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GEOTECHNICAL STUDY
CHILDRENS MUSEUM
3900 NORTH GARDEN DRIVE
LEHI, UTAH

Project No. 081002

July 22, 2008

Prepared For:

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1.0 INTRODUCTION

This report presents the results of a geotechnical study for a proposed childrens museum to be located at approximately 3900 North Garden Drive (Thanksgiving Point) in Lehi, Utah. The general location of the site is shown on Figure No. 1, *Vicinity Map*, at the end of this report.

The purposes of this study were to 1) evaluate the subsurface soil conditions at the site, 2) assess the engineering characteristics of the subsurface soils, and 3) provide geotechnical recommendations for general site grading and the design and construction of foundations, concrete floor slabs, miscellaneous concrete flatwork, and asphalt paved parking. The scope of work completed for this study included field reconnaissance, subsurface investigation, field and laboratory soil testing, engineering analysis, and the preparation of this report.

2.0 CONCLUSIONS

The following is a brief summary of our findings and conclusions:

a. At the test hole locations, we encountered approximately 5 to 6 inches of sod and topsoil on the surface followed by layers of Clay (CL), Silt (ML), Sand (SM), and Gravel (GP-GM), extending to the maximum depths explored of about 16½ to 30¼ feet below the existing surface. Groundwater was not encountered within the depths explored.

b. Subsurface soils were not saturated and consisted of stiff to very stiff clay and silt underlain by medium dense to very dense sands and gravels. Based on these soil conditions, we estimate the site to have low liquefaction potential.

c. All footings should bear entirely on undisturbed uniform native soils, or entirely on a minimum 18 inches of structural fill placed on undisturbed native soils. A maximum bearing capacity of 2,000 psf may be used for design of footings constructed on native soils, and 2,500 psf for footing constructed on structural fill. More details regarding foundation design can be found in Section 10.0 of this report.

These findings and conclusions should not be relied upon without reading and consulting this entire report for a more detailed description of the geotechnical evaluation and recommendations contained herein.

3.0 PROPOSED CONSTRUCTION

We understand that the proposed structure will be an approximate 24,000 square foot building. We have based our recommendations in this report on the assumption that foundation loads for the proposed structures will not exceed 10,000 pounds per linear foot for bearing walls, 100,000 pounds for column loads, and 200 pounds per square foot for floor slabs. If structural loads will be greater our office should be notified so that we may review our recommendations and, if necessary, make modifications.

In addition to the construction described above, we anticipate that utilities will be installed to service the proposed building; that exterior concrete flatwork will be placed in the form of curb, gutter, and sidewalks; and that asphalt concrete paved parking areas will be constructed.

4.0 GENERAL SITE DESCRIPTION

At the time of our subsurface investigation most of the site was a landscaped area vegetated with grass and some trees, but the southern quarter of the site was undeveloped land. A dirt road crossed through the site from north to south. The ground surface sloped slightly downward to the west. The site was bounded on the north by Garden Drive, on the south by undeveloped land, on the east by a golf course, and on the west by gardens.

5.0 SUBSURFACE EXPLORATION

Under the direction of a qualified member of our geotechnical staff, subsurface explorations were conducted at the site on July 7, 2008 by drilling three exploratory test holes to depths of about 16½ to 30¼ feet below the existing ground surface using an all-terrain hydraulic drill rig. The approximate locations of the test holes are shown on Figure No. 2, *Site Plan and*

Location of Test Holes. Graphical representations and detailed descriptions of the soils encountered are shown on Figure Nos. 3 through 5, *Test Hole Log* at the end of this report. The stratification lines shown on the logs represent the approximate boundary between soil units; the actual transition may be gradual. Due to potential natural variations inherent in soil deposits, care should be taken in interpolating between and extrapolating beyond exploration points. A key to the symbols and terms on the logs is presented on Figure No. 6, *Legend*.

Samples of the subsurface soils were collected in the test holes at depth intervals of approximately 2½ to 5 feet. Relatively undisturbed samples were collected by pushing thin-walled "Shelby" tubes into undisturbed soils below the augers. Disturbed samples were collected with a 1⅜ inch inside diameter split spoon sampler. The split spoon sampler was driven 18 inches into undisturbed soil with a 140 pound hammer free-falling through a distance of 30 inches. The blows for each 6 inch interval (or less) are noted on the logs when more than 50 blows per 6 inches (or less) were achieved. The blow count provides a reasonable indication of the in-place relative density of sandy soils, but provides only a limited indication of the relative stiffness of cohesive (clayey) materials, since the penetration resistance for these soils is a function of the moisture content. In gravelly soils, the blow count may be higher than it otherwise would be, particularly when one or more gravel particles are larger than the sampler diameter.

The soil samples collected were classified by visual examination in the field following the guidelines of the Unified Soil Classification System (USCS). The samples were transported to our Orem, Utah laboratory where they will be retained for 30 days following the date of this report and then discarded, unless a written request for additional holding time is received prior to the 30 day limit.

6.0 LABORATORY TESTING

Selected soil samples collected in the test holes were tested in the laboratory to assess pertinent engineering properties and to aid in refining field classifications, if needed. Tests performed included natural moisture content and dry density tests, one-dimensional consolidation tests, liquid and plastic limits determinations, and mechanical gradation analyses. The following table summarizes the laboratory test results, which are also included on the attached test hole logs at the respective sample depths, and on Figure Nos. 7 through 9, *Consolidation-Swell Test*.

Table No. 1: Laboratory Test Results

TEST HOLE NO.	DEPTH (ft.)	NATURAL MOISTURE (%)	NATURAL DRY DENSITY (pcf)	ATTERBERG LIMITS		GRAIN SIZE DISTRIBUTION (%)			SOIL TYPE
				LIQUID LIMIT	PLASTICITY INDEX	GRAVEL (+ #4)	SAND	SILT/ CLAY (- #200)	
TH-1	5	16	95	28	3	---	---	---	ML
TH-1	20	10	---	---	---	0	78	22	SM
TH-2	2½	27	94	36	14	---	---	---	CL
TH-2	15	22	---	27	10	---	---	---	CL
TH-3	7½	32	91	36	12	---	---	---	CL

As part of the consolidation test procedure, water was added to the samples to assess moisture sensitivity when the samples were loaded to an equivalent pressure of 1,000 psf. This part of the consolidation test indicated slight to low moisture sensitivity (about 1% or less) in the form of collapse (settlement). The recommendations provided in Section 12.0 should be carefully followed.

