Utah Geological Survey

Project: Investigation of a recent cut-slope failure and implications for geotechnical slope-stability recommendations at Green Hill Country Estates Phase VI, Ogden Valley, Weber County, Utah.			Requesting Agency: Weber County Planning Department
By: Bill D. Black	Date: 06-22-98	County: Weber	Job No: 98-18
USGS Quadrangle: Browns Hole (1368)		Number of attachments: 0	

INTRODUCTION

At the request of Craig Barker, Weber County Planning Department, I conducted a reconnaissance of a recent cut-slope failure in an undeveloped portion of Green Hill Country Estates Phase VI east of Huntsville, Utah, in the NW1/4NE1/4 section 9, T. 6 N., R. 2 E., Salt Lake Base Line and Meridian. Applied Geotechnical Engineering Consultants (AGEC) previously conducted a geotechnical and landslide study for the development (AGEC, 1996), which was reviewed by Francis Ashland (Utah Geological Survey) at the request of the Weber County Planning Department and found to be thorough and adequate (Ashland, 1996). The purpose of my reconnaissance was to evaluate whether the slope of the failed cut met AGEC's (1996) recommendations and, if so, whether future slope-stability problems may be anticipated in spite of their recommendations being followed. The scope of work included a literature review and a site visit on May 29, 1998. Rob Edgar (AGEC) and Curtis Christensen (Weber County Engineer) were present during the site visit to conduct a follow-up investigation for possible expansive soils. I inspected only one area undergoing cut-slope failure; other cuts in the development may also be failing.

DISCUSSION

The 1998 slope failure is in a west-facing 4:1 (horizontal:vertical) road-cut slope about 15 feet (4.6 m) high on the east side of Maple Canyon in the eastern part of the Green Hill Country Estates development. The surface of rupture appears to be shallow (about 3 feet [0.9 m] deep) and is between an upper high-plasticity clay layer and an underlying clayey gravel deposit. I observed water seeping from the toe of the failure during my reconnaissance, which suggests the slope is saturated. AGEC (1996) previously noted four similar landslides that occurred during spring 1995 in 3.5:1 cut slopes in the development. The 1998 failure is not in an area of pre-existing landslides (AGEC, 1996). AGEC (1996) speculated the 1995 failures were triggered by a reduction in strength when clay soils became wet during infiltration of spring runoff. No failures were found in areas where the upper soil consists of clayey gravel (AGEC, 1996).

To maintain stability of road cuts and other cut slopes at the site, AGEC (1996) recommended no cuts steeper than 4:1 in natural clay soils. Although AGEC (1996) observed no

evidence of shallow ground water during their subsurface investigation, they indicate the risk from slope instability is higher if shallow water is present. The 1998 failure is in a 4:1 cut slope saturated by spring runoff, and the slope of the cut is slightly steeper than the natural slope. This suggests disturbance of the natural slope may cause even shallow cuts in the clay soils to fail when wet.

RECOMMENDATIONS

Cut slopes in the clay soils at the site conform to AGEC's (1996) recommendations but are still failing. Thus, I recommend that:

- AGEC review and revise their recommendations as needed for maintaining cut-slope stability,
- Weber County devise a means to ensure that AGEC's recommendations are followed and that no unplanned cuts are made (such as for landscaping),
- AGEC's (1996) recommendation to maintain good surface drainage upslope of the cut slopes and to direct water away from the cut faces be followed, and
- as a precaution, landowners minimize landscape irrigation. Although spring runoff is the principal cause of both the 1995 and 1998 failures, landscape irrigation may cause further slope instability.

REFERENCES

Applied Geotechnical Engineering Consultants, Inc., 1996, Geotechnical and landslide study--Green Hill Country Estates Phase VI, part of sections 4 and 9, T6N, R2E, SLB&M, Weber County, Utah: Midvale, Utah, unpublished consultant's report, 21 p.

Ashland, Francis, 1996, Review of a geotechnical and landslide-hazard report for the proposed Green Hill Country Estates Phase VI, Weber County, Utah, *in* Mayes, B.H., compiler, Technical reports for 1996 Applied Geology Program: Utah Geological Survey Report of Investigation 231, p. 109-111.

STAFF REPORT TO PLANNING COMMISSION

June 15, 1998

Preliminary approval of Green Hill Country Estates
36 Lots

Finding of Fact:

The petitioner is requesting preliminary approval of Green Hill Country Estates located in Maple Canyon in Green Hill. Phase 6 will consist of 36 Lots. This property is zoned Forest F-5 which requires 5 acres per lot. This subdivision is a cluster subdivision where the lots are 1 plus acre in size with the remaining of the five acres in common open space.

