Geotechnical Engineering Report

Proposed LPS District Office Building
O Street and Cotner Boulevard
Lincoln, Nebraska

March 15, 2012
Terracon Project No. A3125004

Prepared for:
Lincoln Public Schools
Lincoln, Nebraska

Prepared by:
Terracon Consultants, Inc.
Lincoln, Nebraska

Michael D Ringler

MICHAEL D
RINGLER
E-7619

March 15, 2012

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March 15, 2012

Terracon

Lincoln Public Schools
c/o Sinclair Hille Architects
700 Q Street
Lincoln, Nebraska 68508

Attn: Ms. Lizabeth A Kuhlman, AIA, LEED AP

Re: Geotechnical Engineering Report
Proposed LPS District Office Building
O Street and Cotner Boulevard
Lincoln, Nebraska
Terracon Project No. A3125004

Dear Ms. Kuhlman:

Terracon Consultants, Inc. (Terracon) has completed a subsurface exploration and geotechnical engineering evaluation for the above referenced project. These services were performed in general accordance with our proposal dated February 1, 2012 (Terracon Proposal No. A3120008rev). This report presents the results of our subsurface exploration and provides geotechnical recommendations for design and construction of foundations for the proposed LPS District Office building, subgrade preparation for floor slabs and pavements, and earthwork. An independent report will be submitted under a separate cover for the retail/shops and anchor store.

We appreciate the opportunity to work with you on this project, and look forward to providing review of geotechnical aspects of the plans and specifications, and also providing observation and testing during construction. If you have any questions regarding this report, or if we may be of further service to you, please contact us.

Sincerely,
Terracon Consultants, Inc.

Michael D. Ringler

for Bradley A. Levich, P.E.
Principal Engineer

Michael D. Ringler, P.E.
Project Geotechnical Engineer

BAL/MDR:bal/leb

Distribution: Addressee (2 bound and 1 pdf)
Mr. Michael Eisenbarth, P.E. R.O Youker (1 bound and 1 pdf)

Terracon Consultants, Inc. 3220 North 20th Street, Suite 3 Lincoln, Nebraska 68521
P [402] 466-3911 F [402] 466-0811 terracon.com

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EXECUTIVE SUMMARY

A geotechnical engineering exploration has been completed for the proposed three-story LPS District Office building located southeast of the intersection of O Street and Cotner Boulevard in Lincoln, Nebraska. As requested, nineteen soil borings were performed to depths of approximately 10 to 80 feet below the existing ground surface. Logs of the borings along with an Exploration Location Diagram are included in Appendix A.

Based on the information obtained from our subsurface exploration, the site can be developed for the proposed project. The following geotechnical conditions and considerations were identified:

- The borings generally encountered loess soils (lean to fat clay and lean clay) underlain by sands and glacial till soils and silty fine sands to the depths explored. Existing fill soils were encountered overlying the native soils in several borings.
- Groundwater was encountered at depths of about 19 to 28 feet in some borings.
- All existing fill soils should be removed from the building area, and replaced with structural fill. We recommend proofrolling existing fill within exterior pavements to determine suitability for pavement subgrade. Stable fill could be left in place below exterior pavements.
- Medium strength lean clay soils with relatively high moisture contents were encountered in the borings.
- Moderate plasticity (lean to fat clay) soils are present on this site. These soils can experience volume changes (shrink-swell movements) with variations in moisture content. Footing foundations, floor slabs, and pavements supported on expansive soils may experience cycles of upward and downward movement that may result in distortion or structural damage.
- A layer of low plasticity cohesive fill is recommended below all grade-supported floor slabs in order to help reduce the risk of post-construction moisture variations in the expansive soils. The use of structural slabs or a greater thickness of low plasticity cohesive fill is recommended if it is necessary to eliminate or further reduce the risk of floor slab movements.
- A subdrain system (granular drainage layer and drain tile) is recommended below the basement-level floor slab.
- Support of the building loads on spread footing foundations appears feasible within the basement area, since these footings will bear on glacial till.

- Due to the depth of glacial till and variable support conditions, supporting main floor loads on deep foundations extending into glacial till soils is recommended.

- A granular drainage layer and subdrains are recommended around the outside perimeter of the basement walls, to help prevent hydrostatic loading.

- A layer of reworked and recompacted on-soil is recommended below exterior pavements.

This summary should be used in conjunction with the entire report for design purposes. It should be recognized that details were not included or fully developed in this section, and the report must be read in its entirety for a comprehensive understanding of the items contained herein. Section **5.0 GENERAL COMMENTS** should be read for an understanding of the report limitations.

GEOTECHNICAL ENGINEERING REPORT
PROPOSED LPS DISTRICT OFFICE BUILDING
O STREET AND COTNER BOULEVARD
LINCOLN, NEBRASKA

Terracon Project No. A3125004
March 15, 2012

1.0 INTRODUCTION

A geotechnical engineering exploration has been completed for the proposed new LPS District Office building located southeast of the intersection of O Street and Cotner Boulevard in Lincoln, Nebraska. Nineteen soil borings were performed to depths of approximately 10 to 80 feet below the existing ground surface. Logs of the borings along with an Exploration Location Diagram are included in Appendix A of this report.

The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- subsurface soil conditions
- groundwater conditions
- lateral earth pressures and drainage
- foundation design and installation
- floor slab subgrade preparation
- site grading and earthwork
- exterior pavement subgrade preparation
- minimum thicknesses of exterior pavements

2.0 PROJECT INFORMATION

2.1 Project Description

Item	Description
Site layout	See Appendix A, Exhibit A-2, Exploration Location Diagram.
Proposed structure and FFE	Footprint dimensions of approximately 163 by 200 feet. The office building will include the construction of a three story LPS District Office with a basement area. Current plans show the basement area on the west and south sides of the building footprint, and will be approximately 14,400 square feet in plan area. The building is anticipated to consist of poured below grade walls and precast above-grade structure. The current planned finished floor elevation of the main floor is 1263.0 feet and the basement elevation is anticipated to be about 1248.33 feet, approximately 14.67 feet below the main level floor.

Item	Description
Proposed structural loads	Columns: 350 kips (given) Walls: 21 klf (given) Slabs: 150 psf max (assumed)
Maximum allowable settlement	■ ½-inch total (given) ■ ¼ inch over 20 feet along walls (given)
Grading	Based on the information from Olsson Associates, we anticipate about 2 to 4 feet of cut to reach main level FFE for the building. The basement area will require about 18 to 19 feet of cut.
Cut and fill slopes	Anticipated 3H:1V or flatter
Below grade structures	Below grade walls for basement area
Site retaining walls	None anticipated

2.2 2.2 Site Location and Description

Item	Description
Location	See Appendix A, Exhibit A-1, Site Location Diagram. The project is located southeast of the intersection of O Street and Cotner Boulevard in Lincoln, Nebraska
Existing structures	The site is currently a vacant lot and ground cover consists of bare soil and existing asphaltic cement concrete from a previous old parking lot.
Previous structures	A prior office building was razed about 2 years ago. The footings and utilities associated with the building were reportedly removed from the old office building area. The old building reportedly had a small basement area near the south side of the building. Additional utilities may be present on the site.
Existing topography	Based on the topographic plan provided by Olsson Associates, the site slopes down to the east from elevation of about 1268 feet along the west property line to about 1240 feet at the southeast side.

3.0 SUBSURFACE CONDITIONS

3.1 Mapped Soil Units

Surface soils at the project site were mapped as part of the effort to develop the Lancaster County NRCS-USDA Soil Survey. The following table summarizes the soil units identified in the Soil Survey.

Soil Unit	Parent Material	Shrink/Swell Potential	Flooding Frequency	Depth to Seasonal High Water Table
Urban Land-Wymore-Aksarben	Loess	Moderate	None	More than 80 inches

The soil survey indicates Urban Land complex on this site, which means the soil profile may have been considerably altered by grading associated with urban development. Additional information is presented in the Soil Survey of Lancaster County, Nebraska.

3.2 Typical Profile

Subsurface conditions at the boring locations can be generalized as follows:

Description	Approximate Depth to Bottom of Stratum	Material Encountered	Consistency
Surface	varies	Root zone / Asphaltic cement concrete	---
Stratum 1 (Fill)	B-3: 8 feet B-5, B-7, B-13, B-15, B-18 and B-19: 3 feet B-12: 5 feet	(Fill) Lean to Fat Clay and Fat Clay	---
Stratum 2	B-8, B-9, B-11, B-14, and B-16: 3 feet B-12, B-13: 5 feet B-15: 8 feet	Fat Clay and Lean to Fat Clay	Stiff to Very Stiff
Stratum 2 (Loess)	B-1 and B-10: 13 feet B-2: 14 feet B-3: 10 feet B-4 : 8 feet B-5, B-6, B-9, B-11, B-13 and B-17: 18 feet B-7, B-8, B-12: 23 feet B-14, B-15, B-16, and B-19: 10-foot termination depth	Lean Clay Becoming reddish brown and sandy (Lean to Fat Clay with sand in B-3 and B-17)	Medium Stiff to Hard

Description	Approximate Depth to Bottom of Stratum	Material Encountered	Consistency
Stratum 3	B-1: 18 feet B-2: 16 ft B-4: 13 feet B-17: 35 foot termination depth	Silty Fine Sand	Dense
Stratum 4 (Glacial Till or weathered till)	B-7: 25-foot termination depth B-6, B-8, B-9, B-11, B-12: 30-foot termination depth B-1 and B-5: 35-foot termination depth B-13: 40-foot termination depth B-10: 45-foot termination depth B-2, B-3, B-4: 80-foot termination depth	Sandy Lean Clay to Sandy Lean to Fat Clay, and Lean Clay with sand	Medium Stiff to Hard

Conditions encountered at each boring location are indicated on the individual boring logs. The stratification lines shown on the boring logs represent the approximate boundaries between soil types. In-situ, transitions between materials may be gradual. Additional information can be found on the boring logs in Appendix A of this report.

The existing fill is not present at all boring locations, and other variations could occur between borings locations or across the site. Additional variations may be attributable to previous grading and construction.

3.3 Groundwater

The borings were observed during and after drilling operations for the presence and level of groundwater. The groundwater levels observed at these times are indicated on the boring logs included in Appendix A and are summarized in the following table.

Boring Number(s)	Elevation To Observed Groundwater (site datum, feet)	
	While Drilling	After Drilling
B-13	28	19
B-4	Not observed due to drilling method	

Boring Number(s)	Elevation To Observed Groundwater (site datum, feet)	
B-17	23	20
Remaining borings	None	None

Groundwater level fluctuations occur due to seasonal variations in the amount of rainfall, runoff, local stream levels and other factors not evident at the time the borings were performed. Therefore, groundwater levels during construction or at other times in the life of the structures will be higher or lower than the levels indicated on the boring logs. It is also our experience that perched water often forms overlying compacted cohesive fill and over dense native clay layers. The possibility of groundwater level fluctuations and development of perched water conditions should be considered when developing the design and construction plans for the project.

4.0 RECOMMENDATIONS FOR DESIGN AND CONSTRUCTION

4.1 Geotechnical Considerations

4.1.1 Existing Fill

Existing fill soils were encountered in Boring B-3 within the proposed new building. Due to the variability of the existing fill, we recommend that all existing fill soils be removed and replaced with structural fill within the building footprint.

Existing fill soils were encountered in Borings B-5, B-15, B-18 and B-19 in the exterior pavement area. Terracon is not familiar with compaction specifications associated with the existing fill. Any such records would aid our evaluation of the existing fill. There is a risk to the owner when pavements are constructed on or above existing fill material due to potential variations in composition and compaction. These conditions pose a risk of larger than tolerable settlement of pavements supported above the fill. Complete removal and replacement of the fill would eliminate this risk.

Provided the owner is willing to accept the risk associated with supporting the new pavements over the existing fill materials in exchange for reduced construction costs, it is our opinion that stable portions of the existing fill could be left in place for support of the new pavements. As a minimum, we recommend proofrolling the existing fill. Existing fill that is stable under a proofroll may be left in place under exterior pavements.

Additional discussion and recommendations are provided in subsection **4.2 Site Preparation and Earthwork**.

4.1.2 Moderate Plasticity Clays

Moderate plasticity (fat clay and lean to fat clay soils) soils are present on this site, particularly in the upper few feet of the soil profile. Footing foundations, floor slabs, and pavements supported on these types of potentially expansive soils will experience cycles of upward and downward movement (due to moisture content fluctuations within the expansive clays) that may result in distortion or structural damage. This report provides recommendations to help mitigate the effects of soil shrinkage and expansion. However, even if these procedures are followed, some movement should still be anticipated since some moderate-plasticity clay soils will remain below the proposed structures. The severity of cracking and other damage such as uneven floor slabs and pavements will probably increase if any modification of the site results in excessive wetting or drying of the expansive soils.

To help reduce the risk of subgrade volume changes and subsequent movement and cracking of grade-supported floor slabs, we recommend providing a layer of low plasticity fill below all grade supported floor slabs as follows.

- We recommend the basement slab be underlain by a granular drainage layer at least 6 inches thick, in turn underlain by at least 10 inches of low plasticity cohesive fill. Using a FFE of 1248.33 feet and a 4-inch thick basement slab, the bottom elevation of the low-plasticity fill will be at 1246.67 ft.
- We recommend the main level slab be underlain by an aggregate base, in turn underlain by at least 24 inches of low-plasticity cohesive fill. Using a FFE of 1263.0 feet and a 4-inch thick floor slab, the bottom elevation of the low plasticity cohesive fill will be at 1260.17 ft.

The recommendations presented in this report regarding moderate to high plasticity clay soils are based on our knowledge of the site soil conditions and our experience with similar sites and structures. These recommendations, if followed, will not eliminate the risk of minor movement and cosmetic distress (e.g., cracking in slabs) that is typically considered tolerable for the types of structures planned at this site. The risk of movement could be further reduced if significantly more expensive measures are used during design and construction (e.g., installing a thicker low plasticity fill zone, using structurally-supported floor slabs, supporting the building on deep foundations, etc.).

Additional discussion and recommendations are provided in subsection **4.2 Site Preparation and Earthwork**.

4.1.3 Foundation Support

We anticipate footings in the basement area will bear on glacial till. We recommend supporting the basement foundation loads on footing foundations bearing on the glacial till. If new fill is encountered at basement foundation elevation, the footings should be extended deeper to bear on natural glacial till soils. We recommend that the main floor foundations be supported on deep foundations extending to the glacial till. We understand that the main floor foundation loads will be extended to glacial till using auger cast in place piles (ACIP).

It is our opinion the native lean clays are suitable for support of only relatively light loads on spread footing foundations. As an alternative to a deep foundation system for the main level building foundations, a ground improvement system, such as stone columns or Geopiers®, may be considered in certain areas to allow use of spread footings supporting slightly higher loads and/or to reduce settlements. However, due to project schedule and design requirements this may not be a feasible alternative.

Additional discussion and recommendations are provided in subsection **4.3 Foundation Recommendations**.

4.1.4 Exterior Pavements

Existing fill and moderate expansive clay are expected in the pavement area. We recognize that complete removal in the pavement area would require significant excavations and that the existing pavement has reportedly performed adequately. Pavements in Lincoln area are commonly supported on moderate plasticity clay, and so recommendations to implement this alternative are presented in this report. If the owner is willing to accept a higher risk of pavement movement, consideration can be given to supporting the proposed pavement on existing moderately plasticity soils. This would involve a slightly higher risk of pavement movement if the soils experience moisture content fluctuations following construction. As alternate, the owner could consider lime stabilizing the upper 12 inches of the on-site soils to help reduce the risk of pavement movement, or importing 18 inches of approved cohesive fill to form the pavement subgrades. The owner of the project should be consulted to determine the economic impacts of these alternatives and to assess the risk levels of these alternatives in comparison with the owner’s risk tolerance.

4.1.5 Construction Observation and Testing

Terracon should be retained to observe stripping, site preparation, removal of existing fill, removal of desiccated native clay, removal of soft or unstable native soils, and subgrade preparation. We can assist in identifying existing fill soils or low-strength native soils that should be undercut and removed, as well as identifying additional corrective measures that may become apparent during construction.

We should be retained to evaluate and perform laboratory tests on proposed fill materials to evaluate compliance with the project specifications. We can also review laboratory tests of proposed fill soils provided by suppliers and contractors. We should be retained to monitor fill placement, and to perform field density tests as each lift of fill is placed, in order to evaluate compliance with the project specification and design requirements.

We should be retained to observe and test bearing soils exposed in footing foundation excavations, observe and document installation of deep foundation system elements, and to evaluate floor slab and pavement subgrades immediately prior to paving.

4.2 Site Preparation and Earthwork

4.2.1 Site Preparation

Site preparation should commence with stripping of all vegetation, organic soils, root systems, pavements, and any soft, frozen or otherwise unsuitable materials. A stripping depth of about 6 to 9 inches is expected to be adequate in most areas. However, areas of both deeper and shallower stripping could be encountered. A Terracon geotechnical representative should help evaluate actual stripping depths at the time of construction.

It is our experience poorly compacted backfill is commonly found in utility line trenches and adjacent to existing foundations or old foundations. Utility lines should be re-routed outside of the new building/structure areas. Backfill above the utility lines and backfill associated with foundation elements should be removed and replaced. We recommend the previous foundations, stem walls, and basement slabs be removed.

Existing fill was encountered in Boring B-3, which is located in the new building area. We recommend all existing fill be removed in the building area, and to at least 5 feet beyond the building perimeter. Complete removal of all existing fill is not required below exterior pavements, provided the existing fill is proofrolled and found to be stable.

We recommend providing a layer of low plasticity fill below all grade supported floor slabs as stated above in **Section 4.1.2 Moderate Plasticity Clays.** We anticipate that overexcavation and replacement will be required to install this layer.

As discussed above, several options are available for support of exterior pavements. If the owner is willing to accept a higher risk of pavement movement, the pavement can be supported on existing moderately plasticity clay. If existing fill and moderately plasticity clay are left in place, we recommend proofrolling the subgrade as stated above. Following proofrolling, the upper 8 inches of the subgrade should be scarified and recompacted to at least 98 percent of the material’s standard Proctor density (ASTM D698).

Proofrolling is recommended after stripping and overexcavation is completed, prior to placing new fill. Proofrolling aids in providing a firm base for compaction of fill and delineating soft or disturbed areas that may exist below subgrade level. Unsuitable areas observed at this time should be improved by scarification and recompaction or by undercutting and replacement with structural fill. Proofrolling may be accomplished with a fully loaded, tandem-axle dump truck or other equipment providing an equivalent subgrade loading. A minimum gross weight of 25 tons is recommended for the proofrolling equipment.

Slippage can occur if fill is placed on slopes steeper than about 5 horizontal to 1 vertical (5H:1V). Therefore, we recommend that slopes steeper than about 5H:1V be flattened or benched prior to placing fill. We recommend this process consist of removing vegetation and sod, and then forming benches or horizontal steps wide enough to accommodate construction equipment, and separated by vertical risers less than 2 feet high. A scarification and recompaction process is recommended on slopes flatter than 5H:1V, to help the new fill bond on the slope. This process involves scarifying the surface to a depth of about 8 inches, and then moisture conditioning and recompacting the scarified soil as recommended in subsection **4.2.4 Structural Fill Compaction Requirements**.

We noted a relatively soft wet area near the south side of the property at the toe of existing slope. Subgrade stabilization and a drain system (drain tiles in granular trenches) may be needed in this area to prevent ponding of water below pavements.

4.2.2 Chemical Stabilization

The chemical stabilization procedure should form at least a 12-inch thick stabilized subgrade below the pavement. The chemical stabilization could be performed by mixing slurry quick lime into the subgrade; we recommend the slurry method since the site lies within a developed urban area and using slurry will minimize the risk of dust drifting to the adjacent properties. If the use of dry quick lime or Class C fly ash is contemplated, we should be contacted to provide additional recommendations.

Based on previous experience with similar materials, about 3 to 5 percent active quick lime is estimated for effective stabilization. Additional testing using the on-site soils and the source of lime proposed for the project would be required to evaluate actual percentages required for adequate stabilization.

For proper lime stabilization, the stabilizing agent should be thoroughly mixed into the clay soils. High speed rotary pulverization equipment should be used for pulverizing and mixing the fly ash or lime into the clay. The use of an agricultural disk for this purpose is considered inadequate and is not recommended.

Construction traffic directly on the subgrade should be restricted to only traffic required for the paving machine. Heavy construction equipment and repetitive loads of any equipment should not be allowed.

The use of specialized procedures and equipment by experienced personnel will be required for effective subgrade stabilization. If stabilization is to be used, Terracon should be retained to provide additional testing and assist in developing more detailed materials and construction specifications.

4.2.3 Structural Fill Composition Requirements

We recommend the structural fill meet the following material composition requirements:

Fill Type [1]	USCS Classification	Acceptable Location for Placement
Low Plasticity Cohesive [5]	CL LL≤45 and 10≤PI≤25 [2]	Most locations and elevations.
Moderate Plasticity Cohesive [5, 6]	CL LL<50 and 10<PI<30 [2]	Below exterior pavements.
Well Graded Granular [4]	SP, SW, GW	Granular leveling course below main level floor slabs.
Granular Drainage Layer [7]	SP, SW	Granular drainage layer below basement-level floor slabs and adjacent to below-grade basement walls.
On-Site Soils [3]	Varies	The majority of the on-site soils are not suitable for reuse as “Low Plasticity Cohesive” fill. However, the on-site soils appear suitable for moderately plasticity cohesive fill, and can be used below exterior pavements if meeting the plasticity criteria above.

