PLAN OF CONTROL
PREPARED FOR PROPOSED SANTIAGO GEOLOGIC HAZARD ABATEMENT DISTRICT
ANAHEIM HILLS, ANAHEIM, CALIFORNIA

INTRODUCTION

This report is a Plan of Control for the GHAD area shown on the map attached hereto, pursuant to the provisions of the Public Resources Code, Sections 26500, et. seq.

GEOLOGIC HAZARD DESCRIPTION

Area soil and rock are subject to a variety of damaging geologic phenomena. Existing or potential problems have been caused by landsliding, settlement, slope creep, expansive soils and rising groundwater.

Ground deformation evolving into the Santiago Landslide was first recognized in Summer 1992. Subsequently, above-average rainfall in Winter 1992-93 accelerated land movement and defined an area of involvement as described by Eberhart and Stone, Inc., Geotechnical Consultants (E&S) in their technical report for the Santiago Landslide dated June 28, 1996, as on-file and available for review at the City of Anaheim. This reference report contains detailed determination of the properties damaged by landsliding, particularly Plate H.1 in Volume Va, and is the principal source of geologic, hydrogeologic and geotechnical information regarding the conditions of failure.

Area marine sedimentary rock of the Puente Formation, specifically the La Vida and overlying Soquel Members, became locally destabilized by rising groundwater. The resulting rock-block

landslide mass detached along weak, north-dipping stratification, facilitated by an adversely oriented (for area stability) fault which allowed translational movement at the toe (down-slope) limit of landsliding. These geologic factors are discussed in depth by the E&S report and illustrated on geologic maps and cross sections appended thereto. A precise limit or boundary for the landslide mass was defined by a continuous series of cracks and other contemporaneous damages, as portrayed on the reference Plate H.1 of the E&S report. The limit of Santiago Landslide surface distress is plotted on the map attached to this Plan of Control.

The hillside terrain encompassing the Santiago Landslide is comprised of both developed and undeveloped residential lands. A Geologic Hazard Abatement District (GHAD) is proposed for the Santiago Landslide and nearby areas. The District will cover all or portions of Tracts 7587, 7918, 8376, 8377, 9080, 9133, 9134, 9135, 9136, 10996 and 10997. The boundaries of the GHAD are shown on the attached map.

GEOLOGIC HAZARD POTENTIAL

Santiago landslide formation was caused by a combination of four primary factors:

1. North-facing hillside topography
2. Geologic structure as north-dripping strata and south-dipping ancient faults
3. Geologically weak materials along critical sedimentary beds and faults
4. Rising groundwater

The City of Anaheim implemented a massive groundwater drainage and withdrawal effort as the only feasible method to arrest Santiago landslide movement in 1993. Substantial groundwater

elevation declines were achieved and movement stopped. However, if water levels were ever to rise to elevations equivalent to those of January 1993, reactivation of the Santiago Landslide is certain. Therefore, the dewatering system installed by the City of Anaheim must be diligently operated, monitored and maintained as specified by the E&S report and this Plan of Control.

The City has acknowledged that the abatement of renewed Santiago Landslide movement is at present and for the foreseeable future totally dependent upon effective groundwater control, and that renewed movement of the landslide could cause severe damages to properties and improvements, both public and private. The City has reviewed the E&S report describing the geologic conditions and addressing the requirements for on-going dewatering. Because the current dewatering, groundwater observation, and landslide movement detection system is complex and requires detailed monitoring, maintenance and reportage; the City and property owner representatives have requested that a GHAD be established for the Santiago Landslide area. A principle purpose of the GHAD is to mitigate the risk of reactivation of the Santiago Landslide, to direct and fund the operation and maintenance of the dewatering system, monitoring of groundwater elevations and landslide movements, and evaluate landslide stability on a regular basis for the life of those improvements potentially impacted by any renewed landslide movement.

It has been determined from hydrogeologic analyses that the rising groundwater in the Santiago landslide area was primarily due to local recharge of applied landscape irrigation. Therefore, properties contributing to the destabilizing elevated groundwater include those that are contiguous with and tributary to properties directly underlain or damaged by Santiago Landslide movements of 1992-93. These "tributary" properties influenced original destabilization of the Santiago Landslide by groundwater recharge and their on-going recharge water must be withdrawn by the GHAD dewatering system. Therefore, these "tributary" properties should be included in the

GHAD; along with the properties within the surface distress boundary.