7.0 SUBSURFACE CONDITIONS

7.1 Soil Types

On the surface of the site, we encountered sod and topsoil which we estimated to extend about 5 to 6 inches in depth at the test hole locations. Below the topsoil we encountered layers of Lean Clay with sand (CL) and Silt with sand (ML) extending to the bottom of Test Holes 2 and 3 (about 16½ foot depths), and to about 15 feet below the ground surface in Test Hole 1. Below the clay in TH-1 we encountered Poorly Graded Gravel with silt and sand

(GP-GM), Poorly Graded Gravel with sand (GP), and Silty Sand (SM) layers to the bottom of the test hole at about 30 feet 3½ inches below the ground surface.

Based on blow counts of 14 to 32 blows per foot the clay and silt soils appeared to have stiff to hard consistency. Blow counts of 21 blows per foot to more than 50 blows for 6 inches indicate medium dense to very dense relative densities for the subsurface sand and gravel layers.

7.2 Groundwater Conditions

Groundwater was not encountered within the depths explored. Groundwater levels will fluctuate in response to the season, precipitation and snow melt, irrigation, and other on and off-site influences. Precisely quantifying these fluctuations would require long term monitoring.

8.0 SITE GRADING

8.1 General Site Grading

Unsuitable soils and vegetation should be removed from below foundation, floor slab, and exterior concrete flatwork. Unsuitable soils consist of topsoil, organic soils, undocumented fill, soft, loose, or disturbed native soils, and any other inapt materials. We encountered sod and topsoil on the surface of the site which we estimated to extend about 5 to 6 inches below the ground surface. The sod and topsoil (including soil with roots larger than about ¼ inch in diameter) should be completely removed, even if found to extend deeper, along with any other unsuitable soils that may be encountered.

The ground surface at the site sloped slightly downward to the west, thus we do not anticipate cutting and filling to depths greater than 3 feet. Fill placed over large areas, even if only a few feet in depth, can cause consolidation in the underlying native soils resulting in settlement of the fill. If more than 3 feet of grading fill will be placed above the existing surface (to raise site grades), Earthtec should be notified so that we may assess potential settlement and make additional recommendations if needed. Such recommendations may include placing the fill several weeks prior to construction to allow settlement to occur.

8.2 Temporary Excavations

For temporary excavations less than 5 feet in depth into the native soils or into structural fill, slopes should not be made steeper than ½H:1V (Horizontal:Vertical). Temporary excavations extending up to 10 feet in depth should not be made steeper than 1H:1V. If groundwater seepage or other unstable conditions are encountered in excavations, flatter slopes, shoring, or bracing may be required.

8.3 Fill Material

Near surface soils (to about 15 feet in depth) are not suitable for use as structural fill but may be stockpiled for use as fill in landscape areas.

Regular structural fill should consist of imported material meeting the following requirements:

Maximum particle size:	4 inches
Percent retained on the 3/4 inch sieve (coarse gravel):	30 maximum
Percent passing the No. 200 sieve (fines):	15 maximum
Liquid Limit of fines:	35 maximum
Plasticity Index of fines:	15 maximum

In some situations, particles larger than 4 inches and/or more than 30 percent coarse gravel may be acceptable, however, compaction and compaction testing may be more difficult. As a result more strict quality control measures than normally used may be required. Such measures may include using thinner lifts, and increased or full time observation of fill placement.

Utility trenches below the building and pavements should be backfilled with structural fill. In other areas, utility trenches may be backfilled with the native soil. Native clay and silt soils (as observed in the test holes) may be time consuming to compact due to more difficulty controlling the moisture content needed to obtain optimum compaction. All backfill soil should meet the following requirements:

Maximum particle size:	4 inches
Liquid Limit of fines:	35 maximum
Plasticity Index of fines:	15 maximum

8.4 <u>Fill Placement and Compaction</u>

The thickness of each lift should be appropriate for the compaction equipment that is used. We recommend a maximum lift thickness of 4 inches for hand operated equipment, 6 inches for most "trench compactors", and 8 inches for larger rollers, unless it can be demonstrated by in-place density tests that the required compaction can be obtained throughout a thicker lift. The full thickness of each lift of structural fill placed should be compacted to at least the following percentages of the maximum dry density, as determined by ASTM D-1557:

In landscape areas not supporting structural loads:	90%
Less than 5 feet of fill below foundations, flatwork and pavements:	95%
Five or more feet of fill below foundations, flatwork and pavements:	98%

Generally, placing and compacting fill at a moisture content within 2% of the optimum moisture content, as determined by ASTM D-1557, will facilitate compaction. Typically, the further the moisture content is from optimum the more difficult it will be to achieve the required compaction.

Fill should be tested frequently during placement and early testing is recommended to demonstrate that placement and compaction methods are achieving the required compaction. It is the contractor's responsibility to ensure that fill materials and compaction efforts are consistent so that tested areas are representative of the entire fill.

8.5 Stabilization

Near surface layers of clay and silt were encountered in the test holes. These soils may rut and pump during grading and construction. The likelihood of rutting and/or pumping, and the depth of disturbance, is proportional to the moisture content in the soil, the load applied to the ground surface, and the frequency of the load. Consequently, rutting and pumping can be minimized by avoiding concentrated traffic, minimizing the load applied to the ground surface by using lighter equipment and/or partial loads, by working in dry times of the year, or by providing a working surface for equipment.

During grading the soil in any obvious soft spots should be removed and replaced with granular material. If rutting or pumping occurs traffic should be stopped in the area of concern. The soil in rutted areas should be removed and replaced with granular material. In areas where pumping occurs the soil should either be allowed to sit until pore pressures dissipate (several hours to several days) and the soil firms up, or be removed and replaced with granular material. Typically, we recommend removal to a minimum depth of 18 inches. Removal and replacement to a greater depth may be required.

For granular material, we recommend using angular well-graded gravel, such as pit run, or crushed rock with a maximum particle size of four inches. We suggest that the initial lift be approximately 12 inches thick and be compacted with a static roller-type compactor. A finer granular material such as sand, gravelly sand, sandy gravel or road base may also be used. The more angular and coarse the material, the thinner the lift that will be required. We recommend that the fines content (percent passing the no. 200 sieve) be less than 15%, the liquid limit be less than 35, and the plasticity index be less than 15.

Using a geosynthetic fabric, such as Mirafi 500X or equivalent, may also reduce the amount of material required and avoid mixing of the granular material and the subgrade. If a fabric is used, following removal of disturbed soils and water, the fabric should be placed over the bottom and up the sides of the excavation a minimum of 18 inches. The fabric should be placed in accordance with the manufacturer's recommendations, including proper overlaps. The granular material should then be placed over the fabric in compacted lifts. Again, we suggest that the initial lift be approximately 12 inches thick and be compacted with a static roller-type compactor.

