Applied Geotechnical Engineering Consultants, Inc.

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RIVERTON CITY ENGINEER

GEOTECHNICAL INVESTIGATION

PROPOSED NEFF MEADOWS SUBDIVISION

APPROXIMATELY 11850 SOUTH 2780 WEST

RIVERTON, UTAH

PREPARED FOR:

ROYAL VIEW HOMES
12570 SOUTH 3600 WEST
RIVERTON, UTAH 84065

ATTENTION: JAY RINDLESBACH

PROJECT NO. 973816

DECEMBER 31, 1997

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CONCLUSIONS

1. The subsurface soil at the site generally consists of approximately 1 foot of topsoil overlying lean clay which extends to depths of 6½ to 10 feet below the ground surface. Layers of sand and gravel were encountered below the clay in some of the test pits.

2. No free water was encountered in the test pits to the maximum depth investigated.

3. The upper soil at the site consists of clay and silt. These fine-grained soils will result in considerable construction difficulties during periods in which the upper soils are very moist, such as in the winter and spring or at times of prolonged rainfall. Placement of granular fill in traffic areas will assist in accessing the property when the upper soils are very moist.

4. The proposed residences may be supported on spread footings bearing on the natural undisturbed soil or on at least 2 feet of structural fill overlying fine-grained, moisture-sensitive soils with visible voids. Footings bearing on natural undisturbed clay soils may be designed for an allowable bearing pressure of 1,500 psf. Footings bearing on at least 2 feet of structural fill or on natural gravel may be designed using an allowable bearing pressure of 2,500 psf.

5. Some of the clay and silt soil encountered at the site has a moderate porous structure and are moisture sensitive. The moisture-sensitive clay and silt soils were found to compress a moderate amount with the addition of light to moderate loads when wetted. Precautions with respect to constructing in moisture-sensitive soil areas are included in the report.

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

SCOPE

This report presents the results of a Geotechnical Investigation for the proposed Neff Meadows Subdivision to be located at approximately 2780 West 11850 South in Riverton, Utah. The report presents the subsurface conditions encountered, laboratory test results, and recommendations for foundations and pavement.

Three test pits were excavated to obtain information on the subsurface conditions and to obtain samples for laboratory testing. Information from field and laboratory studies was used to define conditions at the site and 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

No structures or pavements are present at the site. The site consists of a vacant field surrounded by residential dwellings. There is an irrigation ditch approximately 2 feet deep which extends in an east/west direction through the middle of the site.

The site is generally level and slopes very gently down to the east. Vegetation at the site consists of grass and weeds. Residences in the surrounding area consist of one to two-story wood frame structures with basements.

FIELD STUDY

The field study was conducted on December 23, 1997. Three test pits were excavated at the locations indicated on Figure 1. The test pits were excavated with a rubber-tired backhoe. Logs of the subsurface conditions encountered in the test pits are graphically shown on Figure 2.

SUBSURFACE CONDITIONS

The subsurface soil at the site generally consists of approximately 1 foot of topsoil overlying lean clay which extends to depths of 6½ to 10 feet below the ground surface. Layers of sand and gravel were encountered below the clay in some of the test pits.

A description of the soil encountered in the test pits follows:

Topsoil - The topsoil consists of clay with sand. It is moist, brown and contains roots.

Lean Clay - The lean clay contains moderate amounts of sand and silt. Some of the clay and silt have a moderately porous structure. The clay is medium stiff to stiff, moist and light brown to grayish brown in color.

Laboratory tests conducted on samples of the clay indicate natural moisture contents range between 12 and 17 percent and natural dry densities range from 76 to 87 pounds per cubic foot (pcf). A sample of the clay was found to have an unconfined compressive strength of 870 pounds per square foot (psf). Consolidation tests conducted on samples of the clay indicate that the clay will compress a moderate amount with the addition of light to moderate loads. The results of consolidation tests

indicate that the natural soil becomes more compressible when wetted. Results of the consolidation tests are presented on Figures 3 and 4.

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

A summary of the laboratory test results is presented on Table I and on the Logs of Exploratory Test Pits.

