## Addendum 2

Project: **RFP NUMBER 2425-01 – TROY SCHOOL DISTRICT 2025 SITE IMPROVEMENTS PAVING PROJECTS**

Bid Due date: 11:00 AM Local Time, Monday, December 9, 2024 (UNCHANGED)

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This Addendum is issued as modifications to the RFP previously issued to provide clarifications to the scope of work. This Addendum supersedes the original RFP. This along with the RFP becomes the bid documents.

## I. General Information

1. For questions e-mail purchasingoffice@troy.k12.mi.us or through Buildingconnected.com.
2. Any bidder requesting to visit the site should contact Mark Paulus at lecoleplanners3@gmail.com or (248) 880-6791 to schedule a time. No bidder shall visit the building without scheduling it with Mark Paulus.
3. Morse Elementary School geotechnical pavement investigation dated September 28, 2023. (Enclosed)
4. Leonard Elementary School geotechnical pavement investigation dated September 23, 2024. (Enclosed)
5. Transportation Center geotechnical pavement investigation dated December 28, 2021. (Enclosed)
6. Athens High School geotechnical pavement investigation dated November 7, 2024. (Enclosed)

END

Report on Geotechnical
Pavement Investigation

# Morse Elementary School
# 475 Cherry Avenue
# Troy, Michigan 48083

Latitude 42.555771° N
Longitude 83.136898° W

Prepared for:

Lecole Planners, LLC
145 North Center Street B
Northville, Michigan 48167

G2 Project No. 230716
September 28, 2023

September 28, 2023

Ms. Michelle Kerns
Lecole Planners, LLC
145 North Center Street B
Northville, Michigan 48167

Re: Report of Geotechnical Pavement Investigation
Morse Elementary School
475 Cherry Avenue
Troy, Michigan 48083
G2 Project No. 230716

Dear Ms. Kerns,

In accordance with your request, we have completed the geotechnical pavement investigation for the proposed rehabilitation/reconstruction of the pavements at Morse Elementary School in the City of Troy, Michigan. This report presents the results of our observations and analyses and our recommendations for pavement design and construction considerations as they relate to the geotechnical conditions along the alignment of the proposed pavement rehabilitation/reconstruction.

As always, we appreciate the opportunity to be of service to Lecole Planners, LLC and Troy School District and look forward to discussing the recommendations presented. In the meantime, if you have any questions regarding this report or any other matter pertaining to the project, please let us know.

Sincerely,

**G2 Consulting Group, LLC**

Amy L. Schneider, P.E
Project Manager

Noel J. Hargrave-Thomas, P.E.
Principal

ALS/NJHT/ljv

Enclosures

**EXECUTIVE SUMMARY**

We understand the project consists of rehabilitation/reconstruction of the access drives, parking lots, and play surface west and north of the school. We anticipate traffic for the lots and access drives will generally consists of cars, delivery trucks, and garbage trucks and the play surface will be predominantly pedestrian traffic and light snow plowing equipment. We anticipate a standard-duty pavement section will be required. However, considering the dumpster at the north side of the lot, we have also provided a heavy-duty section if required by the civil engineer.

Approximately 3 to 5 inches of bituminous concrete are present at the soil boring locations. The bituminous concrete is underlain by 3-3/4 to 21 inches of gravelly sand natural aggregate base at borings B-1 through B-5 and B-7. Loose to medium compact silty sand fill is present below the aggregate base at boring B-3 and bituminous concrete at borings B-6 and B-8 and extends to approximate depths ranging from 1-1/2 to 2-1/2 feet. Buried silty sand topsoil with between 5 and 10 percent organic matter underlies the aggregate base and fill at borings B-1, B-3, and B-4 and extends to approximate depths ranging from 2 to 3-1/2 feet. The deep aggregate deposits are at the areas of the topsoil deposits and may be associated with previous undercuts or subgrade stabilization. Native loose to medium compact granular soils, consisting of sand, silty sand, sandy gravel, underlie the fill, pavement section, and buried topsoil and extend to the explored depth of 4 feet. No measurable groundwater was observed during or upon completion of drilling operations at the soil boring locations.

The existing pavements are in fair condition with areas of moderate severity distress. The existing pavements are generally not suitable to be rehabilitated by mill and overlay due to the thin existing pavement section at borings B-1 through B-5 and B-7, thin aggregate at borings B-2, B-5, and B-7, and lack of aggregate base at borings B-6 and B-8. Therefore, we recommend completely removing the existing bituminous concrete and a sufficient amount of aggregate base, fill, or native soils to accommodate the design pavement section and constructing a new pavement section.

Following removal of the bituminous concrete and required aggregate base/fill/native soil, we anticipate the exposed subgrade soils (remaining aggregate base or loose to medium compact granular native and fill soils) will generally be suitable for support of the proposed pavement section. The exposed subgrade soils should be thoroughly proof compacted with a large vibratory roller making a minimum of 10 passes in 2 perpendicular directions across the subgrade to densify the granular soils for support of the new pavement section. Unsuitable soils or soils exhibiting excessive instability should be removed by undercutting to expose stable soils. Any remaining unstable or unsuitable areas noted should be improved by additional compaction or removed and replaced with engineered fill.

We recommend a budget be allocated for undercutting on the order of 20 to 25 percent, with the percentage increasing as the subgrade is exposed to precipitation. The contractor should be prepared to utilize tri-axial geogrid, as necessary, to minimize extensive undercuts. To further minimize the potential for subgrade instability and undercuts, we recommend the exposed subgrade not be left exposed to precipitation, and construction operations be performed during the summer months to ensure dry, warm, weather.

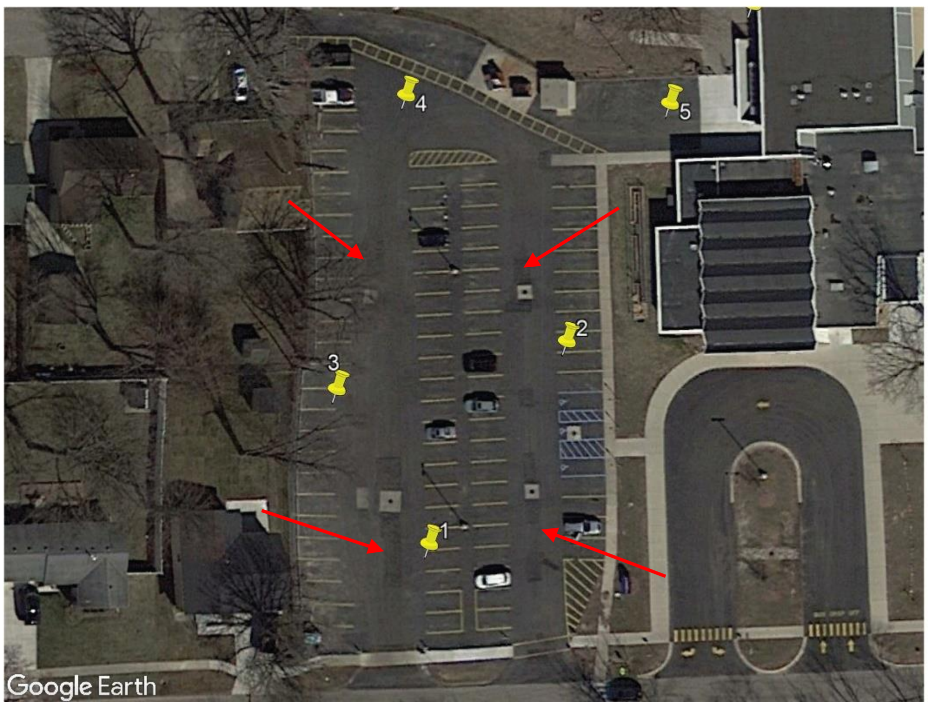
Based on the results of our analyses, we recommend a standard-duty flexible pavement consisting of 2 inches of 5EML bituminous concrete wearing course over 2 inches of 4EML, supported on 8 inches of existing MDOT 22A natural aggregate base of imported MDOT 21AA dense graded aggregate base. We recommend a heavy-duty flexible pavement section consisting of 2 inches of 5EML bituminous concrete wearing course over 3 inches of MDOT 3EML bituminous concrete leveling course, supported on 10 inches of existing MDOT 22A natural aggregate base of imported MDOT 21AA dense graded aggregate base. We recommend all bituminous concrete materials have a binder from RAP less than 17 percent of the total binder and using a binder of PG 64-22.

This summary is not to be considered separate from the entire text of this report, with all the conclusions and qualifications mentioned herein. Details of our analysis and recommendations are discussed in the following sections and in the Appendix of this report.

## PROJECT DESCRIPTION

We understand the project consists of rehabilitation/reconstruction of the access drives, parking lots, and play surface west and north of the school. We anticipate traffic for the lots and access drives will generally consists of cars, delivery trucks, and garbage trucks and the play surface will be predominantly pedestrian traffic and light snow plowing equipment. We anticipate a standard-duty pavement section will be required. However, considering the dumpster at the north side of the lot, we have also provided a heavy-duty section if required by the civil engineer.

The age of the existing pavements was not available upon completion of this report. However, after reviewing Google Earth Historical Aerial Photographs, it appears the pavements were constructed sometime prior to 1999. Concrete collars were constructed around the catch basins between 2007 and 2010 and between 2011 and 2015. Concrete patches were constructed throughout the parking lot between 2020 and 2021, indicated with red arrows below.




The purpose of our investigation is to determine and evaluate the general pavement and subsurface conditions within existing pavements and develop general recommendations for the proposed pavement rehabilitation/reconstruction and pavement design.

## SCOPE OF SERVICES

The field operations, laboratory testing, and engineering report preparation were performed under direction and supervision of a licensed professional engineer. Our services were performed according to generally accepted standards and procedures in the practice of geotechnical engineering in this area. Our scope of services for this project is as follows:

1. We drilled a total of eight pavement core/hand auger soil borings within the parking lots and access drives extending to a depth of 4 feet each below existing grade. We measured the existing pavement section materials (bituminous concrete) and identified the type and condition of subgrade soils.

2. We performed laboratory testing on samples obtained from the soil borings. Laboratory testing included visual engineering classification, moisture content, organic matter content (loss-on-ignition), and grain size distribution.

3. We prepared this engineering report which includes our evaluation of the subsurface conditions at the site and our recommendations for pavement rehabilitation/reconstruction.

**FIELD OPERATIONS**

G2 Consulting Group, LLC (G2), selected the number depth and location of the soil borings. The soil borings were located in the field by a G2 representative by use of GPS assisted mobile technology in conjunction with conventional taping methods. The approximate soil boring locations are presented on the Soil Boring Location Plan, Plate No. 1. No ground surface elevations were available at the time of this investigation.

We used a gas powered core rig equipped with a 4-inch diameter diamond-tipped core barrel to core the pavement locations. Pavement cores were drilled through the full depth of the existing pavement structure to obtain an accurate determination of the pavement thickness.

Hand auger borings were performed using a 3-inch diameter hand auger. Within each hand-auger boring, soil samples were obtained at depths of 2 and 4 feet and at transitions in soil types. The soil samples were placed in sealed containers in the field and brought to the laboratory for testing and classification. A Dynamic Cone Penetrometer (DCP) test was performed within each hand auger boring at depths of 2 feet and 4 feet to evaluate the consistency of the in-situ soil. DCP testing involves driving a 1-1/2 inch diameter cone with a 45˚ vertex angle into the ground using a 15-pound weight dropped 20 inches after the cone is seated into the bottom of the hand auger borehole. The Dynamic Cone Penetrometer is driven successive 1-3/4 increments. The blow counts for each 1-3/4 inch increment are presented on the individual hand-auger soil boring logs.

During drilling operations, a G2 engineer maintained logs of the encountered subsurface conditions, including changes in stratigraphy and observed groundwater levels to be used in conjunction with our analysis of the subsurface conditions. The final hand-auger boring logs are based on the field logs and laboratory soil classification and testing. After completion of boring operations, the boreholes were backfilled with excavated soil and capped with cold patch.

**LABORATORY TESTING**

Representative soil samples were subjected to laboratory testing to determine soil parameters pertinent to pavement design and site preparation. An experienced geotechnical engineer classified the samples in general conformance with the Unified Soil Classification System.

Laboratory testing included natural moisture content, grain-size distribution, and organic matter content. The grain-size distributions were determined in general accordance with ASTM D422, “Standard Test Method for Particle-Size Analysis of Soils”. The organic matter content of representative samples was determined in accordance with ASTM Test Method D 2974, “Standard Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils.”

The results of the moisture content, organic matter content, and unconfined compressive strength laboratory tests are indicated on the soil boring logs at the depths the samples were obtained. Grain size distribution results are also presented graphically on Figure No. 9 in the Appendix. We will hold the soil samples for 60 days from the date of this report. If you would like the samples, please let us know.

## EXISTING PAVEMENT CONDITIONS

Approximately 3 to 5 inches of bituminous concrete are present at the soil boring locations. The bituminous concrete is underlain by 3-3/4 to 21 inches of gravelly sand natural aggregate base at borings B-1 through B-5 and B-7. A grain size test was performed on a representative sample of the natural aggregate base from boring B-2. Test results indicated the material is out of specification for gradation requirements of MDOT 22A dense-graded aggregate base based on the percent passing the No. 200 sieve as presented on Figure No. 9. The existing aggregate base can be reused for the new pavement section or within undercut areas.

The parking lot and play surface are in fair condition with low to moderate severity block, joint, and fatigue cracking (Photograph Nos. 3,4, 9, and 10). Areas of high severity fatigue cracking are present throughout the lot (Photograph Nos. 1, 2, 5, 7, and 8). Crack sealing is visible at the play surface (Photograph Nos. 12 through 15). It appears patching was performed within both the lot and the play surface (Photograph Nos. 2, 6, and 12). The pavement is flush against the building at the north side of the school (Photograph No. 12) and the concrete sidewalk (Photograph Nos. 7, 9, and 10).

No curb or gutter are present around the perimeter of the lot or play surface. Catch basins are present through the center of the lot. Portland cement concrete collars have been constructed around a few of the catch basins (Photograph Nos. 1, 3, and 6).

## EXISTING SUBSURFACE CONDITIONS

Silty sand fill is present below the aggregate base at boring B-3 and bituminous concrete at borings B-6 and B-8 and extends to approximate depths ranging from 1-1/2 to 2-1/2 feet. Buried silty sand topsoil underlies the aggregate base and fill at borings B-1, B-3, and B-4 and extends to approximate depths ranging from 2 to 3-1/2 feet. Native loose sand, silty sand, and sandy gravel underlie the fill, pavement section, and buried topsoil and extend to the explored depth of 4 feet.

The buried topsoil is loose to medium compact with Dynamic Cone Penetrometer (DCP) Test N-values ranging from 7 to 12 blows per 1-3/4 inch drive and organic matter contents ranging from 5.2 to 10.0 percent. The silty sand fill at borings B-3, B-6, and B-8 is loose to medium compact with DCP Test N-values ranging from 10 and 11 blows per 1-3/4 inch drive. The underlying native granular soils are medium compact with DCP Test N-values ranging from 11 to 27 blows per 1-3/4 inch.

The stratification depths shown on the soil boring logs represent the soil conditions at the boring locations. Variations may occur between borings. Additionally, the stratigraphic lines represent the approximate boundaries between soil types. The transition may be more gradual than what is shown. We have prepared the boring logs on the basis of laboratory classification and testing as well as field logs of the soils encountered.

The Soil Boring Location Plan, Plate No. 1, Soil Boring Logs Figure Nos. 1 through 8, and Grain Size Distribution, Figure No. 9, are presented in the Appendix. The soil profiles described above are generalized descriptions of the soil conditions at the boring locations. General Notes Terminology defining the nomenclature used on the boring logs and elsewhere in this report is presented on Figure No. 10.

## GROUNDWATER CONDITIONS

No measurable groundwater was observed during or upon completion of drilling operations. Fluctuations in perched and long-term groundwater levels should be anticipated due to seasonal variations and following periods of prolonged precipitation.

## PAVEMENT EVALUATION AND RECOMMENDATIONS

### General

The existing pavements are in fair condition with areas of moderate severity distress. The existing pavements are generally not suitable to be rehabilitated by mill and overlay due to the thin existing pavement section at borings B-1 through B-5 and B-7, thin aggregate at borings B-2, B-5, and B-7, and lack of aggregate base at borings B-6 and B-8. Therefore, we recommend completely removing the existing bituminous concrete and underlying aggregate base, fill, and native soils to accommodate the design pavement section and constructing a new pavement section.

### Pavement Subgrade Preparation

Once the existing bituminous concrete and underlying aggregate base, fill, and native soils have been removed to accommodate the design pavement section, we anticipate the exposed subgrade soils (remaining aggregate base and loose to medium compact granular native and fill soils) will generally be suitable for support of the proposed pavement section. The exposed subgrade soils should be thoroughly proof compacted with a large vibratory roller making a minimum of 10 passes in 2 perpendicular directions across the subgrade to densify the granular soils for support of the new pavement section. Unsuitable soils or soils exhibiting excessive instability should be removed by undercutting to expose stable soils. Any remaining unstable or unsuitable areas noted should be improved by additional compaction or removed and replaced with engineered fill.

Subgrade undercuts, if required, should be evaluated by a qualified engineering technician to determine if subgrade stabilization is necessary. We recommend undercut excavations, where required, be backfilled with MDOT 21AA dense graded aggregate placed in an engineered manner. We recommend a budget be allocated for undercutting on the order of 20 to 25 percent, with the percentage increasing as the subgrade is exposed to precipitation. The contractor should be prepared to utilize tri-axial geogrid, as necessary, to minimize extensive undercuts.

To minimize subgrade instability and undercuts, we recommend the exposed subgrade not be left exposed to precipitation and construction operations be performed during the summer months to ensure dry, warm, weather. Additionally, the subgrade may become unstable under repeated loading of construction traffic; therefore, construction equipment should be limited on the exposed subgrade.

All engineered fill should be compacted to a density of at least 95 percent of the maximum density determined by the Modified Proctor (ASTM D1557) method of testing. Lift thicknesses should not exceed 9 inches. All engineered fill material should be placed and compacted at approximately the optimum moisture content. Frozen material should not be used as fill, nor should fill be placed on a frozen subgrade.

### Pavement Design

We performed pavement design analyses in accordance with the “AASHTO Guide for Design of Pavement Structures”. The subgrade soils will generally consist of aggregate base and granular native and fill soils which are considered good for support of pavements. Based on the existing granular subgrade soils, we have provided design pavement sections based on an effective subgrade resilient modulus of 8,000 pounds per square inch (psi).

We anticipate traffic for the lots and access drives will generally consists of cars, delivery trucks, and garbage trucks and the play surface will be predominantly pedestrian traffic and light snow plowing equipment. If any actual traffic volume information becomes available, G2 should be notified so we can reevaluate our recommendations. We have designed the standard-duty pavement section on an estimated 50,000 equivalent single-axle loads (ESALs) over a 20-year design life and the heavy-duty pavement section on an estimated 150,000 ESALs. For evaluation purposes, we have utilized a serviceability loss of 2.0, a standard deviation of 0.49 for flexible pavements, and a reliability factor of 0.90. If additional traffic volume information becomes available, G2 should be notified so we can re-evaluate our recommendations. Based on the results of our analysis, we recommend the following pavement design cross sections:

| Standard-Duty Flexible Pavement Section | | |
|---|---|---|
| **Material** | **Thickness** | **Structural Coefficient** |
| Bituminous Wearing Course (MDOT 5EML) | 2 inches | 0.42 |
| Bituminous Leveling Course (MDOT 4EML) | 2 inches | 0.42 |
| Existing 22A Natural Aggregate or MDOT 21AA Dense Graded Aggregate | 8 inches | 0.14 |

| Heavy-Duty Flexible Pavement Section | | |
|---|---|---|
| **Material** | **Thickness** | **Structural Coefficient** |
| Bituminous Wearing Course (MDOT 5EML) | 2 inches | 0.42 |
| Bituminous Leveling Course (MDOT 3EML) | 3 inches | 0.42 |
| Existing 22A Natural Aggregate or MDOT 21AA Dense Graded Aggregate | 10 inches | 0.14 |

Large front-loading refuse trucks can impose significant concentrated wheel loads at trash dumpster pick-up areas. This type of loading can result in rutting of asphalt pavements and ultimately in failure. Therefore, we recommend 8 inches of Portland cement concrete pavement be used in this area and be large enough to accommodate the entire truck during pick-up operations.

All pavement materials are specified within the 2012 Standard Specifications for Construction from the Michigan Department of Transportation. The aggregate materials for the subbase are described in Section 902. The bituminous pavement materials are described in Section 501 and can be assigned a structural coefficient number of 0.42. The existing 22A natural aggregate base can be assigned a structural coefficient number of 0.12, and any imported MDOT 21AA dense graded aggregate base material can be assigned a structural coefficient number of 0.14. We recommend all bituminous concrete materials have a binder from RAP less than 17 percent of the total binder and using a binder of PG 64-22.

### Pavement Drainage

Proper pavement drainage is essential for long-term pavement performance. The pavement should be properly sloped to promote effective surface drainage and prevent water from ponding. We also recommend pavement subbase materials consist of non-frost-susceptible aggregates where possible.

### Pavement Maintenance

Regular timely maintenance should be performed on the pavement to reduce the potential deterioration associated with moisture infiltration through surface cracks. The owner should be prepared to seal the cracks with a hot-applied elastic crack filler as soon as possible after cracking develops and as often as necessary to block the passage of water to the subgrade soils.

## GENERAL COMMENTS

We have formulated the evaluations and recommendations presented in this report relative to site preparation and pavement construction on the basis of data provided to us relating to the location, type, and grade for the proposed site. Any significant change in this data should be brought to our attention for review and evaluation with respect to the prevailing subsurface conditions.

The scope of the present investigation was limited to evaluation of subsurface conditions for the construction of the proposed pavement reconstruction and other related aspects of the proposed project. No chemical, environmental, or hydrogeological testing or analysis were included in the scope of this investigation. If changes occur in the design, location, or concept of the project, the conclusions and recommendations contained in this report are not valid unless G2 Consulting Group, LLC reviews the changes. G2 Consulting Group, LLC will then confirm the recommendations presented herein or make changes in writing.

We have based the analyses and recommendations submitted in this report upon the data from soil borings performed at the approximate locations shown on the Soil Boring Location Plan, Plate No. 1. This report does not reflect variations that may occur between the actual boring locations. The nature and extent of any such variations may not become clear until the time of construction. If significant variations then become evident, it may be necessary for us to re-evaluate our report recommendations.

Soil conditions at the site could vary from those generalized on the basis of soil borings made at specific locations. It is, therefore, recommended that G2 Consulting Group, LLC be retained to provide soil engineering services during the water main and roadway construction phases of the proposed project. This is to observe compliance with the design concepts, specifications, and recommendations. Also, this allows design changes to be made in the event that subsurface conditions differ from those anticipated prior to the start of construction.

**APPENDIX**

Project Name: Morse Elementary School

Project Location: 475 Cherry Avenue
Troy, Michigan 48083

G2 Project No. 230716

Latitude: N/A Longitude: N/A

# Soil Boring No. **B-1**

G2 CONSULTING GROUP

| SUBSURFACE PROFILE | | SOIL SAMPLE DATA | | | | |
|---|---|---|---|---|---|---|
| GROUND SURFACE ELEVATION: N/A | DEPTH (ft) | SAMPLE TYPE/NO. | DCP BLOWS/ 1.75-INCHES | MOISTURE CONTENT (%) | DRY DENSITY (PCF) | UNCOF. COMP. ST. (PSF) |
| Bituminous Concrete (3-1/2 inches) | 0.3 | AS-1 | | | | |
| Natural Aggregate Base: Brown Sand and Gravel with trace silt (16 1/2 inches) | 1.7 | AS-2 | 12 | | | |
| Buried Topsoil: Medium Compact Dark Brown Silty Sand (Organic Matter Content = 5.2%) | 2.5 | | | | | |
| Medium Compact Brown Sandy Gravel with trace silt | 4.0 | AS-3 | 27 | | | |
| End of Boring @ 4 ft, Auger Refusal | 5 | | | | | |

Total Depth: 4 ft
Drilling Date: August 26, 2023
Inspector:
Contractor: G2 Consulting Group LLC
Driller: A. Nolan

Drilling Method:
4-inch diameter diamond tipped core barrel;
3-inch diameter hand auger

Water Level Observation:
Dry during and upon completion

Notes:
Auger Refusal Encountered at 2-1/2 feet

Excavation Backfilling Procedure:
Auger cuttings and capped with cold patch

Figure No. 1

Project Name: Morse Elementary School

Project Location: 475 Cherry Avenue
Troy, Michigan 48083

G2 Project No. 230716

Latitude: N/A Longitude: N/A

# Soil Boring No. **B-2**

G2 CONSULTING GROUP

## SUBSURFACE PROFILE / SOIL SAMPLE DATA

GROUND SURFACE ELEVATION: N/A

| DEPTH (ft) | Description | Bottom Depth (ft) | SAMPLE TYPE/NO. | DCP BLOWS/ 1.75-INCHES | MOISTURE CONTENT (%) | DRY DENSITY (PCF) | UNCOF. COMP. ST. (PSF) |
|---|---|---|---|---|---|---|---|
| | Bituminous Concrete (3 inches) | 0.3 | | | | | |
| | Natural Aggregate Base Brown Sand and Gravel with trace silt (4 inches) | 0.6 | AS-1 | | | | |
| | Brown Sand with trace silt and gravel | 1.5 | | | | | |
| | Medium Compact Brown Sandy Gravel with trace silt | 3.0 | AS-2 | 23 | | | |
| | Medium Compact Brown Sand with trace silt and gravel | 4.0 | AS-3 | 12 | | | |
| 5 | End of Boring @ 4 ft, Auger Refusal | | | | | | |

Total Depth: 4 ft
Drilling Date: August 26, 2023
Inspector:
Contractor: G2 Consulting Group LLC
Driller: A. Nolan

Drilling Method:
4-inch diameter diamond tipped core barrel;
3-inch diameter hand auger

Water Level Observation:
Dry during and upon completion

Notes:
Auger Refusal Encountered at 2 feet

Excavation Backfilling Procedure:
Auger cuttings and capped with cold patch

Figure No. 2

Project Name: Morse Elementary School

Project Location: 475 Cherry Avenue
Troy, Michigan 48083

G2 Project No. 230716

Latitude: N/A Longitude: N/A

# Soil Boring No. **B-3**

G2 CONSULTING GROUP

| DEPTH (ft) | PRO-FILE | SUBSURFACE PROFILE — GROUND SURFACE ELEVATION: N/A | DEPTH (ft) | SAMPLE TYPE/NO. | DCP BLOWS/ 1.75-INCHES | MOISTURE CONTENT (%) | DRY DENSITY (PCF) | UNCOF. COMP. ST. (PSF) |
|---|---|---|---|---|---|---|---|---|
| | | Bituminous Concrete (3 inches) — 0.3 | | AS-1 | | | | |
| | | Natural Aggregate Base Brown Sand and Gravel with trace silt (21 inches) — 2.0 | | AS-2 | 11 | | | |
| | | Fill: Medium Compact Brown Silty Sand with trace gravel, occasional clay clods — 2.7 | | | | | | |
| | | Buried Topsoil: Loose Dark Brown Silty Sand (Organic Matter Content = 5.8%) — 3.5 | | | | | | |
| | | Medium Compact Gray Silty Sand with trace gravel — 4.0 | | AS-3 | 15 | | | |
| 5 | | End of Boring @ 4 ft | 5 | | | | | |

Total Depth: 4 ft
Drilling Date: August 26, 2023
Inspector:
Contractor: G2 Consulting Group LLC
Driller: A. Nolan

Water Level Observation:
Dry during and upon completion

Excavation Backfilling Procedure:
Auger cuttings and capped with cold patch

Drilling Method:
4-inch diameter diamond tipped core barrel;
3-inch diameter hand auger

