REPORT OF GEOTECHNICAL EXPLORATION

BRIDGES HOUSING
HIGHWAY 6/34 AND S. SOUTHERN HILLS ROAD
NEAR HASTINGS, NEBRASKA

PREPARED FOR
STATE OF NEBRASKA

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INTRODUCTION

This report presents results of the geotechnical exploration performed for the proposed Bridges Housing northwest of the intersection between Highway 6/34 & S. Southern Hills Road, near Hastings, Nebraska. This exploration was authorized by the State of Nebraska.

The purpose of this geotechnical exploration was to evaluate the subsurface conditions at the site in order to provide conclusions and recommendations regarding the design of foundations and to provide construction guidelines with regard to other geotechnical aspects of the proposed development. The following scope of services was performed for this project:

- Drilled 6 soil test borings to depths ranging from 15 to 25 feet within the proposed building areas and performed laboratory tests on soil samples obtained during the drilling operations.
- Conducted a geotechnical engineering evaluation of the available data to provide recommendations regarding the anticipated construction on conventional shallow foundations.
- Prepared a report presenting all data, soil boring logs, observations and recommendations.

The scope of this exploration did not include any environmental assessment for the presence of wetlands and/or hazardous or toxic materials in the soil or groundwater on or near this site. Any statements in this report regarding odors, discoloration, or suspicious conditions are strictly for the information of our client.

This report was prepared by a professional engineer registered in the State of Nebraska with the firm of ***Olsson***. The conclusions and recommendations contained herein are based on generally accepted, professional, geotechnical engineering practice at the time of this report within this geographic area. No other warranty is expressed or implied. This report has been prepared for the exclusive use of ***Sinclair Hill Architects*** and the ***State of Nebraska*** with the specific application to the proposed project.

The following sections of this report include comments on issues related to foundation and pavement construction and earthwork, and related geotechnical aspects of the proposed construction. The recommendations contained herein are not intended to dictate construction methods or sequences. Instead, they are furnished solely to help designers identify potential construction problems related to foundation and earthwork plans and specifications, based upon findings derived from sampling. Depending upon the final design chosen for the project, the recommendations may also be useful to personnel who observe construction activity. Potential contractors for the project must evaluate potential construction problems on the basis of their review of the contract documents, their own knowledge of and experience in the local area, and on the basis of similar projects in other localities, taking into account their own proposed methods and procedures.

PROJECT INFORMATION

Site Location and Description

The proposed development is located northwest of the intersection between Highway 6/34 & S. Southern Hills Road, near Hastings, Nebraska. The approximate location of the site is depicted on the Site Location Plan included in Appendix A.

At the time of our field exploration, the majority of the existing ground surface in the area of the proposed improvements is currently covered with a cultivated agricultural field and slopes upward to the southwest with approximately 7 feet of relief across the development area. At the time of our drilling operations the ground surface was readily accessible with our truck-mounted drill rig.

Project Description

The project site is intended to be developed for three separate buildings. The proposed construction will consist of two single story, slab-on-grade buildings and one single-story structure with a walk out basement. The basement will be located under the entire building area. The purpose of this report was to evaluate the site as to its suitability for the proposed development.

Grading operations to reach the proposed first floor finished floor elevation of 1942.5 for building #1 will likely require a maximum fill depth of 6 feet and a maximum excavation depth of 5 feet to reach the basement finished floor elevation of 1932. A maximum structural fill placement depth of 1 foot and little to no excavation is anticipated to reach the finished floor elevation of 1936 for building #2. A maximum structural fill placement depth of 2 feet and little to no excavation is anticipated to reach the finished floor elevation of 1933 for building #3. The location of building #1, #2, and #3 are shown on the Boring Location Map in Appendix A.

Maximum column and continuous footing loads were also provided by ***R.O. Youker, Inc.*** as 20kips and 5 kips per foot, respectively.

EXPLORATORY AND TEST PROCEDURES

Field Exploration

The field exploration program consisted of performing 6 test borings at the approximate locations depicted on the Boring Location Plan (Appendix A). The boring locations were established in the field using existing reference points. Ground surface elevations were obtained by a topographic map provided by ***Olsson*** and rounded to the nearest foot. In general, the locations and elevations of the borings should be considered approximate.

The test borings were advanced to depths ranging from 15 to 25 feet with a truck-mounted drill rig using four-inch diameter continuous-flight augers. Soil samples were obtained at selected intervals in the test borings. Soil samples designated as "U" samples on the Boring Logs were obtained in general accordance with ASTM D-1587 (Thin-Walled Tube Sampling of Soils). Soil samples designated as “SS” samples were obtained in general accordance with ASTM D-1586 (Penetration Test and Split-Barrel Sampling of Soils). Recovered samples were extruded in the field, sealed in containers, labeled, and protected for transportation to the laboratory for testing.

Descriptions of the soils encountered in the test borings were prepared in general accordance with ASTM D-2488 (Visual-Manual Procedure for Description and Identification of Soils). Soil stratification, as shown on the Boring Logs, represents soil conditions at the boring locations; however, variations may occur between or around the boring locations. The lines of demarcation represent the approximate boundary between soil types, but the transition may be more gradual. Water level readings were obtained in the drill holes at the times and under conditions stated on the Boring Logs.

Laboratory Testing

The laboratory testing program was established to evaluate the engineering properties of the recovered soil samples. Moisture content tests and density determinations were used to determine the existing moisture/density state of the soils. Unconfined compression tests and unconsolidated undrained (UU) triaxial tests were used to define the stress-strain characteristics and related shear strength of the cohesive soils. Two one-dimensional odometer tests were performed on selected samples to evaluate the consolidation and collapse characteristics. Two Atterberg limits test was conducted to aid in the classification of the soils under the Unified Soils Classification System. All tests were conducted in general accordance with current ASTM or state-of-the-art test procedures. A summary of the laboratory test results is presented in Appendix C.

SUBSURFACE CONDITIONS

Area Geology

This site lies in the dissected plains region of Nebraska. This region consists of hilly lands that have been eroded by water and wind. Typically, the upland areas are covered with a mantle of wind-deposited soils (loess) of various ages which overly sandstone and stream-deposited sands and gravels.

Test Boring Summary

The following soil types were encountered in the test borings performed at the site:

Developed Zone

A developed zone, approximately 6.0 inches thick, was encountered in all of the soil test borings, which consisted of variable amounts of organics and roots. It should be noted that the developed zone and material encountered is to be stripped and stockpiled outside of the construction area prior to the placement of the structural fill.

Peoria Loess

Soils identified as Peoria Loess were encountered in each soil test boring and extended to a depth ranging from 11.5 to 2.5 feet below the ground surface. The Peoria loess generally consisted of soft to very stiff, light yellowish brown to light brown, moist, mostly lean clay, some silt, trace fine sand and iron. Laboratory tests on recovered soil samples from this stratum indicated moisture contents ranging from 11.5 to 24.2 percent, dry densities ranging from 87.2 to 103.4 pounds per cubic foot (pcf), and an UU compressive strength of 1.8 tons per square foot (tsf). Atterberg limits tests conducted on samples of the Peoria loess resulted in a liquid limit ranging from 35 to 36 and a plasticity index ranging from 13 to 15. The standard penetration resistance blow counts (N) values obtained in the Peoria loess ranged from 3 to 14 blows per foot (bpf). The standard penetration resistance blow counts indicated a consistency ranging from soft to stiff within the Peoria loess.

Loveland Formation

Soils identified as Loveland were encountered in each soil test boring and extended to the base of boring. The Loveland generally consisted of firm to stiff, light reddish brown to dark brown mottled with dark greyish brown, moist, mostly silty clay with some fine to coarse sand and trace fat clay. Laboratory tests on recovered soil samples from this stratum indicated moisture contents ranging from 4.8 to 15.4 percent and dry densities ranging from 100.5 to 109.4 psf. The standard penetration resistance blow counts (N) values obtained in the Loveland ranged from 13 to 32 blows per foot (bpf). The standard penetration resistance blow counts indicated a consistency ranging from stiff to hard within the Loveland formation.

Groundwater Summary

Groundwater was not encountered in the soil test borings. Groundwater levels will fluctuate depending on seasonal variations of precipitation, runoff, and other factors and may occur at higher elevations at some time in the future. The *Drainage and Groundwater Consideration* section of this report will address any site drainage concerns.

CONCLUSIONS AND RECOMMENDATIONS

The conclusions and recommendations presented in the following sections of this report are based on the information available regarding the proposed construction, the results obtained from our soil test borings and laboratory tests, and our experience with similar projects. Because the soil test borings represent a very small statistical sampling of subsurface conditions, it is possible that conditions may be encountered during construction that are substantially different from those indicated by the soil test borings. In these instances adjustments to design and construction may be necessary.

This geotechnical report is based on the Site Plan and project information provided by ***Sinclair Hille and RO Youker*** and the assumptions stated in this report. Changes in the proposed location or design of the structure can have significant effects on the conclusions and recommendations of the geotechnical report. ***Olsson*** should be contacted in the event of such changes.

Site Preparation

In all new fill and excavation areas, deleterious materials deemed unsuitable by the full-time field observer shall be removed from the proposed construction areas, and replaced with controlled fill. Site clearing, grubbing, and stripping will need to be performed only during dry weather conditions. Operation of heavy equipment on the site during wet conditions could result in excessive rutting and mixing of organic debris with the underlying soils.

Based on the laboratory results, the Peoria loess was found to be collapsible upon saturation and will require remedial measures to meet the settlement requirements and bearing capacity recommendations provided in this report. From the results of the collapse test, if a 5-foot layer of the collapsible, low density soil would become saturated under the building, as much as 1.5 inches of settlement could occur. However, under the present moisture condition of the Peoria loess soils, settlement of the proposed structures should not exceed 0.5 inch of total movement.

