Applied Geotechnical Engineering Consultants, Inc.

# GEOTECHNICAL INVESTIGATION

# PROPOSED MEDICAL CLINIC

# APPROXIMATELY 5600 WEST 13400 SOUTH

# RIVERTON, UTAH

PREPARED FOR:

INTERMOUNTAIN HEALTH CARE
36 SOUTH STATE STREET, 23RD FLOOR
SALT LAKE CITY, UTAH 84111

ATTENTION: TOM URIONA

PROJECT NO. 1070333

APRIL 25, 2007

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## TABLE OF CONTENTS

## EXECUTIVE SUMMARY

1. The subsurface materials encountered at the site consist of approximately 1 to 1½ feet of fill overlying clay in Test Pits TP-1 and TP-2. Approximately 1 to 2 feet of topsoil was encountered in Test Pits TP-3, TP-4, TP-5 and TP-6. Approximately 2 feet of fill was encountered in Test Pit TP-7. Poorly-graded gravel with clay and sand was encountered below the clay in Test Pits TP-1 and TP-2 and below the fill and topsoil in the other test pits. The gravel extends the maximum depth investigated, approximately 12 feet.
2. No subsurface water was encountered in the test pits or boring at the time of excavating.

3. The proposed building may be supported on spread footings bearing on the undisturbed, natural gravel or on compacted structural fill extending down to the undisturbed, natural gravel. The existing fill, topsoil and the clay encountered in Test Pits TP-1 and TP-2 should be removed from the area of the proposed building.

   Footings bearing on the undisturbed, natural gravel or on compacted structural fill extending down to the gravel may be designed using an allowable net bearing pressure of 2,500 pounds per square foot. A higher bearing pressure could be considered, if needed.

4. The upper natural soil in the area of Test Pits TP-1 and TP-2 consists of lean clay which will be easily disturbed by construction traffic when it is very moist to wet, such as in the winter and spring or at times of prolonged rainfall. Placement of 1 to 2 feet of granular fill will provide limited access for construction equipment when the upper soil is very moist to wet.

5. Geotechnical information related to foundations, subgrade preparation, pavement design and materials is included in the report.

## SCOPE

This report presents the results of a geotechnical investigation for a proposed Medical Clinic to be located at approximately 5600 West 13400 South in Riverton, Utah. The report presents the subsurface conditions encountered, laboratory test results and recommendations for foundations and pavement. The study was conducted in general accordance with our proposal dated March 14, 2007.

Field exploration was conducted to obtain information on the subsurface conditions and to obtain samples for laboratory testing. Samples obtained during the field investigation were tested in the laboratory to determine physical and engineering characteristics of the on-site soil and to define conditions at the site for our engineering analysis. Results of the field exploration and laboratory tests were analyzed to develop recommendations for the proposed foundations and pavement.

This report has been prepared to summarize the data obtained during the study and to present our conclusions and recommendations based on the proposed construction and the subsurface conditions encountered. Design parameters and a discussion of geotechnical engineering considerations related to construction are included in the report.

## SITE CONDITIONS

The site is located south and east of the credit union at the southeast corner of 13400 South and 5600 West. The site encompasses an area of approximately 7 acres and consists of undeveloped land.

There were no structures or pavement on the property at the time of our site visit. There is a small basin in the northwest portion of the property. There was no water in the basin at the time of our site visit.

The ground surface on the property slopes gently down to the east. Vegetation at the site consists of grass and weeds.

There is residential development to the west and south of the property. There is commercial development to the northwest and north of the site. 13400 South, a three-lane, asphalt-paved road, extends along the north edge of the property. 5600 West Street, a two-lane, asphalt-paved road, extends along the west edge of the property. There is a park to the east of the property.

## FIELD STUDY

The field study was conducted on April 4, 2007. Seven test pits were excavated at the approximate locations indicated on Figure 1. The test pits were excavated with a rubber-tired backhoe. The test pits were logged and soil samples obtained by a representative from AGEC. Logs of the subsurface conditions encountered in the test pits are graphically shown on Figures 2 and 3.

The test pits were backfilled without significant compaction. The backfill in the test pits should be properly compacted where it will support proposed buildings, floor slabs or pavement.

## SUBSURFACE CONDITIONS

The subsurface materials encountered at the site consist of approximately 1 to 1½ feet of fill overlying clay in Test Pits TP-1 and TP-2. Approximately 1 to 2 feet of topsoil was encountered in Test Pits TP-3, TP-4, TP-5 and TP-6. Approximately 2 feet of fill was encountered in Test Pit TP-7. Poorly-graded gravel with clay and sand was encountered below the clay in Test Pits TP-1 and TP-2 and below the fill and topsoil in the other test pits. The gravel extends the maximum depth investigated, approximately 12 feet.

A description of the various soils encountered in the test pits follows:

Fill - The fill ranges from clayey gravel to lean clay. It is moist, brown to dark brown and contains occasional roots and organics.

Laboratory tests conducted on a sample of the fill indicate a moisture content of 20 percent and a dry density of 94 pounds per cubic foot (pcf).

Topsoil - The topsoil consists of lean clay with occasional gravel. It is moist, brown and contains roots and organics.

Lean Clay - The lean clay contains small amounts of sand and gravel. It has a slightly porous structure. The clay is stiff to very stiff, slightly moist and light brown.

Laboratory tests conducted on samples of the clay indicate it has natural moisture contents range from 10 to 12 percent and natural dry densities ranging from 86 to 88 pcf.

Consolidation tests conducted on samples of the clay indicate that the soil will compress a moderate to large amount with the addition of light to moderate loads. The clay was found to become more compressible with the addition of water. Additional compression also occurred in the consolidation tests upon wetting under

a constant pressure of 1,000 pounds per square foot (psf). Results of the consolidation tests are presented on Figures 4, 5 and 6.

Poorly-Graded Gravel with Clay and Sand - The gravel contains cobbles up to approximately 4 inches in size. It is dense, slightly moist to moist and brown to light brown and reddish-brown.

Results of gradation tests performed on samples of the gravel are presented on Figures 7 and 8.

Results of the laboratory tests are summarized on Table I and are included on the logs of the test pits.

## SUBSURFACE WATER

No subsurface water was encountered in the test pits the time of excavating to the maximum depth investigated, approximately 12 feet below the ground surface.

## PROPOSED CONSTRUCTION

The location and type of construction for the medical building were unknown at the time of our investigation. We have assumed that the building would be similar to other medical clinics in the area. We have assumed that the building would consist of a one to two-story structure with a slab-on-grade floor.

We have assumed building loads consisting of wall loads up to 5 kips per lineal foot and column loads up to 150 kips.

We anticipate that paved parking areas will be constructed around the building. We have assumed traffic for paved areas consisting of less than 1,000 passenger vehicles per day, five delivery trucks per day and two garbage trucks per week.

