Subsurface Exploration and Geotechnical Engineering Analysis
Armory Detention Pond
Oshkosh, Wisconsin
May 4, 2012

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Subject: Subsurface Exploration and Geotechnical Engineering Analysis for the Armory Stormwater Management Project in Oshkosh, Wisconsin
AECOM Project No. 60247182

Dear Mr. Rabe,

AECOM has completed the subsurface exploration and geotechnical engineering evaluation for the above-referenced project. The following report contains the logs of nine (9) test pits and five (5) soil borings completed at the site, our evaluation of the subsurface conditions encountered, and our recommendations as to the suitability of the native soils within the proposed water quality ponds for use as a low permeability liner. This report also contains recommendations for the design and construction of the proposed storm sewer lines, including earthwork, site preparation, design of cut slopes, conceptual earth retention, backfill requirements and other geotechnical-related design and construction considerations. In addition, the report presents the results of the geophysical seismic refraction survey that was completed at the site.

We have been pleased to provide you with our subsurface exploration and geotechnical engineering services. If you have questions regarding this report or if we may provide additional assistance, please contact us.

Yours sincerely,

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1 Project Overview

The City of Oshkosh has engaged AECOM to design a water quality pond and associated storm sewer lines at the Armory near the roadways Menard Drive and Crystal Springs Avenue in Oshkosh, Wisconsin. The location of the project site is shown on the Soil Boring Location Diagram (Figure 1) in the attachments to this report. The basin is planned as an east-west oriented feature and has a total area of approximately 18 acres. The permanent pool area has an area of approximately 7.88 acres. The bottom elevation will be at an approximate elevation of 758 feet, which is approximately 12 to 19 feet below existing site grades. We anticipate that the design preference is to construct the wet detention basin using native soils as a low permeability liner if the WDNR Technical Standard 1001 requirements can be met.

A storm sewer inlet is planned near the west corner of the basin. The new storm sewer will run west along Menard Drive and then southwest through the parking lot of the existing retail development. The storm sewer then connects to a proposed sewer line which extends west under US Highway 41. Design elevations and storm sewer invert elevation were not available at the time this report was issued; however, it was assumed that the storm sewers will be installed using conventional cut and cover techniques and that excavations ranging from approximately 5 to 15 feet will be required to install the piping.

The purposes of this report are to describe the subsurface conditions encountered in the borings, evaluate the subsurface information with respect to the proposed water quality ponds, and to present recommendations regarding the design and construction of the detention basin liner.
2 Exploration Results

2.1 Boring Layout and Survey Procedures

Nine (9) test pits and five (5) soil borings were selected by AECOM and located in the field by an AECOM representative at the locations shown on the Soil Boring Location Diagram (Figure 1). The as-completed test pit and soil boring locations and elevations were measured by City of Oshkosh surveyors. The surveyed locations are in reference to the Wisconsin State Plan south coordinate system. Elevations are referenced to the NAD 88 elevation datum.

2.2 Subsurface Exploration Procedures

The test pits were completed by a two-person City of Oshkosh excavation crew using a John Deere 75D excavator. Test pits were excavated to refusal at depths ranging from 9 to 12 feet. Bulk samples were collected at varying depths of the clay material from each test pit.

A log of the soils classified from the test pits was maintained by an AECOM representative. The relative ease or difficulty in advancing the excavation was also noted by the AECOM representative. Soil samples were containerized in the field and returned to our Green Bay, Wisconsin laboratory for further classification and testing. Water level observations made in the open test pits are noted on the test pit logs.

Soil borings were completed by a two-person drill crew using a truck mounted D-120 drill rig. Soil borings B-1, B-2, and B-3 were completed within the proposed footprint of the basin. Borings B-4 and B-5 were completed along the alignment of the proposed storm sewer. The borings were advanced using a combination of continuous solid stem flight augers and rotary wash drilling techniques. Auger refusal was encountered between 26.9 and 28 feet in the storm sewer borings, and between 22 and 27 feet in the basin borings. The basin borings were advanced an additional 20 feet for rock core samples. Soil sampling in the storm sewer borings was generally performed at 2 ½ foot intervals to the boring termination depths. Soil sampling in the basin borings was generally performed at continuous intervals to the top of bedrock, and rock core sampling was generally performed in 5 foot runs. Soil samples were obtained using split-spoon techniques in general accordance with ASTM D 1586, “Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils.” Rock core samples were obtained using an NX sized diamond tipped core barrel.

Wells were installed in borings B-1, B-2, and B-3. The wells consisted of 2 inch diameter schedule 40 PVC with a 20 foot manufactured well screen, 2 feet of stickup, and a 4-inch diameter protective cover. Well construction diagrams are included in Appendix D. A more detailed explanation of both the drilling and sampling procedures used is included in Appendix E.

A log of the soil samples and rock core samples obtained from the borings was maintained by the drill crew. Soil samples were sealed and rock cores were placed in core boxes in the field and returned to our Oshkosh, Wisconsin laboratory for further classification and testing. Water level observations made in the open boreholes are noted on the lower left hand corner of the boring logs. Upon completion, the borings were backfilled in general accordance with Wisconsin Department of Natural Resource (WDNR) regulations. Copies of the borehole abandonment forms and well installation forms are included in Appendix D.

2.3 Laboratory Procedures

The soil samples were visually examined by a Geotechnical Engineer on the basis of texture and plasticity in accordance with the AECOM Soil Classification System, which is included in Appendix H. The estimated group symbol included in parentheses following the soil descriptions on the boring logs is in general conformance with the Unified Soil Classification System, which serves as the basis of the AECOM Soil Classification System. A brief explanation of the classification of soil samples is included in the AECOM Field and Laboratory Procedures in Appendix E of this report.

Calibrated penetrometer and moisture content tests were performed on representative portions of the soil samples collected from the borings. Three bulk samples were selected for classification and characterization testing consisting of grain size distribution in general accordance with ASTM D422, Atterberg Limits in general accordance with ASTM D4318, and Standard
Proctor Moisture-Density Relationship in general accordance with ASTM D698. Three remolded permeability tests were also performed. The samples were remolded to 90% of the maximum dry density at the optimum moisture content as determined from the Standard Proctor tests. The hydraulic conductivity testing was determined in general accordance with ASTM D5084. Results of the field and laboratory tests were then described on the boring logs which are contained in Appendix F.

The procedures utilized in preparing the final boring logs from the field logs and laboratory test data are described on the sheets entitled “AECOM Field and Laboratory Procedures” which are included in Appendix E. Soil samples recovered from the borings will be retained in our laboratory for a period of 90 days, after which they will be discarded unless specific instructions as to their disposition are received.

2.4 Geophysical Survey

Our previous experience in the vicinity of the Armory site indicated that the base of the detention basin would extend or below the bedrock surface. To provide additional information for bidding and pricing the project, a geophysical survey was performed to provide additional information on the excavation characteristics of the material at the site and how they vary with depth. The geophysical survey also determined the relative uniformity of the depth to non-rippable rock across the site.

The goal of the geophysical survey was to measure the variation of the seismic velocity of the onsite materials with depth. Measuring the seismic velocity of a material is the most cost-effective non-destructive method for evaluating the rippability of weathered and intact rock. The seismic velocity is the criterion in the Caterpillar Handbook on Ripping which defines the type and size of equipment that is required to remove various types of materials.

A total of thirty-two seismic refraction traverses were performed over various portions of the site in an effort to assess the rock velocity and variability as it pertains to rippability. Seismic refraction surveying is based on the travel times and refracted raypaths of acoustic waves sent through the subsurface. The waves are initiated by a source at the surface, and the response is measured by geophones placed at discrete intervals along a specified survey line. Plotted travel times increase with distance from the source, creating a slope that is related to the velocity of the material through which the waves traveled. When the waves intercept a material of different velocity, the slope of the observed wave arrivals will change.

AECOM used a Geometrics Geode seismograph to simultaneously sample, record, and display 24 channels of seismic data. The menu-driven display and associated software on the instrument allows for setup of each seismic spread, inspection of the data after collection, and preliminary interpretation of the data in the field.

The survey was performed in the relatively flat-lying and accessible portions of the proposed detention basin footprint. The seismic arrays were collected at various orientations in an effort to make maximum use of open areas where long line segments could be collected with minimal topographic changes. A total of 32 individual arrays (spreads) were collected at various orientations within the survey area. The locations of these arrays are shown in Appendix G. Some profiles locations were adjusted to avoid obstructions such as current retention ponds, drainage ditches, or the grassy hill present at the site. Data was collected from each profile using a 5-ft geophone spacing to maximize resolution, creating 115-ft long profiles. An 8-lb sledge hammer was used to initiate seismic waves at five locations within the 120 ft array length and at two offset positions 20 ft off the ends of each profile. The profile endpoints were staked in the field and surveyed for position and elevation at a later date by the City of Oshkosh, and provided to us for data interpretation and inclusion in our geotechnical report.
3 Exploration Results

3.1 Site Conditions

The proposed stormwater management project is located on the Armory property where it is bordered by Crystal Springs Avenue to the north and Menard Dr. to the west. Based on the approximate ground surface elevations obtained at the individual test pit and boring locations, there is as much as 8 feet of topographic relief between locations. A large mound of soil is currently present in the eastern portion of the proposed basin. It would appear this soil is the spoil that was left from when the existing drainage features on the armory site were constructed. The top of this mound extends approximately 16 feet above the surrounding site grades.

3.2 Subsurface Conditions

Based on the results of the test pits and borings, the soil profile is reasonably uniform across the site. There is a relatively thin veneer of topsoil at the surface, underlain by native silty clay. The native clay extends to depths of 10 to 19.5 feet below existing grade. More granular deposits were encountered below these depths, ranging in texture from sandy silt to silty sand. The sandy silt layer was on the order of 2 to 6 feet thick. The sandy silt layer transitioned to a sandy gravel or gravelly sand directly above the bedrock surface. Bedrock was encountered at depths of 22 to 27 feet below grade. A more detailed explanation of each of these strata is provided in the following paragraphs.

Dark brown to black silty clay topsoil with traces of fine sand and gravel was encountered at the surface in most borings and test pits to depths ranging from 1 to 2.5 feet. Fill was encountered in boring B-3, and in test pits TP-5 through TP-9. The fill encountered in the test pits consisted of a mixture of silty clay with cobbles and boulders. The fill was on the order of 1.5 to 4 feet thick. Buried topsoil was encountered below the fill. The buried topsoil ranged in thickness from 0.5 to 2.5 feet. No buried topsoil was encountered in TP-9. The fill encountered in boring B-3 consisted of a thin layer of asphalt underlain by a sand and gravel base course. The base course was about 1.9 feet thick. Boring B-4 also encountered a thin layer of asphalt at the surface, but no base course was present beneath the pavement section.

Native reddish-brown silty clay (CL) with traces of fine to coarse gravel and fine to coarse sand was encountered below the topsoil and/or dark-brown silty clay to depths ranging from 10 to 19.5 feet. The consistency of the reddish-brown silty clay ranged from stiff to hard based on the unconfined compressive strength as estimated from calibrated penetrometer test results. The moisture contents of representative silty clay samples ranged from approximately 15 to 30 percent. Atterberg limits tests were completed on representative bulk samples of the native reddish-brown silty clay obtained from the test pits. A summary of the Atterberg limits test results is presented in Table 1. The test results indicate the clay is of moderate plasticity, and that the natural moisture content of the clay is approximately equal to the plastic limit. The individual test results are provided in Appendix F.

<table>
<thead>
<tr>
<th>Test No.</th>
<th>Depth (ft.)</th>
<th>Soil Type</th>
<th>Liquid Limit</th>
<th>Plastic Limit</th>
<th>Plasticity Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>T-2</td>
<td>6</td>
<td>CL</td>
<td>44</td>
<td>19</td>
<td>25</td>
</tr>
<tr>
<td>T-6</td>
<td>5</td>
<td>CH</td>
<td>57</td>
<td>24</td>
<td>33</td>
</tr>
<tr>
<td>T-9</td>
<td>8</td>
<td>CL</td>
<td>42</td>
<td>19</td>
<td>23</td>
</tr>
</tbody>
</table>

Three standard Proctor moisture-density tests were also completed in general accordance with ASTM D-698 on bulk samples of the reddish brown silty clay. The maximum dry density varied from 106 to 122 pounds per cubic foot (pcf), with an optimum moisture content ranging from 13 to 20 percent. This would suggest that some moisture conditioning may be required at the time of construction to place and compact the materials to an adequate degree.
The silty clay is underlain by more granular deposits ranging in texture from sandy silts to silty sands. The relative density of the sandy silt and silty sand/gravelly sand deposits was typically in the dense to extremely dense range. These deposits were generally on the order of 2 to 8 feet thick, and were present above the bedrock.

Bedrock was encountered at depths of 22 to 27 feet. The rock consisted of a dolomitic limestone, which was highly fractured at the surface and became more competent with depth. Please refer to the boring logs and photographic logs in Appendix C for detailed information on the bedrock.

Additional variations to the above general profile were noted. Refer to the individual boring logs in Appendix C for specific information. It should be noted that the stratification lines indicated on the boring logs were selected on the basis of laboratory tests, field logs, and visual observations of the recovered samples. The stratification lines that occur on the boring logs are in some cases estimated; in-situ, the transition between soil types in both the horizontal and vertical directions may be gradual.

### 3.3 Groundwater Conditions

A summary of the groundwater level measurements obtained during excavating operations is presented in Table 2.

<table>
<thead>
<tr>
<th>Test Pit No.</th>
<th>Depth to Groundwater (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>While Excavating</td>
</tr>
<tr>
<td>TP-4</td>
<td>8.75</td>
</tr>
<tr>
<td>TP-8</td>
<td>Not Encountered</td>
</tr>
</tbody>
</table>

Groundwater was not encountered in test pits TP-1 through TP-3, TP-5 through TP-7, and TP-9 during excavation. TP-6 was checked after excavation for groundwater because of the sand and gravel layer underlying the reddish-brown silty clay; however, no groundwater was encountered. The groundwater in test pit TP-4 was encountered during excavation. Given the predominantly cohesive nature of the site soils, we anticipate that the groundwater level measurements are likely indicative of perched water conditions and are not necessarily indicative of the long term position of the local groundwater table.

