

**Proposed Salt Springs
Road Water Booster
Station Relocation**

**Tod Avenue SW
Lordstown, Ohio**

Geotechnical Subsurface Investigation

**Village of Lordstown
1455 Salt Springs Road
SW, Lordstown, Ohio
44481**

January 15, 2024

CT Project No. 231265



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January 15, 2024

CT Project No. 231265

Mr. Chris Peterson
Village of Lordstown
1455 Salt Springs Road SW
Lordstown, Ohio 44481

Geotechnical Subsurface Investigation
Proposed Salt Springs Road Water Booster Station Relocation
Tod Avenue SW
Lordstown, Ohio

Following is the report of the geotechnical subsurface investigation performed by CT Consultants, Inc. (CT) for the referenced project. This study was performed in accordance with a CT Proposal, dated August 12, 2022, which was authorized by you with signature of a Work authorization on August 16, 2022.

This final report contains the results of our study, our engineering interpretation of the results with respect to the project characteristics, and our recommendations for foundations, floor slabs, below-grade walls, and pavements.

Soil samples collected during this investigation will be stored at our laboratory for 90 days from the date of this report. The samples will be discarded after this time unless you request that they be saved or delivered to you.

Should you have any questions regarding this report or require additional information, please contact our office.

Sincerely,

CT Consultants, Inc.

Negoslav Tosanovic, P.E.
Geotechnical Project Manager



Christopher P. Iott, P.E.
Chief Geotechnical Engineer

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GEOTECHNICAL SUBSURFACE INVESTIGATION
PROPOSED SALT SPRINGS ROAD
WATER BOOSTER STATION RELOCATION
TOD AVENUE SW
VILLAGE OF LORDSTOWN, OHIO

FOR

VILLAGE OF LORDSTOWN
1455 SALT SPRINGS ROAD SW
LORDSTOWN, OHIO 44481

SUBMITTED

JANUARY 15, 2024
CT PROJECT NO. 231265

CT CONSULTANTS, INC.
908-2 SAHARA TRAIL
YOUNGSTOWN, OHIO 44514
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1.0 INTRODUCTION

This geotechnical subsurface investigation report has been prepared for the proposed Water Booster Station relocation from Salt Springs Road to the new location known as Parcel Number 45-189203 located on the west side of Tod Avenue SW (SR 45) in Lordstown, Ohio. The general area of the project is approximately two-thirds mile south of Hallock Young Road, just north of the Lordstown Village / Jackson Township limits, as shown on the attached Site Location Map (Plate 1.0).

This report summarizes our understanding of the proposed construction, describes the investigative and testing procedures, presents the findings, discusses our evaluations and conclusions, and provides our design and construction recommendations for foundations, floor slabs, below-grade walls, and pavements.

This study was performed in accordance with a CT Proposal, dated August 12, 2022, which was authorized by Mr. Chris Peterson of Village of Lordstown with signature of a Work authorization on August 16, 2022.

The purpose of this investigation was to evaluate the subsurface conditions and laboratory data relative to the design and construction of foundations, building slab, below-grade walls, and pavements at the referenced site. This investigation included two (2) test borings, field and laboratory soil testing, and a geotechnical engineering evaluation of the test results.

This report includes:

- A description of the subsurface soil and groundwater conditions encountered in the borings.
- Design recommendations for building foundations, floor slabs, pavements, and below-grade walls related to the proposed development.
- Recommendations concerning soil- and groundwater-related construction procedures such as site preparation, earthwork,

foundation, building slabs, below-grade walls, and pavement construction, as well as related field testing.

This investigation did not include an environmental assessment of the subsurface materials at this site.

2.0 INVESTIGATIVE PROCEDURES

This subsurface investigation included two (2) test borings drilled by CT on November 8, 2023. The test borings were located in the field by CT in accordance with a Proposed Boring Location Plan. Ground surface elevations at the boring locations were estimated to the nearest foot based on a provided site plan with existing and proposed topography. The approximate locations of the borings and an aerial background are shown on the Test Boring Location Plan (Plate 2.0).

The test borings were performed in general accordance with geotechnical investigative procedures outlined in ASTM Standard D 6151. The test borings performed during this investigation were drilled with a CME 550 ATV-mounted drilling rig utilizing 2¼-inch inside diameter hollow-stem augers. Note that both borings are planned to be drilled to depth of 30 feet but, due to encountered solid bedrock at a depth of 8.5 feet and auger refusal, both borings were terminated shallower than planned at 8.5 feet below existing grades.

During auger advancement, soil samples were collected at 2½-foot intervals or less. Split-spoon (SS) samples were obtained by the Standard Penetration Test (SPT) Method (ASTM D 1586), which consists of driving a 2-inch outside diameter split-barrel sampler into the soil with a 140-pound weight falling freely through a distance of 30 inches. The sampler was driven in three successive 6-inch increments with the number of blows per increment being recorded. The sum of the number of blows required to advance the sampler the second and third 6-inch increments is termed the Standard Penetration Resistance (N-value) and is presented on the Logs of Test Borings attached to this report. The samples were sealed in jars and transported to our laboratory for further classification and testing.

All of the recovered samples of the subsoils were visually or manually classified in accordance with the Unified Soil Classification System (USCS) (ASTM D 2487 and D 2488) and were tested in our laboratory for moisture content (ASTM D 2216). A particle size analysis (ASTM D 6913 and D 7928) and an Atterberg limits test (ASTM D 4318) were performed on representative samples from Borings B-1 (SS-1 and SS-2) and, due to granular soil nature, only a particle size analysis was performed on a sample from Boring B-2 (SS-1), all to determine soil classification and soil index properties. The test results are presented on the Logs of Test Borings, Tabulation of

Test Data sheet, Grain Size Distribution sheet, and Atterberg limits sheet attached to this report.

Soil conditions encountered in the test borings are presented in the Logs of Test Borings, along with information related to sample data, SPT results, water conditions observed in the borings, and laboratory test data. It should be noted that these logs have been prepared on the basis of laboratory classification and testing as well as field logs of the encountered soils.