If the proposed construction, building loads or traffic is significantly different from what is described above, we should be notified so that we can reevaluate our recommendations.

## RECOMMENDATIONS

Based on the subsurface conditions encountered, laboratory test results, and the proposed construction, the following recommendations are given:

### A. Site Grading

Site grading plans were not available at the time of our investigation. We anticipate that there will be less than 5 feet of cut and fill required for the proposed building. We have assumed that there may be on the order of 5 to 10 feet of cut and fill required for the proposed parking and paved areas around the proposed building.

1. Subgrade Preparation

Prior to placing grading fill or base course, unsuitable fill, topsoil, organics, debris and other deleterious material should be removed. The subgrade should be scarified to a depth of approximately 6 inches, the moisture of the subgrade adjusted to within 2 percent of optimum and the subgrade compacted to at least 90 percent of the maximum dry density as determined by ASTM D-1557. The subgrade should then be proof-rolled to identify soft areas. Soft areas should be removed and replaced with granular fill containing less than 15 percent passing the No. 200 sieve.

The upper natural soil in the north portion of the property consists of clay. Access difficulties may be encountered if the clay becomes very moist to wet, such as during the winter or spring, or after periods of prolonged rainfall. Placement of approximately 1 to 2 feet of gravel will provide limited access for moderately loaded construction equipment when the clay is very moist to wet. Under these conditions, consideration may be given to not scarifying the subgrade, but cutting to undisturbed natural soil below the topsoil and placing gravel as needed for access and pavement construction.

2. Excavation

Excavation at the site can be accomplished with typical excavation equipment.

3. Materials

Materials placed as fill to support the proposed building should be non-expansive granular soil. The clay is generally not suitable for use as structural fill but may be used as site grading fill below pavement areas or as utility trench backfill if the topsoil, organics and other deleterious materials are removed, or it may be used in landscape areas.

The natural gravel may be considered for use as structural fill below the proposed building if it meets the criteria for imported structural fill given below. We anticipate that the natural gravel will meet this criteria. The gravel may also be used as site grading fill below pavement areas and as utility trench backfill if the topsoil, organics and other deleterious materials are removed, or it may be used in landscape areas.

The moisture content of the natural soil is near to below the optimum moisture content. Wetting of the soil will likely be needed to facilitate compaction if the on-site soil is used as fill.

Listed below are materials recommended for imported structural fill.

| Fill to Support | Recommendation |
|---|---|
| Footings | Non-expansive granular material<br>Passing No. 200 sieve < 35%<br>Liquid Limit < 30%<br>Maximum size 4 inches |
| Floor Slab<br>(Upper 4 inches) | Non-expansive granular material<br>Passing No. 200 sieve < 5%<br>Maximum size 2 inches |
| Floor Slab | Non-expansive granular material<br>Passing No. 200 sieve < 50%<br>Liquid Limit < 30%<br>Maximum size 6 inches |

4. Compaction

Compaction of materials placed at the site should equal or exceed the minimum densities as indicated below when compared to the maximum dry density as determined by ASTM D-1557.

| Fill to Support | Compaction |
|---|---|
| Foundations | ≥95% |
| Concrete flatwork and pavement | ≥90% |
| Landscaping | ≥85% |
| Retaining wall backfill | 85 - 90% |

To facilitate the compaction process, the fill should be compacted at a moisture content within 2 percent of the optimum moisture content.

Base course should be compacted to at least 95 percent of the maximum dry density as determined by ASTM D-1557, at a moisture content within 2 percent of the optimum.

Fill and pavement materials placed for the project should be frequently tested for compaction during placement and compaction.

5. Drainage

The ground surface surrounding the building should be sloped away from the building in all directions. Roof down spouts and drains should discharge beyond the limits of backfill.

The collection and diversion of drainage away from the pavement surface is important to the satisfactory performance of the pavement. Proper drainage should be provided.

## B. Foundations

1. Bearing Material

The proposed building may be supported on spread footings bearing on the undisturbed, natural gravel or on compacted structural fill extending down to the undisturbed natural gravel. Structural fill should extend out away from the edge of footings at least a distance equal to the depth of fill placed beneath the footings.

The natural moisture sensitive clay, unsuitable fill, topsoil, organics and other deleterious materials should be removed from below proposed foundation areas.

2. Bearing Pressure

Spread footings bearing on the undisturbed, natural gravel or on compacted structural fill extending down to the natural gravel may be designed using an allowable net bearing pressure of 2,500 psf. A higher bearing pressure could be considered, if needed.

3. Settlement

We estimate that total settlement will be less than ¾ of an inch. Differential settlement is estimated to be less than ½ of an inch.

4. Footing Width and Embedment

The footings should have a width of at least 2 feet and a depth of embedment of at least 1 foot.

5. Temporary Loading Conditions

The allowable bearing pressures may be increased by one-half for temporary loading conditions such as wind and seismic loads.

6. Frost Depth

Exterior footings and footings beneath unheated areas should be placed at least 30 inches below grade for frost protection.

7. Foundation Base

The base of foundation excavations should be cleared of loose or deleterious material prior to structural fill or concrete placement.

8. Construction Observation

A representative of the geotechnical engineer should observe footing excavations prior to structural fill or concrete placement.

## C. Concrete Slab-on-Grade

1. Slab Support

Concrete slabs may be supported on the natural undisturbed soil or on compacted structural fill.

Unsuitable fill, topsoil, organics and other deleterious materials should be removed from below proposed floor slabs.

2. Underslab Sand and/or Gravel

A 4-inch layer of free draining sand and/or gravel (less than 5 percent passing the No. 200 sieve) should be placed below the floor slab for ease of construction and to promote even curing of the slab concrete.

3. Vapor Barrier

A vapor barrier should be placed under the concrete floor if the floor will receive an impermeable floor covering. The barrier will reduce the amount of water vapor passing from below the slab to the floor covering.

## D. Lateral Earth Pressures

1. Lateral Resistance for Footings

Lateral resistance for footings placed on the natural soil is controlled by sliding resistance between the footing and the foundation soil. A friction value of 0.45 may be used in design for ultimate lateral resistance.

2. Subgrade Walls and Retaining Structures

The following equivalent fluid weights are given for design of subgrade walls and retaining structures. The active condition is where the wall moves away

from the soil. The passive condition is where the wall moves into the soil and the at-rest condition is where the wall does not move. The values listed assume a horizontal surface adjacent the wall.

| Soil Type | Active | At-Rest | Passive |
|---|---|---|---|
| Clay | 50 pcf | 65 pcf | 250 pcf |
| Sand & Gravel | 40 pcf | 55 pcf | 300 pcf |

3. Seismic Conditions

Under seismic conditions, the equivalent fluid weight should be increased by 28 pcf for active and at-rest conditions and decreased by 28 pcf for the passive condition. This assumes a short period spectral response acceleration of 1.09g which represents a 2 percent probability of exceedance in a 50 year period (IBC, 2006).