Culinary water will be provided by Green Hill Water and Sewer. The new well will provide enough water to serve these lots. The developer will have to build an additional culinary water storage reservoir. The East Huntsville Township Planning has approved the conditional use for this storage reservoir, and the Utah State Department of Environmental Quality, Division of Drinking Water is reviewing the construction plans of this reservoir. The water reservoir and the well need to be on their own piece of property owned by Green Hill Water and Sewer District. Lot 115 shows the well which cannot be part of the lot. There also needs to be an access easements to these site and a well protection easement, which will also have to be shown on the Subdivision Plat. The State Department of Environmental Quality, Division of Drinking Water has also been reviewing the common drain field which will serve the waste water needs of this phase, and has listed their conditions for approval.

A Geotechnicial report has been done and reviewed by Utah State Department of Natural Resources Utah Geological Survey. This reports and recommendations need to be followed. The State would like further assessment of the extent of expansive soils on the property that could effort roads and utilities. These reports recommend footing excavation be observed for expansive soils, so a lot specific foundation recommendations can be made. Utah State Department of Natural Resources Utah Geological Survey has reviewed the latest landslides and makes the following recommendation which shall be followed by the developer.

"The cut slopes in the clay soils at the site conform to AGEC's (1996) recommendations but are still failing, thus the State recommends 1) AGEC review and revise their recommendations as needed for maintaining cut-slope stability, 2) Weber County ensures that AGEC's recommendations are followed and no unplanned cuts are made such as for landscaping, 3) AGEC's (1996) recommendation to maintain good surface drainage upslope of the cut slopes and to divert water away from the cut faces be followed, and 4) as precaution, landowners minimize landscape irrigation. Although spring runoff is the principal cause of both the 1995 and 1998 failures, landscape irrigation may cause further slope instability."

The Engineering office has concerns about the improvements that have been done. These improvements will have to meet County Engineering standards

There are lots that are more than 25 percent slopes. These Lots need to have an area 75 ft. by 100 ft. with slopes less than 25 percent shown as a buildable area or those lots need to show as a restricted lot. Restricted lots will have to go before the Hillside Review Committee. In the Forest F-5 Zone, any area that is more than 60 percent slope cannot be considered as buildable area or as part of the common space. The 60 percent slope was reviewed during the original submittal of this subdivision. The petitioner has followed fairly closely that original lay out of the subdivision.

There are 115 Lots that been proposed or approved in all phases of Green Hill Country Estates. There are 112 lots in the Forest F-5 Zone which requires 5 acres per lot, and 13 lots in the Forest F-40 Zone which requires 40 acres per. To meet these requirements the petitioner needs 1025 acres. There is a total of 1565.718 acres in this project. The additional 500 acres replaces the area that is more than 60 percent slope. This also excludes the 12.68 acres of area that was removed from common area in In 1983.

Conformance to General Plan:

Conforms to the General Plan

Conditions for Preliminary Approval:

1. See Engineering letters.
2. Weber Fire District requires 9 fire hydrants
3. Geotechnical reports and the States recommendations be followed.
4. A culinary water reservoir be installed or bonded for and shown on their own property.
5. Requirements from the State on the common drain field.
6. Cut and fill information needs to be submitted for the road.

Questions to ask:

Staff Recommendations:

Staff recommends preliminary approval of Green Hill Country Estates Phase 6, subject to staff and other agency comments.

WEBER COUNTY

RECEIVED

NOV 01 1995

WEBER COUNTY
PLANNING

Sent Nov 2/1995

October 31.1995

PUBLIC WORKS/
ENGINEERING
Curtis Christensen
Director

Building Inspections
(801) 399-8374
Business License
(801) 399-8394
Engineering
(801) 399-8371

Jim Gentry
Weber County Planning

Re: **Green Hill Country Estates No. 6 (Revised)**

Our office has reviewed the above referenced Preliminary Plan and approves said Plan subject to following:

1. The preliminary plan is incomplete. You will need to submit complete drainage, culinary water, sewer and street grade plan. Cut and fill limits and public utility easements for all lots will need to addressed in the preliminary plan.

2. State approval of water and sewer plans for this phase and other phases.

3. All culverts and drainage crossings will need to be brought up to County Standards, there appears to be some drainage crossings with CMP, these will need to be replaced with RCP. Water shed calculations will need to be submitted to verify drainage crossing sizes.

4. Some large areas have already been disturbed, with signs of slope failure. This will require an Erosion Control Plan which may be included in your NPDES Permit.

