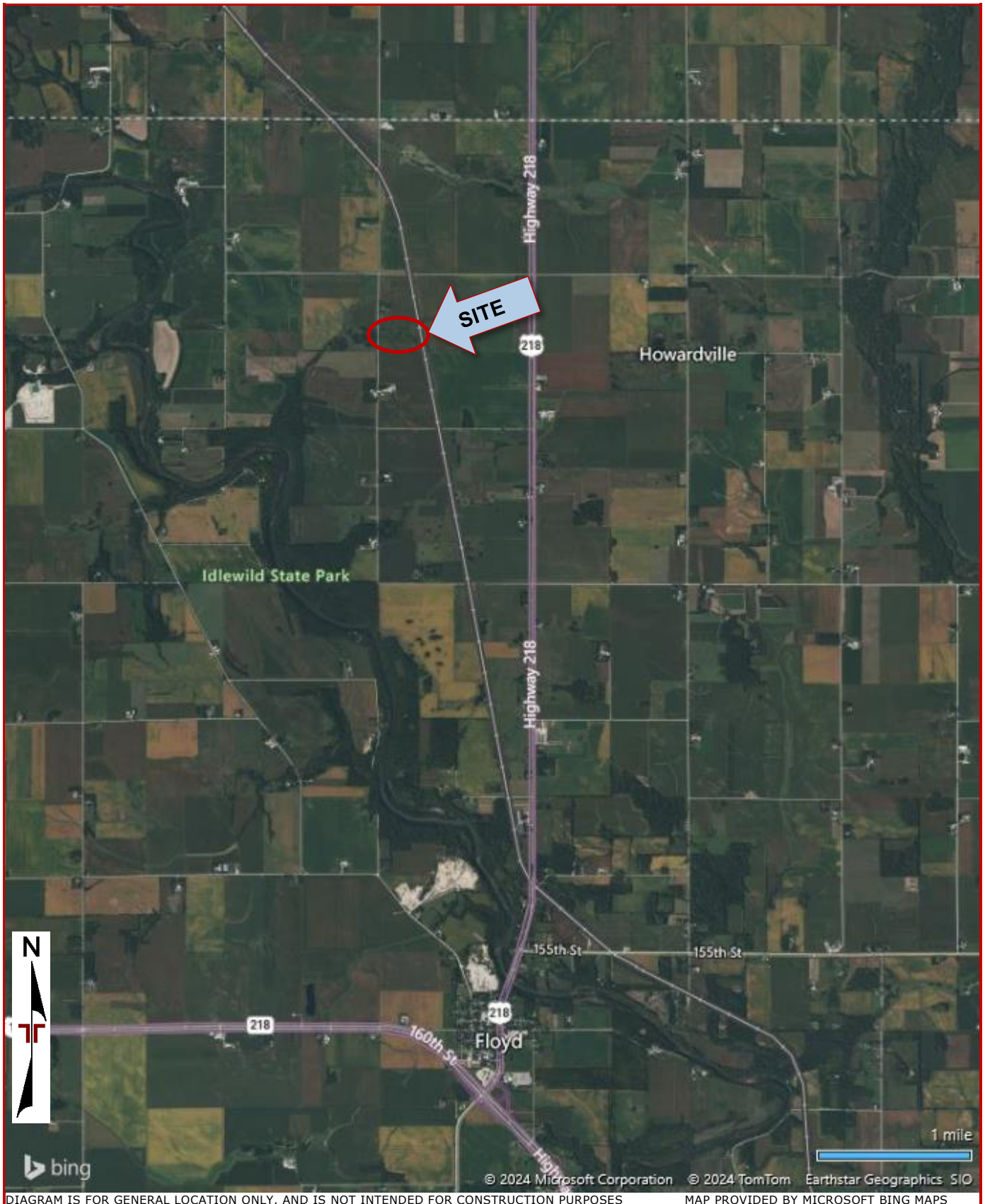


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES MAP PROVIDED BY MICROSOFT BING MAPS

Exploration Plan

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY ISG

Exploration and Laboratory Results

Contents:

Boring Logs (Borings 1 through 5)

Note: All attachments are one page unless noted above.

IDALS Floyd County Wetland
Ocean Ave | Floyd, IA
Terracon Project No. 13245077

Terracon
3105 Capital Way, Ste 5
Cedar Falls, IA

Boring Log No. 1

Location: See Exploration Plan

Latitude: 43.1925° Longitude: -92.7511°

Depth (Ft.) Elevation.: 1084.0 (Ft.)

