APPENDIX G

PRELIMINARY STORMWATER CONTROL PLAN

PRELIMINARY
STORMWATER CONTROL PLAN

The Terraces of Lafayette

City Permit Number: _____

LAFAYETTE
CONTRA COSTA COUNTY
CALIFORNIA

September 23, 2011

Prepared By:

ENGINEERS / SURVEYORS / PLANNERS

1646 N California Blvd, Suite 400
Walnut Creek, CA 94596
(925) 940-2200

Report prepared for:

Lafayette, Contra Costa County, California

Stormwater Control Plan for The Terraces of Lafayette
Lafayette, CA

City Permit Number:
BKF Engineers Job No.: 20115003

Dan Schaefer, P.E., LEED © A.P.
Principal

Table of Contents

Section **Page**

I. PROJECT SETTING

A. Project Description and Information Summary

Existing Site

The existing 22.27 acre site is bordered by Highway 24 at the south, Deer Hill Rd at the northwest and Pleasant Hill Rd. at the east (**Figure 1**). The site reaches a max elevation of 465 along Deer Hill Rd. Approximately 50% of the site slopes 0-15% with the lowest elevation of approximately 326 along Pleasant Hill Rd.

An existing residence is located to the north of the site approximately 100 feet from Pleasant Hill Rd and 450 feet from Deer Hill Rd. Existing driveway access is located off both Deer Hill Rd and Pleasant Hill Rd.

The site receives approximately 23-inches of annual rainfall. The existing site is roughly 3.3% impervious. The proposed site will be 53% impervious (**Figure 2**). For reference, the Preliminary Geotechnical Feasibility Report prepared by ENGEO has been attached. (**Appendix A**).

An existing culvert crosses under Deer Hill Rd and directs runoff into an existing creek which drains east across the north portion of the site and discharges into a culvert under Pleasant Hill Rd.

Project Description

Proposed site improvements include, but are not limited to, the following:

1. 2 and 3 story multi-family building
2. Circulation roads between buildings
3. Carports and Garages
4. Clubhouse and Pool Area
5. Pedestrian paths
6. Play structures
7. Turf recreation areas

The new site improvements on the 22.27 acre site create and/or replace greater than 10,000 SF of impervious surfaces. Therefore, the project is subject to the treatment and flow components referenced in the NPDES permit.

B. Opportunities and Constraints of Stormwater Control

The Stormwater Control Plan shows the grading and drainage patterns of the site, and the methods proposed to remove suspended solids and pollutants from storm water runoff. Treatment of all runoff from the project area is required according to current stormwater

C.3 requirements. Storm water treatment requirements are met by implementing bioretention areas throughout the site to treat the proposed improvements.

Opportunities:

New buildings, roads and site features generally conform to the existing terrain of the site. 3 existing storm drainage structures and 1 culvert collect water from the site at the south eastern and eastern edge of the site. The proposed storm drain system connects a series of bioretention basins and generally maintains the existing hydrology of the site by directing runoff to the respective existing storm drain structures. (**Figure 3**)

Bioretention areas have been placed adjacent to and behind buildings and roads in flat areas to maximize treatment prior to discharge into a treated storm drain system (**Figure 4A and 4B**). Drainage from sloped landscape areas are collected with earthen ditches lined with jute netting which allows drainage to flow directly to the treated storm drain systems which bypass bioretention areas and discharge to the offsite storm drainage facilities.

Frontage sidewalk along Deer Hill Rd. will drain towards the property into a landscape area to bypass treatment.

Constraints:

Existing slopes, along with the lack of an existing drainage system, impair the ability to control the direction of runoff flow and also hinder the amount of infiltration that can occur. Infiltration of storm water into the site soils may not be feasible due to low permeability rates reported by the Geotechnical Engineer.

Bioretention areas or Integrated Management Practices (IMPs) with engineered soil are sized to accept stormwater from existing and proposed areas at the bottom of each of the Drainage Management Areas (DMAs).

II. Measures to Limit Imperviousness

A. Pervious Site Improvements

- Turf areas
- Planted slopes

B. Drainage as a Design Element

- Slope landscape areas bypass Bioretention Areas.
- Bioretention Areas treat stormwater by allowing stormwater infiltrate through engineered soil. A perforated pipe collects and conveys the treated subsurface stormwater to outfalls with energy dissipation or storm drain catch basins which drain to the existing watershed.

C. Minimizing Volume of Runoff

- Large landscaped areas are included in the design.

III. Selection and Primary Design of Storm Water Treatment BMP's

Impervious areas on the site, including building roofs, parking areas, sidewalks and driveways are separated into 19 DMAs. The stormwater runoff from each DMA drains to specific IMPs. Sloped landscape areas are self treating areas and drain directly to treated storm drain system. The turf area behind building G will be self retaining and will be connected directly to the treated storm drain system.

Since the project does create more than an acre of impervious area, flow-control is required, per the guidelines established in the CCCWP Storm Water C.3 Guidebook (5th Edition, October 2010). With that in mind, these IMP's were designed for flow control and treatment.

A. General Bioretention Area Characteristics

In general, bioretention areas are configured as described in the CCCWP Storm Water C.3 Guidebook (5th Edition, October 2010). The areas are sized such that the surface area of each swales "flat" surface area (total surface area of the swale, minus the surface area of the side slopes not inundated) equals at least 4% of the factored impervious drainage area being served (**Figure 4A-4B**). A sizing summary of each bioretention area can be found on **Table 2**.

Each bioretention area was designed with the following characteristics:

- Vegetation selected for viability and to minimize need for fertilizers and pesticides in well-drained soil.
- 18" of engineered soil with an infiltration rate of 5 inches per hour.
- Splash blocks, cobbles or rip rap dissipation at inlets and outlets to bioretention areas.
- Perforated-pipe subdrain connected to storm drainage system.
- Irrigation system connected to water supply.

B. Specific descriptions of each DMA and IMP are as follows:

A summary of all proposed, impervious/pervious surface area has been listed in **Appendix B.**

DMA 1 includes drainage from an entrance road, parking area and garages. Runoff from this area discharges into **IMP 1** located at the south of the site. See **Figure 4A.**

DMA 2 includes drainage from an entrance road, parking area and garages. Runoff from this area discharges into **IMP 2** located at the south of the site. See **Figure 4A.**

DMA 3 and DMA 4 include drainage from Building A and Building H. Runoff from these areas discharge into **IMP 3/4** located at the south of the site. See **Figure 4A.**

DMA 5 includes drainage entrance road from Pleasant Hill Rd. Runoff from this area discharges into **IMP 5** from a trench drain. See **Figure 4A.**

DMA 6 includes drainage from access road, parking and Building B. Runoff from these areas discharges into **IMP 6** located south of the club house. **See Figure 4A.**

DMA 7 includes drainage from access road, parking and Buildings C and D. Runoff from this area is carried through an untreated storm drain pipe which discharges into **IMP 7/11/12** located adjacent to Deer Hill Rd. **See Figure 4B.**

DMA 8 includes drainage from access road, parking, Buildings I and J. Runoff from this area discharges into **IMP 8** located behind Building I and J. **See Figure 4A.**

DMA 9 includes drainage from access road, parking, Club House, Buildings K and L. Runoff from this area discharges to the east into **IMP 9** located behind Building K and L. **See Figure 4B.**

DMA 10 includes drainage from access road, parking and Buildings G. Runoff from this area discharges to the east into **IMP 10** located north of Building L. **See Figure 4B.**

DMA 11 and DMA12 includes drainage from access roads, which drain through trench drains and discharges to **IMP 7/11/12** through an untreated storm drain line. **See Figure 4B.**

DMA 13 includes drainage from access road, and Leasing Office. Runoff from this area discharges to the east into **IMP 13** located north of the Leasing Office. **See Figure 4B.**

DMA 14 includes drainage from access road, parking and Building M. Runoff from this area discharges to the south into **IMP 14** located south of the Building M. **See Figure 4B.**

DMA 15 includes drainage from access road. Runoff from this area discharges to the east into **IMP 15** located just north of the Pleasant Hill Rd. **See Figure 4B.**

DMA 16 includes drainage from Building N. Runoff from this area discharges to the north into **IMP 16** located just north of Building N. **See Figure 4B.**

DMA 17 includes drainage from Building F. Runoff from this area discharges to the south into **IMP 17** located just north of Building F. **See Figure 4B.**

DMA 18 includes drainage from Building N's parking lot. Runoff from this area discharges to the south into **IMP 18** located just south of Building N. **See Figure 4B.**

DMA 19 includes drainage from Building E. Runoff from this area discharges into **IMP 6** located south of the club house. **See Figure 4A.**

Self Retaining Areas includes drainage from the slope and turf area behind Building G.

Self Treating Areas includes drainage from landscape slopes around the site which drain into treated storm drain pipes that bypass the bioretention areas.

IV. Source Control Measures

The following activities occur in areas designated for improvement in the Terraces of Lafayette and have potential to allow pollutants to enter runoff:

- Landscape maintenance
- Facility cleaning
- Construction/demolition of existing buildings
- Grading

All areas where these activities occur will drain to Bioretention Areas. To further reduce the potential for pollutants to enter runoff, permanent and operational BMP's will be implemented as described in **the Contra Costa County Integrated Management Practice Summary**.

Table 1. Sources and Source Control BMP's

Potential Source	Permanent BMP's	Operational BMP's
On-site Storm Drain Inlets	• Mark all inlets with the words "No Dumping! Flows to Creek" or similar	• Maintain and periodically repaint or replace inlet markings.
Landscape/outdoor pesticide and fertilizer use.	• Landscaping will be designed to minimize required irrigation and runoff, to promote surface infiltration, and to minimize the use of fertilizers and pesticides that can contribute to storm water pollution. • Plantings for IMP's will be selected to be appropriate to anticipated soil and moisture conditions. • Where possible, pest-resistant plants will be selected, especially for locations adjacent to hardscape. • Plants will be selected appropriate to site soils, slopes, climate, sun, wind, rain, land use, air movement, ecological consistency, and plant interactions.	• Landscaping to be maintained using minimum or no pesticides. • Person or contractor responsible for landscape maintenance to use IPM principles.
Plazas, sidewalks and parking lots. Facility Cleaning Construction and Demolition of Buildings		• Potential sources shall be swept regularly to prevent the accumulation of litter and debris. Debris from pressure washing shall be collected to prevent entry into the storm drain system. Wash water containing any cleaning agent or degreaser shall be collected and discharged to the sanitary sewer and not discharged to a storm drain.

V. Permitting and Code Compliance Issues

There are no known conflicts between the proposed storm water control plan and Contra Costa County ordinances or policies. Any conflicts found will be resolved through the design review process or during subsequent permitting.

VI. IMP Operations and Maintenance

A. Means to Finance and Implement IMP Maintenance

The property owner will provide a Storm Water Control Operation and Maintenance (O&M) Plan for the review of the Public Works Department, and record an Operations and Maintenance Agreement, including any necessary rights-of-entry, prior to Issuance of a building permit. Additionally, the property owner will annex into any financing mechanisms (e.g. Community Facilities District) formed to insure that all costs associated with the perpetual Operation & Maintenance, administration and reporting of these water quality features (including costs associated with all required County administration and reporting) are paid for by the property owner(s) that are or will be benefiting from this development.

B. Summary of Maintenance Requirements

Bioretention areas remove pollutants as effluent moves through a layer of imported, engineered soil. Treatment runoff then infiltrates through permeable engineered soil layer into a perforated pipe which discharges to existing storm drain facilities. Routine maintenance is needed to ensure that flow is unobstructed, that inlets and outlets are not clogged, and that erosion is prevented. Typical routine maintenance consists of the following:

- Maintain vegetation and irrigation systems
- Inspect periodically and after storm events to ensure that inlets and outlets have not clogged and rivulets have not formed.
- Planting and replanting any grassy or vegetated areas that become eroded or bald.
- Examine vegetation to ensure that it is healthy and dense enough to provide filtering and to protect soils from erosion. Replenish mulch as necessary, remove fallen leaves and debris, prune large shrubs or trees, and mow turf areas. Confirm that irrigation is adequate and not excessive. Replace dead plants and remove invasive vegetation.
- Inhibit any potential vectors by filling in the ground around the basin and by ensuring that there are no areas where water stands longer than 72 hours following a storm. If mosquito larvae are present and persistent, contact the County Vector Control District for information and advice. Mosquito larvicides should be applied only when absolutely necessary and only by a licensed individual or contractor.

VII. Construction Plan C.3 Checklist

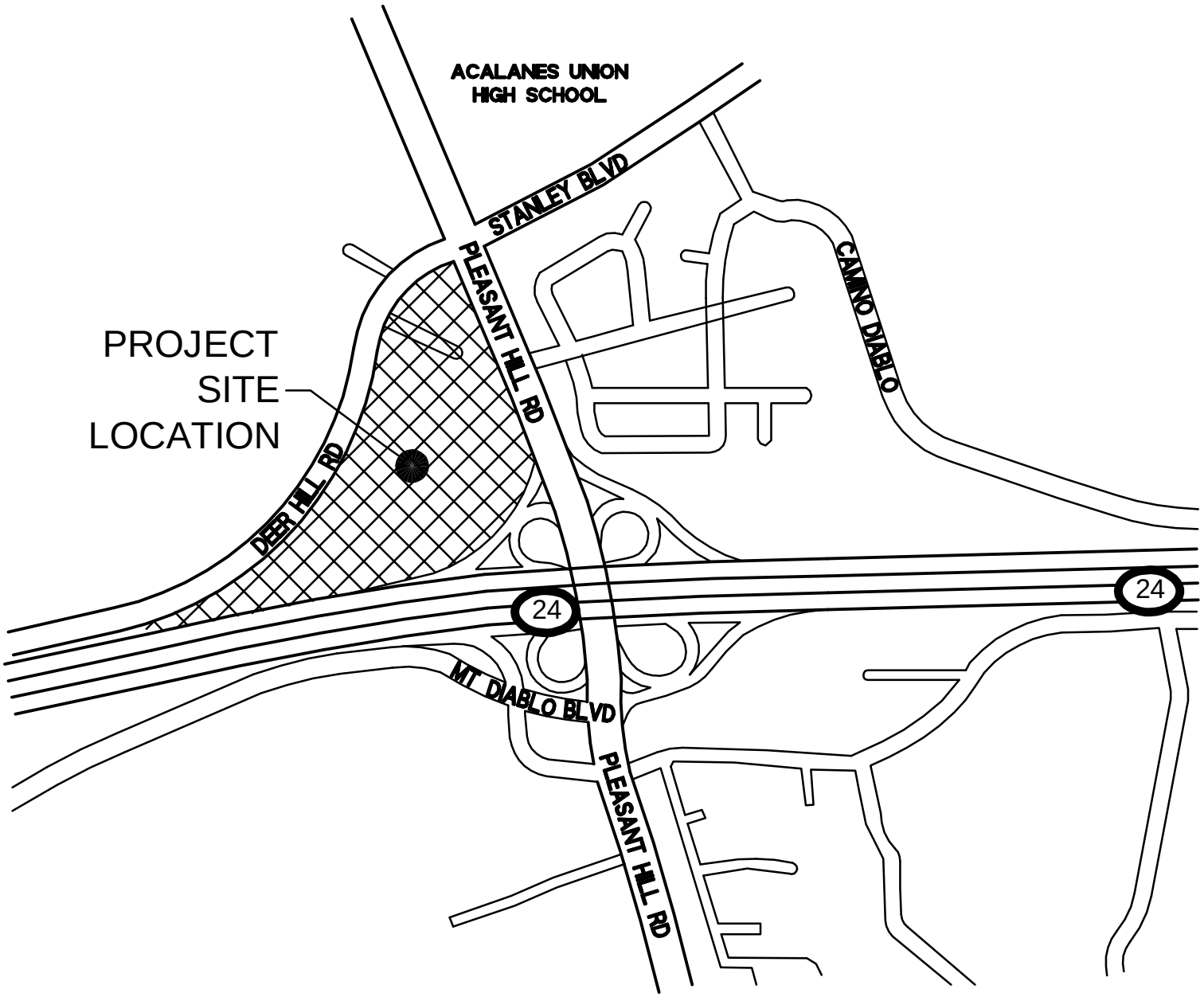
Stormwater Control Plan Reference	BMP Description	Improvement Plan Sheet Number
Draft – N/A	Draft – N/A	Draft – N/A
Storm Drain Inlet	Stencil with "No Dumping" signs.	
Plant Selection	Minimize use of fertilizers and pesticides.	
Final Grading Plan	Grading plan shall conform to delineation of drainage areas in the SWCP.	
Final Drainage Plan	Drainage plan shall conform to SWCP; drainage from impervious areas, including building roofs, is routed to bioretention areas, as shown in SWCP.	

VIII. Owner's Certification

The selection, sizing, and preliminary design of treatment BMP's and other control measures in the plan meet the requirements of Regional Water Quality Control Board Order R2-2003-0022

IX. Hydrograph Modification Compliance

Because this project adds more than 1-acre of impervious area, hydrograph modification compliance is required.