Experience indicates that the actual subsoil conditions at a site could vary from those generalized on the basis of test borings made at specific locations. Therefore, it is essential that a geotechnical engineer be retained to provide soil engineering services during the site preparation, excavation, and foundation phases of the proposed project. This is to observe compliance with the design concepts, specifications, and recommendations, and to allow design changes in the event subsurface conditions differ from those anticipated prior to the start of construction.

3.0 PROPOSED CONSTRUCTION

It is planned that site will receive about three feet of engineered fill across the future construction area.

Based on the provided information, the proposed water booster station will consist of a relatively small, slab-on-grade, single story building. The structure will be on the order of 29 feet by 12 feet in plan within an approximately 150 feet by 75 feet site. The structure will be located in the rear portion of the site. The area surrounding the building will be constructed using a gravel surface. There will be an approximately 100 feet by 20 feet paved driveway as a connection to Tod Avenue. No deep water well is anticipated for this project. It was indicated that the new structure may include below grade portions extending no deeper than 10 feet below the floor and consisting of concrete pre-cast circular ring elements installed on top of each other. The below-grade portion may bear on concrete mat or circular, ring foundation.

Maximum foundation loads were not available at the time of preparing this report but are assumed to be light in magnitude. Maximum column loads are assumed to be less than 100 kips and maximum wall loads are assumed to be 1,500 pounds per lineal foot (plf).

Pavements are anticipated to consist of flexible (asphalt) sections and/or rigid (concrete) sections.

4.0 GENERAL SITE AND SUBSURFACE CONDITIONS

4.1 General Site Conditions

At the time of our investigation, the project site consisted of a relatively flat field covered with grass and mature trees. Ground elevation at the boring locations is at approximately Elev. 974. Note that pavement on Tod Avenue SW is approximately four feet higher than terrain of the future construction site.

The surface materials encountered at Boring B-1 consisted of approximately 6 inches of topsoil, while at the location of Boring B-2 approximately 12 inches of crushed stone was encountered.

4.2 General Site Geology

Published geologic maps from the Ohio Department of Natural Resources (ODNR) indicate that the project site is located within the glaciated portion of Ohio. Predominantly Wisconsinan soil deposits consisted of till up to 10 feet in thickness underlain by sandstone bedrock.

Bedrock at the site consists of upper Allegheny and Pottsville Groups, including undifferentiated middle and lower Pennsylvanian aged Shale, siltstone, sandstone, conglomerate, limestone, underclay, coal, and flint.

4.3 General Soil and Rock Conditions

Based on the results of our field and laboratory tests, the subsoils encountered underlying the topsoil in Boring B-1 consisted of cohesive till materials overlying weathered sandstone. No distinct cohesive till was encountered underlying the crushed stone in Boring B-2. Rather, very highly weathered sandstone in the form of silty sand with gravel was encountered in the upper portion of this boring, and was underlain by weathered sandstone.

Summaries of the encountered conditions are provided below, and additional descriptions of the soil and rock stratigraphy encountered in the borings are presented on the Logs of Test Borings attached to the report.

The **cohesive till** encountered underlying the topsoil in Boring B-1 extended to top of weathered sandstone at a depth of approximately 7 feet. These cohesive soils consisted of predominantly lean clay (CL) with varying amounts of sand, and included trace of gravel and organics in upper profile zone and with sandstone fragments at deeper depths close to the bedrock. In the upper 3 ½ feet, the cohesive soils exhibited medium stiff consistency with an SPT N-value of 8 blows per foot (bpf), whereas the underlying cohesive soils exhibited very hard consistency where the SPT resulted in an N-value of 54 bpf and split-spoon refusal (SSR). Unconfined compressive strengths ranged from 8,000 pounds per square foot (psf) to greater than 9,000 psf (maximum reading obtainable using a hand penetrometer). Moisture contents generally ranged from 11 to 20 percent. Liquid Limits of 33 percent and 31 percent, and plasticity Index values of 10 percent and 9 percent were determined for samples obtained from this stratum. These values, along with the associated particle size gradations, are indicative of lean clay with sand (CL) and sandy lean clay (CL) as classified in accordance with the Unified Soil Classification System (USCS).

Underlying the crushed stone in Boring B-2, **very highly weathered sandstone** consisting of **loose** silty sand (SM) with gravel was encountered to a depth of approximately 3 ½ feet. An SPT N-value and a moisture content of 13 percent were determined for the recovered sample.

The underlying **weathered sandstone** in Borings B-1 and B-2 was penetrable with drill rig augers to auger refusal at a depth of 8 ½ feet. Within the weathered sandstone, the SPT resulted in split-spoon refusal (SSR, 50 or more blows for 6 inches or less penetration).

4.4 Groundwater Conditions

Groundwater was not encountered during drilling operations nor upon completion of drilling. It should be noted that the boreholes were drilled and backfilled within the same day, and stabilized water levels may not have occurred over this limited time period.

Based on the limited data available, such as the soil characteristics and the moisture conditions encountered in the borings, it is our opinion that the “normal” groundwater level may generally be encountered at depths below the soil/weathered sandstone interface. However, we cannot exclude the possibility that some water can be encountered during the foundation construction and below grade structure installation. In particular, “perched” water may be encountered in granular soils or weathered sandstone that is underlain by the less permeable more intact bedrock. It should be noted that groundwater elevations can fluctuate with seasonal and climatic influences. Therefore, the groundwater conditions may vary at different times of the year from those encountered during this investigation.

5.0 DESIGN RECOMMENDATIONS

The following analyses and recommendations are based on our understanding of the proposed construction and upon the data obtained during our field exploration. If the project information or location as outlined is incorrect or should change significantly, a review of these recommendations should be made by CT. These recommendations are subject to the satisfactory completion of the construction recommendations that follow.