5. California Bearing test along with a soil study for all cut and fill Roadway surfaces.

6. Lots with a grade of 25% or more slope will need to be listed as a RESTRICTED Lot. Build able areas will need to be shown on plat at time of submittal.

7. There are areas of active land slides. mitigation of these and future slide areas will need to be addressed at this time.

Sincerely,

Patrick Dean

Public Works/
Engineering
2510 Washington Blvd., 1st Mezz.
Ogden, Utah, 84401-3113
(801) 399-8371
Fax: (801) 399-8305

Applied Geotechnical Engineering Consultants, Inc.

June 18, 1998

Jim Aland
6393 South Bybee Drive
Ogden, Utah 84403

Attention: Jim Aland
Fax: (801) 479-7360

Subject: Geotechnical Consultation
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 and landslide study for the Green Hill Country Estates, Phase VI, located within Section 4 and 9 of Township 6 North, Range 2 East of the Salt Lake Base and Meridian, east of Huntsville in Weber County, Utah. Our findings and recommendations are included in a report dated June 5, 1996 under Project No. 66095.

A representative of AGEC was requested to visit the site on May 7, 1998 to attend a meeting to discuss an additional landslide which has developed adjacent to the subdivision road and additional movement of some of the landslide areas previously investigated.

Based on the discussion at the meeting and the continued movement of the previously studied landslides and the new landslide area, it was proposed that additional investigation and evaluation be conducted.

ADDITIONAL STUDY

Additional field investigation was conducted on May 29, 1998 to observe the areas of known landslides, to measure cross-sections through slide areas, and to excavate test pits to observe subsurface conditions and obtain samples for laboratory testing.

The purpose of the additional study is to evaluate the existing conditions in the landslide areas and to provide additional recommendations for stabilizing landslide areas, if needed. Recommendations were previously given for stabilizing landslide areas in the above referenced report.

The additional investigation was also conducted to obtain samples of the natural soil to further evaluate the potential expansive characteristics of the on-site soil.

Laboratory testing is in progress to further evaluate the expansive characteristics of the soil. The conditions within the existing landslide areas are also being evaluated to determine if additional recommendations for stabilizing landslide areas should be provided.

Preliminary information indicates that the existing landslides can be stabilized following the recommendations included in the above referenced geotechnical report. We understand that only minor repairs have been made to the landslide areas and we anticipate that additional measures will be taken to stabilize the landslide areas.

Based on our knowledge of the site, the area is suitable for residential development. Due to the potential for slope instability, expansive soils and existing fill, we will be providing geotechnical guidance for design and construction of the residences in our report. The engineering analysis will be conducted once the laboratory testing is complete.

The results of our additional investigation and engineering analysis will be present on completion.

If you have any questions, or if aspects of the project change during our investigation, please given us a call.

Sincerely,

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, INC.

Jay R. McQuivey, P.E.

JRM/cs
Reviewed by JEN, P.E.

Michael O. Leavitt
Governor
Ted Stewart
Executive Director
M. Lee Allison
State Geologist

State of Utah
DEPARTMENT OF NATURAL RESOURCES
UTAH GEOLOGICAL SURVEY

2363 South Foothill Drive
Salt Lake City, Utah 84109-1491
801-467-7970
801-467-4070 (Fax)

July 2, 1996

Jim Gentry, Planner
Weber County Planning Commission
2510 Washington Blvd.
Ogden, Utah 84401

Reference: UGS Technical Report 96-19 - Green Hill Country Estates Phase VI

Dear Jim:

I have enclosed my review, conducted at your request, of a geologic report by Applied Geotechnical Engineering Consultants, Inc, entitled "Geotechnical and landslide study - Green Hill Country Estates Phase VI, part of sections 4 and 9, T6N, R2E, SLB&M - Weber County, Utah."

I appreciate the opportunity to be of continued service to Weber County. Please call if you have any questions regarding this review or require additional information.

Sincerely,

Francis Ashland, Project Geologist
Applied Geology Program

Enclosure

Gary

Utah Geological Survey

Project: Review of a geotechnical and landslide-hazard report for the proposed Green Hill Country Estates Phase VI, Weber County, Utah			Requesting Agency: Weber County Planning Commission
By: Francis Ashland	Date: 7-2-96	County: Weber	Job No: 96-19
USGS Quadrangle: Browns Hole (1368)		Number of attachments: none	

INTRODUCTION

At the request of Jim Gentry, Weber County Planning Commission, I reviewed geologic-hazard portions of a geotechnical and landslide-hazard report for the proposed Green Hill Country Estates Phase VI (Applied Geotechnical Engineering Consultants, Inc. [AGEC], 1996). The proposed subdivision is in the SE1/4 section 4 and the N1/2 section 9, T. 6 N., R. 2 E., Salt Lake Base Line and Meridian. The scope of work included a review of unpublished geotechnical data. I performed no field inspection of the property.

