**Wegerzyn Gardens MetroPark Multi-Use Trail and Pedestrian Bridge Project**
Project 24-003

**Project Description:**

Construct two sections of paved multi-use trails, one a maximum of 2,100 linear feet and one a maximum of 1,600 linear feet. Design, fabricate and install an H10 rated pedestrian bridge with a minimum clear span of 50' long. Provide all required survey and engineering, fabrication, labor and materials required to implement the project. A soil boring study has been completed at the bridge location. The project is part of a Clean Ohio Grant project and is subject to prevailing wages.

**Project Background:**

The project site consists of several parcels that were acquired as a part of a Clean Ohio Greenspace Grant. The western parcels were called the Foxton Apartments and consisted of about 21 single story buildings, roadway, utilities and associated site improvements. This complex was destroyed by the Dayton Memorial Day tornados. As a part of the grant, this complex was demolished including the full removal of foundations. Utilities were removed where they were encountered, and any manholes were also demolished and backfilled. The site was graded to allow for drainage and restoration. The eastern parcel consisted of an old City of Dayton Tree Nursery with a high density of Callery Pear located on the west side of the creek. Non-Native trees have been removed as a part of the restoration project. The east side of the parcel has been leased to Five Rivers MetroParks as prairie and community garden space. All parcels are now owned by Five Rivers MetroParks. Five Rivers MetroParks is under contract with Stantec to complete a restoration of the project area and the selected contractor will need to coordinate construction efforts with Stantec. The proposed trails will create a northern set of loop trails for Wegerzyn Gardens MetroPark.

**Survey Data**

Some preliminary survey spot elevations were provided by Stantec and county planimetric 2' contour interval data is provided below. Additional data will likely be required to complete the design and shall be provided by the contractor. Available data can be provided electronically in .dwg or .shp files as needed.

**Coordination with Restoration Contractor**

The site is being ecologically restored by a separate contractor. The restoration contractor will require a centerline layout of the proposed trails no later than June 30, 2024 to allow for

restoration activities to be completed in parallel with this project outside of the trail and bridge footprint.

**Existing Paved Multi-Use Path**

Contractor shall maintain access to the existing pathway at times when construction activities are not directly affecting the use of the. The contractor shall notify the owner 14 days in advance to close the pathway when activities conflict with use of the path.

**Existing Utilities:**

There is an existing sanitary line between the creek and the existing multi-use path. This line is or will be abandoned in place but is well out of the footprint of the proposed bridge. There is a parallel sanitary line on the east side of the cart path, but this is out of the proposed work limits. Locations can be determined from exposed manhole covers and from the drawing provided below. Owner has no other knowledge of active utilities in the project area. It is the responsibility of the contractor to contact OUPS to locate all public utilities.

**Paved Multi-Use Trails:**

The project includes two sections of new paved multi-use trail segments. See layout plans below.

The western segment is a maximum of 2100 linear feet long and connects to the existing multi-use trail at Shoup Mill Road at the north end of the project and continues southeast to connect to the multi-use trail at the west side of the community gardens. This segment will create an approximate one-mile loop with the existing trail.

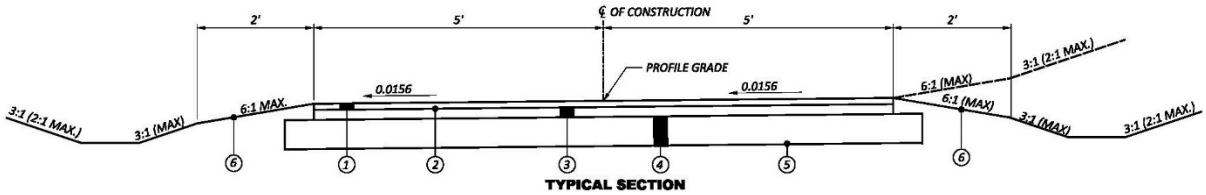
The eastern segment will connect to the multi-use trail at the north corner of the community gardens and follow a mowed pathway to connect to the end of the paved drive at the east end of the community gardens. This segment will create another trail loop for park users and maintenance access.

Both trail segments shall be constructed to handle light vehicular traffic such as pickup trucks, utility vehicles and mowers per detail below.

Trails shall be constructed to the Ohio Department of Transportation Construction and Material Specifications and as detailed below.

Flair proposed trails where they abut existing trails. Provide a smooth and even transition between proposed and existing work.

Trails shall have a maximum cross slope of 1.5 percent and a maximum longitudinal slope of 5 percent. Trails may be crowned or side sloped with a preference to side slope. Trails shall be designed to shed water efficiently. Side swales are not required or desired unless site conditions require their use to properly move water away from the trail and across the site. No standing water will be permitted on the trails. Trails may be elevated above existing grade as required to facilitate proper drainage. Provide edge berming per the detail below to provide smooth and even transition between top of pavement and surrounding grade with slopes not to exceed 6:1.



TYPICAL SECTION

Key:

1- Item 441 – 2" Asphalt Concrete Surface Course, Type 1 (449), PG64-22
2- Item 407 – Tack Coat (Applied at 0.05 Gal/SY)
3- Item 441 – 2" Asphalt Concrete Intermediate Course, Type 2, (449)
4- Item 304 – 6" Aggregate Base
5- Item 204 – Subgrade Compaction
6- Side Swales only as required for proper drainage- Berm trail to ensure smooth and even transition between the pavement and existing grade

**Pedestrian Bridge**

Design, provide and install a new prefabricated web truss style pedestrian bridge, foundations and abutments required to cross the stream channel on the western trail segment. Provide review drawings to the owner as a part of the bid submittal. Span shall be a minimum of 50' clear span to allow for drainage. Walk to be 12'0" inside rail to inside rail. Provide continuous grip-able handrails along entire span of the bridge, both sides, 34-38" above final bridge deck, be between 1-1/4" and 2" OD and provide 1—1/2" minimum clearance between handrail and bridge structure elements per ADA requirements and painted. Color per notes below.

Loading shall be H10 rated. Bridge structure to be weathering steel. Do not use tubing style components in the bridge structure. Maximum slope on the bridge deck to be 5% longitudinally and a maximum of 1.5% cross slope.

Contractor shall provide sealed engineering drawings by a registered professional in the state of Ohio. Fabricator shall have a minimum of 6 years' experience fabricating bridge structures prior to release for fabrication.

Set bridge at elevation sufficient to ensure free passage of water and debris under the bridge. Upstream there is a box culvert that carries the existing multi-use path that is approximately 45' wide and approximately 6' high that may be used as a reference.

See geotechnical report provided below for foundation and abutment design guidance.

Bridge deck to be broomed finished concrete and provided with strength capable of the specified loading and a minimum compressive strength of 4.0 KSI.

Note: At some point in history, the creek was widened and straightened, and the spoils appear to have been placed on the east side of the creek. There is not a need to maintain this mound between the creek and the existing multi-use path. Contractor may excavate the area near at the proposed bridge location to provide a more level crossing and eliminate the need for ramps to access the top of the mound. Care shall be taken to preserve existing trees. Any trees to be removed shall be approved by the owner prior to removal.

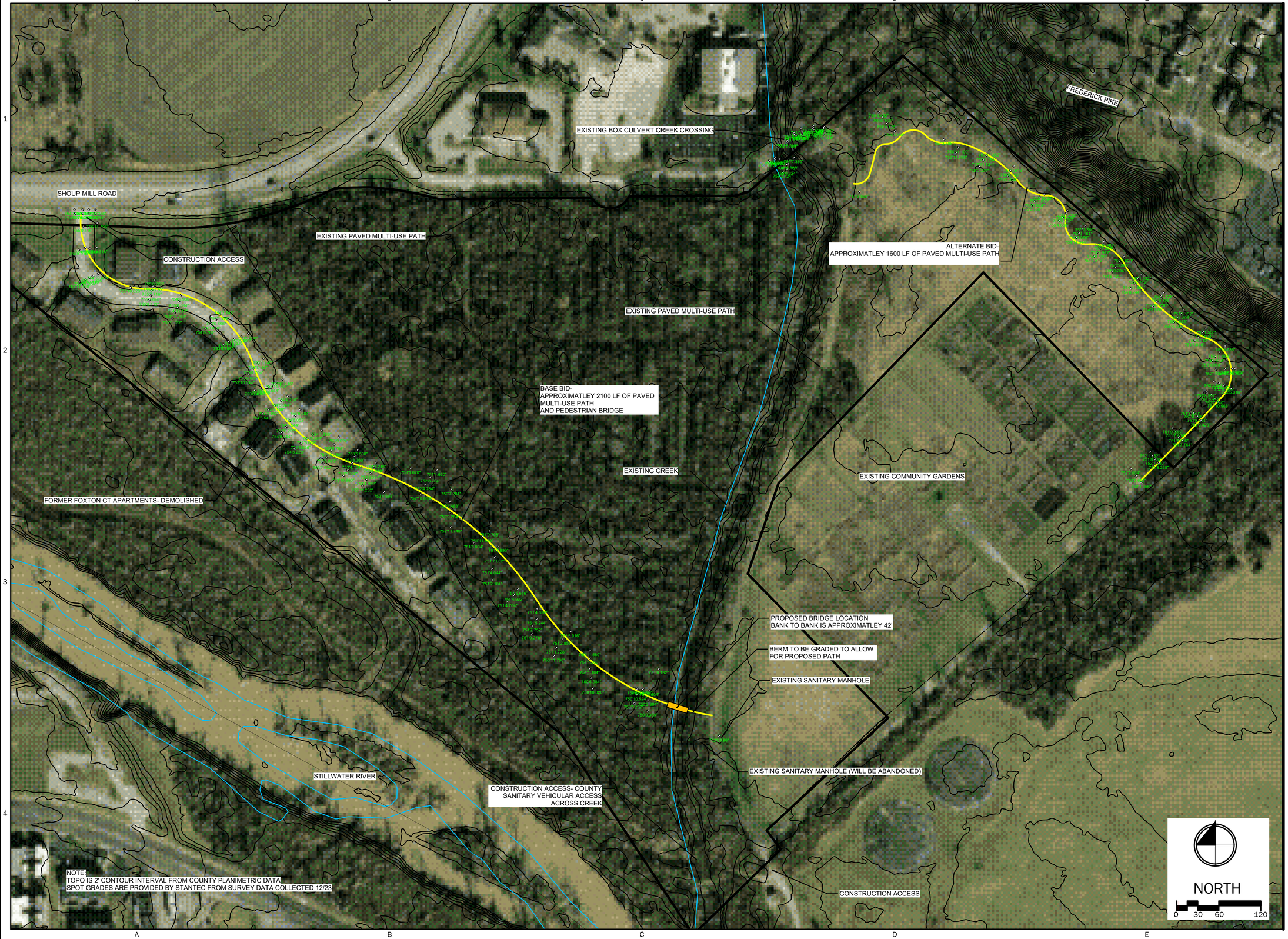
Bollards shall be provided at each end of the bridge. Submit cut sheets for approval.

Paint: Handrails shall be painted.

All components that are to be painted are to be primed with Sherwin Williams Macropoxy 646fc or approved equal. Apply per manufacturer's specifications. Apply one coat (3-4 mills dry) of exterior metal protective topcoat to steel construction. Coating to be Sherwin Williams gloss Acrolon 218 or approved equal for spray application or high solids polyurethane for brushed or rolled application. Apply per manufacturer's specifications. color to be Sherwin Williams SW6041 Otter. Paint shall be factory applied and contractor shall touch up any blemishes in the paint that occur during shipping or installation with the specified paint.

**Seeding:**

Seeding is required 10 feet on either side of the trails. See seeding specifications.




PROJECT

# MULTI-USE TRAIL AND PEDESTRIAN BRIDGE PROJECT

WEGERZYN GARDENS
METROPARK
DAYTON, OHIO

SEAL

STATE OF OHIO
ERIC R. SAUER
867
REGISTERED LANDSCAPE ARCHITECT

ISSUE

TRAIL PLANS

ISSUE NOTES

| DATE | COMMENT |
|---|---|
| | |
| | |
| | |
| | |
| | |
| | |
| | |

DATE: 1/22/24
PROJECT NO: 24-003
DRAWN BY: ERS
CHECKED BY: ERS

DRAWING TITLE

TRAILPLAN

SHEET NO.

LD-100

FIVE RIVERS METROPARKS
409 E. MONUMENT AVE, THIRD FLOOR
DAYTON, OHIO 45402

937.274-3107 OFFICE
937.262.7106FAX

WWW.METROPARKS.ORG


**abandoned sewer**

N
W E
S

MONTGOMERY COUNTY
ENVIRONMENTAL SERVICES

0 0.02 0.04 0.08 mi

Date Printed: 9/25/2023

# Soil Study for Proposed Pedestrian Bridge
# Riverside Drive, Dayon, Ohio

**Submitted To:**

**Five Rivers MetroParks**

Attn: Mr. Eric Sauer

409 East Monument Avenue, Third Floor

Dayton, Ohio 45402

Report No. 211911-1223-230

December 07, 2023

BOWSER MORNER®

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**www.bowser-morner.com**

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Dayton, Ohio 45401-0051
**P.** 937.236.8805 **F.** 937.233.2016
**www.bowser-morner.com**

December 07, 2023

Five Rivers MetroParks
409 E. Monument Avenue
Third Floor
Dayton, Ohio 45402

Attention: Mr. Eric Sauer, RLA, PMP,
CLARB, LEED AP

Re: Report No. 211911-1223-230; Soil Study for Proposed Pedestrian Bridge, Riverside Drive, Dayton, Ohio

Dear Mr. Sauer:

Bowser-Morner, Inc. is pleased to submit our report of the soil study for the above-referenced project. The purpose of this study is to determine the physical characteristics of the soil strata and allowable bearing capacity for the proposed pedestrian bridge. Also noted are other conditions that could affect the design and/or construction of the structure.

