



**Updated Hydrogeologic Assessment of the Proposed Malibu
Memorial Park Tract Map 69653, 4000 Malibu Canyon
Road, Malibu, California**

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Table of Contents

1.0 INTRODUCTION.....	4
2.0 PROPOSED DEVELOPMENT	4
3.0 PHYSIOGRAPHIC AND GEOLOGIC SETTING	4
3.1 Geologic Materials.....	5
3.2 Geologic Structure	5
4.0 HYDROGEOLOGIC SETTING.....	6
5.0 WASTEWATER DISPOSAL.....	7
6.0 EXISTING GROUNDWATER CONDITIONS.....	7
7.0 SUMMARY AND CONCLUSIONS.....	9
APPENDIX A - REFERENCES.....	10
APPENDIX B - FIGURES	13

List of Tables

Table 1: Groundwater Monitoring Results

List of Figures

Figure 1: Rancho Malibu Resort Location Map
Figure 2: Geology Map
Figure 3: Groundwater Elevation Contour Map
Figure 4: Groundwater Hydrograph

List of Appendices

Appendix A: References
Appendix B: Figures

Updated Hydrogeologic Assessment of the Proposed Malibu Memorial Park Tentative Tract Map 69653, 4000 Malibu Canyon Road, Malibu, California

1.0 INTRODUCTION

A hydrogeologic assessment was conducted on the Malibu Memorial Park to evaluate the cumulative impacts to groundwater from on-site treated water dispersal at the development proposed for the parcel at 4000 Malibu Canyon Road (referred to herein as the “Project Site”), pursuant to the requirements of Chapter 18.5 of the City of Malibu LCP-LIP (2002). The project is located north of Pacific Coast Highway (PCH) on Winter Mesa (see Figure 1).

The objective of the assessment was to evaluate the potential effect of treated water dispersal on groundwater levels at the Project Site and adjacent properties down gradient. This work is based upon a literature review and site visit of the Project Site and surrounding properties. We also utilized geological and geotechnical data from the following sources:

- Regional geologic publications: Yerkes and Campbell (1980), and Dibblee (1993).
- Previous consulting reports specific to the Malibu Memorial Site: Van Beveren & Butelo (2007), Merrill (1975a,b), Leighton and Associates (1989), EnSitu Engineering (2008), and Young (2008a).
- Recent project-specific reports/plans for the Malibu Memorial Park: Young (2008), EnSitu Engineering (2012 and 2015), Rubicon Engineering (2013 and 2014), Earth Forensics (2012) and GeoSoils (2011 and 2012).
- Consulting reports for nearby properties: Aquifer Science and Technology (2008), Glen Lukos Associates (2008), Young (2008b), EnSitu Engineering (2009), Leighton and Associates, Inc. (2007b, 2009), and Psomas (2009).

Subsurface data from the reports listed above were obtained from more than 120 borings drilled on and adjacent to the Project Site. The borings included those made for geotechnical analyses, groundwater monitoring, and percolation testing. The data were used to evaluate where groundwater exists beneath the Project Site as well as the geologic conditions that exist at and near the Project Site. References for the reports and publications are listed Appendix A.

2.0 PROPOSED DEVELOPMENT

Green Acres, LLC, is developing the Malibu Memorial Park and Chapel, comprised of approximately 21.0 acres of a 27.8 acre property located east of Malibu Canyon Road, west of Civic Center Way, and north of Pacific Coast Highway in the City of Malibu, California (the “Project”). The unstable slope areas along the perimeter of the site comprise the remaining 7 acres of the parcel that Green Acres has elected not to develop. The proposed

Memorial Park project contains approximately 17,500 GSF of FAR development and will include the construction of a 8,500 SF Main Chapel facility, 8,500 SF subterranean parking basement (19 parking spaces), 48 free-standing Mausoleum structures totaling approximately 9,000 SF (approx. 186 SF/each), approximately 30,600 plot spaces will allow for various crypt configurations, cremation and fractional burial options, as well as surface parking for 132 guest vehicles along the entry drive and Chapel ring.