Model Layer	Graphic Log	Depth (Ft.)	Water Level Observations	Sample Type	Recovery (In.)	Field Test Results	HP (psf)	Strength Test: Test Type	Strength Test: Compressive Strength (psf)	Strength Test: Strain (%)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits: LL-PL-PI	Organic Content (%)
1		0.3 **TOPSOIL** 1083.7												
2		**SANDY LEAN CLAY (CL)**, trace gravel, dark gray, stiff			9	2-4-5 N=9					21.8			
					5		3000 (HP)				23.0			
		6.0 1078												
		SANDY LEAN CLAY (CL), trace gravel, brown and gray, medium stiff to stiff			9	1-2-2 N=4 2500 (HP)					19.3			
		9.0 1075												
3		**SANDY LEAN CLAY (CL)**, trace gravel, gray, very stiff to hard			15			UC	5806	12.7	20.3	112		
					13	4-8-11 N=19 8500 (HP)	9000+ (HP)				14.3			
					18	4-7-11 N=18 7500 (HP)	7000 (HP)				14.7			
		25.5 1058.5			15	3-5-9 N=14 7000 (HP)	7000 (HP)				15.6			
		Boring Terminated at 25.5 Feet												

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevation Reference: Elevations were provided by ISG.

Water Level Observations
None observed while drilling

None observed after drilling

Drill Rig
589

Hammer Type
Automatic

Driller
CL

Notes

Advancement Method
Hollow Stem Auger

Abandonment Method
Boring backfilled with soil cuttings upon completion.

Logged by
CR

Boring Started
11-12-2024

Boring Completed
11-12-2024

IDALS Floyd County Wetland
Ocean Ave | Floyd, IA
Terracon Project No. 13245077

Terracon
3105 Capital Way, Ste 5
Cedar Falls, IA

Boring Log No. 2

Location: See Exploration Plan

Latitude: 43.1926° Longitude: -92.7510°

Depth (Ft.) Elevation.: 1083.5 (Ft.)

Model Layer	Graphic Log	Depth (Ft.)	Water Level Observations	Sample Type	Recovery (In.)	Field Test Results	HP (psf)	Strength Test: Test Type	Strength Test: Compressive Strength (psf)	Strength Test: Strain (%)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits: LL-PL-PI	Organic Content (%)
		0.5 **TOPSOIL** 1083												
1		**SANDY LEAN CLAY (CL)**, trace gravel and organics, dark gray			7			UC	3180	14.1	20.4	105		3.7
		4.0 1079.5												
2		**LEAN CLAY (CL)**, with sand, gray and brown, stiff to medium stiff			4	2-4-4 N=8 3500 (HP)					17.4			
					14			UC	1715	14.9	34.4	99		
		9.0 1074.5												
3		**SANDY LEAN CLAY (CL)**, trace gravel, gray, very stiff to hard			18	2-4-7 N=11 5500 (HP)					16.8			
					16	3-5-9 N=14	6000 (HP)				15.9			
					18	4-7-10 N=17 6000 (HP)					15.3			
		sand seams encountered at about 24 feet			17	5-11-13 N=24 9000 (HP)					14.5			
		25.5 1058												
		Boring Terminated at 25.5 Feet												

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevation Reference: Elevations were provided by ISG.

Water Level Observations
None observed while drilling

None observed after drilling

Drill Rig
589

Hammer Type
Automatic

Driller
CL

Notes

Advancement Method
Hollow Stem Auger

Abandonment Method
Boring backfilled with soil cuttings upon completion.

Logged by
CR

Boring Started
11-12-2024

Boring Completed
11-12-2024

IDALS Floyd County Wetland
Ocean Ave | Floyd, IA
Terracon Project No. 13245077

Terracon
3105 Capital Way, Ste 5
Cedar Falls, IA

Boring Log No. 3

Location: See Exploration Plan

Latitude: 43.1928° Longitude: -92.7499°

Depth (Ft.) Elevation.: 1083.5 (Ft.)

Model Layer	Graphic Log	Depth (Ft.)	Water Level Observations	Sample Type	Recovery (In.)	Field Test Results	HP (psf)	Strength Test: Test Type	Strength Test: Compressive Strength (psf)	Strength Test: Strain (%)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits: LL-PL-PI	Organic Content (%)
1		0.3 **TOPSOIL** 1083.2												
2		**SANDY LEAN CLAY (CL)**, trace gravel and organics, dark brown 2.0 1081.5												
					10	4-3-5 N=8 5500 (HP)					17.0 18.5			6.9
3		**SANDY LEAN CLAY (CL)**, trace gravel, gray and brown, stiff to very stiff												
		5			4		4000 (HP)				16.4	114		
					16	2-4-6 N=10	4000 (HP)				19.4			
		10.0 1073.5												
		10.5 1073 **SANDY LEAN CLAY (CL)**, trace gravel, gray, very stiff			18	3-5-8 N=13	6000 (HP) 7000 (HP)				17.8 15.0			
		Boring Terminated at 10.5 Feet												

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevation Reference: Elevations were provided by ISG.

