Earth Investigations Consultants

October 5, 2005
Job 1663.01.01

CirclePoint
135 Main Street, Suite 1600
San Francisco, California 94105

Attention: Mr. Ted Heyd, Project Manager

RE: SUPPLEMENTAL GEOTECHNICAL PEER REVIEW
Slope Stability
Proposed Forest Green Estates, Tract 8268
Richmond, California

Ladies and Gentlemen:

INTRODUCTION

Pursuant to your request and authorization, we have completed supplemental geotechnical review of the August 3, 2005 report prepared by Terrasearch, Inc. (TI). This report was prepared in response to the following issues regarding site stability and mitigation contained in our initial peer review dated July 1, 2004, and presented at the May 10, 2005 meeting hosted by Mr. Joe Light at the City of Richmond Planning Department:

- Characterization of the site ground water and its potential impact to global stability in the southern and western parts of the site. This was to be accomplished by installation of a series 10, nested piezometers to a depth of 120 feet, and periodic reading, over a period of at least 1 average rainfall season (Figure 1, Geologic Site Plan);
- Analyze and recommend measures to mitigate potential destabilizing ground water, and the potential impact(s) of the recommended mitigation(s) on the hydrologic and geohydrologic regime;
- Analysis of deep-seated landslide creep reported in the western and south margins of the site (Terrasearch, Inc., 2003). This was to be accomplished by installation to a depth of up to 150 feet, and periodic reading of three (3) slope inclinometers over a period of 1 average rainfall season, and by (Figure 1). The inclinometers were also to be utilized for establishment of the supplemental ground water monitoring;
- Mitigation of creep, and of the potential impact(s) recommended mitigations may have on to site stability, grading and encroachment onto adjacent properties.

DISCUSSION

In our 2005 review, we raised concern over potential instability from natural conditions and measures to mitigate site storm drainage for the proposed development. From iterative, computerized slope stability analyses (XSTABL, v.5) of an ancient landslide underlying the site to a depth of 203 feet, TI (2003) concluded that global instability of the entire mass could occur if the ground water surface were to rise to within 100 feet of the ground surface, and the upper 150 feet could reactivate if ground water were to rise within 30 feet of the ground surface. The analyses were based upon assumed ground water conditions and relatively conservative, rupture surface strength parameters. TI (2003) acknowledged it would be necessary to carefully evaluate the potential impact to stability of the proposed detention ponds and percolation wells proposed to manage site waters. [According to the May 12, 2005 version of the site development plan, 3 detention ponds, 7 water quality basins, and 1 seasonal wetlands remain as integral parts of the site drainage mitigation scheme (Figure 2, Grading Impact Plan). The proposed infiltration wells have apparently been deleted.] Contingent upon supplemental geotechnical testing and analyses to verify assumptions in the analyses, preliminary measures to mitigate perceived instability were recommended, including: 1). Construction of earthen shear keys in the south and west parts of the site to depths up to 80 feet and base widths of 40-50 feet wide accompanied by subdrainage that would flow by gravity to site drainages; and 2.) Construction of a tied-back "stitch-pier" lateral retention system comprised of a row of 3-foot diameter by 80-foot deep reinforced concrete piers interconnected by a concrete grade beam across the toe of the La Colina Landslide. This mitigation would probably include removal and replacement as a buttress the earth of the toe region of landslide along the western margin of the site. It is anticipated that relatively surficial landslides mapped in the northwest part of the site would be removed during mass grading.

In our May 2005 meeting, which followed a July 2004 meeting with TI and their review consultant Alan Kropp and Associates (AKA), it was decided and agreed to by TI that a careful evaluation of the site ground water regime, including any influence from the inactive fault mapped across the south side of the site, and potential impact of creep by the La Colina Landslide, was necessary to conclude feasibility for a majority of the site between proposed Lot 40 and the southwest property corner (Figure 1, NB: the lot numbering system is inconsistent on the attached figures. The project geologic map and the proposed subdivision map should reflect the same lot numbering system for future ease of reference). The option of phasing the project to exclude this area from the current development plan was rejected. In response, TI recommended, and we agreed, that installation of 10 nested piezometers at selected locations around the site would reasonably characterize the ground water conditions for supplemental stability analyses; and that installation of 3 inclinometers/piezometers in the west and

south parts of the site would characterize the presence and depth of landslide creep. TI (2005) measured ground water elevations 6 times between October 13, 2004 and July 14, 2005; a period favorably coincident with a higher-than-average rainfall (Table 1). They characterized the occurrence of ground water as non-reflective of a regional ground water table, but rather locally perched ground water "zones", within the upper 120 feet of the ancient landslide mass, and with greater occurrence in the west and south parts than in the central part. TI inferred the higher occurrence of ground water may be related to stratigraphic anomalies within the slide mass, coupled with topographic controls (e.g., more ground water in Piezometer 1 because it was sited in a broad swale). Simple pump testing at the 3, 8-inch diameter, inclinometer holes indicate an average recharge rate of 0.12 gallons/minute.