Figure No. 3

Project Name: Morse Elementary School

Project Location: 475 Cherry Avenue
Troy, Michigan 48083

G2 Project No. 230716

Latitude: N/A Longitude: N/A

# Soil Boring No. **B-4**

G2 CONSULTING GROUP

## SUBSURFACE PROFILE / SOIL SAMPLE DATA

GROUND SURFACE ELEVATION: N/A

| DEPTH (ft) | STRATUM DESCRIPTION | DEPTH TO BOTTOM (ft) | SAMPLE TYPE/NO. | DCP BLOWS/ 1.75-INCHES | MOISTURE CONTENT (%) | DRY DENSITY (PCF) | UNCOF. COMP. ST. (PSF) |
|---|---|---|---|---|---|---|---|
| | Bituminous Concrete (3-1/2 inches) | 0.3 | AS-1 | | | | |
| | Natural Aggregate Base<br>Brown Sand and Gravel with trace silt<br>(16-1/2 inches) | 1.7 | | | | | |
| | Buried Topsoil:<br>Loose Dark Brown Silty Sand<br>(Organic Matter Content = 10.0%) | 2.0 | AS-2 | 7 | | | |
| | Medium Compact Brown and Gray Silty Sand with trace gravel | 4.0 | AS-3 | 16 | | | |
| 5 | End of Boring @ 4 ft | | | | | | |

Total Depth: 4 ft
Drilling Date: August 26, 2023
Inspector:
Contractor: G2 Consulting Group LLC
Driller: A. Nolan

Water Level Observation:
Dry during and upon completion

Excavation Backfilling Procedure:
Auger cuttings and capped with cold patch

Drilling Method:
4-inch diameter diamond tipped core barrel;
3-inch diameter hand auger

Figure No. 4

Project Name: Morse Elementary School

Project Location: 475 Cherry Avenue
Troy, Michigan 48083

G2 Project No. 230716

Latitude: N/A Longitude: N/A

# Soil Boring No. **B-5**

G2 CONSULTING GROUP

| SUBSURFACE PROFILE | | | | SOIL SAMPLE DATA | | | | |
|---|---|---|---|---|---|---|---|---|
| DEPTH ( ft) | PRO-FILE | GROUND SURFACE ELEVATION: N/A | DEPTH ( ft) | SAMPLE TYPE/NO. | DCP BLOWS/ 1.75-INCHES | MOISTURE CONTENT (%) | DRY DENSITY (PCF) | UNCOF. COMP. ST. (PSF) |
| | | Bituminous Concrete (3-1/4 inches) 0.3 | | | | | | |
| | | Natural Aggregate Base Brown Sand and Gravel with trace silt (3-3/4 inches) 0.6 | | AS-1 | | | | |
| | | Medium Compact Brown and Gray Sand with trace silt and gravel | | AS-2 | 14 | | | |
| | | 4.0 | | AS-3 | 11 | | | |
| 5 | | End of Boring @ 4 ft | 5 | | | | | |

Total Depth: 4 ft
Drilling Date: August 26, 2023
Inspector:
Contractor: G2 Consulting Group LLC
Driller: A. Nolan

Water Level Observation:
Dry during and upon completion

Excavation Backfilling Procedure:
Auger cuttings and capped with cold patch

Drilling Method:
4-inch diameter diamond tipped core barrel;
3-inch diameter hand auger

Figure No. 5

PAVEMENT CORE DCP 230716.GPJ 20140820 G2 CONSULTING DATA TEMPLATE.GDT 9/28/23

Project Name: Morse Elementary School

Project Location: 475 Cherry Avenue
Troy, Michigan 48083

G2 Project No. 230716

Latitude: N/A Longitude: N/A

# Soil Boring No. **B-6**

CONSULTING GROUP

| DEPTH (ft) | PRO-FILE | SUBSURFACE PROFILE — GROUND SURFACE ELEVATION: N/A | DEPTH (ft) | SAMPLE TYPE/NO. | DCP BLOWS/ 1.75-INCHES | MOISTURE CONTENT (%) | DRY DENSITY (PCF) | UNCOF. COMP. ST. (PSF) |
|---|---|---|---|---|---|---|---|---|
| | | Bituminous Concrete (5 inches) | 0.4 | | | | | |
| | | Fill: Loose Brown Silty Sand with trace gravel, occasional clay clods | 2.0 | AS-1 | 10 | 15.9 | | |
| | | Medium Compact Brown and Gray Sand with trace silt and gravel | 4.0 | AS-2 | 16 | | | |
| 5 | | End of Boring @ 4 ft | 5 | | | | | |

Total Depth: 4 ft
Drilling Date: August 26, 2023
Inspector:
Contractor: G2 Consulting Group LLC
Driller: A. Nolan

Drilling Method:
4-inch diameter diamond tipped core barrel;
3-inch diameter hand auger

Water Level Observation:
Dry during and upon completion

Excavation Backfilling Procedure:
Auger cuttings and capped with cold patch

Figure No. 6

Project Name: Morse Elementary School

Project Location: 475 Cherry Avenue
Troy, Michigan 48083

G2 Project No. 230716

Latitude: N/A Longitude: N/A

# Soil Boring No. **B-7**

G2 CONSULTING GROUP

## SUBSURFACE PROFILE

| DEPTH (ft) | PRO-FILE | GROUND SURFACE ELEVATION: N/A | DEPTH (ft) |
|---|---|---|---|
| | | Bituminous Concrete (3-1/4 inches) | 0.3 |
| | | Natural Aggregate Base Brown Sand and Gravel with trace silt (5-3/4 inches) | 0.8 |
| | | Medium Compact Brown Silty Sand with trace gravel | 1.5 |
| | | Medium Compact Brown and Gray Silty Sand with trace gravel | 4.0 |
| 5 | | End of Boring @ 4 ft | 5 |

## SOIL SAMPLE DATA

| SAMPLE TYPE/NO. | DCP BLOWS/ 1.75-INCHES | MOISTURE CONTENT (%) | DRY DENSITY (PCF) | UNCOF. COMP. ST. (PSF) |
|---|---|---|---|---|
| AS-1 | | | | |
| AS-2 | 16 | | | |
| AS-3 | 15 | | | |

Total Depth: 4 ft
Drilling Date: August 26, 2023
Inspector:
Contractor: G2 Consulting Group LLC
Driller: A. Nolan

Water Level Observation:
Dry during and upon completion

Excavation Backfilling Procedure:
Auger cuttings and capped with cold patch

Drilling Method:
4-inch diameter diamond tipped core barrel;
3-inch diameter hand auger

Project Name: Morse Elementary School

Project Location: 475 Cherry Avenue
Troy, Michigan 48083

G2 Project No. 230716

Latitude: N/A Longitude: N/A

# Soil Boring No. **B-8**

G2 CONSULTING GROUP

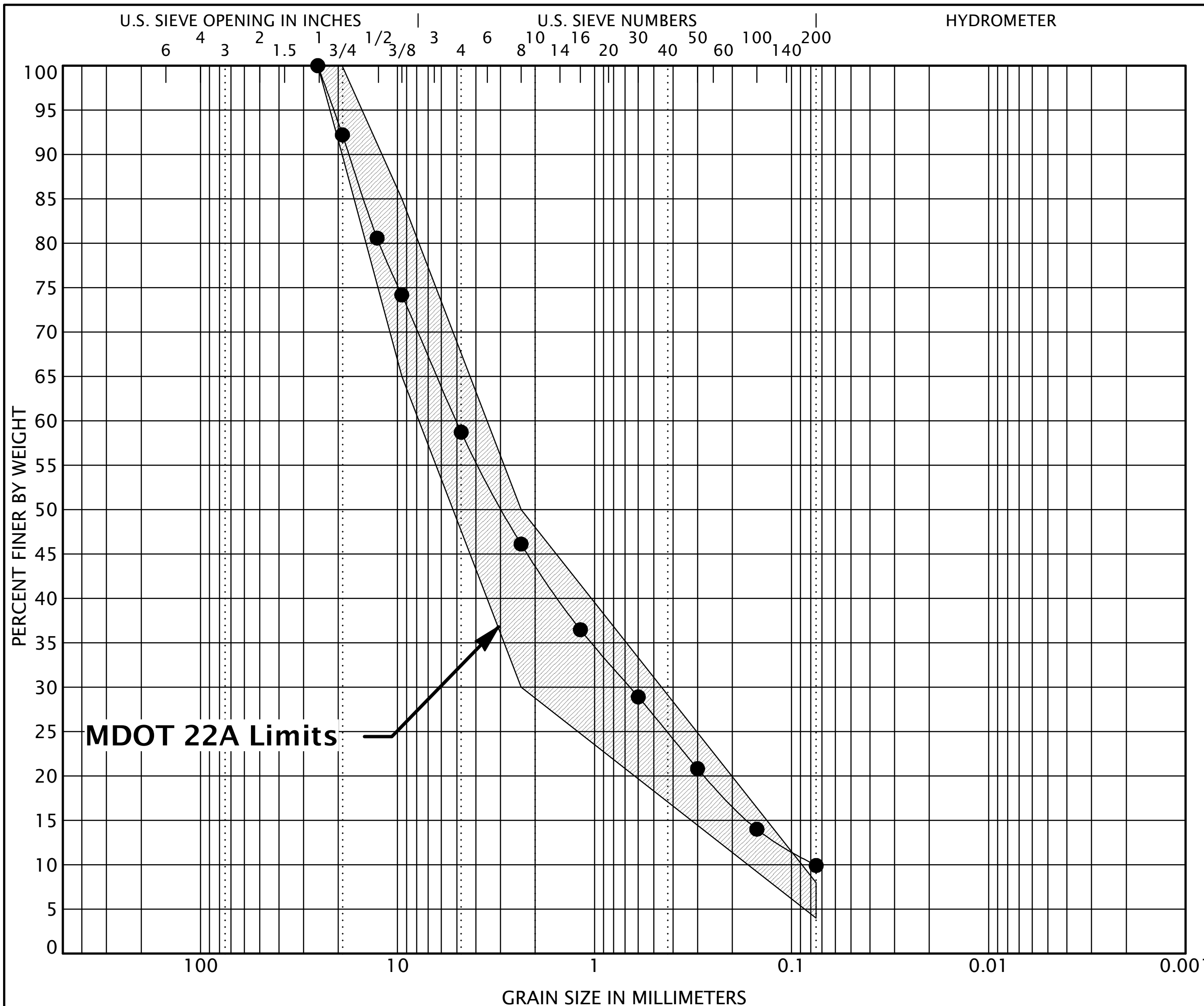
| DEPTH (ft) | PROFILE | SUBSURFACE PROFILE — GROUND SURFACE ELEVATION: N/A | DEPTH (ft) | SAMPLE TYPE/NO. | DCP BLOWS/ 1.75-INCHES | MOISTURE CONTENT (%) | DRY DENSITY (PCF) | UNCOF. COMP. ST. (PSF) |
|---|---|---|---|---|---|---|---|---|
| 0.4 | | Bituminous Concrete (4-1/4 inches) | | | | | | |
| 1.5 | | Fill: Medium Compact Brown and Dark Brown Silty Sand with trace gravel | | | | | | |
| | | | | AS-1 | 13 | | | |
| 4.0 | | Medium Compact Brown and Gray Silty Sand with trace gravel | | AS-2 | 18 | | | |
| 5 | | End of Boring @ 4 ft | 5 | | | | | |

Total Depth: 4 ft
Drilling Date: August 26, 2023
Inspector:
Contractor: G2 Consulting Group LLC
Driller: A. Nolan

Water Level Observation:
Dry during and upon completion

Excavation Backfilling Procedure:
Auger cuttings and capped with cold patch

Drilling Method:
4-inch diameter diamond tipped core barrel;
3-inch diameter hand auger




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen ID | Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|
| ● B-2 AS-1 | Brown Sand and Gravel with trace silt | | | | 1.14 | 66.09 |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

| Specimen ID | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| ● B-2 AS-1 | 25.4 | 5.033 | 0.662 | 0.076 | 41.3 | 48.8 | 9.9 | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

G2 CONSULTING GROUP

# GRAIN SIZE DISTRIBUTION

Project Name: Morse Elementary School

Project Location: 475 Cherry Avenue
Troy, Michigan 48083

G2 Project No.: 230716

Figure No. 9

# GENERAL NOTES TERMINOLOGY

Unless otherwise noted, all terms herein refer to the Standard Definitions presented in ASTM 653.

**PARTICLE SIZE**

| | | |
|---|---|---|
| Boulders | | - greater than 12 inches |
| Cobbles | | - 3 inches to 12 inches |
| Gravel | - Coarse | - 3/4 inches to 3 inches |
| | - Fine | - No. 4 to 3/4 inches |
| Sand | - Coarse | - No. 10 to No. 4 |
| | - Medium | - No. 40 to No. 10 |
| | - Fine | - No. 200 to No. 40 |
| Silt | | - 0.005mm to 0.074mm |
| Clay | | - Less than 0.005mm |

**CLASSIFICATION**

The major soil constituent is the principal noun, i.e. clay, silt, sand, gravel. The second major soil constituent and other minor constituents are reported as follows:

| Second Major Constituent (percent by weight) | Minor Constituent (percent by weight) |
|---|---|
| Trace - 1 to 12% | Trace - 1 to 12% |
| Adjective - 12 to 35% | Little - 12 to 23% |
| And - over 35% | Some - 23 to 33% |

**COHESIVE SOILS**

If clay content is sufficient so that clay dominates soil properties, clay becomes the principal noun with the other major soil constituent as modifier, i.e. sandy clay. Other minor soil constituents may be included in accordance with the classification breakdown for cohesionless soils, i.e. silty clay, trace sand, little gravel.

| Consistency | Unconfined Compressive Strength (psf) | Approximate Range of (N) |
|---|---|---|
| Very Soft | Below 500 | 0 - 2 |
| Soft | 500 - 1,000 | 3 - 4 |
| Medium | 1,000 - 2,000 | 5 - 8 |
| Stiff | 2,000 - 4,000 | 9 - 15 |
| Very Stiff | 4,000 - 8,000 | 16 - 30 |
| Hard | 8,000 - 16,000 | 31 - 50 |
| Very Hard | Over 16,000 | Over 50 |

Consistency of cohesive soils is based upon an evaluation of the observed resistance to deformation under load and not upon the Standard Penetration Resistance (N).

**COHESIONLESS SOILS**

| Density Classification | Relative Density % | Approximate Range of (N) |
|---|---|---|
| Very Loose | 0 - 15 | 0 - 4 |
| Loose | 16 - 35 | 5 - 10 |
| Medium Compact | 36 - 65 | 11 - 30 |
| Compact | 66 - 85 | 31 - 50 |
| Very Compact | 86 - 100 | Over 50 |

Relative Density of cohesionless soils is based upon the evaluation of the Standard Penetration Resistance (N), modified as required for depth effects, sampling effects, etc.

**SAMPLE DESIGNATIONS**

AS - Auger Sample – Cuttings directly from auger flight
BS - Bottle or Bag Samples
S - Split Spoon Sample - ASTM D 1586
LS - Liner Sample with liner insert 3 inches in length
ST - Shelby Tube sample - 3 inch diameter unless otherwise noted
PS - Piston Sample - 3 inch diameter unless otherwise noted
RC - Rock Core - NX core unless otherwise noted

STANDARD PENETRATION TEST (ASTM D 1586) - A 2.0 inch outside-diameter, 1-3/8 inch inside-diameter split barrel sampler is driven into undisturbed soil by means of a 140-pound weight falling freely through a vertical distance of 30 inches. The sampler is normally driven three successive 6-inch increments. The total number of blows required for the final 12 inches of penetration is the Standard Penetration Resistance (N).

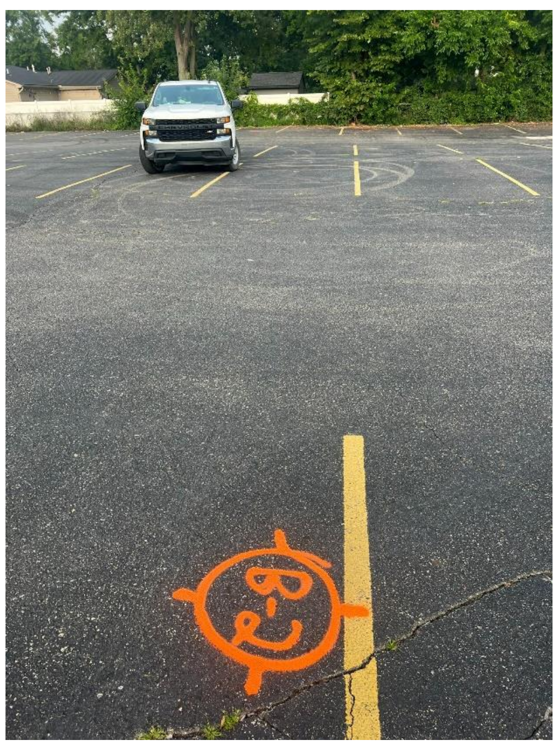
**Photographic Documentation**
**Morse Elementary School**
**Troy, Michigan**
**G2 Project No. 230716**


Photograph No. 1: Looking north, low to moderate severity block, joint, and fatigue cracking. Concrete collar around basin.


Photograph No. 2: Low to moderate severity fatigue cracking. Note previous patch.

**Photographic Documentation**
**Morse Elementary School**
**Troy, Michigan**
**G2 Project No. 230716**

Photograph No. 3:  Looking south, low to moderate severity block and fatigue cracking.



Photograph No. 4:  Low to moderate severity block and fatigue cracking.

**Photographic Documentation**
**Morse Elementary School**
**Troy, Michigan**
**G2 Project No. 230716**

Photograph No. 5: Moderate to high severity fatigue cracking through center of drive lane, looking east.

Photograph No. 6: Looking south toward entrance, erosion from west edge of pavement indicating sheet draining to lot.

**Photographic Documentation**
**Morse Elementary School**
**Troy, Michigan**
**G2 Project No. 230716**

Photograph No. 7: Moderate severity fatigue cracking looking east.

Photograph No. 8: Moderate to high severity fatigue cracking looking south.

**Photographic Documentation**
**Morse Elementary School**
**Troy, Michigan**
**G2 Project No. 230716**

Photograph No. 9: Low to moderate severity fatigue cracking looking west.


Photograph No. 10: Low severity fatigue cracking looking north playground. New concrete to the east adjacent to the school.

**Photographic Documentation**
**Morse Elementary School**
**Troy, Michigan**
**G2 Project No. 230716**


Photograph No. 11: Moderate to high severity fatigue cracking and settlement evident.

Photograph No. 12: Looking south. Pavement is flush to building.
Previous patch and crack sealing visible.


Photograph No. 13: Moderate severity cracking with previous crack sealing.

Photograph No. 14: Pavement flush to grass looking east.

**Photographic Documentation**
**Morse Elementary School**
**Troy, Michigan**
**G2 Project No. 230716**

Photograph No. 15:  Pavement flush to building. Moderate to high severity cracking.

CONSULTING
GROUP

**Report on Geotechnical**
**Pavement Investigation**

# Leonard Elementary School
# Pavement Improvements
# 4401 Tallman Drive
# Troy, Michigan 48085

Latitude 42.583730˚ N
Longitude 83.139107˚ W

Prepared for:

Lecole Planners, LLC
145 North Center Street B
Northville, Michigan 48167

G2 Project No. 240681
September 23, 2024

September 23, 2024

Ms. Michelle Kerns `
Lecole Planners, LLC
145 North Center Street B
Northville, Michigan 48167

Re: Report on Geotechnical Pavement Investigation
Leonard Elementary School Pavement Improvements
4401 Tallman Drive
Troy, Michigan 48085
G2 Project No. 240681

Dear Ms. Kerns:

We have completed the geotechnical pavement investigation for the proposed pavement improvements at Leonard Elementary School in Troy, Michigan. This report presents the results of our observations and analyses and our recommendations for earthwork operations, pavement design, and construction considerations as they relate to the geotechnical conditions on site.

As always, we appreciate the opportunity to be of service to Lecole Planners, LLC and Troy School District and look forward to discussing the recommendations presented. In the meantime, if you have any questions regarding our report or any other matter pertaining to the project, please contact us.

Sincerely,

**G2 Consulting Group, LLC**

Amy L. Schneider, P.E.
Project Manager

Noel J. Hargrave-Thomas, P.E.
Project Consultant

ALS/NJHT/ljv

Enclosures

STATE OF MICHIGAN
AMY L. SCHNEIDER
ENGINEER
NO.
6201053128
LICENSED PROFESSIONAL ENGINEER

9/23/24

## EXECUTIVE SUMMARY

The proposed project consists of rehabilitation or reconstructing the existing pavements at Leonard Elementary School in Troy, Michigan. The purpose of our investigation is to determine and evaluate the general subsurface and existing pavement conditions and develop recommendations for pavement rehabilitation or reconstructing.

Six hand auger soil borings were performed throughout the property. Approximately 3 to 4 inches of bituminous concrete underlain by 6 to 12 inches of limestone are present at boring locations. Crushed concrete underlies the limestone (except at boring B-4) and extends to an approximate depth of 22 inches at borings B-3 and B-6 and auger refusal at approximate depths ranging from 15 to 24 inches at borings B-1, B-2, and B-5. We anticipate the crushed concrete may be associated with previous undercuts at the time of pavement construction. Very stiff to hard silty clay fill with organic matter underlies the crushed concrete or limestone at borings B-3, B-4, and B-6 and extends to the explored depth of 4 feet. Groundwater was encountered at an approximate depth of 2 feet during and upon completion of drilling operations at boring B-2. No measurable groundwater was encountered during or upon completion of drilling operations at the remaining boring locations.

Considering the areas of moderate severity distress, we recommend the existing bituminous concrete be removed and a new standard-duty and heavy-duty bituminous concrete pavement section be constructed on the existing aggregate base. Following removal of the pavement, the existing aggregate base should be graded to allow placement of the proposed bituminous concrete section. The exposed aggregate base should be thoroughly proof compacted with a vibratory roller making a minimum of 10 passes across the subgrade in 2 perpendicular directions and visually evaluated by qualified personnel for support of pavements. Any unstable or unsuitable areas noted during proof compaction operations should be improved through additional compaction or undercut and replaced with engineered fill.

Based on the large areas of fatigue cracking throughout the drop off loop and parking lot, a budget for undercuts should be anticipated, on the order of 20 to 25 percent of the pavement surface. Undercut budgets should assume the need to remove the crushed concrete below the limestone aggregate base (which extends to depths of up to approximately 22 inches at the boring locations) to expose the underlying subgrade for stability evaluation. Subgrade undercuts, where required, should be evaluated by a qualified engineering technician to determine if subgrade stabilization is necessary. We recommend undercut excavations be backfilled with MDOT 21AA limestone dense graded aggregate placed in an engineered manner. The contractor should also be prepared to utilize tri-axial geogrid to minimize extensive undercuts. In addition, we recommend additional drainage structures be installed, particularly in the parking lot. Such drains should extend to minimum depths of 4 inches below the bottom of the aggregate base course or granular fill placed within undercut areas and connect to the nearest drainage structure.

We performed pavement design analyses in accordance with the “AASHTO Guide for Design of Pavement Structures”. Based on the existing fill subgrade soils, we used an effective subgrade resilient modulus of 5,000 pounds per square inch (psi), an estimated 50,000 18-kip equivalent single-axle loads (ESALs) for standard-duty pavements and 150,000 ESALs for heavy-duty pavements, a serviceability loss of 2.0, a standard deviation of 0.49 for flexible pavements, and a reliability factor of 0.90 for design of the proposed pavement sections.

We recommend a standard-duty bituminous concrete pavement section of 2 inches of MDOT 5EML wearing course over 2 inches of MDOT 4EML leveling course, supported on the existing aggregate base and a heavy-duty bituminous concrete pavement section of 2 inches of MDOT 5EML wearing course over 3 inches of MDOT 4EML leveling course (placed in 2 lifts), supported on the existing aggregate base. In areas of undercuts, we recommend a minimum of 8 inches and 10 inches of MDOT 21AA limestone dense graded aggregate for the standard-duty and heavy-duty sections, respectively.

This summary is not to be considered separate from the entire text of this report with all the conclusions and qualifications mentioned herein. Details of our analysis and recommendations are discussed in the following sections and in the Appendix of this report.

## PROJECT DESCRIPTION

The proposed project consists of rehabilitation or reconstructing the existing pavements at Leonard Elementary School in Troy, Michigan. This investigation includes the drop off loop and the parking lot as indicated on the Soil Boring Location Plan, Plate No. 1 in the Appendix. The remaining pavements on the property were previously rehabilitated. We anticipate the drop off loop will require a heavy-duty bituminous concrete section due to buses and increased passenger vehicle traffic, and the parking lot will require a standard-duty bituminous concrete section.

The existing and proposed grades were not available at the time of this investigation; however, we anticipate final grades will be similar to existing grades with minor variations for drainage. The purpose of our investigation is to determine and evaluate the general subsurface and existing pavement conditions and develop recommendations for pavement rehabilitation or reconstructing.

## SCOPE OF SERVICES

The field operations, laboratory testing, and engineering report preparation were performed under the direction and supervision of a licensed professional engineer. Our services were performed according to generally accepted standards and procedures in the practice of geotechnical engineering. Our scope of services for this project is as follows:

1. We performed a cursory visual identification of the types and relative magnitudes of observable pavement distress throughout the subject areas.

2. We performed six pavement cores and hand auger soil borings, B-1 through B-6, throughout the property extending to a depth of 4 feet or until refusal with the hand auger equipment was encountered.

3. We performed laboratory testing on representative samples obtained from the hand auger soil borings. Laboratory testing included visual engineering classification, moisture content, organic matter content (L.O.I.), grain-size distribution, and unconfined compressive strength determination.

4. We prepared this engineering report. The report includes recommendations regarding pavement reconstruction recommendations and construction considerations related to site preparation and pavement design.

## FIELD OPERATIONS

Lecole Planners, in conjunction with G2, selected the number, depth, and location of the hand auger soil borings. The soil boring locations were located in the field using GPS assisted mobile technology by a G2 staff engineer. The approximate boring locations are shown on the Soil Boring Location Plan, Plate No. 1 in the Appendix. Ground surface elevations were not available at the time of this report, and no surveying was conducted to determine elevations at the boring locations.

We used a gas-powered core rig equipped with a 4-inch diameter diamond-tipped core barrel to core the pavement at the hand auger boring locations. Pavement cores were drilled through the full depth of the existing pavement structure to obtain an accurate determination of the pavement thickness. Core samples were measured and photographed in the field.

The hand auger soil borings were performed using a 3-inch diameter bucket hand auger. Within each hand auger boring, soil samples were obtained at 2-foot intervals, as able, and at transitions in soil types. The soil samples were placed in sealed containers in the field and brought to the laboratory for testing and classification.

A Dynamic Cone Penetrometer (DCP) test was performed within each hand auger boring at a depth of 2 feet and 4 feet to evaluate the consistency of the in-situ soil. DCP testing involves driving a 1-1/2 inch diameter cone with a 45° vertex angle into the ground using a 15-pound weight dropped 20 inches after the cone is seated into the bottom of the hand auger borehole. The Dynamic Cone Penetrometer is driven successive 1-3/4 increments. The blow counts for each 1-3/4 inch increment are presented on the individual hand-auger soil boring logs.

Soil samples were placed in sealed containers in the field and brought to our laboratory for testing and classification. During boring operations, a G2 field engineer maintained logs of the encountered subsurface conditions, including changes in stratigraphy and observed groundwater levels. The final hand auger boring logs are based on the field logs supplemented by laboratory soil classification and test results. After completion of drilling operations, the boreholes were backfilled with auger cuttings and capped with asphalt cold patch.

**LABORATORY TESTING**

Representative soil samples were subjected to laboratory testing to determine soil parameters pertinent to pavement design and site preparation. An experienced geotechnical engineer classified the samples in general conformance with the Unified Soil Classification System.