Water Level Observations
None observed while drilling

None observed after drilling

Drill Rig
589

Hammer Type
Automatic

Driller
CL

Notes

Advancement Method
Hollow Stem Auger

Abandonment Method
Boring backfilled with soil cuttings upon completion.

Logged by
CR

Boring Started
11-12-2024

Boring Completed
11-12-2024

IDALS Floyd County Wetland
Ocean Ave | Floyd, IA
Terracon Project No. 13245077

Terracon
3105 Capital Way, Ste 5
Cedar Falls, IA

Boring Log No. 4

Location: See Exploration Plan

Latitude: 43.1927° Longitude: -92.7485°

Depth (Ft.) Elevation.: 1089.0 (Ft.)

Model Layer	Graphic Log	Depth (Ft.)	Water Level Observations	Sample Type	Recovery (In.)	Field Test Results	HP (psf)	Strength Test: Test Type	Strength Test: Compressive Strength (psf)	Strength Test: Strain (%)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits: LL-PL-PI	Organic Content (%)
1		0.3 **TOPSOIL** 1088.7 **SANDY LEAN CLAY (CL)**, trace gravel, dark brown 3.5 1085.5			10	2-3-3 N=6 6500 (HP)	8000 (HP)				18.5			
2		**SANDY LEAN CLAY (CL)**, with sand seams, trace gravel, gray and brown, stiff to very stiff 9.0 1080			14		2500 (HP)				20.0		42-15-27	
					18	3-5-8 N=13 6500 (HP)					18.4			
3		**SANDY LEAN CLAY (CL)**, trace gravel, gray, very stiff 11.0 1078			18		6500 (HP)				16.2			
		Boring Terminated at 11 Feet												

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See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevation Reference: Elevations were provided by ISG.

Water Level Observations
None observed while drilling

None observed after drilling

Drill Rig
589

Hammer Type
Automatic

Driller
CL

Notes

Advancement Method
Hollow Stem Auger

Abandonment Method
Boring backfilled with soil cuttings upon completion.

Logged by
CR

Boring Started
11-12-2024

Boring Completed
11-12-2024

IDALS Floyd County Wetland
Ocean Ave | Floyd, IA
Terracon Project No. 13245077

Terracon
3105 Capital Way, Ste 5
Cedar Falls, IA

Boring Log No. 5

Location: See Exploration Plan

Latitude: 43.1929° Longitude: -92.7476°

Depth (Ft.) Elevation.: 1099.0 (Ft.)

Model Layer	Graphic Log	Depth (Ft.)	Water Level Observations	Sample Type	Recovery (In.)	Field Test Results	HP (psf)	Strength Test: Test Type	Strength Test: Compressive Strength (psf)	Strength Test: Strain (%)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits: LL-PL-PI	Organic Content (%)
		0.3 **TOPSOIL** 1098.7												
1		**SANDY LEAN CLAY (CL)**, trace gravel and organics, brown and gray 3.5 1095.5			4						16.9	114		
2		**SANDY LEAN CLAY (CL)**, trace gravel, with sand seams, gray and brown, stiff 6.0 1093			15	4-3-5 N=8 3000 (HP)					19.4			
3		**SANDY LEAN CLAY (CL)**, trace gravel, gray and brown, very stiff			14			UC	5755	7.3	18.8	113		
		10.5 1088.5			18	3-5-8 N=13	6000 (HP)				19.2			
		Boring Terminated at 10.5 Feet												

5
10

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevation Reference: Elevations were provided by ISG.

Water Level Observations
None observed while drilling

None observed after drilling

Drill Rig
589

Hammer Type
Automatic

Driller
CL

Notes

Advancement Method
Hollow Stem Auger

Abandonment Method
Boring backfilled with soil cuttings upon completion.

Logged by
CR

Boring Started
11-12-2024

Boring Completed
11-12-2024

Supporting Information

Contents:

Note: All attachments are one page unless noted above.