1. Structural fill should consist of approved materials that are free of organic matter, debris, and particles larger than 3 inches in maximum dimension. Frozen material should not be used, and fill should not be placed on a frozen subgrade. A sample of each material type should be submitted to the geotechnical engineer for evaluation.
2. LL = Liquid Limit, PI = Plasticity Index.
3. Sorting of on-site fat clay and soils containing debris, organics, etc, will be necessary. Delineation of unsuitable on-site soils should be performed in the field by a Terracon representative. Moisture conditioning will be necessary for the on-site soils.
4. Well-graded, crushed stone or crushed concrete, containing 100 percent passing the 1-inch sieve, less than about 40 percent passing the No.40 sieve, and less than 5 percent passing the No. 200 sieve. Should be placed only immediately prior to placing floor slab concrete. If this layer serves as a capillary moisture break for the main level slab, it should be at least 6 inches thick.
5. Fill meeting a PI of 10 to 20 is preferred; however, based on our knowledge and experience in Lincoln, we anticipate that finding fill soils meeting a PI of 20 or less may be difficult. Utilizing lean

Fill Type [1]	USCS Classification	Acceptable Location for Placement

clay soils with a liquid limit of less than 45 percent and a plasticity index between 20 and 25 percent is generally accepted in the Lincoln area, although this will somewhat increase the risk of shrink-swell movement.

6. Utilizing soils with higher liquid limits and plasticity indices can be considered below the pavements, although this will increase the risk of shrink-swell movement. If used below pavements, we recommend they be placed more than 2 feet below pavements.
7. Well-graded, free-draining, granular material placed below the basement level floor slab and adjacent to below-grade basement walls. We recommend this material be well-graded, have a maximum particle size of 1 inch, and contain less than 7 percent fines. Nebraska Department of Road "47B Fine Aggregate for Concrete" or approved alternate. We recommend a minimum 6-inch thickness below the basement level slab, and it should be placed only immediately prior to placing floor slab concrete.

4.2.4 Structural Fill Compaction Requirements

Item	Description
Fill Lift Thickness [4]	8 inches or less in loose thickness
Compaction Requirements [1, 3] ■ **Below footings and upper 8 inches below pavement** ■ **All other locations**	 98% of the material's standard Proctor maximum dry density (ASTM D 698) 95% of the material's standard Proctor maximum dry density (ASTM D 698), or 70% of relative density (ASTM D 4253/4254).
Moisture Content – Cohesive Soil	Within the range of 0 to +4 percent of the optimum moisture content as determined by the standard Proctor test at the time of placement and compaction
Moisture Content – Granular Material [2]	Workable moisture levels

1. We recommend structural fill be tested for moisture content and compaction during placement. Should the results of the in-place density tests indicate the specified moisture or compaction limits have not been met, the area represented by the test should be reworked and retested as required until the specified moisture and compaction requirements are achieved.
2. Specifically, moisture levels should be maintained low enough to allow for satisfactory compaction to be achieved without the cohesionless fill material pumping when proofrolled or containing excess water (ponding).
3. Consideration can be given to compacting all fill below pavements to 95% during mass grading. Immediately prior to paving, we recommend the subgrade below exterior pavements be rough-graded as needed, proofrolled, and then scarified and recompacted.
4. Thinner lifts may be required in excavations or confined areas, or when hand-operated compaction equipment is used.

4.2.5 Utility Trench Backfill

All trench excavations should be made with sufficient working space to permit construction, including backfill placement and compaction. If utility trenches are backfilled with relatively clean granular material, they should be capped with either pavement or at least 18 inches of cohesive fill to reduce the infiltration and conveyance of surface water through the trench backfill.

Utility trenches are a common source of water infiltration and migration. All utility trenches that penetrate beneath the buildings should be effectively sealed to restrict water intrusion and flow through the trenches that could migrate below the buildings. We recommend constructing an effective clay “trench plug” that extends at least 5 feet out from the face of the building exterior. The clay plug material should be placed to completely surround the utility line and be compacted in accordance with recommendations in this report.

4.2.6 Construction Grading and Drainage

Any areas of standing surface water should be drained as far in advance of construction as possible. Any saturated soils should be removed prior to placing fill or proceeding with construction.

The on-site soils will be sensitive to disturbance from construction activity and water seepage. If precipitation occurs immediately prior to or during construction, the near-surface clay soils could increase in moisture content and become more susceptible to disturbance. Construction activity should be monitored, and should be curtailed if the construction activity is causing subgrade disturbance. A Terracon representative can help with monitoring and developing recommendations to avoid subgrade disturbance.

Surface water should not be allowed to pond on the site and soak into the soil during construction. Construction staging should provide drainage of surface water and precipitation away from the building and pavement areas. Any water that collects over or adjacent to construction areas should be promptly removed, along with any softened or disturbed soils. Surface water control in the form of sloping surfaces, drainage ditches and trenches, and sump pits and pumps will be important to avoid ponding and associated delays due to precipitation and seepage.

4.2.7 Construction Considerations

Upon completion of filling and grading, care should be taken to maintain the subgrade moisture content prior to construction of floor slabs, footings, pavements, and retaining walls. Construction traffic over the completed subgrade should be avoided to the extent practical. Heavy or concentrated loads or numerous repetitions of lighter loads could cause subgrade disturbance / failure and should be avoided. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. If the subgrade should become frozen, desiccated, saturated, or disturbed, the affected material should be removed or these materials should be scarified, moisture conditioned, and recompacted prior to floor slab and pavement construction.

As a minimum, all temporary excavations should be sloped or braced as required by Occupational Health and Safety Administration (OSHA) regulations to provide stability and safe working conditions. Temporary excavations will probably be required during grading operations. The grading contractor, by his contract, is usually responsible for designing and constructing stable, temporary excavations and should shore, slope or bench the sides of the excavations as required, to maintain stability of both the excavation sides and bottom. All excavations should comply with applicable local, state and federal safety regulations, including the current OSHA Excavation and Trench Safety Standards.

4.2.8 Landscaping and Grading Considerations

Poor site drainage and ponding of surface water can increase the potential for frost heave, swell, or settlement within the native or recompacted clay soils or clay fill. Excessive moisture can reduce the soil's bearing capacity and contribute to settlement and cracking. Finished grading slopes should promote drainage away from the building, retaining wall, and pavement areas to help prevent post-construction wetting of the bearing soils. We recommend final grades for seeded and landscaped areas be sloped at least 5 percent within 10 feet around the building to direct surface water well away from the building. We recommend cohesive backfill be placed in utility trenches and adjacent to building foundations and curbs, and this fill be compacted to at least 95 percent of standard Proctor maximum dry density to help prevent surface water infiltration. Roof drains should be extended to discharge on pavements or in lawn areas more than 5 feet from the structures. Pavements or sidewalks installed adjacent to the building should slope away from the building at a grade of 2% or more.

After building construction and landscaping, we recommend verifying final grades to document that effective drainage has been achieved. Grades around the structure should also be periodically inspected and adjusted as necessary, as part of the structure’s maintenance program.

Trees or other vegetation with aggressive root systems have the ability to remove moisture from the subgrade and foundation soils. Trees and shrubbery should be kept away from the exterior edges of the foundation elements a lateral distance at least equal to 1.5 times their expected mature height.

4.3 Foundation Recommendations

4.3.1 Foundation Support Discussion

The borings encountered native soils composed of loess (generally lean clay) underlain by silty fine sands and glacial till soils. It is our opinion the loess is suitable for supporting only lightly-loaded column and wall loads on spread footing foundations and differential settlement would be relatively high between footings supported on loess and glacial till soils. Based on this information, we recommend supporting footing foundations at the basement level on glacial till, and extending the main floor foundations to glacial till using deep foundations. As discussed above, we understand ACIP piles have been selected for support of the main floor foundations and spread footings bearing on glacial till have been selected for the basement foundations.

4.3.2 ACIP Piles

4.3.2.1 Design Recommendations

Soil strength parameters for use in design of ACIP piles were evaluated from the boring information and laboratory test results. Based on this information, the following skin friction and end bearing values may be used for determining the allowable capacities of ACIP piles.

Elevation, ft.	Allowable Unit Skin Friction in Compression (psf) [1, 4, 5]	Allowable Compressive End Bearing (psf) [2, 3]
Above 1248.3	Neglect	Neglect
1248.3 – 1186	1,000	10,000

1. Side resistance should be neglected within 42 inches of final grade due to frost effects.
2. Allowable end bearing includes a safety factor of between 2 and 3.
3. Use of end bearing requires at least 5 feet of penetration into the indicated soil layer and requires a minimum element length of 25 feet.
4. Allowable unit skin friction includes a safety factor of about 2. The bottom one diameter of the shaft should be neglected when calculating pile capacity.
5. Allowable unit skin friction in uplift can be obtained by multiplying the compressive skin friction within the reinforced length of the pile by 0.7; total uplift resistance includes the frictional resistance plus the effective weight of the concrete used in the foundation elements, pile caps, and grade beams.

ACIP piles should be a minimum of 14 inches in diameter. Allowable compressive capacities may be computed by multiplying the embedded surface area of the pile or shaft in a particular depth zone by the skin friction value for that zone and adding the actual end area of the pile or shaft times the end bearing value.

Allowable design pile load capacities confirmed by performing load tests on ACIP piles may exceed the capacities calculated using the recommended design skin friction and end-bearing values discussed above. It is recommended that a Terracon geotechnical engineer monitor and evaluate ACIP pile load tests to assess allowable design load capacity values derived from the tests.

Group effects can be neglected and the total capacity of the group taken as a sum of the individual pile capacities only if adjacent piles are spaced at least three pile or shaft diameters (center-to-center) and pile groups include 8 elements or fewer. Design of the piling as structural members should be in accordance with applicable building codes. The ACIP piles should be designed for an allowable design load that limits the average compressive stress in the pile section to not more than 25% of the design 28-day unconfined compressive strength (f'_c) of the ACIP pile grout or as allowed by the building code.

It is recommended that the pile caps and grade beams along the building exteriors and in unheated areas extend at least 3½ feet below outside grade for frost protection. Allowable resistance to lateral loads of the portions of pile caps and grade beams that are located below a 3½-foot frost depth and bear directly against properly compacted fill or undisturbed stiff natural clay may be calculated using the allowable passive earth pressures presented in subsection **4.5 Lateral Earth Pressures**. The passive resistance of the soils against the foundation above a 3½ -foot depth should be neglected due to frost action.

An increased equivalent fluid pressure of 300 pcf could be used for calculating allowable passive earth pressures against the projected width of individual piles, but it is our experience that more resistance can be allowed if a computer modeling program such as L-Pile or Group typically allows use of a higher lateral resistance than is calculated using a passive earth pressure against the foundation elements.

For a group of shafts oriented parallel to a lateral load, design parameters for allowable passive resistance should be reduced in accordance with the following table.

Group Reduction Factors – Laterally Loaded ACIP Piles

Shaft Spacing (Diameters)	Reduction Factors Leading Row	 Second Row	 Third Row and Higher
8D	1.0	1.0	1.0
5D	0.9	0.85	0.7
3D	0.8	0.6	0.4

Tensile and lateral load resistance of auger-cast piles should be neglected unless the piles are adequately reinforced. The installation of a long reinforcing cage can be problematic in auger-cast piles. Therefore, it may be appropriate to design the foundations with deeper pile caps or grade beams or utilize other means of lateral support where very high lateral loads occur. Terracon can provide additional and detailed lateral and moment load analysis for individual piles and pile groups once more detailed design information is available. It is our experience that significant lateral load can be supported by ACIP piles, especially if the pile tops are fixed from rotation and adequate reinforcement is installed. At a minimum, we recommend a #8 bar be installed in each pile extending full length. Reinforcement should include centering devices to assure the steel has adequate concrete cover.

4.3.2.2 Installation Recommendations

The successful completion of ACIP piles will depend to a large extent on the suitability of the equipment and installation procedures used. ACIP piles (14 to 18 inches in diameter) are constructed by extending continuous hollow-stemmed augers to a predetermined depth and then pumping a fluid cement grout under pressure through the center of the hollow shaft as the augers are withdrawn, leaving a continuous concrete pile.

Care should be taken during the ACIP pile installation because of the potential for both “necking” and “overdrilling” during the installation procedure. The water-bearing sands are susceptible to loosening upon overdrilling, and can also cause necking if the auger withdrawal procedure is rushed. Controlled withdrawal of the auger will be necessary and a sufficient head of grout should be maintained in the auger system at all times to prevent necking down of the fluid mortar due to hydrostatic pressures (for example: a minimum overpump of 120 percent, a grout head of 7 feet, or as achieved in a test pile). The quantity of the concrete grout placed in each element should be checked against the calculated volume required to obtain design pile dimensions; a minimum overpump of 120% or as achieved in a test pile is recommended. It is recommended that Terracon review and comment on specifications developed for pile installation. A Terracon representative should monitor actual pile installation on a full-time basis.

Installing adjacent ACIP piles with clear distance spacing of less than 15 feet should be delayed until mortar in the initial pile has set. This is recommended to avoid possible grout intrusion between the piles which could jeopardize the integrity of both piles. If two piles are separated by a blocking pile (e.g., diagonal corners of a 5-pile group with an “X” configuration blocked by the center pile), the clear distance spacing can be reduced to 12 feet.

The estimated maximum settlement of ACIP pile foundations designed and constructed in accordance with our recommendations is on the order of ½-inch. The settlement of a pile group will be larger than the settlement of an individual pile. Settlement of a pile group should be evaluated after loading conditions and foundation details are available.

4.3.3 Spread Footing Foundations

4.3.3.1 Support Conditions and Design Recommendations

In our opinion, the basement footings could be supported on the glacial till. We recommend the footings extend through all fill into either very stiff glacial till or dense sand. Based on the limited depth of the footings, the footings may need to be extended deeper to bear in glacial till or dense sand. Design and installation recommendations for shallow foundations for the proposed building follow.

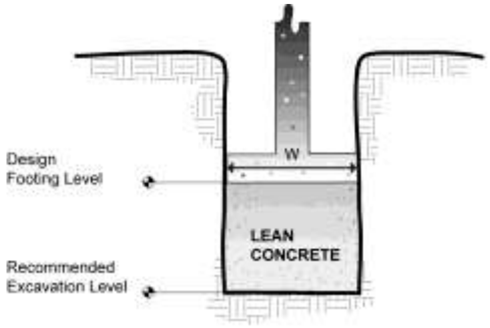
Description	Column	Wall
Net allowable bearing pressure (soil) [1, 4]	4,000 psf	4,000 psf
Minimum dimensions	30 inches	24 inches
Minimum embedment of perimeter footings and footings beneath unheated areas [2]	42 inches	42 inches
Estimated total settlement [3]	<1/2 inch	<1/2 inch
Estimated differential settlement [3]	1/4 inch between columns	1/4 inch over 20 feet

1. The recommended net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation. Assumes any poorly compacted fill, disturbed soil, or soft soils, if encountered, will be undercut and replaced with lean concrete. Assumes footings extend through all fill to approved glacial till or sand.
2. For frost protection and to reduce the effects of seasonal moisture variations in the subgrade soils. If construction extends into freezing weather, we recommend that either all footings extend to frost depth (as measured from adjacent grade at the time of construction) or that the foundations be protected from the elements by straw, frost blankets, or similar means.
3. The foundation settlement will depend upon the variations within the subsurface soil profile, the structural loading conditions, the embedment depth of the footings, the thickness of compacted fill, and the quality of the earthwork operations. The above settlement estimates have assumed the maximum footing size is 9.5 feet for column footings, 5.5 feet for continuous footings, and relatively uniform loading. These estimates do not include settlements due to inadequate preparation of bearing surfaces or desiccation due to poor moisture maintenance of the exposed floor subgrades, and will require thorough observation and testing by Terracon during construction to carefully evaluate the suitability of the bearing soils. The settlements are based on the soils encountered at the boring locations, larger settlements are possible due to varying soil conditions between the boring locations.
4. We estimate a modulus of subgrade reaction (k) value of about 50 pci for the recommended bearing pressure and estimated settlement.

4.3.3.2 Construction Considerations

The bearing materials exposed in all foundation excavations should be observed and tested by a Terracon representative. If unsuitable bearing materials are encountered in a footing excavation, the excavation should be extended deeper to suitable materials. The footing could then bear directly on the suitable materials at the lower level or on lean concrete backfill placed back up to design bearing level.

If loose sand is encountered that extends to a depth of less than 1 foot below the bearing depth, this material could be surfically compacted using a vibrating plate compactor. If more than about 1 foot of loose sand or unsuitable bearing materials are encountered in a footing excavation, the excavation should be extended deeper to suitable materials. The footings could bear directly on the suitable materials at the lower level or on lean concrete backfill placed in the excavations. A schematic of the undercutting and lean concrete backfill procedure is shown on the adjacent figure.



Lean Concrete Backfill

NOTE: Excavations in sketches shown vertical for convenience. Excavations should be sloped as necessary for safety.

The clay and sand soils on this site are susceptible to disturbance from construction activities, particularly if the soils have high natural moisture contents or become wetted by surface water or seepage. Care should be taken during excavation and construction of footings to avoid disturbing the bearing soils. The base of all foundation excavations should be free of water and loose material prior to placement of concrete. Concrete should be placed within a few hours after excavating to reduce disturbance of the bearing materials. If the materials at bearing level become excessively dry, disturbed or saturated, the affected material should be removed prior to placing concrete. A 2- to 3-inch lean concrete “mud mat” could be placed in the base of the foundation excavations to reduce the potential for disturbance of bearing soils and provide a stable working surface.

4.3.4 Seismic Considerations

Based upon the results of the borings, we estimate the project site as “Site Class C” according to the 2006 International Building Code (IBC). A more detailed and accurate Site Class evaluation can be achieved by using the SeisOpt®ReMi™ method to develop the full depth shear wave profile, although we doubt a improvement in the Site Class can be achieved with further testing. The Site Class C recommendation is based on the building foundations (whether spread footings or deep foundations) bearing on glacial till.

In our opinion, the following spectral response accelerations are applicable to this site location based on the applicable response maps: S_s = 0.176g and S_1 = 0.046g. These values are based on a 2% probability of exceedance in 50 years, and were obtained from the Interpolated Probabilistic Ground Motion for the continuous 48 states by Latitude and Longitude, USGS 2002 Data Base. The S_s and S_1 values are for a Site Class B, and should be adjusted with applicable site coefficients listed in Tables 1613.5.3(1) and 1613.5.3(2) of the 2006 IBC.

4.4 Floor Slabs

4.4.1 Design Recommendations

Item	Description
Main Level Floor slab support [1]	An aggregate base underlain by at least 24 inches of structural fill prepared according to subsection **4.2 Site Preparation and Earthwork**.
Basement Level Floor slab support [1]	An aggregate base underlain by at least 10 inches of structural fill prepared according to subsection **4.2 Site Preparation and Earthwork**.
Modulus of subgrade reaction	125 pounds per square inch per inch (psi/in) for point loading conditions.
Aggregate base course/capillary break [2]	6 inches of granular material.

1. Floor slabs should be structurally independent of any building footings or walls to reduce the possibility of floor slab cracking caused by differential movements between the slab and foundation.
2. The floor slab design should include a capillary break comprised of compacted, granular material at least 6 inches thick, as described in subsection **4.2 Site Preparation and Earthwork**.

Slabs-on-grade should be isolated from structures and utilities to allow for independent movement. Joints should be constructed at regular intervals as recommended by the American Concrete Institute (ACI) to help control the location of any cracking. Keyed and doweled joints should be considered. The owner should be made aware that differential movement between the slabs and foundations could occur.

The use of a vapor retarder should be considered beneath concrete slabs on grade that will be covered with wood, tile, carpet or other moisture sensitive or impervious coverings, or when the slab will support equipment sensitive to moisture. When conditions warrant the use of a vapor retarder, the slab designer should refer to ACI 302 and/or ACI 360 for procedures and cautions regarding the use and placement of a vapor retarder.

4.4.2 Basement Slab Drainage System

We recommend a drainage base consisting of State of Nebraska "47B Fine Aggregate for Concrete" (clean, well-graded sand/gravel) be placed below the basement level floor slab. The drainage material should be 6 inches thick and compacted with a large vibratory plate or moderate sized vibratory smooth steel drum self-propelled roller.

A permanent drainage system is recommended in conjunction with the granular base layer below the basement level floor slab. The drain system should include 4-inch diameter Contech A2000, or approved alternate (typical plastic drainage pipe is not recommended), drainage pipes designed to provide positive drainage to sumps or gravity discharge outlet pipes. The pipes should be laid in 12-inch wide trenches excavated at least 6 inches below the bottom of the granular base layer. A non-woven geotextile such as Contech C60NW, or equivalent, should be used to line the bottom and sides of the pipe trenches. The pipes should be laid directly on the fabric and then State of Nebraska "47B Fine Aggregate for Concrete" should be used to backfill the remainder of the trench.

The pipe slots or perforations should be sized to prevent infiltration of the 47B Fine Agregate into the drain tile. We recommend the drain lines be located around the perimeter of the basement and within the interior at spacing of about 25 to 40 feet. All pipes should be provided with cleanouts. If a sump is used, we recommend a backup pump.

Care will be necessary to avoid contaminating the granular base layer located directly below the floor slab with soil prior to floor slab placement. We recommend the drain tile be installed and granular base layer be placed only immediately prior to slab concrete placement.