3.0 PHYSIOGRAPHIC AND GEOLOGIC SETTING

The proposed Malibu Memorial occupies approximately 28.7 acres at the northeast corner of Pacific Coast Highway and Malibu Canyon Road. Civic Center Drive borders the site to the north and northeast, while a wastewater treatment and disposal field borders the site to the east. The majority of the site is located on one of several uplifted terraces in the Malibu area. The terrace surface slopes gently toward the east. A steep hillside, about 50 feet high, separates the proposed development area from Winter Canyon to the east. The steep slopes along the eastern edge of the Project Site are scarps related to landslides. Cut slopes have been constructed along Malibu Canyon Road, Civic Center Drive and Pacific Coast Highway.

The Project Site is currently vacant and covered with grass, brush and trees. The site was previously used as a commercial nursery and numerous metal planting cans and wooden crates were observed scattered throughout the site, on the surface. Remnant, unpaved, access roads have been graded throughout the site.

3.1 Geologic Materials

The Project Site is underlain by different bedrock types. Figure 2 is a generalized geology map of the site. The Monterey Formation, Trancus, Sespe, Vaqueros, and Conejo Volcanics are present at depths to 84 feet, with all but the Monterey exposed at the surface.

Unconsolidated marine and non-marine sediments, collectively referred to as terrace deposits, cap the bedrock. Marine deposits consist of gray to light brown well graded sand and gravelly sand, while non-marine deposits consist of reddish to yellowish brown, dense, silty sand and sand with varying amounts of gravel.

A landslide is located along the eastern part of the site.

3.2 Geologic Structure

Bedrock has been strongly deformed by tectonic processes and generally dips to the southeast with minor local folding and variations in dip orientation (Van Beveren & Butelo, 2007).

Many faults and shears (minor faults) were reported in Leighton's bucket auger borings and trenches in the easterly project limits. These features are exhibited by offset bedding and dragged (folded) bedding planes and are common in the Monterey Formation. The faults and shears

encountered appear to be randomly oriented and do not display a preferred orientation. Fractures and joints are also common within the Monterey Formation. These joints as encountered in our explorations were observed to be randomly oriented.

The Malibu Coast fault, a major structure in the region, trends east-west through the southern portion of the site. The fault has significantly offset the various bedrock units in the area, however it does not impact the upper part of the older terrace deposits (Leighton and Associates, 1989; Van Beveren & Butelo, 2007)

4.0 HYDROGEOLOGIC SETTING

At the Project Site, the top of the mesa slopes gently to the east and south, then becoming gradually steeper (up to about a 4:1 slope gradient) at the northern and eastern perimeter. There are no drainages, natural or manmade, contributing surface flow to the Project Site. Precipitation that falls on the site travels by sheet flow to the eastern and northern perimeter slopes.

To the east and north of the Project Site, the Winter Canyon watershed trends southeast, and encompasses approximately 150 acres. The overall relief of the watershed is 1,325 feet and is divided into two channel gradients of 0.22 feet per foot in the foothills and 0.07 feet per foot in the lower reaches of the channel, from the foothills to the ocean. The lower reaches of the Winter Canyon have experienced significant man-made alterations over the years by grading and by placement of various stormwater control measures.

Although they are adjacent, Winter Canyon and Malibu Creek are separate watersheds. A low ridge on the eastern side of Winter Canyon functions as a drainage divide for surface and subsurface waters, thereby separating the Project Site and Winter Canyon hydrologically from the Malibu Creek/Civic Center area groundwater basin. The lack of hydraulic conductivity between the two basins is further supported by their very different water levels and flow gradients as illustrated in Figures 3 and 4 of the Risk Assessment of Decentralized Wastewater Treatment Systems in High Priority Areas in the City of Malibu (Stone Environmental, 2004). In addition, the California Department of Water Resources excludes Winter Canyon from their map of the Malibu Valley Groundwater Basin (DWR Basin Number 4-22, dated October 2003).

Based on the monitoring wells on the Project Site and Pepperdine, groundwater flow direction is divided over the site. Along the eastern margin, the flow direction is easterly to southeasterly (Figure 4). Along the western margin, the flow direction is westerly to southwesterly. It is possible that the groundwater flow has been somewhat impeded by the Malibu Coast fault. If the fault were acting as a semi-permeable barrier to the subsurface flow, groundwater would potentially mound against the fault and flow parallel to it, ultimately draining through Winter Canyon to the east. Groundwater level data is plotted both as a groundwater contour map (see Figure 4) and as a hydrograph (see Figure 5).