Areas of groundwater recharge which are considered tributary to the rise in groundwater, and can contribute water to the landslide south of Serrano Avenue, include at least portions or all of Tracts 7587, 9080, 10996 and 10997; as well as those portions of Tracts 9133, 9134 and 9135 located southeasterly of the Rimwood Fault (see E&S 1996). Tract 13760 , Lot 34 of Tract 7587 and the easterly approximately one-third of Parcel 3, P.M. 87-252 are vacant lands within the tributary area and should be considered for inclusion in the GHAD during their development process.

HAZARD MITIGATION PLAN

Recognition of anomalously high groundwater in the Santiago Landslide area led to the recommendation that dewatering offered potential for abating movement. Shortly after accelerated movement in January 1993, groundwater withdrawal efforts were implemented. Two systems were installed to lower the water table from 1993 maximums and maintain groundwater elevations at relatively safe levels:

Active Dewatering consists of pumped vertical wells discharging into the City storm drain system. A total of 37 wells were installed. Their locations and current evaluation/status are listed on the attached tabulation.

Passive Dewatering is accomplished by an extensive network of near-horizontal gravity drains drilled into north-facing slopes in and around the landslide mass. Subsurface water is collected by in-ground perforated pipes and conveyed to the City storm drains via buried pipelines.

All dewatering systems locations and construction details are as portrayed in the E&S report and Appendices except that two additional pumping wells have been installed as recommended therein. Their locations, along with descriptions of all dewatering wells, are provided in the attached tabulation. As-built construction plans for the dewatering system shall be provided to the GHAD. Wells are supplied with appropriate monitoring facilities to measure discharge volumes, water levels and diagnose electro-mechanical performance.

The primary control for area-wide groundwater elevation monitoring consists of dedicated groundwater observation wells and five deep piezometer installations, many equipped with automatic water level or pressure data-loggers. Acquired groundwater elevations for each monitoring point have been tabulated in graphic form as a hydrograph (plot of water elevation through time) in order to evaluate recharge/discharge (water rise/decline) and assess potential groundwater trends influence on landslide stability. Key historic groundwater stands were analyzed by E&S to determine their effect on the landslide and develop guidelines for using groundwater elevations to maximize stability. The objective is to achieve area groundwater elevations no higher than those recorded for October 5, 1994 each and every year at the onset (October 15) of the seasonal rain-year.

It is anticipated that the GHAD will retain a minimum of three entities to provide technical and contractual services:

1. Primary geologic/geotechnical consultant to conduct monitoring of water elevations from monitoring wells, pumps and piezometers; perform inclinometer surveys; compile pump discharge volumes; and report and analyze findings.

2. Pump/well Contractor to service pumps, monitor performance and report to the primary consultant.

3. Review geologic/geotechnical consultant to assist the GHAD Board in reviewing reports and activities of the Primary Consultant and pump/well Contractor.

Specific monitoring, maintenance and reportage requirements are outlined by the accompanying schedules, procedures, and protocols.

OTHER GEOLOGIC HAZARDS

Detailed geologic and geotechnical investigations were conducted for the design and construction of improvements for residential tract areas encompassed by the GHAD. These reports are on file and available for review at the City of Anaheim. Reportage identified geologic hazards and provided mitigation recommendations which include: removal and recompaction of potentially compressible soils, complete or partial removal of ancient landslides, stabilization of potentially unstable cut slopes, surface and subsurface drainage improvements, and specific structure foundation designs.

Such other geologic hazards could cause damage to property and improvements, both public and private. Area earthwork includes deep canyon and remedial earth fills which have potential for differential settlements due to variable fill thickness, consistency, underlying alluvium and old landslide deposits, and/or moisture contents. Local volumes of clay-rich fill or bedrock materials are expansive and experience potentially damaging swelling or shrinkage in response to changes

in water content. Such low-strength, swelling soils are subject to gravity creep where exposed on or near the face of slopes. Ancient, inactive faults are present as discontinuities in local bedrock materials. Such planes of weakness may experience local differential movement in response to strong earthquake ground vibrations, promote local slope instability, or act as conduits/barriers for groundwater migration.

It is recognized that land development design and construction of improvements addressed many of these geologic hazards based on the standards of care and available technology at the time of development. However, there will always be some potential for the occurrence of a geologic hazard.

Inclusion in the GHAD is beneficial for areas where residents may have concerns regarding geologic hazards due to proximity to the Santiago Landslide. In the event of a geologic hazard other than as defined herein for the Santiago Landslide, properties within the GHAD have a mechanism to address and mitigate any such future geologic hazard. In such event, the GHAD Board should retain a qualified geologic/geotechnical consultant to identify the hazard, define its nature and extent, and prepare an appropriate plan of control.