5.1 Shallow Spread Foundations

Based on the results of the field and laboratory testing for the borings performed for this investigation along with a Finish Floor Elevation of three feet above the current grade, the soils encountered at the anticipated foundation bearing depth (3½ feet for protection from frost penetration for exterior foundations, or slightly shallower for interior foundations) are expected to consist of the following materials, depending on the footing relative location:

1. Predominantly medium stiff native cohesive soils,
2. Predominantly **loose** native granular soils (very highly weathered sandstone), or
3. Structural fill materials used to achieve the proposed design grades.

Deeper below-grade walls may bear on the materials described above, or weathered sandstone bedrock. Recommendations for bearing on these materials are presented below. Recommendations for lateral earth pressures for below-grade walls are provided in Section 5.9.

Following the satisfactory completion of the site preparation and footing excavation inspections outlined in this report, the proposed structure may be supported on a conventional shallow foundation system. For strip (wall) footings and individual (square) footings, we recommend a net allowable bearing pressure of 2,000 pounds per square foot (psf). In using a net allowable soil pressure, the weight of the footings, backfill over the footings, or floor slabs need not be included in the structural loads for dimensioning footings. The bearing materials should be field-verified as being

native cohesive soil with a minimum unconfined compressive strength of 2,000 psf, native granular soils that meet the compaction criteria below, or properly placed and compacted new engineered fill.

It should be anticipated that the native granular soils will require in-place densification, or removal and replacement with new engineered fill. Suitable bearing of native granular foundation subgrade soils should be verified as:

- Exhibiting a compacted (in-situ) dry density of at least 100 percent of the maximum dry density determined by Standard Proctor (ASTM D 698) laboratory compaction,
- A dynamic cone penetrometer (DCP) reading of at least 8 blows per increment (average over three increments), or
- Other methods to demonstrate an equivalent SPT N-value of 10 bpf or greater.

If unsuitable foundation soils are encountered during foundation installation, over-excavation should extend through these materials to suitable bearing soils, with widening of the footing over-excavation as described below. The base of the over-excavation should be widened one foot for every foot of depth below the planned bearing depth, with the over-excavation centered along the footing. The over-excavated areas should be backfilled with dense-graded aggregate, placed in controlled lifts, and compacted to not less than 100 percent of the maximum dry density as determined by ASTM 698 (Standard Proctor). Alternatively, the over-excavated areas could be backfilled with lean concrete having a minimum compressive strength of 1,500 pounds per square inch (psi) or other flowable controlled-density fill having a minimum compressive strength of 300 psi. If foundations will be placed at the base of the over-excavation or the lean concrete fill option will be utilized, widening the footing over-excavation will not be required. If the controlled-density fill option is utilized, the footing over-excavation shall be widened as discussed above.

Higher design bearing pressures could be used for deeper below-grade walls that extend into weathered sandstone. Where bearing on rock for the deeper foundations is likely, we recommend that consideration be given to extending the bearing of common walls or connected segments within a given building area to bedrock so that all foundations are supported on similar bearing to avoid localized differential settlement. Loose or broken rock should be cleared from the foundation excavation. For these conditions, an allowable bearing pressure of 10 tons per square foot (tsf) can be used in foundation design.

In footing excavations with rock sloping less than 10 percent, rock need not be undercut or flattened, except as required to remove an asperity or undulation to meet the minimum thickness of concrete indicated for structural design of the footing. Should the slope of the footing excavation exceed 10 percent after removal of any weathered or loose rock, the rock surface must be undercut to create a flatter and more uniform bearing surface. Otherwise, stepped footings or doweling should be used to avoid excessive rock excavation. Settlement of foundations bearing on bedrock is expected to be negligible. Consideration should be given to equipment and schedule required for rock excavation. Rock excavation recommendations are provided in Section 5.10.

Care must be taken wherever a foundation must be supported by two strata with significantly different stiffness, such as the overburden sands and clays and the underlying weathered sandstone encountered at this site, to prevent excessive differential settlement and areas of high stress concentrations within the foundation system. If footings are required to transition from bearing on rock to bearing on soil, we recommend that the hard bedrock formation occurring within 6 inches of the foundation bearing elevation be undercut and replaced with compacted crushed stone (ODOT Item 304 or similar gradation) so as to alleviate an abrupt "hard spot" and the potential for excessive differential settlement. These foundations should all be designed using bearing pressures listed above for bearing on soil.

All exterior footings and footings in unheated areas should be constructed at a minimum frost penetration depth of 3½ feet below finished exterior grades. Interior footings may bear at a convenient depth below the floor slab, provided they are supported on native cohesive soils as described above, native granular soils that meet the compaction criteria listed above, properly placed and compacted new engineered fill, or lean concrete or flowable controlled-density fill. Wall (strip) footings should be at least 18 inches wide, and column (square) footings should be at least 30 inches square, regardless of sizing based on design loads and the allowable bearing pressure. Similarly, for foundations bearing on rock, wall footings should be at least 12 inches wide and column footings should be at least 24 inches square, regardless of sizing based on design loads and the allowable bearing pressures.

It should be noted that use of trench footings (i.e., placement of foundation concrete without forming) may not be feasible in some areas due to the presence of granular soils. Forming of footings and backfilling around CMU or poured foundation walls should be anticipated.

Utilizing the above allowable bearing pressures and proper foundation inspection techniques, the total settlement associated with the structure bearing in soil should not exceed ¾ inch, and differential settlement should not exceed ½ inch. It should be noted that the total settlement of soil-bearing portions of the structure would be differential settlement compared to rock-bearing portions of the structure that are anticipated to exhibit negligible settlement.

5.2 Seismic Considerations

We have reviewed seismic design parameters in accordance with the Ohio Building Code (OBC) criteria, which references ASCE 7. It should be noted that the OBC seismic site characterization is based on the upper 100 feet of the geologic profile and the borings performed for this investigation extended only to a maximum depth of 8.5 feet below existing grade, where auger refusal occurred on intact bedrock.