4.4.3 Construction Considerations

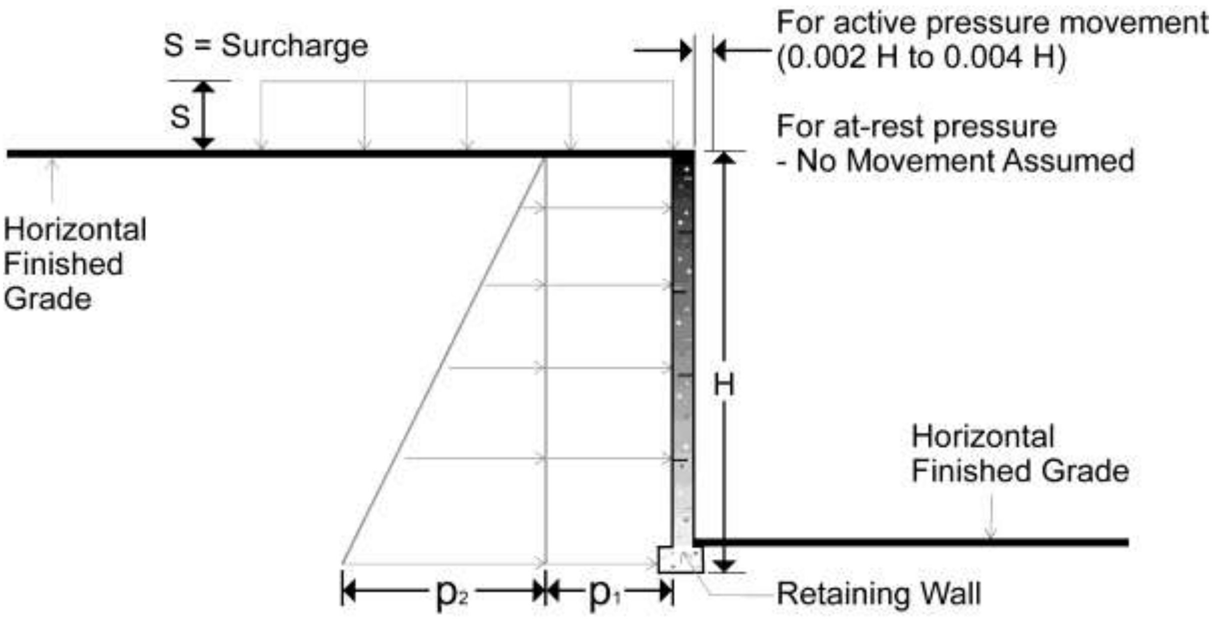
On most project sites, grading for floor slab subgrades is accomplished relatively early in the construction phase. Fills are placed and compacted, and the initial surface is prepared in a relatively uniform manner. However, as construction proceeds, excavations are made into these areas, rainfall and surface water saturates some areas, heavy traffic from construction equipment disturbs the subgrade, and surface irregularities are often filled with loose materials to temporarily improve trafficability. As a result, the floor slab subgrade, prepared early in the project should be carefully evaluated as the time for slab construction approaches. Within a few days of slab installation, we recommend the areas be observed and tested. Particular attention should be given to high traffic areas that become rutted and disturbed, and to areas where backfilled trenches are located. Areas where unstable conditions exist should be repaired by removing and replacing the materials with low plasticity structural fill. All floor slab subgrade areas should be moisture conditioned and properly compacted to the recommendations in subsection **4.2 Site Preparation and Earthwork**.

4.5 Lateral Earth Pressures

4.5.1 Design

The lateral earth pressure recommendations given in this subsection are applicable to the design of rigid retaining walls subject to slight rotation, such as cantilever, or gravity type concrete walls. These recommendations are not applicable to the design of modular block - geogrid reinforced backfill walls (also termed MSE walls). We understand MSE walls are not currently planned, so this report does not address MSE walls. However, we would be pleased to develop a proposal for evaluation and design of such wall systems upon request.

Reinforced concrete walls with unbalanced backfill levels on opposite sides should be designed for earth pressures at least equal to those indicated in the following table. Earth pressures will be influenced by structural design of the walls, conditions of wall restraint, methods of construction and/or compaction and the strength of the materials being restrained. Two wall restraint conditions are shown. Active earth pressure is commonly used for design of free-standing cantilever retaining walls and assumes wall movement. The "at-rest" condition assumes no wall movement. The recommended design lateral earth pressures do not include a factor of safety.



EARTH PRESSURE COEFFICIENTS

Earth Pressure Conditions	Coefficient For Backfill Type	Equivalent Fluid Density (Pcf)	Surcharge Pressure, P_1 (Psf)	Earth Pressure, P_2 (Psf)
Active (Ka)	Granular - 0.33	40	(0.33)S	(40)H
	Lean Clay - 0.39	47	(0.39)S	(47)H
At-Rest (Ko)	Granular - 0.46	55	(0.46)S	(55)H
	Lean Clay - 0.56	67	(0.56)S	(67)H
Passive (Kp)	Granular - 3.0	360	---	---
	Lean Clay - 2.4	288	---	---

Applicable conditions to the above include:

- For active earth pressure, wall must rotate about base, with top lateral movements of about 0.002 **H** to 0.004 **H**, where **H** is wall height
- For passive earth pressure to develop, wall must move horizontally to mobilize resistance.
- Uniform surcharge, where **S** is surcharge pressure
- In-situ soil backfill weight a maximum of 120 pcf
- Horizontal backfill, compacted between 95 and 98 percent of standard Proctor maximum dry density
- No hydrostatic pressure acting on wall
- No loading from compaction equipment
- No loading from nearby footings or slabs
- No dynamic loading
- Finished grade is horizontal both behind wall and at toe of wall
- No safety factor included in soil parameters
- Ignore passive pressure in frost zone

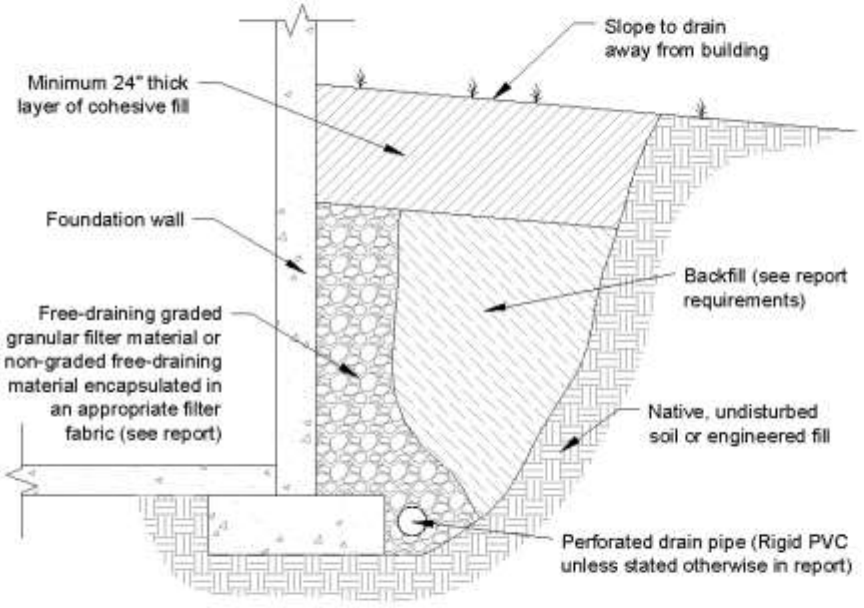
Backfill placed against structures should consist of granular soils or low plasticity cohesive soils. For the granular values to be valid, the granular backfill must extend out from the base of the wall at an angle of at least 45 and 60 degrees from vertical for the active/at-rest and passive cases, respectively. To calculate the resistance to sliding, a value of 0.40 should be used as the ultimate coefficient of friction where the footing bears on suitable soil.

Footings, floor slabs or other loads bearing on backfill behind walls may have a significant influence on the lateral earth pressure. Placing footings within wall backfill and in the zone of active soil influence on the wall should be avoided unless structural analyses indicate the wall can safely withstand the increased pressure.

In our opinion, a footing drain system is not required behind walls retaining interior fill and where the tops of the walls and the retained backfill are protected from wetting with the exterior walls and roof of the structure (e.g., truck loading docks). If the project design results in areas where installation of (unprotected) retaining walls are necessary to provide grade separation, we recommend a perimeter drain be installed at the foundation level in these areas to control the water level behind the wall. If this is not possible, then combined hydrostatic and lateral earth pressures should be calculated for lean clay backfill using an equivalent fluid weighing 95 and 100 pcf for active and at-rest conditions, respectively. These pressures do not include the influence of surcharge, equipment or floor loading, which should be added. Heavy equipment should not operate within a distance closer than the exposed height of retaining walls to prevent lateral pressures more than those provided.

4.5.2 Drainage Systems

For structures that are not designed to be watertight, a perforated rigid plastic or metal drain line is recommended behind the base of walls extending below adjacent grade to prevent hydrostatic loading on the walls. The invert of a drain line around below-grade areas should be at least 12 inches below the top of subgrade elevation for the interior floor. The drain line should be sloped to provide positive gravity drainage to a sump or other suitable outlet. The drain line should be surrounded by free-draining granular material graded to prevent the intrusion of soil fines into the granular material or the intrusion of the granular material into the drain pipe perforations. Alternatively, a coarse, clean, free-draining granular material could be used to surround the pipe if this material is encapsulated with suitable filter fabric.



At least a 2-foot wide section of free-draining granular fill is recommended for backfill above the drain line and adjacent to the wall and should extend to within 2 feet of final grade. The granular backfill should be capped with compacted cohesive fill to help prevent infiltration of surface water into the drain system.

A prefabricated drainage structure may be used above a drain line and the surrounding filter, in lieu of free-draining granular fill. A prefabricated drainage structure is a plastic drainage core or mesh which is covered with filter fabric to prevent soil intrusion, and is fastened to the wall prior to placing backfill.

4.6 Exterior Pavements

4.6.1 Design Recommendations

Pavement subgrades should be prepared in accordance with the recommendations presented in section **4.2 Site Preparation and Earthwork**. We recommend the exterior pavements be supported directly on recompacted on-site clays, which we believe is consistent with typical local practice for parking lots and driveways. If a granular base is provided below exterior pavements, Terracon should be contacted to provide additional recommendations. For example, subdrains are recommended in conjunction with a granular base to prevent water from ponding in the granular base.

Terracon performed a California Bearing Ratio (CBR) test on a composite sample of the existing fill soils. The CBR test measured a CBR value of 6.6. Due to potential post-construction saturation and environmental impacts to the subgrade, we recommend a design CBR value of 3 be used for this project, with the following pavement minimum sections:

- <u>Standard Duty Pavements</u>: For parking areas subjected to low volumes of automobile traffic, a full-depth ACC section having a total thickness of at least 6 inches, or a PCC pavement section having a thickness of at least 5 inches, is recommended.

- <u>Heavy-Duty Pavements</u>: Entry drives and truck driveways require increased pavement thicknesses. A minimum 7-inch thick ACC section, or a minimum 6-inch thick PCC section, is recommended in these areas.

- <u>Truck Pads</u>: A minimum 7-inch thick PCC section is recommended for aprons in front of truck loading docks, in delivery truck parking areas, and refuse pick-up areas.

Terracon has observed dishing in some parking lots surfaced with ACC. Dishing is usually observed in frequently-used parking stalls (such as near the front of the building), and occurs under the wheel footprint in these stalls. The use of higher grade asphaltic cement such as PG70-28, or surfacing these areas with PCC, is recommended. The dishing is exacerbated by factors such as irrigated islands or planter areas, sheet surface drainage to the front of the building, and placing the ACC directly on a compacted clay subgrade. The use of lower grade asphalt cement, such as PG64-22 is relatively common in this area and may be considered, but would provide lower reliability against rutting and creeping during warm weather.

Minimum surface course thicknesses of 2 inches in automobile areas and 3 inches in driveways are recommended for asphaltic cement concrete pavement sections. An ACC base course thickness of 4 inches is recommended.

We recommend that ACC pavement specifications reference Chapters 5 and 12 of the 2006 City of Lincoln Standard Specification. For ACC mix design, we recommend that type of SP4 Special be used for the surface and base mix; however, since the parking lot areas are subjected to slow-moving and static load conditions, PG70-28 asphalt cement is recommended for the surface course.

A Portland cement concrete mix design with a minimum 28-day modulus of rupture of 550 psi should be used for concrete pavements (ASTM C 78-84, Third Point Loading Method). This is roughly equivalent to a 28-day compressive strength of 4,000 psi. In addition, Portland cement concrete paving should contain about 5 to 7 percent entrained air, and should have a maximum water-cement ratio of about 0.45.

A formal pavement design has not been completed for this project. Terracon can be retained to provide a formal pavement design if design traffic and pavement design life information is provided. Thicker pavement sections could be used to reduce maintenance and extend the expected service life of the pavements.

4.6.2 Construction Considerations

Construction traffic on the pavements was not considered in developing the recommended minimum pavement thicknesses. Construction traffic can cause significant damage to pavements, especially to partially-completed pavement sections (e.g., base course lifts). If the pavements will be subject to traffic by construction equipment/vehicles, the pavement thicknesses should be revised to consider the effects of the additional loading.

Construction scheduling often involves grading and paving by separate contractors and can involve a time lapse between the end of grading operations and the commencement of paving. Disturbance, desiccation or wetting of the subgrade soils between grading and paving can result in deterioration of the previously completed subgrade.

Immediately prior to paving, we recommend the subgrade below exterior pavements be rough-graded as needed, and then proofrolled. Areas of soft clay should be reworked and recompacted as stated above. Then the subgrade should be scarified and recompacted.

4.6.3 Drainage and Maintenance Considerations

Reducing subgrade saturation is an important factor in maintaining the subgrade strength. Water allowed to pond on or next to pavements could saturate the subgrade and cause premature pavement deterioration. Positive surface drainage should be provided away from the edges of paved areas, and all pavements should be sloped to provide rapid surface drainage.

Additional measures which would reduce the risk of subgrade saturation would include crowning of pavement subgrades to drain toward the edges rather than the center, and installing perimeter subsurface drains next to irrigated planters or other areas where surface water could pond.

Periodic maintenance will also extend the service life of the pavements and should include patching and repair of deteriorated areas, crack sealing, and surface sealing.

4.7 Exterior Slabs

The clay soils encountered in the borings are susceptible to frost heave. Our borings did not indicate a groundwater source for water close to the ground surface. Rather, it is our experience that surface water infiltration and utility leaks present the greatest risk of abnormal frost heave conditions. Therefore, with proper design, drainage and maintenance, we would expect typical performance for the Lincoln area. The risk of frost heave may be reduced by providing surface drainage away from the building and slabs.

If frost action needs to be eliminated in critical areas, then we recommend the use of structural slabs (e.g., as structural stoops in front of building doors). This is a common practice in Lincoln.

Placing non-frost-susceptible (granular) material in large areas under sidewalks and pavements, and installing a drain tile to collect any water in the granular fill and direct it to the storm drain system, would further control frost heave. However, it is our opinion that placing non-frost susceptible material in large areas under exterior pavements and sidewalks would be exceedingly expensive, and would also be an unusual design and construction procedure for Lincoln. We should be contacted to provide additional recommendations should consideration be given to placing non-frost-susceptible (granular) material in large areas.

5.0 GENERAL COMMENTS

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

Support of pavements above existing fill soils is discussed in this report. However, even with the recommended construction testing services, there is an inherent risk for the owner that compressible fill or unsuitable material within or buried by the fill will not be discovered. This risk of unforeseen conditions cannot be eliminated without completely removing the existing fill, but can be reduced by performing additional testing and evaluation.

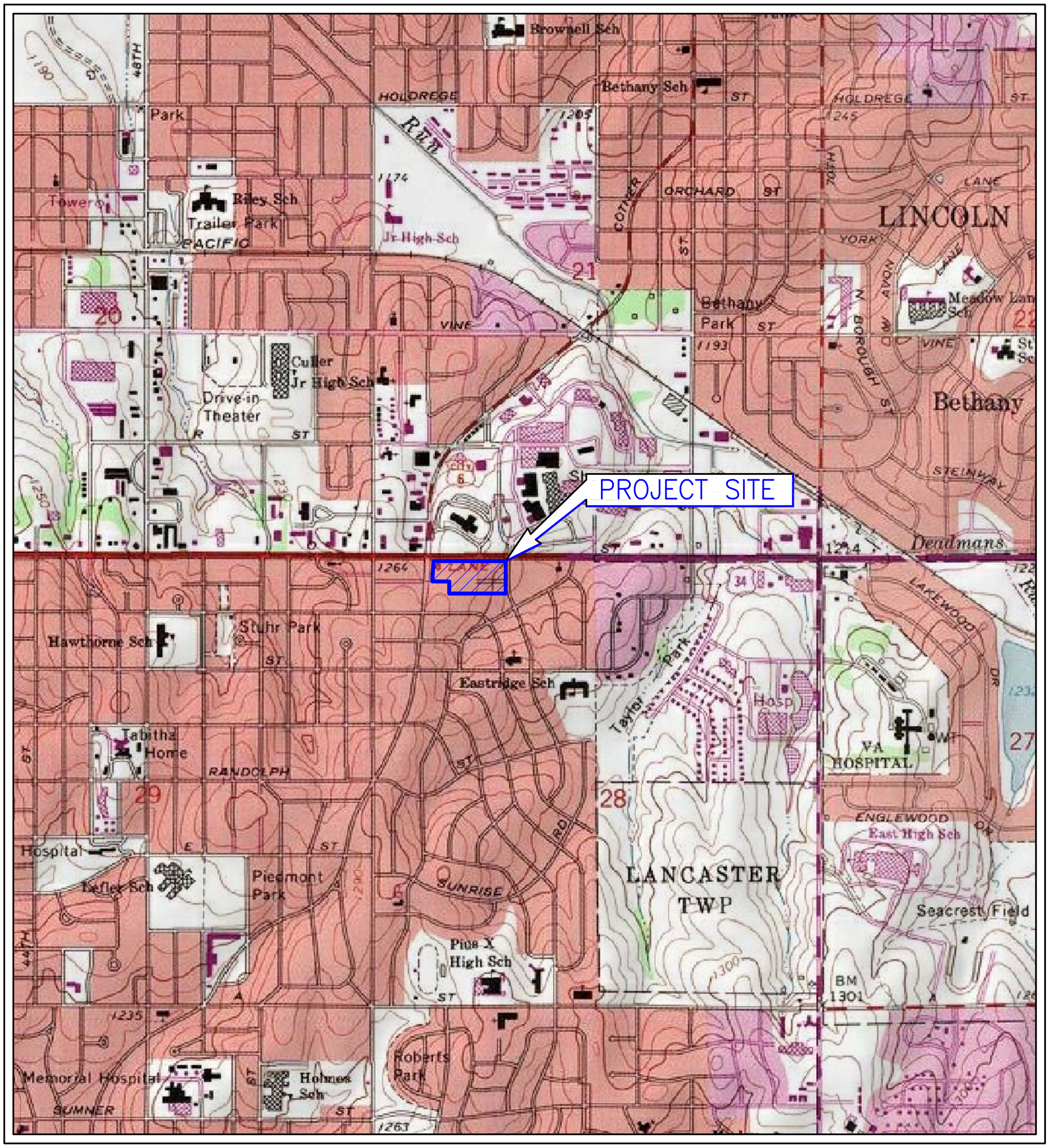
The analysis and recommendations presented in this report are based upon the data obtained from the borings performed at the indicated locations and from other information discussed in this report. This report does not reflect variations that may occur between borings, across the site, or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. If variations appear, we should be immediately notified so that further evaluation and supplemental recommendations can be provided.

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

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranties, either express or implied, are intended or made. Site safety, excavation support, and dewatering requirements are the responsibility of others. In the event that changes in the nature, design, or location of the project as outlined in this report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless Terracon reviews the changes and either verifies or modifies the conclusions of this report in writing.

APPENDIX A
FIELD EXPLORATION

UNITED STATES — DEPARTMENT OF THE INTERIOR — GEOLOGICAL SURVEY



SCALE 1:24 000

KILOMETERS	1	.5	0	1	2
METERS	1000		0	1000	2000

MILES 1 .5 0 1

FEET 1000 0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000

CONTOUR INTERVAL 10 FEET

NATIONAL GEODETIC VERTICAL DATUM OF 1929

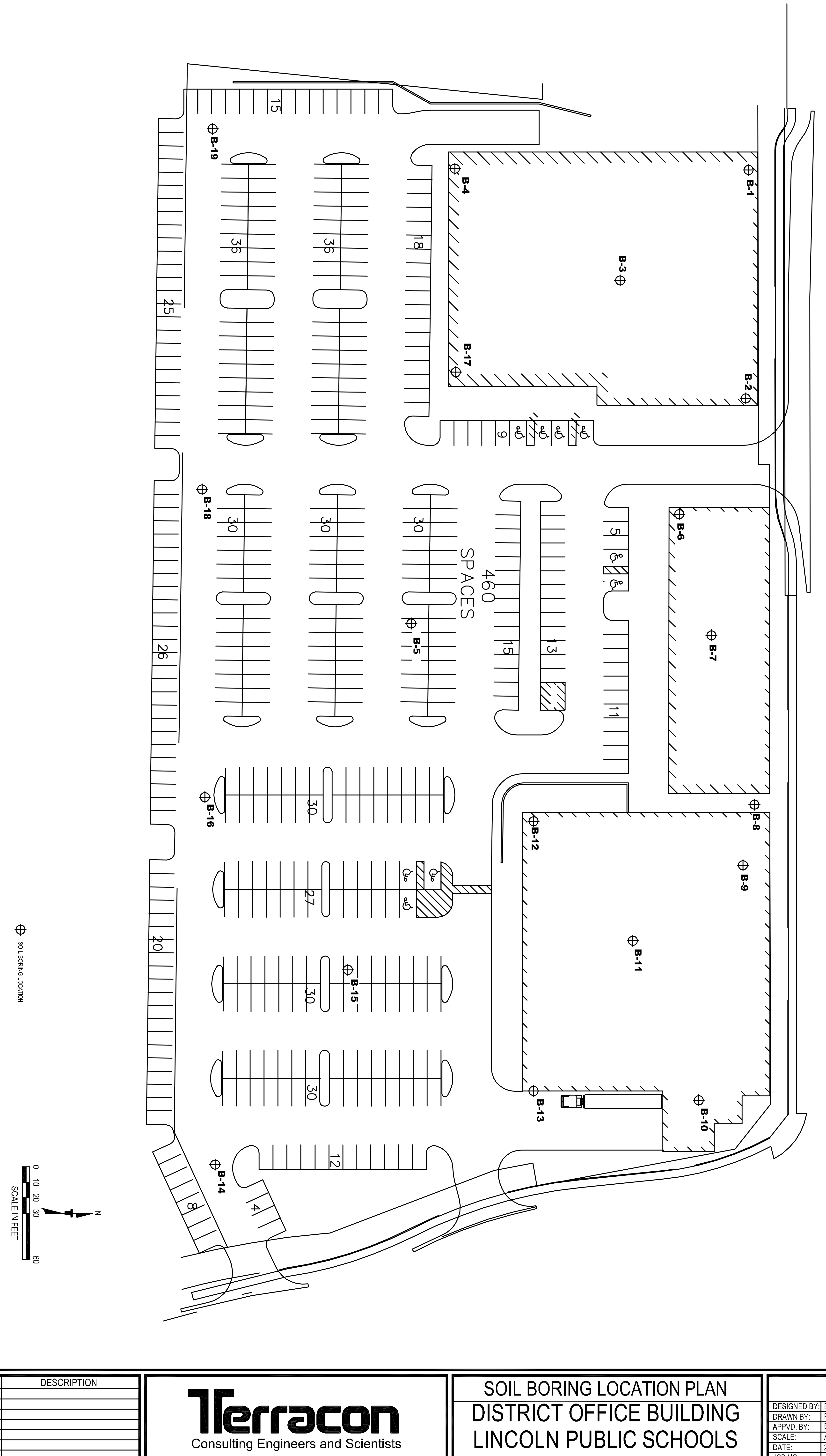
LINCOLN, NEBRASKA
QUADRANGLE
1980
7.5 MINUTE SERIES (TOPOGRAPHIC)

N

Project Mngr: BAL	Project No. A3125004		SITE LOCATION / TOPOGRAPHIC MAP
Drawn By: PAI	Scale: AS SHOWN	Terracon Consulting Engineers and Scientists	DISTRICT OFFICE BUILDING LINCOLN PUBLIC SCHOOLS SOUTH COTNER BOULEVARD & 'O' STREET
Checked By: MDR	File No. A3125004C01	3220 NORTH 20th STREET, SUITE 3 LINCOLN, NE 68521	
Approved By: BAL	Date: 2/28/12	PH. (402) 466-3911 FAX. (402) 466-0811	LINCOLN NEBRASKA

FIG. No.