9.0 SEISMIC CONSIDERATIONS

9.1 Faulting

Based upon published data, no known faults traverse the site. No surficial evidence of faulting was observed during our field investigation. The nearest mapped[1] fault trace is about 2 to 2¼ miles east of the site. Hecker describes this fault as a subsidiary fault of the main Wasatch Fault and says that movement along this fault "appears to have occurred during, and may be related to, the recession of Lake Bonneville".

9.2 Liquefaction Potential

The site is located within an area which has been mapped by the Utah Geological Survey[2] as having low liquefaction potential. Liquefaction is a phenomenon where a soil loses intergranular strength due to an increase in soil pore water pressures during a dynamic event such as an earthquake. The potential for liquefaction is based on several factors, including 1) the grain size distribution of the soil, 2) the plasticity of the fine fraction of the soil (material passing the No. 200 sieve), 3) relative density of the soil, 4) earthquake strength (magnitude) and duration, and 5) overburden pressures. In addition, the soils must be saturated for liquefaction to occur. As a part of this investigation, the potential for liquefaction to occur in the soils we encountered was assessed.

Loose, saturated sands are most susceptible to liquefaction, but soft, sensitive silt soils also have the potential to experience failure and movement during a seismic event. Subsurface soils were composed of unsaturated stiff to hard clay and silt overlying medium dense to very

[1] Hecker, S., 1993, Quaternary Faults and Folds, Utah, Utah Geologic Survey, Bulletin 127.

[2] Liquefaction Potential Map, Utah Geological Survey, Public Information Series 28. 1994.

dense sand and gravel soils. These conditions support the mapped low liquefaction potential designation.

9.3 IBC Site Classification

The Site Class definitions in the International Building Code (IBC) are based upon the soil properties in the upper 100 feet of the soil profile. These properties are determined from SPT blow counts, undrained shear strength values, and/or shear velocity measurements. The code states, "When the soil properties are not known in sufficient detail to determine the site class, Site Class D shall be used unless the building official or geotechnical data determines that Site Class E or F soil is likely to be present at the site." We encountered some potentially liquefiable soil layers, but given the small amount of possible movements due to liquefaction, we recommend using Site Class D.

The site is located at approximately 40.432 degrees latitude and -111.908 degrees longitude. Using Site Class D, the design spectral response acceleration parameters are 0.805 *g* for S_{DS} (short period) and 0.491 *g* for S_{D1} (one-second period). The intermediate values from the IBC used to obtain these design parameters are contained in Table Nos. 2 and 3 below.

Table No. 2: Design Acceleration for Short Period

S_S	F_a	S_{MS}	S_{DS}
1.169 g	1.033	1.207 g	0.805 g

S_S = Mapped spectral acceleration for short periods from Figure 1615(5)
F_a = Site coefficient from Table 1615.1.2(1)
$S_{MS} = F_a \cdot S_s$ = Maximum considered earthquake spectral response accelerations for short periods
$S_{DS} = \frac{2}{3} S_{MS}$= Five-percent damped design spectral response acceleration at short periods

Table No. 3: Design Acceleration for 1 Second Period

S_1	F_v	S_{M1}	S_{D1}
0.488 g	1.512	0.737 g	0.491 g

S_1 = Mapped spectral accelerations for 1-second period from Figure 1615(6)
F_v = Site coefficient from Table 1615.1.2(2)
$S_{M1} = F_v \cdot S_1$ = Maximum considered earthquake spectral response accelerations for 1-second period
$S_{D1} = \frac{2}{3} S_{MS}$ = Five-percent damped design spectral response acceleration at 1 second period

10.0 FOUNDATIONS

10.1 General

The foundation recommendations presented in this report are based on the soil conditions encountered in the test holes, the results of laboratory testing of samples of the native soils, the site grading recommendations presented in this report, and the foundation loading conditions presented in Section 3.0, *Proposed Construction*, of this report. If loading conditions are significantly different, we should be notified in order to re-evaluate our design parameters and estimates (higher loads may cause more settlement), and to provide additional recommendations if necessary.

Conventional strip and spread footings may be used to support the proposed structure. Foundations should not be installed on topsoil, undocumented fill, debris, combination soils, organic soils, frozen soil, or in ponded water. If foundation soils become disturbed during construction they should be removed or recompacted.

We recommend that foundations be constructed entirely on firm, undisturbed, uniform native soils, or entirely on a minimum 18 inches of structural fill placed on undisturbed native soils. For design of conventional strip and spread footings, the following parameters are recommended:

Minimum embedment for frost protection:	30 inches
Minimum strip footing width:	20 inches
Minimum spot footing width:	30 inches
Maximum allowable net bearing pressure (native soils):	2,000 psf
Maximum allowable net bearing pressure (min. 18" struc. fill):	2,500 psf
Bearing pressure increase for transient loading:	33 percent

Structural fill used below foundations should extend laterally a minimum of 6 inches for every 12 vertical inches of structural fill placed. For example, if 18 inches of structural fill are required to bring the excavation to footing grade, the structural fill should extend laterally a minimum of 9 inches beyond the edge of the footings on both sides.

10.2 Estimated Settlement

If the proposed foundations are properly designed and constructed using the parameters provided above, total settlement for non-earthquake conditions is estimated to not exceed one inch. Differential settlement is anticipated to be one-half of the total settlement over a 25-foot length of foundation. Additional settlement or movement could occur during an earthquake due to ground shaking, if more than 3 feet of grading fill is placed above the existing ground surface, or if foundation soils are allowed to become wetted.

10.3 Lateral Earth Pressures

Below grade walls also act as soil retaining structures and should be designed to resist pressures induced by the backfill soils. The lateral pressures imposed on a retaining structure are dependant on the rigidity of the structure and its ability to resist rotation. Most retaining walls that can rotate or move slightly will develop an active lateral earth pressure condition. Structures that are not allowed to rotate or move laterally, such as subgrade basement walls, will develop an at-rest lateral earth pressure condition. Lateral pressures applied to structures may be computed by multiplying the vertical depth of backfill material by the appropriate equivalent fluid density. Any surcharge loads in excess of the soil weight applied to the backfill should be multiplied by the appropriate lateral pressure coefficient and added to the soil pressure. For static conditions the resultant forces occur at about 1/3 the height of the wall, while for seismic conditions the resultant forces occur at about 0.6 times the height of the wall, both measured from the bottom of the wall. The lateral pressures presented in the table below are based on drained, native clay and silt soils remaining as backfill material using a 28° friction angle and a dry unit weight of 120 pcf.