NOT TO SCALE

BKF
ENGINEERS / SURVEYORS / PLANNERS

1646 N. CALIFORNIA BLVD.,
SUITE 400
WALNUT CREEK, CA 94596
PH: (925) 940-2200
FAX: (925) 940-2299

Subject THE TERRACES OF LAFAYETTE
VICINITY MAP

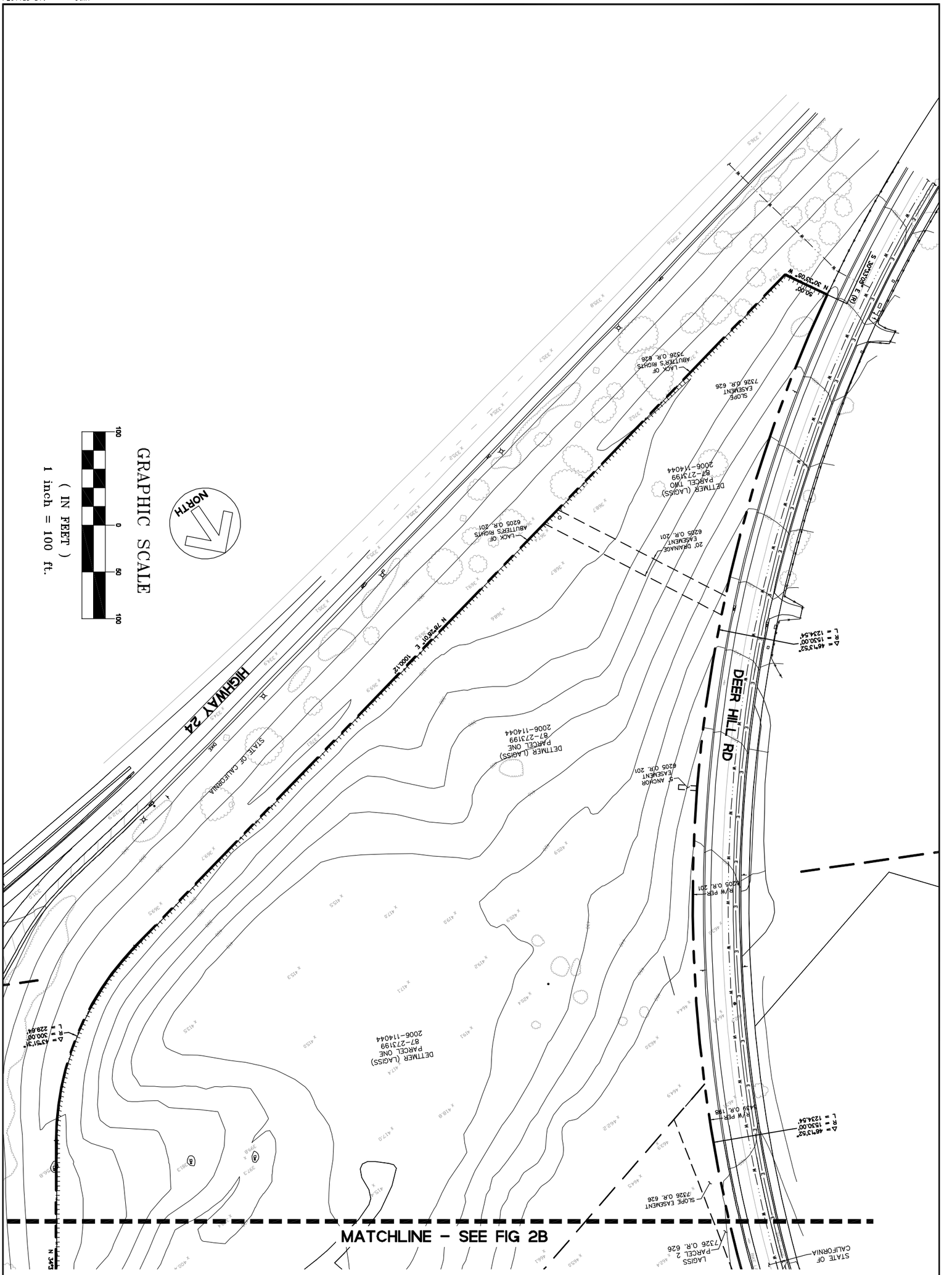
Job No. 20115003

By MM Date 03.21.11 Chkd. KW

SHEET 1 OF 1

DRAWING NAME: K:\Eng11\115003\DWG\EXHIBIT\SMCP EXHIBIT\01-FIGURE.dwg
PLOT TIME: 03-10-11
PLOTTED BY: mena

DRAWING NAME: K:\Eng11\115003\DWG\EXHIBIT\SWCP EXHIBIT\02-FIGURE.dwg
PLOT TIME: 09-23-11
PLOTTED BY: stmi



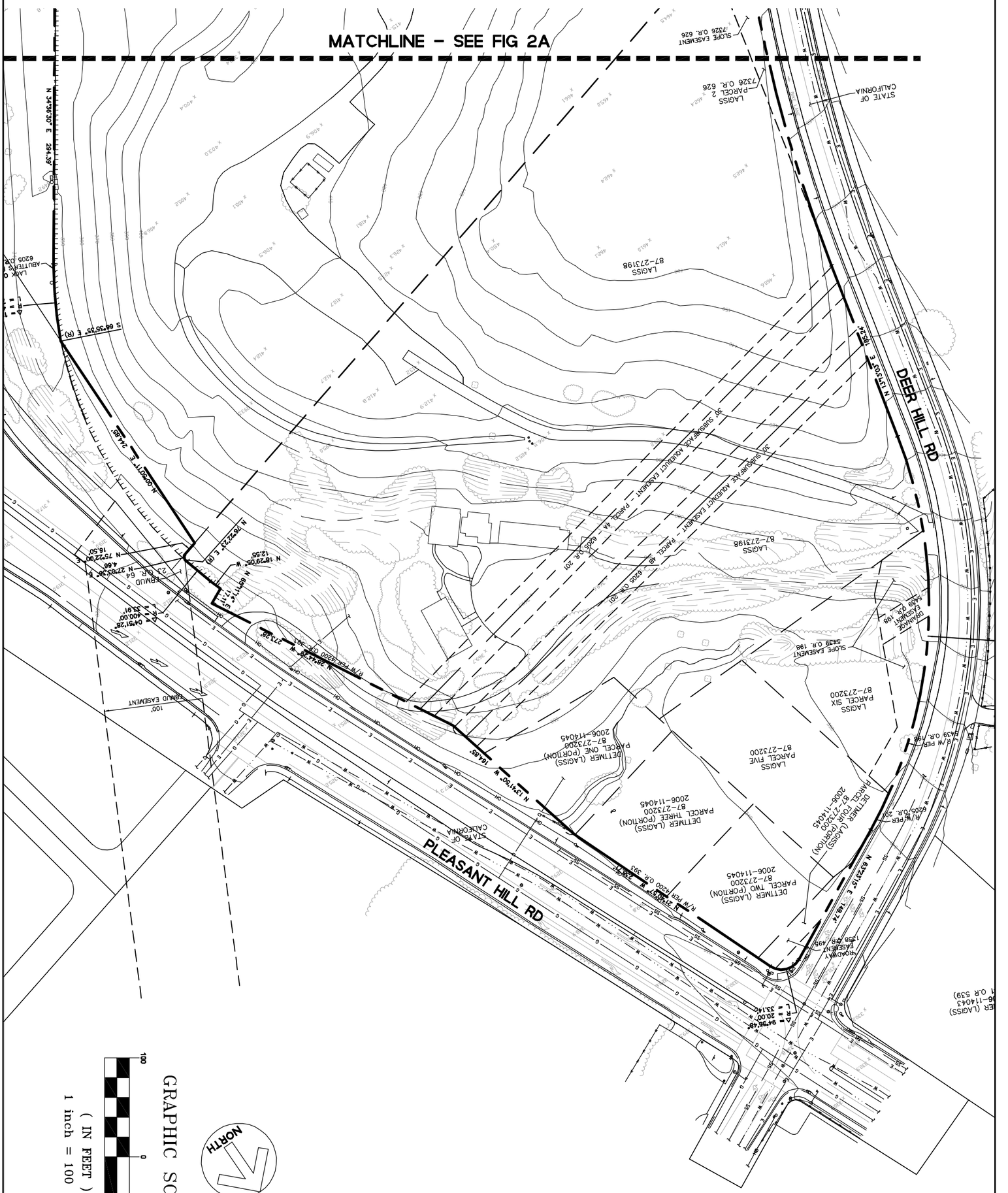
Drawing Number:	Date: 3/21/11	No.	Revisions
FIG 2	Scale: AS SHOWN		
2 OF 7	Design: KW		
	Drawn: MM		
	Approved: CM		
	Job No: 20115003		

THE TERRACES OF LAFAYETTE
FIGURE 2 - EXISTING CONDITIONS

LAFAYETTE CONTRA COSTA COUNTY CA

BKF ENGINEERS / SURVEYORS / PLANNERS
1646 N. CALIFORNIA BLVD., SUITE 400
WALNUT CREEK, CA 94596
PH: (925) 940-2200
FAX: (925) 940-2299

DRAWING NAME: K:\Eng11\115003\DWG\EXHIBIT\SWCP EXHIBIT\02-FIGURE.dwg
PLOT TIME: 09-23-11
PLOTTED BY: stmi



GRAPHIC SCALE
(IN FEET)
1 inch = 100 ft.
100 0 50 100

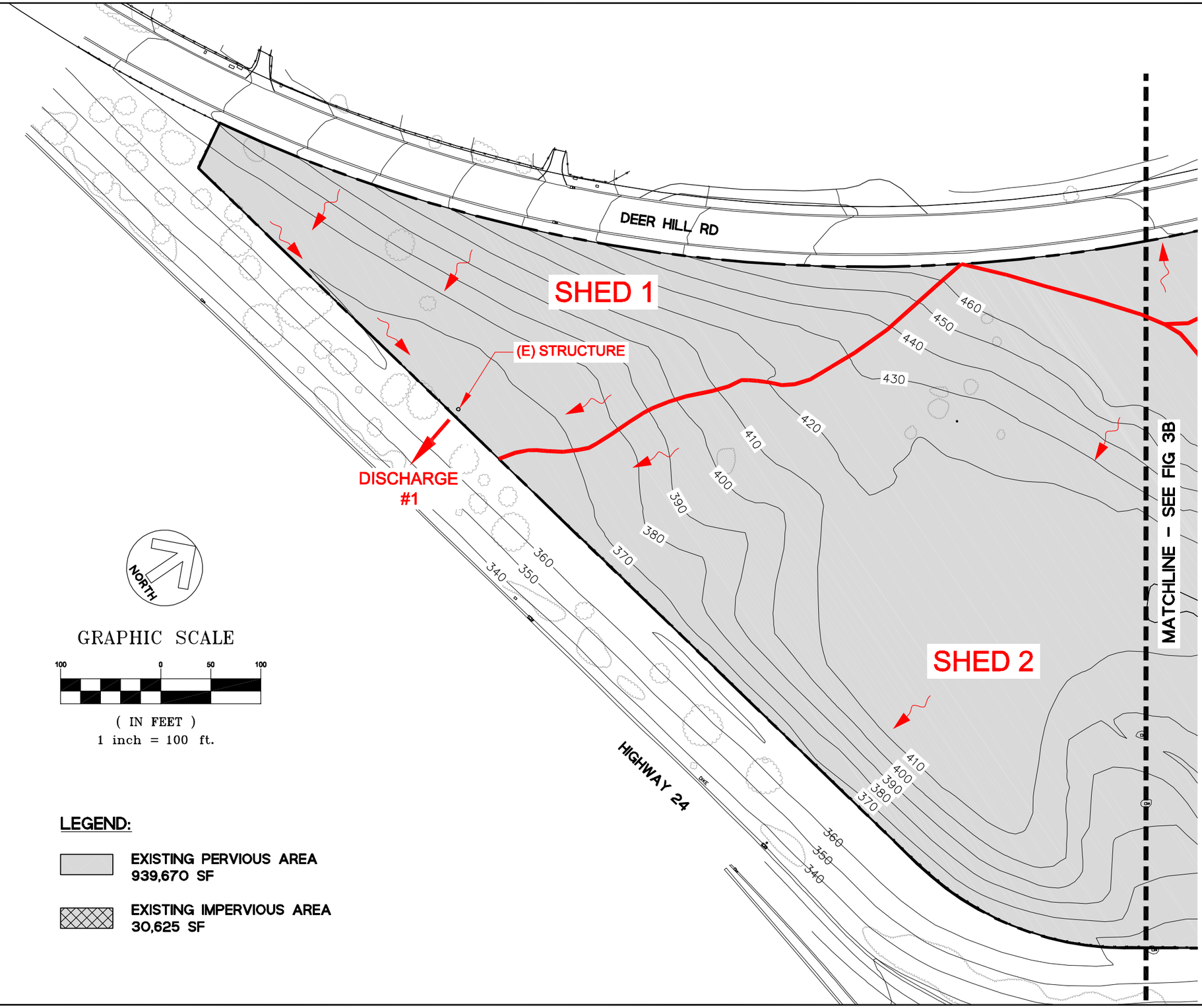
NORTH

Drawing Number:	Date: 3/21/11	No.	Revisions
FIG 2	Scale: AS SHOWN		
3 OF 7	Design: KW		
	Drawn: MM		
	Approved: CM		
	Job No: 20115003		

THE TERRACES OF LAFAYETTE
FIGURE 2 - EXISTING CONDITIONS

LAFAYETTE CONTRA COSTA COUNTY CA

BKF ENGINEERS / SURVEYORS / PLANNERS
1646 N. CALIFORNIA BLVD., SUITE 400
WALNUT CREEK, CA 94596
PH: (925) 940-2200
FAX: (925) 940-2299



NORTH

GRAPHIC SCALE

100 0 50 100

(IN FEET)
1 inch = 100 ft.

LEGEND:

EXISTING PERVIOUS AREA
939,670 SF

EXISTING IMPERVIOUS AREA
30,625 SF

BKF
ENGINEERS / SURVEYORS / PLANNERS
1646 N. CALIFORNIA BLVD., SUITE 400
WALNUT CREEK, CA 94596
PH: (925) 940-2200
FAX: (925) 940-2299

THE TERRACES OF LAFAYETTE

FIGURE 3 – EXISTING IMPERVIOUS/PERVIOUS AREAS

LAFAYETTE CONTRA COSTA COUNTY CA

No.	Revisions

Date: 3/21/11
Scale: AS SHOWN
Design: KW
Drawn: MM
Approved: CM
Job No: 20115003

Drawing Number:
FIG 3
4 OF 7

DRAWING NAME: K:\Eng11\115003\DWG\EXHIBIT\SWCP EXHIBIT\03-FIGURE.dwg
PLOT TIME: 08:45:11
PLOTTED BY: work

DEER HILL RD

SHED 4

SHED 3

MATCHLINE – SEE FIG 3A

EXISTING RESIDENCE

PLEASANT HILL RD

DISCHARGE #4

(E) CULVERT HEADWALL

DISCHARGE #3

(E) STRUCTURE

(E) STRUCTURE

NORTH

GRAPHIC SCALE

100 0 50 100

(IN FEET)
1 inch = 100 ft.