A-1



REV.	DATE	BY	DESCRIPTION

Terracon
Consulting Engineers and Scientists
15080 A CIRCLE OMAHA, NE 68144
PH. (402) 330-2202 FAX. (402) 330-7606

SOIL BORING LOCATION PLAN
DISTRICT OFFICE BUILDING
LINCOLN PUBLIC SCHOOLS
SOUTH COTNER BOULEVARD & 'O' STREET
LINCOLN NEBRASKA

DESIGNED BY:	BAL
DRAWN BY:	PAI
APPVD. BY:	BAL
SCALE:	AS SHOWN
DATE:	2/29/12
JOB NO.	A3125004
ACAD NO.	A3125004C01
FIGURE NO.:	A-2

P:\2012\A3125004\PROJECT DOCUMENTS (Reports-Letters-Drafts To Clients)\Drawings\A3125004C01.dwg Layout: Site 2/29/2012 1:55 PM

Field Exploration Description

The drill crew staked the boring locations relative to existing physical features. Distances were measured with a mechanical wheel or nylon tape and right angles were estimated. The approximate boring locations are shown on Exhibits A-2 and A-3 in Appendix A. The locations of the soil borings should be considered accurate only to the degree implied by the means and methods used to define them.

Ground surface elevations indicated on the boring logs are approximate and have been rounded to the nearest ½-foot. The elevations were obtained by the drill crew using a surveyor's level and rod. The elevations of all the borings except Boring B-14 were referenced to the chiseled square on top of curb near northwest corner of existing parking lot. An elevation of 1264.84 feet was given for the benchmark by Olsson Associates. The elevation of Boring B-14 was referenced to a chiseled square on top of the curb north side of entrance to LPS. An elevation of 1246.81 feet was given for this benchmark by Olsson Associates. The elevations of the soil borings should be considered accurate only to the degree implied by the means and methods used to define them.

The borings were advanced with an ATV-mounted drilling rig utilizing continuous flight hollow-stemmed augers to advance the boreholes, although the wash rotary method of drilling was used in Boring B-4 below a depth of about 7 feet. Representative samples were obtained using thin-walled tube and split-barrel sampling procedures. In the thin-walled tube sampling procedure, a thin-walled, 3-inch OD, seamless steel tube with a sharp cutting edge is pushed hydraulically into the ground to obtain relatively undisturbed samples of cohesive or moderately cohesive soils. In the split-barrel sampling procedure, a standard 2-inch O.D. split-barrel sampling spoon is driven into the ground with an automated 140-pound hammer falling a distance of 30 inches. The number of blows required to advance the sampling spoon the last 12 inches of a normal 18-inch penetration is recorded as the standard penetration resistance value. These values are indicated on the boring logs at the depths of occurrence. The samples were sealed and transported to the laboratory for testing and classification. In addition, bulk samples were obtained from selected borings.

The drill crew prepared a field log for each boring. Each log included visual classifications of the materials encountered during drilling as well as the driller's interpretation of the subsurface conditions between samples. The boring logs included with this report represent an interpretation of the field logs and include modifications based on laboratory observation and tests of the samples.

LOG OF BORING NO. B-01

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CLIENT
Lincoln Public Schools

SITE **North Cotner Blvd and O Street**
Lincoln, NE

PROJECT
LPS District Office Building Development

Approx. Surface Elev.: 1264.5 ft

Depth	Elev.	Description
		6 inches asphaltic cement concrete at surface
		LEAN CLAY, trace sand Light olive brown, stiff Becoming light reddish brown below about 5 ft Becoming sandy below about 8 ft
13	1251.5	**SILTY FINE SAND** Yellowish brown
18	1246.5	**SANDY LEAN CLAY,** trace gravel Olive brown, hard
35	1229.5	Very stiff layer at 34 ft
		BOTTOM OF BORING

DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	TYPE	RECOVERY, in.	SPT - N ** BLOWS / ft.	TESTS WATER CONTENT, %	DRY UNIT WT pcf	UNCONFINED STRENGTH, psf	
			HS						
	CL	1	ST	8		29	91	2500*	
	CL	2	ST	15		28	89	3500*	LL=40% PI=20%
5	CL	3	ST	20		26	86	2500*	LL=37% PI=16%
			HS						
	CL	4	ST	5		18	98	3500*	
10			HS						
	SM	5	ST	17		20	106		
15			HS						
	CL	6	ST	16		18	110	9000+*	
20			HS						
	CL	7	ST	12		19	108	9000*	
25			HS						
	CL	8	ST	17		20	106	9000+*	
30			HS						
35	CL	9	SS	18	19	21			

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

*Calibrated Hand Penetrometer
**CME Automatic Hammer

WATER LEVEL OBSERVATIONS, ft			
WL	▽ N/E	WD	▼ N/E AB
WL	▼ N/E	AB	▽
WL			

Terracon

BORING STARTED	2-3-12		
BORING COMPLETED	2-3-12		
RIG	ATV	FOREMAN	SP
APPROVED	MDR	JOB #	A3125004

LOG OF BORING NO. B-02

CLIENT
Lincoln Public Schools

SITE **North Cotner Blvd and O Street**
Lincoln, NE

PROJECT
LPS District Office Building Development

GRAPHIC LOG	DESCRIPTION Approx. Surface Elev.: 1266 ft	DEPTH, ft.	USCS SYMBOL	SAMPLES: NUMBER	TYPE	RECOVERY, in.	SPT - N ** BLOWS / ft.	TESTS: WATER CONTENT, %	DRY UNIT WT pcf	UNCONFINED STRENGTH, psf	
▨	Vegetation, root zone at surface **LEAN CLAY,** trace sand Light brown, very stiff to hard				HS						
			CL	1	ST	14		17		8500*	
			CL	2	ST	15		19	96	9000+* 4220	
		5	CL	3	ST	8		18	98	9000*	
					HS						
	Becoming reddish brown below about 8 ft		CL	4	ST	12		19	99	9000+*	
		10			HS						
	14 1252		CL SM	5	ST	14		21 18	102		
	SILTY FINE SAND 16 Light reddish brown 1250	15			HS						
	SANDY LEAN CLAY, trace sand Olive brown, very stiff		CL	6	ST	13		19	108	8500*	LL=46% PI=30%
		20			HS						
			CL	7	SS	18	18	20			
		25			HS						
			CL	8	SS	18	16	21			
		30			HS						
			CL	9	SS	18	22	20			
		35			HS						
			CL	10	SS	18	15	22			
		40			HS						
			CL	11	SS	18	14	21			
	Continued Next Page	45									

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

*Calibrated Hand Penetrometer
**CME Automatic Hammer

WATER LEVEL OBSERVATIONS, ft			
WL	▽ N/E	WD	▼
WL	▼		▽
WL			

Terracon

BORING STARTED			2-6-12
BORING COMPLETED			2-6-12
RIG	ATV	FOREMAN	SP
APPROVED	MDR	JOB #	A3125004

LOG OF BORING NO. B-02

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CLIENT
Lincoln Public Schools

SITE **North Cotner Blvd and O Street**
Lincoln, NE

PROJECT
LPS District Office Building Development

DESCRIPTION

SANDY LEAN CLAY, trace sand
Olive brown, very stiff

Becoming olive gray below about 53 ft

80 Hard layer at 79 ft 1186

BOTTOM OF BORING

DEPTH, ft.	USCS SYMBOL	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: RECOVERY, in.	SAMPLES: SPT - N ** BLOWS / ft.	TESTS: WATER CONTENT, %	TESTS: DRY UNIT WT pcf	TESTS: UNCONFINED STRENGTH, psf
			HS					
	CL	12	SS	18	22	18		
50			HS					
	CL	13	SS	18	15	20		
55			HS					
	CL	14	SS	18	16	20		
60			HS					
	CL	15	SS	18	17	19		
65			HS					
	CL	16	SS	18	20	19		
70			HS					
	CL	17	SS	18	17	19		
75			HS					
	CL	18	SS	12	26	18		
80								

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

*Calibrated Hand Penetrometer
**CME Automatic Hammer

WATER LEVEL OBSERVATIONS, ft		
WL	▽ N/E	WD ▼
WL	▼	▽
WL		

Terracon

BORING STARTED	2-6-12		
BORING COMPLETED	2-6-12		
RIG	ATV	FOREMAN	SP
APPROVED	MDR	JOB #	A3125004

LOG OF BORING NO. B-03

Page 1 of 2

CLIENT **Lincoln Public Schools**	
SITE **North Cotner Blvd and O Street** **Lincoln, NE**	PROJECT **LPS District Office Building Development**

GRAPHIC LOG	DESCRIPTION Approx. Surface Elev.: 1266.5 ft	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N ** BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf	
▩	Vegetation, root zone at surface				HS						
▩	**(FILL) LEAN TO FAT CLAY,** trace sand Light olive brown Becoming lean clay below about 3 ft			1	ST	17		27	96	4000*	LL=45% PI=26%
▩				2	ST	3		25		4000*	
▩	Mottled grayish brown, reddish brown below about 5 ft	5		3	ST	9		26	93	5000*	
▩	8 1258.5				HS						
▨	**LEAN CLAY** with sand, trace gravel Reddish brown, very stiff 10 1256.5		CL	4	ST	8		18	99	6000*	LL=45% PI=30%
▨	**SANDY LEAN CLAY,** trace gravel Light olive brown, very stiff	10			HS						
▨			CL	5	ST	11		20	107	9000+*	LL=48% PI=32%
▨		15			HS						
▨			CL	6	SS	18	21	19			
▨		20			HS						
▨	Becoming olive brown below about 23 ft		CL	7	SS	18	18	19			
▨		25			HS						
▨			CL	8	SS	18	17	20			
▨		30			HS						
▨			CL	9	SS	18	19	20			
▨		35			HS						
▨			CL	10	SS	18	16	21			
▨		40			HS						
▨			CL	11	SS	18	18	20			
		45									

Continued Next Page

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

*Calibrated Hand Penetrometer
**CME Automatic Hammer

WATER LEVEL OBSERVATIONS, ft				BORING STARTED		2-5-12
WL	▽ N/E WD	▼ N/E AB		BORING COMPLETED		2-5-12
WL	▼ N/E AB	▽		RIG ATV	FOREMAN	SP
WL				APPROVED MDR	JOB #	A3125004

Terracon

BOREHOLE A3125004 LOGS.GPJ TERRACON.GDT 3/13/12

LOG OF BORING NO. B-03

Page 2 of 2

CLIENT **Lincoln Public Schools**	
SITE **North Cotner Blvd and O Street** **Lincoln, NE**	PROJECT **LPS District Office Building Development**

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES				TESTS		
				NUMBER	TYPE	RECOVERY, in.	SPT - N ** BLOWS / ft.	WATER CONTENT, %	DRY UNIT WT pcf	UNCONFINED STRENGTH, psf
	<u>SANDY LEAN CLAY,</u> trace gravel Olive brown, very stiff				HS					
			CL	12	SS	18	23	19		
		50			HS					
	Becoming dark olive gray below about 54 ft		CL	13	SS	18	23	20		
		55			HS					
			CL	14	SS	18	20	22		
		60			HS					
			CL	15	SS	18	19	20		
		65			HS					
			CL	16	SS	18	23	21		
		70			HS					
			CL	17	SS	18	23	20		
		75			HS					
	80 1186.5		CL	18	SS	18	21	18		
	BOTTOM OF BORING	80								

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

*Calibrated Hand Penetrometer
**CME Automatic Hammer

WATER LEVEL OBSERVATIONS, ft				
WL	▽ N/E	WD	▼ N/E	AB
WL	▼ N/E	AB	▽	
WL				

BORING STARTED			2-5-12
BORING COMPLETED			2-5-12
RIG	ATV	FOREMAN	SP
APPROVED	MDR	JOB #	A3125004

LOG OF BORING NO. B-04

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CLIENT **Lincoln Public Schools**	
SITE **North Cotner Blvd and O Street** **Lincoln, NE**	PROJECT **LPS District Office Building Development**

GRAPHIC LOG	DESCRIPTION Approx. Surface Elev.: 1267 ft	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N ** BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf	
	Vegetation, root zone at surface				WB						
	LEAN CLAY, trace sand Light olive brown, medium stiff		CL	1	ST	9		32	85	2000*	LL=42% PI=23%
	Becoming stiff below about 3 ft		CL	2	ST	13		22	96	4000*	
	Becoming reddish brown, very stiff below about 5 ft	5	CL	3	ST	7		18	105	6500*	
	8 1259				WB						
	SILTY FINE SAND Yellowish brown		SM	4	ST	16		15	99		
		10			WB						
	13 1254										
	SANDY LEAN CLAY, trace gravel Light olive brown, hard to very stiff		CL	5	ST	14		23	99	8000*	
		15			WB						
			CL	6	ST	5		20	105	9000+*	LL=48% PI=30%
		20			WB						
			CL	7	SS	18	26	20			
		25			WB						
			CL	8	SS	18	18	21			
		30			WB						
			CL	9	SS	18	15	22			
		35			WB						
	Becoming olive brown below about 38 ft		CL	10	SS	18	19	20			
		40			WB						
			CL	11	SS	18	15	22			
	Continued Next Page	45									

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

*Calibrated Hand Penetrometer
**CME Automatic Hammer

WATER LEVEL OBSERVATIONS, ft				
WL	▽ N/E	WD	▼ N/E	AB
WL	▼ N/E	AB	▽	
WL				

Terracon

BORING STARTED	2-4-12		
BORING COMPLETED	2-4-12		
RIG	ATV	FOREMAN	SP
APPROVED	MDR	JOB #	A3125004

LOG OF BORING NO. B-04

CLIENT
Lincoln Public Schools

SITE **North Cotner Blvd and O Street**
Lincoln, NE

PROJECT
LPS District Office Building Development

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	TYPE	RECOVERY, in.	SPT - N ** BLOWS / ft.	TESTS WATER CONTENT, %	DRY UNIT WT pcf	UNCONFINED STRENGTH, psf
▨	**SANDY LEAN CLAY,** trace gravel Olive brown, hard to very stiff				WB					
▨			CL	12	SS	18	19	20		
▨		50			WB					
▨	Becoming dark olive gray below about 53 ft		CL	13	SS	18	20	20		
▨		55			WB					
▨			CL	14	SS	18	22	19		
▨		60			WB					
▨			CL	15	SS	18	22	19		
▨		65			WB					
▨			CL	16	SS	18	22	18		
▨		70			WB					
▨			CL	17	SS	18	22	18		
▨		75			WB					
▨	80 1187	80	CL	18	SS		22	18		
	BOTTOM OF BORING									

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

*Calibrated Hand Penetrometer
**CME Automatic Hammer

WATER LEVEL OBSERVATIONS, ft			
WL	∇ N/E WD	▼ N/E AB	
WL	▼ N/E AB	∇	
WL			

BORING STARTED	2-4-12		
BORING COMPLETED	2-4-12		
RIG	ATV	FOREMAN	SP
APPROVED	MDR	JOB #	A3125004

LOG OF BORING NO. B-05

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CLIENT
Lincoln Public Schools

SITE **North Cotner Blvd and O Street**
Lincoln, NE

PROJECT
LPS District Office Building Development

Approx. Surface Elev.: 1264.5 ft

GRAPHIC LOG (depth, ft)	DESCRIPTION	Elev., ft
3	Vegetation, root zone at surface **(FILL) LEAN CLAY,** trace sand Light brown	1261.5
18	**LEAN CLAY,** trace sand Light brown, very stiff Stiff layer at 9 ft Becoming reddish brown below about 13 ft	1246.5
35	**SANDY LEAN CLAY,** trace gravel Light olive brown, very stiff to hard	1229.5
	BOTTOM OF BORING	

DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N ** BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf
			HS					
		1	ST	10		22	97	7500*
	CL	2	ST	8		25	82	4500*
5	CL	3	ST	14		26	84	8000*
			HS					
	CL	4	ST	21		28	85	3500*
10			HS					
	CL	5	ST	13		23	98	4500*
15			HS					
	CL	6	ST	9		21	104	6000*
20			HS					
	CL	7	ST	13		20	106	9000+*
25			HS					
	CL	8	ST	12		21	104	9000+*
30			HS					
35	CL	9	SS	18	23	19		

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

*Calibrated Hand Penetrometer
**CME Automatic Hammer

WATER LEVEL OBSERVATIONS, ft			
WL	▽ N/E	WD ▼ N/E	AB
WL	▽	▽	
WL			

Terracon

BORING STARTED			2-3-12
BORING COMPLETED			2-3-12
RIG	ATV	FOREMAN	SP
APPROVED	MDR	JOB #	A3125004

LOG OF BORING NO. B-06

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CLIENT
Lincoln Public Schools

SITE **North Cotner Blvd and O Street**
Lincoln, NE

PROJECT
LPS District Office Building Development

Approx. Surface Elev.: 1264.5 ft

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf
	6 inches asphaltic cement concrete at surface **LEAN CLAY,** trace sand Light brown, very stiff				HS					
			CL	1	ST	15		22	87	5500*
			CL	2	ST	15		26	85	5000*
		5	CL	3	ST	16		26	87	4500*
					HS					
			CL	4	ST	21		27	91	5000*
		10			HS					
	Becoming reddish brown below about 13 ft		CL	5	ST	9		25	93	5500*
		15			HS					
	18 1246.5									
	SANDY LEAN TO FAT CLAY Yellowish brown, stiff		CL CH	6	ST	19		24	99	3500*
		20			HS					
	22 1242.5									
	SANDY LEAN CLAY, trace gravel Light grayish brown, hard		CL	7	ST	14		19	109	9000+*
		25			HS					
			CL	8	ST	13		20	108	9000+*
	30 1234.5	30								
	BOTTOM OF BORING									

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

*Calibrated Hand Penetrometer
**CME Automatic Hammer

WATER LEVEL OBSERVATIONS, ft			
WL	▽ N/E WD	▼ N/E AB	
WL	▽	▽	
WL			

Terracon

BORING STARTED			2-3-12
BORING COMPLETED			2-3-12
RIG	ATV	FOREMAN	SP
APPROVED	MDR	JOB #	A3125004

LOG OF BORING NO. B-07

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CLIENT
Lincoln Public Schools

SITE **North Cotner Blvd and O Street**
Lincoln, NE

PROJECT
LPS District Office Building Development

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES				TESTS			
	Approx. Surface Elev.: 1262.5 ft			NUMBER	TYPE	RECOVERY, in.	SPT - N BLOWS / ft.	WATER CONTENT, %	DRY UNIT WT pcf	UNCONFINED STRENGTH, psf	
▩	6 inches asphaltic cement concrete at surface 3 **(FILL) FAT CLAY,** trace sand 1259.5 Olive brown				HS						
				1	ST	7		22	102	8500*	LL=56% PI=36%
▨	**LEAN CLAY,** trace sand Light brown, stiff		CL	2	ST	10		24	95	4000*	LL=48% PI=29%
		5	CL	3	ST	25		27	91	4000* 3290	
					HS						
			CL	4	ST	14		27	92	4000* 2840	
		10			HS						
	Becoming reddish brown below about 13 ft		CL	5	ST	15		25	95	3500* 2270	
		15			HS						
			CL	6	ST	8		23	100	4500*	
		20			HS						
	23 1239.5										
▧	**SANDY LEAN CLAY,** trace gravel 25 Olive brown, very stiff 1237.5		CL	7	ST	18		20	109	9000+* 6170	
	BOTTOM OF BORING	25									

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

*Calibrated Hand Penetrometer
**CME Automatic Hammer

WATER LEVEL OBSERVATIONS, ft		
WL	▽ N/E	WD ▼
WL	▼	▼
WL		

BORING STARTED			2-7-12
BORING COMPLETED			2-7-12
RIG	ATV	FOREMAN	SP
APPROVED	MDR	JOB #	A3125004

LOG OF BORING NO. B-08

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CLIENT
Lincoln Public Schools