LANDSLIDES

The AGEC (1996) report indicates landsliding on the property of clay soils in road cuts with slopes exceeding 3.5:1 (horizontal:vertical). AGEC speculates four existing landslides were triggered by a reduction in strength when soils became wet during infiltration of runoff in spring 1995. In addition, AGEC infers that increases in slope angle due to road cuts may also have contributed to the failures. AGEC recommends lower final cut-slope angles for the soil types at the property and upslope surface drainage that I believe will reduce the likelihood of future landsliding. AGEC also recommends several options for stabilization of the four existing landslides (AGEC, figure 2) including excavation and replacement, regrading to flatter slopes, and regrading to present slope angles in combination with subsurface interceptor drains. I believe these recommendations are adequate to stabilize existing landslides as long as construction is carefully monitored. AGEC's assessment of the landslide hazard at the property is thorough, well documented, and supported by laboratory testing and field observations.

OTHER GEOLOGIC HAZARDS

The AGEC (1996) report lists or makes recommendations to reduce losses from other potential geologic hazards, including expansive soils, shallow ground water, and earthquake ground shaking. AGEC indicates local expansive clay soils on the property that swell upon wetting to nearly 3 percent while under a load of 1 ksf. Because consolidation tests were performed on only two samples, the extent of expansive soils and their maximum swell potential are not well known. AGEC recommends shallow spread footings on "natural undisturbed soil or... compacted structural fill." To reduce foundation heave, AGEC recommends measures to reduce the chance of wetting expansive soils near structures including site grading, installation of underdrains, and a precaution

regarding irrigation. AGEC also recommends that a geotechnical engineer observe all footing excavations to identify whether expansive soils are present in the subgrade, and I strongly concur. However, AGEC provides no specific foundation recommendations in the event that expansive soils are present beneath footings. I believe that such lot-specific foundation recommendations should be provided wherever expansive soils are encountered in the foundation subgrade. AGEC indicates that, "ideally", expansive soils beneath floor slabs should be excavated and replaced with structural fill. In addition, AGEC recommends "positive joints" between floor slabs and bearing walls that allow the slab to heave independently, and a perimeter "positive drainage system." Although AGEC's foundation and floor slab recommendations may be adequate, my experience indicates that spread footings and slab-on-grade are not conservative designs for areas with expansive soils. Elsewhere in Utah, expansive soils exhibiting similar amounts of swell under a load of 1 ksf have caused building distress or heave. Also, although AGEC's grading, drainage, and irrigation recommendations would, if properly implemented, reduce the potential for damage to structures, they do not address the potential damage to roads, other paved areas, and buried utilities. Because of the complexity of AGEC's recommendations and the difficulties in implementation, I believe that some damage to structures as well as roads, utilities, and paved areas should be anticipated.

The AGEC (1996) report indicates no ground water in any excavation to a depth of 7 feet. However, because the excavations were made in November, ground-water levels may have been at or near a seasonal low and may not be representative of other times of the year. AGEC indicates shallow perched ground-water conditions are possible during times of runoff or snowmelt and recommends an underdrain system that, if implemented, should be adequate to deal with post-construction shallow ground water. For construction during the late winter or spring, shallow ground water may be encountered during homesite excavation.

AGEC recommends building to seismic zone 3 standards to help reduce losses from ground shaking in a moderate to strong earthquake, and I concur.

SUMMARY

AGEC's assessment of landsliding at the property is thorough and well documented, and I concur with its conclusions and recommendations related to this hazard. AGEC's surface grading, drainage, irrigation, and "positive-joint" system recommendations are reasonable to reduce problems from expansive soils but assuring that they are followed will be difficult. AGEC's recommendation to observe footing excavations to identify expansive soils is adequate, provided lot-specific foundation recommendations are given wherever expansive soils are found in the foundation subgrade. AGEC does not address the potential for damage to roads, utilities, and paved areas, and further assessment of the extent of expansive soils on the property may be necessary to address this issue. I concur with other recommendations to reduce losses from shallow ground water and earthquake ground shaking.

REFERENCE

Applied Geotechnical Engineering Consultants, Inc., 1996, Geotechnical and landslide study - Green Hill Country Estates Phase VI, part of sections 4 and 9, T6N, R2E SLB&M - Weber County, Utah: Midvale, Utah, unpublished consultant's report, 21 p.