LEGEND:

EXISTING PERVIOUS AREA
939,670 SF

EXISTING IMPERVIOUS AREA
30,625 SF

BKF
ENGINEERS / SURVEYORS / PLANNERS
1646 N. CALIFORNIA BLVD., SUITE 400
WALNUT CREEK, CA 94596
PH: (925) 940-2200
FAX: (925) 940-2299

THE TERRACES OF LAFAYETTE
FIGURE 3 – EXISTING IMPERVIOUS/PERVIOUS AREAS

LAFAYETTE CONTRA COSTA COUNTY CA

No.	Revisions

Date: 3/21/11
Scale: AS SHOWN
Design: KW
Drawn: MM
Approved: CM
Job No: 20115003

Drawing Number:
FIG 3
5 OF 7

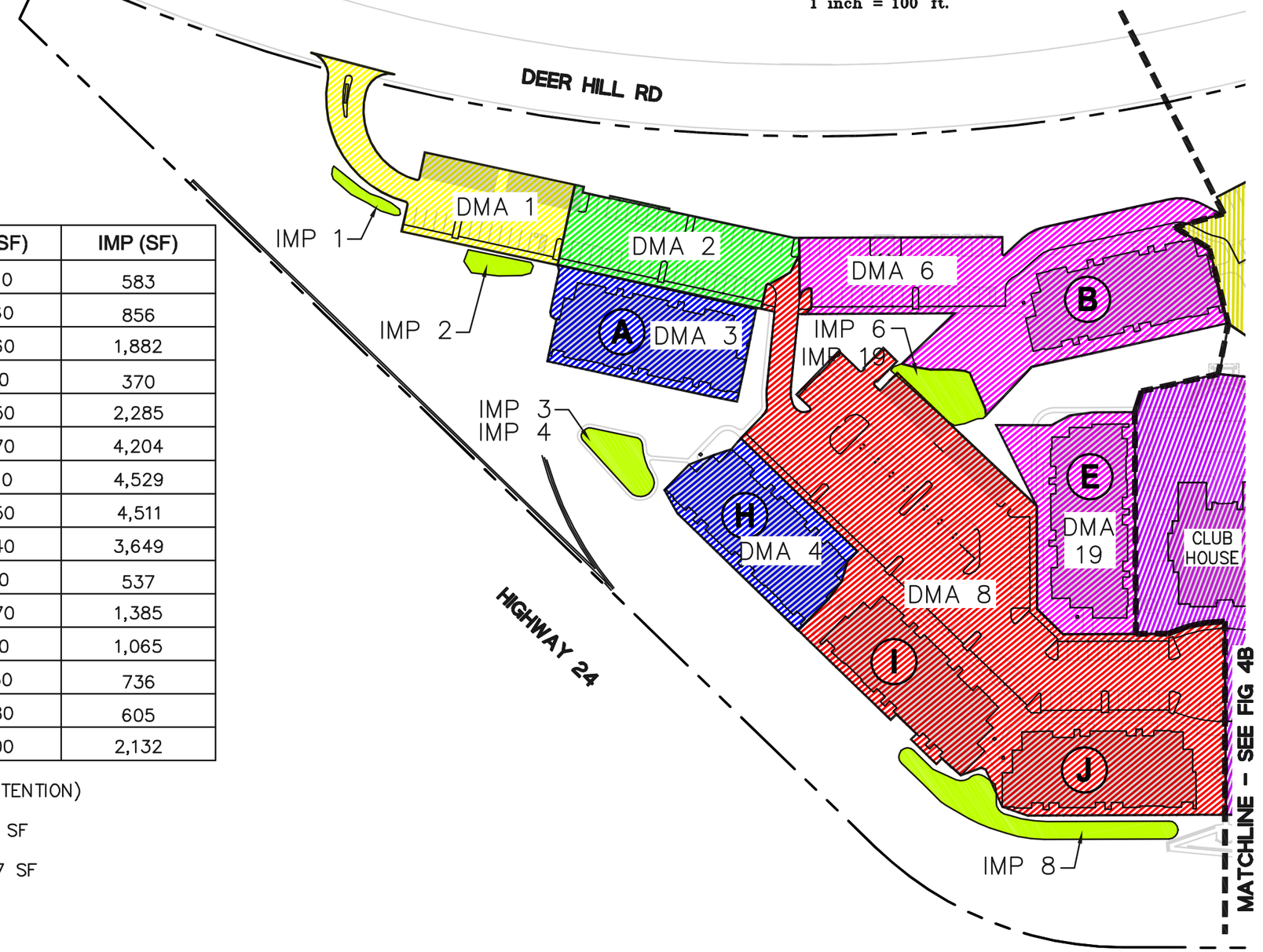
DRAWING NAME: K:\Engl1\Y115003\DWG\EXHIBIT\SWCP EXHIBIT\03-FIGURE.dwg
PLOT TIME/DATE: 03-25-11
PLOTTED BY: work

GRAPHIC SCALE

100 0 50 100

(IN FEET)
1 inch = 100 ft.

NORTH



	DMA #/IMP#	DMA (SF)	IMP (SF)
	1	12,910	583
	2	12,060	856
	3, 4	25,960	1,882
	5	5,720	370
	6,19	50,550	2,285
	7,11,12	68,470	4,204
	8	81,010	4,529
	9	96,050	4,511
	10	32,940	3,649
	13	5,650	537
	14	32,370	1,385
	15	8,990	1,065
	16	12,150	736
	17	12,280	605
	18	17,800	2,132

TREATMENT AREAS (BIORETENTION)

SELF RETAINING – 19,010 SF

SELF TREATING – 453,277 SF

BKF
1646 N. CALIFORNIA BLVD., SUITE 400
WALNUT CREEK, CA 94596
PH: (925) 940-2200
FAX: (925) 940-2299

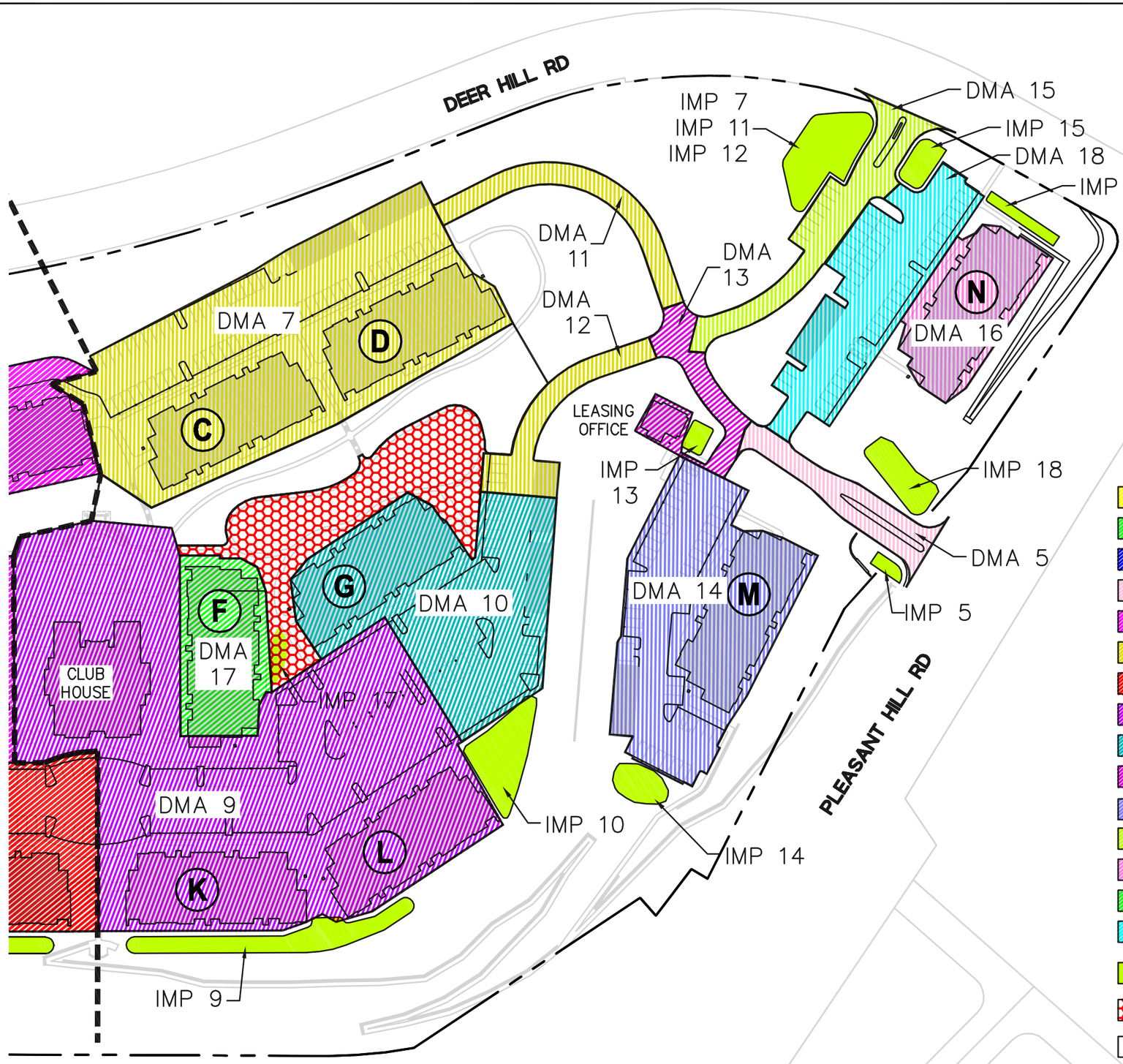
THE TERRACES OF LAFAYETTE
FIGURE 4 – PROPOSED C.3 COMPLIANCE PLAN
LAFAYETTE CONTRA COSTA COUNTY CA

No.	Revisions

DMA'ed: 3/21/11
Scale: AS SHOWN
Design: KW
Drawn: MM
Approved: CM
Job No: 20115003

Drawing Number:
FIG 4A
6 OF 7

DRAWING NAME: K:\Engr\115003\DWG\EXHIBIT\SWMP EXHIBIT\04-FIGURE.dwg
PLOT TIME: Oct 25, 11 8:11am
PLOTTED BY:



GRAPHIC SCALE

100 0 50 100

(IN FEET)
1 inch = 100 ft.

DMA #/IMP#	DMA (SF)	IMP (SF)
1	12,910	583
2	12,060	856
3, 4	25,960	1,882
5	5,720	370
6,19	50,550	2,285
7,11,12	68,470	4,204
8	81,010	4,529
9	96,050	4,511
10	32,940	3,649
13	5,650	537
14	32,370	1,385
15	8,990	1,065
16	12,150	736
17	12,280	605
18	17,800	2,132

TREATMENT AREAS (BIORETENTION)

SELF RETAINING – 19,010 SF

SELF TREATING – 453,277 SF

1646 N. CALIFORNIA BLVD., SUITE 400
WALNUT CREEK, CA 94596
PH: (925) 940-2200
FAX: (925) 940-2299
BKF Engineers | Planners

THE TERRACES OF LAFAYETTE
FIGURE 4 – PROPOSED C.3 COMPLIANCE PLAN
LAFAYETTE CA
CONTRA COSTA COUNTY

No.	Revisions

DMA's: 3/21/11
Scale: AS SHOWN
Design: KW
Drawn: MM
Approved: CM
Job No: 20115003

Drawing Number:
FIG 4B
7 OF 7

DRAWING NAME: K:\Engi1\115003\DWG\EXHIBIT\SWCP EXHIBIT\04-FIGURE.dwg
PLOT DATE: 03-23-11
PLOTTED BY: smi

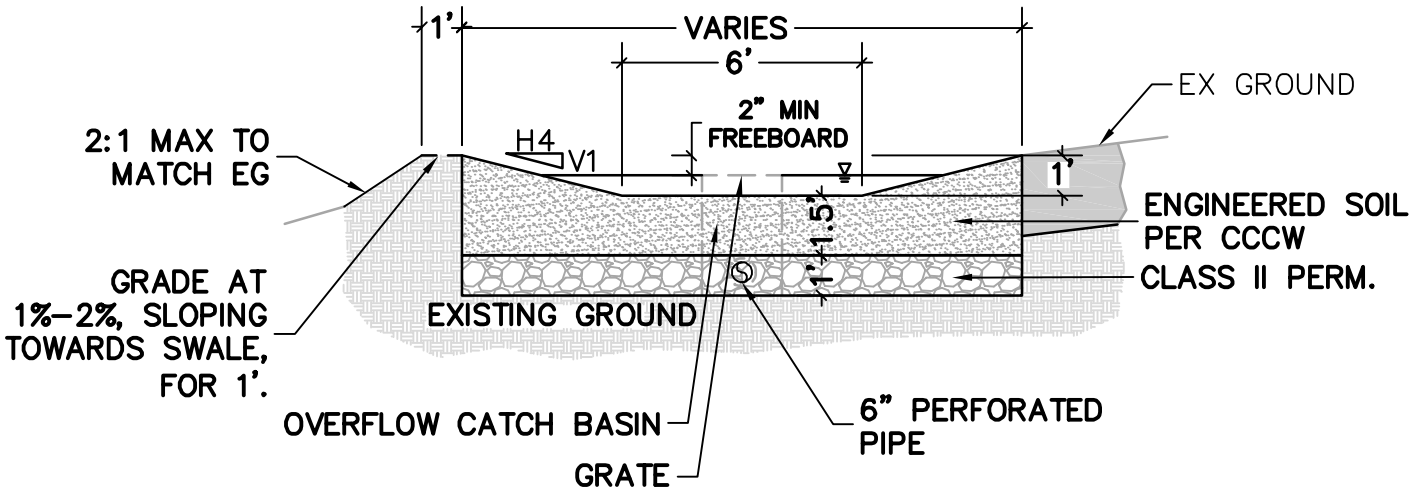


FIGURE 5
BIORETENTION SECTION

BKF ENGINEERS / SURVEYORS / PLANNERS

1646 N. CALIFORNIA BLVD.,
SUITE 400
WALNUT CREEK, CA 94596
PH: (925) 940-2200
FAX: (925) 940-2299

Subject THE TERRACES OF LAFAYETTE
PROPOSED BIORETENTION SECTION
Job No. 20115003
By MM Date 03/21/11 Chkd. KW
SHEET 1 OF 1

Appendix A

PRELIMINARY
GEOTECHNICAL FEASIBILITY

DEER HILL ROAD APARTMENTS
LAFAYETTE, CALIFORNIA

Submitted to:

O'Brien Land Company, LLC
3031 Stanford Ranch Road, Suite 2-310
Rocklin, CA 95765

Prepared by:
ENGEO Incorporated

February 23, 2011
Project No. 9181.000.000

.

- Expect Excellence -

Project No.
9181.000.000

February 23, 2011

Mr. David R. Baker
O'Brien Land Company, LLC
3031 Stanford Ranch Road, Suite 2-310
Rocklin, CA 95765

Subject: Deer Hill Apartments
Deer Hill Road
Lafayette, California

PRELIMINARY GEOTECHNICAL FEASIBILITY REPORT

Dear Mr. Baker:

This preliminary geotechnical feasibility report presents our geologic findings and preliminary geotechnical recommendations for the proposed Deer Hill Road Apartments in Lafayette, California. The purpose of the report is to address basic geotechnical considerations for project development and potential geologic hazards, suitable for submittal with the project map.

If you have any questions or comments regarding this report, please call and we will be glad to discuss them with you.

Sincerely,

ENGEO Incorporated

J. Brooks Ramsdell, CEG
jbr/pjs/dsh/jf:pgex

Daniel S. Haynosch, GE

TABLE OF CONTENTS

1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE

This report presents a summary of geologic constraints and preliminary geotechnical recommendations and mitigation measures for project development. This study included a review of geologic literature and maps, geologic reconnaissance of the site, examination of aerial photographs, collection of four surface samples for evaluation of index soil properties, and preparation of this report. No subsurface investigation was undertaken for the preparation of this report.

The conclusions and recommendations presented in this report are preliminary in nature. This report was prepared for the exclusive use of O'Brien Land Company, LLC and their design team consultants. In the event that any changes are made in the character, design or layout of the development, ENGEO should review the conclusions and recommendations contained in this report to determine whether modifications to the report and related recommendations are necessary. This document may be reproduced in its entirety in the context of preparation of the EIR submittal package. However, it may not be quoted or excerpted without the express written consent of ENGEO Incorporated.

1.2 PROJECT LOCATION AND DESCRIPTION

The project site is located southeast of Deer Hill Road and northwest of the intersection of Pleasant Hill Road and Highway 24 in Lafayette, California (Figure 1). According to the Concept Site Plan prepared by LCA Architects (August 13, 2010), the project site encompasses roughly 22 acres. Cuts and fills related to grading for Deer Hill Road, Highway 24 and a minor quarry operation have altered the original topography of the site. Several existing structures including a residence and maintenance buildings are present in the eastern portion of the site. An existing paved driveway off Deer Hill Road provides access to the residence and existing buildings and an unimproved dirt road provides access to the portions of the site that were quarried in the past.

The current topography of the project site can generally be characterized as four relatively flat-lying areas (terraces) separated by slopes that vary from inclinations of 1.5:1 to 4:1 (horizontal:vertical). The southern terminus of Lafayette Ridge is located just north of Deer Hill Road and the project site. The majority of the site is grass-covered with trees flanking the paved driveway, existing residence and drainage at the eastern portion of the site. Current elevations range from a high of about 463 feet above mean sea level (msl) on the northernmost terrace adjacent to Deer Hill Road to a low of about 330 feet above msl at the drainage near Pleasant Hill Road at the eastern edge of the site. The Mokelumne aqueduct parallels the southeastern and southern project site boundary.

1.3 PROPOSED PROJECT

According to the Concept Site Plan prepared by LCA Architects (August 13, 2010), the proposed development consists of eight apartment buildings with a total of 330 units, swimming pool, public sports fields and associated interior roadways and parking areas. Based on the current concept plans, the proposed sports fields occupy the uppermost terrace adjacent to Deer Hill Road; six of the proposed apartment buildings occupy the larger mid-height terrace; one of the proposed apartment buildings occupies the pad where the existing residence and maintenance buildings are; and one of the proposed buildings occupies the flat area southwest of the intersection of Pleasant Hill Road and Deer Hill Road.

1.4 REGIONAL GEOLOGY AND SEISMICITY

1.4.1 Geologic Setting

The site is located within the Coast Ranges physiographic province at the southern terminus of Lafayette Ridge. The Coast Ranges physiographic province is typified by a system of northwest-trending, fault-bounded mountain ranges and intervening alluviated valleys. Reliez Valley is located east of the site. The valley floor is covered with alluvium derived largely from the surrounding hills, including those on site.

Bedrock in the Coast Ranges consists of igneous, metamorphic and sedimentary rocks that range in age from Jurassic to Pleistocene. The present physiography and geology of the Coast Ranges are the result of deformation and deposition along the tectonic boundary between the North American plate and the Pacific plate. Plate boundary fault movements are largely concentrated along the well-known fault zones, which in the area include the San Andreas, Hayward, and Calaveras faults, as well as other lesser-order faults.

