Applied Geotechnical Engineering Consultants, Inc.

August 4, 1998

Jim Aland
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Ogden, Utah 84409-0307

Attention: Jim Aland
Fax No. 801-479-6360

Subject: Supplemental Geotechnical Investigation
Green Hill Country Estates Phase VI
Part of Sections 4 and 9, T6N, R2E, SLB&M
Weber County, Utah
Project No. 66095

Gentlemen:

Applied Geotechnical Engineering Consultants, Inc. conducted a geotechnical investigation and landslide study for the Green Hill Country Estates Phase VI and presented our findings and recommendations in a report dated June 5, 1996 under Project No. 66095. The approximate area of the proposed subdivision is shown on Figure 1.

SCOPE

AGEC was requested to conduct additional investigation of a new slide area and to observe the condition of the previously studied slide areas in May 1998. We were also requested to further evaluate the extent and severity of expansive soils at the site.

This letter presents the results of the supplementary investigation and provides additional recommendations addressing the conditions encountered and evaluated during this study.

ADDITIONAL FIELD STUDY

Nine test pits were excavated with a rubber-tired backhoe in the Phase VI area on May 29, 1998. The test pits were excavated at the approximate locations indicated on Figure 2.

The test pits were logged and soil samples obtained by a geologist from AGEC. The new and previously studied slide areas were also observed. Logs of the subsurface conditions encountered in the test pits are graphically presented on Figure 3 with Legend and Notes on Figure 4.

SITE CONDITIONS

The site was visited on May 29 and July 16, 1998. At the time of our site visits the site conditions were the same as were described in the above referenced report.

One additional slide area was observed at the approximate location shown on Figure 2. The slide appears to be a relatively shallow failure and appears to have occurred as a result of the existing road cut. The soil in the new slide area is very moist to wet and relatively soft, similar to previous slide areas studied. There is a natural spring up-slope from the new slide area.

The approximate locations of the previously studied slide areas are also shown on Figure 2. These areas were observed at the time of our site visits. The slide areas were measured to extend further up the slope and wider than they were at the time of our previous study.

Based on our discussion with the developer, we understand that soil was removed from the slide areas following our previous study and prior to the time of our subsequent site visits. It appears that the removal of soil from the slide areas has allowed the slope above the previous slide area to move as a result of removal of the resisting soil mass.

SUBSURFACE CONDITIONS

Subsurface conditions encountered in the test pits consist of approximately ½ to 1 foot of topsoil (if present) overlying low and high plastic clay and some clayey gravel layers.

The upper several feet of soil in the area of TP-5A, TP-6A and TP-7A was observed to be disturbed from the new slide.

The following is a description of the subsurface conditions encountered in the test pits.

Topsoil - The topsoil consists of sandy clay which is moist, dark brown and contains roots.

Clay - The clay consists of low and high plastic clay with occasional gravel and cobbles. It is soft to very stiff, slightly moist to wet and reddish brown to gray in color.

Laboratory tests conducted on samples of the clay indicate natural moisture contents of 21 to 34 percent and natural dry densities of 81 to 104 pounds per cubic foot. Samples of the clay were found to have Liquid Limits of 60 to 80 percent and plasticity indexes of 42 to 57 percent.

Consolidation tests conducted on samples of the clay (conducted on samples with their in-situ moisture content) indicate that the clay will swell slightly and compress a small amount with the addition of light to moderate loads. When the samples were air-dried

prior to testing, the soil was observed to be moderately to highly expansive when wetted. Results of the consolidation tests are presented on Figures 5, 6 and 7.

Gravel - The gravel is clayey and contains cobbles and occasional boulders. The gravel is dense, moist to very moist and reddish brown to grayish brown in color.

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

SUBSURFACE WATER

Free water was measured at a depth of approximately 6 feet below the ground surface in TP-9A when measured 48 days after the test pit was excavated. No free water was observed in the other test pits at the time of excavating.

Due to the location of the site, we anticipate that the subsurface water encountered is the result of perched groundwater conditions. With the relatively impervious nature of the natural soil and the slope of the site, water may be transmitted through permeable layers.

Slotted PVC pipe was installed in Test Pit TP-9A to facilitate future measurement of the subsurface water level. Fluctuations on the water level area anticipated with time. Evaluation of the water level fluctuations is beyond the scope of this letter.

