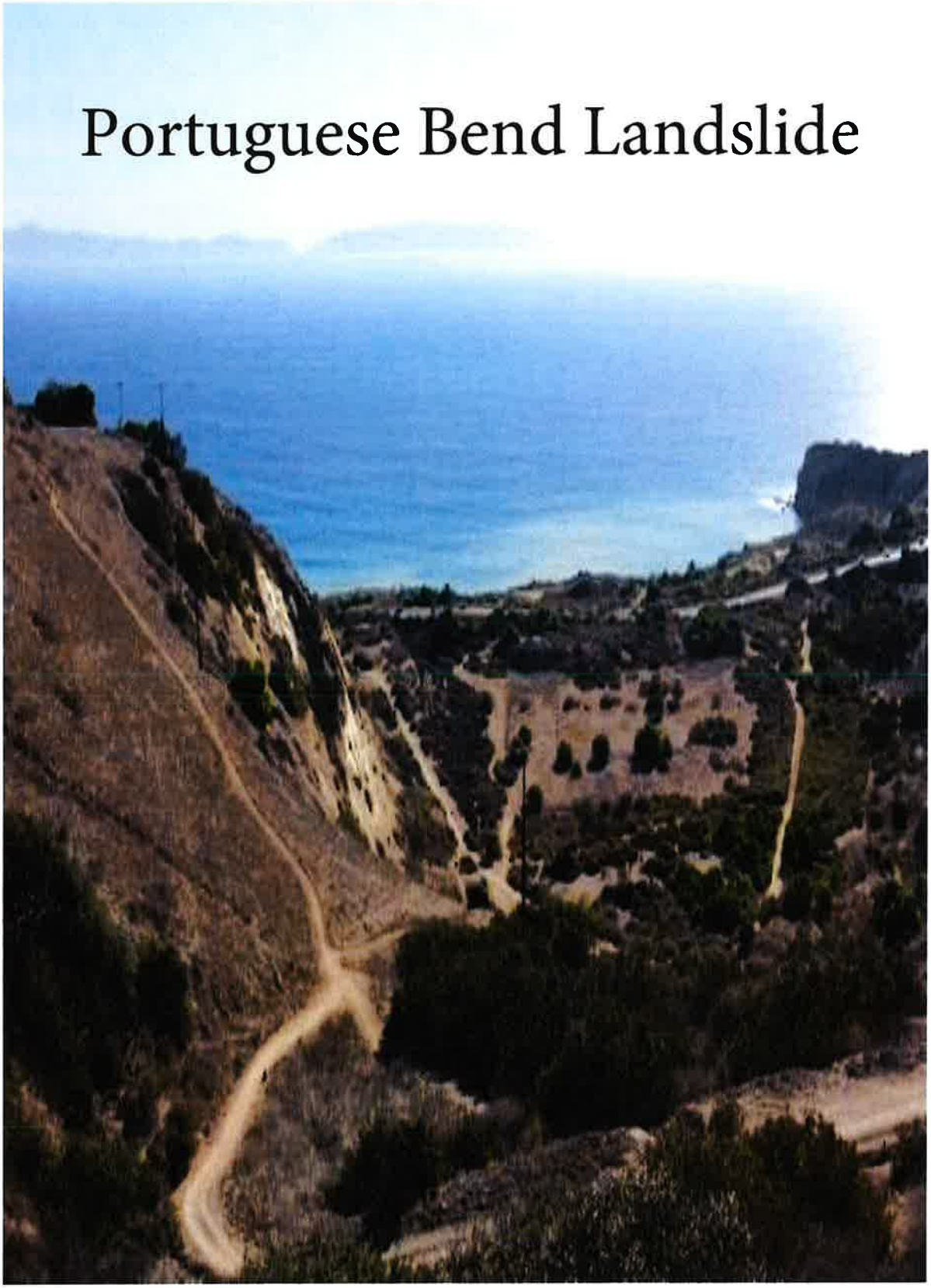
Portuguese Bend Landslide



Portuguese Bend Landslide

Background

The City currently spends between $600,000 to $800,000 per year to maintain a safe, passable roadway through the Portuguese Bend Landslide Area. This constant repaving of Palos Verdes Drive South has been going on for approximately 40 years. It's estimated that this has cost the City approximately $40M. The cause is reactivated landslides within the greater Ancient Altamira Landslide Complex, which encompasses over two of the City's roughly fourteen square miles, and moves at rates between hundredths of an inch per year and tens of feet per year. Regular travelers through the area are familiar with the frequent need to repair cracks and smooth out the roadway, and the disruption it brings to daily commutes. Furthermore, they present a challenge to City Public Works staff who are tasked with maintaining safe access through this area for the public, and especially in case of emergencies. Los Angeles County maintains above-grade, pressurized sanitary sewer lines which run through the landslide and are placed next to an arterial roadway. The pipes need constant inspection, monitoring and maintenance. These sewer lines are approximately 12 inches in diameter and are located along the roadway next to the ocean.

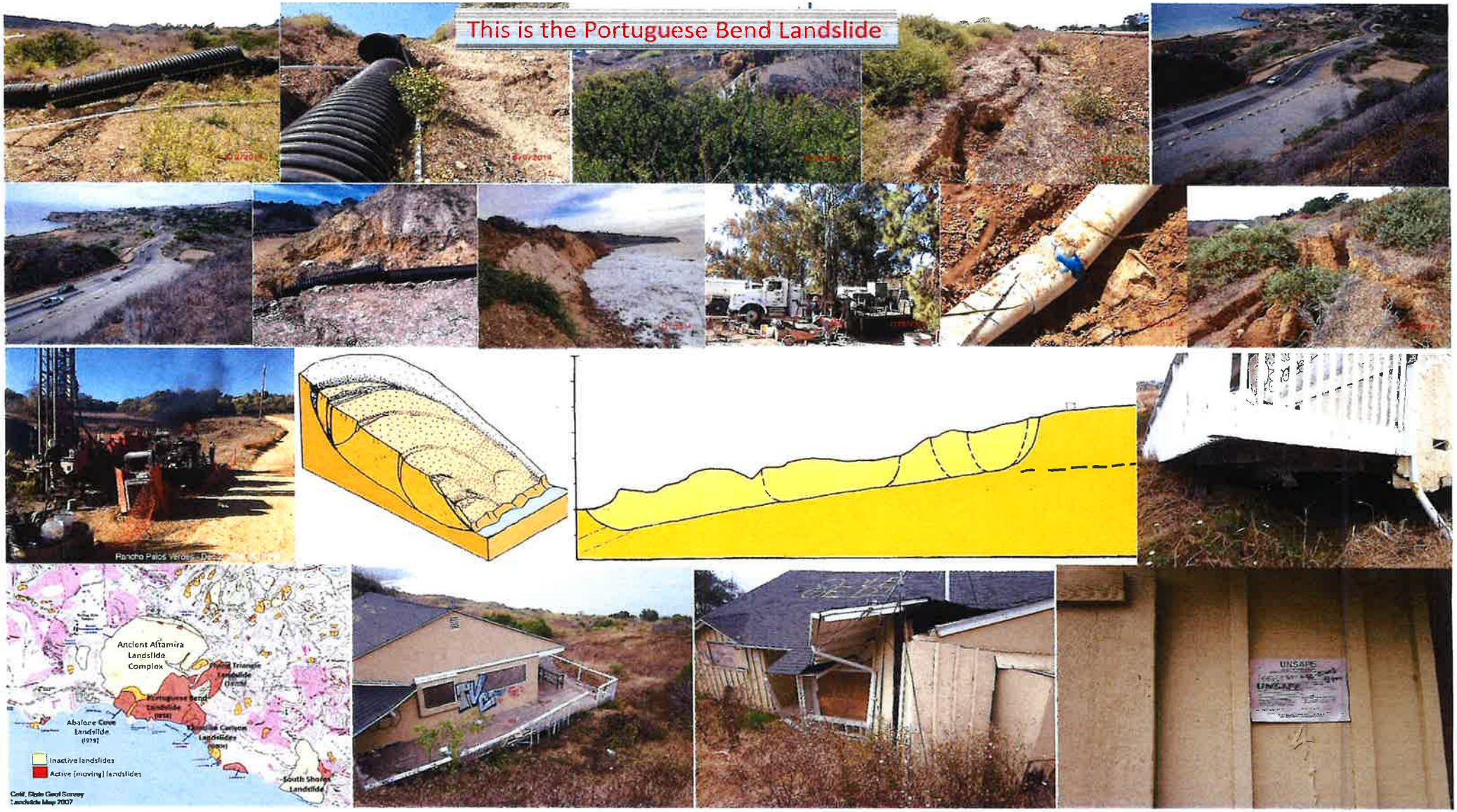
Solutions

The City sought to develop a comprehensive program that would ultimately result in stabilizing the extensive landslide complex that exists in the Portuguese Bend area. The consultant, Daniel B. Stephens and Associates, examined the area firsthand, reviewed prior studies, and updated the existing feasibility study. A Final Feasibility Study was presented to the City Council and several remedies were approved by the City Council to be implemented: subsurface dewatering, storm water control, engineered slope stabilization measures, and eliminating septic system discharge into the landslide.

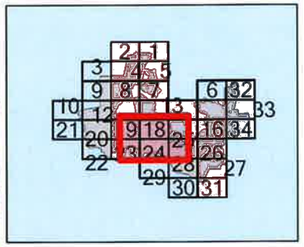
Specifically, the design for the lower portion of the landslide would convey the drainage runoff to the ocean directly; as well as include groundwater extraction horizontal drains (hydro-augers). The installation of hydro-augers will provide passive dewatering without the requirement of surface mounted equipment. Additionally, a hydrologic study and engineering analysis of the canyons will be performed to identify where, how, and to what extent the storm water infiltrates into the groundwater in the Portuguese Bend Landslide Complex.

Currently, the project is in the design phase and there will be a Public Outreach meeting on May 29, 2019. The City is also negotiating with the City of Rolling Hills to address and resolve the runoff as well as sanitary sewer effluent generated by septic tanks and private treatment systems within the City of Rolling Hills which contribute to landslide movement.

This is the Portuguese Bend Landslide



City of Rancho Palos Verdes | Landslide Area



Legend

- Landslide Area
- City Boundary

1: 12,000

0 0.125 0.25 0.5 0.75 1 Miles

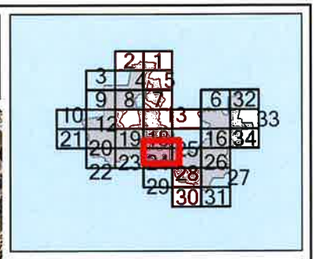
NAD_1983_StatePlane_California_V_FIPS_0405_Feet

The information on this map is for reference only and may not be up-to-date. Please contact the City for more information.

Notes

Landslide area in City of Rancho Palos Verdes

City of Rancho Palos Verdes | Landslide Area



Legend

- Property Lines

1: 4,000

0 0.0375 0.075 0.15 0.225 0.3 Miles

NAD_1983_StatePlane_California_V_FIPS_0405_Feet

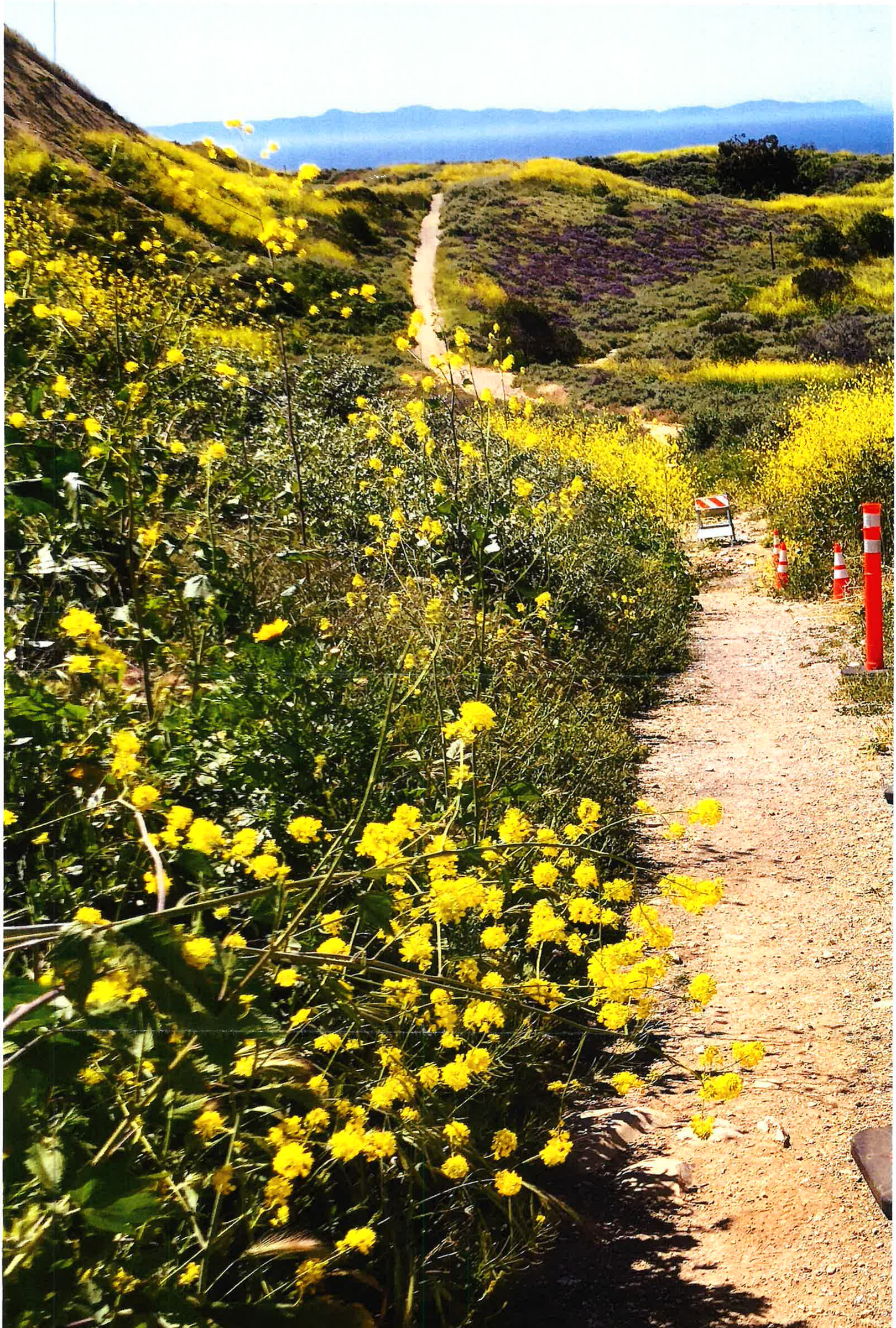
The information on this map is for reference only and may not be up-to-date. Please contact the City for more information.

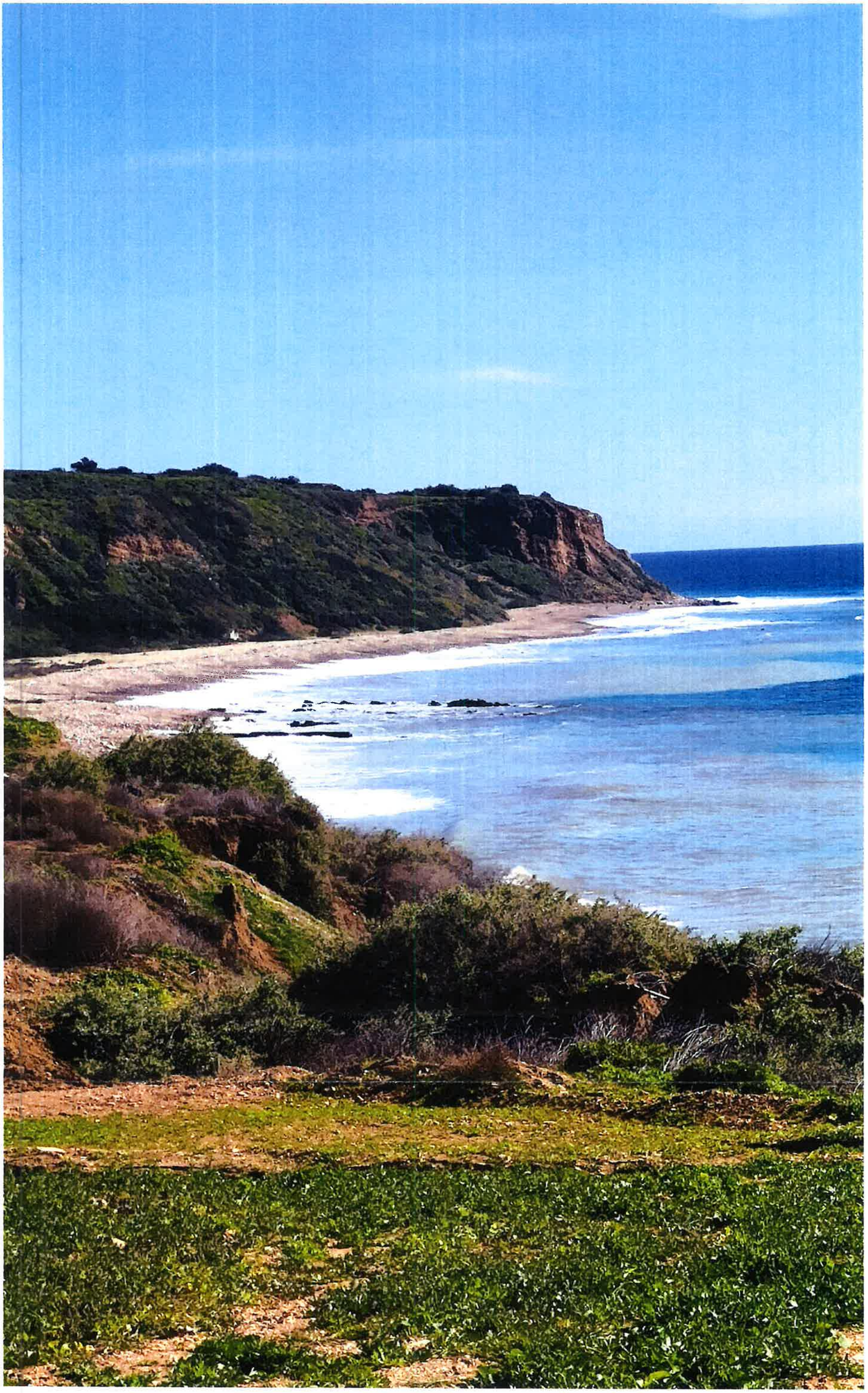
Notes

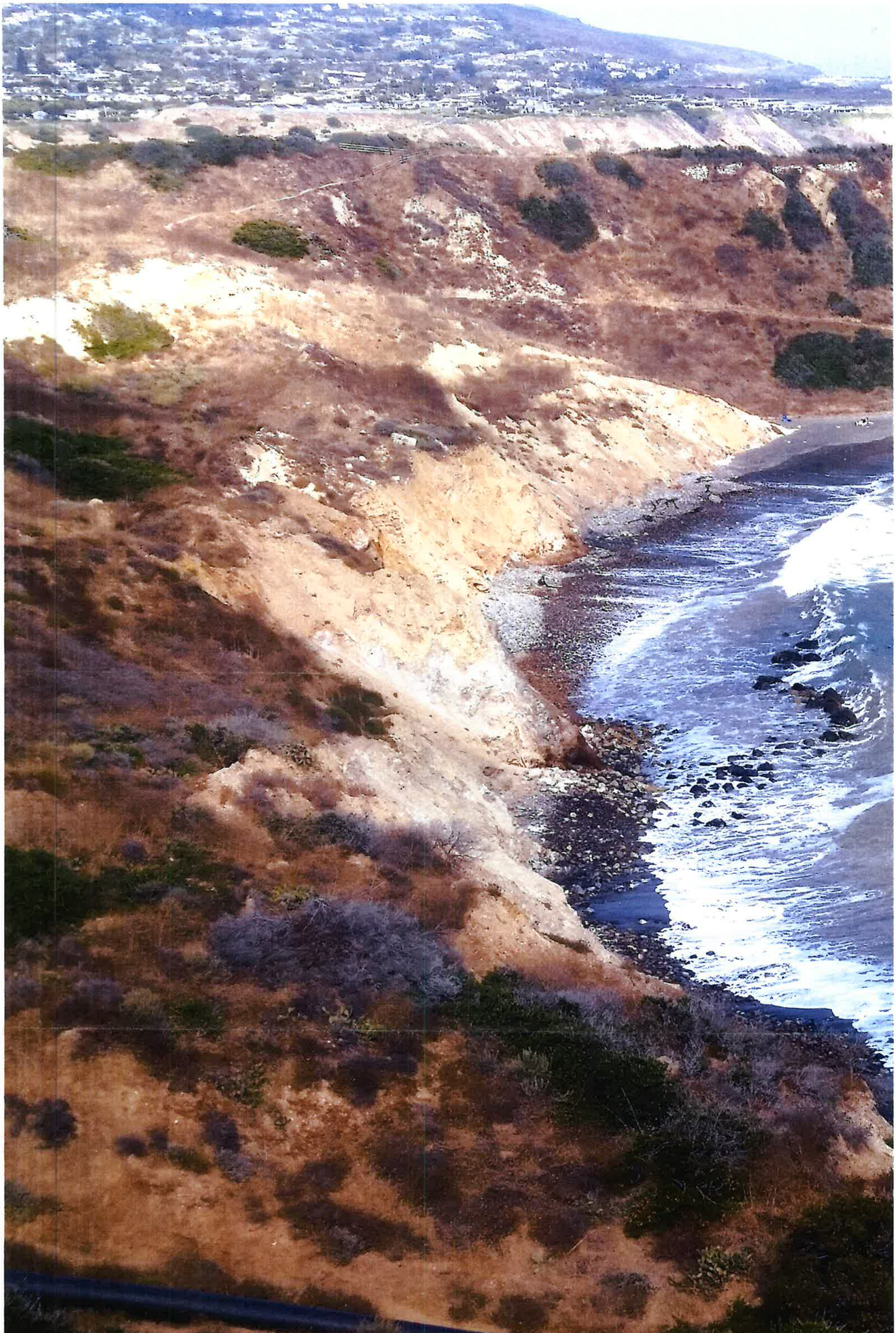
Landslide area with property lines in the City of Rancho Palos Verdes


POMEGRANATE
PERIWINKLE
TANGERINE
KUMQUAT
CHERRY HILL LN
PALOS VERDES DR S
SEAWALL
YACHT HARBOR
0 120 240 480 720 960
Feet


1/21/2014





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SURVEYS

Survey Report

of the

Portuguese Bend Landslide 2018-2019 Monitoring Surveys

Dated: June 11, 2019, Revised July 9, 2019

for the

City of Rancho Palos Verdes

prepared by

McGee Surveying Consulting

The Portuguese Bend Landslide is monitored on a tri-annual basis beginning with the initial survey of all current monitoring points at the beginning of the rainy season in September-October of each year and two subsequent partial monitoring surveys of a subset of points in mid-winter and mid- spring. The initial survey is addressed in this Report and the partial surveys are addressed as Addendums at the end of this Report. The average date of each survey follows.

Initial Survey - October 10, 2018 Full Monitoring Survey - No. 22
Second Survey - January 29, 2019 Partial Monitoring Survey - No. 23
Third Survey - May 7, 2019 Partial Monitoring Survey - No. 24

INDEX

APPENDIX

ATTACHMENT: "PB MOVEMENT DATA POSTING 2007-2018.10.xlsx" (Overall & Annual Movements)

McGEE SURVEYING CONSULTING
5290 Overpass Road, Ste#107, Santa Barbara, CA 93111

Survey Report
of the
Portuguese Bend Landslide Monitoring Survey
October 10, 2018 Initial Monitoring No. 22
for the
City of Rancho Palos Verdes
Prepared June 11, 2019, Revised July 9, 2019
by
McGee Surveying Consulting

PROJECT OVERVIEW:

McGee Surveying Consulting (MSC) performed a landslide monitoring survey in October 2018, January and May 2019 at Portuguese Bend on behalf of the City of Rancho Palos Verdes. The City of Rancho Palos Verdes assumed responsibility for monitoring the Portuguese Bend Landslide Complex circa 1994 from the County of Los Angeles. The surveys are planned, coordinated and executed by Michael McGee, PLS3945 of MSC who is responsible for the processing of the observations, network adjustments, analysis and reports.

The survey determined precise positions on an array of monitoring points to assess their periodic movements and overall movements since the date of establishment. The results of the initial September-October survey of 65 points are described in this Report and in the attached annual spreadsheet titled "PB MOVEMENT DATA POSTING 2007-2018.10 rev.xlsx". Two subsequent partial monitoring surveys of a sub-set of about 30 points are conducted in the following winter and spring. The results are reported here as addendums.

The Global Navigation Satellite System (GNSS) formerly referred to as GPS is used to measure positions of points because of its high accuracy and cost efficiency. The horizontal and vertical positions of the monitoring points are based on the North American Datum of 1983 (NAD83) and the North American Vertical Datum of 1988 (NAVD 88). The survey is referenced to physical monuments known as California CGPS (Continuous GPS) Stations in the region which are permanently mounted GPS and GNSS receivers tracking satellites 24 hours a day for monitoring seismic activity. The CGPS in California are comparable to the national CORS (Continuously Operated Reference Stations) Network.

The accuracy standard for these surveys follows. Points that move 5 centimeters (0.16 feet or 2 inches) or less per year are surveyed to meet an accuracy standard of one centimeter (0.033 feet) at the 95% Level of Confidence. Where the movements are greater, the accuracy standard is two centimeters (0.066 feet) at the 95% Level of Confidence. Field procedures are designed to accomplish this purpose and Quality Control-Quality Assurance (QAQC) processes discussed hereafter are incorporated to verify these accuracies are attained.

Prior to September 2007, successive coordinate differences were used by others to compute movements; however, arithmetic differences do not provide statistical information about the relative movement accuracies. Beginning with the initial survey by MSC in the 2007 survey, field and office procedures were designed to assure the accuracy and reliability of measurements and provide for queries between epochs that include statistical information and relative precisions of the reported movements. The temporal movements and statistical data are based on a rigorous simultaneous least-squares adjustment of multiple observations at two different epochs.

HISTORY

This monitoring survey is a continuation of a program initiated by the County of Los Angeles and taken over by the City of Rancho Palos Verdes circa 1994. McGee Surveying Consulting has conducted the field surveys and reporting since September 2007. The monitoring surveys have occurred annually since 2007, semi-annually since 2012 and three times a year beginning with the September 2014 survey. See the annual Survey Reports on file with the City Engineering Department commencing in 2007. The present status of monitored points is provided in the Appendix under "Monitoring Point Status". See the September 2007 Survey Report for a history of the previous survey process between 1994 and 2007. The historical 1994-2006 positions of all points are listed in the Charles Abbott Associates Inc. file "ALL POINTS MOST RECENT OBSERVED POSITION AS OF SEPTEMBER 15, 2006.xls". This file was attached as an electronic file to the 2007 Survey Report.

PROJECT DATUMS, REFERENCE SYSTEM

Horizontal Datum: The North American Datum of 1983 is the horizontal datum as established by the National Geodetic Survey (NGS) referred to as NAD83 (2007) Epoch 2007.00. The NAD83 (2007) Epoch 2007.00 Adjustment is one of a series of national adjustments of the NAD83 Datum since its adoption in 1986 and is the realization used for these monitoring surveys beginning in 2007. The positions of the CGPS Stations listed below were obtained in September 2007 from the California Spatial Reference Center (CSRC). The CSRC provides California Public Resources Code sanctioned positions for the CGPS Stations. The current national realization of NAD83 is the 2011 Adjustment published by the NGS and referred to as the NAD83 (2011) Epoch 2010.00 Adjustment. The CSRC published an updated adjustment of the CGPS stations in California known as the NAD83(2011) Epoch 2017.50 Adjustment. However, the above referenced NAD83 (2007) Epoch 2007.00 realization is retained by this survey to be consistent with prior reporting and the primary purpose of determining relative movements over time since the difference in epochs causes a 4.4 centimeter shift per year.

Reference Network: This survey is referenced to the CGPS Stations PVE3, PVHS, PVRS & VTIS shown and listed below. For more information see NGS Data Sheets for the PID's listed below and the CSRC website.

CGPS Stations (north up)

NAD83 (2007) Epoch 2007.00 - Units: Feet

CGPS	Latitude(dms)	Longitude(dms)	EH(feet)	NGS PID	NAME
PVE3	33 44 35.853290	-118 24 15.269036	235.42	None	PALOS VERDES CORS
PVHS	33 46 46.020150	-118 22 19.741258	853.99	AJ1915	PENINSULA HIGH SCH
PVRS *	33 46 25.891904	-118 19 14.067218	198.63	AJ1916	PALOS VERDES RES
VTIS	33 42 45.489584	-118 17 37.712290	197.52	AJ1936	MARINE EXCHANGE

* Falls in the proximity of a Fault Line as shown above but appears unaffected to date
Note: Some Stations are occasionally off-line during a monitoring campaign as stated in the reports.

Vertical Datum: The North American Vertical Datum of 1988 (NAVD88) established by the NGS.

Reference Network: CGPS Station VTIS is also a Second Order leveled benchmark and the original basis for the elevations in this survey. The Elevations of CGPS stations following.

CGPS	NAVD88 Ht. (Feet)	
PVE3	235.421	Determined by this Survey based on VTIS and agreeing with NGS BM at Hawthorne & PVDS
PVHS	972.1	Based on a Refined Geoid Model
PVRS	316.37	Based on Second Order Leveling by CSRC
VTIS	315.26	Based on Second Order Leveling by CSRC and the basis for NAVD88 for this survey

Geoid Model: Geoid03 was the available model at the time of the initial 2007 survey. The Geoid09 Model became available from the NGS in 2009 and Geoid12B in 2012; however, Geoid03 is retained to be consistent with prior reported heights and the primary purpose of determining relative height changes over time.

Projection: Plane coordinates are NAD83 California State Plane Coordinates Zone 5 in US Feet: The State Plane Coordinate Parameters follow: The average Scale Factor is 1.00007543 and the Height Reduction Factor based on the average ellipsoid heights is 0.99999092, therefore the average Combined Grid Factor is 1.00006635. Distances in this survey are grid. To obtain ground distances divide grid distances by the above Combined Grid Factor. Grid bearings resulting from this survey must be rotated by a Convergence Angle to obtain geodetic (true) bearings. The average convergence angle is -0°12'-30"± (rotate left 0°12'30").

Datum Stability: The City of Rancho Palos Verdes sits on the Pacific Plate which in this vicinity is moving west-northwesterly relative to the North American Plate about 4.4 centimeters (0.14 feet) per year. The area southwesterly of the Fault Line shown on the above map includes the City and is moving at a near constant rate as exhibited by the International Terrestrial Reference Frame (ITRF) north, east and up velocities of the CGPS Stations obtained from SOPAC and listed below.

	ANNUAL VELOCITIES (mtrs)			ANALYSIS PERIOD	
SITE	N	E	Up	START - DATE	- END
PVE3	0.019	-0.040	-0.000	2000.73	2019.36
PVHS	0.019	-0.040	0.000	1999.51	2019.36
PVRS	0.019	-0.039	0.000	1999.09	2019.36
VTIS	0.019	-0.039	-0.001	1998.94	2019.36

These CGPS Stations surround the Portuguese Bend Landslide and provide a rigid reference frame from which to validate the stability of the monitoring network during each survey campaign. See the MSC September 2007 Monitoring Survey Report and the adjustment results below for validation of network stability.

FIELD SURVEYS, DATA COLLECTION, EQUIPMENT & PROCESSING

Two Leica GS15 geodetic GNSS receivers/antennas listed below were mounted on two-meter fixed height poles to collect satellite signal data. The receivers tracked the Global Navigation Satellite Systems (GNSS) consisting of Navstar GPS, GLONASS, and Galileo satellites. A calibration of the poles was conducted to verify their heights and plumb are within 0.003 feet (1 mm) consistent with prior years. There were no equipment failures.

65 monitoring points were occupied and reported in this October 2018 survey. Site photographs and recovery sheets detailing the location, character of the monuments and obstructions were updated. See the Appendix for

"Monitoring Point Status". Point AB61, established in September 2007 sits on Portuguese Point above a stable basalt formation and was used as the primary base station up through October 2018. In January 2019, Point AB20 became the primary base station because of its central location, secured access and no impact on the eco-system; however, future surveys will continue to be referenced to AB61 and PVE3 as described herein.

The October 2018 field survey commenced each day by setting a Leica GS15 GNSS receiver in static mode on a fixed height pole at AB61. A roaming GS15 operating in static mode collected observations on a fixed height pole at the remaining 64 points.

Points with annual movements less than 5 centimeters were measured with two or more independent occupations by each roving receiver resulting in a minimum of two vectors to each point from AB61. An independent occupation means the points were occupied under a different constellation of satellites usually on a different day. Residuals in the measured vectors within 0.03 feet (1 cm) horizontally are accepted, otherwise additional measurements are required. Experience has shown the measurements generally agree less than 0.02 feet. The CGPS stations were connected with nine 2-7 hour observations collected over eight days. Points in the active areas with annual movements greater than 5 centimeters were single occupied by each roving receiver and a comparison with the linear movements from prior years was made to verify the measurement accuracy. AB12 was single occupied due to restricted access. AB12 will be replaced with AB70 in the October 2019 Survey.

Trees and foliage that over-shadow points interfere with signals received from satellites and affect the quality of measurements. To obtain the best possible accuracies, the varying satellite constellation is compared with obstruction diagrams to estimate the best time for observing the greatest number of satellites. To improve the accuracy of the measurements, satellites that are obstructed by trees and foliage are either turned off during the observation or noted for removal in post-processing. Generally, 12 or more un-obstructed satellites are available supporting a static type solution based on 15 minutes of data collection. If the satellite geometry and number of satellites are insufficient then the receiver is moved to another point and returned later when satellite availability improves.

Date of Survey: M22's 09/12-13/18 and 10/07-13/18 (mean date 10/10/2018) between 0700-1800 PDST (+7 hrs for UTC).
GNSS Survey Parameters:
Constellation: 31 US NAVSTAR GPS satellites, 24 Russian GLONASS and 13 Galileo Satellites.
Observables: L1 & L2 Carrier Waves on GPS and GLONASS, and four Carrier Waves on Galileo Satellites
Epoch Rate - Occupation Times: 15 second epoch rate for 15 minute occupations at monitoring points and nine 2-7 hour occupations at the base station AB61.
Satellites: 15-24; GDOP =< 3; Elevation Mask for Data Collection at 15°
Ephemeris: Precise for Static Post-Processing of CGPS baseline connections and Broadcast for onsite baselines.
Weather: Mostly clear skies, temperature 66°-75° F, no significant weather.
Space Weather: Boulder K Index 2-5 averaging 3 (gauges ionospheric activity on a scale of 0-9; less than 6 preferred)
Equipment:
GNSS Base Receiver Unit No.: M8, Operator: M. McGee, PLS; Occupied Base Station: AB61
Make & Model: Leica GS15 with integrated Antenna; Mount: Fixed Height Pole #1; Antenna Height: 1.801m
GNSS Rover Receiver Unit No.: M9, Operator: M. McGee, PLS
Make & Model: Leica GS15 with integrated Antenna; Mount: Fixed Height Pole #3; Antenna Height: 1.800m

Rinex files (satellite observations) for the CGPS Stations were downloaded from the SOPAC website. Vectors were processed using Leica Infinity v3.0 post processing software with Absolute Antenna Models obtained from the NGS website. Network adjustments and analysis were performed with "Starnet-PRO" version 9.1.4.7868 Software.

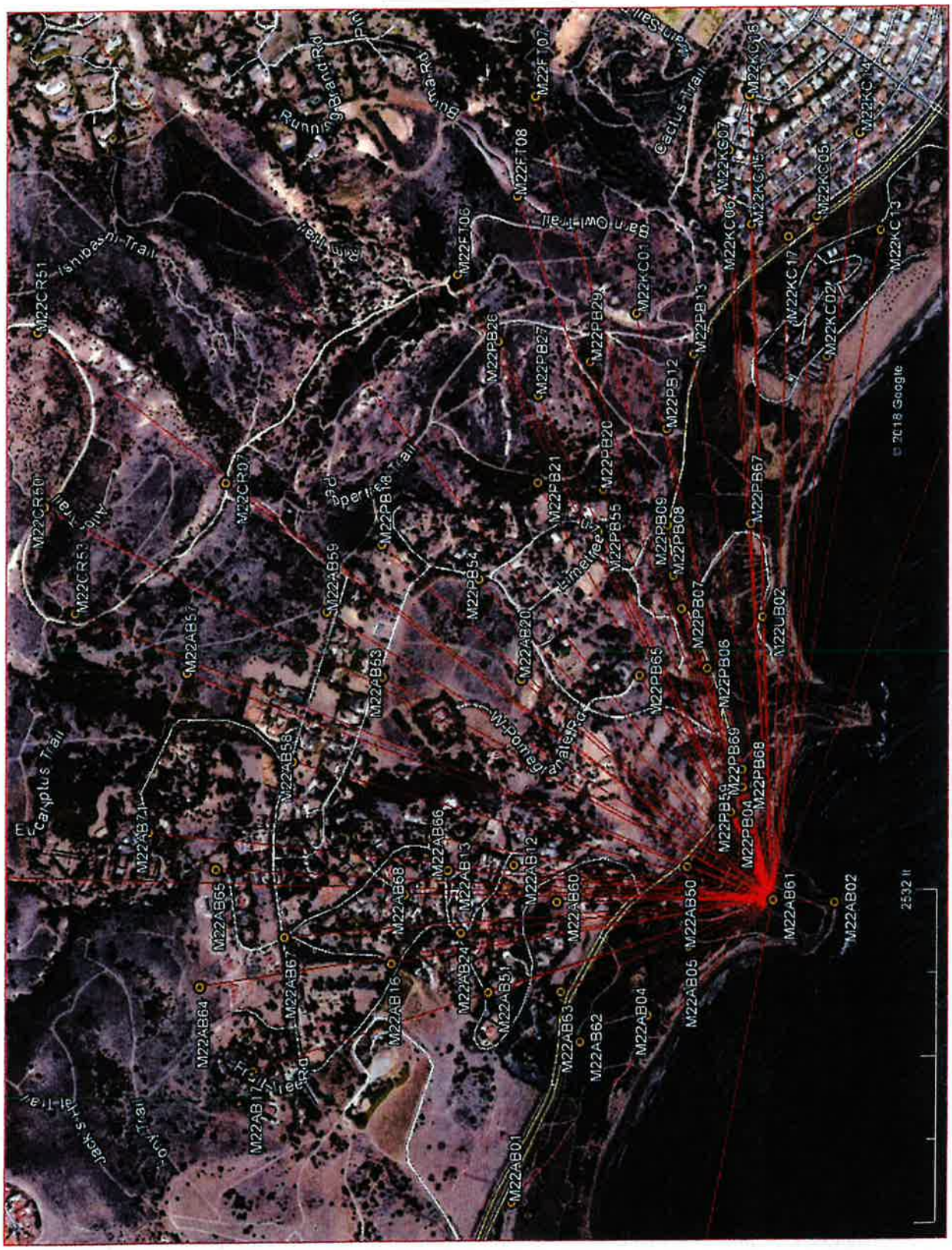
NETWORK

AB61 is the primary Base Station situated on Portuguese Point a relatively stable location and the focal point of the network connecting the monitoring points and CGPS Stations. Sixty-five points and four CGPS Stations were connected with 140 measured vectors. See the following Aerial Network Maps.