1.4.2 Seismicity

Figure 3 shows the approximate location of active and potentially active faults and significant historic earthquakes mapped within the San Francisco Bay Region. Based on the 2010 USGS Quaternary Fault and Fold Database (QFFD), the nearest active fault is the Northern Calaveras fault located approximately 4.5 miles south of the site. Other active faults located near the site include the Concord-Green Valley fault located approximately 5 miles to the east of the site, and the Hayward fault located approximately 8 miles to the west.

Based on an evaluation of the termination of the northern Calaveras fault by Unruh and Kelson (2002), the Lafayette fault, which is located approximately 200 feet west of the project site, is considered to be a potentially active right-lateral strike-slip fault that is interpreted as one of a series of structures that may accommodate slip on the northern Calaveras fault. According to the State of California, a fault is considered to be "active" if it has had identifiable movement within the last 11,000 years; the time period for a "potentially active fault" is 2 million years. Plate 1 of the Unruh and Kelson report identifies a series of lineations (linear alignments of topographic features seen on aerial photographs) located along the west side of Pleasant Hill Road adjacent to

the project site (Reliez Valley fault) as well as a distinct saddle and tonal lineament located at the westernmost portion of the project site (Figure 6). These lineations are classified by Unruh and Kelson (2002) as "weakly pronounced," "distinct," and "strongly pronounced."

The Uniform California Earthquake Rupture Forecast (UCERF) (2008) evaluated the 30-year probability of a M6.7 or greater earthquake occurring on the known active fault systems in the Bay Area, including the Calaveras fault. The UCERF generated an overall probability of 63 percent for the Bay Area as whole, and a probability of 7 percent for the Calaveras fault, 3 percent for the Concord-Green Valley fault, and 31 percent for the Hayward fault.

1.5 GEOLOGIC MATERIALS

1.5.1 Artificial Fill (Qaf)

There are deposits of fill at the site associated with the existing residence and access road, the previous quarry operation and the grading for Deer Hill Road (Figure 7). With the exception of the fills for Deer Hill Road, it is unlikely that these fill deposits were rigorously compacted. During our site reconnaissance, we observed that the mid-slope, level terrace is blanketed by road grindings. These were likely placed at some point following the quarry operation at the site.

1.5.2 Surficial Soils

As a result of previous site grading and quarrying activities, the majority of the native surficial soils have likely been removed. In some isolated locations, for example, adjacent to the drainage in the northeastern portion of the site, the ground surface is mantled with 1 to 5 feet of residual soil formed from weathering and decomposition of the underlying bedrock or older alluvium. The composition of the residual soils typically varies based on the underlying parent material. On the site, the weathering of the underlying soils and bedrock typically produces a sandy clay soil with a low to moderate shrink swell potential.

Mappable deposits of colluvium (Qc), typically thicker than 5 feet, may be present in the existing southeast-trending swale in the southern portion of the site, and in the swale in the southwestern portion of the site. Colluvium is a soil deposit formed from downslope movement and deposition of residual soil by such processes as slope wash, sloughing/shallow sliding, and creep. Colluvium at the site typically consists of silty to sandy clay with some scattered rock fragments.

1.5.3 Alluvium (Qal)

Soils deposited by stream flow and sheet wash have accumulated adjacent to the southeast-trending drainage in the eastern portion of the site adjacent to Bollinger Canyon Creek. Based on creek bank exposures, the alluvium appears to consist of relatively thick (10 to 30 feet) accumulations of interbedded sand and silty sand-gravel mixtures.

1.5.4 Landslides

Based on landslide mapping by Nilsen (1975) and Haydon (1996), several landslides have been mapped at the site (Figures 4 and 5). Landslide mapping by Haydon (1996) has been incorporated into the General Plan and Zoning Ordinances for the City of Lafayette. Previous grading and quarrying operations at the site have obscured the original topography at the site and have removed portions of the landslides identified on the referenced geologic maps. Figure 7 depicts landslides identified by our geologic mapping and previous mapping at the project site. We have categorized landslides as relatively shallow surficial earthflows and deeper-seated earthflows and rotational slumps. Earthflows on the site typically occur within deposits of colluvium that have accumulated in swale areas. Deep-seated rotational slumps commonly incorporate portions of bedrock. Field exploration for the purpose of determining the presence, absence, depth and extents of landslides that may be present at the site should be part of the design-level exploration for the project.

1.5.5 Late to Middle Miocene Sedimentary Rocks

According to published maps covering the site by Dibblee (2005) and Graymer (1994), the project site is underlain by late to middle Miocene marine sedimentary rock primarily consisting of sandstone. Based on mapping by Dibblee, the site is underlain by marine sandstone, clay shale/ siltstone of the Monterey Formation. According to Graymer, bedrock underlying the majority of the site comprises the Briones Formation (Tbr – Miocene) with Neroly Formation (Tn) underlying the westernmost corner of the project site. At the property, the bedding within the bedrock units generally strikes northwest–southeast and dips moderately towards the southwest. Exposures of this bedrock unit were generally observed to be weak to moderately strong, closely fractured and moderately weathered.

2.0 LABORATORY TESTING

A site reconnaissance was performed by an ENGEO geologist on February 1, 2011. During the site reconnaissance, surface samples of soil and bedrock were collected and tested in our laboratory to determine their engineering characteristics. For this project, we performed the laboratory tests summarized in Table 1 below.

TABLE 1
Summary of Laboratory Testing

Characteristic	Test Method	Location of Results Within this Report
Plasticity Index	ASTM D4318	Appendix A
Hydrometer Analysis	ASTM D422	Appendix A

3.0 CONCLUSION AND RECOMMENDATIONS

Based on the results of our geologic reconnaissance at the site, we conclude that the proposed residential development of the property is feasible provided that the project is appropriately designed for the geologic and geotechnical hazards identified in this report. The proposed improvements should be designed with appropriate mitigations for the geologic hazards discussed below. These project considerations are common to residential and commercial construction projects throughout California. The following sections of this report discuss significant impacts and present geotechnical mitigation measures designed to reduce impacts to less than significant levels.

3.1 GROUND RUPTURE

The site is not located in a State of California Earthquake Fault Zone, and there are no known active faults passing though the project site. The work by Unruh and Kelson (2002) discussed above indicates that the Lafayette and Reliez Valley faults should be considered potentially active. Subsurface fault trenching should be a part of the design-level exploration if proposed building envelopes are in the vicinity of the mapped traces of either of these two faults.

3.2 SEISMIC GROUND SHAKING

An earthquake of moderate to high magnitude generated within the San Francisco Bay Region could cause considerable ground shaking at the site, similar to that which has occurred in the past. To mitigate the shaking effects, all structures should be designed using sound engineering judgment and the 2007 California Building Code (CBC) requirements, as a minimum. Seismic design provisions of current building codes generally prescribe minimum lateral forces, applied statically to the structure, combined with the gravity forces of dead-and-live loads. The code-prescribed lateral forces are generally considered to be substantially smaller than the comparable forces that would be associated with a major earthquake. Therefore, structures should be able to: (1) resist minor earthquakes without damage, (2) resist moderate earthquakes without structural damage but with some nonstructural damage, and (3) resist major earthquakes without collapse but with some structural as well as nonstructural damage. Conformance to the current building code recommendations does not constitute any kind of guarantee that significant structural damage would not occur in the event of a maximum magnitude earthquake; however, it is reasonable to expect that a well-designed and well-constructed structure will not collapse or cause loss of life in a major earthquake (SEAOC, 1996).

3.3 LIQUEFACTION, LATERAL SPREADING, AND GROUND LURCHING

Liquefaction is a phenomenon in which saturated cohesionless soils are subject to a temporary loss of shear strength because of pore pressure buildup under the cyclic shear stresses associated with earthquakes. Lateral spreading is a failure within a nearly horizontal soil zone, commonly associated with liquefaction, which causes the overlying soil mass to move towards a free face or down a gentle slope. Ground lurching can occur in soft, saturated clays and silts that are subjected to strong ground shaking during earthquakes. According to the USGS Liquefaction

Susceptibility map for the central San Francisco Bay Region (2006), the northeastern portion of the site just southwest of the intersection of Pleasant Hill Road and Deer Hill Road is considered to have moderate liquefaction susceptibility. The potential for liquefaction in this area should be assessed during a design-level exploration.

3.4 LANDSLIDES

As depicted on Figures 4, 5 and 7, a number of landslides have been identified on the project site. Landslide movement can be triggered by changes in groundwater elevation due to rainfall, saturation by leaking utilities or impounded water, stream incision, man-made excavations and fill placement, as well as by seismic ground shaking. Landslide movement can cause large vertical and horizontal ground movements, ground warping and bulging, displacement of large masses of debris from slopes onto roads and structures, and blocking of stream courses. Landslides at the site can be mitigated by a combination of the following measures:

- Landslide avoidance
- Partial landslide debris removal and buttressing with engineered fill
- Complete landslide debris removal and replacement as engineered fill

The presence or absence of the landslides previously mapped at the site should be evaluated during a design-level exploration of the project site. Detailed site-specific corrective grading plans and landslide mitigation measures should be prepared during review of the final 40-scale grading plans. It is important to note that to preserve the natural topography, wildlife habitat, and vegetation of the site, stabilization of slide masses is planned only for slides that directly threaten the proposed improvements.

3.5 SLOPE STABILITY

Graded slopes proposed for the project could be subject to slope stability issues related to natural soil and groundwater conditions in cut slopes and in foundation soils below fills. The stability of graded slopes is also affected by construction methods such as slope inclination, fill compaction and the adequacy of subsurface drainage systems. Seismic ground shaking can result in lateral and vertical deformation of graded slopes.

Based on the performance of existing slopes and on our experience in the Lafayette area, we recommend that graded cut and fill slopes within the project be inclined no steeper than 2:1 (horizontal:vertical). Cut or fill slopes 30 feet high or greater, inclined steeper than 3:1 should be provided with drainage benches at 30-foot maximum vertical intervals.

As project planning proceeds, it will be necessary to perform detailed, site-specific analyses for proposed graded slopes and to provide detailed recommendations and corrective grading plans that will depict specific geotechnical design measures based on the final project grading plans.

Graded slopes constructed for this project will be required to meet standards of slope stability that are appropriate for residential construction. Standards for Contra Costa County and for

Northern California typically require that all graded slopes have a minimum factor of safety of 1.5 for static conditions and 1.1 for seismic loading conditions.

3.6 EXPANSIVE SOILS

An important geotechnical consideration is the potentially expansive nature of the native soil and bedrock across the proposed development area. Based on lab testing, the soils and bedrock units at the project site have PIs that range between 6 and 23. This is indicative of low to moderate plasticity and moderate expansion potential. Expansive soils shrink and swell as a result of seasonal fluctuation in moisture content. This can cause heaving and cracking of slabs-on-grade, pavements, and structures founded on shallow foundations. Building damage due to volume changes associated with expansive soils can be reduced through proper foundation design.

Successful construction on expansive soils requires special attention during construction. It is imperative that exposed soils be kept moist by watering for several days before placement of concrete. It is extremely difficult to remoisturize clayey soils without excavation, moisture conditioning, and recompaction.

3.7 EXISTING FILLS

As shown on Figure 7, existing fills are present on site associated with previous grading and quarrying activities at the site. Common mitigation techniques for non-engineered fills, if within or at the margin of the grading limits, include removal and replacement as engineered fill, provided the material is deemed suitable for reuse by the Geotechnical Engineer at the time of grading. We do not anticipate the material will be unsuitable for reuse. We also anticipate that the road grindings present at the site should be suitable for reuse provided they are placed as engineered fill within paved areas.

4.0 LIMITATIONS AND UNIFORMITY OF CONDITIONS

This report presents preliminary geotechnical recommendations for planning purposes. If changes occur in the nature or design of the project, we should be allowed to review this report and provide additional recommendations, if any. It is the responsibility of the owner to transmit the information and recommendations of this report to the appropriate organizations or people involved in design of the project, including but not limited to developers, owners, buyers, architects, engineers, and designers. The conclusions and recommendations contained in this report are solely professional opinions and are valid for a period of no more than 2 years from the date of report issuance.

We strived to perform our professional services in accordance with generally accepted geotechnical engineering principles and practices currently employed in the area; no warranty is expressed or implied. There are risks of earth movement and property damages inherent in building on or with earth materials. We are unable to eliminate all risks or provide insurance; therefore, we are unable to guarantee or warrant the results of our services.

This report is based upon field and other conditions discovered at the time of report preparation. We developed this report with no subsurface exploration data. Considering possible underground variability of soil, rock, stockpiled material, and groundwater, additional costs may be required to complete the project. We recommend that the owner establish a contingency fund to cover such costs. If unexpected conditions are encountered, notify ENGEO immediately to review these conditions and provide additional and/or modified recommendations, as necessary.

This document must not be subject to unauthorized reuse, that is, reusing without written authorization of ENGEO. Such authorization is essential because it requires ENGEO to evaluate the document's applicability given new circumstances, not the least of which is passage of time.

Actual field or other conditions will necessitate clarifications, adjustments, modifications or other changes to ENGEO's documents. Therefore, ENGEO must be engaged to prepare the necessary clarifications, adjustments, modifications or other changes before construction activities commence or further activity proceeds. If ENGEO's scope of services does not include onsite construction observation, or if other persons or entities are retained to provide such services, ENGEO cannot be held responsible for any or all claims arising from or resulting from the performance of such services by other persons or entities, and from any or all claims arising from or resulting from clarifications, adjustments, modifications, discrepancies or other changes necessary to reflect changed field or other conditions.

REFERENCES

Dibblee, T. W., Jr., 2005, Geologic Map of the Walnut Creek Quadrangle, Alameda and Contra Costa Counties, California, DF 149, 2005.

Graymer, R.W., et al.; 1999, Preliminary Geologic Map Emphasizing Bedrock Formations in Contra Costa County, California, USGS, Open File Report 94-82.

Haydon, W.D., 1995, Landslide Hazards in the Martinez-Orinda-Walnut Creek, Landslide Hazard Identification Map No. 32, DMG Open File Report 95-12

Nilsen, T. H., 1975, Preliminary Photointerpretation Map of Landslide and Other Surficial Deposits of the Walnut Creek 7½' Quadrangle, Contra Costa County, California, USGS 75-277-55.

Pacific Aerial Surveys; 1928, flight C165 B-18 and B-17

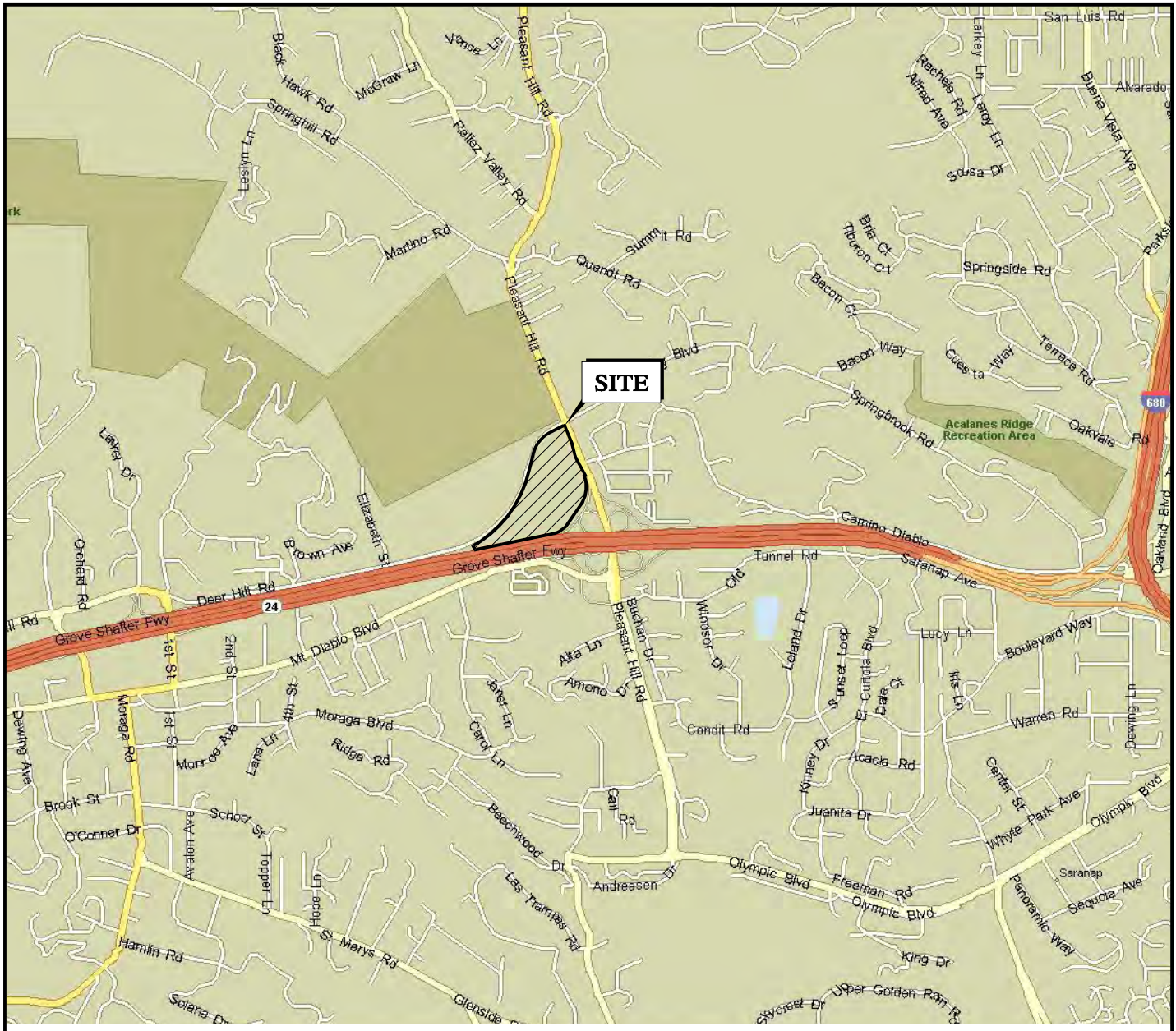
Pacific Aerial Surveys; Various Years and Flight Lines with Stereo Coverage of Site

Unruh, J. R., and Kelson, K. I., 2002, Critical Evaluation of the Northern Termination of the Calaveras Fault, Eastern San Francisco Bay Area, California, Final Technical Report for the U.S. Geological Survey, National Earthquake Hazards Reduction Program, Project No. 1430.