Using the N_{ch} -method, the average SPT N-value (N_{ch}) was calculated to be greater than 50 bpf, which is indicative of a Site Class C “Very dense soil and soft rock soil” designation. As such, a Site Class C “Very dense soil and soft rock soil” designation may be utilized for this site. Depending on final grading, if foundations will bear within

10 feet of the bedrock which resulted in auger refusal in the borings (Elev. 965.5±), these foundations and the associated structures may be designed using Site Class B ("rock").

5.3 Subgrades

5.3.1 Existing Subgrade

The subgrades that would result upon the satisfactory completion of the site preparation as described in Section 6.0 of this report are considered moderately suitable for support of the proposed pavements and floor slabs. Based on field and laboratory data developed during this investigation, the subgrade soils consist of the following:

1. Predominantly medium stiff native cohesive soils,
2. Predominantly **loose** granular soils, or
3. Structural fill materials used to achieve the proposed design grades.

Laboratory analyses for Boring B-1 (SS-1 and SS-2) indicate that the cohesive subgrade soils may be generally classified as A-4a in accordance with the Ohio Department of Transportation (ODOT) system of soil classification. Laboratory analyses for Boring B-2 (SS-1) indicate the granular subgrade soils may be classified as A-2-4. The granular soils are considered good to fair as subgrade soils. The cohesive soils are considered fair to poor as subgrade materials because they have relatively low permeabilities and a high percentage of silt and clay particles, which makes them susceptible to moisture, frost penetration, and frost heave. Therefore, the cohesive soils will dictate floor slab and pavement design.

At the time of this investigation, moisture content in the upper 3 feet of the **cohesive subgrade soils** was in the order of 20 percent. This moisture content is estimated to be slightly above the expected optimum moisture content for these soils. Therefore, remedial action may be needed to adjust the moisture contents of the cohesive existing materials and achieve proper compaction of the subgrade.

At the time of this investigation, moisture content in the upper 3 feet of the **granular subgrade soils** was on the order of 13 percent. This moisture content is estimated to

be slightly above the expected optimum moisture content for these soils. Therefore, remedial action may be needed to adjust the moisture contents of the granular existing materials and achieve proper compaction of the subgrade. Additionally, modification may be required due to the loose compactness of these materials.

5.3.2 Modified Subgrade

Where soils are dry of optimum, water should be uniformly mixed into the subgrade. Where soils are wet of optimum, lowering the moisture content by scarification and aeration (discing and exposure to sun and wind) may be required. However, this may not be feasible if construction occurs during wet seasonal conditions. Very moist to wet soils will “pump” under the operation of heavy equipment, resulting in deep rutting and perhaps rendering the operation of grading and paving equipment difficult or impossible.

Therefore, other methods of subgrade modification may be required in areas of high moisture content. Modification may be achieved by undercutting and replacement with granular subbase (possibly in combination with a geotextile separation layer or geogrid reinforcement), mixing stone into the subgrade, or treating the subgrade with lime or cement. The method of subgrade modification should be determined at the time of construction (See Section 6.1, “Construction Recommendations - Site and Subgrade Preparation”).

5.4 Floor Slabs

It is recommended that all floor slabs be “floating”, that is, fully ground supported and not structurally connected to walls or foundations. This is to reduce the possibility of cracking and displacement of the floor slabs because of differential movements between the slab and the foundation. Such movements could be detrimental to slabs that are rigidly connected to the foundations. There may be certain areas where it will be difficult or impractical to make the slab floating. In such areas, it may be necessary to increase the slab thickness and reinforcement to prevent the foundation from cracking the slab and settling independently.

For properly prepared subgrade soils, a modulus of subgrade reaction (k) of 165 pounds per cubic inch (pci) may be used for floor slab design. It is recommended that the floor slab be supported on a minimum 6-inch layer of relatively clean granular material such as sand and gravel or crushed stone. This is to help distribute concentrated loads and provide more uniform subgrade support beneath the slab.

5.5 Flexible (Asphalt) Pavement

Based on the results of the laboratory testing and visual classifications, we recommend a subgrade CBR value of 7 percent for flexible pavement design for the Group A-4a or better soils. This CBR value is based on subgrade compacted to at least 100 percent of the maximum dry density as determined by ASTM D 698 (Standard Proctor) or verified as stable through proof rolling.

It should be noted that we are not privy to the design traffic loads or intended design life. The subgrade support recommendations indicated herein should be reviewed by the site engineer in conjunction with the design traffic criteria to determine the required pavement sections. In any case, we recommend the light-duty pavement cross-section consist of at least 3 inches of asphalt underlain by 6 inches of aggregate base for even the lightest-duty pavements based on our experience regarding environmental exposure and reasonable serviceability. For the same reason, we recommend the heavy-duty pavement cross-section consist of at least 4 inches of asphalt underlain by 8 inches of aggregate base.

All paving operations should conform to Ohio Department of Transportation (ODOT) specifications. The pavement and subgrade preparation procedures outlined in this report should result in a reasonably workable and satisfactory pavement. It should be recognized, however, that all flexible pavements need repairs or overlays from time to time as a result of progressive yielding under repeated traffic loads for a prolonged period of time, as well as exposure to weather conditions.

5.6 Rigid (Concrete) Pavement

For properly prepared subgrade soils consisting of ODOT A-4a or better soils, a modulus of subgrade reaction (k) of 165 pounds per cubic inch (pci) may be used for rigid pavement design. A concrete pavement section is recommended in the loading-unloading areas, areas of repetitive turning, site exit and entrance aprons, and trash enclosure areas (including where the truck parks while servicing the container). This section should consist of a minimum of 6 inches of reinforced, air-entrained concrete with a minimum compressive strength of 3,500 pounds per square inch (psi) underlain by a minimum of 6 inches of a dense-graded aggregate base such as ODOT Item 304. The pavement section should be supported on subgrade compacted to at least 100 percent of the maximum dry density as determined by ASTM D 698 (Standard Proctor) or verified as stable through proof rolling.