The monitoring plan utilizes the CGPS Stations to verify the stability of the reference frame. PVE3 is the primary CGPS Station used to control this survey. PVE3 is located south of RPV City Hall and 1.8 miles west-northwest of Base Station AB61. CGPS Stations PVE3, PVRS and VTIS are used to validate the stability of the network. Note: Some Stations are occasionally off-line during a monitoring campaign as stated in the reports.

CGPS Stations & Monitoring Network (north left)

Monitoring Network



MONITORING POINT HISTORY & STATUS

The October 2018 survey is the 22nd Monitoring Survey. For data management purposes during the field survey and data processing, the point names are prefixed with a sequential number to distinguish between monitoring surveys. For example, on the 16th monitoring survey AB61 was named M16AB61 where M16 indicates the sequence number since the initial M01 September 2007 Monitoring Survey. The prefix is stripped in the "COORDINATES LIST" and "PB MOVEMENT DATA POSTING" documents.

2007: Between 1994 and 2006, 149 monitoring points were established to monitor the Portuguese Bend Landslides, many of which were lost or destroyed. Sixty of the original points were recovered in 2007. Eight of the 60 points were deleted because they were near other points better suited for GNSS satellite measurements leaving 52 original points monitored in September 2007 and movements reported between September 2006 and September 2007. Three of the 52 points (AB09, KC11 & PB51) were monitored in September 2007 for the last time and replaced by new points set nearby and better suited for satellite observations. Eighteen new points were set and surveyed in 2007 and had their movements reported for the first time in the following December 2008 survey.
2008: In December 2008, 49 original and 18 new points were surveyed for a total of 67 monitoring points. In December, it was noted that AB05 had been disturbed by a mowing machine. AB05 was found chipped and leaning to southerly about 0.4'. The movement reporting resumed in 2009. Analysis of the movement and historic data made it possible to estimate the disturbance to within 0.05'. The original 1995 position of AB05 was re-referenced S14°E 0.29' to be consistent with the disturbed position, resulting in correct overall reported movements. Note, KC01 was previously reported by others on 9/14/2006 to have moved N 29°E 1.24' from its 12/09/2005 position. In September 2008, this survey found a buried partially illegible brass cap in concrete stamped "COUNTY ENGINEER RE8869 1956 STA ??IELDS" S31°W 1.48 feet from the 1" IP used by on the 2005 and prior surveys. Since the initial September 2007 MSC survey used the 1" IP all subsequent surveys will use said pipe for consistency. The original 1994 position of KC01 (brass cap) was re-referenced to the 1" IP, resulting in a correct overall movement as reported by this survey.
2009: PB64 was set east of the Archery Range to replace PB63 (set in 2007) which had become unsafe to access and was lost in 2010. PB64 was reported for the first time in October 2010.
2010: Points AB03 and BB25 were discontinued. AB03 is on the edge of a cliff 192 feet west-southwest of AB61 making it redundant, and BB25 is on a freestanding rock susceptible to disturbance by wave action. In the summer of 2010, PB62 was destroyed by road construction and in October 2010, PB65 was set 24' south-southwest of PB62's location and reported for the first time in October 2011. The following points may have been disturbed prior to the October 2010 survey: AB05 appears to have been disturbed by mower machinery, AB15 (½" GIP in a meter box) is driven over by vehicles occasionally accessing an adjacent field, and KC02 (½" GIP in a meter box) is occasionally parked on by vehicles accessing the beach.
2011: In October, new points AB62 and AB63 (initially referred to as AB62R and AB63R) were set to replace AB06 and AB07 which were hazardous to occupy due to their location near the traveled way of Palos Verde Drive South.
2012: In September, prior to initiating the survey, eight new monuments AB64, AB65, AB66, AB67, AB68, CR53, KC17 and PB66 were constructed to replace AB54, AB18, AB52, AB55, AB15, CR52, KC04 and PB53 respectively. The monuments were replaced because of poor sky visibility except for KC04 which was difficult to access and AB55 which was destroyed by trenching in the past year. Monuments were set with the following design as noted in the "Point Descriptions". Monuments set in soil are 1" x 5' GIP driven flush and encase in a 6" PVC pipe sitting on a concrete collar down 12-18". Monuments set in asphalt are 1/2" x 2' rebar driven below the surface inside a free floating 2" plastic collar encased in concrete. Points AB15, AB18, AB52, AB54, CR52, KC04 and PB53 were monitored (surveyed and reported) for the last time in 2012 and discontinued.
2013: BB52 is on a freestanding rock susceptible to disturbance by wave action and was monitored for the last time in October and discontinued.
2014: In April PB64 was monitored for the last time due to unsafe access conditions and PB67 (a 5' t-bar steel post driven 3' into the ground) was set north-northwesterly about 250' as a replacement and reported for the first time in September 2014 after 4.5 months whereas all other points in the "PB MOVEMENT DATA POSTING" are reported for 11.5 months since October 2013. In September, AB69 located about 260' NE of AB12 and

AB70 located about 150' SE of AB12 were set as potential replacements; however, AB69 was destroyed by lot improvements and AB70 proved to be too obstructed for accurate results.
2015: In April, new points PB68, PB69 and PB70 were set to monitor movements of "Palos Verdes Drive South" and reported in October. In October, Monitoring Point AB56 was found disturbed by construction and AB71 (magnetic nail in AC) was set as a temporary replacement. In October, the steel post for PB67 was not found (removed by others) therefore an inconspicuous ½" x 4' rebar was set flush in its place. Because of the large movement in this area a more permanent monument is not necessary.
2016: In October, the temporary point set for AB71 in October 2015 was determined to have been destroyed by road work. AB71 was reset 12' easterly with a 2" screw and brass washer drilled into a granite curb on the south side of Vanderlip Road. Movement information will be available in the fall of 2017.
KC16 was raised about 0.29' to the surface of the road by others between the two occupations in October 2016.
2017: Movement of AB71 (replacement for AB56) reported for the first time in October.
2018: KC14 was raised 0.19' to the surface of the road by others on 11/15/17. PB25 was deleted from the monitoring since PB26 nearby provides the similar movement information.
2019: AB12 is difficult to access because it is in a horse corral and on private land. AB70 was set in 2014 as a future replacement for AB12 in a cul-de-sac at the southeast end of Figtree Road. AB70 is an obstructed site; however, improvements in receiver technology now make accurate measurements possible; therefore, AB70 was measured May 20, 2019 and found to be S33-30E 148.26' and 29.1' lower than AB12. The velocity of AB12 over the last 4.2 years was S24W 0.12' per year and at AB70 was S25W 0.09' per year. AB70 will be substituted on future surveys.

ADJUSTMENTS & ANALYSIS

Adjustment 1: An adjustment to develop NAD83 (2007) 2007.00 Epoch Latitude, Longitude, Ellipsoid Heights and State Plane Coordinates. CGPS Station PVE3 was fixed at its published NAD83 (2007) Epoch 2007.00 position listed above in a Minimally Constrained Adjustment to determine positions of points in this survey and verify its stability relative to other CGPS stations. PVE3 is located 1.8 miles westerly of and outside the influence of the slide area and has been fixed in all adjustments since 2007. The SOPAC published Time Series indicates the horizontal and vertical position of PVE3 is stable. The on-site base station(s) and other operating CGPS Stations are measured relative to PVE3 and used to assess stability of the survey reference frame. The results are listed in the Coordinate List in the Appendix. Differences between surveys for key points are listed in the table below in feet.

Original 9/2007 Positions to 10/10/2018

ID	dN	dE	dZ	
AB01	0.013	-0.084	-0.039	
AB17	-0.025	-0.024	-0.074	
AB61	-0.017	-0.003	-0.008	
CR50	-0.035	-0.017	-0.053	
CR51	-0.033	0.006	-0.183	
KC16	-0.001	-0.004	0.311	
PVE3	-0.000	-0.000	-0.000	< Fixed
PVHS	-0.004	0.010	-0.000	
PVRS	-0.007	0.023	-0.009	
VTIS	0.004	0.001	-0.014	

10/04/2017 Positions to 10/10/2018

ID	dN	dE	dZ
AB01	-0.002	0.004	-0.096
AB17	0.001	-0.010	-0.104
AB61	-0.008	-0.010	-0.083
CR50	-0.002	0.004	-0.060
CR51	0.003	-0.001	-0.096
KC16	0.013	0.003	-0.070
PVE3	-0.000	-0.000	-0.000
PVE3RP	0.008	-0.009	0.003
PVHS	-0.002	-0.006	0.035
PVRS	0.001	0.006	-0.022
VTIS	0.004	-0.009	-0.014

Comments: There are no significant horizontal differences at the Base Station AB61 compared to the October 2017 and 2007 surveys. Given that PVE3 agrees with AB61 and the other CGPS Stations, the survey reference frame is deemed stable and successfully recovered. The vertical differences between 2017 and 2018 will have to be analyzed by the City Geologist; however, this survey included sufficient redundant measurements to assure the differences reported here with the accuracy requirement. An adjustment constrained to the other CGPS Stations is not necessary because the purpose here is to track the relative monitoring point movements over time

and test the stability of the monitoring network reference frame. See the appended "COORDINATE LIST" and prior Survey Reports for prior years coordinate lists.

Adjustment 2: An adjustment to develop NAVD88 Orthometric Heights (Elevations). The CGPS Station PVE3 was fixed horizontally at its NAD83 position and vertically at its NAVD88 Height determined in the September 2007 Survey. The 2007 Height was based on the published 2nd Order NAVD88 Height of CGPS Station VTIS. This Adjustment combines the measured ellipsoid height differences with the NGS Geoid03 Model (models the separation between the ellipsoid and geoid surfaces) to determine the NAVD88 orthometric heights of the CGPS Stations and monitoring points. See the appended Coordinate List for NAVD88 Heights.

ACCURACY

This survey conforms to the intent of the California Spatial Reference Center and California Lands Surveyors Association's "GNSS Surveying Standards and Specifications, 1.1" (2014) and the Federal Geodetic Control Subcommittee (FGCS) "Specifications for GPS Relative Positioning" (1988).

Vector Residuals: The vector lengths, two dimensional residuals and the absolute value of the vertical residuals are listed below in feet. Vectors to single occupied points are excluded to avoid optimistically skewing the results; however, the statistics given below are applicable to all measurements. Analysis of residuals resulting from minimally constrained Adjustment #1 led to the rejection of 10 of 33 vectors connecting the CGPS Stations to the Base Station and 8 out of 107 on-site vectors connecting the Base Station to Monitoring Points.

	Vector Lengths		Two Dimensional Residuals			Vertical Residuals (absolute)		
Network	Vary	Average	Average	Std.Dev.	Maximum	Average	Std.Dev.	Range
Mon. Pts	13-9396	3972	0.009	0.006	0.029	0.008	0.008	-0.034 to +0.024
CGPS	9397-26102	16935	0.010	0.007	0.034	0.004	0.016	-0.029 to +0.032

Movement Accuracy: The relative movements reported between October 4, 2017 and October 10, 2018 (12.2 months) statistically attained an average accuracy of 0.03 feet at the 95% Level of Confidence. The actual accuracy of measurements held to the "one-centimeter standard" are estimated to be less than 0.02 feet as demonstrated by the vector residuals, repeatability of measurements at points considered stable, and deflection analysis. Refer to the sections titled ACCURACY and QAQC ANALYSIS in this Report for more information.

As a matter of information, the probability at the 95% level of confidence is that movement (signal) has occurred at a point when the horizontal distance between two epochs is greater than the 95% Error (noise). No movement is considered detected unless the movement exceeds the 95% Error for individual points. See the attached "PB MOVEMENT DATA POSTING 2007-2018.10.xlsx" for the relative movements and the estimated error at the 95% Level of Confidence for individual points.

NAVD88 Heights: The North American Vertical Datum of 1988 orthometric heights resulting from Adjustment #2 are derived from the difference in ellipsoid heights combined with the Geoid03 Model and constrained to the NAVD88 height of PVE3. The NAVD88 Height was determined in 2007 based on the second order orthometric height of CGPS Station VTIS. The relative accuracy of the heights is expected to be 0.03 feet, or greater at obstructed sites. The absolute accuracy of the heights relative to the datum is dependent on the published orthometric height on the Station VTIS. Up until October 2011 there were no specific requirements for vertical accuracies. In October 2011, a 0.03-foot relative vertical accuracy preference was introduced for points AB17, AB57, CR07, CR50 and CR51. In the September 2012 and subsequent surveys, the preference was extended to include all points.

QUALITY CONTROL - QUALITY ASSURANCE (QAQC) ANALYSIS

To ensure the accuracy and validity of the measurement systems used in these GNSS monitoring surveys, an independent test was conducted in 2007 using conventional terrestrial based instruments as reported in the "QAQC ANALYSIS" section of the September 2007 Monitoring Survey Report. Comparing the results of the GNSS systems with conventional instrumentation found horizontal measurements agreed 0.01 feet on average. In November 2011, the GNSS instruments and fixed height poles used in this survey were calibrated on the National Geodetic Survey's Santa Maria Baseline and found to agree 0.003 to 0.006 feet with the published distances. In February 2018, the GNSS instruments and fixed height poles were calibrated on the NGS Camarillo Baseline and found to agree 0.003 feet with the published distances.

To validate the radial survey method used in these surveys to position points from base stations AB61 and/or AB20, independent GNSS intra-net cross connections were measured and compared with the stand alone computed inverse distances in the 2007, 2008 and 2009 surveys. The results found the two-dimensional accuracy to agree 0.01 feet on average, indicating the radial method of measurements is reliable. Therefore, the additional labor cost of measuring cross connection between points is of no benefit when it comes to the integrity or accuracy of these surveys. See the "QAQC ANALYSIS" section of the September 2007 and the December 2008 Monitoring Survey Reports for detailed analysis.

Deflection Analysis is a method established by this surveyor to assess the consistency of the direction of movements reported from period to period with the overall. Assuming that movements are generally linear, the separation or the deflection from the overall direction to the present direction is an implication of the accuracy obtained with these procedures since the expectation is zero (no deflection). Analysis of the individual movement deflections finds the implied accuracy varies 0.01 to 0.02 feet.

SUMMARY

Point movement ranges by landslide zones are listed below in feet:

```
(AB##) 0.00 to 0.11
(CR##) 0.00 to 0.06
(FT##) 0.02 to 0.12
(KC##) 0.01 to 0.08
(PB##) 0.07 to 1.34 and 3.94 at PB67
(UB02) 0.97
```

See the Appendix for a graphic of the horizontal movements depicted by 1" and 1' contours.

See the attached " PB MOVEMENT DATA POSTING 2007-2018.10.xlsx " spreadsheet for overall and periodic movements of each point. The movements are given in north, east and up or down as well as a vector of distance and direction relative to north. The direction is given as an azimuth in degrees where 0° is north and increases clockwise (90° East, 180° South, 270° West). The overall movements listed in the spreadsheet are from the date when a point was established to the present survey.

RECOMMENDATION

Re-locating obstructed monuments has long term benefits resulting in better accuracy and lower cost surveys due to improved sky visibility for tracking satellites; however, alternate locations are not always suitable for geological analysis. Points AB16, AB17, AB24, AB58 and PB18 have limited sky visibility and would benefit from tree trimming. PB18 was completely overgrown in May 2019 and the adjacent shrubbery and Pepper Tree must be cleared.

ATTACHMENTS

The following document is attached to this Report: "PB MOVEMENT DATA POSTING 2007-2018.10.xlsx" listing the coordinates of the initial positions and all subsequent monitoring surveys with the overall and periodic movements of monitoring points since 2007.

SURVEYOR'S STATEMENT

This is a Report on the procedures, criteria and results of the City of Rancho Palos Verdes Portuguese Bend Landslide Monitoring Surveys. This Report includes the Initial Fall Survey, the Second Winter (Addendum No.1) and the Third Spring Survey (Addendum No.2). This survey was conducted and the report prepared by me at the request of Ron Dragoo, Principal Engineer of the City of Rancho Palos Verdes.

Michael R. McGee P.L.S. 3945 — Date 6/11/2019

APPENDIX

13- Table of Horizontal and Vertical Movements
14- Aerial Photo of Monitoring Points with Movements and Contours
15- Monitoring Point Status
16- Coordinate List for the Oct. 10, 2018 Survey: NAD83 (2007) Epoch 2007.00 Geodetic, Grid, NAVD88
17- ADDENDUM No. 1: Second Survey – January 29, 2019 Partial Monitoring Survey No. 23
17- ADDENDUM No. 2: Third Survey – May 7, 2019 Partial Monitoring Survey No. 24
18- Table of Partial Monitoring Survey Horizontal and Vertical Movements

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Table of Annual Movements of Monitoring Points

Portuguese Bend Landslide Monitoring

Horizontal and Vertical Movements in Feet

October 4, 2017 to October 10, 2018 - 12.2 Months

Listed below are the horizontal movements and vertical (elevation) changes during the above annual period. See the attached spreadsheet titled "PB MOVEMENT DATA POSTING 2007-2018.10.xlsx" for more details and a history of movements. Note: The measurement confidence is 0.02' (1/4"); therefore, movements of 0.02' or less are deemed to have not moved.

Point ID	Horizontal Movements	Vertical Changes	Point ID	Horizontal Movements	Vertical Changes
AB01	0.00	-0.10	KC01	0.08	-0.10
AB02	0.01	-0.07	KC02	0.04	-0.09
AB04	0.11	-0.11	KC05	0.03	-0.09
AB05	0.09	-0.10	KC06	0.03	-0.08
AB12	0.08	-0.09	KC07	0.01	-0.07
AB13	0.05	-0.15	KC13	0.02	-0.12
AB16	0.02	-0.13	KC14	0.01	-0.05
AB17	0.01	-0.10	KC15	0.03	-0.09
AB20	0.06	-0.09	KC16	0.01	-0.07
AB24	0.06	-0.09	KC17	0.02	-0.10
AB50	0.05	-0.11	PB04	0.34	-0.21
AB51	0.04	-0.14	PB06	0.42	-0.11
AB53	0.05	-0.11	PB07	0.54	-0.11
AB57	0.07	-0.12	PB08	0.44	-0.07
AB58	0.06	-0.14	PB09	0.62	-0.20
AB59	0.08	-0.16	PB12	1.34	-0.39
AB60	0.04	-0.11	PB13	0.94	-0.16
AB61	0.01	-0.08	PB18	0.07	-0.15
AB62	0.11	-0.08	PB20	1.18	-0.38
AB63	0.07	-0.12	PB21	0.60	-0.27
AB64	0.02	-0.12	PB26	0.11	-0.10
AB65	0.02	-0.16	PB27	1.27	-0.34
AB66	0.04	0.02	PB29	0.92	-0.37
AB67	0.02	-0.09	PB54	0.08	-0.12
AB68	0.04	-0.11	PB55	0.54	-0.32
AB71	0.04	-0.12	PB59	0.55	-0.31
CR07	0.06	-0.14	PB65	0.13	-0.12
CR50	0.00	-0.06	PB67	3.94	-0.69
CR51	0.00	-0.10	PB68	0.29	-0.24
CR53	0.01	-0.09	PB69	0.30	-0.20
FT06	0.12	-0.15	PB70	0.26	-0.37
FT07	0.08	-0.06	UB02	0.97	-0.08
FT08	0.02	-0.08			

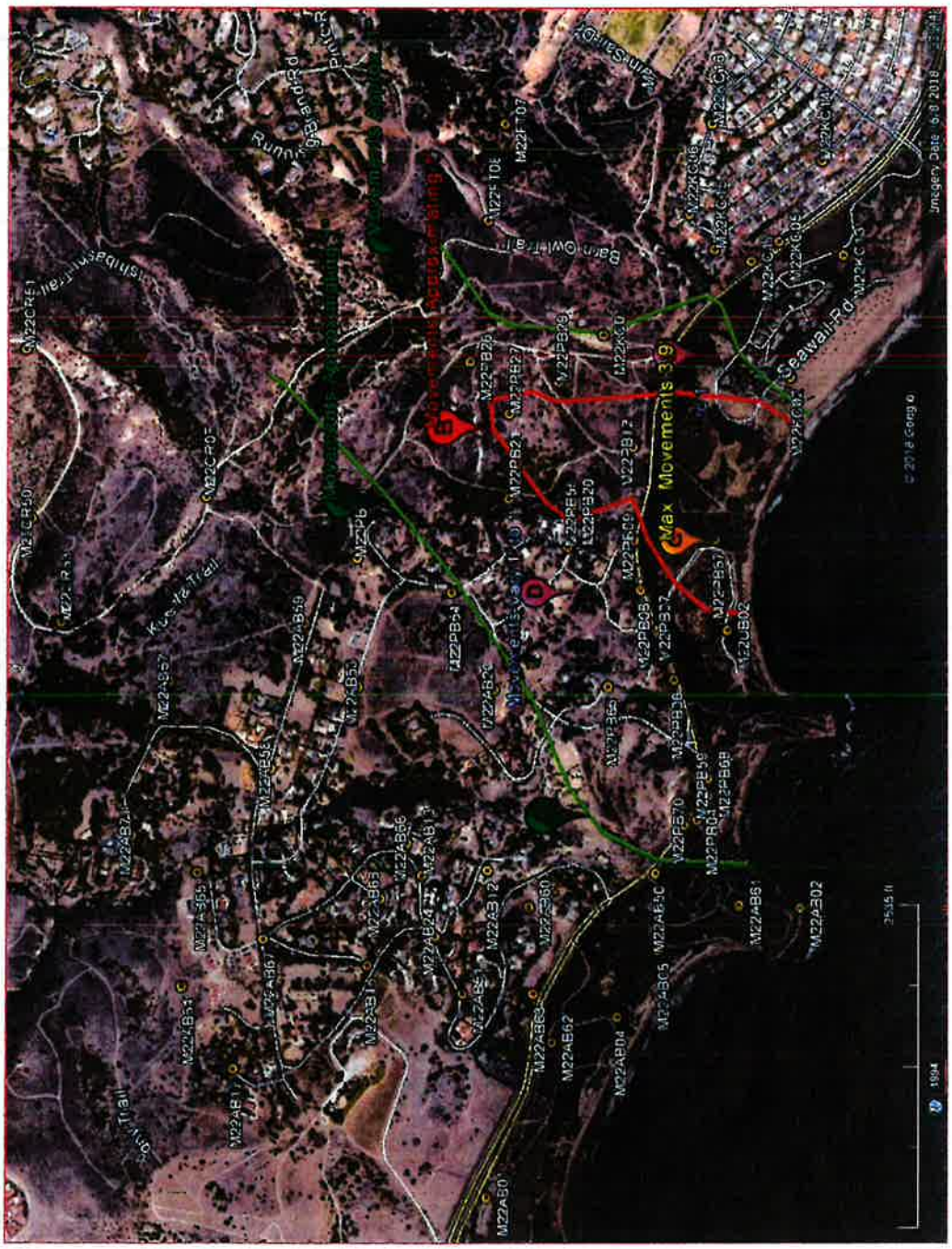
Aerial Photo of Monitoring Points with Movements

(north is left)

General Depiction of Horizontal Movements - October 4, 2017 to Oct. 10, 2018

(Generalized depiction of movements and not to be used for planning or development purposes)

A = Approximate 1-inch Contour Movement Line
B = Approximate 12-inch (1 foot) Contour Movement Line
C = Maximum Measured Movement of 3.9 feet
D = Movements Vary 1 inch to 1 foot between Contours Lines A & B, 1 inch or less outside of A



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RANCHO PALOS VERDES - PORTUGUESE LAND SLIDE MONITORING POINT STATUS -Updated 06/11/19

Annual Obs. Date	Comments
09/01/07	71 Points Surveyed 60 old points found with 52 monitored plus 19 new points
12/01/08	67 Points Surveyed AB09, KC11, PB51 discontinued; BB53 destroyed; AB05 disturbed
11/01/09	68 Points Surveyed Set PB64 to replace PB63 destroyed subsequently
10/01/10	65 Points Surveyed Discontinued AB03, BB25; set PB65 to replace PB62 destroyed by paving
10/03/11	69 Points Surveyed; Set AB62 & AB63 to replace AB06 & AB07
09/14/12	72 Points Surveyed; Discontinued AB06, AB07; AB55 destroyed by trenching; Added 8 new points
10/06/13	65 Points Surveyed; Discontinued AB15, AB18, AB52, AB54, CR52, KC04, PB53
09/19/14	64 Points Surveyed; Discontinued BB52, PB67 set in April 2014; Added PVE3RP (reference to PVE3 antenna)
10/08/15	66 Points Surveyed; AB56 Destroyed & Replaced by AB71A; PB68, PB69, & PB70 Set in April 2015
10/05/16	66 Points Surveyed; AB71A Destroyed & Replaced by AB71;
10/04/17	66 Points Surveyed; 30 Points to Survey in Feb 2018 and April 2018
10/10/18	65 Points Surveyed; 30 Points to Survey in Jan 2019 and May 2019

Pt ID	Comments	GNSS	Pt ID	Comments	GNSS
AB01	Base Station 1994-2006	G	KC01	NE'ly/2 monuments 1.5' apart, Access Issues	G
AB02		G	KC02		G
AB04		G	KC05		G
AB05		G	KC06		G
AB12	To be replaced by AB70 Oct. 2019	G	KC07		G
AB13		F	KC13		G
AB16		P	KC14	Raised 0.19' by others 11/2018	G
AB17		F	KC15		F
AB20	Base Sta.. 2018->	G	KC16	Raised 0.29' by others 10/2016	G
AB24		F	KC17	Replaced KC04	G
AB50		G	PB04		G
AB51		G	PB06		G
AB53		F	PB07		G
AB57		G	PB08		G
AB58		P	PB09		G
AB59		G	PB12		G
AB60		G	PB13		G
AB61	Base Sta.. 2007-2018	G	PB18	Overgrown	P
AB62		G	PB20	S'ly/ 2 monuments 5.3' apart	G
AB63		G	PB21		F
AB64		G	PB25	Deleted Oct. 2018	G
AB65		G	PB26		F
AB66		G	PB27		G
AB67		G	PB29		G
AB68		G	PB54		F
AB71	Replaced AB56 10/2016	F	PB55		F
CR07		G	PB59		G
CR50		F	PB65		G
CR51		G	PB67		G
CR53		G	PB68		G
FT06		F	PB69		G
FT07	Access Issues	G	PB70		G
FT08		G	UB02		G
			PVE3RP	Reference to CGPS Sta. PVE3	G

GNSS column indicates site is Good, Fair or Poor for Satellite Visibility Conditions

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10/10/2018 COORDINATE LIST

Portuguese Bend Landslide 10/10/2018 Monitoring Survey No. 22
Prepared by McGee Surveying Consulting: Document Date 06/11/2019, Revised Ortho Hts 07/09/19

Datum: Horizontal & EH are NAD83 (2007) 2007.00 Epoch; California State Plane Zone 5; Vertical: NAVD88
Note, Fixed CGPS Station PVE3 at Record 3D Position & NAVD88 Height per September 2007 Survey;
See 2007 and subsequent Survey Reports

Point	Latitude	Longitude	EH(ft)	North(ft)	East(ft)	OrthoHt(ft)	Description
AB01	33-44-38.30262	118-22-53.05186	60.104	1729427.561	6445709.557	178.586	Punched 1/2" GIP in meter box
AB02	33-44-13.84878	118-22-26.19243	-2.027	1726946.974	6447968.685	116.468	4" BC "SAN PEDRO 1936" on conc. block
AB04	33-44-28.08740	118-22-36.29136	-51.326	1728389.556	6447121.139	67.131	BC "CO ENG STA Q2.." on 2"GIP in mass of conc.
AB05	33-44-24.98778	118-22-30.09445	-38.009	1728074.255	6447643.327	80.437	BC "CO ENG STA Q3.." on 2"GIP in mass of conc.
AB12	33-44-38.27207	118-22-22.72226	164.812	1729414.862	6448270.932	283.156	BC "CO ENG STA 7A.." in mass of conc.
AB13	33-44-43.34312	118-22-23.16215	246.062	1729927.637	6448235.685	364.383	Punched 1/2" GIP in meter box
AB16	33-44-47.57859	118-22-31.51215	258.044	1730358.430	6447532.124	376.381	Punched 1/2" GIP in meter box
AB17	33-44-58.06059	118-22-41.08432	324.389	1731421.095	6446727.749	442.722	Punched 1/2" GIP in meter box
AB20	33-44-37.77169	118-22-05.96679	277.933	1729359.059	6449685.775	396.204	BC "CO ENG STA W. FIX 1956.." in mass of conc.
AB24	33-44-42.35164	118-22-28.79605	217.345	1729829.177	6447759.527	335.697	Cotton spindle in conc. In road
AB50	33-44-25.10987	118-22-22.94795	63.567	1728084.352	6448246.934	181.986	Nail in conc. collar of well
AB51	33-44-40.22836	118-22-34.15244	186.685	1729616.222	6447306.374	305.068	PK mag nail in plastic plug "LS6957" in 1"GIP
AB53	33-44-48.36522	118-22-05.70084	234.552	1730429.887	6449712.158	352.773	Chiseled + on s edge conc. Vault
AB57	33-45-03.16768	118-22-05.20509	446.464	1731926.129	6449759.504	564.621	6" mag nail & washer in conc. in 2"x 36" GIP
AB58	33-44-55.14168	118-22-13.27639	287.290	1731117.277	6449074.935	405.515	Punched RR spike on s side road
AB59	33-44-52.53717	118-21-59.79470	315.889	1730849.811	6450212.464	434.066	6" mag nail & washer in conc. in 2"x 36" GIP
AB60	33-44-35.03927	118-22-26.06645	60.946	1729089.104	6447987.294	179.322	6" mag nail & washer in conc. in 2"x 28" GIP
AB61	33-44-18.57302	118-22-25.95810	21.990	1727424.479	6447990.253	140.458	6" mag nail & washer in conc. in 2"x 24" GIP
AB62	33-44-33.22730	118-22-38.63351	24.518	1728909.896	6446925.285	142.957	6" mag nail & washer in conc. in 1"x 24" GIP
AB63	33-44-34.71525	118-22-34.12239	62.288	1729058.887	6447306.826	180.698	Punched 1/2 x 40" rebar
AB64	33-45-02.13621	118-22-33.46040	413.879	1731830.688	6447373.101	532.160	2" mag nail on NE side 2' conc. Collar/Well B12
AB65	33-45-00.93065	118-22-22.90363	340.232	1731705.496	6448264.115	458.474	2" mag nail & washer in conc. in 1"x 60" GIP
AB66	33-44-44.53342	118-22-20.15045	255.993	1730047.022	6448490.470	374.296	1/2"x 24" punched rebar 1" below AC/collar
AB67	33-44-55.71620	118-22-29.06610	286.975	1731180.298	6447741.758	405.267	1/2"x 24" punched rebar 1" below AC/collar
AB68	33-44-46.61069	118-22-25.31254	275.041	1730258.633	6448055.312	393.357	1/2"x 24" punched rebar 1" below AC/collar
AB71	33-45-06.07024	118-22-19.51922	453.196	1732224.002	6448551.837	571.402	2"screw&brass washer"PLS3945" on VanderlipDr.
CR07	33-45-00.26674	118-21-48.09396	513.776	1731627.613	6451203.390	631.873	6" mag nail & washer in conc. in old 1" IP
CR50	33-45-13.97072	118-21-50.11950	754.551	1733013.580	6451037.357	872.607	Tack & shiner on lower rock wall
CR51	33-45-14.49684	118-21-34.43628	858.075	1733062.000	6452361.867	976.068	Tack & shiner on conc. pad
CR53	33-45-11.63350	118-21-59.73965	662.552	1732780.260	6450224.153	780.654	2" mag nail & washer in conc. in 1"x 60" GIP
FT06	33-44-42.78113	118-21-29.58706	370.304	1729854.366	6452759.917	488.389	6" mag nail & washer in conc. in 2"x 36" GIP
FT07	33-44-36.86787	118-21-13.66370	470.487	1729251.825	6454102.549	588.530	6" mag nail & washer in conc. in 2"x 36" GIP
FT08	33-44-38.19499	118-21-22.57468	540.327	1729388.643	6453350.473	658.401	6" mag nail & washer in conc. in 2"x 36" GIP
KC01	33-44-29.13021	118-21-33.11100	194.041	1728475.441	6452457.387	312.217	6" mag nail & washer in conc. in old 1" IP
KC02	33-44-14.54586	118-21-37.05776	-104.533	1727002.286	6452118.782	13.734	Punched 1/2" GIP in meter box
KC05	33-44-15.36968	118-21-24.51039	109.253	1727081.787	6453178.808	227.454	Punched 1/2" GIP in meter box
KC06	33-44-22.33144	118-21-21.96762	181.634	1727784.797	6453396.059	299.790	Punched 1/2" GIP in meter box
KC07	33-44-22.09042	118-21-18.55895	195.305	1727759.414	6453683.857	313.447	Punched 1/2" GIP in meter box
KC13	33-44-10.41116	118-21-25.78304	72.835	1726580.906	6453069.541	191.067	Cotton spindle in AC turnout
KC14	33-44-12.03469	118-21-17.07086	141.912	1726742.425	6453805.947	260.097	Brass pin&washer "LS8773" set above spike in CL
KC15	33-44-20.39681	118-21-25.21860	168.797	1727590.198	6453120.798	286.976	Cotton spindle in cul-de-sac
KC16	33-44-20.55016	118-21-13.64610	209.087	1727602.245	6454098.230	327.215	Brass pin&washer "LS8773" set above spike in Xn
KC17	33-44-17.54890	118-21-26.32512	97.017	1727302.632	6453026.322	215.216	2" mag nail & washer in conc. in 1"x 50" GIP
PB04	33-44-20.94634	118-22-15.81599	47.124	1727661.226	6449847.713	165.533	Nail & tag "RCE26120" in conc. in 3" pipe
PB06	33-44-23.64938	118-22-05.05432	58.330	1727931.138	6449757.607	176.676	Punched cap on 2" GIP
PB07	33-44-25.62730	118-21-59.69421	78.757	1728129.433	6450211.029	197.069	Brass tag "LA CO DPW" in conc. in 2" GIP
PB08	33-44-26.27316	118-21-56.72562	76.035	1728193.812	6450461.980	194.331	Punched cap on 2" GIP
PB09	33-44-26.72963	118-21-52.15220	69.568	1728238.553	6450848.396	187.841	Punched cap on 2" GIP in cable box
PB12	33-44-26.80852	118-21-43.48951	63.459	1728243.884	6451580.032	181.693	Punched cap on 2" GIP in cable box
PB13	33-44-24.76021	118-21-36.79748	87.873	1728034.787	6452144.465	206.088	Punched cap on 2" GIP in cable box
PB18	33-44-48.40713	118-21-53.76901	244.605	1730430.449	6450719.804	362.774	Punched 1/2" GIP in meter box
PB20	33-44-31.61892	118-21-48.93357	111.831	1728731.832	6451122.013	230.056	Punched cap on 2" GIP in cable box
PB21	33-44-36.60570	118-21-48.27840	153.263	1729235.751	6451179.167	271.462	Punched cap on 2" GIP in cable box
PB26	33-44-39.63236	118-21-35.58808	164.722	1729537.863	6452251.988	282.851	Brass tag "LA CO DPW" in conc. in 2" GIP
PB27	33-44-36.59731	118-21-40.42530	151.299	1729232.512	6451842.376	269.462	Punched cap on 2" GIP in cable box
PB29	33-44-32.65891	118-21-37.47877	49.947	1728833.482	6452089.789	168.116	Brass tag "LA CO DPW" in conc. in 2" GIP
PB54	33-44-41.07534	118-21-56.95141	239.384	1729690.248	6450448.356	357.599	PK mag nail in plastic plug "LS6957" in 1"GIP
PB55	33-44-31.97349	118-21-52.73767	120.236	1728768.840	6450800.873	238.476	PK mag nail in plastic plug "LS6957" in 1"GIP
PB59	33-44-21.83751	118-22-18.06146	37.880	1727752.017	6448658.401	156.294	PK mag nail in plastic plug "LS?" in 1" GIP
PB65	33-44-28.81264	118-22-05.67003	169.206	1728453.288	6449707.519	287.529	2"alum.cap "PLS3945" on 5/8"x 24"rebar flush/AC
PB67	33-44-20.41096	118-21-52.06211	-47.648	1727599.765	6450853.688	70.657	1/2" x 3' rebar
PB68	33-44-20.97329	118-22-14.21575	53.928	1727663.452	6448982.873	172.330	2" Alum Cap "PLS3945" in 1"x 30" GIP
PB69	33-44-22.12891	118-22-16.64848	45.470	1727781.034	6448777.845	163.877	2" Alum Cap "PLS3945" in 1"x 30" GIP
PB70	33-44-22.83743	118-22-18.53442	35.609	1727853.247	6448618.830	154.021	2" Alum Cap "PLS3945" in 1"x 30" GIP
UB02	33-44-19.46177	118-22-00.45747	-55.762	1727506.389	6450144.293	62.586	PK mag nail in plastic plug "?" in 1"GIP
PVE3	33-44-35.85329	118-24-15.26904	235.421	1729207.091	6438765.184	354.360	CGPS Pos. Fixed in 2007 and subsequent surveys
PVE3RP				1729195.880	6438764.665	346.877	PK in Conc. Base, RP to PVE3
PVHS	33-46-46.02015	118-22-19.74135	854.021	1742328.079	6448570.488	972.037	CGPS Pos. Determined as by this Survey
PVRS	33-46-25.89196	118-19-14.06707	198.587	1740239.295	6464237.900	316.295	CGPS Pos. Determined as by this Survey
VTIS	33-42-45.48970	118-17-37.71231	197.499	1717933.689	6472307.221	315.244	CGPS Pos. Determined as by this Survey

Addendum No. 1

Monitoring Survey No. 23 Report
Portuguese Bend Landslide Monitoring
January 29, 2019 Partial Monitoring Survey
for the
City of Rancho Palos Verdes
by
McGee Surveying Consulting

Addendum No. 1 Report briefly describes the second tri-annual Portuguese Bend Monitoring Survey M23. The field survey took place January 28-31, 2019 (average date 01/29/19). This partial survey included 30 points which are a sub-set of the full monitoring array reported in October 2018. A Minimally Constrained Adjustment was processed to develop NAD83 (2007) Epoch 2007.00 Geodetic and State Plane Coordinates in feet. The adjustment fixed CGPS Station PVE3 and included two other CGPS Stations PVRS and VTIS with three 3-9 hour observations (PVHS not operating). The CGPS stations are known to be stable over time and indicated the survey reference frame was stable and successfully recovered.

