Geotechnical Engineering Report

PROPOSED VA MEDICAL CENTER PARKING RAMP

Iowa City, Iowa

January 26, 2011

Project No. 06105627.01

Prepared for:

Loebl Schlossman & Hackl
Chicago, Illinois

Prepared by:

Terracon Consultants, Inc.
Iowa City, Iowa

Terracon

January 26, 2011

Loebl Schlossman & Hackl
233 North Michigan Avenue, Suite 3000
Chicago, IL 60601

Attn: Mr. Mark Nichols, AIA

Re: Geotechnical Engineering Report
Proposed VA Medical Center Parking Ramp
Iowa City, Iowa
Terracon Project Number: 06105627.01

Dear Mr. Nichols:

Terracon Consultants, Inc. (Terracon) has completed the geotechnical engineering services for the above referenced project. This study was performed in general accordance with the Agreement for Geotechnical Services, dated April 23, 2010. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork and the design and construction of foundations and floor slabs for the proposed project.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report, or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.

for Steven D. Gerber, P.E.
Geotechnical Engineer

André M. Gallet, P.E.
Senior Principal
Iowa No. 13430

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TABLE OF CONTENTS

TABLE OF CONTENTS– continued

Exhibit No.

EXECUTIVE SUMMARY

A geotechnical engineering report has been completed for the Proposed VA Medical Center Parking Ramp located at the southeast quadrant of the intersection of U.S. Highway 6 and Woolf Avenue in Iowa City, Iowa. Six (6) borings, designated B-1 through B-6, were drilled to depths ranging from about 41 to 59 feet below existing grades.

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

- Based on the soil conditions encountered and the anticipated structural loads, we recommend the proposed parking ramp foundations and retaining walls be supported on a deep foundation system of drilled shafts bearing into the underlying bedrock formation, or on shallow foundations supported on soils improved with aggregate piers (e.g. Geopier® "Rammed Aggregate Piers®" or "Vibro-Replacement Stone Columns®).

- The borings encountered about 2 to 6 inches of asphaltic concrete at the surface underlain by about 3 to 6 inches of Portland cement concrete in Borings B-1, 3, and 5 and/or about 4 to 9 inches of crushed limestone.

- Boring B-1 encountered about 13½ feet of apparent fill, and these materials should be improved as a minimum for slab-on-grade support.

- The silty soils on the site are considered highly frost susceptible. Control of subsurface drainage will be important to help reduce potential differential frost heave effects in the soil subgrade.

- Assuming proper site preparation and any necessary subgrade repair, total and differential settlement should be within anticipated client/owner specifications.

- Groundwater is not anticipated in shallow excavations; however, it should be anticipated in deep foundation excavations.

- Close observation of the construction operations discussed herein will be critical in achieving the design subgrade support. We therefore recommend that the Terracon be retained to perform this portion of the work.

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. The section titled **GENERAL COMMENTS** should be read for an understanding of the report limitations.

GEOTECHNICAL ENGINEERING REPORT
PROPOSED VA MEDICAL CENTER PARKING RAMP
IOWA CITY, IOWA

Project No. 06105627.01
January 26, 2011

1.0 INTRODUCTION

Our geotechnical engineering report has been completed for the proposed VA Medical Center Parking Ramp located at the southeast quadrant of the intersection of U.S. Highway 6 and Woolf Avenue in Iowa City, Iowa. Six (6) soil borings, designated B-1 through B-6 were drilled to depths ranging from about 41 to 59 feet below existing grades. Logs of the borings, a Site Location Plan and a Boring Location Plan 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 and rock conditions
- groundwater conditions
- earthwork/subgrade preparation
- foundation design considerations
- pavement design considerations

2.0 PROJECT INFORMATION

2.1 Project Description

ITEM	DESCRIPTION
Structures	5-story parking garage ■ 1st level at-grade ■ 4 elevated levels ■ No future vertical expansion is planned
Building construction	■ Slab-on-grade lower level floor ■ Cast-in-place superstructure ■ Columns on a 20-foot by 61-foot grid
Finished floor elevation	Ground level within about 1 foot of existing site grades (assumed)
Maximum loads	Columns (provided): ■ Interior: 680 kips DL + 250 kips LL = 930 kips TL ■ Exterior: 385 kips DL + 110 kips LL = 495 kips TL Slabs: 250 psf maximum (assumed)
Maximum allowable settlement	1-inch total & ½ inch differential (provided)
Grading	Less than 1 foot from existing grades. (assumed)

2.2 Site Location and Description

ITEM	DESCRIPTION
Location	Southeast quadrant of the intersection of U.S. Highway 6 and Woolf Avenue in Iowa City, Iowa
Existing improvements	The site is currently a surface level parking lot
Existing topography	Relatively level, with surface elevations from about 709 to 710 feet

3.0 SUBSURFACE CONDITIONS

3.1 Subsurface Profile

Description	Approximate Depth to Bottom of Stratum	Material Encountered	Consistency/Density
Surface:	2 to 6 inches 0 to 6 inches 4 to 9 inches	Asphaltic Concrete PCC Paving Aggregate Base	N/A
Fill	13½ feet	Lean Clay to Silty Clay	Poorly Compacted
Clayey Soils	27 to 42 feet	Silty Clay, Lean Clay, Sandy Lean Clay	Soft to Medium Stiff to Hard
Sandy Soils	41 to 48½ feet	Clayey Sand, Fine to Medium Sand	Loose to Medium Dense
Weathered Limestone	5 to 56 feet in Borings B-5 and B-1, respectively, or the termination depth of the remaining borings	Moderately to severely weathered limestone	N/A
Limestone	55 and 59 feet in B-5 and B-1, respectively. Borings terminated in this material.	Slightly weathered limestone	N/A

Conditions encountered at each boring location are indicated on the individual boring logs. Stratification boundaries on the boring logs represent the approximate location of changes in soil and rock types; in-situ, the transition between materials may be gradual. Details for each of the borings can be found on the boring logs in Appendix A of this report.

3.2 Groundwater Conditions

The boreholes were observed while drilling and after completion for the presence and level of groundwater. Groundwater was observed during drilling at a depth of 42 feet during drilling in Boring B-1. It should be noted that water was introduced into the boreholes during the washed boring technique used to advance Borings 2, 3, 4, and 6; thus, the groundwater levels were obscured. Longer term monitoring in cased holes or piezometers would be required for an evaluation of the groundwater conditions at the project site.

Groundwater level fluctuations occur due to seasonal variations in the amount of rainfall, runoff and other factors not evident at the time the borings were performed. In addition, perched water can develop over low permeability soil or rock strata. Therefore, groundwater levels during construction or at other times in the life of the structure may be higher or lower than the levels indicated on the boring logs. The possibility of groundwater level fluctuations and perched water should be considered when developing the design and construction plans for the project.

3.3 Existing Retaining Wall Test Pits

Two (2) test pits were performed along the east side of the existing retaining wall on January 17, 2011 with a backhoe excavator. Hand auger probes were advanced approximately 4 feet below bottom of existing footing elevation in the test pits. The locations of the test pits, designated TP-1 and TP-2 are shown on Exhibit A-2, and were performed at approximately the locations requested by Walker Parking Consultants. Logs of the test pits are included in Appendix A.

Top of footing elevation was approximately 4 to 4½ feet below top of pavement elevation in the test pits. The footing observed in both test pits was approximately 12 inches thick, and extended laterally about 36 inches from the wall.

The test pits were backfilled with crushed stone, and the pavements patched with Portland cement concrete. Reports of the backfill and concrete patch testing will be provided under separate cover.

4.0 RECOMMENDATIONS FOR DESIGN AND CONSTRUCTION

4.1 Geotechnical Considerations

Special measures will be required during the design and construction phases of the proposed parking ramp project due to the following:

- Heavy structural loading conditions;

- Lower strength soil conditions;
- Existing structures;
- Existing fill soils;
- Frost susceptible silty soils,
- Potential for Karst bedrock conditions.

The upper soil profile consisted of about 17 to 22 feet of lower strength lean clay to silty clay that is not suitable to support the proposed heavily loaded structure and retaining walls. Boring B-1 also encountered apparent existing fill to a depth of about 13½ feet. Therefore, the proposed structure and retaining walls should be supported on a deep foundation system that extends and bears on competent bedrock or on shallow foundations supported on a ground improvement system of aggregate piers.

Several deep foundation systems could be considered for support of the proposed structure including drilled shafts, driven steel pipe or H-piles or micro-piles. As an alternative to a deep foundation system, the proposed structure could possibly be supported on a soil improvement system of "Geopier®, Rammed Aggregate Piers®, "Vibro-Replacement Stone Columns®", or other similar aggregate pier systems that would extend through the existing fill and lower strength soils. These systems are proprietary and would be designed and constructed by licensed contractors. Typically, foundations supported on aggregate piers can be designed with net allowable bearing pressures ranging from 3,000 to 6,000 psf. However, due to the proximity of the existing VA Medical Center and the adjacent structures, it is our opinion that the most viable foundation alternative for this project is drilled shafts extending to competent bedrock. Design and construction recommendations for drilled shafts are included in this report. We would be pleased to provide additional recommendations regarding other foundation systems upon request.

Existing fill was apparently encountered at Boring B-1 to a depth of about 13½ feet (possible adjacent underground utility) and other fill materials are anticipated to be located in other areas across the site. The fill encountered in Boring B-1 appears to be poorly compacted and does not appear to have been placed using moisture-density control procedures. It should be noted that structures bearing over uncontrolled fill could experience greater than normal settlement. Thus, consideration should be given to the complete removal of all existing fill from below floor slabs and pavements or some type of soil stabilization in order to eliminate risk of excessive pavement distress.

If the owner is willing to accept risk for higher than normal settlement, consideration could be given to leaving portions of these soils in-place below floor slab and pavement areas in order to reduce construction cost. As a minimum, we recommend that the existing soils be removed a depth of at least 2 feet in the areas of existing fill and replaced with properly compacted crushed stone. The actual depths of existing fill that require removal will vary and must be further evaluated during earthwork operations. The use of a geotextile or geogrid could also be considered to increase stability and minimize the potential for excessive settlement. The slabs should also be isolated from the walls and columns to allow for independent movement. While these measures would help reduce the potential for total or differential settlement to exceed construction tolerances, the nature of undocumented fill precludes reliable settlement estimates.

Drilling fluid loss up to 100 percent occurred while drilling in the transition zone from soil to less weathered bedrock in Borings B-4, B-5 and B-6. The drilling fluid may have generally escaped through joints and fissures within the limestone; however, it is also possible that the drilling fluid drained into a void in the bedrock. It is not uncommon to have voids in the form of solution cavities and/or Karst conditions in limestone formations. Interconnection of voids can allow for a drainage pathway for groundwater, which, in turn, can cause piping in the overburden soils. If prevalent, these conditions could lead to sinkhole activity; however, no records of known sinkholes were identified in the area and no evidence of an advanced state of internal soil migration of the overburden soils was identified. It should also be noted that the nature of the erosional surface of the bedrock can lead to an undulating top of bedrock elevation. Consequently, the shaft tip elevations may vary across the site and should be documented during the observation of their installation. Additional exploration and testing could be performed to further evaluate the karst conditions on the site; however, we do not believe it will affect our recommendations. As a minimum, the specifications should address the conditions and require that the drilled shaft contractor have experience with Karst conditions. In addition, we recommend full-time observation of the drilling and construction of the drilled shafts and of the probe holes as discussed in Section 4.3.

4.2 Earthwork

4.2.1 Site Preparation

Prior to placing any new fill, all vegetation, topsoil, existing uncontrolled fill, existing improvements (e.g., utilities, foundations, slabs, etc.) and any otherwise unsuitable material should be removed from the construction areas. The existing pavement materials should be removed or could be rubblized and used as backfill. The depth of removal should be performed to a relatively uniform elevation across the individual footprints of planned structures. Excessively wet or dry material should either be removed or moisture conditioned and recompacted.