Groundwater level fluctuations may occur with time and seasonal change due to variations in precipitation, evaporation, surface water runoff, and local dewatering. Perched water pockets and a higher water table level may also be encountered during wet weather periods. To determine a more accurate long-term groundwater table, groundwater monitoring wells were installed in the three borings. The data collected thus far suggests that groundwater is higher in elevation in the southwest area of the proposed footprint and lower in elevation in the northeast area. On average, water levels range from roughly 754.7 to 759.1 feet in elevation. Table 3 presents the summary of the well water levels collected to date.

<table>
<thead>
<tr>
<th>Boring No.</th>
<th>Groundwater Elevation (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3-14-12</td>
</tr>
<tr>
<td>B-1</td>
<td>753.7</td>
</tr>
<tr>
<td>B-2</td>
<td>758.9</td>
</tr>
<tr>
<td>B-3</td>
<td>759.0</td>
</tr>
</tbody>
</table>
3.4 Geophysical Survey

The survey setup and computer analysis program (Geometrics Seisimager®) provide an estimate of the depth to bedrock using Refraction Tomography. This method was employed in order to obtain better resolution of the data, since the high-velocity bedrock interface is relatively close to the ground surface. Traditional seismic refraction processing techniques yielded models that generally agreed with confirmatory boreholes, but in which the soil and rock velocities varied laterally and did not always remain consistent at the endpoints of adjacent arrays. For this reason, the sections were reprocessed using Seisimager Refraction Tomography processing software in order to develop sections that depict a velocity gradient that will better represent actual in situ soil and rock conditions.

Seisimager utilizes processing algorithms based upon a nonlinear travel time tomography methodology described by Hayashi and Takahashi (2001). A shortest-path algorithm described by Moser (1991) constitutes the forward model, and inversion is accomplished via the simultaneous iterative reconstruction technique (SIRT). An initial velocity model based on the soil boring and test pit data was created by generating a two-dimensional starting model from the expected velocity range, depth to the deepest layer, and the number of layers in which to divide the zones. The program then generated the geometry and velocity distribution for the initial model.

For the interpretations shown in this report, unsaturated sediments have a compressional wave velocity less than 5,000 feet per second (fps), while saturated sediments have a velocity of 5,000 to 5,500 fps. Materials in the 5,500 to 7,500 fps velocity range can include very hard dense glacial till materials and weak, weathered rock. Weathered rock that is rippable is roughly defined as material with a velocity up to about 7,300 fps. Above 7,300 - 7,500 fps limestone is considered more competent and its rippability can be equipment-dependent (based on size and manufacturer). The following table presents the rippability rating from the Caterpillar Performance Handbook 38th Edition.
In general, the modeled sections show seismic velocities in the 1,000 to 5,500 fps range for the uppermost 15 to 18 feet of each survey line. These plots are included in Appendix G. Abrupt increases from 5,500 to over 7,000 fps were observed in the 18 to 26 foot depth range. These higher velocity zones likely represent some combination of the saturated, very dense gravelly sands, as well as a portion of the weathered bedrock surface that is weak enough to be rippable. It is important to note that this survey method characterizes materials by seismic velocities only and cannot differentiate between dense sediments and very weak rock (crumbly, rippable). The 7,300 fps contour that is highlighted on the velocity models provides an interpreted maximum rippable depth of the subsurface materials, which may be comprised of very hard till, dense gravel and boulders, weathered limestone, or some combination thereof. The zone of material which has velocities ranging from 5,000 fps to 7,300 fps can be classified as marginally rippable based on the Caterpillar criteria presented above.

The bedrock elevation shows some variability and based on the confirmatory drilling, may have a rippable weathered zone from a few to several feet in thickness. The borings have shown that competent (non-rippable) rock is deeper than previously thought, based on test pits that were performed in advance of the borehole and seismic efforts. The hard bouldery-clay till encountered in the test pits indicates that heavy earth-moving machinery will likely be necessary to remove this stiff rocky material.

Source: Caterpillar (2008)
The specific conclusions determined from this survey effort include the following:

- Calculation of the competent (non-rippable) bedrock elevation is shown in Appendix G as varying from Elevation 744 to 756 ft across the site.

- The boundary where the soils and weathered rock at the site is no longer rippable using heavy construction machinery appears to vary from 18 to 26 ft below ground surface across the site. The majority of the survey area is interpreted to have 22 to 24 fee of rippable material which may include soil, glacial till and weak or weathered rock.

- There may be zones of in situ carbonate bedrock that are indistinguishable (seismically) from the overburden due to its loss of rigidity from intense weathering. This material is characterized as rippable, but may impede efforts to quantify rock removal volumes due to seismic properties that are similar to very dense sediments.
4 Analysis and Recommendations

4.1 Water Quality Pond Liner Construction

Based on the planned bottom elevation of 758 feet for the basin, we anticipate that excavations ranging from approximately 11 to 20 feet deep will be required. The soil conditions encountered in the borings indicate that the proposed bottom of the detention basin will be within or near the sandy silt and sandy gravel layers that were encountered in the borings. It will be necessary to install a compacted clay liner in the base of the detention basin in order for it to hold water.

Based on the conditions encountered in the test pits and borings and the results of the Atterberg limit tests completed on representative soil samples, the native silty clay meets the minimum criteria for a Type A Liner as outlined in the Wisconsin Department of Natural Resources (WDNR) Technical Standard 1001 (D). Thus, where native silty clay is encountered at the base and/or side-slopes of the water quality pond excavation, we anticipate that this material can be compacted in place to form a natural water quality pond liner. The remainder of the clayey excavation spoil could be used to construct the liner in areas where more granular deposits were encountered as required. Native soils that do not meet the WDNR Type A liner requirements, or other unsuitable material encountered at the base and/or side slopes of the wet detention basin should be removed to a minimum depth of 2 feet with re-compact native silty clay. Additional recommendations for the placement of the clay liner materials are contained below.

In accordance with WDNR Technical Standard 1001 (D), we recommend that the clay at the base and side slopes of the water quality pond (either compacted in-place or reused from the water quality pond excavation) have an average Plasticity Index (PI) of 12 or more; an average Liquid Limit (LL) of 25 or greater, with no value less than 20; and at least 50% of the soil by weight finer than the #200 sieve. Our test results indicate the on-site native silty clays meet these requirements. The native silty clay should be compacted in accordance with National Resources Conservation Service (NRCS) Wisconsin Construction Specification 300, Clay Liners, using a sheepsfoot (or similar type) compactor weighing at least 25,000 pounds, operated continuously, in maximum 6-inch loose lifts. The clay liner should be compacted to a minimum of 95% of the maximum dry density and at a moisture content at least 2% wet of optimum as determined by ASTM D-698 (standard Proctor). We recommend using the standard Proctor as a basis for compaction as it allows greater flexibility in moisture control during construction.

The minimum compacted thickness of the clay liner (either compacted in-place or reused from the excavation) must be 2 feet in accordance with WDNR Technical Standard 1001 (D). The moisture content tests performed on the overburden materials indicate that the natural moisture content of the native clay is likely in excess of the optimum moisture in the Proctor test. In the event that the clays become dried during construction, water may be applied by sprinkling the clay after placement and before compaction, as necessary. Uniform moisture distribution can be obtained by diskin. The compacted clay should be free of organics, cobbles, boulders, debris and any other unsuitable soils. The coefficient of permeability of the compacted soils should be no greater than 1x10^-7 cm/second. Based on the results of the remolded permeability tests that were performed, the onsite soils will achieve this permeability or less if they are compacted to the specification recommended above. Permeability test results are included in Appendix F.

Additionally, we recommend that any topsoil, fill soils, and/or native soils that do not meet the WDNR Type A liner requirements, or other unsuitable material encountered at the base and/or side slopes of the detention basin, should be removed to a minimum depth of 2 feet and replaced with re-compact native silty clay.

The proposed bottom of the detention basin is situated at an elevation of approximately 758. An additional two feet of cut will be necessary to facilitate the installation of the compacted clay liner at the bottom and along the sides of the basin which will extend to an approximate elevation of 756. This excavation will extend below the groundwater level which varies from elevation 756 to 759 across the site. Groundwater will likely be encountered during excavation of the basin. It will be necessary to provide temporary dewatering as the excavation progresses. Sump pits and trenching will likely be sufficient to facilitate the dewatering. Sumps and trenches will need to be excavated to depths extending below an elevation of 756 for the placement of the clay liner.

Prior to the placement of the clay liner, we recommend a non-woven geotextile fabric is installed on the exposed subgrade. This separating fabric is necessary to prevent piping of the clay liner material into the underlying more coarse material. The
permanent pool elevation for the basin will be at an approximate elevation of 763 which would cause a downward gradient through the liner which could cause the migration of the liner soils into the subgrade.

### 4.2 Storm Sewer Construction

As noted in Section 1.0, we have assumed that excavations ranging from approximately 5 to 15 feet deep will be required to install the proposed storm sewer lines. From top to bottom, the generalized subsurface profile within this depth range along the proposed storm sewer construction consisted of topsoil or bituminous concrete underlain by native clay. Assuming construction is performed during a time of low to normal water levels, the above general subsurface conditions should allow for excavation and construction of the storm sewer lines to depths of 5 to 15 feet, with possible localized groundwater pumping required to control perched water. Depending on the final design invert elevations, some additional excavation and replacement of unsuitable fill and/or native soils may be required at the base of the sewer trench to provide a suitable base for placement of bedding material. Additional recommendations regarding the excavation and construction of the proposed sanitary sewer are contained in the following paragraphs.

We anticipate that the storm sewer will be installed using conventional cut and cover techniques and will likely utilize trench box shoring to maintain the excavation. Sloughing of the sidewall soils into the excavation may occur, particularly where seams or layers of more granular sand and silt soils are encountered. However, given the predominantly cohesive nature of the site soils above a depth of 15 feet in the boring performed along the sewer alignment, we anticipate that the contractor should be able to maintain the sidewall stability long enough to set the trench box shoring. In order to provide safe construction of the storm sewer lines, the overall excavation and installation and use of trench box shoring should be performed under the direction of a competent person designated by the project contractor.

The storm sewer should be installed as per the recommendations provided in the Standard Specifications for Sewer and Water Construction in Wisconsin, current edition. If soft or wet soils are encountered at the base, the excavation should be extended an additional 3 inches (minimum) and backfilled with a crushed stone material meeting the gradation requirements of section 8.43.6 of the specification. The additional excavation and crushed stone placement should be performed under the observation of a member of the project design team. Bedding material placed below and adjacent to the storm sewer pipe should conform to the requirements of section 8.43.2 of the above specification. Cover material (fill placed over the sewer pipe and above the bedding material) should conform to section 8.43.3 of the specification. We anticipate that excavated material could be used to backfill the remainder of the trench above the cover material, provided all deleterious materials are removed prior to placement and the fill is placed as per the requirements of section 8.43.5 of the specification. It should be noted that there can be an increased risk of consolidation of cohesive backfill when compared to granular material, post placement, if proper compaction methods are not used. We recommend that the backfill be consolidated in accordance with section 2.6.14(b) (mechanical compaction) rather than by flooding (section 2.6.14(a)), particularly where cohesive soils are used as backfill.

Existing fill was encountered in test pits TP-5, TP-6, TP-7, and TP-8 as well as boring B-3 performed as part of this investigation. No information related to the placement methods of the existing fill was available at the time of this report. Although fill was not encountered in B-4 or B-5 along the proposed storm sewer, constructing utilities or other structures over undocumented fill may result in consolidation of the fill material as a result of any new loading and an increased risk of excessive total or differential settlement. Additionally, excessive consolidation of the fill material and related settlement is more likely in areas where new loading is imposed on the existing material. If it is determined that new loading is anticipated, additional evaluation of potential settlement of the sanitary sewer or relevant structure should be performed.

We recommend that new fill be placed within -2 to +4 percent of the optimum moisture content as determined by the standard Proctor test. Compaction of cohesive soils should be performed using a sufficiently large vibratory sheepsfoot roller to confirm that the soils are adequately mixed and compacted. Compaction of granular soils should be performed using a sufficiently large vibratory roller or plate compactor.

We recommend that an AECOM representative be present during the excavation and filling operations. This is to confirm that only approved fill materials are used, as well as to confirm that the soils have been placed in accordance with the project
specifications. This would allow confirmation that the existing subgrade is undisturbed and that the site is prepared according to the intent of this report. Refer to the “AECOM Earthwork Guideline” included in Appendix I for additional information regarding site preparation.

4.3 Construction Considerations

All excavations which extend greater than 5 feet in depth should be advanced in accordance with OSHA regulations with properly sloped or braced sides to prevent excavation instability. Excavation safety is the responsibility of the contractor. We recommend that temporary excavation sides in the overburden soils at the site be planned with a slope of 1.5 H: 1 V or flatter to prevent excavation instability. Material stockpiles or heavy equipment should not be placed near the edge of the excavation slopes within the overburden soils. The actual stable slope angle should be determined during construction and will depend upon the loading, soil, and groundwater conditions encountered.

Excavations to construct the detention basin and storm sewer lines may extend below the local groundwater table. Some seepage may be encountered in excavations below the water table as well as in seams of more granular material above the water table. Based on the well readings which have been performed to date, the final bottom grade of the basin will be at or slightly above the groundwater table at the site. The excavation required to install the clay liner may extend below the groundwater table. Due to the granular nature of the material directly above the bedrock, groundwater inflow could be significant. Test excavations in the pond footprint should be considered prior to construction. A dewatering system such as shallow well points may be necessary to temporary lower the groundwater table to facilitate the installation of the compacted clay liner. Consideration for subgrade protection and improvement, if necessary, are discussed in Appendix I. Subgrade exposure time to wet conditions can contribute to basal instability and should be minimized. Water accumulations on exposed subgrade soils are detrimental and should be removed promptly. A quick condition can develop at the base if the soils are not adequately dewatered. If dewatering efforts are difficult during placement of the liner additional overexcavation and construction of a drainage blanket could be beneficial. An additional 12 inches of undercut would be performed; a layer of fabric and 12 inches of coarse stone could be placed at the base of the excavation to help facilitate dewatering. A second layer of fabric would then be placed and the two foot clay liner would be constructed on top of that.