For a detailed history of the program and surveys see "History" above and the Monitoring Survey Reports by MSC dating back to 2007. The Field Surveys, Equipment, Data Collection and Network Design were as described in the above Report with the following addition.

A new Leica GS18T GNSS Receiver was acquired for this project with the future expectation of improving productivity. The GS18 was used to duplicate the survey effort by double occupying all points as a test to compare the accuracy of the GS18 with GS15 Receivers used since 2010. The GS18 incorporates an advanced algorithm with an Inertial Measurement Unit (IMU) to eliminate the need for leveling the instrument. Comparing the results of the two independent surveys found an increase in production with the GS18 with a small loss in accuracy. The results will be addressed in the October 2019 Survey Report. Movements are summarized in the "Periodic Horizontal & Vertical Movement in Feet" below.

Addendum No. 2

Monitoring Survey No. 24 Report
Portuguese Bend Landslide Monitoring
May 7, 2019 Partial Monitoring Survey

Addendum No. 2 Report briefly describes the second tri-annual Portuguese Bend Monitoring Survey M24. The field survey took place May 5-8, 2019 (average date 05/07/19). This partial survey included 28 points which are a sub-set of the full monitoring array reported in October 2018. Points AB04, FT07, PB12 and PB18 were overgrown and not accessable. AB12 has access issues as it is located on private land used for a horse corral with guard dogs. AB70 established in 2014 was recovered and will be used as a future substitute for AB12 as noted in "History" above. A Minimally Constrained Adjustment was processed to develop NAD83 (2007) Epoch 2007.00 Geodetic and State Plane Coordinates in feet. The adjustment fixed CGPS Station PVE3 and included two other CGPS Stations PVHS and VTIS with four 3-7 hour observations. The CGPS stations are known to be stable over time and indicated the survey reference frame was stable and successfully recovered.

For a detailed history of the program and surveys see "History" above and the Monitoring Survey Reports by MSC dating back to 2007. The Field Surveys, Equipment, Data Collection and Network Design were as described in the above Report with the following addition.

The Leica GS18T GNSS Receiver discussed above was used to double and triple occupy all points in this survey utilizing a GS15 receiver as a base station. The results of the January 2018 survey with the GS18 were found to be similar to past results with the GS15. Based on the January test results, the GS18 Receiver was substituted on this survey for the roaming GS15 Receiver used since 2010. On the next monitoring survey in October 2019 the application of the GS18 will be fully implemented which will increase production with little loss in precision resulting in an accumulated cost savings for the City over the next few years. Movements are summarized in the "Periodic Horizontal & Vertical Movement in Feet" below.

Note: Columns 4-7 revised 07/09/19

PORTUGUESE BEND LANDSLIDE "PARTIAL MONITORING" MOVEMENTS						
Oct. 2018 to May 2019 Periodic Horizontal & Vertical Movements in Feet						
	10/10/2018 (M22) to 01/29/2019 (M23) = 3.6 mo		01/29/2018 (M23) to 05/07/2019 (M24) = 3.3 mo		10/10/2018 (M22) to 05/07/2019 (M24) = 6.9 mo	
Mon.Pt.	Movement Distance	Elevation Change	Movement Distance	Elevation Change	Movement Distance	Elevation Change
AB04	0.12	0.09	Not Observed	Not Observed	Not Observed	Not Observed
AB12	0.05	0.07	0.10	-0.09	0.16	-0.01
AB13	0.06	0.07	Not Observed	Not Observed	0.09	0.00
AB16	0.02	0.11	0.00	-0.06	0.03	0.05
AB17	0.03	0.16	0.01	-0.06	0.02	0.10
AB20	0.08	0.07	0.12	-0.09	0.17	-0.02
AB50	0.05	0.08	0.04	-0.06	0.07	0.02
AB59	0.05	0.17	0.12	-0.12	0.16	0.04
AB60	0.07	0.10	0.08	-0.13	0.15	-0.02
AB61	0.02	0.12	0.01	-0.14	0.00	-0.02
AB65	0.05	0.12	0.03	-0.08	0.08	0.04
CR07	0.02	0.08	0.06	-0.15	0.08	-0.07
CR50	0.02	0.07	0.01	-0.13	0.03	-0.05
FT06	0.04	0.05	0.13	-0.15	0.17	-0.10
FT07	0.02	0.06	Not Observed	Not Observed	Not Observed	Not Observed
KC06	0.04	0.09	0.01	-0.13	0.02	-0.04
KC07	0.05	0.11	0.02	-0.12	0.03	0.00
KC13	0.03	0.11	0.09	-0.09	0.06	0.02
KC16	0.04	0.10	0.03	-0.11	0.00	-0.01
KC17	0.01	0.06	0.03	-0.09	0.04	-0.03
PB04	0.29	0.01	0.45	-0.27	0.77	-0.26
PB12	0.50	0.00	Not Observed	Not Observed	Not Observed	Not Observed
PB13	0.36	0.07	0.44	-0.13	0.86	-0.06
PB18	0.02	0.14	Not Observed	Not Observed	Not Observed	Not Observed
PB26	0.07	0.11	0.15	-0.14	0.21	-0.02
PB55	0.28	0.26	0.34	-0.20	0.63	0.05
PB59	0.45	-0.08	0.68	-0.37	1.15	-0.46
PB67	1.14	-0.13	1.96	-0.44	3.18	-0.57
PB68	0.24	0.02	0.37	-0.26	0.62	-0.25
PB69	0.25	-0.02	0.43	-0.25	0.70	-0.27
PB70	0.23	-0.22	0.36	-0.55	0.61	-0.77
Note: Movements of 0.03 feet (3/8") or greater are deemed to have actually moved.						
See "PB MOVEMENT DATA POSTING 2007-(Present).xlsx" for the Oct. 2017 to Oct. 2018 annual summary						

Survey Report

of the

Portuguese Bend Landslide 2017-2018 Monitoring Surveys

Dated: December 4, 2017, Appended March 23, 2018 and April 23, 2018

for the

City of Rancho Palos Verdes

prepared by

McGee Surveying Consulting

The Portuguese Bend Landslide is monitored on a tri-annual basis beginning with the primary survey of 66 Monitoring Points at the beginning of the rainy season in September-October of each year. The primary survey is addressed in this Report and two subsequent partial monitoring surveys of 30 Points conducted in mid-winter and mid- spring are addressed as Addendums No. 1 and No. 2 to this Report. Consequently, this Report is issued three times with the third being the final Report for the rainy season. The average date of each survey follows.

Initial Survey - October 4, 2017 Full Monitoring Survey No. 19 Report
Second Survey - February 12, 2018 Partial Monitoring Survey No. 20 Report
Third Survey - April 16, 2018 Partial Monitoring Survey No. 21

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APPENDIX

McGEE SURVEYING CONSULTING
5290 Overpass Road, Ste#107, Santa Barbara, CA 93111

Survey Report
of the
Portuguese Bend Landslide Monitoring Survey
October 4, 2017 Initial Monitoring No. 19
for the
City of Rancho Palos Verdes
Prepared December 4, 2017 Revised March 23, 2018
by
McGee Surveying Consulting

PROJECT OVERVIEW:

McGee Surveying Consulting performed a landslide monitoring survey in October 2017 at Portuguese Bend on behalf of the City of Rancho Palos Verdes. This survey established positions on monitoring points to determine overall and periodic movements. The results of the survey are described in this Report and in the attached annual spreadsheet titled "PB MOVEMENT DATA POSTING 2007-2017.10 rev.xlsx". Two partial monitoring surveys follow in the winter and spring and are reported as addendums to this Report.

The field surveys are planned, coordinated and executed by Michael McGee, PLS3945 of McGee Surveying Consulting who is also responsible for the final processing of the observations, network adjustments, analysis and reports. Sixty-six monitoring points covering a 1.5 by 2 mile area were measured to determine the rate and extent of ground movement as reported herein. The City of Rancho Palos Verdes assumed responsibility for monitoring the Portuguese Bend Landslide Complex circa 1994 from the County of Los Angeles. The Global Navigation Satellite System (GNSS) formerly referred to as GPS technology is used to measure positions of points because of its high accuracy and cost efficiency. The horizontal and vertical positions of the monitoring points are based on the North American Datum of 1983 (NAD83) and the North American Vertical Datum of 1988 (NAVD 88). The survey is referenced to physical monuments known as California CGPS (Continuous GPS) Stations in the region which are permanently mounted GPS and GNSS receivers used for monitoring seismic activity. The CGPS in California are comparable to the national CORS (Continuously Operated Reference Stations) network.

Points that move a few inches or less per year are surveyed to meet an accuracy standard of one centimeter (0.033 feet) at the 95% Level of Confidence. In the active slide area where the movements are greater than 0.25 feet per year (PB and UB points), the accuracy standard is two centimeters (0.066 feet) at the 95% Level of Confidence. Field procedures are designed to accomplish this purpose and Quality Control-Quality Assurance (QAQC) processes discussed hereafter are incorporated to verify these accuracies are attained.

Prior to September 2007, successive coordinate differences were used to compute movements; however, arithmetic differences do not provide statistical information about the relative movement accuracies. Beginning with the initial 2007 survey, field and office procedures were designed to assure the accuracy and reliability of measurements and provide for queries between epochs that include statistical information about the relative precisions of the reported movements. Measurements of temporal movements and statistical analysis are based on a rigorous simultaneous least squares adjustment of multiple observations at two different epochs for each monitoring point.

HISTORY

This monitoring survey is a continuation of a program initiated by the County of Los Angeles and taken over by the City of Rancho Palos Verdes circa 1994. McGee Surveying Consulting has conducted the field surveys and reporting since September 2007. The monitoring surveys have occurred annually since 2007, semi-annually since 2012 and three times a year beginning with the September 2014 survey. See the September 2007 Survey

Report for a history of the previous survey process between 1994 and 2007. See the Survey Reports on file with the City commencing in 2007 for details of each monitoring campaign.

PROJECT DATUMS, REFERENCE SYSTEM

Horizontal Datum: The horizontal datum is the North American Datum of 1983 established by the National Geodetic Survey (NGS) referred to as NAD83 (2007) 2007.00 Epoch. The NAD83 (2007) 2007.00 Epoch adjustment is one of a series of national adjustments of the NAD83 Datum since its adoption in 1986 and is the realization used for these monitoring surveys beginning in 2007. The positions listed below were obtained in September 2007 from the California Spatial Reference Center (CSRC). The CSRC provides California Public Resources Code sanctioned positions for the California CGPS Stations. The current national realization of NAD83 is the 2011 adjustment published by the NGS and referred to as the NAD83 (2011) 2010.00 Epoch Adjustment. The CSRC published an updated adjustment of the CGPS stations in California known as the NAD83(2011) 2017.50 Epoch Adjustment. However, the above referenced NAD83 (2007) 2007.00 Epoch realization is retained by this survey to be consistent with prior reporting and the primary purpose of determining relative movements over time.

Reference Network: The survey is referenced to the CGPS Stations (continuously operating GPS & GNSS receivers). For more information see NGS Data Sheets for the PID's listed below (no data sheet exists for PVE3) and the CSRC website.

Units: Feet

NAD83 (2007) 2007.00 Epoch

CGPS	Latitude(dms)	Longitude(dms)	EH(feet)	NGS PID	NAME
PVE3	33 44 35.853290	-118 24 15.269036	235.42	none	PALOS VERDES CORS
PVHS	33 46 46.020150	-118 22 19.741258	853.99	AJ1915	PENINSULA HIGH SCH
PVRS**	33 46 25.891904	-118 19 14.067218	198.63	AJ1916	PALOS VERDES RES
VTIS	33 42 45.489584	-118 17 37.712290	197.52	AJ1936	MARINE EXCHANGE

** Falls in the proximity of a Fault Line as shown below but appears unaffected to date

CGPS Stations (north up)

Vertical Datum: The North American Vertical Datum of 1988 (NAVD88) established by the NGS.
Reference Network: CGPS Station VTIS is also a Second Order leveled benchmark and the original basis for the elevations in this survey. See the Record Elevations of CGPS stations following.

CGPS	NAVD88 Ht. (Feet)	
PVE3	none	
PVHS	972.1	Based on a Refined Geoid Model
PVRS	316.37	Based on Second Order Leveling by CSRC
VTIS	315.26	Based on Second Order Leveling by CSRC and basis for this survey

Geoid Model: Geoid03 available at the time of the initial 2007 survey. Note the Geoid09 Model became available from the NGS in 2009 and Geoid12B in 2012; however, Geoid03 is retained to be consistent with prior reported heights and the primary purpose of determining relative height changes over time.

Projection: Plane coordinates are NAD83 California State Plane Coordinates Zone 5 in US Feet: The State Plane Coordinate Parameters follow: The average Scale Factor is 1.00007543, the Height Reduction Factor based on the average ellipsoid heights is 0.99999092, and the average Combined Grid Factor is 1.00006635. Distances in this survey are grid. To obtain ground distances divide grid distances by the Combined Grid Factor. Grid bearings resulting from this survey must be rotated by a Convergence Angle to obtain geodetic (true) bearings. The average convergence angle is -0-12-30± (rotate left 0-12-30).

Datum Stability: Rancho Palos Verdes sits on the Pacific Plate which is moving west-northwesterly relative to the North American Plate about 4 centimeters (0.14 feet) per year. The area southwesterly of the Fault Line shown on the above map includes the City and is moving at a constant rate as exhibited by the International Terrestrial Reference Frame (ITRF) north, east and up velocities of the CGPS Stations obtained from SOPAC and listed below.

	ANNUAL VELOCITIES (mtrs)			ANALYSIS PERIOD	
SITE	N	E	Up	START_DATE	END_DATE
PVE3	0.019	-0.040	-0.000	2000.731	2017.828
PVHS	0.019	-0.040	0.001	1999.511	2017.828
PVRS	0.019	-0.039	0.000	1999.095	2017.828
VTIS	0.019	-0.039	-0.001	1998.938	2017.828

These CGPS Stations surround the Portuguese Bend Landslide providing a rigid reference frame from which to validate the stability of the network during each monitoring campaign. See the September 2007 Monitoring Survey Report by McGee Surveying Consulting and the Adjustment results below for validation of network stability.

FIELD SURVEYS, DATA COLLECTION, EQUIPMENT & PROCESSING

Two Leica geodetic GNSS receivers/antennas listed below were mounted on two-meter fixed height poles to collect satellite signal data. The GS15 receivers tracked Navstar GPS, GLONASS, Galileo and BeiDou satellites. A calibration of the poles is conducted to verify their heights and plumb. The poles were found to be plumb within 0.003 feet consistent with prior years. There were no equipment failures.

Sixty-six monitoring points were occupied and reported in this survey. Site photographs and recovery sheets detailing the location, character of the monuments and obstructions were updated. See the Appendix for "Monitoring Point Status". AB61, established in September 2007 on Portuguese Point, is used as the primary base station in each survey because it sits above a stable basalt formation.

The field survey commenced each day by setting a Leica GS15 GNSS receiver on a fixed height pole at AB61 while a second GS15 GNSS receiver roamed freely collecting observations on a fixed height pole at the remaining 65 points. Points with annual movements less than 0.2' were measured with two or more independent occupations resulting in a minimum of two vectors to each point from AB61. An independent occupation means

the points were occupied under a different constellation of satellites usually on a different day. If the two measurements are within 0.03 feet (1 cm) horizontally, they are accepted, otherwise a third measurement is required. Experience has shown the two measurements are generally less than 0.015 feet. AB61 and the CGPS stations were connected with 4-10 hour observations averaging 8 hours collected over six days. Points in the active areas with annual movements greater than 0.2' were single occupied. AB12 was single occupied due to restricted access. A comparison with the linear movements from prior years is made to verify their accuracy.

Trees and foliage that over-shadowed points interfere with signals received from satellites and affect the quality of measurements. To obtain the best possible accuracies, the satellite constellation is compared with obstruction diagrams to estimate the best time for observing un-obstructed satellites. To improve the accuracy of the measurements, satellites that are obstructed by trees and foliage are either turned off during the observation or noted for removal in post-processing. Generally, if six or more un-obstructed satellites with a GDOP of less than four (measure of the geometry or strength of figure of the constellation) are available, then the measurement commences for a minimum of 15 minutes of data collection. If the geometry and number of satellites are insufficient then the receiver is moved to another point and returned later when satellite availability improves.

Date of Survey: 10/01/17 to 10/07/17 (mean date 10/04/2017) between 0600-1800 PDST (+7 hrs for UTC).
GNSS Survey Parameters:
Constellation: 31 US NAVSTAR GPS satellites, 24 Russian GLONASS, 14 Galileo and 18 Beidou Satellites.
Observables: L1 & L2 Carrier Waves on GPS, GLONASS and Beidou, and four Carrier Waves on Galileo Satellites
Epoch Rate - Occupation Times: 15 second epoch rate for 15-minute occupations at monitoring points and six 4-10 hour occupations at the base station AB61.
Satellites: 17-21; GDOP =< 2; Elevation Mask for Data Collection at 15° and Processing at 15°
Ephemeris: Precise for Static Post-Processing of CGPS connections and Broadcast for onsite.
Weather: Mostly clear skies, temperature 60°-90° F, no significant weather.
Space Weather: Boulder K Index was 0-3 averaging 1-2 (gauges ionospheric activity on a scale of 0-9; less than 6 preferred)
Equipment:
GNSS Base Receiver Unit No.: M8, Operator: M. McGee, PLS; Station Occupied: AB61 (Base1)
Make & Model: Leica GS15; Antenna Leica GS15; Mount: Fixed Height Pole #1; Antenna Height: 1.803m
GNSS Rover Receiver Unit No.: M9, Operator: M. McGee, PLS;
Make & Model: Leica GS15; Antenna Leica GS15; Mount: Fixed Height Pole #3; Antenna Height: 1.800m

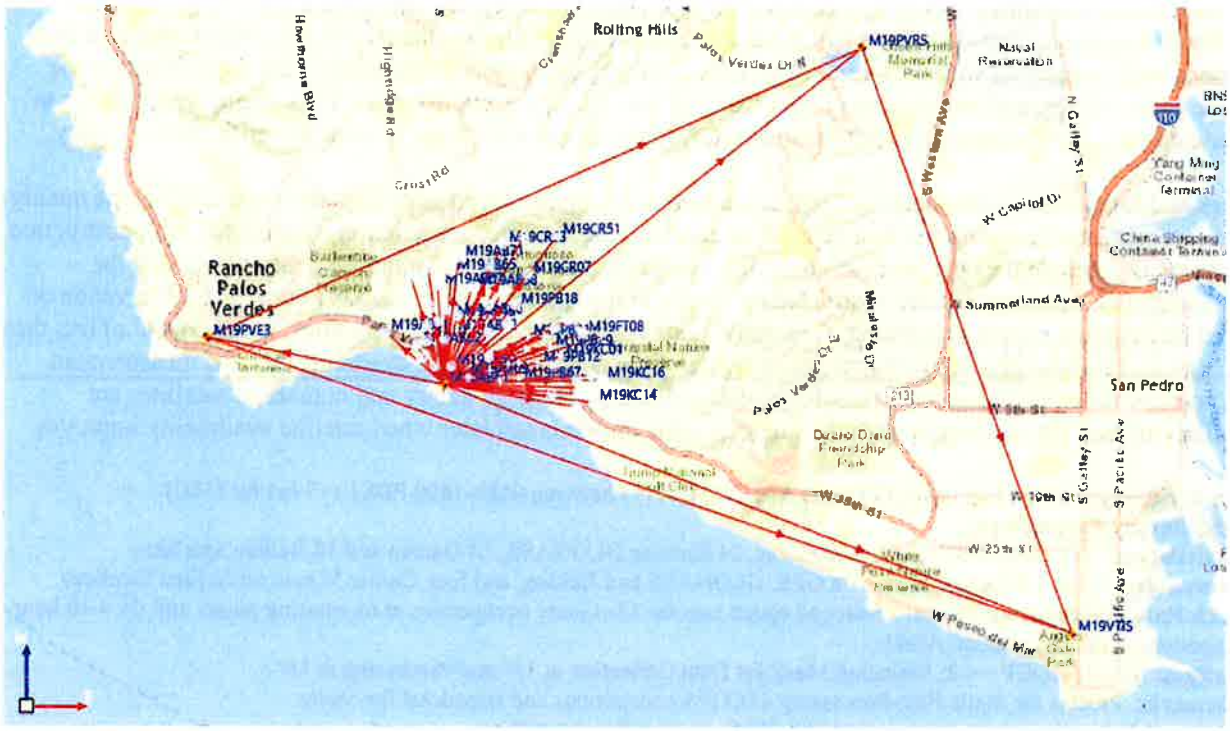
Rinex files (satellite observations) for the CGPS Stations were downloaded from the SOPAC website. Vectors were processed using Leica Infinity v2.4 post processing software with Absolute Antenna Models obtained from the NGS website. Network adjustments and analysis were performed with "Starnet-PRO" version 9.0 software.

NETWORK

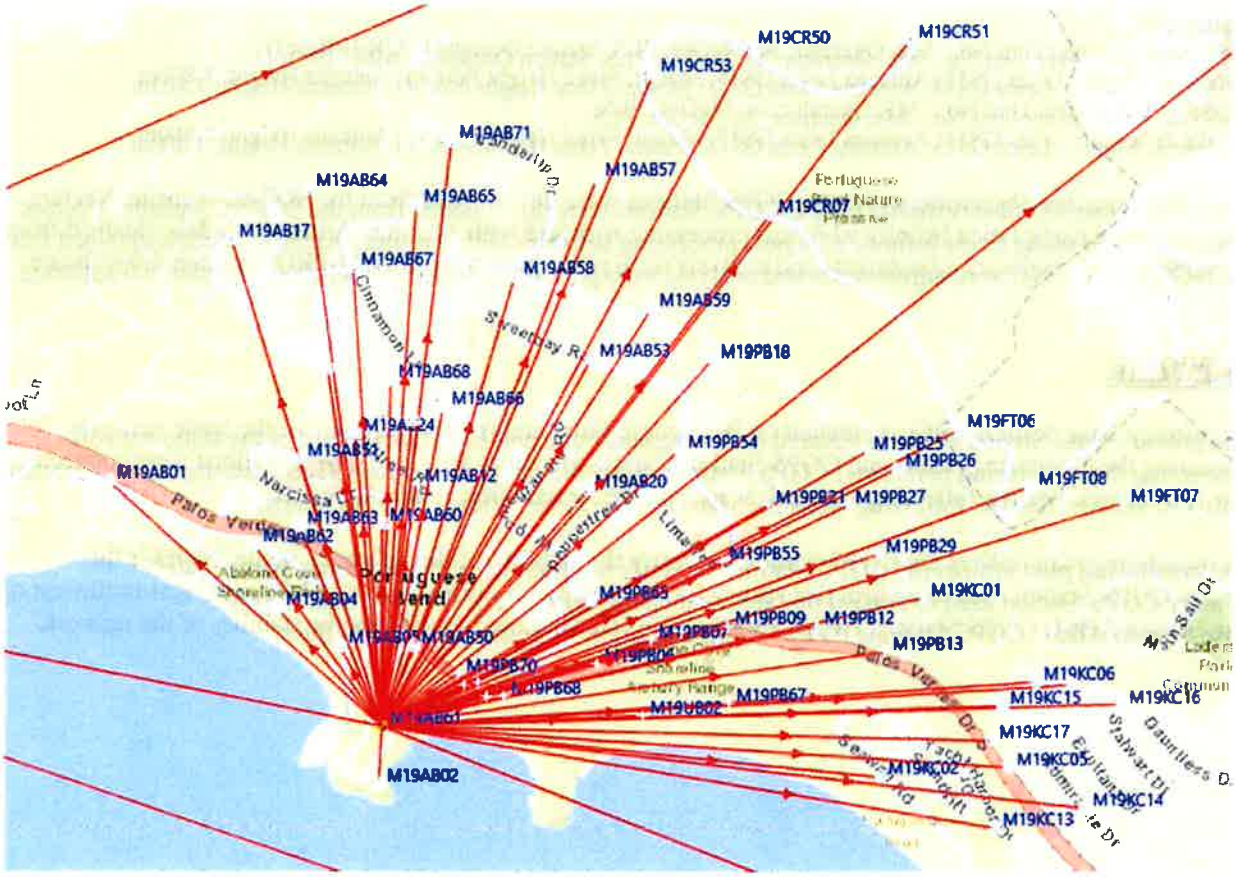
The primary Base Station AB61 is situated on Portuguese Point and is the focal point of the static network connecting the monitoring points and CGPS Stations. Sixty-six points and three CGPS Stations were connected with 130 vectors. See the following Network Maps and the Aerial View in the Appendix.

The monitoring plan utilizes the CGPS Stations to verify the stability of the reference frame. PVE3 is the primary CGPS Station used to control this survey located just south of City Hall and 1.8 miles west-northwest of Base Station AB61. CGPS Stations PVE3, PVRS and VTIS were used to validate the stability of the network.

Monitoring Network and CGPS Stations (north up)



Monitoring Network (north up)



MONITORING POINT HISTORY and STATUS

This is the 19th Monitoring Survey. For data management purposes during the field survey and data processing, the point names are prefixed with a sequential number to distinguish between monitoring surveys. For example, on the 16th monitoring survey AB61 was named M16AB61 where M16 indicates the sequence number since the initial September 2007 Monitoring Survey. The prefix is stripped in the "COORDINATES LIST" and "PB MOVEMENT DATA POSTING" documents.

Between 1994 and 2006, 149 monitoring points were established to monitor the Portuguese Bend Landslides, many of which were lost or destroyed. Sixty of the original points were recovered in 2007. Eight of the 60 points were deleted because they were near other points better suited for GNSS satellite measurements leaving 52 original points monitored and reported between September 2006 and September 2007. Three of the 52 points (AB09, KC11 & PB51) were monitored in September 2007 for the last time and replaced by new points, set nearby and better suited for satellite observations.
2007: Eighteen new points were set in 2007 and had their movements reported for the first time in the following December 2008 survey. In September, it was noted that KC01 was previously reported by others on 9/14/2006 to have moved N 29°E 1.24' from its 12/09/2005 position. In September 2008, this survey found a buried partially illegible brass cap in concrete stamped "COUNTY ENGINEER RE8869 1956 STA ??IELDS" S31°W 1.48 feet from the 1" IP used by the previous survey and this survey in the initial September 2007 and subsequent surveys. The original 1994 position of KC01 (brass cap) was re-referenced to the 1" IP, resulting in a correct overall movement as reported by this survey.
2008: In December 2008, 49 original and 18 new points were surveyed for a total of 67 monitoring points. In December, it was noted that AB05 had been disturbed by a mowing machine. AB05 was found chipped and leaning to southerly about 0.4'. The movement reporting resumed in 2009. Analysis of the movement and historic data made it possible to estimate the disturbance to within 0.05'. The original 1995 position of AB05 was re-referenced S14°E 0.29' to be consistent with the disturbed position, resulting in correct overall reported movements.
2009: PB64 was set east of the Archery Range to replace PB63 (set 2007) which had become unsafe to access and was lost in 2010. PB64 was reported for the first time in October 2010.
2010: Points AB03 and BB25 were discontinued. AB03 is on the edge of a cliff 192 feet west-southwest of AB61 making it redundant, and BB25 is on a freestanding rock susceptible to disturbance by wave action. In the summer of 2010, PB62 was destroyed by road construction and in October 2010, PB65 was set 24' south-southwest of PB62's location and reported for the first time in October 2011. The following points may have been disturbed prior to the October 2010 survey: AB05 appears to have been disturbed by mower machinery, AB15 (½" GIP in a meter box) is driven over by vehicles occasionally accessing an adjacent field, and KC02 (½" GIP in a meter box) is occasionally parked on by vehicles accessing the beach.
2011: In October, new points AB62 and AB63 (initially referred to as AB62R and AB63R) were set to replace AB06 and AB07 which were hazardous to occupy due to their location near the traveled way of Palos Verde Drive South.
2012: In September, prior to initiating the survey, eight new monuments AB64, AB65, AB66, AB67, AB68, CR53, KC17 and PB66 were constructed to replace AB54, AB18, AB52, AB55, AB15, CR52, KC04 and PB53 respectively. The monuments were replaced because of poor sky visibility except for KC04 which was difficult to access and AB55 which was destroyed by trenching in the past year. Monuments were set with the following design. Monuments set in soil are 1" x 5' GIP driven flush and encase in a 6" PVC pipe sitting on a concrete collar down about 18". Monuments set in asphalt are 1/2" x 2' rebar driven below the surface inside a free floating 2" plastic collar encased in concrete.
2013: Points AB15, AB18, AB52, AB54, CR52, KC04 and PB53 were surveyed for the last time in 2012 and discontinued. BB52 is on a freestanding rock susceptible to disturbance by wave action and was monitored for the last time in October and discontinued.
2014: In April PB64 was monitored for the last time due to unsafe access conditions and PB67 (a 5' t-bar steel post driven 3' into the ground) was set north-northwesterly about 250' as a replacement and reported for the first time in September 2014 after 4.5 months whereas all other points in the "PB MOVEMENT DATA POSTING"

are reported for 11.5 months since October 2013. In September, AB69 located about 260' NE of AB12 and AB70 located about 140' SE of AB12 were set as potential replacements; however, AB69 was destroyed by lot improvements and AB70 proved to be too obstructed for accurate results.
2015: In April, new points PB68, PB69 and PB70 were set to monitor movements of "Palos Verdes Drive South" and reported in October. In October, Monitoring Point AB56 was found disturbed by construction and AB71 (magnetic nail in AC) was set as a temporary replacement. In October, the steel post for PB67 was not found. An inconspicuous ½" x 4' rebar was set flush in its place. Because of the large movement in this area a more permanent monument is not necessary.
2016: In October, the temporary point for AB71 was destroyed by road work prior to this survey. AB71 was reset 12' easterly with a 2" screw and brass washer drilled into a granite curb on Vanderlip Road. No movement information will be available until the fall 2017. KC16 was raised about 0.29' to the surface of the road by others between the two October 2016 occupations.
2017: Movement of AB71 (replacement for AB56) reported for the first time in October.

ADJUSTMENTS & ANALYSIS

Adjustment 1: An adjustment to develop NAD83 (2007) 2007.00 Epoch Latitude, Longitude, Ellipsoid Heights and State Plane Coordinates. CGPS Station PVE3 was fixed at its published NAD83 (2007) 2007.00 Epoch position listed previously in a Minimally Constrained Adjustment to determine positions of points in this survey and verify its stability relative to other CGPS stations. PVE3 is located 1.8 miles westerly of and outside the influence of the slide area and has been fixed in all adjustments since 2007. The SOPAC published Time Series indicates the horizontal and vertical position of PVE3 is stable. The primary base station AB61 and other operating CGPS Stations were measured relative to PVE3 and used to assess stability of the survey reference frame. The positions are based on six 4-10 hour occupations (observations). The results are listed in the Coordinate List in the Appendix. Differences between surveys for key points are listed in the table below in feet.

09/2014 Positions to 10/2015

ID	dN	dE	dZ	
PVE3	-0.000	-0.000	-0.000	< Fixed >
PVRS	0.001	0.007	0.016	
VTIS	0.003	0.005	0.049	
AB17	0.015	-0.017	0.042	
AB61	-0.007	0.003	-0.001	<Base Station>
CR51	0.011	0.005	0.017	
KC16	0.014	0.008	0.010	

9/2007 Positions to 10/2015

ID	dN	dE	dZ
PVE3	-0.000	-0.000	-0.000
PVRS	-0.004	0.016	0.000
VTIS	-0.000	0.017	-0.007
AB17	-0.004	-0.022	-0.020
AB61	-0.005	0.007	-0.055
CR51	-0.028	0.014	-0.112
KC16	0.013	-0.005	-0.048

10/2015 Positions to 10/2016

ID	dN	dE	dZ	
PVE3	-0.000	-0.000	-0.000	< Fixed >
PVHS	-0.007	0.000	0.024	<10/2013
PVRS	0.000	0.003	0.019	
VTIS	-0.001	-0.010	0.009	
AB17	-0.019	-0.010	0.051	
AB61	0.000	-0.002	0.016	
CR51	-0.014	-0.011	0.012	
KC16	-0.022	0.001	-----	

9/2007 Positions to 10/2016

ID	dN	dE	dZ
PVE3	-0.000	-0.000	-0.000
PVHS	-0.006	0.011	0.042
PVRS	-0.003	0.019	0.019
VTIS	-0.002	0.006	0.002
AB17	-0.023	-0.032	0.031
AB61	-0.004	0.005	-0.038
CR51	-0.042	0.002	-0.099
KC16	-0.009	-0.003	-----

10/2016 Positions to 10/2017

ID	dN	dE	dZ	
PVE3	-0.000	-0.000	-0.000	< Fixed >
PVRS	-0.004	-0.001	-0.007	
VTIS	0.002	0.003	-0.001	
AB17	-0.001	0.018	-0.001	<Base Station>
AB61	-0.004	0.000	0.112	
CR51	0.004	0.004	0.013	
KC16	-0.004	-0.003	0.059	

9/2007 Positions to 10/2017

ID	dN	dE	dZ
PVE3	-0.000	-0.000	-0.000
PVRS	-0.008	0.018	0.012
VTIS	0.000	0.009	0.000
AB17	-0.025	-0.013	0.029
AB61	-0.008	0.006	0.074
CR51	-0.037	0.007	-0.087
KC16	-0.014	-0.006	0.381

Comments: The Base Station AB61 has no significant differences since October 2016 and 2007 as referenced to PVE3. Given that PVE3 and AB61 agree, the survey reference frame is deemed stable and successfully recovered. An adjustment constrained to the other CGPS Stations is not necessary because the purpose here is to track their movements over time to test the stability of the reference frame and validate the measured movements. See the "COORDINATE LIST" in the Appendix for a list of coordinates resulting from this adjustment. See prior Survey Reports for coordinates resulting from earlier surveys.

Adjustment 2: An adjustment to develop NAVD88 Orthometric Heights (Elevations). The CGPS Station PVE3 was fixed horizontally at its NAD83 position and vertically at its NAVD88 height determined in the September 2007 survey. The 2007 height was based on the published 2nd Order NAVD88 Height of CGPS Station VTIS. This Adjustment combines the measured ellipsoid height differences with the NGS Geoid03 Model (models the separation between the ellipsoid and geoid surfaces) to determine the NAVD88 orthometric heights of the CGPS Stations and monitoring points. The results are listed in the Coordinate List in the Appendix.

ACCURACY

This survey conforms to the intent of the California Spatial Reference Center & California Lands Surveyors Association's "GNSS Surveying Standards and Specifications, 1.1" (2014) and the Federal Geodetic Control Subcommittee (FGCS) "Specifications for GPS Relative Positioning" (1988).

Vector Residuals: The vector lengths, two dimensional residuals and the absolute value of the vertical residuals are listed below in feet. Analysis of residuals resulting from minimally constrained Adjustment #1 led to the rejection of 4 out of 21 vectors connecting the CGPS Stations to the Base Station AB61 with 4-10 hour observations and 0 out of 108 vectors connecting AB61 to monitoring points with 15 minute observations. Vectors to single occupied points are excluded to avoid optimistically skewing the results; however, the statistics given below are applicable to all measurements.