The samples collected that were not used to perform the laboratory tests will be kept in our laboratory for 30 days unless you advise us otherwise. If you have any questions or if we can help you in any way on this project or future work, please call us.

Sincerely,
BOWSER-MORNER, INC.

"This document was originally issued by Chris R. Ryan, M.S.C.E., P.E. and Daniel Otieno on December 07, 2023. This document is not considered a sealed document."

Daniel M. Otieno
Geotechnical Engineer

Chris R. Ryan, M.S.C.E., P.E.
Sr. Geotechnical Engineer

DO/CRR/an
3-Client
2-File

**TABLE OF CONTENTS**

# Section I

Text

# 1.0 INTRODUCTION

A pedestrian bridge will be constructed in the Wegerzyn MetroPark off Riverside Drive in Dayton, Ohio. A vicinity map (Figure 1) is included in Section III of this report. Our findings on the soil conditions and groundwater levels with respect to the potential construction problems, and recommendations for the allowable bearing capacity for the construction of the pedestrian bridge are given in this report.

Authorization to proceed with this soil study was given by Five Rivers MetroParks in a signed proposal acceptance sheet dated September 25, 2023. The work was to proceed in accordance with our proposal and agreement, Quotation No. 23-2771-102 dated September 25, 2023.

The draft soil boring logs and preliminary foundation recommendations were emailed to Mr. Eric Sauer on November 7, 2023.

# 2.0 WORK PERFORMED

## 2.1 Field Work

Two (2) soil borings were made at the locations shown on the boring location plan, Figure 2 in Section III. The boring logs and boring location plan are included in Section III. The borings were made with an ATV boring rig using hollow-stem augers and standard penetration resistance methods. The standard penetration tests were performed in accordance with ASTM D1586, which includes a 140-pound hammer, 30-inch drops, and two-inch-O.D. split-spoon samplers driven at maximum depth intervals of five feet or at major changes in stratum, whichever occurred first. The disturbed split-spoon samples were visually classified, logged, sealed in moisture-proof jars, and taken to the Bowser-Morner, Inc. laboratory for study. The depths where these "SS"-type split-spoon samples were collected are noted on the corresponding boring logs.

## 2.2 Laboratory Work

One (1) Atterberg limits test was performed in accordance with ASTM D4318 to determine the liquid and plastic limits on the most visibly plastic cohesive soil or as needed for soil classification. In addition, nine (9) moisture content determinations were made in accordance with ASTM D2216. The moisture contents ranged from 6.6% to 39.9% for the fill, from 21.8% to 24.6% for the brown or gray fine silty sand, and from 6.6% to 8.8% for the brown silty sand with gravel. The moisture content for the gray silty lean clay was 7.6%. The results of the laboratory tests are summarized in Table 2-1 and included in Section III of this report.

**Table 2-1. Summary of Laboratory Test Results**

| Boring No. | Depth (ft.) | Moisture Content (%) | Atterberg Limits LL | PL | PI |
|---|---|---|---|---|---|
| 1 | 1.0 – 2.5 | 6.6 | | | |
| | 6.0 – 7.5 | 16.4 | | | |
| | 13.5 – 15.0 | 24.6 | | | |
| | 23.5 – 25.0 | 8.8 | | | |

**Table 2-1. Summary of Laboratory Test Results**

| Boring No. | Depth (ft.) | Moisture Content (%) | Atterberg Limits LL | PL | PI |
|---|---|---|---|---|---|
| 2 | 28.5 – 30.0 | 6.6 | | | |
| | 3.5 – 5.0 | 6.9 | | | |
| | 8.5 – 10.0 | 39.9 | | | |
| | 18.5 – 20.0 | 21.8 | | | |
| | 28.5 – 15.0 | 7.6 | 16 | 11 | 5 |

## 3.0 SOIL AND GROUNDWATER CONDITIONS

Based on the information from the two borings made for this study, the subgrade soil conditions are described in descending order below:

- Twelve to 14.2 feet of undocumented and uncontrolled fill consisting of topsoil, brown sand with gravel, light brown-to-gray silty sand, and peat.
- Below the fill layer, 5.5 to 10.1 feet of very loose-to-medium dense, brown and gray, fine silty sand.
- In Boring 1 and below the brown and gray, fine silty sand layer, 12.5 feet of dense-to-very dense, brown silty sand with gravel extending to the bottom of the boring at depth of 30 feet below the existing grade.
- In Boring 2 and below the brown, fine silty sand layer, 5.7 feet of very stiff, gray, silty lean clay extending to the bottom of the boring at a depth of 30 feet below the existing grade.

Free groundwater was encountered during the advancement of the borings at the depths and elevations summarized in Table 3-1.

**Table 3-1. Summary of Groundwater Observations**

| Boring No. | Depth Groundwater First Observed (ft) Depth | Elevation* | Groundwater Observations at Completion of Boring Depth | Elevation* |
|---|---|---|---|---|
| 1 | 6.0 | 91.6 | 6.0 | 91.6 |
| 2 | 7.0 | 91.6 | 6.7 | 91.9 |

*Refers to an assumed elevation of 100.0 feet for the benchmark shown on the boring location plan.

Free groundwater is defined as water that seeps into an open borehole before it is backfilled. Groundwater observations were made during the boring operations by noting the depth of water on the boring tools and in the open boreholes following withdrawal of the boring augers. However, it should be noted that short-term water level readings are not necessarily a reliable indication of the groundwater level and that significant fluctuations may occur due to variations in rainfall and other factors. For specific questions on the soil conditions, please refer to the individual boring logs in Section III.

# 4.0 DISCUSSION AND RECOMMENDATIONS

## 4.1 Project Description

A new pedestrian bridge will be constructed in the Wegerzyn MetroPark off Riverside Drive in Dayton, Ohio. The proposed bridge will be approximately 50 feet long. No specific design or loading information was provided for this report.

The following recommendations are based on this information. If the above statements are incorrect or changes are made, Bowser-Morner, Inc. should be notified so that the new data can be reviewed and additional recommendations and services can be given if required to meet the needs of your project.

## 4.2 Foundation Recommendations

Based on the information from the two borings made in the proposed pedestrian bridge site, the site is covered with undocumented and uncontrolled fill and weak soils that extend to the approximate depths and elevations outlined in Table 4-1. Based on the results of the standard penetration tests (SPT), the allowable bearing capacities of the subgrade soil beneath the weak soil layer are also tabulated in Table 4-1.

**Table 4-1. Depths and Elevations to Bearing Strata**

| Boring No. | Depth to Bearing Strata (ft) | Elevation* of Bearing Strata (ft) | Fill, and/or Weak Soil | Recommended Net Allowable Bearing Capacity (psf) |
|---|---|---|---|---|
| 1 | 12.0 | 88.0 | Fill | 1,000 |
| | 17.5 | 82.5 | Fill and Weak Soil | 4,000 |
| 2 | 14.2 | 85.8 | Fill | 1,000 |
| | 18.5 | 81.5 | Fill and Weak Soil | 4,000 |

* Refers to an assumed elevation of 100.0 feet for the benchmark shown on the boring location plan.

The fill is unreliable to support the bridge foundations and should be removed and wasted. Two foundation methods can be considered for the support of the bridge foundations. These methods are:

1. Removal of the existing weak soil and replacement of compacted backfill, or
2. Installation of drilled piers or auger-cast piers.

The discussions of these methods follow:

### 4.2.1 Removal of Weak Soil and Replacement of Compacted Backfill

The fill at the depths and elevations outlined in Table 4-1 are not reliable to support the proposed pedestrian bridge foundations and should be removed and wasted. The weaker soil can be removed to the suitable depth with the desired allowable bearing capacities as outlined in Table 4-1 and replaced with compacted backfill. The excavations within the construction limits should extend to suitable soils. The bottoms of footing foundations

should be placed at least 36 inches below the final adjacent grades to protect against frost penetration and heaving.

The abutment foundation excavations can extend to a depth of 12.0 and 14.2 feet in the vicinity of Borings 1 and 2 respectively. The bottom of the excavation will be on the silty sand layer. The footing foundations supported on these layers at this depth can be designed with an allowable bearing capacity of 1,000 pounds per square foot. If a higher bearing capacity is required, the abutment foundation excavations can extend to a depth of 17.5 and 18.5 feet in the vicinity of Borings 1 and 2 respectively. The bottom of the excavation will be on the silty sand or silty sand with gravel layer. The footing foundations supported on these layers at this depth can be designed with an allowable bearing capacity of 4,000 pounds per square foot.

Alternatively, after the bottoms of the excavations extend to the depths and elevations outlined in Table 4-1, the excavations can be backfilled with compacted backfill. The base of each excavation also should extend one lateral foot for every foot of excavation below the bottom of the footing foundations for both sides of the abutments as shown in Figure 3 in Section III. A maximum allowable side slope of 1 (horizontal) to 1 (vertical) should be maintained in the excavations for stability and for the safety of the workers. Horizontal benches should be provided on the face of the excavation for the backfill to be keyed into the sides of the excavations.

After the excavations extend to the desired grade, the top foot at the bottom of each excavation should be compacted to at least 90% of the maximum dry-unit weight as defined by the modified Proctor test (ASTM D1557) before any new fill or foundation is placed. Any soft soil pockets should be undercut and replaced with compacted fill.

After the bottoms of the excavations have been compacted, structural fill can be placed to bring the bottoms of the excavations to the desired grade if needed. The fill placed below the bottom of the abutment foundations should be placed in eight-inch-thick lifts and compacted to at least 95% of the maximum dry-unit weight as determined by the modified Proctor test (ASTM D1557). Structural fill should be placed in accordance with the recommendations given in Section 4.3.

The soil removed from this site that is free of organic or objectionable materials as defined by a field technician who is qualified in soil material identification and compaction procedures can be reused as backfill. Objectionable or undesirable soils are defined as those materials that cannot meet design placement specifications or materials that will deteriorate with time.

Alternatively, controlled density fill (CDF) with a 28-day compressive strength of at least 100 psi can be used as backfill. If CDF is selected as backfill, the excavation should extend at least one foot beyond the perimeter of the footing foundations.

The bridge foundations can be supported on the original soil at the depths and elevations outlined in Table 4-1 or on the newly compacted backfill or CDF extending to the depths and elevations outlined in Table 4-1 and designed with the corresponding net allowable

bearing capacities outlined in Table 4-1. For the allowable bearing capacity outlined above, the total settlement is estimated to be about one inch.

The bottoms of the foundations should be constructed below the maximum depth for potential scouring and at least 36 inches below the final grade to protect against potential frost penetration and heaving problems of the abutment foundations. Alternatively, riprap can be designed and placed to prevent scouring of the stream bottom. The scouring study and the design of the riprap should be performed by others and are beyond the scope of our study.

### 4.2.2 Installation of Drilled Piers or Auger-Cast Piles

Alternatively, drilled piers or auger-cast piles can be installed to support the bridge foundations. We recommend that auger-cast piles or drilled piers be used to transfer the loads through the weak soils to the suitable bearing stratum. The bottoms of the auger-cast piles or the drilled piers should extend below the depths outlined in Table 4-2.

**Table 4-2. Depths and Elevations to Bearing Strata**

| Boring No. | Depth to Top of Bearing Stratum (ft) | Elevation* of Bearing Strata (ft) | Elevation at Top of Bearing Stratum (ft) |
|---|---|---|---|
| 1 | 23.5 | 76.5 | 8,000 |
| 2 | 28.5 | 71.5 | 8,000 |

* Refers to an assumed elevation of 100.0 feet for the benchmark shown on the boring location plan.

The auger-cast piles or drilled piers supported on the silty sand with gravel layer or very stiff silty lean clay layer at the depths and elevations outlined in Table 4-2 can be designed with an allowable end-bearing capacity of 8,000 (psf). The pier and piles can also be designed with an average, allowable side-friction capacity of 200 psf for the parts of the piers or piles in contact with the subgrade soil below the fill layer. For the parts of drilled piers or the auger-cast piles in contact with the soils below the depths and the elevations outlined in Table 4-2 can be designed with an allowable side friction of 350 psf.

A negative drag-down force of 100 psf should be used for the parts of the piles in contact with the fill layer at the first depths and elevations given in Table 4-1.

To determine the actual allowable capacity of the deep foundations, we recommend that static pile-load tests be performed to verify the allowable deep foundation capacity.

### 4.2.3 Site Classification For Seismic Design

Based on the results of the standard penetration tests (SPT) in the single boring, the average “N” value is between 13 and 28 blows per foot for the soil layer within 30 feet below the existing grade. Based on the results of the average “N” value, it is our opinion that the site can be classified as a “D” type in accordance with the *Ohio Building Code*.