Witter C.W., Knudsen K.L., et al., 2006, Map of Quaternary Deposits and Liquefaction Susceptibility in the Central San Francisco Bay Region, USGS Open File Report 06-1037, 2006

2007 Working Group on California Earthquake Probabilities, 2008, The Uniform California Earthquake Rupture Forecast, Version 2 (UCERF 2): U.S. Geological Survey Open-File Report 2007-1437 and California Geological Survey Special Report 203 [http://pubs.usgs.gov/of/2007/1437/].

FIGURES

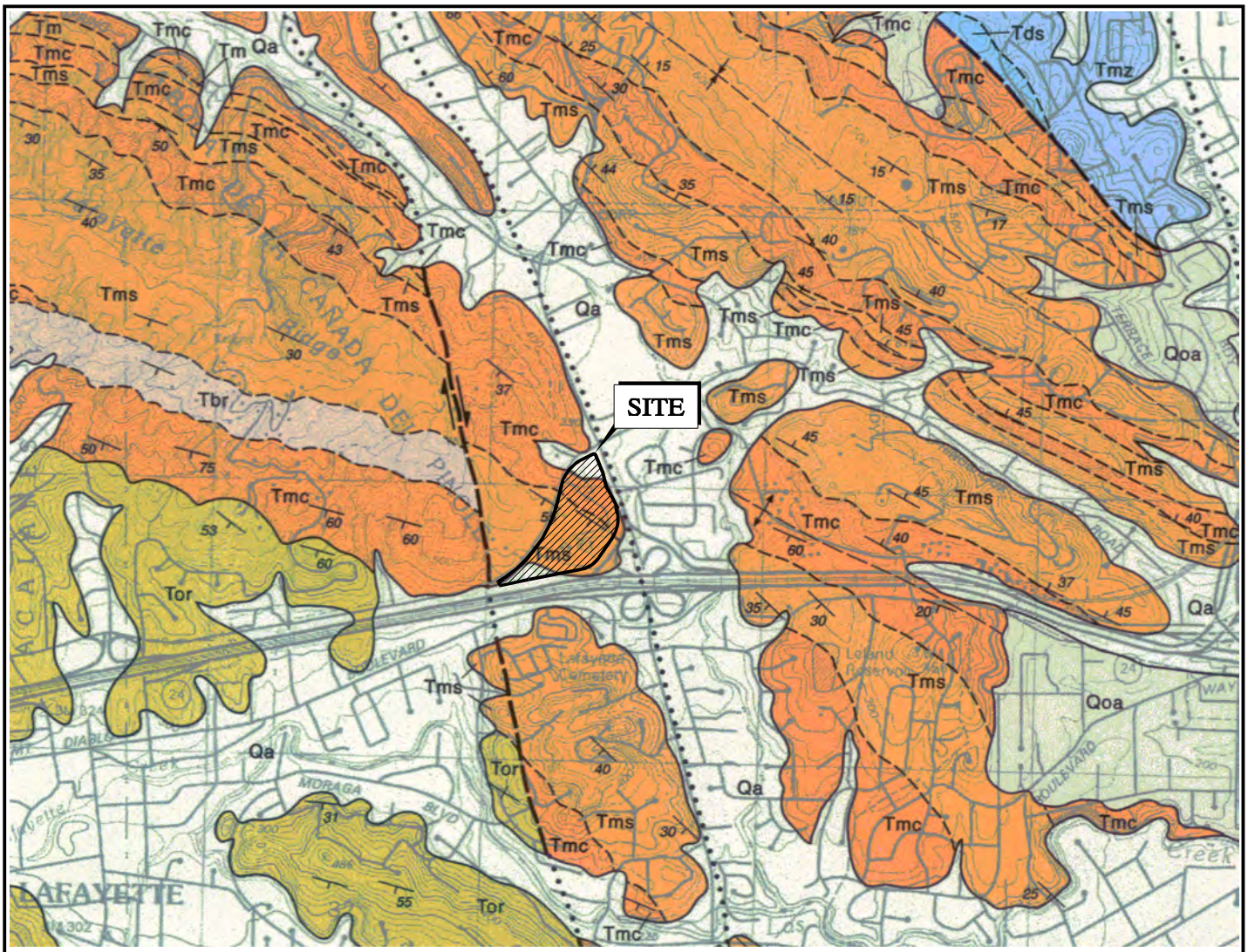


BASE MAP SOURCE: MS STREETS AND TRIPS

ENGEO Expect Excellence	VICINITY MAP DEER HILL ROAD APARTMENTS LAYAYETTE, CALIFORNIA	PROJECT NO.: 9181.000.000 SCALE: AS SHOWN DRAWN BY: PC CHECKED BY: PJS	FIGURE NO. 1

G:\Drafting\DRAFTING2_Dwg\9181\000\GEX\9181000000-GEX-1-VicMap-0211.dwg Plot Date: 2-22-11 spatters

ORIGINAL FIGURE PRINTED IN COLOR



EXPLANATION

BEDROCK CONTACT-DASHED WHERE GRADATIONAL OR APPROXIMATELY LOCATED

FAULT-DASHED WHERE INFERRED, DOTTED WHERE CONCEALED, QUERIED WHERE EXISTENCE IS DOUBTFUL; DOUBLE ARROWS INDICATE STRIKE-SLIP MOVEMENT

AXIS OF FOLD

ANTICLINE SYNCLINE

STRIKE AND DIP OF STRATA

INCLINED VERTICAL OVERTURNED

Qa	ALLUVIAL GRAVEL
Qoa	ALLUVIAL GRAVEL (OLDER)
Tor	PEBBLE CONGLOMERATE (ORINDA FORMATION)
Tbr	SANDSTONE (BRIONES)
Tms	SANDSTONE (MONTEREY FORMATION)
Tmc	CLAYSTONE (MONTEREY FORMATION)
Tds	DOMENGENE SANDSTONE
Tmz	MARTINEZ FORMATION

N

0 FEET 2000

0 METERS 1000

BASE MAP SOURCE: DIBBLEE, 2005

ENGEO Expect Excellence

REGIONAL GEOLOGIC MAP

DEER HILL ROAD APARTMENTS

LAFAYETTE, CALIFORNIA

PROJECT NO.: 9181.000.000

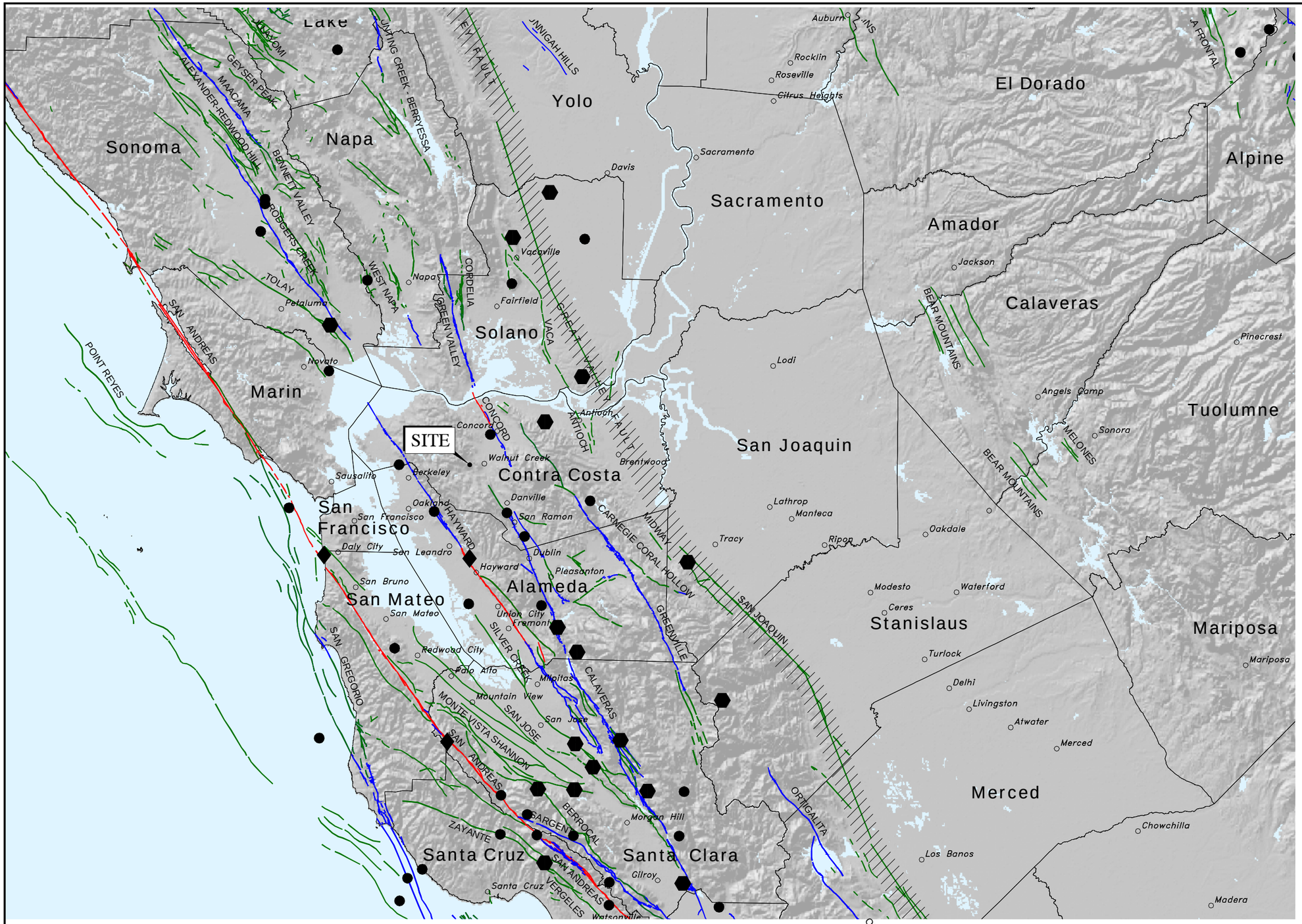
SCALE: AS SHOWN

DRAWN BY: PC CHECKED BY: PJS

FIGURE NO. 2

G:\Drafting\DRAFTING2_Dwg\9181\000\GEX\9181000000-GEX-2-RegGeoMap-Dibblee-0211.dwg Plot Date: 2-22-11 spatters

ORIGINAL FIGURE PRINTED IN COLOR



EXPLANATION

- MAGNITUDE 7+
- MAGNITUDE 6-7
- MAGNITUDE 5-6
- HISTORIC FAULT
- HOLOCENE FAULT
- QUATERNARY FAULT
- HISTORIC BLIND THRUST FAULT ZONE

BASE MAP SOURCE:
U.S.G.S. 1-ARC SECOND S.R.T.M. DATABASE
U.S.G.S. QUATERNARY FAULT DATABASE, MARCH, 2006
U.S.G.S. HISTORIC EARTHQUAKE DATABASE (1800-2000)

ENGEO Expect Excellence

REGIONAL FAULTING AND SEISMICITY

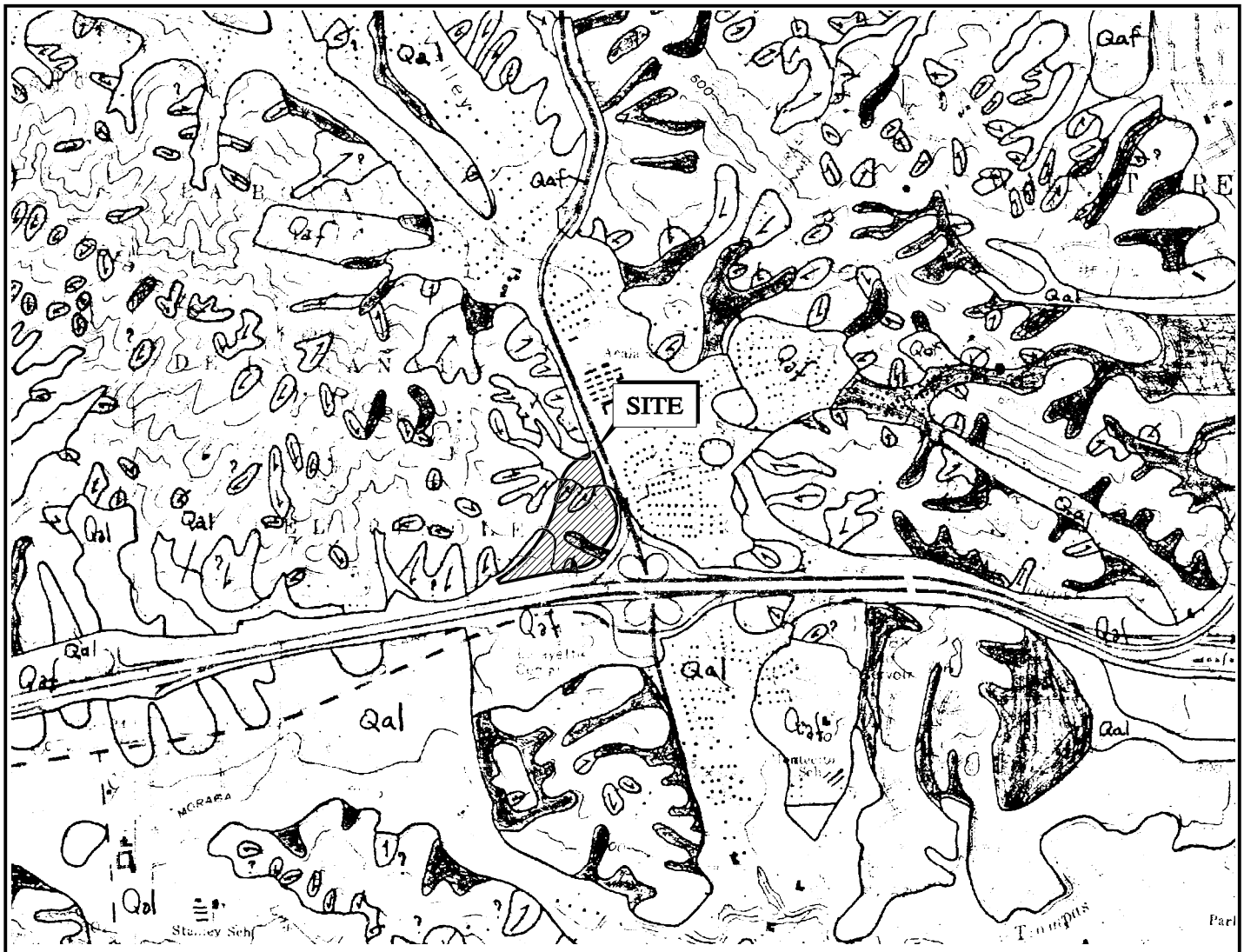
DEER HILL ROAD APARTMENTS

LAYAYETTE, CALIFORNIA

PROJECT NO.: 9181.000.000		FIGURE NO 3
SCALE: AS SHOWN		
DRAWN BY: PC	CHECKED BY: PJS	

G:\Drafting\DRAFTING2_Dwg\9181\000\GEX\9181000000-GEX-3-RegFaultSeismic-0211.dwg Plot Date: 2-22-11 spatters

ORIGINAL FIGURE PRINTED IN COLOR



N

0 FEET 2000

0 METERS 1000

EXPLANATION

- LANDSLIDE DEPOSIT. ARROWS INDICATE GENERAL DIRECTION OF DOWNSLOPE MOVEMENT. QUERIED WHERE UNCERTAIN
- Qal — ALLUVIAL DEPOSIT
- Qt — ALLUVIAL TERRACE DEPOSIT. QUERIED WHERE UNCERTAIN
- COLLUVIAL DEPOSIT AND/OR SMALL ALLUVIAL FAN DEPOSIT
- Qaf — ARTIFICIAL FILL
- BEDROCK. QUERIED WHERE IDENTIFICATION UNCERTAIN