	Vector Lengths		Two Dimensional Residuals			Vertical Residuals (absolute)		
Network	Vary	Average	Average	Std.Dev.	Maximum	Average	Std.Dev.	Range
Mon. Pts	479-7182	3849	0.007	0.004	0.017	0.009	0.008	-0.038 to +0.033
CGPS	9397-35383	19436	0.007	0.005	0.016	0.007	0.005	-0.017 to +0.016

Local Accuracy: The relative accuracy of points resulting from the minimally constrained Adjustment #1 is estimated at the 95% Level of Confidence in feet.

	Monitoring Points		CGPS Stations	
	2D	Vertical	2D	Vertical
Average	0.013	0.029	0.006	0.007

Movement Accuracy: The relative movements reported between October 5, 2016 and October 4, 2017 (12.0 months) statistically attained an average accuracy of 0.016 feet at the 95% Level of Confidence and range 0.006 to 0.024 feet. The actual accuracy of measurements held to the "one-centimeter standard" are estimated to approach 0.01 feet as demonstrated by the vector residuals, repeatability of measurements at points considered stable, and deflection analysis. Refer to the sections titled ACCURACY and QAQC ANALYSIS in this Report for more information.

Statistically, the probability at the 95% level of confidence is that movement (signal) has occurred at a point when the horizontal distance between two epochs is greater than the 95% Error (noise). No movement is considered detected unless the movement exceeds the 95% Error for individual points. Applying this criterion, 5 points have not moved. See the attached "PB MOVEMENT DATA POSTING 2007-2017.10.xlsx" for the relative movements and the estimated error at the 95% Level of Confidence for individual points.

NAVD88 Heights: The North American Vertical Datum of 1988 orthometric heights resulting from Adjustment #2 are derived from the difference in ellipsoid heights combined with the Geoid03 Model and constrained to the NAVD88 height of PVE3 determined in 2007 based on the second order orthometric height of VTIS. The relative accuracy of the heights is expected to be 0.03 feet or better, but can be greater at obstructed sites. The absolute accuracy of the heights relative to the datum is dependent on the published orthometric height on the CGPS Station VTIS. Up until October 2011 there were no specific requirements for vertical accuracies. In October 2011, a 0.03-foot relative vertical accuracy preference was introduced for points AB17, AB57, CR07, CR50 and CR51. In the September 2012 and subsequent surveys the preference was extended to all points.

QUALITY CONTROL - QUALITY ASSURANCE (QAQC) ANALYSIS

To ensure the accuracy and validity of the measurement systems used in these GNSS monitoring surveys, an independent test was conducted in 2007 using conventional terrestrial based instruments as reported in the "QAQC ANALYSIS" section of the September 2007 Monitoring Survey Report. Comparing the results of the GNSS systems with conventional instrumentation found horizontal measurements agreed 0.01 feet on average. In November 2011, the GNSS instruments and fixed height poles used in this survey were calibrated on the National Geodetic Survey's Santa Maria Baseline and found to agree with published distances 0.003 to 0.006 feet. In February 2018, the GNSS instruments and fixed height poles were calibrated on the NGS Camarillo Baseline and found to agree with published distances 0.003 feet.

To validate the radial survey method used in these surveys to position points from base stations AB61, independent GNSS intra-net cross connections were measured and compared with the stand alone computed inverse distances in the 2007, 2008 and 2009 surveys. The results found the two-dimensional accuracy to agree 0.01 feet on average, indicating the radial method of measurements is reliable and the additional labor cost of measuring cross connection between points is not warranted. See the "QAQC ANALYSIS" section of the September 2007 and the December 2008 Monitoring Survey Reports for detailed analysis.

Deflection Analysis is a method established by this surveyor to assess the consistency of the direction of movements reported from period to period. Assuming that movements are generally linear for points moving less than a foot, the separation or the deflection between the direction of the previous and present periods taken over the moved distance implies the accuracy obtained with the equipment, methods and procedures. Analysis of individual deflections found the separations and implied accuracy varied 0.01 to 0.02 feet.

SUMMARY

Point movement ranges by slide zones are listed below in feet:

```
(AB##) 0.00 to 0.29
(CR##) 0.00 to 0.13
(FT##) 0.04 to 0.29
(KC##) 0.00 to 0.25
(PB##) 0.19 to 2.43 and 12.44 at PB67
(UB02) 2.78
```

See the Appendix for a graphic of the horizontal movements depicted by 1" and 1' contours.

See the attached " PB MOVEMENT DATA POSTING 2007-2017.10.xlsx " spreadsheet for overall and periodic movements of each point. The movements are given in north, east and up or down as well as a vector of distance and direction relative to north. The direction is given as an azimuth in degrees where 0° is north and increases clockwise (90° East, 180° South, 270° West). The overall movements listed in the spreadsheet are from the date when a point was first set to the present survey.

The present status of monitored points is provided in the Appendix under "Monitoring Point Status". The historical status of all monitoring points is provided in the September 2007 Survey Report. The historical 1994-2006 positions of all points are listed in the Charles Abbott Associates Inc. file "ALL POINTS MOST RECENT OBSERVED POSITION AS OF SEPTEMBER 15, 2006.xls". This file was attached as an electronic file to the 2007 Survey Report.

RECOMMENDATION

An ongoing re-location program for monuments has long term benefits resulting in better accuracy and lower cost surveys due to improved sky visibility for tracking satellites. No monuments were re-located during this survey. Points AB16, AB17, AB24 and AB58 have limited sky visibility and are candidates for re-location or deletion. AB12 is in a horse corral and is difficult to access; however, there are no nearby alternatives.

Two points could be substantially improved by tree trimming along public roads where there are no adjacent residences by trimming the Pepper Trees northeast and southwest of AB17 on Fruit Tree Road and northeast of AB58 on Narcissa Drive.

Attachments: The following document is attached to this Report.
"PB MOVEMENT DATA POSTING 2007-2017.10.xlsx" listing the coordinates of the initial positions, the overall and periodic movements of monitoring points since 2007.

SURVEYOR'S STATEMENT

This is a Report on the procedures, criteria and results of the City of Rancho Palos Verdes Portuguese Bend Landslide Monitoring Surveys. This Report includes the Initial Survey conducted in the fall, the Second Survey Addendum No.1 added in the winter and the Third Survey Addendum No.2 added in the spring. This survey was conducted and the report prepared by me at the request of Ron Dragoo, Principal Engineer of the City of Rancho Palos Verdes.

Initial Survey - Full Monitoring Signature

Michael R. McGee P.L.S. 3945 — Date 12/5/17

Second Survey - Partial Monitoring Signature

Michael R. McGee P.L.S. 3945 — Date 3/23/18

Third Survey - Partial Monitoring Signature

Michael R. McGee P.L.S. 3945 — Date 4/23/18

LICENSED LAND SURVEYOR
MICHAEL RANDOLPH MCGEE
LS3945
STATE OF CALIFORNIA

APPENDIX

12- Aerial Photo of Monitoring Points with Movements and Contours
13- Table of Horizontal and Vertical Movements
14- Monitoring Point Status
15- Coordinate List for the Oct. 4, 2017 Survey: NAD83 (2007) 2007.00 Epoch Geodetic, Grid, NAVD88
16- ADDENDUM No. 1: Second Survey – February 12, 2018 Partial Monitoring Survey No. 20
17- ADDENDUM No. 2: Third Survey – April 16, 2018 Partial Monitoring Survey No. 21
18- ADDENDUM No. 1 & 2: Table of Partial Monitoring Survey Horizontal and Vertical Movements

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Aerial Photo of Monitoring Points with Movements and Contours

(north is left)

General Depiction of Horizontal Movements - October 5, 2016 to Oct. 4, 2017

(Generalized depiction of movements and not to be used for planning or development purposes)

A = Approximate 1 inch Contour Line
B = Approximate 12 inch or 1 foot Contour Line
C = Maximum Measured Movement of 12.4 feet
D = Movements Vary 1 inch to 1 foot between Lines A & B

AB24*0.14 = Typical Point ID with Movement in Feet

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Table of Movements at Monitoring Points

Portuguese Bend Landslide Monitoring

Horizontal and Vertical Movements in Feet

October 5, 2016 to October 4, 2017 - 12.0 Months

Listed below are the horizontal movements and vertical (elevation) changes in the last annual period. See the attached spreadsheet titled "PB MOVEMENT DATA POSTING 2007-2017.10.xlsx" for more details and a history of movements. Note: The measurement confidence is 0.02' (1/4"); therefore, movements greater than 0.02' are deemed to have actually moved.

Point ID	Horizontal Movements	Vertical Changes	Point ID	Horizontal Movements	Vertical Changes
AB01	0.02	0.09	KC01	0.25	0.03
AB02	0.01	0.08	KC02	0.11	0.11
AB04	0.29	0.07	KC05	0.06	0.08
AB05	0.19	0.11	KC06	0.09	0.02
AB12	0.18	0.09	KC07	0.01	0.06
AB13	0.13	0.08	KC13	0.07	0.11
AB16	0.04	0.11	KC14	0.02	0.05
AB17	0.02	0.00	KC15	0.09	0.04
AB20	0.20	0.06	KC16	0.01	0.06
AB24	0.14	0.05	KC17	0.09	0.10
AB50	0.13	0.10	PB04	1.12	-0.26
AB51	0.09	0.08	PB06	1.00	-0.06
AB53	0.18	0.05	PB07	1.21	-0.05
AB57	0.11	0.00	PB08	1.10	0.11
AB58	0.14	0.08	PB09	1.32	-0.11
AB59	0.18	0.04	PB12	2.43	-0.38
AB60	0.17	0.12	PB13	1.76	-0.01
AB61	0.00	0.11	PB18	0.19	0.09
AB62	0.20	0.07	PB20	2.02	-0.34
AB63	0.20	0.06	PB21	1.22	0.00
AB64	0.03	0.08	PB25	0.26	0.01
AB65	0.10	0.14	PB26	0.28	0.05
AB66	0.12	0.03	PB27	2.16	-0.30
AB67	0.04	0.03	PB29	1.70	-0.31
AB68	0.11	0.05	PB54	0.21	0.07
AB71	0.09	-0.01	PB55	1.31	-0.13
CR07	0.13	-0.04	PB59	1.67	-0.60
CR50	0.01	0.02	PB65	0.34	0.06
CR51	0.01	0.01	PB67	12.44	-1.97
CR53	0.05	0.04	PB68	0.94	-0.21
FT06	0.25	-0.05	PB69	0.99	-0.27
FT07	0.29	0.02	PB70	0.82	-0.91
FT08	0.04	0.05	UB02	2.78	0.10

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RANCHO PALOS VERDES - PORTUGUESE LAND SLIDE MONITORING POINT STATUS Prepared 12/04/2017	
Notes:	180+/- Monitoring Points established since 1994 through 2016
09/01/07	71 Points Surveyed 60 old points found with 52 monitored plus 19 new points
12/01/08	67 Points Surveyed AB09, KC11, PB51 discontinued; BB53 destroyed; AB05 disturbed
11/01/09	68 Points Surveyed Set PB64 to replace PB63 destroyed subsequently
10/01/10	65 Points Surveyed Discontinued AB03, BB25; set PB65 to replace PB62 destroyed by paving
10/03/11	69 Points Surveyed; Set AB62 & AB63 to replace AB06 & AB07
09/14/12	72 Points Surveyed; Discontinued AB06, AB07; AB55 destroyed by trenching; Added 8 new points
10/06/13	65 Points Surveyed; Discontinued AB15, AB18, AB52, AB54, CR52, KC04, PB53
09/19/14	64 Points Surveyed; Discontinued BB52, PB67 set in April 2014; Added PVE3RP (reference to PVE3 antenna)
10/08/15	66 Points Surveyed; AB56 Destroyed & Replaced by AB71A; PB68, PB69, & PB70 Set in April 2015
10/05/16	66 Points Surveyed; AB71A Destroyed & Replaced by AB71;
10/04/17	66 Points Surveyed; 30 Points to Survey in Feb 2018 and April 2018

Pt ID	Last Obs'd	Comments	GNSS	Pt ID	Last Obs'd	Comments	GNSS
AB01	10/04/2017	Base Station 1994-2006	G	KC01	10/04/2017	NE'ly/2 monuments 1.5' apart	G
AB02	"		G	KC02	"		G
AB04	"		G	KC05	"		G
AB05	"		G	KC06	"		G
AB12	"		G	KC07	"		G
AB13	"		F	KC13	"		G
AB16	"		P	KC14	"		G
AB17	"		F	KC15	"		F
AB20	"	NE'ly/ 2 monuments	G	KC16	"	Raised 0.29' by others 10/2016	G
AB24	"		F	KC17	"	Replaced KC04	G
AB50	"		G	PB04	"		G
AB51	"		G	PB06	"		G
AB53	"		F	PB07	"		G
AB57	"		G	PB08	"		G
AB58	"		P	PB09	"		G
AB59	"		G	PB12	"		G
AB60	"		G	PB13	"		G
AB61	"	Base Sta.. 2007-Present	G	PB18	"		G
AB62	"		G	PB20	"	S'ly/ 2 monuments 5.3' apart	G
AB63	"		G	PB21	"		F
AB64	"		G	PB25	"		G
AB65	"		G	PB26	"		F
AB66	"		G	PB27	"		G
AB67	"		G	PB29	"		G
AB68	"		G	PB54	"		F
AB71	"	Replaced AB56 10/2016	F	PB55	"		F
CR07	"		G	PB59	"		G
CR50	"		F	PB65	"		G
CR51	"		G	PB67	"		G
CR53	"		G	PB68	"		G
FT06	"		F	PB69	"		G
FT07	"		G	PB70	"		G
FT08	10/04/2017		G	UB02	10/04/2017		G

GNSS column indicates site is Good, Fair or Poor for Satellite Visibility Conditions

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10/04/17 COORDINATE LIST

Portuguese Bend Landslide 10/04/2017 Monitoring Survey No. 19
Prepared by McGee Surveying Consulting: Document Date 12/04/2017 Rev. 03/23/18

Datum: Horizontal & EH are NAD83 (2007) 2007.00 Epoch; California State Plane Zone 5; Vertical: NAVD88
Note, Fixed CGPS Station PVE3 at Record 3D Position & NAVD88 Height per September 2007 Survey;
See 2007 and subsequent Survey Reports

Point	Latitude	Longitude	EH(ft)	North(ft)	East(ft)	OrthoHt(ft)	Description
AB01	33-44-38.30264	118-22-53.05190	60.200	1729427.563	6445709.554	178.68	Punched 1/2" GIP in meter box
AB02	33-44-13.84885	118-22-26.19248	-1.955	1726946.981	6447968.680	116.54	4" BC "SAN PEDRO 1936" on conc. block
AB04	33-44-28.08825	118-22-36.29052	-51.221	1728389.642	6447121.211	67.24	BC "CO ENG STA Q2.." on 2"GIP in mass of conc.
AB05	33-44-24.98844	118-22-30.09368	-37.911	1728074.322	6447643.392	80.54	BC "CO ENG STA Q3.." on 2"GIP in mass of conc.
AB12	33-44-38.27281	118-22-22.72200	164.904	1729414.936	6448270.954	283.25	BC "CO ENG STA 7A.." in mass of conc.
AB13	33-44-43.34363	118-22-23.16216	246.207	1729927.688	6448235.684	364.53	Punched 1/2" GIP in meter box
AB16	33-44-47.57883	118-22-31.51213	258.174	1730358.454	6447532.126	376.51	Punched 1/2" GIP in meter box
AB17	33-44-58.06058	118-22-41.08420	324.493	1731421.094	6446727.759	442.83	Punched 1/2" GIP in meter box
AB20	33-44-37.77222	118-22-05.96721	278.027	1729359.113	6449685.739	396.30	BC "CO ENG STA W. FIX 1956.." in mass of conc.
AB24	33-44-42.35218	118-22-28.79581	217.438	1729829.231	6447759.547	335.79	Cotton spindle in conc. In road
AB50	33-44-25.11020	118-22-22.94748	63.672	1728084.385	6448246.974	182.09	Nail in conc. collar of well
AB51	33-44-40.22869	118-22-34.15228	186.829	1729616.255	6447306.387	305.21	PK mag nail in plastic plug "LS6957" in 1"GIP
AB53	33-44-48.36573	118-22-05.70081	234.659	1730429.939	6449712.161	352.88	Chiseled + on s edge conc. Vault
AB57	33-45-03.16837	118-22-05.20529	446.587	1731926.199	6449759.488	564.74	6" mag nail & washer in conc. in 2"x 36" GIP
AB58	33-44-55.14231	118-22-13.27651	287.427	1731117.340	6449074.926	405.65	Punched RR spike on s side road
AB59	33-44-52.53793	118-21-59.79463	316.046	1730849.888	6450212.470	434.22	6" mag nail & washer in conc. in 2"x 36" GIP
AB60	33-44-35.03968	118-22-26.06633	61.056	1729089.145	6447987.304	179.43	6" mag nail & washer in conc. in 2"x 28" GIP
AB61	33-44-18.57310	118-22-25.95798	22.073	1727424.487	6447990.262	140.54	6" mag nail & washer in conc. in 2"x 24" GIP
AB62	33-44-33.22832	118-22-38.63305	24.598	1728909.999	6446925.324	143.04	6" mag nail & washer in conc. in 1"x 24" GIP
AB63	33-44-34.71584	118-22-34.12199	62.411	1729058.946	6447306.860	180.82	Punched 1/2 x 48" rebar
AB64	33-45-02.13598	118-22-33.46046	413.997	1731830.665	6447373.095	532.28	2" mag nail on NE side 2' conc. Collar/Well B12
AB65	33-45-00.93070	118-22-22.90337	340.395	1731705.500	6448264.137	458.64	2" mag nail & washer in conc. in 1"x 60" GIP
AB66	33-44-44.53376	118-22-20.15074	255.978	1730047.056	6448490.446	374.28	1/2"x 24" punched rebar 1" below AC conc. collar
AB67	33-44-55.71641	118-22-29.06611	287.060	1731180.319	6447741.758	405.35	1/2"x 24" punched rebar 1" below AC conc. collar
AB68	33-44-46.61108	118-22-25.31252	275.153	1730258.673	6448055.314	393.47	1/2"x 24" punched rebar 1" below AC conc. collar
AB71	33-45-06.07061	118-22-19.51937	453.316	1732224.039	6448551.824	571.52	2"screw&brass washer"PLS3945" on VanderlipDr.
CR07	33-45-00.26727	118-21-48.09417	513.912	1731627.667	6451203.373	632.01	6" mag nail & washer in conc. in old 1" IP
CR50	33-45-13.97074	118-21-50.11955	754.612	1733013.582	6451037.353	872.67	Tack & shiner on lower rock wall
CR51	33-45-14.49681	118-21-34.43627	858.171	1733061.996	6452361.868	976.16	Tack & shiner on conc. pad
CR53	33-45-11.63359	118-21-59.73971	662.646	1732780.269	6450224.148	780.75	2" mag nail & washer in conc. in 1"x 60" GIP
FT06	33-44-42.78226	118-21-29.58686	370.450	1729854.480	6452759.935	488.53	6" mag nail & washer in conc. in 2"x 36" GIP
FT07	33-44-36.86844	118-21-13.66300	470.552	1729251.803	6454102.608	588.60	6" mag nail & washer in conc. in 2"x 36" GIP
FT08	33-44-38.19515	118-21-22.57469	540.411	1729388.659	6453350.472	658.49	6" mag nail & washer in conc. in 2"x 36" GIP
KC01	33-44-29.13081	118-21-33.11047	194.139	1728475.502	6452457.432	312.32	6" mag nail & washer in conc. in old 1" IP
KC02	33-44-14.54623	118-21-37.05778	-104.440	1727002.323	6452118.780	13.83	Punched 1/2" GIP in meter box
KC05	33-44-15.36995	118-21-24.51042	109.343	1727081.814	6453178.806	227.55	Punched 1/2" GIP in meter box
KC06	33-44-22.33164	118-21-21.96741	181.710	1727784.818	6453396.077	299.87	Punched 1/2" GIP in meter box
KC07	33-44-22.09033	118-21-18.55899	195.374	1727759.405	6453683.853	313.52	Punched 1/2" GIP in meter box
KC13	33-44-10.41128	118-21-25.78319	72.951	1726580.919	6453069.529	191.18	Cotton spindle in AC turnout
KC14	33-44-12.03472	118-21-17.07094	141.776	1726742.428	6453805.940	259.96	Punched spike in center road
KC15	33-44-20.39699	118-21-25.21829	168.882	1727590.216	6453120.825	287.06	Cotton spindle in cul-de-sac
KC16	33-44-20.55003	118-21-13.64613	209.157	1727602.232	6454098.227	327.29	Brass pin&washer "LS8773" set above spike in Xn
KC17	33-44-17.54910	118-21-26.32512	97.120	1727302.651	6453026.322	215.32	2" mag nail & washer in conc. in 1"x 50" GIP
PB04	33-44-20.94963	118-22-15.81517	47.338	1727661.559	6448847.783	165.75	Nail & tag "RCE26120" in conc. in 3" pipe
PB06	33-44-23.65349	118-22-05.05375	58.437	1727931.553	6449757.657	176.78	Punched cap on 2" GIP
PB07	33-44-25.63253	118-21-59.69309	78.868	1728129.962	6450211.126	197.18	Brass tag "LA CO DPW" in conc. in 2" GIP
PB08	33-44-26.27748	118-21-56.72479	76.109	1728194.248	6450462.052	194.41	Punched cap on 2" GIP
PB09	33-44-26.73575	118-21-52.15204	69.770	1728239.172	6450848.411	188.04	Punched cap on 2" GIP in cable box
PB12	33-44-26.82104	118-21-43.48444	63.850	1728245.148	6451580.464	182.08	Punched cap on 2" GIP in cable box
PB13	33-44-24.76864	118-21-36.79290	88.034	1728035.639	6452144.855	206.25	Punched cap on 2" GIP in cable box
PB18	33-44-48.40781	118-21-53.76880	244.758	1730430.518	6450719.822	362.93	Punched 1/2" GIP in meter box
PB20	33-44-31.63026	118-21-48.93012	112.213	1728732.977	6451122.309	230.44	Punched cap on 2" GIP in cable box
PB21	33-44-36.61155	118-21-48.27938	153.538	1729236.343	6451179.087	271.74	Punched cap on 2" GIP in cable box
PB25	33-44-40.92754	118-21-38.74199	207.808	1729669.749	6451986.106	325.95	Punched cap on 2" GIP in cable box
PB26	33-44-39.63338	118-21-35.58778	164.825	1729537.966	6452252.014	282.95	Brass tag "LA CO DPW" in conc. in 2" GIP
PB27	33-44-36.60985	118-21-40.42532	151.634	1729233.780	6451842.379	269.80	Punched cap on 2" GIP in cable box
PB29	33-44-32.66740	118-21-37.47488	50.319	1728834.339	6452090.121	168.49	Brass tag "LA CO DPW" in conc. in 2" GIP
PB54	33-44-41.07614	118-21-56.95133	239.500	1729690.329	6450448.364	357.72	PK mag nail in plastic plug "LS6957" in 1"GIP
PB55	33-44-31.97884	118-21-52.73767	120.556	1728769.381	6450800.875	238.80	PK mag nail in plastic plug "LS6957" in 1"GIP
PB59	33-44-21.84289	118-22-18.06036	38.186	1727752.560	6448658.496	156.60	PK mag nail in plastic plug "LS?" in 1" GIP
PB65	33-44-28.81389	118-22-05.66966	169.322	1728453.414	6449707.551	287.64	2" alum. cap "MCGEE SURVEYING" on 5/8"x 24"rebar
PB67	33-44-20.44978	118-21-52.05737	-46.962	1727603.687	6450854.103	71.34	1/2" x 3' rebar
PB68	33-44-20.97613	118-22-14.21541	54.166	1727663.740	6448982.903	172.57	2" Alum Cap "PLS3945" in 1"x 30" GIP
PB69	33-44-22.13163	118-22-16.64715	45.670	1727781.308	6448777.958	164.08	2" Alum Cap "PLS3945" in 1"x 30" GIP
PB70	33-44-22.83979	118-22-18.53308	35.979	1727853.485	6448618.945	154.39	2" Alum Cap "PLS3945" in 1"x 30" GIP
UB02	33-44-19.47128	118-22-00.45904	-55.686	1727507.351	6450144.164	62.66	PK mag nail in plastic plug "?" in 1"GIP
PVE3	33-44-35.85329	118-24-15.26904	235.421	1729207.091	6438765.184	354.36	CGPS Pos. Fixed in 2007 and subsequent surveys
PVHS							CGPS Non-Operational
PVRS	33-46-25.89195	118-19-14.06714	198.609	1740239.294	6464237.895	316.32	CGPS Pos. Determined as by this Survey
VTIS	33-42-45.48966	118-17-37.71221	197.513	1717933.684	6472307.229	315.26	CGPS Pos. Determined as by this Survey

Addendum No. 1

Monitoring Survey No. 20 Report
Portuguese Bend Landslide Monitoring
February 12, 2018 Partial Monitoring Survey
for the
City of Rancho Palos Verdes
by
McGee Surveying Consulting

Overview:

This Addendum No. 1 Report describes the February 12, 2018 (average date) tri-annual Portuguese Bend Monitoring Survey. This partial survey included 30 points which are a sub-set of the full monitoring set reported above. AB13 was substituted for AB12 due to access issues on private land used as a horse corral with guard dogs. Reviewing the movements of AB12 and AB13 over the last 10 years finds the movements are consistent in direction, and the distance at AB12 is generally about equal or up to 1/3 greater than at AB13. It is recommended AB13 be substituted for AB12 and that AB12 be monitored once a year during the primary fall survey.

This survey followed the procedures described in previous surveys. For a detailed history of the program and surveys see "History" above and Monitoring Survey Reports by this surveyor dating back to 2007. The field survey took place February 11-13, 2018. The Field Surveys, Equipment, Data Collection and Network Design were as described in the above Report. Four continuously operating GPS stations (CGPS) were connected to this survey with three 4-8 hour observations.

The movements reported between October 4, 2017 and February 12, 2018 (4.3 months) statistically attained an average accuracy of 0.019 feet at the 95% Level of Confidence. The vectors residuals follow: the 2D averaged 0.007' with a maximum of 0.021' and the vertical averaged 0.011' with a maximum of 0.075'.

A Minimally Constrained Adjustment was processed to develop NAD83 (2007) 2007.00 Epoch Geodetic and State Plane Coordinates in feet. CGPS Station PVE3 was fixed and the differences in north, east and up from the 10/04/2017 survey to the 02/12/2018 survey are listed in feet below.

	10/04/2017 to 02/12/2018		
Station	dN	dE	dZ
AB04	-0.057	-0.044	-0.034
AB13	-0.035	0.004	-0.051
AB16	-0.028	-0.005	-0.037
AB17	-0.008	-0.003	0.012
AB20	-0.044	-0.011	-0.025
AB50	-0.018	-0.023	-0.027
AB59	-0.044	0.008	-0.006
AB60	-0.042	-0.014	-0.026
AB61	-0.009	0.004	-0.016
AB65	-0.006	-0.003	-0.050
CR07	-0.032	0.010	-0.021
CR50	-0.010	-0.006	-0.001
FT06	-0.072	-0.003	-0.038
FT07	-0.019	-0.042	-0.019
KC06	-0.011	-0.009	0.011
KC07	-0.000	0.010	-0.014
KC13	-0.017	0.000	-0.015
KC16	0.005	0.001	-0.006
KC17	-0.014	0.004	-0.031
PB04	-0.158	-0.033	-0.082
PB12	-0.587	-0.177	-0.196

PB13	-0.380	-0.182	-0.063
PB18	-0.031	-0.001	-0.028
PB26	-0.072	-0.013	0.009
PB55	-0.263	0.022	0.110
PB59	-0.242	-0.039	-0.116
PB67	-1.812	-0.196	-0.300
PB68	-0.134	-0.010	-0.089
PB69	-0.124	-0.055	-0.068
PB70	-0.114	-0.053	-0.156
PVE3	-0.000	-0.000	-0.000
PVRS	-0.016	0.000	-0.025
VTIS	0.001	0.003	-0.026

The differences from the original 2007 positions below

PVRS	-0.024	0.018	-0.013
VTIS	0.002	0.013	-0.026

As a standard procedure the adjustment was constrained to the CGPS station PVE3 and finds no difference, within the accuracy of the measurement system, in the positions of the primary base station AB61 and the positions of the CGPS stations PVRS and VTIS. The CGPS stations and KC16 are known to be stable over time and indicate the survey reference frame was stable and successfully recovered.

The Movement Distances and Elevation Changes are summarized in the "**Periodic Horizontal & Vertical Movement in Feet**" below.

McGEE SURVEYING CONSULTING
5290 Overpass Road, Ste#107, Santa Barbara, CA 93111

Addendum No. 2

Monitoring Survey No. 21 Report
Portuguese Bend Landslide Monitoring
April 16, 2018 Partial Monitoring Survey
for the
City of Rancho Palos Verdes
by
McGee Surveying Consulting

Overview:

This Addendum No. 2 Report describes the April 16, 2018 (average date) tri-annual Portuguese Bend Monitoring Survey. This partial survey included 30 points which are a sub-set of the full monitoring set reported above.

This survey followed the procedures described in previous surveys. For a detailed history of the program and surveys see "History" above and Monitoring Survey Reports by this surveyor dating back to 2007. The field survey took place April 15-17, 2018. The Field Surveys, Equipment, Data Collection and Network Design were as described in the above Report. Four continuously operating GPS stations (CGPS) were connected to this survey with three 5-8 hour observations.

The movements reported between February 12, 2018 and April 16, 2018 (1.6 months) statistically attained an average accuracy of 0.02 feet at the 95% Level of Confidence. The vectors residuals follow: the 2D averaged 0.005' with a maximum of 0.016' and the vertical averaged 0.009' with a maximum of 0.031'.

A Minimally Constrained Adjustment was processed to develop NAD83 (2007) 2007.00 Epoch Geodetic and State Plane Coordinates in feet. CGPS Station PVE3 was fixed and the differences in north, east and up from the 02/12/2018 survey to the 04/16/2018 survey are listed in feet below.

02/12/2018 to 04/16/2018

Station	dN	dE	dZ
AB04	0.00	-0.01	0.01
AB13	0.00	0.00	-0.01
AB16	0.01	0.00	-0.02
AB17	0.01	0.00	0.01
AB20	-0.01	-0.01	0.03
AB50	0.00	-0.01	0.01
AB59	0.00	0.00	0.02
AB60	0.01	0.00	0.00
AB61	0.01	-0.01	0.01
AB65	0.01	-0.01	0.01
CR07	0.01	0.01	0.01
CR50	0.03	0.00	0.01
FT06	-0.01	0.00	0.02
FT07	-0.01	-0.03	0.05
KC06	0.00	-0.01	-0.01
KC07	0.01	0.00	0.03
KC13	0.00	0.01	0.01
KC16	0.00	0.00	0.01
KC17	0.01	-0.01	0.01
PB04	-0.03	-0.01	-0.01
PB12	-0.22	-0.10	0.01
PB13	-0.16	-0.08	0.02
PB18	-0.01	-0.01	0.03
PB26	0.00	-0.01	-0.02
PB55	-0.05	-0.05	-0.07
PB59	-0.09	-0.02	-0.03

PB67	-0.62	-0.05	-0.10
PB68	-0.04	0.00	0.00
PB69	-0.04	-0.02	0.00
PB70	-0.03	-0.03	-0.06
PVE3	0.00	0.00	0.00
PVRS	0.03	0.01	0.01
VTIS	0.00	0.00	0.03

As a standard procedure the adjustment was constrained to the CGPS station PVE3 and finds no difference, within the accuracy of the measurement system, in the positions of the primary base station AB61 and the positions of the CGPS stations PVRS and VTIS. The CGPS stations and KC16 are known to be stable over time and indicate the survey reference frame was stable and successfully recovered.

The Movement Distances and Elevation Changes are summarized in the **"Periodic Horizontal & Vertical Movement in Feet"** below.

PORTUGUESE BEND LANDSLIDE MONITORING						
Partial Monitoring Horizontal & Vertical Movements in Feet						
	10/04/2017 to		02/12/2018 to		10/04/2017 to	
	02/12/2018 = 4.3 months		04/16/2018 = 1.6 months		04/16/2018 = 5.9 months	
Mon. Pt.	Movement	Elevation	Movement	Elevation	Movement	Elevation
	Distance	Change	Distance	Change	Distance	Change
AB04	0.07	-0.03	0.01	0.01	0.08	-0.02
AB13	0.04	-0.05	0.00	-0.01	0.03	-0.06
AB16	0.03	-0.04	0.01	-0.02	0.02	-0.06
AB17	0.01	0.01	0.01	0.01	0.00	0.02
AB20	0.05	-0.03	0.01	0.03	0.06	0.00
AB50	0.03	-0.03	0.01	0.01	0.04	-0.02
AB59	0.04	-0.01	0.00	0.02	0.05	0.01
AB60	0.04	-0.03	0.01	0.00	0.04	-0.03
AB61	0.01	-0.02	0.01	0.01	0.00	0.00
AB65	0.01	-0.05	0.02	0.01	0.01	-0.04
CR07	0.03	-0.02	0.01	0.01	0.03	-0.01
CR50	0.01	0.00	0.03	0.01	0.02	0.01
FT06	0.07	-0.04	0.01	0.02	0.08	-0.02
FT07	0.05	-0.02	0.03	0.05	0.08	0.03
KC06	0.01	0.01	0.01	-0.01	0.02	0.00
KC07	0.01	-0.01	0.01	0.03	0.02	0.01
KC13	0.02	-0.02	0.01	0.01	0.02	0.00
KC16	0.01	-0.01	0.00	0.01	0.01	0.00
KC17	0.01	-0.03	0.01	0.01	0.01	-0.02
PB04	0.16	-0.08	0.03	-0.01	0.20	-0.10
PB12	0.61	-0.20	0.24	0.01	0.85	-0.19
PB13	0.42	-0.06	0.18	0.02	0.60	-0.05
PB18	0.03	-0.03	0.01	0.03	0.04	0.01
PB26	0.07	0.01	0.01	-0.02	0.07	-0.01
PB55	0.26	0.11	0.07	-0.07	0.31	0.05
PB59	0.25	-0.12	0.09	-0.03	0.34	-0.15
PB67	1.82	-0.30	0.62	-0.10	2.45	-0.41
PB68	0.13	-0.09	0.04	0.00	0.18	-0.09
PB69	0.14	-0.07	0.05	0.00	0.18	-0.07
PB70	0.13	-0.16	0.04	-0.06	0.17	-0.21
Note: The measurement confidence is 0.02' (1/4"); therefore, movements greater than 0.02' are deemed to have actually moved. See "PB MOVEMENT DATA POSTING 2007-(Present).xlsx" for details.						

Survey Report

of the

Portuguese Bend Landslide Monitoring Surveys

Dated: January 30, 2017, Appended March 15 and July 6, 2017

for the

City of Rancho Palos Verdes

prepared by

McGee Surveying Consulting

The Portuguese Bend Landslide is monitored on a tri-annual basis beginning with the rainy season. The initial survey of 66 monuments is conducted in the in September-October and reported herein. Two subsequent partial monitoring surveys of about 30 monuments are conducted in mid-winter and mid- spring. The second and third surveys are reported as Addendums No. 1 and No. 2 to this Report. Therefore, this Report is issued three times a year with the third being the final for the rainy season. The average date of each survey follows.

Initial Survey - October 5, 2016 Full Monitoring Survey No. 16 Report
Second Survey - February 24, 2017 Partial Monitoring Survey No. 17 Report
Third Survey – May 03, 2017 Partial Monitoring Survey No. 18

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APPENDIX

McGEE SURVEYING CONSULTING
5290 Overpass Road, Ste#107, Santa Barbara, CA 93111

Survey Report
of the
Portuguese Bend Landslide Monitoring Survey
October 5, 2016 Primary Monitoring
for the
City of Rancho Palos Verdes
prepared by
McGee Surveying Consulting
January 30, 2017

PROJECT OVERVIEW:

McGee Surveying Consulting performed a landslide monitoring survey in October 2016 at Portuguese Bend on behalf of the City of Rancho Palos Verdes. This survey established positions on monitoring points to determine overall and periodic movements. The results of the survey are described in this Report and in the attached spreadsheet titled "PB MOVEMENT DATA POSTING 2007-2016.10.xlsx". Two partial monitoring surveys are performed in the winter and spring and reported as addendums to this Report.

The field survey was planned, coordinated and executed by Michael McGee, PLS3945 of McGee Surveying Consulting who was also responsible for the final processing of the observations, network adjustments, analysis and reports. The monitoring points cover a 1½ mile square area and are measured to determine the rate and extent of ground movement. The area has been monitored by the City of Rancho Palos Verdes circa 1994 having been taken over from the County of Los Angeles. The Global Navigation Satellite System (GNSS (formerly referred to as GPS)) technology is used to measure positions based on the North American Datum of 1983 (NAD83) and the North American Vertical Datum of 1988 (NAVD 88). This survey is referenced to California CGPS (Continuous GPS) Stations in the region which are permanently mounted GPS and GNSS receivers used for monitoring seismic activity. The CGPS in California are similar to the national CORS (Continuously Operated Reference Stations).

Points that move a few inches or less per year are required to meet an accuracy standard of one centimeter (0.033 feet) at the 95% Level of Confidence. In the active slide area where the movements are greater than 0.25 feet per year (PB and UB points), the accuracy standard is two centimeters (0.066 feet) at the 95% Level of Confidence. Field procedures are designed to accomplish this purpose and Quality Control-Quality Assurance (QAQC) processes discussed hereafter are incorporated to verify these accuracies are attained.

Prior to September 2007, successive coordinate differences were used to compute movements; however, arithmetic differences do not provide statistical information about the relative movement accuracies. Beginning with the initial 2007 survey, field and office procedures were designed to assure the accuracy and reliability of measurements and provide for queries between epochs that include statistical information about the relative precisions of the reported movements. Measurements of temporal movements are based on a rigorous simultaneous least squares adjustment of multiple observations at two different epochs for each point.