Prior to placing any new fill, all surficial vegetation, topsoil, existing fill material, and debris from removal of existing structures and pavements, and any otherwise unsuitable materials should be removed from the construction areas. The depth of removal should be evaluated during construction. Excessively wet or dry material should either be removed or moisture conditioned and recompacted.

We anticipate that existing/buried utility lines and structures may be present in the proposed construction area. It has been our experience that poorly compacted backfill is commonly found adjacent to below-grade foundations and in utility line trenches. Utility lines should be re-routed outside of the construction areas whenever feasible. Whether the utility lines are abandoned or not, any poorly compacted backfill should be removed and replaced.

After rough grade has been established, the exposed subgrade should be proofrolled by the contractor and test probed by Terracon. Proofrolling on cohesive soils can be performed by using a partially loaded dump truck with a maximum weight of 20 tons. This surficial proofroll will help identify and delineate low density, soft, or disturbed areas that may exist below subgrade level, helps to provide a stable base for the compaction of new structural fill, and delineates low density, soft, or disturbed areas that may exist below subgrade level. If unsuitable areas are observed during this process, subgrade improvement will then be necessary to establish a suitable subgrade support condition; especially during wet or cool periods of the year. Subgrade conditions should be observed by Terracon during construction.

Methods of subgrade improvement could include scarification, moisture conditioning, and recompaction, and removal of unstable materials and replacement with granular fill (with or without geotextile or geogrid). The appropriate method of improvement, if required, would be dependent on factors such as schedule, weather, the size of area to be stabilized, and the nature of the instability. More detailed recommendations can be provided during construction as the need for subgrade stabilization occurs. Performing site grading operations during warm seasons and dry periods would help reduce the amount of subgrade stabilization required.

- **Scarification and Recompaction** - It may be feasible to scarify, moisture condition (e.g. dry), and recompact the exposed soils. The success of this procedure would depend primarily upon favorable weather and sufficient time to dry the soils. Even with adequate time and favorable weather, stable subgrades may not be achieved if the thickness of the unstable material is greater than about 1 to 1½ feet.

- **Crushed Stone/Aggregate** - The use of crushed stone, crushed concrete, and/or gravel could be considered to improve subgrade stability. Typical undercut depths would range from about ½ to 1 foot. The use of a geotextile or geogrid could also be considered after underground work, such as utility construction, is completed or in deep fill areas. We recommend that equipment not be operated above the fabric or geogrid until one full lift of crushed stone fill is placed above it. The maximum particle size of granular material placed over geotextile fabric or geogrid should not exceed 1½ inches. Granular gradation requirements provided by the geosynthetic product manufacturer should be verified prior to material purchase and delivery to the site.

- **Chemical Stabilization** - Incorporation of Class C fly ash, hydrated lime, lime kiln dust or Portland cement could be considered in order to reduce the soils' moisture content as well as improve subgrade stability. Chemical modification should be performed by a pre-qualified contractor having experience with successfully stabilizing subgrades in the project area on similar sized projects with similar soil conditions. Results of chemical analysis of the additive materials should be provided to the geotechnical engineer prior to use. Equipment which limits fugitive dust should also be considered to limit the hazards associated with chemicals blowing across the site or onto adjacent property. Additional testing would be needed for us to develop specific recommendations to improve subgrade stability by blending chemicals with the site soils. However, on a preliminary basis, 14 to 16 percent by soil weight of Class C flay ash and 4 to 6 percent by soil weight of hydrated lime could be used for budgeting purposes. Additional testing could include, but not be limited to, determining the most suitable stabilizing agent, the optimum amounts required, the potential for sulfate induced heave, and freeze-thaw durability of the subgrade.

A Terracon representative should observe subgrade preparation and could assist in developing appropriate stabilization procedures based on conditions encountered during construction. Upon completion of filling and grading, care should be taken to maintain the subgrade moisture content prior to construction of the grade supported slabs and/or pavements. The site should also be graded to prevent ponding of surface water in the prepared subgrades and 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 further construction.

4.2.2 Demolition Considerations

It is important that the demolition of the existing structures at the site and other improvements be performed with close observation and testing. Any unsuitable fill and lower strength native materials should also be removed at this time. Portions of the grade slabs will be supported on the new fill placed in the demolition excavations. The demolition contractor should be aware of project requirements for backfilling so that removal of these fill materials and replacement under controlled conditions is not necessary upon construction of the new structure.

4.2.3 Excavation Considerations

All excavations should comply with the requirements of OSHA 29CFR, Part 1926, Subpart P, "Excavations" and its appendices, as well as other applicable codes. This document states that the excavation safety is the responsibility of the contractor. Reference to this OSHA requirement should be included in the project specifications. Slope heights, slope inclinations and/or excavation depths should in no case exceed those specified in local, state or federal safety regulations, including current OHSA excavation and trench safety standards. If any excavations extend to depths greater than 20 feet, according to OHSA regulations, side slopes and/or bracing must be designed by a professional engineer.

Due to proximity of existing structures, special care should be taken to prevent disturbance of bearing soils and/or undermining structures. We recommend excavations be shored or braced to maintain stability and protect adjacent structures. The bracing or sheet piles should be designed to resist the lateral earth pressures and would reduce the potential for caving or sloughing of soils. Sloped excavations could be considered if the lateral extent would not impact adjacent utilities, pavements and/or structures. Where poorly compacted variable fill materials are encountered, flatter slopes than those required by OHSA could be required to maintain the stability of the excavation(s).

4.2.4 Material Requirements

New fills placed for the project should be low volume change cohesive soil or granular soil. Fill placed in confined excavations such as utility trenches should consist of relatively clean and well-graded granular material. This should provide for greater ease of placement and compaction in confined areas where larger compaction equipment cannot be operated. The use of granular fill in these isolated and potentially deeper excavations would reduce the potential for differential settlement for the structure components.

Most of site soils, as encountered in the borings, are considered suitable for use as fill materials and mass grading; however, some sorting and moisture conditioning will be required. Engineered fill should meet the following material property requirements:

Fill Type [1]	USCS Classification	Acceptable Location for Placement
Clean Granular Fill	SP, GP (P200<6%)	All locations (Non-frost susceptible[2])
Select Granular Fill	SP, SP-SM, GP, GW, SW[3] (P200<12%)	All locations (Slightly Frost Susceptible [4])
Granular Fill	SM and SC [3] (P200 <50%)	All locations except where non-frost susceptible fill or cohesive fill is required
Structural Fill	Meets the requirements for Granular Fill	All locations and elevations except where non-frost susceptible fill or cohesive fill is required
Cohesive Fill	CL, CL-ML LL<45, PI<23	As a cohesive cap in landscaped areas
On-Site Soils	CL, CL-ML, SP	Material free of debris or other unsuitable materials is suitable for reuse[5]

1. Controlled, compacted fill should consist of approved materials that are free of organic matter, debris, or other deleterious substance. 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. Non-frost susceptible fill (USACE EM 1110-3-138 Table 2-1: NFS) should also consist of less than 3% particles finer than 0.020 mm in sands or 1.5% in well graded gravels
3. In addition to the soil types mentioned above and dual classifications where 5%<P200<12%.
4. Slightly frost susceptible fill (USACE EM 1110-3-138 Table 2-1: PFS, S1; S2) should also consist of less than 6% particles finer than 0.020 mm.
5. Significant moisture conditioning (drying) will be required to achieve compaction.

4.2.5 Compaction Requirements

Moisture conditioning (e.g., drying of clays) of the existing site soils will be required if they are used as engineered fill. Appropriate laboratory tests, including Standard Proctor (ASTM D698) moisture-density relationship tests and Atterberg Limits tests (on cohesive soils), should be performed on proposed fill materials prior to their use as engineered fill. Further evaluation of any on-site soils or off-site fill materials should be performed by Terracon prior to their use in compacted fill sections.

The recommended degree of compaction and moisture content criteria for engineered fill materials are as follows:

Item	Description
Fill Lift Thickness	9 inches or less in loose thickness when heavy, self-propelled compaction equipment is used
	4 to 6 inches in loose thickness when hand-guided equipment (i.e. jumping jack or plate compactor) is used
Minimum Compaction Requirement [1, 2] Below Slabs-on-grade and Pavements	98% of the material's maximum dry density value as determined by ASTM Standard Test Method D 698 for upper foot of subgrade and aggregate base below pavements
	95% of the material's maximum dry density value as determined by ASTM Standard Test Method D 698 for slabs-on-grade and top foot of subgrade below pavements
Moisture Content Cohesive Soil	Generally -2% to +3% of optimum as determined by ASTM Standard Test Method D 698
Moisture Content Granular Material [3]	Generally -3% to +3% of optimum as determined by ASTM Standard Test Method D 698

1. We recommend that each lift of structural fill be tested for moisture content and compaction prior to the placement of additional structural fill or concrete. 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. If granular material is a coarse sand or gravel, is of a uniform size, or has a low fines content, compaction comparison to relative density may be more appropriate. The relative density should achieve 70% of material's maximum density value per ASTM Standard Test Methods D 4253 and D 4254.
3. The gradation of a granular material affects its stability and the moisture content required for proper compaction.

4.2.6 Utility Trench Backfill

Excavations should be performed in accordance with governing safety regulations. All vehicles and soil piles should be kept back from the crest of excavation slopes. The stability of excavation slopes should be reviewed continuously by qualified personnel. The responsibility for excavation safety and temporary construction slopes lies solely with the contractor.

Utility trenches are a common source of water infiltration and migration. All utility trenches that penetrate beneath the building should be effectively sealed to restrict water intrusion and flow through the trenches that could migrate below the building. 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 consist of low plasticity clay soils compacted to the requirements provided in the table above. The clay fill should completely surround the utility line and be properly placed and compacted in accordance with recommendations in this report.

4.2.7 Grading and Drainage

Final surrounding grades should be sloped away from the structure on all sides to prevent ponding of water. Pavement subgrades and pavements should be sloped to provide rapid drainage of surface water. Water should not be allowed to pond on or adjacent to the pavements since this could saturate the subgrade and contribute to premature pavement deterioration. Irrigation adjacent to structures should be avoided.

4.2.8 Construction Considerations

The soil types encountered in the borings may be susceptible to disturbance from construction activity and should be considered as frost-susceptible. Heavy equipment traffic directly on prepared surfaces should be avoided. The use of light construction equipment would aid in reducing subgrade disturbance. Weather conditions such as freezing, thawing, rain, or dry weather can also contribute to subgrade disturbance. Upon completion of filling and grading, care should be taken to maintain the subgrade moisture content prior to construction of floor slabs and pavements. Construction traffic over the completed subgrade should be avoided to the extent practical. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. If the subgrade becomes saturated, desiccated, or disturbed, the affected material should be scarified, moisture conditioned, and recompacted prior to construction of structures. If a significant period of time elapses between site grading and further construction, the subgrade should be reworked and retested prior to placement of slabs and pavements.

Terracon should be retained during the construction phase of the project to observe earthwork operations and to perform necessary tests and observations during subgrade preparation, placement and compaction of structural fill, backfilling of excavations, and just prior to construction of slabs and pavements.

4.3 Drilled Shaft Foundation Recommendations

4.3.1 Design Considerations

Based upon the lower strength soils encountered in the borings and the relatively heavy structural loading conditions, we recommend the proposed parking ramp structure be supported on a deep foundation system consisting of drilled, straight-sided shafts. We recommend the drilled shafts extend through the lower strength overburden soils, existing fill, and highly weathered limestone bedrock and bear on the underlying competent, moderately-weathered limestone bedrock. Each column could be designed to be supported on a single drilled shaft. The recommendations in this section are developed for shafts bearing on suitable bedrock.