Therefore, it is recommended the building areas first be overexcavated to an elevation listed in Table 1.

TABLE 1

BUILDING OVEREXCAVATION ELEVATION

Building	Overexcavation Elevation (feet)
Building #1	1926.25*
Building #2	1930**
Building #3	1927**

*-Six feet below the basement finished floor elevation of 1932.25

**-Six feet below the finished floor elevation of 1936 and 1933 for buildings 2 and 3, respectively

The core-out will not remove all of the collapsible loess, but will reduce the potential for surface water or leaking utility lines from penetrating into the underlying material by providing a layer of low permeability structural fill soil. Excavations for the building pad should be extended horizontally 10 feet beyond the perimeter of the building pad. The sides of the excavation should be sloped at a 1(H):1(V) to permit controlled earth fill to be placed against the sides of the excavations to the specified degree of compaction as stated in the *Structural Fill* section of this report. Backfill placed on sloped areas within the building area shall be “benched” horizontally a minimum of five feet into the side of the slope, so that the lifts of backfill are placed and compacted in as nearly a horizontal plane as possible. Each bench shall have a vertical height no greater than 2 feet with lifts placed and compacted as required. Lifts of backfill material shall be placed and compacted in such a fashion to allow overlying lifts to interlock with the underlying soils to reduce consolidation potential along the slope interface. A representative from ***Olsson*** should observe the building area to document conformance to the above recommendations.

Once the base of the core-out elevation has been reached, we recommend scarifying and recompacting the upper 12 inches of the exposed soil subgrade. The soil subgrade should be compacted to at least 98 percent of the maximum standard proctor dry density at a moisture content ranging from -3 to +3 percent of optimum. It is recommended that any areas to receive structural fill be proofrolled with a loaded dump truck, scraper, or similar rubber-tired equipment weighing at least 15 tons. Proofrolling operations should be observed by the on-site field representative to determine if any soft soil conditions are present.

To provide a working base in the core out area additional remedial measures may be necessary. Typical stabilization methods may include lifts of crushed stone material, either alone or in combination with geofabric or geogrid, overlying the soft soils. The identification of areas that may require undercutting and/or stabilization should be based on the actual conditions at the time of construction, and will depend on the location and extent of the soft area. It is recommended the appropriate proofrolling operation and stabilization method be determined after the core-out has been performed and depending on the visual observations noted during the core-out operation. An ***Olsson*** geotechnical engineer may elect to eliminate the proofrolling operation if subgrade conditions warrant.

The core out material is suitable for reuse as structural fill in the core out area. The core-out area should be backfilled in accordance with the *Structural Fill* - section of this report. The permanent fill should be placed and compacted in accordance with the recommendations stated in the *Structural Fill* section of this report.

Note: The possibility of changes to the moisture content of the soil below the building pads is ultimately dependent on site drainage and potential leakage of underground utility lines. It is our opinion that if the on-site employees closely monitor utility lines for possible leaks and storm runoff is adequately drained away from site facilities and structures, the risk of saturation of the underlying soils and collapse can be significantly reduced. If situations such as a leak in a pipe joint or ponding water resulting from poor site drainage is identified in close proximity to the buildings, the site grades should be modified or the repair of the leak fixed immediately. The risk of saturation is also dependent upon the pond's permanent pool elevation. At the time of the topographic survey, the water level was at 1926.4. If at any point the permanent pool elevation will be raised in the pond above elevation 1926.4, the geotechnical engineer should be consulted to determine if any remedial measures would be necessary.

Foundation Design

Based on the results of the soil test borings, laboratory testing and our engineering evaluation, it is our opinion that the subsurface conditions are suitable for supporting the buildings on a conventional shallow foundation system. Assuming the core out procedures in the *Site Preparation* section of this report are implemented and a basement finish floor elevation of 1932.25 for building #1 and a finished floor elevation of 1936 and 1933 for buildings #2 and #3, respectively, the interior and exterior foundations will be supported on new structural fill. Based on the above soil properties and assuming the recommendations above are followed, we recommend that building foundations be designed for a maximum net allowable soil bearing pressure of 2,000 psf.

The net allowable bearing pressure refers to the bearing pressure at foundation level in excess of the surrounding overburden pressure. Footings should have minimum dimensions in accordance with local building codes. Exterior footings and footings in unheated areas should bear at a minimum depth of 3½ feet below the lowest adjacent final ground surface. It is recommended that interior footings in heated areas bear at a depth as shallow as possible below the lowest adjacent final ground surface. The analyses for interior and exterior footings utilized bearing depths of 2 and 3½ feet, respectively, below the finished floor elevation.

Provided the recommendations contained in this report are followed, total post-construction settlements are anticipated to be less than 0.5 inch with differential settlements anticipated to be less than 0.25 inch. To reduce effects of differential settlement, a floating floor slab independent from the wall and column loads with expansion joints will be critical in minimizing the potential cracking that can occur along and around the proposed foundation system. Floor slab control joints should be used to reduce damage due to shrinkage cracks.

It is possible that some soils at the site will have an allowable soil bearing pressure less than the recommended design value. Therefore, foundation bearing surface inspections should be performed by an ***Olsson*** representative during footing construction to aid in the identification of such soils. After foundation subgrades have been observed and documented and any required remedial measures are performed, concrete should be placed as quickly as possible to avoid exposure of the foundation subsoils to wetting, drying or freezing. If soils in the areas of foundation support are subjected to such conditions, the footings should be reevaluated.

Floor Slab Subgrade Preparation

The soil subgrade in the areas of concrete slab-on-grade support is often disturbed during foundation and superstructure construction. Additionally, floor slab areas are often disturbed by construction equipment traffic between the time of initial grading and final construction. To prepare the floor slab subgrade, the top 12 inches of the subgrade in the building area should be compacted to a minimum of 98 percent of the maximum dry density as determined by the standard Proctor test (ASTM D698-91). The moisture content should also be controlled between -1 and +3 percent of the materials optimum. The final subgrade should be proofrolled and evaluated by a field representative immediately prior to placement of the concrete to detect any localized areas of instability. If required, the methods of stabilization will typically include the use of crushed stone and/or a geosynthetic fabric or grid installed over the soft soils. The identification of areas that may require undercutting and/or stabilization should be based on the actual conditions at the time of construction, and will depend on the location and extent of the soft area.

To reduce the potential for moisture leaching from the concrete after placement, it is also recommended that enough water be added to nearly saturate the granular cushion (if used). The granular cushion should be compacted to a minimum of 70 percent of the materials relative density. Laboratory maximum and minimum index density for the relative density tests should be performed in accordance with ASTM D4253 and D4254. If these recommendations are implemented, a subgrade modulus of at least 125 psi/in for the floor slab design is acceptable.

Structural Fill

During construction, we recommend that new structural fill materials have a liquid limit less than 45 and a plasticity index less than 25. Highly plastic silt (MH) or clay (CH) fill soils should not be placed within the upper 4 feet of the final ground elevation. Soils which have a liquid limit greater than 45 and a plasticity index greater than 25 will typically require removal or blending with less plastic materials to produce lower Atterberg limits. In addition to the plasticity characteristics, the fill soils should be relatively free of organic materials (less than about two hundredths of a percent by weight) or other deleterious materials and should not contain particle sizes larger than 3 inches.

During grading operations, representative samples of structural fill materials proposed for import to the site should be periodically checked via laboratory testing. A full-time representative from the testing agency should be on site to monitor excavation and grading operation as well as the suitability of fill materials. Any imported fill material should be tested prior to placement at the site to document compliance with the criteria stated in this section of the report.

Suitable fill material should be placed in thin lifts (lift thickness depends on type of compaction equipment, but in general, lifts of 8-inch loose measurement are recommended). The soil should be compacted using a sheepsfoot roller (static or vibratory) or similar equipment capable of achieving the specified compaction recommendations. Within small excavations, such as in utility trenches (less than 24 inches in width), around manholes, or behind retaining walls, we recommend the use of "wacker packers", "Rammax" compactors or vibrating plate compactors to achieve the specified compaction. Maximum loose lift thicknesses of 4-inches are recommended in small fill areas.

Some of the borrow soils which will be obtained from cut areas at the site will likely be significantly below their optimum moisture content and will require the application of water to meet the structural fill specifications.

We recommend that structural fill and backfill be placed and compacted in accordance with the criteria stated in Table 2. A qualified field representative should periodically observe fill placement operations and perform field density tests concurrently to document that the specified compaction is being achieved.

TABLE 2

STRUCTURAL FILL PLACEMENT GUIDELINES

Areas of Fill Placement	Compaction Recommendation (ASTM D698-Standard Proctor)	Moisture Content (Percent of Optimum)
Granular Cushion Beneath Floor Slab (If used)	98%*	As necessary to obtain density
Floor Slab/Soil Subgrade - 12” below the base of the granular cushion (if used) or Floor Slab	98%	-1 to +3 percent
Structural fill placed below and within 10 feet of the perimeter of the building pad	98%	-3 to +3 percent
Utility Trenches - Within building and pavement areas	98%	-3 to +3 percent
Beneath Landscaped/Grass Areas	92%	As necessary to obtain density

* - Alternative Compaction Method – 70% Relative Density

The moisture content of suitable borrow soils should generally be between the ranges specified in Table 2. More stringent moisture limits may be necessary with certain soils. Adjustment of moisture content may be necessary to allow compaction in accordance with project specifications. Dependent on the percentage of fines, the clean, free-draining aggregates utilized in the granular cushion beneath the floor slab could alternatively be consolidated by means of a vibratory compactor to at least 70% “relative density”, as determined in accordance with ASTM D 4253 (Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table) and D 4254 (Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculations of Relative Density).