5.0 WASTEWATER DISPOSAL

All on-site generated wastewater will be sent off-site to the City of Malibu treatment plant for processing.

6.0 EXISTING GROUNDWATER CONDITIONS

There are 8 existing on-site groundwater monitoring wells. On October 17, 2014 a groundwater survey was conducted and the results are shown in Figure 4. To confirm that groundwater levels have remained near October 2014 levels, a groundwater level survey was conducted on October 6, 2015 and is shown in Table 1. Since the water levels have not drastically changed, the groundwater elevation contour map in Figure 4 was not updated.

Table 1: Groundwater Level Monitoring Survey (October 6, 2015)

WELL ID	North (Y) (feet)	East (X) (Feet)	Elevation (Z) (feet)	Depth to Water (ft-bgs)	Groundwater Elevation (feet)
RM1	1836935.11	6348764.00	225.06	34.9	190.16
RM2	1835982.84	6348817.26	216.63	102.26	114.37
RM3	1836215.18	6349221.17	225.48	67.3	158.18
RM4	1836455.43	6349495.73	223.62	90.44	133.18
RM5	1836045.74	6349750.67	172.71	124.3	48.41
MW02	1836029.01	6348968.04	220.92	62.35	158.57
MW03	1836188.49	6349446.95	220.89	73.52	147.37
MW04	1836319.163	6348636.62	226	47.65	178.35
LAMW-5S	1836607.783	6349923.71	104.55	52.5	52.05

In addition to the on-site wells, two groundwater monitoring wells on the Pepperdine property to the west and northwest and 3 wells on the Crummer Property were evaluated to help determine historical groundwater levels in Winter Canyon.

Table 2: Groundwater Monitoring Results.

Well Name	Highest Elevation (ft amsl)	Lowest Elevation (ft amsl)	Comments
MW-1 (on-site)	NA	NA	Dry
MW-2 (on-site)	171.02	158.61	
MW-3 (on-site)	148.05	147.39	
LMW-1 (Crummer)	119.32	114.70	
RM1 (on-site)	190.16	189.78	
RM2 (on-site)	117.77	114.37	
RM3 (on-site)	159.05	158.18	
RM4 (on-site)	133.18	128.51	
RM5 (on-site)	49.41	48.41	
LMW-2 (Crummer)	104.38	99.21	
LMW-6 (Crummer)	140.96	138.36	
MW-5a (Pepperdine)	162.50	154.36	
MW-11 (Pepperdine)	142.53	128.65	
LAMW-5S	57.90	51.29	

Note: All water levels are based on “mean sea level” (NAVD88).

Based on the current groundwater conditions on-site and historical conditions off-site, there appears to be significant vadose zone on-site.

7.0 SUMMARY AND CONCLUSIONS

Based on our review of previous work on the Project Site and adjacent properties along with our site visit, the depth to groundwater beneath the site is greater than 60 feet. The potential for *irrigation water* to daylight in the eastern and southern perimeter slopes around the Project Site appears to be negligible due to depth of the groundwater and overall permeability of the soils (GeoSoils Consultants, Inc., 2012). The faults onsite may also act as semi-permeable barriers, at least locally. Additional monitoring would aid in further evaluating the impacts the faults may or may not have on the overall groundwater flow system.

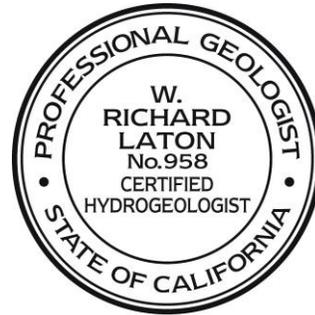
Analysis of the Malibu Memorial Park, which is based on a literature review and site visit, indicates little potential significant cumulative impact on groundwater levels, both onsite and offsite, will occur as a result of operations.

Respectfully submitted,

EARTH FORENSICS, Inc.