5.7 Pavement Drainage

Based on the poorly-drained nature of the clayey subgrade soils which were present in Boring B-1, it is anticipated that surface water infiltration may collect in the aggregate base course. Without adequate drainage, water will remain in the base for extended periods of time, creating localized wet, soft pockets. The presence of these pockets will increase the likelihood that pavement distress (cracking, potholes, etc.) will develop. Drainage features may include grading the subgrade surface to slope downward to the outside edge of pavements and/or providing longitudinal edge drains connected to storm sewers or other outlets. A system of “finger drains” could also be installed near catch basins within the pavement areas to collect surface water, thus reducing the potential for freeze-thaw effects on the pavement.

5.8 Groundwater Control

Encountered groundwater conditions were previously discussed in Section 4.4. Based on the limited data available, such as the soil characteristics and the moisture conditions encountered in the borings, it is our opinion that the “normal” groundwater level may generally be encountered at depths below the soil/weathered

sandstone interface. It should be noted that “perched” water may be encountered in sand layers or weathered sandstone that is underlain by more intact bedrock.

It is our experience that adequate control of groundwater seepage, “perched” water, or surface water run-off into shallow excavations should be achievable by minor dewatering systems, such as pumping from prepared sumps. In the event excessive seepage is encountered during construction, CT may be notified to evaluate whether other dewatering methods are required.

5.9 Below-Grade Walls

Below-grade walls and their associated foundations are not expected to extend below the depths of auger refusal in the borings, and are anticipated to be installed within existing cohesive soils, granular soils, and augerable weathered sandstone bedrock. Excavation in soil and bedrock is presented in the following section, and bearing pressure recommendations for below-grade wall foundations are presented in Section 5.1. This section includes design parameters for below-grade wall lateral earth pressure design.

For below-grade walls that are restrained from rotation and are considered rigid and non-yielding, lateral earth pressures should be assumed for “at-rest” conditions. An at-rest lateral earth pressure coefficient (k_0) of 0.50 should be used along with a soil unit weight of 130 pounds per cubic foot (pcf) in determining the lateral pressure acting on the walls. For retaining structures or below-grade walls that are not restrained at the top of the wall (including sheet piling for construction), an active lateral earth pressure coefficient (k_a) of 0.33 may be used for design. Alternatively, equivalent fluid weights of 65 pcf and 45 pcf may be used for at-rest and active case designs, respectively. These values are based on the assumption that the governing existing predominately cohesive soils encountered in the subsurface profile will constitute the major portion of the backfill area and retained earth behind the walls.

For granular types of soil, if used for fill in the entire active pressure and at-rest pressure zones, assuming that soils are meeting gradation characteristics of USCS soil types GW, GP, SW, or SP, the following parameters can be used for retaining

structure design: k_a may be taken as 0.25, k_o may be taken as 0.40, and the soil unit weight may be assumed as 120 pcf, or alternatively, equivalent fluid weights of 30 pcf and 50 pcf may be used for the active and “at-rest” design cases, respectively.

5.10 Excavations and Slopes

The sides of temporary excavations for building foundations, utility installations, and other construction should be adequately sloped to provide stable sides and safe working conditions. Otherwise, the excavation must be properly braced against lateral movements. In any case, applicable Occupational Safety and Health Administration (OSHA) safety standards must be followed. Note that installation of lateral bracing elements such as H-piles associated with post-and-panel walls, as well as sheetpiling, may be limited due to the presence of weathered rock shallow in the subsurface profile and auger refusal on more intact rock at depths on the order of 8½ feet below existing grades.

Based on the test borings, it is likely that excavations will encounter a range of soil conditions that include the following OSHA designations:

- Type A soils (cohesive soils with unconfined compressive strengths of 3,000 pounds per square foot (psf) or greater),
- Type B soils (cohesive soils with unconfined compressive strengths greater than 1,000 psf but less than 3,000 psf, and dry rock that is not stable), and
- OSHA Type C soils (cohesive soils with unconfined compressive strengths of 1,000 psf or less and granular soils).

For temporary excavations in Type A, B and C soils, side slopes must be no steeper than ¾ horizontal to 1 vertical (¾H:1V), 1H:1V, and 1½H:1V, respectively. For situations where a higher strength soil is underlain by a lower strength soil and the excavation extends into the lower strength soil, the slope of the entire excavation is governed by that required for the lower strength soil. In all cases, flatter slopes may

be required if lower strength soils or adverse seepage conditions are encountered during construction.

Based on the conditions encountered in the test borings, the probable method of excavation within the “weathered sandstone” zone is expected to consist of conventional excavation equipment such as a backhoe or track excavator, with some assistance from pneumatic chippers, jackhammers, or hydraulic wedging equipment. However, excavation into the “more intact sandstone” zone beyond the depth of auger refusal in the borings is expected to be unproductive and uneconomical with conventional excavation equipment. Excavations that must extend into this zone will likely require extensive use of rock removal methods, including pneumatic chippers, jackhammers, or hydraulic wedging equipment, as well as drilling and use of expansive chemicals to fracture and loosen the rock.

For permanent excavations and slopes, we recommend that grades be no steeper than 3H:1V without a more extensive geotechnical evaluation of the proposed construction plans and site conditions.

6.0 CONSTRUCTION RECOMMENDATIONS

6.1 Site and Subgrade Preparation

Prior to proceeding with construction operations, all topsoil, root mats, vegetation, and other deleterious non-soil materials should be removed from the proposed construction areas. Suitable topsoil may be stockpiled for later use in landscaped areas. It is important to note that topsoil thicknesses referenced in the borings may vary across the site, particularly due to the previous earthwork operations observed at the site. Typically, soils with more than 5 percent organics are not recommended as subgrade soils in structure and pavement areas, but dark colored soils having the appearance of topsoil with only trace “root hairs” of 5 percent or less may not necessarily require stripping. For these “transitional” soils, the actual moisture content and subgrade stability under proof-rolling operations is more critical than the color in determination of the amount of stripping or subgrade undercut. The actual amount of required stripping should be determined in the field by a geotechnical engineer or qualified representative.