## 4.3 Compaction Requirements

Structural fill placed below the foundation bearing elevation should be compacted to at least 95% of the maximum dry unit weight with moisture contents within 2% of the optimum moisture content as determined by the modified Proctor test (ASTM D1557). Fill placed above the bottoms of the foundations or under pavement areas should be compacted to at least 90% of the maximum dry unit weight with moisture contents within 2% of the optimum moisture content as determined by the modified Proctor test (ASTM D1557). The compaction should be accomplished by placing the fill in successive, horizontal, approximately six- to eight-inch-thick loose lifts and mechanically compacting each lift to at least the specified minimum dry density. Field density tests should be performed at a minimum rate of one per 2,500 square feet of fill area and for each lift to verify that adequate compaction is achieved. Backfill for utility trenches, foundation excavations, etc., within structures or paved areas, is considered structural fill and should be placed in accordance with these recommendations.

It must be emphasized that the excavation and compaction of soil fill are highly influenced by weather conditions. Performing the earthwork under wet and frozen conditions is generally very difficult. As a result, compaction of wet silty and clayey soil should be avoided during wet and frozen conditions because the wet soil cannot be compacted to the required unit weight without drying or other soil stabilization methods. Alternatively, granular soil can be used as backfill to facilitate the backfill and compaction work during winter and wet weather conditions. The construction cost during the winter and wet weather conditions will be higher by the purchase of granular soil from the sand and gravel pits.

Puddling or jetting of the backfill material, including the utility trenches, should not be allowed as a compaction method. Silty or clayey soils encountered above foundation depth will often soften, and the bearing capacity may be reduced if water ponds in the excavation.

Lean concrete that is placed below the bottom of foundation should have a minimum 28-day compressive strength of 2,000 pounds per square inch (psi).

## 4.4 Foundation Excavations

During the foundation excavations, the subsurface conditions should be verified. Changes in subsurface conditions other than what are shown on the boring logs warrant additional subsurface investigation before the bridge foundations are constructed.

The foundation excavations should be observed to ensure that the loose, soft, or otherwise undesirable materials are removed and that the foundations will be supported directly on an acceptable surface. At the time of this observation, it may be necessary to use a hand penetration device in the base of the foundation excavation to ensure that the soils immediately below the foundation base are satisfactorily prepared to support the foundations. Please note that such shallow observations do not replace an adequate deep-boring program and structural fill compaction QA/QC records. The overall performance of the foundations is governed by the soils below the bottom of the footing foundation.

If pockets of soft, loose, or otherwise unsuitable materials are encountered in the footing excavations and it is inconvenient to lower the footings, the proposed footing elevations may be reestablished by backfilling after the undesirable materials have been removed. The excavation under each footing should extend to suitable soils, and the base of the excavation should extend one lateral foot for every foot of excavation below the bottom of the footing foundation as shown in Figure 3 in Section III. The entire excavation should then be refilled with well-compacted, engineered fill. Special care should be taken to remove the sloughed, loose, or soft materials near the base of the excavation slopes. Extra care should also be taken to tie-in the compacted fill with the excavation slopes, with benches as necessary, to ensure that no pockets of loose or soft materials are left along the excavation slopes below the foundation bearing level. The contractor should maintain temporary cut slopes in accordance with the current OSHA regulations governing trenching and slope stability.

Soils exposed at the bases of satisfactory foundation excavations should be protected against any detrimental change in condition such as from construction disturbances, rain, and freezing. Surface runoff should be drained away from the excavation and not allowed to pond. If possible, foundation concrete should be placed the same day the excavation is made. If this is not practical, the foundation excavations should be adequately protected. Also, for this reason, proper drainage should be maintained after construction. It must be emphasized that all excavations must conform to all state, federal, and local regulations relative to slope geometry.

## 4.5 Construction Dewatering

At the time of our study, free groundwater was encountered in both borings at a depth of between 6.0 and 7.0 feet below the existing grade during the boring operations as outlined in Table 3-1. However, it should be noted that short-term water level readings are not necessarily a reliable indication of the groundwater level and that significant fluctuations may occur due to variations in rainfall and other factors. Any groundwater and surface water infiltration encountered in the excavations during construction should be lowered to the bottom of the excavation in silt and clay soils and should be lowered to at least three feet below the bottom of the maximum excavation in the sand and gravel layers using sumps and pumps. Sumps can consist of perforated pipes or drums installed vertically in the relatively permeable granular soils, surrounded with free draining sand, and gravel. The perforations of the pipe should be covered with a layer of filter fabric to keep silt and fine sand from pumping through the sumps. Care must be exercised when pumping from sumps that extend into silts or other granular soils since general deterioration of the bearing soils and a localized “quick” condition could result. The groundwater should be kept at a level below the fill operation during the placement and compaction of the backfill materials during the construction of the foundations. During the foundation excavations, the perimeters of the excavation should be diked to keep any creek water from flooding the excavations.

Temporary steel casings should be used during the drilled-pier installation to keep the shafts from caving in. If the groundwater cannot be lowered before the concrete is placed, a tremie method of placing the concrete should be used during the installation of the drilled piers. Free groundwater should not be a problem for auger-cast piles.

The amount and type of dewatering required during construction will depend on groundwater levels at the time of construction. Typically, groundwater levels are highest during winter and spring, and lower in summer and early fall.

### 4.6 Drainage

Adequate drainage should be provided at the site to minimize any increase in moisture content of the foundation soils during and after construction. The exterior grade including all pavements or parking areas should be sloped away from the new bridge foundations to keep water from ponding.

## 5.0 CLOSURE

### 5.1 Basis of Recommendations

The evaluations, conclusions, and recommendations in this report are based on our interpretation of the field and laboratory data obtained during the exploration, our understanding of the project and our experience with similar sites and subsurface conditions. Data used during this exploration included, but were not necessarily limited to:

- Two exploratory borings performed during this study.
- Observations of the project site by our staff.
- The results of the laboratory soil tests.
- The site plan provided by Five Rivers MetroParks.
- Limited interaction with Mr. Eric Sauer, RLA, PMP, CLARB, LEED AP of Five Rivers MetroParks.
- Published soil or geologic data of this area.

In the event that changes in the project characteristics are planned, or if additional information or differences from the conditions anticipated in this report become apparent, Bowser-Morner, Inc. should be notified so that the conclusions and recommendations contained in this report can be reviewed and, if necessary, modified or verified in writing.

### 5.2 Limitations and Additional Services

The subsurface conditions discussed in this report and those shown on the boring logs represent an estimate of the subsurface conditions based on interpretation of the boring data using normally accepted geotechnical engineering judgments. Although individual test borings are representative of the subsurface conditions at the boring locations on the dates shown, they are not necessarily indicative of subsurface conditions at other locations or at other times.

Regardless of the thoroughness of a subsurface exploration, there is the possibility that conditions between borings will differ from those at the boring locations, that conditions are not as anticipated by designers, or that the construction process has altered the soil conditions.

As variations in the soil profile are encountered, additional subsurface sampling and testing may be necessary to provide data required to reevaluate the recommendations of this report. Consequently, after submission of this report, it is recommended that Bowser-Morner, Inc. be authorized to perform additional services to work with the designer(s) to minimize errors and omissions regarding the interpretation and implementation of this report.

Before construction begins, we recommend that Bowser-Morner, Inc.:

- Work with the designers to implement the recommended geotechnical design parameters into plans and specifications.
- Consult with the design team regarding interpretation of this report.
- Establish criteria for the construction observation and testing for the soil conditions encountered at this site.
- Review final plans and specifications pertaining to geotechnical aspects of design.

During construction, we recommend that Bowser-Morner, Inc.:

- Observe the construction, particularly the site preparation, fill placement, and foundation excavation or installation.
- Perform in-place density testing of all compacted fill.
- Perform materials testing of soil and other materials as required.
- Consult with the design team to make design changes in the event that differing subsurface conditions are encountered.

If Bowser-Morner, Inc. is not retained for these services, we shall assume no responsibility for construction compliance with the design concepts, specifications or recommendations.

## 5.3 Warranty

Our professional services have been performed, our findings obtained and our recommendations prepared in accordance with generally accepted geotechnical engineering principles and practices. No other warranty, express or implied, is made.

The scope of this study did not include an environmental assessment for the presence or absence of hazardous or toxic materials in the soil, surface water, groundwater or air, on, within or beyond the site studied. Any statements in the report or on the boring logs regarding odors, staining of soils or other unusual items or conditions observed are strictly for the information of our client.

To evaluate the site for possible environmental liabilities, we recommend an environmental assessment, consisting of a detailed site reconnaissance, a record review, and report of findings. Additional subsurface drilling and sampling, including groundwater sampling, may be required. Bowser-Morner, Inc. can provide this service and would be pleased to provide a cost proposal to perform such a study, if requested.

This report has been prepared for the exclusive use of Five Rivers MetroParks for specific application to the pedestrian bridge on Riverside Drive in Dayton, Ohio (see Figure 1 in Section III of this report). Specific design and construction recommendations have been provided in the various sections of the report. The report shall therefore, be used in its entirety. This report is not a bidding document and shall not be used for that purpose. Anyone reviewing this report must interpret and draw their own conclusions regarding specific construction techniques and methods chosen. Bowser-Morner, Inc. is not responsible for the independent conclusions, opinions or recommendations made by others based on the field exploration and laboratory test data presented in this report.

# Section II

# Specifications

# CLEARING AND GRADING SPECIFICATIONS

## I. GENERAL CONDITIONS

The contractor shall furnish all labor, materials, and equipment, and perform all work and services necessary to complete in a satisfactory manner the site preparation, excavation, filling, compaction and grading as shown on the plans and as described therein.

This work shall consist of all clearing and grading, removal of existing structures unless otherwise stated, preparation of the land to be filled, filling of the land, spreading and compaction of the fill, and all subsidiary work necessary to complete the grading of the cut and fill areas to conform with the lines, grades, slopes, and specifications.

This work is to be accomplished under the constant and continuous supervision of the Owner or his designated representative.

In these specifications the terms "approved" and "as directed" shall refer to directions to the Contractor from the Owner or his designated representative.

## II. SUBSURFACE CONDITIONS

Prior to bidding the work, the Contractor shall examine, investigate and inspect the construction site as to the nature and location of the work, and the general and local conditions at the construction site, including, without limitation, the character of surface or subsurface conditions and obstacles to be encountered on and around the construction site; and shall make such additional investigation as he may deem necessary for the planning and proper execution of the work. Borings and/or soil investigations shall have been made. Results of these borings and studies will be made available by the Owner to the Contractor upon his request, but the Owner is not responsible for any interpretations or conclusions with respect thereto made by the Contractor on the basis of such information, and the Owner further has no responsibility for the accuracy of the borings and the soil investigations.

If conditions other than those indicated are discovered by the Contractor, the Owner should be notified immediately. The material which the Contractor believes to be a changed condition should not be disturbed so that the Owner can investigate the condition.

## III. SITE PREPARATION

Within the specified areas, all trees, brush, stumps, logs, tree roots, and structures scheduled for demolition shall be removed and disposed of.

All cut and fill areas shall be properly stripped. Topsoil will be removed to its full depth and stockpiled for use in finish grading. Any rubbish, organic and other objectionable soils, and other deleterious material, shall be disposed of off the site, or as directed by the Owner or his designated representative if on site disposal is provided. In no case shall such objectionable material be allowed in or under the fill unless specifically authorized in writing.

Prior to the addition of fill, the original ground shall be compacted to job specifications as outlined below. Special notice shall be given to the proposed fill area at this time. If wet spots, spongy conditions, or ground water seepage is found, corrective measures must be taken before the placement of fill.

## IV. FORMATION OF FILL AREAS

Fills shall be formed of satisfactory materials placed in successive horizontal layers of not more than eight (8) inches in loose depth for the full width of the cross section. The depth of lift may be increased if the Contractor can demonstrate the ability to compact a larger lift. If compaction is accomplished using hand-tamping equipment, lifts will be limited to 4-inch lose lifts.

All material entering the fill shall be free of organic matter such as leaves, grass, roots, and other objectionable material.

The operations on earth work shall be suspended at any time when satisfactory results cannot be obtained because of rain, freezing weather, or other unsatisfactory conditions. The Contractor shall keep the work areas graded to provide the drainage at all times.

The fill material shall be of the proper moisture content before compaction efforts are started. Wetting or drying of the material and manipulation to secure a uniform moisture content throughout the layer shall be required. Should the material be too wet to permit proper compaction or rolling, all work on all portions of the embankment thus affected shall be delayed until the material has dried to the required moisture content. The moisture content of the fill material should be no more than two (2) percentage points higher or lower than optimum unless otherwise authorized. Sprinkling shall be done with equipment that will satisfactorily distribute the water over the disced area.

Compaction operations shall be continued until the fill is compacted to not less than 90% above foundation elevation and 95% below foundation elevation, of the maximum density as determined in accordance with the latest ASTM D-1557 (Modified). Any areas inaccessible to a roller shall be consolidated and compacted by mechanical tampers. The equipment shall be operated in such a manner that hardpan, cemented gravel, clay or other chunky soil material will be broken up into small particles and become incorporated with the other material in the layer.