SITE **North Cotner Blvd and O Street**
Lincoln, NE

PROJECT
LPS District Office Building Development

GRAPHIC LOG	DESCRIPTION Approx. Surface Elev.: 1260.5 ft	DEPTH, ft.	USCS SYMBOL	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: RECOVERY, in.	SAMPLES: SPT - N BLOWS / ft.	TESTS: WATER CONTENT, %	TESTS: DRY UNIT WT pcf	TESTS: UNCONFINED STRENGTH, psf
	6 inches asphaltic cement concrete at surface				HS					
	3 — 1257.5 **FAT CLAY,** trace sand		CL CH	1	ST	10		32	84	5500*
	Dark brown to olive brown, very stiff to stiff Slightly organic to about 2 ft		CL CH	2	ST	11		23	95	3000*
	LEAN CLAY, trace sand Light brown, stiff	5	CL	3	ST	8		25	91	3000*
					HS					
			CL	4	ST	9		28	90	3500* 2400
		10			HS					
	Becoming reddish brown below about 13 ft		CL	5	ST	15		24	94	3000*
		15			HS					
			CL	6	ST	26		23 25	98 98	3500* 1500*
	23 — 1237.5	20			HS					
	SANDY LEAN CLAY, trace gravel Olive brown, very stiff to hard		CL	7	SS	15		19	108	7500* 4340
		25			HS					
	30 — 1230.5		CL	8	ST	10		19	106	9000+*
	BOTTOM OF BORING	30								

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

*Calibrated Hand Penetrometer
**CME Automatic Hammer

WATER LEVEL OBSERVATIONS, ft		
WL	▽ N/E	WD ▼
WL	▼	▼
WL		

Terracon

BORING STARTED			2-9-12
BORING COMPLETED			2-9-12
RIG	ATV	FOREMAN	SP
APPROVED	MDR	JOB #	A3125004

BOREHOLE A3125004 LOGS.GPJ TERRACON.GDT 3/13/12

LOG OF BORING NO. B-09

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CLIENT
Lincoln Public Schools

SITE **North Cotner Blvd and O Street**
Lincoln, NE

PROJECT
LPS District Office Building Development

Approx. Surface Elev.: 1258.5 ft

GRAPHIC LOG	DESCRIPTION	Depth, ft	Elev., ft
▨	6 inches asphaltic cement concrete at surface **FAT CLAY,** trace sand Dark brown, very stiff	3	1255.5
▨	**LEAN CLAY,** trace sand Light brown, very stiff to stiff Becoming reddish brown below about 13 ft	18	1240.5
▨	**LEAN CLAY** with sand Olive brown, medium stiff	20	1238.5
▨	**SANDY LEAN CLAY,** trace gravel Olive brown, very stiff to hard	30	1228.5
	BOTTOM OF BORING		

DEPTH, ft.	USCS SYMBOL	SAMPLES				TESTS			
		NUMBER	TYPE	RECOVERY, in.	SPT - N BLOWS / ft.	WATER CONTENT, %	DRY UNIT WT pcf	UNCONFINED STRENGTH, psf	
			HS						
	CH	1	ST	6		21		7000*	LL=62% PI=39%
	CL CH	2	ST	8		24	96	5000* 4000	
5	CL	3	ST	15		25	94	3500*	
			HS						
	CL	4	ST	17		29	94	2000*	
10			HS						
	CL	5	ST	13		24	96	4000* 3220	
15			HS						
	CL	6	ST	22		24	100	2000* 1320	
20			HS						
	CL	7	ST	14		20	106	8720	
25			HS						
30	CL	8	ST	13		20	109	9000+* 6780	

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

*Calibrated Hand Penetrometer
**CME Automatic Hammer

WATER LEVEL OBSERVATIONS, ft			
WL	▽ N/E	WD ▼	
WL	▼	▽	
WL			

Terracon

BORING STARTED			2-9-12
BORING COMPLETED			2-9-12
RIG	ATV	FOREMAN	SP
APPROVED	MDR	JOB #	A3125004

LOG OF BORING NO. B-10

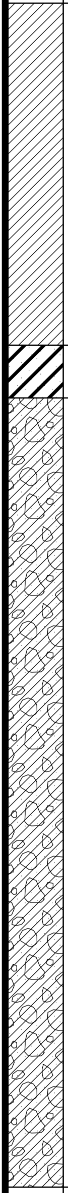
Page 1 of 2

CLIENT
Lincoln Public Schools

SITE **North Cotner Blvd and O Street**
Lincoln, NE

PROJECT
LPS District Office Building Development

GRAPHIC LOG



DESCRIPTION

Approx. Surface Elev.: 1250 ft

8 inches asphaltic cement concrete at surface
LEAN CLAY, trace sand
Light brown, very stiff to stiff

Becoming reddish brown below about 6 ft

13 1237

SANDY LEAN TO FAT CLAY
Olive brown, very stiff
15 1235

SANDY LEAN CLAY, trace gravel
Olive brown, very stiff

45 1205

Continued Next Page

DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N ** BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf	
			HS						
	CL CH	1	ST	5		21		7000*	
	CL	2	ST	17		16	101	2500*	LL=41% PI=17%
5	CL	3	ST	12		28	90	3000*	
			HS						
	CL	4	ST	18		23	96	5500* 1380	
10			HS						
	CL CH	5	ST	13		23	102	7500* 4480	
15			HS						
	CL	6	ST	11		20	107	9000+* 6580	
20			HS						
	CL	7	SS	18	23	19			
25			HS						
	CL	8	SS	18	19	19			
30			HS						
	CL	9	SS	18	16	20			
35			HS						
	CL	10	SS	18	19	19			
40			HS						
	CL	11	SS	18	22	18			
45									

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

*Calibrated Hand Penetrometer
**CME Automatic Hammer

WATER LEVEL OBSERVATIONS, ft		
WL	▽ N/E	WD ▼
WL	▼	▼
WL		

Terracon

BORING STARTED			2-9-12
BORING COMPLETED			2-9-12
RIG	ATV	FOREMAN	SP
APPROVED	MDR	JOB #	A3125004

LOG OF BORING NO. B-10

Page 2 of 2

CLIENT **Lincoln Public Schools**	
SITE **North Cotner Blvd and O Street** **Lincoln, NE**	PROJECT **LPS District Office Building Development**

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES				TESTS			
				NUMBER	TYPE	RECOVERY, in.	SPT - N ** BLOWS / ft.	WATER CONTENT, %	DRY UNIT WT pcf	UNCONFINED STRENGTH, psf	
	BOTTOM OF BORING										

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

*Calibrated Hand Penetrometer
**CME Automatic Hammer

WATER LEVEL OBSERVATIONS, ft			
WL	▽ N/E	WD	▼
WL	▼		▽
WL			

Terracon

BORING STARTED			2-9-12
BORING COMPLETED			2-9-12
RIG	ATV	FOREMAN	SP
APPROVED	MDR	JOB #	A3125004

LOG OF BORING NO. B-11

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CLIENT **Lincoln Public Schools**

SITE **North Cotner Blvd and O Street**
Lincoln, NE

PROJECT **LPS District Office Building Development**

Approx. Surface Elev.: 1253.5 ft

Depth, ft	Description	Elev., ft
	6-inches asphaltic cement concrete at surface	
3	**FAT CLAY,** trace sand Dark olive brown, very stiff	1250.5
	LEAN CLAY, trace sand Light grayish brown, very stiff to stiff Becoming reddish brown, sandy below about 13 ft	
18	**SANDY LEAN CLAY,** trace gravel Olive brown, very stiff to hard	1235.5
30	**BOTTOM OF BORING**	1223.5

		SAMPLES				TESTS			
USCS SYMBOL	NUMBER	TYPE	RECOVERY, in.	SPT - N ** BLOWS / ft.	WATER CONTENT, %	DRY UNIT WT pcf	UNCONFINED STRENGTH, psf	
		HS						
CH	1	ST	7		24	96	5500*	LL=58% PI=39%
CL	2	ST	9		25	94	5000*	
CL	3	ST	11		26	91	3000*	
		HS						
CL	4	ST	11		20	103	4150	
		HS						
CL	5	ST	17		19	103	4500* 3170	
		HS						
CL	6	ST	15		20	109	8000*	
		HS						
CL	7	ST	12		19	111	9280	
		HS						
CL	8	SS	18	18	19			

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

*Calibrated Hand Penetrometer
**CME Automatic Hammer

WATER LEVEL OBSERVATIONS, ft			
WL	∇ N/E	WD	▼
WL	▼		∇
WL			

Terracon

BORING STARTED	2-9-12		
BORING COMPLETED	2-9-12		
RIG	ATV	FOREMAN	SP
APPROVED	MDR	JOB #	A3125004

BOREHOLE A3125004 LOGS.GPJ TERRACON.GDT 3/13/12

LOG OF BORING NO. B-12

Page 1 of 1

CLIENT
Lincoln Public Schools

SITE **North Cotner Blvd and O Street**
Lincoln, NE

PROJECT
LPS District Office Building Development

Approx. Surface Elev.: 1260 ft

Depth, ft	DESCRIPTION	Elev.
5	6 inches asphaltic cement concrete at surface **(FILL) LEAN CLAY,** trace sand Olive gray Becoming dark gray below about 4 ft	1255
7	**FAT CLAY,** trace sand Olive gray, very stiff	1253
23	**LEAN CLAY,** trace sand Light grayish brown, stiff Becoming reddish brown, very stiff below about 18 ft	1237
30	**SANDY LEAN CLAY,** trace gravel Olive brown, stiff to very stiff	1230
	BOTTOM OF BORING	

		SAMPLES				TESTS			
DEPTH, ft.	USCS SYMBOL	NUMBER	TYPE	RECOVERY, in.	SPT - N BLOWS / ft.	WATER CONTENT, %	DRY UNIT WT pcf	UNCONFINED STRENGTH, psf	
			HS						
		1	ST	7		27	93	5000*	
		2	ST	14		31	89	3000*	
5	CH	3	ST	8		26	96	5000*	LL=59% PI=40%
			HS						
	CL	4	ST	18		28	91	2500*	
10			HS						
	CL	5	ST	18		27	91	3500* 1880	
15			HS						
	CL	6	ST	11		22	97	6000*	
20			HS						
	CL	7	ST	19		24	100	4000* 2460	
25			HS						
	CL	8	ST	14		19	109	9580	
30									

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

*Calibrated Hand Penetrometer
**CME Automatic Hammer

WATER LEVEL OBSERVATIONS, ft		
WL	▽ N/E	WD ▼
WL	▼	▼
WL		

BORING STARTED	2-9-12
BORING COMPLETED	2-9-12
RIG ATV	FOREMAN SP
APPROVED MDR	JOB # A3125004

LOG OF BORING NO. B-13

CLIENT
Lincoln Public Schools

SITE **North Cotner Blvd and O Street**
Lincoln, NE

PROJECT
LPS District Office Building Development

Approx. Surface Elev.: 1250 ft

Depth	DESCRIPTION	Elev.
	6 inches asphaltic cement concrete at surface	
3	**(FILL) LEAN CLAY,** trace sand Olive gray	1247
5	**FAT CLAY,** trace sand Olive brown, very stiff	1245
	LEAN CLAY, trace sand Light olive brown, stiff Becoming reddish brown, very stiff below about 13 ft	
18	**SANDY LEAN CLAY,** trace gravel ▼ Olive gray, hard to very stiff ▽ Stiff layer at 34 ft	1232
40	**BOTTOM OF BORING**	1210

DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N ** BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf
			HS					
		1	ST	14		30	91	2000*
	CH	2	ST	17		24	97	4500* 3030
5	CL	3	ST	26		27	93	3500* 1560
			HS					
	CL	4	ST	19		26	95	3500* 2210
10			HS					
	CL	5	ST	18		24	97	5000*
15			HS					
	CL	6	ST	20		25	101	2500* 1520
20			HS					
	CL	7	ST	20		20	108	9270
25			HS					
	CL	8	SS	18	15	21		
30			HS					
	CL	9	SS	18	13	20		
35			HS					
40	CL	10	SS	18	15	23		

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

*Calibrated Hand Penetrometer
**CME Automatic Hammer

WATER LEVEL OBSERVATIONS, ft			
WL	▽ 28 WS	▼ 19 AB	
WL	▼	▼	
WL			

Terracon

BORING STARTED	2-9-12		
BORING COMPLETED	2-9-12		
RIG	ATV	FOREMAN	SP
APPROVED	MDR	JOB #	A3125004

LOG OF BORING NO. B-14

Page 1 of 1

CLIENT **Lincoln Public Schools**	
SITE **North Cotner Blvd and O Street** **Lincoln, NE**	PROJECT **LPS District Office Building Development**

GRAPHIC LOG	DESCRIPTION Approx. Surface Elev.: 1243.5 ft	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	TYPE	RECOVERY, in.	SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	DRY UNIT WT pcf	UNCONFINED STRENGTH, psf
	6 inches asphaltic cement concrete at surface				HS					
	3 **FAT CLAY,** trace sand 1240.5		CH	1	ST	14		31	85	6000* 1660
	Dark brown, stiff		CL CH	2	ST	9		25	99	2000*
	LEAN CLAY, trace sand Olive gray, stiff	5	CL CH	3	ST	10		26	98	2940
	8 1235.5				HS					
	LEAN CLAY, trace sand 10 Light olive brown, stiff 1233.5		CL	4	ST	13		28	95	2910
	BOTTOM OF BORING	10								

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

*Calibrated Hand Penetrometer
**CME Automatic Hammer

WATER LEVEL OBSERVATIONS, ft		
WL	▽ N/E	WD ▼
WL	▼	▼
WL		

Terracon

BORING STARTED			2-10-12
BORING COMPLETED			2-10-12
RIG	ATV	FOREMAN	SP
APPROVED	MDR	JOB #	A3125004

LOG OF BORING NO. B-15

Page 1 of 1

CLIENT	**Lincoln Public Schools**
SITE	**North Cotner Blvd and O Street** **Lincoln, NE**
PROJECT	**LPS District Office Building Development**

GRAPHIC LOG	DESCRIPTION Approx. Surface Elev.: 1253.5 ft	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf
	6 inches asphaltic cement concrete at surface				HS					
	3 **(FILL) LEAN CLAY,** trace sand — 1250.5 Olive brown			1	ST	15		26	98	1500*
	LEAN TO FAT CLAY, trace sand Olive gray, very stiff		CL CH	2	ST	10		28	91	5500* 4370
		5	CL CH	3	ST	7		25	95	5500*
	8 — 1245.5				HS					
	LEAN CLAY, trace sand Olive gray, stiff 10 — 1243.5		CL	4	ST	23		29	87	3000* 520
	BOTTOM OF BORING	10								

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

*Calibrated Hand Penetrometer
**CME Automatic Hammer

WATER LEVEL OBSERVATIONS, ft		
WL	▽ N/E	WD ▼
WL	▼	▽
WL		

BORING STARTED			2-10-12
BORING COMPLETED			2-10-12
RIG	ATV	FOREMAN	SP
APPROVED	MDR	JOB #	A3125004

BOREHOLE A3125004 LOGS.GPJ TERRACON.GDT 3/13/12

LOG OF BORING NO. B-16

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CLIENT

Lincoln Public Schools

SITE **North Cotner Blvd and O Street**
Lincoln, NE

PROJECT
LPS District Office Building Development

GRAPHIC LOG	DESCRIPTION Approx. Surface Elev.: 1255 ft	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf
▨	Vegetation, root zone at surface				HS					
▨	**FAT CLAY,** trace sand Brown, stiff		CH	1	ST	11		29	87	3000*
	3 — 1252									
▨	**LEAN CLAY,** trace sand Light brown, medium stiff		CL	2	ST	12		29	91	1500*
▨		5	CL	3	ST	12		30	90	1750
▨					HS					
▨	Becoming reddish brown below about 8 ft		CL	4	ST	13		28	84	2500*
	10 — 1245	10								
	BOTTOM OF BORING									

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

*Calibrated Hand Penetrometer
**CME Automatic Hammer

WATER LEVEL OBSERVATIONS, ft		
WL	▽ N/E WD ▼	
WL	▼	▼
WL		

BORING STARTED	2-10-12		
BORING COMPLETED	2-10-12		
RIG	ATV	FOREMAN	SP
APPROVED	MDR	JOB #	A3125004

LOG OF BORING NO. B-17

Page 1 of 1

CLIENT
Lincoln Public Schools

SITE **North Cotner Blvd and O Street**
Lincoln, NE

PROJECT
LPS District Office Building Development

GRAPHIC LOG	DESCRIPTION Approx. Surface Elev.: 1265 ft	DEPTH, ft.	USCS SYMBOL	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: RECOVERY, in.	SAMPLES: SPT - N ** BLOWS / ft.	TESTS: WATER CONTENT, %	TESTS: DRY UNIT WT pcf	TESTS: UNCONFINED STRENGTH, psf
	Vegetation, root zone at surface **LEAN CLAY,** trace sand Light brown, very stiff				HS					
			CL	1	ST	8		26	89	5000*
			CL	2	ST	9		25	92	5000*
		5	CL	3	ST	17		25	95	4500*
					HS					
	Becoming reddish brown, hard below about 8 ft		CL	4	ST	7		17	105	9000*
	13 1252	10			HS					
	LEAN TO FAT CLAY with sand Light grayish brown		CL CH	5	ST	6		24	98	
	18 1247	15			HS					
	SILTY FINE SAND Light brown, dense		SM	6	ST	6		19		
	▽	20			HS					
			SM	7	SS	18	31	21		
		25			HS					
			SM	8	SS	18	40	25		
		30			HS					
	Becoming Fine to Medium Sand below about 33 ft 35 1230		SP	9	SS	18	37	22		
	BOTTOM OF BORING	35								

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

*Calibrated Hand Penetrometer
**CME Automatic Hammer

WATER LEVEL OBSERVATIONS, ft		
WL	▽ 23 WS	▼ AB
WL	▼	▼
WL		

Terracon

BORING STARTED			2-3-12
BORING COMPLETED			2-3-12
RIG	ATV	FOREMAN	SP
APPROVED	MDR	JOB #	A3125004

LOG OF BORING NO. B-18

Page 1 of 1

CLIENT
Lincoln Public Schools

SITE **North Cotner Blvd and O Street**
Lincoln, NE

PROJECT
LPS District Office Building Development

GRAPHIC LOG	DESCRIPTION Approx. Surface Elev.: 1263.5 ft	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf
▩	Vegetation, root zone at surface **(FILL) LEAN TO FAT CLAY,** trace sand Olive brown				HS					
				1	ST	22		23	102	3000*
	3 1260.5									
▨	**LEAN CLAY,** trace sand Light brown, stiff		CL	2	ST	19		28	89	2010
	Becoming reddish brown, very stiff to stiff below about 6 ft	5	CL	3	ST	20		28 26	90 91	5500*
					HS					
			CL	4	ST	10		22	102	3000* 2610
	10 1253.5	10								
	BOTTOM OF BORING									

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

*Calibrated Hand Penetrometer
**CME Automatic Hammer

WATER LEVEL OBSERVATIONS, ft		
WL	▽ N/E WD ▼	
WL	▼	▽
WL		

Terracon

BORING STARTED	2-10-12
BORING COMPLETED	2-10-12
RIG ATV	FOREMAN SP
APPROVED MDR	JOB # A3125004

LOG OF BORING NO. B-19

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CLIENT
Lincoln Public Schools

SITE **North Cotner Blvd and O Street**
Lincoln, NE

PROJECT
LPS District Office Building Development

Approx. Surface Elev.: 1267 ft

GRAPHIC LOG	DESCRIPTION		DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf
	Vegetation, root zone at surface					HS					
	(FILL) LEAN TO FAT CLAY, trace sand				1	ST	18		21	100	8000*
3	Olive brown	1264									
	LEAN CLAY, trace sand Reddish brown, stiff to very stiff Becoming sandy below about 5 ft			CL	2	ST	17		20	91	3500*
			5	CL	3	ST	15		17	100	4500*
						HS					
				CL	4	ST	16		15	107	3000* 1170
10		1257	10								
	BOTTOM OF BORING										

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

*Calibrated Hand Penetrometer
**CME Automatic Hammer

WATER LEVEL OBSERVATIONS, ft		
WL	▽ N/E	WD ▼
WL	▼	▽
WL		

Terracon

BORING STARTED			2-10-12
BORING COMPLETED			2-10-12
RIG	ATV	FOREMAN	SP
APPROVED	MDR	JOB #	A3125004

BOREHOLE A3125004 LOGS.GPJ TERRACON.GDT 3/13/12

APPENDIX B
LABORATORY TESTING

Laboratory Testing

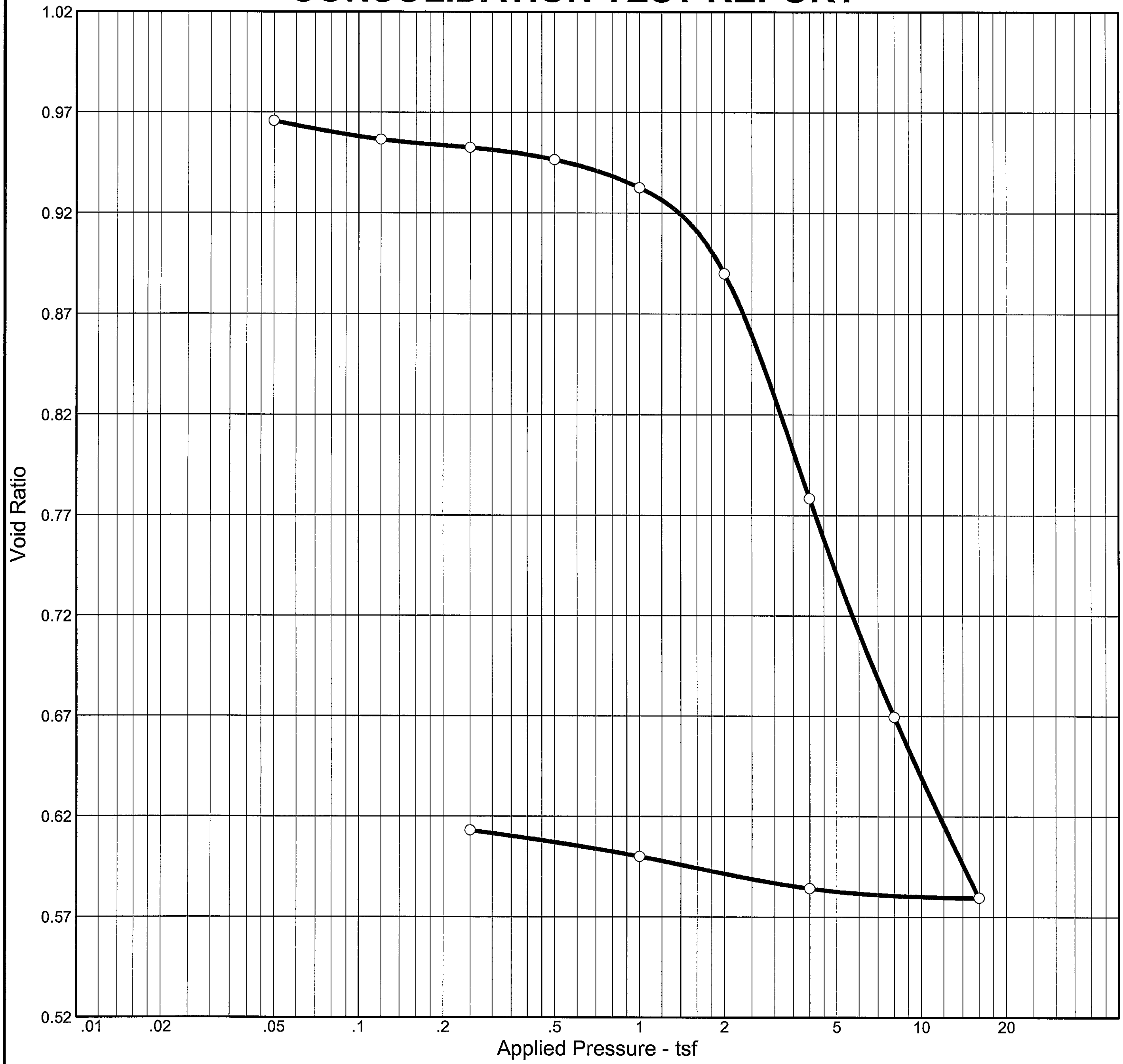
In the laboratory, moisture content tests were performed on the recovered samples. The dry unit weight and unconfined compressive strength of intact, thin-walled tube samples were determined. Hand penetrometer tests were also performed to estimate the consistency of select cohesive samples. The results of these laboratory tests are shown on the boring logs in Appendix A at their corresponding sample depths.