Lateral Earth Pressure

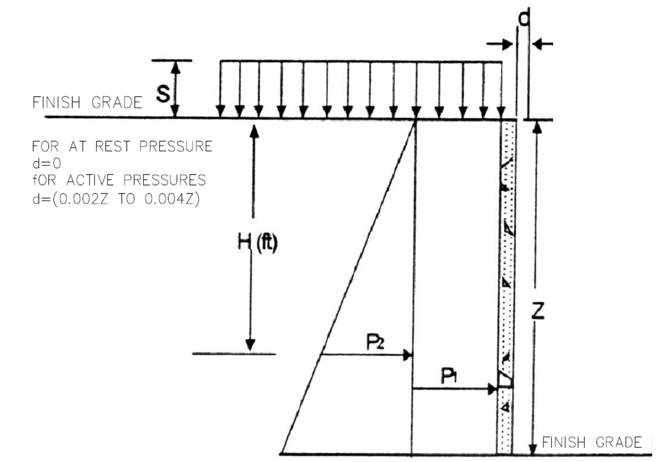
The following soil parameters are provided for use in designing grade retaining walls and/or foundation walls subject to lateral earth pressures. The parameters are based on the understanding that retained soils will be similar in composition to the on-site soils encountered during this investigation.

Walls which are rigidly restrained at the top and are essentially unable to deflect or rotate should be designed for "at rest" earth pressure conditions. Walls that are unrestrained at the top and are free to deflect or rotate slightly may be designed for "active" earth pressure conditions. The "passive" earth pressure condition should be used to evaluate the resistance of soil to lateral loads. Table 3 presents recommended values of earth pressure coefficients based on our experience with soils in the area. Equivalent fluid densities are frequently used for the calculation of lateral earth pressures for the "at-rest" and "active" conditions and are therefore provided in Table 3. The equivalent fluid densities in Table 3 do not include the effects of surcharge loading (P_1).

TABLE 3
EARTH PRESSURE PARAMETERS

LEGEND OF SYMBOLS	
Z	WALL HEIGHT (ft)
H	DEPTH BELOW SURFACE (ft)
d	WALL DISPLACEMENT (ft)
S	SURCHARGE LOAD (psf)
P_1	SURCHARGE PRESSURE (psf)
P_2	EARTH LOAD (psf)
K (Table 3)	COEFFICIENT OF EARTH PRESSURE
G (Table 3)	EQUIVALENT FLUID DENSITY (psf)

PRESSURE CALCULATIONS	
SURCHARGE PRESSURE	P_1 (psf) = K x S (psf)
EARTH PRESSURE	P_2 (psf) = G (pcf) x H (ft)



BACKFILL TYPE		FRICTION ANGLE	TOTAL SOIL DENSITY
COHESIVE -	Lean Clay (CL)	26°	120 pcf
GRANULAR* -	Less than 10% Fines (SP, GP)	32°	120 pcf

EARTH PRESSURE COEFFICIENT (K)			EQUIVALENT FLUID DENSITY (G)	
			DRAINED CONDITION	UNDRAINED CONDITION
AT REST (K_0)	Cohesive	- 0.56	68 pcf	95 pcf
	Granular*	- 0.47	56 pcf	
ACTIVE (K_a)	Cohesive	- 0.39	47 pcf	85 pcf
	Granular*	- 0.31	37 pcf	
PASSIVE (K_p)	Cohesive	- 2.00	240 pcf	170 pcf
	Granular*	- 3.00	360 pcf	

* If granular backfill is utilized, it is recommended the granular backfill be permanently drained

These design recommendations are based on the following assumptions:

- 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.

- Drained conditions assume a permanent drainage system behind the retaining wall that will allow no development of hydrostatic pressure.
- Horizontal backfill.
- The upper 40 inches do not contribute resistance against horizontal movement if the soil is subject to frost action and seasonal volume change.
- Onsite backfill soils having a bulk unit weight of 120 pcf.
- Backfill soils placed within the height of the retaining wall consisting of selected lean clay should be tested to verify the lean clays exhibit low plasticity and can achieve a minimum friction angle of 26 degrees.
- Imported granular backfill soils having a minimum angle of internal friction of 32 degrees.
- Uniform surcharge, where S is surcharge pressure, in psf.
- Heavy equipment and other concentrated load components not included.
- No safety factor is included.

Backfill soils placed within seven tenths of the height of the wall could consist of selected lean clay exhibiting an Atterberg liquid limit of less than 40. For granular soils, the granular backfill must extend out from the base of the wall at an angle of 45 and 60 degrees from the active and passive cases, respectively. To calculate the resistance to sliding on native soil and crushed angular limestone, an ultimate coefficient of friction value of 0.3 and 0.45 should be used, respectively, where the footing bears on suitable approved bearing soil. A factor of safety of at least 1.5 to 2 should be applied.

Slopes and Temporary Excavations

The owner and the contractor should make themselves aware of and become familiar with applicable local, state, and federal safety regulations, including current OSHA excavation and trench safety standards. Construction site safety generally is the sole responsibility of the contractor. The contractor shall also be solely responsible for the means, methods, techniques, sequences, and operations of construction operations. ***Olsson*** is providing the following information solely as a service to our client. Under no circumstances should ***Olsson's*** provision of the following information be construed to mean that we are assuming responsibility for construction site safety or the contractor's activities, as such responsibility is not implied and should not be inferred.

The contractor should be aware that slope height, slope inclination, and excavation depths (including utility trench excavations) should in no case exceed those specified in local, state, or federal safety regulations; e.g., *OSHA Health and Safety Standards for Excavations, 29 CFR Part 19266,* or successor regulations. Such regulations are strictly enforced and, if not followed, the owner, the contractor, or earthwork or utility subcontractors could be liable for substantial penalties.

For this site, the overburden soil encountered in our exploratory borings consisted of lean clay. We anticipate that OSHA will classify these materials as type B. OSHA recommends a maximum slope inclination of 1H: 1V for type B soils.

Note: Soils encountered in the construction excavations may vary significantly across the site. Our preliminary soil classifications are based solely on the materials encountered in the widely spaced boring locations. The contractor should verify that similar conditions exist throughout the proposed area of excavation. If different subsurface conditions are encountered at the time of construction, ***Olsson*** recommends that they be contacted immediately to evaluate the conditions encountered. If any excavations, including utility trenches, are extended to depths of more than 20 feet, OSHA requires that the side slopes of such excavations be designed by a professional engineer registered in the state where construction is occurring.

As an alternative to temporary slopes, vertical excavations can be temporarily shored. The contractor or the specialty subcontractor should be responsible for the design of the temporary shoring in accordance with applicable regulatory requirements.

Construction Equipment Mobility

Some of the soils encountered at this site may be highly susceptible to softening under the action of construction equipment traffic in combination with wet weather. Mitigation of equipment mobility problems and management of soft surficial soils will be greatly dependent on the severity of the problem, the season in which construction is performed and prevailing weather conditions.

Some general guidelines for reducing equipment mobility problems and dealing with soft, wet, surficial soils are as follows:

- Optimize surface water drainage at the site
- Whenever possible, wait for dry weather conditions to prevail, and do not operate construction equipment on the site during wet conditions. Rutting the surface will only aggravate the problem.
- Use construction equipment that is well suited for the intended job under the site conditions. Heavy rubber-tired equipment typically requires better site conditions than light, track-mounted equipment, especially on granular and less cohesive soil conditions.
- Implement a construction schedule that realistically allows for rain days. Pressure to perform earthwork under a tight schedule is frequently counterproductive.

Ultimately, it may be necessary to take steps to aggressively improve construction mobility if construction must proceed under unfavorable conditions. Methods for addressing equipment mobility problems may range from removing several feet of soft wet soils, to utilizing crushed stone materials and/or appropriate stabilization fabrics. Other methods include cement modification of soils, lime stabilization, etc. The optimal approach should be determined by a representative of the geotechnical engineer at the time of construction.

Any additional disturbance below the proposed subgrade elevation should be the responsibility of the general contractor to stabilize by means which are in accordance with the project specifications and this report. Any site or soil conditions which are a result of adverse weather conditions and which may require additional measures to improve construction mobility and site conditions should be the responsibility of the general contractor. The contractor should not allow water to collect near the surface of foundation or floor slab areas, either during or after construction. Site grading should be designed to provide rapid and efficient drainage of water away from the building and pavement areas at all times during construction.