Given the potential impact to site stability, TI recommends control of ground water by a scheme presented by Drilltech Drilling and Shoring (2005). The creative ground water withdrawal system involves drilling 2, 25- to 30-foot diameter shafts to a depth of 120 feet in the southern part of the site (Figure 2). A series of 300-foot long, horizontal drains (hydraugers) will be arranged in a radial pattern from varying elevations of each shaft wall to intercept ground water. The shaft will be designed as a sump to collect the water from the hydraugers. Accumulated water would either be pumped to a storm drainage facility, such as a seasonal wetland, or drained by gravity to an onsite swale, which, given the terrain would probably be in the middle of the site.

For additional stability across the western and south-central parts of the site, a 40-foot deep buttress is recommended (Figure 1), however, justification for the distribution and depth of buttressing is unclear. The distribution will be constrained by site boundaries and sensitive habitats. In an analysis of the walls of the buttress excavation, TI concludes a temporary 1H:1V slope is unstable, requiring excavation in 75-foot sections below a depth of 20 feet. The upper 20 feet can be mass graded.

To further assess active landsliding encroaching onto the western part of the site, TI drilled 3 borings on the adjacent Park Property (Figure 1; logs of borings not included in submittal). They conclude the borings confirm the presence of a large creeping landslide to depths of 60 to 65 feet, and of a smaller active landslide to a depth of 48 feet. Ground water was encountered at depths ranging from 25 to 40 feet, with perched water at 15 feet. Slope inclinometer data to confirm interpretation of landsliding and creep depths from the borings was not presented.

With the supplemental exploration, TI maintains the originally proposed tieback, "stitch pier" retention system, along with the buttressing, will provide sufficient protection from the active and creeping landslides.

All of the earth from the mitigations is to be stockpiled in "areas designated for grading. However, distribution on the site of temporary stockpiles is not specified. We understand that the excavated material will balance in the subdivision grading scheme.

CONCLUSIONS AND RECOMMENDED ACTION

The following are aspects of landslide mitigation that should be addressed to satisfy the geotechnical and hydrogeological aspects of the proposed project. The reply should be contained in a supplemental letter submitted to our office for review and approval:

- AKA was involved in the project as an independent reviewer of TI's work and was instrumental in the earlier geotechnical reviews of the project. AKA should be given the opportunity to review and comment on the supplemental report, and the recommended supplemental letter;
- We recommended that a planar surface of rupture be analyzed, in addition to the circular analyses submitted. This analysis should be performed with the supplemental geotechnical data;
- We judge the evaluation of ground water elevations across the site reasonable. However, there are a few items that remain unknown:
    - Will it be acceptable to extend the hydraugers offsite as illustrated on Figure 1?
    - Confirmation of the flow of ground water to the proposed sumps is necessary to confirm there will be adequate capacity at the discharge locations. If water is discharged into the site drainage system, what is the anticipated flow offsite?
    - Water quality should be analyzed, and measures to mitigate pollution, if any, should be specified;
    - TI should evaluate any potential settlement from ground water withdrawal;
- We expected to have data for review from the inclinometer readings. This information is vital in the assessment of the proposed mitigation on the southern and western parts of the site, especially given the proposed deep excavation(s) in these potentially unstable areas. We recommend TI present a more thorough assessment with documentation, i.e., specific cross-sections;
- With respect to the tieback, "stitch pier" retention system, more information would be helpful in reviewing the wall dimensions:
    - TI should graphically illustrate the geotechnical relationship between the slide surface(s) to be stabilized and the tieback, "stitch piers". This is essential in designing the length and inclination of the tiebacks;

  - The direction and approximate location of the tiebacks should be illustrated. It is usually necessary to secure permission for offsite improvements;
  - Drilltech indicates the piers will extend below the slide surface encroaching into the western part of the site. What depth is the target slide surface?
  - Presumably there will a buried wall or grade beam associated with the retention system. How will the buried element(s) be drained?
- The proposed stockpile distribution and thickness should be evaluated and illustrated on the Grading Impact Plan.