Terracon
3105 Capital Way, Ste 5
Cedar Falls, IA

General Notes

Sampling

Shelby Tube

Split Spoon

Water Level

Water Initially Encountered

Water Level After a Specified Period of Time

Water Level After a Specified Period of Time

Cave In Encountered

Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.

Field Tests

N	Standard Penetration Test Resistance (Blows/Ft.)
(HP)	Hand Penetrometer
(T)	Torvane
(DCP)	Dynamic Cone Penetrometer
UC	Unconfined Compressive Strength
(PID)	Photo-Ionization Detector
(OVA)	Organic Vapor Analyzer

Descriptive Soil Classification

Soil classification as noted on the soil boring logs is based Unified Soil Classification System. Where sufficient laboratory data exist to classify the soils consistent with ASTM D2487 "Classification of Soils for Engineering Purposes" this procedure is used. ASTM D2488 "Description and Identification of Soils (Visual-Manual Procedure)" is also used to classify the soils, particularly where insufficient laboratory data exist to classify the soils in accordance with ASTM D2487. In addition to USCS classification, coarse grained soils are classified on the basis of their in-place relative density, and fine-grained soils are classified on the basis of their consistency. See "Strength Terms" table below for details. The ASTM standards noted above are for reference to methodology in general. In some cases, variations to methods are applied as a result of local practice or professional judgment.

Location And Elevation Notes

Exploration point locations as shown on the Exploration Plan and as noted on the soil boring logs in the form of Latitude and Longitude are approximate. See Exploration and Testing Procedures in the report for the methods used to locate the exploration points for this project. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

Strength Terms

Relative Density of Coarse-Grained Soils
(More than 50% retained on No. 200 sieve.)
Density determined by Standard Penetration Resistance

Relative Density	Standard Penetration or N-Value (Blows/Ft.)
Very Loose	0 - 3
Loose	4 - 9
Medium Dense	10 - 29
Dense	30 - 50
Very Dense	> 50

Consistency of Fine-Grained Soils
(50% or more passing the No. 200 sieve.)
Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance

Consistency	Unconfined Compressive Strength Qu (psf)	Standard Penetration or N-Value (Blows/Ft.)
Very Soft	less than 500	0 - 1
Soft	500 to 1,000	2 - 4
Medium Stiff	1,000 to 2,000	4 - 8
Stiff	2,000 to 4,000	8 - 15
Very Stiff	4,000 to 8,000	15 - 30
Hard	> 8,000	> 30

Relevance of Exploration and Laboratory Test Results

Exploration/field results and/or laboratory test data contained within this document are intended for application to the project as described in this document. Use of such exploration/field results and/or laboratory test data should not be used independently of this document.

Unified Soil Classification System

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]				Soil Classification	
				Group Symbol	Group Name [B]
Coarse-Grained Soils: More than 50% retained on No. 4 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	Cu≥4 and 1≤Cc≤3 [E]	GW	Well-graded gravel [F]
			Cu<4 and/or [Cc<1 or Cc>3.0] [E]	GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH	GM	Silty gravel [F, G, H]
			Fines classify as CL or CH	GC	Clayey gravel [F, G, H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	Cu≥6 and 1≤Cc≤3 [E]	SW	Well-graded sand [I]
			Cu<6 and/or [Cc<1 or Cc>3.0] [E]	SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH	SM	Silty sand [G, H, I]
			Fines classify as CL or CH	SC	Clayey sand [G, H, I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	PI > 7 and plots above "A" line [J]	CL	Lean clay [K, L, M]
			PI < 4 or plots below "A" line [J]	ML	Silt [K, L, M]
		Organic:	$\frac{LL\ oven\ dried}{LL\ not\ dried} < 0.75$	OL	Organic clay [K, L, M, N]
					Organic silt [K, L, M, O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above "A" line	CH	Fat clay [K, L, M]
			PI plots below "A" line	MH	Elastic silt [K, L, M]
		Organic:	$\frac{LL\ oven\ dried}{LL\ not\ dried} < 0.75$	OH	Organic clay [K, L, M, P]
					Organic silt [K, L, M, Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor			PT	Peat

[A] Based on the material passing the 3-inch (75-mm) sieve.
[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.
[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.
[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay.
[E] $Cu = D_{60}/D_{10}$ $Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$
[F] If soil contains ≥ 15% sand, add "with sand" to group name.
[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.
[H] If fines are organic, add "with organic fines" to group name.
[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.
[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.
[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.
[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.
[N] PI ≥ 4 and plots on or above "A" line.
[O] PI < 4 or plots below "A" line.
[P] PI plots on or above "A" line.
[Q] PI plots below "A" line.