BASE MAP SOURCE: NILSEN, 1975

ENGEO Expect Excellence

REGIONAL LANDSLIDE MAP - NILSEN

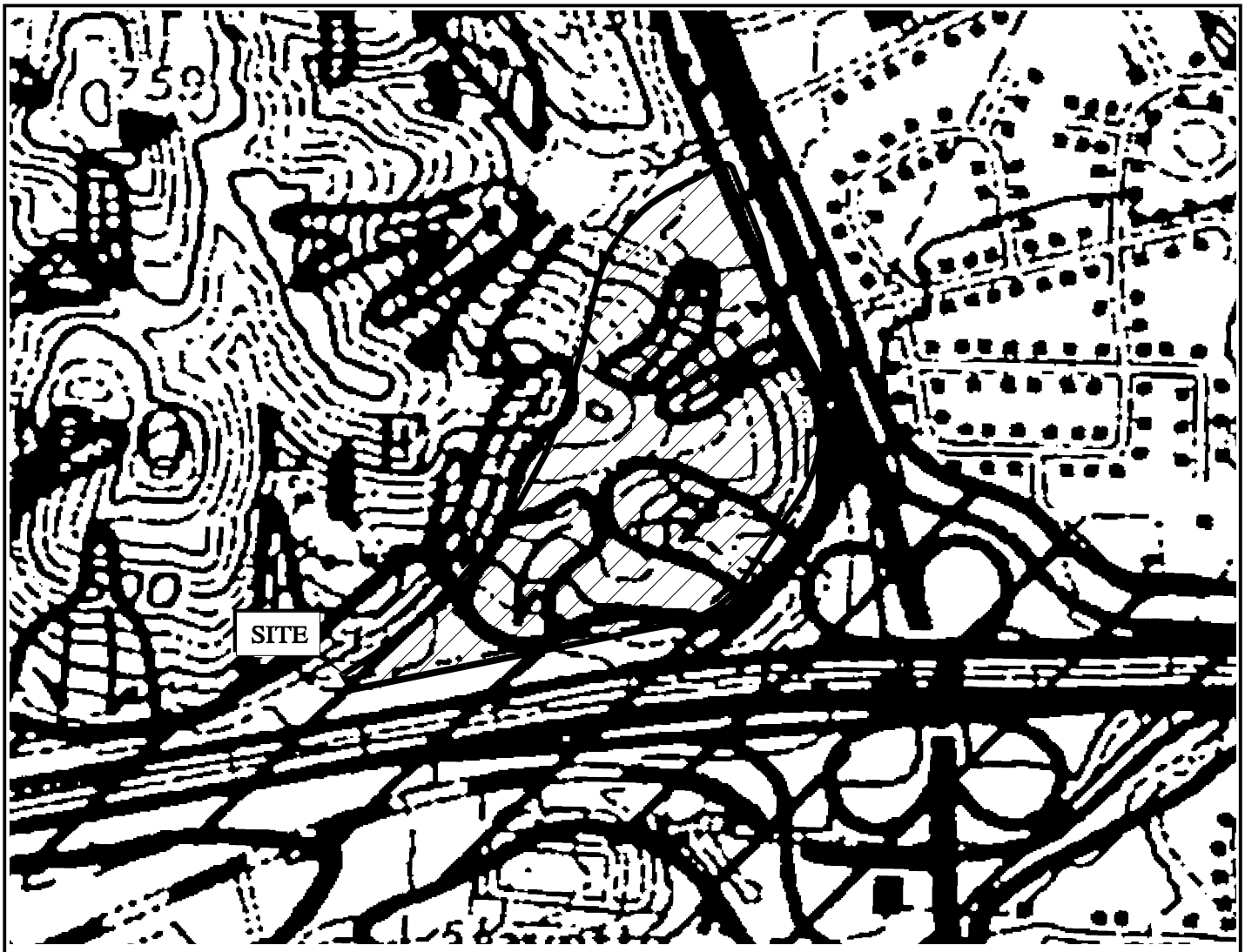
DEER HILL ROAD APARTMENTS

LAFAYETTE, CALIFORNIA

PROJECT NO.: 9181.000.000		FIGURE NO. 4
SCALE: AS SHOWN		
DRAWN BY: PC	CHECKED BY: PJS	

G:\Drafting\DRAFTING2_Dwg\9181\000\GEX\9181000000-GEX-4-RegLandslideMap-Nilsen-0211.dwg Plot Date: 2-22-11 spatters

ORIGINAL FIGURE PRINTED IN COLOR



N

EXPLANATION

DEFINITE OR PROBABLE LANDSLIDE

AREAS NOT CLASSIFIED

0 FEET 2000

0 METERS 1000

BASE MAP SOURCE: HAYDEN, 1995

ENGEO Expect Excellence

REGIONAL LANDSLIDE MAP - HAYDEN

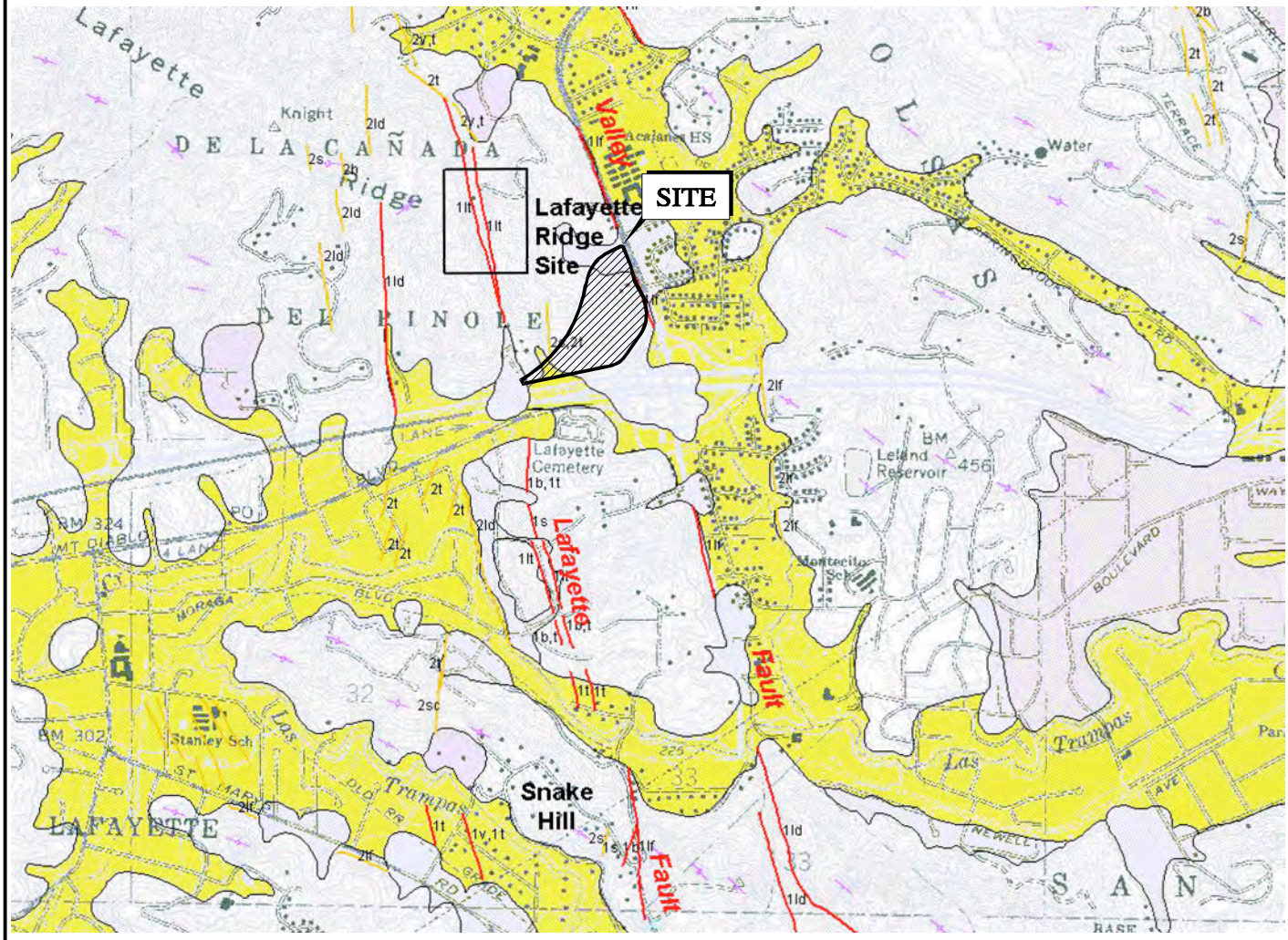
DEER HILL ROAD APARTMENTS

LAFAYETTE, CALIFORNIA

PROJECT NO.: 9181.000.000		FIGURE NO. 5
SCALE: AS SHOWN		
DRAWN BY: PC	CHECKED BY: PJS	

G:\Drafting\DRAFTING2_Dwg\9181\000\GEX\9181000000-GEX-5-RegLandslideMap-Hayden-0211.dwg Plot Date: 2-22-11 spatters

ORIGINAL FIGURE PRINTED IN COLOR



EXPLANATION

- Bedding orientation
- Bedding orientation; vertical or undetermined
- Spring

FAULT-RELATED GEOMORPHIC FEATURES

- Strongly pronounced
- Distinct
- Weakly pronounced

SURFICIAL DEPOSITS

- Qha
- Qhf
- Qht
- Qls
- Qoa
- Qof
- Bedrock

N

0 FEET 2000

0 METERS 1000

BASE MAP SOURCE: LETTIS CALAVERAS REPORT, 2002

ENGEO Expect Excellence

LINEAMENT AND SURFICIAL DEPOSIT MAP

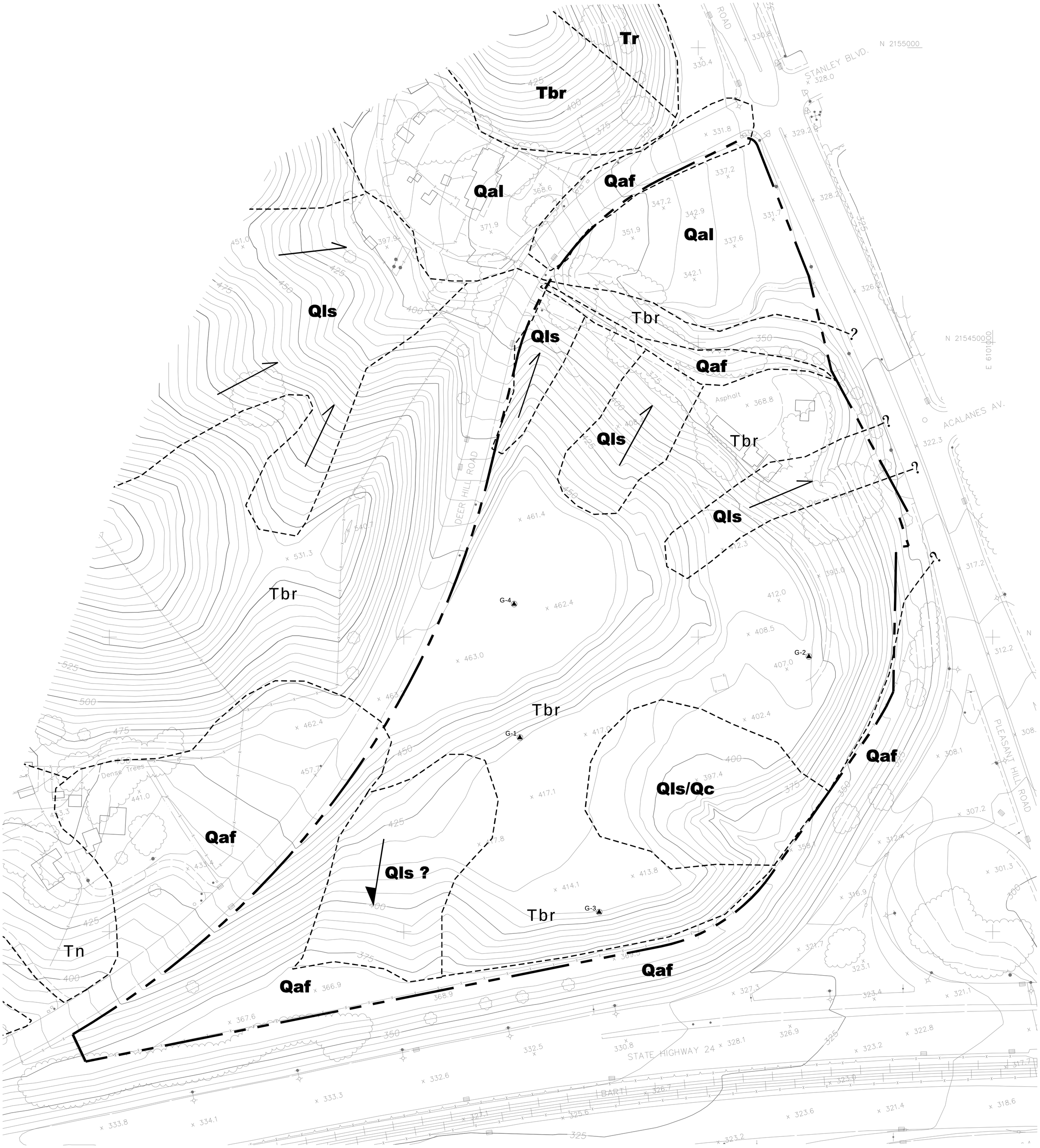
DEER HILL ROAD APARTMENTS

LAFAYETTE, CALIFORNIA

PROJECT NO.: 9181.000.000		FIGURE NO. 6
SCALE: AS SHOWN		
DRAWN BY: PC	CHECKED BY: PJS	

G:\Drafting\DRAFTING2_Dwg\9181\000\GEX\9181000000-GEX-6-LineamentSurficialMap-0211.dwg Plot Date: 2-22-11 spatters

ORIGINAL FIGURE PRINTED IN COLOR



EXPLANATION

G-4 ▲ APPROXIMATE LOCATION OF GRAB SAMPLE

Qaf FILL

Qls LANDSLIDES — EARTHFLOW; DEEP-SEATED

Qc COLLUVIUM
Tr RODEO SHALE
Tbr BRIONES SANDSTONE
Tn NEROLY FORMATION

N

0 FEET 80
0 METERS 40

BASE MAP SOURCE: UNKNOWN

ENGEO Expect Excellence

SITE GEOLOGIC MAP
DEER HILL ROAD APARTMENTS
LAFAYETTE, CALIFORNIA

PROJECT NO.: 9181.000.000 | FIGURE NO. 7
SCALE: AS SHOWN
DRAWN BY: PC | CHECKED BY: PJS

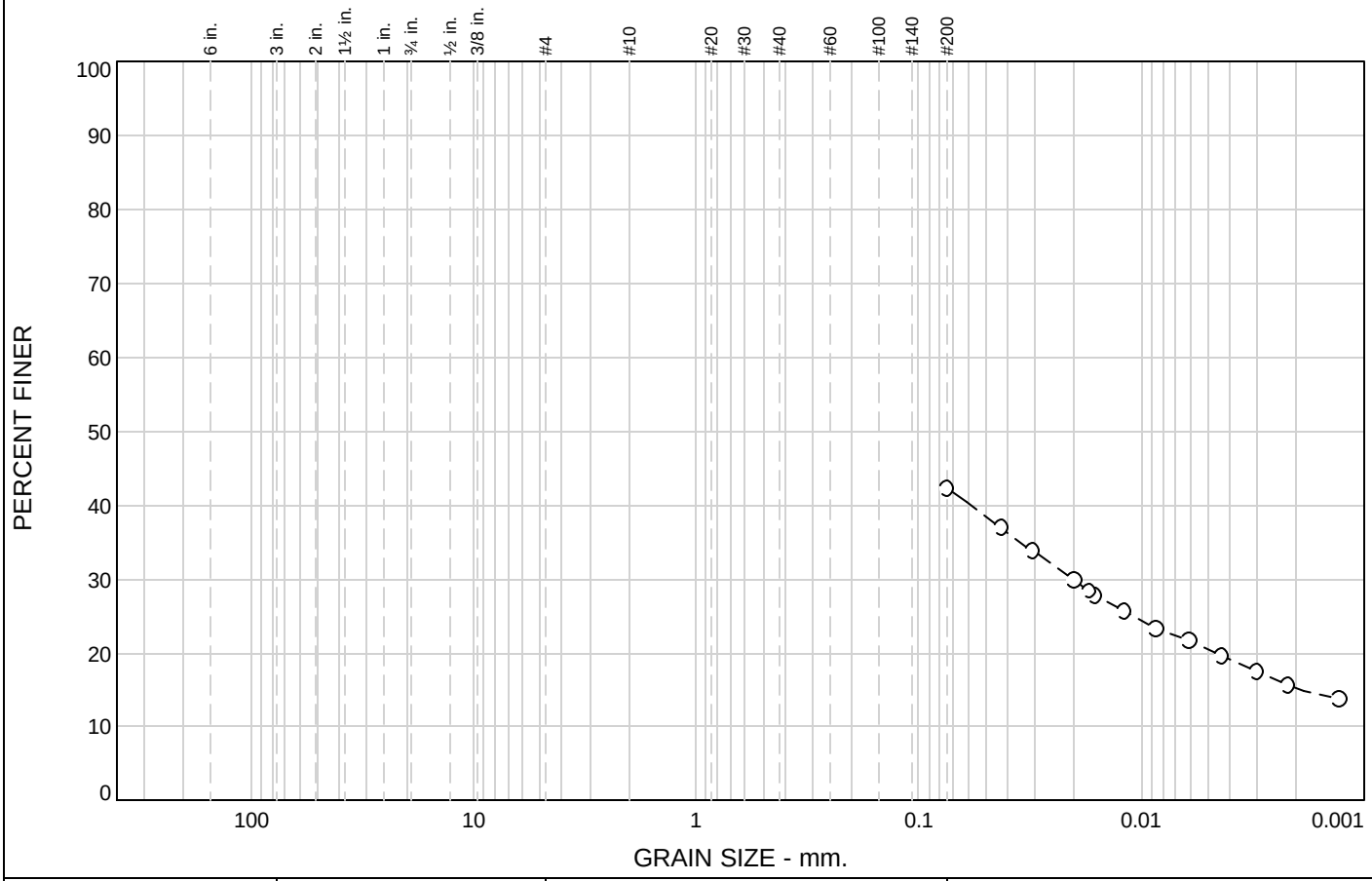
ORIGINAL FIGURE PRINTED IN COLOR

G:\Drafting\DRAFTING2_Dwg\9181\000\GEX\9181000000-GEX-7-SiteGeoMap-0211.dwg Plot Date: 2-22-11 spatters

APPENDIX A

Laboratory Testing

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						27.0	15.3

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	42.3		
0.0429 mm.	37.0		
0.0310 mm.	33.9		
0.0202 mm.	29.8		
0.0172 mm.	28.4		
0.0162 mm.	27.8		
0.0120 mm.	25.7		
0.0086 mm.	23.3		
0.0061 mm.	21.8		
0.0044 mm.	19.7		
0.0030 mm.	17.6		
0.0022 mm.	15.7		
0.0013 mm.	13.8		

* (no specification provided)

Soil Description

Light yellowish brown silty SANDSTONE.