When preparing the project plans and specifications, we recommend separate bid items for earth excavation, hard excavation, rippable rock and rock removal. Based on the observations of the test pit excavations, the upper 10 to 12 feet appears to be excavatable using conventional earth moving equipment. Below this layer, dense till with cobbles and boulders is present which will require large excavation equipment and will likely decrease the production rate of the earth moving contractor. Rippable rock will need to be defined based on an assumed type and size of dozer with a ripping tooth which will be the basis of the bid. Rock removal will consist of material which cannot be ripped and will require hammering or drilling to be removed.
5 General Qualifications

This report has been prepared in general accordance with normally accepted geotechnical engineering practices to aid in the evaluation of this site and to assist our Client in the design of this project. We have prepared this report for the purpose intended by our Client, and reliance on its contents by anyone other than our Client is done at the sole risk of the user. No other warranty, either expressed or implied, is made. The scope is limited to the specific project and location described herein, and our description of the project represents our understanding of the significant aspects relevant to the geotechnical characteristics. In the event that any changes in the design or location of the facilities as outlined in this report are planned, we should be informed so that the changes can be reviewed and the conclusions of this report modified, as necessary, in writing by the Geotechnical Engineer. As a check, we recommend that we be authorized to review the project plans and specifications to confirm that the recommendations contained in this report have been interpreted in accordance with our intent. Without this review, we will not be responsible for the misinterpretation of our data, our analysis, and/or our recommendations, nor how these are incorporated into the final design.

The analysis and recommendations submitted in this report are based on the data obtained from the test pits and soil borings performed at the locations indicated on the location diagram and from the information discussed in this report. This report does not reflect any variations which may occur between the test pits and borings. In the performance of subsurface explorations, specific information is obtained at specific locations at specific times. However, it is a well known fact that variations in soil and rock conditions exist on most sites between test pit and boring locations and that seasonal and annual fluctuations in groundwater levels will likely occur. The nature and extent of variations may not become evident until the course of construction. If variations then appear evident, it will be necessary for a re-evaluation of the recommendations contained in this report after performing on-site observations during the construction period and noting the characteristics of the variations.

The Geotechnical Engineer of Record is the Professional Engineer who authored the geotechnical report. It is recommended that all construction operations dealing with earthwork and foundations be observed by the Geotechnical Engineer of Record or the Geotechnical Engineer’s appointed representative to confirm that the design requirements are fulfilled in the actual construction. For some projects, this may be required by the governing building code.

The scope of services for this project does not include either specifically or by implication any environmental or biological (e.g. mold, fungi, bacteria, viruses, and the byproducts of such organisms) assessment of the site, or identification of or prevention of pollutants, hazardous materials, or conditions. Other studies beyond the scope of this project would be required to evaluate the potential of such contamination or pollution.
Figures
Figure 1 – Geotechnical Investigation Diagram
Appendix A.

AECOM Standard Boring Log Procedures
In the process of obtaining and testing samples and preparing this report, standard procedures are followed regarding field logs, laboratory data sheets and samples.

Field logs are prepared during performance of the drilling and sampling operations and are intended to essentially portray field occurrences, sampling locations and procedures.

Samples obtained in the field are frequently subjected to additional testing and reclassification in the laboratory by experienced geotechnical engineers, and as such, differences between the field logs and the final logs may exist. The engineer preparing the report reviews the field logs, laboratory test data and classifications, and using judgment and experience in interpreting this data, may make further changes. It is common practice in the geotechnical engineering profession not to include field logs and laboratory data sheets in engineering reports, because they do not represent the engineer’s final opinions as to appropriate descriptions for conditions encountered in the exploration and testing work. Results of laboratory tests are generally shown on the boring logs or are described in the text of the report, as appropriate.

Samples taken in the field, some of which are later subjected to laboratory tests, are retained in our laboratory for sixty days and are then discarded unless special disposition is requested by our client. Samples retained over a long period of time, even in sealed jars, are subject to moisture loss which changes the apparent strength of cohesive soil, generally increasing the strength from what was originally encountered in the field. Since they are then no longer representative of the moisture conditions initially encountered, observers of these samples should recognize this factor.
Appendix B.

AECOM General Boring Log Notes
Drilling and Sampling Symbols:

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SS</td>
<td>Split Spoon - 1-3/8&quot; I.D. 2&quot; O.D. (Unless otherwise noted)</td>
</tr>
<tr>
<td>ST</td>
<td>Shelby Tube-2&quot; O.D. (Unless otherwise noted)</td>
</tr>
<tr>
<td>PA</td>
<td>Power Auger</td>
</tr>
<tr>
<td>DB</td>
<td>Diamond Bit-NX, BX, AX</td>
</tr>
<tr>
<td>AS</td>
<td>Auger Sample</td>
</tr>
<tr>
<td>JS</td>
<td>Jar Sample</td>
</tr>
<tr>
<td>VS</td>
<td>Vane Shear</td>
</tr>
<tr>
<td>OS</td>
<td>Osterberg Sampler</td>
</tr>
<tr>
<td>HS</td>
<td>Hollow Stem Auger</td>
</tr>
<tr>
<td>WS</td>
<td>Wash Sample</td>
</tr>
<tr>
<td>FT</td>
<td>Fish Tail</td>
</tr>
<tr>
<td>RB</td>
<td>Rock Bit</td>
</tr>
<tr>
<td>BS</td>
<td>Bulk Sample</td>
</tr>
<tr>
<td>PM</td>
<td>Pressuremeter Test</td>
</tr>
</tbody>
</table>

Standard "N" Penetration: Blows per foot of a 140 pound hammer falling 30 inches on a 2 inch O.D. split spoon sampler, except where otherwise noted.

Water Level Measurement Symbols:

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>WL</td>
<td>Water Level</td>
</tr>
<tr>
<td>WS</td>
<td>While Sampling</td>
</tr>
<tr>
<td>WD</td>
<td>While Drilling</td>
</tr>
<tr>
<td>AB</td>
<td>After Boring</td>
</tr>
<tr>
<td>WCI</td>
<td>Wet Cave In</td>
</tr>
<tr>
<td>DCI</td>
<td>Dry Cave In</td>
</tr>
<tr>
<td>BCR</td>
<td>Before Casing Removal</td>
</tr>
<tr>
<td>ACR</td>
<td>After Casing Removal</td>
</tr>
</tbody>
</table>

Water levels indicated on the boring logs are the levels measured in the boring at the time indicated. In pervious soils, the indicated elevations are considered reliable groundwater levels. In impervious soils, the accurate determination of groundwater elevations may not be possible, even after several days of observations; additional evidence of groundwater elevations must be sought.

Gradation Description and Terminology:

Coarse grained or granular soils have more than 50% of their dry weight retained on a #200 sieve; they are described as boulders, cobbles, gravel or sand. Fine grained soils have less than 50% of their dry weight retained on a #200 sieve; they are described as clay or clayey silt if they are cohesive and silt if they are non-cohesive. In addition to gradation, granular soils are defined on the basis of their relative in-place density and fine grained soils on the basis of their strength or consistency and their plasticity.

<table>
<thead>
<tr>
<th>Major Component of Sample</th>
<th>Size Range</th>
<th>Description of Other Components Present in Sample</th>
<th>Percent Dry Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boulders</td>
<td>Over 8 in. (200 mm)</td>
<td>Trace</td>
<td>1-9</td>
</tr>
<tr>
<td>Cobbles</td>
<td>8 inches to 3 inches (200 mm to 75 mm)</td>
<td>Little</td>
<td>10-19</td>
</tr>
<tr>
<td>Gravel</td>
<td>3 inches to #4 sieve (75 mm to 4.76 mm)</td>
<td>Some</td>
<td>20-34</td>
</tr>
<tr>
<td>Sand</td>
<td>#4 to #200 sieve (4.76 mm to 0.074 mm)</td>
<td>And</td>
<td>35-50</td>
</tr>
<tr>
<td>Silt</td>
<td>Passing #200 sieve (0.074 mm to 0.005 mm)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clay</td>
<td>Smaller than 0.005 mm</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Consistency of Cohesive Soils:

<table>
<thead>
<tr>
<th>Unconfined Compressive Strength, Qu, tsf</th>
<th>Consistency</th>
<th>N-Blows per foot</th>
<th>Relative Density</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;0.25</td>
<td>Very Soft</td>
<td>0 - 3</td>
<td>Very Loose</td>
</tr>
<tr>
<td>0.25 - 0.49</td>
<td>Soft</td>
<td>4 - 9</td>
<td>Loose</td>
</tr>
<tr>
<td>0.50 - 0.99</td>
<td>Medium (firm)</td>
<td>10 - 29</td>
<td>Medium Dense</td>
</tr>
<tr>
<td>1.00 - 1.99</td>
<td>Stiff</td>
<td>30 - 49</td>
<td>Dense</td>
</tr>
<tr>
<td>2.00 - 3.99</td>
<td>Very Stiff</td>
<td>50 - 80</td>
<td>Very Dense</td>
</tr>
<tr>
<td>4.00 - 8.00</td>
<td>Hard</td>
<td>&gt;80</td>
<td>Extremely Dense</td>
</tr>
<tr>
<td>&gt;8.00</td>
<td>Very Hard</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix C.

AECOM Boring Logs and Photographic Logs
### DESCRIPTION OF MATERIAL

<table>
<thead>
<tr>
<th>Run</th>
<th>Depth (ft.)</th>
<th>Recovery (%)</th>
<th>RQD (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>C-1</td>
<td>22.5 - 27.0</td>
<td>53%</td>
<td>0%</td>
</tr>
<tr>
<td>C-2</td>
<td>27.0 - 31.5</td>
<td>96.3%</td>
<td>66.7%</td>
</tr>
<tr>
<td>C-3</td>
<td>31.5 - 36.5</td>
<td>100%</td>
<td>55%</td>
</tr>
<tr>
<td>C-4</td>
<td>36.5 - 41.5</td>
<td>88.6%</td>
<td>81.1%</td>
</tr>
</tbody>
</table>

End of Boring

Standard Penetration Tests Performed with Automatic Deidrich Hammer

*Calibrated Penetrometer

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

---

**SITE LOCATION**

City of Oshkosh

**PROJECT NAME**

Armory Detention Basin

**ARCHITECT-ENGINEER**

AECOM

**CLIENT**

City of Oshkosh

**LOG OF BORING NUMBER**

B-1

---

**SURFACE ELEVATION**

+769.7

---

**DEPTH (FT)** | **ELEVATION (FT)** | **DESCRIPTION OF MATERIAL**
--- | --- | ---
1 | SS | Clayey topsoil and silt - trace gravel, sand, and roots - medium (OL, Clay)
2 | SS | Silty clay - little sand and gravel - reddish brown - very stiff to stiff (CL, Clay)
3 | SS | Sandy silt, trace clay and gravel - gray - dense - wet (ML, Silty Loam)
4 | SS | Sandy gravel, trace silt - brown - dense - wet (GP-GM, Loamy Sand)
5 | SS | Gray dolomitic limestone with some dark seams of limestone, intermitent pockets of quartz and pyrite noted
6 | SS | Run Depth Recovery RQD # (ft.) (%) (%) C-1 22.5 - 27.0 53% 0%
7 | SS | C-2 27.0 - 31.5 96.3% 66.7%
8 | SS | C-3 31.5 - 36.5 100% 55%
9 | SS | C-4 36.5 - 41.5 88.6% 81.1%
10 | SS | End of Boring
11 | SS | Run Depth Recovery RQD # (ft.) (%) (%) C-1 22.5 - 27.0 53% 0%
12 | SS | C-2 27.0 - 31.5 96.3% 66.7%
13 | SS | C-3 31.5 - 36.5 100% 55%
14 | SS | C-4 36.5 - 41.5 88.6% 81.1%

---

**UNCONFINED COMpressive Strength**

<table>
<thead>
<tr>
<th>TONS/FT.</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLASTIC LIMIT %</td>
<td>10</td>
<td>20</td>
<td>30</td>
<td>40</td>
<td>50</td>
</tr>
<tr>
<td>WATER CONTENT %</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LIQUID LIMIT %</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**RECOVERY**

- Run C-1
- Run C-2
- Run C-3
- Run C-4

---

**LOG OF BORING NUMBER**

B-1

---

**CLIENT**

City of Oshkosh

**PROJECT NAME**

Armory Detention Basin

**ARCHITECT-ENGINEER**

AECOM

**LOG OF BORING NUMBER**

B-1

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**SURFACE ELEVATION**

+769.7

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--- | --- | ---
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<th>1</th>
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<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
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<td>30</td>
<td>40</td>
<td>50</td>
</tr>
<tr>
<td>WATER CONTENT %</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LIQUID LIMIT %</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**RECOVERY**

- Run C-1
- Run C-2
- Run C-3
- Run C-4

---

**LOG OF BORING NUMBER**

B-1

---

**SURFACE ELEVATION**

+769.7

---

**DEPTH (FT)** | **ELEVATION (FT)** | **DESCRIPTION OF MATERIAL**
--- | --- | ---
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4 | SS | Sandy gravel, trace silt - brown - dense - wet (GP-GM, Loamy Sand)
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11 | SS | Run Depth Recovery RQD # (ft.) (%) (%) C-1 22.5 - 27.0 53% 0%
12 | SS | C-2 27.0 - 31.5 96.3% 66.7%
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14 | SS | C-4 36.5 - 41.5 88.6% 81.1%

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**UNCONFINED COMpressive Strength**