Laboratory testing included natural moisture content, organic matter content (loss-on-ignition), grain size distribution, and unconfined compressive strength determination. The organic matter content of representative samples was determined in accordance with ASTM Test Method D 2974, "Standard Test Methods for Moisture, Ash and Organic Matter of Peat and Other Organic Soils". The grain-size distributions were determined in general accordance with ASTM C-136, "Standard Test Methods for Sieve Analysis of Fine and Coarse Aggregate". The unconfined compressive strengths were determined by using a spring-loaded hand penetrometer. The hand penetrometer estimates the unconfined compressive strength to a maximum of 4-1/2 tons per square foot (tsf) by measuring the resistance of the soil sample to the penetration of a calibrated spring-loaded cylinder.

The results of the moisture content, organic matter content, and unconfined compressive strength laboratory tests are indicated on the boring logs at the depths the samples were obtained. Grain size distribution results are presented graphically on Figure No. 7 in the Appendix. We will hold the soil samples for 60 days from the date of this report. If you would like us to retain the samples beyond this date or you would like the samples, please let us know.

**SITE CONDITIONS**

Leonard Elementary School is located at 4401 Tallman Drive in Troy, Michigan. The school building is situated on the west side of the property. A drop-off drive and a parking lot are present east of the school and an additionally parking lot is present north of the school. Additionally, two access drives extend from Tallman Drive into the property. The north access drive and parking lot north of the school were previously reconstructed and are not part of this scope.

*2005*

*2006*

Review of historical Google Earth imagery indicates the east lot and drive were reconstructed between 2005 and 2006

## SOIL CONDITIONS

Six hand auger soil borings were performed throughout the property. Approximately 3 to 4 inches of bituminous concrete underlain by 6 to 12 inches of limestone are present at boring locations. Crushed concrete underlies the limestone (except at boring B-4) and extends to an approximate depth of 22 inches at borings B-3 and B-6 and auger refusal at approximate depths ranging from 15 to 24 inches at borings B-1, B-2, and B-5. We anticipate the crushed concrete may be associated with previous undercuts at the time of pavement construction.

A grain size analysis was performed on the limestone sample obtained from boring B-3. The aggregate base material meets gradation requirements of MDOT 21AA. The aggregate base material relative to gradation requirements of MDOT 21AA dense-graded aggregate is presented on the Grain Size Distribution, Figure No. 7, and the table below. The limestone material can be stockpiled where cut to accommodate the new pavement section as well where undercuts are required and reused in the new pavement section.

| Sieve Size | MDOT 21AA<br>Percent Passing Specification | B-3<br>Aggregate Base<br>Percent Passing |
|---|---|---|
| 1-1/2” | 100 | 100 |
| 1” | 85 to 100 | 95 |
| 1/2” | 50 to 75 | 56 |
| No. 8 | 20 to 45 | 25 |
| Loss by Wash | 4 to 8 | 8 |
| **Meets 21AA Gradation** | | YES |

Silty clay fill with organic matter underlies the crushed concrete or limestone at borings B-3, B-4, and B-6 and extends to the explored depth of 4 feet. The fill is very stiff to hard in consistency with moisture contents ranging from 11 to 25 percent, unconfined compressive strengths ranging from 6,000 to 9,000 psf, and organic matter contents ranging from less than 1 percent to 2 percent.

The stratification depths shown on the boring logs represent the soil conditions at the boring locations. Variations may occur between locations. Additionally, the stratigraphic lines represent the approximate boundaries between soil types. The transition may be more gradual than what is shown. We have prepared the boring and test pit logs on the basis of laboratory classification and testing, as well as field logs of the soils encountered.

The Soil Boring Location Plan, Plate No. 1, Soil Boring Logs, Figure Nos. 1 through 6, and Grain Size Distribution, Figure No. 7, are presented in the Appendix. The soil profiles described above are generalized descriptions of the conditions encountered at the boring locations. General Notes Terminology defining the nomenclature used on the boring logs and elsewhere in this report are presented on Figure No. 8.

## GROUNDWATER CONDITIONS

Groundwater was encountered at an approximate depth of 2 feet during and upon completion of drilling operations at boring B-2. No measurable groundwater was encountered during or upon completion of drilling operations at the remaining boring locations.

Fluctuations in perched and long-term groundwater levels should be anticipated due to seasonal variations and following periods of prolonged precipitation. It should also be noted that groundwater observations made during drilling operations in cohesive soils are not necessarily indicative of the static groundwater level. This is due to the low permeability of such soils and the tendency of drilling operations to seal off the natural paths of groundwater flow.

## PAVEMENT RECOMMENDATIONS

### Existing Conditions

Based on visual observations and the condition of the pavement cores, the existing bituminous pavements are in fair condition. The drop off loop generally exhibits low to moderate severity block cracking (Photograph Nos. 3, 7, and 9) with large areas of moderate severity fatigue cracking (Photograph Nos. 1, 2, and 10). The parking lot generally exhibits low to moderate severity block cracking (Photograph No. 14) with longitudinal cracking down the center of the lot (Photograph Nos. 16 and 17). Additionally, areas of moderate severity fatigue cracking are present throughout the lot (Photograph Nos. 15 and 19 through 21). Fatigue cracking can be indicative of poor subgrade support and/or lack of drainage.

Based on visual observations, the site is relatively flat. Curb and gutter are present around the perimeter of the pavements and the west side of the drive abuts the concrete sidewalk. The drop off loop appears to be designed to drain to drainage structures in the interior gutters. The parking lot appears to be designed to drain to one drainage structure in the southwest corner of the lot. Additionally, one catch basin is present toward the northwest side of the lot.

### Surface Reconstruction

Considering the areas of moderate severity distress, we recommend the existing bituminous concrete be removed and a new standard-duty and heavy-duty bituminous concrete pavement section be constructed on the existing aggregate base. Following removal of the pavement, the existing aggregate base should be graded to allow placement of the proposed bituminous concrete section.

The exposed aggregate base should be thoroughly proof compacted with a vibratory roller making a minimum of 10 passes across the subgrade in 2 perpendicular directions and visually evaluated by qualified personnel for support of pavements. Any unstable or unsuitable areas noted during proof compaction operations should be improved through additional compaction or undercut and replaced with engineered fill. Based on the large areas of fatigue cracking throughout the drop off loop and parking lot, a budget for undercuts should be anticipated, on the order of 20 to 25 percent of the pavement surface. Undercut budgets should assume the need to remove the crushed concrete below the limestone aggregate base (which extends to depths of up to approximately 22 inches at the boring locations) to expose the underlying subgrade for stability evaluation.

Subgrade undercuts, where required, should be evaluated by a qualified engineering technician to determine if subgrade stabilization is necessary. We recommend undercut excavations be backfilled with MDOT 21AA limestone dense graded aggregate placed in an engineered manner. The contractor should also be prepared to utilize tri-axial geogrid to minimize extensive undercuts. To minimize the potential for undercuts, we recommend earthwork be performed in dry, warm months.

Based on the fatigue cracking visible throughout the drop off loop and parking lot, we anticipate drainage may be a contributing factor to the instability throughout the site. Therefore, we recommend additional drainage structures be installed, including finger drains to remove groundwater from the aggregate base layer. Such drains should extend to minimum depths of 4 inches below the bottom of the aggregate base course or granular fill placed within undercut areas and connect to the nearest drainage structure.

Engineered fill should be placed in uniform horizontal layers, not more than 9 inches in loose thickness. The engineered fill should be compacted to achieve a density of at least 95 percent of the maximum dry density, as determined by the modified Proctor compaction test (ASTM D 1557). Any granular fill used within the site may be compacted within 2 percent above or below optimum moisture content. Frozen material should not be used as fill, nor should fill be placed on a frozen subgrade.

We performed pavement design analyses in accordance with the "AASHTO Guide for Design of Pavement Structures". The subgrade soils are anticipated to consist of fill soils with up to 5 percent organic matter. Based on the existing subgrade soils, we have provided design pavement sections based on an effective subgrade resilient modulus of 5,000 pounds per square inch (psi) for the cohesive fill soils with organic matter. We have evaluated the standard-duty pavement section on an estimated 50,000 18-kip equivalent single-axle loads (ESALs) and the heavy-duty section on an estimated 150,000 ESALs. For evaluation purposes, we have utilized a serviceability loss of 2.0, a standard deviation of 0.49 for flexible pavements, and a reliability factor of 0.90. If additional traffic volume information becomes available, G2 should be notified so we can re-evaluate our recommendations. Based on the results of our analysis and construction considerations, we recommend the following pavement design cross sections:

| Standard-Duty Flexible Pavement – Surface Reconstruction | | |
|---|---|---|
| **Material** | **Thickness** | **Structural Coefficient** |
| Bituminous Wearing Course (MDOT 5EML) | 2 inches | 0.42 |
| Bituminous Leveling Course (MDOT 4EML) | 2 inches | 0.42 |
| Existing Aggregate Base | | 0.12 |

**Where undercuts are required, a minimum of 8 inches of MDOT 21AA limestone dense graded aggregate should be placed.*

| Heavy-Duty Flexible Pavement – Surface Reconstruction | | |
|---|---|---|
| **Material** | **Thickness** | **Structural Coefficient** |
| Bituminous Wearing Course (MDOT 5EML) | 2 inches | 0.42 |
| Bituminous Leveling Course (MDOT 4EML) - Placed in 2 lifts | 3 inches | 0.42 |
| Existing Aggregate Base | | 0.12 |

**Where undercuts are required, a minimum of 10 inches of MDOT 21AA limestone dense graded aggregate should be placed.*

All pavement materials are specified within the 2020 Standard Specifications for Construction prepared by the Michigan Department of Transportation. The bituminous pavement materials can be found in Division 5 and the dense-graded aggregate base materials are described in Division 9. Per MDOT specifications, the asphalt pavement materials can be assigned a structural coefficient number of 0.42 and any imported MDOT 21AA dense-graded limestone aggregate base can be assigned a structural coefficient number of 0.14. We recommend that bituminous concrete utilize grade PG 68-22 binder, with no more than 17 percent of the overall binder content from reclaimed asphalt pavement (RAP) within the top wearing course layer.

**Pavement Drainage**

Proper pavement drainage is essential for long-term pavement performance. The pavement and subgrade should be properly sloped to promote effective surface and subsurface drainage and prevent water from ponding, especially as pavements age and water infiltrates the surface. We recommend pavement subbase materials consist of non-frost-susceptible aggregates where possible.

As previously discussed, we recommend additional drainage structures be installed, including finger drains to remove groundwater from the aggregate base layer. Such drains should extend to minimum depths of 4 inches below the bottom of the aggregate base course or granular fill placed within undercut areas and connect to the nearest drainage structure.

**Pavement Maintenance**

Regular timely maintenance should be performed on the bituminous pavement to reduce the potential deterioration associated with moisture infiltration through surface cracks. The owner should be prepared to seal the cracks with a hot-applied elastic crack filler as soon as possible after cracking develops and as often as necessary to block the passage of water to the subgrade soils.

## GENERAL COMMENTS

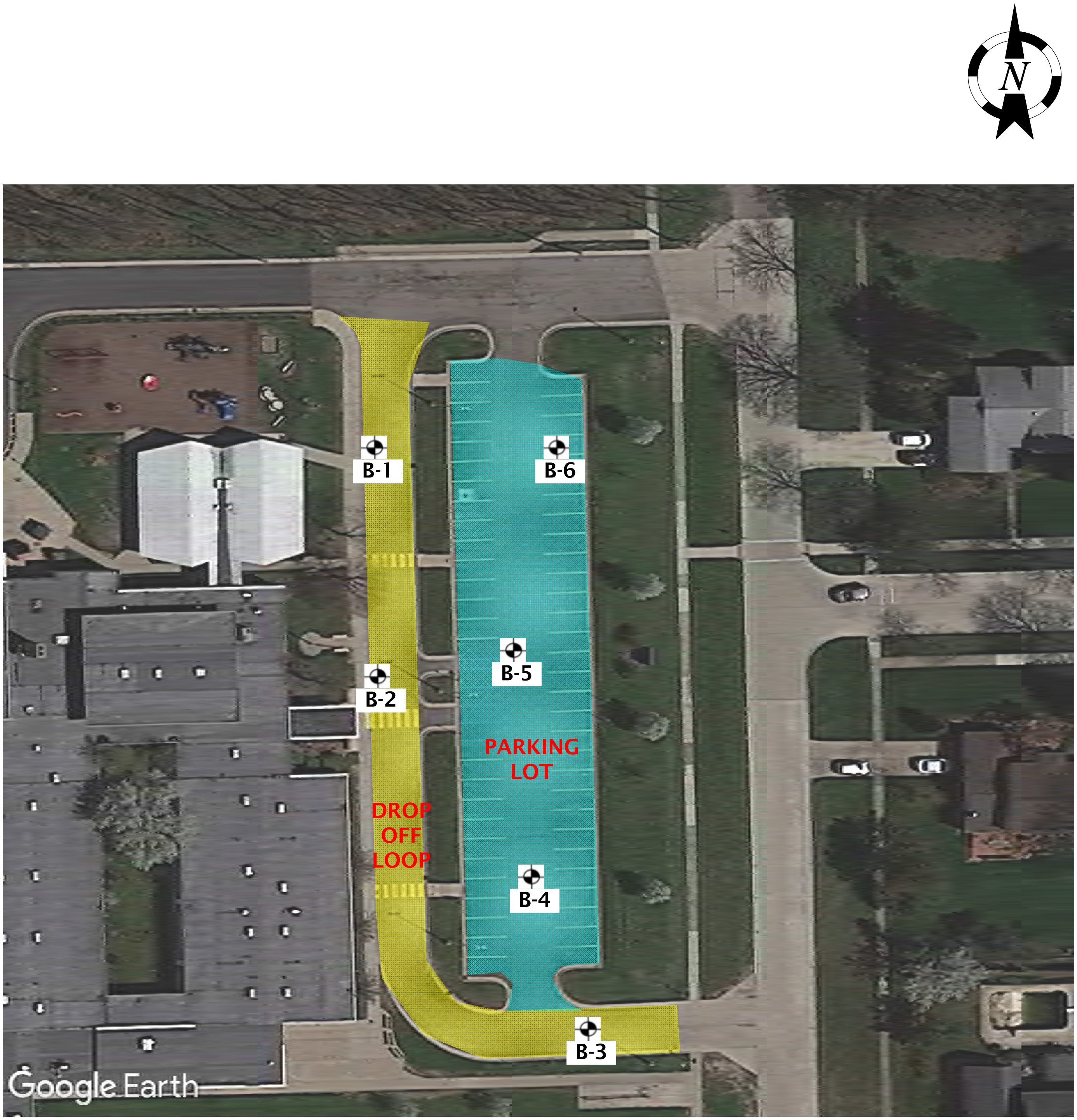
We have formulated the evaluations and recommendations presented in this report relative to site preparation and pavement design based on data provided to us relating to the location, type, and grade for the proposed improvements. Any significant change in this data should be brought to our attention for review and evaluation with respect to the prevailing subsurface conditions. Furthermore, if changes occur in the design, location, or concept of the project, the conclusions and recommendations contained in this report are not valid unless G2 Consulting Group, LLC reviews the changes. G2 Consulting Group, LLC will then confirm the recommendations presented herein or make changes in writing.

The scope of the present investigation was limited to evaluation of subsurface conditions for the support of the pavements and other related aspects of the development. No chemical, environmental, or hydrogeological testing or analyses were included in the scope of this investigation. If changes occur in the design, location, or concept of the project, the conclusions and recommendations contained in this report are not valid unless G2 Consulting Group, LLC reviews the changes. G2 Consulting Group, LLC will then confirm the recommendations presented herein or make changes in writing.

We have based the analyses and recommendations submitted in this report upon the data from soil borings performed at the approximate locations shown on the Soil Boring Location Plan, Plate No. 1. This report does not reflect variations that may occur between the actual boring locations and the actual structure locations. The nature and extent of any such variations may not become clear until the time of construction. If significant variations then become evident, it may be necessary for us to re-evaluate our report recommendations.

Soil conditions at the site could vary from those generalized based on soil borings made at specific locations. It is, therefore, recommended that G2 Consulting Group, LLC be retained to provide soil and pavement engineering services during site preparation, excavation, and construction phases of the proposed project. This is to observe compliance with the design concepts, specifications, and recommendations. Also, this allows design changes to be made in the event that subsurface conditions differ from those anticipated prior to the start of construction.

**APPENDIX**




**Legend**

⌖ Soil Borings Drilled by G2 Consulting Group, LLC on September 11, 2024

## Soil Boring Location Plan

Leonard Elementary School Pavement Improvements
4401 Tallman Drive
Troy, Michigan 48085

| | | |
|---|---|---|
| G2 CONSULTING GROUP | Project No. 240681 | |
| | Drawn by: ALS | |
| | Date: 9/22/24 | Plate No. 1 |
| | Scale: NTS | |

Project Name: Leonard Elementary School Pavement Improvements

Project Location: 4401 Tallman Drive
Troy, Michigan 48085

G2 Project No. 240681

Latitude: N/A Longitude: N/A

# Soil Boring No. **B-1**

G2 CONSULTING GROUP

## SUBSURFACE PROFILE / SOIL SAMPLE DATA

GROUND SURFACE ELEVATION: N/A

| DEPTH (ft) | PRO-FILE | DESCRIPTION | DEPTH (ft) | SAMPLE TYPE/NO. | DCP BLOWS/ 1.75-INCHES | MOISTURE CONTENT (%) | DRY DENSITY (PCF) | UNCOF. COMP. ST. (PSF) |
|---|---|---|---|---|---|---|---|---|
| | | Bituminous Concrete (3-1/2 inches) | 0.3 | | | | | |
| | | Crushed Limestone: Sandy Gravel with trace silt (7 inches) | 0.9 | AS-1 | | | | |
| | | Crushed Concrete Gravel and Cobbles with trace silt and sand | 2.0 | | | | | |
| | | End of Boring @ 2 ft | | | | | | |
| 5 | | | 5 | | | | | |

Total Depth: 2 ft
Drilling Date: September 11, 2024
Inspector:
Contractor: G2 Consulting Group, LLC
Driller: A. Nolan

Drilling Method:
4 inch diameter diamond-tipped core barrel and 3 inch diameter hand auger

Water Level Observation:
2 feet during and upon completion of drilling operations

Excavation Backfilling Procedure:
Auger cuttings and capped with cold patch

Figure No. 1

PAVEMENT CORE DCP 240681.GPJ 20140820 G2 CONSULTING DATA TEMPLATE.GDT 9/26/24

Project Name: Leonard Elementary School Pavement Improvements
Project Location: 4401 Tallman Drive, Troy, Michigan 48085

G2 Project No. 240681
Latitude: N/A Longitude: N/A

# Soil Boring No. **B-2**

G2 CONSULTING GROUP

| SUBSURFACE PROFILE | | | | SOIL SAMPLE DATA | | | | |
|---|---|---|---|---|---|---|---|---|
| DEPTH (ft) | PRO-FILE | GROUND SURFACE ELEVATION: N/A | DEPTH (ft) | SAMPLE TYPE/NO. | DCP BLOWS/ 1.75-INCHES | MOISTURE CONTENT (%) | DRY DENSITY (PCF) | UNCOF. COMP. ST. (PSF) |
| | | Bituminous Concrete (4 inches) 0.3 | | | | | | |
| | | Crushed Limestone: Sandy Gravel with trace silt (7 inches) 0.9 | | AS-1 | | | | |
| | | Crushed Concrete Gravel and Cobbles with trace silt and sand 1.3 | | | | | | |
| | | End of Boring @ 1.3 ft | | | | | | |
| 5 | | | 5 | | | | | |

Total Depth: 1.3 ft
Drilling Date: September 11, 2024
Inspector:
Contractor: G2 Consulting Group, LLC
Driller: A. Nolan

Drilling Method:
4 inch diameter diamond-tipped core barrel and 3 inch diameter hand auger

Water Level Observation:
Dry during and upon completion of drilling operations

Excavation Backfilling Procedure:
Auger cuttings and capped with cold patch

Figure No. 2

Project Name: Leonard Elementary School Pavement Improvements

Project Location: 4401 Tallman Drive
Troy, Michigan 48085

G2 Project No. 240681

Latitude: N/A Longitude: N/A

# Soil Boring No. **B-3**

G2 CONSULTING GROUP

| SUBSURFACE PROFILE | | | | SOIL SAMPLE DATA | | | | |
|---|---|---|---|---|---|---|---|---|
| DEPTH (ft) | PRO-FILE | GROUND SURFACE ELEVATION: N/A | DEPTH (ft) | SAMPLE TYPE/NO. | DCP BLOWS/ 1.75-INCHES | MOISTURE CONTENT (%) | DRY DENSITY (PCF) | UNCOF. COMP. ST. (PSF) |
| | | Bituminous Concrete (4 inches) — 0.3 | | | | | | |
| | | Crushed Limestone: Sandy Gravel with trace silt (8 inches) — 1.0 | | AS-1 | | | | |
| | | Crushed Concrete Gravel and Cobbles with trace silt and sand — 1.8 | | AS-2 | 23 | 11.4 | | 8000* |
| | | Fill: Hard Dark Brown and Gray Silty Clay with trace sand and gravel (Organic Matter Content @2'=0.5%; @4'=0.8%) — 4.0 | | AS-3 | 27 | 13.9 | | 8000* |
| 5 | | End of Boring @ 4 ft | 5 | | | | | |

Total Depth: 4 ft
Drilling Date: September 11, 2024
Inspector:
Contractor: G2 Consulting Group, LLC
Driller: A. Nolan

Drilling Method:
4 inch diameter diamond-tipped core barrel and 3 inch diameter hand auger

Water Level Observation:
Dry during and upon completion of drilling operations

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings and capped with cold patch

Figure No. 3

Project Name: Leonard Elementary School Pavement Improvements
Project Location: 4401 Tallman Drive
Troy, Michigan 48085

G2 Project No. 240681
Latitude: N/A Longitude: N/A

# Soil Boring No. B-4

G2 CONSULTING GROUP

| SUBSURFACE PROFILE | | | | SOIL SAMPLE DATA | | | | |
|---|---|---|---|---|---|---|---|---|
| DEPTH (ft) | PRO-FILE | GROUND SURFACE ELEVATION: N/A | DEPTH (ft) | SAMPLE TYPE/NO. | DCP BLOWS/ 1.75-INCHES | MOISTURE CONTENT (%) | DRY DENSITY (PCF) | UNCOF. COMP. ST. (PSF) |
| | | Bituminous Concrete (3-1/4 inches) — 0.3 | | | | | | |
| | | Crushed Limestone: Sandy Gravel with trace silt (12 inches) — 1.3 | | AS-1 | | | | |
| | | Fill: Very Stiff Dark Brown and Gray Silty Clay with trace sand and gravel (Organic Matter Content in AS-2 = 1.3%; AS-3 = 2.0%) — 4.0 | | AS-2 | 20 | 16.2 | | 6000* |
| | | | | AS-3 | 21 | 24.6 | | 6000* |
| 5 | | End of Boring @ 4 ft | 5 | | | | | |

Total Depth: 4 ft
Drilling Date: September 11, 2024
Inspector:
Contractor: G2 Consulting Group, LLC
Driller: A. Nolan

Drilling Method:
4 inch diameter diamond-tipped core barrel and 3 inch diameter hand auger

Water Level Observation:
Dry during and upon completion of drilling operations

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings and capped with cold patch

Project Name: Leonard Elementary School Pavement Improvements
Project Location: 4401 Tallman Drive
Troy, Michigan 48085

G2 Project No. 240681
Latitude: N/A Longitude: N/A

# Soil Boring No. **B-5**

G2 CONSULTING GROUP

| SUBSURFACE PROFILE | | | | SOIL SAMPLE DATA | | | | |
|---|---|---|---|---|---|---|---|---|
| DEPTH ( ft) | PRO-FILE | GROUND SURFACE ELEVATION: N/A | DEPTH ( ft) | SAMPLE TYPE/NO. | DCP BLOWS/ 1.75-INCHES | MOISTURE CONTENT (%) | DRY DENSITY (PCF) | UNCOF. COMP. ST. (PSF) |
| | | Bituminous Concrete (3 inches) 0.3 | | | | | | |
| | | Crushed Limestone: Sandy Gravel with trace silt (8 inches) 0.9 | | AS-1 | | | | |
| | | Crushed Concrete Gravel and Cobbles with trace silt and sand 1.3 | | | | | | |
| | | End of Boring @ 1.3 ft | | | | | | |
| 5 | | | 5 | | | | | |

Total Depth: 1.3 ft
Drilling Date: September 11, 2024
Inspector:
Contractor: G2 Consulting Group, LLC
Driller: A. Nolan

Drilling Method:
4 inch diameter diamond-tipped core barrel and 3 inch diameter hand auger

Water Level Observation:
Dry during and upon completion of drilling operations

Excavation Backfilling Procedure:
Auger cuttings and capped with cold patch

Figure No. 5

Project Name: Leonard Elementary School Pavement Improvements

Project Location: 4401 Tallman Drive
Troy, Michigan 48085

G2 Project No. 240681

Latitude: N/A Longitude: N/A

# Soil Boring No. **B-6**

G2 CONSULTING GROUP

## SUBSURFACE PROFILE / SOIL SAMPLE DATA

GROUND SURFACE ELEVATION: N/A

| DEPTH (ft) | PROFILE / DESCRIPTION | SAMPLE TYPE/NO. | DCP BLOWS/ 1.75-INCHES | MOISTURE CONTENT (%) | DRY DENSITY (PCF) | UNCOF. COMP. ST. (PSF) |
|---|---|---|---|---|---|---|
| 0.3 | Fractured Bituminous Concrete (3-1/4 inches) | | | | | |
| 0.8 | Crushed Limestone: Sandy Gravel with trace silt (6 inches) | AS-1 | | | | |
| 1.8 | Crushed Concrete Gravel and Cobbles with trace silt and sand | | | | | |
| | | AS-2 | 23 | 15.0 | | 7000* |
| 4.0 | FIll: Very Stiff to Hard Dark Brown and Gray Silty Clay with trace sand and gravel (Organic Matter Content @2'=0.6%; @4'=0.7%) | AS-3 | 31 | 13.6 | | 9000* |
| | End of Boring @ 4 ft | | | | | |
| 5 | | | | | | |

Total Depth: 4 ft
Drilling Date: September 11, 2024
Inspector:
Contractor: G2 Consulting Group, LLC
Driller: A. Nolan

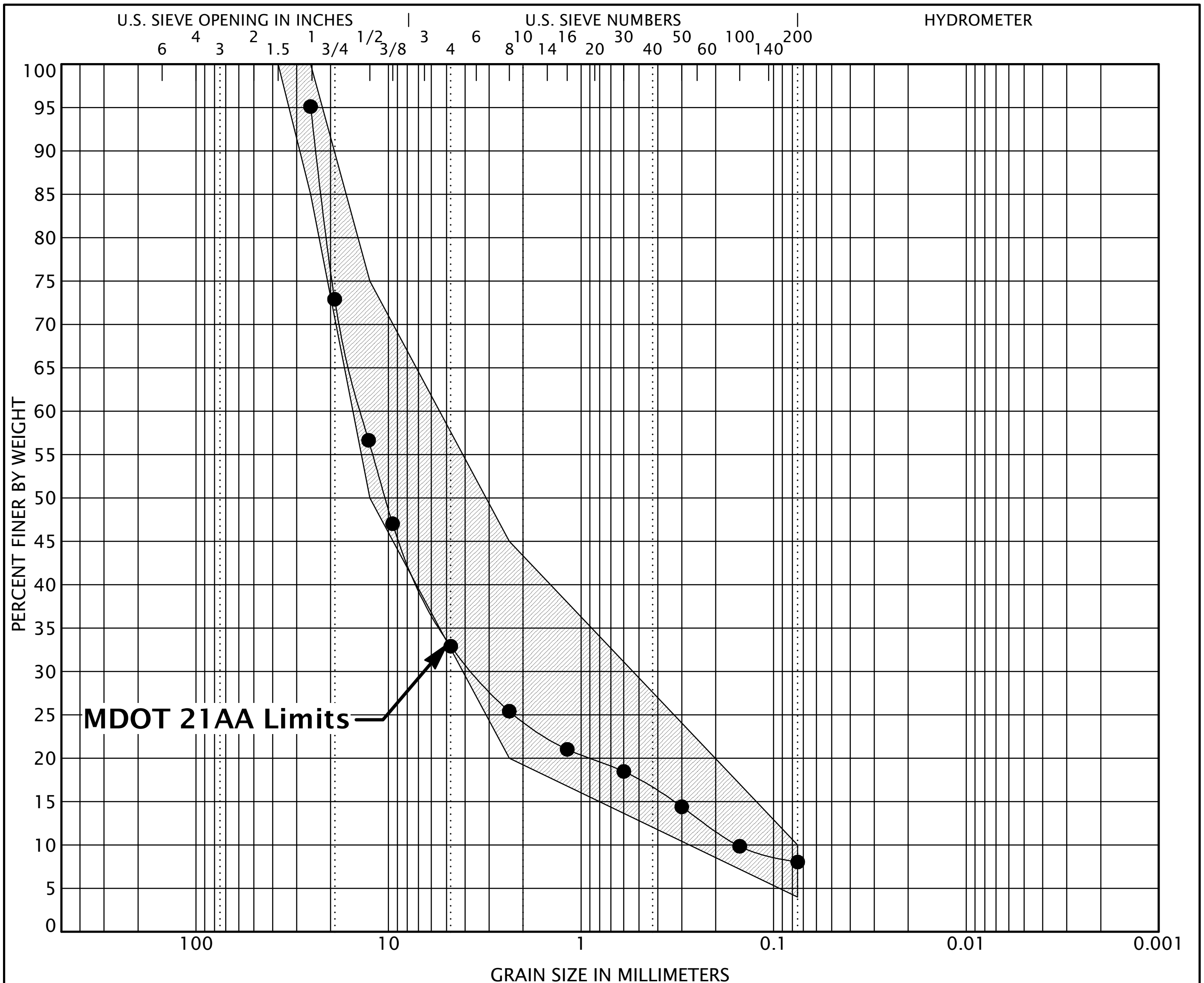
Drilling Method:
4 inch diameter diamond-tipped core barrel and 3 inch diameter hand auger

Water Level Observation:
Dry during and upon completion of drilling operations

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings and capped with cold patch

Figure No. 6




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen ID | | Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● | B-3 AS-1 | Sandy Gravel with trace silt | | | | 6.19 | 89.98 |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

| Specimen ID | | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|---|
| ● | B-3 AS-1 | 25.4 | 13.807 | 3.622 | 0.153 | 62.2 | 24.9 | 8.0 | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

G2 CONSULTING GROUP

# GRAIN SIZE DISTRIBUTION

Project Name: Leonard Elementary School Pavement Improvements

Project Location: 4401 Tallman Drive
Troy, Michigan 48085

G2 Project No.: 240681

Figure No. 7

# GENERAL NOTES TERMINOLOGY

Unless otherwise noted, all terms herein refer to the Standard Definitions presented in ASTM 653.