WEBER COUNTY

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Director

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September 19, 1996

Jim Aland
6393 South Bybee Drive
Ogden, Utah 84403

Dear Jim,

On August 23, 1996 I visited the proposed Greenhill No. 6 Subdivision site after being notified sewer was being installed. Excavated material was being used for bedding. This material had large rock in it. I ask Dan Bond, the job foreman, about the material and he told me they were picking the rock out of the bedding. I believe it would be extremely difficult to free material of all rock without a screen. I told him he needed to import acceptable material for bedding. I also noticed that compaction of material was not being done. No compaction equipment was seen on site. At that time Dan tried to contact Jim Aland, the developer, with no success.

The next week you, Curtis Christensen, and I met on the subdivision site. You showed us material on site that was rock free. It was agreed this material could be used as bedding. I also told you that the material needed to be compacted. You said he would inform the contractor. On subsequent inspections I was unable to observe bedding and backfill procedures however I did observe compaction equipment on site and noticed that some approved bedding material had been excavated.

Because of the questionable methods of installing the sewer, before the county accepts Greenhill No. 6 for recording, a video will be required of all sewer lines. If problems are found repairs will need to be made. Video taping will need to be done by an independent contractor.

If you have any questions please call.

Sincerely,

Dennis Richardson
Weber County Engineering

cc: Weber County Planning
Greenhill No. 6 File

Public Works/
Engineering
2510 Washington Blvd., 1st Mezz.
Ogden, Utah, 84401-3113
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State of Utah
DEPARTMENT OF ENVIRONMENTAL QUALITY
DIVISION OF WATER QUALITY

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November 12, 1997

Mr. James Aland
Green Hill Country Estates
Water and Sewer District
6393 South Bybee Drive
Ogden, UT 84403

Dear Mr. Aland:

SUBJECT: Wastewater Disposal System
System Inspection

On October 6, 1997 we met at the site and reviewed the progress of the work. The previously requested flood control, maintenance, and repair work has been completed, except for cleaning the existing transfer and drain lines in the last three pairs of lines in the eastern drain field. I also reviewed the district maintenance contract. Your system operation requirements or related contracts must include inspection of the drain fields and septic tanks on a regular basis to assure timely cleaning. These items must be included in written operation and maintenance requirements. An enclosure on this subject is attached.

A water use study was received on October 22, 1997. It shows usage records during the winter of 1996-97 which indicates an average use of 257 gallons per day (gpd) per lot. You have proposed a rating of 300 gpd/connection. This is acceptable to extend to the remaining lots. However, the district must accept all liability for this reduction in water usage rate related to the wastewater disposal system.

Drain field No. 1, the Western System:
Fifty pairs of one hundred foot lines have been installed for the newer western system. The flow is to be alternated between the two halves of this system on a six month interval. An incidental additional leg of 100-feet is installed on the westerly half of this system. The drain field will receive wastewater from sixty-one lots at 300 gpd each for a total of 18,300 gpd. The absorption rate of 1.29 gallons per square foot per day (gpsfd) requires 4,729 lineal feet (lf) of 3-foot wide trench. 5,000 lf minimum has been installed for each half of this system. Therefore this system is deemed adequate. This field serves lots 24-30, lot nos. 31 and 32 are serviced by individual disposal systems, lots 33-46, and lots 78-117.

Drain field No. 2, the Eastern System:
Fifty pairs of one hundred foot lines have been installed for the eastern system. The flow is to be alternated between the two halves of this system on a six month interval. The field will receive wastewater from fifty-three lots at 300 gpd each for a total of 15,900 gpd. The absorption rate of 1.00 gpsfd requires 5,300 lf of 3-foot wide trench. 5,000 lf has been installed for each half of this system. Therefore the system is inadequate and needs three additional pairs of 100-foot long drain lines added. This field serves lots 1-23 and lots 47-77, lot number 69 being the same as number 73.

Therefore, the following items must be completed prior to our approval:

1. Cleaning the transfer and drain lines in the last three pairs of the existing eastern drain field system.
2. Addition of three pairs of 100-foot long drain field lines to the end of the eastern drain field system.
3. Include Drain field and septic tank maintenance as part of the written operational requirements.
4. A final site inspection by the division.

We request that you please complete the above with a written response and request for a final inspection.

Sincerely,

Signed

David A. Rupp, P.E.
Design Evaluation Section

cc: Mr. Joe DeCaria, Weber-Morgan District Health Dept.
Mr. Mark Babbitt, Great Basin Engineering, Ogden, UT

Enclosure:
R317-513, *Recommendations for the Maintenance of Septic Tanks and Absorption Systems*
L: greenhillprelnl.isp
File: Green Hill Country Estates