SUPPLEMENTAL RECOMMENDATIONS

A. Slope Stability

The area of the proposed development includes an area which is mapped as a historic landslide. The site is prone to slope movement unless site grading, slope retention and drainage is carefully planned. The following recommendations are given.

1. Existing slide areas, including the new slide area, should be repaired to protect road cuts and the stability of the adjacent hillside. Recommendations for repairing the slide areas are presented in the above referenced report.

2. Site grading should be carefully planned for the proposed residences. Lot specific geotechnical investigations should be conducted to evaluate stability of proposed and existing cuts, fills and retaining systems.

3. Recommendations given in the above referenced geotechnical report should be followed.

B. Expansive Soil Areas

Shallow foundations and flat concrete or pavement placed on expansive soil similar to that encountered at the site can experience movement causing structural distress if the soil is subjected to changes in moisture content.

1. Lot specific geotechnical investigations should be conducted to identify expansive soil areas and to give specific foundation recommendations.

2. As a minimum, the foundation recommendations given in the above referenced report including drainage precautions and protecting the foundation soils from changes in moisture should be followed.

3. Based on the data obtained during the field and laboratory studies, straight shaft drilled piers drilled into the natural soil or bedrock are considered to be a positive foundation system to support the proposed residences in areas where highly expansive soils are encountered.

   A drilled pier foundation is intended to transfer the support of the structure down to a zone of relatively stable moisture content and to load the piers sufficiently to resist uplift pressure.

   Using this type of foundation, each column is supported on a single drilled pier and the building walls are placed on grade beams supported by a series of piers. Loads applied to the piers are transmitted to the soil partially through peripheral shear stresses which develop on the sides of the pier and partially through end bearing pressure.

   In addition to their ability to reduce differential movements caused by expansive materials, straight-shaft piers have the advantage of providing high supporting capacity with a relatively small amount of movement.

   Pier capacity and depth to bearing stratum should be determined during lot specific investigations. Alternative pier foundations systems including helical piers or driven piles could also be considered.

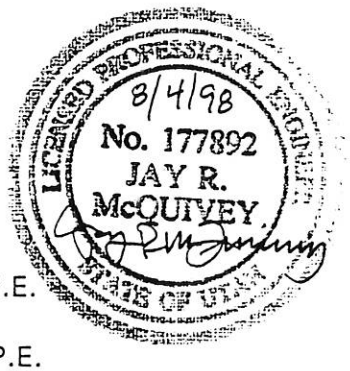
4. Floor slabs present a very difficult problem where highly expansive materials are present near the floor slab elevation because sufficient dead load cannot be imposed on them to resist uplift pressure generated when the materials are wetted and expand. Based on the moisture-volume change of some of the soils present at the site, some lots may require the use of structural floors above a well ventilated crawl space to prevent damage from floor slab movement. The floor slab should be supported on grade beams and piers the same as the main structure.

LIMITATIONS

This letter 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 in the letter 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 excavation or additional exploration 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.