HISTORY

This monitoring survey is a continuation of a program initiated by the County of Los Angeles and taken over by the City of Rancho Palos Verdes circa 1994. McGee Surveying Consulting has conducted the field surveys and reporting since September 2007. The monitoring surveys have occurred annually since 2007, semi-annually since 2012 and three times a year beginning with the September 2014 survey. See the September 2007 Survey Report for a history of the previous survey process between 1994 and 2007. See the Survey Reports on file with the City after 2006 for details of each monitoring campaign.

PROJECT DATUMS, REFERENCE SYSTEM

Horizontal Datum: North American Datum of 1983 established by the National Geodetic Survey (NGS) referred to as NAD83 (2007) 2007.00 Epoch. The NAD83 (2007) 2007.00 Epoch adjustment is one of a series of national adjustments of NAD83 since its adoption in 1986 and is the realization used for these monitoring surveys since 2007. The latest realization of NAD83 is the 2011 adjustment referred to as NAD83 (2011) 2010.00 Epoch; however, the above referenced 2007 realization is retained to be consistent with prior reporting and the primary purpose of determining relative movements over time.

Reference Network: The survey is referenced to the CGPS Stations (continuously operating GNSS receivers). For more information see NGS Data Sheets for the PID's listed below (no data sheet exists for PVE3). The positions listed below were obtained in September 2007 from the California Spatial Reference Center (CSRC). The CSRC provides CA Public Resources Code sanctioned positions for the California CGPS Stations.
Units: Feet

CGPS	Latitude(dms)	Longitude(dms)	EH(feet)	NGS PID	NAME
PVE3	33 44 35.853290	-118 24 15.269036	235.42	none	PALOS VERDES CORS
PVHS	33 46 46.020150	-118 22 19.741258	853.99	AJ1915	PENINSULA HIGH SCH
PVRS**	33 46 25.891904	-118 19 14.067218	198.63	AJ1916	PALOS VERDES RES
VTIS	33 42 45.489584	-118 17 37.712290	197.52	AJ1936	MARINE EXCHANGE

** Falls in the proximity of a Fault Line as shown below but appears unaffected to date

CGPS Stations (north up)

Vertical Datum: North American Vertical Datum of 1988 (NAVD88) established by the NGS.
Reference Network: CGPS Station VTIS is also a Second Order leveled benchmark and the original basis for the elevations in this survey. See the Record Elevations of CGPS stations following.

CGPS	NAVD88 Ht(feet)	
PVE3	none	
PVHS	972.1	Based on a Refined Geoid Model
PVRS	316.37	Based on Second Order Leveling by CSRC
VTIS	315.26	Based on Second Order Leveling by CSRC and basis for this survey

Geoid Model: Geoid 03: Note Geoid09 became available from the NGS in 2009 and Geoid12A in 2012; however, Geoid03 is retained to be consistent with prior reported heights and the primary purpose of determining relative height changes over time.

Projection: Plane coordinates are NAD83 California State Plane Coordinates Zone 5 in US Feet: The State Plane Coordinate Parameters follow: The average Scale Factor is 1.00007543, the Height Reduction Factor based on the average ellipsoid heights is 0.99999092, and the average Combined Grid Factor is 1.00006635. Distances in this survey are grid. To obtain ground distances divide grid distances by the Combined Grid Factor. Grid bearings resulting from this survey must be rotated by a Convergence Angle to obtain geodetic (true) bearings. The average convergence angle is -0-12-30± (rotate left 0-12-30).

Datum Stability: Rancho Palos Verdes sits on the Pacific Plate which is moving west-northwesterly relative to the North American Plate about 4 centimeters (0.14 feet) per year. The area southwesterly of the Fault Line shown on the above map includes the City and is moving at a constant rate as exhibited by the International Terrestrial Reference Frame (ITRF) north, east and up velocities of the CGPS Stations listed below. Note, there was no change.

	ANNUAL VELOCITIES/METERS			ANALYSIS PERIOD	
SITE	N	E	Up	START_DATE	END_DATE
PVE3	0.019	-0.039	-0.000	2000.7312	2017.0151
PVHS	0.019	-0.040	0.001	1999.5112	2017.0151
PVRS	0.019	-0.039	0.000	1999.0946	2017.0151
VTIS	0.019	-0.039	-0.001	1998.9380	2016.8105

These CGPS Stations provide a rigid reference frame for the Portuguese Landslide Monitoring Program that is validated during each monitoring campaign. See the Adjustments results below and the September 2007 Monitoring Survey Report by McGee Surveying Consulting for additional information.

FIELD SURVEYS, DATA COLLECTION, EQUIPMENT & PROCESSING

Three Leica geodetic GNSS receivers/antennas listed below were mounted on two-meter fixed height poles or tripod/tribrach to collect satellite signal data. The GS15 receivers tracked Navstar GPS, GLONASS and BeiDou satellites. Prior to initiating the field observations, a calibration of the poles and tribrach was conducted to verify their heights and plumb. The poles were found to be plumb within 0.003 feet consistent with prior years. There were no equipment failures.

Sixty-six monitoring points were occupied and reported in this survey. Site photographs and recovery sheets detailing the location, character of the monuments and obstructions were maintained and updated. See the Appendix for "Monitoring Point Status". Monument AB61, established in September 2007 on Portuguese Point, is used as the primary base station in each survey because it sits above a stable basalt formation. AB20 serves as a secondary base during each survey.

The field survey commenced each day by setting a Leica GS15 GNSS receiver on a fixed height pole at AB61 and on a tribrach/tripod at AB20 while a third GS15 GNSS receiver roamed freely collecting observations on a fixed height pole at the remaining 64 points. Points with annual movements less than 0.25' were measured with two or more independent occupations resulting in a minimum of four vectors to each point from AB61 and AB20. An independent occupation means the points were occupied under a different constellation of satellites usually on a different day. If the two measurements are within 0.03 feet (1 cm) horizontally, they are accepted, otherwise a third measurement is required. AB61, AB20 and the CGPS stations were connected with 8 hour (average) observations collected over a six-day period. Nineteen points in the active areas with annual

movements greater than 0.25' were single occupied. AB12 was single occupied due to restricted access. A comparison with the linear movements from prior years was made to verify their accuracy.

Many of the points are over-shadowed by mature trees and shrubberies which interfere with signals received from satellites and affect the quality of measurements. To obtain the best possible accuracies, the satellite constellation is compared with obstruction diagrams to estimate the best time for observing un-obstructed satellites. To improve the accuracy of the measurements, satellites that are obstructed by foliage and trees are either turned off during the observation or noted for removal in post-processing. If six or more un-obstructed satellites with a GDOP of less than three (measure of the geometry or strength of figure of the constellation) are available, then the measurement commences for a minimum of 15 minutes of data collection. If the geometry and number of satellites are insufficient then the receiver is moved to another point and returned later when satellite availability improves.

Date of Survey: 09/27-28/2016 and 10/9-12/16 (mean date 10/05/2016) between 0600-1800 PDST (+7 hrs for UTC).
GNSS Survey Parameters:
Constellation: 30 US NAVSTAR GPS satellites and 24 Russian GLONASS satellites.
Observables: GPS L1 & L2 and GLONASS L1 & L2 Carrier Waves
Epoch Rate - Occupation Times: 15 second epoch rate - 15 minute occupations at monitoring points and six 8 hour occupations at base stations.
Satellites: 11-18; GDOP =< 2; Elevation Mask for Data Collection at 15° and Processing at 15°
Ephemeris: Rapid for Static Post-Processing of CGPS connections and Broadcast for onsite.
Weather: A mixture of clear and cloudy skies with marine layer on the last two days, temperature 70°-85° F, no significant weather.
Space Weather: Boulder K Index (gauges ionospheric activity on a scale of 0-9; prefer less than 5 to avoid noisy data) was 4-6 on 09/27-28/2016. When the K factor reached 6 the survey was suspended until 10/09-12/2016 when it ranged 0-3.
Equipment:
GNSS Base Receiver Unit No.: M8, Operator: M. McGee, PLS; Station Occupied: AB61 (Base1)
Make & Model: Leica GS15; Antenna Leica GS15; Mount: Fixed Height Pole #1; Antenna Height: 1.803m
GNSS Rover Receiver Unit No.: M9, Operator: M. McGee, PLS;
Make & Model: Leica GS15; Antenna Leica GS15; Mount: Fixed Height Pole #3; Antenna Height: 1.800m
GNSS Rover Receiver Unit No.: M7, Operator: M. McGee, PLS, Station Occupied: AB20 (Base2)
Make & Model: Leica GS15; Antenna Leica GS15; Mount: Tribrach on Tripod; Antenna Height: varies

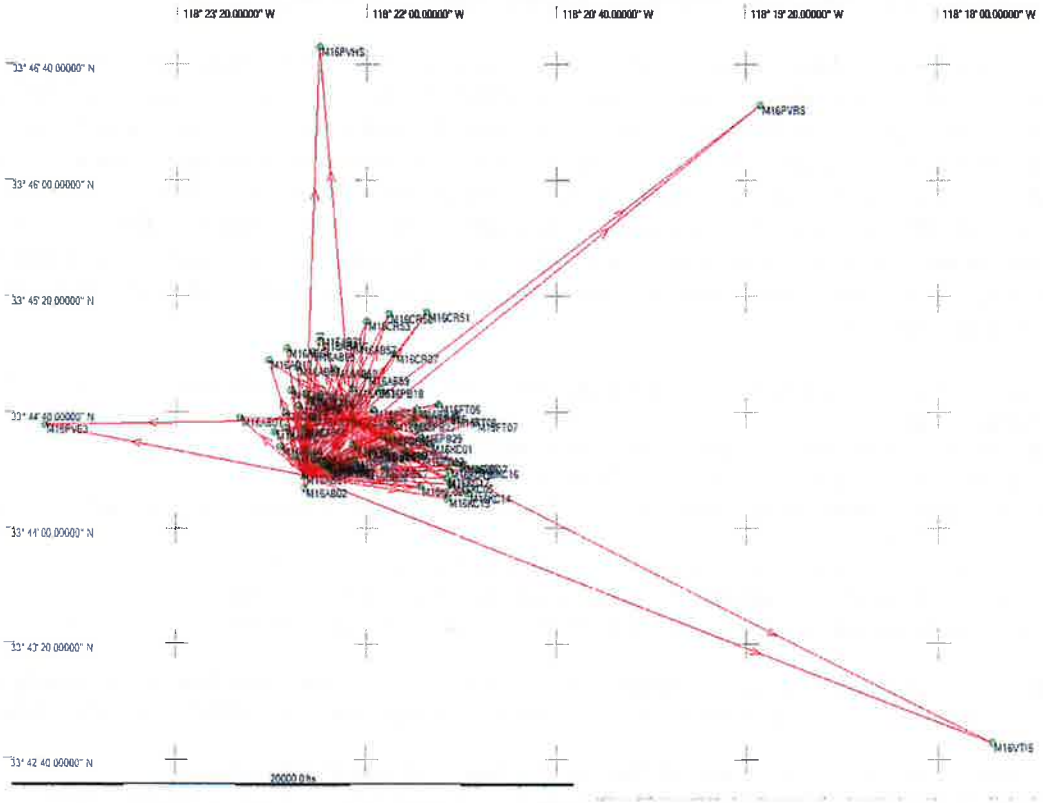
Vectors were processed using Leica LGO v8.4 post processing software. Analysis of residuals led to the rejection of 3 out of 48 vectors connecting the CGPS Stations to AB61 and AB20, and 0 out of 222 vectors connecting monitoring points. Network adjustments and analysis were performed with "Starnet-PRO" version 8.2.3 software. Rinex files of the satellite measurements for the CGPS Stations were downloaded from the SOPAC website. The Rapid Ephemeris and Absolute Antenna Models were obtained from the NGS website.

NETWORK

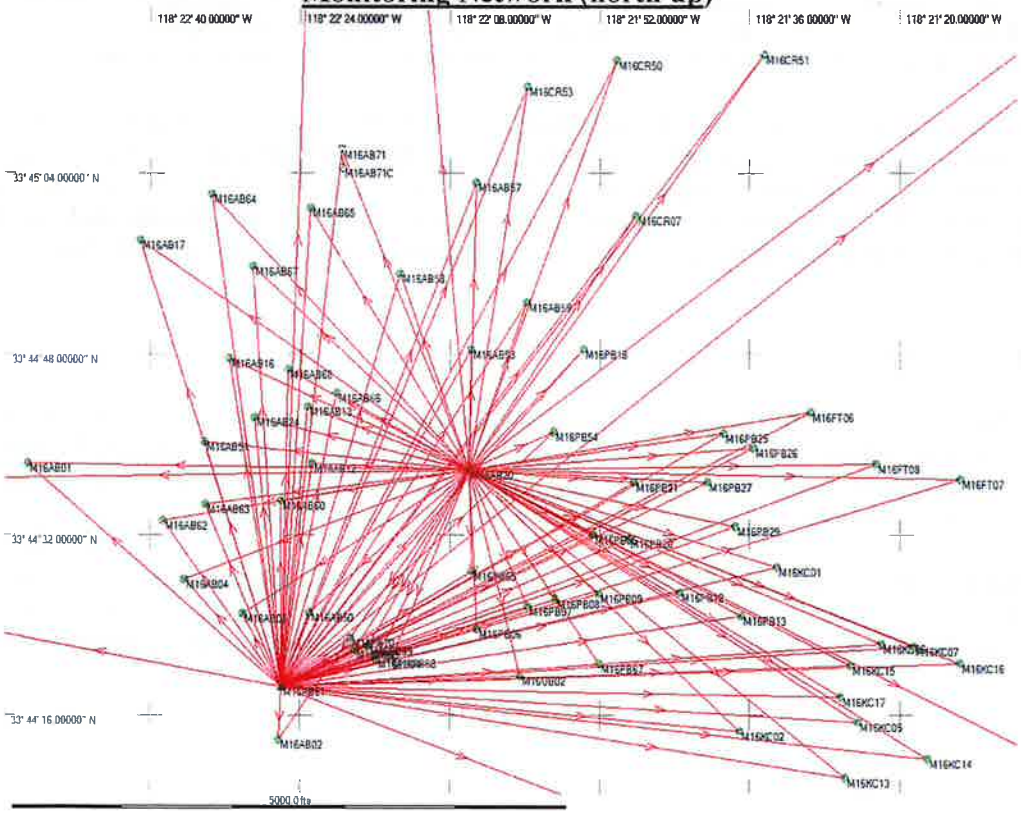
The primary Base Station is AB61, which sits on Portuguese Point, is the focal point of the static network connecting the monitoring points and CGPS Stations. AB20, a second Base Station is centrally located sitting on top of a high bluff overlooking Portuguese Bend. Sixty-six points and four CGPS Stations were connected with 270 vectors. See the following Network Maps and the Aerial View in the Appendix.

The monitoring plan utilizes the CGPS Stations to verify the stability of the reference frame. The primary CGPS Station used to control this survey is PVE3 located just south of City Hall and 1.8 miles west-northwest of Base Station AB61. CGPS Stations PVHS, PVRS and VTIS are used to validate the stability of the network.

Monitoring Network and CGPS Stations (north up)



Monitoring Network (north up)



MONITORING POINT HISTORY and STATUS

This is the 16th Monitoring Survey. For data management purposes during the field survey and data processing, the point names are prefixed with the sequential number to distinguish between monitoring surveys. For example, on the 16th monitoring survey, AB61 was named M16AB61 where M16 indicates the sequence number since the initial September 2007 Monitoring Survey. The prefix is stripped in the "COORDINATES LIST" and "PB MOVEMENT DATA POSTING 2007-2016.10.xlsx".

Between 1994 and 2006, 149 monitoring points were established to monitor the Portuguese Bend Landslides, many of which were lost or destroyed. Sixty of the original points were recovered in 2007. Eight of the 60 points were deleted because they were in close proximity of other points better suited for GNSS satellite measurements leaving 52 points monitored and reported between September 2006 and September 2007. Three of the 52 points (AB09, KC11 & PB51) were monitored in September 2007 for the last time and replaced by new points, set nearby and better suited for satellite observations.

2007: Eighteen new points were set in 2007 and had their movements reported for the first time in the following December 2008 survey. In September, it was noted that KC01 was previously reported by others on 9/14/2006 to have moved N 29°E 1.24' from its 12/9/2005 position. In the September 2008 survey, a buried partially illegible brass cap in concrete stamped "COUNTY ENGINEER RE8869 1956 STA ??IELDS" was found S31°29'W 1.48 feet from the 1" IP used by the previous survey and this survey in the initial September 2007 and subsequent surveys. The original 1994 position of KC01 was re-referenced to the 1" IP, resulting in correct overall reported movements.

2008: In December 2008, 49 original and 18 new points were surveyed for a total of 67 monitoring points. In December, it was noted that AB05 had been disturbed by a mowing machine. AB05 was found chipped and leaning to southerly about 0.4'. The movement reporting resumed in 2009. Analysis of the movement and historic data made it possible to estimate the disturbance to within 0.05'. The original 1995 position of AB05 was re-referenced S14°02'E 0.29' to be consistent with the disturbed position, resulting in correct overall reported movements.

2009: PB64 was set east of the Archery Range to replace PB63 (set 2007) which had become unsafe to access and was lost in 2010. PB64 was reported for the first time in October 2010.

2010: Points AB03 and BB25 were discontinued. AB03 is on the edge of a cliff 192 feet west-southwest of AB61 making it redundant, and BB25 is on a freestanding rock susceptible to disturbance by wave action. In the summer of 2010, PB62 was destroyed by road construction and in October 2010, PB65 was set 24' south-southwest of PB62's location and reported for the first time in October 2011. The following points may have been disturbed prior to the October 2010 survey. AB05 appears to have been disturbed by mower machinery, AB15 (½" GIP in a meter box) is driven over by vehicles occasionally accessing an adjacent field, and KC02 (½" GIP in a meter box) is occasionally parked on by vehicles accessing the beach.

2011: In October, new points AB62 and AB63 (initially referred to as AB62R and AB63R) were set to replace AB06 and AB07 which were hazardous to occupy due to their location near the traveled way of Palos Verde Drive South.

2012: In September, prior to initiating the survey, eight new monuments AB64, AB65, AB66, AB67, AB68, CR53, KC17 and PB66 were constructed to replace AB54, AB18, AB52, AB55, AB15, CR52, KC04 and PB53 respectively. The monuments were replaced because of poor sky visibility except for KC04 which was difficult to access and AB55 which was destroyed by trenching in the past year. Monuments were set with the following design. Monuments set in soil are 1" x 5' GIP driven flush and encase in a 6" PVC pipe sitting on a concrete collar down about 18". Monuments set in asphalt are 1/2" x 2' rebar driven below the surface inside a free floating 2" concrete encased plastic collar.

2013: Points AB15, AB18, AB52, AB54, CR52, KC04 and PB53 were surveyed for the last time in 2012 and discontinued. BB52 is on a freestanding rock susceptible to disturbance by wave action and was monitored for the last time in October and discontinued.

2014: In April PB64 was monitored for the last time due to unsafe access conditions and PB67 (a 5' t-bar steel post driven 3' into the ground) was set NNW'ly about 250' as a replacement and reported for the first time in September 2014 after 4.5 months whereas all other points in the "PB MOVEMENT DATA POSTING 2007-

2016.10.xlsx" are reported for 11.5 months since October 2013. In September, AB69 located about 260' NE of AB12 and AB70 located about 140' SE of AB12 were set as potential replacements; however, AB69 was destroyed by lot improvements and AB70 proved to be too obstructed for accurate results.
2015: In April, new points PB68, PB69 and PB70 were set to monitor movements of "Palos Verdes Drive South" and reported in October. In October, Monitoring Point AB56 was found disturbed by construction and AB71 (magnetic nail in AC) was set as a temporary replacement. In October, the steel post for PB67 was not found. An inconspicuous ½" x 4' rebar was set flush in its place. Because of the large movement in this area a more permanent monument is not necessary.
2016: In October, the temporary point for AB71 was destroyed by road work prior to this survey. AB71 was reset 12' easterly with a 2" screw and brass washer drilled into a granite curb on Vanderlip Road. No movement information will be available until the fall 2017. KC16 was raise to the surface of the road by others between the two occupations by this survey. Estimated height changed +0.33'+/-.

See the "Monitoring Point Status" in the Appendix for the present status of monitoring points.

ADJUSTMENTS & ANALYSIS

Adjustment 1: An adjustment to develop NAD83 (2007) 2007.00 Epoch Geodetic, Ellipsoid and State Plane Coordinates. CGPS Station PVE3 was fixed at its published NAD83 (2007) 2007.00 Epoch position listed above in a Minimally Constrained Adjustment to determine positions of points in this survey and verify its stability relative to other CGPS stations. PVE3 is located 1.8 miles westerly of and outside the influence of the slide area. PVE3 has been fixed in all adjustments since 2007. The CSRC publishes a Time Series representing the horizontal and vertical stability of PVE3 which indicate the position is stable. The primary base station AB61 and three other operating CGPS Stations were measured relative to PVE3 and used to assess stability of the survey reference frame. The positions are based on 8 hour (average) observations for six days. Differences in feet from one monitoring survey to another for key points are listed in the table below.

10/2013 Positions to 09/2014

ID	dN	dE	dZ	
PVE3	0.000	0.000	0.000	< Fixed >
PVRS	-0.011	-0.011	-0.003	
AB17	0.004	0.029	-0.078	
AB61	0.019	-0.005	-0.005	<Base Station>
CR51	0.001	-0.006	-0.047	
KC16	0.004	-0.023	-0.038	

9/2007 Positions to 09/2014

ID	dN	dE	dZ
PVE3	0.000	0.000	0.000
PVRS	-0.005	0.009	-0.016
AB17	-0.019	-0.005	-0.062
AB61	0.002	0.004	-0.054
CR51	-0.038	0.010	-0.129
KC16	-0.001	-0.013	-0.058

09/2014 Positions to 10/2015

ID	dN	dE	dZ	
PVE3	-0.000	-0.000	-0.000	< Fixed >
PVRS	0.001	0.007	0.016	
VTIS	0.003	0.005	0.049	
AB17	0.015	-0.017	0.042	
AB61	-0.007	0.003	-0.001	<Base Station>
CR51	0.011	0.005	0.017	
KC16	0.014	0.008	0.010	

9/2007 Positions to 10/2015

ID	dN	dE	dZ
PVE3	-0.000	-0.000	-0.000
PVRS	-0.004	0.016	0.000
VTIS	-0.000	0.017	-0.007
AB17	-0.004	-0.022	-0.020
AB61	-0.005	0.007	-0.055
CR51	-0.028	0.014	-0.112
KC16	0.013	-0.005	-0.048

10/2015 Positions to 10/2016

ID	dN	dE	dZ	
PVE3	-0.000	-0.000	-0.000	< Fixed >
PVHS	-0.007	0.000	0.024	<10/2013
PVRS	0.000	0.003	0.019	
VTIS	-0.001	-0.010	0.009	
AB17	-0.019	-0.010	0.051	
AB61	0.000	-0.002	0.016	
CR51	-0.014	-0.011	0.012	
KC16	-0.022	0.001	-----	

9/2007 Positions to 10/2016

ID	dN	dE	dZ
PVE3	-0.000	-0.000	-0.000
PVHS	-0.006	0.011	0.042
PVRS	-0.003	0.019	0.019
VTIS	-0.002	0.006	0.002
AB17	-0.023	-0.032	0.031
AB61	-0.004	0.005	-0.038
CR51	-0.042	0.002	-0.099
KC16	-0.009	-0.003	-----

Comments: The Base Station AB61 has no significant difference since October 2015 and 2007 as referenced to PVE3. Given that PVE3 and AB61 are in agreement, the survey reference frame is deemed stable and successfully recovered. An adjustment constrained to the other CGPS Stations is not necessary because the purpose here is to track their movements over time to test the stability of the reference frame and validate the measured movements. See the "COORDINATE LIST" in the Appendix for a list of coordinates resulting from this adjustment. See prior Survey Reports for coordinates resulting from earlier surveys.

Adjustment 2: An adjustment to develop NAVD88 Orthometric Heights (Elevations). The CGPS Station PVE3 was fixed horizontally and vertically at its NAVD88 height determined in the September 2007 survey. The 2007 height was based on the published 2nd Order NAVD88 Height of CGPS Station VTIS. This Adjustment combines the measured ellipsoid height differences with the NGS Geoid03 Model (models the separation between the ellipsoid and geoid surfaces) to determine the NAVD88 orthometric heights of the CGPS Stations and monitoring points.

ACCURACY

This survey conform to the intent of the California Spatial Reference Center & California Lands Surveyors Association's "GNSS Surveying Standards and Specifications, 1.1" (2014) and the Federal Geodetic Control Subcommittee (FGCS) "Specifications for GPS Relative Positioning" (1988).

Vector Residuals: The vector lengths, two dimensional residuals and the absolute value of the vertical residuals resulting from minimally constrained Adjustment #1 are listed below in feet. Three vectors to CGPS Stations were removed due to large residuals. Forty vectors to single occupied monitoring points are not included because they have no independent residuals and would optimistically skew the results. The statistics given below are applicable for all points.

	Vector Lengths		Two Dimensional Residuals			Vertical Residuals (absolute)		
Network	Vary	Average	Average	Std.Dev.	Maximum	Average	Std.Dev.	Range
Mon. Pts	479-7182	3171	0.007	0.005	0.037	0.012	0.010	-0.058 to +0.036
CGPS Sta's	9397-26102	17525	0.006	0.003	0.014	0.012	0.009	-0.035 to +0.032

Local Accuracy: The relative accuracy of vectors resulting from the minimally constrained Adjustment #1 is estimated at the 95% Level of Confidence in feet.

	Monitoring Points		CGPS Stations	
	2D	Vertical	2D	Vertical
Average	0.010	0.021	0.004	0.005
Maximum	0.018	0.046	0.004	0.007

Network Accuracy: The network accuracy of the coordinates derived from Adjustment #1 relative to the NAD83 Datum fixed at the CGPS Station PVE3 are estimated at the 95% Level of Confidence in feet.

	Monitoring Points		CGPS Stations	
	2D	Vertical	2D	Vertical
Average	0.010	0.022	0.004	0.005
Maximum	0.019	0.046	0.005	0.008

At the 95% confidence level, the average coordinate has a horizontal radius of circular error is 0.010 feet and a vertical of 0.022 feet with a max of 0.019 and 0.046 feet respectively.

Movement Accuracy: The relative movements reported between October 8, 2015 and October 5, 2016 (12.0 months) statistically attained an average accuracy of 0.014 feet at the 95% Level of Confidence and range 0.005 to 0.020 feet. The actual accuracy of measurements held to the "one-centimeter standard" are estimated to approach 0.01 feet as demonstrated by the vector residuals, repeatability of measurements at points considered stable, and deflection analysis. Refer to the sections titled ACCURACY and QAQC ANALYSIS in this Report for more information.

Statistically, the probability at the 95% level of confidence is that movement (signal) has occurred at a point when the horizontal distance between two epochs is greater than the 95% Error (noise). No movement is considered detected unless the movement exceeds the 95% Error for individual points. Applying this criterion, 6 points have not moved. See the attached "PB MOVEMENT DATA POSTING 2007-2016.10.xlsx" for the relative movements and the estimated error at the 95% Level of Confidence for individual points.

NAVD88 Heights: The North American Vertical Datum of 1988 orthometric heights resulting from Adjustment #2 are derived from the difference in ellipsoid heights combined with the Geoid03 Model and constrained to the NAVD88 height of PVE3 determined in 2007. The relative accuracy of the heights is expected to be 0.03 feet or better, but can be greater at obstructed sites. The absolute accuracy of the heights relative to the datum is dependent on the published orthometric height on the CGPS Station VTIS. Up until October 2011 there were no specific requirements for vertical accuracies. In October 2011, a 0.03-foot relative vertical accuracy preference was introduced for points AB17, AB57, CR07, CR50 and CR51. In the September 2012 and subsequent surveys the preference was extended to all points.

QUALITY CONTROL - QUALITY ASSURANCE (QAQC) ANALYSIS

To ensure the accuracy and validity of the measurement systems used in these GNSS monitoring surveys, an independent test was conducted in 2007 using conventional terrestrial based instruments as reported in the "QAQC ANALYSIS" section of the September 2007 Monitoring Survey Report. Comparing the results of the GNSS systems with conventional instrumentation found horizontal measurements agreed 0.01 feet on average. In November of 2011 the GNSS instruments and fixed height poles used in this survey were calibrated on the Santa Maria National Geodetic Survey Baseline and found to agree with published distances 0.003 to 0.006 feet.

To validate the radial survey method used in these surveys to position points from base stations AB61 and AB20, independent GNSS cross connections were measured and compared with the stand alone computed inverse distances in the 2007, 2008 and 2009 surveys. The results found the two dimensional accuracy to agree 0.01 feet on average, indicating the radial method of measurements is reliable and the additional labor cost of measuring cross connection between points is not warranted. See the "QAQC ANALYSIS" section of the September 2007 and the December 2008 Monitoring Survey Reports for detailed analysis.

Deflection Analysis is a method established by this surveyor to assess the consistency of the direction of movements reported from period to period. Assuming that movements are generally linear for points moving less than a foot, the separation or the deflection between the direction of the previous and present periods taken over the moved distance implies the accuracy obtained with the equipment, methods and procedures. Analysis of individual deflections found the separations and implied accuracy varied 0.01 to 0.02 feet.

SUMMARY

Point movement ranges by zones are listed below in feet:

```
(AB##) 0.00 to 0.06
(PB##) 0.04 to 1.60 and 9.73 at PB67
(KC##) 0.02 to 0.03
(CR##) 0.00 to 0.02
(FT##) 0.02 to 0.04
(KC##) 0.00 to 0.05
```

See the Appendix for a graphic of the horizontal movements depicted by zones ranging 0" to 1", 1" to 1' and 1'to 10'.

See the attached " PB MOVEMENT DATA POSTING 2007-2016.10.xlsx " spreadsheet for overall and periodic movements of each point. The movements are given in north, east and up or down as well as a vector of distance and direction relative to north. The direction is given as an azimuth in degrees where 0° is north and increases clockwise (90° East, 180° South, 270° West). The overall movements are from the date when a point was first set listed in the spreadsheet to the present survey.

The present status of monitored points is provided in the Appendix under "Monitoring Point Status". The historical status of all monitoring points is provided in the September 2007 Survey Report. The historical 1994-2006 positions of all points are listed in the Charles Abbott Associates Inc. file "ALL POINTS MOST RECENT OBSERVED POSITION AS OF SEPTEMBER 15, 2006.xls" attached as an electronic file to the 2007 Report.

RECOMMENDATION

An ongoing re-location program for monuments has long term benefits resulting in better accuracy and lower cost surveys due to improved sky visibility for tracking satellites. No monuments were re-located during this survey; however, Point AB56 was destroyed prior to the October 2015 monitoring and replaced. It was destroyed again prior to the October 2016 monitoring and replaced by AB71. Points AB16, AB17, AB24 and AB58 have limited sky visibility and are candidates for re-location or deletion. AB12 is in a horse corral and is difficult to access; however, there are no nearby alternatives.

Attachments: The following document is attached to this Report.
"PB MOVEMENT DATA POSTING 2007-2016.10.xlsx" listing the coordinates of the initial positions, the overall and periodic movements of monitoring points since 2007.

SURVEYOR'S STATEMENT

This is a Report on the procedures, criteria and results of the City of Rancho Palos Verdes Portuguese Bend Landslide Monitoring Surveys. This Report includes the Initial Monitoring Survey conducted in the fall and two Partial Monitoring Surveys added to the report as Addendum No.1 and Addendum No.2 in the following winter and spring. This survey was performed and the report prepared by me at the request of Ron Dragoo, Principal Engineer of the City of Rancho Palos Verdes.

Initial Monitoring Survey No. 16

Michael R. McGee P.L.S. 3945 — Date 01/30/2017

Addendum No. 1 - Partial Monitoring Survey No. 17

Michael R. McGee P.L.S. 3945 — Date 03/15/2017

Addendum No. 2 - Partial Monitoring Survey No. 18

Michael R. McGee P.L.S. 3945 — Date 7/05/2017

APPENDIX

McGEE SURVEYING CONSULTING
5290 Overpass Road, Ste#107, Santa Barbara, CA 93111

Aerial View of the October 2016 Monitoring Points (North is left)

and

General Dipiction of Horizontal Movements by Zones - October 8, 2015 to Oct. 5, 2016

(The zones shown here are a generalized depiction of movements and are not to be used for planning or development purposes)

Zone A = 0" – 1" Zone B = 1" – 1' Zone C = 1' – 10'

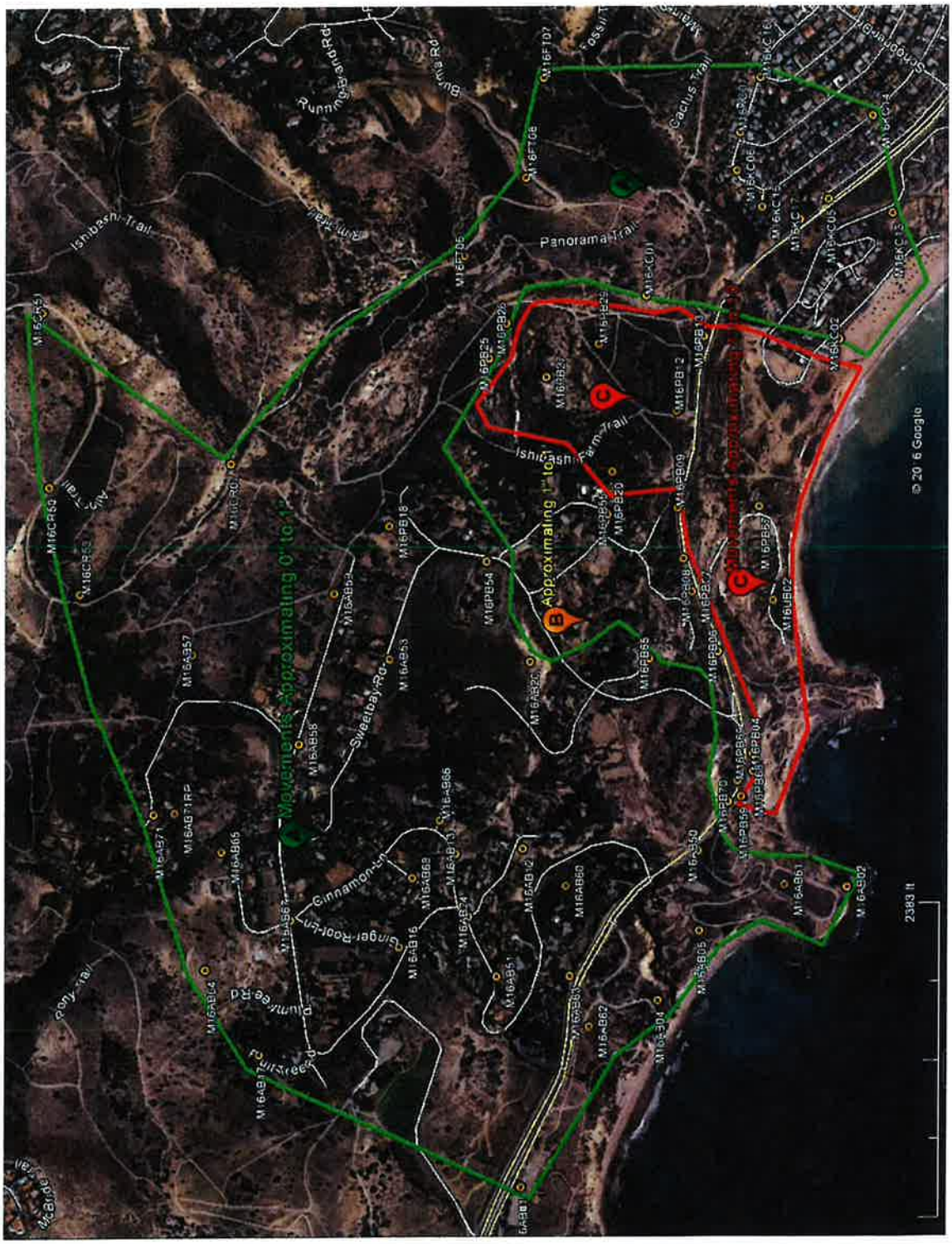


Table of Movements at Monitoring Survey Points

Listed below are the movements and elevation changes in the last annual period. See the attached spreadsheet titled "PB MOVEMENT DATA POSTING 2007-2016.10.xlsx" for the history of annual movements.

PORTUGUESE BEND LANDSLIDE MONITORING
Horizontal & Vertical Movements in Feet
Full Monitoring: 12.0 months
Oct. 8, 2015 to Oct. 5, 2016

Point ID	Movement Distance	Elevation Change	Point ID	Movement Distance	Elevation Change
AB01	0.03	0.06	KC01	0.05	0.01
AB02	0.00	0.03	KC02	0.03	-0.02
AB04	0.05	0.01	KC05	0.02	0.00
AB05	0.04	0.00	KC06	0.02	0.02
AB12	0.05	0.00	KC07	0.00	0.03
AB13	0.03	0.01	KC13	0.02	0.00
AB16	0.05	-0.01	KC14	0.01	0.03
AB17	0.02	0.05	KC15	0.02	0.02
AB20	0.04	0.04	KC16	0.02	
AB24	0.04	0.05	KC17	0.03	0.02
AB50	0.04	0.03	PB04	0.71	-0.25
AB51	0.02	0.02	PB06	0.68	-0.09
AB53	0.03	-0.02	PB07	0.78	-0.07
AB57	0.06	0.06	PB08	0.68	-0.02
AB58	0.03	0.01	PB09	0.87	-0.16
AB59	0.05	-0.01	PB12	1.60	-0.35
AB60	0.03	0.00	PB13	1.06	-0.07
AB61	0.00	0.02	PB18	0.04	-0.02
AB62	0.03	0.01	PB20	1.34	-0.29
AB63	0.05	0.00	PB21	0.80	-0.06
AB64	0.02	0.04	PB25	0.06	0.01
AB65	0.03	0.06	PB26	0.08	0.03
AB66	0.04	0.02	PB27	1.39	-0.19
AB67	0.02	0.04	PB29	1.09	-0.34
AB68	0.03	0.02	PB54	0.05	-0.04
AB71			PB55	0.76	-0.21
CR07	0.04	-0.02	PB59	1.08	-0.49
CR50	0.00	0.02	PB65	0.11	0.00
CR51	0.02	0.01	PB67	9.73	-1.24
CR53	0.01	0.00	PB68	0.52	-0.28
FT06	0.04	-0.02	PB69	0.61	-0.25
FT07	0.04	0.01	PB70	0.53	-0.66
FT08	0.02	0.03	UB02	2.55	0.00

Note: Movements greater than 0.02' (1/4") are deemed to have actually moved.