**PARTICLE SIZE**

| | | |
|---|---|---|
| Boulders | | - greater than 12 inches |
| Cobbles | | - 3 inches to 12 inches |
| Gravel | - Coarse | - 3/4 inches to 3 inches |
| | - Fine | - No. 4 to 3/4 inches |
| Sand | - Coarse | - No. 10 to No. 4 |
| | - Medium | - No. 40 to No. 10 |
| | - Fine | - No. 200 to No. 40 |
| Silt | | - 0.005mm to 0.074mm |
| Clay | | - Less than 0.005mm |

**CLASSIFICATION**

The major soil constituent is the principal noun, i.e. clay, silt, sand, gravel. The second major soil constituent and other minor constituents are reported as follows:

| Second Major Constituent (percent by weight) | Minor Constituent (percent by weight) |
|---|---|
| Trace - 1 to 12% | Trace - 1 to 12% |
| Adjective - 12 to 35% | Little - 12 to 23% |
| And - over 35% | Some - 23 to 33% |

**COHESIVE SOILS**

If clay content is sufficient so that clay dominates soil properties, clay becomes the principal noun with the other major soil constituent as modifier, i.e. sandy clay. Other minor soil constituents may be included in accordance with the classification breakdown for cohesionless soils, i.e. silty clay, trace sand, little gravel.

| Consistency | Unconfined Compressive Strength (psf) | Approximate Range of (N) |
|---|---|---|
| Very Soft | Below 500 | 0 - 2 |
| Soft | 500 - 1,000 | 3 - 4 |
| Medium | 1,000 - 2,000 | 5 - 8 |
| Stiff | 2,000 - 4,000 | 9 - 15 |
| Very Stiff | 4,000 - 8,000 | 16 - 30 |
| Hard | 8,000 - 16,000 | 31 - 50 |
| Very Hard | Over 16,000 | Over 50 |

Consistency of cohesive soils is based upon an evaluation of the observed resistance to deformation under load and not upon the Standard Penetration Resistance (N).

**COHESIONLESS SOILS**

| Density Classification | Relative Density % | Approximate Range of (N) |
|---|---|---|
| Very Loose | 0 - 15 | 0 - 4 |
| Loose | 16 - 35 | 5 - 10 |
| Medium Compact | 36 - 65 | 11 - 30 |
| Compact | 66 - 85 | 31 - 50 |
| Very Compact | 86 - 100 | Over 50 |

Relative Density of cohesionless soils is based upon the evaluation of the Standard Penetration Resistance (N), modified as required for depth effects, sampling effects, etc.

**SAMPLE DESIGNATIONS**

AS - Auger Sample – Cuttings directly from auger flight
BS - Bottle or Bag Samples
S - Split Spoon Sample - ASTM D 1586
LS - Liner Sample with liner insert 3 inches in length
ST - Shelby Tube sample - 3 inch diameter unless otherwise noted
PS - Piston Sample - 3 inch diameter unless otherwise noted
RC - Rock Core - NX core unless otherwise noted

STANDARD PENETRATION TEST (ASTM D 1586) - A 2.0 inch outside-diameter, 1-3/8 inch inside-diameter split barrel sampler is driven into undisturbed soil by means of a 140-pound weight falling freely through a vertical distance of 30 inches. The sampler is normally driven three successive 6-inch increments. The total number of blows required for the final 12 inches of penetration is the Standard Penetration Resistance (N).

**Photographic Documentation**
**Leonard Elementary School**
**G2 Project No. 240681**

Photograph No. 1: Moderate severity fatigue cracking, looking north from B-1

Photograph No. 2: Moderate severity fatigue cracking, looking south at B-1

Photograph No. 3: Low severity block and fatigue cracking, south of B-1

Photograph No. 4: Drainage structure in gutter

Photograph No. 5: Drainage structure in gutter

Photograph No. 6: Interior of structure

Photograph No. 7: Low to moderate severity block cracking near B-2. New concrete around drainage structure.

Photograph No. 8: Low severity fatigue cracking near B-2

Photograph No. 9: Low severity block and fatigue cracking north of B-2

Photograph No. 10: Moderate severity fatigue cracking south of B-2. Sediment along gutter.


Photograph No. 11: Drainage structure at south curve


Photograph No. 12: Low severity transverse and fatigue cracking at south entrance.

**Photographic Documentation**
**Leonard Elementary School**
**G2 Project No. 240681**

Photograph No. 13: Moderate severity fatigue cracking near B-3

Photograph No. 14: Low severity block and fatigue cracking looking north from B-4

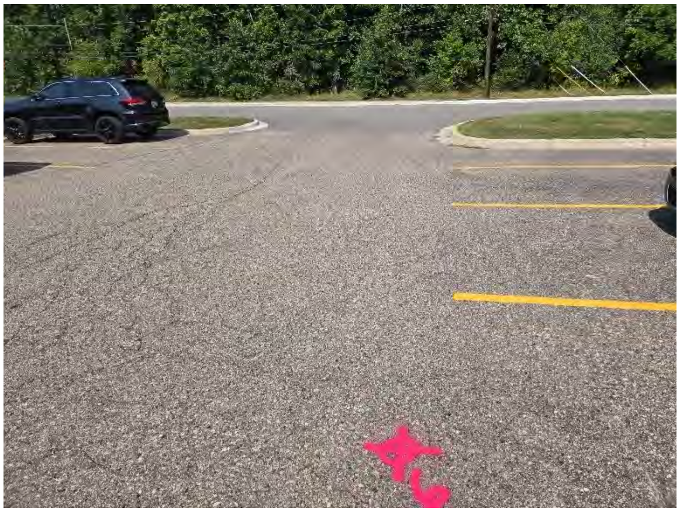
Photograph No. 15: Moderate severity fatigue cracking looking south at B-4

Photograph No. 16: Moderate severity fatigue cracking looking south at B-5

Photograph No. 17: Low to moderate severity fatigue and longitudinal cracking looking north from B-5

Photograph No. 18: Low to moderate severity fatigue cracking behind parking stalls

**Photographic Documentation**
**Leonard Elementary School**
**G2 Project No. 240681**



Photograph No. 19: Moderate severity fatigue cracking in center lot looking north at B-6

Photograph No. 20: Moderate severity fatigue cracking in center lot looking south at B-6

Photograph No. 21: Moderate severity fatigue cracking in center lot looking south at B-6

Photograph No. 22: B-1

Photograph No. 23: B-2

Photograph No. 24: B-2

**Photographic Documentation**
**Leonard Elementary School**
**G2 Project No. 240681**

Photograph No. 25:  B-3

Photograph No. 26:  B-4

Photograph No. 27:  B-5

Photograph No. 28:  B-6

Report on Geotechnical
Pavement Investigation

# Transportation District Building
# 1140 Rankin Street
# Troy, Michigan 48083

Latitude 42.542742˚ N
Longitude 82.129975˚ W

Prepared for:

Lecole Planners, LLC
145 North Center Street B
Northville, Michigan 48167

G2 Project No. 210880
December 20, 2021

December 20, 2021

Ms. Michelle Kerns
Lecole Planners, LLC
145 North Center Street B
Northville, Michigan 48167

Re: Report of Geotechnical Pavement Investigation
Transportation District Building
1140 Rankin Drive
Troy, Michigan 48083
G2 Project No. 210880

Dear Ms. Kerns,

In accordance with your request, we have completed the geotechnical investigation for the proposed rehabilitation/reconstruction of the pavements at the Transportation District Building located within the City of Troy, Michigan. This report presents the results of our observations and analyses and our recommendations for pavement design and construction considerations as they relate to the geotechnical conditions along the alignment of the proposed pavement rehabilitation/reconstruction.

As always, we appreciate the opportunity to be of service to Lecole Planners, LLC on this project and look forward to discussing the recommendations presented. In the meantime, if you have any questions regarding this report or any other matter pertaining to the project, please let us know.

Sincerely,

**G2 Consulting Group, LLC**

Jeffrey M. Hayball, P.E.
Project Engineer

Noel J. Hargrave-Thomas, P.E.
Principal

Amy L. Schneider, P.E.
Project Manager/Associate

JMH/NJHT/ALS/ljv

Enclosures

**EXECUTIVE SUMMARY**

We understand the project consists of rehabilitation/reconstruction of pavement areas at the Troy Schools Transportation District Building located within the City of Troy, Michigan. The site consists of a northwest parking lot, east parking lot which spans the east side of the building and connects to the south side of the building, and a southwest parking lot. Per the Dimension and Paving Plan prepared by PEA Group (Sheet C-3.0), new standard-duty bituminous concrete pavements will be constructed within a portion of the northwest lot and the entire east lot. New standard-duty bituminous concrete pavements will be constructed on the north side of the existing building, spanning between the northwest and northeast parking lots. Patches of heavy-duty Portland cement concrete will be constructed around the southern garage. No work will be done at the southwest lot. Traffic counts at the site were not available upon completion of this report. However, it is our understanding traffic generally consists of cars, loaded dump trucks, delivery trucks, garbage trucks, and semi-trucks.

The existing pavements consist of bituminous concrete measuring 4 to 6-1/2 inches in thickness at borings B-3 through B-9. Approximately 24 inches of medium silty clay topsoil are present at the ground surface of borings B-1 and B-2. Granular fill soils, consisting of loose silty sand and clayey sand with approximately 2-1/2 to 5-1/2 percent organic matter, underlie the bituminous concrete within borings B-3 through B-9 and extend to depths ranging from 2-1/2 to 3 feet below existing grade. Native stiff to very stiff silty clay is present below the granular fill soils within borings B-3 through B-9 and extends to the explored depth of 4 feet. Native loose clayey sand underlies the silty clay topsoil within borings B-1 and B-2 and extends to the explored depth of 4 feet. Groundwater was observed within borings B-1, B-2, and B-4 through B-7 at depths ranging from 12 inches to 3 feet during drilling operations. Groundwater was measured at an approximate depth of 18 inches within boring B-2 upon completion of drilling operations. No measurable groundwater was observed within borings B-1 and B-4 through B-7 upon completion of drilling operations. Groundwater was not observed within the remaining borings during or upon completion of drilling operations.

The existing pavements are in poor conditions with more than half of the pavement exhibiting moderate to high severity transverse, longitudinal, and fatigue cracking. No aggregate base material is present beneath the bituminous concrete at the soil boring locations. The existing pavements are generally not suitable to be rehabilitated by mill and overlay due to the condition of the existing pavements and lack of aggregate base. Therefore, we recommend completely reconstructing the existing bituminous concrete pavements. In addition, we recommend finger drains be installed at each catch basin location to collect surface runoff water that may pond atop of the clayey sand subgrade soils.

Significant subgrade instability may be encountered due to the presence of fill soils with up to 5-1/2 percent organic matter. These soils may become unstable under repeated loading of construction traffic and exposure to precipitation. We recommend a budget be allocated for undercutting 50 to 60 percent of the pavement areas due to the presence of clayey sand fill with organic matter and assumed water infiltration through the extensive pavement distress. In addition, we recommend the exposed subgrade not be left exposed to precipitation and construction operations be performed during the summer months to ensure dry, warm, weather.

Based on the results of our analyses, we recommend the proposed standard-duty flexible pavement section consist of 2 inches of 5EML bituminous concrete wearing course over 2 inches of MDOT 4EML bituminous concrete leveling course, supported on a minimum of 10 inches of MDOT 21AA dense graded aggregate base course. We recommend all bituminous concrete materials have a binder from RAP less than 17 percent of the total binder and using a binder of PG 64-22. We recommend the heavy-duty rigid pavement section consist of a minimum 7 inches of Portland cement concrete supported on 6 inches of MDOT dense-graded aggregate base.

This summary is not to be considered separate from the entire text of this report, with all the conclusions and qualifications mentioned herein. Details of our analysis and recommendations are discussed in the following sections and in the Appendix of this report.

## PROJECT DESCRIPTION

We understand the project consists of rehabilitation/reconstruction of pavement areas at the Troy Schools Transportation District Building located within the City of Troy, Michigan. The site consists of a northwest parking lot, east parking lot which spans the east side of the building and connects to the south side of the building, and a southwest parking lot. Per the Dimension and Paving Plan prepared by Professional Engineering Associates (Sheet C-3.0), new standard-duty bituminous concrete pavements will be constructed within a portion of the northwest lot and the entire east lot. New standard-duty bituminous concrete pavements will be constructed on the north side of the existing building, spanning between the northwest and northeast parking lots. Patches of heavy-duty Portland cement concrete will be constructed around the southern garage. No work will be done at the southwest lot.

Traffic counts at the site were not available upon completion of this report. However, it is our understanding traffic generally consists of cars, loaded dump trucks, delivery trucks, garbage trucks, and semi-trucks. The age of the existing pavements was not available upon completion of this report. However, after review of Google Earth Historical Aerial Photographs, it appears the pavements were constructed sometime prior to 2002. In addition, it appears the pavements within the southwest parking lot were seal coated between 2020 and 2021.

The purpose of our investigation is to determine and evaluate the general pavement and subsurface conditions within existing pavements and develop general recommendations for the proposed pavement rehabilitation/reconstruction and pavement design.

## SCOPE OF SERVICES

The field operations, laboratory testing, and engineering report preparation were performed under direction and supervision of a licensed professional engineer. Our services were performed according to generally accepted standards and procedures in the practice of geotechnical engineering in this area. Our scope of services for this project is as follows:

1. We drilled a total of nine pavement core/hand auger soil borings for the proposed project, each extending to a depth of 4 feet below existing grade. Hand auger borings B-1 and B-2 were performed within the new connector parking lot on the north side of the existing building. Pavement core/hand auger boring B-3 was drilled within the northwest parking lot. Pavement core/hand auger borings B-4 through B-8 were performed within the east parking lot. Pavement core/hand auger boring B-9 was performed within the southwest parking lot. Pavement core/hand auger soil boring B-8 was proposed to be performed in a Portland cement concrete pavement area adjacent to an existing garage but was offset into bituminous concrete pavements due to limit access to perform the boring. We measured the existing pavement section materials (bituminous concrete) and identified the type and condition of subgrade soils.

2. We performed laboratory testing on samples obtained from the soil borings. Laboratory testing included visual engineering classification, moisture content, organic matter content (loss-on-ignition), and unconfined compressive strength determinations.

3. We prepared this engineering report which includes our evaluation of the subsurface conditions at the site and our recommendations for pavement rehabilitation/reconstruction.

## FIELD OPERATIONS

G2 Consulting Group, LLC (G2), selected the number depth and location of the soil borings. The soil borings were located in the field by a G2 representative by use of GPS assisted mobile technology in conjunction with conventional taping methods. The approximate soil boring locations are presented on the Soil Boring Location Plan, Plate No. 1. Ground surface elevations were interpolated from spot elevations presented on a topographic survey performed by PEA Group dated December 15, 2021

We used a gas powered core rig equipped with a 4-inch diameter diamond-tipped core barrel to core the pavement locations. Pavement cores were drilled through the full depth of the existing pavement structure to obtain an accurate determination of the pavement thickness.

Hand auger borings were performed using a 3-inch diameter hand auger. Within each hand-auger boring, soil samples were obtained at depths of 2 feet, 4 feet, and at transitions in soil types. The soil samples were placed in sealed containers in the field and brought to the laboratory for testing and classification. A Dynamic Cone Penetrometer (DCP) test was performed within each hand auger boring at depths of 2 feet and 4 feet to evaluate the consistency of the in-situ soil. DCP testing involves driving a 1-1/2 inch diameter cone with a 45˚ vertex angle into the ground using a 15-pound weight dropped 20 inches after the cone is seated into the bottom of the hand auger borehole. The Dynamic Cone Penetrometer is driven successive 1-3/4 increments. The blow counts for each 1-3/4 inch increment are presented on the individual hand-auger soil boring logs.

During drilling operations, a G2 professional engineer maintained logs of the encountered subsurface conditions, including changes in stratigraphy and observed groundwater levels to be used in conjunction with our analysis of the subsurface conditions. The final hand-auger boring logs are based on the field logs and laboratory soil classification and testing. After completion of boring operations, the boreholes were backfilled with excavated soil and capped with cold patch.

## LABORATORY TESTING

Representative soil samples were subjected to laboratory testing to determine soil parameters pertinent to pavement design, and site preparation. An experienced geotechnical engineer classified the samples in general conformance with the Unified Soil Classification System.

Laboratory testing included natural moisture content, organic matter content (loss-on-ignition), and unconfined compressive strength determinations. The organic matter content of representative samples was determined in accordance with ASTM Test Method D 2974, "Standard Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils". The unconfined compressive strengths were determined by using a spring-loaded hand penetrometer. The hand penetrometer estimates the unconfined compressive strength to a maximum of 4-1/2 tons per square foot (tsf) by measuring the resistance of the soil sample to the penetration of a calibrated spring-loaded cylinder.

The results of the moisture content, organic matter content, and unconfined compressive strength laboratory tests are indicated on the soil boring logs at the depths the samples were obtained. We will hold the soil samples for 60 days from the date of this report. If you would like the samples, please let us know.

## EXISTING PAVEMENT CONDITIONS

The existing pavements consist of bituminous concrete measuring 4 to 6-1/2 inches in thickness. No aggregate base was observed at the hand auger boring locations. Moderate severity transverse, longitudinal, and fatigue cracking are present along more than half of the pavement surface. The pavements in the east parking lot are sloped to drain into catch basins generally located within the middle of the parking lots/pavement areas. No curb and gutter are present around the pavements, with the exception of at the concrete entrance aprons.

Portland cement concrete collars have been constructed around most of the catch basins. The catch basins generally consist of brick and mortar atop of pre-cast concrete structures or block and mortar construction. Cracking of the mortar joints within the catch basins was observed during our site visit.

## EXISTING SUBSURFACE CONDITIONS

Approximately 24 inches of silty clay topsoil are present at the ground surface of borings B-1 and B-2. Granular fill soils, consisting of silty sand and clayey sand with trace organic matter, underlie the bituminous concrete within borings B-3 through B-9 and extend to depths ranging from 2-1/2 to 3 feet below existing grade. Native silty clay is present below the granular fill soils within borings B-3 through B-9 and extends to the explored depth of 4 feet. Native clayey sand underlies the silty clay topsoil within borings B-1 and B-2 and extends to the explored depth of 4 feet.

The silty clay topsoil is medium in consistency with moisture contents of 29 and 35 percent, organic matter contents of 4.3 and 6.2 percent, and unconfined compressive strengths of 1,000 and 1,250 pounds per square foot (psf). The granular fill soils are loose in compactness with Dynamic Cone Penetrometer (DCP) Test N-values ranging from 6 to 8 blows per 1-3/4 inch drive and organic matter contents ranging from 2.5 to 5.5 percent. The native silty clay is stiff to very stiff in consistency with natural moisture contents ranging from 13 to 24 percent and unconfined compressive strengths ranging from 2,500 to 7,000 psf. The native clayey sand is loose in compactness with DCP Test N-values of 7 and 8 blows per 1-3/4 inch drive.

The stratification depths shown on the soil boring logs represent the soil conditions at the boring locations. Variations may occur between borings. Additionally, the stratigraphic lines represent the approximate boundaries between soil types. The transition may be more gradual than what is shown. We have prepared the boring logs on the basis of laboratory classification and testing as well as field logs of the soils encountered.

The Soil Boring Location Plan, Plate No. 1, Soil Boring Logs Figure Nos. 1 through 9, and Photographic Documentation, Figure Nos. 10 through 13, are presented in the Appendix. The soil profiles described above are generalized descriptions of the soil conditions at the boring locations. General Notes Terminology defining the nomenclature used on the boring logs and elsewhere in this report is presented on Figure No. 14.

## GROUNDWATER CONDITIONS

Groundwater observations were made during and upon completion of the drilling operations. Groundwater was observed within borings B-1, B-2, and B-4 through B-7 at depths ranging from 12 inches to 3 feet during drilling operations. Groundwater was measured at an approximate depth of 18 inches within boring B-2 upon completion of drilling operations. No measurable groundwater was observed within borings B-1 and B-4 through B-7 upon completion of drilling operations. Groundwater was not observed within the remaining borings during or upon completion of drilling operations.

Fluctuations in perched and long-term groundwater levels should be anticipated due to seasonal variations and following periods of prolonged precipitation. It should also be noted that groundwater observations made during drilling operations in predominantly fined grained or cohesive soils are not necessarily indicative of the static groundwater level. This is due to the low permeability of such soils and the tendency of drilling operations to seal off the natural paths of groundwater flow.

## PAVEMENT EVALUATION AND RECOMMENDATIONS

### General

The existing pavements are in poor conditions with more than half of the pavement exhibiting moderate severity transverse, longitudinal, and fatigue cracking. No aggregate base material is present beneath the bituminous concrete at the hand auger boring locations.

The existing pavements are generally not suitable to be rehabilitated by mill and overlay due to the condition of the existing pavements and lack of aggregate base. Therefore, we recommend completely reconstructed the existing bituminous concrete pavements. In addition, we recommend finger drains be installed at each catch basin location to collect surface runoff water that may pond atop of the clayey sand subgrade soils.

**Pavement Subgrade Preparation**

We recommend completely removing the existing bituminous concrete within the existing pavement areas and all topsoil within the proposed new pavement areas. Approximately 2 feet of topsoil are present within the new pavement areas and will need to be completely removed within the proposed pavement alignment and replaced with engineered fill to the base of the new pavement section. Undercutting the exposed subgrade will also be required within the existing pavement areas to account for the proposed aggregate base course. Once the subgrade has been cut to the proposed subgrade elevation, we recommend these soils be evaluated for stability.

We anticipate the subgrade soils will generally consist of clayey sand fill with up to 5-1/2 percent organic matter. All exposed subgrade soils should be evaluated for stability before constructing the new pavement cross-section. Significant subgrade instability may be encountered due to the presence of fill soils with up to 5-1/2 percent organic matter. We recommend the subgrade soils be proof rolled using a heavily loaded, rubber-tired, tandem-axle dump truck. Unsuitable soils or soils exhibiting excessive instability, such as severe rutting, should be removed by undercutting to expose stable soils. Any remaining unstable or unsuitable areas noted should be improved by additional compaction or removed and replaced with engineered fill.

The existing fill soils may become unstable under repeated loading of construction traffic and/or precipitation. We recommend a budget be allocated for undercutting up to 50 percent of the pavement areas due to the presence of clayey sand fill with organic matter and assumed water infiltration through the extensive pavement distress, with the percentage increasing as the subgrade is exposed to precipitation. To minimize subgrade instability and undercuts, we recommend the exposed subgrade not be left exposed to precipitation and construction operations be performed during the summer months to ensure dry, warm, weather.

Subgrade undercuts, if required, should be evaluated by a qualified engineering technician to determine if subgrade stabilization is necessary. We recommend undercut excavations, where required, be backfilled with MDOT 21AA dense graded aggregate placed in an engineered manner. Lift thicknesses should not exceed 9 inches. The use of a tri-axial geogrid may reduce undercut depths, if needed.

We recommend a drain tile be placed within any undercut area and connected to the closest catch basin to prevent groundwater from pooling within the granular soils in undercuts. All engineered fill should be compacted to a density of at least 95 percent of the maximum density determined by the Modified Proctor (ASTM D1557) method of testing. All engineered fill material should be placed and compacted at approximately the optimum moisture content. Frozen material should not be used as fill, nor should fill be placed on a frozen subgrade.

**Pavement Design**

We performed pavement design analyses in accordance with the "AASHTO Guide for Design of Pavement Structures". The subgrade soils will generally consist of clayey sand fill with trace organic matter. Based on the existing subgrade soils, we have provided design pavement sections based on an effective subgrade resilient modulus of 4,000 pounds per square inch (psi).

It is our understanding traffic at the site consists of cars, dump trucks, garbage trucks, and semi-trucks. If any actual traffic volume information becomes available, G2 should be notified so we can reevaluate our recommendations. We have designed the pavement section on an estimated of 75,000 18-kip equivalent single-axle loads (ESALs) over a 20-year design life. For evaluation purposes, we have utilized a serviceability loss of 2.0, a standard deviation of 0.49 for flexible pavements, and a reliability factor of 0.95.

Based on the results of our analyses, we recommend the proposed standard-duty flexible pavement section consist of 2 inches of 5EML bituminous concrete wearing course over 2 inches of MDOT 4EML bituminous concrete leveling course, supported on a minimum of 10 inches of MDOT 21AA dense graded aggregate base course. We recommend all bituminous concrete materials have a binder from RAP less than 17 percent of the total binder and using a binder of PG 64-22. We recommend the heavy-duty rigid pavement section consist of a minimum 7 inches of Portland cement concrete supported on 6 inches of MDOT dense-graded aggregate base.

All pavement materials are specified within the 2012 Standard Specifications for Construction from the Michigan Department of Transportation. The aggregate materials for the subbase are described in Section 902. The bituminous pavement materials are described in Section 501 and can be assigned a structural coefficient number of 0.42. Imported MDOT 21AA dense graded aggregate base material can be assigned a structural coefficient number of 0.14.