Table No. 4: Lateral Earth Pressures

CONDITION	LATERAL PRESSURE COEFFICIENT	EQUIVALENT FLUID PRESSURE (pcf)
Active	0.36 0.49	43 (Static) 59 (Seismic)
At-Rest (Rankine)	0.53	64 (Static)
Passive (Rankine)	2.77 4.00	330 (Static) 480 (Seismic)

These pressure values are based on drained conditions. It is important that water is not allowed to build up (hydrostatic pressures) behind retaining structures. Retaining walls should incorporate drainage behind the walls as appropriate, and surface water should be directed away from the top and bottom of the walls.

Resistance to sliding may incorporate the friction acting along the base of foundations, which may be computed using a coefficient of friction of 0.45 for native clay or silt and 0.70 for structural fill meeting the recommendations presented herein. These values may be increased by one-third for transient wind and seismic loads.

The pressure and coefficient values presented above are ultimate; therefore an appropriate factor of safety may need to be applied to these values for design purposes. The appropriate factor of safety will depend on the design condition and should be determined by the project structural engineer.

11.0 FLOOR SLABS

To facilitate construction, act as a capillary break, and aid in distributing floor loads we recommend that all at-grade slabs and exterior flatwork be underlain by four inches of free-draining granular material, such as "pea" gravel or three-quarters to one-inch minus clean gravel, supported on firm native soils or structural fill.

To help control normal shrinkage and stress cracking the floor slabs should have the following features:

1. Adequate reinforcement for the anticipated floor loads with the reinforcement continuous through interior floor joints;

2. Frequent crack control joints; and

3. Non-rigid attachment of the slabs to foundation and bearing walls.

Special precautions should be taken during placement and curing of all concrete slabs and flatwork. Excessive slump (high water-cement ratios) of the concrete and/or improper finishing and curing procedures used during hot or cold weather conditions may lead to excessive shrinkage, cracking, spalling, or curling of slabs. We recommend all concrete placement and curing operations be performed in accordance with American Concrete Institute (ACI) codes and practices.

12.0 MOISTURE CONTROL AND SURFACE DRAINAGE

As part of good construction practice, precautions should be taken during and after construction to reduce the potential for water to collect near foundation walls. We recommend the following:

1. Adequate compaction of foundation backfill should be provided i.e. a minimum of 90% of ASTM D-1557. **Water consolidation methods should not be used.**

2. The ground surface should be graded to drain away from the building in all directions. We recommend a minimum fall of 6 inches in the first 10 feet.

3. Roof runoff should be collected in rain gutters with down spouts designed to discharge well outside of the backfill limits, or at least 10 feet from foundations, whichever is greater.

4. Sprinklers should be aimed away, and all sprinkler components located at least 3 feet, from foundation walls. Sprinkler systems should be well maintained, checked for leaks frequently, and repaired promptly.

5. Any additional precautions which may become evident during construction.

13.0 PAVEMENT RECOMMENDATIONS

We assume that parking for the structure will be in the existing parking lot on the north side of Garden Drive. The site plan indicates a short access road along the eastern side of the building. We have based our pavement design on the near surface native soils encountered in the test holes and estimate a California Bearing Ratio (CBR) value of 3 to be appropriate.

We anticipate the traffic volume will be very light (less than 50 vehicles per day) and consist of mostly of delivery trucks and perhaps a weekly garbage truck. Based on these parameters and the procedures outlined in the *AASHTO Guide for Design of Pavement Structures (1993)*, we recommend the minimum asphalt pavement section presented in the table below.

Table No. 5: Pavement Section Design

ASPHALT THICKNESS (in)	COMPACTED ROADBASE THICKNESS (in)	COMPACTED SUBBASE THICKNESS (in)
3	6	0*

* Stabilization may be required

If the pavement will be required to support construction traffic, or more traffic than listed above, our office should be notified so that we can re-evaluate the pavement section recommendations. All subbase, base material, and asphalt should conform to local or UDOT requirements regarding gradation, oil content, and any other requirements pertaining to the project. We recommend that all roadbase and subbase be properly processed, moisture conditioned, and compacted to a minimum of 95% of the maximum dry density as determined by ASTM-D 1557. All asphalt should be compacted to a minimum of 95% of the laboratory Marshal mix design density

14.0 GENERAL CONDITIONS

The exploratory data presented in this report was collected to provide geotechnical design recommendations for this project. The test holes may not be indicative of subsurface conditions outside the study area or between points explored and thus have a limited value in depicting subsurface conditions for contractor bidding. Variations from the conditions portrayed in the test holes may occur and which may be sufficient to require modifications in the design. If during construction, conditions are different than presented in this report, please advise us so that the appropriate modifications can be made.

The geotechnical study as presented in this report was conducted within the limits prescribed by our client, with the usual thoroughness and competence of the engineering profession in the area. No other warranty or representation, either expressed or implied, is intended in our proposals, contracts or reports.

The recommendations presented herein are based on the assumption that an adequate program of tests and observations will be followed during construction to verify compliance with our recommendations. We also assume that we will review the project plans and specifications to verify that our conclusions and recommendations are incorporated and remain appropriate (based on the actual design).