SUBSURFACE WATER

No free water was encountered in the test pits at the time of excavating to the maximum depth investigated, 12½ feet.

PROPOSED CONSTRUCTION

The property for the proposed subdivision encompasses an area of approximately 4 acres. We understand that the area will be subdivided into seven residential lots. We have assumed maximum wall loads of 3 kips per lineal foot and maximum column loads of 15 kips based on typical residential construction in the area.

Neff Meadows Circle cul-de-sac (2780 West Street) will be constructed through the subdivision. We have assumed traffic for roads consisting of 200 cars per day, 2 delivery trucks and 2 garbage trucks per week. If the building or traffic loads are significantly different from those described above, we should be notified to re-evaluate our recommendations.

RECOMMENDATIONS

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

A. Site Grading

Final site grading plans were not available at the time of report writing. We anticipate that there will be only minor amounts of cut and fill.

The upper natural soil was found to be moist. However, the topsoil and much of the upper natural soil on the site consists of clay and silt which may become wet and soft during periods of heavy precipitation or spring runoff. During these periods, construction traffic may cause rutting and disturbance of the natural soils at the site. Care should be taken to minimize disturbance of the natural soils, particularly in the areas of buildings and pavement. Placement of granular fill in traffic areas will help provide equipment access during periods when the near surface soils are very moist.

1. Excavation

We anticipate that excavation at the site can be accomplished with typical excavation equipment.

Care should be taken not to disturb the natural soils below foundations. A smooth cutting edge should be considered for excavation equipment when excavating foundations in the natural clay to reduce disturbance of the bearing soils.

2. Pavement Subgrade Preparation

Prior to placing grading fill or base course, all organic material, existing fill and other deleterious material should be removed.

The pavement subgrade should be scarified to a depth of approximately 6 inches, moisture conditioned to within 2 percent of the optimum moisture content and 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 any soft areas. Soft areas should be removed and replaced with compacted fill.

3. Materials

Listed below are materials recommended for structural fill.

Fill to Support	Recommendation
Footings	Non-expansive granular soil -200 <35%, LL < 30% Maximum size 4 inches
Floor Slabs (Upper 4 inches)	Sand and Gravel -200 < 5% Maximum size 2 inches
Slab Support	Non-expansive granular soil -200 < 50%, LL < 30% Maximum size 6 inches

The upper soils are primarily clay and silt which are fine-grained materials. The fine-grained soils are not suitable for use as fill below structures, but may be

used under pavement or as wall or utility trench backfill, if the topsoil, organics and other deleterious material are removed or they may be used in landscaped areas. The sand and gravel may be used as structural fill if it meets the critera given above.

The moisture content of the on-site natural soil was found to be generally near the optimum moisture content at the time of our field investigation. Moisture conditioning of the on-site natural soil may be required prior to use as backfill.

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 Floor	≥ 90%
Wall Backfill	85 to 90%

To facilitate the compaction process, the fill should be compacted at a moisture content within 2 percent of the optimum moisture content as determined by ASTM D-1557.

The base course should be compacted to at least 95 percent of the maximum dry density as determined by ASTM D-1557.

5. Drainage

With the presence of moisture-sensitive soils, it is important that the following drainage precautions be observed during construction and maintained at all times after the residences have been completed.

a. Excessive wetting or drying of soils in foundation excavations in clay or silt soils should be avoided.

b. The ground surface surrounding the exterior of the residences should be sloped away from the structures in all directions, maintaining a slope of at least 6 inches in the first 10 feet away from the residences.

c. The upper 2 feet of foundation wall backfill should be low permeable clay or silt soil. The on-site clay and silt may be used as this material.

d. Roof down spouts and drains should discharge well beyond the limits of backfill.

e. Sprinkler lines and sprinkler heads should not be placed within 10 feet of the foundation walls.

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

B. Foundations

1. Bearing Material

With the proposed construction and the subsurface conditions encountered, we recommend that the residences be supported on the natural undisturbed soil or on at least 2 feet of compacted structural fill overlying fine-grained moisture-sensitive soils.