See "PB MOVEMENT DATA POSTING 2007-(present)" for annual summary

MCGEE SURVEYING CONSULTING							
RANCHO PALOS VERDES - PORTUGUESE LAND SLIDE MONITORING POINT STATUS for 2017 Prepared 01/26/2017							
Notes:	162+ Monitoring Points established since 1994						
09/01/07	71 Points Surveyed 60 old points found with 52 monitored plus 19 new points						
12/01/08	67 Points Surveyed AB09, KC11, PB51 discontinued; BB53 destroyed; AB05 disturbed						
11/01/09	68 Points Surveyed Set PB64 to replace PB63 destroyed subsequently						
10/01/10	65 Points Surveyed Discontinued AB03, BB25; set PB65 to replace PB62 destroyed by paving						
10/03/11	69 Points Surveyed; Set AB62 & AB63 to replace AB06 & AB07						
09/14/12	72 Points Surveyed; Discontinued AB06, AB07; AB55 destroyed by trenching; Added 8 new points						
10/06/13	65 Points Surveyed; Discontinued AB15, AB18, AB52, AB54, CR52, KC04, PB53						
9/19/14	64 Points Surveyed; Discontinued BB52, PB67 set in April 2014; Added PVE3RP (reference to PVE3 antenna)						
10/08/15	66 Points Surveyed; AB56 Destroyed & Replaced by AB71A; PB68, PB69, & PB70 Set in April 2015						
10/05/16	66 Points Surveyed; AB71A Destroyed & Replaced by AB71;						
	30+/- Points to Survey in Feb 2017 and April 2017						
Pt ID	Last Obs'd	Comments	GNSS	Pt ID	Last Obs'd	Comments	GNSS
AB01	10/05/2016	Base 1994-2006	G	KC01	10/05/2016	NE'ly/2 pipes 1.5' apart	G
AB02	"		G	KC02	"		G
AB04	"		G	KC05	"		G
AB05	"		G	KC06	"		G
AB12	"		G	KC07	"		G
AB13	"		F	KC13	"		G
AB16	"		P	KC14	"		G
AB17	"		F	KC15	"		F
AB20	"	NE'ly/ 2 monuments	G	KC16	"	Raised 0.33' by others	G
AB24	"		F	KC17	"	Replaced KC04	G
AB50	"		G	PB04	"		G
AB51	"		G	PB06	"		G
AB53	10/05/2016		F	PB07	"		G
AB57	10/05/2016		G	PB08	"		G
AB58	"		P	PB09	"		G
AB59	"		G	PB12	"		G
AB60	"		G	PB13	"		G
AB61	"	BASE 2007-Present	G	PB18	"		G
AB62	"		G	PB20	"	S'ly/ 2 pipes 5.3' apart	G
AB63	"		G	PB21	"		F
AB64	"		G	PB25	"		G
AB65	"		G	PB26	"		F
AB66	"		G	PB27	"		G
AB67	"		G	PB29	"		G
AB68	"		G	PB54	"		F
AB71	10/05/2016	Replaced AB56 10/2016	F	PB55	"		F
CR07	"		G	PB59	"		G
CR50	"		F	PB65	10/05/2016		G
CR51	"		G	PB67	10/05/2016		G
CR53	"		G	PB68	"		G
FT06	"		F	PB69	"		G
FT07	"		G	PB70	"		G
FT08	10/05/2016		G	UB02	10/05/2016		G
GNSS column indicates site is Good, Fair or Poor for Satellite Visibility Conditions							

McGEE SURVEYING CONSULTING
5290 Overpass Road, Ste#107, Santa Barbara, CA 93111

10/05/16 COORDINATE LIST

Portuguese Bend Landslide 10/05/2016 Monitoring Survey No. 16
Prepared by McGee Surveying Consulting: Document Date: 01/26/2017

Datum: Horizontal & EH are NAD83 (2007) 2007.00 Epoch; California State Plane Zone 5; Vertical: NAVD88 Note, Fixed CGPS Station PVE3 at Record 3D Position & NAVD88 Height per September 2007 Survey; See 2007 and subsequent Survey Reports

Point	Latitude	Longitude	EH(ft)	North(ft)	East(ft)	OrthoHt(ft)	Description
AB01	33-44-38.30243	118-22-53.05177	60.112	1729427.542	6445709.564	178.59	Punched 1/2" GIP in meter box
AB02	33-44-13.84894	118-22-26.19241	-2.034	1726946.990	6447968.687	116.46	4" BC "SAN PEDRO 1936" on conc. block
AB04	33-44-28.09039	118-22-36.28821	-51.292	1728389.858	6447121.407	67.17	BC "CO ENG STA Q2.." on 2"GIP in mass of conc.
AB05	33-44-24.98951	118-22-30.09180	-38.018	1728074.429	6447643.552	80.43	BC "CO ENG STA Q3.." on 2"GIP in mass of conc.
AB12	33-44-38.27444	118-22-22.72125	164.811	1729415.100	6448271.018	283.16	BC "CO ENG STA 7A.." in mass of conc.
AB13	33-44-43.34475	118-22-23.16141	246.126	1729927.801	6448235.749	364.45	Punched 1/2" GIP in meter box
AB16	33-44-47.57918	118-22-31.51206	259.067	1730358.490	6447532.132	376.40	Punched 1/2" GIP in meter box
AB17	33-44-58.06060	118-22-41.08442	324.494	1731421.096	6446727.740	442.83	Punched 1/2" GIP in meter box
AB20	33-44-37.77406	118-22-05.96650	277.965	1729359.299	6449685.800	396.24	BC "CO ENG STA W. FIX 1956.." in mass of conc.
AB24	33-44-42.35338	118-22-28.79512	217.391	1729829.352	6447759.606	335.74	Cotton spindle in conc. In road
AB50	33-44-25.11088	118-22-22.94615	63.571	1728084.453	6448247.086	181.99	Nail in conc. collar of well
AB51	33-44-40.22951	118-22-34.15190	186.745	1729616.338	6447306.420	305.13	PK mag nail in plastic plug "LS6957" in 1"GIP
AB53	33-44-48.36751	118-22-05.70040	234.604	1730430.119	6449712.196	352.83	Chiseled + on s edge conc. Vault
AB57	33-45-03.16942	118-22-05.20559	446.588	1731926.305	6449759.462	564.75	6" mag nail & washer in conc. in 2"x 36" GIP
AB58	33-44-55.14373	118-22-13.27646	287.343	1731117.484	6449074.930	405.57	Punched RR spike on s side road
AB59	33-44-52.53975	118-21-59.79466	316.002	1730850.072	6450212.469	434.18	6" mag nail & washer in conc. in 2"x 36" GIP
AB60	33-44-35.04120	118-22-26.06547	60.932	1729089.298	6447987.377	179.31	6" mag nail & washer in conc. in 2"x 28" GIP
AB61	33-44-18.57315	118-22-25.95799	21.960	1727424.492	6447990.262	140.43	6" mag nail & washer in conc. in 2"x 24" GIP
AB62	33-44-33.23018	118-22-38.63218	24.531	1728910.186	6446925.400	142.97	6" mag nail & washer in conc. in 1"x 24" GIP
AB63	33-44-34.71763	118-22-34.12096	62.353	1729059.127	6447306.948	180.76	Punched 1/2 x 48" rebar
AB64	33-45-02.13632	118-22-33.46048	413.914	1731830.699	6447373.094	532.20	2" mag nail on NE side 2' conc. Collar/Well B12
AB65	33-45-00.93166	118-22-22.90378	340.258	1731705.598	6448264.103	458.50	2" mag nail & washer in conc. in 1"x 60" GIP
AB66	33-44-44.53481	118-22-20.15018	255.945	1730047.163	6448490.494	374.25	1/2"x 24" punched rebar 1" below AC conc. collar
AB67	33-44-55.71679	118-22-29.06604	287.032	1731180.357	6447741.763	405.32	1/2"x 24" punched rebar 1" below AC conc. collar
AB68	33-44-46.61213	118-22-25.31233	275.102	1730258.778	6448055.331	393.42	1/2"x 24" punched rebar 1" below AC conc. collar
AB71	33-45-06.07146	118-22-19.51955	453.324	1732224.125	6448551.809	571.53	2" screw & brass washer"PLS3945" on VanderlipDr.
CR07	33-45-00.26859	118-21-48.09410	513.951	1731627.800	6451203.379	632.05	6" mag nail & washer in conc. in old 1" IP
CR50	33-45-13.97072	118-21-50.11938	754.594	1733013.579	6451037.368	872.65	Tack & shiner on lower rock wall
CR51	33-45-14.49676	118-21-34.43633	858.158	1733061.991	6452361.863	976.15	Tack & shiner on conc. pad
CR53	33-45-11.63358	118-21-59.73908	662.607	1732780.268	6450224.201	780.71	2" mag nail & washer in conc. in 1"x 60" GIP
FT06	33-44-42.78457	118-21-29.58594	370.502	1729854.713	6452760.013	488.59	6" mag nail & washer in conc. in 2"x 36" GIP
FT07	33-44-36.86993	118-21-13.66002	470.535	1729252.032	6454102.861	588.58	6" mag nail & washer in conc. in 2"x 36" GIP
FT08	33-44-38.19505	118-21-22.57428	540.359	1729388.649	6453350.507	658.43	6" mag nail & washer in conc. in 2"x 36" GIP
KC01	33-44-29.13299	118-21-33.10907	194.105	1728475.722	6452457.551	312.28	6" mag nail & washer in conc. in old 1" IP
KC02	33-44-14.54726	118-21-37.05739	-104.548	1727002.428	6452118.814	13.72	Punched 1/2" GIP in meter box
KC05	33-44-15.37036	118-21-24.50986	109.265	1727081.856	6453178.853	227.47	Punched 1/2" GIP in meter box
KC06	33-44-22.33187	118-21-21.96636	181.692	1727784.841	6453396.166	299.85	Punched 1/2" GIP in meter box
KC07	33-44-22.09037	118-21-18.55891	195.313	1727759.409	6453683.860	313.45	Punched 1/2" GIP in meter box
KC13	33-44-10.41184	118-21-25.78278	72.839	1726580.975	6453069.563	191.07	Cotton spindle in AC turnout
KC14	33-44-12.03474	118-21-17.07070	141.728	1726742.430	6453805.961	259.91	Punched spike in center road
KC15	33-44-20.39755	118-21-25.21744	168.843	1727590.272	6453120.897	287.02	Cotton spindle in cul-de-sac
KC16	33-44-20.55008	118-21-13.64609	209.098	1727602.236	6454098.230	327.23	Brass pin&washer "LS8773" set above spike in Xn
KC17	33-44-17.54973	118-21-26.32442	97.025	1727302.715	6453026.381	215.22	2" mag nail & washer in conc. in 1"x 50" GIP
PB04	33-44-20.96037	118-22-15.81184	47.596	1727662.644	6448848.068	166.01	Nail & tag "RCE26120" in conc. in 3" pipe
PB06	33-44-23.66322	118-22-05.05191	58.502	1727932.537	6449757.816	176.85	Punched cap on 2" GIP
PB07	33-44-25.64426	118-21-59.68995	78.917	1728131.147	6450211.395	197.23	Brass tag "LA CO DPW" in conc. in 2" GIP
PB08	33-44-26.28816	118-21-56.72203	76.003	1728195.327	6450462.288	194.30	Punched cap on 2" GIP
PB09	33-44-26.74879	118-21-52.15112	69.876	1728240.490	6450848.494	188.15	Punched cap on 2" GIP in cable box
PB12	33-44-26.84404	118-21-43.47589	64.231	1728247.471	6451581.195	182.47	Punched cap on 2" GIP in cable box
PB13	33-44-24.78439	118-21-36.78407	88.039	1728037.228	6452145.606	206.25	Punched cap on 2" GIP in cable box
PB18	33-44-48.40965	118-21-53.76858	244.669	1730430.705	6450719.841	362.84	Punched 1/2" GIP in meter box
PB20	33-44-31.64967	118-21-48.92462	112.557	1728734.938	6451122.780	230.78	Punched cap on 2" GIP in cable box
PB21	33-44-36.62357	118-21-48.27985	153.542	1729237.558	6451179.051	271.74	Punched cap on 2" GIP in cable box
PB25	33-44-40.93012	118-21-38.74147	207.795	1729670.010	6451986.151	325.93	Punched cap on 2" GIP in cable box
PB26	33-44-39.63607	118-21-35.58718	164.780	1729538.238	6452252.065	282.91	Brass tag "LA CO DPW" in conc. in 2" GIP
PB27	33-44-36.63122	118-21-40.42475	151.938	1729235.940	6451842.434	270.10	Punched cap on 2" GIP in cable box
PB29	33-44-32.68293	118-21-37.46731	50.632	1728835.907	6452090.766	168.80	Brass tag "LA CO DPW" in conc. in 2" GIP
PB54	33-44-41.07810	118-21-56.95058	239.431	1729690.527	6450448.427	357.65	PK mag nail in plastic plug "LS6957" in 1"GIP
PB55	33-44-31.99176	118-21-52.73585	120.690	1728770.686	6450801.033	238.93	PK mag nail in plastic plug "LS6957" in 1"GIP
PB59	33-44-21.85909	118-22-18.05629	38.789	1727754.196	6448658.846	157.20	PK mag nail in plastic plug "LS?" in 1" GIP
PB65	33-44-28.81717	118-22-05.66879	169.266	1728453.745	6449707.626	287.59	2" alum. cap "MCGEE SURVEYING" on 5/8"x 24"rebar
PB67	33-44-20.57198	118-21-52.04031	-44.992	1727616.035	6450855.589	73.31	1/2" x 3' rebar
PB68	33-44-20.98543	118-22-14.21438	54.377	1727664.679	6448982.994	172.78	2" Alum Cap "PLS3945" in 1"x 30" GIP
PB69	33-44-22.14080	118-22-16.64302	45.944	1727782.234	6448778.311	164.35	2" Alum Cap "PLS3945" in 1"x 30" GIP
PB70	33-44-22.84715	118-22-18.52905	36.892	1727854.228	6448619.208	155.30	2" Alum Cap "PLS3945" in 1"x 30" GIP
UB02	33-44-19.49856	118-22-00.46352	-55.781	1727510.110	6450143.796	62.57	PK mag nail in plastic plug "?" in 1"GIP
PVE3	33-44-35.85329	118-24-15.26904	235.421	1729207.091	6438765.184	354.36	CGPS Pos. Fixed in 2007 and subsequent surveys
PVHS	33-46-46.02013	118-22-19.74133	854.064	1742328.077	6448570.490	972.08	CGPS Pos. Determined by this Survey
PVRS	33-46-25.89199	118-19-14.06712	198.616	1740239.299	6464237.896	316.32	CGPS Pos. Determined by this Survey
VTIS	33-42-45.48963	118-17-37.71225	197.515	1717933.682	6472307.226	315.26	CGPS Pos. Determined by this Survey

McGEE SURVEYING CONSULTING
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Addendum No.1
Monitoring Survey No. 17 Report
Portuguese Bend Landslide Monitoring
February 24, 2017 Partial Monitoring Survey
for the
City of Rancho Palos Verdes
by
McGee Surveying Consulting
March 14, 2017

Overview:

This Addendum No. 1 Report describes the February 2017 tri-annual Portuguese Bend Monitoring Survey. This partial survey included 30 points which are a sub-set of the full monitoring set.

This survey followed the procedures described in previous surveys. For a detailed history of the program and surveys see "History" above and previous Monitoring Survey Reports back to 2007. The field survey took place February 23-25, 2017. The Field Surveys, Equipment, Data Collection and Network Design were as described in the above Report. The survey included 30 onsite points, two of which were base stations AB61 and AB20 connecting each point with two to six vectors. An equipment issue occurred at the backup base AB20 resulting in a reliance on vectors from AB61 with good results. Four continuously operating GPS stations (CGPS) were connected to this survey with three 4-8 eight hours observations.

The movements reported between October 5, 2016 and February 24, 2017 (4.7 months) statistically attained an average accuracy of 0.019 feet at the 95% Level of Confidence. The overall vectors residuals follow: the 2D averaged 0.005' with a maximum of 0.016' and the vertical averaged 0.009' with a maximum of 0.041'.

A Minimally Constrained Adjustment was processed to develop NAD83 (2007) 2007.00 Epoch Geodetic and State Plane Coordinates in feet. CGPS Station PVE3 was fixed and the differences are listed in feet from the October 5, 2016 to the February 24, 2017 positions below.

10/05/2016 to 02/24/2017

Station	dN	dE	dZ	
AB04	-0.08	-0.06	0.01	
AB12	-0.04	0.00	0.00	
AB16	-0.02	0.01	0.05	
AB17	-0.02	0.03	-0.04	
AB20	-0.05	-0.02	-0.01	
AB50	-0.02	-0.03	-0.02	
AB59	-0.05	0.01	0.07	
AB60	-0.07	-0.01	0.05	
AB61	-0.01	0.01	0.11	Primary Base Station
AB65	-0.02	0.00	0.16	
CR07	-0.03	-0.01	0.02	
CR50	0.00	-0.01	0.03	
FT06	-0.07	-0.02	0.04	
FT07	-0.04	-0.06	0.01	
KC06	0.00	-0.02	-0.01	
KC07	-0.02	0.00	0.01	
KC13	-0.02	-0.01	0.04	
KC16	-0.01	0.00	-0.02	
KC17	0.00	-0.01	0.02	
PB04	-0.44	-0.09	-0.12	
PB12	-0.78	-0.23	-0.18	
PB13	-0.54	-0.28	-0.01	
PB18	-0.05	0.00	0.04	

PB26	-0.05	-0.02	-0.03	
PB55	-0.42	-0.08	-0.04	
PB59	-0.64	-0.12	-0.25	
PB67	-5.52	-0.70	-0.96	
PB68	-0.36	-0.01	-0.06	
PB69	-0.36	-0.12	-0.15	
PB70	-0.26	-0.10	-0.41	
PVE3	0.00	0.00	0.00	Fixed CGPS Station
PVHS	0.00	0.00	0.01	CGPS Station
PVRS	-0.02	0.00	-0.05	CGPS Station
VTIS	-0.01	0.00	-0.03	CGPS Station

The adjustment, constrained to the CGPS station PVE3 as a standard procedure, finds no difference within the noise level of the measurement system in the horizontal position at the primary base station AB61 nor with CGPS stations PVHS, PVRS and VTIS as well as stations CR50 and KC16 considered to be fairly stable over time. The survey reference frame was deemed stable and successfully recovered. The results are compiled below.

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Addendum No.2
Monitoring Survey No. 18 Report
Portuguese Bend Landslide Monitoring
May 3, 2017 Partial Monitoring Survey
for the
City of Rancho Palos Verdes
by
McGee Surveying Consulting
July 6, 2017

Overview:

This Addendum No. 2 Report describes the May 3, 2017 tri-annual Portuguese Bend Monitoring Survey. This partial survey included 29 points which are a sub-set of the full monitoring set.

This survey followed the procedures described in previous surveys. For a detailed history of the program and surveys see "History" above and previous Monitoring Survey Reports back to 2007. The field survey took place May 1-6, 2017. The Field Surveys, Equipment, Data Collection and Network Design were as described in the above Report. The survey included 29 onsite points, with a base station at AB61 connecting each point with one to three vectors. Access to FT07 was prevented due to hazardous conditions and will be resumed at the next monitoring. Four continuously operating GPS stations (CGPS) were connected to this survey with four 2-8 eight hours observations.

The movements reported between February 24, 2017 and May 3, 2017 (2.2 months) statistically attained an average accuracy of 0.019 feet at the 95% Level of Confidence. The overall vectors residuals follow: the 2D averaged 0.004' with a maximum of 0.013' and the vertical averaged 0.005' with a maximum of 0.027'.

A Minimally Constrained Adjustment was processed to develop NAD83 (2007) 2007.00 Epoch Geodetic and State Plane Coordinates in feet. CGPS Station PVE3 was fixed and the differences are listed in feet from the February 24, 2017 to the May 3, 2017 positions below.

02/24/2017 to 05/03/2017

Station	dN	dE	dZ	
AB04	-0.07	-0.07	0.01	
AB12	-0.05	-0.03	0.03	
AB16	-0.01	0.00	0.02	
AB17	0.02	-0.01	0.02	
AB20	-0.05	-0.02	0.01	
AB50	-0.02	-0.04	0.04	
AB59	-0.05	0.02	-0.04	
AB60	-0.03	-0.03	0.01	
AB61	0.00	0.00	-0.05	Primary Base Station
AB65	-0.03	0.01	0.06	
CR07	-0.05	0.00	-0.02	
CR50	0.00	0.01	-0.01	
FT06	-0.07	-0.02	-0.05	
KC06	-0.03	-0.04	0.01	
KC07	-0.01	0.01	0.03	
KC13	-0.03	-0.01	0.03	
KC16	0.00	0.00	0.04	
KC17	-0.05	-0.03	0.00	
PB04	-0.30	-0.09	-0.09	
PB12	-0.64	-0.19	-0.09	
PB13	-0.42	-0.23	0.03	
PB18	-0.07	-0.02	0.02	
PB26	-0.10	0.00	0.05	
PB55	-0.34	-0.04	-0.16	
PB59	-0.50	-0.12	-0.18	

PB67	-3.21	-0.38	-0.52	
PB68	-0.29	-0.03	-0.10	
PB69	-0.27	-0.12	-0.09	
PB70	-0.24	-0.12	-0.28	
PVE3	0.00	0.00	0.00	Fixed CGPS Station
PVHS	0.01	0.00	-0.03	CGPS Station
PVRS	0.02	0.01	0.05	CGPS Station
VTIS	0.01	0.00	0.04	CGPS Station

The adjustment, constrained to the CGPS station PVE3 as a standard procedure, finds no difference within the noise level of the measurement system in the horizontal position at the primary base station AB61 nor with CGPS stations PVHS, PVRS and VTIS as well as stations CR50 and KC16 considered to be fairly stable over time. The survey reference frame was deemed stable and successfully recovered. The results are compiled below.

Note: The movement of points in the last 7 months is nearly the same as in the previous 12 months.

PORTUGUESE BEND LANDSLIDE MONITORING						
Periodic Horizontal & Vertical Movement in Feet						
	10/05/2016 to		02/24/2017 to		10/05/2016 to	
	02/24/2017 = 4.7 mo		05/03/2017 = 2.2 mo		05/03/2017 = 6.9 mo	
Mon.Pt.	Movement	Elevation	Movement	Elevation	Movement	Elevation
	Distance	Change	Distance	Change	Distance	Change
AB04	0.10	0.01	0.10	0.01	0.20	0.01
AB12	0.04	0.00	0.06	0.03	0.10	0.02
AB16	0.02	0.05	0.01	0.02	0.03	0.07
AB17	0.04	-0.04	0.02	0.02	0.02	-0.02
AB20	0.05	-0.01	0.05	0.01	0.10	0.00
AB50	0.03	-0.02	0.04	0.04	0.08	0.02
AB59	0.05	0.07	0.06	-0.04	0.10	0.03
AB60	0.07	0.05	0.05	0.01	0.11	0.06
AB61	0.02	0.11	0.00	-0.05	0.02	0.06
AB65	0.02	0.16	0.03	0.06	0.06	0.21
CR07	0.03	0.02	0.05	-0.02	0.08	0.00
CR50	0.01	0.03	0.01	-0.01	0.00	0.01
FT06	0.07	0.04	0.07	-0.05	0.14	0.00
FT07	0.08	0.01				
KC06	0.02	-0.01	0.04	0.01	0.06	-0.01
KC07	0.02	0.01	0.01	0.03	0.03	0.04
KC13	0.02	0.04	0.04	0.03	0.05	0.07
KC16	0.01	-0.02	0.00	0.04	0.02	0.02
KC17	0.01	0.02	0.06	0.00	0.06	0.02
PB04	0.44	-0.12	0.31	-0.09	0.76	-0.21
PB12	0.81	-0.18	0.67	-0.09	1.48	-0.27
PB13	0.61	-0.01	0.48	0.03	1.09	0.02
PB18	0.05	0.04	0.07	0.02	0.12	0.06
PB26	0.06	-0.03	0.10	0.05	0.16	0.03
PB55	0.42	-0.04	0.35	-0.16	0.77	-0.20
PB59	0.65	-0.25	0.51	-0.18	1.16	-0.44
PB67	5.56	-0.96	3.23	-0.52	8.80	-1.48
PB68	0.36	-0.06	0.29	-0.10	0.64	-0.16
PB69	0.38	-0.15	0.29	-0.09	0.67	-0.24
PB70	0.27	-0.41	0.27	-0.28	0.54	-0.69
Note: Movements greater than 0.02' (1/4") are deemed to have actually moved.						
See "PB MOVEMENT DATA POSTING 2007-(Present).xlsx" for annual summary						

Survey Report

of the

Portuguese Bend Landslide Monitoring Surveys

Dated: Feb. 3, 2016, Revised & Appended March 11, 2016, Appended April 22, 2016, Revised Aug. 9, 2016

for the

City of Rancho Palos Verdes

prepared by

McGee Surveying Consulting

The Portuguese Bend Landslide is monitored on a tri-annual basis beginning and ending with the rainy season. The initial survey of about 70 monuments is conducted in the early fall and reported below in detail. Two subsequent partial monitoring surveys of about 30 monuments are conducted in mid-winter and early spring. The second and third surveys are reported as Addendums No. 1 and No. 2 to this Report. Therefore, this Report is issued three times with the third being the final for the particular rainy season. The average date of the surveys follows.

Initial Survey - Full Monitoring: October 8, 2015
Second Survey - Partial Monitoring: February 16, 2016
Third Survey - Partial Monitoring: April 19, 2016

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APPENDIX

ATTACHMENT: "PB MOVEMENT DATA POSTING 2007-present.xlsx" (Overall & Periodic Movement)

McGEE SURVEYING CONSULTING
5290 Overpass Road, Ste#107, Santa Barbara, CA 93111

Survey Report
of the
Portuguese Bend Landslide Monitoring Survey
October 8, 2015 Full Monitoring
for the
City of Rancho Palos Verdes
prepared by
McGee Surveying Consulting
February 3, 2016

PROJECT OVERVIEW:

McGee Surveying Consulting performed a landslide monitoring and control survey dated October 8, 2015 at Portuguese Bend on behalf of the City of Rancho Palos Verdes. This survey established positions on monitoring points to determine overall and periodic movements. The results of the survey are described in this Report and in the attached spreadsheet titled "PB MOVEMENT DATA POSTING 2007-2015.10.xlsx". Two partial monitoring surveys will be performed in the winter and spring and reported as addendums to this Report.

The field survey was planned, coordinated and executed by Michael McGee, PLS3945 of McGee Surveying Consulting who was also responsible for the final processing of the observations, network adjustments, analysis and reports. The monitoring points cover a 1½ mile square area and are measured to determine the rate and extent of ground movement. This monitoring program has occurred annually since 2007, semi-annually since 2012 and three times a year beginning with the September 2014 survey. The area has been monitored by the City of Rancho Palos Verdes since 1994 and prior by the County of Los Angeles. The Global Navigation Satellite System (GNSS formerly referred to as GPS) technology was used to measure positions based on the North American Datum of 1983 (NAD83) and the North American Vertical Datum of 1988 (NAVD 88). This survey is referenced to the California CGPS (Continuous GPS) Stations in the region which are permanently mounted GPS receivers used for monitoring seismic activity. The CGPS in California are similar to the national CORS (Continuously Operated Reference Stations).

Points that move a few inches or less per year are required to meet an accuracy standard of one centimeter (0.033 feet) at the 95% Level of Confidence. In the active slide area where the movements are greater than 0.25 feet per year (PB and UB points), the accuracy standard is two centimeters (0.066 feet) at the 95% Level of Confidence. Field procedures are designed to accomplish this purpose and Quality Control-Quality Assurance (QAQC) processes discussed hereafter are incorporated to verify these accuracies are attained.

Prior to September 2007, successive coordinate differences were used to compute movements which do not provide statistical information about the relative movement accuracies. Beginning with the initial 2007 survey, field and office procedures were designed to assure the accuracy and reliability of measurements and provide for queries between epochs that include statistical information about the relative precisions of the reported movements. Thereafter, measurements of temporal movements are based on a rigorous simultaneous least squares adjustment of multiple observations at two different epochs for each point.

HISTORY

This monitoring survey is a continuation of a program initiated by the County of Los Angeles and taken over by the City of Rancho Palos Verdes circa 1994. McGee Surveying Consulting has conducted the field surveys and reporting since September 2007. See the September 2007 Survey Report for a history of the previous survey process between 1994 and 2007. See the Survey Reports subsequent to 2007 for details of each monitoring campaign. Beginning with the 2012 rainy season (begins in September) full monitoring continued as usual and a

partial monitoring was initiated in the following winter-spring. Beginning in September 2014 a full monitoring was conducted and a partial monitoring surveys were conducted in the February and April.

PROJECT DATUMS, REFERENCE SYSTEM

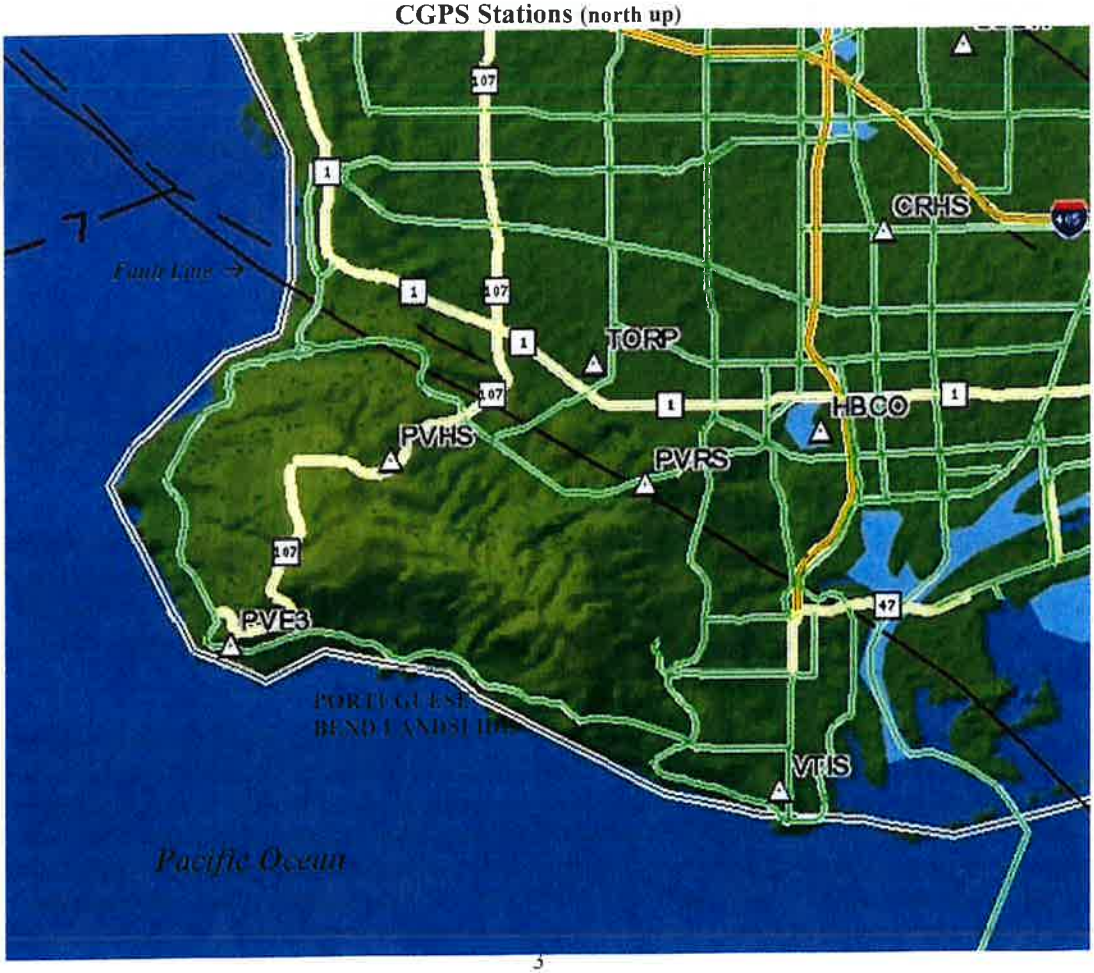
Horizontal Datum: North American Datum of 1983 established by the National Geodetic Survey (NGS) referred to as NAD83 (2007) 2007.00 Epoch. The NAD83 (2007) 2007.00 Epoch adjustment is one of a series of national adjustments of NAD83 since its adoption in 1986 and is the realization used for these monitoring surveys since 2007. The latest realization of NAD83 is the 2011 adjustment referred to as NAD83 (2011) 2010.00 Epoch; however, the above referenced 2007 realization is retained to be consistent with prior reporting and the primary purpose of determining relative changes over time.

Reference Network: The survey is referenced to the CGPS Stations (continuously operating GNSS receivers). For more information see NGS Data Sheets for the PID's listed below (no data sheet exists for PVE3). The positions listed below were obtained in September 2007 from the California Spatial Reference Center (CSRC). The CSRC provides CA Public Resources Code sanctioned positions for the California CGPS Stations.
Units: Feet

CGPS	Latitude(dms)	Longitude(dms)	EH(feet)	NGS PID	NAME
PVE3	33 44 35.853290	-118 24 15.269036	235.42	none	PALOS VERDES CORS
PVHS*	33 46 46.020150	-118 22 19.741258	853.99	AJ1915	PENINSULA HIGH SCH
PVRS**	33 46 25.891904	-118 19 14.067218	198.63	AJ1916	PALOS VERDES RES
VTIS	33 42 45.489584	-118 17 37.712290	197.52	AJ1936	MARINE EXCHANGE

* Not Operational During Survey
** Falls in the proximity of a Fault Line as shown below but appears unaffected to date

CGPS Stations (north up)



Vertical Datum: North American Vertical Datum of 1988 (NAVD88) established by the NGS.
Reference Network: CGPS Station VTIS is also a Second Order leveled benchmark and the original basis for the heights by this survey.

CGPS	NAVD88 Ht(feet)	
PVE3	none	
PVHS	972.1	Based on a Refined Geoid Model
PVRS	316.37	Based on Second Order Leveling by CSRC
VTIS	315.26	Based on Second Order Leveling by CSRC and original basis for this survey

Geoid Model: Geoid 03; note Geoid09 became available from the NGS in 2009 and Geoid12A in 2012; however, Geoid03 is retained to be consistent with prior reported heights and the primary purpose of determining relative changes over time.

Projection: NAD83 California State Plane Coordinates Zone 5 in US Feet: The State Plane Coordinate Parameters follow: The average Scale Factor is 1.00007543, the Height Reduction Factor based on the average ellipsoid heights is 0.99999092, and the average Combined Grid Factor is 1.00006635. Distances in this survey are grid. To obtain ground distances divide grid distances by the Combined Grid Factor. Grid bearings resulting from this survey must be rotated by a Convergence Angle to obtain geodetic (true) bearings. The average convergence angle is -0-12-30± (rotate left 0-12-30).

Datum Stability: Rancho Palos Verdes sits on the Pacific Plate which is moving west-northwesterly relative to the North American Plate about 4 centimeters (0.14 feet) per year. The area southwesterly of the Fault Line shown on the above map includes the City and is moving at a constant rate as exhibited by the International Terrestrial Reference Frame (ITRF) north, east and up velocities of the CGPS Stations listed below. Note, there was no change.

ANNUAL VELOCITIES IN METERS

SITE	N	E	U	START_DATE	END_DATE
PVE3	0.019	-0.039	-0.000	2000.7327	2016.0397
PVRS	0.019	-0.039	0.000	1999.0948	2016.0397
VTIS	0.019	-0.039	-0.001	1998.9407	2016.0397

These CGPS Stations provide a rigid reference frame for the Portuguese Landslide Monitoring Program that is validated during each monitoring campaign. See the Adjustments results below and the September 2007 Monitoring Survey Report by McGee Surveying Consulting for additional information.

FIELD SURVEYS, DATA COLLECTION, EQUIPMENT & PROCESSING

Three Leica geodetic GNSS receivers/antennas listed below were mounted on two meter fixed height poles or tripod/tribrach to collect satellite signal data. The GS15 receivers track Navstar GPS and GLONASS satellites. Prior to initiating the field observations a calibration of the poles and tribrach were conducted to verify their heights and plumb. The top of the poles were found to be plumb within 0.003 feet of the bottom consistent with prior years. There were no equipment failures.

Sixty-nine monitoring points were occupied and reported in this survey. Site photographs and recovery sheets detailing the location, character of the monuments and obstructions were maintained and updated. See the Appendix for "Monitoring Point Status". Monument AB61, established in September 2007 on Portuguese Point, is used as the primary base station in each survey because it sits above a stable basalt formation. AB20 serves as a secondary base during the surveys.