(Signature)

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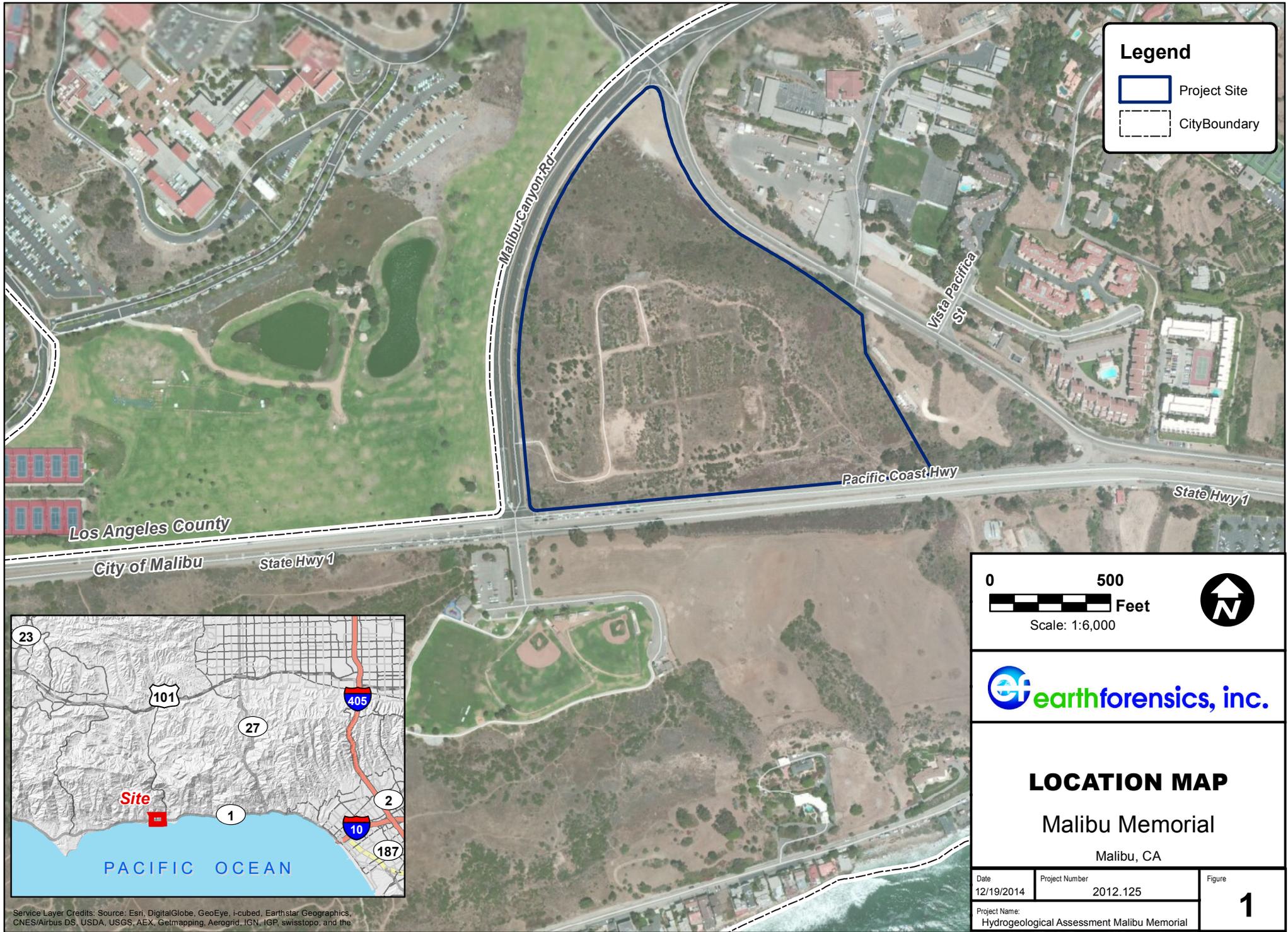
APPENDIX A - REFERENCES