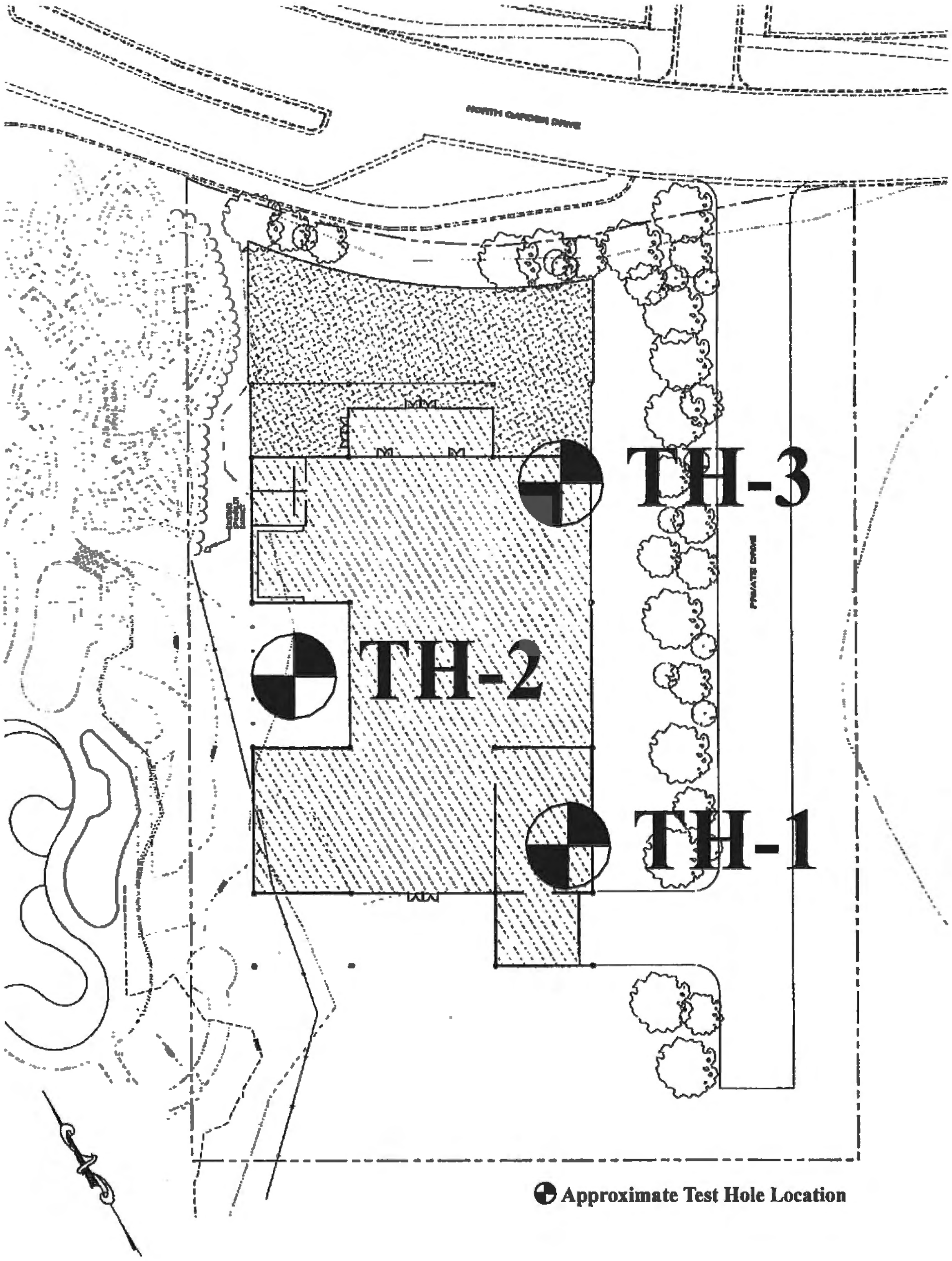
We appreciate the opportunity of providing our services on this project. If we can answer questions or be of further service, please call.

AERIAL PHOTO VICINITY MAP

CHILDRENS MUSEUM

PROJECT NO.: 081002	Earthtec Engineering Inc.	FIGURE NO.: 1

SITE PLAN & LOCATION OF TEST HOLES
CHILDRENS MUSEUM



PROJECT NO.: 081002	Earthtec Engineering Inc.	FIGURE NO.: 2

TEST HOLE LOG

NO.: TH-1

PROJECT:	Childrens Museum	**PROJECT NO.:**	081002
CLIENT:	Thanksgiving Point	**DATE:**	07/07/08
LOCATION:	Refer to Figure 2.	**ELEVATION:**	NM
OPERATOR:	Ray Con	**LOGGED BY:**	D.D.
EQUIPMENT:	Deidrich D-120 A.T.		

DEPTH TO WATER; INITIAL ∇ : **AT COMPLETION ▼ :**

Depth (Ft.)	Graphic Log	USCS	Description	Samples	Blows per foot	Water Cont. (%)	Dry Dens. (pcf)	LL	PI	Gravel (%)	Sand (%)	Fines (%)	Other Tests
0			TOPSOIL: Clay, silt, sand, roots, organics, moist, dark brown.										
		ML	SILT with sand, hard, moist, gray-brown, iron oxide stains.										
3					32								
6						16	95	28	3				C
9		CL	LEAN CLAY with sand, sand lenses, very stiff, moist, gray-brown, iron oxide stains.		20								
12													
15		GP-GM	POORLY GRADED GRAVEL with silt and sand, very dense, moist, gray.		50/3.5"								
18													

Notes: No groundwater encountered.

Tests Key

- CBR = California Bearing Ratio
- C = Consolidation
- R = Resistivity
- DS = Direct Shear
- SS = Soluble Sulfates
- UC = Unconfined Compressive Strength

TEST HOLE LOG

NO.: TH-1

PROJECT: Childrens Museum
CLIENT: Thanksgiving Point
LOCATION: Refer to Figure 2.
OPERATOR: Ray Con
EQUIPMENT: Deidrich D-120 A.T.
DEPTH TO WATER; INITIAL ▽ :

PROJECT NO.: 081002
DATE: 07/07/08
ELEVATION: NM
LOGGED BY: D.D.
AT COMPLETION ▼ :

Depth (Ft.)	Graphic Log	USCS	Description	Samples	Blows per foot	Water Cont. (%)	Dry Dens. (pcf)	LL	PI	Gravel (%)	Sand (%)	Fines (%)	Other Tests
21		SM	SILTY SAND, very dense to medium dense, moist, brown.		61	10				0	78	22	
24													
					21								
27													
		GP	POORLY GRADED GRAVEL with sand, very dense, moist, brown.										
30			- poor sample recovery at 30 feet.		50/3.5"								
			Bottom at approximately 30 feet 3.5 inches.										
33													
36													
39													

Notes: No groundwater encountered.

Tests Key
CBR = California Bearing Ratio
C = Consolidation
R = Resistivity
DS = Direct Shear
SS = Soluble Sulfates
UC = Unconfined Compressive Strength

TEST HOLE LOG

NO.: TH-2

PROJECT: Childrens Museum
CLIENT: Thanksgiving Point
LOCATION: Refer to Figure 2.
OPERATOR: Ray Con
EQUIPMENT: Deidrich D-120 A.T.
DEPTH TO WATER; INITIAL ∇ :

PROJECT NO.: 081002
DATE: 07/07/08
ELEVATION: NM
LOGGED BY: D.D.
AT COMPLETION ▼ :

Depth (Ft.)	Graphic Log	USCS	Description	Samples	Blows per foot	Water Cont. (%)	Dry Dens. (pcf)	LL	PI	Gravel (%)	Sand (%)	Fines (%)	Other Tests
0			SOD: About 3 inches.										
			TOPSOIL: Clay, silt, sand, roots, organics, moist, dark brown.										
			LEAN CLAY with sand, sand lenses, very stiff to stiff, moist, gray-brown.										
3						27	94	36	14				C
6					18								
9		CL											
12					16								
15					14	22		27	10				
18			Bottom at approximately 16.5 feet.										

Notes: No groundwater encountered.