The field survey commenced each day by setting a Leica GS15 GNSS receiver on a fixed height pole at AB61 and on a tribrach/tripod at AB20 while a third GS15 GNSS receiver roamed freely collecting observations on a fixed height pole at the other 68 points. Points with annual movements less than 0.25' were measured with two or more independent occupations resulting in a minimum of four vectors to each point from AB61 and AB20. Independent occupations means the points were occupied under a different constellation of satellites usually on a different day. If the two measurements were within 0.03 feet (1 cm) horizontally, they were accepted,

otherwise a third measurement was required. On each day over a six day period, vectors based on 8 hours of observations connected AB61, AB20 to the CGPS stations. Twenty points, in the active areas, with annual movements greater than 0.25' were single occupied. A comparison with the linear movements from prior years was made to verify their accuracy.

Many of the points are over-shadowed by mature trees and shrubberies which interfere with signals received from satellites and affect the quality of measurements. To obtain the best possible accuracies, the satellite constellation is compared with obstruction diagrams to estimate the best time for observing un-obstructed satellites. To improve the accuracy of the measurements, satellites obstructed by foliage and trees are either turned off during the observation or noted for removal in post-processing. If six or more un-obstructed satellites with a GDOP of less than three (measure of the geometry or strength of figure of the constellation) are available, then the measurement commenced for a minimum of 15 minutes of data collection. If the geometry and number of satellites are insufficient then the receiver was moved to another point and returned later when satellite availability improved.

Date of Survey: 10/04/15 to 10/13/15 (mean date 10/08/2015) between 0600-1800 PDST (+7 hrs for UTC).
GNSS Survey Parameters:
Constellation: 30 US NAVSTAR GPS satellites and 24 Russian GLONASS satellites.
Observables: GPS L1 & L2 and GLONASS L1 & L2 Carrier Waves
Epoch Rate - Occupation Times: 15 seconds epoch rate - 15 minute occupations at monitoring points and six 8 hour occupations at base stations.
Satellites: 11-17; GDOP =< 2; Elevation Mask for Data Collection at 15° and Processing at 15°
Ephemeris: Rapid for Static Post-Processing of CGPS connections and Broadcast for onsite.
Weather: A mixture of clear and cloudy skies, temperature 68°-85° F, no significant weather.
Space Weather: Boulder K Index was 2-3 except 5-7 on 10/07/15, 3-5 on 10/12/15 and 4 on 10/13/15 (gauges ionospheric activity on a scale of 0-9; prefer less than 5 to avoid noisy data).
Equipment:
GNSS Base Receiver Unit No.: M5, Operator: M. McGee, PLS; Station Occupied: AB61 (Base1)
Make & Model: Leica GS15; Antenna Leica GS15; Mount: Fixed Height Pole #1; Antenna Height: 1.803m
GNSS Rover Receiver Unit No.: M6, Operator: M. McGee, PLS;
Make & Model: Leica GS15; Antenna Leica GS15; Mount: Fixed Height Pole #3; Antenna Height: 1.800m
GNSS Rover Receiver Unit No.: M7, Operator: M. McGee, PLS, Station Occupied: AB20 (Base2)
Make & Model: Leica GS15; Antenna Leica GS15; Mount: Tribrach on Tripod; Antenna Height: varies

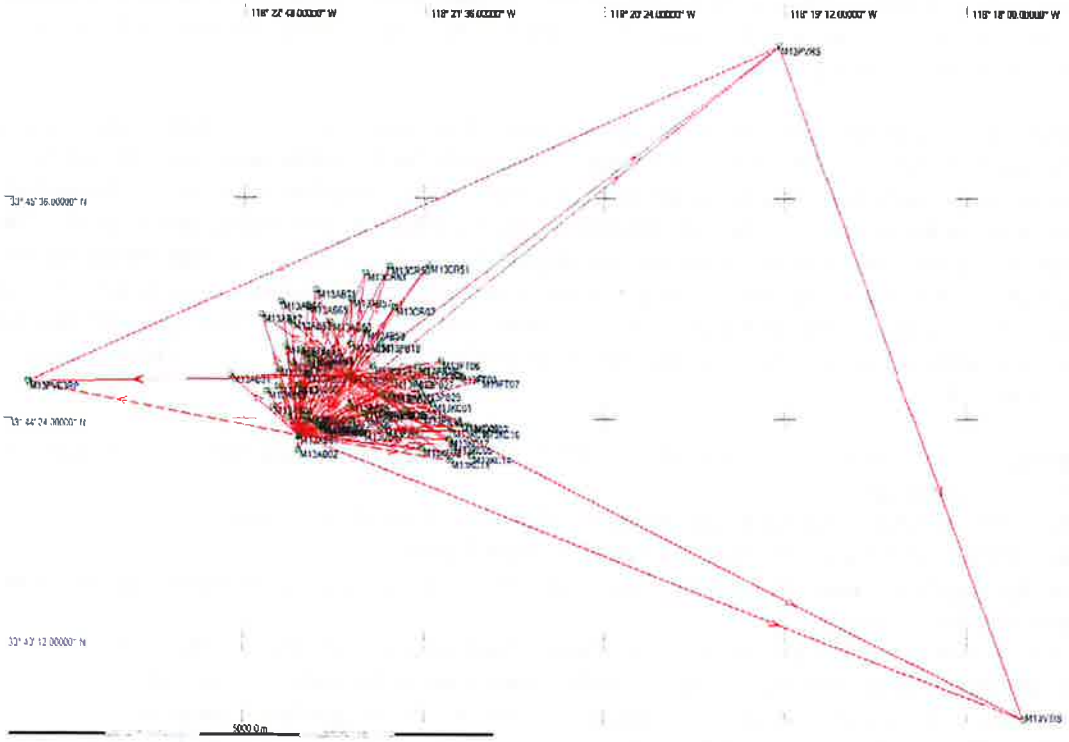
Vectors were processed using Leica LGO v8.4 post processing software. Analysis of residuals led to the rejection of 5 out of 52 vectors connecting the CGPS Stations to AB61 and AB20, and 0 out of 226 vectors connecting monitoring points. Network adjustments and analysis were performed with "Starnet-PRO" version 8.1.2 software. Rinex files of the satellite measurements for the CGPS Stations were downloaded from the SOPAC website. The Rapid Ephemeris and Absolute Antenna Models were downloaded from the NGS website.

NETWORK

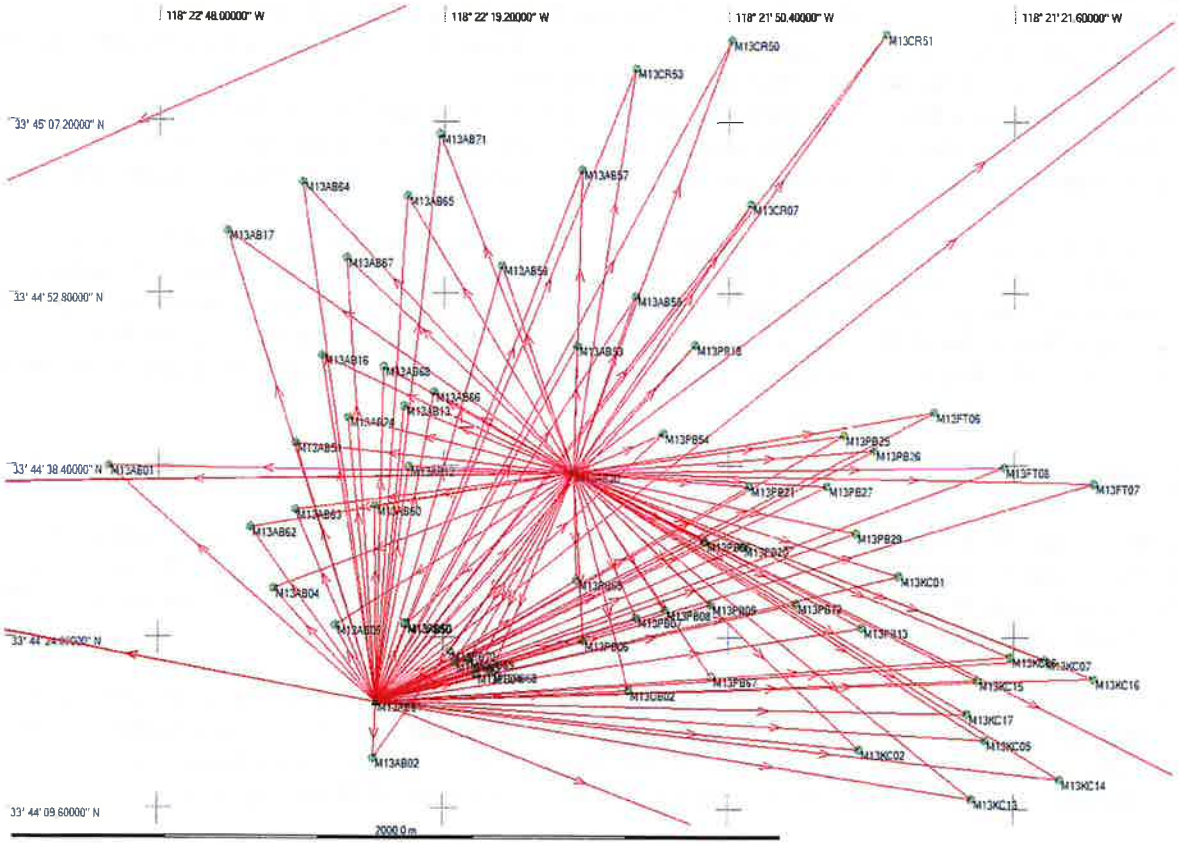
AB61, the primary Base Station, sits on Portuguese Point and is the focal point of the static network connecting the monitoring points and CGPS Stations. AB20, a second Base Station is centrally located sitting on top of a high bluff overlooking Portuguese Bend. Sixty-nine points and three CGPS Stations were connected with 278 vectors. See the following Network Maps and the Aerial View in the Appendix.

The monitoring plan utilizes the CGPS Stations to verify the stability of the reference frame. The primary CGPS Station used to control this survey is PVE3 located just south of City Hall and 1.8 miles west-northwest of Base Station AB61. CGPS Stations PVRS (3.9 miles northeast) and VTIS (4.9 miles east-southeast) are used to validate the stability of the network. During this survey PVE3, PVRS and VTIS were operating.

Monitoring Network and CGPS Stations (north up)



Monitoring Network (north up)



MONITORING POINT HISTORY and STATUS

This is the 13th Monitoring Survey. For data management purposes during the field survey and data processing, the point names are prefixed with the sequential number of the survey to distinguish between monitoring surveys. For example, on the 13th monitoring survey, AB61 was named M13AB61 where M13 indicates the sequence number of the survey since the initial September 2007 Monitoring Survey. The prefix is stripped in the COORDINATES LIST and FULL DATA POSTING.

Between 1994 and 2006, 149 monitoring points were established to monitor the Portuguese Bend Landslides, many of which were lost or destroyed. Sixty of the original points were recovered in 2007. Eight of the 60 points were deleted because they were in close proximity of other points better suited for GNSS satellite measurements leaving 52 points monitored and reported between September 2006 and September 2007. Three of the 52 points (AB09, KC11 & PB51) were monitored in September 2007 for the last time and replaced by new points, set nearby and better suited for satellite observations.

2007: Eighteen new points were set in 2007 and had their movements reported for the first time in the following December 2008 survey. In September, it was noted that KC01 was previously reported by others on 9/14/2006 to have moved N 29°E 1.24' from its 12/9/2005 position. In the September 2008 survey, a buried partially illegible brass cap in concrete stamped "COUNTY ENGINEER RE8869 1956 STA ??IELDS" was found S31°29'W 1.48 feet from the 1" IP used by this survey in the initial September 2007 and subsequent surveys. The original 1994 position of KC01 was re-referenced to the 1" IP, resulting in correct overall reported movements.
2008: In December 2008, 49 original and 18 new points were surveyed for a total of 67 monitoring points. In December, it was noted that AB05 had been disturbed by a mowing machine. AB05 was found chipped and leaning to southerly about 0.4'. The movement reporting resumed in 2009. Analysis of the movement and historic data made it possible to estimate the disturbance to within 0.05'. The original 1995 position of AB05 was re-referenced S14°02'E 0.29' to be consistent with the disturbed position, resulting in correct overall reported movements.
2009: PB64 was set east of the Archery Range to replace PB63 (set 2007) which had become unsafe to access and was lost in 2010. PB64 was reported for the first time in October 2010.
2010: Points AB03 and BB25 were discontinued. AB03 is on the edge of a cliff 192 feet west-southwest of AB61 making it redundant, and BB25 is on a freestanding rock susceptible to disturbance by wave action. In the summer of 2010, PB62 was destroyed by road construction and in October 2010, PB65 was set 24' south-southwest of PB62's location and reported for the first time in October 2011. The following points may have been disturbed prior to the October 2010 survey. AB05 appears to have been disturbed by mower machinery, AB15 (½" GIP in a meter box) is driven over by vehicles occasionally accessing an adjacent field, and KC02 (½" GIP in a meter box) is occasionally parked on by vehicles accessing the beach.
2011: In October, new points AB62 and AB63 (initially referred to as AB62R and AB63R) were set to replace AB06 and AB07 which were hazardous to occupy due to their location near the traveled way of Palos Verde Drive South.
2012: In September, prior to initiating the survey, eight new monuments AB64, AB65, AB66, AB67, AB68, CR53, KC17 and PB66 were constructed to replace AB54, AB18, AB52, AB55, AB15, CR52, KC04 and PB53 respectively. The monuments were replaced because of poor sky visibility except for KC04 which was difficult to access and AB55 which was destroyed by trenching in the past year. Monuments were set with the following design. Monuments set in soil are 1" x 5' GIP driven flush and encase in a 6" PVC pipe sitting on a concrete collar down about 18". Monuments set in asphalt are 1/2" x 2' rebar driven below the surface inside a free floating 2" concrete encased plastic collar.
2013: Points AB15, AB18, AB52, AB54, CR52, KC04 and PB53 were surveyed for the last time in 2012 and discontinued. BB52 is on a freestanding rock susceptible to disturbance by wave action and was monitored for the last time in October and discontinued.
2014: In April PB64 was monitored for the last time due to unsafe access conditions and PB67 (a 5' t-bar steel post driven 3' into the ground) was set NNW'ly about 250' as a replacement and reported for the first time in September 2014 after 4.5 months whereas all other points in the "PB Movement Data Posting" are reported for

11.5 months since October 2013. In September, AB69 about 260' NE of AB12 and AB70 about 140' SE of AB12 were set as potential replacements; however, AB69 was destroyed by lot improvements and AB70 proved to be too obstructed for accurate results.
2015: In April, new points PB68, PB69 and PB70 were set to monitor movements of "Palos Verdes Drive South" and reported in October. In October, Monitoring Point AB56 was found disturbed by construction and a magnetic nail in AC was set as a temporary replacement which was destroyed in the fall; therefore, no movement information is available. In October, the steel post for PB67 was not found and an inconspicuous ½" x 4' rebar was set in its place. Because of the rapid movement in this area a more permanent monument is not necessary.

See the "Monitoring Point Status" in the Appendix for the present status of monitoring points.

MINIMALLY CONSTRAINED ADJUSTMENTS & ANALYSIS

Adjustment 1: Adjustment to develop NAD83 (2007) 2007.00 Epoch Geodetic, Ellipsoid and State Plane Coordinates. CGPS Station PVE3 was fixed at its published NAD83 (2007) 2007.00 Epoch position in a Minimally Constrained Adjustment to determine positions and verify its stability relative to other CGPS stations. PVE3 is located 1.8 miles west of and outside the influence of the slide area. PVE3 has been fixed in all adjustments since 2007. The CSRC publishes a Time Series representing the horizontal and vertical stability of PVE3 which indicate the position has been stable prior to 2007. The primary base station AB61 and two other operating CGPS Stations were measured relative to PVE3 and used to assess stability of the survey reference frame. The positions are based on 8 hours of observations collected daily for six days and three hours on the seventh day. The coordinate differences from previous positions to the present are listed below in feet.

10/2013 Positions to 09/2014

ID	dN	dE	dZ	
PVE3	0.000	0.000	0.000	< Fixed >
PVRS	-0.011	-0.011	-0.003	
AB17	0.004	0.029	-0.078	
AB61	0.019	-0.005	-0.005	<Base Station>
CR51	0.001	-0.006	-0.047	
KC16	0.004	-0.023	-0.038	

9/2007 Positions to 09/2014

ID	dN	dE	dZ
PVE3	0.000	0.000	0.000
PVRS	-0.005	0.009	-0.016
AB17	-0.019	-0.005	-0.062
AB61	0.002	0.004	-0.054
CR51	-0.038	0.010	-0.129
KC16	-0.001	-0.013	-0.058

09/2014 Positions to 10/2015

ID	dN	dE	dZ	
PVE3	-0.000	-0.000	-0.000	< Fixed >
PVRS	0.001	0.007	0.016	
VTIS	0.003	0.005	0.049	
AB17	0.015	-0.017	0.042	
AB61	-0.007	0.003	-0.001	<Base Station>
CR51	0.011	0.005	0.017	
KC16	0.014	0.008	0.010	

9/2007 Positions to 10/2015

ID	dN	dE	dZ
PVE3	-0.000	-0.000	-0.000
PVRS	-0.004	0.016	0.000
VTIS	-0.000	0.017	-0.007
AB17	-0.004	-0.022	-0.020
AB61	-0.005	0.007	-0.055
CR50	-0.038	-0.004	-0.026
KC16	0.013	-0.005	-0.048

Comments: The Base Station AB61 has no measureable horizontal difference since September 2014 and 2007 as referenced to PVE3. The differences at CGPS Station PVRS and VTIS demonstrate a possible consistent easterly shift and will be watched. PVRS and VTIS have no measureable vertical difference; however, the differences at several monitoring points are down and up over the last year and down from the 2007 survey. Notwithstanding the vertical is less precise than the horizontal positions, it would appear that there may be indications of subsidence which is left to the Geologists for an opinion. Given that PVE3 and AB61 are in agreement, the survey reference frame is deemed stable and successfully recovered. An adjustment constrained to the other CGPS Stations is not preferred or necessary because the purpose here is to track their movements over time to test the stability of the reference frame. See the "COORDINATE LIST" in the Appendix for a list of coordinates resulting from this adjustment. See prior Survey Reports for coordinates resulting from earlier surveys.

Adjustment 2: Adjustment to develop Orthometric Heights (Elevations) in NAVD88. The CGPS Station PVE3 was fixed horizontally and vertically at its NAVD88 orthometric height determined in the September 2007 survey. The 2007 height was based on the published 2nd Order NAVD88 Height of CGPS Station VTIS. This Adjustment combined the measured ellipsoid height differences with the NGS Geoid 03 (models the separation between the ellipsoid and geoid surfaces) to determine NAVD88 orthometric heights of the other CGPS Stations and the monitoring points. Vertical differences (dZ) for at key points in this survey are listed in the table in Adjustment #1 above.

ACCURACY

This survey conform to the intent of the California Spatial Reference Center & California Lands Surveyors Association's "GNSS Surveying Standards and Specifications, 1.1" (2014) and the Federal Geodetic Control Subcommittee (FGCS) "Specifications for GPS Relative Positioning" (1988).

Vector Residuals: The number of vectors, vector lengths, two dimensional residuals and the absolute value of the vertical residuals resulting from Adjustment #1 are listed below in feet. Thirty-three vectors to single occupied monitoring points are not included because they have no independent residuals and would optimistically skew the results. The statistics given below are applicable for all points.

		Vector Lengths		Two Dimensional Residuals			Vertical Residuals (absolute)		
Network	No.	Vary	Average	Average	Std.Dev.	Maximum	Average	Std.Dev.	Range
Monitoring Pt	193	479-7182	3333	0.009	0.005	0.037	0.011	0.011	-0.069 to +0.037
CGPS Sta's	47	1931-27757	18467	0.009	0.005	0.023	0.011	0.008	-0.024 to +0.023

Local Accuracy: The precisions and accuracy of vectors resulting from the minimally constrained adjustment at the 95% Level of Confidence are listed below in feet.

	Relative Distance Error		
Network	Average	Maximum	Av.Precision
Monitoring Pt	0.009	0.016	1: 278,300
CGPS Sta's	0.004	0.007	1:3,745,000

Coordinate Accuracy: The Standard Deviations (68% Level of Confidence) of the coordinates derived from Adjustment #1, relative to the CGPS Station PVE3 follow in feet.

	Monitoring Points			CGPS Stations		
	North	East	Up	North	East	Up
Average Standard Deviation	0.004	0.004	0.012	0.002	0.002	0.004
Maximum Standard Deviation	0.007	0.007	0.023	0.002	0.002	0.005

At the 95% confidence level, the average coordinate has a horizontal radius of circular error is 0.010 feet and a vertical of 0.024 feet with a max of 0.017 and 0.046 feet respectively.

Network Accuracy: The network accuracy (absolute accuracy relative to the reference frame) is expected to be less than 0.02 feet horizontal relative to the NAD83 Datum and Epoch based on the CGPS Stations.

NAVD88 Heights: The North American Vertical Datum of 1988 orthometric heights resulting from Adjustment #2 are derived from the difference in ellipsoid heights combined with the Geoid 03 model and constrained to the height of PVE3 determined in 2007. The average relative accuracy of the heights is 0.03 feet at the 95% level of confidence, but may be greater at obstructed sites. The absolute accuracy of the heights relative to the datum is dependent on the published orthometric height on the CGPS Station VTIS. Although relative elevation accuracies can be within 0.03 feet, up until October 2011 there were no requirements for vertical accuracies. In October 2011, a preference of 0.03 foot relative vertical accuracy was instigated for the following points: AB17, AB57, CR07, CR50 and CR51. In the September 2012 and subsequent surveys the criteria was extended to all points.

Movement Accuracy: For this period, 47 points are reported to have moved less than 0.30 feet with an average movement of 0.03 feet and a range of 0.00 to 0.15 feet. The relative error at the 95% Level of Confidence averaged 0.013 feet with a range of 0.005 to 0.019 feet. Overall, after removing outlier PB55 (severely obstructed site), the estimated 95% relative movement error averaged 0.014 feet with a range of 0.005 to 0.019 feet. No movement is considered detected unless the movement exceeds the 95% Error for individual points. See the attached "PB MOVEMENT DATA POSTING" for the estimated relative movement errors at the 95% Level of Confidence for individual points.

QUALITY CONTROL - QUALITY ASSURANCE (QAQC) ANALYSIS

To ensure the accuracy and validity of the measurement systems used in these GNSS monitoring surveys, an independent test was conducted in 2007 using conventional terrestrial based instruments as reported in the "QAQC ANALYSIS" section of the September 2007 Monitoring Survey Report. Comparing the results of the GNSS systems with conventional instrumentation found horizontal measurements agreed 0.01 feet on average. In November of 2011 the GNSS instruments and fixed height poles used in this survey were calibrated on the Santa Maria National Geodetic Survey Baseline and found to agree with published distances 0.003 to 0.006 feet.

To validate the radial survey method used in these surveys to position points from base stations AB61 and AB20, independent GNSS cross connections were measured and compared with the stand alone computed inverse distances in the 2007, 2008 and 2009 surveys. The results found the two dimensional accuracy to agree 0.01 feet on average, indicating the radial method of measurements is reliable and the additional labor cost of measuring cross connection between points is not warranted. See the "QAQC ANALYSIS" section of the September 2007 and the December 2008 Monitoring Survey Reports for detailed analysis.

Deflection Analysis is a method established by this surveyor to assess the consistency of the direction of movements reported from period to period. Assuming that movements are generally linear for points moving less than a foot, the separation or the deflection between the direction of the previous and present periods taken over the moved distance implies the accuracy obtained with the equipment, methods and procedures. Analysis of individual deflections indicates that for points with multiple occupations the separations varied 0.01 to 0.02 feet.

SUMMARY

The relative movements reported between September 19, 2014 and October 8, 2015 (12.6 months) statistically attained an average accuracy of 0.014 feet at the 95% Level of Confidence for points occupied two or more times. The actual accuracy of measurements held to the "one-centimeter standard" are estimated to approach 0.01 feet as demonstrated by the vector residuals, repeatability of measurements at points considered stable, and the analysis of movement deflections over time. Refer to the sections titled ACCURACY and QAQC ANALYSIS in this Report for more information.

Between September 19, 2014 and October 8, 2015 (12.6 months) point movements are reported as follows: Portuguese Bend Landslide (PB##) moved 0.05 to 1.80 feet and 8.55 feet at PB67, Abalone Cove Landslide (AB##) moved 0.02 to 0.05 feet, and Klondike Canyon (KC##) moved 0.02 to 0.03 feet. See the graphic depiction of the Horizontal Movement in the Appendix.

Statistically, the probability at the 95% level of confidence is that movement (signal) has occurred at a point when the horizontal distance between two epochs is greater than the 95% Error (noise). See the "Movement Data Posting" for a listing of the 95% Error estimates (range 0.011 to 0.019 feet not including single occupied points). Applying this criteria, 11 points have not moved.

See the attached "PB MOVEMENT DATA POSTING" spreadsheet for overall and periodic movements of each point. The movements are given in north, east and up or down as well as a vector of distance and direction relative to north. The direction is given as an azimuth in degrees where 0° is north and increases clockwise (90° East, 180° South, 270° West). The overall movements are from the beginning position of each point which varies between 1994 and the date for newly established points.

The present status of monitored points is provided in the Appendix under "Monitoring Point Status". The historical status of all monitoring points is provided in the September 2007 Survey Report. The historical 1994-2006 positions of all points are listed in the Charles Abbott Associates Inc. file "ALL POINTS MOST RECENT OBSERVED POSITION AS OF SEPTEMBER 15, 2006.xls" attached as an electronic file to the 2007 Report.

RECOMMENDATION

An ongoing re-location program for monuments has long term benefits resulting in better accuracy and lower cost surveys due to improved sky visibility for tracking satellites. In this October 2015 survey, no monuments were re-located. Points AB16, AB17, AB24 and AB58 have limited sky visibility and are candidates for re-located or deletion. AB12 is in a horse corral and is difficult to access; however, there are no nearby alternatives.

Attachments: The following document is attached to this Report.
"PB MOVEMENT DATA POSTING" lists the coordinates of the initial positions, the overall and periodic movements of monitoring point since 2007.

SURVEYOR'S STATEMENT

This is a Report on the procedures, criteria and results of the City of Rancho Palos Verdes Portuguese Bend Landslide Monitoring Surveys. This Report includes the Initial Survey conducted in the fall, the Second Survey Addendum No.1 added in the winter and the Third Survey Addendum No.2 added in the spring. This survey was conducted and the report prepared by me at the request of Ron Dragoo, Principal Engineer of the City of Rancho Palos Verdes.

Initial Survey - Full Monitoring Signature

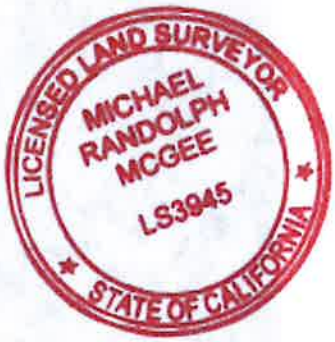
Michael R. McGee P.L.S. 3945 Date 02/03/16

Second Survey - Partial Monitoring Signature

Michael R. McGee P.L.S. 3945 Date 03/11/16

Third Survey - Partial Monitoring Signature

Michael R. McGee P.L.S. 3945 Date 04/22/16

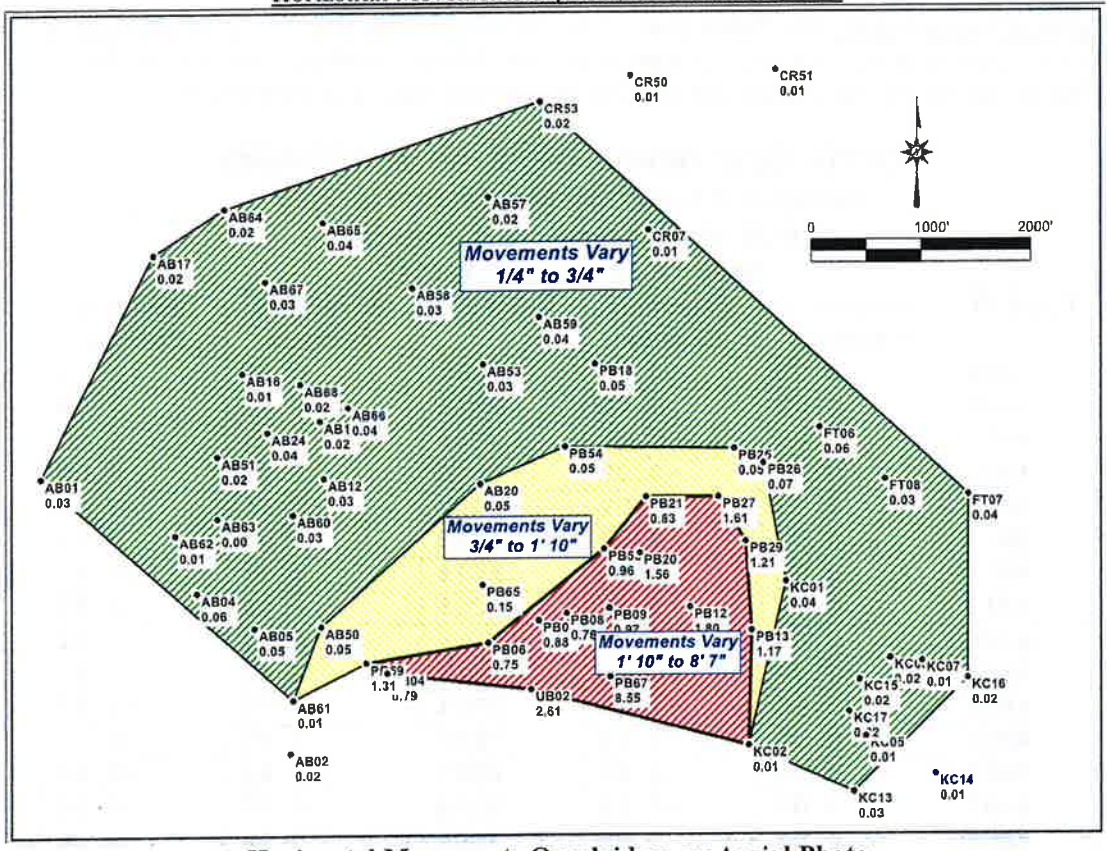


APPENDIX

12- Aerial Photo of Monitoring Points
13- Graphical Representation of the Horizontal Movements
14- Table of Horizontal and Vertical Movements in Last Year
15- Monitoring Point Status
16- Coordinate List of the Oct. 8, 2015 Survey: NAD83 (2007) 2007.00 Epoch Geodetic, Grid, NAVD88
17- ADDENDUM No. 1: Second Report on the February 16, 2016 Partial Monitoring Survey
18- ADDENDUM No. 2: Third Report on the April 19, 2016 Partial Monitoring Survey
19- ADDENDUM No. 2: Table of Partial Monitoring Survey Horizontal and Vertical Movements

Aerial View of Monitoring Points – (Photography Dated 03/23/2015) (north left)
(Red Line= Original Centerline PVDS)

Horizontal Movements Sept. 19, 2014 to Oct. 8, 2013



Horizontal Movements Overlaid on an Aerial Photo

Table of Movements: The Table below lists the movements and elevation changes in the last year. See the attached spreadsheet titled "PB MOVEMENT DATA POSTING 2007-(present)" for the overall and periodic movement history of each point.

PORTUGUESE BEND LANDSLIDE MONITORING
Horizontal & Vertical Movements in Feet

Full Monitoring: 12.6 months
Sept. 19, 2014 to Oct. 8, 2015

Point ID	Movement Distance	Elevation Change	Point ID	Movement Distance	Elevation Change
AB01	0.03	0.03	KC01	0.04	0.01
AB02	0.02	0.00	KC02	0.01	0.03
AB04	0.06	0.00	KC05	0.01	0.00
AB05	0.05	-0.02	KC06	0.02	0.00
AB12	0.03	0.01	KC07	0.01	-0.01
AB13	0.02	0.02	KC13	0.03	0.01
AB16	0.01	0.03	KC14	0.01	0.00
AB17	0.02	0.04	KC15	0.02	0.00
AB20	0.05	0.00	KC16	0.02	0.01
AB24	0.04	-0.01	KC17	0.02	0.01
AB50	0.05	-0.02	PB04	0.79	-0.27
AB51	0.02	-0.01	PB06	0.75	-0.10
AB53	0.03	0.05	PB07	0.88	-0.05
AB57	0.02	-0.02	PB08	0.76	0.06
AB58	0.03	0.03	PB09	0.97	-0.14
AB59	0.04	0.01	PB12	1.80	-0.41
AB60	0.03	0.00	PB13	1.17	-0.09
AB61	0.01	0.00	PB18	0.05	-0.04
AB62	0.01	0.00	PB20	1.56	-0.30
AB63	0.00	-0.01	PB21	0.83	-0.08
AB64	0.02	0.00	PB25	0.05	0.00
AB65	0.04	-0.03	PB26	0.07	-0.01
AB66	0.04	0.02	PB27	1.61	-0.27
AB67	0.03	0.01	PB29	1.21	-0.34
AB68	0.02	-0.01	PB54	0.05	0.08
CR07	0.01	0.01	PB55	0.96	-0.07
CR50	0.01	0.04	PB59	1.31	-0.63
CR51	0.01	0.02	PB65	0.15	-0.02
CR53	0.02	0.01	PB67	8.55	-0.84
FT06	0.06	-0.02	*PB68	0.25	-0.05
FT07	0.04	-0.03	*PB69	0.24	-0.07
FT08	0.03	0.00	*PB70	0.22	-0.28
			UB02	2.61	0.00

* = Points set in April 2015, Period = 5.7 Months

Note: Given the accuracies of the measurements, Movements & Elevation Changes at or greater than 0.02' (1/4") and 0.04' (1/2") respectively are deemed to have actually moved.

See "PB MOVEMENT DATA POSTING 2007-(present)" for more details.