We recommend drilled shafts bearing on approved, moderately-weathered limestone bedrock be sized using a maximum net allowable end-bearing pressure of 80,000 pounds per square foot (psf). Highly weathered limestone bedrock was encountered in the borings performed at depths ranging from about 41 to 48½ feet below the existing grade. Based on the test results of the rock cores obtained from Borings B-1 and B-5, moderately-weathered limestone bedrock was encountered at depths of about 51 and 46 feet below grade; approximately 4 to 6 feet into the bedrock formation.

We recommend the drilled shafts be designed a minimum of 30 inches in order to permit cleaning and testing of shaft bottoms, and extend at least 1 shaft diameter into the bedrock formation in order to develop the full end-bearing capacity. For purposes of this report, competent bedrock is defined as having an RQD of at least 40%. The competent bedrock (moderately weathered limestone) surface was encountered in Borings B-1 and B-5 at elevations of approximately 649 and 654 feet, respectively. Belling of drilled shafts is not applicable on this project. Larger capacities will require larger shaft diameters or deeper embedment into the less-weathered bedrock (RQD of 80%); however, difficult rock coring installation procedures would be required to achieve higher capacity shafts. We would be pleased to provide additional information upon request.

The length of the drilled shafts will vary across the parking ramp structure because of the varying elevations of the bedrock and the various depths of penetration needed to reach competent bearing material. Shaft lengths may be estimated for design and bidding purposes, but it should be understood the actual bearing elevation will need to be determined at the time of shaft installation. If Terracon is not performing the observation and testing services during drilled shaft construction, we recommend a load test be performed to evaluate the load-bearing capacity of the drilled shafts.

For drilled shaft foundations designed and constructed in accordance with the recommendations in this report, we estimate settlements would be about ½ inch or less. Differential settlement should be considered equal to total settlement. All shafts should be spaced at least 3 diameters on center. Foundation elements should extend at least 3½ feet below grade for frost protection. Foundation shafts, caps and/or grade beams subjected to uplift loading could be designed using an allowable skin friction value of 450 psf for the overburden soils and 1,000 psf for the highly weathered limestone bedrock.

The table below provides recommended design parameters for the lateral capacity of drilled shafts.

Strata	ALLOWABLE PASSIVE RESISTANCE (psf)	L-Pile Initial Modulus of Subgrade Reaction K (pci)	e50
Overburden Soils, Upper 3 Shaft Diameters (Min 3 ½ ft)	Neglect	NA	NA
Overburden Soils	1,500	100	0.01
Highly Weathered Limestone	20,000	125	NA
Moderately Weathered Limestone	40,000	2,000	0.004

1. The allowable passive resistance would apply to the projected diameter of the pile and require some movement to mobilize resistance. Group action for lateral resistance of piles should be taken into account when spacing is less than 8 diameters (center to center), and design parameters for allowable passive resistance should be reduced in accordance with the following table.

Group Reduction Factors – Laterally Loaded Piles	
Pile Spacing (Diameters)	**Reduction Factors**
8D	1.0
6D	0.7
4D	0.4
3D	0.25

2. Skin friction capacity and passive resistance should be neglected within 3½ feet of final grade due to frost effects.

It should be noted that the load capacities provided herein are based on the stresses induced in the supporting strata. The structural capacity of the shafts should be checked to assure that they can safely accommodate the combined stresses induced by axial and lateral forces. Lateral deflections of piles should be evaluated using an appropriate analysis method, and will depend upon the pile's diameter, length, configuration, stiffness and "fixed head" or "free head" condition. We can provide additional analyses and estimates of lateral deflections for specific loading conditions upon request. The load-carrying capacity of piles may be increased by increasing the diameter and/or length.

4.3.2 Construction Considerations

We recommend that the foundation bid package require prospective bidders to meet minimum qualifications, as well as require a detailed description of the bidder's means and methods for installing the shafts. In addition, we recommend that the drilled shaft foundation contractor be experienced with the local site conditions for this project, and the drilled shaft construction be observed by Terracon personnel on a full-time basis.

A full-depth temporary steel casing will be required to stabilize the sides of the shaft excavations in the overburden. Difficult drilling conditions should be expected within both the sandy soils above the bedrock and in the highly weathered bedrock, and the potential for hard bedrock drilling conditions should also be considered. Temporary steel casing should be used for safety whenever personnel enter the drilled shaft excavation for cleaning and testing. If casing is removed during concrete placement, care should be exercised to maintain concrete inside the casing at a sufficient level to resist earth and hydrostatic pressures present on a casing exterior. Any water or loose soil should be removed from the bottom of the drilled shafts prior to placement of the concrete.

Use of a telescoping casing arrangement can be considered to avoid handling long casing lengths. The lower casing, in particular, should be of sufficient length and stiffness and have an appropriate cutting edge to allow it to be firmly seated into the bedrock in order to seal out groundwater. If possible, excess water should be evacuated from the casing in order to place concrete in the "dry".

"Wet" shafts should be constructed by slurry displacement techniques. In this process, the shaft excavation is filled with approved polymer based slurry to counter-balance the hydraulic forces below the water level and stabilize the wall of the shaft. Concrete would then be placed with a tremie into the slurry-filled excavation. The tremie remains inserted several feet into the fresh concrete until placement is complete. The slurry should have a sand content no greater than 1 percent at the time concrete placement commences. The maximum unit weight of the slurry should be established in consultation with Terracon.

Concrete for "dry" drilled shaft construction should have a slump of about 5 to 7 inches. Concrete should be directed into the shaft utilizing a centering chute. Use of a tremie for placement of concrete in a dry shaft (less than 2 inches of water at the time of the concrete placement) is not recommended. Concrete for "wet" shaft construction would require higher slump concrete.

The bedrock at the base of the shaft excavations should be observed and evaluated accordingly. Probe holes should be performed in a portion of the drilled shafts to help verify rock quality and check for voids or weak clay seams and/or layers within the bedrock formation. The number of probe holes and locations will depend upon final drilled shaft layout, structural loads, and actual rock quality encountered during construction. For bidding purposes, we recommend including an allowance to have the contractor test probe one-quarter (¼) of the drilled shafts. It may be possible to reduce the number of probe holes performed, and this will be determined by Terracon during construction. The probe holes should be approximately 2 inches in diameter and should extend below the base of the shaft excavation a distance at least equal to the shaft diameter or 4 feet, whichever is greater, provided competent bedrock is encountered. Hand held pneumatic drilling equipment should be used for drilling the probe holes in "dry" shafts. For safety reasons or for "wet" shafts, we recommend probe holes be performed prior to construction using diamond bit rock coring drilling procedures. In addition, sounding of bedrock using the Kelley bar will be required for all shafts, prior to concrete placement.

4.4 Seismic Site Classification

The average shear-wave velocity analysis and recommendations presented in this report are based upon the data obtained from the seismic refraction testing previously performed at several sites on the Iowa City VA Medical Center campus for other projects. These analyses do not reflect variations that may occur across the site, or variations that may occur throughout the year, such as groundwater fluctuations. The refraction microtremor method is an approximate method, and one of many methods that can be used to determine shear-wave velocities. There are other costlier methods that can be used to further increase the accuracy of the seismic site classification and shear-wave profile.

DESCRIPTION	VALUE
2006 International Building Code Site Classification (IBC) [1]	C[2]
Site Latitude	N 41° 39' 51.58"
Site Longitude	W 91° 32' 57.55"
S_s Spectral Acceleration for a Short Period	<0.10g>
S_s Spectral Acceleration for a 1-Second Period	<0.06g>

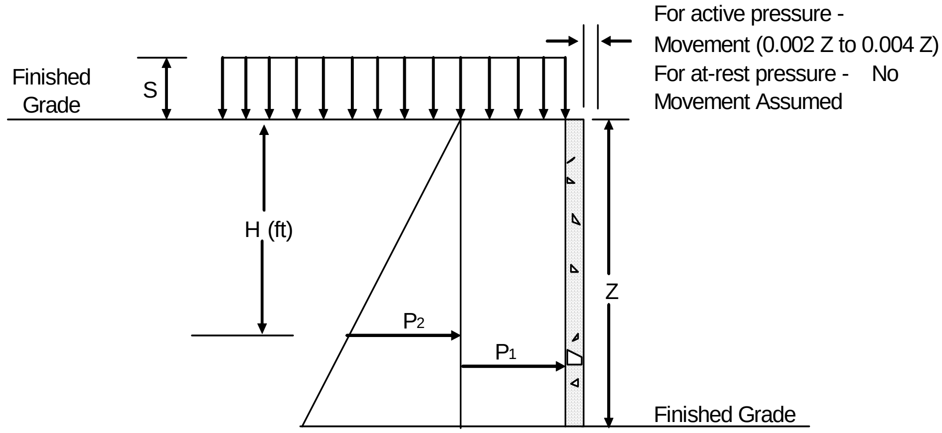
1. In general accordance with the *2006 International Building Code,* Table 1613.5.2.
2. The 2006 International Buildin*g Code (IBC) requires a site soil* profile determination extending a depth of 100 feet for seismic site classification. The current scope does not include the required 100 foot soil profile determination. Borings for this site extended to a maximum depth of approximately 59 feet and this seismic site class assignment considers that moderately weathered limestone bedrock continues below the maximum depth of the subsurface exploration.

4.5 Lateral Earth Pressures

Any below-grade 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 rotation and should be used for basement walls and other walls restrained from movement. The surcharge components would apply where drives, surface parking or other loading will be applied adjacent to the below grade walls. The recommended design lateral earth pressures are for cast-in-place concrete walls only and do not include a factor of safety or any provision for possible hydrostatic pressure on the walls. These recommendations are not applicable to the design of modular block - geogrid reinforced backfill walls and additional analyses and evaluation would be required for these walls.

EARTH PRESSURE COEFFICIENTS



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 - 0.42	50	(0.42)S	(50)H
At-Rest (Ko)	Granular - 0.50	60	(0.50)S	(60)H
	Lean Clay - 0.59	71	(0.59)S	(71)H
Passive (Kp)	Granular - 3.0	360	---	---
	Lean Clay - 2.37	285	---	---

Conditions applicable to the previous values include:

- For active earth pressure, wall must rotate about base, with top lateral movements 0.002 Z to 0.004 Z, where Z is wall height,
- For passive earth pressure, 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 final graded backfill, compacted to at least 95 percent of the ASTM D 698 maximum dry density,
- Loading from heavy compaction equipment not included,
- No groundwater acting on wall for "drained" values,
- No safety factor included,
- Ignore passive pressure in frost zone.

Backfill placed against the below grade walls 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 0.35 could be used as the allowable coefficient of friction between the footing and the underlying soil.

Heavy construction equipment should not operate within a distance closer than the exposed height of retaining walls to prevent lateral pressures greater than those provided. Backfill placed in non-structural areas adjacent to the walls should be placed in thin lifts and compacted using hand-operated equipment to at least 95 percent, but no more than 98 percent, of the material's maximum standard Proctor dry density (ASTM D 698).

A perforated rigid drain line installed at the foundation level behind the base of walls extending below adjacent grade is recommended to prevent hydrostatic loading on the walls. The drain line should be sloped to provide positive gravity drainage and should be surrounded by free draining granular material graded to prevent the intrusion of fines, or an alternative free draining granular material encapsulated with suitable filter fabric. At least a 2-foot wide section of free draining granular fill should be used for backfill above the drain line and adjacent to the wall and should extend to within 2 feet of final grade. In unpaved areas, the granular backfill should be capped with compacted cohesive fill to minimize infiltration of surface water into the drain system. A prefabricated drainage structure may be used above a drain line as an alternative to free draining granular fill.