In the construction of filled areas, starting layers shall be placed in the deepest portion of the fill, and as placement progresses, additional layers shall be constructed in horizontal planes. If directed, original slopes shall be continuously, vertically benched to provide horizontal fill planes. The size of the benches shall be formed so that the base of the bench is horizontal and the back of the bench is vertical. As many benches as are necessary to bring the site to final grade shall be constructed. Filling operations shall begin on the lowest bench, with the fill being placed in horizontal eight (8) inch loose lifts unless otherwise authorized. The filling shall progress in this manner until the entire first bench has been filled, before any fill is placed on the succeeding benches. Proper

drainage shall be maintained at all times during benching and filling of the benches, to insure that all water is drained away from the fill area.

When rock and other embankment material are excavated at approximately the same time, the rock shall be incorporated into the outer portion of the areas. Stones or fragmentary rock larger than four (4) inches in their greatest dimensions will not be allowed in the fill unless specifically authorized in writing. Rock fill shall be brought up in layers as specified or as directed, and every effort shall be exerted to fill the voids with the finer material to form a dense, compact mass. Rock or boulders shall be disposed of as deleterious material per Item III.

Frozen material shall not be placed in the fill nor shall the fill be placed upon frozen material.

The Contractor shall be responsible for the stability of all fills made under the contract, and shall replace any portion, which in the opinion of the Owner or his designated representative, has become displaced due to carelessness or negligence on the part of the Contractor. Fill damaged by inclement weather shall be repaired at the Contractor's expense.

## V. SLOPE RATIO AND STORM WATER RUN-OFF

Slopes shall not be greater than 2 (horizontal) to 1 (vertical) in both cut and fill, and storm water shall not be drained over the slopes.

## VI. GRADING

The Contractor shall furnish, operate, and maintain such equipment as is necessary to construct uniform layers, and control smoothness of grade for maximum compaction and drainage.

## VII. COMPACTING

The compaction equipment shall be approved equipment of such design, weight, and quantity to obtain the required density in accordance with these specifications.

## VIII. TESTING AND INSPECTION SERVICES

Testing and inspection services will be provided by the Owner.

## IX. SPECIAL CONDITIONS

# SPECIFICATIONS FOR AUGER CAST PILES

## 1. STANDARDS AND DEFINITIONS

a. Standards - All standards refer to latest edition.

b. Definitions

b.1 Owner - In these specifications the word "Owner" shall mean

_____.

b.2 Engineer - In these specifications the word "Engineer" shall mean the designated representative of _____.

b.3 Design Engineer - In these specifications the words "Design Engineer" shall mean Bowser-Morner, Inc., P.O. Box 51, Dayton, Ohio 45401.

b.4 Contractor - In these specifications the word "Contractor" shall mean the firm or corporation undertaking the execution of the work under the terms of these specifications.

b.5 Approved - In these specifications the work "approved" shall refer to the approval of the Owner or his designated representative.

b.6 As Directed - In these specifications the words "as directed" shall refer to the directions to the Contractor from the Owner or his designated representative.

## 2. GENERAL

a. Scope of Work

The work covered by these specifications consists of furnishing all labor, equipment (including monitoring equipment) and materials for the construction of auger cast piles. The Contractor, upon due notice from the Engineer, shall furnish records of past successful experience in performing this type of work and shall submit to the Engineer for approval a description of the materials to be used and the proposed method of operations, and shall furnish records and data to demonstrate that the finished piles will meet, in all respects, the quality and properties required by these specifications.

Prior to bidding the work, the Contractor shall examine, investigate, and inspect the construction site as to the nature and location of the work, and the general and local conditions of the construction site, including, without limitations, the character of surface or subsurface conditions and obstacles to be encountered on and around the construction site; and shall make such additional investigation as he may deem necessary for the planning and proper execution of the work.

Borings and/or soil examinations have been made. Results of these borings and studies will be made available by the Owner to the Contractor upon request, but the Owner shall not be responsible for any interpretations or conclusions with respect thereto made by the Contractor on the basis of such information, and the Owner further has no responsibility for the accuracy of the borings and the soil examinations.

If conditions other than those indicated are discovered by the Contractor, the Owner shall be notified immediately. The material which the Contractor believes to be a changed condition should not be disturbed so that the Owner can investigate the condition.

b. General Conditions

Auger cast piles are placed by rotating a continuous flight hollow-shaft auger into the ground to a pre-determined pile depth. Mortar shall be pumped with sufficient pressure, as the auger is withdrawn, to fill the hole preventing hole collapse. There should be sufficient pressure to cause the lateral penetration of the mortar into soft or porous zones of the surrounding soil. A head of 3 or 4 feet of mortar shall be carried above the injection point around the perimeter of the auger flighting at all time during the raising of the auger so that the mortar has a displacing action which removes loose material from the hole. This method of displacement shall be used at all times and not be dependent on whether the hole is sufficiently stable to retain its shape without support from the earth-filled auger. If reinforcement is required, it shall be placed while the mortar is fluid. (The placement of reinforcement in tension piles and anchors, when reinforcement is required the full length of the pile, is covered in a separate specification).

This work is to be accomplished under the observation of the Owner and/or his designated representative.

## 3. HIGH-STRENGTH MORTAR

The mortar shall consist of a mixture of Portland cement, fluidifier, sand, and water. It shall be proportioned and mixed so as to provide a mortar capable of maintaining the solids in suspension without appreciable water gain, yet which will flow laterally penetrating and filling voids in the foundation material. Mineral filler may be added to the above mix in lieu of a small percentage of the Portland cement at the Contractor's option. The materials shall be so proportioned as to provide a hardened mortar having a compressive strength of 4000 psi at 28 days.

The mortar shall be tested by making one set of three 2-inch cubes for each day during which auger cast piles are placed. A set of cubes shall consist of one cube to be tested at seven days, and two cubes to be tested at twenty-eight days. Test cubes shall be made and tested in accordance with ASTM C-109, with the exception that the mortar should be restrained from expansion by a top plate.

## 4. MATERIALS

a. Portland Cement - Portland cement shall conform to Federal Specifications SS-C-192 or current ASTM C-150.

b. Mineral Filler - Mineral filler shall be finely powdered siliceous material which possesses the property of combining the lime liberated during the process of hydration of Portland cement.

c. Fluidifier - Fluidifier shall be a compound possessing characteristics which will increase the fluidity of the mixture, reduce bleeding, assist in the strength cement mortar (INTERAID as manufactured by the Grout Supply Company, Brecksville, Ohio meets these specifications). Other commercially available admixes shall show prior test results before approval.

d. Water - Water shall be fresh, clean, and free from injurious amounts of sewage, oil, acids, alkali, salts, or organic matter.

e. Fine Aggregate - Sand shall meet the requirements of current ASTM C-33.

The sand shall consist of hard, dense, durable, uncoated rock particles and be free of injurious amounts of silt, loam, lumps, soft or flaky particles, shale, alkali, organic matter, mica, and other deleterious substances. If washed, the washing method shall be such as will not remove desirable fines, and the sand shall subsequently be permitted to drain until the residual-free moisture is reasonably uniform and stable. The sand shall be well-graded from fine to coarse, with fineness modulus between 1.40 and 3.40. The fineness modulus is defined as the total divided by 100 of the cumulative percentage retained on U.S. Standard Sieve Nos. 16, 30, 50, and 100.

## 5. MIXING AND PUMPING OF HIGH-STRENGTH CEMENT MORTAR

Only approved pumping, continuous mixing and agitating equipment shall be used in the preparation and handling of the mortar. All oil or other rust inhibitors shall be removed from mixing drums and mortar pumps. If ready-mix mortar is used, an agitating storage tank of sufficient size may be required, if directed by the Engineer, between the ready-mix truck and the mortar pump to insure a homogeneous mix and continuity in the pumping operations. All materials shall be such as to produce a homogeneous mortar of the desired consistency. If there is a lapse in the operation, the mortar shall be recirculated through the pump. All materials shall be accurately measured by volume or weight as they are fed to the mixer. Time of mixing shall be not less than one minute. If agitated continuously, the mortar may be held in the mixer or agitator for a period not exceeding two hours at temperatures below $70^{O}$F and for a period not exceeding one and one-half hours at higher temperatures.

The mortar pump shall be a positive displacement piston type pump capable of developing displacing pressures at the pump up to 350 psi.

## 6. PILE INSTALLATION

Accurate records shall be maintained showing the depth to which piles are placed and the quantity of mortar used. Any unusual conditions encountered during pile installation shall be noted. The mortar pump shall be provided with a pressure gauge in clear view of the equipment operator. Rate of mortar injection and rate of auger withdrawal form the soil shall be so coordinated as to maintain at all times a positive pressure on this gauge, which will, in turn, indicate the existence of a removing pressure on the bottom of the auger flight in conformance with Section 2 of these specifications. The pump rams shall be fitted with a re-zeroing counter visible to the operator. The counter shall index after each ram has traveled one full cycle and have a capacity to record all strokes of the ram required to fill the piling with mortar. After each piling is completed the counter shall be reset to zero. Auger hoisting equipment shall be designed to enable the auger to be withdrawn smoothly and steadily. The volume of column shall be at least 15% greater than the net volume of the piles specified. If the pressure indicated on the gauge drops during injection, the auger shall be drilled at least 2 feet down the hole and the injection pressure continued. The minimum pressure required shall be 250 psi.

## 7. LOCATION OF PILES

Piles shall be located as shown on plans or as otherwise directed by the Engineer. Pile centers shall be located to an accuracy of plus or minus 3 inches.

Adjacent piles shall not be placed until the mortar in the piles has reached its initial set in order that there will be no interconnection between adjacent piles while the mortar is in a fluid state. This will normally require an overnight wait.

## 8. OBSTRUCTIONS

Should any obstruction (including but not limited to boulders and timbers) be encountered which shall prevent placing the pile to the depth required, or shall cause the pile to drift from the required location, the pile shall be completed in accordance with Paragraph 2, and this short pile added to the unit lengths for payment. If required by the Engineer, an additional adjacent pile shall be placed and paid for in accordance with the contract documents for additional footage. Refusal shall be defined as the depth where the penetration of the standard augering equipment is one foot per minute or less.

## 9. PILE TESTING

Pile load tests, if required, shall be performed in accordance with ASTM D-1143-74, insofar as it applies to bearing piles constructed in accordance with these specifications, or as otherwise permitted by the Engineer. If test piles are required, they shall be placed, tested, and approved by the Engineer prior to installation of structural piles.

## 10. DETERMINATION OF PILE DIAMETER AND LENGTH

The length and diameter of augered cast-in-place piles shall be as shown on the plans. These dimensions may be revised as a result of soil foundation information obtained during pile installation or as a result of pile load tests, subject to approval of the Engineer.

## 11. PILE TOPS

Where the pile cut-off is near the surface or above the bottom of the excavation, metal sleeves or casing of the proper diameter and at least 18 inches long shall be placed around the pile tops. (Special condition may require metal sleeves of additional length).

## 12. AUGERING EQUIPMENT

The hole through the high-strength mortar is pumped during the placement of the pile shall be located at the bottom of the auger head below the bar containing the cutting teeth.

The auger flighting shall be continuous from the auger head to the top of auger with no gaps or other breaks. The pitch of the auger flighting shall not exceed 9 inches.

Augers over 40 feet in length shall contain a middle guide.

The auger cast piling leads should be prevented from rotating by a stabilizing arm.

## 13. BID BASIS (ITEMS NOT APPLICABLE MAY BE OMITTED)

a. Bid shall be for a lump sum amount based on the number of piles, estimated length, and the total estimated footage as shown in the plans and/or specifications.

b. Separate unit prices shall be quoted to cover each of the following:

1) A unit price per pile for additional piles (of estimated length) placed over the base number of piles quoted upon.

2) A unit price per pile credit for fewer piles (of estimated length) placed over the base number of piles quoted upon.

3) Charge for additional footage over the total base amount of footage quoted upon.

4) Credit for less footage than the total base amount quoted upon.

c. Load tests (if required) shall be bid at a unit price for each test.

d. No payment shall be made for misplaced, faulty, or otherwise unacceptable piles caused by the negligence of the piling Contractor.

# SPECIFICATION FOR DRILLED PIERS

Drilled piers shall be constructed in accordance with American Concrete Institute (ACI) Standard 336. The Contractor shall have a copy of this standard available on the job site. The specifications include but are not limited to the following:

1. The Contractor shall furnish all labor, equipment and materials necessary to complete the drilled piers (caissons), in strict accordance with the plans and specifications.

2. The piers shall be formed by means acceptable to the Owner and shall extend to the depth shown on the drawing unless otherwise approved by the Owner.

3. The work includes the excavation of all materials, both wet and dry, and the removal of all excavated material from the job site if directed.

4. The maximum variation of the center of any pier from the required location shall be 2 inches at the ground surface, and no pier shall be out of plumb more than 1% (one percent) of its drilled length including bell. If these tolerances are exceeded, alterations as required by the Owner shall be provided without additional cost to the Owner.

5. The diameter of each pier and bell shall conform to the dimensions shown on the plans.

6. Boulders shall be removed as extra work. The Contractor shall establish in this contract a unit price for removing boulders. Boulders are considered as being larger than one cubic foot in size. Smaller material shall not be classified as boulders.

7. The depth of drilled piers, for contract work purposes, is shown on the drawings. If, in order to reach suitable material (as determined by the Owner or his representative) the depth of piers is deeper or more shallow, the price shall be adjusted in accordance with the contract.