Atterberg limits tests were performed on fourteen samples obtained from the site. Atterberg limits tests are used to classify fine-grained soils, and can be correlated with parameters used evaluate compressibility, stress history, and the expansive properties of soils. Results of the Atterberg limits tests are reported at the corresponding depths on the boring logs.

One-dimensional consolidation tests were performed on two thin-walled tube samples (Sample 3 from Boring B-1, and Sample 2 from Boring B-10), and swell tests were performed on three thin-walled tube samples (Sample 6 from Boring B-2, Sample 4 from Boring B-3, and Sample 1 from Boring B-11). A standard Proctor test and CBR test were performed on a composite sample of the brown / light brown lean clay. The results of these tests are included in Appendix B.

The samples were classified in the laboratory based on visual observation, texture, plasticity, and the laboratory testing described above. The descriptions of the soils indicated on the boring logs are in general accordance with the General Notes in Appendix C and the Unified Soil Classification System (USCS). A summary of the USCS is included in Appendix C.

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	C_r	Swell Press. (tsf)	Swell %	e_o
Sat.	Moist.											
73.2 %	26.1 %	85.9	37	16	2.706		1.08	0.30	0.02			0.966

MATERIAL DESCRIPTION	USCS	AASHTO
Brown and gray Lean clay		

Project No. A3125004 **Client:** Lincoln Publc Schools

Project: LPS District Office Building Development
Lincoln, NE

Source: B-1 **Sample No.:** S-3 **Elev./Depth:** 5-7'

Terracon, Inc.

Cincinnati, Ohio

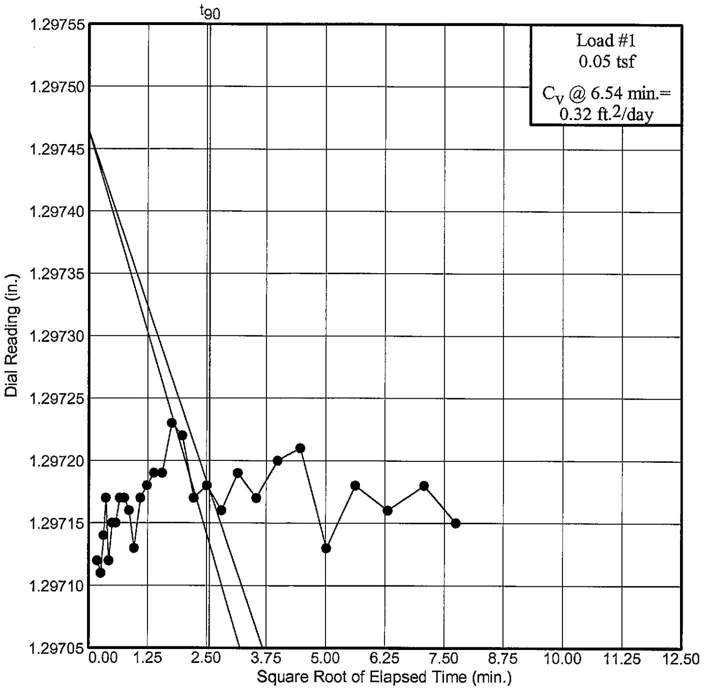
Remarks:

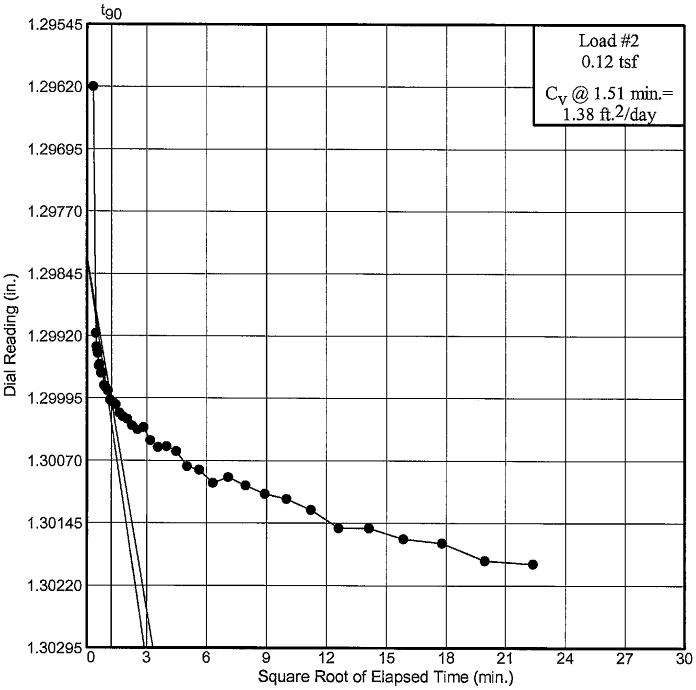
Lab No. 1983

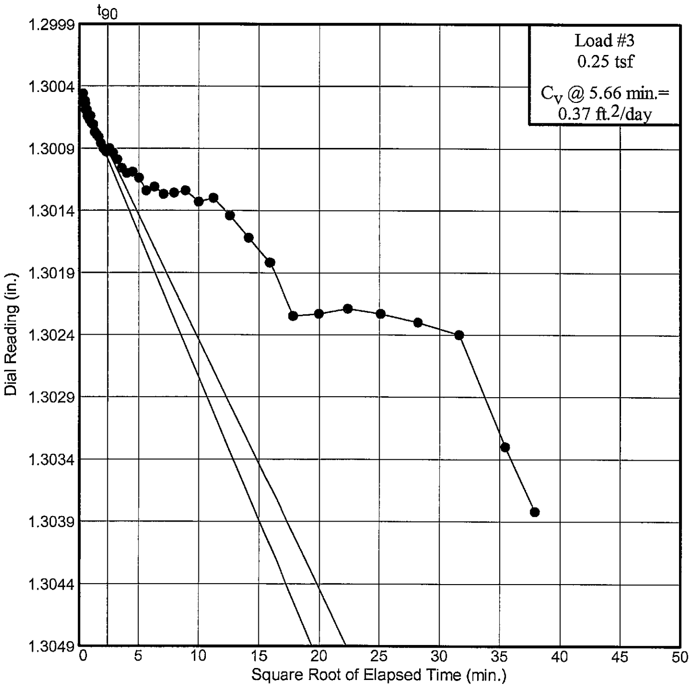
Figure

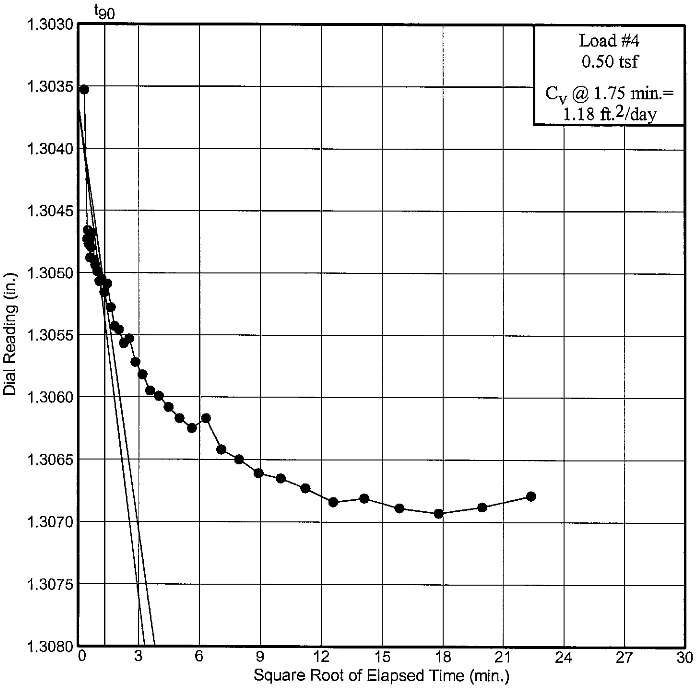
Dial Reading vs. Time

Project No.: A3125004
Project: LPS District Office Building Development
Lincoln, NE
Source: B-1 Sample No.: S-3 Elev./Depth: 5-7'









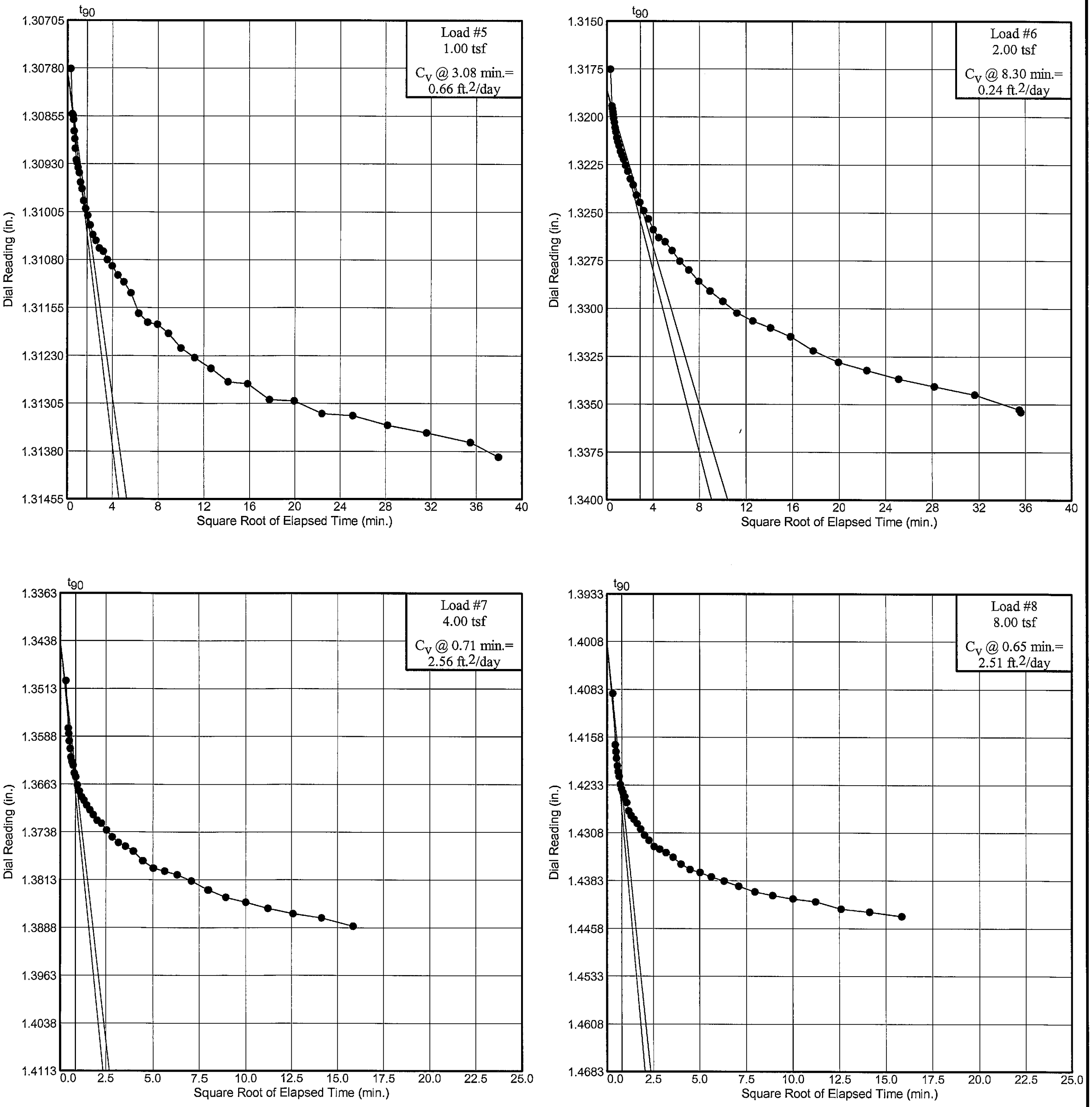
Terracon, Inc.

Cincinnati, Ohio

Figure

Dial Reading vs. Time

Project No.: A3125004
Project: LPS District Office Building Development
Lincoln, NE
Source: B-1 **Sample No.:** S-3 **Elev./Depth:** 5-7'



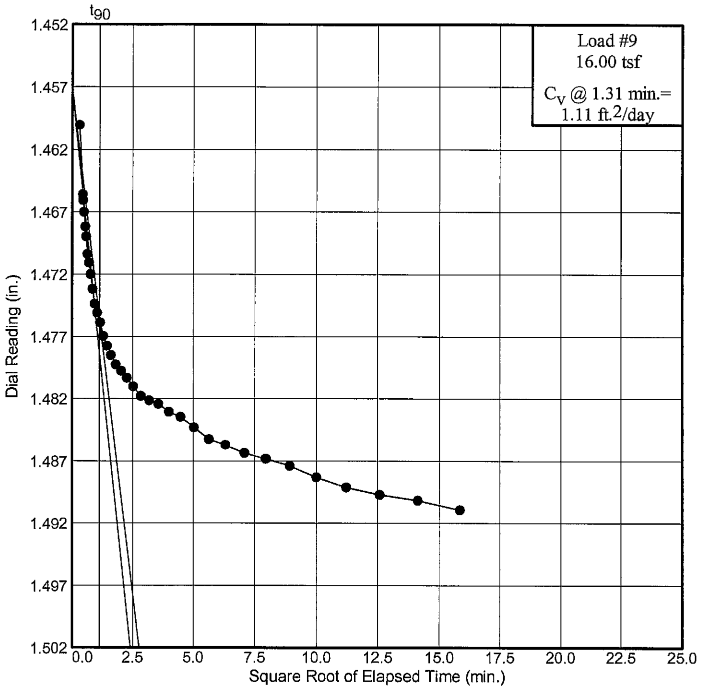
Terracon, Inc.

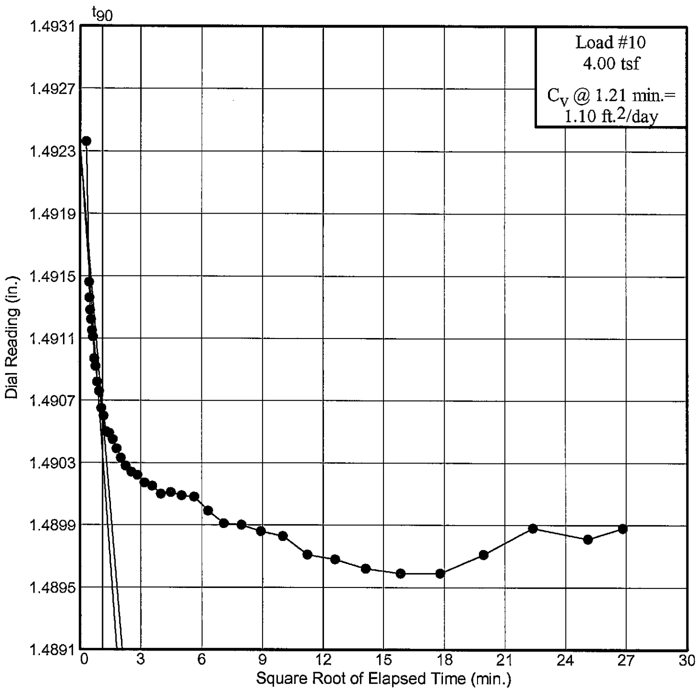
Cincinnati, Ohio

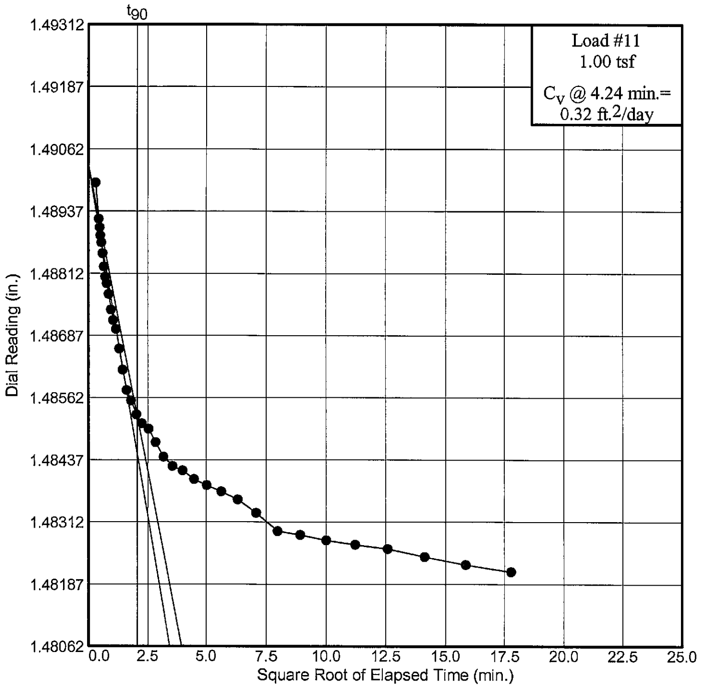
Figure

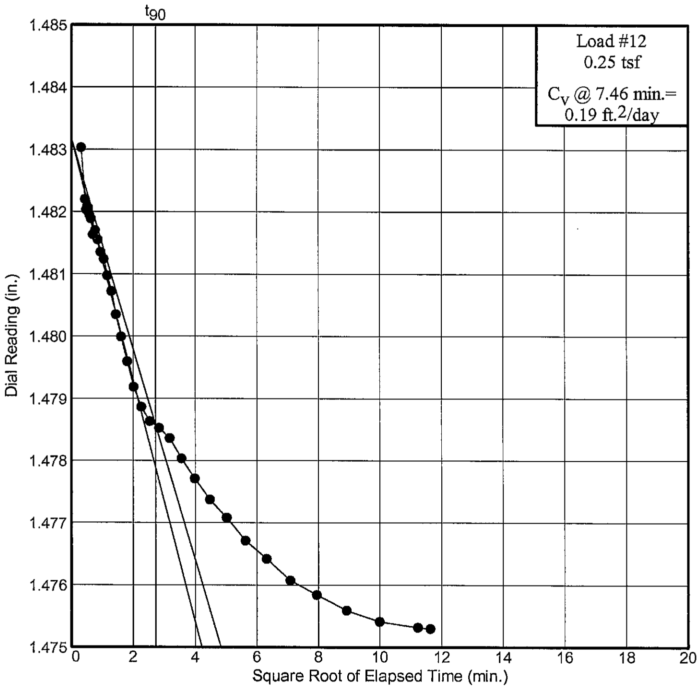
Dial Reading vs. Time

Project No.: A3125004
Project: LPS District Office Building Development
Lincoln, NE
Source: B-1 **Sample No.:** S-3 **Elev./Depth:** 5-7'







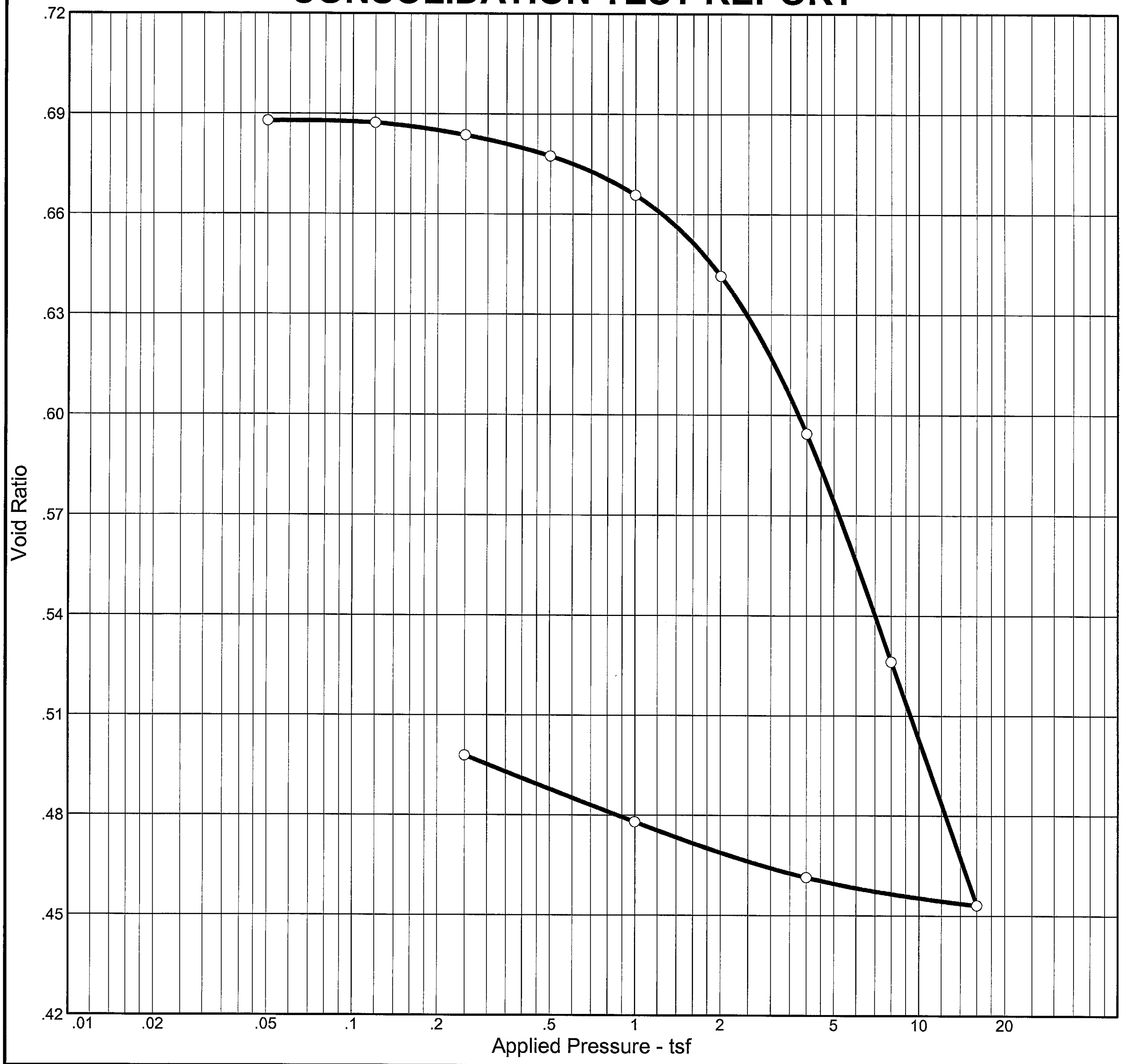


Terracon, Inc.