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APPENDIX B - FIGURES



Legend

- Project Site
- City Boundary

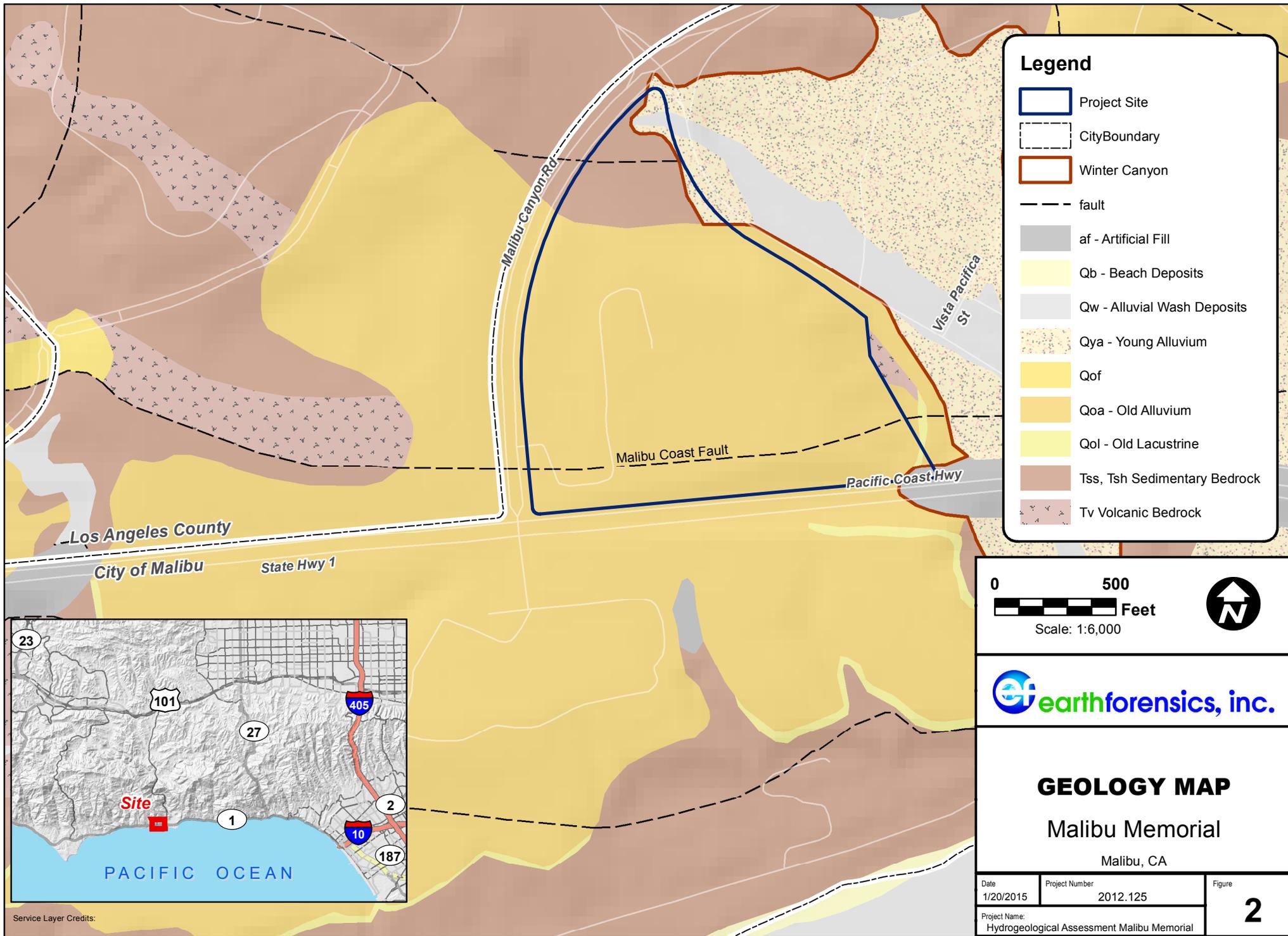
0 500
 Feet
 Scale: 1:6,000

earthforensics, inc.

LOCATION MAP
 Malibu Memorial
 Malibu, CA

Date 12/19/2014	Project Number 2012.125	Figure 1
Project Name: Hydrogeological Assessment Malibu Memorial		

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the



Legend

- Project Site
- City Boundary
- Winter Canyon
- fault
- af - Artificial Fill
- Qb - Beach Deposits
- Qw - Alluvial Wash Deposits
- Qya - Young Alluvium
- Qof
- Qoa - Old Alluvium
- Qol - Old Lacustrine
- Tss, Tsh Sedimentary Bedrock
- Tv Volcanic Bedrock