4. Safety Factors

The values recommended above assume mobilization of the soil to achieve ultimate soil strength. Conventional safety factors used for structural analysis for such items as overturning and sliding resistance should be used in design.

## E. Liquefaction, Faulting and Seismicity

1. Liquefaction

The site is located in an area mapped as having a "very low" potential for liquefaction (Salt Lake County, 1995). Based on our understanding of the geologic conditions at the site, liquefaction is not considered to be a hazard for the proposed structure.

2. Faulting

There are no mapped active faults extending near to through the property. The closest mapped fault to the site, which is considered active, is the Salt Lake segment of the Wasatch Fault, approximately 9½ miles to the east (Salt Lake County, 1995).

3. Seismicity

Listed below is a summary of the site parameters for the International Building Code 2006.

| | | |
|---|---|---|
| a. | Site Class | D |
| b. | Short Period Spectral Response Acceleration, $S_S$ | 1.09g |
| c. | One Second Period Spectral Response Acceleration, $S_1$ | 0.62g |

## F. Water Soluble Sulfates

One sample of the natural soil was tested in the laboratory for water soluble sulfate content. Results of the test indicate that there is less than 0.1 percent water soluble sulfate in the soil. Based on the results of the test and published literature, the natural soil possesses a negligible sulfate attack potential on concrete. Sulfate-resistant cement is not needed for concrete placed in contact with the natural soil. Other conditions may dictate the type of cement to be used in concrete for the project.

## G. Pavement

Based on the subsoil conditions encountered, laboratory test results and the assumed traffic, the following pavement support recommendations are given:

1. Subgrade Support

The near surface soil consists of clay and gravel. We have assumed a CBR value of 3 percent for the clay subgrade.

When the subgrade consists of clay and is very moist to wet, a layer of granular fill may be necessary to construct the pavement. Placement of 1 to 2 feet of gravel will provide limited support for construction equipment over very moist to wet clay. The need for gravel can be reduced if care is taken to minimize subgrade disturbance with construction traffic and to construct the pavement during dry and hot weather.

2. Pavement Thickness

Based on the subsoil conditions, the assumed traffic, a design life of 20 years for flexible pavement and 30 years for rigid pavement and methods presented by the Utah Department of Transportation and the Portland Cement Association, a pavement section consisting of 3 inches of asphaltic concrete overlying 8 inches of high-quality base course is calculated. The pavement section may be reduced to 6 inches in areas where no significant truck traffic is expected and where the subgrade consist of at least 6 inches of granular borrow or the natural gravel.

Alternatively, a rigid pavement section consisting of 5 inches of Portland cement concrete placed on a prepared subgrade could be used.

3. Pavement Material

a. Flexible Pavement (Asphaltic Concrete)

The pavement materials should meet the material specifications for the applicable jurisdiction. Other materials may be considered for use in the pavement section. The use of other materials could result in different pavement material thicknesses.

b. Rigid Pavement (Portland Cement Concrete)

The design assumes that a concrete shoulder or curb will be placed at the edge of the pavement and that the pavement will have aggregate interlock joints.

The pavement materials should meet the material specifications for the applicable jurisdiction. The pavement thickness indicated above assumes that the concrete will have a 28-day compressive strength of at least 4,000 pounds per square inch. Concrete should be air entrained with approximately 6 percent air. The maximum allowable slump will depend on the method of placement, but should not exceed 4 inches.

4. Jointing

Joints for concrete pavement should be laid out in a square or rectangular pattern. Joint spacings should not exceed 30 times the thickness of the slab. The joint spacings indicated should accommodate the contraction of the concrete and under these conditions steel reinforcing will not be required. The depth of joints should be approximately one-fourth of the slab thickness.

## LIMITATIONS

This report has been prepared in accordance with generally accepted soil and foundation engineering practices in the area for the use of the client for design purposes. The conclusions and recommendations included within the report are based on the information obtained from the test pits excavated at the approximate locations indicated on Figure 1 and the data obtained from laboratory testing. Variations in the subsurface conditions may not become evident until additional exploration or excavation is conducted. If the subsurface conditions or groundwater level is found to be significantly different from what is described above, we should be notified to reevaluate our recommendations.

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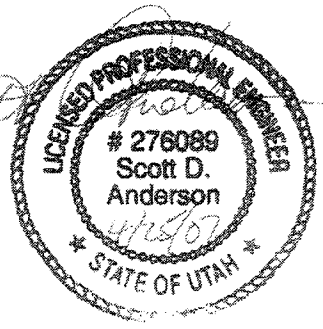



Scott D. Anderson, P.E.

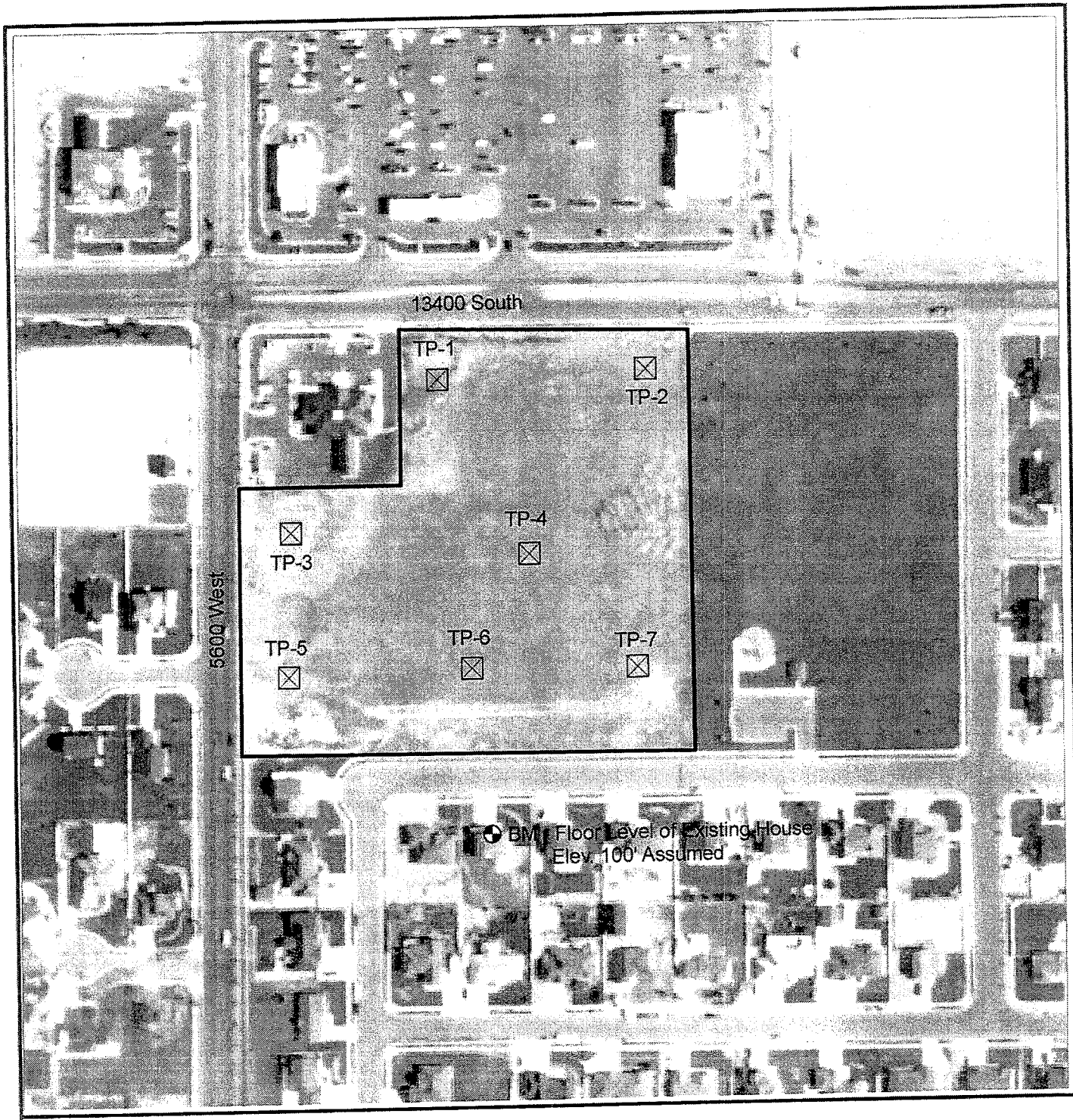
Reviewed by Jay R. McQuivey, P.E.