REFERENCES

Drilltech Drilling and Shoring, Inc., 2005, Conceptual description of landslide mitigation measures, Forest Green Estates, Richmond, California: Contractor's August 15 3 page letter to Land Research and Management, attention Mr. James J. Santurro, Job 527.

Earth Investigations Consultants, 2004, Geotechnical peer review, geotechnical and hydrology reports, proposed Forest Green Estates, Tract 8268, Richmond, California: Geotechnical consultant's July 1 report to Public Affairs Management, attention, Ms. Mary Bean, 11 pages with illustrations.

Terraseach, Inc., 2003, Geologic and geotechnical investigation, Forest Green Estates, Tract 8268, Clark Road, Richmond, California: Geotechnical consultant's March 19 report to General Holding, Inc., Job 7707.G, 53 pages with illustrations, graphs and tables.

_____, 2005, Response to review and supplemental recommendations on Forest Green Estates, Wesley Way and La Crescenta Road, Richmond, California: Geotechnical consultant's August 3 report to General Holding, Inc., Job 7707.G, 6 pages with illustrations and tables.

We trust that this provides you with the information you require at this time. If you require any additional information, please call.

Very truly yours,

Earth Investigations Consultants

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Engineering Geologist 1132

Thomas J. Stimac
Geotechnical Engineer 806

JEB:TJS:jb:eir
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TABLE 1 SUMMARY OF GROUNDWATER MONITORING

Piezometer	Depth	10/13/2004 Water Levels	11/30/2004	12/1/2004 Water Levels	1/7/2004 Water Levels	3/31/2005 Water Levels	4/26/2005	5/4/2005	7/14/2005
P-1	40	40.2		Dry	39.9	40.5	14.5	14.7	21.1
	80	36.5		49.5	36.2	28.3	27.2	27.3	28.8
	120	8.6		64.9	7.5	4.8	3.8	3.6	3.6
P-2	40	35.4		38.1	21.8	13.7	13.1	13.5	16.7
	80	77.8	H	79.3	40.3	39.5	39.2	39.2	38.9
	120	57	O	89.6	34.4*	61.6	52.7	52.7	52.7
P-3	40	38.4	L	39.4	not accessible	40.1	40.1	40.1	40
	80	Dry	E	Dry	not accessible	Dry	DRY	DRY	DRY
	120	Dry	S	Dry	not accessible	119.1	118.9	118.8	118.1
P-4	40	31.9		35.8	4.2	12.5	18.2	15.3	19.4
	80	40.2	P	53.2	21.4	12.8	19.4	20.8	21.5
	120	38	U	81.4	8.7	11.7	17.1	18.1	22.4
P-5	40	38.1	R	Dry	34.3	32.6	30.4	30.1	31.5
	80	44.7	G	67.1	40.8	39.8	38.1	37.9	40.9
	120	Dry	E	Dry	117.8	111.8	108.5	108.4	75
P-6	40	33.8	D	36.9	29.5	16.9	15.9	16.2	22.3
	80	31.3		56.2	31	21.9	20.6	20.5	23.2
	120	53.6		81.1	53.1	49.5	51.2	51.1	50.6
P-7	40							11.2	11.8
	80							78.6	20.7
	120							33.1	29.9
P-8	40							10.4	14.7
	80							29.7	24.4
	120							28.7	29.8
P-9	40							31.5	38.1
	80							DRY	DRY
	120							76.4	77.9
P-10	40							9.2	9.9
	80							15.5	10.6
	120							17.2	18.9
PD-1	40								16.3
	80								24.3
	120								23.9
PD-2	45								15
	65								40.7
Inclinometer	95								45
I-1	120	56.6		71.1	52.9	53	50.6		52.8
I-2	120	44.6		77	68.2	12.6	17		23.9
I-3	150	126.5		133.2	40	35.5	35		34.1