<table>
<thead>
<tr>
<th>TONS/FT.</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLASTIC LIMIT %</td>
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<td>20</td>
<td>30</td>
<td>40</td>
<td>50</td>
</tr>
<tr>
<td>WATER CONTENT %</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LIQUID LIMIT %</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**RECOVERY**

- Run C-1
- Run C-2
- Run C-3
- Run C-4

---

**LOG OF BORING NUMBER**

B-1

---

**SURFACE ELEVATION**

+769.7

---

**DEPTH (FT)** | **ELEVATION (FT)** | **DESCRIPTION OF MATERIAL**
--- | --- | ---
1 | SS | Clayey topsoil and silt - trace gravel, sand, and roots - medium (OL, Clay)
2 | SS | Silty clay - little sand and gravel - reddish brown - very stiff to stiff (CL, Clay)
3 | SS | Sandy silt, trace clay and gravel - gray - dense - wet (ML, Silty Loam)
4 | SS | Sandy gravel, trace silt - brown - dense - wet (GP-GM, Loamy Sand)
5 | SS | Gray dolomitic limestone with some dark seams of limestone, intermitent pockets of quartz and pyrite noted
6 | SS | Run Depth Recovery RQD # (ft.) (%) (%) C-1 22.5 - 27.0 53% 0%
7 | SS | C-2 27.0 - 31.5 96.3% 66.7%
8 | SS | C-3 31.5 - 36.5 100% 55%
9 | SS | C-4 36.5 - 41.5 88.6% 81.1%
10 | SS | End of Boring
11 | SS | Run Depth Recovery RQD # (ft.) (%) (%) C-1 22.5 - 27.0 53% 0%
12 | SS | C-2 27.0 - 31.5 96.3% 66.7%
13 | SS | C-3 31.5 - 36.5 100% 55%
14 | SS | C-4 36.5 - 41.5 88.6% 81.1%
The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

---

**Calibrated Penetrometer**

---

**End of Boring
Standard Penetration Tests Performed with Automatic Deidrich Hammer**

---

**Site Location**
Menard Drive, Oshkosh, Wisconsin

---

**Description of Material**

<table>
<thead>
<tr>
<th>Depth (ft.)</th>
<th>Sample No.</th>
<th>Sample Type</th>
<th>Description of Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SS</td>
<td></td>
<td>Silty clay, trace sand and gravel - black - stiff (CL, Clay)</td>
</tr>
<tr>
<td>2</td>
<td>SS</td>
<td></td>
<td>Silty clay, little sand and gravel - reddish brown - hard to very stiff (CL, Clay)</td>
</tr>
<tr>
<td>12.0</td>
<td>SS</td>
<td></td>
<td>Sandy silt, little clay - brownish gray - dense to extremely dense - moist to wet (ML, Silty Loam)</td>
</tr>
<tr>
<td>18.0</td>
<td>RB</td>
<td></td>
<td>Silty sand and gravel - brown - extremely dense - moist to wet (GP-GM, Sandy Loam)</td>
</tr>
<tr>
<td>23.0</td>
<td>CB</td>
<td></td>
<td>Light gray dolomitic limestone with pockets of quartz and small flecks of pyrite. Dark gray limestone near end</td>
</tr>
</tbody>
</table>

---

**Run C-1**

<table>
<thead>
<tr>
<th>Depth (ft.)</th>
<th>Recovery (%)</th>
<th>RQD (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>23.0 - 28.2</td>
<td>99.2%</td>
<td>67.2%</td>
</tr>
</tbody>
</table>

---

**Run C-2**

<table>
<thead>
<tr>
<th>Depth (ft.)</th>
<th>Recovery (%)</th>
<th>RQD (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>28.2 - 33.1</td>
<td>100%</td>
<td>53.4%</td>
</tr>
</tbody>
</table>

---

**Run C-3**

<table>
<thead>
<tr>
<th>Depth (ft.)</th>
<th>Recovery (%)</th>
<th>RQD (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>33.1 - 38.0</td>
<td>96.7%</td>
<td>68.3%</td>
</tr>
</tbody>
</table>

---

**Run C-4**

<table>
<thead>
<tr>
<th>Depth (ft.)</th>
<th>Recovery (%)</th>
<th>RQD (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>38.0 - 42.1</td>
<td>96.1%</td>
<td>86.2%</td>
</tr>
</tbody>
</table>

---

**End of Boring**

---

**Notes:**
- Silty clay, trace sand and gravel - black - stiff (OL, Clay)
- Silty clay, little sand and gravel - reddish brown - hard to very stiff (CL, Clay)
- Sandy silt, little clay - brownish gray - dense to extremely dense - moist to wet (ML, Silty Loam)
- Silty sand and gravel - brown - extremely dense - moist to wet (GP-GM, Sandy Loam)
- Light gray dolomitic limestone with pockets of quartz and small flecks of pyrite. Dark gray limestone near end
Bituminous concrete

Fill: Gravely sand - brown - moist (SP, Sand)

Silty clay - dark black - very stiff - moist (CL, Clay)

Silty clay, trace sand and gravel - reddish brown - very stiff - moist (CL, Clay)

Sandy silt, little gravel - brown - extremely dense - moist to wet (SM, Silty Loam)

Gravelly sand, little silt - brown - very dense to dense - moist to wet (SP-SM, Sandy Loam)

Apparent dolomite bedrock

Light gray dolomitic limestone with quartz crystals, occasional seams of pyrite

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.
The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

<table>
<thead>
<tr>
<th>DEPTH(FT)</th>
<th>SURFACE ELEVATION</th>
<th>DESCRIPTION OF MATERIAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>+778.9</td>
<td>Bituminous concrete</td>
</tr>
<tr>
<td>4.5</td>
<td></td>
<td>Sandy silty clay - little gravel - brown - hard (CL)</td>
</tr>
<tr>
<td>5.0</td>
<td></td>
<td>Silty clay - trace sand and gravel - reddish brown - medium to very stiff (CL)</td>
</tr>
<tr>
<td>10.0</td>
<td></td>
<td>Silty clay - trace sand and gravel - reddish brown - medium to hard - moist (CL)</td>
</tr>
<tr>
<td>15.0</td>
<td></td>
<td>Sample 6 - Disturbed, 6&quot; cobble at 13 feet</td>
</tr>
<tr>
<td>20.0</td>
<td></td>
<td>Sandy silt, trace clay - gray - medium dense - wet (ML)</td>
</tr>
<tr>
<td>25.0</td>
<td></td>
<td>Clayey silt, trace sand - gray - very stiff to hard (CL)</td>
</tr>
<tr>
<td>28.0</td>
<td></td>
<td>Weathered dolomite, apparent bedrock at 28.0 feet</td>
</tr>
</tbody>
</table>

*Calibrated Penetrometer

+ Indicates unconfined compressive strength higher than 4.5 tsf

Standard Penetration Tests Performed with Automatic Deidrich Hammer
2.5

17.0

20.0

22.5

27.0

28.0

**Sandy topsoil and clay - trace gravel and roots - black - loose - moist (OL)**

**Silty clay - little sand and gravel - reddish brown - stiff to hard (CL)**

**Sample from 3.0-inch spoon**

**Sample from 3.0-inch spoon**

**Silty sand - little clay and gravel - brown - medium dense - wet (SM)**

**Silty clay trace gravel and sand - brownish gray - very stiff (CL)**

**Gravelly sand, little silt - gray - extremely dense to dense (SP-SM)**

**Fractured dolomite, apparent bedrock at 28.0 feet**

End of Boring
Boring backfilled with bentonite cement grout
Standard Penetration Tests Performed with Automatic Deidrich Hammer

* Calibrated Penetrometer

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

**UNCONFINED COMPRESSIVE STRENGTH**

<table>
<thead>
<tr>
<th>TONS/FT²</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
</table>

**PENETRATION BLOWS/(FT)**

**WATER CONTENT %**

**LIQUID LIMIT %**

**PLASTIC LIMIT %**

**DEVELOPMENT DISTANCE (FT)**

**DEPTH (FT)**

**ELEVATION (FT)**

**SURFACE ELEVATION** +780.2
## PHOTOGRAPHIC LOG

<table>
<thead>
<tr>
<th>Photo No.</th>
<th>Date</th>
<th>BORING: B-1</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3/12/12</td>
<td>RQD: Run 1: N/A, Run 2: 66.7%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RUN: C-1, C-2, part of C-3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DEPTH: 22.5 – 28, 28 – 31.5 and 31.5 – 37</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RUN 1 DESCRIPTION: Gray limestone with some dark seams of limestone</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RUN 2 DESCRIPTION: Gray limestone with pockets of white limestone, quartz,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>and pyrite</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RECOVERY: Run 1: 53.0%, Run 2: 96.3%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Photo No.</th>
<th>Date</th>
<th>BORING: B-1</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>3/12/12</td>
<td>RQD: Run 3: 88.6%, Run 4: 81.1%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RUN: Part of C-3 and C-4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DEPTH: 31.5 – 37 and 37 – 42</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RUN 3 DESCRIPTION: Gray limestone with intermittent pockets of quartz,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>flecks of pyrite, and a pocket of white limestone</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RUN 4 DESCRIPTION: Gray limestone</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RECOVERY: Run 3: 100.0%, Run 4: 55.0%</td>
</tr>
<tr>
<td>Photo No.</td>
<td>Date</td>
<td>Client Name:</td>
</tr>
<tr>
<td>----------</td>
<td>---------------</td>
<td>--------------</td>
</tr>
</tbody>
</table>

| 3        | 3/12/12       |   BORING:   | B-2             |               |                    |              |          |

| 3/12/12  |               | RUN:        | C-1 and C-2,    | DEPTH:        | 23 – 28 and 28 – 33|               |          |

| RUN 1 DESCRIPTION: | Light gray limestone with pockets of quartz and small flecks of pyrite. Dark gray limestone near end |
| RUN 2 DESCRIPTION: | Light gray and dark gray limestone layers with pockets of quartz and pyrite in the dark limestone |

| RECOVERY: | Run 1: 99.2%  | Run 2: 100.0% |               |               |                    |              |          |

| RQD:      | Run 1: 67.2%  | Run 2: 53.4%  |               |               |                    |              |          |

| 4        | 3/12/12       |   BORING:   | B-2             |               |                    |              |          |

| 3/12/12  |               | RUN:        | Part of C-2, C-3, and part of C-4 | DEPTH: | 33 – 38 and 38 – 42.1 |               |          |

| RUN 3 DESCRIPTION: | Light gray and dark gray limestone layers with pockets of quartz and pyrite in the dark limestone |
| RUN 4 DESCRIPTION: | Gray limestone with layer of quartz |

| RECOVERY: | Run 3: 96.7%  | Run 4: 96.1% |               |               |                    |              |          |

| RQD:      | Run 3: 68.3%  | Run 4: 86.2% |               |               |                    |              |          |
### PHOTOGRAPHIC LOG

<table>
<thead>
<tr>
<th>Photo No.</th>
<th>Date</th>
<th>Client Name</th>
<th>Site Location</th>
<th>Project No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>3/12/12</td>
<td>City of Oshkosh</td>
<td>Oshkosh, Wisconsin</td>
<td>60247182</td>
</tr>
</tbody>
</table>

**BORING:** B-2  
**RUN:** Part of C-4  
**DEPTH:** 38 – 42.1

**RUN 4 DESCRIPTION:** Gray limestone  
**RECOVERY:** 96.1%  
**RQD:** 86.2%

<table>
<thead>
<tr>
<th>Photo No.</th>
<th>Date</th>
<th>BORING: B-3</th>
<th>Run 1 DESCRIPTION</th>
<th>Run 2 DESCRIPTION</th>
<th>Run 3 DESCRIPTION</th>
<th>Run 4 DESCRIPTION</th>
<th>Recovery:</th>
<th>RQD:</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>3/13/12</td>
<td>C-1, C-2, C-3, and C-4</td>
<td>Light gray limestone with quartz crystals</td>
<td>Dark gray limestone with pockets of quartz and pyrite</td>
<td>Thin layer of fine, gray sand. Gray limestone</td>
<td>Sandy, silty gravel, gray limestone with pockets of quartz and pyrite</td>
<td>Run 1: 70.8%</td>
<td>Run 1: 70.8%</td>
</tr>
</tbody>
</table>

**Photo:** Sample images of core samples with measurements and descriptions.

**RECOVERY:** Run 1: 70.8%  
Run 2: 100%  
Run 3: 100%  
Run 4: 93.0%

**RQD:** Run 1: N/A  
Run 2: 86.1%  
Run 3: N/A  
Run 4: 75.6%
**PHOTOGRAPHIC LOG**

<table>
<thead>
<tr>
<th>Client Name:</th>
<th>City of Oshkosh</th>
<th>Site Location:</th>
<th>Oshkosh, Wisconsin</th>
<th>Project No.:</th>
<th>60247182</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Photo No.</th>
<th>Date:</th>
<th>3/13/12</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>BORING:</td>
<td>B-3</td>
</tr>
<tr>
<td></td>
<td>RUN:</td>
<td>C-5</td>
</tr>
<tr>
<td></td>
<td>DEPTH:</td>
<td>34.4 – 37.7</td>
</tr>
</tbody>
</table>

**DESCRIPTION:** Dark gray limestone with intermittent pockets of quartz, flecks of pyrite, and a pocket of white/light gray limestone

**RECOVERY:** 96.0%

**RQD:** 70.7%
Appendix D.

WNDR Borehole Abandonment Forms and Well Construction Diagrams
Well / Drillhole / Borehole Filling & Sealing
Form 3300-005 (R 4/08)

Notice: Completion of this report is required by chs. 160, 281, 283, 289, 291-293, 295, and 299, Wis. Stats., and ch. NR 141, Wis. Adm. Code. In accordance with chs. 281, 289, 291-293, 295, and 299, Wis. Stats., failure to file this form may result in a forfeiture of between $10-25,000, or imprisonment for up to one year, depending on the program and conduct involved. Personally identifiable information on this form is not intended to be used for any other purpose. Return form to the appropriate DNR office and bureau. See instructions on reverse for more information.