Atterberg Limits

PL= 28 LL= 34 PI= 6

Coefficients

D_{85}= D_{60}= D_{50}=
D_{30}= 0.0207 D_{15}= 0.0019 D_{10}=
C_u= C_c=

Classification

USCS= SM AASHTO= A-4(0)

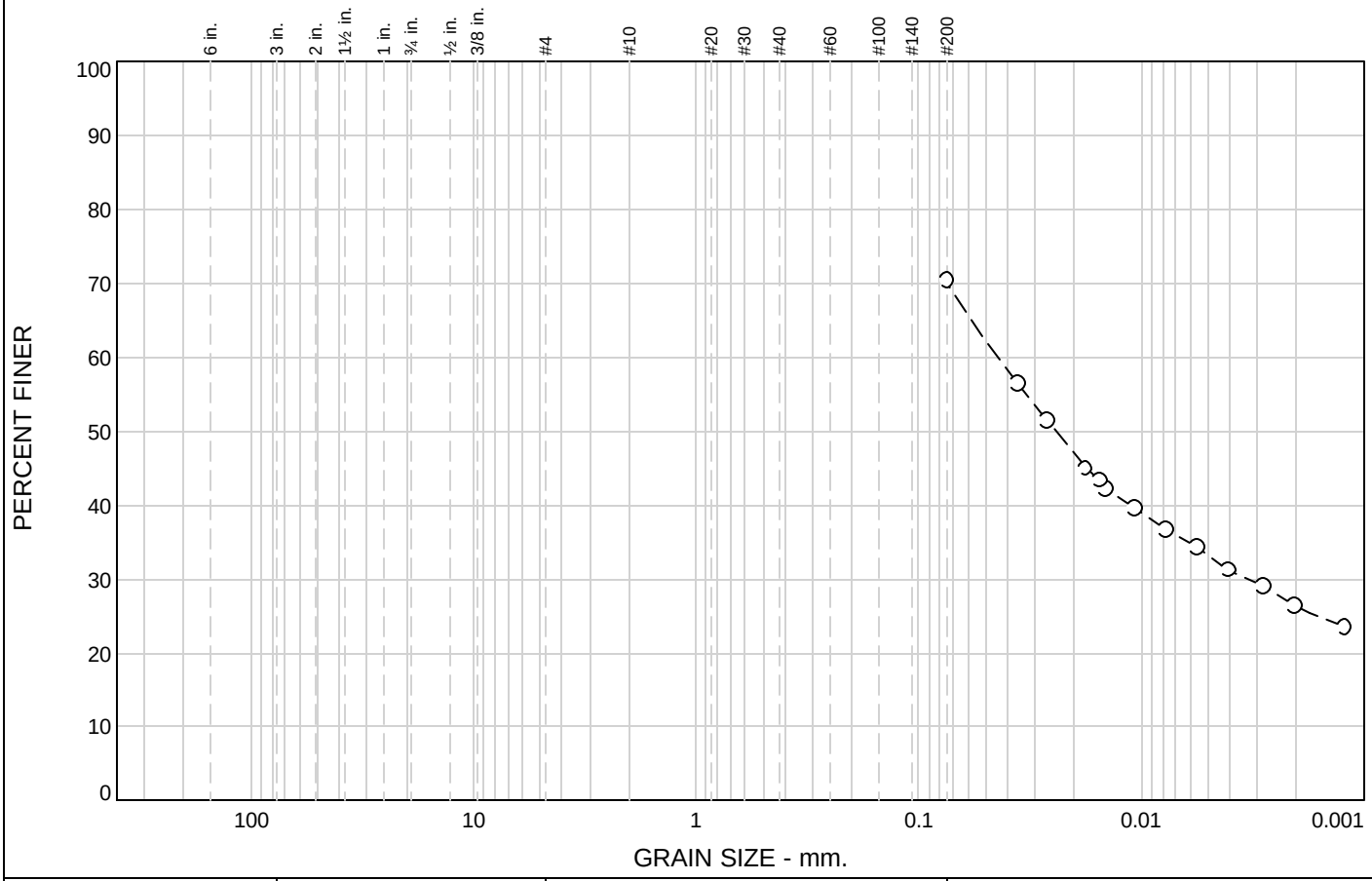
Remarks

Sample No.: #1 @ 6' **Source of Sample:** **Date:** 2/16/11
Location: **Elev./Depth:**

ENGEO INCORPORATED
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS
MATERIALS TESTING

Client:
Project: Deer Hill Road Apartments
Project No: 9181.000.000

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						44.3	26.1

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	70.4		
0.0359 mm.	56.4		
0.0267 mm.	51.6		
0.0180 mm.	45.1		
0.0154 mm.	43.4		
0.0145 mm.	42.4		
0.0108 mm.	39.7		
0.0078 mm.	36.7		
0.0056 mm.	34.4		
0.0041 mm.	31.3		
0.0028 mm.	29.1		
0.0021 mm.	26.4		
0.0012 mm.	23.6		

* (no specification provided)

Soil Description

Brown sandy CLAY.

Atterberg Limits

PL= 20 LL= 43 PI= 23

Coefficients

D_{85}= D_{60}= 0.0440 D_{50}= 0.0245
D_{30}= 0.0033 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CL AASHTO= A-7-6(15)

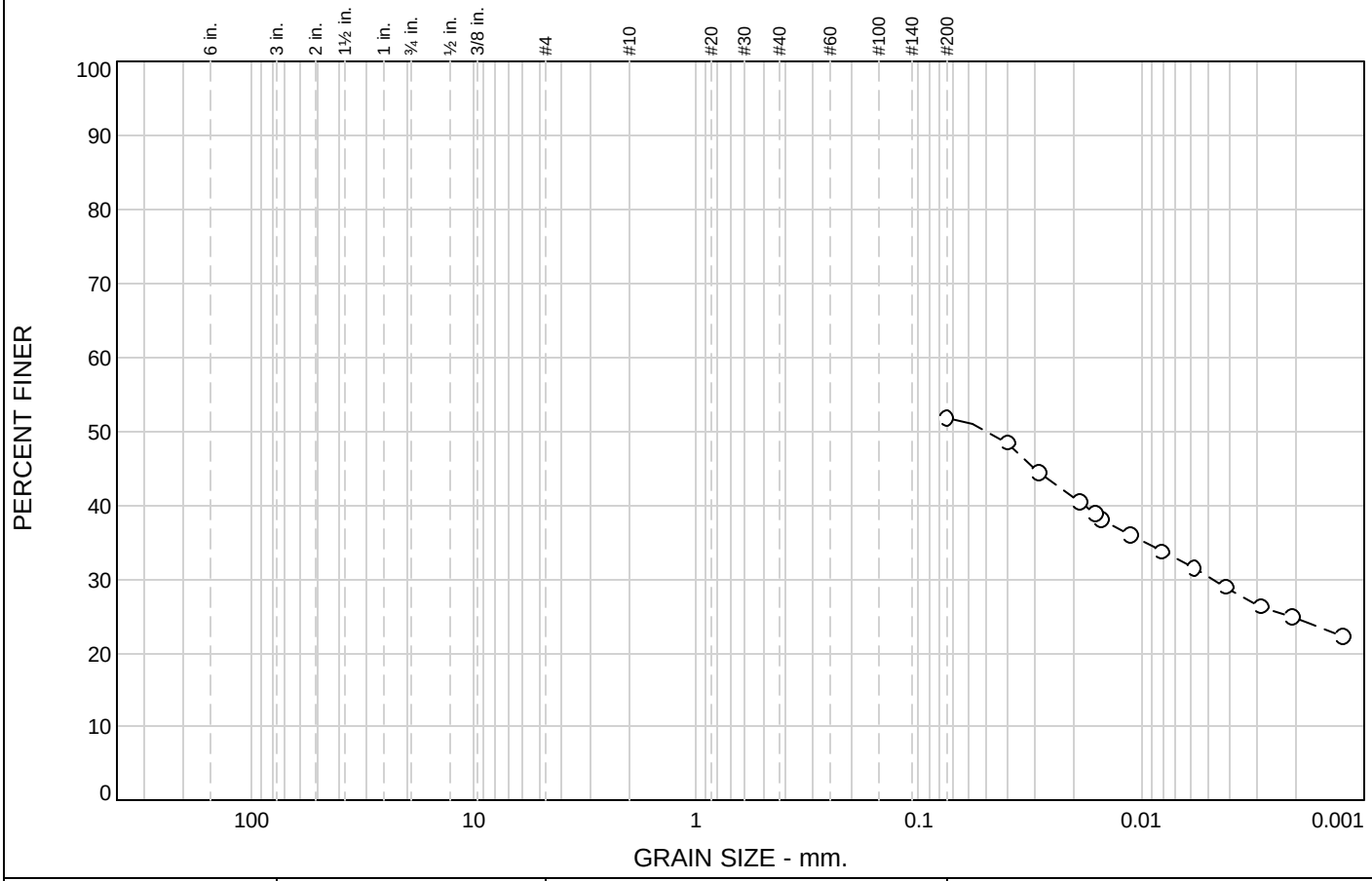
Remarks

Sample No.: #2 @ 6' **Source of Sample:** **Date:** 02/16/11
Location: **Elev./Depth:**

ENGEO INCORPORATED
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS
MATERIALS TESTING

Client:
Project: Deer Hill Road Apartments
Project No: 9181.000.000

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						27.0	24.7

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	51.7		
0.0397 mm.	48.4		
0.0290 mm.	44.5		
0.0189 mm.	40.5		
0.0162 mm.	38.8		
0.0152 mm.	38.1		
0.0113 mm.	36.0		
0.0081 mm.	33.7		
0.0058 mm.	31.5		
0.0042 mm.	28.9		
0.0029 mm.	26.3		
0.0021 mm.	24.9		
0.0012 mm.	22.3		

* (no specification provided)

Soil Description

Brown sandy CLAY with sandstone fragments.

Atterberg Limits

PL= 19 LL= 41 PI= 22

Coefficients

D_{85}= D_{60}= D_{50}= 0.0473
D_{30}= 0.0048 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CL AASHTO= A-7-6(8)

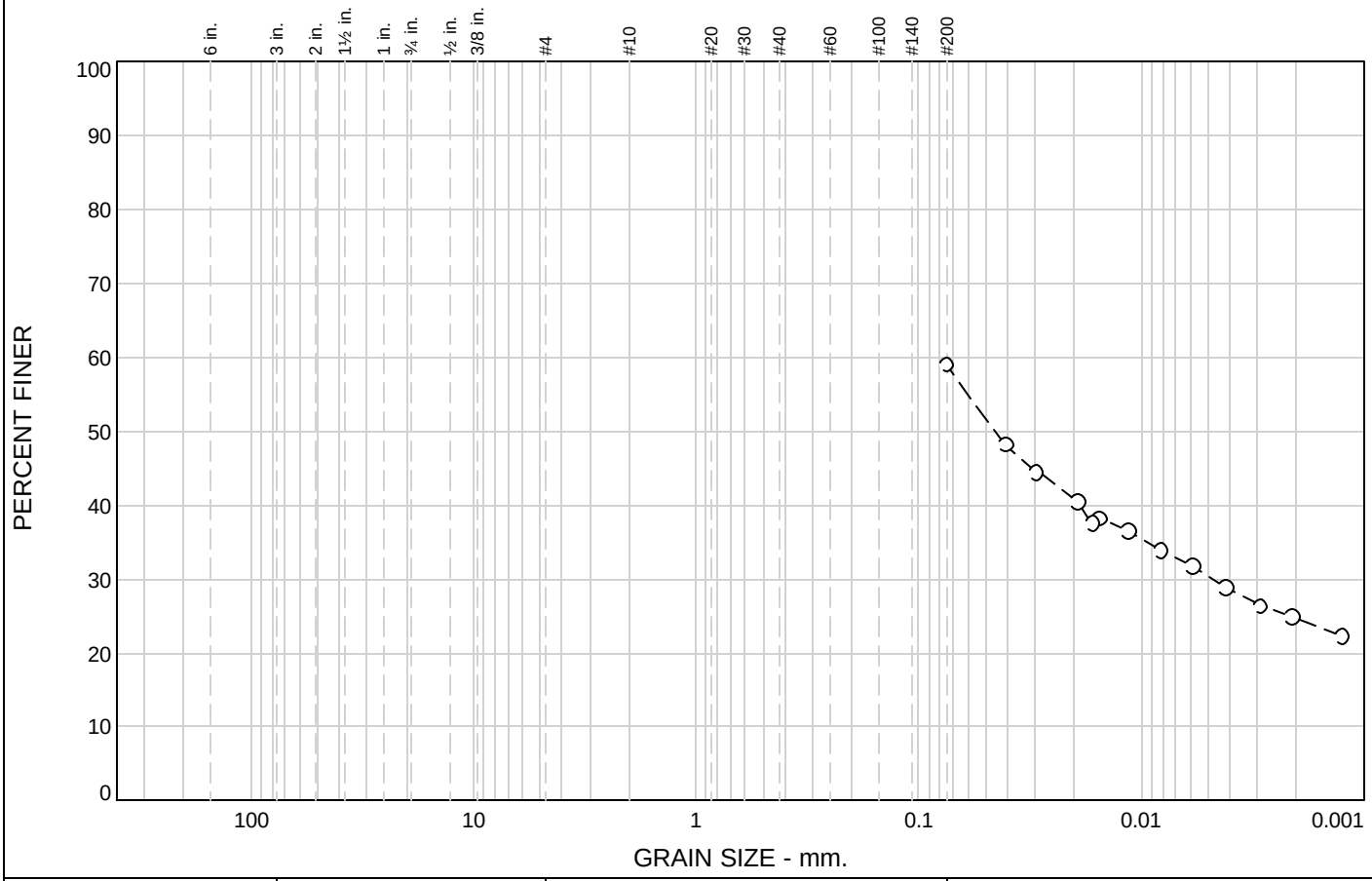
Remarks

Sample No.: #3 @ 0.5' **Source of Sample:** **Date:** 02/16/11
Location: **Elev./Depth:**

ENGEO INCORPORATED
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS
MATERIALS TESTING

Client:
Project: Deer Hill Road Apartments
Project No: 9181.000.000

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						34.4	24.6

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	59.0		
0.0409 mm.	48.2		
0.0297 mm.	44.4		
0.0193 mm.	40.4		
0.0166 mm.	37.6		
0.0155 mm.	38.2		
0.0114 mm.	36.5		
0.0082 mm.	33.9		
0.0059 mm.	31.7		
0.0042 mm.	28.8		
0.0029 mm.	26.4		
0.0021 mm.	24.9		
0.0013 mm.	22.2		

* (no specification provided)

Soil Description

Dark brown sandy CLAY.