4.6 Pavements

4.6.1 Subgrade Preparation

The subgrade soils should be prepared as recommended in Section **4.2 Earthwork** of this report to provide a uniform subgrade for pavement construction. Areas that appear desiccated following site stripping may require further undercutting and moisture conditioning. If a significant precipitation event occurs after the evaluation or if the surface becomes disturbed, the subgrade should be reviewed by a Terracon representative immediately prior to paving. The subgrade should be in its finished form at the time of the final evaluation.

4.6.2 Design Considerations

Traffic patterns and anticipated loading conditions were not available at the time that this report was prepared. We anticipate that traffic loadings will include daily automobile and occasional delivery and trash removal trucks. The thickness of pavements subjected to heavy truck traffic should be should be determined using expected traffic volumes, vehicle types, and vehicle loads and should be performed in accordance with local, city, or county ordinances, and any requirements of the Department of Veterans Affairs.

Pavement thickness can be determined using AASHTO, Asphalt Institute, and/or other methods if traffic loading information, desired pavement life, and terminal serviceability are provided. Specific wheel loads, axle configurations, frequencies, and other information could be required in some instances. Terracon can provide thickness recommendations for pavements subjected to other loads if this information is provided.

Pavement performance is affected by its surroundings. In addition to providing preventive maintenance, the project civil engineer should consider the following recommendations in the design and layout of pavements:

- Final grade adjacent to parking lots and drives should slope down from pavement edges at a minimum 2%,
- The subgrade and the pavement surface should have a minimum ¼ inch per foot slope to promote proper surface drainage,
- Install appropriate edge drainage and pavement under drain where surrounding areas are anticipated to be frequently wetted (e.g. landscaped areas, islands, runoff from building roof drains, wash racks, etc.),
- Install joint sealant and seal cracks immediately,
- Seal all landscaped areas in, or adjacent to pavements to reduce moisture migration to subgrade soils,
- Place compacted, low permeability backfill against the exterior side of curb and gutter; and,
- Place curb, gutter and/or sidewalk directly on clay subgrade soils rather than on unbound granular base course materials.

4.6.3 Typical Pavement Thicknesses

A formal pavement design has **not** been completed for this project. In addition, traffic estimates have not been provided and CBR tests have not been performed as part of the scope of this investigation. For this project, we have estimated a CBR value of 3 for design of ACC pavement sections constructed on subgrades prepared and designed as recommended in Sections **4.5 Pavements** and **4.2 Earthwork** of this report. A modulus of subgrade reaction (k) value of 75 to 100 pci is estimated for design of PCC pavement sections. Tests could be performed to verify these values.

The following pavement sections apply to a design life of about 20 years and are considered to be minimum values. Thicker pavement sections could be used to reduce maintenance and extend the expected service life of the pavements, and may be required because of actual loadings and desired design life. Other design sections could be considered as information becomes available and other more economical design and construction approaches could be possible and considered later during the project.

Typical Pavement Section Thickness (inches)						
Traffic Area	**Alternative**	**Asphaltic Cement Concrete Surface Course**	**Asphaltic Cement Concrete Base Course(s)**	**Portland Cement Concrete [1]**	**Aggregate Base Course [2]**	**Total Thickness**
Light Duty (Car Parking)	PCC	--	--	5.0	4.0	9.0
	ACC	2.0	2.0	--	6.0	10.0
Heavy Duty (Truck and Drive Areas)	PCC	--	--	6.0	4.0	10.0
	ACC	2.0	4.5	--	6.0	14.5
Trash Container Pad [3]	PCC	--	--	7.0	4.0	11.0

1. f'_c of 4,000 psi at 28 days. Minimum modulus of rupture of 550 psi. Maximum water to cement ratio of 0.45. Air entrained 5 to 7 percent. PCC pavements are recommended for trash container pads and in any other areas subjected to heavy wheel loads and/or turning traffic.
2. The aggregate base below pavements should meet Iowa DOT Section No's 4121, 4123 or 4132, or an approved alternate gradation.
3. The trash container pad should be large enough to support the container and the tipping axle of the collection truck.

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 buildings), and occurs under the wheel footprint in these stalls. The use of higher-grade asphaltic cement, or surfacing these areas with PCC, should be considered. The dishing is exacerbated by factors such as irrigated islands or planter areas, sheet surface drainage to the front of structures, and placing the ACC directly on a compacted clay subgrade.

4.6.4 Pavement Drainage

Pavements should be sloped to provide rapid drainage of surface water. Water allowed to pond on or adjacent to the pavements will saturate the subgrade and contribute to premature pavement deterioration. In addition, the pavement subgrade should be graded to provide positive drainage within the granular base section. Appropriate sub-drainage or connection to a protected, reliable outlet should be provided to remove water from the granular subbase.

4.6.5 Pavement Maintenance

The pavement sections provided in this report represent minimum recommended thicknesses and, as such, periodic maintenance should be anticipated. Therefore preventive maintenance should be planned and provided for through an on-going pavement management program. Preventive maintenance activities are intended to slow the rate of pavement deterioration, and to preserve the pavement investment. Preventive maintenance consists of both localized maintenance (e.g. crack and joint sealing and patching) and global maintenance (e.g. surface sealing). Preventive maintenance is usually the first priority when implementing a planned pavement maintenance program and provides the highest return on investment for pavements. Prior to implementing any maintenance, additional engineering observation is recommended to determine the type and extent of preventive maintenance. Even with periodic maintenance, some movements and related cracking may still occur and repairs may be required.

4.6.7 Construction Considerations

On most project sites, the site grading is generally accomplished early in the construction phase. However, as construction proceeds, the subgrade may be disturbed due to utility excavations, construction traffic, desiccation, rainfall, etc. As a result, the pavement subgrade may not be suitable for placement of base rock and concrete, and corrective action will be required.

We recommend the area underlying the pavement slabs be rough graded and then thoroughly proofrolled with a loaded tandem axle dump truck prior to final grading and placement of base rock. Particular attention should be paid to high traffic areas that were rutted and disturbed earlier and to areas where backfilled trenches are located. Areas where unsuitable conditions are located should be repaired by removing and replacing the affected material with properly compacted fill. All pavement subgrade areas should be moisture conditioned and properly compacted to the recommendations in this report immediately prior to placement of the base rock and concrete.

4.7 Frost Considerations

The soils on this site are highly frost susceptible, and small amounts of groundwater can be detrimental to the performance of the slabs and pavements. Exterior slabs and pavements should be expected to heave. If frost action needs to be eliminated in critical areas, we recommend the use of structural slabs (e.g., as structural stoops in front of doors. It is our opinion that placing non-frost susceptible material in large areas under exterior pavements and sidewalks would be exceedingly expensive and an unusual design and construction procedure in Iowa. Strong consideration should be given to the potential frost effect in the transition areas between doorways, slabs, and pavements in ADA accessible pathways. Consideration can also be made to structurally supporting the ground level slab on the deep foundation system.

The following recommendations are provided to help reduce potential frost heave:

- Providing surface drainage away from the parking ramp, and grade area towards the site storm drainage system;
- Installing drain-tile around the perimeter of the structure, stoops and exterior slabs and to connect directly to the storm drainage system;
- Installing drain-tile in the slab subgrade and finger drains about catch basins to connect directly to the storm drainage system;
- Grading silty subgrades such that groundwater potentially perched in overlying more permeable subgrades, such as sand or aggregate base, slopes toward the site drainage system;
- Placing non-frost susceptible fill as backfill around stoops/entrance areas;
- Placing a 3:1 (Horizontal: Vertical) transition zone between non or low frost susceptible soils and other soils.

As an alternative to extending the non-frost susceptible fill to the full frost depth, consideration can be made to placing extruded polystyrene or cellular concrete under a buffer of at least 1 foot of non-frost susceptible fill.

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.

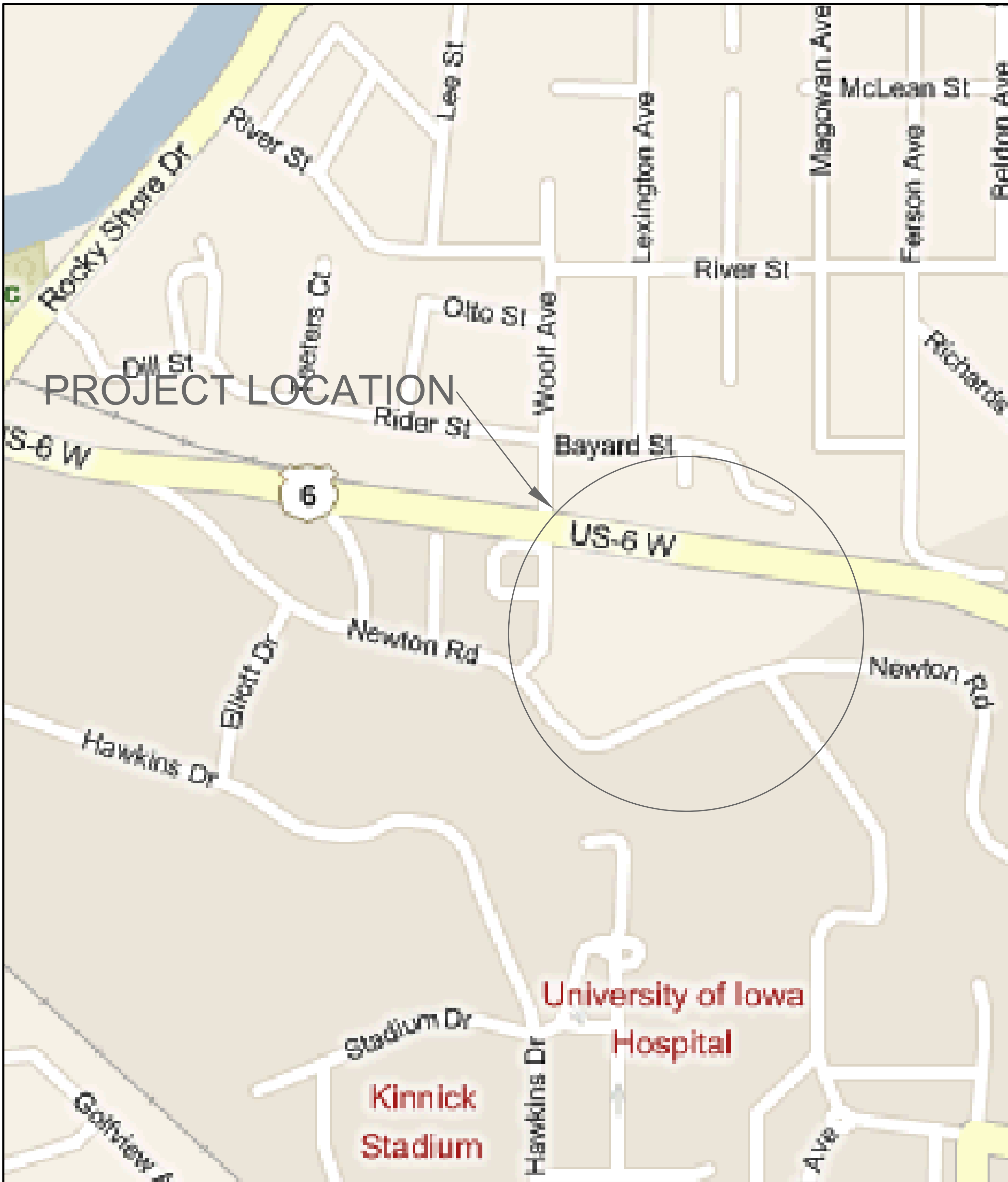
The analysis and recommendations presented in this report are based upon the limited data obtained from the borings performed at the indicated locations and from other information discussed in this report. This report does not reflect variations that may occur between borings, across the site, or due 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.