SDA/ni

## REFERENCES

International Building Code, 2006; International Code Council, Inc. Falls Church, Virginia.

Salt Lake County, 1995, Surface Rupture and Liquefaction Potential Special Study Areas Map, Salt Lake County, Utah, adopted March 31, 1989, revised March 1995, Salt Lake County Public Works - Planning Division, 2001 South State Street, Salt Lake City, Utah.



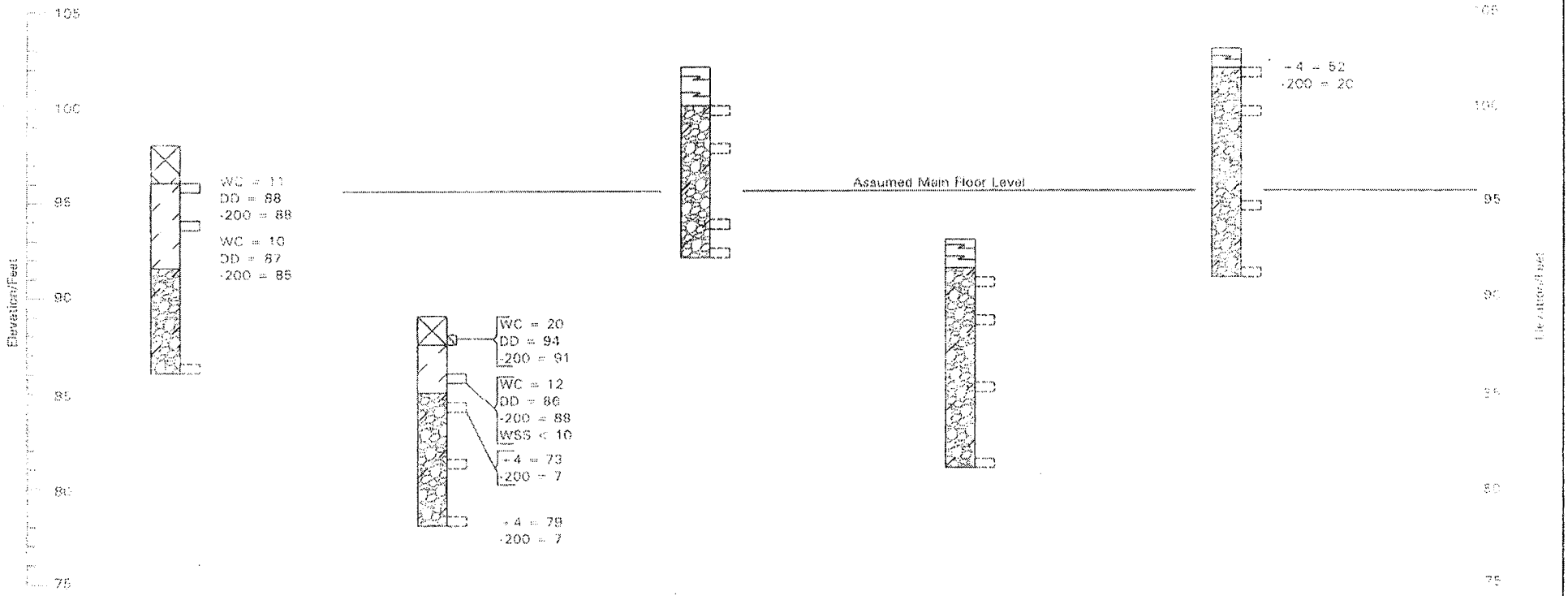

USGS Aerial Photograph 2006

NORTH

Approximate Scale
1 inch = 200 feet

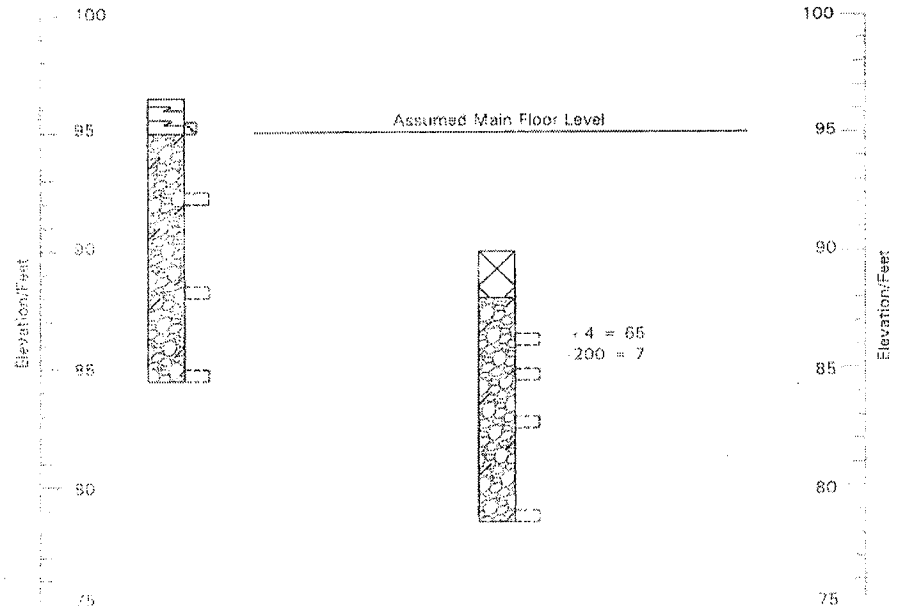
**PROPOSED MEDICAL CLINIC**
**APPROXIMATELY 5600 WEST 134000 SOUTH**
**RIVERTON, UTAH**

| 1070333 | AGEC | Locations of Test Pits | Figure 1 |
|---|---|---|---|




Approximate Vertical Scale 1" = 8'

See Figure 3 for Legend and Notes




Approximate Vertical Scale 1" = 8'

LEGEND:

Fill; ranges from clayey gravel to lean clay, moist, brown to dark brown, occasional roots and organics.