1. Well Location Information

<table>
<thead>
<tr>
<th>County</th>
<th>Well Unique Well # of Removed Well</th>
<th>Hicap #</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Latitude / Longitude (Degrees and Minutes) Method Code (see instructions)

<table>
<thead>
<tr>
<th>N</th>
<th>W</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

¼ / ¼ Section Township Range

Original Well Address

Well Street Address

Well City, Village or Town Well ZIP Code

Subdivision Name Lot #

Reason For Removal From Service Well Unique Well # of Replacement Well

2. Facility / Owner Information

<table>
<thead>
<tr>
<th>Facility Name</th>
<th>Oshkosh Armory Basin</th>
</tr>
</thead>
</table>

Facility ID (FID or PWS)

License/Permit/Monitoring # Boring 

Original Well Owner

Present Well Owner

Mailing Address of Present Owner

City of Present Owner Oshkosh State WI ZIP Code

4. Pump, Liner, Screen, Casing & Sealing Material

Pump and piping removed? Yes No N/A

Liner(s) removed? Yes No N/A

Screen removed? Yes No N/A

Casing left in place? Yes No N/A

Was casing cut off below surface? Yes No N/A

Did sealing material rise to surface? Yes No N/A

Did material settle after 24 hours? Yes No N/A

If yes, was hole retopped? Yes No N/A

If bentonite chips were used, were they hydrated with water from a known safe source? Yes No N/A

Required Method of Placing Sealing Material

Conductor Pipe-Gravity Yes No N/A

Conductor Pipe-Pumped Yes No N/A

Screened & Poured (Bentonite Chips) Yes No N/A

Other (Explain):

Sealing Materials

Bentonite Cement Grout Yes No N/A

Bentonite- Sand Slurry Yes No N/A

Bentonite-Chips Yes No N/A

Concrete Yes No N/A

For Monitoring Wells and Monitoring Well Boreholes Only:

Bentonite Chips Yes No N/A

Bentonite - Cement Grout Yes No N/A

Granular Bentonite Yes No N/A

Bentonite - Sand Slurry Yes No N/A

5. Material Used To Fill Well / Drillhole

<table>
<thead>
<tr>
<th>From (ft.)</th>
<th>To (ft.)</th>
<th>No. Yards, Sacks Sealant or Volume (circle one)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface</td>
<td>28'</td>
<td>30 Gal.</td>
</tr>
</tbody>
</table>

6. Comments

Pumped from bottom up via electric pump

7. Supervision of Work

Name of Person or Firm Doing Filling & Sealing Subsurface Exploration Services, LLC

License # 3-1-12

Date of Filling & Sealing (mm/dd/yyyy)

DNR Use Only

Date Received Noted By

Street or Route 2900 Lowell Drive

Telephone Number (920) 544-4228

Comments

City Green Bay State WI ZIP Code 54311

Signature of Person Doing Work

Date Signed 3-1-12
State of Wis., Dept. of Natural Resources

dnr.wi.gov

Well / Drillhole / Borehole Filling & Sealing
Form 3300-005 (R 4/08)

Notice: Completion of this report is required by chs. 160, 281, 283, 289, 291-293, 295, and 299, Wis. Stats., and ch. NR 141, Wis. Adm. Code. In accordance with chs. 281, 289, 291-293, 295, and 299, Wis. Stats., failure to file this form may result in a forfeiture of between $10-25,000, or imprisonment for up to one year, depending on the program and conduct involved. Personally identifiable information on this form is not intended to be used for any other purpose. Return form to the appropriate DNR office and bureau. See instructions on reverse for more information.

Verification Only of Fill and Seal

1. Well Location Information

- County: Wisconsin
- Well Unique Well # of Removed Well: __________
- Hicap #: __________
- Latitude / Longitude (Degrees and Minutes): __________ 'N
  __________ 'W
- ¼ / ¼ Section: __________ Township: __________ Range: __________ E
- or Gov't Lot #: __________
- Well Street Address: ________________________________
- Well City, Village or Town: __________________________
- Well ZIP Code: __________
- Subdivision Name: _________________________________
- Lot #: __________
- Reason For Removal From Service: ___________________
- Wi Unique Well # of Replacement Well: __________

2. Facility / Owner Information

- Facility Name: __________
- Facility ID (FID or PWS): __________
- License/Permit/Monitoring #: __________
- Original Well Owner: __________
- Present Well Owner: __________
- Mailing Address of Present Owner: __________________________
- City of Present Owner: __________________
- State: __________
- ZIP Code: __________

3. Well / Drillhole / Borehole Information

- Monitoring Well: __________
- Water Well: __________
- Borehole / Drillhole: __________
- Original Construction Date (mm/dd/yyyy): 3-2-12
  If a Well Construction Report is available, please attach.
- Construction Type: __________
- Other (specify): __________________
- Formation Type: __________
- Unconsolidated Formation: __________
- Bedrock: __________
- Total Well Depth From Ground Surface (ft.): __________
  Casing Diameter (in.): __________
- Lower Drillhole Diameter (in.): 4-1/2
  Casing Depth (ft.): 7.5
- Was well annular space grouted? __________
- Yes No Unknown
- If yes, to what depth (feet)? Depth to Water (feet): 4.0

4. Pump, Liner, Screen, Casing & Sealing Material

- Pump and piping removed? __________ Yes No N/A
- Liner(s) removed? __________ Yes No N/A
- Screen removed? __________ Yes No N/A
- Casing left in place? __________ Yes No N/A
- Was casing cut off below surface? __________ Yes No N/A
- Did sealing material rise to surface? __________ Yes No N/A
- Did material settle after 24 hours? __________ Yes No N/A
- If yes, was hole retopped? __________ Yes No N/A
- If bentonite chips were used, were they hydrated with water from a known safe source? __________ Yes No N/A
- Required Method of Placing Sealing Material: __________
  Conductor Pipe-Gravity: __________
  Conductor Pipe-Pumped: __________
  Screened & Poured (Bentonite Chips): __________
  Other (Explain): __________________
- Sealing Materials: __________
  Neat Cement Grout: __________
  Sand-Cement (Concrete) Grout: __________
  Bentonite-Sand Slurry: __________
  Concrete: __________
  Bentonite Chips: __________
- For Monitoring Wells and Monitoring Well Boreholes Only:
  Bentonite Chips: __________
  Bentonite - Cement Grout: __________
  Granular Bentonite: __________
  Bentonite - Sand Slurry: __________

5. Material Used To Fill Well / Drillhole

- From (ft.): 28.5
- To (ft.): 30
- No. Yards, Sacks Sealant or Volume (circle one): 30 CARS
- Mix Ratio or Mud Weight: __________________

6. Comments

GROUTED FROM BOTTOM UP VIA FLOWLINE PUMP

7. Supervision of Work

- Name of Person or Firm Doing Filling & Sealing: Subsurface Exploration Services, LLC
- License #: __________
- Date of Filling & Sealing (mm/dd/yyyy): 3-2-12
- Date Received: __________
- Noted By: __________________
- Street or Route: 2900 Lowell Drive
- Telephone Number: (920) 544-4228
- City: Green Bay
- State: WI
- ZIP Code: 54311
- Signature of Person Doing Work: __________________
- Date Signed: 3-2-12

DNR Use Only

- Comments: __________________
MONITORING WELL INSTALLATION DETAIL

END OF CAP WITH HOLE ON STANDPIPE? YES OR NO

STANDPIPE STICKUP FT. 2'

CONCRETE
(CROSS OUT IF NOT USED)

BENTONITE CEMENT POWDER
(CROSS OUT IF NOT USED)

BACKFILL MATERIAL
BENTONITE
CHIPS/PELLETS

PIPE DIA. 2 IN.
SCH. 40
(IF PVC USED)

BENTONITE PELLETS
(CROSS OUT IF NOT USED)

SILICA SAND

PEA GRAVEL CONCRETE SAND
ON-SITE SAND
SILICA SAND
(CIRCLE ONE)

DEPT.
771.8
771.6
768.8

ELEV.

1) TYPE OF RISER PIPE
PVC GALVANIZED, STAINLESS, OTHER
MULTIPLE CASING: SIZE ______ LENGTH ______;
SIZE 2' LENGTH 12'

2) TYPE OF CASING JOINTS
BELLED, COUPLINGS, THREADED, OTHER FLASH

3) TYPE OF WELL SCREEN
PVC GALVANIZED, STAINLESS, OTHER

4) SCREEN SLOT SIZE 0.010"

5) SCREEN LENGTH 20' (22' to 42' DEPTH)

6) INSTALLED PROTECTOR PIPE W/LOCK? YES OR NO

7) DRILLING METHOD HOLLOW STEM AUGER
DRILLING FLUID NONE
BOREHOLE DIAMETER 11"

8) BACKFILL MATERIAL INSTALLATION FROM SURFACE, TREMIE

9) HOW WAS THE WELL DEVELOPED?
BAILING, PUMPING, SURGING, COMPRESSED AIR

10) APPROXIMATE WATER VOLUME REMOVED OR ADDED?
5 GAL 10 GAL 15 GAL OTHER

11) WATER CLARITY BEFORE DEVELOPMENT
CLEAR, TURBID, OPAQUE

12) WATER CLARITY AFTER DEVELOPMENT
CLEAR, TURBID, OPAQUE

13) DID THE WATER HAVE AN ODOR? YES OR NO

14) WATER LEVEL SUMMARY

1) DEPTH FROM GROUND SURFACE AFTER DEVELOPMENT? 16.24'

2) OTHER MEASUREMENTS:
DATE 4/13/2012 , 15.32 FT. BELOW GROUND
DATE 5/02/2012 , 14.97 FT. BELOW GROUND

WELL NO. B-1 DATE INSTALLED 2/28/12 DRILL RIG D-140

DRILLER DRILL CREW SUBSURFACE EXPLORATION SERVICES (SES)

JOB/CLIENT ARMORY DETENTION BASIN - CITY OF OSHKOSH AECOM PROJECT NO. 60247182

X\LIBRARY\BLOCK\WELL.DWG
MONITORING WELL INSTALLATION DETAIL

DEPT

END OF CAP WITH HOLE ON STANDPIPE?

YES OR NO

STANDPIPE STICKUP FT. 2'

22.4'

CONCRETE
(CROSS OUT IF NOT USED)

BENTONITE CEMENT POMDER
(CROSS OUT IF NOT USED)

BACKFILL MATERIAL
BENTONITE

CHIPS/PELLETS

PIPE DIA.
2 IN.

SCH. 40
(IF PVC USED)

BENTONITE PELLETS
(CROSS OUT IF NOT USED)

SILICA SAND

PEA GRAVEL CONCRETE SAND ON SITE SAND

SILICA SAND
(CIRCLE ONE)

ELEV.

1) TYPE OF RISER PIPE

PVC GALVANIZED, STAINLESS, OTHER
MULTIPLE CASING: SIZE _______ LENGTH _______
SIZE 2' LENGTH 12'

2) TYPE OF CASING JOINTS

BELLED, COUPLINGS, THREADED, OTHER, FLASH

3) TYPE OF WELL SCREEN

PVC GALVANIZED, STAINLESS, OTHER

4) SCREEN SLOT SIZE .010"

5) SCREEN LENGTH 20' (22.4' to 42.4' DEPTH)

6) INSTALLED PROTECTOR PIPE W/LOCK? YES OR NO

7) DRILLING METHOD HOLLOW STEM AUGER

DRILLING FLUID NONE

BOREHOLE DIAMETER 11"

8) BACKFILL MATERIAL INSTALLATION FROM

SURFACE, TREMIE

9) HOW WAS THE WELL DEVELOPED?

BAILING, PUMPING, SURGING, COMPRESSED AIR

10) APPROXIMATE WATER VOLUME REMOVED OR ADDED?

5 GAL, 10 GAL, 15 GAL, OTHER

11) WATER CLARITY BEFORE DEVELOPMENT

CLEAR, TURBID, OPAQUE

12) WATER CLARITY AFTER DEVELOPMENT

CLEAR, TURBID, OPAQUE

13) DID THE WATER HAVE AN ODOR? YES OR NO

14) WATER LEVEL SUMMARY

1) DEPTH FROM GROUND SURFACE AFTER DEVELOPMENT?

13.45'

2) OTHER MEASUREMENTS:

DATE 4/13/2012 ____, 12.72 _____ FT. BELOW GROUND

DATE 5/02/2012 ____, 12.31 _____ FT. BELOW GROUND

WELL NO. B-2 DATE INSTALLED 2/29/12 DRILL RIG D-140

DRILLER ______________ DRILL CREW SUBSURFACE EXPLORATION SERVICES (SES)

JOB/CLIENT ARMORY DETENTION BASIN - CITY OF OSHKOSH AECOM PROJECT NO. 60247182

X:/LIBRARY/LIBRARY/DBDL/WELL.DWG
MONITORING WELL INSTALLATION DETAIL

DEPTH

END OF CAP WITH HOLE ON STANDPIPE?

YES OR NO

3' STANDPIPE STICKUP
FOX 3'

CONCRETE
(CROSS OUT IF NOT USED)

BENTONITE CEMENT POWDER
(CROSS OUT IF NOT USED)

BACKFILL MATERIAL
BENTONITE
CHIPS/PELLETS

PIPE DIA. 2 IN.
SCH. 40

(IF PVC USED)

BENTONITE PELLETS
(CROSS OUT IF NOT USED)

SILICA SAND

PEA GRAVEL CONCRETE SAND ON-SITE SAND
SILICA SAND
(CIRCLE ONE)

ELEV.