**Pavement Drainage**

Proper pavement drainage is essential for fine grained subgrade soils. The pavement and subgrade should be properly sloped to promote effective surface and subsurface drainage and prevent water from ponding. We also recommend pavement subbase materials consist of non-frost-susceptible aggregates where possible.

We recommend underdrains be installed between catch basins. In addition, we recommend installing a minimum of four (4) finger drains at each catch basin to remove groundwater from the aggregate base layer. Such drains should extend to minimum depths of 4 inches below the bottom of the proposed aggregate base course or granular fill placed within undercut areas and connect to the nearest catch basin.

**Pavement Maintenance**

Regular timely maintenance should be performed on the pavement to reduce the potential deterioration associated with moisture infiltration through surface cracks. The owner should be prepared to seal the cracks with a hot-applied elastic crack filler as soon as possible after cracking develops and as often as necessary to block the passage of water to the subgrade soils.

## GENERAL COMMENTS

We have formulated the evaluations and recommendations presented in this report relative to site preparation and pavement construction on the basis of data provided to us relating to the location, type, and grade for the proposed site. Any significant change in this data should be brought to our attention for review and evaluation with respect to the prevailing subsurface conditions.

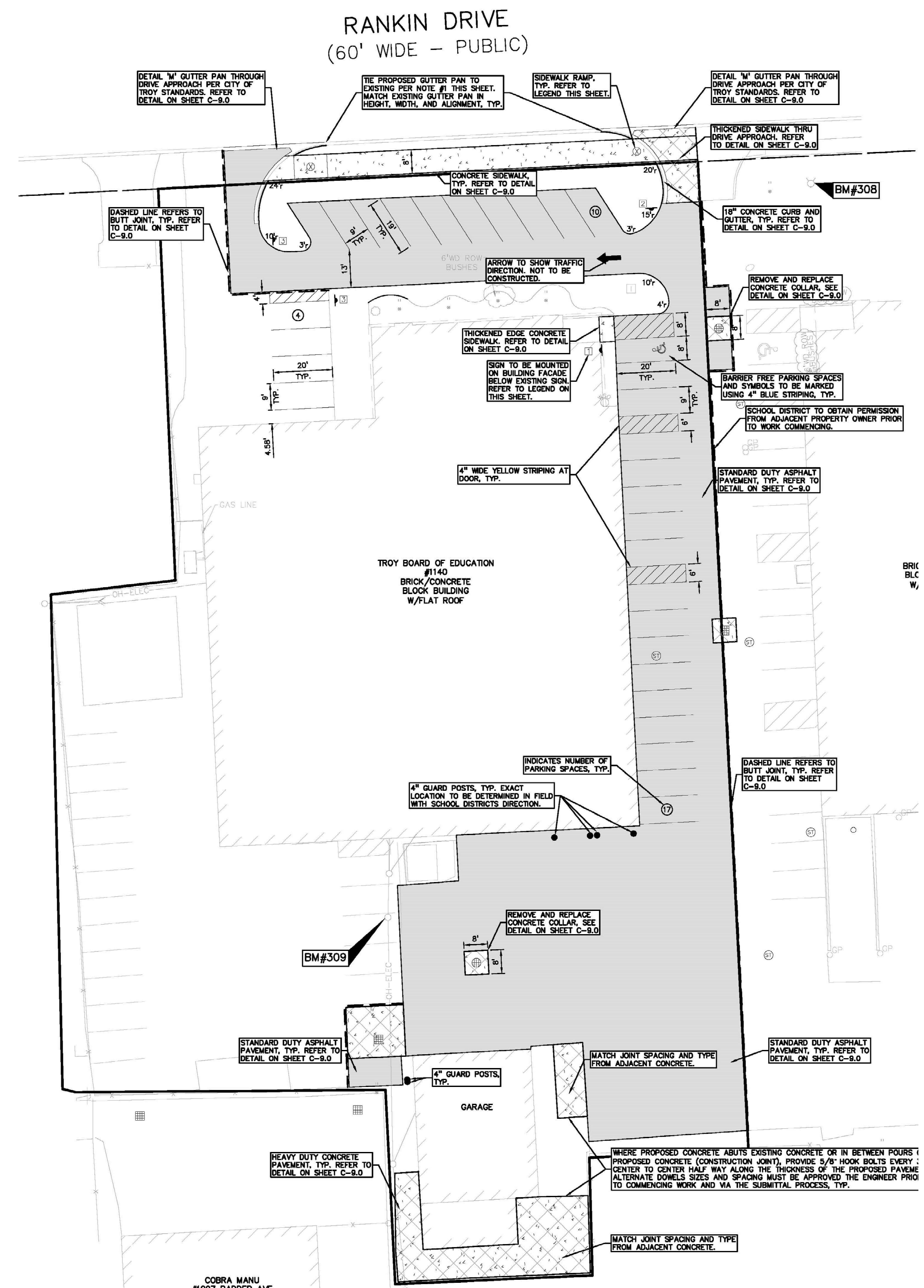
The scope of the present investigation was limited to evaluation of subsurface conditions for the construction of the proposed pavement reconstruction and other related aspects of the proposed project. No chemical, environmental, or hydrogeological testing or analysis were included in the scope of this investigation. If changes occur in the design, location, or concept of the project, the conclusions and recommendations contained in this report are not valid unless G2 Consulting Group, LLC reviews the changes. G2 Consulting Group, LLC will then confirm the recommendations presented herein or make changes in writing.

We have based the analyses and recommendations submitted in this report upon the data from soil borings performed at the approximate locations shown on the Soil Boring Location Plan, Plate No. 1.

This report does not reflect variations that may occur between the actual boring locations. The nature and extent of any such variations may not become clear until the time of construction. If significant variations then become evident, it may be necessary for us to re-evaluate our report recommendations.

Soil conditions at the site could vary from those generalized on the basis of soil borings made at specific locations. It is, therefore, recommended that G2 Consulting Group, LLC be retained to provide soil engineering services during the water main and roadway construction phases of the proposed project. This is to observe compliance with the design concepts, specifications, and recommendations. Also, this allows design changes to be made in the event that subsurface conditions differ from those anticipated prior to the start of construction.

**APPENDIX**


**Legend**

⊕ Pavement Core/Hand Auger Soil Borings performed by G2 Consulting Group, LLC on December 6, 2021

| **Soil Boring Location Plan** | | |
|---|---|---|
| Transportation District Building<br>1140 Rankin Drive<br>Troy, Michigan 48083 | | |
| G2 CONSULTING GROUP | Project No. 210880 | |
| | Drawn by: JMH | |
| | Date: 12/16/21 | Plate No. 1 |
| | Scale: NTS | |

Project Name: Transportation District Building

Project Location: 1140 Rankin Drive
Troy, Michigan 48083

G2 Project No. 210880

Latitude: N/A Longitude: N/A

# Soil Boring No. **B-1**

G2 CONSULTING GROUP

| SUBSURFACE PROFILE | | | | SOIL SAMPLE DATA | | | | |
|---|---|---|---|---|---|---|---|---|
| ELEV. (ft) | PRO-FILE | GROUND SURFACE ELEVATION: 651.5 ft ± | DEPTH (ft) | SAMPLE TYPE/NO. | DCP BLOWS/ 1.75-INCHES | MOISTURE CONTENT (%) | DRY DENSITY (PCF) | UNCOF. COMP. ST. (PSF) |
| | | Topsoil: Medium Dark Brown Silty Clay (Organic Matter Content = 6.2%) | 2.0 | AS-1 | 4 | 35.3 | | 1000* |
| | | Loose Brown Clayey Sand with trace silt and gravel | 4.0 | AS-2 | 8 | | | |
| 646.5 | | End of Boring @ 4 ft | 5 | | | | | |

Total Depth: 4 ft
Drilling Date: December 6, 2021
Inspector: DJ Radich, P.E.
Contractor: G2 Consulting Group, LLC
Driller: J. Bowles

Drilling Method:
4-inch diameter diamond tipped core barrel;
3-inch diameter hand auger

Water Level Observation:
12 inches during; dry upon completion

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings and capped with cold patch

Figure No. 1

Project Name: Transportation District Building

Project Location: 1140 Rankin Drive
Troy, Michigan 48083

G2 Project No. 210880

Latitude: N/A Longitude: N/A

# Soil Boring No. **B-2**

G2 CONSULTING GROUP

| SUBSURFACE PROFILE | | | | SOIL SAMPLE DATA | | | | |
|---|---|---|---|---|---|---|---|---|
| ELEV. (ft) | PRO-FILE | GROUND SURFACE ELEVATION: 651.5 ft ± | DEPTH (ft) | SAMPLE TYPE/NO. | DCP BLOWS/ 1.75-INCHES | MOISTURE CONTENT (%) | DRY DENSITY (PCF) | UNCOF. COMP. ST. (PSF) |
| | | Topsoil: Medium Dark Brown Silty Clay (Organic Matter Content = 4.3%) | 2.0 | AS-1 | 5 | 28.5 | | 1250* |
| | | Loose Brown Clayey Sand with trace silt and gravel | 4.0 | AS-2 | 7 | | | |
| 646.5 | | End of Boring @ 4 ft | 5 | | | | | |

Total Depth: 4 ft
Drilling Date: December 6, 2021
Inspector: DJ Radich, P.E.
Contractor: G2 Consulting Group, LLC
Driller: J. Bowles

Drilling Method:
4-inch diameter diamond tipped core barrel;
3-inch diameter hand auger

Water Level Observation:
18 inches during and upon completion

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings and capped with cold patch

Figure No. 2

Project Name: Transportation District Building

Project Location: 1140 Rankin Drive
Troy, Michigan 48083

G2 Project No. 210880

Latitude: N/A Longitude: N/A

# Soil Boring No. **B-3**

G2 CONSULTING GROUP

| SUBSURFACE PROFILE | | | | SOIL SAMPLE DATA | | | | |
|---|---|---|---|---|---|---|---|---|
| ELEV. (ft) | PRO-FILE | GROUND SURFACE ELEVATION: 652.0 ft ± | DEPTH (ft) | SAMPLE TYPE/NO. | DCP BLOWS/ 1.75-INCHES | MOISTURE CONTENT (%) | DRY DENSITY (PCF) | UNCOF. COMP. ST. (PSF) |
| | | Bituminous Concrete (4 inches) | 0.3 | | | | | |
| | | Fill: Loose Brown Silty Sand with trace gravel | 3.0 | AS-1 | | | | |
| | | | | AS-2 | 8 | | | |
| | | Very Stiff Brown and Gray Silty Clay with trace sand and gravel | 4.0 | AS-3 | 20 | 19.0 | | 6000* |
| 647.0 | | End of Boring @ 4 ft | 5 | | | | | |

Total Depth: 4 ft
Drilling Date: December 6, 2021
Inspector: DJ Radich, P.E.
Contractor: G2 Consulting Group, LLC
Driller: J. Bowles

Drilling Method:
4-inch diameter diamond tipped core barrel;
3-inch diameter hand auger

Water Level Observation:
Dry during and upon completion

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings and capped with cold patch

Project Name: Transportation District Building

Project Location: 1140 Rankin Drive
Troy, Michigan 48083

G2 Project No. 210880

Latitude: N/A Longitude: N/A

# Soil Boring No. **B-4**

G2 CONSULTING GROUP

| SUBSURFACE PROFILE | | | | SOIL SAMPLE DATA | | | | |
|---|---|---|---|---|---|---|---|---|
| ELEV. (ft) | PRO-FILE | GROUND SURFACE ELEVATION: 651.0 ft ± | DEPTH (ft) | SAMPLE TYPE/NO. | DCP BLOWS/ 1.75-INCHES | MOISTURE CONTENT (%) | DRY DENSITY (PCF) | UNCOF. COMP. ST. (PSF) |
| | | Bituminous Concrete (4-1/2 inches) | 0.4 | | | | | |
| | | Fill: Loose Dark Brown Clayey Sand with trace gravel and organic matter (Organic Matter Content = 4.2%) | 3.0 | AS-1 | 8 | 26.8 | | |
| | | Stiff Brown and Gray Silty Clay with trace sand and gravel | 4.0 | AS-2 | 8 | 24.1 | | 2500* |
| 646.0 | | End of Boring @ 4 ft | 5 | | | | | |

Total Depth: 4 ft
Drilling Date: December 6, 2021
Inspector: DJ Radich, P.E.
Contractor: G2 Consulting Group, LLC
Driller: J. Bowles

Drilling Method:
4-inch diameter diamond tipped core barrel;
3-inch diameter hand auger

Water Level Observation:
2-1/2 feet during; dry upon completion

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings and capped with cold patch

Figure No. 4

PAVEMENT CORE DCP 210880.GPJ 20140820 G2 CONSULTING DATA TEMPLATE.GDT 12/19/21

Project Name: Transportation District Building

Project Location: 1140 Rankin Drive
Troy, Michigan 48083

G2 Project No. 210880

Latitude: N/A Longitude: N/A

# Soil Boring No. **B-5**

G2 CONSULTING GROUP

| SUBSURFACE PROFILE | | | | SOIL SAMPLE DATA | | | | |
|---|---|---|---|---|---|---|---|---|
| ELEV. (ft) | PRO-FILE | GROUND SURFACE ELEVATION: 651.0 ft ± | DEPTH (ft) | SAMPLE TYPE/NO. | DCP BLOWS/ 1.75-INCHES | MOISTURE CONTENT (%) | DRY DENSITY (PCF) | UNCOF. COMP. ST. (PSF) |
| | | Bituminous Concrete (4 inches) | 0.3 | | | | | |
| | | Fill: Loose Dark Brown Clayey Sand with trace gravel and organic matter (Organic Matter Content = 2.6%) | 3.0 | AS-1 | 6 | 26.1 | | |
| | | Stiff Brown and Gray Silty Clay with trace sand and gravel | 4.0 | AS-2 | 10 | 23.8 | | 3000* |
| 646.0 | | End of Boring @ 4 ft | 5 | | | | | |

Total Depth: 4 ft
Drilling Date: December 6, 2021
Inspector: DJ Radich, P.E.
Contractor: G2 Consulting Group, LLC
Driller: J. Bowles

Drilling Method:
4-inch diameter diamond tipped core barrel;
3-inch diameter hand auger

Water Level Observation:
3 feet during; dry upon completion

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings and capped with cold patch

Project Name: Transportation District Building

Project Location: 1140 Rankin Drive
Troy, Michigan 48083

G2 Project No. 210880

Latitude: N/A Longitude: N/A

# Soil Boring No. **B-6**

G2 CONSULTING GROUP

| SUBSURFACE PROFILE | | | | SOIL SAMPLE DATA | | | | |
|---|---|---|---|---|---|---|---|---|
| ELEV. (ft) | PRO-FILE | GROUND SURFACE ELEVATION: 650.5 ft ± | DEPTH (ft) | SAMPLE TYPE/NO. | DCP BLOWS/ 1.75-INCHES | MOISTURE CONTENT (%) | DRY DENSITY (PCF) | UNCOF. COMP. ST. (PSF) |
| | | Bituminous Concrete (4-1/2 inches) | 0.4 | | | | | |
| | | Fill: Loose Dark Brown Clayey Sand with trace gravel and organic matter (Organic Matter Content = 3.0%) | 2.5 | AS-1 | 8 | 26.9 | | |
| | | Very Stiff Brown and Gray Silty Clay with trace sand and gravel | 4.0 | AS-2 | 23 | 12.5 | | 7000* |
| 645.5 | | End of Boring @ 4 ft | 5 | | | | | |

Total Depth: 4 ft
Drilling Date: December 6, 2021
Inspector: DJ Radich, P.E.
Contractor: G2 Consulting Group, LLC
Driller: J. Bowles

Drilling Method:
4-inch diameter diamond tipped core barrel;
3-inch diameter hand auger

Water Level Observation:
3 feet during; dry upon completion

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings and capped with cold patch

Figure No. 6

Project Name: Transportation District Building

Project Location: 1140 Rankin Drive
Troy, Michigan 48083

G2 Project No. 210880

Latitude: N/A Longitude: N/A

# Soil Boring No. **B-7**

G2 CONSULTING GROUP

| SUBSURFACE PROFILE | | | | SOIL SAMPLE DATA | | | | |
|---|---|---|---|---|---|---|---|---|
| ELEV. (ft) | PRO-FILE | GROUND SURFACE ELEVATION: 650.5 ft ± | DEPTH (ft) | SAMPLE TYPE/NO. | DCP BLOWS/ 1.75-INCHES | MOISTURE CONTENT (%) | DRY DENSITY (PCF) | UNCOF. COMP. ST. (PSF) |
| | | Bituminous Concrete (5-1/4 inches) | 0.4 | | | | | |
| | | Fill: Loose Dark Brown Clayey Sand with trace gravel and organic matter (Organic Matter Content = 2.5%) | 3.0 | AS-1 | 7 | 24.2 | | |
| | | Very Stiff Brown and Gray Silty Clay with trace sand and gravel | 4.0 | AS-2 | 20 | 19.4 | | 6000* |
| 645.5 | | End of Boring @ 4 ft | 5 | | | | | |

Total Depth: 4 ft
Drilling Date: December 6, 2021
Inspector: DJ Radich, P.E.
Contractor: G2 Consulting Group, LLC
Driller: J. Bowles

Drilling Method:
4-inch diameter diamond tipped core barrel;
3-inch diameter hand auger

Water Level Observation:
3 feet during; dry upon completion

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings and capped with cold patch

Figure No. 7

Project Name: Transportation District Building

Project Location: 1140 Rankin Drive
Troy, Michigan 48083

G2 Project No. 210880

Latitude: N/A Longitude: N/A

# Soil Boring No. **B-8**

G2 CONSULTING GROUP

## SUBSURFACE PROFILE / SOIL SAMPLE DATA

GROUND SURFACE ELEVATION: 651.0 ft ±

| ELEV. (ft) | PROFILE | DESCRIPTION | DEPTH (ft) | SAMPLE TYPE/NO. | DCP BLOWS/ 1.75-INCHES | MOISTURE CONTENT (%) | DRY DENSITY (PCF) | UNCOF. COMP. ST. (PSF) |
|---|---|---|---|---|---|---|---|---|
| | | Bituminous Concrete (4-1/2 inches) | 0.4 | | | | | |
| | | Fill: Loose Dark Brown Clayey Sand with trace gravel and organic matter (Organic Matter Content = 5.5%) | 3.0 | AS-1 | 6 | 29.5 | | |
| | | Very Stiff Brown and Gray Silty Clay with trace sand and gravel | 4.0 | AS-2 | 22 | 17.8 | | 6500* |
| 646.0 | | End of Boring @ 4 ft | 5 | | | | | |

Total Depth: 4 ft
Drilling Date: December 6, 2021
Inspector: DJ Radich, P.E.
Contractor: G2 Consulting Group, LLC
Driller: J. Bowles

Drilling Method:
4-inch diameter diamond tipped core barrel;
3-inch diameter hand auger

Water Level Observation:
Dry during and upon completion

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings and capped with cold patch

Figure No. 8

Project Name: Transportation District Building

Project Location: 1140 Rankin Drive
Troy, Michigan 48083

G2 Project No. 210880

Latitude: N/A Longitude: N/A

# Soil Boring No. **B-9**

G2 CONSULTING GROUP

| SUBSURFACE PROFILE | | | | SOIL SAMPLE DATA | | | | |
|---|---|---|---|---|---|---|---|---|
| ELEV. ( ft) | PRO-FILE | GROUND SURFACE ELEVATION: 651.0 ft ± | DEPTH ( ft) | SAMPLE TYPE/NO. | DCP BLOWS/ 1.75-INCHES | MOISTURE CONTENT (%) | DRY DENSITY (PCF) | UNCOF. COMP. ST. (PSF) |
| | | Bituminous Concrete (6-1/2 inches) | 0.5 | | | | | |
| | | Fill: Loose Dark Brown Clayey Sand with trace gravel and organic matter (Organic Matter Content = 5.1%) | 3.0 | AS-1 | 7 | 32.0 | | |
| | | Stiff Brown and Gray Silty Clay with trace sand and gravel | 4.0 | AS-2 | 10 | 23.6 | | 3000* |
| 646.0 | | End of Boring @ 4 ft | 5 | | | | | |

Total Depth: 4 ft
Drilling Date: December 6, 2021
Inspector: DJ Radich, P.E.
Contractor: G2 Consulting Group, LLC
Driller: J. Bowles

Drilling Method:
4-inch diameter diamond tipped core barrel;
3-inch diameter hand auger

Water Level Observation:
Dry during and upon completion

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings and capped with cold patch

**Photographic Documentation**
**Transportation District Building**
**Troy, Michigan**
**G2 Project No. 210880**

Photograph No. 1: Moderate severity fatigue cracking and evidence of settlement near boring B-3. View to the south.

Photograph No. 2: Moderate to high severity transverse, longitudinal, and fatigue cracking near boring B-4. View to the south.

**Photographic Documentation**
**Transportation District Building**
**Troy, Michigan**
**G2 Project No. 210880**

Photograph No. 3: Moderate severity transverse, longitudinal, and fatigue cracking near boring B-5. View to the south.


Photograph No. 4: High severity block, fatigue, transverse and longitudinal cracking near boring B-6. View to the south.

**Photographic Documentation**
**Transportation District Building**
**Troy, Michigan**
**G2 Project No. 210880**

Photograph No. 5: Low to moderate severity transverse and longitudinal cracking near boring B-7. Concrete collar around basin. View to the north.


Photograph No. 6: Moderate severity transverse and longitudinal cracking near boring B-8. View to the west.

**Photographic Documentation**
**Transportation District Building**
**Troy, Michigan**
**G2 Project No. 210880**


Photograph No. 7: Moderate to high severity transverse, longitudinal, and fatigue cracking near boring B-9. Crack sealing in one area. View to the northeast.

C2G CONSULTING GROUP

# GENERAL NOTES TERMINOLOGY

Unless otherwise noted, all terms herein refer to the Standard Definitions presented in ASTM 653.

## PARTICLE SIZE

| | | |
|---|---|---|
| Boulders | | - greater than 12 inches |
| Cobbles | | - 3 inches to 12 inches |
| Gravel | - Coarse | - 3/4 inches to 3 inches |
| | - Fine | - No. 4 to 3/4 inches |
| Sand | - Coarse | - No. 10 to No. 4 |
| | - Medium | - No. 40 to No. 10 |
| | - Fine | - No. 200 to No. 40 |
| Silt | | - 0.005mm to 0.074mm |
| Clay | | - Less than 0.005mm |

## CLASSIFICATION

The major soil constituent is the principal noun, i.e. clay, silt, sand, gravel. The second major soil constituent and other minor constituents are reported as follows:

| Second Major Constituent (percent by weight) | Minor Constituent (percent by weight) |
|---|---|
| Trace - 1 to 12% | Trace - 1 to 12% |
| Adjective - 12 to 35% | Little - 12 to 23% |
| And - over 35% | Some - 23 to 33% |

## COHESIVE SOILS

If clay content is sufficient so that clay dominates soil properties, clay becomes the principal noun with the other major soil constituent as modifier, i.e. sandy clay. Other minor soil constituents may be included in accordance with the classification breakdown for cohesionless soils, i.e. silty clay, trace sand, little gravel.

| Consistency | Unconfined Compressive Strength (psf) | Approximate Range of (N) |
|---|---|---|
| Very Soft | Below 500 | 0 - 2 |
| Soft | 500 - 1,000 | 3 - 4 |
| Medium | 1,000 - 2,000 | 5 - 8 |
| Stiff | 2,000 - 4,000 | 9 - 15 |
| Very Stiff | 4,000 - 8,000 | 16 - 30 |
| Hard | 8,000 - 16,000 | 31 - 50 |
| Very Hard | Over 16,000 | Over 50 |

Consistency of cohesive soils is based upon an evaluation of the observed resistance to deformation under load and not upon the Standard Penetration Resistance (N).

## COHESIONLESS SOILS

| Density Classification | Relative Density % | Approximate Range of (N) |
|---|---|---|
| Very Loose | 0 - 15 | 0 - 4 |
| Loose | 16 - 35 | 5 - 10 |
| Medium Compact | 36 - 65 | 11 - 30 |
| Compact | 66 - 85 | 31 - 50 |
| Very Compact | 86 - 100 | Over 50 |

Relative Density of cohesionless soils is based upon the evaluation of the Standard Penetration Resistance (N), modified as required for depth effects, sampling effects, etc.

## SAMPLE DESIGNATIONS

AS - Auger Sample – Cuttings directly from auger flight
BS - Bottle or Bag Samples
S - Split Spoon Sample - ASTM D 1586
LS - Liner Sample with liner insert 3 inches in length
ST - Shelby Tube sample - 3 inch diameter unless otherwise noted
PS - Piston Sample - 3 inch diameter unless otherwise noted
RC - Rock Core - NX core unless otherwise noted

STANDARD PENETRATION TEST (ASTM D 1586) - A 2.0 inch outside-diameter, 1-3/8 inch inside-diameter split barrel sampler is driven into undisturbed soil by means of a 140-pound weight falling freely through a vertical distance of 30 inches. The sampler is normally driven three successive 6-inch increments. The total number of blows required for the final 12 inches of penetration is the Standard Penetration Resistance (N).

CONSULTING GROUP

Report on Geotechnical Investigation

# Troy Athens High School Running Track and Pavement Improvements 4333 John R Road Troy, Michigan 48085

Latitude 42.582186˚ N
Longitude 83.112681˚ W

Prepared for:

Lecole Planners, LLC
145 North Center Street B
Northville, Michigan 48167

G2 Project No. 240782
November 7, 2024

CONSULTING GROUP

November 7, 2024

Ms. Michelle Kerns
Lecole Planners, LLC
145 North Center Street B
Northville, Michigan 48167

Re: Report on Geotechnical Investigation
Troy Athens High School Running Track and Pavement Improvements
4333 John R Road
Troy, Michigan 48085
G2 Project No. 240782

Dear Ms. Kerns:

In accordance with your request, we have completed a geotechnical investigation for the proposed running track and parking lot rehabilitation at Troy Athens High School in Troy, Michigan. This report presents the results of our field investigation, our observations and analyses, and our recommendations for subgrade preparation, track and pavement design, and construction considerations as they relate to the geotechnical conditions at the site.

We appreciate the opportunity to be of service to Lecole Planners and Troy School District and look forward to discussing the recommendations presented herein. In the meantime, if you have any questions regarding this report or any other matter pertaining to the project, please call us.

Sincerely,

**G2 Consulting Group, LLC**

Amy L. Schneider, P.E.
Project Manager, Associate

Noel J. Hargrave-Thomas, P.E.
Principal

ALS/NJHT/ljv

Enclosures

STATE OF MICHIGAN
AMY L. SCHNEIDER
ENGINEER
NO.
6201053128
LICENSED PROFESSIONAL ENGINEER
11/7/24

**EXECUTIVE SUMMARY**

The proposed project includes reconstruction of the existing running track and south parking lot at Troy High School in Troy, Michigan. Both areas will be reconstructed in the same alignment with similar finished grades. Based on the Athletics Site Plan prepared by Foresite (L1.01, dated August 30, 2024), the running track and high jump area are to be reconstructed, and a new trough drain constructed along the inside of the track at the north end. Based on the Grading and SESC Plan prepared by PEA Group (C-3.4, dated November 1, 2024), the parking lot is designed to be flush with existing grade along the west and will sheet drain to the existing curb and gutter and catch basins at the east side of the lot.

Approximately 1/2 to 3/4 inches of rubberized track underlain by 2-1/2 to 5-1/2 inches of bituminous concrete are present at borings B-1 through B-7. Approximately 2-3/4 to 4 inches of bituminous concrete are present at borings B-64 through B-68. The bituminous concrete is underlain by approximately 3 to 10 inches of sand and gravel crushed limestone underlie the bituminous concrete. Additionally, approximately 4 to 7 inches of pulverized asphalt are present below the crushed limestone at borings B-1 through B-3 and B-5 through B-7. Loose silty sand fill underlies the pulverized asphalt and crushed limestone at borings B-1, B-2, B-6, B-7, and B-64 through B-67. Very stiff to hard silty clay fill and sandy clay fill are present below the limestone, pulverized asphalt, and silty sand fill at borings B-4 through B-7, B-64, and B-65 and extend to approximate depths ranging from 3 feet to the explored depth of 4 feet. Native very stiff to hard silty clay underlies the fill or crushed concrete at borings B-1, B-2, B-6, B-7, B-66, and B-68. Groundwater was encountered at approximate depths of 1-1/2 and 3 feet during drilling operations at borings B-66 and B-67, respectively. No measurable groundwater was encountered during or upon completion of drilling operations at the remaining boring locations.