Upon completion of stripping and clearing, the areas intended to support floor slabs, new fill, and pavements should be carefully inspected by a geotechnical engineer. At that time, the engineer may require proof rolling for the on-site cohesive subgrade soils utilizing a 20- to 30-ton loaded truck or other pneumatic-tired vehicle of similar size and weight. Subgrade soils may consist of granular soils in some areas. Subgrade preparation in these areas may require proof rolling/compaction of the granular subgrades utilizing a smooth-drum roller. The roller or truck should make a minimum of two passes in each of two perpendicular directions covering the proposed development area, with additional passes as necessary to achieve required compaction and/or subgrade stabilization.

The purpose of proof rolling the cohesive subgrades is to locate any weak, soft, or excessively wet soils that may be present at the time of construction. The purpose of the proof rolling/compaction of the granular soils is to densify zones of loose materials that are encountered in the upper portion of the soil profile, thereby

providing more uniform subgrade support. We recommend a roller with a minimum dead weight on the drums of 8 tons and traveling at speeds not exceeding approximately 4 feet per second (about 3 miles per hour). These operational criteria should provide sufficient dynamic compaction energy to alleviate loose soil conditions within the zone of influence for subgrade support.

Any unsuitable materials observed during the inspection and proof-rolling operations should be undercut and replaced with compacted fill or stabilized in place utilizing conventional remedial measures such as discing, aeration, and re-compaction. Once the site has been proof rolled, inspected, and stabilized, the proof-rolled or inspected subgrades should not be exposed to wet conditions. It should be recognized that during periods of wet weather, the silty/clayey soils that will be exposed at design subgrades will tend to pond water for short periods of time, with the potential to deteriorate the prepared subgrade.

The results of the inspection and proof-rolling operations will be partially dependent on construction operations, the moisture content of the soil, and the weather conditions prevalent at the time. If pumping or rutting is encountered and difficulty is experienced in the operation of construction equipment, CT should be notified in order to determine which method of subgrade modification may be best suited for the conditions encountered. Should such conditions be experienced, we may recommend that a small test area be used to determine the necessary depth of undercutting and stone replacement or other remedial action necessary to achieve a stable subgrade condition.

6.2 Fill

Material for engineered fill or backfill required to achieve design grades may consist of any non-organic soils having a maximum dry density as determined by the Standard Proctor (ASTM D 698) of 90 pounds per cubic foot (pcf) or greater. To retain the subgrade support characteristics utilized for the design CBR-value and k-value presented in this report, fill utilized to achieve design subgrade elevations should consist of ODOT A-4a or better soils. On-site soils may be used as engineered fill materials provided that they are free of organic matter, excessive moisture, and rock

or stone fragments larger than 3 inches in diameter. Depending on seasonal conditions, the on-site soils may be wet of optimum and may require scarification and aeration to achieve satisfactory compaction. If the construction schedule does not allow for scarification and aeration activities, it may be more practical or economical to utilize imported granular fill.

Fill should be placed in uniform layers no more than 8 inches thick (loose measure) and adequately keyed into stripped and scarified soils. All fill within the building areas and pavement subgrades should be compacted to not less than 100 percent of the maximum dry density as determined by ASTM D 698 (Standard Proctor).

The upper soil profile at the site consists of predominantly cohesive soils, although granular soils may be encountered in some area. The contractor should be prepared to use a sheepsfoot roller to provide effective compaction of the existing cohesive subgrade soils and new cohesive fill. Where granular soils are present or new engineered fill consists of granular material, a vibratory smooth-drum roller would provide effective compaction of these materials. In narrow utility excavations, the deeper profile on-site cohesive soils may be difficult to compact; therefore, a clean granular material may be required in these areas.

Scarified subgrade soils and all fill material should be within 3 percent of the optimum moisture content to facilitate compaction. Furthermore, fill material should not be frozen or placed on a frozen base. It is recommended that all earthwork and site preparation activities be conducted under adequate specifications and properly monitored in the field by a qualified geotechnical testing firm.

6.3 Foundation Excavations

As mentioned in Section 5.1, foundation excavations should have a detailed footing inspection performed for each foundation. A geotechnical engineer or qualified representative should perform these inspections to verify that the exposed materials are similar to those encountered in the borings and that engineered fill has been properly placed and compacted such that it is capable of supporting the design bearing pressure.

We recommend that the foundation excavations be concreted as soon as practical after they are excavated and that water not be allowed to pond in any excavation. If it is necessary to leave the bearing surface open for any extended period of time, we recommend that a thin mat of lean concrete be placed over the bottom of the excavation to reduce damage to the surface from weather or construction. Foundation concrete should not be placed on frozen or saturated subgrade.

7.0 QUALIFICATION OF RECOMMENDATIONS

Our evaluation of foundations, building slabs, below-grade walls, and pavement design and construction conditions has been based on our understanding of the site and project information and the data obtained during our field investigation. The general subsurface conditions were based on interpretation of the subsurface data at specific boring locations. Regardless of the thoroughness of a subsurface investigation, there is the possibility that conditions between borings will differ from those at the boring locations, that conditions are not as anticipated by the designers, or that the construction process has altered the soil conditions. Therefore, experienced geotechnical engineers should observe earthwork and foundation construction to confirm that the conditions anticipated in design are noted. Otherwise, CT assumes no responsibility for construction compliance with the design concepts, specifications, or recommendations.

The design recommendations in this report have been developed on the basis of the previously described project characteristics and subsurface conditions. If project criteria or locations change, a qualified geotechnical engineer should be permitted to determine whether the recommendations must be modified. The findings of such a review will be presented in a supplemental report.