779.8

1) TYPE OF RISER PIPE
PVC, GALVANIZED, STAINLESS, OTHER
MULTIPLE CASING: SIZE ______ LENGTH ______;
SIZE 2" LENGTH 12"

2) TYPE OF CASING JOINTS
BELLED, COUPLINGS, THREADED, OTHER, FLASH

3) TYPE OF WELL SCREEN
PVC, GALVANIZED, STAINLESS, OTHER

4) SCREEN SLOT SIZE 0.010"

5) SCREEN LENGTH 20' (17.7' to 37.7' DEPTH)

6) INSTALLED PROTECTOR PIPE W/LOCK? YES OR NO

7) DRILLING METHOD HOLLOW STEM AUGER
DRILLING FLUID: NONE
BOREHOLE DIAMETER: 11"

8) BACKFILL MATERIAL INSTALLATION FROM SURFACE, TREMIE

9) HOW WAS THE WELL DEVELOPED?
Bailing, Pumping, Surging, Compressed Air

10) APPROXIMATE WATER VOLUME REMOVED OR ADDED?
5 GAL, 10 GAL, 15 GAL, OTHER

11) WATER CLARITY BEFORE DEVELOPMENT
CLEAR, TURBID, OPAQUE

12) WATER CLARITY AFTER DEVELOPMENT
CLEAR, TURBID, OPAQUE

13) DID THE WATER HAVE AN ODOR? YES OR NO

14) WATER LEVEL SUMMARY

1) DEPTH FROM GROUND SURFACE AFTER DEVELOPMENT?
17.87'

2) OTHER MEASUREMENTS:

DATE 4/13/2012, 17.81 FT. BELOW GROUND
DATE 5/02/2012, 17.52 FT. BELOW GROUND

WELL NO. B-3 DATE INSTALLED 3/01/12 DRILL RIG D-149

DRILLER SUBSURFACE EXPLORATION SERVICES (SES)

JOB/CLIENT ARMORY DETENTION BASIN - CITY OF OSHKOSH AECOM PROJECT NO. 60247182

X:\LIBRARY\BLOCK\F\WELL.DWG
Test Pit Field Record

TEST PIT NO. 1  
TP-1

AECOM Project No. 60247182

AECOM Technical Services Inc.

Date: 2/14/2012
Weather: Clouds/Snow and 34°F
Excavation Equipment
Time Started: 10:50
Equipment: Deere 75D Backhoe-loader
Time Completed: 11:05
Contractor: City of Oshkosh
Surface Elevation: 769.8

Sampled by: SRK

<table>
<thead>
<tr>
<th>DEPTH (ft.)</th>
<th>Sample Number</th>
<th>Soil Description</th>
<th>Excavation Effort</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td></td>
<td>0-2 Black silty clay with trace sand (Topsoil) (CL, Clay)</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2-2.5 Light brown silty clay with trace sand (CL, Clay)</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td></td>
<td>T-1 (~2')</td>
<td>2.5-3.25 Grayish-brown clay with trace silt and sand (CL, Clay)</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td>3.0 tsf</td>
</tr>
<tr>
<td>6</td>
<td>T-1 (~5')</td>
<td>3.25-9 Reddish-brown silty clay with trace sand and gravel (CL, Clay)</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td>Excavator Refusal</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Remarks: End of Test Pit at 9'.

Proportions Used
- trace (tr.) 0-10%
- little (lt.) 10-20%
- some (so.) 20-30%
- and 30-50%

Excavation Effort
- E - Easy
- M - Moderate
- D - Difficult

Groundwater level

TP 1 through 9 logs.xls
## Test Pit Field Record

**TEST PIT NO. 2  TP-2**

**AECOM Project No. 60247182**

**Date:** 2/14/2012  
**Weather:** Clouds and 34°F  
**Time Started:** 11:15  
**Time Completed:** 11:45  
**Surface Elevation:** 771.2  
**Excavation Equipment**  
**Equipment:** Deere 75D Backhoe-loader  
**Contractor:** City of Oshkosh  
**Sampled by:** SRK

### Soil Description

<table>
<thead>
<tr>
<th>DEPTH (ft.)</th>
<th>Sample Number</th>
<th>Soil Description</th>
<th>Excavation Effort</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-1</td>
<td>0-1</td>
<td>Black silty clay with trace sand (Topsoil) (CL, Clay)</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td>0-2</td>
<td>2</td>
<td>0-8.5 Reddish-brown silty clay with trace sand and gravel (CL, Clay)</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td></td>
<td>T-2</td>
<td>Some cobbles and boulders</td>
<td>M/D</td>
<td></td>
</tr>
<tr>
<td>0-10</td>
<td></td>
<td>Excavator Refusal</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Remarks:** End of Test Pit at 8.5’

**Proportions Used**
- trace (tr.) 0-10%
- little (lt.) 10-20%
- some (so.) 20-30% and 30-50%

**Excavation Effort**
- E - Easy
- M - Moderate
- D - Difficult
- ▼ - Groundwater level
Test Pit Field Record

TEST PIT NO. 3  
TP-3

AECOM Project No. 60247182

AECOM Technical Services Inc.

Date: 2/14/2012
Weather: Clouds and 34°F

Excavation Equipment
Equipment: Deere 75D Backhoe-loader
Contractor: City of Oshkosh

Time Started: 12:35
Time Completed: 13:00
Surface Elevation: 771.4

Sampled by: SRK

<table>
<thead>
<tr>
<th>DEPTH (ft.)</th>
<th>Sample Number</th>
<th>Soil Description</th>
<th>Excavation Effort</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>0-1 Black/dark brown silty clay with trace sand and gravel (Topsoil) (CL, Clay)</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>1-2 Dark Brown silty clay with trace sand and gravel (CL, Clay)</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2-2.5 Light brown silty clay with trace sand (CL, Clay)</td>
<td></td>
<td>Possible seam</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.5-3.5 Dark Brown silty clay with trace sand and gravel (CL, Clay)</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3.5-4 Light brown silty clay with trace sand (CL, Clay)</td>
<td></td>
<td>Possible seam</td>
</tr>
<tr>
<td>6</td>
<td>T-3</td>
<td>4-9 Reddish Brown silty clay with trace sand and gravel (CL, Clay)</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cobble and Boulders</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>Excavator Refusal</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Remarks: End of Test Pit at 9'

<table>
<thead>
<tr>
<th>Proportions Used</th>
<th>Excavation Effort</th>
</tr>
</thead>
<tbody>
<tr>
<td>trace (tr.) 0-10%</td>
<td>E - Easy</td>
</tr>
<tr>
<td>little (lt.) 10-20%</td>
<td>M - Moderate</td>
</tr>
<tr>
<td>some (so.) 20-30%</td>
<td>D - Difficult</td>
</tr>
<tr>
<td>and 30-50%</td>
<td></td>
</tr>
</tbody>
</table>

Groundwater level
Test Pit Field Record

TEST PIT NO. 4
TP-4

AECOM Project No. 60247182

AECOM Technical Services Inc.

Date: 2/14/2012
Weather: Clouds/Snow and 34°F

Excavation Equipment: Deere 75D Backhoe-loader
Contractor: City of Oshkosh

Surface Elevation: 772.0

Sampled by: SRK

<table>
<thead>
<tr>
<th>DEPTH (ft.)</th>
<th>Sample Number</th>
<th>Soil Description</th>
<th>Excavation Effort</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-1.5</td>
<td></td>
<td>0-1.5 Dark brown silt with clay and trace sand (Topsoil) (CL, Clay)</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>1.5-3 Brown silty clay with trace sand (CL, Clay)</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>T-4</td>
<td>3-9.25 Reddish brown silty clay with trace sand (CL, Clay)</td>
<td>M</td>
<td>1.5 tsf</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>8.75 Groundwater encountered during excavation</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Remarks: End of Test Pit at 9.25'. Groundwater at 8.75'.

Proportions Used
- trace (tr.) 0-10%
- little (lt.) 10-20%
- some (so.) 20-30%
- and 30-50%

Excavation Effort
- E - Easy
- M - Moderate
- D - Difficult

- Groundwater level

Soil Description
- AECOM Technical Services Inc.
<table>
<thead>
<tr>
<th>DEPTH (ft.)</th>
<th>Sample Number</th>
<th>Soil Description</th>
<th>Excavation Effort</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td></td>
<td>0-4 Brown silty clay with cobbles and boulders (Fill) (CL, Clay)</td>
<td>D</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>4-4.5 Dark brown silty clay with trace sand and gravel (Buried Topsoil) (CL, Clay)</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>T-5</td>
<td>4.5-11.5 Reddish-brown silty clay with trace sand and gravel (CL, Clay)</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td>Excavator Refusal</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Remarks:
End of Test Pit at 11.5’

Proportions Used
- trace (tr.) 0-10%
- little (lt.) 10-20%
- some (so.) 20-30% and 30-50%

Excavation Effort
- E - Easy
- M - Moderate
- D - Difficult

Groundwater level

AECOM Project No. 60247182
Date: 2/14/2012
Weather: Clouds/Snow and 30°F
Time Started: 8:42
Time Completed: 9:05
Surface Elevation: 777.0

Contractor: City of Oshkosh
### Test Pit Field Record

**TEST PIT NO. 6**

**AECOM Project No. 60247182**

**TP-6**

**AECOM Technical Services Inc.**

---

**Date:** 2/14/2012  
**Weather:** Clouds/Snow and 30°F  
**Excavation Equipment:** Equipment: Deere 75D Backhoe-loader  
**Contractor:** City of Oshkosh

---

**Time Started:** 9:25  
**Time Completed:** 9:45  
**Surface Elevation:** 773.5

---

**Sampled by:** SRK

---

**Soil Description**

<table>
<thead>
<tr>
<th>DEPTH (ft.)</th>
<th>Sample Number</th>
<th>Soil Description</th>
<th>Excavation Effort</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td></td>
<td>0-1.5 Brown silty clay with cobbles and boulders (Fill) (CL, Clay)</td>
<td>D</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>1.5-4 Dark brown silty clay with trace sand and gravel (Buried Topsoil) (CL, Clay)</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>T-6</td>
<td>4-9 Reddish-brown silty clay with trace sand and gravel (CL, Clay)</td>
<td>M</td>
<td>1.25 tsf</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td>Excavator Refusal</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**Remarks:** End of Test Pit at 9'

---

**Proportions Used Excavation Effort**

- trace (tr.) 0-10% E - Easy
- little (lt.) 10-20% M - Moderate
- some (so.) 20-30% D - Difficult
- and 30-50% Groundwater level

---

**Groundwater level**
**Test Pit Field Record**  
**TEST PIT NO. 7**  
TP-7

**AECOM Project No. 60247182**

**Date:** 2/14/2012  
**Weather:** Clouds/Snow and 30°F  
**Time Started:** 8:24  
**Time Completed:** 8:40  
**Surface Elevation:** 776.5

**Excavation Equipment**  
**Equipment:** Deere 75D Backhoe-loader  
**Contractor:** City of Oshkosh

**Sampled by:** SRK

<table>
<thead>
<tr>
<th>DEPTH (ft.)</th>
<th>Sample Number</th>
<th>Soil Description</th>
<th>Excavation Effort</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td></td>
<td>0-3.5 Brown silty clay with cobbles and boulders (Fill) (CL, Clay)</td>
<td>D</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>3.5-4.5 Dark brown silty clay with trace sand and gravel (Buried Topsoil) (CL, Clay)</td>
<td>M/D</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>6</td>
<td>4.5-10.5 Reddish-brown silty clay with trace sand and gravel (CL, Clay)</td>
<td>M/D</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Remarks:** End of Test Pit at 10.5'

<table>
<thead>
<tr>
<th>Remarks</th>
<th>Proportions Used</th>
<th>Excavation Effort</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Proportions Used</td>
<td></td>
</tr>
<tr>
<td></td>
<td>trace (tr.) 0-10%</td>
<td>E - Easy</td>
</tr>
<tr>
<td></td>
<td>little (lt.) 10-20%</td>
<td>M - Moderate</td>
</tr>
<tr>
<td></td>
<td>some (so.) 20-30%</td>
<td>D - Difficult</td>
</tr>
<tr>
<td></td>
<td>and 30-50%</td>
<td>△ - Groundwater level</td>
</tr>
</tbody>
</table>
## Test Pit Field Record

**TEST PIT NO. 8**

**TP-8**

**AECOM Project No. 60247182**

**AECOM Technical Services Inc.**

**Date:** 2/14/2012  
**Weather:** Clouds/Snow and 30°F  
**Time Started:** 7:45  
**Time Completed:** 8:15  
**Surface Elevation:** 776.9  

**Excavation Equipment**

- **Equipment:** Deere 75D Backhoe-loader  
- **Contractor:** City of Oshkosh

**Sampled by:** SRK

### Excavation Details

- **Time Started:** 7:45  
- **Equipment:** Deere 75D Backhoe-loader  
- **Time Completed:** 8:15  
- **Surface Elevation:** 776.9

### Soil Description Table

<table>
<thead>
<tr>
<th>Depth (ft.)</th>
<th>Sample Number</th>
<th>Soil Description</th>
<th>Excavation Effort</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td></td>
<td>0-3.5 Brown silty clay with cobbles and boulders (Fill) (CL, Clay)</td>
<td>D</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>3.5-4.5 Dark brown silty clay with trace sand and gravel (Buried Topsoil) (CL, Clay)</td>
<td>M/D</td>
<td></td>
</tr>
<tr>
<td>6 8 10</td>
<td>T-8 M/D</td>
<td>4.5-11 Reddish-brown silty clay with trace sand and gravel (CL, Clay)</td>
<td>M/D</td>
<td>1.75 tsf</td>
</tr>
<tr>
<td>12</td>
<td></td>
<td>Excavator Refusal</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Remarks:

- **End of Test Pit at 11’**

#### Proportions Used

- **trace (tr.)** 0-10%
- **little (lt.)** 10-20%
- **some (so.)** 20-30%
- **and 30-50%**

#### Excavation Effort

- **E - Easy**
- **M - Moderate**
- **D - Difficult**

- **Groundwater level**
**Test Pit Field Record**

**TEST PIT NO. 9**

**TP-9**

**AECOM Project No. 60247182**

**AECOM Technical Services Inc.**

**Date:** 2/14/2012

**Weather:** Clouds/Snow and 30°F

**Time Started:** 10:20

**Time Completed:** 10:35

**Surface Elevation:** 771.3

**Excavation Equipment**

**Equipment:** Deere 75D Backhoe-loader

**Contractor:** City of Oshkosh

**Sampled by:** SRK

### Soil Description

<table>
<thead>
<tr>
<th>DEPTH (ft.)</th>
<th>Sample Number</th>
<th>Soil Description</th>
<th>Excavation Effort</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-1.5</td>
<td>2</td>
<td>Brown silty clay with cobbles and boulders (Fill) (CL, Clay)</td>
<td>D</td>
<td></td>
</tr>
<tr>
<td>1.5-8.5</td>
<td>T-9</td>
<td>Reddish-brown silty clay with trace sand and gravel (CL, Clay)</td>
<td>M</td>
<td>Possible seam (light brown silty-clay with trace sand) between 2.5 and 3'</td>
</tr>
<tr>
<td>1-8</td>
<td></td>
<td>Some cobbles and boulders</td>
<td>M/D</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td>Excavator Refusal</td>
<td>M</td>
<td></td>
</tr>
</tbody>
</table>

**Remarks:** End of Test Pit at 9'

**Proportions Used**

- Trace (tr.) 0-10%
- Little (lt.) 10-20%
- Some (so.) 20-30% and 30-50%

**Excavation Effort**

- E - Easy
- M - Moderate
- D - Difficult

- Groundwater level
Appendix E.