0 500

 Feet
 Scale: 1:6,000



GEOLOGY MAP

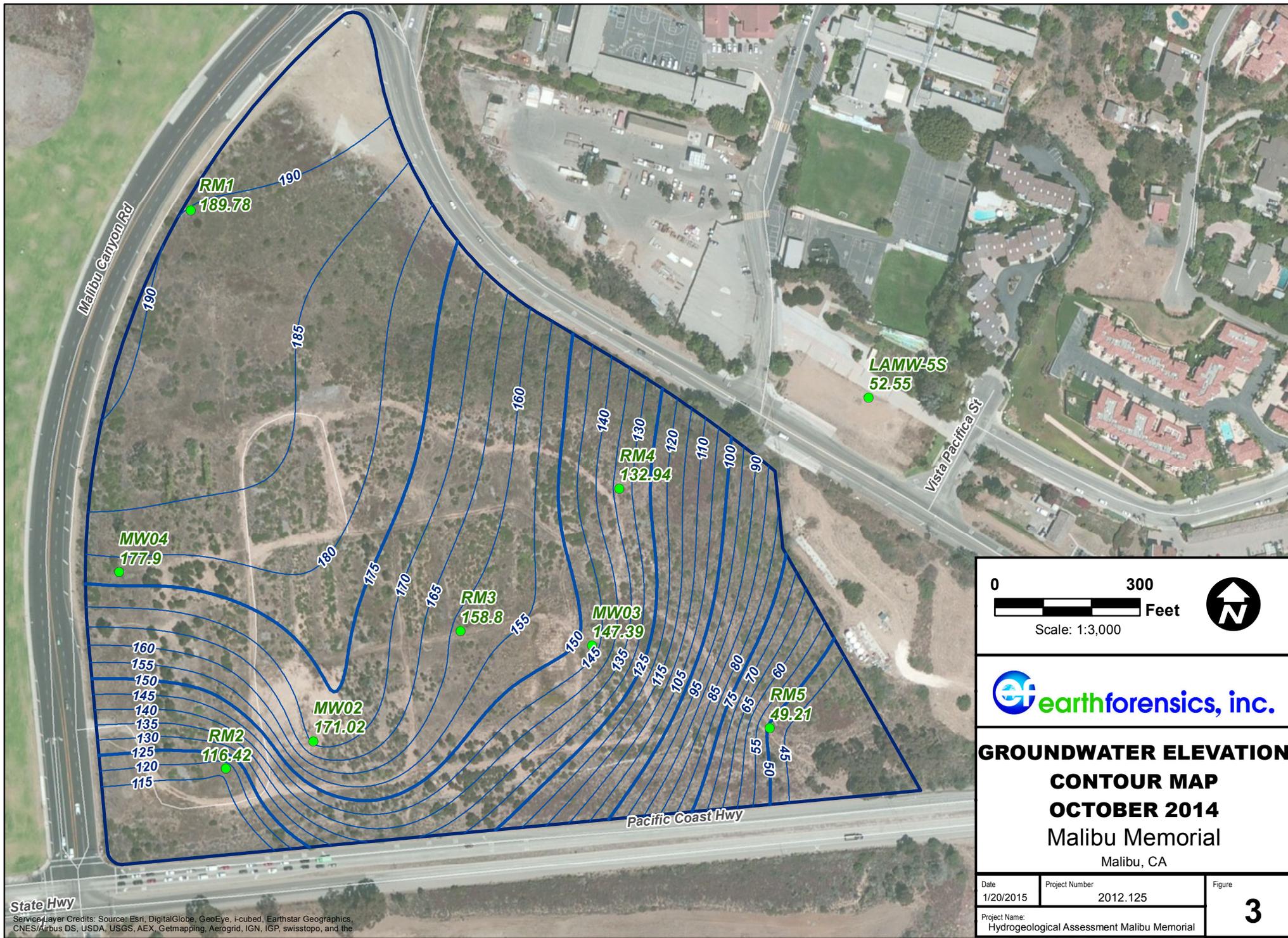
Malibu Memorial

Malibu, CA

Date 1/20/2015	Project Number 2012.125	Figure 2
Project Name: Hydrogeological Assessment Malibu Memorial		



Service Layer Credits:



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, I-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the

Scale: 1:3,000		
GROUNDWATER ELEVATION CONTOUR MAP OCTOBER 2014 Malibu Memorial Malibu, CA		
Date 1/20/2015	Project Number 2012.125	Figure 3
Project Name: Hydrogeological Assessment Malibu Memorial		

Figure 4
Groundwater Hydrographs
Malibu Memorial