Drainage and Groundwater Considerations

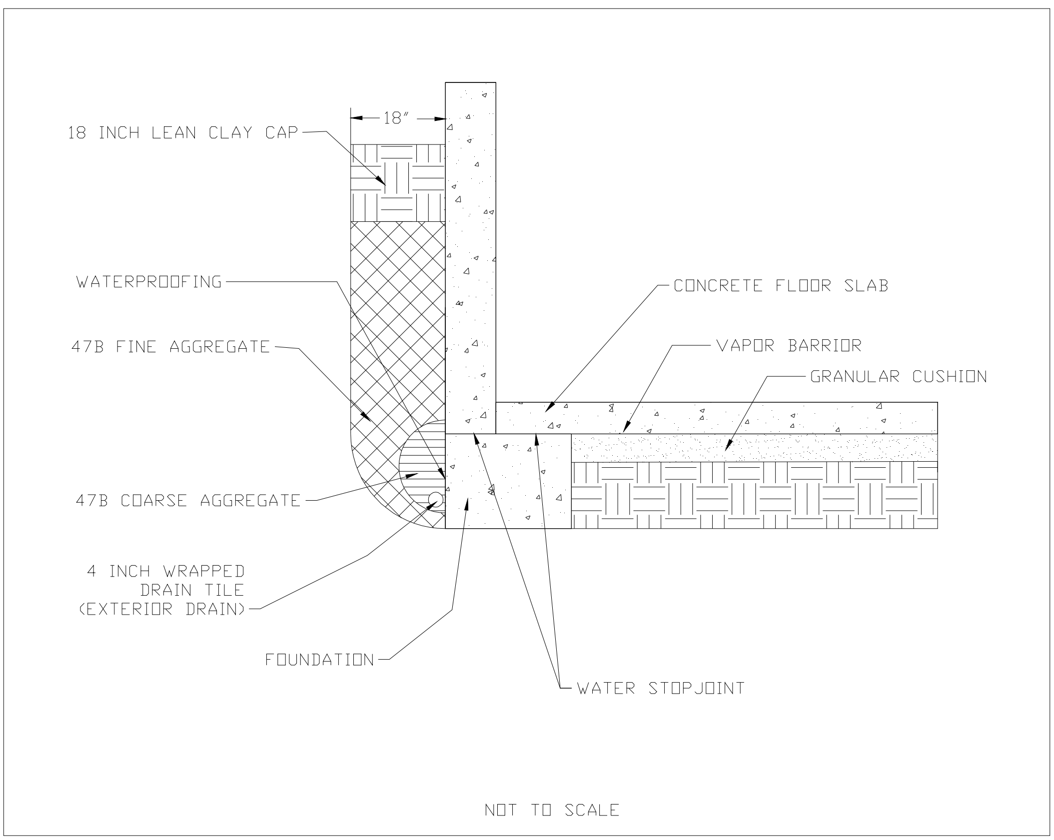
Groundwater was not encountered in the soil test borings at the time of drilling operations and is not expected to be a factor during construction. In general, water should not be allowed to collect near the surface of the foundation or floor slab areas of the structures during or after construction. Since soils generally tend to consolidate when exposed to free water, provisions should be made to remove seepage water from excavations, should it occur. In addition, undercut or excavated areas should be sloped toward one corner to facilitate the collection and removal of rainwater or surface runoff.

In general, water should not be allowed to collect near the surface of the foundation or floor slab areas of the structures during or after construction. Since soils generally tend to soften when exposed to free water, provisions should be made to remove seepage water from excavations, should it occur. In addition, undercut or excavated areas should be sloped toward one corner to facilitate the collection and removal of rainwater or surface runoff.

The site should also be graded to avoid water flows, concentrations, or pools behind grade retaining walls. If swales are designed at the top of the walls, proper line and slope should be considered to avoid any moisture infiltration behind the walls. Special attention to sources of storm water from building roofs, gutter downspouts, and paved areas draining to one point is needed.

It is recommended that a drain tile be installed around the outside perimeter of the basement foundation for building #1 to properly discharge accumulated water. A typical foundation drain tile system is shown in Figure 1.

FIGURE 1
Foundation Drain



Additionally, in order to minimize concerns related to improper drainage away from building foundations that tend to soften subgrade soils that are exposed to water, we provide the following general recommendations:

- Due to the collapsible nature of the Peoria loess soils when saturated, it will be critical that the site grading provides for efficient drainage of rainfall away from the building areas.
- Roof run-off should be collected and transferred directly to the storm sewer system, if possible, or to a location well away from the building. Conventional downspout drainage leading to splash blocks, though not as desirable, may be used.
- External hose connections should incorporate splash blocks to prevent localized accidental flooding of foundation soils. External hose connections should have cutoff valves inside the building to prevent accidental or unauthorized use of external hose connections.
- Building maintenance personnel should be informed of the potential problems associated with watering in close proximity to the building. Excessive watering of shrubs or lawns near buildings should be avoided. Placement of deep-rooted or water-intensive shrubs near buildings also should be avoided.

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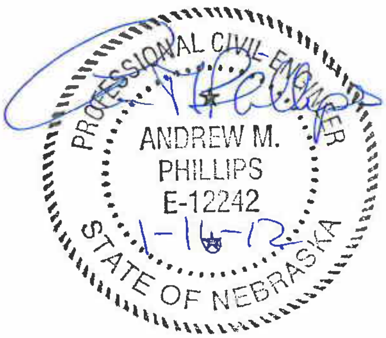
We trust that this report will assist you in the design and construction of the proposed project. ***Olsson*** appreciates the opportunity to provide our services on this project and look forward to working with you during construction and on future projects. Should you have any questions, please do not hesitate to contact us.

Respectfully submitted,

Olsson Associates



Prepared by:

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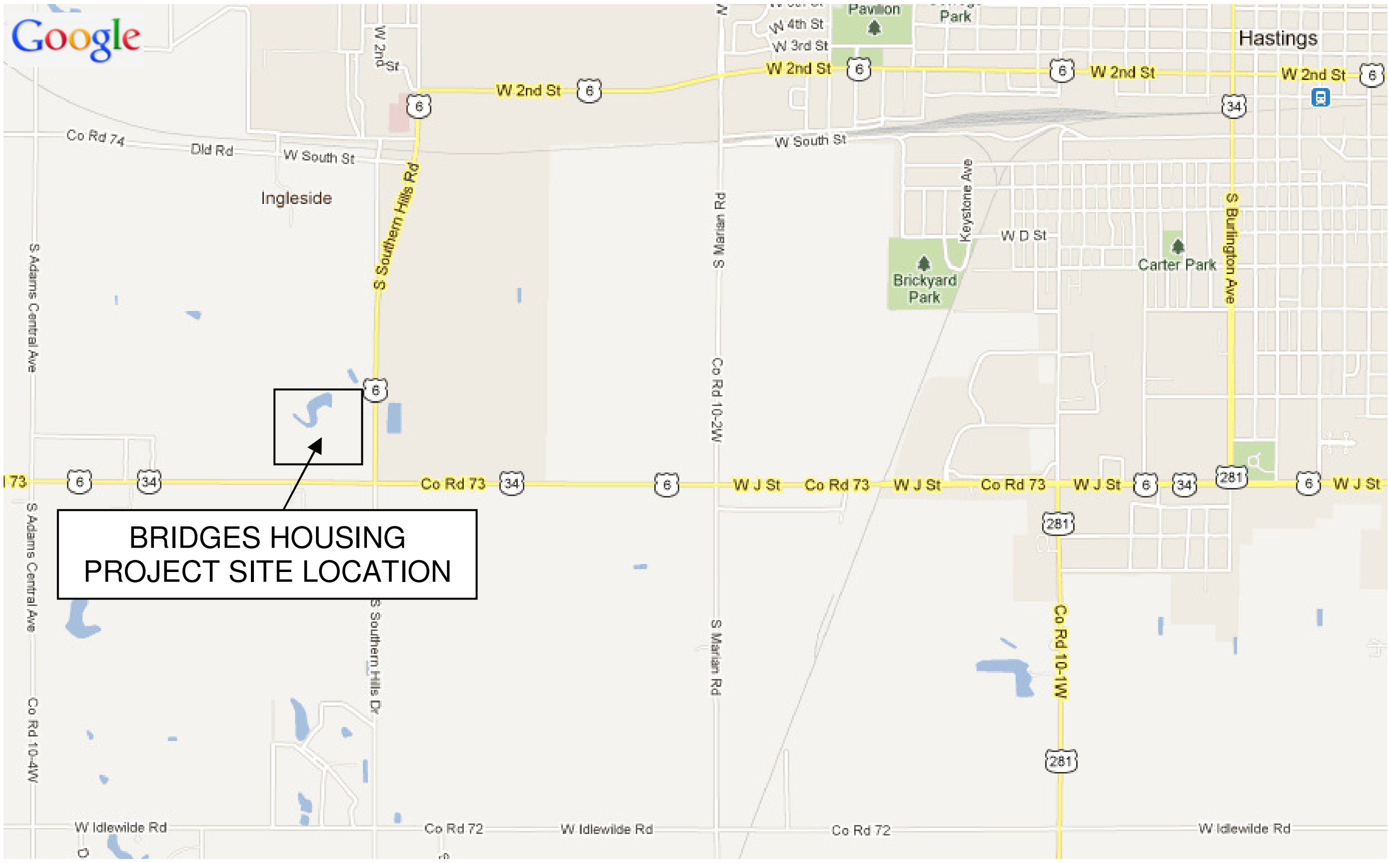
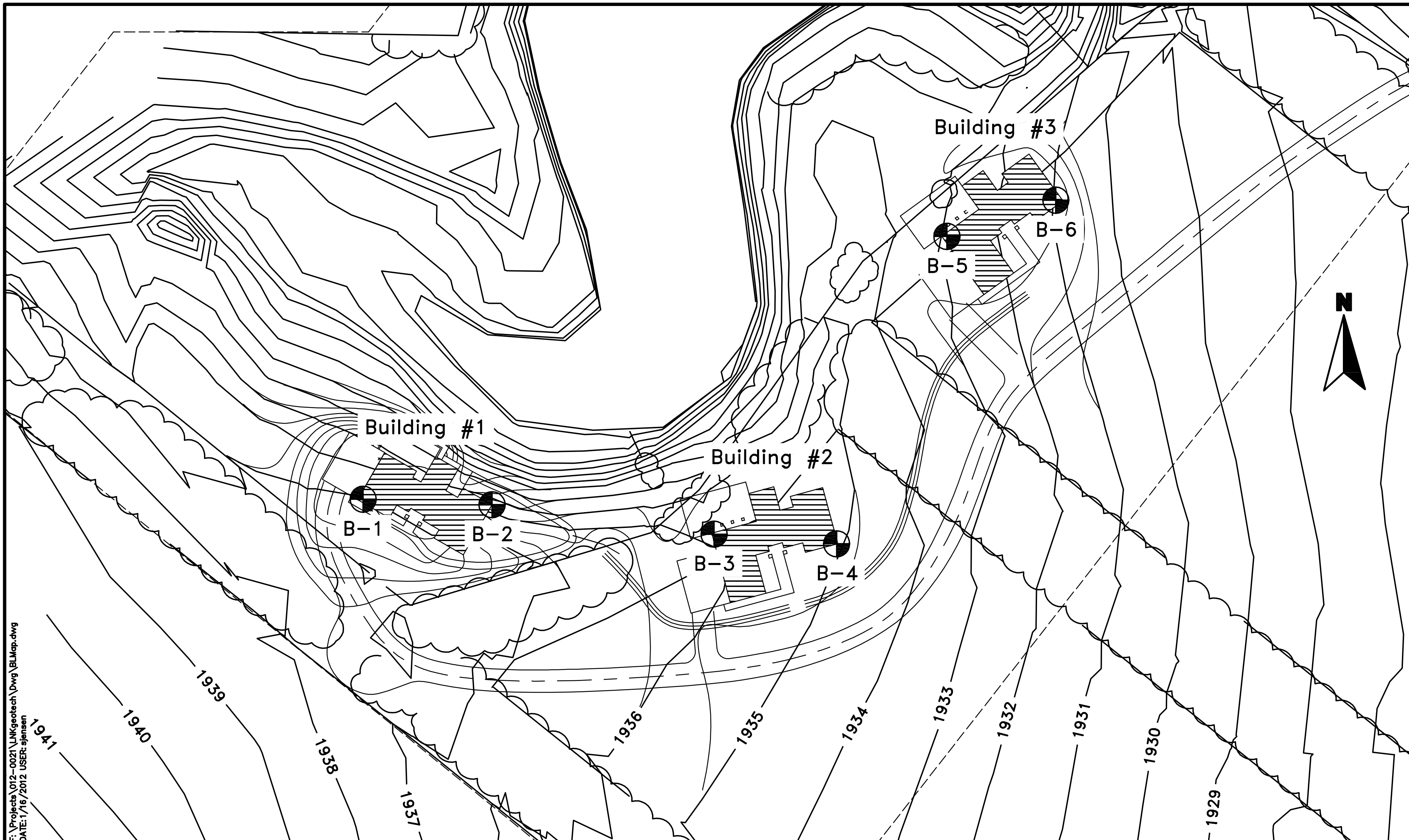
APPENDIX A