8. Each pier shall be inspected by the Owner or his representative to insure that the pier is bearing on suitable material, that the bell is of the required size and is free of debris and water before concrete is poured. The Contractor shall case any pier into which workmen or an inspector will enter. Concrete shall not be placed until the pier is approved by the Owner or his representative.

9. The Contractor shall provide and operate all equipment necessary to pump and remove all water that may be encountered in the construction of piers, without additional payment therefore. The Contractor shall case all piers where necessary to stop the flow of water and belling shall be done in a dry shaft below the casing.

10. The drilled pier shall be filled with concrete as specified below. In instances where the shaft has been cased to stop water flow, the concrete shall be brought to a point equal in depth to the head of water above the bottom of the casing before pulling of the casing is started. The casing shall be pulled by a slow, even lift utilizing a pulling beam. Once begun, the pulling shall be continuous and the placing of the concrete shall follow the casing up, with a constant head of concrete equal to the head of water above the bottom of the casing maintained. In instances where the shaft has been cased to prevent caving or sloughing of

the sides, the concrete shall be brought to a point five feet above the bottom edge of the casing before the pulling of the casing is started.

The casing shall be pulled in a uniform manner so as to maintain a minimum of five feet head of concrete in the casing.

11. Concrete shall have a compressive strength of 4,000 psi in 28 days at a slump of 3" to 6".

12. Concrete shall be placed in accordance with ACI 336.3R-4 in such a manner that segregation of the concrete is avoided. The concrete shall be placed by means of chutes or some other method so the concrete drops vertically into the center of the pier.

13. The Contractor shall use mechanical vibrators to consolidate the concrete placed in the top five feet of the piers.

14. The pouring of concrete for any one pier shall be continuous. Any interruption in the progress of excavation, protection of the excavation with steel liners, or pouring of the concrete must have the approval of the Owner or his representative.

15. Testing and observation services will be provided by the Owner and be done in accordance with ACI 336.3R-5.

# Section III

## Boring Log Terminology, Boring Logs, Laboratory Data, And Prints

# BORING LOG TERMINOLOGY

**Stratum Depth:**

Distance in feet and/or inches below ground surface.

**Stratum Elevation:**

Elevation in feet below ground surface elevation.

**Description of Materials:**

Major types of soil material existing at boring location. Soil classification based on one of the following systems: Unified Soil Classification System., Ohio State Highway Classification System, Highway Research Board Classification System, Federal Aviation Authority Classification System, Visual Classification.

**Sample No.:**

Sample numbers are designated consecutively, increasing with depth for each boring.

**Sample Type:**

"A" Split spoon, 2" O.D., 1-3/8" I.D., 18" in length.

"B" Rock Core

"C" Shelby Tube 3" O.D. except where noted

"D" Soil Probe

"E" Auger Cuttings

"F" Sonic

**Sample Depth:**

Depth below top of ground at which appropriate sample was taken.

**Blows per 6" on Sampler:**

The number of blows required to drive a 2" O.D., 1-3/8" I.D., split spoon sampler, using a 140 pound hammer with a 30-inch free fall, is recorded for 6" drive increments. (Example: 3/8/9).

**"N" Blows/Ft.:**

Standard penetration resistance. This value is based on the total number of blows required for the last 12" of penetration. (Example: 3/8/9: N = 8 + 9 = 17)

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**Water Observations:**

Depth of water recorded in test boring is measured from top of ground to top of water level. Initial depth indicates water level during boring, completion depth indicates water level immediately after boring, and depth after "X" number hours indicates water level after letting water rise or fall over a time period. Water observations in pervious soil are considered reliable ground water levels for that date. Water observations in impervious soils can not be considered accurate ground water measurements for that date unless records are made over several days' time. Factors such as weather, soil porosity, etc., will cause the ground water level to fluctuate for both pervious and impervious soils.

## SOIL DESCRIPTION

**Color:**

When the color of the soil is uniform throughout, the color recorded will be such as brown, gray, or black and may be modified by adjectives such as light and dark. If the soil's predominant color is shaded by a secondary color, the secondary color precedes the primary color, such as: gray-brown, yellow-brown. If two major and distinct colors are swirled throughout the soil, the colors will be modified by the term mottled, such as: mottled brown and gray.

| Particle Size | Visual |
|---|---|
| Boulders | Larger than 8" |
| Cobbles | 8" to 3" |
| Gravel – Coarse | 3" to 3/4" |
| – Fine | 2 mm. To 3/4" |
| Sand – Coarse | 2 mm. – 0.6 mm. (Pencil lead size) |
| – Medium | 0.6 mm. – 0.2mm. Table sugar and salt size) |
| – Fine | 0.2 mm. – 0.06 mm. (Powdered sugar and human hair size) |
| Silt | 0.06 mm. – 0.002 mm. |
| Clay | 0.002 and smaller (Particle size of both Silt and Clay not visible To naked eye |

**Soil Components**

| Major Component: | Minor Component Term |
|---|---|
| Gravel | Trace 1-10% |
| Sand | Some 11-35% |
| Silt | And 36-50% |
| Clay | |

**Moisture Content**

| Term | Relative Moisture |
|---|---|
| Dry | Powdery |
| Damp | Moisture content below plastic limit |
| Moist | Moisture content above plastic limit but below liquid limit |
| Wet | Moisture content Above liquid limit |

**Condition of Soil Relative to Compactness Granular Material**

| | |
|---|---|
| Very Loose | 5 blows/ft. or less |
| Loose | 6 to 10 blows/ft. |
| Medium Dense | 11 to 30 blows/ft. |
| Dense | 30 to 50 blows/ft. |
| Very Dense | 51 blows/ft. or more |

**Condition of Soil Relative to Consistency Cohesive Material**

| | |
|---|---|
| Very Soft | 3 blows/ft. or less |
| Soft | 4 to 5 blows/ft. |
| Medium Stiff | 6 to 10 blows/ft. |
| Stiff | 11 to 15 blows/ft. |
| Very stiff | 16 to 30 blows/ft. |
| Hard | 31 blows/ft. or more |

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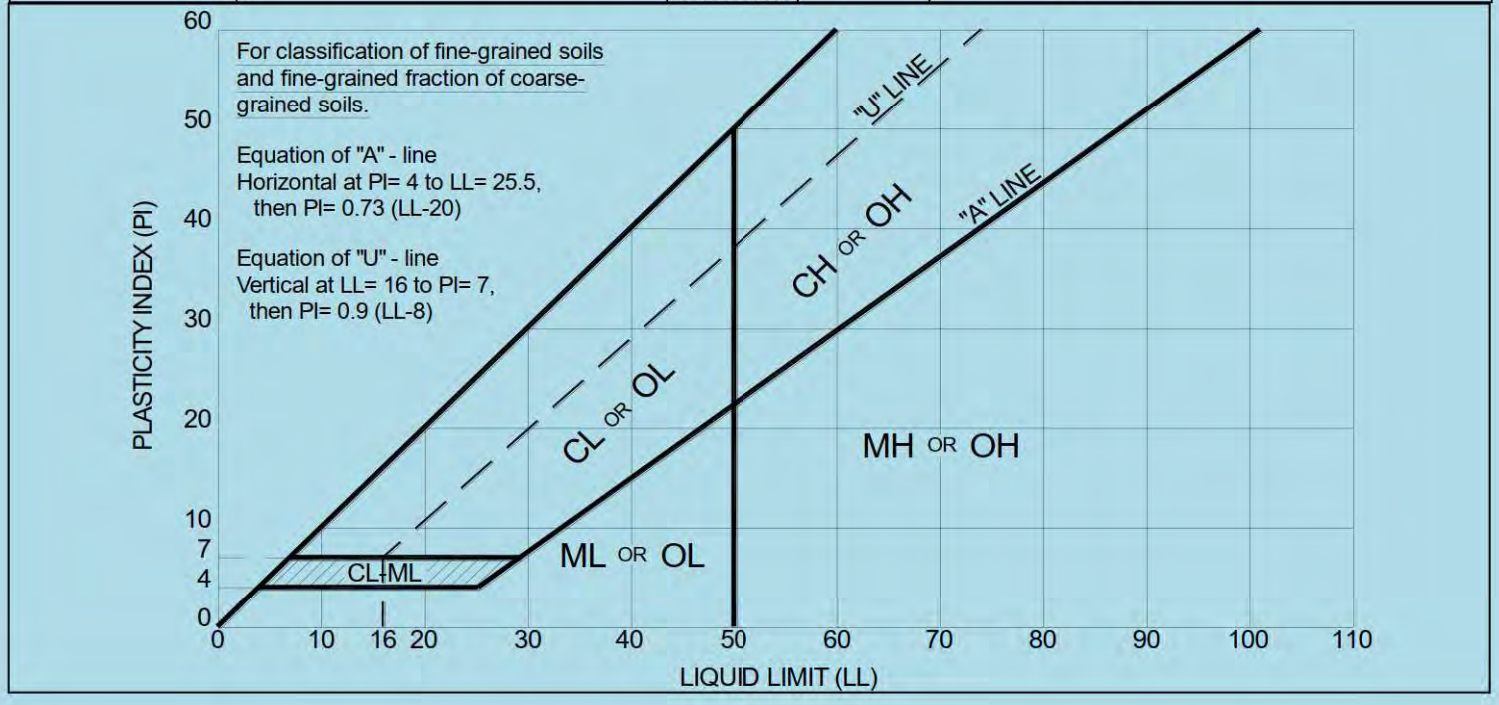
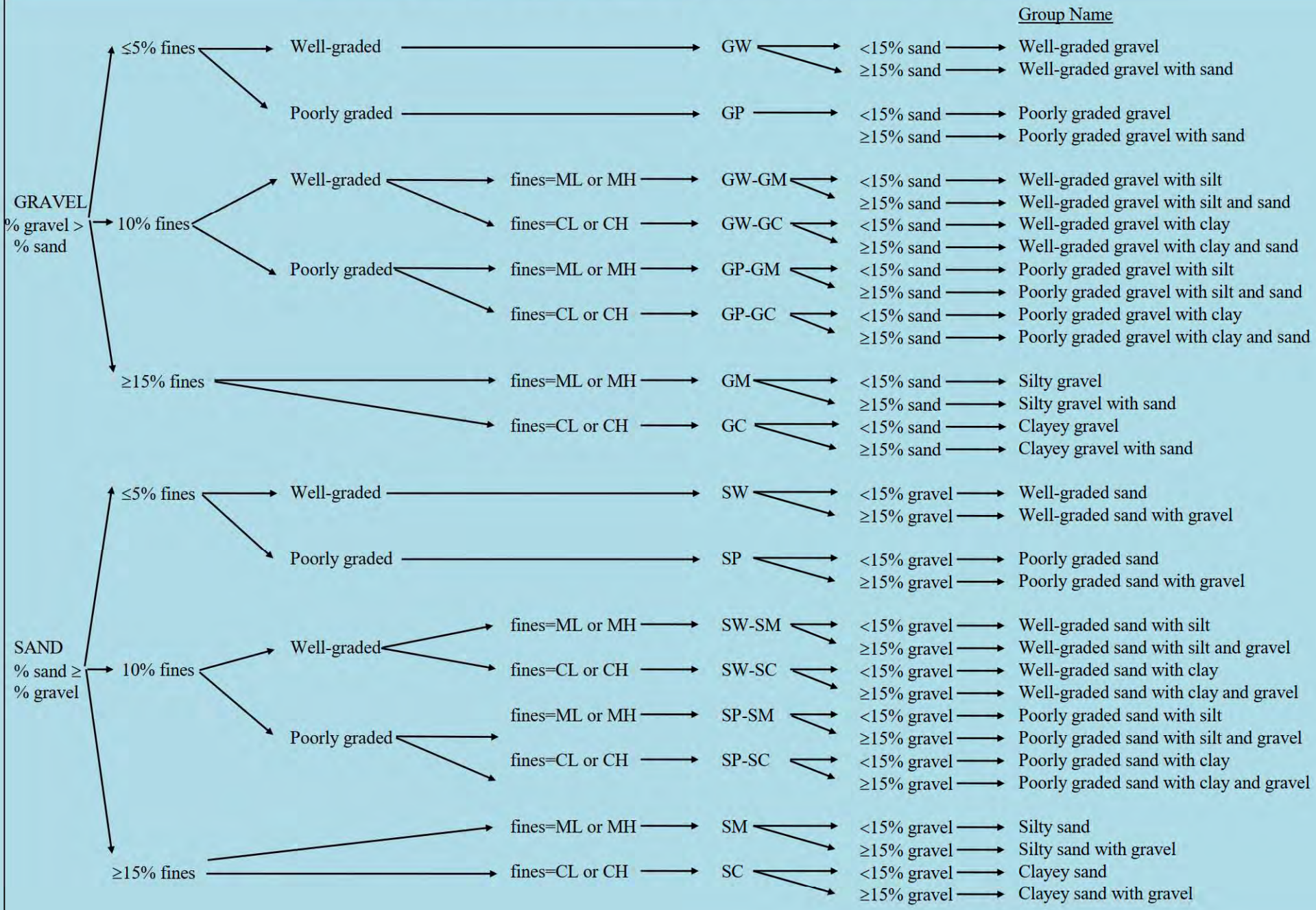
# UNIFIED CLASSIFICATION SYSTEM