AECOM Field and Laboratory Procedures

AECOM Subsurface Exploration Procedures

AECOM Sampling Procedures

Laboratory Index Test Procedures
Auger Sampling (AS)
In this procedure, soil samples are collected from cuttings off of the auger flights as they are removed from the ground. Such samples provide a general indication of subsurface conditions; however, they do not provide undisturbed samples, nor do they provide samples from discrete depths.

Split-Barrel Sampling (SS) - (ASTM Standard D-1586-99)
In the split-barrel sampling procedure, a 2-inch O.D. split barrel sampler is driven into the soil a distance of 18 inches by means of a 140-pound hammer falling 30 inches. The value of the Standard Penetration Resistance is obtained by counting the number of blows of the hammer over the final 12 inches of driving. This value provides a qualitative indication of the in-place relative density of cohesionless soils. The indication is qualitative only, however, since many factors can significantly affect the Standard Penetration Resistance Value, and direct correlation of results obtained by drill crews using different rigs, drilling procedures, and hammer-rod-spoon assemblies should not be made. A portion of the recovered sample is placed in a sample jar and returned to the laboratory for further analysis and testing.

Shelby Tube Sampling Procedure (ST) - ASTM Standard D-1587-94
In the Shelby tube sampling procedure, a thin-walled steel seamless tube with a sharp cutting edge is pushed hydraulically into the soil and a relatively undisturbed sample is obtained. This procedure is generally employed in cohesive soils. The tubes are identified, sealed and carefully handled in the field to avoid excessive disturbance and are returned to the laboratory for extrusion and further analysis and testing.

Giddings Sampler (GS)
This type of sampling device consists of 5-foot sections of thin-wall tubing which are capable of retrieving continuous columns of soil in 5-foot maximum increments. Because of a continuous slot in the sampling tubes, the sampler allows field determination of stratification boundaries and containerization of soil samples from any sampling depth within the 5-foot interval.
Hand-Auger Drilling (HA)
In this procedure, a sampling device is driven into the soil by repeated blows of a sledge hammer or a drop hammer. When the sampler is driven to the desired sample depth, the soil sample is retrieved. The hole is then advanced by manually turning the hand auger until the next sampling depth increment is reached. The hand auger drilling between sampling intervals also helps to clean and enlarge the borehole in preparation for obtaining the next sample.

Power Auger Drilling (PA)
In this type of drilling procedure, continuous flight augers are used to advance the boreholes. They are turned and hydraulically advanced by a truck, trailer or track-mounted unit as site accessibility dictates. In auger drilling, casing and drilling mud are not required to maintain open boreholes.

Hollow Stem Auger Drilling (HS)
In this drilling procedure, continuous flight augers having open stems are used to advance the boreholes. The open stem allows the sampling tool to be used without removing the augers from the borehole. Hollow stem augers thus provide support to the sides of the borehole during the sampling operations.

Rotary Drilling (RB)
In employing rotary drilling methods, various cutting bits are used to advance the boreholes. In this process, surface casing and/or drilling fluids are used to maintain open boreholes.

Diamond Core Drilling (DB)
Diamond core drilling is used to sample cemented formations. In this procedure, a double tube (or triple tube) core barrel with a diamond bit cuts an annular space around a cylindrical prism of the material sampled. The sample is retrieved by a catcher just above the bit. Samples recovered by this procedure are placed in sturdy containers in sequential order.
Water Content (Wc)
The water content of a soil is the ratio of the weight of water in a given soil mass to the weight of the dry soil. Water content is generally expressed as a percentage.

Hand Penetrometer (Qp)
In the hand penetrometer test, the unconfined compressive strength of a soil is determined, to a maximum value of 4.5 tons per square foot (tsf) or 7.0 tsf depending on the testing device utilized, by measuring the resistance of the soil sample to penetration by a small, spring-calibrated cylinder. The hand penetrometer test has been carefully correlated with unconfined compressive strength tests, and thereby provides a useful and a relatively simple testing procedure in which soil strength can be quickly and easily estimated.

Unconfined Compression Tests (Qu)
In the unconfined compression strength test, an undisturbed prism of soil is loaded axially until failure or until 20% strain has been reached, whichever occurs first.

Dry Density (γd)
The dry density is a measure of the amount of solids in a unit volume of soil. Use of this value is often made when measuring the degree of compaction of a soil.

Classification of Samples
In conjunction with the sample testing program, all soil samples are examined in our laboratory and visually classified on the basis of their texture and plasticity in accordance with the AECOM Soil Classification System which is described on a separate sheet. The soil descriptions on the boring logs are derived from this system as well as the component gradation terminology, consistency of cohesive soils and relative density of granular soils as described on a separate sheet entitled "AECOM General Notes". The estimated group symbols included in parentheses following the soil descriptions on the boring logs are in general conformance with the Unified Soil Classification System (USCS) which serves as the basis of the AECOM Soil Classification System.
Appendix F.

AECOM Geotechnical Test Results

Atterburg Limit Test Results

Grain Size Distribution Curves

Standard Proctor Moisture-Density Relationship

Remodeled Hydraulic Conductivity
LIQUID AND PLASTIC LIMITS TEST REPORT

Dashed line indicates the approximate upper limit boundary for natural soils

SOIL DATA

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>SOURCE</th>
<th>SAMPLE NO.</th>
<th>DEPTH</th>
<th>NATURAL WATER CONTENT (%)</th>
<th>PLASTIC LIMIT (%)</th>
<th>LIQUID LIMIT (%)</th>
<th>PLASTICITY INDEX (%)</th>
<th>USCS</th>
</tr>
</thead>
<tbody>
<tr>
<td>●</td>
<td>ON SITE</td>
<td>T-2</td>
<td>6'</td>
<td>19.1</td>
<td>19</td>
<td>44</td>
<td>25</td>
<td>CL</td>
</tr>
</tbody>
</table>
LIQUID AND PLASTIC LIMITS TEST REPORT

Dashed line indicates the approximate upper limit boundary for natural soils

SOIL DATA

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>SOURCE</th>
<th>SAMPLE NO.</th>
<th>DEPTH</th>
<th>NATURAL WATER CONTENT (%)</th>
<th>PLASTIC LIMIT (%)</th>
<th>LIQUID LIMIT (%)</th>
<th>PLASTICITY INDEX (%)</th>
<th>USCS</th>
</tr>
</thead>
<tbody>
<tr>
<td>●</td>
<td>ON SITE</td>
<td>T-6</td>
<td>5'</td>
<td>29.2</td>
<td>24</td>
<td>57</td>
<td>33</td>
<td>CH</td>
</tr>
</tbody>
</table>
LIQUID AND PLASTIC LIMITS TEST REPORT

Dashed line indicates the approximate upper limit boundary for natural soils

SOIL DATA

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>SOURCE</th>
<th>SAMPLE NO.</th>
<th>DEPTH</th>
<th>NATURAL WATER CONTENT (%)</th>
<th>PLASTIC LIMIT (%)</th>
<th>LIQUID LIMIT (%)</th>
<th>PLASTICITY INDEX (%)</th>
<th>USCS</th>
</tr>
</thead>
<tbody>
<tr>
<td>●</td>
<td>ON SITE</td>
<td>T-9</td>
<td>8'</td>
<td>16.2</td>
<td>19</td>
<td>42</td>
<td>23</td>
<td>CL</td>
</tr>
</tbody>
</table>

Client: CITY OF OSHKOSH
Project: OSHKOSH ARMORY DETENTION POND
Project No.: 60247182
Material Description
RED BROWN SILTY CLAY, SOME SAND, LITTLE GRAVEL

Atterberg Limits
PL = 19  LL = 44  PI = 25

Coefficients
D_90 = 8.2988  D_85 = 3.8340  D_60 = 0.0619
D_50 = 0.0205  D_30 = 0.0021  D_15 =
D_10 =
C_U =
C_C =

Classification
USCS = CL  AASHTO = A-7-6(13)

Remarks

Source of Sample: ON SITE
Sample Number: T-2  Depth: 6'

Client: CITY OF OSHKOSH
Project: OSHKOSH ARMORY DETENTION POND
Project No: 60247182  Date: 03/02/12

AECOM
**Material Description**

RED BROWN SILTY CLAY, LITTLE FIND SAND

**Atterberg Limits**

<table>
<thead>
<tr>
<th>Coefficient</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>PL</td>
<td>24</td>
</tr>
<tr>
<td>LL</td>
<td>37</td>
</tr>
<tr>
<td>PI</td>
<td>33</td>
</tr>
</tbody>
</table>

**Coefficients**

<table>
<thead>
<tr>
<th>Coefficient</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>D90</td>
<td>0.2020</td>
</tr>
<tr>
<td>D50</td>
<td>0.0053</td>
</tr>
<tr>
<td>D10</td>
<td>0.0053</td>
</tr>
<tr>
<td>Cu</td>
<td></td>
</tr>
<tr>
<td>Cc</td>
<td></td>
</tr>
</tbody>
</table>

**Classification**

USCS = CH

AASHTO = A-7-6(28)

**Remarks**

- Material Description
- Atterberg Limits
- Coefficients
- Classification
- Remarks

---

<table>
<thead>
<tr>
<th>SIEVE SIZE</th>
<th>PERCENT FINER</th>
<th>SPEC.</th>
<th>PASS?</th>
</tr>
</thead>
<tbody>
<tr>
<td>.375</td>
<td>100.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#4</td>
<td>99.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#10</td>
<td>99.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#40</td>
<td>97.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#100</td>
<td>88.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#200</td>
<td>81.4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* (no specification provided)
Material Description
RED BROWN SILTY CLAY, SOME SAND, LITTLE GRAVEL

Atterberg Limits
PL = 19  LL = 42  PI = 23

Coefficients
D90 = 10.1765  D85 = 6.4736  D60 = 0.0713
D50 = 0.0433  D30 = 0.0032  D15 =
D10 =
Cv =
Cc =

Classification
USCS = CL  AASHTO = A-7-6(11)

Remarks

Source of Sample: ON SITE
Sample Number: T-9
Depth: 8'

Date: 03/02/12

Client: CITY OF OSHKOSH
Project: OSHKOSH ARMORY DETENTION POND
Project No: 60247182
Figure
Test specification: ASTM D 698-00a Method B Standard
ASTM D 4718-87 Oversize Corr. Applied to Each Test Point

<table>
<thead>
<tr>
<th>Elev/Depth</th>
<th>Classification</th>
<th>Nat. Moist.</th>
<th>Sp.G.</th>
<th>LL</th>
<th>PI</th>
<th>% &gt; 3/8 in.</th>
<th>% &lt; No.200</th>
</tr>
</thead>
<tbody>
<tr>
<td>6'</td>
<td>CL</td>
<td>19.1</td>
<td>2.75</td>
<td>44</td>
<td>25</td>
<td>8.6</td>
<td>63.4</td>
</tr>
</tbody>
</table>

**ROCK CORRECTED TEST RESULTS**

- Maximum dry density = 117.6 pcf
- Optimum moisture = 14.2 %

**UNCORRECTED**

- 114.3 pcf
- 15.3%

**MATERIAL DESCRIPTION**

- RED BROWN SILTY CLAY, SOME SAND, LITTLE GRAVEL

**Remarks:**

- Source of Sample: ON SITE
- Depth: 6’
- Sample Number: T-2
Maximum dry density = 106.2 pcf
Optimum moisture = 19.8 %

<table>
<thead>
<tr>
<th>Elev/ Depth</th>
<th>Classification</th>
<th>Nat. Moist.</th>
<th>Sp.G.</th>
<th>LL</th>
<th>PI</th>
<th>% &gt; #4</th>
<th>% &lt; No.200</th>
</tr>
</thead>
<tbody>
<tr>
<td>5'</td>
<td>CH</td>
<td>29.2</td>
<td>2.7</td>
<td>57</td>
<td>33</td>
<td>0.8</td>
<td>81.4</td>
</tr>
</tbody>
</table>

Test results: RED BROWN SILTY CLAY, LITTLE FIND SAND

Remarks: CITY OF OSHKOSH

Project No.: 60247182  Project: OSHKOSH ARMORY DETENTION POND

Source of Sample: ON SITE  Depth: 5'  Sample Number: T-6
COMPACATION TEST REPORT

Test specification: ASTM D 698-00a Method B Standard
ASTM D 4718-87 Oversize Corr. Applied to Each Test Point