Topsoil; lean clay with occasional gravel, moist, brown, roots and organics.

Lean Clay (CL); contains small amounts of sand and gravel, slightly porous structure, stiff to very stiff, slightly moist, light brown.

Poorly Graded Gravel with Clay and Sand (GP-GC); contains cobbles up to approximately 4 inches in size, dense, slightly moist to moist, brown to light brown and reddish brown.

Indicates relatively undisturbed hand drive sample taken.

Indicates disturbed sample taken.

Indicates relatively undisturbed block sample taken.

NOTES:

1. Test pits were excavated on April 4, 2007 with a rubber-tired backhoe.
2. Locations of test pits were measured approximately by pacing from features shown on Figure 1.
3. Elevations of test pits were measured by automatic level and refer to the bench mark shown on Figure 1.
4. The test pit locations and elevations should be considered accurate only to the degree implied by the method used.
5. The lines between the materials shown on the test pit logs represent the approximate boundaries between material types and the transitions may be gradual.
6. No free water was encountered in the test pits at the time of excavation.
7. WC = Water Content (%);
   DD = Dry Density (pcf);
   +4 = Percent Retained on the No. 4 Sieve;
   -200 = Percent Passing No. 200 Sieve;
   WSS = Water Soluble Sulfates (ppm).

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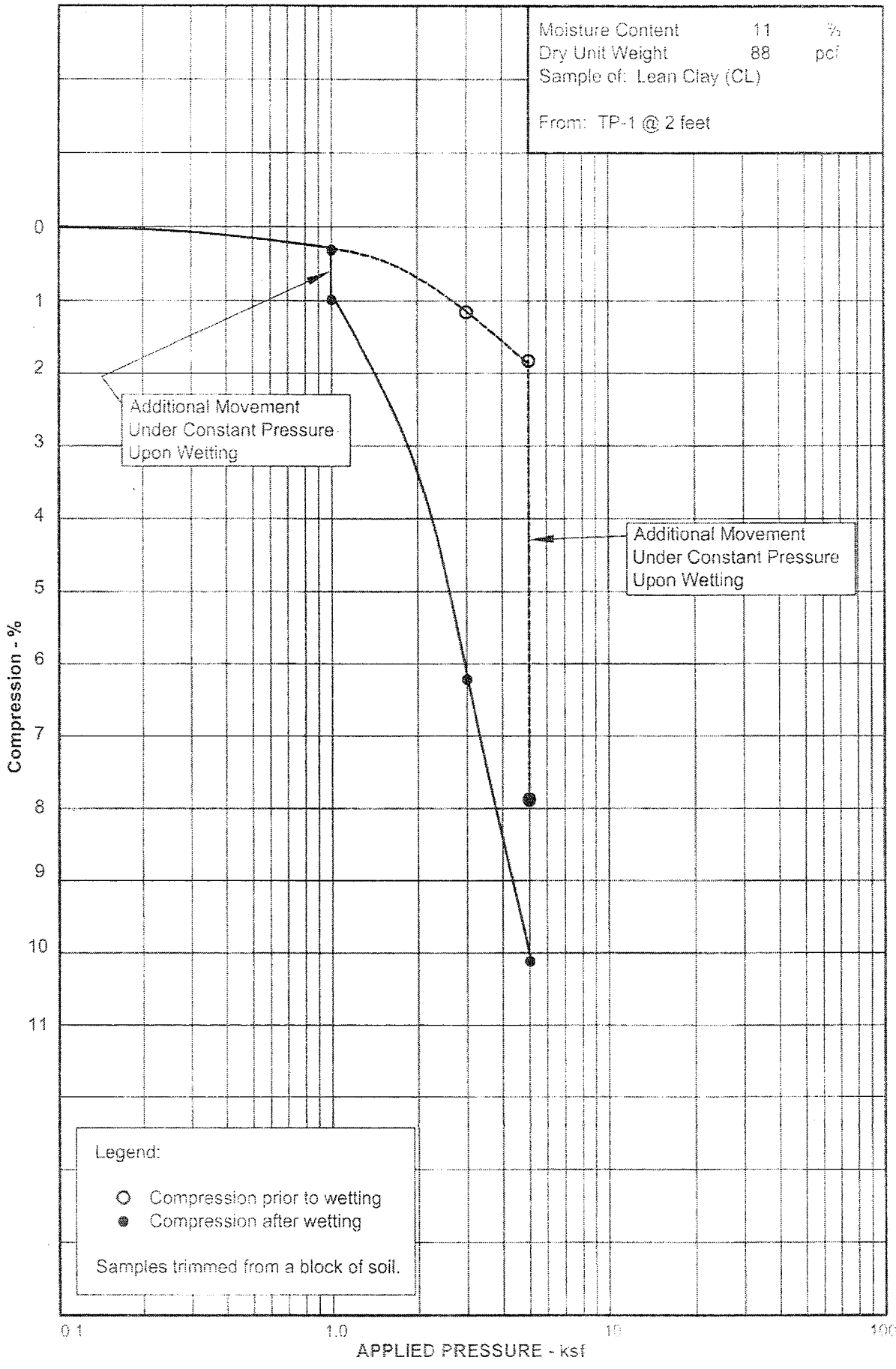