Based on minimal visible distress of the rubberized membrane at the track alignment and total combined crushed limestone and pulverized asphalt section of approximately 8 to 15 inches, we recommend the track be rehabilitated by milling the existing bituminous concrete a maximum of 1-1/2 inches and constructing a bituminous concrete overlay consisting of 1-1/2 inches of MDOT 5E1 bituminous concrete wearing course. At the north end of the field within the high jump area, only 2-1/4 inches of bituminous concrete are present which is not sufficient to mill. Therefore, we recommend the bituminous concrete be completely removed and a new bituminous concrete section consisting of 1-1/2 inches of MDOT 5E1 over 1-1/2 inches of MDOT 4E1 be constructed on the existing aggregate base.

The existing parking lot is in fair condition. Considering the combined thickness of the existing aggregate base and underlying pulverized asphalt, we recommend the existing bituminous concrete be removed and a new standard-duty pavement section be constructed on the existing aggregate base. The existing bituminous concrete should be completely removed, the underlying aggregate base graded to accommodate the proposed design pavement section, the exposed aggregate base thoroughly proof-compacted with a vibratory roller, and the compacted base visually evaluated by qualified personnel for support of pavements. Any unstable or unsuitable areas noted during proof compaction operations should be improved through additional compaction or undercut and replaced with engineered fill. We recommend a budget on the order of 10 to 15 percent of surface area be allocated for undercutting during proof compaction operations based on the existing pavement distress, anticipated to be focused predominantly on the east side of the lot.

The west side of the parking lot is flush with the grass and concrete curb and gutter line the east side of the lot with two drainage structures at the edge of the gutter. It appears the existing pavement is designed to sheet drain from the west to the curb and gutter and drainage structures and the proposed pavement is also designed to drain in the same manner. The most significant distress noted across the lot is at the east side which indicates drainage may be a contributing factor in the observed pavement distress. As such, we recommend additional drainage be included in the new parking lot design, as discussed in the Pavement Drainage section of this report.

Do not consider this summary separate from the entire text of this report, with all the conclusions and qualifications mentioned herein. Details of our analysis and recommendations are discussed in the following sections and in the Appendix of this report.

## PROJECT DESCRIPTION

The proposed project includes reconstruction of the existing running track and south parking lot at Troy High School in Troy, Michigan. Both areas will be reconstructed in the same alignment with similar finished grades. Based on the Athletics Site Plan prepared by Foresite (L1.01, dated August 30, 2024), the running track is to be reconstructed, the high jump area reconstructed, and a new trough drain constructed along the inside of the track at the north end. Based on the Grading and SESC Plan prepared by PEA Group (C-3.4, dated November 1, 2024), the lot is designed to be flush with existing grade along the west and will sheet drain to the existing curb and gutter and catch basins on the east side of the lot. We understand an edge drain is designed to extend along the east side of the lot in a north/south direction. If the layout or elevations are to be altered, G2 Consulting Group, LLC (G2) should be notified so that we can review the recommendations provided within this report.

## SCOPE OF SERVICES

Field operations, laboratory testing, and engineering report preparation were performed under the direction and supervision of a licensed professional engineer. Our services were performed according to generally accepted standards and procedures in the practice of geotechnical engineering in this area. Our scope of services for this project is as follows:

1. We drilled seven pavement cores / hand auger soil borings within the alignment of the existing running track extending to a depth of 4 feet each below existing grade. We drilled five pavement cores / hand auger soil borings in the existing parking lot extending to a depth of 4 feet each.

2. We performed laboratory testing on representative samples obtained from the soil borings. Laboratory testing included visual engineering classification, natural moisture content, organic matter content (loss-on-ignition), unconfined compressive strength determination, and grain size distribution.

3. We prepared this engineering report. Our report includes recommendations regarding running track and pavement design and construction considerations related to the proposed site improvements.

## FIELD OPERATIONS

Lecole Planners, in conjunction with G2, selected the number, depth, and location of the soil borings. The soil borings were staked throughout the property by a G2 engineer prior to our drilling operations measuring from known surface features using conventional taping methods and utilizing Google Earth in conjunction with cellular technology. The approximate soil boring locations are shown on the Soil Boring Location Plan, Plate Nos. 1 and 2 in the Appendix. Ground surface elevations were interpolated from the topographic spot and contour lines presented on the Topographic Surveys prepared by PEA Group.

We used a gas-powered core rig equipped with a 4-inch diameter diamond-tipped core barrel to core the pavement locations. Pavement cores were drilled through the full depth of the existing pavement structure to obtain an accurate determination of the pavement thickness.

Hand auger borings were performed using a 3-inch diameter hand auger. Within each hand-auger boring, soil samples were obtained at 2 feet and 4 feet and at transitions in soil types. The soil samples were placed in sealed containers in the field and brought to the laboratory for testing and classification. A Dynamic Cone Penetrometer (DCP) test was performed within each hand auger boring at depths of 2 and 4 feet to evaluate the consistency of the in-situ soil. DCP testing involves driving a 1-1/2-inch diameter cone with a 45° vertex angle into the ground using a 15-pound weight dropped 20 inches after the cone is seated into the bottom of the hand auger borehole. The Dynamic Cone Penetrometer is driven successive 1-3/4 increments. The blow counts for each 1-3/4-inch increment are presented on the individual hand auger soil boring logs.

The soil samples were placed in sealed containers in the field and brought to our laboratory for testing and classification. During field operations, a G2 Project Engineer maintained logs of the subsurface conditions, including changes in stratigraphy and observed groundwater levels. The final boring logs are based on the field logs supplemented by laboratory soil classification and test results. Upon completion of drilling operations, the soil borings were backfilled with auger cuttings and capped with cold patch and rubberized membrane, where applicable.

**LABORATORY TESTING**

Representative soil samples were subjected to laboratory testing to determine soil parameters pertinent to foundation design and site preparation. An experienced geotechnical engineer classified the samples in general conformance with the Unified Soil Classification System.

Laboratory testing included grain size distribution, natural moisture content, organic matter content, and unconfined compressive strength determination. Grain size distribution was determined in general conformance with ASTM C 136 method of testing. The organic matter content of representative samples was determined in accordance with ASTM Test Method D 2974, "Standard Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils". The unconfined compressive strengths were determined by using a spring-loaded hand penetrometer. The hand penetrometer estimates the unconfined compressive strength to a maximum of 4-1/2 tons per square foot (tsf) by measuring the resistance of the soil sample to the penetration of a calibrated spring-loaded cylinder.

The results of the moisture content laboratory tests are indicated on the boring logs at the depths the samples were obtained. Grain size distribution results are also presented graphically on Figure No. 13 in the Appendix. We will hold the soil samples for 60 days from the date of this report. If you would like the samples, please let us know.

**SITE CONDITIONS**

Troy High School is located at 4333 John R Road in Troy, Michigan. The athletic stadium is located on the northwest side of the school and the parking lot associated with this report is located at the southwest side of the overall school property. Based on Google Earth historical aerial images, the athletic complex was constructed prior to 1999 and new bleachers and a synthetic turf field were constructed between 2006 and 2007. The parking lot is bituminous concrete and was constructed in 2006.

**SOIL CONDITIONS**

**Running Track (Borings B-1 through B-7)**

Approximately 1/2 to 3/4 inches of rubberized membrane underlain by 2-1/2 to 5-1/2 inches of bituminous concrete are present at the boring locations. Approximately 3 to 10 inches of sand and gravel crushed limestone underlie the bituminous concrete. Additionally, 4 to 7 inches of pulverized asphalt are present below the crushed limestone except at boring B-4. Silty sand fill underlies the pulverized asphalt at borings B-1, B-2, B-6, and B-7 and extends to approximate depths ranging from 1-1/2 to 2-3/4 feet. Silty clay fill and sandy clay fill are present below the pulverized asphalt or crushed limestone within borings B-3 through B-5 and extend to the explored depth of 4 feet. Native silty clay is present below the silty sand fill within the other borings and extends to the explored depth of 4 feet.

The silty sand fill is loose in compactness with Dynamic Cone Penetrometer (DCP) Test N-values of 6 and 7 blows per 1-3/4 inch drive. The cohesive fill soils are very stiff to hard in consistency with moisture contents ranging from 11 to 16 percent, unconfined compressive strengths ranging from 4,000 to 8,000 psf, and organic matter contents ranging from 1.0 to 2.0 percent. The native silty clay is very stiff to hard in consistency with natural moisture contents ranging from 10 to 20 percent and unconfined compressive strengths ranging from 4,000 to 9,000 psf.

**Parking Lot (Borings B-64 through B-68)**

Approximately 2-3/4 to 4 inches of bituminous concrete underlain by 5 to 9 inches of sand and gravel crushed limestone are present at the boring locations. Approximately 6 to 7 inches of crushed concrete are present below the limestone at borings B-64 and B-65. Silty sand fill underlies the crushed concrete and crushed limestone at borings B-64 through B-67 and extends to approximate depths ranging from 1-3/4 to 3-1/2 feet. Silty clay fill underlies the silty sand fill at borings B-64 and B-65 and extends to the explored depth of 4 feet. Native silty clay is present below the silty sand fill and crushed limestone at borings B-66 and B-68 and extends to the explored depth of 4 feet.

The silty sand fill is loose in compactness with DCP Test N-values ranging from 6 to 9 blows per 1-3/4 inch drive. The silty clay fill is hard in consistency with moisture contents of 9 and 11 percent and unconfined compressive strengths of 9,000 psf. The native silty clay is very stiff to hard in consistency with natural moisture contents ranging from 12 to 22 percent and unconfined compressive strengths ranging from 7,000 to 8,000 psf.

**General**

The stratification depths shown on the soil boring logs represent the soil conditions at the boring locations. Variations may occur away from the boring locations. Additionally, the stratigraphic lines represent the approximate boundary between soil types. The transition may be more gradual than what is shown. We have prepared the boring logs based on the field logs of soils encountered supplemented by laboratory classification and testing.

The Soil Boring Location Plan, Plate Nos. 1 and 2, Soil Boring Logs, Figure Nos. 1 through 12, and Grain Size Distribution, Figure No. 13, are presented in the Appendix. The soil profiles described above are generalized descriptions of the conditions encountered at the boring locations. General Notes Terminology defining the nomenclature used on the soil boring logs and elsewhere in this report is presented on Figure No. 14.

**GROUNDWATER CONDITIONS**

Groundwater observations were made during and upon completion of drilling operations at the soil boring locations. Groundwater was encountered at approximate depths of 1-1/2 and 3 feet during drilling operations at borings B-66 and B-67, respectively. No measurable groundwater was encountered during or upon completion of drilling operations at the remaining boring locations.

Fluctuations in perched and long-term groundwater levels should be anticipated due to seasonal variations and following periods of prolonged precipitation. It should also be noted that groundwater observations made during drilling operations in cohesive soils are not necessarily indicative of the static groundwater level. This is due to the low permeability of such soils and the tendency of drilling operations to seal off the natural paths of groundwater flow.

**SITE PREPARATION RECOMMENDATIONS**

We anticipate earthwork operations will consist of removing existing rubberized membrane, bituminous concrete, and installation of drainage structures. We recommend all earthwork operations be performed under adequate specifications and properly monitored in the field by qualified geotechnical engineers and technicians. Specific recommendations relative to the athletic track and parking lot are provided in the respective sections herein.

Any engineered fill placed within the site should consist of approved, environmentally clean material. Engineered fill should be free of organic matter, frozen soil, clods, or other harmful substances. The fill should be placed in uniform horizontal layers, not more than 9 inches in loose thickness. The engineered fill should be compacted to achieve a density of at least 95 percent of the maximum dry density, as determined by the Modified Proctor compaction test (ASTM D 1557). Any granular fill used within the site may be compacted within 2 percent above or below optimum moisture content. Frozen material should not be used as fill, nor should fill be placed on a frozen subgrade.

**ATHLETIC TRACK RECOMMENDATIONS**

We understand the existing running track is to be rehabilitated. Based on Google Earth historical images, the track was constructed prior to 2002. The track surface appears to be in good condition with some low severity longitudinal cracking visible through the membrane and breakdown of the membrane itself. Approximately 1/2 to 3/4 inches of rubberized membrane over 2-1/2 to 5-1/2 inches of bituminous concrete are present at the boring locations. The pavement cores are in good condition. Photographic documentation of the track surface and individual cores is presented on Figure Nos. 15 through 22 in the Appendix.

Approximately 3 to 10 inches of sand and gravel crushed limestone underlie the bituminous concrete. Additionally, 4 to 7 inches of pulverized asphalt are present below the crushed limestone, with the exception of at boring B-4. Grain size analyses were performed on samples of the aggregate base obtained from borings B-3 and B-7. The crushed limestone meets or is slightly out of specification for gradation requirements of MDOT 21AA dense-graded aggregate, as presented on Figure No. 13, Grain Size Distribution, and the table below. The value in bold indicates where the material is slightly out of specification.

| Sieve Size | MDOT21AA Percent Passing Specification | B-3 Aggregate Base Percent Passing | B-7 Aggregate Base Percent Passing |
|---|---|---|---|
| 1-1/2” | 100 | 100 | 100 |
| 1” | 85 to 100 | 92 | 97 |
| 1/2” | 50 to 75 | 68 | 72 |
| No. 8 | 20 to 45 | 25 | 39 |
| Loss by Wash | 4 to 8 | 6 | **10** |
| **Meets 21AA Gradation** | | YES | **NO** |

Based on minimal visible distress of the rubberized membrane at the track alignment and total combined crushed limestone and pulverized asphalt section of approximately 8 to 15 inches, we recommend the track be rehabilitated by milling the existing bituminous concrete a maximum of 1-1/2 inches and constructing a bituminous concrete overlay consisting of 1-1/2 inches of MDOT 5E1 bituminous concrete wearing course. At the north end of the field within the high jump area, only 2-1/4 inches of bituminous concrete are present which is not sufficient to mill. Therefore, we recommend the bituminous concrete be completely removed and a new bituminous concrete section consisting of 1-1/2 inches of MDOT 5E1 over 1-1/2 inches of MDOT 4E1 be constructed on the existing aggregate base.

Prior to constructing the overlay, any existing cracks or joints in the pavement surface wider than 1/8 inch should be cleaned, covered with emulsified tack, then fill with a hand patching bituminous concrete mix. Any areas of the pavement that exhibit excessive fatigue cracking or deterioration should be completely removed to expose the existing subgrade soils and replaced with a full depth patch.

For full depth patches, the bituminous concrete should be saw-cut a minimum 2 feet laterally from the distressed area to be removed. The underlying aggregate should be proof compacted and areas that remain unstable should be undercut and replaced with a minimum of 8 inches of MDOT 21AA dense

graded aggregate. We recommend the bituminous concrete section within full depth patch areas match the removed pavement thickness (or a minimum total thickness of 3 inches) and consist of MDOT 3E1 or 4E1 bituminous concrete leveling course. Prior to placing the full-depth patch, a tack coat should be applied to the sides of the saw-cut pavement. Additionally, after milling and full depth patching, as required, a bituminous tack coat must be placed prior to placement of the overlay.

At the high jump area, the existing bituminous concrete should be completely removed and the underlying aggregate base graded to accommodate the proposed design pavement section and construction of the proposed trough drain. The exposed aggregate base should be thoroughly proof compacted with a vibratory roller making a minimum of 10 passes across the subgrade in 2 perpendicular directions and visually evaluated by qualified personnel for support of pavements. Any unstable or unsuitable areas noted during proof compaction operations should be improved through additional compaction or undercut and replaced with engineered fill.

Subgrade undercuts, if required within full depth patches, should be evaluated by a qualified engineering technician to determine if subgrade stabilization is necessary. All engineered fill should be compacted as described in the SITE PREPARATION section of this report. Undercuts backfilled with granular soils will need to be tied into the drain system to avoid trapping water in the granular soils surrounded by the cohesive soils and creating “bathtubs”.

The new membrane surface should be applied to the track bituminous pavement surface upon completion of the required pavement curing period. We recommend a minimum pavement curing period of two weeks prior to placing any membrane running surface. However, the manufacturer’s recommendations should be followed and may be longer than two weeks.

All pavement materials are specified within the 2020 Standard Specifications for Construction prepared by the Michigan Department of Transportation. The bituminous pavement materials can be found in Division 5 and the dense-graded aggregate base materials are described in Division 9. Per MDOT specifications, the asphalt pavement materials can be assigned a structural coefficient number of 0.42, any imported MDOT 21AA dense-graded aggregate base can be assigned a structural coefficient number of 0.14, and the existing aggregate base can be assigned a structural coefficient number of 0.11. We recommend that bituminous concrete utilize grade PG 64-22, with no more than 17 percent of the overall binder content from reclaimed asphalt pavement (RAP) within the top wearing course layer.

**PARKING LOT PAVEMENT RECOMMENDATIONS**

We understand the south parking lot is to be reconstructed in the same alignment with a standard-duty bituminous concrete section. The existing bituminous pavements are in fair condition, exhibiting generally moderate severity fatigue cracking throughout as depicted in the photographs on Figure Nos. 22 through 25. Potholes and moderate to high severity distress are visible on the east side of the lot (Photograph No. 22). The bituminous concrete cores are in good condition as depicted in the photographs on Photograph Nos. 23 through 27.

The west side of the parking lot is flush with the grass and concrete curb and gutter line the east side of the lot with two drainage structures at the edge of the gutter. It appears the existing pavement is designed to sheet drain from the west to the curb and gutter and drainage structures and the proposed pavement is also designed to drain in the same manner. The most significant distress noted across the lot is at the east side which indicates drainage may be a contributing factor in the observed pavement distress. As such, we recommend additional drainage be included in the new parking lot design, as discussed in the Pavement Drainage section of this report.

Grain size analyses were performed on aggregate base samples obtained from borings B-64 and B-68. The aggregate base material does not meet the gradation requirements of MDOT 21AA dense-graded aggregate as presented in the chart below and on Figure No. 13, Grain Size Distribution.

| Sieve Size | MDOT21AA Percent Passing Specification | B-64 Aggregate Base Percent Passing | B-68 Aggregate Base Percent Passing |
|---|---|---|---|
| 1-1/2" | 100 | 100 | 100 |
| 1" | 85 to 100 | 93 | 98 |
| 1/2" | 50 to 75 | **77** | **82** |
| No. 8 | 20 to 45 | 37 | 39 |
| Loss by Wash | 4 to 8 | **14** | **10** |
| **Meets 21AA Gradation** | | **NO** | **NO** |

Considering the combined thickness of the aggregate base and underlying pulverized asphalt, we recommend the existing bituminous concrete be removed and a new pavement section be constructed on the existing aggregate base following installation of additional drainage structures. The existing bituminous concrete should be completely removed and the underlying aggregate base graded to accommodate the proposed design pavement section. The exposed aggregate base should be thoroughly proof compacted with a vibratory roller making a minimum of 10 passes across the subgrade in 2 perpendicular directions and visually evaluated by qualified personnel for support of pavements. Any unstable or unsuitable areas noted during proof compaction operations should be improved through additional compaction or undercut and replaced with engineered fill.

We recommend a budget on the order of 10 to 15 percent of surface area be allocated for undercutting during proof compaction operations based on the existing pavement distress, focused predominantly on the east side of the lot. Subgrade undercuts, if required, should be evaluated by G2 personnel to determine if subgrade stabilization is necessary. We recommend undercut excavations, where required, be backfilled with MDOT 21AA dense graded aggregate placed in an engineered manner. Lift thicknesses should not exceed 9 inches. The use of a tri-axial geogrid may reduce undercut depths, if needed. We recommend a drain tile be placed within any undercut areas and connected to adjacent drainage structures to prevent groundwater from pooling within the granular soils in undercuts and creating "bathtubs" in the cohesive soils. All engineered fill should be compacted as described in the SITE PREPARATION section of this report.

To minimize subgrade instability and undercuts, we recommend the exposed subgrade not be left exposed to precipitation and construction operations be performed during the summer months to ensure dry, warm, weather.

We performed pavement design analyses in accordance with the "AASHTO Guide for Design of Pavement Structures". The subgrade soils are anticipated to consist of silty sand fill and native silty clay. Cohesive are considered fair for support of pavements, predominantly due to their poor drainage properties. We have provided design pavement sections based on an effective subgrade resilient modulus of 6,000 pounds per square inch (psi).

We anticipate traffic at the parking lot will consist of cars. We have evaluated the standard-duty pavement section on an estimated of 50,000 18-kip equivalent single-axle loads (ESALs) over a 20-year design life. For evaluation purposes, we have utilized a serviceability loss of 2.0, a standard deviation of 0.49 for flexible pavements, and a reliability factor of 0.85. If additional traffic volume information becomes available, G2 should be notified so we can re-evaluate our recommendations. Based on the results of our analysis and construction considerations, we recommend the following pavement design cross section for the new pavement:

| Standard-Duty Flexible Pavement Section | | |
|---|---|---|
| **Material** | **Thickness** | **Structural Coefficient** |
| Bituminous Wearing Course (MDOT 5EML) | 2 inches | 0.42 |
| Bituminous Leveling Course (MDOT 4EML) | 2 inches | 0.42 |
| Existing Aggregate Base | | 0.11 |

All pavement materials are specified within the 2020 Standard Specifications for Construction prepared by the Michigan Department of Transportation. The bituminous pavement materials can be found in Division 5 and the dense-graded aggregate base materials are described in Division 9. Per MDOT specifications, the asphalt pavement materials can be assigned a structural coefficient number of 0.42, any imported MDOT 21AA dense-graded aggregate base can be assigned a structural coefficient number of 0.14, and the existing aggregate base can be assigned a structural coefficient number of 0.11. We recommend that bituminous concrete utilize grade PG 68-22 binder, with no more than 17 percent of the overall binder content from reclaimed asphalt pavement (RAP) within the top wearing course layer.

**Pavement Drainage**

Proper pavement drainage is essential for long-term pavement performance, especially considering the historical distress of the lot and native cohesive soils. The pavement and subgrade should be properly sloped to promote effective surface and subsurface drainage and prevent water from ponding, especially as the pavements age. We also recommend pavement subbase materials consist of non-frost-susceptible aggregates where possible.

We recommend additional drainage structures be installed, particularly along the west and east sides of the lot based on the proposed west / east sheet drain design. This will catch water before it goes under the pavement on the west side as well as water entering distress on the east side as the pavement ages. In addition, we recommend installing finger drains at each catch basin to remove groundwater from the aggregate base layer. Such drains should extend to minimum depths of 4 inches below the bottom of the proposed aggregate base course or granular fill placed within undercut areas and connect to the nearest catch basin. We also recommend edge drains be installed around the pavement perimeter to prevent seepage into the pavement base.

**Pavement Maintenance**

Regular timely maintenance should be performed on the bituminous pavement to reduce the potential deterioration associated with moisture infiltration through surface cracks. The owner should be prepared to seal the cracks with a hot-applied elastic crack filler as soon as possible after cracking develops and as often as necessary to block the passage of water to the subgrade soils.

**GENERAL COMMENTS**

We have formulated the evaluations and recommendations presented in this report relative to site preparation on the basis of data provided to us relating to the location, type, and grade for the proposed site. Any significant change in this data should be brought to our attention for review and evaluation with respect to the prevailing subsurface conditions. Furthermore, if changes occur in the design, location, or concept of the project, the conclusions and recommendations contained in this report are not valid unless G2 Consulting Group, LLC reviews the changes. G2 Consulting Group, LLC will then confirm the recommendations presented herein or make changes in writing.

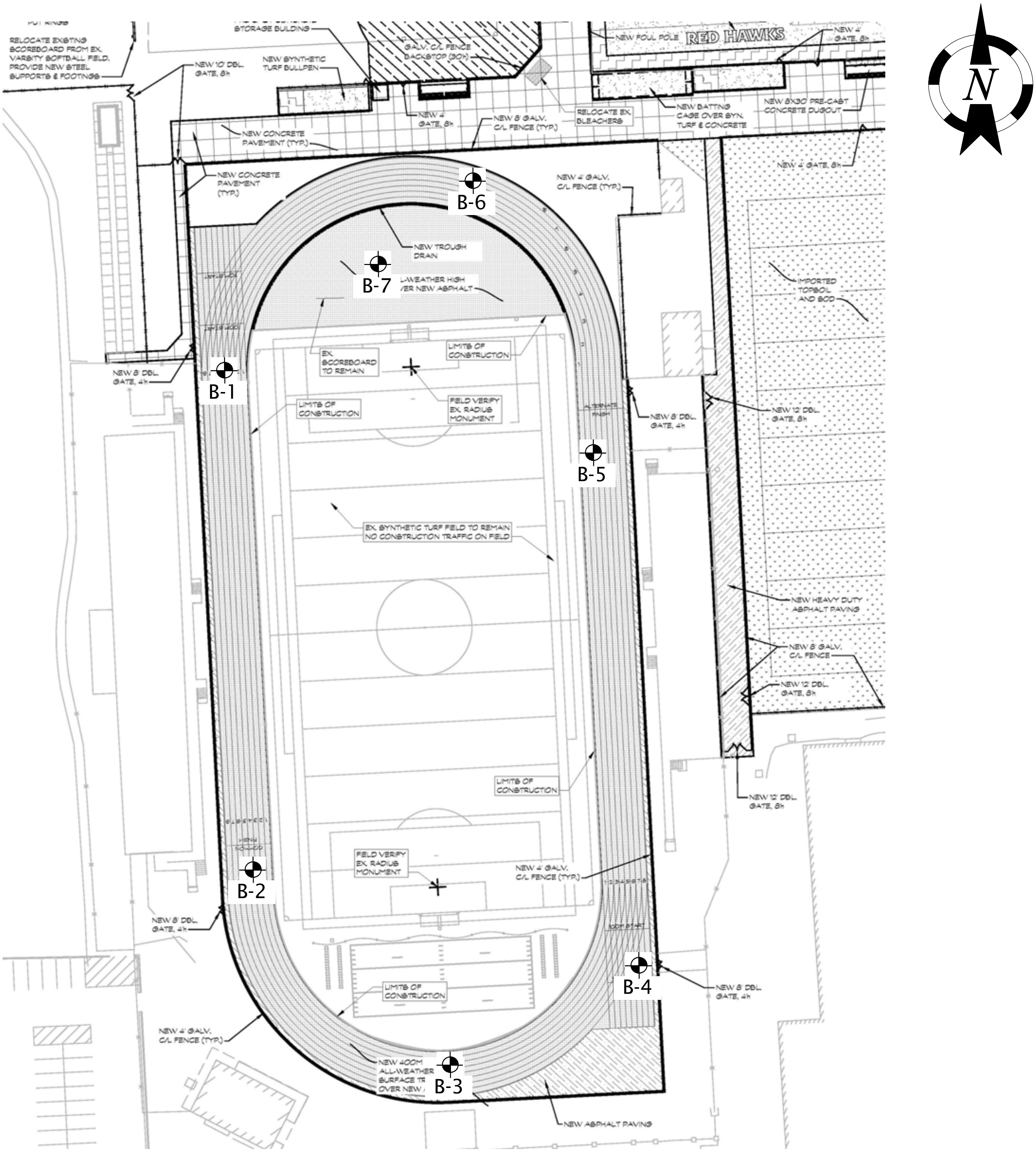
The scope of the present investigation was limited to evaluation of subsurface conditions for the support of proposed running track and pavement improvements and other related aspects of the development.

No chemical, environmental or hydrogeological testing or analyses were included in the scope of this investigation.