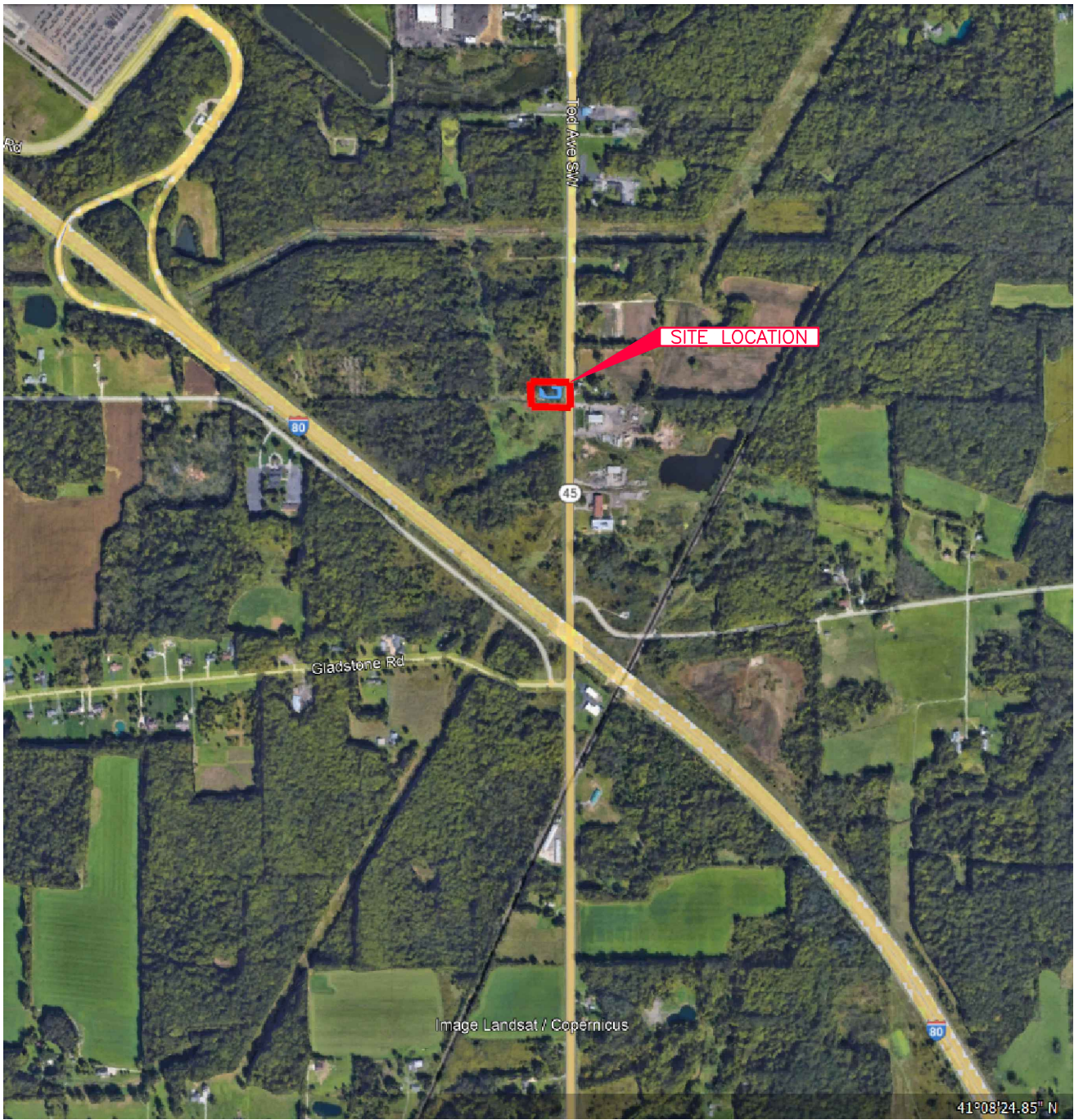
The nature and extent of variations between the borings may not become evident until the course of construction. If such variations are encountered, it will be necessary to reevaluate the recommendations of this report after on-site observations of the conditions.

Our professional services have been performed, our findings derived, and our recommendations prepared in accordance with generally accepted geotechnical engineering principles and practices. This warranty is in lieu of all other warranties either expressed or implied. CT is not responsible for the conclusions, opinions, or recommendations of others based on this data.

Plates

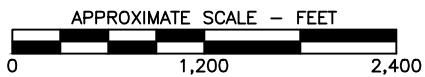
Plate 1.0 Site Location Map

Plate 2.0 Test Boring Location Plan



LEGEND

— APPROXIMATE SITE LOCATION



**PLATE 1.0
SITE LOCATION MAP**

PROPOSED SALT SPRINGS ROAD WATER BOOSTER STATION RELOCATION
TOD AVENUE SW
VILLAGE OF LORDSTOWN, OHIO 44481

PREPARED FOR
**VILLAGE OF LORDSTOWN
LORDSTOWN, OHIO**

DRAWN TRR/11-27-23

CHECKED NT/12-5-23

REVISED

APPROVED

JOB NO. 231265

DRAWING NUMBER

B_231265-01-PLATE 1 SM





Image Landsat / Copernicus

LEGEND

B-1  APPROXIMATE TEST BORING LOCATION

 APPROXIMATE SITE BOUNDARY

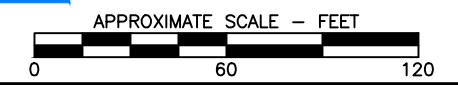


PLATE 2.0
TEST BORING LOCATION PLAN
PROPOSED SALT SPRINGS ROAD WATER BOOSTER STATION RELOCATION
TOD AVENUE SW
VILLAGE OF LORDSTOWN, OHIO 44481

PREPARED FOR
VILLAGE OF LORDSTOWN
LORDSTOWN, OHIO

DRAWN TRR/11-27-23 CHECKED NT/12-5-23
REVISED APPROVED

JOB NO. 231265
DRAWING NUMBER
B_231265-01-PLATE 2 BLP



APPENDIX A
Logs of Test Borings



CT Consultants, Inc.
 1915 N 12th Street
 Toledo Ohio 43604
 Telephone: (419)324-2222