Project No. 1070333 CONSOLIDATION TEST RESULTS Figure 4

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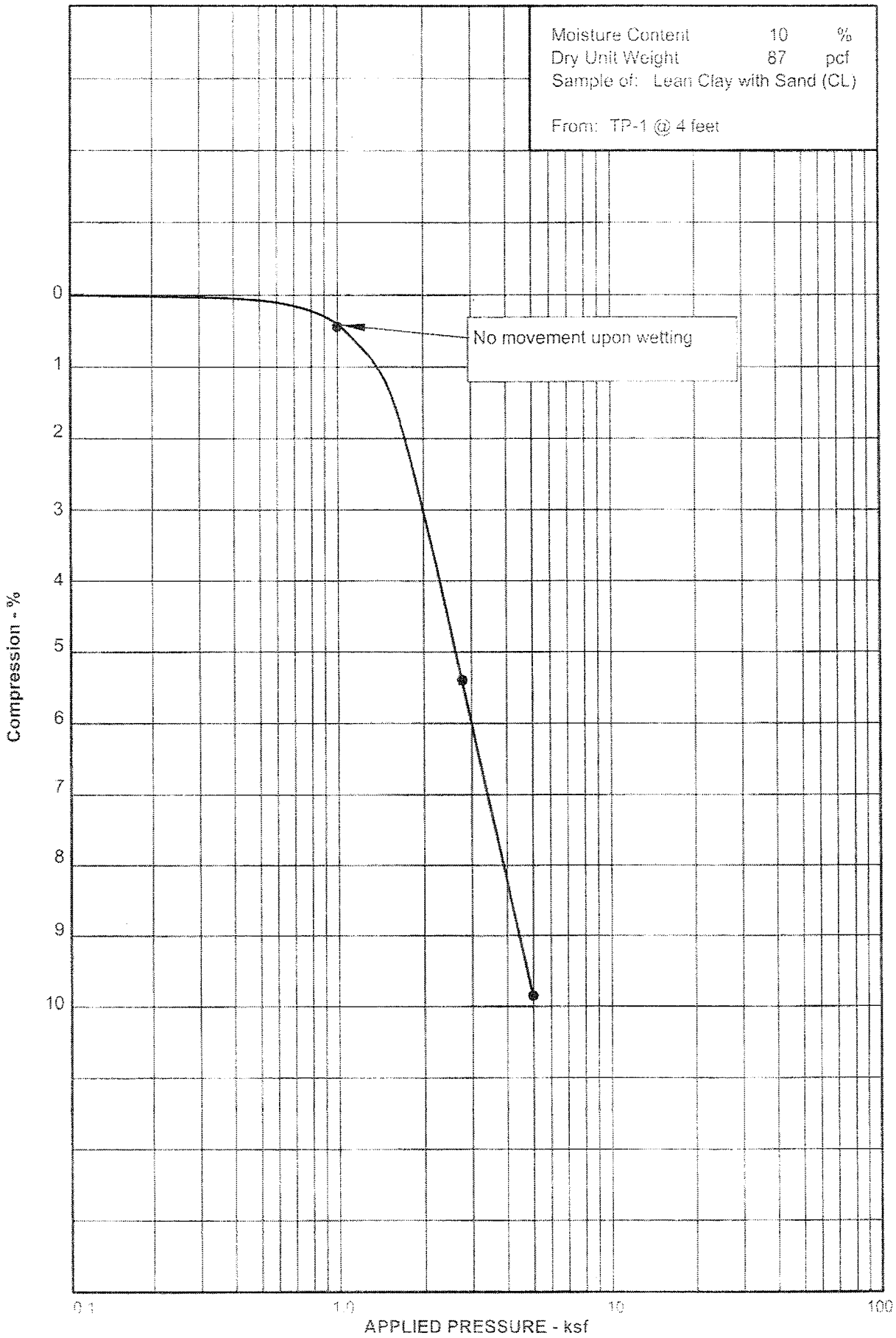
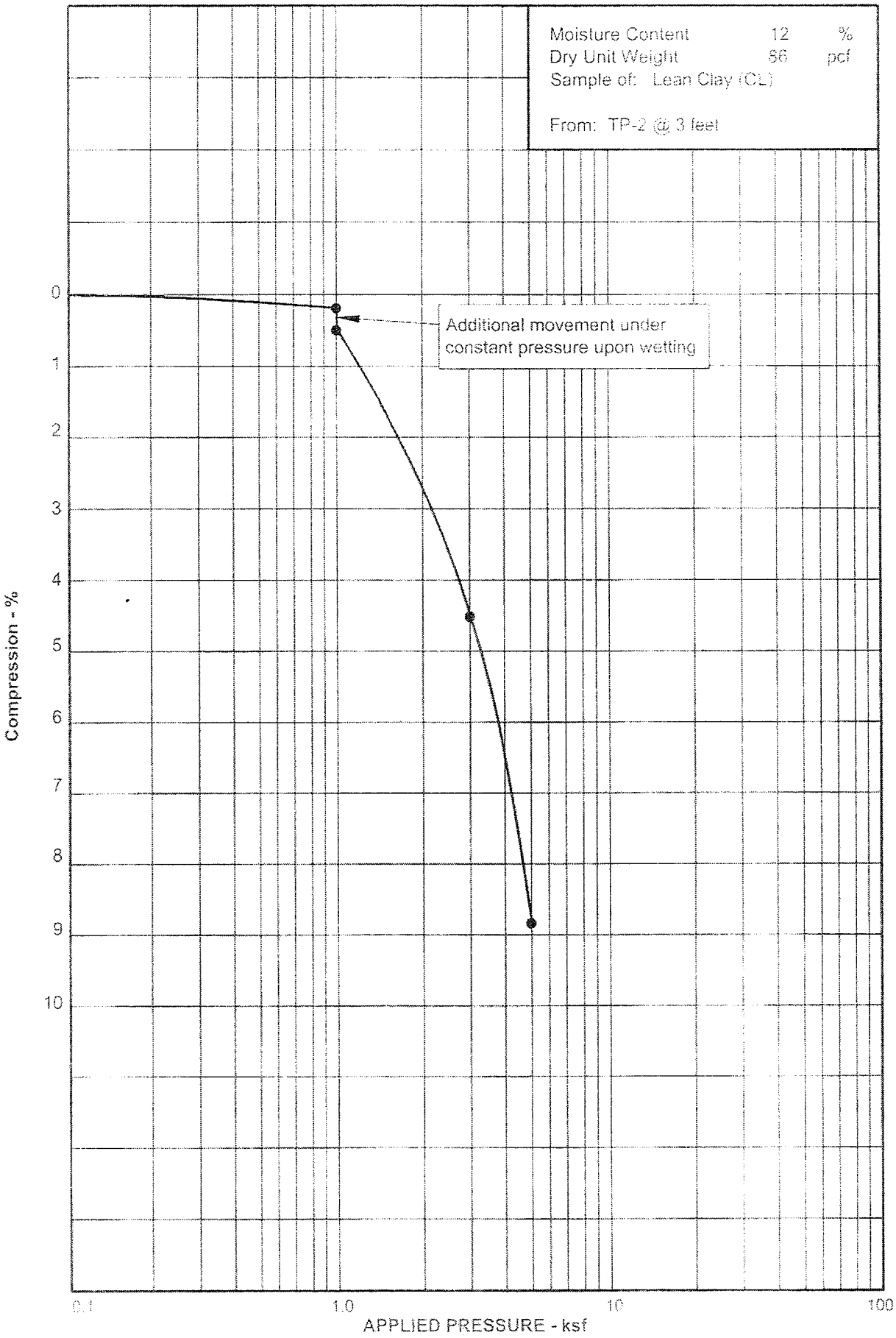
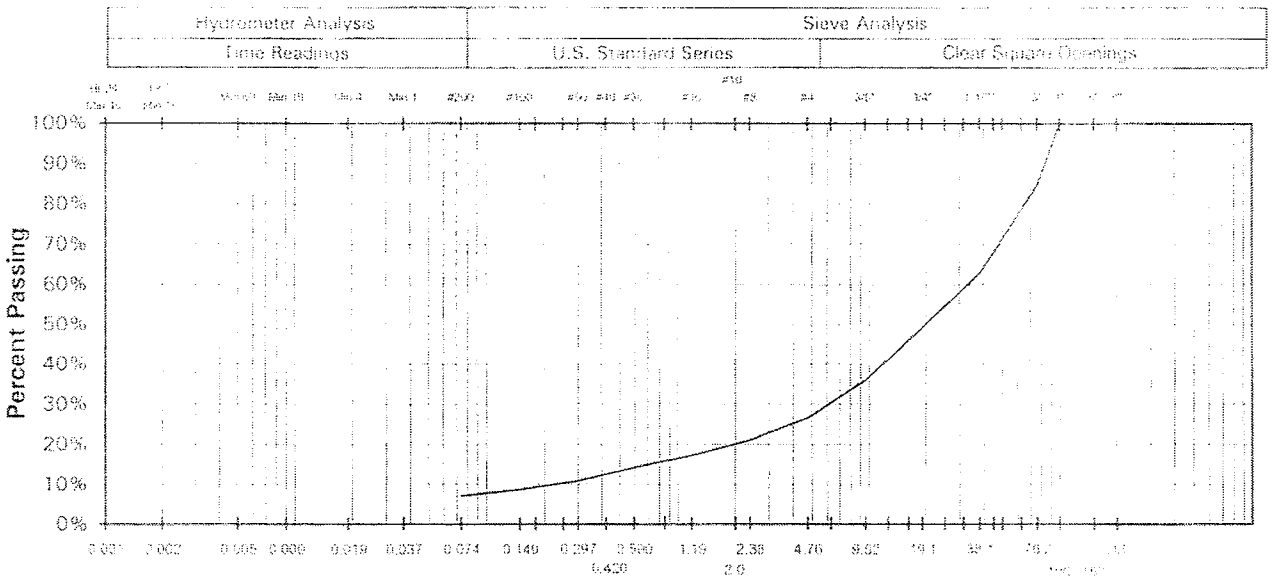