Site Location Plan
Boring Location Map



SITE LOCATION PLAN

BRIDGES HOUSING
NEAR HASTINGS , NEBRASKA
OA PROJECT NO. 012-0021



LEGEND

SOIL BORING LOCATION

PROJECT: 012-0021	
DRAWN BY: SVJ	REVISIONS: XXX
DATE: 1/13/12	

BORING LOCATION MAP
HASTINGS, NEBRASKA

OLSSON ASSOCIATES
1111 Lincoln Mall, Suite 111
P.O. Box 84608
Lincoln, NE 68501-4608
TEL 402.474.6311
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APPENDIX B

Symbols & Nomenclature

Boring Logs

SYMBOLS AND NOMENCLATURE

DRILLING NOTES

DRILLING AND SAMPLING SYMBOLS

SS:	Split-Spoon Sample
U:	Thin-walled Tube Sample
% Rec:	Percentage of Thin-walled Tube sample recovered
SPT Blow Counts:	Standard Penetration Test blows per 6" penetration
HSA:	Hollow Stem Auger
CFA:	Continuous Flight Auger
N.E.:	Not Encountered
N.A.:	Not Available

DRILLING PROCEDURES

Soil sampling and standard penetration testing performed in accordance with ASTM D 1586. The standard penetration resistance (SPT) 'N' value is the number of blows of a 140 pound hammer falling 30 inches to drive a 2 inch O.D., 1.4 inch I.D. split-spoon sampler one foot. The thin-walled tube sampling procedure is described by ASTM specification D 1587.

WATER LEVEL MEASUREMENTS

Water levels indicated on the boring logs are levels measured in the borings at the times indicated. In relatively high permeable materials, the indicated levels may reflect the location of groundwater. In low permeability soils, the accurate determination of groundwater levels is not possible with only short-term observations.

SOIL PROPERTIES & DESCRIPTIONS

Soil descriptions are based on the Unified Soil Classification System (USCS) as outlined in ASTM Designations D-2487 and D-2488. The USCS group symbol shown on the boring logs correspond to the group names listed below.

Group Symbol	***Group Name***	***Group Symbol***	***Group Name***
GW	Well Graded Gravel	CL	Lean Clay
GP	Poorly Graded Gravel	ML	Silt
GM	Silty Gravel	OL	Organic Clay or Silt
GC	Clayey Gravel	CH	Fat Clay
SW	Well Graded Sand	MH	Elastic Silt
SP	Poorly Graded Sand	OH	Organic Clay or Silt
SM	Silty Sand	PT	Peat
SC	Clayey Sand		

PARTICLE SIZE

Boulders	12 in. +	Coarse Sand	4.75mm-2.0mm	Silt	0.075mm-0.005mm
Cobbles	12 in.-3 in.	Medium Sand	2.0mm-0.425mm	Clay	<0.005mm
Gravel	3 in.-4.75mm	Fine Sand	0.425mm-0.075mm		

COHESIVE SOILS

Consistency	**Unconfined Compressive Strength (Qu) (psf)**
Very Soft	<500
Soft	500 - 1000
Firm	1001 - 2000
Stiff	2001 - 4000
Very Stiff	4001 - 8000
Hard	> 8000

COHESIONLESS SOILS

Relative Density	**Angle Value**
Very Loose	0 - 3
Loose	4 - 9
Medium Dense	10 - 29
Dense	30 - 49
Very Dense	≥ 50

OLSSON ASSOCIATES

SOIL TEST BORING REPORT

BORING NO. B-1

LOCATION:	SEE BORING LOCATION PLAN
LAT/LONG:	N--°--'--", W--°--'--"
JOB NO.:	012-0021
DATE START:	12/28/2011
DATE FINISH:	12/28/2011
DRILL COMPANY:	OLSSON ASSOCIATES
EQUIPMENT USED:	CME 75
DRILLED BY:	A. SNOOK
PREPARED BY:	S. JENSEN

PROJECT: BRIDGES HOUSING - HASTINGS, NEBRASKA
CLIENT: SINCLAIR HILLE ARCHITECTS

DEPTH TO GROUNDWATER

NE	WHILE DRILLING
NE	0 HOURS AFTER COMP.
NP	24 HOURS AFTER COMP.

BASE OF BORING AT 25.0 FEET

ELEV (ft)	SOIL PROFILE	DEPTH (ft)	SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
	APPROX. SURFACE ELEV. (ft): 1937.00									
	DEVELOPED ZONE 0.5'									
1936.0	***PEORIA LOESS***	1								
1935.0	Lean clay (CL) Stiff, light brown, moist, mostly lean clay, trace fine sand	2	SS-1	CL	4 7 6	--	--	--	--	--
1934.0		3								
1933.0	Lean clay (CL) Stiff, light yellowish brown, moist, mostly lean clay, trace fine sand	4	U-2	CL	--	36/21	14.9	91.3	1.8 (UU)	--
1932.0		5								
1931.0		6								
1930.0		7								
1929.0		8								
1928.0	Lean clay (CL) Firm, light yellowish brown, moist, mostly lean clay, trace fine sand and silt	9	SS-3	CL	4 4 4	--	--	--	--	--
1927.0		10								
1926.0		11								
1925.0		12								
1924.0		13								
1923.0	Lean clay (CL) Stiff, light yellowish brown, moist, mostly silty lean clay, trace fine sand	14	U-4	CL	--	35/23	17.9	90.8	--	--
1922.0		15								
1921.0		16								
1920.0		17								
1919.0		18								
1918.0	Lean clay (CL) Stiff, light yellowish brown, moist, mostly silty lean clay, trace fine sand	19	SS-5	CL	5 4 5	--	--	--	--	--
1917.0		20								

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE ID.		COMPONENT %		GROUNDWATER
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	
		>30	Hard	NR	NO RECOVERY			

BORING NO. B-1

SOIL TEST BORING REPORT

BORING NO. B-1

PROJECT:	BRIDGES HOUSING - HASTINGS, NEBRASKA
CLIENT:	SINCLAIR HILLE ARCHITECTS
LOCATION:	SEE BORING LOCATION PLAN
LAT/LONG:	N--°--'--", W--°--'--"
JOB NO.:	012-0021
DATE START:	12/28/2011
DATE FINISH:	12/28/2011
DRILL COMPANY:	OLSSON ASSOCIATES
EQUIPMENT USED:	CME 75
DRILLED BY:	A. SNOOK
PREPARED BY:	S. JENSEN

DEPTH TO GROUNDWATER

NE	WHILE DRILLING
NE	0 HOURS AFTER COMP. ∇
NP	24 HOURS AFTER COMP. ▼

BASE OF BORING AT 25.0 FEET

SOIL PROFILE

APPROX. SURFACE ELEV. (ft): 1937.00

ELEV (ft)	SOIL PROFILE	DEPTH (ft)	SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
	PEORIA LOESS									
1916.0		21								
1915.0		22								
	22.5'									
1914.0	***LOVELAND FORMATION***	23								
1913.0	Sandy lean clay (CL)	24								
	Stiff, dark reddish brown, moist, mostly lean clay, some fine to coarse sand		U-6	CL	--	--	12.5	100.5	--	--
1912.0		25								
	BASE OF BORING @ 25.0 FEET									
1911.0		26								
1910.0		27								
1909.0		28								
1908.0		29								
1907.0		30								
1906.0		31								
1905.0		32								
1904.0		33								
1903.0		34								
1902.0		35								
1901.0		36								
1900.0		37								
1899.0		38								
1898.0		39								
1897.0		40								

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE ID.		COMPONENT %		GROUNDWATER
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	
		>30	Hard	NR	NO RECOVERY			

BORING NO. B-1

OLSSON ASSOCIATES

SOIL TEST BORING REPORT

BORING NO. B-2

LOCATION: SEE BORING LOCATION PLAN
LAT/LONG: N--°--'--", W--°--'--"
JOB NO.: 012-0021
DATE START: 12/28/2011
DATE FINISH: 12/28/2011
DRILL COMPANY: OLSSON ASSOCIATES
EQUIPMENT USED: CME 75
DRILLED BY: A. SNOOK
PREPARED BY: S. JENSEN

PROJECT: BRIDGES HOUSING - HASTINGS, NEBRASKA
CLIENT: SINCLAIR HILLE ARCHITECTS

DEPTH TO GROUNDWATER

NE WHILE DRILLING
NE 0 HOURS AFTER COMP.
NP 24 HOURS AFTER COMP.