Respectfully submitted,

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DWC/MWM/dc

03/393-416text.J05

DEWATERING WELLS

DW-1	Location:	Knuckle of Georgetown Circle
	Status:	No pump, plumbed into system
	Recommendation:	Maintain well for future use, if needed
DW-2	Location:	Front of 6832 Georgetown Circle
	Status:	Pumping, typically 10-100 g.p.d.
	Recommendation:	Pull pump, preserve well
DW-3	Location:	Front of 6816 Georgetown Circle
	Status:	Pumping, typically 0-10 g.p.d.
	Recommendation:	Pull pump, preserve well
DW-4	Location:	Front of 6848 Georgetown Circle
	Status:	Pumping, typically 100-100 g.p.d.
	Recommendation:	Pull pump, preserve well
DW-5	Location:	Front of 6890 Georgetown Circle (cul-de-sac)
	Status:	Pumping, typically 10-100 g.p.d.
	Recommendation:	Pull pump, preserve well
DW-6	Location:	Front of 6856 Georgetown Circle
	Status:	Pumping, typically 150-400 g.p.d.
	Recommendation:	Pull pump, preserve well
DW-7	Location:	N. side Serrano, ~500' E. of Georgetown
	Status:	Pumping, 100 g.p.d.
	Recommendation:	Pull pump, preserve well
DW-8	Location:	N. side Serrano, 350' E. of Georgetown
	Status:	Pumping, typically 1500-1900 g.p.d.
	Recommendation:	Maintain
DW-9	Location:	N. side Serrano, 175' E. of Georgetown
	Status:	Pumping, typically dry
	Recommendation:	Pull pump, preserve well
DW-10	Location:	Front of 6808 Georgetown Circle
	Status:	Pumping, typically 300-11000 g.p.d.
	Recommendation:	Maintain

DW-11	Location:	S. end of Lehigh Drive
	Status:	Pumping, typically 200-400 g.p.d.
	Recommendation:	Pull pump, preserve well
DW-12	Location:	N. side of Williams Circle cul-de-sac
	Status:	pumping, 30 g.p.d.
	Recommendation:	Pull pump, preserve well
DW-13	Location:	Rear of 1095 Burlwood Drive
	Status:	Pumping, typically 6-10 g.p.d.
	Recommendation:	Pull pump, abandon well
DW-14	Location:	N. side Serrano, ~425' E. of Georgetown
	Status:	Pumping, typically 500-600 g.p.d.
	Recommendation:	Pull pump, preserve well
DW-15	Location:	N. side Serrano, 250' E. of Georgetown
	Status:	Pumping, typically 2200 g.p.d.
	Recommendation:	Maintain
DW-16	Location:	Rimwood cul-de-sac
	Status:	Pumping, typically 10-100 g.p.d.
	Recommendation:	Pull pump, preserve well
DW-17	Location:	Front of 6840 Georgetown Circle
	Status:	Pumping, typically 10-1000 g.p.d.
	Recommendation:	Pull pump, preserve well
DW-18	Location:	S. end Vassar Circle
	Status:	Pumping, typically 10-100 g.p.d.
	Recommendation:	Pull pump, preserve well
DW-19	Location:	S. end of Purdue Circle
	Status:	Pumping, typically 1000 g.p.d.
	Recommendation:	Pull pump, preserve well
DW-20	Location:	N. side Serrano, ~750' E. of Georgetown
	Status:	Pumping, typically 200-1000 g.p.d.
	Recommendation:	Pull pump, preserve well
DW-21	Location:	End of Williams Circle
	Status:	Pumping, ~1 g.p.d.
	Recommendation:	Pull pump, abandon well

DW-22	Location:	Front of 6872 Georgetown circle
	Status:	Pumping, typically 500-600 g.p.d.
	Recommendation:	Pull pump, preserve well
DW-23	Location:	S. side street 1012 Burlwood
	Status:	Pumping, not metered
	Recommendation:	Not needed for Santiago Landslide, offer to H.O.A.
DW-24	Location:	S. end Pegasus
	Status:	Abandoned by City
DW-25	Location:	S. side Burlwood, across from 1016
	Status:	Pumping, 7500 g.p.d.
	Recommendation:	Not needed for Santiago Landslide, offer to H.O.A.
DW-26	Location:	Ave. de Santiago, front of 6871
	Status:	Pumping, typically 100-200 g.p.d.
	Recommendation:	Pull pump, preserve well
DW-27	Location:	Ave. de Santiago, front of 6949
	Status:	Pumping, typically <10 g.p.d.
	Recommendation:	Pull pump, preserve well
DW-28	Location:	Ave. de Santiago, front of 6943
	Status:	Pumping, typically 400-500 g.p.d.
	Recommendation:	Maintain
DW-29	Location:	Front of 6890 Georgetown
	Status:	Pumping, typically >5000 g.p.d.
	Recommendation:	Maintain
DW-30	Location:	Front of 6907 Ave. de Santiago
	Status:	Pumping, typically >5000 g.p.d.
	Recommendation:	Maintain
DW-31	Location:	W. end of Williams Circle
	Status:	Pumping, typically 1300-1400 g.p.d.
	Recommendation:	Maintain
DW-32	Location:	Front of 6937 Ave. de Santiago
	Status:	Pumping, typically 10,000-12,000 g.p.d.
	Recommendation:	Maintain