Project No. 1070333 CONSOLIDATION TEST RESULTS Figure 5

Applied Geotechnical Engineering Consultants, Inc.




Project No. 1070333 CONSOLIDATION TEST RESULTS Figure 6

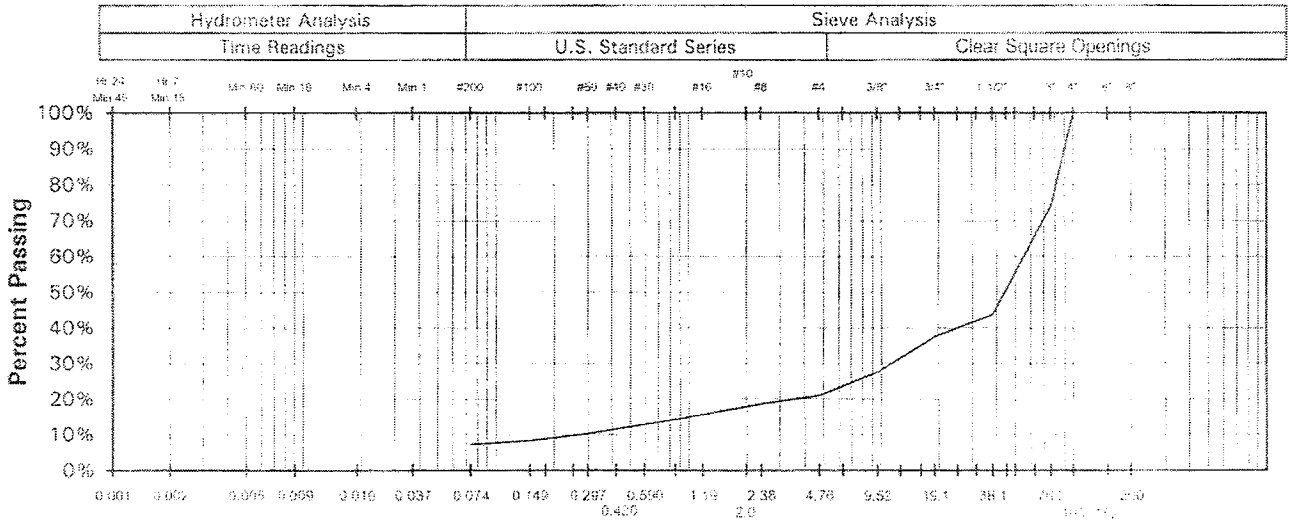



Diameter of Particle in Millimeters

| Clay to Silt | Sand | | | Gravel | | Cobbles | Boulders |
|---|---|---|---|---|---|---|---|
| | Fine | Medium | Coarse | Fine | Coarse | | |

| | | | |
|---|---|---|---|
| Gravel | 73% | Liquid Limit | - |
| Sand | 20% | Plasticity Index | - |
| Silt and Clay | 7% | Sample Location | TP-2 @ 4½ feet |

Sample Description Poorly Graded Gravel with Clay and Sand (GP-GC)




Diameter of Particle in Millimeters

| Clay to Silt | Sand | | | Gravel | | Cobbles | Boulders |
|---|---|---|---|---|---|---|---|
| | Fine | Medium | Coarse | Fine | Coarse | | |

| | | | |
|---|---|---|---|
| Gravel | 79% | Liquid Limit | - |
| Sand | 14% | Plasticity Index | - |
| Silt and Clay | 7% | Sample Location | TP-2 @ 10½ feet |

Sample Description Poorly Graded Gravel with Clay and Sand (GP-GC)