We base the analyses and recommendations submitted in this report upon the data from the soil borings performed at the approximate locations shown on the Soil Boring Location Plan, Plate Nos. 1 and 2. This report does not reflect variations that may occur away from the actual boring locations. The nature and extent of any such variations may not become clear until the time of construction. If significant variations then become evident, it may be necessary for us to re-evaluate our report recommendations.

Accordingly, we recommend G2 Consulting Group, LLC observe all geotechnical related work, including foundation construction, subgrade preparation, and engineered fill placement. G2 Consulting Group, LLC will perform the appropriate testing to confirm the geotechnical conditions given in the report are found during construction.

## APPENDIX




## Legend

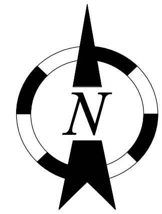
Soil Borings Drilled By G2 Consulting Group, LLC on October 19, 2024

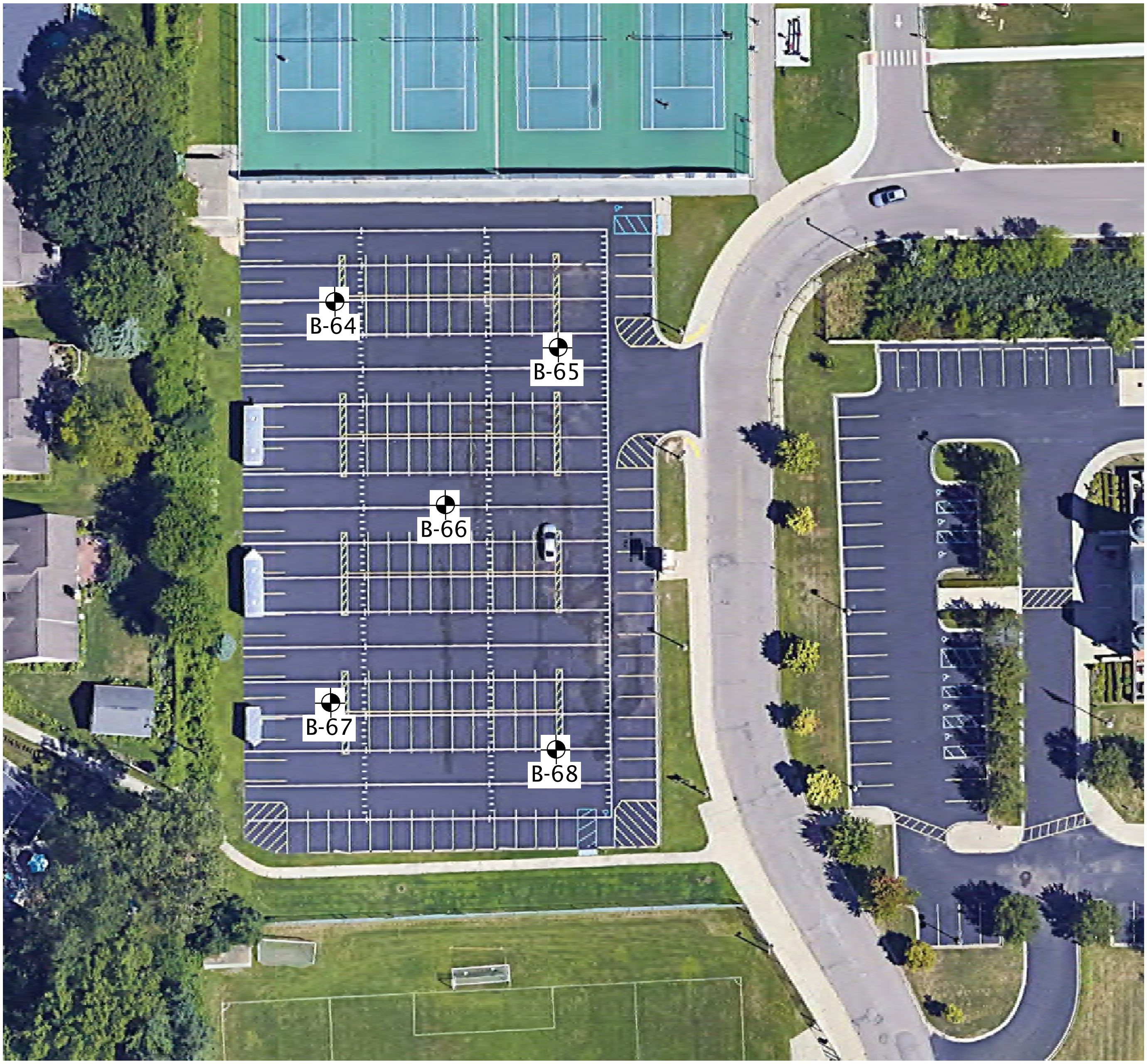
## Soil Boring Location Plan

Troy Athens High School
4333 John R Road
Troy, Michigan 48085

G2 CONSULTING GROUP

| | | |
|---|---|---|
| Project No. 240782 | | |
| Drawn by: ALS | | |
| Date: 11/5/24 | Plate No. 1 | |
| Scale: NTS | | |




## Legend

Soil Borings Drilled By G2 Consulting Group, LLC on October 19, 2024

| Soil Boring Location Plan | | |
|---|---|---|
| Troy Athens High School<br>4333 John R Road<br>Troy, Michigan 48085 | | |
| G2 CONSULTING GROUP | Project No. 240782 | |
| | Drawn by: ALS | |
| | Date: 11/5/24 | Plate No. 2 |
| | Scale: NTS | |

Project Name: Troy Athens High School Running Track and Pavement Improvements
Project Location: 4333 John R Road
Troy, Michigan 48085

G2 Project No. 240782
Latitude: N/A Longitude: N/A

# Soil Boring No. **B-1**

G2 CONSULTING GROUP

## SUBSURFACE PROFILE / SOIL SAMPLE DATA

| ELEV. (ft) | GROUND SURFACE ELEVATION: 654.0 ft ± | DEPTH (ft) | SAMPLE TYPE/NO. | DCP BLOWS/ 1.75-INCHES | MOISTURE CONTENT (%) | DRY DENSITY (PCF) | UNCOF. COMP. ST. (PSF) |
|---|---|---|---|---|---|---|---|
| | Rubberized Track (3/4 inch) Bituminous Concrete (3-3/4 inches) | 0.4 | | | | | |
| | Crushed Limestone: Sand and Gravel (4 inches) | 0.7 | AS-1 | | | | |
| | Pulverized Asphalt (6 inches) | 1.2 | | | | | |
| | Fill: Brown Silty Sand with trace clay and gravel | 1.8 | AS-2 | 22 | 17.9 | | 7000* |
| | Very Stiff Brown and Gray Silty Clay with trace sand and gravel | 4.0 | AS-3 | 30 | 10.0 | | 9000* |
| 649.0 | End of Boring @ 4 ft | 5 | | | | | |

Total Depth: 4 ft
Drilling Date: October 19, 2024
Inspector:
Contractor: G2 Consulting Group, LLC
Driller: A. Nolan

Drilling Method:
4 inch diameter diamond-tipped core barrel and 3 inch diameter hand auger

Water Level Observation:
Dry during and upon completion of drilling operations

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings and capped with cold patch

Figure No. 1

PAVEMENT CORE DCP 240782.GPJ 20140820 G2 CONSULTING DATA TEMPLATE.GDT 11/11/24

Project Name: Troy Athens High School Running Track and Pavement Improvements
Project Location: 4333 John R Road
Troy, Michigan 48085

G2 Project No. 240782
Latitude: N/A Longitude: N/A

# Soil Boring No. **B-2**

G2 CONSULTING GROUP

| SUBSURFACE PROFILE | | | | SOIL SAMPLE DATA | | | | |
|---|---|---|---|---|---|---|---|---|
| ELEV. (ft) | PRO-FILE | GROUND SURFACE ELEVATION: 654.0 ft ± | DEPTH (ft) | SAMPLE TYPE/NO. | DCP BLOWS/ 1.75-INCHES | MOISTURE CONTENT (%) | DRY DENSITY (PCF) | UNCOF. COMP. ST. (PSF) |
| | | Rubberized Track (1/2 inch) Bituminous Concrete (3 inches) — 0.3 | | | | | | |
| | | Crushed Limestone: Sand and Gravel (3 inches) — 0.5 | | AS-1 | | | | |
| | | Pulverized Asphalt (6 inches) — 1.0 | | | | | | |
| | | Fill: Brown Silty Sand with trace clay and gravel — 1.5 | | | | | | |
| | | Very Stiff to Hard Brown and Gray Silty Clay with trace sand and gravel — 4.0 | | AS-2 | 30 | 12.2 | | 9000* |
| | | | | AS-3 | 25 | 12.6 | | 8000* |
| | | End of Boring @ 4 ft | | | | | | |
| 649.0 | | | 5 | | | | | |

Total Depth: 4 ft
Drilling Date: October 19, 2024
Inspector:
Contractor: G2 Consulting Group, LLC
Driller: A. Nolan

Drilling Method:
4 inch diameter diamond-tipped core barrel and 3 inch diameter hand auger

Water Level Observation:
Dry during and upon completion of drilling operations

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings and capped with cold patch

Figure No. 2

Project Name: Troy Athens High School Running Track and Pavement Improvements
Project Location: 4333 John R Road
Troy, Michigan 48085

G2 Project No. 240782
Latitude: N/A Longitude: N/A

# Soil Boring No. **B-3**

G2 CONSULTING GROUP

| SUBSURFACE PROFILE | | | | SOIL SAMPLE DATA | | | | |
|---|---|---|---|---|---|---|---|---|
| ELEV. (ft) | PRO-FILE | GROUND SURFACE ELEVATION: 654.0 ft ± | DEPTH (ft) | SAMPLE TYPE/NO. | DCP BLOWS/ 1.75-INCHES | MOISTURE CONTENT (%) | DRY DENSITY (PCF) | UNCOF. COMP. ST. (PSF) |
| | | Rubberized Track (1/2 inch) Bituminous Concrete (4-1/2 inches) — 0.4 | | | | | | |
| | | Crushed Limestone: Sandy Gravel (6 inches) — 0.9 | | AS-1 | | | | |
| | | Pulverized Asphalt (4 inches) — 1.3 | | | | | | |
| | | Fill: Hard Dark Gray Silty Clay with trace sand, gravel, and occasional sand seams (Organic Matter Content = 1.5%) — 4.0 | | AS-2 | 25 | 12.9 | | 8000* |
| | | | | AS-3 | 27 | 14.8 | | 8000* |
| | | End of Boring @ 4 ft | | | | | | |
| 649.0 | | | 5 | | | | | |

Total Depth: 4 ft
Drilling Date: October 19, 2024
Inspector:
Contractor: G2 Consulting Group, LLC
Driller: A. Nolan

Drilling Method:
4 inch diameter diamond-tipped core barrel and 3 inch diameter hand auger

Water Level Observation:
Dry during and upon completion of drilling operations

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings and capped with cold patch

Figure No. 3

Project Name: Troy Athens High School Running Track and Pavement Improvements

Project Location: 4333 John R Road
Troy, Michigan 48085

G2 Project No. 240782

Latitude: N/A Longitude: N/A

# Soil Boring No. **B-4**

G2 CONSULTING GROUP

| SUBSURFACE PROFILE | | | | SOIL SAMPLE DATA | | | | |
|---|---|---|---|---|---|---|---|---|
| ELEV. (ft) | PRO-FILE | GROUND SURFACE ELEVATION: 654.5 ft ± | DEPTH (ft) | SAMPLE TYPE/NO. | DCP BLOWS/ 1.75-INCHES | MOISTURE CONTENT (%) | DRY DENSITY (PCF) | UNCOF. COMP. ST. (PSF) |
| | | Rubberized Track (1/2 inch) Bituminous Concrete (4 inches) — 0.4 | | | | | | |
| | | Crushed Limestone and Pulverized Asphalt (10 inches) — 1.2 | | AS-1 | | | | |
| | | Fill: Very Stiff Dark Gray Sandy Clay with trace silt, gravel, and occasional sand seams (Organic Matter Content = 2.0%) — 4.0 | | AS-2 | 20 | 14.7 | | 6000* |
| | | | | AS-3 | 14 | 15.9 | | 4000* |
| | | End of Boring @ 4 ft | | | | | | |
| 649.5 | | | 5 | | | | | |

Total Depth: 4 ft
Drilling Date: October 19, 2024
Inspector:
Contractor: G2 Consulting Group, LLC
Driller: A. Nolan

Drilling Method:
4 inch diameter diamond-tipped core barrel and 3 inch diameter hand auger

Water Level Observation:
Dry during and upon completion of drilling operations

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings and capped with cold patch

Figure No. 4

# Soil Boring No. **B-5**

Project Name: Troy Athens High School Running Track and Pavement Improvements
Project Location: 4333 John R Road, Troy, Michigan 48085
G2 Project No. 240782
Latitude: N/A    Longitude: N/A

G2 CONSULTING GROUP

## SUBSURFACE PROFILE / SOIL SAMPLE DATA

GROUND SURFACE ELEVATION: 654.0 ft ±

| ELEV. (ft) | DESCRIPTION | DEPTH (ft) | SAMPLE TYPE/NO. | DCP BLOWS/ 1.75-INCHES | MOISTURE CONTENT (%) | DRY DENSITY (PCF) | UNCOF. COMP. ST. (PSF) |
|---|---|---|---|---|---|---|---|
| | Rubberized Track (1/2 inch) Bituminous Concrete (5-1/2 inches) | 0.5 | | | | | |
| | Crushed Limestone: Sand and Gravel (4 inches) | 0.9 | AS-1 | | | | |
| | Pulverized Asphalt (4 inches) | 1.2 | | | | | |
| | | | AS-2 | 20 | 11.2 | | 6000* |
| | Fill: Very Stiff Dark Gray Sandy Clay with trace silt, gravel, and occasional sand seams (Organic Matter Content = 1.0%) | 4.0 | AS-3 | 23 | 10.8 | | 7000* |
| | End of Boring @ 4 ft | | | | | | |
| 649.0 | | 5 | | | | | |

Total Depth: 4 ft
Drilling Date: October 19, 2024
Inspector:
Contractor: G2 Consulting Group, LLC
Driller: A. Nolan

Drilling Method:
4 inch diameter diamond-tipped core barrel and 3 inch diameter hand auger

Water Level Observation:
Dry during and upon completion of drilling operations

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings and capped with cold patch

Figure No. 5

Project Name: Troy Athens High School Running Track and Pavement Improvements
Project Location: 4333 John R Road
Troy, Michigan 48085

G2 Project No. 240782
Latitude: N/A Longitude: N/A

# Soil Boring No. **B-6**

CONSULTING GROUP

## SUBSURFACE PROFILE / SOIL SAMPLE DATA

GROUND SURFACE ELEVATION: 654.0 ft ±

| ELEV. (ft) | PRO-FILE | DESCRIPTION | DEPTH (ft) | SAMPLE TYPE/NO. | DCP BLOWS/ 1.75-INCHES | MOISTURE CONTENT (%) | DRY DENSITY (PCF) | UNCOF. COMP. ST. (PSF) |
|---|---|---|---|---|---|---|---|---|
| | | Rubberized Track (1/2 inch) Bituminous Concrete (4 inches) | 0.4 | | | | | |
| | | Crushed Limestone: Sand and Gravel (3 inches) | 0.6 | AS-1 | | | | |
| | | Pulverized Asphalt (7 inches) | 1.2 | | | | | |
| | | Fill: Loose Dark Brown Silty Sand with trace clay and gravel (Organic Matter Content = 1.3%) | 3.0 | AS-2 | 6 | | | |
| | | Very Stiff Brown and Gray Silty Clay with trace sand and gravel | 4.0 | AS-3 | 16 | 19.2 | | 5000* |
| | | End of Boring @ 4 ft | | | | | | |
| 649.0 | | | 5 | | | | | |

Total Depth: 4 ft
Drilling Date: October 19, 2024
Inspector:
Contractor: G2 Consulting Group, LLC
Driller: A. Nolan

Drilling Method:
4 inch diameter diamond-tipped core barrel and 3 inch diameter hand auger

Water Level Observation:
Dry during and upon completion of drilling operations

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings and capped with cold patch

Project Name: Troy Athens High School Running Track and Pavement Improvements

Project Location: 4333 John R Road
Troy, Michigan 48085

G2 Project No. 240782

Latitude: N/A Longitude: N/A

# Soil Boring No. **B-7**

G2 CONSULTING GROUP

## SUBSURFACE PROFILE / SOIL SAMPLE DATA

GROUND SURFACE ELEVATION: 654.0 ft ±

| ELEV. (ft) | DESCRIPTION | DEPTH (ft) | SAMPLE TYPE/NO. | DCP BLOWS/ 1.75-INCHES | MOISTURE CONTENT (%) | DRY DENSITY (PCF) | UNCOF. COMP. ST. (PSF) |
|---|---|---|---|---|---|---|---|
| | Rubberized Track (1/2 inch) Bituminous Concrete (2-1/2 inches) | 0.3 | | | | | |
| | Crushed Limestone: Sand and Gravel (10 inches) | 1.1 | AS-1 | | | | |
| | Pulverized Asphalt (5 inches) | 1.5 | | | | | |
| | Fill: Loose Dark Brown Silty Sand with trace clay and gravel (Organic Matter Content = 1.6%) | 2.8 | AS-2 | 7 | | | |
| | Very Stiff Brown and Gray Silty Clay with trace sand and gravel | 4.0 | AS-3 | 14 | 20.1 | | 4000* |
| | End of Boring @ 4 ft | | | | | | |
| 649.0 | | 5 | | | | | |

Total Depth: 4 ft
Drilling Date: October 19, 2024
Inspector:
Contractor: G2 Consulting Group, LLC
Driller: A. Nolan

Drilling Method:
4 inch diameter diamond-tipped core barrel and 3 inch diameter hand auger

Water Level Observation:
Dry during and upon completion of drilling operations

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings and capped with cold patch

Project Name: Troy Athens High School Running Track and Pavement Improvements
Project Location: 4333 John R Road
Troy, Michigan 48085

G2 Project No. 240782
Latitude: N/A Longitude: N/A

# Soil Boring No. **B-64**

G2 CONSULTING GROUP

| SUBSURFACE PROFILE | | | | SOIL SAMPLE DATA | | | | |
|---|---|---|---|---|---|---|---|---|
| ELEV. (ft) | PRO-FILE | GROUND SURFACE ELEVATION: 654.0 ft ± | DEPTH (ft) | SAMPLE TYPE/NO. | DCP BLOWS/ 1.75-INCHES | MOISTURE CONTENT (%) | DRY DENSITY (PCF) | UNCOF. COMP. ST. (PSF) |
| | | Bituminous Concrete (4 inches) — 0.3 | | | | | | |
| | | Crushed Limestone: Sand and Gravel (8 inches) — 1.0 | | AS-1 | | | | |
| | | Crushed Concrete: Sand and Gravel with trace silt — 1.7 | | | | | | |
| | | Fill: Loose Brown Silty Sand with trace clay and gravel (Organic Matter Content = 1.1%) — 3.5 | | AS-2 | 7 | | | |
| | | Fill: Hard Gray Silty Clay with trace sand and gravel — 4.0 | | AS-3 | 30 | 9.3 | | 9000* |
| | | End of Boring @ 4 ft | | | | | | |
| 649.0 | | | 5 | | | | | |

Total Depth: 4 ft
Drilling Date: October 19, 2024
Inspector:
Contractor: G2 Consulting Group, LLC
Driller: A. Nolan

Drilling Method:
4 inch diameter diamond-tipped core barrel and 3 inch diameter hand auger

Water Level Observation:
Dry during and upon completion of drilling operations

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings and capped with cold patch

Project Name: Troy Athens High School Running Track and Pavement Improvements
Project Location: 4333 John R Road
Troy, Michigan 48085

G2 Project No. 240782
Latitude: N/A Longitude: N/A

# Soil Boring No. **B-65**

G2 CONSULTING GROUP

| SUBSURFACE PROFILE | | | | SOIL SAMPLE DATA | | | | |
|---|---|---|---|---|---|---|---|---|
| ELEV. (ft) | PRO-FILE | GROUND SURFACE ELEVATION: 653.0 ft ± | DEPTH (ft) | SAMPLE TYPE/NO. | DCP BLOWS/ 1.75-INCHES | MOISTURE CONTENT (%) | DRY DENSITY (PCF) | UNCOF. COMP. ST. (PSF) |
| | | Bituminous Concrete (4 inches) — 0.3 | | | | | | |
| | | Crushed Limestone: Sand and Gravel (9 inches) — 1.1 | | AS-1 | | | | |
| | | Crushed Concrete :Sand and Gravel with trace silt — 1.7 | | | | | | |
| | | Fill: Loose Brown Silty Sand with trace clay and gravel (Organic Matter Content = 1.0%) — 3.0 | | AS-2 | 6 | | | |
| | | Fill: Hard Gray Silty Clay with trace sand and gravel — 4.0 | | AS-3 | 30 | 11.4 | | 9000* |
| | | End of Boring @ 4 ft | | | | | | |
| 648.0 | | | 5 | | | | | |

Total Depth: 4 ft
Drilling Date: October 19, 2024
Inspector:
Contractor: G2 Consulting Group, LLC
Driller: A. Nolan

Drilling Method:
4 inch diameter diamond-tipped core barrel and 3 inch diameter hand auger

Water Level Observation:
Dry during and upon completion of drilling operations

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings and capped with cold patch

Project Name: Troy Athens High School Running Track and Pavement Improvements
Project Location: 4333 John R Road
Troy, Michigan 48085

G2 Project No. 240782

Latitude: N/A Longitude: N/A

# Soil Boring No. **B-66**

G2 CONSULTING GROUP

| SUBSURFACE PROFILE | | | | SOIL SAMPLE DATA | | | | |
|---|---|---|---|---|---|---|---|---|
| ELEV. (ft) | PRO-FILE | GROUND SURFACE ELEVATION: 653.5 ft ± | DEPTH (ft) | SAMPLE TYPE/NO. | DCP BLOWS/ 1.75-INCHES | MOISTURE CONTENT (%) | DRY DENSITY (PCF) | UNCOF. COMP. ST. (PSF) |
| | | Bituminous Concrete (3-1/4 inches) — 0.3 | | | | | | |
| | | Crushed Limestone: Sand and Gravel (8-3/4 inches) — 1.0 | | AS-1 | | | | |
| | | Fill: Brown Silty Sand with trace gravel — 1.8 | | AS-2 | 27 | 12.1 | | 8000* |
| | | Hard Brown and Gray Silty Clay with trace sand and gravel — 4.0 | | AS-3 | 28 | 13.5 | | 8000* |
| | | End of Boring @ 4 ft | | | | | | |
| 648.5 | | | 5 | | | | | |

Total Depth: 4 ft
Drilling Date: October 19, 2024
Inspector:
Contractor: G2 Consulting Group, LLC
Driller: A. Nolan

Drilling Method:
4 inch diameter diamond-tipped core barrel and 3 inch diameter hand auger

Water Level Observation:
1-1/2 feet during drilling operations; dry upon completion

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings and capped with cold patch

Figure No. 10

PAVEMENT CORE DCP 240782.GPJ 20140820 G2 CONSULTING DATA TEMPLATE.GDT 11/11/24

Project Name: Troy Athens High School Running Track and Pavement Improvements
Project Location: 4333 John R Road
Troy, Michigan 48085

G2 Project No. 240782
Latitude: N/A Longitude: N/A

# Soil Boring No. **B-67**

G2 CONSULTING GROUP

| SUBSURFACE PROFILE | | | | SOIL SAMPLE DATA | | | | |
|---|---|---|---|---|---|---|---|---|
| ELEV. (ft) | PRO-FILE | GROUND SURFACE ELEVATION: 654.0 ft ± | DEPTH (ft) | SAMPLE TYPE/NO. | DCP BLOWS/ 1.75-INCHES | MOISTURE CONTENT (%) | DRY DENSITY (PCF) | UNCOF. COMP. ST. (PSF) |
| | | Bituminous Concrete (3-1/4 inches) 0.3 | | | | | | |
| | | Crushed Limestone: Sand and Gravel (5 inches) 0.7 | | AS-1 | | | | |
| | | Fill: Loose Brown Silty Sand with trace gravel 3.0 | | AS-2 | 9 | | | |
| | | End of Boring @ 3 ft, Auger Refusal | | | | | | |
| 649.0 | | | 5 | | | | | |

Total Depth: 3 ft
Drilling Date: October 19, 2024
Inspector:
Contractor: G2 Consulting Group, LLC
Driller: A. Nolan

Water Level Observation:
3 feet during and upon completion of drilling operations

Excavation Backfilling Procedure:
Auger cuttings and capped with cold patch

Drilling Method:
4 inch diameter diamond-tipped core barrel and 3 inch diameter hand auger

PAVEMENT CORE DCP 240782.GPJ 20140820 G2 CONSULTING DATA TEMPLATE.GDT 11/11/24

Project Name: Troy Athens High School Running Track and Pavement Improvements
Project Location: 4333 John R Road
Troy, Michigan 48085

G2 Project No. 240782
Latitude: N/A Longitude: N/A

# Soil Boring No. **B-68**

2G CONSULTING GROUP

## SUBSURFACE PROFILE

GROUND SURFACE ELEVATION: 653.0 ft ±

| ELEV. (ft) | DEPTH (ft) | Description | Layer bottom depth |
|---|---|---|---|
| | | Bituminous Concrete (2-3/4 inches) | 0.2 |
| | | Crushed Limestone: Sand and Gravel (6 inches) | 0.7 |
| | | Very Stiff Brown and Gray Silty Clay with trace sand and gravel | 4.0 |
| | | End of Boring @ 4 ft | |
| 648.0 | 5 | | |

## SOIL SAMPLE DATA

| SAMPLE TYPE/NO. | DCP BLOWS/ 1.75-INCHES | MOISTURE CONTENT (%) | DRY DENSITY (PCF) | UNCOF. COMP. ST. (PSF) |
|---|---|---|---|---|
| AS-1 | | | | |
| AS-2 | 23 | 20.6 | | 7000* |
| AS-3 | 24 | 22.0 | | 7000* |

Total Depth: 4 ft
Drilling Date: October 19, 2024
Inspector:
Contractor: G2 Consulting Group, LLC
Driller: A. Nolan

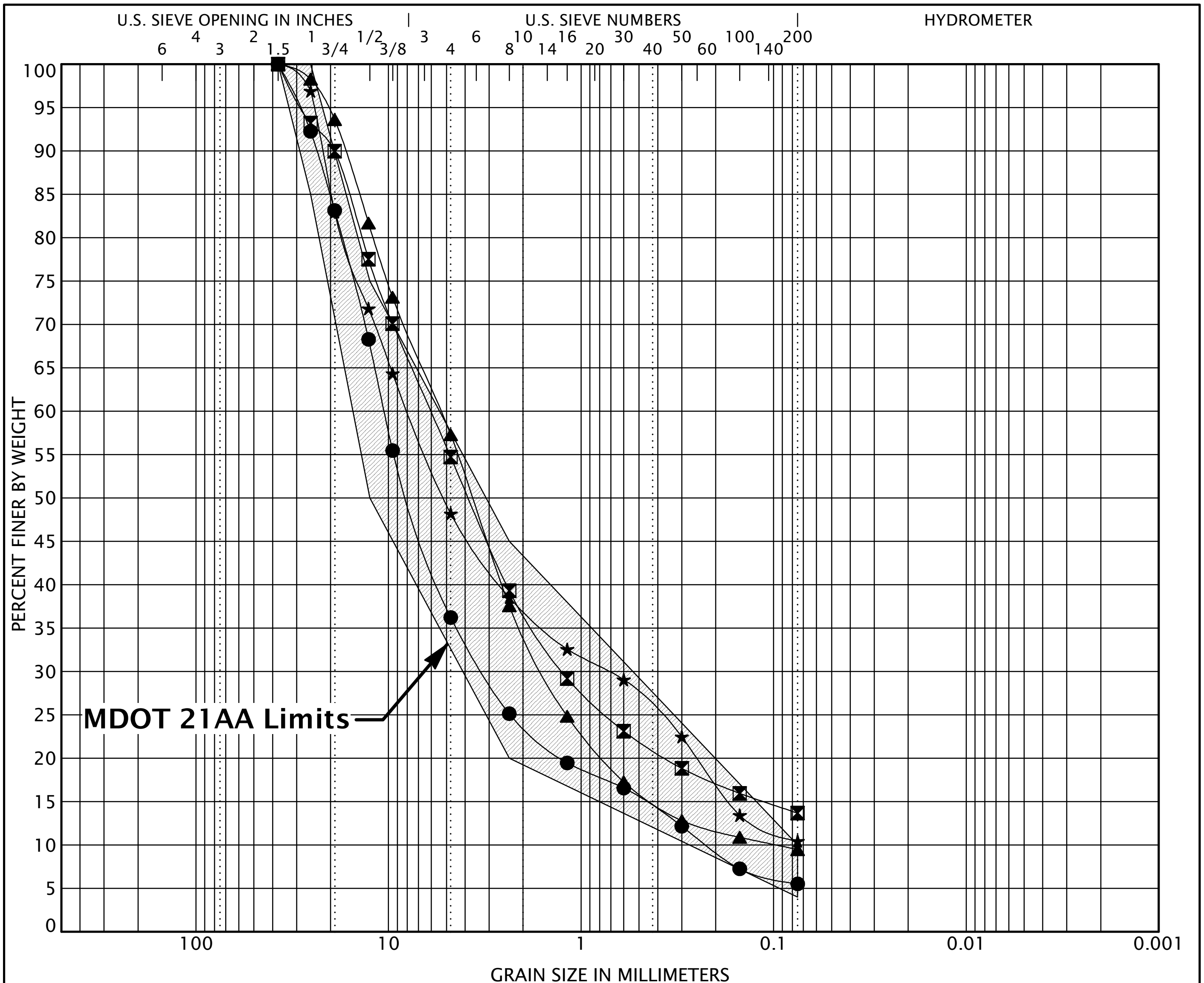
Drilling Method:
4 inch diameter diamond-tipped core barrel and 3 inch diameter hand auger

Water Level Observation:
Dry during and upon completion of drilling operations

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings and capped with cold patch

PAVEMENT CORE DCP 240782.GPJ 20140820 G2 CONSULTING DATA TEMPLATE.GDT 11/11/24




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| | Specimen ID | | Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|---|
| ● | B-3 | AS-1 | Sandy Gravel with trace silt | | | | 4.42 | 47.74 |
| ⧗ | B-64 | AS-1 | Sand and Gravel with little silt | | | | | |
| ▲ | B-68 | AS-1 | Sand and Gravel with trace silt | | | | 4.70 | 55.04 |
| ★ | B-7 | AS-1 | Sand and Gravel with trace silt | | | | 0.97 | 116.90 |

| | Specimen ID | | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|---|---|
| ● | B-3 | AS-1 | 37.5 | 10.547 | 3.209 | 0.221 | 63.8 | 30.7 | 5.5 | |
| ⧗ | B-64 | AS-1 | 37.5 | 6.034 | 1.248 | | 45.3 | 41.0 | 13.7 | |
| ▲ | B-68 | AS-1 | 37.5 | 5.352 | 1.563 | 0.097 | 42.7 | 47.8 | 9.5 | |
| ★ | B-7 | AS-1 | 37.5 | 7.901 | 0.72 | | 51.8 | 37.7 | 10.4 | |

G2 CONSULTING GROUP

# GRAIN SIZE DISTRIBUTION

Project Name: Troy Athens High School Running Track and Pavement Improvements

Project Location: 4333 John R Road, Troy, Michigan 48085

G2 Project No.: 240782

Figure No. 13

US_GRAIN_SIZE_MDOT_21AA 240782.GPJ 20140820 G2 CONSULTING DATA TEMPLATE.GDT 11/11/24

CONSULTING GROUP

# GENERAL NOTES TERMINOLOGY

Unless otherwise noted, all terms herein refer to the Standard Definitions presented in ASTM 653.