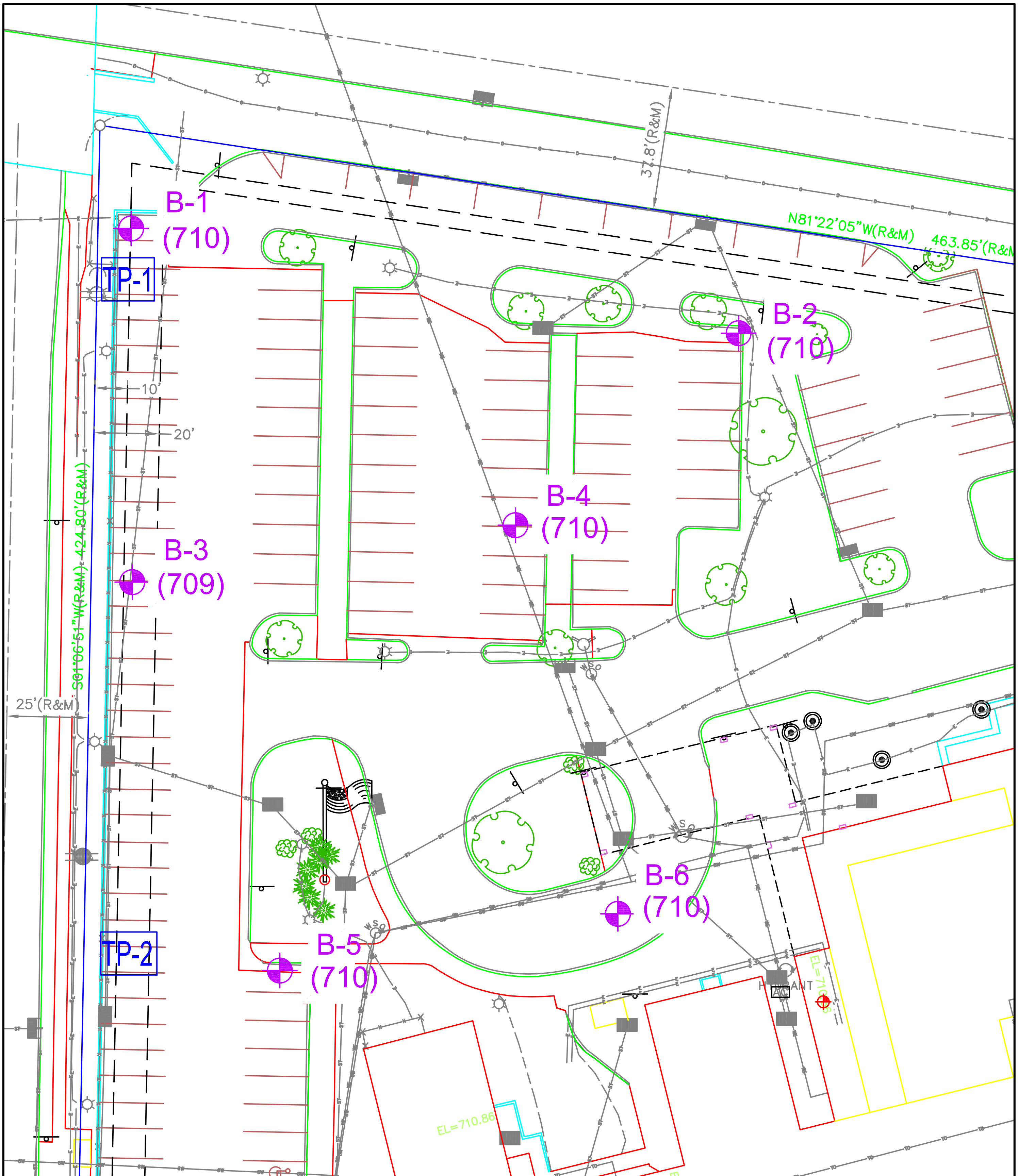
LICENSED PROFESSIONAL ENGINEER ANDRE' M. GALLET 13430 IOWA	I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Iowa. André M. Gallet, P.E. Date 1/26/11 My license renewal date is December 31, 2012.

APPENDIX A
FIELD EXPLORATION



AERIAL PHOTO FROM BING MAPS
THIS DRAWING IS INTENDED FOR GENERAL LOCATION PURPOSES ONLY

NORTH	Project No. / Date	Terracon	SITE LOCATION PLAN	FIG. NO.
0 500' APPROXIMATE DRAWING SCALE	Project No.: 06105627 Date: 12/9/10 Project Mngr: SDG Drawn By: PC File Name: 06105627-01.dwg Layout Name: SITE	Consulting Engineers and Scientists 783 HIGHWAY 1 WEST, UNIT #5 IOWA CITY, IOWA 52246 PH. (319) 688-3007 FAX. (319) 688-3008	PROPOSED VA HOSPITAL CENTER PARKING RAMP LOEBL, SCHLOSSMAN, AND HACKL 601 HIGHWAY 6 IOWA CITY, IOWA	A-1



LEGEND

- APPROXIMATE BORING LOCATION AND ELEVATION

TP-X - APPROXIMATE TEST PIT LOCATION

BASE DRAWING FROM CADD DRAWING PROVIDED BY MMS TITLED '8549001_SITE SURVEY.tdwg'

THIS DRAWING IS INTENDED FOR GENERAL LOCATION PURPOSES ONLY

NORTH

0 40'

APPROXIMATE DRAWING SCALE

Project No. 06105627	Date: 12/9/10
Project Mngr: SDG	Drawn By: PC
File Name: 06105627-01.dwg	
Layout Name: BORING LOCATIONS	

Terracon

Consulting Engineers and Scientists

783 HIGHWAY 1 WEST, UNIT #5 IOWA CITY, IOWA 52246

PH. (319) 688-3007 FAX. (319) 688-3008

BORING LOCATION PLAN

PROPOSED VA HOSPITAL CENTER PARKING RAMP

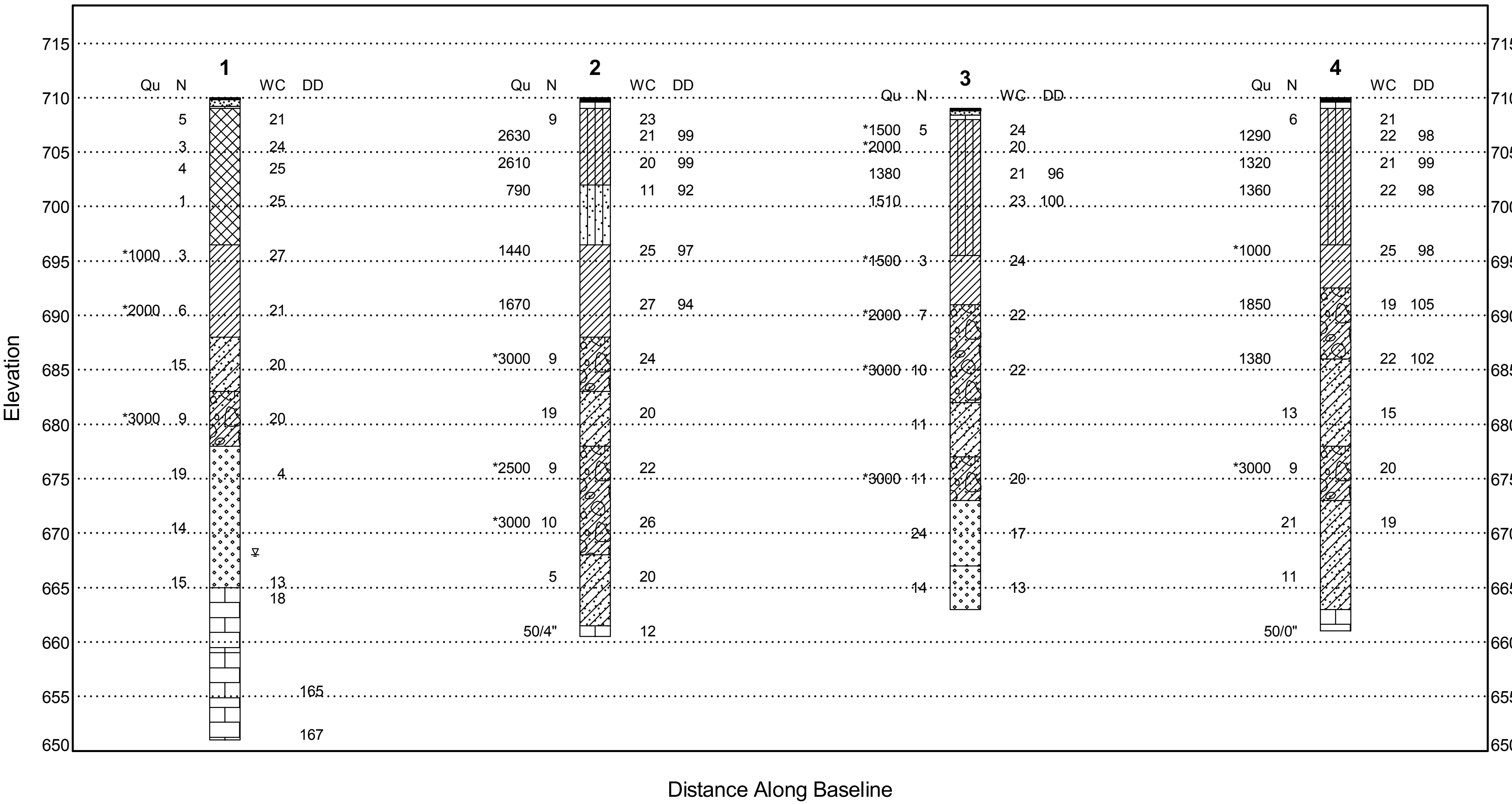
LOEBL, SCHLOSSMAN, AND HACKL

601 HIGHWAY 6

IOWA CITY, IOWA

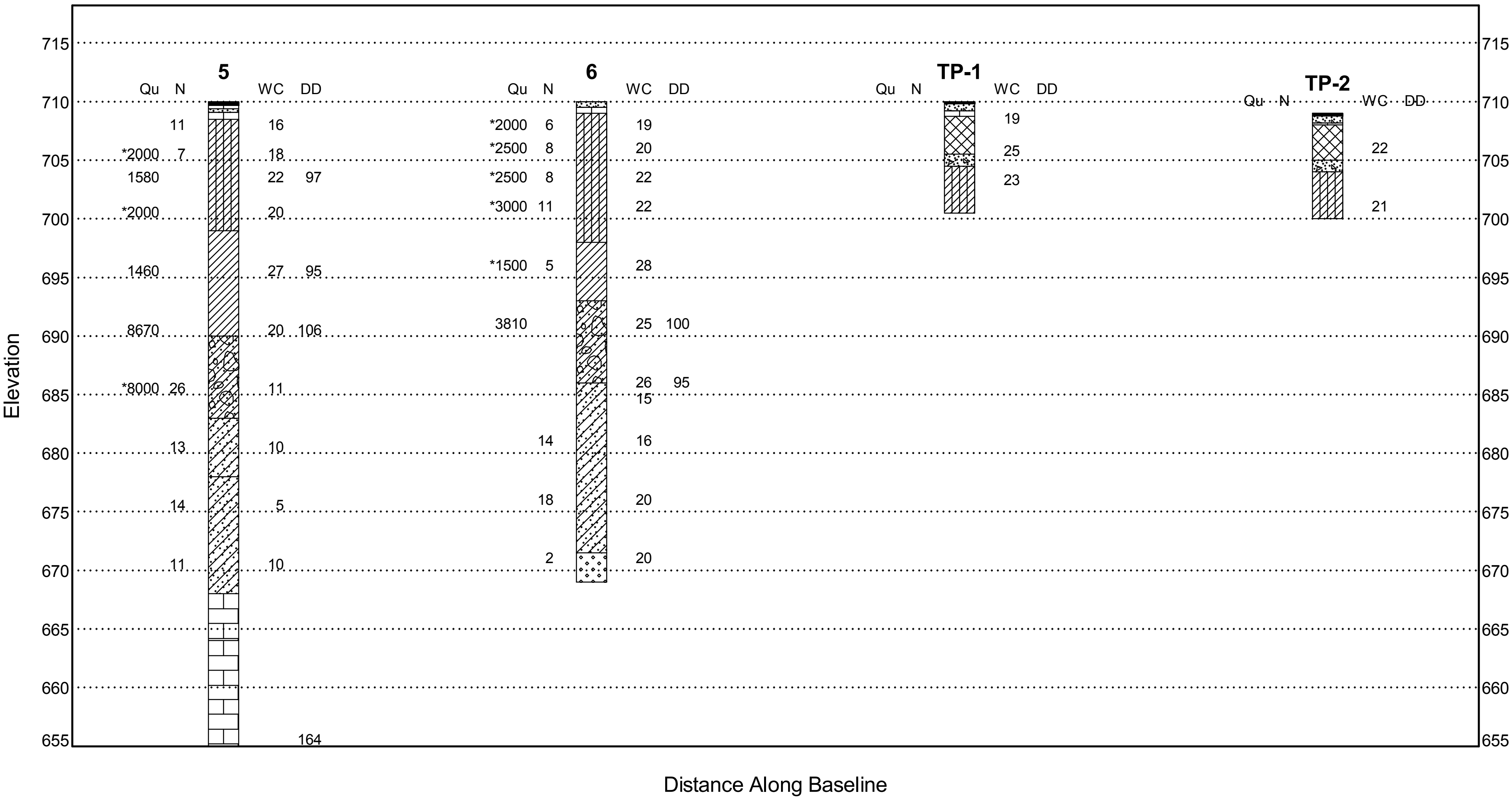
FIG. NO.