Tests Key
CBR = California Bearing Ratio
C = Consolidation
R = Resistivity
DS = Direct Shear
SS = Soluble Sulfates
UC = Unconfined Compressive Strength

TEST HOLE LOG

NO.: TH-3

PROJECT:	Childrens Museum	**PROJECT NO.:**	081002
CLIENT:	Thanksgiving Point	**DATE:**	07/07/08
LOCATION:	Refer to Figure 2.	**ELEVATION:**	NM
OPERATOR:	Ray Con	**LOGGED BY:**	D.D.
EQUIPMENT:	Deidrich D-120 A.T.		
DEPTH TO WATER; INITIAL ∇ :		**AT COMPLETION ▼ :**	

Depth (Ft.) 0	Graphic Log	USCS	Description	Samples	Blows per foot	Water Cont. (%)	Dry Dens. (pcf)	LL	PI	Gravel (%)	Sand (%)	Fines (%)	Other Tests
			SOD: About 3 inches.										
			TOPSOIL: Clay, silt, sand, roots, organics, moist, dark brown.										
			LEAN CLAY with sand, sand lenses, stiff to very stiff, very moist, gray-brown, iron oxide stains.										
3					14								
6					15								
9		CL				32	91	36	12				C
					19								
12													
15													
18			Bottom at approximately 17 feet.										

Notes: No groundwater encountered.

Tests Key

- CBR = California Bearing Ratio
- C = Consolidation
- R = Resistivity
- DS = Direct Shear
- SS = Soluble Sulfates
- UC = Unconfined Compressive Strength

PROJECT NO.: 081002 | **FIGURE NO.:** 5

LEGEND

PROJECT: Childrens Museum **DATE:** 07/07/08
CLIENT: Thanksgiving Point **LOGGED BY:** D.D.

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR SOIL DIVISIONS			USCS SYMBOL	TYPICAL SOIL DESCRIPTIONS
COARSE GRAINED SOILS (More than 50% retaining on No. 200 Sieve)	GRAVELS (More than 50% of coarse fraction retained on No. 4 Sieve)	CLEAN GRAVELS (Less than 5% fines)	GW	Well Graded Gravel, May Contain Sand, Very Little Fines
			GP	Poorly Graded Gravel, May Contain Sand, Very Little Fines
		GRAVELS WITH FINES (More than 12% fines)	GM	Silty Gravel, May Contain Sand
			GC	Clayey Gravel, May Contain Sand
	SANDS (50% or more of coarse fraction passes No. 4 Sieve)	CLEAN SANDS (Less than 5% fines)	SW	Well Graded Sand, May Contain Gravel, Very Little Fines
			SP	Poorly Graded Sand, May Contain Gravel, Very Little Fines
		SANDS WITH FINES (More than 12% fines)	SM	Silty Sand, May Contain Gravel
			SC	Clayey Sand, May Contain Gravel
FINE GRAINED SOILS (More than 50% passing No. 200 Sieve)	SILTS AND CLAYS (Liquid Limit less than 50)		CL	Lean Clay, Inorganic, May Contain Gravel and/or Sand
			ML	Silt, Inorganic, May Contain Gravel and/or Sand
			OL	Organic Silt or Clay, May Contain Gravel and/or Sand
	SILTS AND CLAYS (Liquid Limit Greater than 50)		CH	Fat Clay, Inorganic, May Contain Gravel and/or Sand
			MH	Elastic Silt, Inorganic, May Contain Gravel and/or Sand
			OH	Organic Clay or Silt, May Contain Gravel and/or Sand
HIGHLY ORGANIC SOILS			PT	Peat, Primarily Organic Matter

SAMPLER DESCRIPTIONS

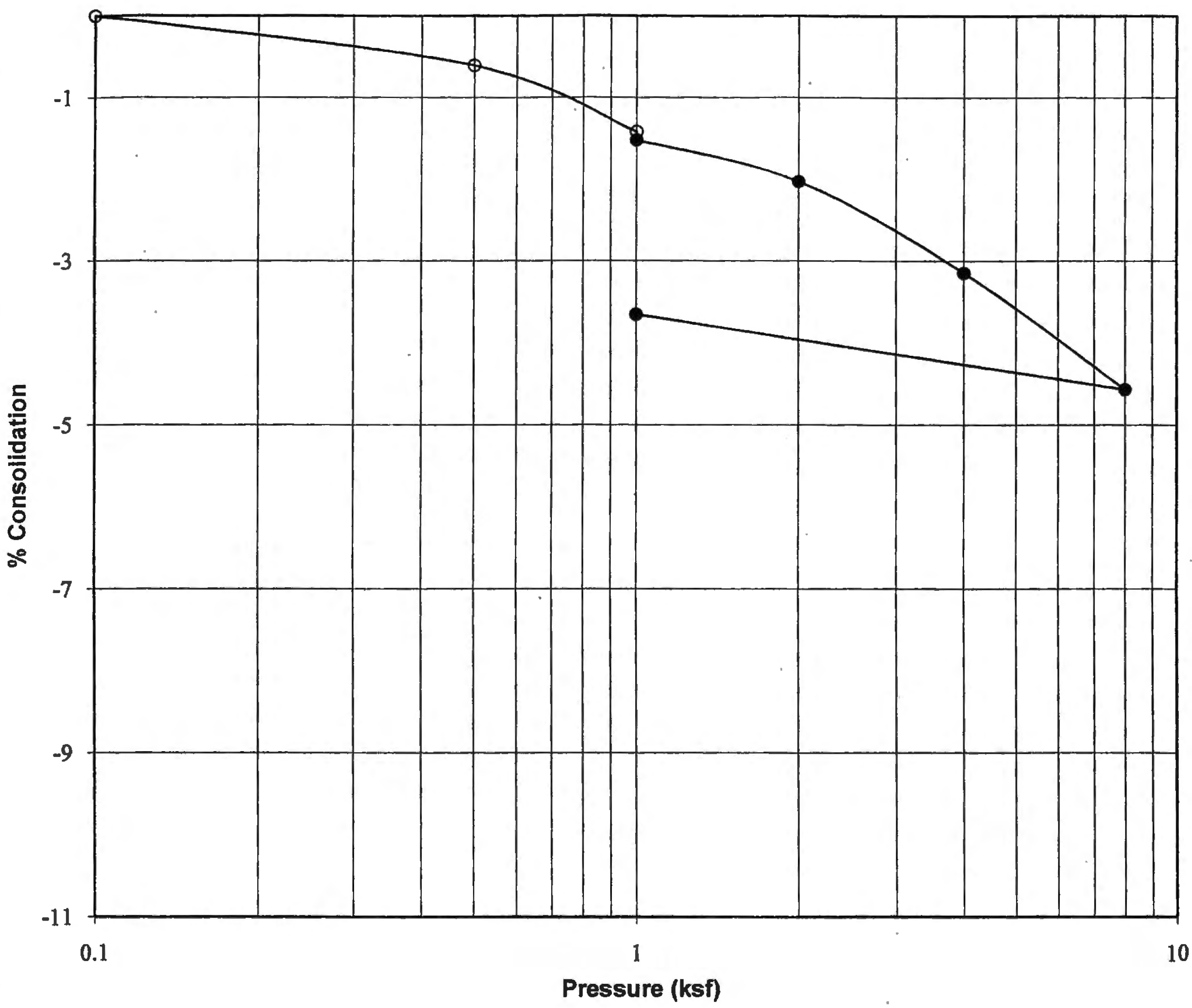
- SPLIT SPOON SAMPLER (1 3/8 inch inside diameter)
- MODIFIED CALIFORNIA SAMPLER (2 inch outside diameter)
- SHELBY TUBE (3 inch outside diameter)
- BLOCK SAMPLE
- BAG/BULK SAMPLE