DW-33	Location:	S. side Serrano, 100' E. of Williams
	Status:	Pumping, typically >2000 g.p.d.
	Recommendation:	Maintain
DW-34	Location:	S. side Serrano, 100' W. of Williams
	Status:	Pumping, typically 2000-4000 g.p.d.
	Recommendation:	Maintain
DW-35	Location:	S. side Serrano, 50' E. of Georgetown
	Status:	Pumping, typically 2500-3500 g.p.d.
	Recommendation:	Maintain
DW-36	Location:	W. end private cul-de-sac, Ave. de Santiago
	Status:	Pumping, 800 g.p.d.
	Recommendation:	Maintain
DW-37	Location:	Lot "B" adjacent 6800 Georgetown Circle
	Status:	Pumping, 11,000 g.p.d.
	Recommendation:	Maintain

PRIMARY GEOLOGIC/GEOTECHNICAL CONSULTANT
MONITORING/MAINTENANCE
SCHEDULES, PROCEDURES & PROTOCOLS
SANTIAGO LANDSLIDE

I GROUNDWATER AND INCLINOMETER MONITORING

1. Monthly inspection and monitoring of groundwater observation wells and piezometers. Includes traffic control, downloading of instrumented wells, measuring of water levels in non-instrumented wells, and inspection for damage or maintenance items.

2. Inspect and monitor groundwater flow from horizontal drains twice per year; three additional inspections every fourth year to account for above-average rainfall.

3. Survey 10 inclinometer casings once per year. Requires traffic control on Serrano Avenue and an additional survey every fourth year to account for above-average rainfall.

4. Repair, service, and maintenance of monitoring equipment. Repair and service of data loggers, replacement and/or recalibration of transducers, replacement of batteries and transducer filters, and repair and/or replacement of field data-logging equipment.

II COMPILATION OF FIELD DATA

1. Monthly compilation of rainfall and groundwater data from observation wells and piezometers to update hydrograph plots.

2. Compile flow data from horizontal drains and update spread-sheet files twice per year.

3. Compilation of dewatering well discharge, dewatering well water levels, and updating of spread-sheet files twice per year.

4. Download and compile inclinometer data yearly.

III EVALUATION OF GROUNDWATER AND INCLINOMETER DATA

1. Monthly comparison of groundwater levels from observation wells and piezometers with data obtained from the previous month, previous quarter, previous year, and the target or baseline levels of October 5, 1994.

2. Compare well discharge volumes with volumes produced during the previous monitoring periods and evaluate the cause of any unusual increase or decrease in volumes. Evaluate changes in dewatering well water levels with pump size, timer settings, and well maintenance procedures.

3. Yearly evaluation of inclinometer data and determination of the direction,

magnitude, rate and significance of any subsurface changes.

IV COORDINATION AND DOCUMENTATION

1. Monthly coordination of findings and conclusions, and submittal of written recommendations to the GHAD board and the well maintenance contractor for any necessary changes in operation and maintenance of the dewatering system, well rehabilitation, and adjustments to monitoring procedure.

2. Annual report documenting the inspection and monitoring results for the preceding rain year by November 1 of each year. The report shall address both the mechanical state of the dewatering system and evaluate preparedness for the up-coming rainfall year, particularly groundwater elevations compared to the October 5, 1994 maximums.

PUMP/WELL CONTRACTOR

MONITORING & MAINTENANCE REQUIREMENTS

SANTIAGO LANDSLIDE

The pump/well contractor shall examine and document the operation and status of each dewatering well and associated discharge system monthly. Monthly reports of contractor observations and maintenance work should be provided to the GHAD board and their consultants for review. Monthly well maintenance reports should include the well identification, date, observations/service person performing the inspection, horsepower of the well pump, number of wires supplying power to the pump, required voltage, actual voltage and amperage measured, current pump-tech timer setting and changes made, depth of the pump in the well, depth to water in the well, flow meter reading, calculated flow (g.p.d.), and comments regarding observed conditions and/or work performed.