Atterberg Limits

PL= 19 LL= 40 PI= 21

Coefficients

D_{85}= D_{60}= D_{50}= 0.0458
D_{30}= 0.0048 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CL AASHTO= A-6(10)

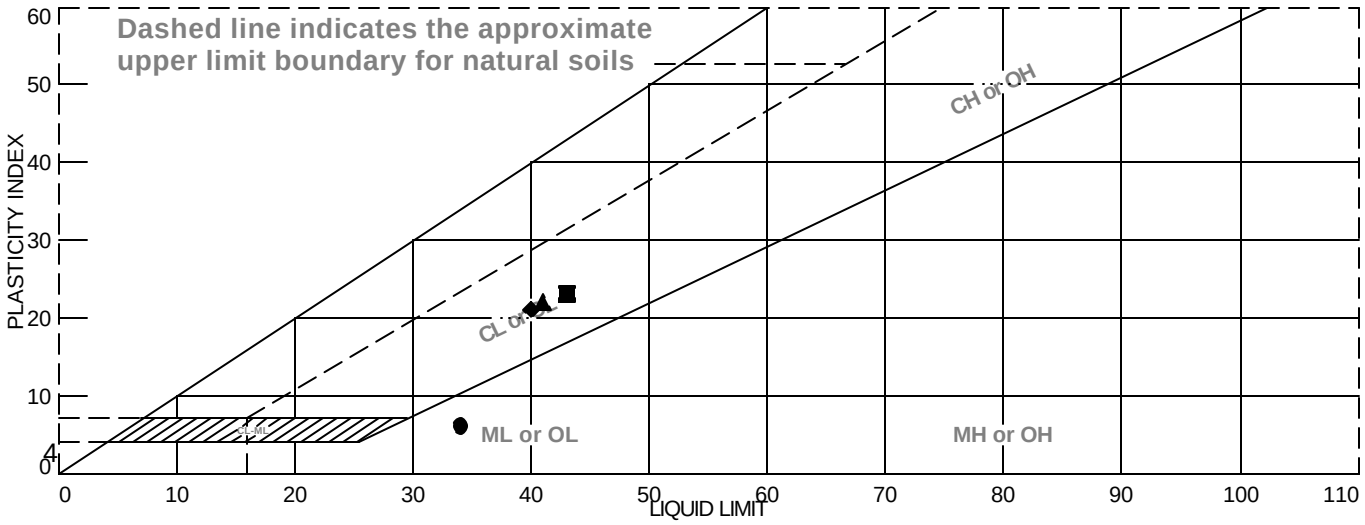
Remarks

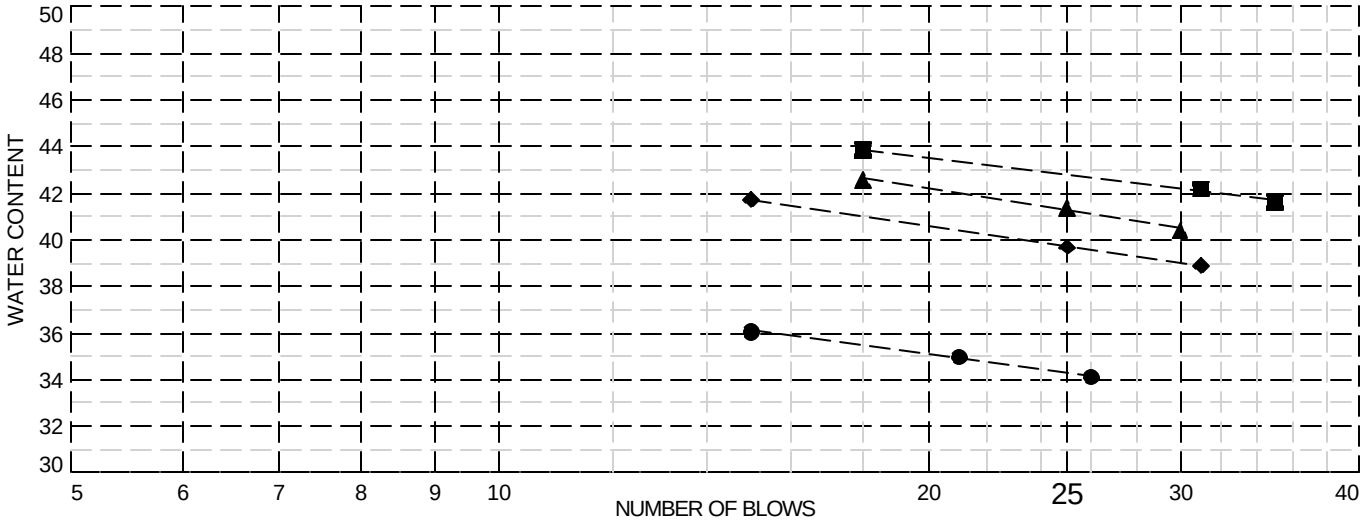
Sample No.: #4 @ 0.5' **Source of Sample:** **Date:** 02/16/11
Location: **Elev./Depth:**

ENGEO INCORPORATED
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS
MATERIALS TESTING

Client:
Project: Deer Hill Road Apartments
Project No: 9181.000.000

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Light yellowish brown silty SANDSTONE.	34	28	6		42.3	SM
■	Brown sandy CLAY.	43	20	23		70.4	CL
▲	Brown sandy CLAY with sandstone fragments.	41	19	22		51.7	CL
◆	Dark brown sandy CLAY.	40	19	21		59.0	CL

Project No. 9181.000.000 **Client:**

Project: Deer Hill Road Apartments

● **Sample Number:** #1 @ 6'
■ **Sample Number:** #2 @ 6'
▲ **Sample Number:** #3 @ 0.5'
◆ **Sample Number:** #4 @ 0.5'

Remarks:

ENGEO INCORPORATED GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS MATERIALS TESTING

Appendix B

Project Name: Terraces of Lafayette
Project Type: Treatment and Flow Control
APN:
Drainage Area: 970,081
Mean Annual Precipitation: 23.0

Self-Treating DMAs

DMA Name	Area (sq ft)
SR	434,032.0

II. Self-Retaining Areas

Self-Retaining DMA	
DMA Name	**Area (sq ft)**
SR	38,860

IV. Areas Draining to IMPs

IMP Name: IMP1
IMP Type: Bioretention Facility
Soil Group: IMP1

DMA Name	Area (sq ft)	Post Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor
DMA1	12,910	Concrete or Asphalt	1.00	12,910
			Total	12,910

IMP Sizing			
IMP Sizing Factor	**Rain Adjustment Factor**	**Minimum Area or Volume**	**Proposed Area or Volume**
0.050	0.877	566	583
0.042	0.877	516*	0
0.055	0.877	623	0
		Maximum Underdrain Flow (cfs)	0.03
		Orifice Diameter (in)	1.06

Area
Surface Volume
Subsurface Volume

* The product of the IMP Sizing Factor and the Rainfall Adjument Factor was less than the minimum value of 0.04. The value of 0.04 was used to adjust the area instead.

IMP Name: IMP2
IMP Type: Bioretention Facility
Soil Group: IMP2

DMA Name	Area (sq ft)	Post Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor

IMP Sizing

DMA Name	Area (sq ft)	Post Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor
DMA2	12,060	Concrete or Asphalt	1.00	12,060
			Total	12,060

IMP Sizing	IMP Sizing Factor	Rain Adjustment Factor	Minimum Area or Volume	Proposed Area or Volume
Area	0.050	0.877	529	856
Surface Volume	0.042	0.877	482*	0
Subsurface Volume	0.055	0.877	582	0
Maximum Underdrain Flow (cfs)				0.03
Orifice Diameter (in)				1.03

* The product of the IMP Sizing Factor and the Rainfall Adjument Factor was less than the minimum value of 0.04. The value of 0.04 was used to adjust the area instead.

IMP Name: IMP3,4
IMP Type: Bioretention Facility
Soil Group: IMP3,4

DMA Name	Area (sq ft)	Post Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor
DMA3	13,350	Conventional Roof	1.00	13,350
DMA4	12,610	Conventional Roof	1.00	12,610
			Total	25,960

IMP Sizing	IMP Sizing Factor	Rain Adjustment Factor	Minimum Area or Volume	Proposed Area or Volume
Area	0.050	0.877	1,138	1,882
Surface Volume	0.042	0.877	1,038*	0
Subsurface Volume	0.055	0.877	1,252	0
Maximum Underdrain Flow (cfs)				0.06
Orifice Diameter (in)				1.51

* The product of the IMP Sizing Factor and the Rainfall Adjument Factor was less than the minimum value of 0.04. The value of 0.04 was used to adjust the area instead.

IMP Name: IMP18
IMP Type: Bioretention Facility
Soil Group: IMP18

DMA Name	Area (sq ft)	Post Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor
DMA18	17,800	Concrete or Asphalt	1.00	17,800
			Total	17,800

IMP Sizing	IMP Sizing Factor	Rain Adjustment Factor	Minimum Area or Volume	Proposed Area or Volume

Area	0.050	0.877	780	2,132
Surface Volume	0.042	0.877	712*	0
Subsurface Volume	0.055	0.877	858	0
Maximum Underdrain Flow (cfs)				0.04
Orifice Diameter (in)				1.25

* The product of the IMP Sizing Factor and the Rainfall Adjument Factor was less than the minimum value of 0.04. The value of 0.04 was used to adjust the area instead.

IMP Name: IMP5
IMP Type: Bioretention Facility
Soil Group: IMP5

DMA Name	Area (sq ft)	Post Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor
DMA5	5,720	Concrete or Asphalt	1.00	5,720
			Total	5,720

IMP Sizing	IMP Sizing Factor	Rain Adjustment Factor	Minimum Area or Volume	Proposed Area or Volume
Area	0.050	0.877	251	370
Surface Volume	0.042	0.877	229*	0
Subsurface Volume	0.055	0.877	276	0
Maximum Underdrain Flow (cfs)				0.01
Orifice Diameter (in)				0.71

* The product of the IMP Sizing Factor and the Rainfall Adjument Factor was less than the minimum value of 0.04. The value of 0.04 was used to adjust the area instead.

IMP Name: IMP6,19
IMP Type: Bioretention Facility
Soil Group: IMP6,19

DMA Name	Area (sq ft)	Post Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor
DMA6	34,470	Concrete or Asphalt	1.00	34,470
DMA19	16,080	Concrete or Asphalt	1.00	16,080
			Total	50,550

IMP Sizing	IMP Sizing Factor	Rain Adjustment Factor	Minimum Area or Volume	Proposed Area or Volume
Area	0.050	0.877	2,216	2,285
Surface Volume	0.042	0.877	2,022*	0
Subsurface Volume	0.055	0.877	2,438	0

Maximum Underdrain Flow (cfs)	0.11
Orifice Diameter (in)	2.10

* The product of the IMP Sizing Factor and the Rainfall Adjument Factor was less than the minimum value of 0.04. The value of 0.04 was used to adjust the area instead.

IMP Name: IMP7-11-12
IMP Type: Bioretention Facility
Soil Group: IMP7-11-12

DMA Name	Area (sq ft)	Post Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor
DMA 7-11-12	68,470	Concrete or Asphalt	1.00	68,470
			Total	68,470

IMP Sizing			
IMP Sizing Factor	**Rain Adjustment Factor**	**Minimum Area or Volume**	**Proposed Area or Volume**
0.050	0.877	3,002	4,204
0.042	0.877	2,739*	0
0.055	0.877	3,302	0

Area
Surface Volume
Subsurface Volume

Maximum Underdrain Flow (cfs)	0.15
Orifice Diameter (in)	2.45

* The product of the IMP Sizing Factor and the Rainfall Adjument Factor was less than the minimum value of 0.04. The value of 0.04 was used to adjust the area instead.

IMP Name: IMP8
IMP Type: Bioretention Facility
Soil Group: IMP8

DMA Name	Area (sq ft)	Post Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor
DMA8	81,010	Concrete or Asphalt	1.00	81,010
			Total	81,010

IMP Sizing			
IMP Sizing Factor	**Rain Adjustment Factor**	**Minimum Area or Volume**	**Proposed Area or Volume**
0.050	0.877	3,551	4,529
0.042	0.877	3,240*	0
0.055	0.877	3,907	0

Area
Surface Volume
Subsurface Volume

Maximum Underdrain Flow (cfs)	0.18
Orifice	2.66

Diameter (in)	

* The product of the IMP Sizing Factor and the Rainfall Adjument Factor was less than the minimum value of 0.04. The value of 0.04 was used to adjust the area instead.

IMP Name: IMP9
IMP Type: Bioretention Facility
Soil Group: IMP9

DMA Name	Area (sq ft)	Post Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor
DMA9	96,050	Concrete or Asphalt	1.00	96,050
			Total	96,050

	IMP Sizing			
	IMP Sizing Factor	Rain Adjustment Factor	Minimum Area or Volume	Proposed Area or Volume
Area	0.050	0.877	4,211	4,511
Surface Volume	0.042	0.877	3,842*	0
Subsurface Volume	0.055	0.877	4,632	0
Maximum Underdrain Flow (cfs)				0.21
Orifice Diameter (in)				2.90

* The product of the IMP Sizing Factor and the Rainfall Adjument Factor was less than the minimum value of 0.04. The value of 0.04 was used to adjust the area instead.

IMP Name: IMP13
IMP Type: Bioretention Facility
Soil Group: IMP13

DMA Name	Area (sq ft)	Post Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor
DMA13	5,650	Concrete or Asphalt	1.00	5,650
			Total	5,650

	IMP Sizing			
	IMP Sizing Factor	Rain Adjustment Factor	Minimum Area or Volume	Proposed Area or Volume
Area	0.050	0.877	248	537
Surface Volume	0.042	0.877	226*	0
Subsurface Volume	0.055	0.877	272	0
Maximum Underdrain Flow (cfs)				0.01
Orifice Diameter (in)				0.70

* The product of the IMP Sizing Factor and the Rainfall Adjument Factor was less than the minimum value of 0.04. The value of 0.04 was used to adjust the area instead.

IMP Name: IMP14
IMP Type: Bioretention Facility

Soil Group: IMP14

DMA Name	Area (sq ft)	Post Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor
DMA14	32,370	Conventional Roof	1.00	32,370
			Total	32,370

IMP Sizing	IMP Sizing Factor	Rain Adjustment Factor	Minimum Area or Volume	Proposed Area or Volume
Area	0.050	0.877	1,419	1,385
Surface Volume	0.042	0.877	1,295*	0
Subsurface Volume	0.055	0.877	1,561	0
Maximum Underdrain Flow (cfs)				0.07
Orifice Diameter (in)				1.68

* The product of the IMP Sizing Factor and the Rainfall Adjument Factor was less than the minimum value of 0.04. The value of 0.04 was used to adjust the area instead.

IMP Name: IMP15
IMP Type: Bioretention Facility
Soil Group: IMP15

DMA Name	Area (sq ft)	Post Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor
DMA15	8,990	Concrete or Asphalt	1.00	8,990
			Total	8,990

IMP Sizing	IMP Sizing Factor	Rain Adjustment Factor	Minimum Area or Volume	Proposed Area or Volume
Area	0.050	0.877	394	1,065
Surface Volume	0.042	0.877	360*	0
Subsurface Volume	0.055	0.877	434	0
Maximum Underdrain Flow (cfs)				0.02
Orifice Diameter (in)				0.89

* The product of the IMP Sizing Factor and the Rainfall Adjument Factor was less than the minimum value of 0.04. The value of 0.04 was used to adjust the area instead.

IMP Name: IMP16
IMP Type: Bioretention Facility
Soil Group: IMP16

DMA Name	Area (sq ft)	Post Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor
DMA16	12,150	Conventional	1.00	12,150

IMP Sizing	IMP Sizing	Rain	Minimum	Proposed

					Factor	Adjustment Factor	Area or Volume	Area or Volume
		Roof						
				Total	12,150			
				Area		0.050	0.877	533	736
				Surface Volume		0.042	0.877	486*	0
				Subsurface Volume		0.055	0.877	586	0
								Maximum Underdrain Flow (cfs)	0.03
								Orifice Diameter (in)	1.03

* The product of the IMP Sizing Factor and the Rainfall Adjument Factor was less than the minimum value of 0.04. The value of 0.04 was used to adjust the area instead.

IMP Name: IMP17
IMP Type: Bioretention Facility
Soil Group: IMP17

DMA Name	Area (sq ft)	Post Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor	IMP Sizing			
					IMP Sizing Factor	Rain Adjustment Factor	Minimum Area or Volume	Proposed Area or Volume
DMA17	12,280	Conventional Roof	1.00	12,280				
			Total	12,280				
			Area		0.050	0.877	538	605
			Surface Volume		0.042	0.877	491*	0
			Subsurface Volume		0.055	0.877	592	0
							Maximum Underdrain Flow (cfs)	0.03
							Orifice Diameter (in)	1.04

* The product of the IMP Sizing Factor and the Rainfall Adjument Factor was less than the minimum value of 0.04. The value of 0.04 was used to adjust the area instead.

Report generated on 9/23/2011 12:00:00 AM by the Contra Costa Clean Water Program IMP Sizing Tool software (version 1.3.1.0).