All topsoil, uncompacted fill or other deleterious material should be removed from below foundation areas. Structural fill placed below foundations should extend out and away from the edge of the footings a distance equal to the depth of fill beneath footings.

If during excavation, soils with visible voids are encountered, the potential for settlement due to wetting and collapse of the soils can be reduced by removing soils with visible voids beneath footing and floor slab areas and either replacing them with structural fill, or extending the foundation deeper in these areas.

2. Bearing Pressure

Spread footings bearing on the natural undisturbed clay soil may be designed for a net allowable bearing pressure of 1,500 psf. Footings bearing on at least 2 feet of structural fill or on natural gravel may be designed for an allowable bearing pressure of 2,500 psf. Footings should have a minimum width of 18 inches and a minimum depth of embedment of 10 inches.

3. Temporary Loading Conditions

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

4. Settlement

For foundations bearing on natural undisturbed soil or on at least 2 feet of structural fill, we estimate that settlement will be less than 1 inch with differential settlements on the order of ¾ of an inch for foundations designed as indicated above. If wetting of foundation soils occurs, footings bearing on moisture-sensitive fine-grained soils could experience additional settlements on the order of 2 to 3 inches. If footings are placed on at least 2 feet of structural fill, additional settlements less than 1 inch are anticipated if wetting occurs.

5. Frost Depth

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

6. Foundation Base

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

The subgrade should not be scarified prior to structural fill placement.

7. Construction Observation

A representative of the geotechnical engineer should observe all footing excavations prior to structural fill or concrete placement. This is particularly important if differential settlement needs to be minimized in areas where moisture-sensitive soils are encountered.

C. Concrete Slab-on-Grade

1. Slab Support

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

2. Slab Joints

Positive joints should be provided between the bearing walls and the floor slab to allow unrestrained vertical movement. This will not prevent movement of the slab should the subsoils become wetted, however, it will reduce damage should movement occur.

3. Underslab Gravel

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

D. Lateral Earth Pressures

1. Lateral Resistance for Footings

Lateral resistance for footings placed on the natural soil or on compacted structural fill is controlled by sliding resistance between the footing and the foundation soils. A friction value of 0.3 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 Types	Active	At-Rest	Passive
Clay and Silt	50 pcf	65 pcf	250 pcf
Sand and Gravel	40 pcf	55 pcf	300 pcf

3. Seismic Conditions

Under seismic conditions, the equivalent fluid weight should be increased by 27 pcf for active and at-rest conditions and decreased by 27 pcf for the passive condition. This assumes a horizontal ground acceleration of 0.3g which represents a 10 percent probability of exceedance in a 50-year period.

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. Seismicity and Liquefaction

The Salt Lake County liquefaction map indicates that the site has a "very low" liquefaction potential. This means that there is less than 5 percent probability that the soil may be subjected to seismic ground shaking great enough to result in liquefaction within a 100-year time period.

Based on the subsurface conditions observed in the test pits, the site is consistent with the "very low" designation.

Based on the location of the site, we recommend that the residences be designed and constructed to meet the Uniform Building Code Seismic Zone 3 criteria.

F. Water Soluble Sulfates

One sample of the natural soil was tested in the laboratory for water soluble sulfate content. The test results indicate that there is less than 0.1 percent water soluble sulfate in a sample obtained from Test Pit TP-1 at a depth of 1½ feet. Based on the test results and published literature, the natural soil possesses negligible sulfate attack potential on concrete. No special cement type is required for concrete placed in contact with natural soil. Other conditions may dictate the type of cement to be used 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 primarily of clay and silt. A California Bearing Ratio (CBR) of 3 percent was assumed for the clay subgrade.

2. Pavement Thickness

   Based on the subsoil conditions and the assumed traffic, a design life of 20 years and methods presented by the Utah Department of Transportation, a pavement section consisting of 3 inches of asphaltic concrete overlying 6 inches of high-quality base course is calculated for the cul-de-sac. If construction occurs when the upper soil is very moist, additional gravel may be needed to provide access for construction equipment.