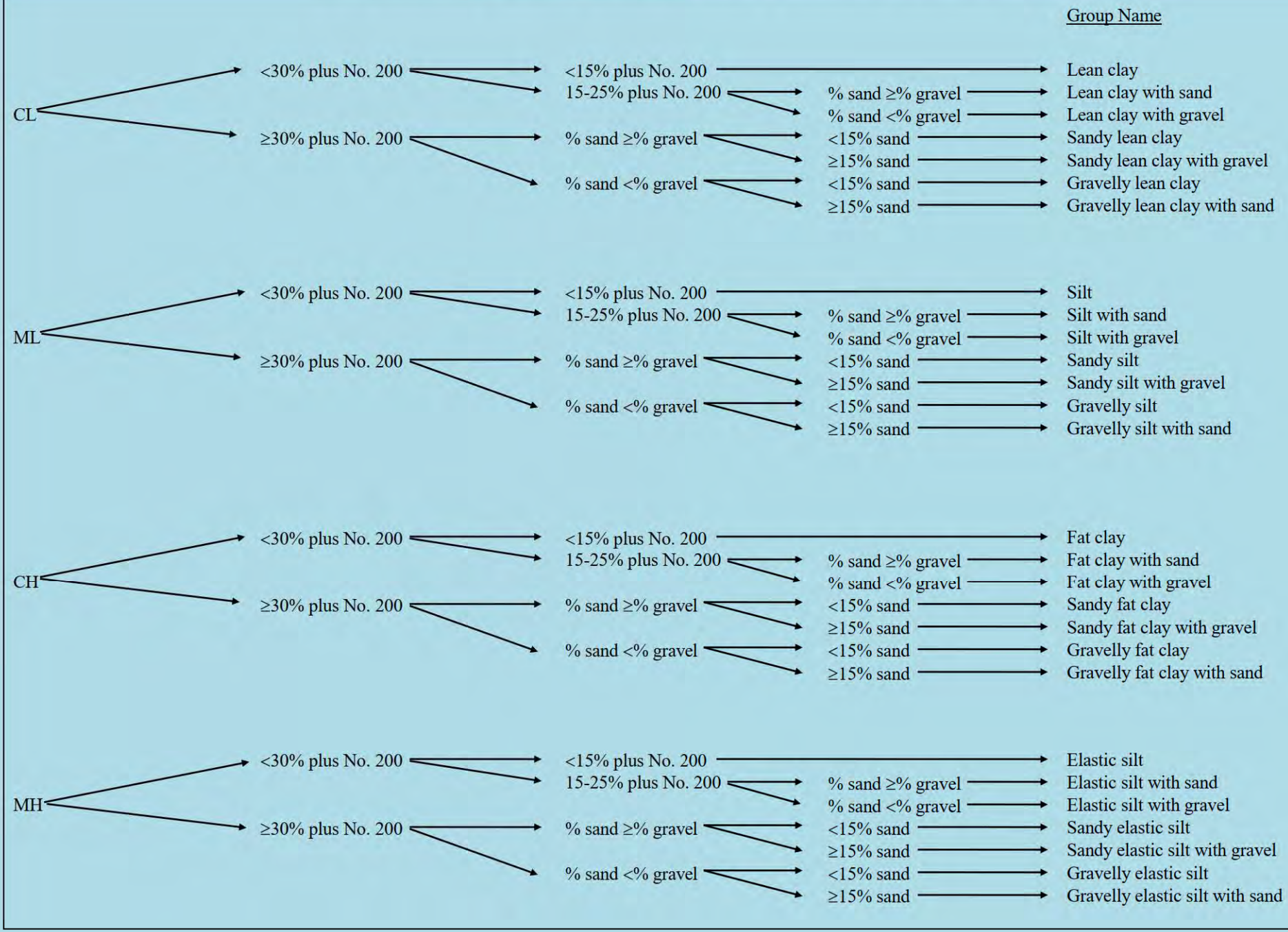
| MAJOR DIVISIONS | | | GRAPH SYMBOL | LETTER SYMBOL | TYPICAL DESCRIPTIONS |
|---|---|---|---|---|---|
| COARSE GRAINED SOILS<br>MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE | GRAVEL AND GRAVELLY SOILS<br>MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE | CLEAN GRAVELS (LITTLE OR NO FINES) | | GW | WELL-GRADED GRAVEL<br>WELL-GRADED GRAVEL WITH SAND |
| | | | | GP | POORLY GRADED GRAVEL<br>POORLY GRADED GRAVEL WITH SAND |
| | | GRAVELS WITH FINES APPRECIABLE AMT. OF FINES) | | GM | SILTY GRAVEL<br>SILTY GRAVEL WITH SAND |
| | | | | GC | CLAYEY GRAVEL<br>CLAYEY GRAVEL WITH SAND |
| | SAND AND SANDY SOILS | CLEAN SAND (LITTLE OR NO FINES) | | SW | WELL-GRADED SAND<br>WELL-GRADED SAND WITH GRAVEL |
| | | | | SP | POORLY GRADED SAND<br>POORLY GRADED SAND WITH GRAVEL |
| | MORE THAN 50% OF COARSE FRACTION PASSING NO. 4 SIEVE | SANDS WITH FINES (APPRECIABLE AMT. OF FINES) | | SM | SILTY SAND<br>SILTY SAND WITH GRAVEL |
| | | | | SC | CLAYEY SAND<br>CLAYEY SAND WITH GRAVEL |
| FINE GRAINED SOILS<br>MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE | SILT AND CLAYS | LIQUID LIMIT LESS THAN 50 | | ML | SILT, SILT WITH SAND, SANDY SILT<br>GRAVELLY SILT, GRAVELLY SILT WITH SAND |
| | | | | CL | LEAN CLAY WITH SAND, SANDY LEAN CLAY<br>GRAVELLY LEAN CLAY WITH SAND |
| | | | | OL | ORGANIC CLAY, SANDY ORGANIC CLAY<br>ORGANIC SILT, SANDY ORGANIC SILT WITH GRAVEL |
| | SILT AND CLAYS | LIQUID LIMIT GREATER THAN 50 | | MH | ELASTIC SILT WITH SAND, SANDY ELASTIC SILT<br>GRAVELLY ELASTIC SILT WITH SAND |
| | | | | CH | FAT CLAY WITH SAND, SANDY FAT CLAY<br>GRAVELLY FAT CLAY WITH SAND |
| | | | | OH | ORGANIC CLAY WITH SAND, SANDY ORGANIC CLAY, ORGANIC SILT, SANDY ORGANIC SILT |
| | HIGHLY ORGANIC SOILS | | | PT | PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS |



# Flow Chart for Visually Identifying Soils Based on ASTM D-2488



# Flow Chart for Visually Identifying Soils Based on ASTM D-2488



## STANDARD PENETRATION RESISTANCE (ASTM D1586)

The purpose of this test is to determine the relative consistency of the soils in a boring, or from boring over the site. This method consists of making a hole in the ground and driving a 2-inch O.D. split spoon sampler into the soil with a 140-pound hammer dropped from a height of 30 inches. The sampler is driven 18 inches and the number of blows recorded for each 6 inches of penetration. Values of standard penetration (N) are determined in blows per foot, summarizing the flows required for the last two 6-inche increments of penetration.

Example : 2-6-8; N = 14

## THIN-WALLED SAMPLER (ASTM D1587)

The purpose of the thin-walled sampler is to recover a relatively undisturbed soil sample for laboratory tests. The sampler is a thin-walled seamless tube with a 3-inch outside diameter, which is hydraulically pressed into the ground, at a constant rate. The ends are then sealed to prevent soil moisture loss, and the tube is returned to the laboratory for tests.

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## UNCONFINED COMPRESSION OR TRIAXIAL TESTS (ASTM D 2166)

The unconfined compression test and the triaxial tests are performed to determine the shearing strength of the soil, to use in establishing its safe bearing capacity. In order to perform the unconfined compression test, it is necessary that the soil exhibit sufficient cohesion to stand in an unsupported cylinder. These tests are normally performed on samples which are 6.0 inches in height and 2.85 inches in diameter. In the triaxial test, various lateral stresses can be applied to more closely simulate the actual field conditions. There are several different types of triaxial tests. These are, however, normally performed on constant strain apparatus with a deformation rate of 0.05 inches per minute.

## CONSOLIDATION TEST (ASTM D 2435)

The purpose of this test is to determine the compressibility of the soil. This test is performed on a sample of soil which is 2.5 inches in diameter and 1.0 inch in height, and has been trimmed from relatively "undisturbed" samples. The test is performed with a lever system or an air activated piston for applying load. The loads are applied in increments and allowed to remain on the sample for a period of 24 hours. The consolidation of the sample under each individual load is measured and a curve of void ratio vs. Pressure is obtained. From the information obtained in this manner and the column loads of the structure, it is possible to calculate the settlement of each individual building column. This information, together with the shearing strength of the soil, is used to determine the safe bearing capacity for a particular structure.

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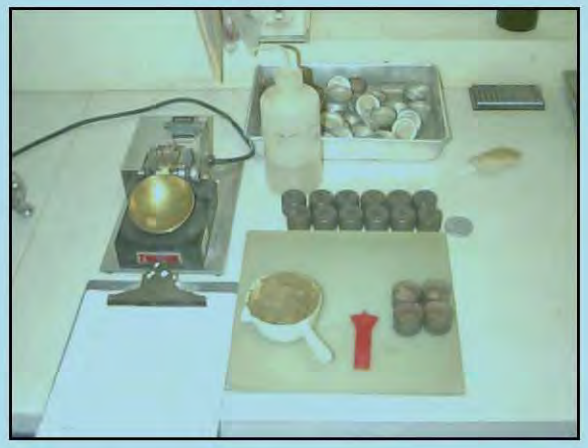
**REVISED TO ASTM D4318**

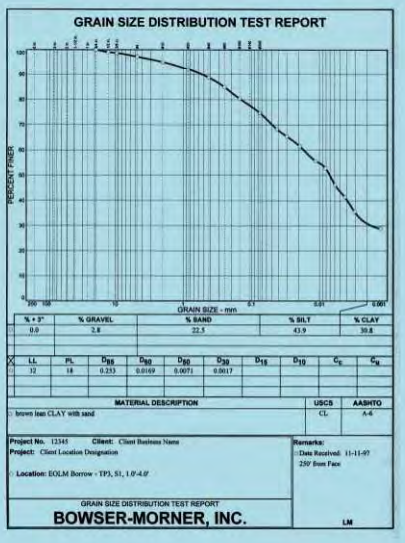
## ATTERBERG LIMITS (ASTM D423 AND D424)

These tests determine the liquid and plastic limits of soils having a predominant percentage of fine particle (silt and clay) sizes. The liquid limit of a soil is the moisture content expressed as a percent at which the soil changes from a liquid to a plastic state, and the plastic limit is the moisture content at which the soil changes from a plastic to a semi-solid state. Their difference is defined as the plasticity index (P.I. = L.L. - P.L.), which is the change in moisture content required to change the soil from a "semi-solid" to a liquid. These tests furnish information about the soil properties which is important in determining their relative swelling potential and their classifications.



## MECHANICAL ANALYSIS (ASTM D422)

This test determines the percent of each particle size of a soil. A sieve analysis is conducted on particle sizes greater than a No. 200 sieve (0.074 mm), and a hydrometer test on particles smaller than the No.200 sieve. The gradation curve is drawn through the points of cumulative percent of particle size, and plotted on semi-logarithmic paper for the combined sieve and hydrometer analysis. This test, together with the Atterberg Limits tests, is used to classify a soil.

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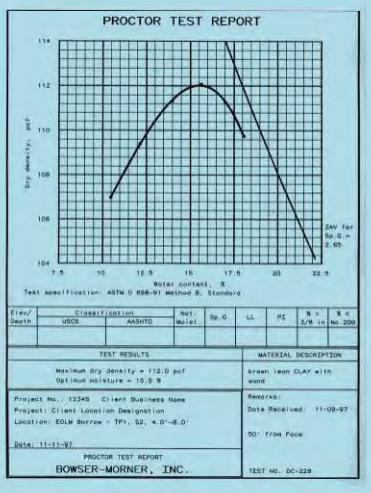
## NATURAL MOISTURE CONTENT (ASTM D2216)

The purpose of this test is to indicate the range of moisture contents present in the soil. A wet sample is weighed, placed in the constant temperature oven at 105° for 24 hours, and re-weighed. The moisture content is the change in weight divided by the dry weight.

## PROCTOR TESTS

The purpose of these tests is to determine the maximum density and optimum moisture content of a soil. The Modified Proctor test is performed in accordance with ASTM D1557. The test is performed by dropping a 10-pound hammer 25 times from an 18-inch height on each of 5 equal layers of soil in a 1/30 cubic foot mold, which represents a compaction effort of 56,250 foot pounds per cubic foot. The moisture content is then raised, and this procedure is repeated. A moisture density curve is then plotted, with the density on the ordinate axis and the moisture on the abscissa axis. The moisture content at which the maximum density requirement can be achieved with a minimum compactive effort is designated as the optimum moisture content (O.M.C.). The Standard Proctor test is performed in accordance with ASTM D698. This test is similar to the Modified Proctor test and is performed by dropping a 5.5 pound hammer 25 times from a height of 12 inches on 3 equal layers of soil in a 1/30 cubic foot mold, which represents a compaction effort of 12,375 foot pounds per cubic foot. This test gives proportionately lower results than the Modified Proctor test.