A-2



SUBSURFACE SOIL PROFILE Exhibit A-3		
VA Medical Center Parking Ramp SEQ of U.S. Highway 6 & Woolf Avenue Iowa City, Iowa		
TI NO. 06105627	DATE Jan 11	PLATE 1

Terracon



SUBSURFACE SOIL PROFILE Exhibit A-3		
VA Medical Center Parking Ramp SEQ of U.S. Highway 6 & Woolf Avenue Iowa City, Iowa		
TI NO. 06105627	DATE Jan 11	PLATE 2

Terracon

LOG OF BORING NO. 1

CLIENT **Loebl Schlossman & Hackl**	OWNER **U.S. Department of Veterans Affairs**
SITE **SEQ of U.S. Highway 6 & Woolf Avenue Iowa City, Iowa**	PROJECT **VA Medical Center Parking Ramp**

DESCRIPTION (Approx. Surface Elevation.: 710 ft)	DEPTH, ft.	USCS SYMBOL	SAMPLES: NUMBER	TYPE	RECOVERY, in.	SPT - N ** BLOWS / ft	TESTS: WATER CONTENT, %	DRY UNIT WT pcf	UNCONFINED STRENGTH, psf
2" Asphaltic Concrete over 6" Portland Cement Concrete over 4-1/4" Crushed Limestone				HS					
			1	SS	6	5	21		
				HS					
FILL, LEAN CLAY TO SILTY CLAY, TRACE SAND, Brown Gray	5		2	SS	7	3	24		
				HS					
			3	SS	14	4	25		
				HS					
	10		4	SS	16	1	25		
				HS					
13.5 — 696.5									
	15	CL	5	SS	12	3	27		*1000
LEAN CLAY, TRACE SAND & GRAVEL, Gray, Soft to Medium Stiff				HS					
	20	CL	6	SS	18	6	21		*2000
				HS					
22 — 688									
CLAYEY FINE TO MEDIUM SAND, TRACE GRAVEL, Brown, Medium Dense	25	SC	7	SS	18	15	20		
				HS					
27 — 683									
SANDY LEAN CLAY, TRACE GRAVEL, Brown Gray, Stiff	30	CL	8	SS	18	9	20		*3000
				HS					
32 — 678									

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 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
WL	∇ 42	WD	▼
WL	▼ Backfilled		▼
WL	Exhibit A-4		

Terracon

BORING STARTED	11-12-10		
BORING COMPLETED	11-12-10		
RIG	928	FOREMAN	MW
APPROVED	SDG	JOB #	06105627

LOG OF BORING NO. 1

CLIENT Loebl Schlossman & Hackl	OWNER U.S. Department of Veterans Affairs
SITE SEQ of U.S. Highway 6 & Woolf Avenue Iowa City, Iowa	PROJECT VA Medical Center Parking Ramp

DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES: NUMBER	TYPE	RECOVERY, in.	SPT - N ** BLOWS / ft	TESTS: WATER CONTENT, %	DRY UNIT WT pcf	UNCONFINED STRENGTH, psf
MEDIUM TO COARSE SAND WITH GRAVEL, TRACE SILT, Brown, Medium Dense				HS					
	35	SP	9	SS	8	19	4		
				HS					
	40	SP	10	SS	6	14			
▽				HS					
45 (665)	45	SP	11	SS	12	15	13 18		
*** **HIGHLY WEATHERED & BROKEN LIMESTONE**, Brown Gray, Medium Hardness, Very Close to Close Joints, Clay filled in some joints				HS					
Practical Auger Refusal @ about 49 feet. 51 (659)	50		R1	DB	79%	RQD 0%			
*** **MODERATELY WEATHERED LIMESTONE**, Light Gray, Moderately Hard, Close Joints 56 (654)	55		R2	DB	100%	RQD 40%			
*** **SLIGHTLY WEATHERED LIMESTONE**, Gray, Hard, Close to Moderately Close Joints 59 (651)			R3	DB	100%	RQD 86%			

BOTTOM OF BORING

*** Classification estimated from disturbed and core samples. Petrographic analysis may reveal other rock types.

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

*Calibrated Hand Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
WL	▽ 42	WD	▼
WL	▼ Backfilled		▼
WL	Exhibit A-4		

Terracon

BORING STARTED	11-12-10		
BORING COMPLETED	11-12-10		
RIG	928	FOREMAN	MW
APPROVED	SDG	JOB #	06105627

LOG OF BORING NO. 2

CLIENT	OWNER
Loebl Schlossman & Hackl	U.S. Department of Veterans Affairs
SITE SEQ of U.S. Highway 6 & Woolf Avenue, Iowa City, Iowa	PROJECT VA Medical Center Parking Ramp

DESCRIPTION (Approx. Surface Elevation.: 710 ft)	DEPTH, ft.	USCS SYMBOL	SAMPLES: NUMBER	TYPE	RECOVERY, in.	SPT - N ** BLOWS / ft	TESTS: WATER CONTENT, %	DRY UNIT WT pcf	UNCONFINED STRENGTH, psf
4" Asphaltic Concrete over 8" Crushed Limestone				PA					
SILTY CLAY, TRACE SAND, Brown, Stiff		CL/ML	1	SS	12	9	23		
		CL/ML	2	ST	10		21	99	2630
	5			PA					
		CL/ML	3	ST	7		20	99	2610
8 — 702				PA					
SILT WITH SAND, Brown, Soft		ML	4	ST	17		11	92	790
	10			WB					
13.5 — 696.5									
LEAN CLAY, TRACE SAND, Gray, Medium Stiff		CL	5	ST	16		25	97	1440
	15			WB					
		CL	6	ST	18		27	94	1670
	20			WB					
22 — 688									
SANDY LEAN CLAY, TRACE GRAVEL, Brown, Stiff		CL	7	SS	17	9	24		*3000
	25			WB					
27 — 683									
CLAYEY FINE TO MEDIUM SAND, TRACE GRAVEL, Brown, Medium Dense		SC	8	SS	18	19	20		
	30			WB					
32 — 678									

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 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft		
WL	NONE	WD
WL	Backfilled	
WL	Exhibit A-4	

Terracon

BORING STARTED	11-11-10
BORING COMPLETED	11-11-10
RIG 928	FOREMAN MW
APPROVED SDG	JOB # 06105627

LOG OF BORING NO. 2

CLIENT **Loebl Schlossman & Hackl**

OWNER **U.S. Department of Veterans Affairs**

SITE **SEQ of U.S. Highway 6 & Woolf Avenue, Iowa City, Iowa**

PROJECT **VA Medical Center Parking Ramp**

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
SANDY LEAN CLAY, TRACE GRAVEL, Brown Gray, Stiff				WB					
		CL	9	SS	18	9	22		*2500
	35			WB					
		CL	10	SS	18	10	26		*3000
	40			WB					
42 — 668									
CLAYEY FINE TO MEDIUM SAND, TRACE GRAVEL, Brown Gray, Loose		SC	11	SS	18	5	20		
	45			WB					
48.5 — 661.5									
*** **HIGHLY WEATHERED & BROKEN LIMESTONE**, Light Gray			12	SS	4	50/4"	12		
49.5 — 660.5									

Practical Sampler Refusal @ about 49.5 feet.
BOTTOM OF BORING

*** Classification estimated from disturbed samples. Core samples and petrographic analysis may reveal other rock types.

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

*Calibrated Hand Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
WL	▽ NONE	WD ▼	
WL	▼ Backfilled	▽	
WL	Exhibit A-4		

Terracon

BORING STARTED	11-11-10		
BORING COMPLETED	11-11-10		
RIG	928	FOREMAN	MW
APPROVED	SDG	JOB #	06105627

LOG OF BORING NO. 3

CLIENT: **Loebl Schlossman & Hackl**

OWNER: **U.S. Department of Veterans Affairs**

SITE: **SEQ of U.S. Highway 6 & Woolf Avenue, Iowa City, Iowa**

PROJECT: **VA Medical Center Parking Ramp**

Approx. Surface Elevation.: 709 ft

DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES: NUMBER	TYPE	RECOVERY, in.	SPT - N ** BLOWS / ft	TESTS: WATER CONTENT, %	DRY UNIT WT pcf	UNCONFINED STRENGTH, psf
2" Asphaltic Concrete over 4" Portland Cement Concrete over 6" Crushed Limestone				PA					
		CL/ML	1	SS	12	5	24		*1500
		CL/ML	2	ST	3		20		*2000
SILTY CLAY, TRACE SAND, Gray Brown, Medium Stiff	5			PA					
		CL/ML	3	ST	9		21	96	1380
				PA					
		CL/ML	4	ST	20		23	100	1510
	10			WB					
13.5 — 695.5									
LEAN CLAY, TRACE SAND, Brown, Medium Stiff		CL	5	SS	18	3	24		*1500
	15			WB					
18 — 691									
SANDY LEAN CLAY, TRACE GRAVEL, Brown, Medium Stiff to Stiff		CL	6	SS	16	7	22		*2000
	20			WB					
		CL	7	SS	18	10	22		*3000
	25			WB					
27 — 682									
CLAYEY FINE TO MEDIUM SAND, Tan Brown, Medium Dense		SC	8	SS	0	11			
	30			WB					
32 — 677									

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 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft		
WL	NONE	WD
WL	Backfilled	
WL	Exhibit A-4	

Terracon

BORING STARTED	11-11-10		
BORING COMPLETED	11-12-10		
RIG	928	FOREMAN	MW
APPROVED	SDG	JOB #	06105627

LOG OF BORING NO. 3

CLIENT	OWNER
Loebl Schlossman & Hackl	U.S. Department of Veterans Affairs
SITE SEQ of U.S. Highway 6 & Woolf Avenue, Iowa City, Iowa	PROJECT VA Medical Center Parking Ramp