BASE OF BORING AT 26.5 FEET

SOIL PROFILE

APPROX. SURFACE ELEV. (ft): 1936.00

ELEV (ft)	SOIL PROFILE	DEPTH (ft)	SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
	DEVELOPED ZONE 0.5'									
1935.0	*PEORIA LOESS*	1								
1934.0	Silty lean clay (CL/ML) Very stiff, light yellowish brown mottled with brown, dry to moist, mostly silty lean clay, trace fine sand	2	U-1	CL/ML	--	--	11.5	87.2	--	--
1933.0		3								
1932.0	Silty lean clay (CL/ML) Stiff, light yellowish brown mottled with brown, dry to moist, mostly silty lean clay, trace fine sand	4	SS-2	CL/ML	5 5 5	--	11.0	--	--	--
1931.0		5								
1930.0		6								
1929.0		7								
1928.0		8								
1927.0	Silty lean clay (CL/ML) Stiff, light yellowish brown, dry to moist, mostly silty lean clay, trace fine sand	9	SS-3	CL/ML	6 5 6	--	12.7	--	--	--
1926.0		10								
1925.0		11								
1924.0		12								
1923.0		13								
1922.0	Silty lean clay (CL/ML) Stiff, light yellowish brown, dry to moist, mostly silty lean clay, trace fine sand, iron	14	SS-4	CL/ML	7 7 8	--	--	--	--	--
1921.0		15								
1920.0		16								
1919.0	17.5'	17								
1918.0	*LOVELAND FORMATION*	18								
1917.0	Silty sand (SM) Medium dense, light reddish brown, moist, mostly fine to coarse sand, little silty clay	19	SS-5	SM	7 8 5	--	4.8	--	--	21.1
1916.0		20								

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE ID.		COMPONENT %		GROUNDWATER
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	
		>30	Hard	NR	NO RECOVERY			

BORING NO. B-2

OLSSON ASSOCIATES

SOIL TEST BORING REPORT

PAGE 2 OF 2 **BORING NO. B-2**

LOCATION:	SEE BORING LOCATION PLAN
LAT/LONG:	N--°--'--", W--°--'--"
JOB NO.:	012-0021
DATE START:	12/28/2011
DATE FINISH:	12/28/2011
DRILL COMPANY:	OLSSON ASSOCIATES
EQUIPMENT USED:	CME 75
DRILLED BY:	A. SNOOK
PREPARED BY:	S. JENSEN

PROJECT: BRIDGES HOUSING - HASTINGS, NEBRASKA
CLIENT: SINCLAIR HILLE ARCHITECTS

DEPTH TO GROUNDWATER

NE	WHILE DRILLING
NE	0 HOURS AFTER COMP.
NP	24 HOURS AFTER COMP.

BASE OF BORING AT 26.5 FEET

SOIL PROFILE

APPROX. SURFACE ELEV. (ft): 1936.00

LOVELAND FORMATION

ELEV (ft)	SOIL PROFILE	DEPTH (ft)	SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
1915.0		21								
1914.0		22								
1913.0		23								
1912.0	Sandy silt (ML)	24								
1911.0	Stiff, dark reddish brown, dry to moist, mostly silt, some fine to coarse sand 25.0'	25	U-6	ML	--	--	12.7	--	--	74.7
1910.0	Fat clay (CH) Hard, dark brown mottled with dark greyish brown, moist, mostly fat clay, trace fine sand and silt, iron	26	SS-7	CH	8 15 17	--	--	--	--	--
1909.0	***BASE OF BORING @ 26.5 FEET***	27								
1908.0		28								
1907.0		29								
1906.0		30								
1905.0		31								
1904.0		32								
1903.0		33								
1902.0		34								
1901.0		35								
1900.0		36								
1899.0		37								
1898.0		38								
1897.0		39								
1896.0		40								

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE ID.		COMPONENT %		GROUNDWATER
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	
		>30	Hard	NR	NO RECOVERY			

BORING NO. B-2

OLSSON ASSOCIATES

SOIL TEST BORING REPORT

PAGE 1 OF 1 — **BORING NO. B-3**

LOCATION:	SEE BORING LOCATION PLAN
LAT/LONG:	N--°--'--", W--°--'--"
JOB NO.:	012-0021
DATE START:	12/28/2011
DATE FINISH:	12/28/2011
DRILL COMPANY:	OLSSON ASSOCIATES
EQUIPMENT USED:	CME 75
DRILLED BY:	A. SNOOK
PREPARED BY:	S. JENSEN

PROJECT: BRIDGES HOUSING - HASTINGS, NEBRASKA
CLIENT: SINCLAIR HILLE ARCHITECTS

DEPTH TO GROUNDWATER

NE	WHILE DRILLING
NE	0 HOURS AFTER COMP.
NP	24 HOURS AFTER COMP.

BASE OF BORING AT 15.0 FEET

SOIL PROFILE

APPROX. SURFACE ELEV. (ft): 1936.00

ELEV (ft)	SOIL PROFILE	DEPTH (ft)
	DEVELOPED ZONE 0.5'	
1935.0	***PEORIA LOESS***	1
1934.0	Silty lean clay (CL/ML) Very stiff, light yellowish brown, dry to moist, mostly silty lean clay, trace fine sand	2
1933.0		3
1932.0	Silty lean clay (CL/ML) Soft, light yellowish brown, dry to moist, mostly silty lean clay, trace fine sand	4
1931.0		5
1930.0		6
1929.0		7
1928.0		8
1927.0	Silty lean clay (CL/ML) Firm, light yellowish brown mottled with brown, moist, mostly silty lean clay, trace fine sand	9
1926.0		10
1925.0	11.0'	11
1924.0		12
1923.0		13
1922.0	Lean clay (CL) Stiff, light brown, moist, mostly lean clay, trace fine sand 14.5'	14
1921.0	***LOVELAND FORMATION*** Lean clay with sand (CL)	15
	BASE OF BORING @ 15.0 FEET	
1920.0		16
1919.0		17
1918.0		18
1917.0		19
1916.0		20

TEST DATA

DEPTH (ft)	SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
2	U-1	CL/ML	--	--	23.0	93.0	--	--
4–5	SS-2	CL/ML	2 1 2	--	--	--	--	--
9–10	U-3	CL/ML	--	--	20.6	98.1	--	--
14–15	SS-4	CL	3 4 5	--	--	--	--	--

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE ID.		COMPONENT %		GROUNDWATER
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	
		>30	Hard	NR	NO RECOVERY			

BORING NO. B-3

OLSSON ASSOCIATES

SOIL TEST BORING REPORT

PROJECT:	BRIDGES HOUSING - HASTINGS, NEBRASKA	PAGE 1 OF 1	BORING NO. B-4
CLIENT:	SINCLAIR HILLE ARCHITECTS	LOCATION:	SEE BORING LOCATION PLAN
		LAT/LONG:	N--°--'--", W--°--'--"
		JOB NO.:	012-0021
		DATE START:	12/28/2011
		DATE FINISH:	12/28/2011
		DRILL COMPANY:	OLSSON ASSOCIATES
		EQUIPMENT USED:	CME 75
		DRILLED BY:	A. SNOOK
		PREPARED BY:	S. JENSEN

DEPTH TO GROUNDWATER

NE	WHILE DRILLING
NE	0 HOURS AFTER COMP. ▽
NP	24 HOURS AFTER COMP. ▼

BASE OF BORING AT 15.0 FEET

SOIL PROFILE

APPROX. SURFACE ELEV. (ft): 1935.00

ELEV (ft)	SOIL PROFILE	DEPTH (ft)	SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
	DEVELOPED ZONE 0.5'									
1934.0	*PEORIA LOESS*	1								
1933.0	Lean clay (CL) Stiff, light brown, moist, mostly lean clay, trace fine sand	2	U-1	CL	--	--	24.2	103.4	--	--
1932.0	3.0'	3								
1931.0	Lean clay (CL) Stiff, light yellowish brown, moist, mostly lean clay, few silt, trace fine sand	4								
1930.0		5	U-2	CL	--	--	21.1	100.0	--	--
1929.0		6								
1928.0		7								
1927.0		8								
1926.0	8.5' Silty lean clay (CL/ML) Firm, light yellowish brown, moist, mostly silty lean clay, trace fine sand	9								
1925.0		10	SS-3	CL/ML	3 2 3	--	--	--	--	--
1924.0		11								
1923.0		12								
1922.0	12.5' *LOVELAND FORMATION*	13								
1921.0	Lean clay with sand (CL) Firm, light reddish brown, moist, mostly lean clay, little fine to coarse sand	14								
1920.0		15	U-4	CL	--	--	15.4	109.4	--	--
	BASE OF BORING @ 15.0 FEET									
1919.0		16								
1918.0		17								
1917.0		18								
1916.0		19								
1915.0		20								