PROCTOR TEST REPORT

Dry density, pcf

Water content, %

ZAV for Sp.G.= 2.65

Test specification: ASTM D 698-91 Method B, Standard

| Elev/ Depth | Classification USCS | Classification AASHTO | Nat. Moist. | Sp.G. | LL | PI | % > 3/4 in | % < No.200 |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |

| TEST RESULTS | MATERIAL DESCRIPTION |
|---|---|
| Maximum dry density = 112.0 pcf<br>Optimum moisture = 15.5 % | Brown lean CLAY with sand |
| Project No.: 12345 Client Business Name<br>Project: Client Location Designation<br>Location: EDLM Borrow - TP1, S2, 4.0'-8.0'<br>Date: 11-11-97 | Remarks:<br>Date Received: 11-09-97<br>50' from Face |
| PROCTOR TEST REPORT<br>BOWSER-MORNER, INC. | TEST NO. DC-228 |

BOWSER MORNER

CLIENT
**Five Rivers MetroParks**

PROJECT
**Soil Study for Proposed Pedestrian Bridge, Riverside Drive, Dayton, Ohio.**

JOB NO. **211911**

BORING STARTED **10/30/23** | BORING COMPLETED **10/30/23**

DRILLER **Cindrill** | METHOD **2 1/4" HSA**

TYPED BY **dmo**

**1** Boring No.

**Sheet 1 of 2**

PROJECT LOCATION
LAT. **39°48'41.3"N** LONG. **84°12'26.7"W**

SURFACE ELEVATION **97.6***

BORING LOCATION
As shown on Boring Location Plan.

It has been necessary to interpolate between samples. Therefore, the contacts between the various soil strata should not be taken as absolute.

COMMENTS
***Surface elevation refers to an assumed elevation of 100.0' for the benchmark shown on the Boring Location Plan.**

N VALUE, blows/ft. (10 20 30 40 50 60 70 80 90)

| DEPTH (ft. BGL) | SAMPLE NO. | VISUAL CLASSIFICATION OF THE MATERIAL | BLOW COUNTS | N VALUE | REMARKS |
|---|---|---|---|---|---|
| 0.0 | | (FILL) TOPSOIL (6") | | | |
| 1.0 | SS1 | (FILL) Medium dense brown SAND with gravel (some cobbles, some silty clay, trace concrete) - moist | 20 13 8 | 21 | |
| 4.0 | SS2 | | 6 8 10 | 18 | |
| 6.0 | | (Becomes wet at 6.0') | | | ▼ |
| 7.0 | SS3 | | 14 8 11 | 19 | |
| 9.0 | SS4 | | 8 7 8 | 15 | |
| 12.0 | | (ORIGINAL) Loose, brown and gray, fine silty SAND - wet | | | |
| 14.0 | SS5 | | 2 2 4 | 6 | |
| 18.0 | | Dense, brown silty SAND with gravel (some cobbles) - wet | | | |
| 19.0 | SS6 | | 9 20 18 | 38 | |
| 22.0 | | | | | |

*Continued Next Page*

WATER LEVEL MEASUREMENTS

| | DEPTH | DATE |
|---|---|---|
| INITIAL | 6.0 | ▽ 10/30/2023 |
| AT COMPLETION | 6.0 | ▼ 10/30/2023 |
| OTHER | N/A | ▼ N/A |

SS — SPLIT SPOON
SL — SPLIT SPOON W/SOIL LINER
NQ— ROCK CORE
ST — SHELBY TUBE
AS — AUGER CUTTINGS
SC — SONIC

BOWSER MORNER

CLIENT
**Five Rivers MetroParks**

PROJECT
**Soil Study for Proposed Pedestrian Bridge, Riverside Drive, Dayton, Ohio.**

JOB NO. **211911**

BORING STARTED **10/30/23** | BORING COMPLETED **10/30/23**

DRILLER **Cindrill** | METHOD **2 1/4" HSA**

TYPED BY **dmo**

**1** Boring No.

**Sheet 2 of 2**

PROJECT LOCATION
LAT. **39°48'41.3"N** LONG. **84°12'26.7"W**

SURFACE ELEVATION **97.6***

BORING LOCATION
As shown on Boring Location Plan.

It has been necessary to interpolate between samples. Therefore, the contacts between the various soil strata should not be taken as absolute.

VISUAL CLASSIFICATION OF THE MATERIAL

COMMENTS
***Surface elevation refers to an assumed elevation of 100.0' for the benchmark shown on the Boring Location Plan.**

| DEPTH (ft. BGL) | SAMPLE NO. | SAMPLER TYPE / RECOVERY | GRAPHIC LOG | VISUAL CLASSIFICATION OF THE MATERIAL | BLOW COUNTS | N VALUE, blows/ft. (10 20 30 40 50 60 70 80 90) | REMARKS |
|---|---|---|---|---|---|---|---|
| 23.0 | | | | Dense, brown silty SAND with gravel (some cobbles) - wet | | | |
| 24.0 | SS7 | | | | 15<br>20<br>23 | ◇43 | |
| 25.0 | | | | | | | |
| 26.0 | | | | | | | |
| 27.0 | | | | | | | |
| 28.0 | | | | | | | |
| 29.0 | SS8 | | | (Becomes very dense at 28.5') | 15<br>23<br>47 | ◇70 | |
| 30.0 | | | | Bottom of boring at 30.0 feet | | | |
| 31.0 | | | | | | | |
| 32.0 | | | | | | | |
| 33.0 | | | | | | | |
| 34.0 | | | | | | | |
| 35.0 | | | | | | | |
| 36.0 | | | | | | | |
| 37.0 | | | | | | | |
| 38.0 | | | | | | | |
| 39.0 | | | | | | | |
| 40.0 | | | | | | | |
| 41.0 | | | | | | | |
| 42.0 | | | | | | | |
| 43.0 | | | | | | | |
| 44.0 | | | | | | | |
| 45.0 | | | | | | | |
| 46.0 | | | | | | | |
| 47.0 | | | | | | | |
| 48.0 | | | | | | | |

CLIENT
**Five Rivers MetroParks**

PROJECT
**Soil Study for Proposed Pedestrian Bridge, Riverside Drive, Dayton, Ohio.**

JOB NO. **211911**

BORING STARTED **10/30/23** | BORING COMPLETED **10/30/23**

DRILLER **Cindrill** | METHOD **2 1/4" HSA**

TYPED BY **dmo**

**2** Boring No.

**Sheet 1 of 2**

PROJECT LOCATION
LAT. **39°48'41.3"N** LONG. **84°12'26.7"W**

SURFACE ELEVATION **98.6***

BORING LOCATION
As shown on Boring Location Plan.

It has been necessary to interpolate between samples. Therefore, the contacts between the various soil strata should not be taken as absolute.

COMMENTS
***Surface elevation refers to an assumed elevation of 100.0' for the benchmark shown on the Boring Location Plan.**

| DEPTH (ft. BGL) | SAMPLE NO. | VISUAL CLASSIFICATION OF THE MATERIAL | BLOW COUNTS | N VALUE, blows/ft. | REMARKS |
|---|---|---|---|---|---|
| 0.0 | | (FILL) TOPSOIL (8") | | | |
| 1.0 | SS1 | (FILL) Loose silty SAND - moist | 6 5 5 | 10 | |
| 3.0 | | (Some coarse sand with gravel at 3.4') | | | |
| 4.0 | SS2 | | 6 5 7 | 12 | |
| 6.0 | | (Becomes very loose at 6.0') | 3 | | |
| 7.0 | SS3 | (Becomes wet at 7.0') | 1 1 | 2 | ▼ |
| 9.0 | SS4 | (FILL) Loose, gray, clayey silty SAND (some organics) - moist-to-wet | 1 5 | 10 | |
| 10.0 | | (FILL) Loose, light brown-to-tan silty SAND with gravel - wet | 5 | | |
| 14.0 | SS5 | (FILL) Very loose, brown and gray silty SAND with clay (some peat) - moist-to-wet | WHO 1 | | |
| | | (ORIGINAL) Brown, fine silty SAND - wet | 3 | 4 | |
| 19.0 | SS6 | (Becomes medium dense at 18.5') | 2 5 13 | 18 | |
| 21.0 | | (Large gravel/cobbles encountered between 20.5' and 23.0') | | | |

*Continued Next Page*

WATER LEVEL MEASUREMENTS

| | DEPTH | DATE |
|---|---|---|
| INITIAL | 7.0 | ▽ 10/30/2023 |
| AT COMPLETION | 6.7 | ▼ 10/30/2023 |
| OTHER | N/A | ▼ N/A |

SS — SPLIT SPOON
SL — SPLIT SPOON W/SOIL LINER
NQ— ROCK CORE
ST — SHELBY TUBE
AS — AUGER CUTTINGS
SC — SONIC

BOWSER MORNER

GINT Report Used: NEWLOGIN Report No.: 211911.GPJ GINT Template Used: OH DOT.GDT Date Printed: 11/2/23

CLIENT
**Five Rivers MetroParks**

PROJECT
**Soil Study for Proposed Pedestrian Bridge, Riverside Drive, Dayton, Ohio.**

JOB NO. **211911**

BORING STARTED **10/30/23** | BORING COMPLETED **10/30/23**

DRILLER **Cindrill** | METHOD **2 1/4" HSA**

TYPED BY **dmo**

**2** Boring No.

**Sheet 2 of 2**

PROJECT LOCATION
LAT. **39°48'41.3"N** LONG. **84°12'26.7"W**

SURFACE ELEVATION **98.6***

BORING LOCATION
As shown on Boring Location Plan.

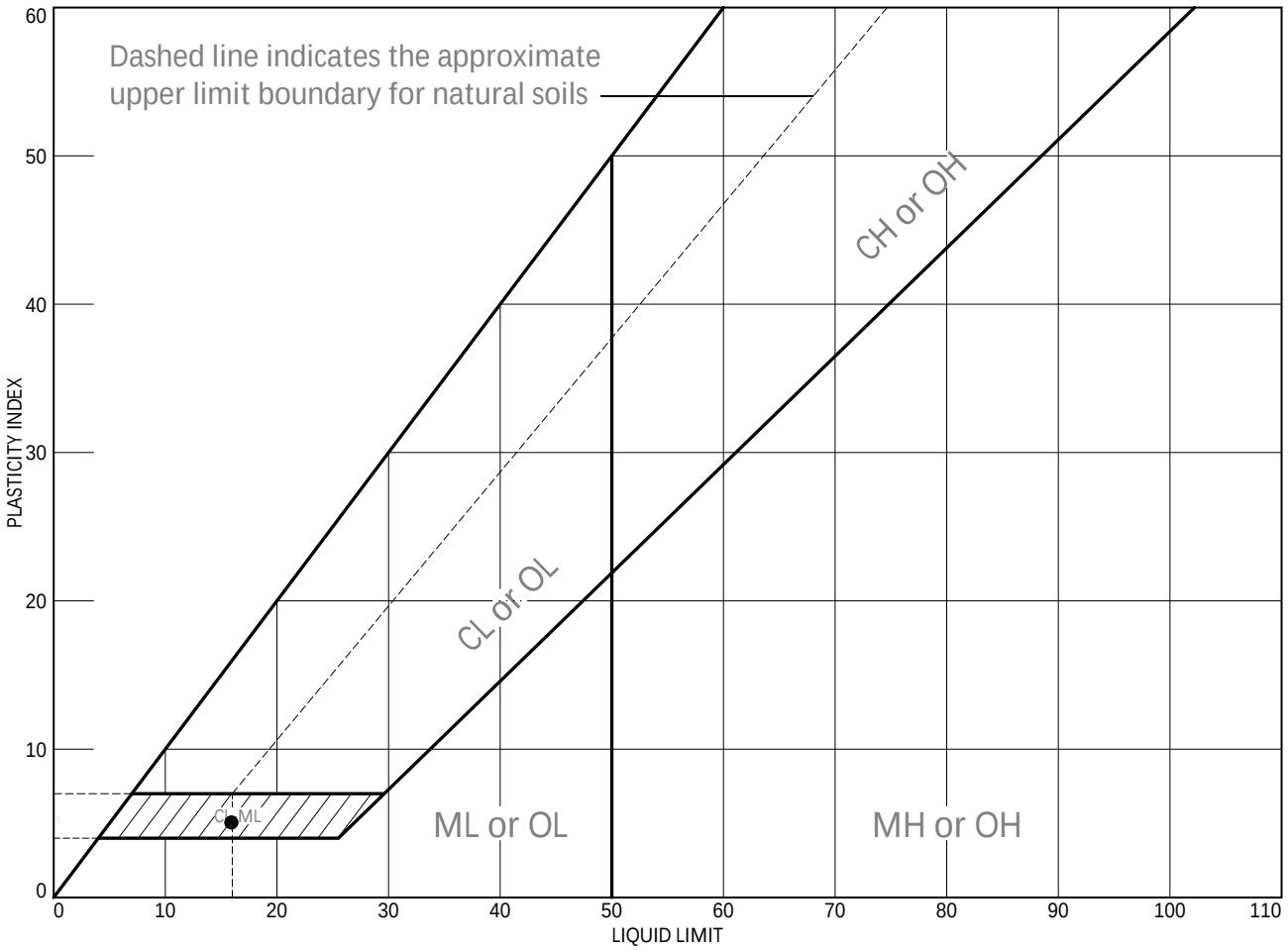
It has been necessary to interpolate between samples. Therefore, the contacts between the various soil strata should not be taken as absolute.