**PARTICLE SIZE**

| | | |
|---|---|---|
| Boulders | | - greater than 12 inches |
| Cobbles | | - 3 inches to 12 inches |
| Gravel | - Coarse | - 3/4 inches to 3 inches |
| | - Fine | - No. 4 to 3/4 inches |
| Sand | - Coarse | - No. 10 to No. 4 |
| | - Medium | - No. 40 to No. 10 |
| | - Fine | - No. 200 to No. 40 |
| Silt | | - 0.005mm to 0.074mm |
| Clay | | - Less than 0.005mm |

**CLASSIFICATION**

The major soil constituent is the principal noun, i.e. clay, silt, sand, gravel. The second major soil constituent and other minor constituents are reported as follows:

| Second Major Constituent (percent by weight) | Minor Constituent (percent by weight) |
|---|---|
| Trace - 1 to 12% | Trace - 1 to 12% |
| Adjective - 12 to 35% | Little - 12 to 23% |
| And - over 35% | Some - 23 to 33% |

## COHESIVE SOILS

If clay content is sufficient so that clay dominates soil properties, clay becomes the principal noun with the other major soil constituent as modifier, i.e. sandy clay. Other minor soil constituents may be included in accordance with the classification breakdown for cohesionless soils, i.e. silty clay, trace sand, little gravel.

| Consistency | Unconfined Compressive Strength (psf) | Approximate Range of (N) |
|---|---|---|
| Very Soft | Below 500 | 0 - 2 |
| Soft | 500 - 1,000 | 3 - 4 |
| Medium | 1,000 - 2,000 | 5 - 8 |
| Stiff | 2,000 - 4,000 | 9 - 15 |
| Very Stiff | 4,000 - 8,000 | 16 - 30 |
| Hard | 8,000 - 16,000 | 31 - 50 |
| Very Hard | Over 16,000 | Over 50 |

Consistency of cohesive soils is based upon an evaluation of the observed resistance to deformation under load and not upon the Standard Penetration Resistance (N).

## COHESIONLESS SOILS

| Density Classification | Relative Density % | Approximate Range of (N) |
|---|---|---|
| Very Loose | 0 - 15 | 0 - 4 |
| Loose | 16 - 35 | 5 - 10 |
| Medium Compact | 36 - 65 | 11 - 30 |
| Compact | 66 - 85 | 31 - 50 |
| Very Compact | 86 - 100 | Over 50 |

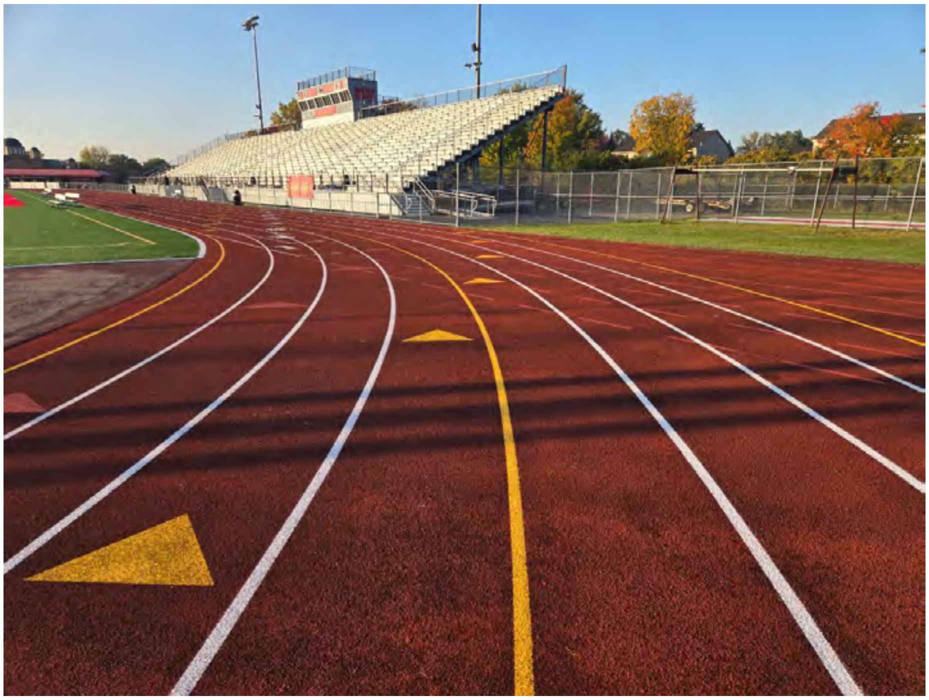
Relative Density of cohesionless soils is based upon the evaluation of the Standard Penetration Resistance (N), modified as required for depth effects, sampling effects, etc.

## SAMPLE DESIGNATIONS

AS - Auger Sample – Cuttings directly from auger flight
BS - Bottle or Bag Samples
S - Split Spoon Sample - ASTM D 1586
LS - Liner Sample with liner insert 3 inches in length
ST - Shelby Tube sample - 3 inch diameter unless otherwise noted
PS - Piston Sample - 3 inch diameter unless otherwise noted
RC - Rock Core - NX core unless otherwise noted

STANDARD PENETRATION TEST (ASTM D 1586) - A 2.0 inch outside-diameter, 1-3/8 inch inside-diameter split barrel sampler is driven into undisturbed soil by means of a 140-pound weight falling freely through a vertical distance of 30 inches. The sampler is normally driven three successive 6-inch increments. The total number of blows required for the final 12 inches of penetration is the Standard Penetration Resistance (N).

**Photographic Documentation**
**Troy Athens High School Track and Parking Lot**
**Troy, Michigan**
**G2 Project No. 240782**

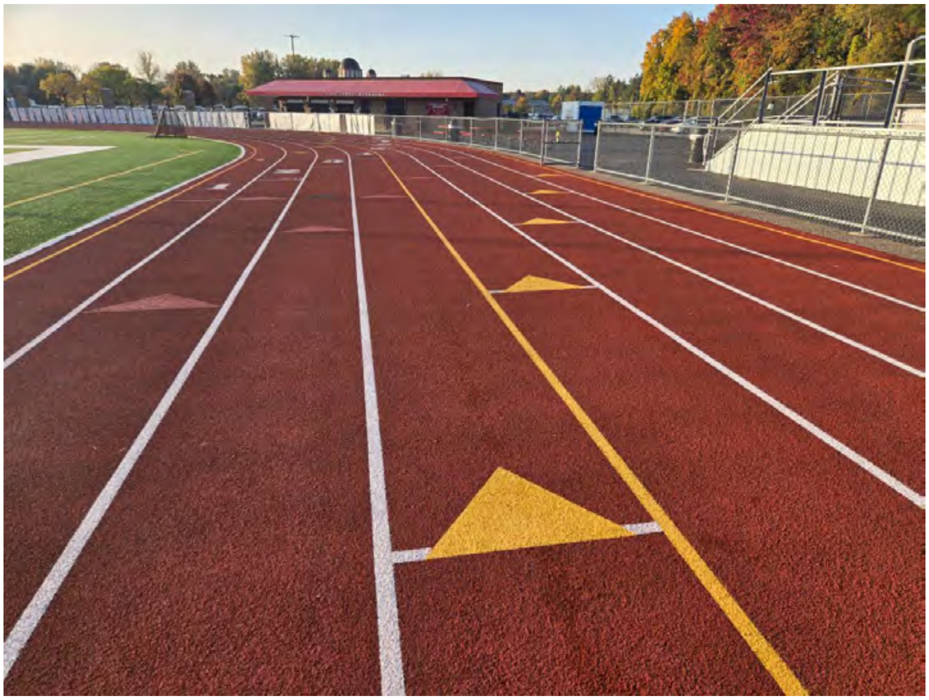


Photograph No. 1: Looking southwest toward B-1, no visible distress

.

Photograph No. 2: Core B-1

**Photographic Documentation**
**Troy Athens High School Track and Parking Lot**
**Troy, Michigan**
**G2 Project No. 240782**



Photograph No. 3: Looking south toward B-2

Photograph No. 4: Core B-2

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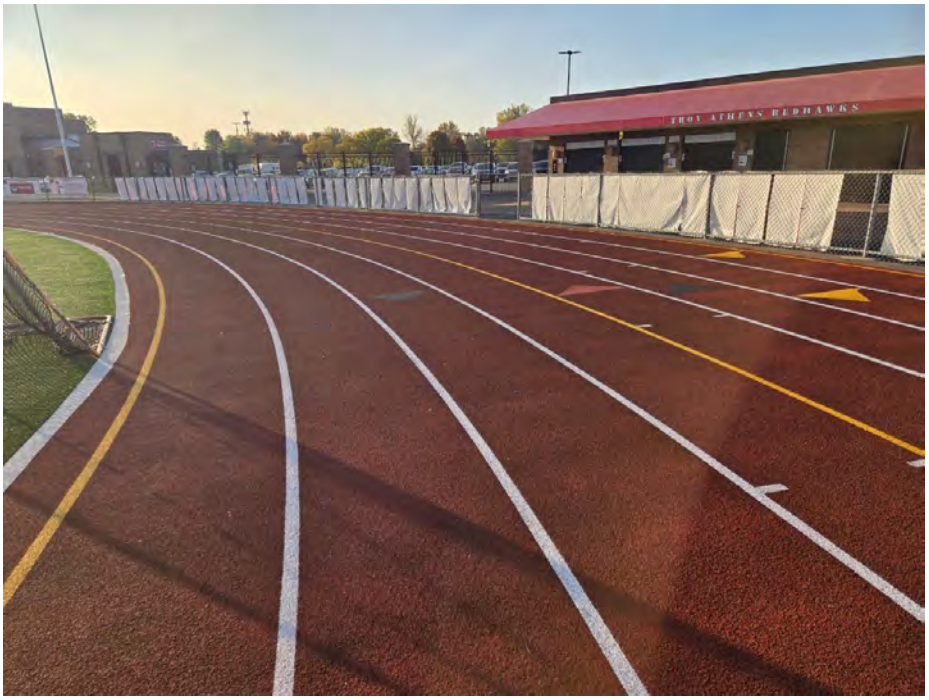

Photograph No. 5:  Looking east at B-3

Photograph No. 6:  Core B-3

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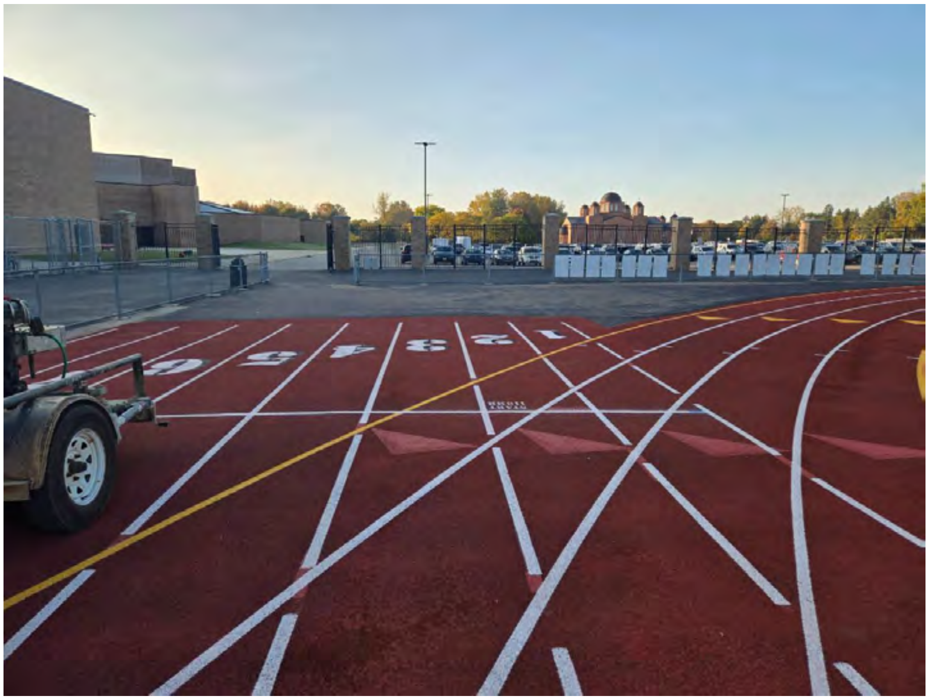
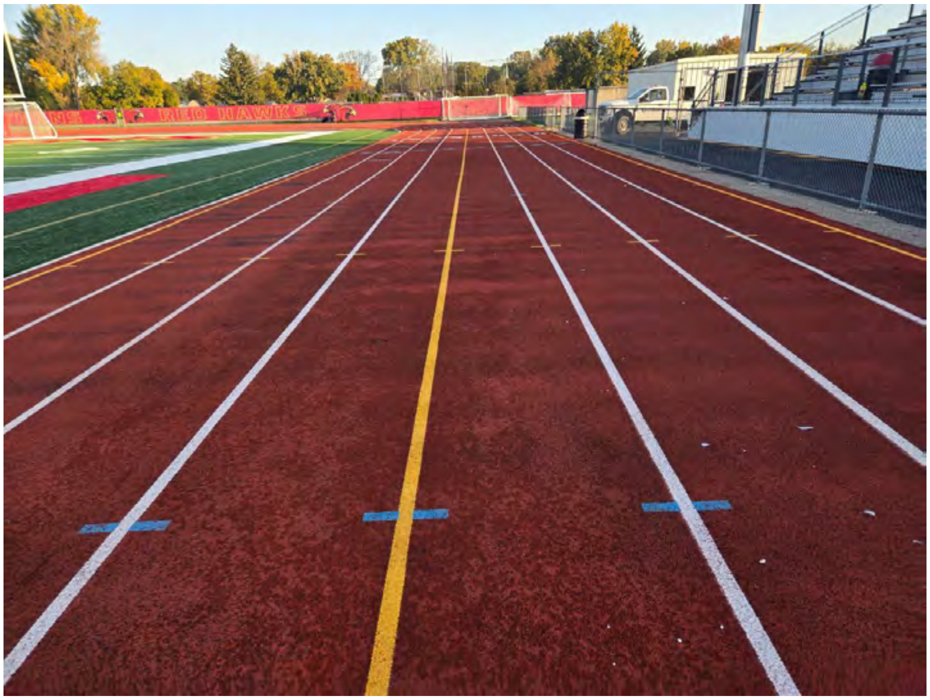
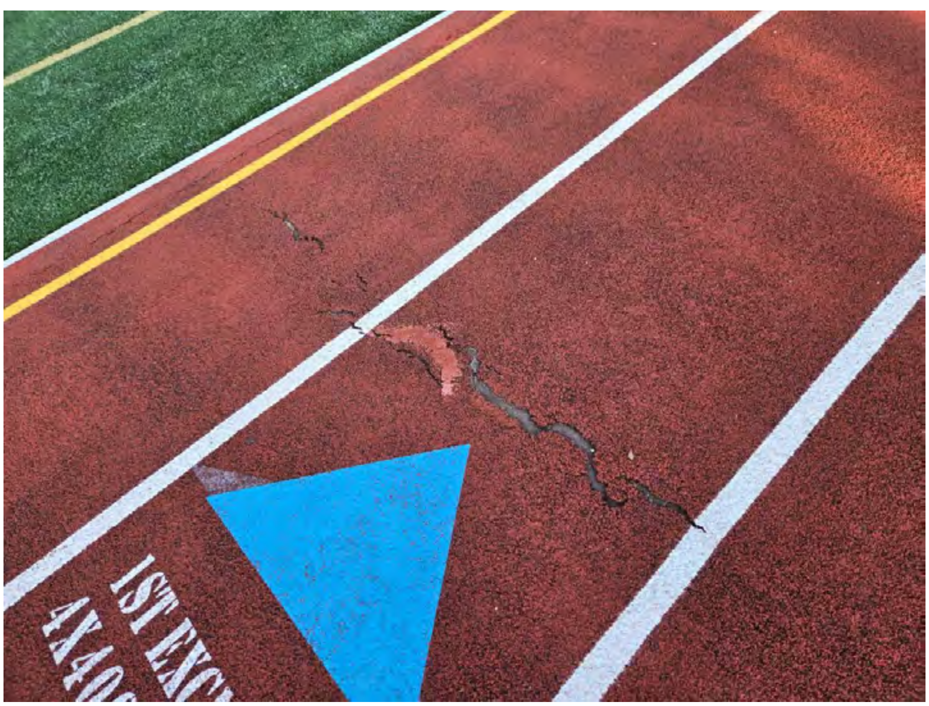


Photograph No. 7: Looking south toward B-4

Photograph No. 8: Core B-4




Photograph No. 9: Looking north toward B-5



Photograph No. 10: Cracking near B-5

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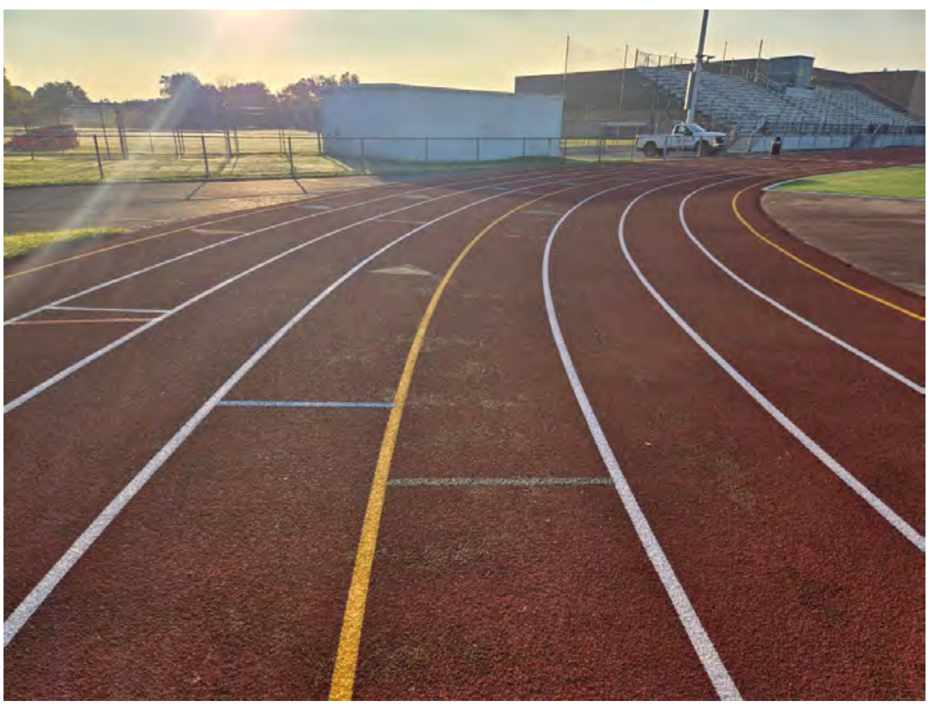
Photograph No. 11: Core 5



Photograph No. 12: Looking southeast toward B-6

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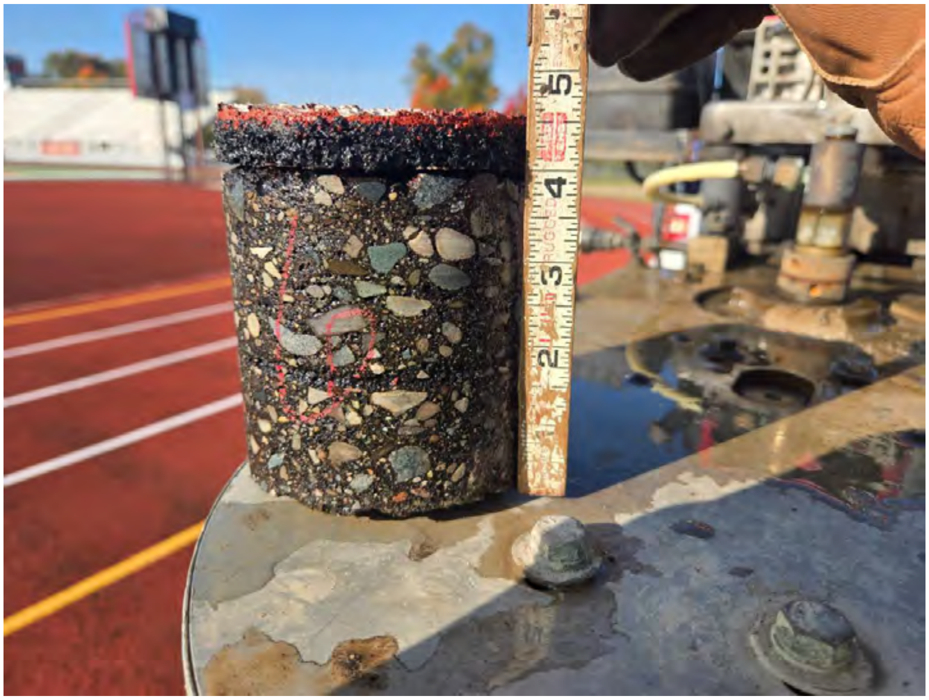
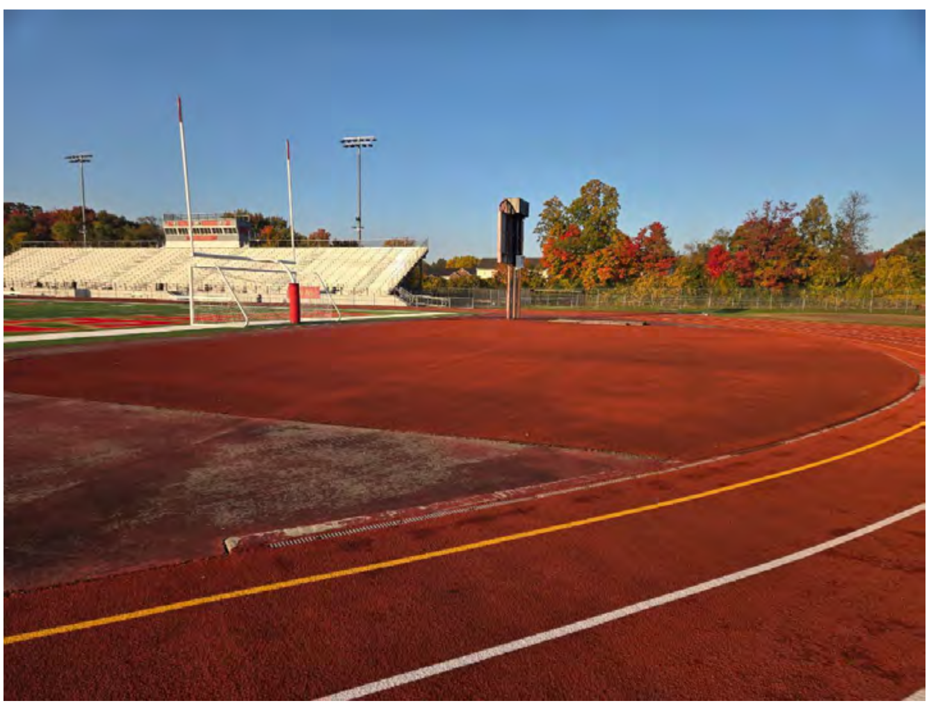


Photograph No. 13: Core 6



Photograph No. 14: Looking southwest toward B-7

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Photograph No. 15: Core 7

Photograph No. 16: Looking west toward B-64, moderate severity block and fatigue cracking

Photograph No. 17: Looking east toward B-65, moderate severity block and fatigue cracking and sediment indicating settlement of subgrade and previous ponding

Photograph No. 18: Looking southeast toward B-66, moderate severity block and fatigue cracking, pavement surface raveling

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Photograph No. 19: Looking south toward B-67, moderate severity block and fatigue cracking and pavement raveling

Photograph No. 20: Looking east toward B-68, moderate severity block and fatigue cracking

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Photograph No. 21:  Looking west toward B-68, high severity fatigue cracking

Photograph No. 22:  Potholes and pavement raveling along east lot, looking north

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Photograph No. 23:  Core B-64

Photograph No. 24:  Core B-65

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Photograph No. 25: Core B-66

Photograph No. 26: Core B-67

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Photograph No. 27:  Core B-68