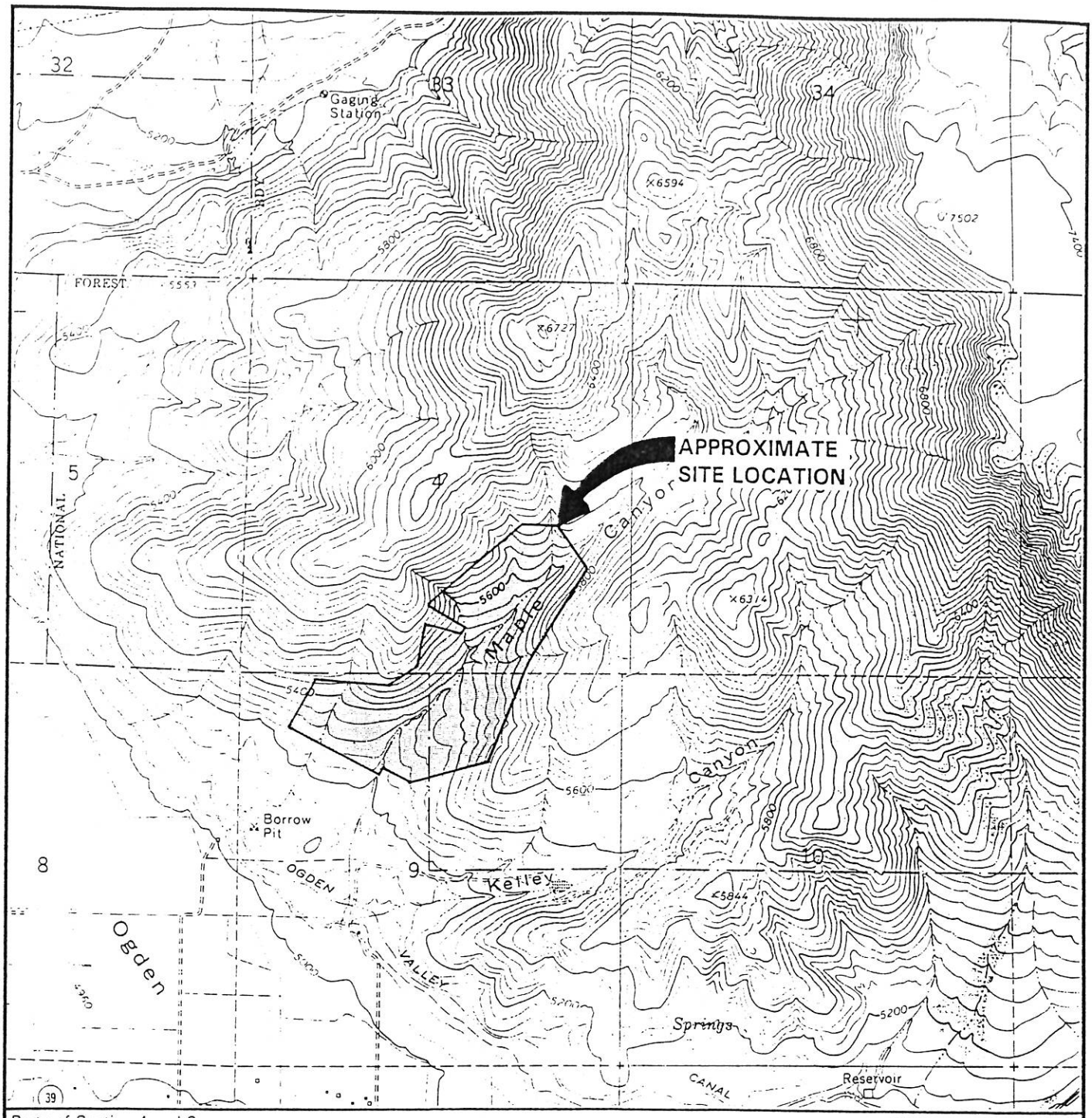
Sincerely,

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, INC.



Jay R. McQuivey, P.E.