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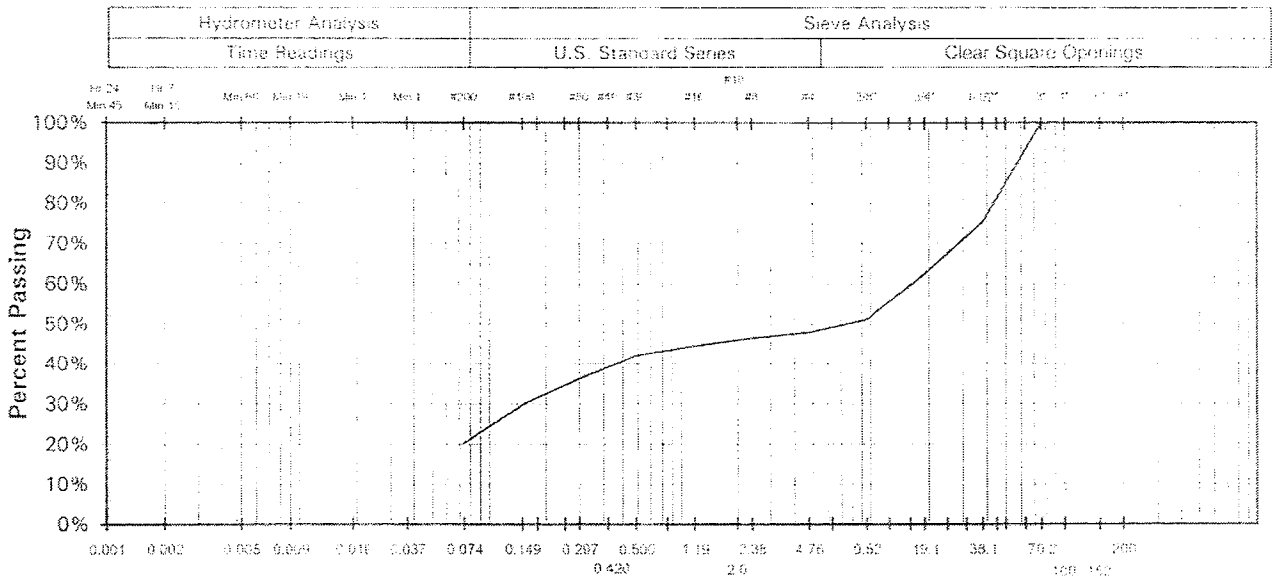
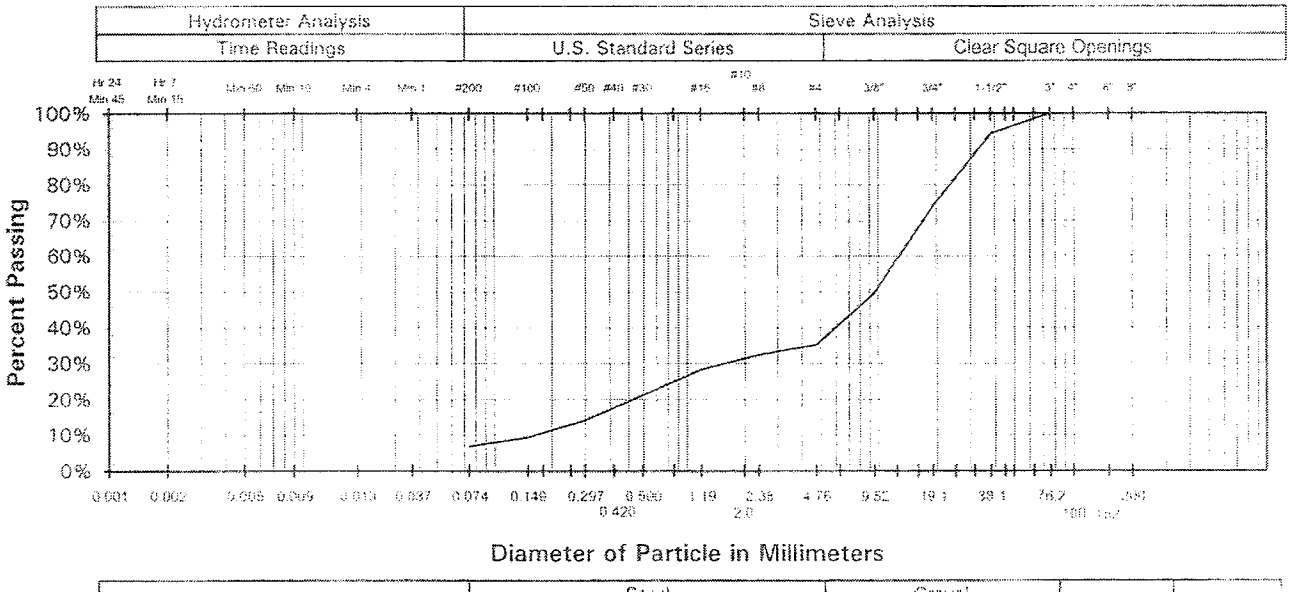



Gravel 52% Liquid Limit -
Sand 28% Plasticity Index -
Silt and Clay 20% Sample Location TP-5 @ 1 foot
Sample Description Clayey Gravel with Sand (GC)




Gravel 65% Liquid Limit -
Sand 28% Plasticity Index -
Silt and Clay 7% Sample Location TP-7 @ 3½ feet
Sample Description Poorly Graded Gravel with Clay and Sand (GP-GC)

Project No. 1070333 GRADATION TEST RESULTS Figure 8

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, INC.

TABLE I

# SUMMARY OF LABORATORY TEST RESULTS

PROJECT NUMBER 1070333

| SAMPLE LOCATION | | NATURAL MOISTURE CONTENT (%) | NATURAL DRY DENSITY (PCF) | GRADATION | | | ATTERBERG LIMITS | | UNCONFINED COMPRESSIVE STRENGTH (PSF) | WATER SOLUBLE SULFATE (ppm) | SAMPLE CLASSIFICATION |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TEST PIT | DEPTH (FEET) | | | GRAVEL (%) | SAND (%) | SILT/ CLAY (%) | LIQUID LIMIT (%) | PLASTICITY INDEX (%) | | | |
| TP-1 | 2 | 11 | 88 | | | 88 | | | | | Lean Clay (CL) |
| | 4 | 10 | 87 | | | 85 | | | | | Lean Clay with Sand (CL) |
| | | | | | | | | | | | |
| TP-2 | 1 | 20 | 94 | | | 91 | | | | | Fill: Lean Clay |
| | 3 | 12 | 86 | | | 88 | | | | <10 | Lean Clay (CL) |
| | 4½ | | | 73 | 20 | 7 | | | | | Poorly Graded Gravel with Clay and Sand (GP-GC) |
| | 10½ | | | 79 | 14 | 7 | | | | | Poorly Graded Gravel with Clay and Sand (GP-GC) |
| | | | | | | | | | | | |
| TP-5 | 1 | | | 52 | 28 | 20 | | | | | Clayey Gravel with Sand (GC) |
| | | | | | | | | | | | |
| TP-7 | 3½ | | | 65 | 28 | 7 | | | | | Poorly Graded Gravel with Clay and Sand (GP-GC) |
| | | | | | | | | | | | |
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