3. Pavement Material

Pavement materials should meet the Utah Department of Transportation Specifications for gradation and quality. The pavement thickness indicated above assumes the base course is high-quality material with a CBR of at least 80 percent. Other materials may be considered for use in the pavement section. The use of other materials may result in different pavement material thicknesses.

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 locations indicated on the site plan and the data obtained from laboratory testing. Variations in the subsurface conditions may not become evident until additional excavation is conducted. If the subsurface conditions or groundwater level are found to be significantly different from those described above, we should be notified to re-evaluate our recommendations.

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, INC.

Chris T. Garris, P.E.

Reviewed by Douglas R. Hawkes, P.E., P.G.

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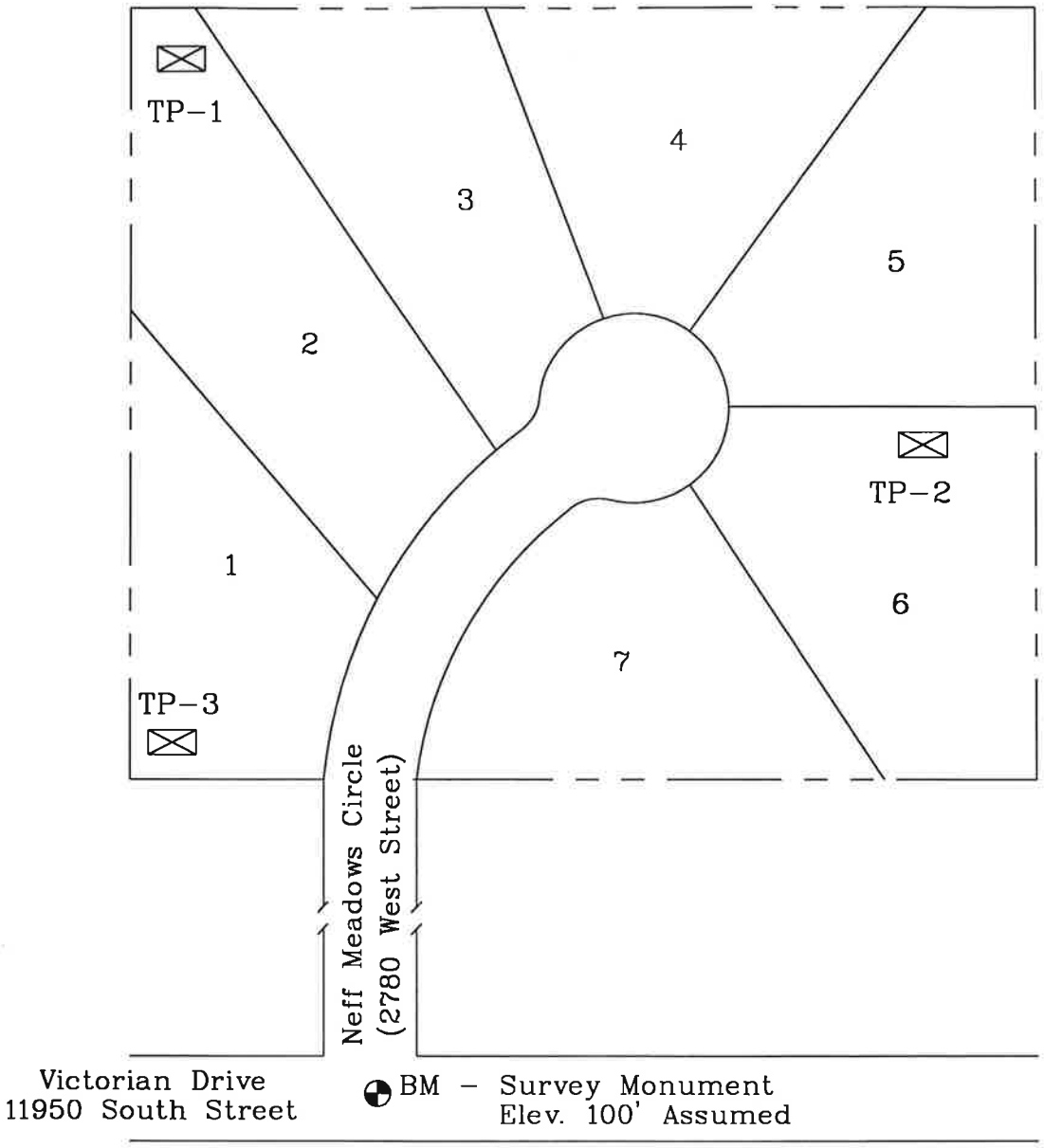