Reviewed by JEN, P.E.
JRM/cs



Parts of Section 4 and 9
T6N, R2E, SLB & M

From USGS Quadrangle
Browns Hole, Utah

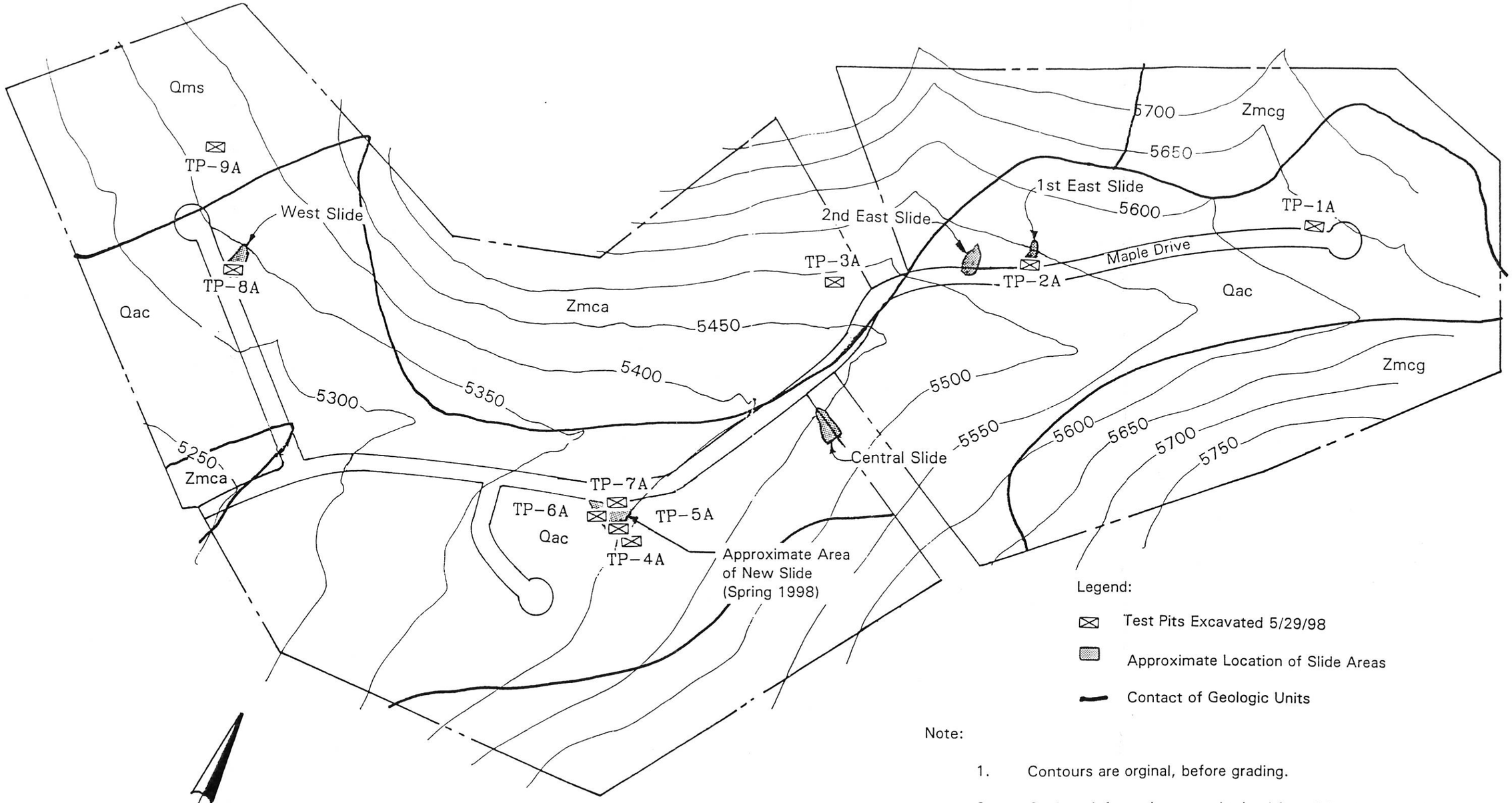
North

Approximate Scale

1" = 2,000

GREENHILL COUNTRY ESTATES - PHASE 6
PART OF SECTIONS 4 AND 9, T6N, R2E, SLB&M
WEBER COUNTY, UTAH

66095	AGE	Site Location Map	Figure 1



GREENHILL COUNTRY ESTATES-PHASE 6
PART OF 4 AND 9, T6N, R2E, SLB&M
WEBER COUNTY, UTAH

Legend:

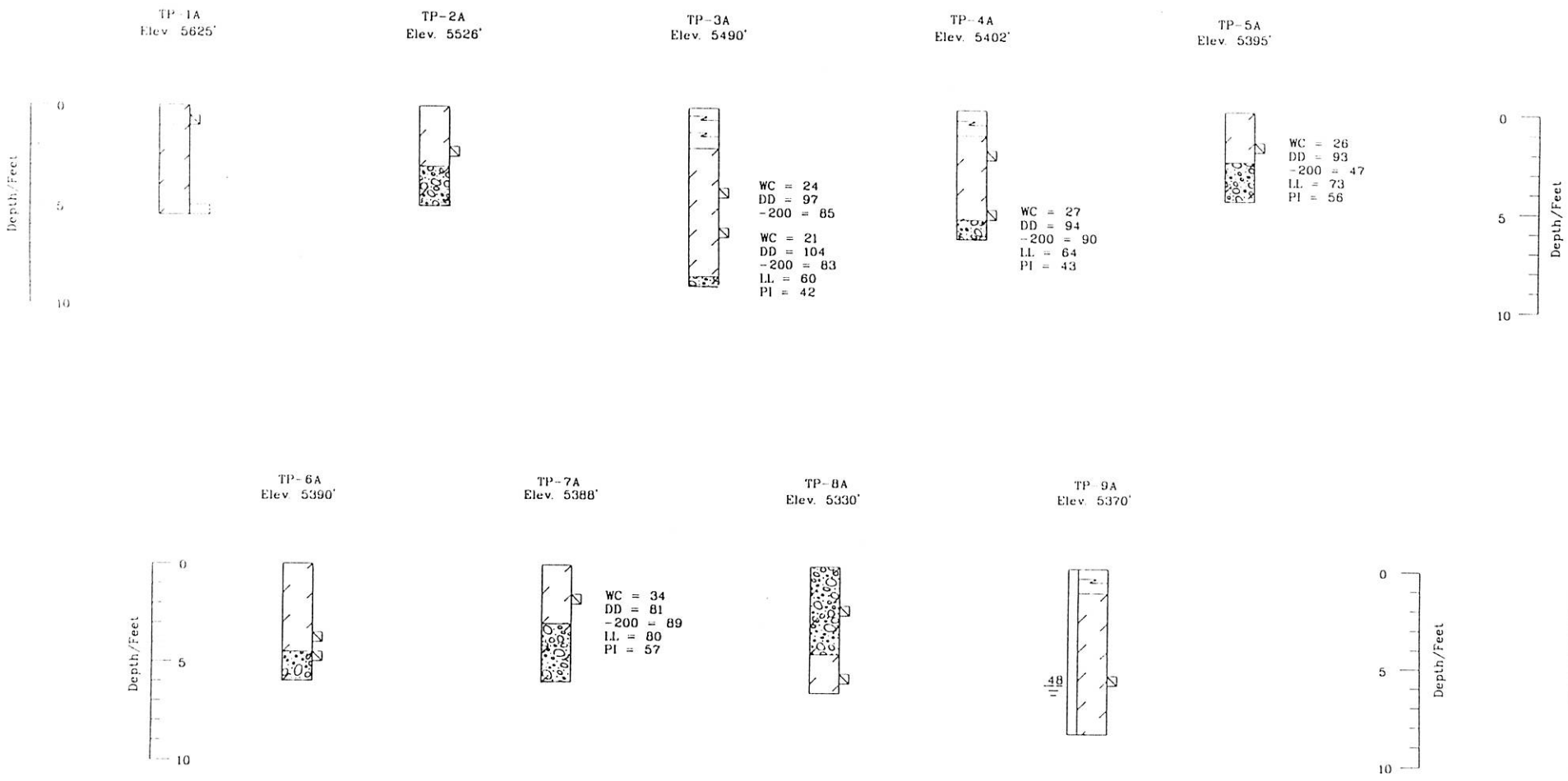
- Test Pits Excavated 5/29/98
- Approximate Location of Slide Areas
- Contact of Geologic Units

Note:

1. Contours are orginal, before grading.
2. Geology information was obtained from Mike Lowe at UGS. The geology map of the area is currently un-published.
3. Explantation of Geologic Units:

Qac - alluvium and colluvium, undivided
Qms - Landslide deposit
(not dated)
Zmcg - Maple Canyon green arkose member
Zmca - Maple Canyon argillite member

66095	AGEC	Site Plan Showing Approximate Landslide Areas, Locations of Test Pits	Figure 2



Approximate Vertical Scale 1" = 8'

See Figure 3 for Legend and Notes

66095	AGEC	Logs of Test Pits	Figure 3

LEGEND

Topsoil, sandy clay, moist, dark brown, roots.

Clay (CL/CH), layers of low and high plastic clay, occasional gravel and cobbles, soft to very stiff, slightly moist to wet, reddish brown to gray.

Clayey Gravel (GC); with cobbles and occasional boulders, dense, moist to very moist, brown to reddish brown to grayish brown.

Indicates relatively undisturbed hand drive sample taken.

Indicates disturbed sample taken.

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Indicates the depth to free water and the number of days after drilling the measurement was taken.