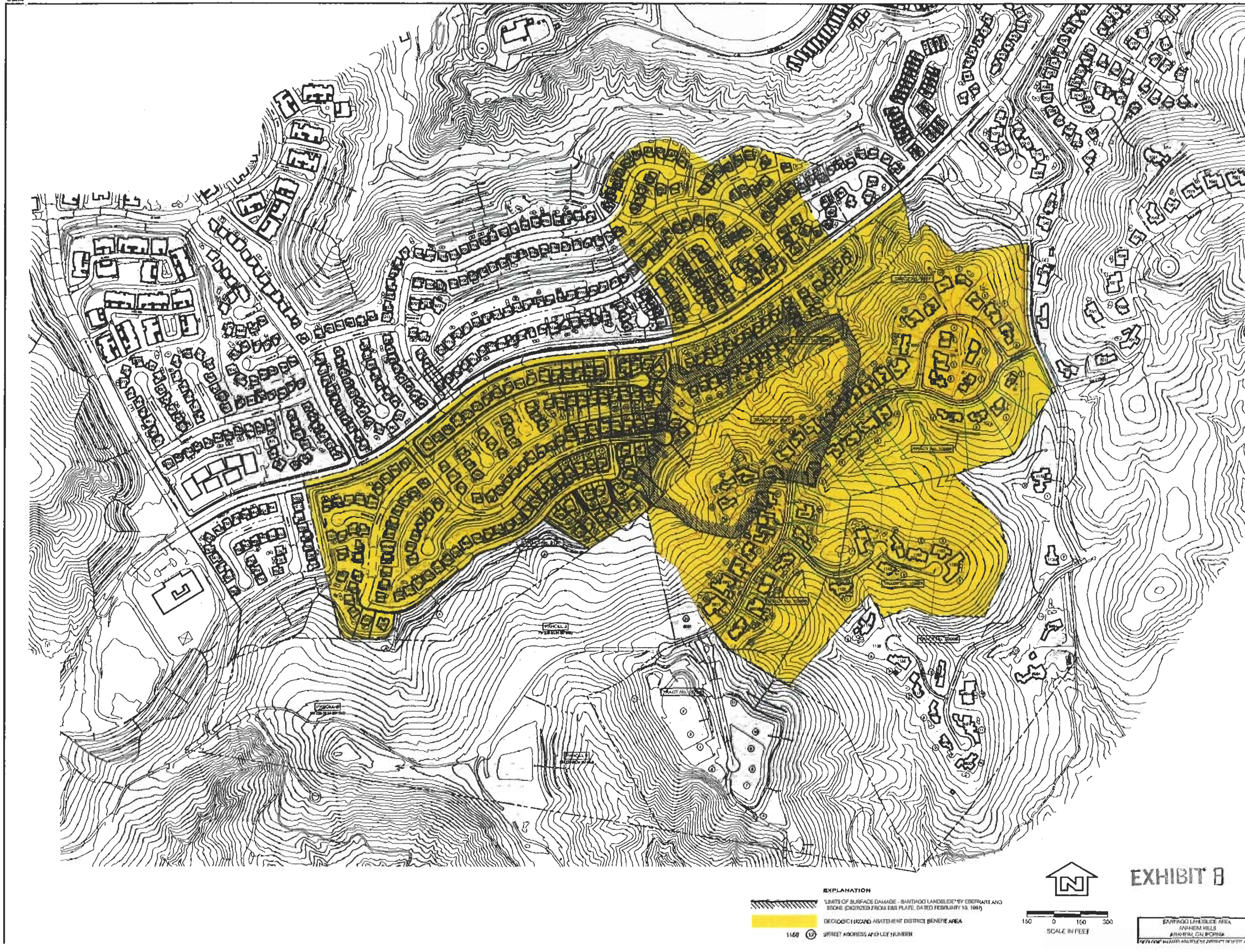
EXHIBIT B
EXPLANATION
"LIMITS OF SURFACE DAMAGE - SANTIAGO LANDSLIDE" BY EBERHART AND STONE (DIGITIZED FROM E&S PLATE, DATED FEBRUARY 13, 1997)
GEOLOGIC HAZARD ABATEMENT DISTRICT BENEFIT AREA
1160 (17) STREET ADDRESS AND LOT NUMBER
N
150 0 150 300
SCALE IN FEET
SANTIAGO LANDSLIDE AREA
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