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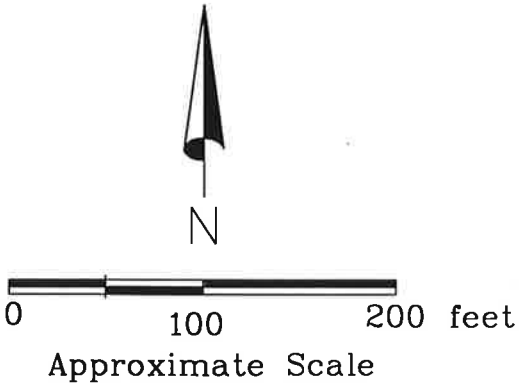
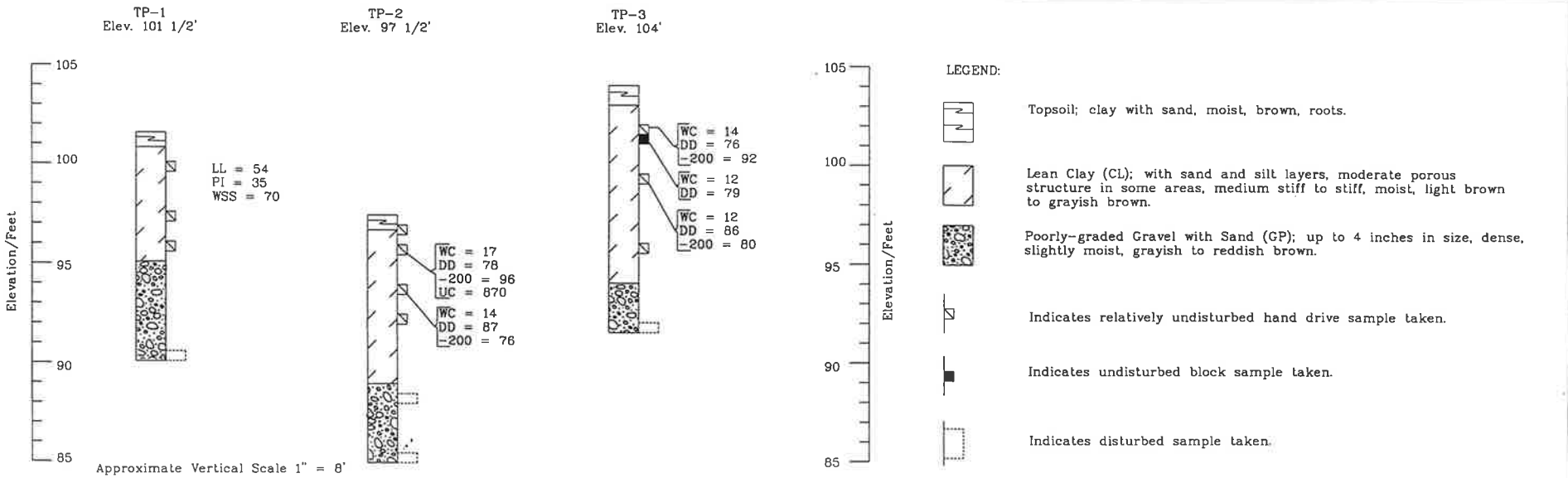


973816	AGEC	Locations of Test Pits	Figure 1



NOTES:

1. Test pits were excavated on December 23, 1997 with a rubber-tired backhoe.
2. Locations of test pits were measured approximately by pacing from features shown on the site plan.
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 test pits at the time of excavation.
7. WC = Water Content (%);
   DD = Dry Density (pcf);
   -200 = Percent Passing No. 200 Sieve;
   LL = Liquid Limit (%);
   PI = Plasticity Index (%);
   UC = Unconfined Compressive Strength (psf);
   WSS = Water Soluble Sulfates (ppm).