NOTES:

1. Test pits were excavated on May 29, 1998 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 determined by interpolating between contours shown on the site plan, or from road profile drawings for test pits adjacent to the roads.
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 (%).

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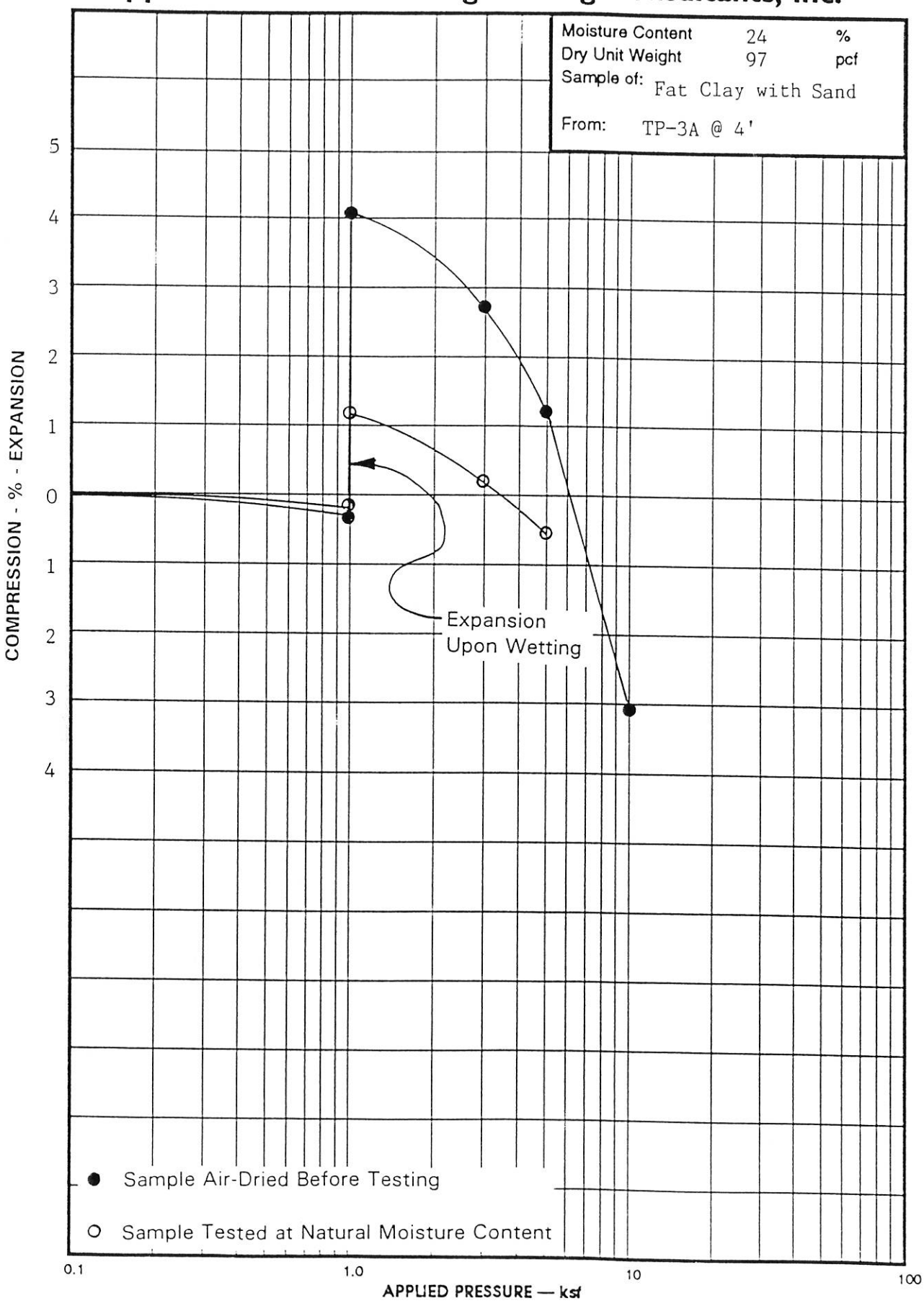
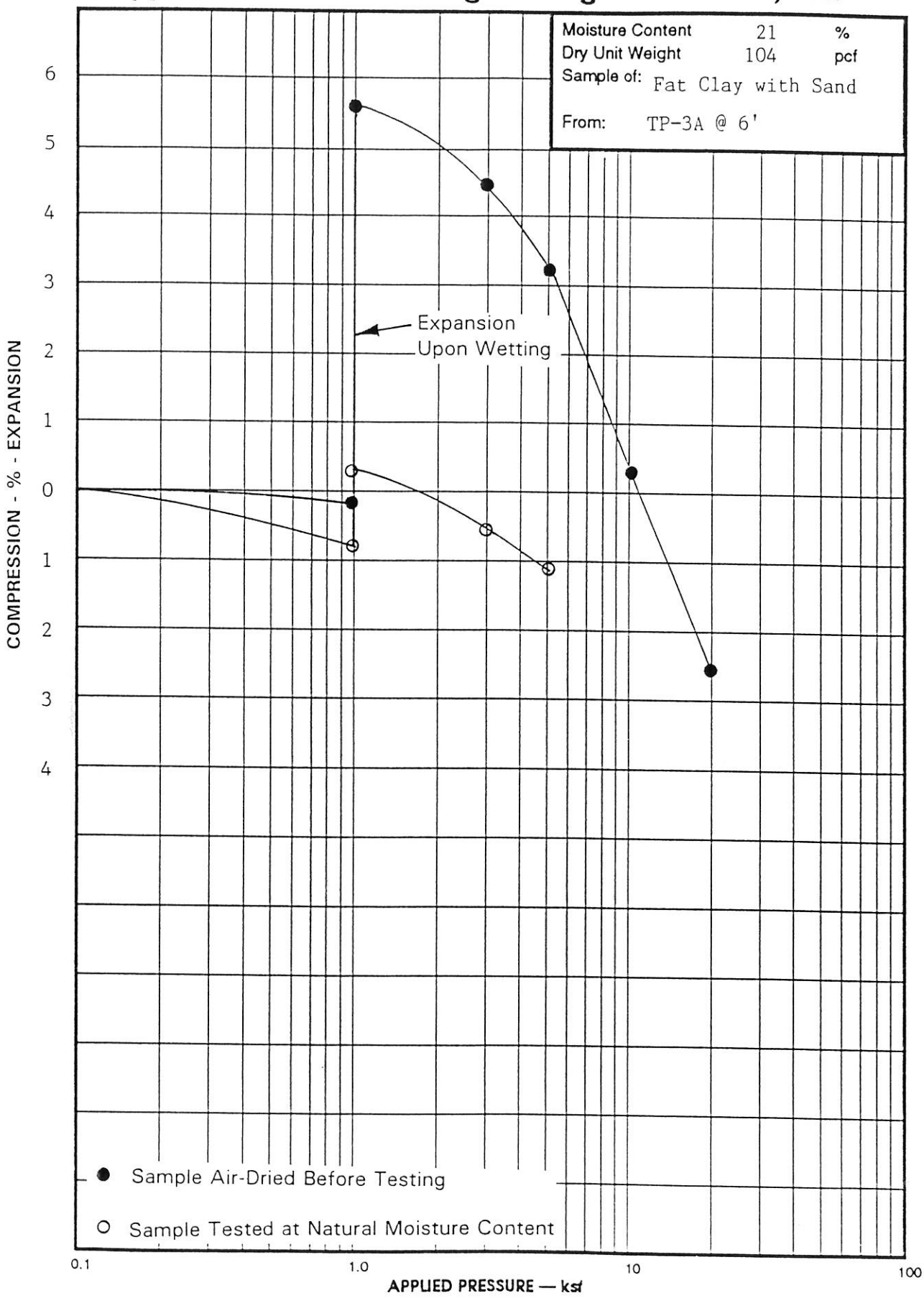