BORING NUMBER B-1

PAGE 1 OF 1

CLIENT Village of Lordstown **PROJECT NAME** Water Booster Station Relocation
PROJECT NUMBER 231265 **PROJECT LOCATION** Tod Avenue SW, Lordstown, OH
DRILLING CONTRACTOR CT Consultants Inc. JP MP **RIG NO.** 550 **GROUND ELEVATION** 974 ft
DRILLING METHOD 2-1/4 in. HSA **GROUND WATER LEVELS:**
DATE STARTED 11/8/23 **COMPLETED** 11/8/23 **AT TIME OF DRILLING** None
LOGGED BY KKC **CHECKED BY** NT **AT END OF DRILLING** None
NOTES Auger refusal at 8.5 feet. **0hrs AFTER DRILLING** Backfilled w/Cuttings and Bentonite Chips

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	UNCONF. COMP. STR. (tsf)	DRY UNIT WT. (pcf)	PL MC LL			
									20	40	60	80
	0.0		TOPSOIL - 6 Inches									
	0.5'		Moist Medium Stiff Brown LEAN CLAY w/Sand, Trace Gravel, and Organics (CL)	SS 1	100	4-4-4 (8)	4.00					▲ 20
972.5	2.5											
	3.5'		Moist Very Hard Gray/Brown SANDY LEAN CLAY w/Sandstone Fragments (CL)	SS 2	100	14-26-28 (54)	>4.5					● 11
970.0	5.0											▲
	7.0'		Brown WEATHERED SANDSTONE	SS 3	100	28-50/2"	>4.5					● 12
967.5	7.5			SS 4	100	50/5"	NP					● 8
	8.5'		Bottom of hole at 8.5 feet.									>> ▲

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CT Consultants, Inc.
 1915 N 12th Street
 Toledo Ohio 43604
 Telephone: (419)324-2222

BORING NUMBER B-2

PAGE 1 OF 1

CLIENT Village of Lordstown **PROJECT NAME** Water Booster Station Relocation
PROJECT NUMBER 231265 **PROJECT LOCATION** Tod Avenue SW, Lordstown, OH
DRILLING CONTRACTOR CT Consultants Inc. JP MP **RIG NO.** 550 **GROUND ELEVATION** 974 ft
DRILLING METHOD 2-1/4 in. HSA **GROUND WATER LEVELS:**
DATE STARTED 11/8/23 **COMPLETED** 11/8/23 **AT TIME OF DRILLING** None
LOGGED BY KKC **CHECKED BY** NT **AT END OF DRILLING** None
NOTES Auger refusal at 8.5 feet. **0hrs AFTER DRILLING** Backfilled w/Cuttings and Bentonite Chips

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	UNCONF. COMP. STR. (tsf)	DRY UNIT WT. (pcf)	PL MC LL			
									20	40	60	80
	0.0		CRUSHED STONE - 12 Inches									
972.5	2.5		Moist Loose Brown/Dark Gray SILTY SAND w/Gravel (SM)	SS 1	100	3-3-3 (6)	NP					▲ 13 ●
970.0	5.0		Brown/Gray WEATHERED SANDSTONE	SS 2	100	35-50/3"	NP					● 5 >>▲
			@5': Gray/Brown									
967.5	7.5		@7': Brown	SS 3	100	50/1"	NP					● 8 >>▲
			@7': Brown	SS 4	100	50/1"	NP					● 6 >>▲
	8.5		Bottom of hole at 8.5 feet.									


























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APPENDIX B







Legend Key

LEGEND KEY

Unified Soil Classification System Soil Symbols

 GW - WELL GRADED GRAVEL Includes Gravel-Sand mixtures, little or no fines.	 GP - POORLY GRADED GRAVEL Includes Gravel-Sand mixtures, little or no fines.	 GM - SILTY GRAVEL Includes Gravel-Sand-Silt mixtures.	 GC - CLAYEY GRAVEL Includes Gravel-Sand-Clay mixtures.
 SW - WELL GRADED SAND Includes Gravelly Sands, little or no fines.	 SP - POORLY GRADED SAND Includes Gravelly Sands, little or no fines.	 SM - SILTY SAND Includes Sand-Silt mixtures.	 SC - CLAYEY SAND Includes Sand-Clay mixtures.
 ML - SILT Includes Silt with Sand and Sandy Silt.	 CL - LEAN CLAY Includes Sandy Lean Clay and Lean Clay with Sand and Gravel.	 MH - ELASTIC SILT Includes Sandy Elastic Silt and Elastic Silt with Sand.	 CH - FAT CLAY Includes Sandy Fat Clay and Fat Clay with Sand.
 CL-ML - SILTY CLAY Includes Clayey Silt of low plasticity.	 OL - ORGANIC SILT and ORGANIC CLAY of low plasticity.	 OH - ORGANIC SILT and ORGANIC CLAY of medium to high plasticity.	 Pt - PEAT Includes humus, swamp and other soils with high organic content.
 FILL MATERIAL - Includes controlled and non-controlled soil and non-soil materials.	 TOPSOIL	 ASPHALT - Bituminous Asphalt	 CONCRETE - Includes broken concrete rubble.
 Shale	 Weathered Shale	 Sandstone	 Weathered Sandstone
 Coal			

Sample Symbols

 SS - Split Spoon	 ST - Shelby Tube	 RC - Rock Core	 GS - Geoprobe Sleeve
	 AU - Auger Cuttings	 GB - Grab	

Notes:

1. Exploratory borings were drilled on November 8, 2023, using 2¼- inch inside diameter hollow-stem augers.
2. These logs are subject to the limitations, conclusions, and recommendations in the report and should not be interpreted separate from the report.
3. The borings were located in the field by CT Consultants, Inc., in accordance with the proposed boring location plan.
4. Unconfined Compressive Strength (tsf):
NP = Non-Plastic
NI = Not Intact

APPENDIX C

Tabulation of Laboratory Test Data

APPENDIX D
Laboratory Test Results



CT Consultants, Inc.
1915 N 12th Street
Toledo Ohio 43604
Telephone: (419)324-2222

GRAIN SIZE DISTRIBUTION

CLIENT Village of Lordstown

PROJECT NAME Water Booster Station Relocation

PROJECT NUMBER 231265

PROJECT LOCATION Tod Avenue SW, Lordstown, OH