Cincinnati, Ohio

Figure

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	C_r	Swell Press. (tsf)	Swell %	e_o
Sat.	Moist.											
62.4 %	15.8 %	100.6	41	17	2.721		2.95	0.24	0.02			0.688

MATERIAL DESCRIPTION	USCS	AASHTO
Brown and gray Lean clay		

Project No. A3125004 **Client:** Lincoln Publc Schools

Project: LPS District Office Building Development
Lincoln, NE

Source: B-10 **Sample No.:** S-2 **Elev./Depth:** 3-5'

Terracon, Inc.

Cincinnati, Ohio

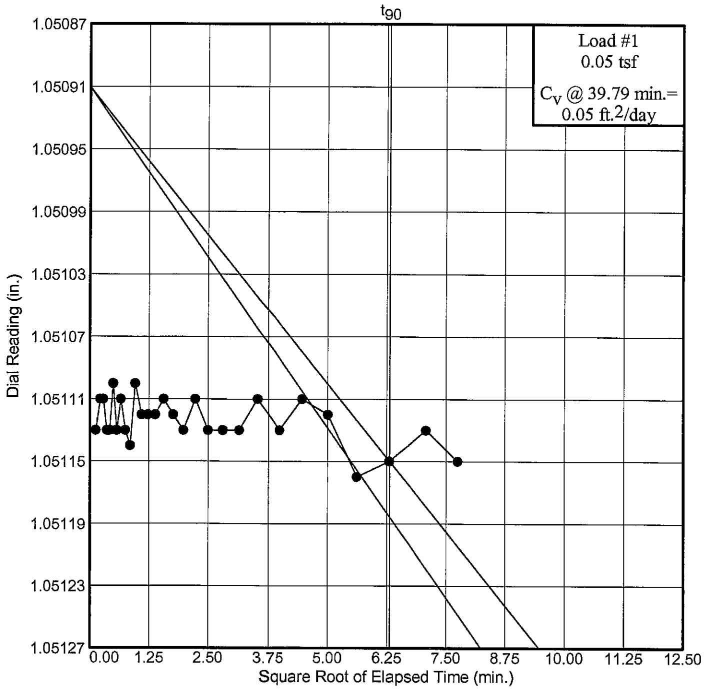
Remarks:

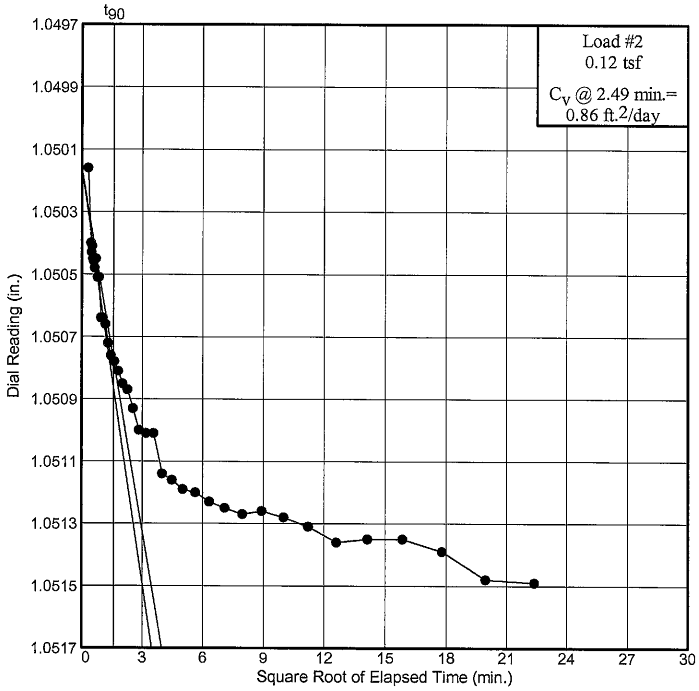
Lab No. 1984

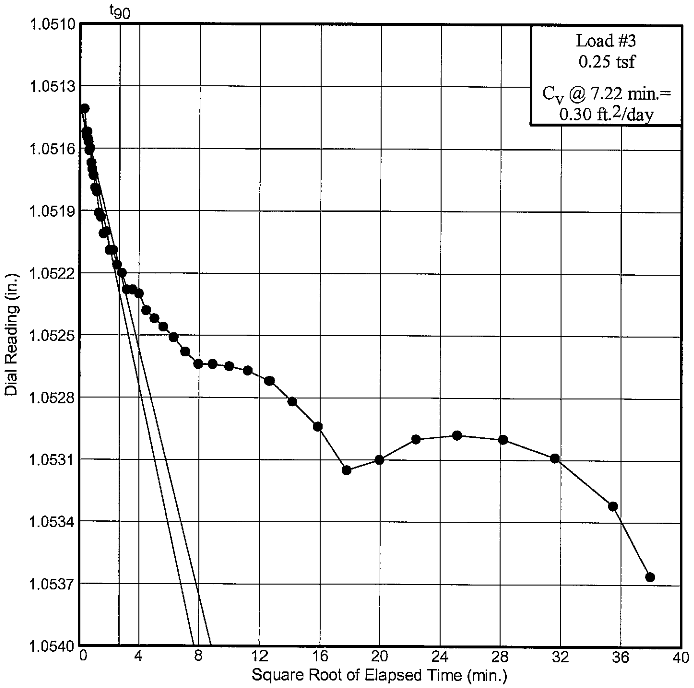
Figure

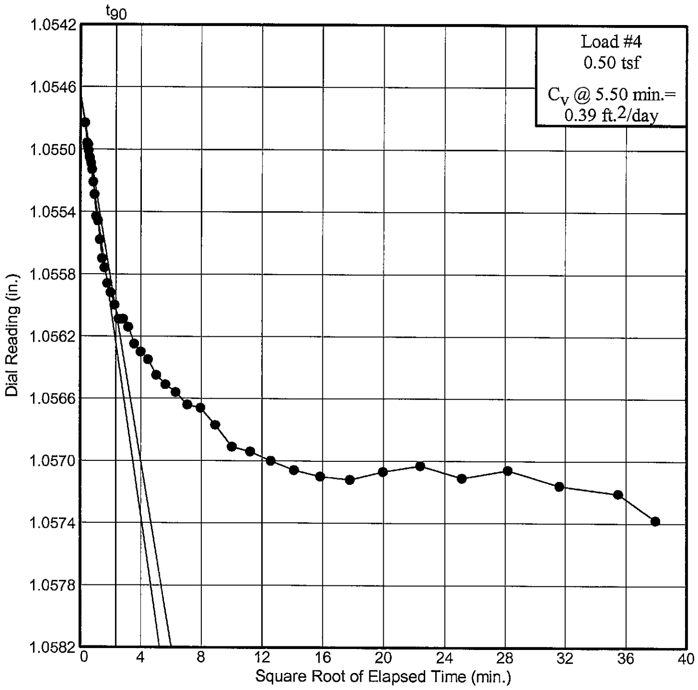
Dial Reading vs. Time

Project No.: A3125004
Project: LPS District Office Building Development
Lincoln, NE
Source: B-10 Sample No.: S-2 Elev./Depth: 3-5'









Terracon, Inc.

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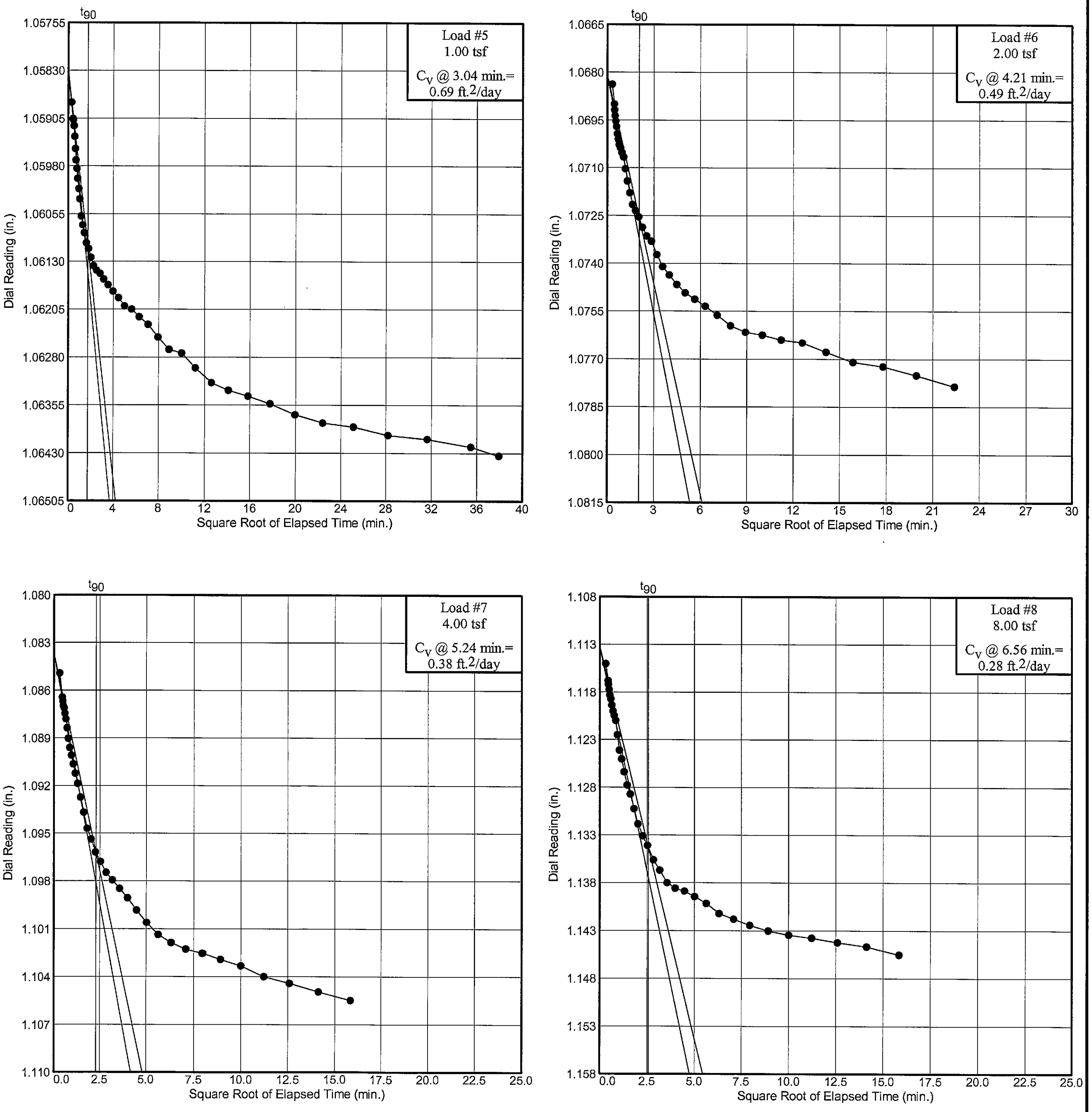
Figure

Dial Reading vs. Time

Project No.: A3125004
Project: LPS District Office Building Development
Lincoln, NE
Source: B-10 Sample No.: S-2 Elev./Depth: 3-5'



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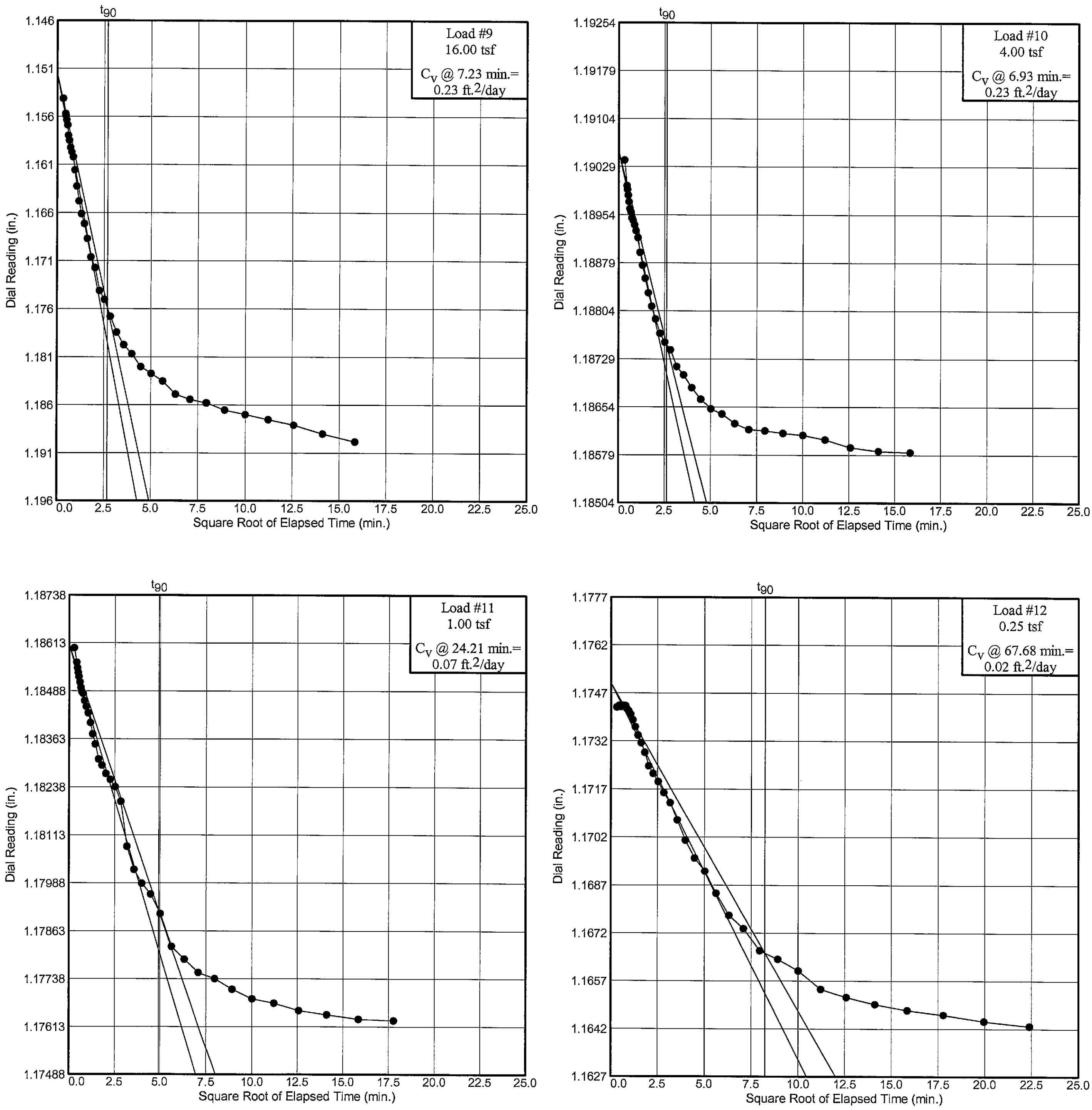
Cincinnati, Ohio

Dial Reading vs. Time

Project No.: A3125004
Project: LPS District Office Building Development
Lincoln, NE
Source: B-10 **Sample No.:** S-2 **Elev./Depth:** 3-5'



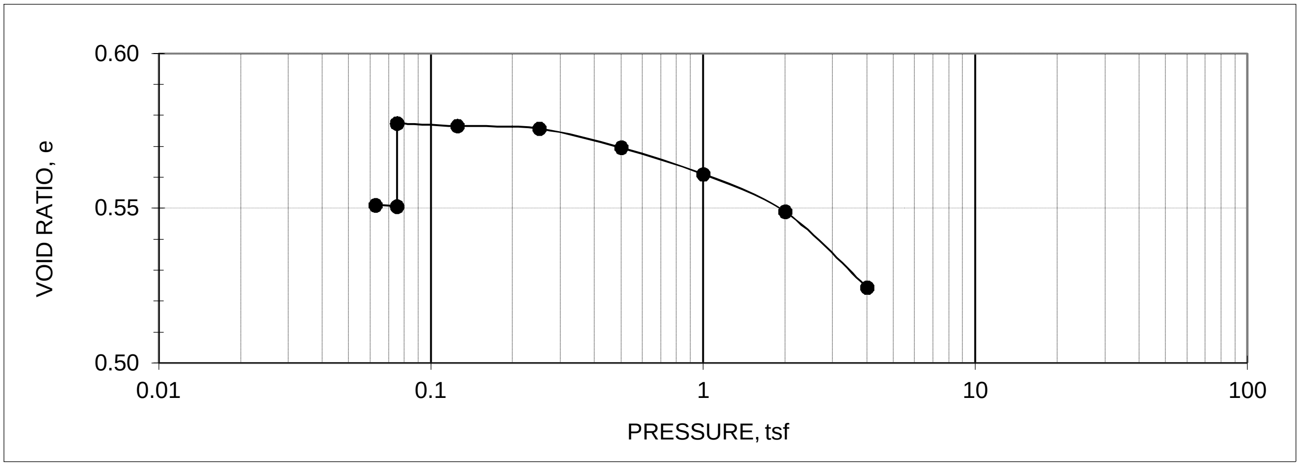
Terracon, Inc.