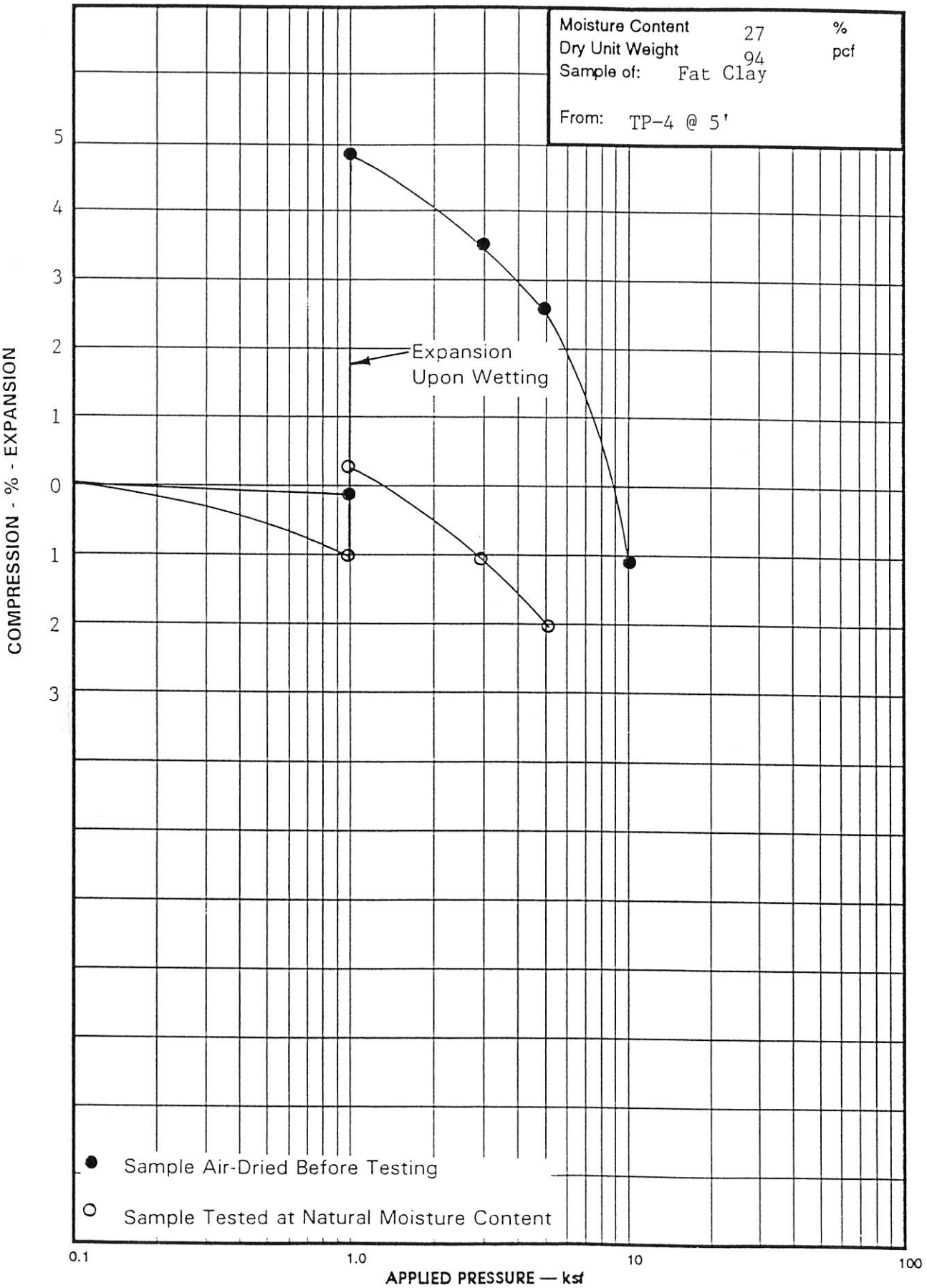
Project No. 66095 **CONSOLIDATION TEST RESULTS** Figure 5

Applied Geotechnical Engineering Consultants, Inc.



Project No. 66095 **CONSOLIDATION TEST RESULTS** Figure 6

Applied Geotechnical Engineering Consultants, Inc.



Project No. 66095 **CONSOLIDATION TEST RESULTS** Figure 7

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, INC.

TABLE I

SUMMARY OF LABORATORY TEST RESULTS

PROJECT NUMBER 66095

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-3A	4	24	97			85					Fat Clay with Sand
	6	21	104			83	60	42			Fat Clay with Sand
TP-4A	5	27	94			90	64	43			Fat Clay
TP-5A	1½	26	93			47	73	56			Clayey Sand
TP-7A	1½	34	81			89	80	57			Fat Clay