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, Brown Gray, Stiff				WB					
		CL	9	SS	18	11	20		*3000
36 — 673	35			WB					
MEDIUM TO COARSE SAND WITH GRAVEL, TRACE SILT, Dark Brown Gray, Medium Dense		SP	10	SS	14	24	17		
42 — 667	40			WB					
FINE TO COARSE SAND, TRACE SILT & GRAVEL, Brown, Medium Dense		SP	11	SS	6	14	13		
46 — 663	45			WB					

Practical Auger Refusal @ about 46 feet on apparent highly weathered limestone.
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 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
WL	NONE	WD	
WL	Backfilled		
WL	Exhibit A-4		

Terracon

BORING STARTED	11-11-10		
BORING COMPLETED	11-12-10		
RIG	928	FOREMAN	MW
APPROVED	SDG	JOB #	06105627

LOG OF BORING NO. 4

CLIENT **Loebl Schlossman & Hackl**	OWNER **U.S. Department of Veterans Affairs**
SITE **SEQ of U.S. Highway 6 & Woolf Avenue Iowa City, Iowa**	PROJECT **VA Medical Center Parking Ramp**

Approx. Surface Elevation.: 710 ft

Depth / Elev.	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
	4" Asphaltic Concrete over 8" Crushed Limestone				HS					
			CL/ML	1	SS	11	6	21		
	SILTY CLAY, TRACE SAND, Gray Brown, Medium Stiff		CL/ML	2	ST	4		22	98	1290
		5			HS					
			CL/ML	3	ST	20		21	99	1320
					HS					
			CL/ML	4	ST	20		22	98	1360
13.5 / 696.5		10			WB					
	LEAN CLAY, TRACE SAND, Gray Brown, Medium Stiff		CL	5	ST	16		25	98	*1000
17.5 / 692.5		15			WB					
	SANDY LEAN CLAY, TRACE GRAVEL, Brown, Medium Stiff		CL	6	ST	18		19	105	1850
24 / 686		20			WB					
	CLAYEY FINE TO MEDIUM SAND, Tan Brown, Medium Dense		CL	7	ST	17		22	102	1380
		25			WB					
			SC	8	SS	14	13	15		
32 / 678		30			WB					

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 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
WL	∇ NONE	WD	▼
WL	▼ Backfilled		∇
WL	Exhibit A-4		

Terracon

BORING STARTED	11-11-10		
BORING COMPLETED	11-11-10		
RIG	928	FOREMAN	MW
APPROVED	SDG	JOB #	06105627

LOG OF BORING NO. 4

CLIENT Loebl Schlossman & Hackl	OWNER U.S. Department of Veterans Affairs
SITE SEQ of U.S. Highway 6 & Woolf Avenue, Iowa City, Iowa	PROJECT VA Medical Center Parking Ramp

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
	SANDY LEAN CLAY, TRACE GRAVEL, Gray Brown, Stiff				WB					
			CL	9	SS	13	9	20		*3000
		35			WB					
37	673									
	CLAYEY FINE TO MEDIUM SAND WITH GRAVEL, Brown Gray, Medium Dense		SC	10	SS	8	21	19		
		40			WB					
			SC	11	SS	0	11			
		45			WB					
47	663									
	*** **HIGHLY WEATHERED & BROKEN LIMESTONE**, Gray			12	SS	0	50/0"			
49	661									

Practical Auger Refusal @ about 49 feet.
BOTTOM OF BORING

*** Classification estimated from disturbed samples. Core samples and petrographic analysis may reveal other rock types.

NOTE: Lost 100% drilling fluid between the depth interval of about 46 and 49 feet below grade.

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

*Calibrated Hand Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
WL	NONE	WD	
WL	Backfilled		
WL	Exhibit A-4		

Terracon

BORING STARTED	11-11-10		
BORING COMPLETED	11-11-10		
RIG	928	FOREMAN	MW
APPROVED	SDG	JOB #	06105627

LOG OF BORING NO. 5

CLIENT **Loebl Schlossman & Hackl**

OWNER **U.S. Department of Veterans Affairs**

SITE **SEQ of U.S. Highway 6 & Woolf Avenue Iowa City, Iowa**

PROJECT **VA Medical Center Parking Ramp**

Approx. Surface Elevation.: 710 ft

DESCRIPTION	Depth (ft) / Elev.	USCS SYMBOL	NUMBER	TYPE	RECOVERY, in.	SPT - N ** BLOWS / ft	WATER CONTENT, %	DRY UNIT WT pcf	UNCONFINED STRENGTH, psf
3" Asphaltic Concrete over 3" Crushed Limestone over 3" Portland Cement Concrete over 9" Crushed Limestone				HS					
		CL/ML	1	SS	13	11	16		
SILTY CLAY, TRACE SAND, Brown, Medium Stiff				HS					
		CL/ML	2	SS	10	7	18		*2000
				HS					
		CL/ML	3	ST	17		22	97	1580
				HS					
	11 / 699	CL/ML	4	ST	3		20		*2000
LEAN CLAY, TRACE SAND, Brown, Medium Stiff to Hard				HS					
		CL	5	ST	16		27	95	1460
				HS					
	20 / 690	CL	6	ST	12		20	106	8670
SANDY LEAN CLAY, TRACE GRAVEL, Gray, Very Stiff to Hard				HS					
	27 / 683	CL	7	SS	18	26	11		*8000
CLAYEY FINE TO MEDIUM SAND, Brown Gray, Medium Dense				HS					
		SC	8	SS	16	13	10		
	32 / 678			HS					

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 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
WL	NONE	WD	
WL	Backfilled		
WL	Exhibit A-4		

Terracon

BORING STARTED	11-11-10		
BORING COMPLETED	11-11-10		
RIG	928	FOREMAN	MW
APPROVED	SDG	JOB #	06105627

LOG OF BORING NO. 5

CLIENT: Loebl Schlossman & Hackl	OWNER: U.S. Department of Veterans Affairs
SITE: SEQ of U.S. Highway 6 & Woolf Avenue, Iowa City, Iowa	PROJECT: VA Medical Center Parking Ramp

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
	CLAYEY FINE TO MEDIUM SAND, TRACE GRAVEL, Brown Gray, Medium Dense				HS					
		35	SC	9	SS	18	14	5		
					HS					
		40	SC	10	SS	12	11	10		
					HS					
	42 — 668									
	*** **HIGHLY WEATHERED & BROKEN LIMESTONE**, Gray, Medium Hard, Very Close Open Joints	45		R1	DB	25%	RQD 0%			
	46 — 664									
	*** **MODERATELY WEATHERED LIMESTONE**, Gray, Hard, Close Joints	50		R2	DB	90%	RQD 60%			
	51 — 659									
	*** **SLIGHTLY WEATHERED LIMESTONE**, Gray, Hard, Close to Moderately Close Joints	55		R3	DB	87%	RQD 83%			
	55 — 655									

BOTTOM OF BORING

*** Classification estimated from disturbed and core samples. Petrographic analysis may reveal other rock types.

NOTE: Lost drilling fluid between the depth interval of about 42 and 46 feet below grade.

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

*Calibrated Hand Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
WL	∇ NONE	WD	▼
WL	▼ Backfilled		▼
WL	Exhibit A-4		

Terracon

BORING STARTED	11-11-10		
BORING COMPLETED	11-11-10		
RIG	928	FOREMAN	MW
APPROVED	SDG	JOB #	06105627

BOREHOLE 06105627.GPJ TERRACON.GDT 1/4/11

LOG OF BORING NO. 6

CLIENT **Loebl Schlossman & Hackl**	OWNER **U.S. Department of Veterans Affairs**
SITE **SEQ of U.S. Highway 6 & Woolf Avenue Iowa City, Iowa**	PROJECT **VA Medical Center Parking Ramp**

GRAPHIC LOG	DESCRIPTION Approx. Surface Elevation.: 710 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" Asphaltic Concrete over 6" Crushed Limestone				PA					
			CL/ML	1	SS	9	6	19		*2000
	SILTY CLAY, TRACE SAND, Brown Gray, Medium Stiff to Stiff				PA					
			CL/ML	2	SS	12	8	20		*2500
		5			PA					
			CL/ML	3	SS	14	8	22		*2500
					WB					
			CL/ML	4	SS	16	11	22		*3000
		10			WB					
	12 — 698									
	LEAN CLAY, TRACE SAND, Gray, Medium Stiff		CL	5	SS	18	5	28		*1500
		15			WB					
	17 — 693									
	SANDY LEAN CLAY, TRACE GRAVEL, Brown Gray, Stiff		CL	6	ST	14		25	100	3810
		20			WB					
	24 — 686		CL	7	ST	21		26	95	
	CLAYEY FINE TO MEDIUM SAND, Gray, Medium Dense	25	SC					15		
					WB					
			SC	8	SS	13	14	16		
		30			WB					

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 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
WL	NONE	WD	
WL	Backfilled		
WL	Exhibit A-4		

Terracon

BORING STARTED	11-12-10		
BORING COMPLETED	11-12-10		
RIG	928	FOREMAN	MW
APPROVED	SDG	JOB #	06105627

LOG OF BORING NO. 6

CLIENT	OWNER
Loebl Schlossman & Hackl	U.S. Department of Veterans Affairs
SITE SEQ of U.S. Highway 6 & Woolf Avenue, Iowa City, Iowa	PROJECT VA Medical Center Parking Ramp

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
	CLAYEY FINE TO MEDIUM SAND, Gray, Medium Dense				WB					
			SC	9	SS	12	18	20		
		35			WB					
38.5		671.5								
	FINE TO COARSE SAND WITH GRAVEL & LIMESTONE FRAGMENTS, Brown and Gray Brown, Very Loose		SW	10	SS	8	2	20		
		40			WB					
41		669								

Practical Auger Refusal @ about 41 feet on apparent highly weathered limestone.
BOTTOM OF BORING

NOTE: Lost 100% drilling fluid between the depth interval of about 39.5 and 41 feet below grade.

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

*Calibrated Hand Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
WL	NONE	WD	
WL	Backfilled		
WL	Exhibit A-4		

Terracon

BORING STARTED	11-12-10		
BORING COMPLETED	11-12-10		
RIG	928	FOREMAN	MW
APPROVED	SDG	JOB #	06105627

LOG OF BORING NO. TP-1

CLIENT **Loebl Schlossman & Hackl**	OWNER **U.S. Department of Veterans Affairs**
SITE **SEQ of U.S. Highway 6 & Woolf Avenue Iowa City, Iowa**	PROJECT **VA Medical Center Parking Ramp**

GRAPHIC LOG	DESCRIPTION Approx. Surface Elevation.: 710 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, psi
	2" Asphaltic Cement Concrete over 6" Portland Cement Concrete over 8" Crushed Limestone					HA					
	FILL, LEAN CLAY TO SILTY CLAY, TRACE SAND, GRAVEL & ORGANICS,				1	AS			19		
4.5	Green Gray and Dark Brown	705.5			2	AS			25		
5.5	**FOOTING FOR RETAINING WALL**	704.5	5								
	LEAN CLAY TO SILTY CLAY, TRACE SAND, Brown Gray, Mottled			CL/ML	3	AS			23		
9.5		700.5									
	BOTTOM OF TEST PIT										

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

*Calibrated Hand Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
WL	▽ NONE	WD	▼
WL	▼ Backfilled		▼
WL	Exhibit A-4		

Terracon

BORING STARTED	1-17-11		
BORING COMPLETED	1-17-11		
RIG	HA	FOREMAN	CM
APPROVED	SDG	JOB #	06105627

LOG OF BORING NO. TP-2

CLIENT **Loebl Schlossman & Hackl**	OWNER **U.S. Department of Veterans Affairs**
SITE **SEQ of U.S. Highway 6 & Woolf Avenue Iowa City, Iowa**	PROJECT **VA Medical Center Parking Ramp**

Approx. Surface Elevation.: 709 ft

GRAPHIC LOG (depth, ft)	DESCRIPTION	Elev., 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, psi
	2" Asphaltic Cement Concrete over 6" Portland Cement Concrete over 6" Crushed Limestone					HA					
4	**FILL, LEAN CLAY WITH SAND TO SILTY CLAY, TRACE GRAVEL**, Brown	705			1	AS			22		
5	**FOOTING FOR RETAINING WALL**	704	5								
9	**SILTY CLAY, TRACE SAND**, Brown	700		CL/ML	2	AS			21		
	BOTTOM OF TEST PIT										

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

*Calibrated Hand Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft		
WL	▽ NONE	WD ▼
WL	▼ Backfilled	▽
WL	Exhibit A-4	

Terracon

BORING STARTED	1-17-11		
BORING COMPLETED	1-17-11		
RIG	HA	FOREMAN	CM
APPROVED	SDG	JOB #	06105627

Field Exploration Description

The soil boring locations were laid out on the site by the VA personnel at the approximate locations requested by Walker Parking Consultants, with the exception of Boring B-6, which was offset by Terracon's drill crew due to the canopy of the existing drop-off lane. Distances from these locations to the reference features indicated on the attached Boring Location Plan are approximate and were estimated. Right angles for the boring location measurements were estimated. The ground surface elevations indicated on the boring logs are also approximate (rounded to the nearest 1 foot), and were obtained by Terracon personnel by interpolating between the contours of the supplied topographic contour map. True surface elevations at the boring locations could differ due to interpolation, and other differences could occur from superposing approximate boring locations.