Note: * PVC opening below 6" of standing water in casing, not accurate reading

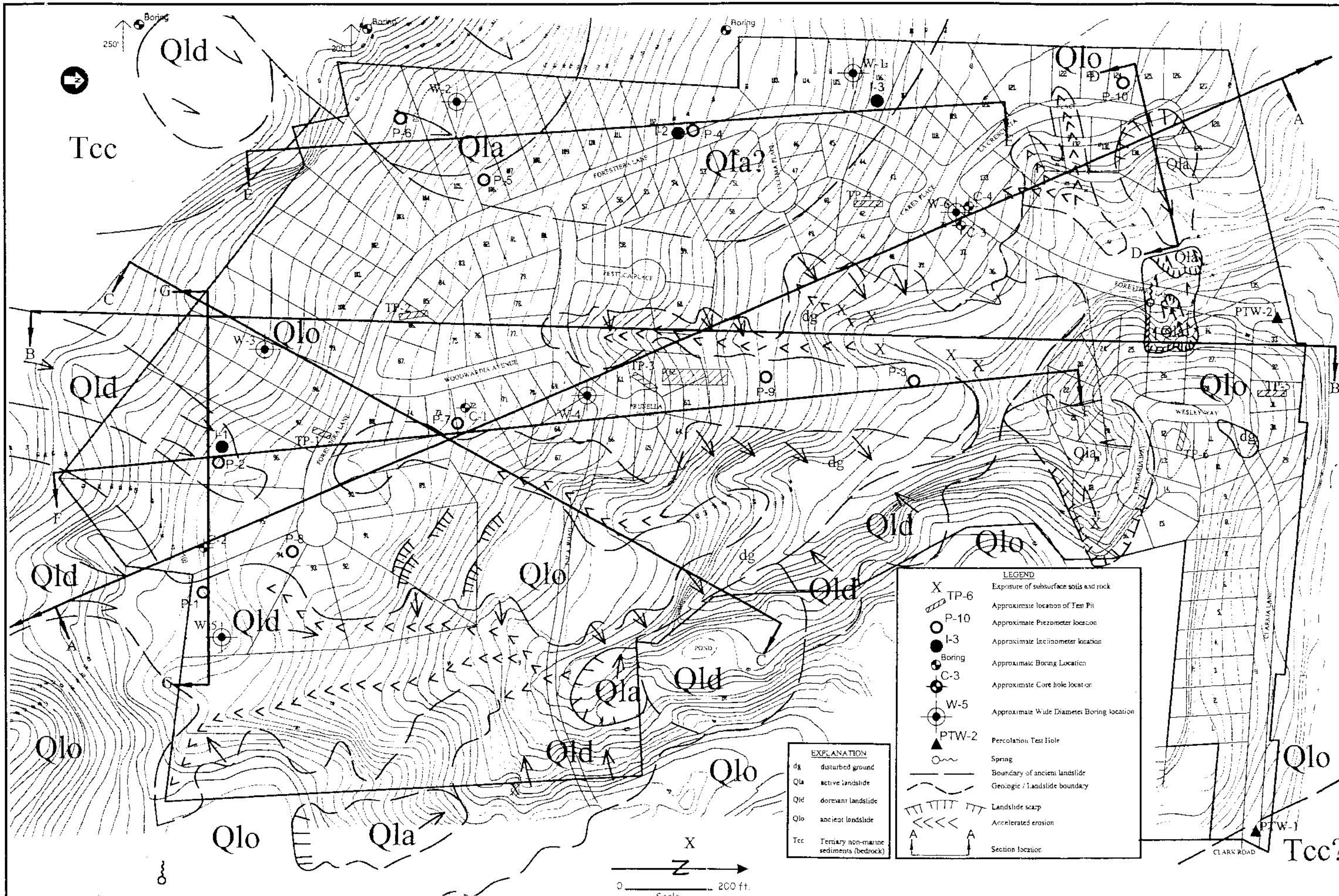

FIG. 1

GEOLOGIC SITE PLAN

Forest Green Estates "A Green Subdivision"
Richmond, California

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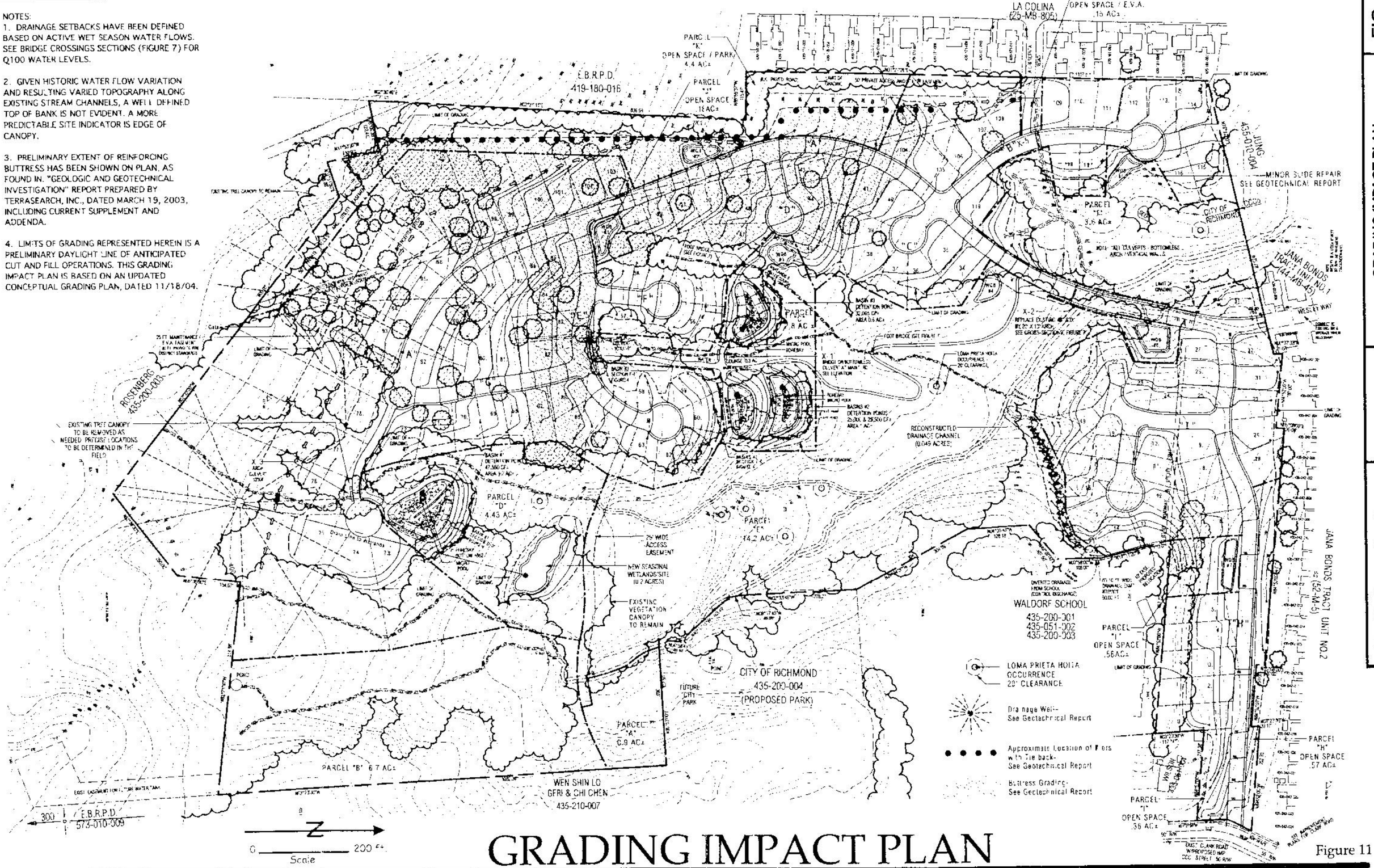
NOTES:
1. DRAINAGE SETBACKS HAVE BEEN DEFINED BASED ON ACTIVE WET SEASON WATER FLOWS. SEE BRIDGE CROSSINGS SECTIONS (FIGURE 7) FOR Q100 WATER LEVELS.

2. GIVEN HISTORIC WATER FLOW VARIATION AND RESULTING VARIED TOPOGRAPHY ALONG EXISTING STREAM CHANNELS, A WELL DEFINED TOP OF BANK IS NOT EVIDENT. A MORE PREDICTABLE SITE INDICATOR IS EDGE OF CANOPY.

3. PRELIMINARY EXTENT OF REINFORCING BUTTRESS HAS BEEN SHOWN ON PLAN, AS FOUND IN, "GEOLOGIC AND GEOTECHNICAL INVESTIGATION" REPORT PREPARED BY TERRASEARCH, INC., DATED MARCH 19, 2003, INCLUDING CURRENT SUPPLEMENT AND ADDENDA.

4. LIMITS OF GRADING REPRESENTED HEREIN IS A PRELIMINARY DAYLIGHT LINE OF ANTICIPATED CUT AND FILL OPERATIONS. THIS GRADING IMPACT PLAN IS BASED ON AN UPDATED CONCEPTUAL GRADING PLAN, DATED 11/18/04.



GRADING IMPACT PLAN
FOREST GREEN ESTATES

Figure 11

FIG. 2

GRADING IMPACT PLAN
Forest Green Estates "A Green Subdivision"
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