VISUAL CLASSIFICATION OF THE MATERIAL

COMMENTS
***Surface elevation refers to an assumed elevation of 100.0' for the benchmark shown on the Boring Location Plan.**

| DEPTH (ft. BGL) | SAMPLE NO. | SAMPLER TYPE / RECOVERY | GRAPHIC LOG | VISUAL CLASSIFICATION OF THE MATERIAL | BLOW COUNTS | N VALUE, blows/ft. (10 20 30 40 50 60 70 80 90) | REMARKS |
|---|---|---|---|---|---|---|---|
| 23.0 | | | | (ORIGINAL) Brown, fine silty SAND - wet | 5 | | |
| 24.0 | SS7 | | | | 9 | | |
| 25.0 | | | | Very stiff, gray, silty lean CLAY (trace gravel) - moist | 14 | ◇ 23 | |
| 26.0 | | | | | | | |
| 27.0 | | | | | | | |
| 28.0 | | | | | | | |
| 29.0 | SS8 | | | | 9<br>12 | | |
| 30.0 | | | | Bottom of boring at 30.0 feet | 14 | ◇ 26 | |
| 31.0 | | | | | | | |
| 32.0 | | | | | | | |
| 33.0 | | | | | | | |
| 34.0 | | | | | | | |
| 35.0 | | | | | | | |
| 36.0 | | | | | | | |
| 37.0 | | | | | | | |
| 38.0 | | | | | | | |
| 39.0 | | | | | | | |
| 40.0 | | | | | | | |
| 41.0 | | | | | | | |
| 42.0 | | | | | | | |
| 43.0 | | | | | | | |
| 44.0 | | | | | | | |
| 45.0 | | | | | | | |
| 46.0 | | | | | | | |
| 47.0 | | | | | | | |
| 48.0 | | | | | | | |

# LIQUID AND PLASTIC LIMITS TEST REPORT




| | MATERIAL DESCRIPTION | LL | PL | PI | %<#40 | %<#200 | USCS |
|---|---|---|---|---|---|---|---|
| ● | B-2, SS 8 | 16 | 11 | 5 | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

Project No. 211911 Client: Five Rivers Metro Park

Project: Proposed Pedestrian Bridge

●Location: B-2 Depth: 28.5' - 30.0' Sample Number: SS 8

BOWSER-MORNER, INC.

Dayton, Ohio

Remarks:

●As Received Moisture Content: 7.6%

Tested By: BLC/MR Checked By: BLC

# Moisture Content of Soil

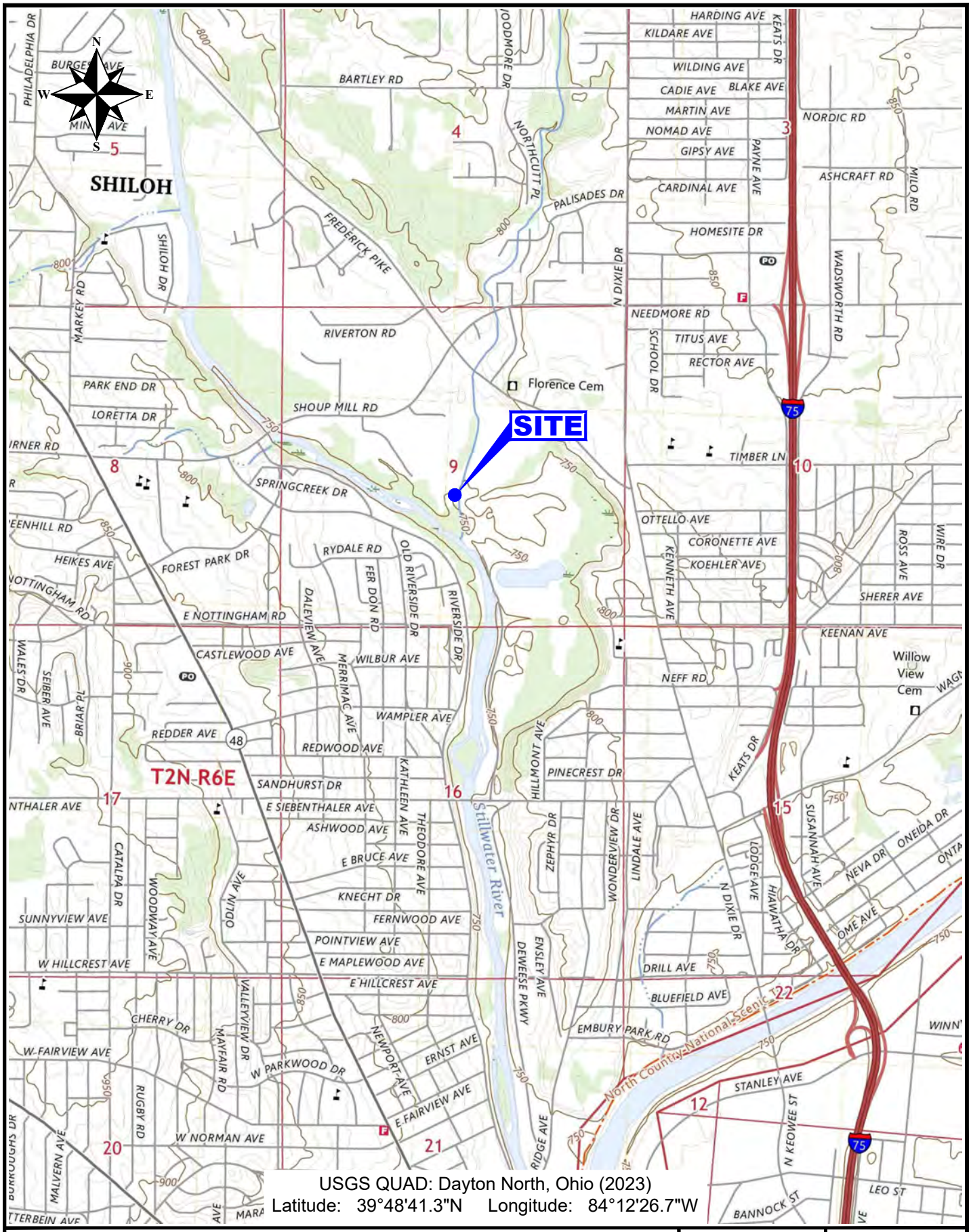
**ASTM (D-2216)**

BOWSER MORNER

Client: Five Rivers MetroParks
Project: Proposed Pedestrian Bridge

Work Order No.: 211911
Date: 11/27/23

| Boring Number | Sample Number | Depth, (ft) | Depth, (m) | Moisture Content, (%) |
|---|---|---|---|---|
| B-1 | SS 1 | 1.0 - 2.5 | 0.3 - 0.8 | 6.6 |
| | SS 2 | 3.5 - 5.0 | 1.1 - 1.5 | Not Tested |
| | SS 3 | 6.0 - 7.5 | 1.8 - 2.3 | 16.4 |
| | SS 4 | 8.5 - 10.0 | 2.6 - 3.0 | Not Tested |
| | SS 5 | 13.5 - 15.0 | 4.1 - 4.6 | 24.6 |
| | SS 6 | 18.5 - 20.0 | 5.6 - 6.1 | Not Tested |
| | SS 7 | 23.5 - 25.0 | 7.2 - 7.6 | 8.8 |
| | SS 8 | 28.5 - 30.0 | 8.7 - 9.1 | 6.6 |
| B-2 | SS 1 | 1.0 - 2.5 | 0.3 - 0.8 | Not Tested |
| | SS 2 | 3.5 - 5.0 | 1.1 - 1.5 | 6.9 |
| | SS 3 | 6.0 - 7.5 | 1.8 - 2.3 | Not Tested |
| | SS 4 | 8.5 - 10.0 | 2.6 - 3.0 | 39.9 |
| | SS 5 | 13.5 - 15.0 | 4.1 - 4.6 | Not Tested |
| | SS 6 | 18.5 - 20.0 | 5.6 - 6.1 | 21.8 |
| | SS 7 | 23.5 - 25.0 | 7.2 - 7.6 | Not Tested |
| | SS 8 | 28.5 - 30.0 | 8.7 - 9.1 | 7.6 |




USGS QUAD: Dayton North, Ohio (2023)
Latitude: 39°48'41.3"N Longitude: 84°12'26.7"W

# VICINITY MAP

Soil Study for Proposed Pedestrian Bridge
Riverside Drive
Dayton, Montgomery County, Ohio
Client: Five Rivers MetroParks

11-2023 EM

| | |
|---|---|
| PROJECT NO. | 211911 |
| SCALE | 1" = 2000' |
| FIGURE NO. | 1 |

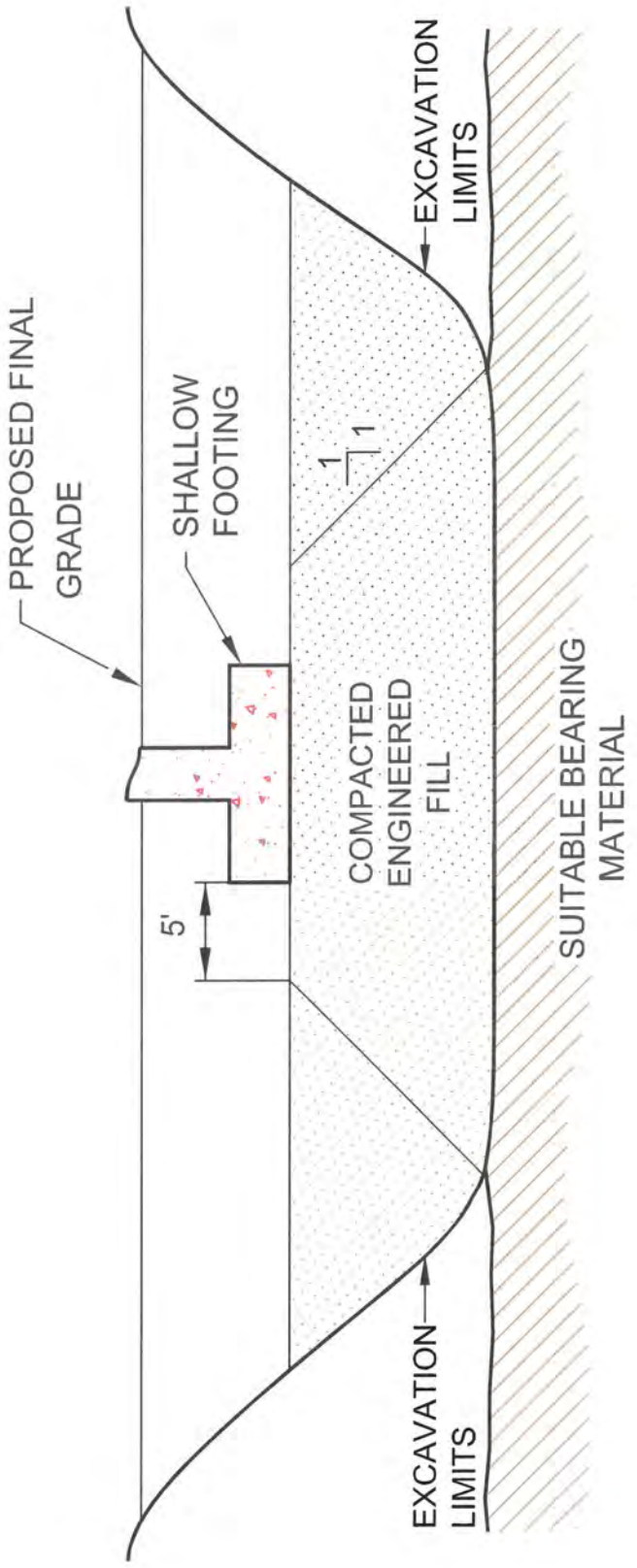
BOWSER MORNER


BOWSER MORNER

| PROJECT NO. | SCALE | FIGURE NO. |
|---|---|---|
| 211911 | 1" = 200' | 2 |

11-2023 EM

BORING LOCATION PLAN
Soil Study for Proposed Pedestrian Bridge
Riverside Drive
Dayton, Montgomery County, Ohio
Client: Five Rivers MetroParks




# DESIGN ILLUSTRATION SHALLOW FOOTINGS IN AN UNDERCUT AREA

SCALE
NONE

FIGURE NO.
3

BOWSER MORNER

## ENGINEERING & ENVIRONMENTAL SERVICES:

Geotechnical Engineering
Subsurface Exploration
Civil Engineering
Environmental Services
Due Diligence
Permitting

## LABORATORY SERVICES:

Geotechnical Laboratories
Construction Materials Laboratories
Mineral Aggregates
Concrete
Stone & Masonry
Asphalt
Analytical Services Laboratories
Industrial Minerals
Product Testing
Mechanical/Metallurgical Testing
Calibration Services
Chemistry Laboratory
Consulting Geology
Radon Reference Laboratory

## CONSTRUCTION SUPPORT SERVICES:

General Construction
Construction Quality Assurance
Building Code Special Inspections
Transportation Projects:
- Contractor QA/QC
- Material Supplier QA/QC
- Owner Quality Assurance

Materials Consulting:
- Construction Engineering

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**Springfield, IL**
**www.bowser-morner.com**