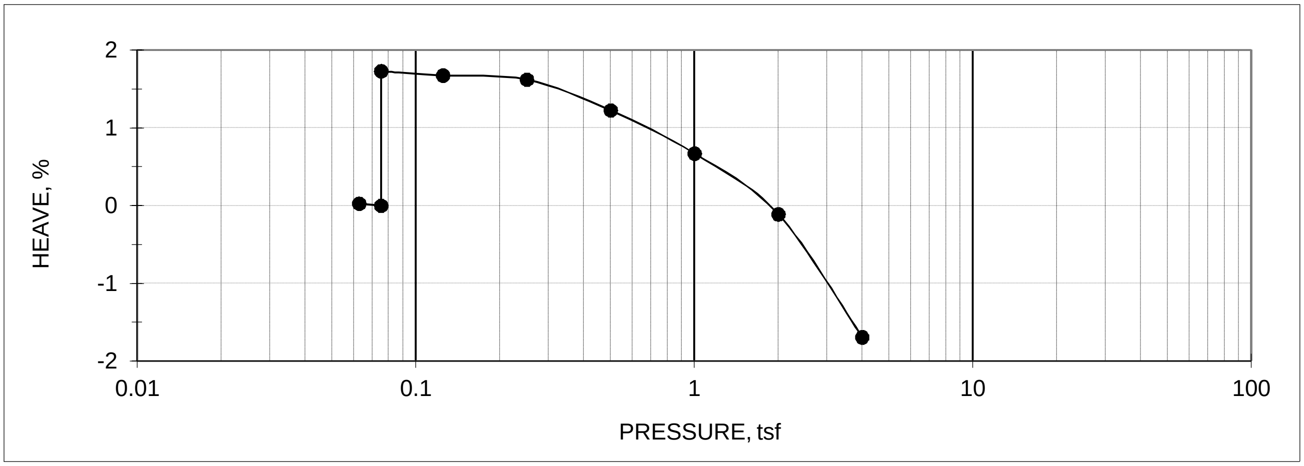
Cincinnati, Ohio

Figure

ONE-DIMENSIONAL SWELL TEST RESULTS - ASTM D4546-08, METHOD C
District Office Building and Development
Lincoln (Nebraska) Public Schools

Terracon Project No. A3125004





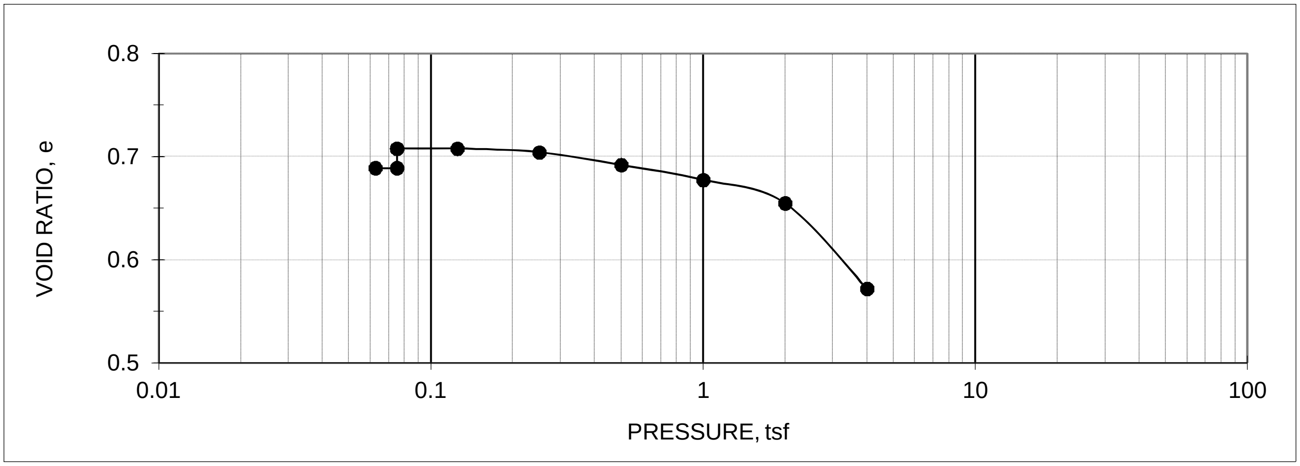
Boring No.	2	Sample No.	6	Depth, ft	18 - 20
Description	LEAN CLAY (CL)				
Sample Diameter, cm	6.35	**ATTERBERG LIMITS**		**BEFORE STABILIZED SWELL**	
Sample Height, cm	1.87	Liquid Limit	46	Initial Void Ratio, eo	0.551
Initial Water Content, %	19	Plastic Limit	16	Unit Weight at eo, pcf	107.9
Initial Dry Density, pcf	108	Plasticity Index	30	Heave (swell), %	0.0
Remolded	No				
				AFTER STABILIZED SWELL	
				Final Void Ratio, evo	0.577
				Unit Weight at evo, pcf	106.1
				Heave (swell), %	1.7

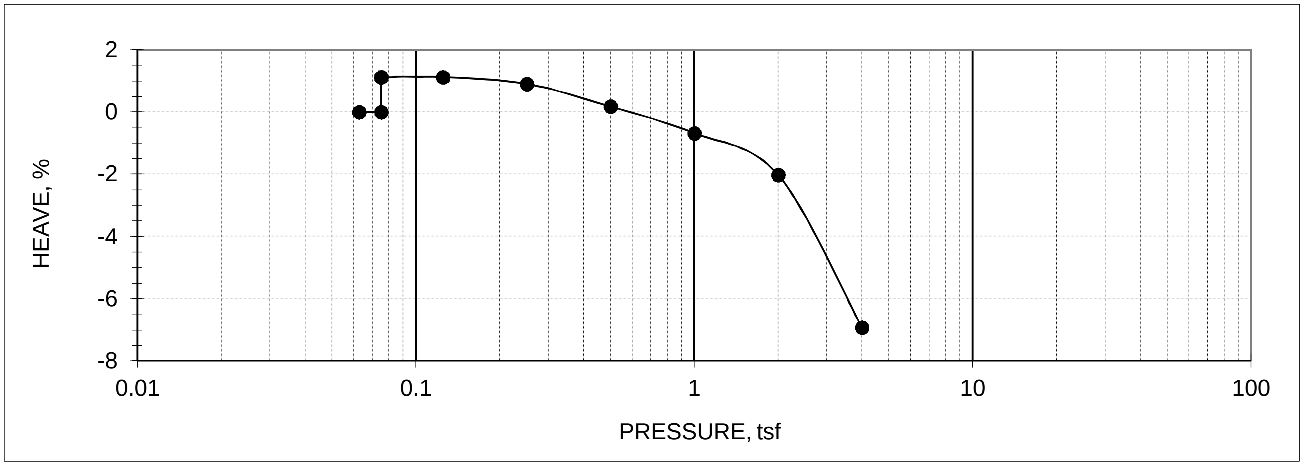
Date February 28, 2012

Terracon

ONE-DIMENSIONAL SWELL TEST RESULTS - ASTM D4546-08, METHOD C
District Office Building and Development
Lincoln (Nebraska) Public Schools

Terracon Project No. A3125004



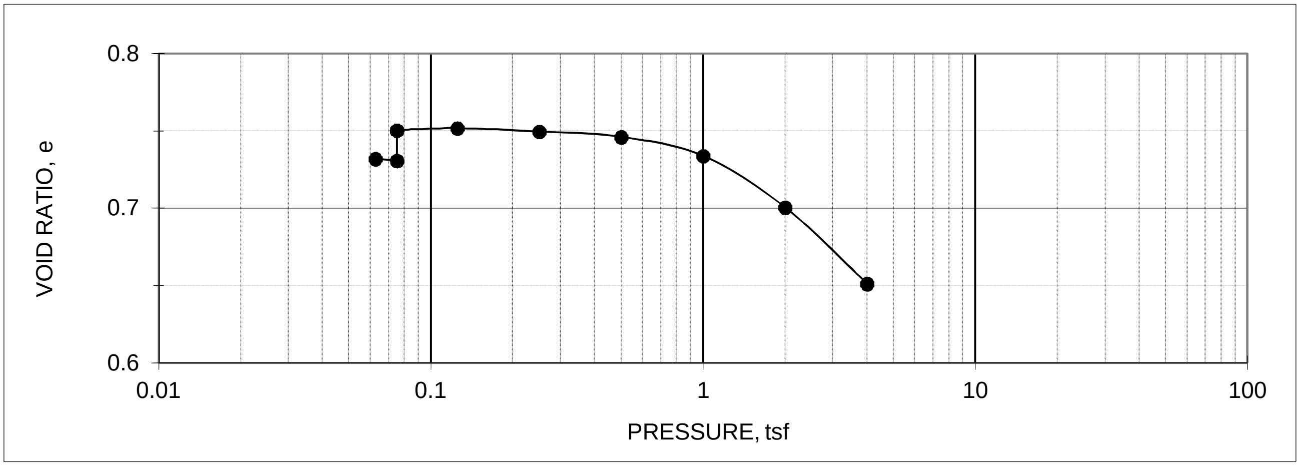


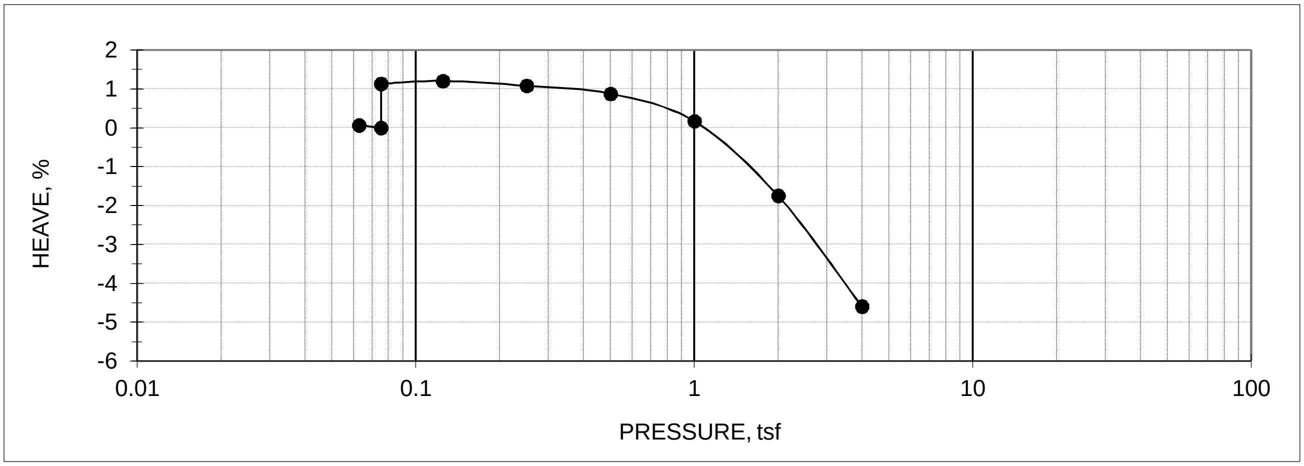
Boring No.	3	Sample No.	4	Depth, ft	8 - 10
Description	SANDY LEAN CLAY WITH GRAVEL (CL)				
Sample Diameter, cm	6.34	**ATTERBERG LIMITS**		**BEFORE STABILIZED SWELL**	
Sample Height, cm	1.86	Liquid Limit	45	Initial Void Ratio, eo	0.689
Initial Water Content, %	18	Plastic Limit	15	Unit Weight at eo, pcf	99.1
Initial Dry Density, pcf	99	Plasticity Index	30	Heave (swell), %	0.0
Remolded	No				
				AFTER STABILIZED SWELL	
				Final Void Ratio, evo	0.708
				Unit Weight at evo, pcf	98.0
				Heave (swell), %	1.1

Date February 28, 2012

ONE-DIMENSIONAL SWELL TEST RESULTS - ASTM D4546-08, METHOD C
District Office Building and Development
Lincoln (Nebraska) Public Schools

Terracon Project No. A3125004





Boring No.	11	Sample No.	1	Depth, ft	1 - 3
Description	FAT CLAY (CH)				
Sample Diameter, cm	6.34	**ATTERBERG LIMITS**		**BEFORE STABILIZED SWELL**	
Sample Height, cm	1.86	Liquid Limit	58	Initial Void Ratio, eo	0.731
Initial Water Content, %	24	Plastic Limit	19	Unit Weight at eo, pcf	96.7
Initial Dry Density, pcf	96	Plasticity Index	39	Heave (swell), %	0.0
Remolded	No				
				AFTER STABILIZED SWELL	
				Final Void Ratio, evo	0.750
				Unit Weight at evo, pcf	95.6
				Heave (swell), %	1.1

Date February 28, 2012

Terracon

Laboratory Compaction Characteristics of Soil

15080 A Circle
Omaha, Nebraska 68144
(402) 330-2202

Client Name: District Office Building and Development
Project Name: Lincoln (Nebraska) Public Schools
Location: South Cotner Boulevard and "O" Street
Lincoln, Nebraska

Source Material: Composite Sample 1
Sample Description: various borings and depths
Brown Lean Clay, Trace Sand
Material Designation: ______ Sample date: Feb 2012
Test Method: D698
Test Procedure: A
Sample Preparation: Dry
Rammer: X Mechanical ____ Manual

Project No.: A3115004 Date: 2/29/2012

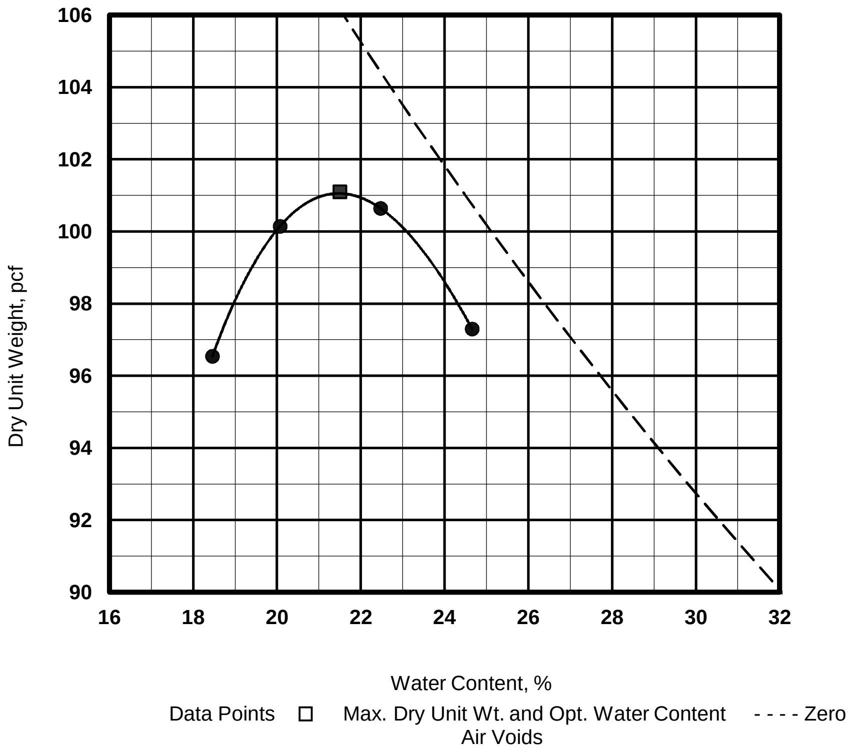
TEST RESULTS

Maximum Dry Unit Wt.: 101.1 pcf
Optimum Water Content: 21.5 %

Liquid Limit: 48 Plastic Limit: 17
Plasticity Index: 31
% passing # 200 sieve: ____

Reviewed by: ____

Zero air voids for specific gravity of 2.68



Terracon
15080 A Circle
Omaha, Nebraska 68144
(402) 330-2202

California Bearing Ratio Test

ASTM Test Method D 1883
Using Test Method D 698 for Preparation and Compaction of Specimen

Client Name: Lincoln Public Schools
Project Name: District Office Building and Development
Location: S Cotner Blvd and "O" St, Lincoln, Nebraska
Source Material: Composite Sample 1, 1-3 ft
Sample Description: Lean Clay (CL)

Project No.: A3125004 Date: 3/12/2012

TEST RESULTS

CBR @ 0.1 In. 6.6

Max Proctor Density (ASTM D 698): 101.1 pcf
Optimum Moisture Content: 21.5 %

	BEFORE SOAKING	AFTER SOAKING
Wet Density of Sample	117.9 pcf	116.5 pcf
Dry Density of Sample	96.4 pcf	95.3 pcf
Water Content of Sample	22.3 %	22.3 %
Water Content of Top Layer		25.8 %

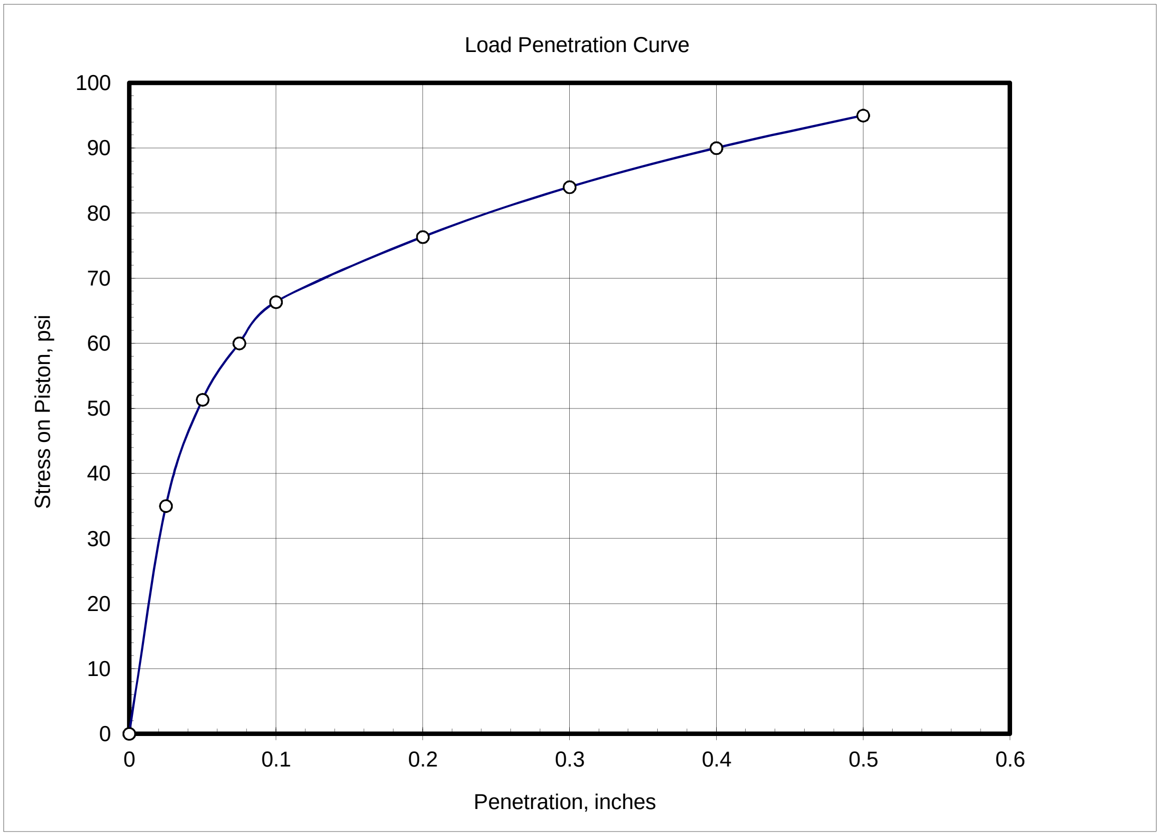
Liquid Limit: 48 Plastic Limit: 17
Plasticity Index: 31
% passing # 200 sieve: ____

Swell 1.2 %

Reviewed by: ____

Compaction 95.4 % of Proctor Maximum Density

Surcharge Loads Soak= 255.3 psf Penetration= 255.3 psf



APPENDIX C
SUPPORTING DOCUMENTS

GENERAL NOTES

DRILLING & SAMPLING SYMBOLS:

SS: Split Spoon - 1-3/8" I.D., 2" O.D., unless otherwise noted
ST: Thin-Walled Tube – 2" O.D., 3" O.D., unless otherwise noted
RS: Ring Sampler - 2.42" I.D., 3" O.D., unless otherwise noted
DB: Diamond Bit Coring - 4", N, B
BS: Bulk Sample or Auger Sample

HS: Hollow Stem Auger
PA: Power Auger (Solid Stem)
HA: Hand Auger
RB: Rock Bit
WB Wash Boring or Mud Rotary

The number of blows required to advance a standard 2-inch O.D. split-spoon sampler (SS) the last 12 inches of the total 18-inch penetration with a 140-pound hammer falling 30 inches is considered the "Standard Penetration" or "N-value".

WATER LEVEL MEASUREMENT SYMBOLS:

WL: Water Level
WCI: Wet Cave in
DCI: Dry Cave in

WS: While Sampling
WD: While Drilling
AB: After Boring

BCR: Before Casing Removal
ACR: After Casing Removal
N/E: Not Encountered

Water levels indicated on the boring logs are the levels measured in the borings at the times indicated. Groundwater levels at other times and other locations across the site could vary. In pervious soils, the indicated levels may reflect the location of groundwater. In low permeability soils, the accurate determination of groundwater levels may not be possible with only short-term observations.

DESCRIPTIVE SOIL CLASSIFICATION: Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

CONSISTENCY OF FINE-GRAINED SOILS

Unconfined Compressive Strength, Qu, psf	Standard Penetration or N-value (SS) Blows/Ft.	Consistency
< 500	0 - 1	Very Soft
500 – 1,000	2 - 4	Soft
1,000 – 2,000	4 - 8	Medium Stiff
2,000 – 4,000	8 - 15	Stiff
4,000 – 8,000	15 - 30	Very Stiff
8,000+	> 30	Hard

RELATIVE DENSITY OF COARSE-GRAINED SOILS

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

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 15
With	15 – 29
Modifier	≥ 30

GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 in. (300mm)
Cobbles	12 in. to 3 in. (300mm to 75mm)
Gravel	3 in. to #4 sieve (75mm to 4.75mm)
Sand	#4 to #200 sieve (4.75 to 0.075mm)
Silt or Clay	Passing #200 Sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 5
With	5 – 12
Modifier	> 12

PLASTICITY DESCRIPTION

Term	Plasticity Index
Non-plastic	0
Low	1-10
Medium	11-30
High	> 30

(Rev 04/10)

UNIFIED SOIL CLASSIFICATION SYSTEM

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

[A] Based on the material passing the 3-in. (75-mm) sieve

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

[E] $$Cu = D_{60}/D_{10} \qquad Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$$

[F] If soil contains ≥ 15% sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.

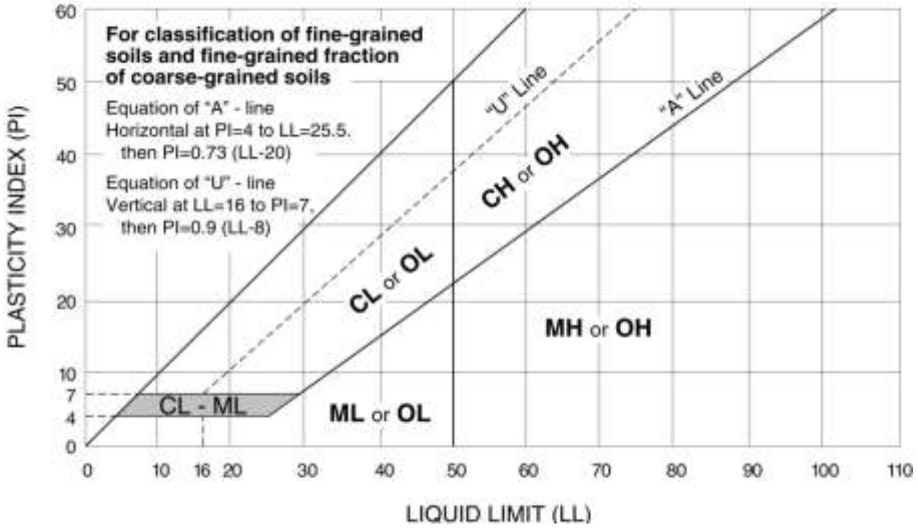
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] PI ≥ 4 and plots on or above "A" line.

[O] PI < 4 or plots below "A" line.

[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.



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