WATER SYMBOLS

- ∇ Water level encountered during field exploration
- ▼ Water level encountered at completion of field exploration

NOTES:
1. The logs are subject to the limitations, conclusions, and recommendations in this report.
2. Results of tests conducted on samples recovered are reported on the logs and any applicable graphs.
3. Strata lines on the logs represent approximate boundaries only. Actual transitions may be gradual.
4. In general, USCS symbols shown on the logs are based on visual methods only: actual designations (based on laboratory tests) may vary.

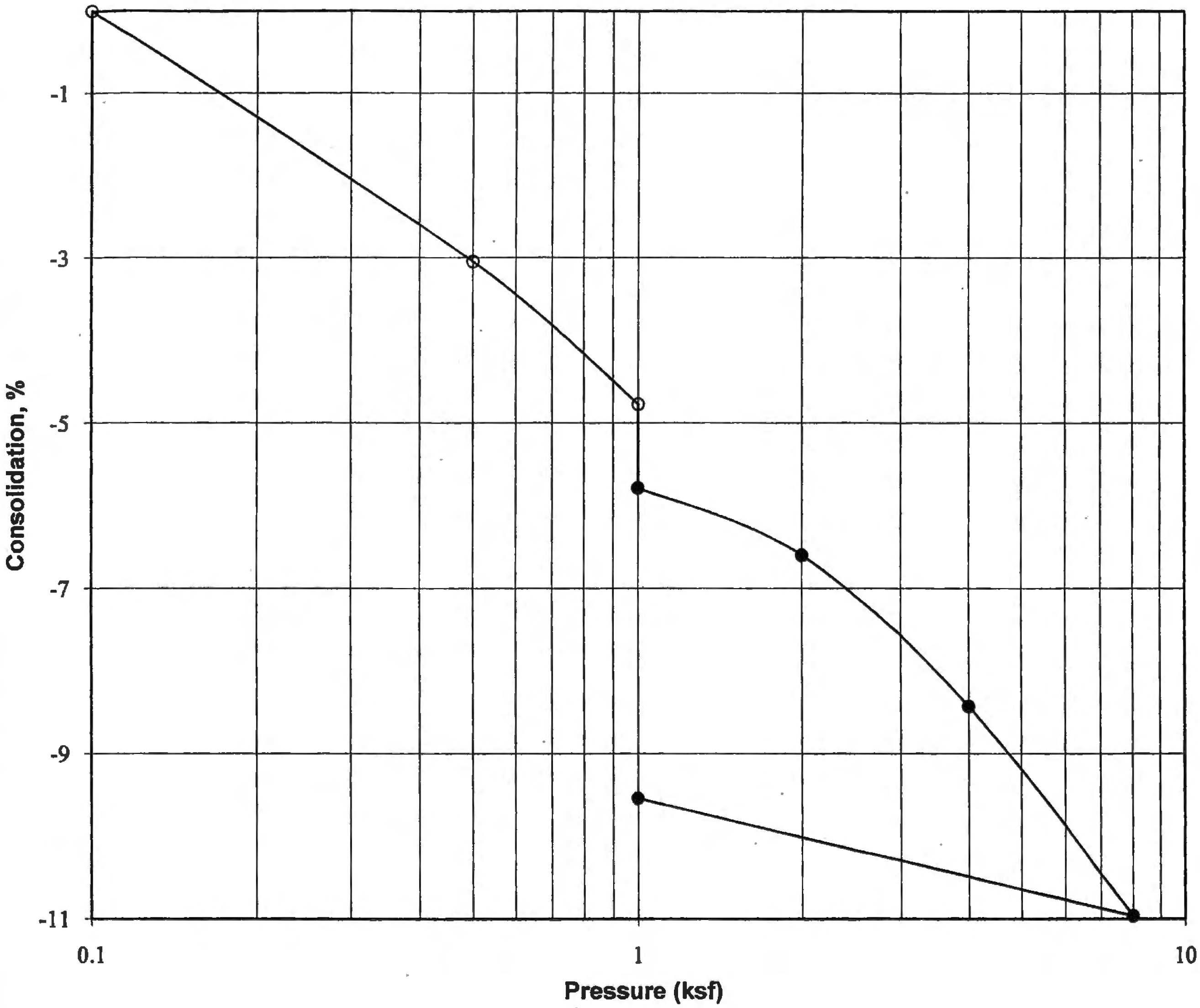
CONSOLIDATION - SWELL TEST



Project:	Childrens Museum
Location:	TH-1
Sample Depth:	5
Description:	Shelby
Soil Type:	SILT with sand (ML)
Natural Moisture, %:	16
Dry Density, pcf:	95
Liquid Limit:	28
Plasticity Index:	3
Water Added at:	1 ksf
Percent Collapse:	0.1