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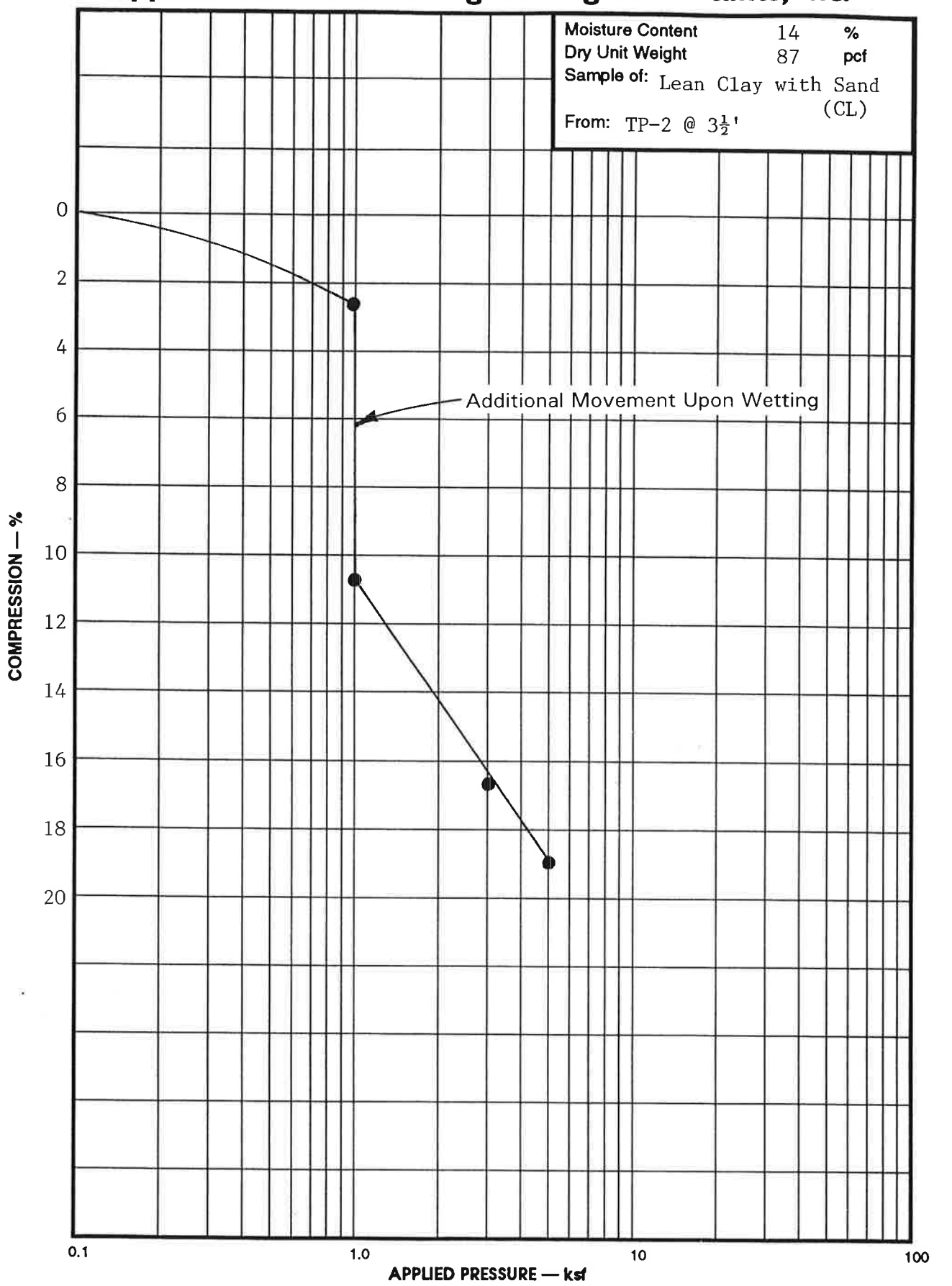

Project No. 973816 **CONSOLIDATION TEST RESULTS** Figure 3