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE ID.		COMPONENT %		GROUNDWATER
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	
		>30	Hard	NR	NO RECOVERY			

BORING NO. B-4

OLSSON ASSOCIATES

SOIL TEST BORING REPORT

BORING NO. B-5

PROJECT:	BRIDGES HOUSING - HASTINGS, NEBRASKA
CLIENT:	SINCLAIR HILLE ARCHITECTS
LOCATION:	SEE BORING LOCATION PLAN
LAT/LONG:	N--˚--'--", W--˚--'--"
JOB NO.:	012-0021
DATE START:	12/28/2011
DATE FINISH:	12/28/2011
DRILL COMPANY:	OLSSON ASSOCIATES
EQUIPMENT USED:	CME 75
DRILLED BY:	A. SNOOK
PREPARED BY:	S. JENSEN

DEPTH TO GROUNDWATER

NE	WHILE DRILLING
NE	0 HOURS AFTER COMP. ∇
NP	24 HOURS AFTER COMP. ▼

BASE OF BORING AT 15.0 FEET

SOIL PROFILE

APPROX. SURFACE ELEV. (ft): 1933.00

ELEV (ft)	SOIL PROFILE	DEPTH (ft)	SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
	DEVELOPED ZONE 0.5'									
1932.0	***PEORIA LOESS***	1								
1931.0	Silty lean clay (CL/ML) Very stiff, light yellowish brown, moist, mostly silty lean clay, trace fine sand	2	U-1	CL/ML	--	--	19.6	100.7	--	--
1930.0		3								
1929.0	Silty lean clay (CL/ML) Stiff, light greyish brown mottled with light yellowish brown, moist, mostly silty lean clay, few fine sand	4	U-2	CL/ML	--	--	21.2	96.8	--	--
1928.0		5								
1927.0		6								
1926.0		7								
1925.0		8								
1924.0	Silty lean clay (CL/ML) Stiff, light brown, moist, mostly silty lean clay, few fine sand	9	SS-3	CL/ML	4 5 7	--	23.8	--	--	--
1923.0		10								
1922.0	11.5'	11								
1921.0	***LOVELAND FORMATION***	12								
1920.0		13								
1919.0	Sandy lean clay (CL) Stiff, light reddish brown, moist, mostly lean clay, some fine to coarse sand	14	U-4	CL	--	--	--	--	--	--
1918.0		15								
	BASE OF BORING @ 15.0 FEET									
1917.0		16								
1916.0		17								
1915.0		18								
1914.0		19								
1913.0		20								

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE ID.		COMPONENT %		GROUNDWATER
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	
		>30	Hard	NR	NO RECOVERY			

BORING NO. B-5

OLSSON ASSOCIATES

SOIL TEST BORING REPORT

PROJECT:	BRIDGES HOUSING - HASTINGS, NEBRASKA	PAGE 1 OF 1	BORING NO. B-6
CLIENT:	SINCLAIR HILLE ARCHITECTS	LOCATION:	SEE BORING LOCATION PLAN
		LAT/LONG:	N--°--'--", W--°--'--"
		JOB NO.:	012-0021
		DATE START:	12/28/2011
		DATE FINISH:	12/28/2011
		DRILL COMPANY:	OLSSON ASSOCIATES
		EQUIPMENT USED:	CME 75
		DRILLED BY:	A. SNOOK
		PREPARED BY:	S. JENSEN

DEPTH TO GROUNDWATER

NE	WHILE DRILLING	
NE	0 HOURS AFTER COMP.	∇
NP	24 HOURS AFTER COMP.	▼

BASE OF BORING AT 15.0 FEET

SOIL PROFILE

APPROX. SURFACE ELEV. (ft): 1931.00

ELEV (ft)	SOIL PROFILE	DEPTH (ft)	SAMPLE	CLASSIFICATION (USCS)	SPT BLOW COUNTS	LL/PL (%)	MOISTURE (%)	DRY DENSITY (pcf)	Qu (UNCONF. STR.) (tsf)	PASSING #200 SIEVE (%)
	DEVELOPED ZONE 0.5'									
1930.0	***PEORIA LOESS***	1								
1929.0	Lean clay (CL) Stiff, light brown, moist, mostly lean clay, trace fine sand	2	U-1	CL	--	--	17.6	99.4	--	--
1928.0	3.5'	3								
1927.0	Silty lean clay (CL/ML)	4			2					
	Firm, light brown, moist, mostly silty lean clay, trace fine sand		SS-2	CL/ML	2	--	--	--	--	--
1926.0		5			3					
1925.0		6								
1924.0		7								
1923.0		8								
1922.0	Silty lean clay (CL/ML)	9								
	Firm, light brown, moist, mostly silty lean clay, trace fine sand		U-3	CL/ML	--	--	21.2	103.8	--	--
1921.0		10								
1920.0		11								
1919.0	12.5'	12								
1918.0	***LOVELAND FORMATION***	13								
1917.0	Clayey sand (SC)	14			3					
	Loose, light reddish brown, moist, mostly fine to coarse sand, little lean clay		SS-4	SC	2	--	8.1	--	--	27.2
1916.0		15			2					
	BASE OF BORING @ 15.0 FEET									
1915.0		16								
1914.0		17								
1913.0		18								
1912.0		19								
1911.0		20								

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE ID.		COMPONENT %		GROUNDWATER
0-3	Very Loose	0-1	Very Soft	SS	SPLIT SPOON	MOSTLY	50-100%	NE - Not Encountered
4-9	Loose	2-4	Soft	U	TUBE	SOME	30-45%	NP - Not Performed
10-29	Med. Dense	5-8	Firm	CA	CALIFORNIA	LITTLE	15-25%	
30-49	Dense	9-15	Stiff	G	GRAB SAMPLE	FEW	5-10%	
>49	Very Dense	16-30	Very Stiff	X	OTHER	TRACE	<5%	
		>30	Hard	NR	NO RECOVERY			

BORING NO. B-6

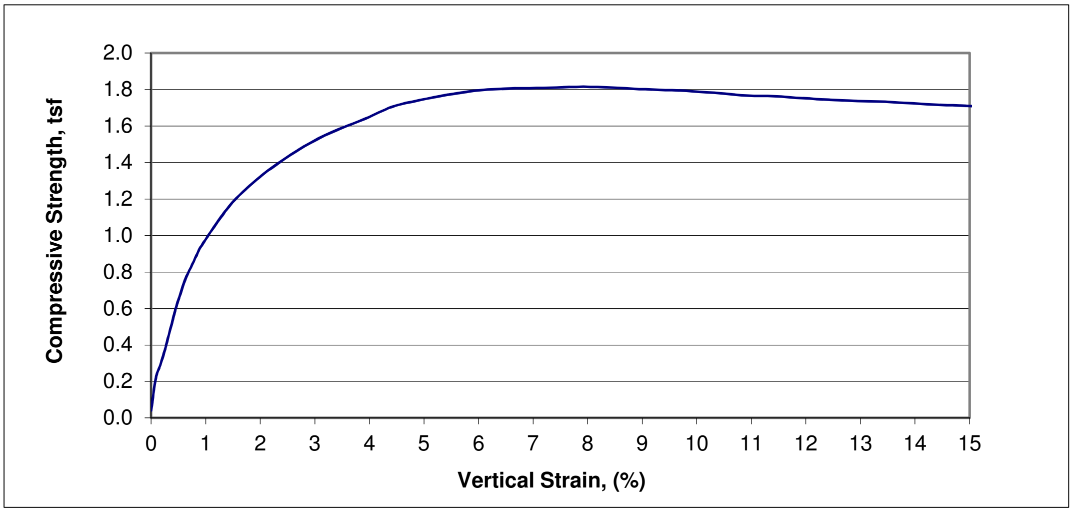
APPENDIX C

Summary of Laboratory Test Results

SUMMARY OF LABORATORY TEST RESULTS
BRIDGES HOUSING
HASTINGS, NEBRASKA
OA Project #: 012-0021

BORING No.	SAMPLE I.D.	SAMPLE DEPTH (ft.)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	VOID RATIO	SAT. (%)	UNCONFINED COMPRESSION		ATTERBERG LIMITS			USCS CLASS.	%Passing #200 Sieve
							STRENGTH (tsf)	STRAIN (%)	LL	PL	PI		
B-1	U-2	3.5-5'	14.9	91.3	0.845	47.5	1.8 (UU)	1.0	36	21	15	CL	
	U-4	13.5-15'	17.9	90.8	0.856	56.4			35	23	13	CL	
	U-6	23.5-25'	12.5	100.5	0.676	50.0							
B-2	U-1	1-2.5'	11.5	87.2	0.933	33.3							
	SS-2	3.5-5'	11.0										
	SS-3	8.5-10'	12.7										
	SS-5	18.5-20'	4.8										21.1
	U-6	23.5-25'	12.7										74.7
B-3	U-1	1-2.5'	23.0	93.0	0.811	76.5							
	U-3	8.5-10'	20.6	98.1	0.718	77.5							
B-4	U-1	1-2.5'	24.2	103.4	0.629	100.0							
	U-2	3.5-5'	21.1	100.0	0.684	83.5							
	U-4	13.5-15'	15.4	109.4	0.540	76.9							
B-5	U-1	1-2.5'	19.6	100.7	0.673	78.6							
	U-2	3.5-5'	21.2	96.8	0.740	77.5							
	SS-3	8.5-10'	23.8										
B-6	U-1	1-2.5'	17.6	99.4	0.694	68.3							
	U-3	8.5-10'	21.2	103.8	0.624	91.8							
	SS-4	13.5-15'	8.1										27.2