<table>
<thead>
<tr>
<th>Elev/Depth</th>
<th>Classification</th>
<th>Nat. Moist.</th>
<th>Sp.G.</th>
<th>LL</th>
<th>PI</th>
<th>% &gt; 3/8 in.</th>
<th>% &lt; No.200</th>
</tr>
</thead>
<tbody>
<tr>
<td>8'</td>
<td>CL</td>
<td>A-7-6(11)</td>
<td>16.2</td>
<td>2.75</td>
<td>42</td>
<td>23</td>
<td>11.1</td>
</tr>
</tbody>
</table>

ROCK CORRECTED TEST RESULTS

Maximum dry density = 122.2 pcf
Optimum moisture = 12.9 %

UNCORRECTED

Material Description: RED BROWN SILTY CLAY, SOME SAND, LITTLE GRAVEL

Remarks:

Project No: 60247182 Client: CITY OF OSHKOSH
Project: OSHKOSH ARMORY DETENTION POND

Source of Sample: ON SITE Depth: 8' Sample Number: T-9

Figure
# HYDRAULIC CONDUCTIVITY DETERMINATION

Rising tailwater method in a triaxial permeameter

ASTM D 5084, Method C (EM-1110-2-1906 7)

<table>
<thead>
<tr>
<th>PROJECT NO.:</th>
<th>60247182</th>
</tr>
</thead>
<tbody>
<tr>
<td>PROJECT:</td>
<td>OSHKOSH ARMORY POND</td>
</tr>
<tr>
<td>DATE:</td>
<td>5/2/2012</td>
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</tbody>
</table>

## SUMMARY OF TEST RESULTS

<table>
<thead>
<tr>
<th>SAMPLE NO.</th>
<th>T-2  6.0'</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOCATION</td>
<td>ON SITE</td>
</tr>
<tr>
<td>CLASSIFICATION</td>
<td>SILTY CLAY, LITTLE GRAVEL, TRACE SAND, RED BROWN</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>INITIAL</th>
<th>FINAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>DRY UNIT WEIGHT (pcf)</td>
<td>109.2</td>
<td>114.6</td>
</tr>
<tr>
<td>WATER CONTENT (%)</td>
<td>15.5</td>
<td>14.2</td>
</tr>
<tr>
<td>DIAMETER (cm)</td>
<td>10.16</td>
<td>10.16</td>
</tr>
<tr>
<td>LENGTH (cm)</td>
<td>11.63</td>
<td>11.33</td>
</tr>
<tr>
<td>HYDRAULIC GRADIENT (MAXIMUM)</td>
<td></td>
<td>7.8</td>
</tr>
<tr>
<td>PERCENT SATURATION</td>
<td>77.682942</td>
<td>82.048995</td>
</tr>
<tr>
<td>HYDRAULIC CONDUCTIVITY k (cm/sec)</td>
<td></td>
<td>8.83E-07</td>
</tr>
</tbody>
</table>
HYDRAULIC CONDUCTIVITY DETERMINATION
Rising tailwater method in a triaxial permeameter
ASTM D 5084, Method C (EM-1110-2-1906 7)

PROJECT NO.: 60247182
PROJECT: OSHKOSH ARMORY POND
DATE: 5/2/2012

SUMMARY OF TEST RESULTS

<table>
<thead>
<tr>
<th>SAMPLE NO.</th>
<th>LOCATION</th>
<th>CLASSIFICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>T-6 5.0'</td>
<td>ON SITE</td>
<td>SILTY CLAY, TRACE SAND AND FINE GRAVEL, RED BROWN</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>INITIAL</th>
<th>FINAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>DRY UNIT WEIGHT (pcf)</td>
<td>95.1</td>
<td>94.7</td>
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<tr>
<td>WATER CONTENT (%)</td>
<td>21.6</td>
<td>30.5</td>
</tr>
<tr>
<td>DIAMETER (cm)</td>
<td>10.16</td>
<td>10.16</td>
</tr>
<tr>
<td>LENGTH (cm)</td>
<td>11.63</td>
<td>11.63</td>
</tr>
<tr>
<td>HYDRAULIC GRADIENT (MAXIMUM)</td>
<td>7.5</td>
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</tr>
<tr>
<td>PERCENT SATURATION</td>
<td>75.905652</td>
<td>106.13016</td>
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<tr>
<td>HYDRAULIC CONDUCTIVITY k (cm/sec)</td>
<td>2.20E-07</td>
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</tr>
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</table>
### SUMMARY OF TEST RESULTS

<table>
<thead>
<tr>
<th>SAMPLE NO.</th>
<th>T-9 8.0'</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOCATION</td>
<td>ON SITE</td>
</tr>
<tr>
<td>CLASSIFICATION</td>
<td>SILTY CLAY, LITTLE GRAVEL, TRACE SAND, RED BROWN</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>INITIAL</th>
<th>FINAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>DRY UNIT WEIGHT (pcf)</td>
<td>111.3</td>
<td>110.8</td>
</tr>
<tr>
<td>WATER CONTENT (%)</td>
<td>13.7</td>
<td>22.2</td>
</tr>
<tr>
<td>DIAMETER (cm)</td>
<td>10.16</td>
<td>10.16</td>
</tr>
<tr>
<td>LENGTH (cm)</td>
<td>11.63</td>
<td>11.63</td>
</tr>
<tr>
<td>HYDRAULIC GRADIENT (MAXIMUM)</td>
<td>7.9</td>
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</tr>
<tr>
<td>PERCENT SATURATION</td>
<td>72.252414</td>
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<tr>
<td>HYDRAULIC CONDUCTIVITY k (cm/sec)</td>
<td>6.98E-07</td>
<td></td>
</tr>
</tbody>
</table>
Appendix G.

Geophysical Survey
Thick Black Line at Rippable Limit
On All Seismic Sections
7300 ft/s seismic velocity

Seismic Velocity (feet per second)

SCALE (ft)

ONE INCH = 40 FEET
Appendix H.

AECOM Soil Classification System
### AECOM Soil Classification System

1. See AECOM General Notes for component gradation terminology, consistency of cohesive soils and relative density of granular soils.
2. Reference: Unified Soil Classification Systems
3. Borderline classifications, used for soils possessing characteristics of two groups, are designated by combinations of group symbols. For example: GW-GC, well-graded gravel-sand mixture with clay binder.

<table>
<thead>
<tr>
<th>Major Divisions</th>
<th>Group Symbols</th>
<th>Typical Names</th>
<th>Laboratory Classification Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low plasticity</td>
<td>GW</td>
<td>Well-graded gravel, gravel-sand mixtures, little or no fines</td>
<td>( C_{u} = \frac{D_{60}}{D_{10}} &gt; 4 ); ( C_{c} = \frac{(D_{60})^2}{D_{60} \times D_{10}} ) between 1 &amp; 3</td>
</tr>
<tr>
<td></td>
<td>GP</td>
<td>Poorly graded gravel, gravel-sand mixtures, little or no fines</td>
<td></td>
</tr>
<tr>
<td></td>
<td>GM</td>
<td>Silty gravel, gravel-sand-silt mixtures</td>
<td></td>
</tr>
<tr>
<td></td>
<td>GC</td>
<td>Clayey gravel, gravel-sand-clay mixtures</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SW</td>
<td>Well-graded sand, gravelly sand, little or no fines</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SP</td>
<td>Poorly graded sand, gravelly sand, little or no fines</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SM</td>
<td>Silty sand, sand-silt mixtures</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SC</td>
<td>Clayey sand, sand-clay mixtures</td>
<td></td>
</tr>
<tr>
<td>High plasticity</td>
<td>ML</td>
<td>Inorganic silt and very fine sand, rock flour, silty or clayey fine sand or clayey silt with slight plasticity</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CL</td>
<td>Inorganic clay of low to medium plasticity, gravelly clay, sandy clay, silty clay, lean clay</td>
<td></td>
</tr>
<tr>
<td></td>
<td>OL</td>
<td>Organic silt and organic silty clay of low plasticity</td>
<td></td>
</tr>
<tr>
<td></td>
<td>MH</td>
<td>Inorganic silt, micaceous or diatomaceous fine sandy or silty soils, elastic silt</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CH</td>
<td>Inorganic clay of high plasticity, fat clay</td>
<td></td>
</tr>
<tr>
<td></td>
<td>OH</td>
<td>Organic clay of medium to high plasticity, organic silt</td>
<td></td>
</tr>
<tr>
<td>Highly organic</td>
<td>PT</td>
<td>Peat and other highly organic soil</td>
<td></td>
</tr>
</tbody>
</table>

### Plasticity Chart

For classification of fine-grained soils and fine fraction of coarse-grained soils.

- Afterberg Limits plotting in hatched areas are borderline classifications, requiring use of dual symbols.
- Equation of A-line: \( PI = 0.7 \times (LL - 20) \)

---

(1) Reference: Unified Soil Classification Systems
Appendix I.

AECOM Earthwork Guideline
Fill or backfill required on the project should consist of a non-frozen, non-organic granular material, aggregate or natural soil that is free of debris and particles larger than 25 percent of the loose lift thickness. The natural water content of cohesive fill soil at the time of compaction should generally be within -2 to +4 percent of the optimum water content determined by the proctor test. Difficulty in obtaining the desired degree of compaction is expected for soil that is too dry or too wet. The water content should be adjusted by sprinkling if too dry or by scarifying and aerating if too wet. Blending with an additive such as fly ash or drier soil may also help produce an acceptable water content.

Fill or backfill which is relatively uniform should be used on the project. Non-uniform materials or mixing two or more materials will reduce the degree of certainty in the test results and will tend to cause variable compressibility of the fill.

Fill or backfill should be placed on a firm, checked subgrade in horizontal lifts with a loose thickness not greater than 12 inches for granular material and 9 inches for cohesive soil. It should then be compacted with equipment that is suited to the soil type and compaction requirements. Normally, vibratory roller or plate compactors are better suited for granular soils, while a sheepsfoot or other "kneading" type of compactors are more effective in cohesive soils. Lighter, hand-propelled compactors should generally be utilized to compact backfill within 5 feet of structures unless the structure is designed to resist expected lateral pressures from use of heavier compactors. When using lighter, hand-propelled compactors, a maximum loose lift thickness of 8 inches should be used for granular material and 6 inches for cohesive soil.

Unless stated otherwise in the report text, fill or backfill that supports foundations, floor slabs that are loaded in excess of 400 psf, and roadway pavement that is subjected to concentrated automobile or truck traffic should be compacted to a dry density of 95% or more of the maximum dry density determined by modified Proctor tests (ASTM D-1557) on representative samples of the fill material. Fill or backfill that supports lightly loaded floor slabs, sidewalks or pavement that is subjected to dispersed automobile traffic should be compacted to a dry density of 90% or more of the maximum dry density determined by modified Proctor tests on representative samples of the fill material. Compaction tests may be considered satisfactory if the average of five consecutive tests on similarly compacted material exceeds the required compaction and no individual test is more than 2% below the required percentage of compaction.

Proper compaction is generally difficult to achieve near the edge of a slope or embankment fill due to lack of confinement. For this reason, we recommend that the compacted fill or backfill zone extend horizontally beyond the edge of foundations a minimum of 1 foot at the subgrade level and then with depth at a minimum slope of 1 horizontal to 1 vertical.

Fill material acceptability, subgrade preparation and testing for suitability, fill placement and fill compaction should be monitored continuously or at least regularly by a qualified soils technician whom reports to the geotechnical engineer for the project. Compaction density for structural fill should be tested at a minimum frequency of once per 5000 ft² of fill area or once per 200 yd³ of compacted material placed unless stated otherwise in our report. In non-structural fill areas, testing frequencies may be reduced in half.
Appendix J.

AECOM Changed Conditions Clause
The owner had a subsurface exploration and testing program performed by a geotechnical consultant. The results of this program are contained in the consultant's report. The consultant's report presents conclusions on the subsurface conditions based on their interpretation of the data obtained in the exploration. The contractor acknowledges that they have reviewed the consultant's report and any addenda thereto, and that their bid for earthwork operations is based on the subsurface conditions, as described in that report. The contract parties recognize that a subsurface exploration does not disclose all conditions as they actually exist and further, conditions may change, particularly groundwater conditions, between the time of subsurface exploration and the time of subsurface construction operations. In recognition of these facts, this clause is made part of the contract and provides a means of equitable additional compensation to the contractor if adverse unanticipated conditions are encountered and found to be materially different than reasonable expected as represented in the contract documents.

If at any time during earthwork, paving, foundation, and underground construction operations, the contractor encounters conditions that they consider to be materially different than those anticipated by the geotechnical consultant's report, contractor shall promptly and before such conditions are disturbed notify the owner's representative in writing of the condition and shall explain: (1) how subsurface or latent physical conditions at the site differ materially from those indicated in the contract, or, (2) what unknown physical conditions were encountered that are of an unusual nature and differ materially from those ordinarily encountered and generally recognized as inherent in work of the character provided for in this contract. The owner's representative will promptly initiate an investigation of the alleged differing site conditions. The contractor will provide access to the conditions and fully cooperate with the investigation. Upon completion, the owner's representative will issue a findings report with a recommendation on merit. Conversely, if owner's representative observes subsurface conditions which are different than those anticipated by the foundation consultant's report, he will also promptly notify the contractor. If a differing site condition claim has been found to have merit, negotiations will commence between the owner and the contractor to arrive at an equitable change in contract price for the necessary additional work or for reduction in work because of the unanticipated conditions. The contractor agrees that unit prices listed in the bid are applicable in computing equitable adjustments for additional or reduced work under the contract. For changed conditions for which unit prices are not listed, the additional work will be paid for on a time and material basis.
About AECOM

AECOM (NYSE: ACM) is a global provider of professional technical and management support services to a broad range of markets, including transportation, facilities, environmental, energy, water and government. With approximately 45,000 employees around the world, AECOM is a leader in all of the key markets that it serves. AECOM provides a blend of global reach, local knowledge, innovation, and collaborative technical excellence in delivering solutions that enhance and sustain the world’s built, natural, and social environments. A Fortune 500 company, AECOM serves clients in more than 130 countries and has annual revenue in excess of $8.0 billion.

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