PROJECT NO.: 081002 | Earthtec Engineering Inc. | **FIGURE NO.:** 7

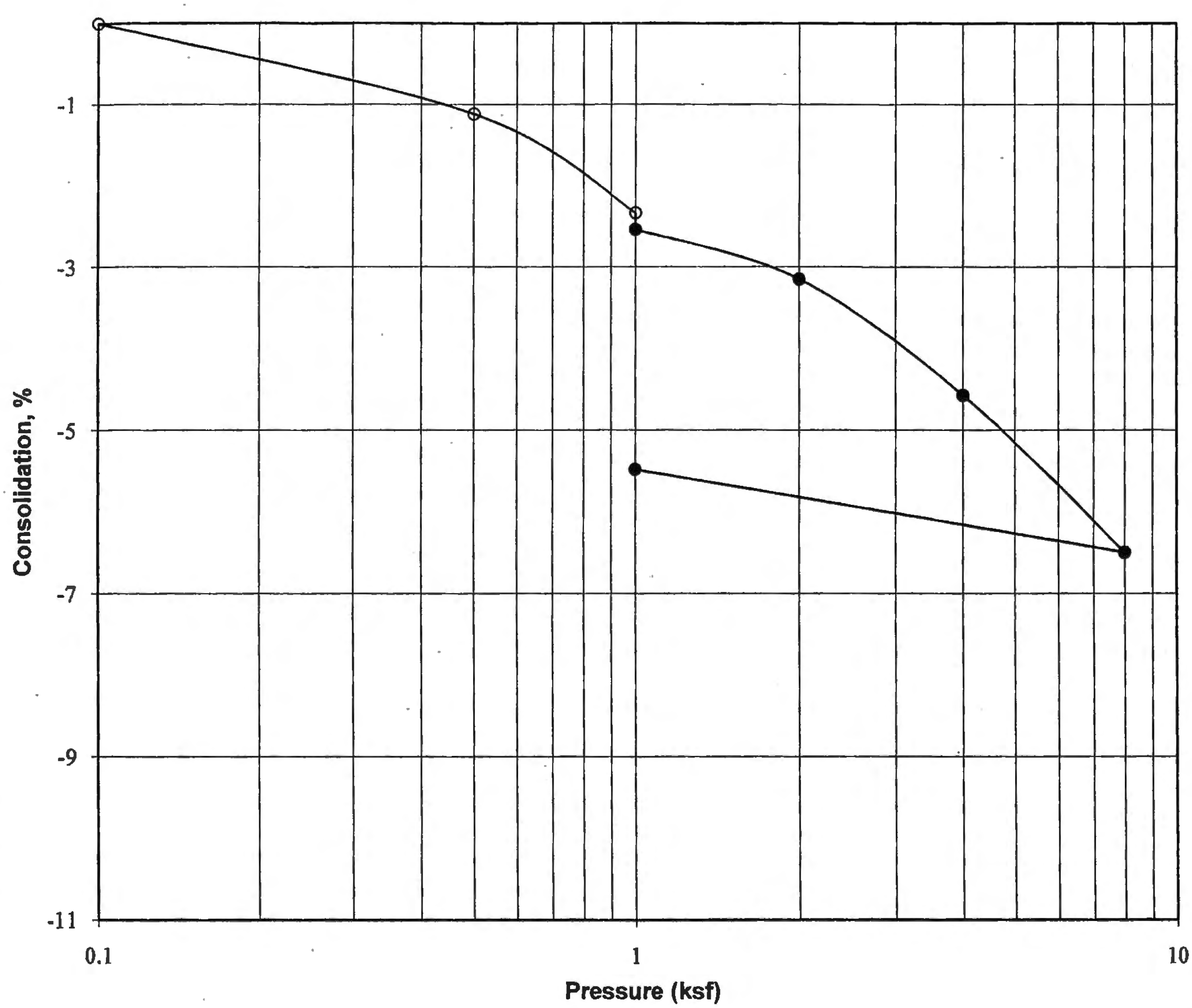
CONSOLIDATION - SWELL TEST



Project:	Childrens Museum
Location:	TH-2
Sample Depth:	2½
Description:	Shelby
Soil Type:	LEAN CLAY with sand (CL)
Natural Moisture, %:	27
Dry Density, pcf:	94
Liquid Limit:	36
Plasticity Index:	14
Water Added at:	1 ksf
Percent Collapse:	1.0

PROJECT NO.: 081002	Earthtec Engineering Inc.	**FIGURE NO.:** 8

CONSOLIDATION - SWELL TEST



Project:	Childrens Museum
Location:	TH-3
Sample Depth:	7½
Description:	Shelby
Soil Type:	LEAN CLAY with sand (CL)
Natural Moisture, %:	32
Dry Density, pcf:	91
Liquid Limit:	36
Plasticity Index:	12
Water Added at:	1 ksf
Percent Collapse:	0.2

PROJECT NO.: 081002	Earthtec Engineering Inc.	**FIGURE NO.:** 9

REAVELEY
ENGINEERS + ASSOCIATES
Consulting Structural Engineers

Wednesday, October 08, 2008

FFKR Architects
730 Pacific Avenue
Salt Lake City, Utah 84104
Attention: Marianne Wander

RE: Geotechnical Information: Maximum Column Loads
The Museum of Natural Curiosity - Schematic Design

The Geotechnical Report by Earthtec Engineering, Inc. dated July 22, 2008 states that the recommendations they have provided are based upon a maximum column load of 100 kips. The proposed building layout consists of columns at sixty feet and forty foot spacing. The typical dead and snow column load for this configuration will be approximately 180 kips. This building also includes a partial basement; the one main building column that will support the suspended main level will have a total load (dead, live and snow) of approximately 230 kips.

Please send this information to Earthtec and request that they provide a letter detailing any changes to their recommendations.

Sincerely,

Jessica Chappell, PE

Jeff Miller, SE

P: 801.486.3883
F: 801.485.0911

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Salt Lake City, Utah 84102
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Earthtec Engineering, Inc.

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Orem, Utah - 84057
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1596 W. 2650 S. #108
Ogden, Utah - 84401
Phone (801) 399-9516
Fax (801) 399-9842

October 13, 2008

Marianne Wander, AIA, LEED
FFKR Architects
730 Pacific Avenue
Salt Lake City, UT 84104

Re: Children's Museum
3900 North Garden Drive
Lehi, Utah
Job No. 081002

Ms. Wander:

Earthtec previously prepared a geotechnical study[1] for the above referenced project. The foundation recommendations provided in the geotechnical report were based upon assumed foundation loads not to exceed 10,000 lbs per linear foot for bearing walls and 100,000 lbs for column loads. We now understand that column loads will be approximately 180,000 lbs, and that one column in a partial basement area will have an approximate 230,000 lb load.

The geotechnical report recommended a maximum bearing capacity of 2,000 psf for foundations constructed on undisturbed native soils, or a maximum bearing capacity of 2,500 psf for foundations constructed on a minimum 18 inches of structural fill placed on undisturbed native soils. For these bearing capacities, the higher foundations loads will induce greater settlements than those stated in the geotechnical report.

To limit the potential settlements we recommend that foundations be constructed entirely on a minimum of 18 inches of structural fill placed on undisturbed native soils and that foundations be designed for a maximum bearing capacity of 2,000 psf.

The information presented in this letter is considered an addendum to the geotechnical report and is subject to the same limitations and exclusions presented therein.

Respectfully;
EARTHTEC ENGINEERING, INC.

Jeffrey J. Egbert, P.E.
Project Geotechnical Engineer

[1] Geotechnical Study, Childrens Museum, 3900 North Garden Drive, Lehi, Utah, Job No. 081002, July 22, 2008.