Unconsolidated Undrained Triaxial Test



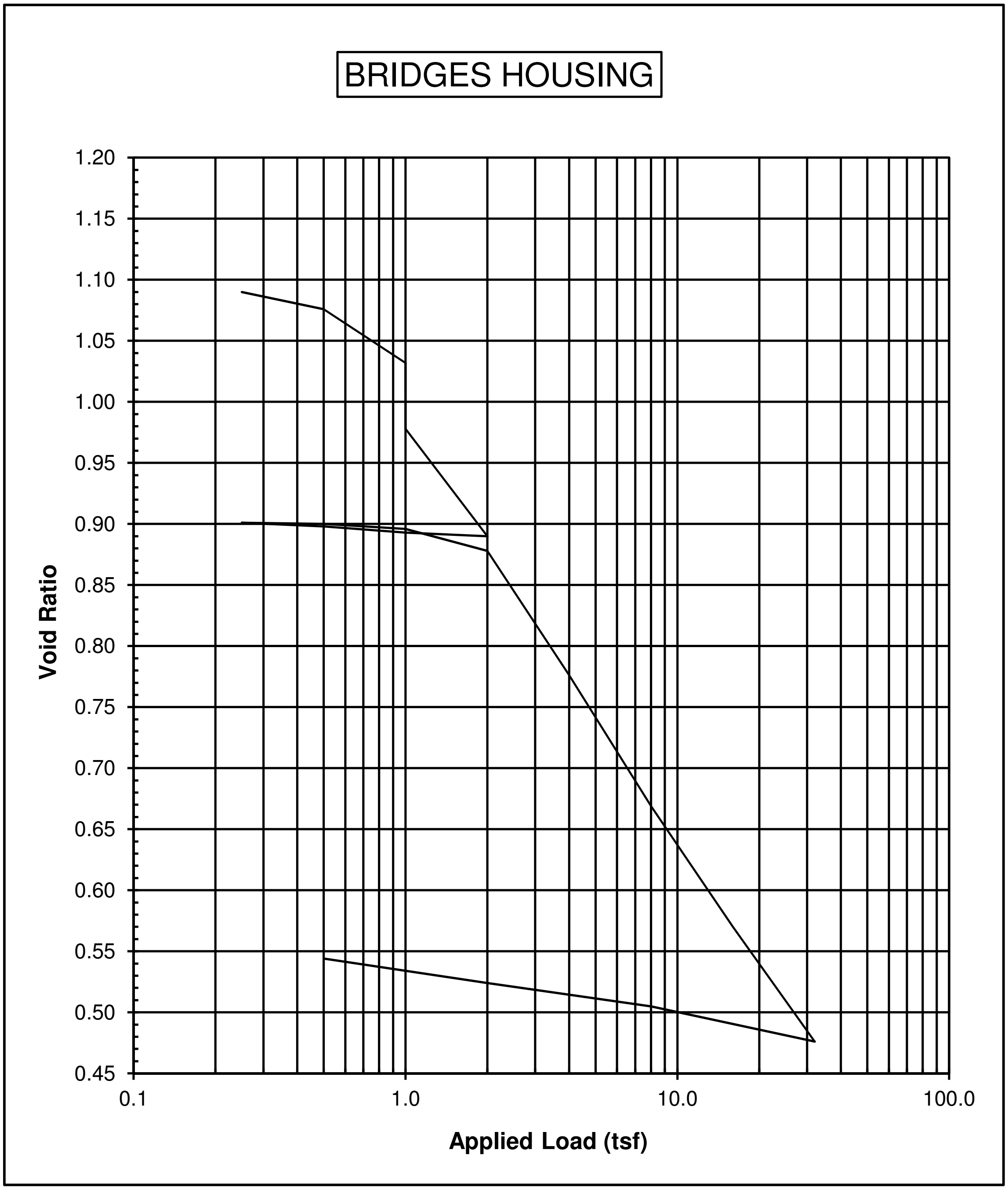
Boring		B-1			
Sample		U-2			
Initial	Diameter (in)	2.845			
	Height, (in)	5.746			
	Water Content, (%)	14.9			
	Dry Density, (pcf)	91.3			
	Saturation, (%)	47.5			
	Void Ratio	0.845			
Compressive Strength, (tsf)		1.816			
Undrained Shear Strength, (tsf)		0.908			
Time to Failure, (min)		7.92			
Strain Rate, (%/min)		1			
Assumed Specific Gravity		2.7			
Liquid Limit		36			
Plastic Limit		21			
Plasticity Index		15			
Failure Sketch		N/A			

OLSSON ASSOCIATES

Project:	Bridges Housing
Location:	Hastings, Nebraska
Project Number:	012-0021
Boring No:	B-1
Sample Type:	Shelby Tube
Description:	Light yellowish brown, Silty lean clay
Remarks:	Cosolodated to 3.5 psi (0.25 tsf)

COLLAPSE/CONSOLIDATION TEST

Drill Hole No.	B-1	Sample No.	U-2 (3.5-5')			
Sample Description	Peoria Loess: Light yellowish brown, lean clay (CL)					
Initial Water Content	14.7%	Dry Unit Weight (pcf)	79.77		Initial Saturation	35.0%
Final Water Content	14.4%	Specific Gravity	2.7	X	Assumed	
Liquid Limit	36	Plastic Limit	21		Plasticity Index	15
Classification	CL					



Project	Bridges Housing		
Location	Hastings, Nebraska		
Job No.	012-0021	Date:	01/02/12

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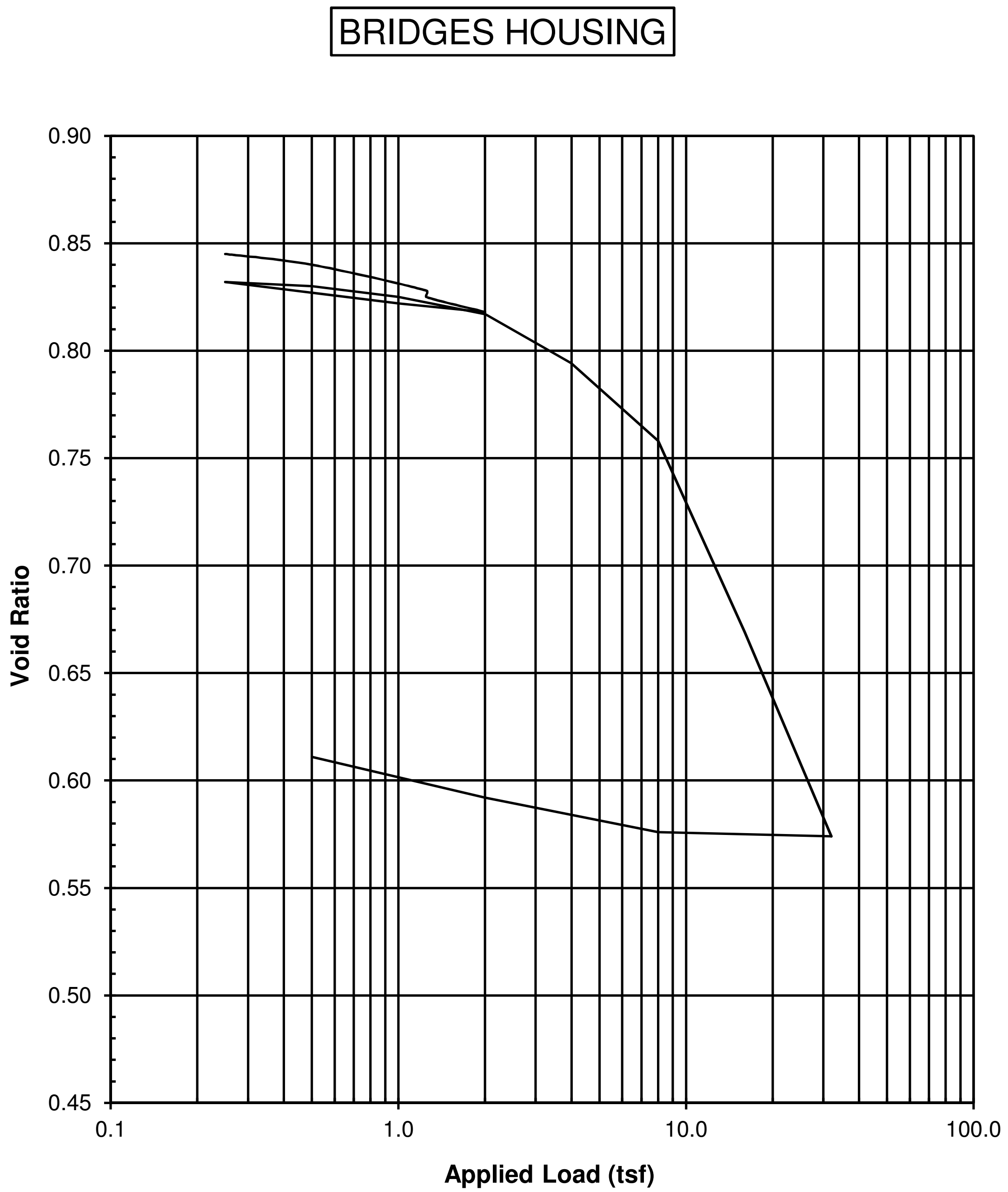
COLLAPSE/CONSOLIDATION TEST

Drill Hole No.	B-1	Sample No.	U-4 (13.5-15')		
Sample Description	Peoria Loess: Light yellowish brown, lean clay				
Initial Water Content	18.0%	Dry Unit Weight (pcf)	90.74	Initial Saturation	56.4%
Final Water Content	17.9%	Specific Gravity	2.7	X	Assumed
Liquid Limit	35	Plastic Limit	23	Plasticity Index	13
Classification	CL				



Project	Bridges Housing		
Location	Hastings, Nebraska		
Job No.	012-0021	Date:	01/02/12

OLSSON ASSOCIATES