The borings were drilled with a truck-mounted rotary drill rig using continuous flight hollow-stem augers, wash boring procedures and/or diamond bit coring procedures to advance the boreholes. Samples of the soil encountered in the borings were obtained using the split barrel and thin-walled tube sampling procedures. In the split-barrel sampling procedure, the number of blows required to advance a standard 2-inch O.D. split-barrel sampler the last 12 inches of the typical total 18-inch penetration by means of a C.M.E. automatic hammer with a free fall of 30 inches, is the standard penetration resistance value (SPT-N). This value is used to estimate the in-situ relative density of cohesionless soils and consistency of cohesive soils. In the thin-walled tube sampling procedure, a thin-walled, seamless steel tube with a sharp cutting edge is pushed hydraulically into the soil to obtain a relatively undisturbed sample.

An NQ2-sized core barrel (~1-7/8-inch I.D.) was used for Borings B-1 and B-5 on this project. After the core samples were retrieved, they were placed in a core box and visually classified by Terracon personnel. The "percent recovery" and rock quality designation (RQD) was determined for each run. The "percent recovery" indicated on the boring logs is the ratio of the sample length retrieved to the drilled length, expressed as a percent. An indication of the actual in-situ rock quality is provided by calculating the sample's RQD. The RQD is the percentage of the length of broken cores retrieved which have core segments at least 4 inches in length compared to each drilled length. The percent recovery and RQD are commonly related to rock soundness and quality is provided in Appendix C of this report. Classification and descriptions of rock core samples are in accordance with the enclosed General Notes, and are based on visual and tactile observations. Petrographic analysis of thin sections may indicate other rock types, and can be performed upon request.

The samples were tagged for identification, sealed to reduce moisture loss, and taken to our laboratory for further examination, testing, and classification. Information provided on the boring logs attached to this report includes soil descriptions, consistency evaluations, boring depths, sampling intervals, and groundwater conditions. The borings were backfilled with auger cuttings and the pavements patched prior to the drill crew leaving the site.

A field log of each boring was prepared by the drill crew. These logs 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 the engineer's interpretation of the field logs and include modifications based on laboratory observation and tests of the samples.

APPENDIX B
LABORATORY TESTING

Laboratory Testing

Soil samples were tested in our laboratory to measure their natural water contents. Dry unit weight determinations and unconfined compression tests were performed on selected portions of thin-wall tube samples, and a calibrated hand penetrometer was used to estimate the approximate unconfined compressive strength of some cohesive samples. The calibrated hand penetrometer has been correlated with unconfined compression tests and provides a better estimate of soil consistency than visual examination alone. The test results are provided on the boring logs included in Appendix A.

Descriptive classifications of the soils indicated on the boring logs are in accordance with the enclosed General Notes and the Unified Soil Classification System. Also shown are estimated Unified Soil Classification Symbols. A brief description of this classification system is attached to this report. All classification was by visual manual procedures. Classification and descriptions of rock core samples are in accordance with the enclosed General Notes, and are based on visual and tactile observations.

APPENDIX C
SUPPORTING DOCUMENTS

GENERAL NOTES

DRILLING & SAMPLING SYMBOLS:

SS:	Split Spoon – 1-$^{3}/_{8}$" I.D., 2" O.D., unless otherwise noted	HS:	Hollow Stem Auger
ST:	Thin-Walled Tube - 2" O.D., unless otherwise noted	PA:	Power Auger
RS:	Ring Sampler - 2.42" I.D., 3" O.D., unless otherwise noted	HA:	Hand Auger
DB:	Diamond Bit Coring - 4", N, B	RB:	Rock Bit
BS:	Bulk Sample or Auger Sample	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	WS:	While Sampling	N/E:	Not Encountered
WCI:	Wet Cave in	WD:	While Drilling		
DCI:	Dry Cave in	BCR:	Before Casing Removal		
AB:	After Boring	ACR:	After Casing Removal		

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 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
1,001 – 2,000	4 – 8	Medium Stiff
2,001 – 4,000	8 – 15	Stiff
4,001 – 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 – 49	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 75 mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm 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
Modifiers	> 12

PLASTICITY DESCRIPTION

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

GENERAL NOTES

Sedimentary Rock Classification

DESCRIPTIVE ROCK CLASSIFICATION:

Sedimentary rocks are composed of cemented clay, silt and sand sized particles. The most common minerals are clay, quartz and calcite. Rock composed primarily of calcite is called limestone; rock of sand size grains is called sandstone, and rock of clay and silt size grains is called mudstone or claystone, siltstone, or shale. Modifiers such as shaly, sandy, dolomitic, calcareous, carbonaceous, etc. are used to describe various constituents. Examples: sandy shale; calcareous sandstone.

LIMESTONE	Light to dark colored, crystalline to fine-grained texture, composed of $CaCo_3$, reacts readily with HCl.
DOLOMITE	Light to dark colored, crystalline to fine-grained texture, composed of $CaMg(CO_3)_2$, harder than limestone, reacts with HCl when powdered.
CHERT	Light to dark colored, very fine-grained texture, composed of micro-crystalline quartz ($Si0_2$), brittle, breaks into angular fragments, will scratch glass.
SHALE	Very fine-grained texture, composed of consolidated silt or clay, bedded in thin layers. The unlaminated equivalent is frequently referred to as siltstone, claystone or mudstone.
SANDSTONE	Usually light colored, coarse to fine texture, composed of cemented sand size grains of quartz, feldspar, etc. Cement usually is silica but may be such minerals as calcite, iron-oxide, or some other carbonate.
CONGLOMERATE	Rounded rock fragments of variable mineralogy varying in size from near sand to boulder size but usually pebble to cobble size (½ inch to 6 inches). Cemented together with various cementing agents. Breccia is similar but composed of angular, fractured rock particles cemented together.

PHYSICAL PROPERTIES:

DEGREE OF WEATHERING

Slight	Slight decomposition of parent material on joints. May be color change.
Moderate	Some decomposition and color change throughout.
High	Rock highly decomposed, may be extremely broken.

HARDNESS AND DEGREE OF CEMENTATION

Limestone and Dolomite:

Hard	Difficult to scratch with knife.
Moderately Hard	Can be scratched easily with knife, cannot be scratched with fingernail.
Soft	Can be scratched with fingernail.

Shale, Siltstone and Claystone

Hard	Can be scratched easily with knife, cannot be scratched with fingernail.
Moderately Hard	Can be scratched with fingernail.
Soft	Can be easily dented but not molded with fingers.

Sandstone and Conglomerate

Well Cemented	Capable of scratching a knife blade.
Cemented	Can be scratched with knife.
Poorly Cemented	Can be broken apart easily with fingers.

BEDDING AND JOINT CHARACTERISTICS

Bed Thickness	Joint Spacing	Dimensions
Very Thick	Very Wide	>10′
Thick	Wide	3′ - 10′
Medium	Moderately Close	1′ - 3′
Thin	Close	2″ - 1′
Very Thin	Very Close	.4″ - 2″
Laminated	—	.1″ - .4″

Bedding Plane	A plane dividing sedimentary rocks of the same or different lithology.
Joint	Fracture in rock, generally more or less vertical or transverse to bedding, along which no appreciable movement has occurred.
Seam	Generally applies to bedding plane with an unspecified degree of weathering.

SOLUTION AND VOID CONDITIONS

Solid	Contains no voids.
Vuggy (Pitted)	Rock having small solution pits or cavities up to ½ inch diameter, frequently with a mineral lining.
Porous	Containing numerous voids, pores, or other openings, which may or may not interconnect.
Cavernous	Containing cavities or caverns, sometimes quite large.

Terracon

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]				Soil Classification: Group Symbol	Soil Classification: 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]	$Cu \geq 4$ and $1 \leq Cc \leq 3$ [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]	$Cu \geq 6$ and $1 \leq Cc \leq 3$ [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) / (Liquid limit - not dried) < 0.75	OL	Organic clay [K,L,M,N]
					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) / (Liquid limit - not dried) < 0.75	OH	Organic clay [K,L,M,P]
					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] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[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] $PI \geq 4$ 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.

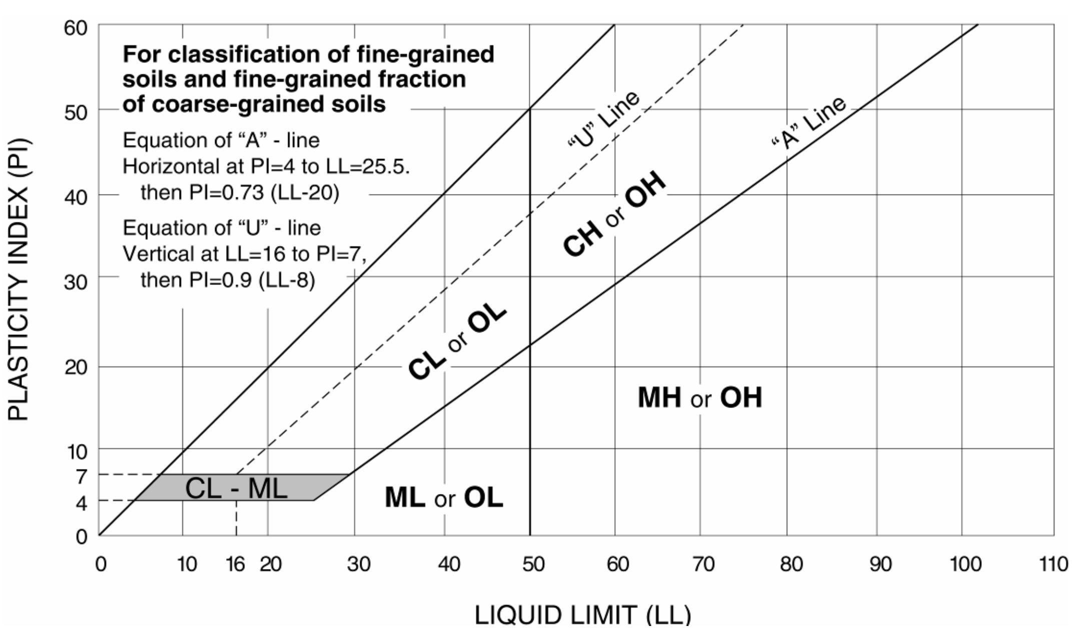


Exhibit C-3