MCGEE SURVEYING CONSULTING							
RANCHO PALOS VERDES - PORTUGUESE LAND SLIDE MONITORING POINT STATUS for 2016 Prepared 01/26/2016							
Notes:	162+/- Monitoring Points established since 1994						
09/01/07	71 Points Surveyed 60 old points found with 52 monitored plus 19 new points						
12/01/08	67 Points Surveyed AB09, KC11, PB51 discontinued; BB53 destroyed; AB05 disturbed						
11/01/09	68 Points Surveyed Set PB64 to replace PB63 destroyed subsequently						
10/01/10	65 Points Surveyed Discontinued AB03, BB25; set PB65 to replace PB62 destroyed by paving						
10/03/11	69 Points Surveyed; Set AB62 & AB63 to replace AB06 & AB07						
09/14/12	72 Points Surveyed; Discontinued AB06, AB07; AB55 destroyed by trenching; Added 8 new points						
10/06/13	65 Points Surveyed; Discontinued AB15, AB18, AB52, AB54, CR52, KC04, PB53						
9/19/14	64 Points Surveyed; Discontinued BB52, PB67 set in April 2014; Added PVE3RP (reference to PVE3 antenna)						
10/08/15	69 Points Surveyed; AB56 Destroyed & Replaced by AB71; PB68, PB69, & PB70 Set in April 2015						
	30+/- Points to Survey in Feb 2016 and April 2016						
Pt ID	Last Obs'd	Comments	GNSS	Pt ID	Last Obs'd	Comments	GNSS
AB01	10/08/2015	Base 1994-2006	G	KC01	10/08/2015	NE'ly/2 pipes 1.5' apart	G
AB02	"		G	KC02	"		G
AB04	"		G	KC05	"		G
AB05	"		G	KC06	"		G
AB12	"		G	KC07	"		G
AB13	"		F	KC13	"		G
AB16	"		P	KC14	"		G
AB17	"		F	KC15	"		F
AB20	"	NE'ly/ 2 monuments	G	KC16	"		G
AB24	"		F	KC17	"	Replaced KC04	G
AB50	"		G	PB04	"		G
AB51	"		G	PB06	"		G
AB53	10/08/2015		F	PB07	"		G
AB56	04/2015	Destroyed prior to Oct.	F	PB08	"		G
AB57	10/08/2015		G	PB09	"		G
AB58	"		P	PB12	"		G
AB59	"		G	PB13	"		G
AB60	"		G	PB18	"		G
AB61	"	BASE 2007-Present	G	PB20	"	S'ly/ 2 pipes 5.3' apart	G
AB62	"		G	PB21	"		F
AB63	"		G	PB25	"		G
AB64	"		G	PB26	"		F
AB65	"		G	PB27	"		G
AB66	"		G	PB29	"		G
AB67	"		G	PB54	"		F
AB68	"		G	PB55	"		F
AB71	10/08/2015	Replaced AB56	F	PB59	"		G
CR07	"		G	PB64	"		G
CR50	"		F	PB65	"		G
CR51	"		G	PB66	"	Discontinued	G
CR53	"		G	PB67	"		G
FT06	"		F	PB68	"		G
FT07	"		G	PB69	"		G
FT08	10/08/2015		G	PB70	"		G
			G	UB02	10/08/2015		G
GNSS column indicates site is Good, Fair or Poor for Satellite Visibility Conditions							

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10/08/15 COORDINATE LIST

Portuguese Bend Landslide 10/08/2015 Monitoring Survey No. 13
Prepared by McGee Surveying Consulting: Document Date: 01/26/2016

Datum: Horizontal & EH NAD83 (2007) Epoch; California State Plane Zone 5; Vertical: NAVD88
Note, Fixed CGPS Station PVE3 at Record 3D Position & Orthometric Height per 09/2007 Survey; See 2007 and subsequent Survey Reports

Point	Latitude	Longitude	EH(ft)	North(ft)	East(ft)	OrthoHt(ft)	Description
AB01	33-44-38.30266	118-22-53.05152	60.05	1729427.57	6445709.59	178.53	Punched 1/2" GIP in meter box
AB02	33-44-13.84893	118-22-26.19236	-2.06	1726946.99	6447968.69	116.44	4" BC "SAN PEDRO 1936" on conc. block
AB04	33-44-28.09078	118-22-36.28776	-51.30	1728389.90	6447121.44	67.15	BC "CO ENG STA Q2.." on 2"GIP in mass of conc.
AB05	33-44-24.98972	118-22-30.09139	-38.02	1728074.45	6447643.59	80.43	BC "CO ENG STA Q3.." on 2"GIP in mass of conc.
AB12	33-44-38.27495	118-22-22.72108	164.82	1729415.15	6448271.03	283.16	BC "CO ENG STA 7A.." in mass of conc.
AB13	33-44-43.34502	118-22-23.16135	246.12	1729927.83	6448235.75	364.44	Punched 1/2" GIP in meter box
AB16	33-44-47.57965	118-22-31.51216	258.08	1730358.54	6447532.12	376.41	Punched 1/2" GIP in meter box
AB17	33-44-58.06080	118-22-41.08430	324.44	1731421.12	6446727.75	442.78	Punched 1/2" GIP in meter box
AB20	33-44-37.77443	118-22-05.96637	277.92	1729359.34	6449685.81	396.20	BC "CO ENG STA W. FIX 1956.." in mass of conc.
AB24	33-44-42.35371	118-22-28.79499	217.34	1729829.39	6447759.62	335.69	Cotton spindle in conc. In road
AB50	33-44-25.11110	118-22-22.94576	63.54	1728084.48	6448247.12	181.96	Nail & shiner in conc. collar of well
AB51	33-44-40.22966	118-22-34.15172	186.73	1729616.35	6447306.44	305.11	PK mag nail in plastic plug "LS6957" in 1"GIP
AB53	33-44-48.36782	118-22-05.70054	234.63	1730430.15	6449712.19	352.85	Chiseled + on s edge conc. Vault
AB57	33-45-03.17002	118-22-05.20548	446.53	1731926.37	6449759.47	564.68	6" mag nail & washer in conc. in 2"x 36" GIP
AB58	33-44-55.14402	118-22-13.27631	287.34	1731117.51	6449074.94	405.56	Punched RR spike on s side road
AB59	33-44-52.54025	118-21-59.79454	316.01	1730850.12	6450212.48	434.18	6" mag nail & washer in conc. in 2"x 36" GIP
AB60	33-44-35.04150	118-22-26.06536	60.93	1729089.33	6447987.39	179.31	6" mag nail & washer in conc. in 2"x 28" GIP
AB61	33-44-18.57314	118-22-25.95797	21.94	1727424.49	6447990.26	140.41	6" mag nail & washer in conc. in 2"x 24" GIP
AB62	33-44-33.23049	118-22-38.63210	24.52	1728910.22	6446925.41	142.96	6" mag nail & washer in conc. in 1"x 24" GIP
AB63	33-44-34.71810	118-22-34.12089	62.35	1729059.17	6447306.95	180.76	Punched 1/2 x 48" rebar
AB64	33-45-02.13646	118-22-33.46064	413.87	1731830.71	6447373.08	532.15	2" mag nail on NE side 2' conc. Collar/Well B12
AB65	33-45-00.93194	118-22-22.90391	340.20	1731705.63	6448264.09	458.44	2" mag nail & washer in conc. in 1"x 60" GIP
AB66	33-44-44.53517	118-22-20.15015	255.93	1730047.20	6448490.50	374.23	1/2" x 24" punched rebar 1" below AC conc. collar
AB67	33-44-55.71700	118-22-29.06603	287.00	1731180.38	6447741.76	405.29	1/2" x 24" punched rebar 1" below AC conc. collar
AB68	33-44-46.61240	118-22-25.31211	275.08	1730258.81	6448055.35	393.40	1/2" x 24" punched rebar 1" below AC conc. collar
AB71	33-45-06.10137	118-22-19.67329	453.72	1732227.20	6448538.84	571.93	2" mag nail on S side Vanderlip Dr. (AC road)
CR07	33-45-00.26894	118-21-48.09414	513.98	1731627.84	6451203.38	632.07	6" mag nail & washer in conc. in old 1" IP
CR50	33-45-13.97070	118-21-50.11935	754.58	1733013.58	6451037.37	872.63	Tack & shiner on lower rock wall
CR51	33-45-14.49690	118-21-34.43619	858.15	1733062.01	6452361.88	976.14	Tack & shiner on conc. pad
CR53	33-45-11.63371	118-21-59.73912	662.61	1732780.28	6450224.20	780.71	2" mag nail & washer in conc. in 1"x 60" GIP
FT06	33-44-42.78497	118-21-29.58586	370.52	1729854.75	6452760.02	488.61	6" mag nail & washer in conc. in 2"x 36" GIP
FT07	33-44-36.87027	118-21-13.65977	470.53	1729252.07	6454102.88	588.57	6" mag nail & washer in conc. in 2"x 36" GIP
FT08	33-44-38.19526	118-21-22.57431	540.33	1729388.67	6453350.51	658.41	6" mag nail & washer in conc. in 2"x 36" GIP
KC01	33-44-29.13340	118-21-33.10884	194.09	1728475.76	6452457.57	312.27	6" mag nail & washer in conc. in old 1" IP
KC02	33-44-14.54753	118-21-37.05748	-104.53	1727002.46	6452118.81	13.74	Punched 1/2" GIP in meter box
KC05	33-44-15.37054	118-21-24.50980	109.26	1727081.87	6453178.86	227.46	Punched 1/2" GIP in meter box
KC06	33-44-22.33195	118-21-21.96617	181.67	1727784.85	6453396.18	299.83	Punched 1/2" GIP in meter box
KC07	33-44-22.09036	118-21-18.55887	195.29	1727759.41	6453683.86	313.43	Punched 1/2" GIP in meter box
KC13	33-44-10.41193	118-21-25.78264	72.84	1726580.98	6453069.58	191.07	Cotton spindle in AC turnout
KC14	33-44-12.03480	118-21-17.07058	141.70	1726742.44	6453805.97	259.88	Punched spike in center road
KC15	33-44-20.39768	118-21-25.21732	168.83	1727590.29	6453120.91	287.01	Cotton spindle in cul-de-sac
KC16	33-44-20.55030	118-21-13.64611	208.73	1727602.26	6454098.23	326.86	Punched spike in intersection
KC17	33-44-17.54996	118-21-26.32424	97.01	1727302.74	6453026.40	215.21	2" mag nail & washer in conc. in 1"x 50" GIP
PB04	33-44-20.96730	118-22-15.81024	47.84	1727663.34	6448848.21	166.25	Nail & tag "RCE26120" in conc. in 3" pipe
PB06	33-44-23.66989	118-22-05.05130	58.60	1727933.21	6449757.87	176.94	Punched cap on 2" GIP
PB07	33-44-25.65185	118-21-59.68828	78.99	1728131.91	6450211.54	197.30	Brass tag "LA CO DPW" in conc. in 2" GIP
PB08	33-44-26.29486	118-21-56.72084	76.02	1728196.00	6450462.39	194.32	Punched cap on 2" GIP
PB09	33-44-26.75741	118-21-52.15117	70.04	1728241.36	6450848.49	188.31	Punched cap on 2" GIP in cable box
PB12	33-44-26.85905	118-21-43.46998	64.59	1728248.99	6451581.70	182.82	Punched cap on 2" GIP in cable box
PB13	33-44-24.79394	118-21-36.77901	88.11	1728038.19	6452146.04	206.32	Punched cap on 2" GIP in cable box
PB18	33-44-48.40985	118-21-53.76824	244.69	1730430.73	6450719.87	362.86	Punched 1/2" GIP in meter box
PB20	33-44-31.66253	118-21-48.92075	112.85	1728736.24	6451123.11	231.08	Punched cap on 2" GIP in cable box
PB21	33-44-36.63142	118-21-48.28117	153.61	1729238.35	6451178.94	271.81	Punched cap on 2" GIP in cable box
PB25	33-44-40.93065	118-21-38.74108	207.78	1729670.06	6451986.18	325.92	Punched cap on 2" GIP in cable box
PB26	33-44-39.63682	118-21-35.58707	164.75	1729538.31	6452252.08	282.88	Brass tag "LA CO DPW" in conc. in 2" GIP
PB27	33-44-36.64499	118-21-40.42451	152.13	1729237.33	6451842.46	270.30	Punched cap on 2" GIP in cable box
PB29	33-44-32.69288	118-21-37.46236	50.98	1728836.91	6452091.19	169.15	Brass tag "LA CO DPW" in conc. in 2" GIP
PB54	33-44-41.07858	118-21-56.95056	239.47	1729690.58	6450448.43	357.69	PK mag nail in plastic plug "LS6957" in 1"GIP
PB55	33-44-31.99923	118-21-52.73597	120.90	1728771.44	6450801.03	239.14	PK mag nail in plastic plug "LS6957" in 1"GIP
PB59	33-44-21.86964	118-22-18.05451	39.28	1727755.26	6448659.00	157.70	PK mag nail in plastic plug "LS?" in 1" GIP
PB65	33-44-28.81826	118-22-05.66844	169.26	1728453.86	6449707.66	287.59	2" alum. cap "MCGEE SURVEYING" on 5/8"x 24"rebar
PB67	33-44-20.66776	118-21-52.02882	-43.75	1727625.72	6450856.59	74.55	1/2" x 3' rebar
PB68	33-44-20.99054	118-22-14.21459	54.66	1727665.20	6448982.98	173.06	2" Alum Cap "PLS3945" in 1"x 30" GIP
PB69	33-44-22.14652	118-22-16.64080	46.20	1727782.81	6448778.50	164.60	2" Alum Cap "PLS3945" in 1"x 30" GIP
PB70	33-44-22.85189	118-22-18.52640	37.55	1727854.71	6448619.51	155.96	2" Alum Cap "PLS3945" in 1"x 30" GIP
UB02	33-44-19.52348	118-22-00.46842	-55.78	1727512.63	6450143.39	62.57	PK mag nail in plastic plug "?" in 1"GIP
PVE3	33-44-35.85329	118-24-15.26904	235.42	1729207.09	6438765.18	354.36	CGPS Pos. Fixed in 2007 and subsequent surveys
PVE3RP	33-44-35.74236	118-24-15.27474	227.96	1729195.88	6438764.66	346.90	Reference Pt: Mag Nail in Conc. Base 11' S/ PVE3
PVRS	33-46-25.89199	118-19-14.06716	198.60	1740239.30	6464237.89	316.30	CGPS Pos. Determined by this Survey
VTIS	33-42-45.48965	118-17-37.71213	197.51	1717933.68	6472307.24	315.25	CGPS Pos. Determined by this Survey

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Addendum No.1
Second Survey Report
Portuguese Bend Landslide Monitoring
February 16, 2016 Partial Monitoring Survey
for the
City of Rancho Palos Verdes
by
McGee Surveying Consulting
March 11, 2016

Overview:

This Addendum No. 1 Report describes the February 2016 tri-annual Portuguese Bend Monitoring Survey. This partial survey included a sub-set of 30 points of the full monitoring set. Monitoring point AB56 was destroyed sometime after the April 2015 survey and AB71A was set in October as a replacement which was destroyed by paving sometime in the fall. Therefore, two new points AB71B and AB71C were set as temporary replacements until a permanent monument is set in the fall 2016 survey.

This survey followed the procedures described in the above October 8, 2015 Full Monitoring Report. For a detailed history of the program and surveys see "History" above and previous Monitoring Survey Reports back to 2007. The field survey took place February 15-18, 2016. The Field Surveys, Equipment, Data Collection and Network Design were as described in the above Report. The survey included 30 onsite points, two of which were base stations connecting each point with two to six vectors. Three continuously operating GPS stations (CGPS) were connected to this survey with 4-6 eight hours vectors each. It is to be noted that solar activity was high during the survey resulting in a minor increase in noise for the data collection.

The movements reported between October 8, 2016 and February 16, 2016 (4.3 months) statistically attained an average accuracy of 0.012 feet at the 95% Level of Confidence. The overall vectors residuals follow: the 2D averaged 0.005' with a maximum of 0.014' and the vertical averaged 0.012' with a maximum of 0.049'.

A Minimally Constrained Adjustment was processed to develop NAD83 (2007) 2007.00 Epoch Geodetic, Ellipsoid and State Plane Coordinates in feet. CGPS Station PVE3 was fixed and the differences are listed in feet from the October 08, 2016 to the February 16, 2016 positions for the CGPS stations and points considered to mostly stable.

10/2015 Positions to 02/2016

Station	dN	dE	dZ	
AB17	-0.012	0.004	0.004	
AB50	-0.010	-0.009	0.024	
AB61	-0.001	0.001	0.009	Primary Base Station
CR50	-0.001	-0.004	0.045	
KC16	-0.024	0.014	0.001	
PVE3	0.000	0.000	0.000	Fixed CGPS Station
PVRS	-0.011	-0.002	-0.011	CGPS Station
VTIS	-0.007	-0.013	-0.007	CGPS Station

The adjustment, as a standard procedure, was constrained to the CGPS station PVE3 which finds no significant difference as expected in the horizontal position at the primary base station AB61. The difference at CGPS stations PVRS is 0.01 feet compared to the October 08, 2016 position. The survey reference frame was deemed stable and successfully recovered. The results are reported below.

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Addendum No.2
Third Survey Report
Portuguese Bend Landslide Monitoring
April 19, 2016 Partial Monitoring Survey
for the
City of Rancho Palos Verdes
by
McGee Surveying Consulting
April 22, 2016

Overview:

This Addendum No. 2 Report describes the April 2016 Portuguese Bend Monitoring Survey. This partial survey included the same sub-set of 30 points reported in Addendum No.1.

This survey followed the procedures described in the above October 8, 2015 Full Monitoring Report. For a detailed history of the program and surveys see "History" above and previous Monitoring Survey Reports back to 2007. The field survey took place April 17-20, 2016. The Field Surveys, Equipment, Data Collection and Network Design were as described in the above Report. The survey included 30 onsite points, two of which were base stations connecting each point with two to four vectors. Two continuously operating GPS stations (CGPS) were connected to this survey with eight 3-7 hours vectors. It is to be noted that solar activity was low during the survey resulting in less noise for the field data collection.

The movements reported between February 16, 2016 and April 19, 2016 (2.0 months) statistically attained an average accuracy of 0.012 feet at the 95% Level of Confidence. The overall vectors residuals follow: the 2D averaged 0.005' with a maximum of 0.016' and the vertical averaged 0.008' with a maximum of 0.037'.

A Minimally Constrained Adjustment was processed to develop NAD83 (2007) 2007.00 Epoch Geodetic, Ellipsoid and State Plane Coordinates in feet. CGPS Station PVE3 was fixed and the differences are listed in feet from the February 16, 2016 to the April 19, 2016 positions for the CGPS stations and points considered to mostly stable.

02/2016 Positions to 04/2016

Station	dN	dE	dZ	
AB17	-0.002	0.005	0.025	
AB50	-0.011	-0.011	0.009	
AB61	-0.002	-0.001	0.008	Primary Base Station
CR50	0.005	0.002	0.075	
KC16	-0.007	-0.004	0.021	
PVE3	0.000	0.000	0.000	Fixed CGPS Station
PVRS	0.012	0.002	0.026	CGPS Station
VTIS	(Not Operating during survey)			CGPS Station

The adjustment, as a standard procedure, was constrained to the CGPS station PVE3 which finds no significant difference as expected in the horizontal position at the primary base station AB61. The difference at CGPS stations PVRS is 0.01 feet compared to the February 16, 2016 position and 0.00 feet compared to the October 8, 2015 position. The survey reference frame was deemed stable and successfully recovered. The results are reported below.

PORTUGUESE BEND LANDSLIDE MONITORING Horizontal & Vertical Movements in Feet						
	Oct. 08, 2015 to Feb. 16, 2016		Feb. 16, 2016 to April 19, 2016		Oct. 08, 2015 to April 19, 2016	
Point ID	Movement Distance	Elevation Change	Movement Distance	Elevation Change	Movement Distance	Elevation Change
AB04	0.04	-0.01	0.01	0.02	0.05	0.01
AB12	0.03	0.02	0.02	-0.01	0.04	0.01
AB16	0.03	-0.01	0.00	0.02	0.04	0.01
AB17	0.01	0.00	0.01	0.02	0.02	0.03
AB20	0.01	0.03	0.01	0.02	0.02	0.05
AB50	0.01	0.02	0.02	0.01	0.03	0.03
AB59	0.01	0.02	0.01	0.01	0.02	0.04
AB60	0.02	0.01	0.01	0.01	0.03	0.01
AB61	0.00	0.01	0.00	0.01	0.00	0.02
AB65	0.03	0.07	0.01	0.03	0.04	0.11
CR07	0.02	0.02	0.01	0.02	0.02	0.04
CR50	0.00	0.05	0.01	0.08	0.00	0.12
FT06	0.02	0.02	0.01	0.03	0.03	0.05
FT07	0.03	0.05	0.01	0.01	0.03	0.06
KC06	0.01	0.03	0.01	0.01	0.02	0.04
KC07	0.02	0.03	0.01	0.03	0.01	0.06
KC13	0.01	0.01	0.01	0.02	0.02	0.03
KC16	0.03	0.00	0.01	0.02	0.03	0.02
KC17	0.02	0.02	0.02	0.00	0.03	0.02
PB04	0.34	-0.12	0.15	-0.04	0.49	-0.16
PB12	0.60	-0.12	0.33	-0.06	0.94	-0.18
PB13	0.40	-0.03	0.22	0.02	0.62	-0.01
PB18	0.02	0.00	0.01	0.04	0.03	0.04
PB26	0.04	0.02	0.02	0.03	0.06	0.05
PB55	0.26	-0.10	0.17	-0.05	0.43	-0.15
PB59	0.44	-0.21	0.27	-0.11	0.71	-0.32
PB67	3.03	-0.36	2.62	-0.31	5.65	-0.67
PB68	0.21	-0.15	0.14	-0.04	0.35	-0.19
PB69	0.27	-0.12	0.14	-0.05	0.41	-0.17
PB70	0.23	-0.30	0.12	-0.14	0.36	-0.44
Note: Given the accuracies of the measurements, Movements & Elevation Changes at or greater than 0.02' (1/4") and 0.04' (1/2") respectively are deemed to have actually moved.						
See "PB MOVEMENT DATA POSTING 2007-(present)" for more historical movements.						

Survey Report

of the

Portuguese Bend Landslide Monitoring Survey

September 19, 2014 Full Monitoring, February 7, 2015 and April 16, 2015 Partial Monitoring

for the

City of Rancho Palos Verdes

by

McGee Surveying Consulting

February 11, 2015, Revised June 10, 2015

INDEX

McGEE SURVEYING CONSULTING
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Survey Report
of the
Portuguese Bend Landslide Monitoring Survey
September 19, 2013 Full Monitoring
for the
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PROJECT OVERVIEW:

McGee Surveying Consulting performed a landslide monitoring and control survey in September 2014 at Portuguese Bend on behalf of the City of Rancho Palos Verdes. This survey established positions on monitoring points to determine overall and periodic movements. The results of the survey are described in this Report and on an attached spreadsheet titled "MOVEMENT DATA POSTING.xlsx" hereafter referred to as the "Movement Data Posting". A two partial monitoring surveys will be performed in the winter and spring of 2015 and reported as an addendum to this Report.

The field survey was planned, coordinated and executed by Michael McGee, PLS3945 of McGee Surveying Consulting who was also responsible for the final processing of the observations, network adjustments, analysis and reports. The monitoring points cover a 1½ mile square area and are measured to determine the rate and extent of ground movement. The monitoring has occurred annually since 2007, semi-annually for the last two years and will be three times a year beginning with the September 2014 survey. The Global Navigation Satellite System (GNSS formerly referred to as GPS) technology was used to measure positions based on the North American Datum of 1983 (NAD83) and the North American Vertical Datum of 1988 (NAVD 88). This survey is referenced to the California CGPS (Continuous GPS) Stations in the region which are permanently mounted GPS receivers used for monitoring seismic activity. The CGPS in California are similar to the national CORS (Continuously Operated Reference Stations).

Points that move a few inches or less per year are required to meet an accuracy standard of one centimeter (0.033 feet) at the 95% Level of Confidence. In the active slide area where the movements are greater than 0.3 feet per year (PB and UB points in the central portion), the accuracy standard is two centimeters (0.066 feet) at the 95% Level of Confidence. Field procedures are designed to accomplish this purpose and Quality Control-Quality Assurance (QAQC) processes discussed hereafter are incorporated to verify these accuracies are attained.

The movements reported between October 4, 2013 and September 19, 2014 (11.5 months) statistically attained an average accuracy of 0.016 feet at the 95% Level of Confidence. The actual accuracy of measurements held to the one centimeter standard are estimated to approach 0.01 feet as demonstrated by the vector residuals, repeatability of measurements at points considered stable, and the analysis of movement deflections over time. Refer to the sections titled ACCURACY and QAQC ANALYSIS in this Report for more information.

HISTORY

This monitoring survey is a continuation of a program initiated by the County of Los Angeles and taken over by the City of Rancho Palos Verdes circa 1994. McGee Surveying Consulting has conducted the field surveys and reporting since September 2007. See the September 2007 Survey Report for a history of the previous survey process between 1994 and 2007. See the subsequent annual Survey Reports for details of each monitoring campaign. Beginning with the 2012 rainy season (begins in September) full monitoring continued as usual and a partial monitoring was initiated in the following winter-spring. Beginning in September 2014 a full monitoring will be conducted and a partial monitoring will be conducted in the following January-February and April-May.

PROJECT DATUMS, REFERENCE SYSTEM

Horizontal Datum: North American Datum of 1983 (NAD83) established by the National Geodetic Survey (NGS); **Epoch:** 2007.00 referred to as NAD83 (2007); **Units:** Feet

Reference Network: The survey is referenced to the CGPS Stations (continuously operating GNSS receivers). For more information see NGS Data Sheets for the PID's listed below (no data sheet exists for PVE3). The positions listed below were obtained in September 2007 from the California Spatial Reference Center (CSRC). The CSRC provides CA Public Resources Code sanctioned positions for the California CGPS Stations.

CGPS	Latitude (dms)	Longitude (dms)	EH (feet)	NGS PID	NAME
PVE3	33 44 35.853290	-118 24 15.269036	235.42	none	PALOS VERDES CORS
PVHS*	33 46 46.020150	-118 22 19.741258	853.99	AJ1915	PENINSULA HIGH SCH
PVRS**	33 46 25.891904	-118 19 14.067218	198.63	AJ1916	PALOS VERDES RES
VTIS*	33 42 45.489584	-118 17 37.712290	197.52	AJ1936	MARINE EXCHANGE

* Not Operational During Survey

** Falls in the proximity of a Fault Line as shown below but appears unaffected to date

CGPS Stations (north up)

Vertical Datum: North American Vertical Datum of 1988 (NAVD88) established by the NGS.

Geoid Model: Geoid 03; note Geoid09 became available from the NGS in 2009 and Geoid12A in 2012; however, Geoid03 is retained to be consistent with prior reported heights and the primary purpose of determining relative changes over time.

Reference Network: CGPS Station VTIS is also a Second Order leveled benchmark and the original basis for the heights by this survey (see NGS Data Sheets for PID's listed above)

CGPS	NAVD88 Ht(feet)	
PVE3	none	
PVHS	972.1	Based on a Refined Geoid Model
PVRS	316.37	Based on Second Order Leveling by CSRC
VTIS	315.26	Based on Second Order Leveling by CSRC and original basis for this survey

Projection: NAD83 California State Plane Coordinates Zone 5: The State Plane Coordinate Parameters follow: The average Scale Factor is 1.00007543, the Height Reduction Factor based on the average ellipsoid heights is 0.99999092, and the average Combined Grid Factor is 1.00006635. Distances in this survey are grid. To obtain ground distances divide grid distances by the Combined Grid Factor. Grid bearings resulting from this survey must be rotated by a Convergence Angle to obtain geodetic (true) bearings. The average convergence angle is -0-12-30± (rotate left 0-12-30).

Datum Stability: The NAD83 (2007) Epoch 2007.00 adjustment is one of a series of national adjustments of NAD83 since its adoption in 1986 and is the realization used for these monitoring surveys since 2007. Rancho Palos Verdes sits on the Pacific Plate which is moving west-northwesterly relative to the North American Plate about 4 centimeters (0.14 feet) per year. The area southwesterly of the Fault Line shown on the above map includes the City and is moving at a constant rate as exhibited by the International Terrestrial Reference Frame (ITRF) north, east and up velocities of the CGPS Stations listed below. These CGPS Stations provide a rigid reference frame for the Portuguese Landslide Monitoring Program that is validated during each monitoring campaign. See the Adjustment results below and the September 2007 Monitoring Survey Report by McGee Surveying Consulting for additional information.

		Annual Velocities in Meters			
SITE	END DATE	N	E	U	START DATE
PVE3	2014.863	0.019	-0.039	-0.000	2000.732
PVHS	2013.965	0.019	-0.040	0.001	1999.512
PVRS	2014.863	0.019	-0.039	0.000	1999.094
VTIS	2014.863	0.019	-0.039	-0.001	1998.940

FIELD SURVEYS, DATA COLLECTION, EQUIPMENT & PROCESSING

Three Leica geodetic GNSS receivers/antennas listed below were mounted on two meter fixed height poles to collect satellite signal data. The GS15 receivers track Navstar GPS and GLONASS satellites. Prior to initiating the field observations a calibration of the fixed height poles was conducted to verify their heights and plumb. The top of the poles were found to be plumb within 0.003 feet of the bottom consistent with prior years. There were no equipment failures.

Sixty-four monitoring points were occupied and reported in this survey. Site photographs and recovery sheets detailing the location, character of the monuments and obstructions were maintained and updated. See the Appendix for "Monitoring Point Status". Monument AB61, established in September 2007 on Portuguese Point, is used as the primary base station in each survey because it sits above a stable basalt formation. AB20 serves as a secondary base for the surveys.

The field survey commenced each day by setting a Leica GS15 GNSS receiver on a fixed height pole at AB61 and on a tribrach on a tripod at AB20 while a third GS15 GNSS receiver roamed freely collecting observations on a fixed height pole at the other 62 points. Points with annual movements less than 0.3' were measured with two or more independent occupations resulting in a minimum of four vectors to each point from AB61 and AB20. Independent occupations means the points were occupied under a different constellation of satellites usually on a different day. If the two measurements were within 0.03 feet (1 cm) horizontally they were accepted, otherwise a third measurement was obtained. On each day over a six day period, vectors based on 4-10 hours of observations connected AB61, AB20 to the CGPS stations. Sixteen points, in the active areas, with

annual movements greater than 0.3' were single occupied. A comparison with the linear movements from prior years was made to verify their accuracy.

Many of the points are over-shadowed by mature trees and shrubberies which interfere with signals received from satellites and affect the quality of measurements. To obtain the best possible accuracies, the satellite constellation is compared with obstruction diagrams to estimate the best time for observing un-obstructed satellites. To improve the accuracy of the measurements, satellites obstructed by foliage and trees are either turned off during the observation or noted for removal in post-processing. If six or more un-obstructed satellites with a GDOP of less than four (measure of the geometry or strength of figure of the constellation) are available, then the measurement commenced for a minimum of 15 minutes of data collection. If the geometry and number of satellites are insufficient then the receiver was moved to another point and returned later when satellite availability improved.

Date of Survey: 9/16/14 to 9/22/14 (mean date 9/19/2014) between 0600-1800 PDST (+7 hrs for UTC).
GNSS Survey Parameters:
Constellation: 30 US NAVSTAR GPS satellites and 24 Russian GLONASS satellites.
Observables: GPS L1 & L2 and GLONASS L1 & L2 Carrier Waves
Epoch Rate & Occupation Times: 15 seconds epochs for 15 minutes and 4-10 hours at base stations
Satellites: 12-17; GDOP < 2.1; Elevation Mask for Data Collection at 15° and Processing at 15°
Ephemeris: Rapid for Static Post-Processing of CGPS connections and Broadcast for onsite.
Weather: Generally clear skies, temperature 67°-80° F.
Space Weather: Boulder K Index was 1-3 except it reached 4 between 1100-1400 hours on 9/19/14 (gauges ionospheric activity on a scale of 0-9, 5 or greater can result in noisy dats).
Equipment:
GNSS Base Receiver Unit No.: M5, Operator: M. McGee, PLS; Station Occupied: AB61 (Base1)
Make & Model: Leica GS15; Antenna Leica GS15; Mount: Fixed Height Pole #1; Antenna Height: 1.803m
GNSS Rover Receiver Unit No.: M6, Operator: M. McGee, PLS;
Make & Model: Leica GS15; Antenna Leica GS15; Mount: Fixed Height Pole #3; Antenna Height: 1.800m
GNSS Rover Receiver Unit No.: M7, Operator: M. McGee, PLS, Station Occupied: AB20 (Base2)
Make & Model: Leica GS15; Antenna Leica GS15; Mount: Tribrach on Tripod; Antenna Height: varies

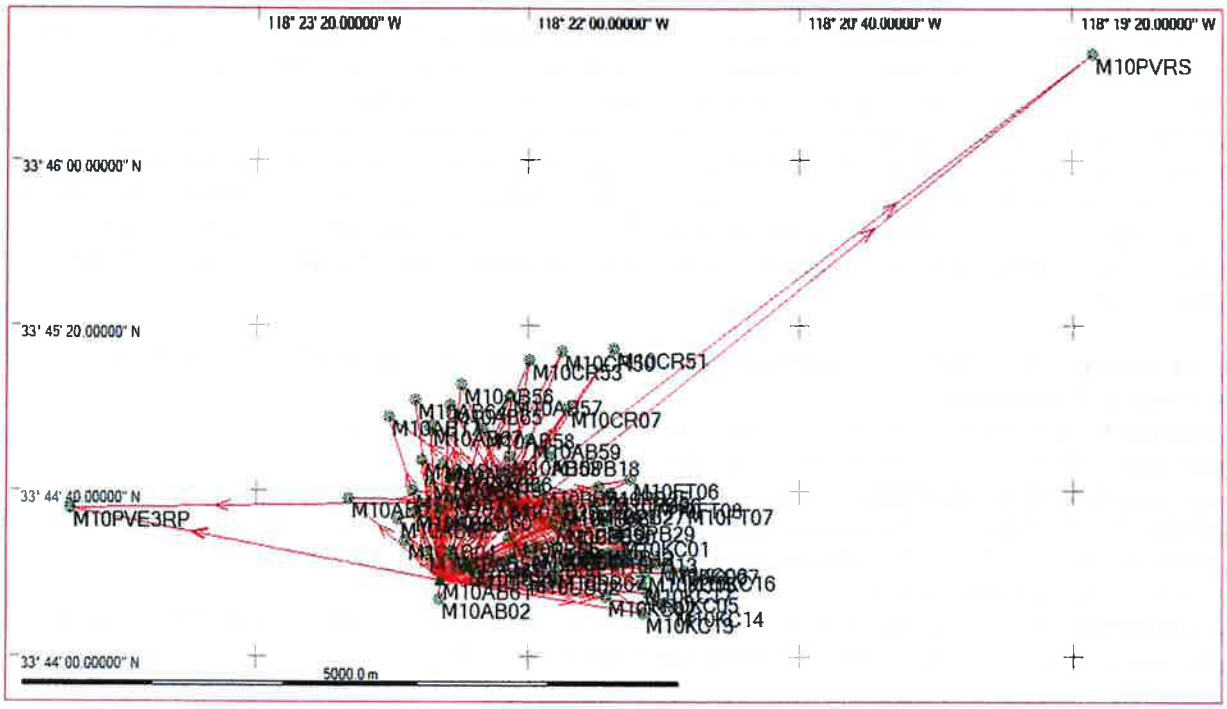
Vectors were processed using Leica LGO v8.1 post processing software. Analysis of residuals led to the rejection of 0 out of 29 vectors connecting the CGPS Stations to AB61 and AB20, and 0 out of 220 vectors connecting monitoring points. Network adjustments and analysis were performed with "Starnet-PRO" version 7.2.0.21 software. Rinex files of the satellite measurements for the CGPS Stations were downloaded from the SOPAC website. The Rapid Ephemeris and Absolute Antenna Models were downloaded from the NGS website.

NETWORK

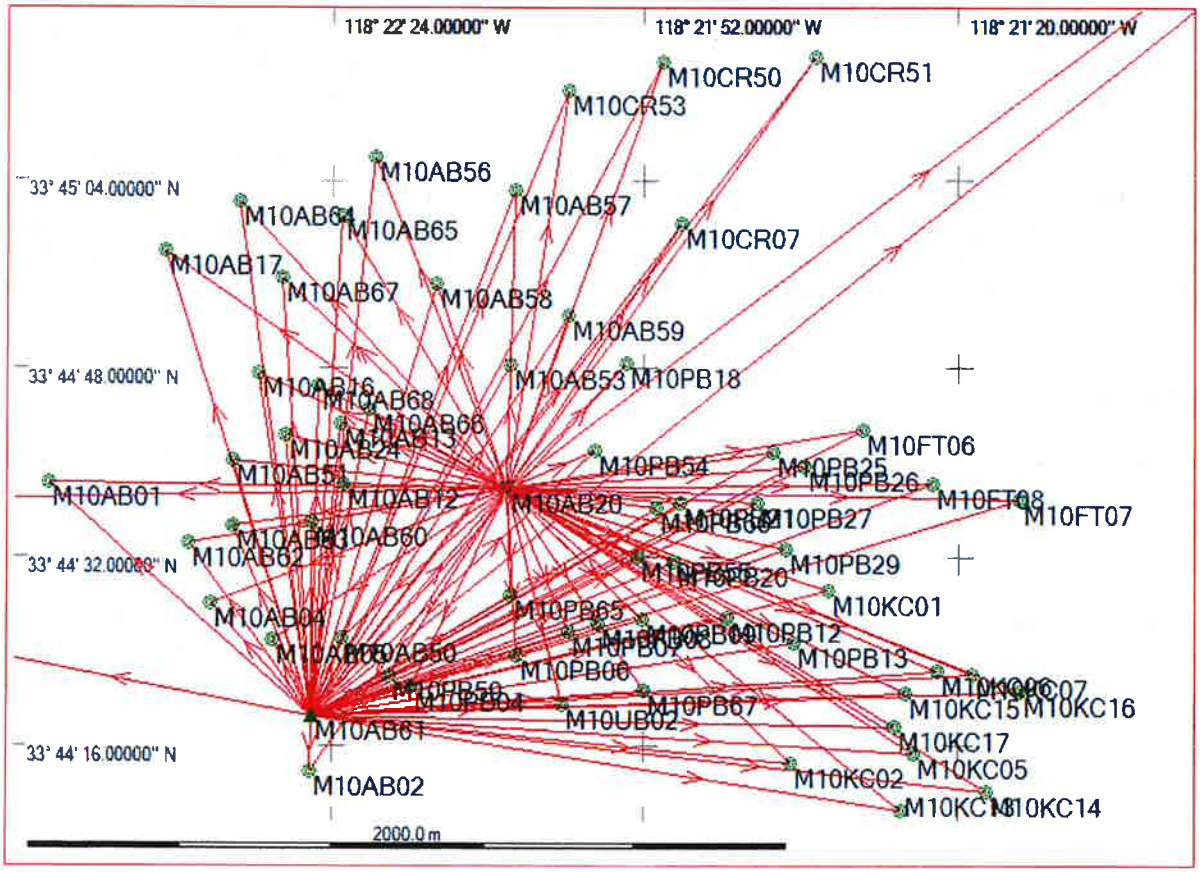
AB61, the primary Base Station, sits on Portuguese Point and is the focal point of the static network connecting the monitoring points and CGPS Stations. AB20, a second Base Station is centrally located sitting on top of a high bluff overlooking Portuguese Bend. Sixty-four points and two CGPS Stations were connected with 249 vectors. See the following Network Maps and the Aerial View in the Appendix.

The monitoring plan utilizes the CGPS Stations to verify the stability of the reference frame. The primary CGPS Station used to control this survey is PVE3 located just south of City Hall and 1.8 miles west-northwest of Base Station AB61. CGPS Station PVHS is 2.8 miles north, PVRS is 3.9 miles northeast, and VTIS is 4.9 miles east-southeast of AB61 are used to validate the stability of the network. During this survey only PVE3 and PVRS were operating.

Monitoring Network with CGPS Stations (north up)



Monitoring Network (north up)



MONITORING POINT HISTORY and STATUS

For data management purposes during the field survey and data processing, the point names were prefixed with "M10" to distinguish between the different monitoring surveys i.e. AB61 was named M10AB61. M10 indicates this survey is the 10th monitoring since the initial September 2007 Monitoring Survey. The prefix is stripped in the COORDINATES LIST and FULL DATA POSTING.

Between 1994 and 2006, 149 monitoring points were established to monitor the Portuguese Bend Landslides, many of which were lost or destroyed. Sixty of the original points were recovered in 2007. Eight of the 60 points were deleted because they were in close proximity of other points better suited for GNSS satellite measurements leaving 52 points monitored and reported between September 2006 and September 2007. Three of the 52 points (AB09, KC11 & PB51) were monitored in September 2007 for the last time because they were replaced by new points, set nearby and better suited for satellite observations. Eighteen new points were set in 2007 and had their movements reported for the first time in the following December 2008 survey. Therefore, in December 2008, 49 original and 18 new points were surveyed for a total of 67 monitoring points.

In the September 2007 Report, it was noted that KC01 was previously reported by others on 9/14/2006 to have moved N 29°E 1.24' from its 12/9/2005 position. In the 2008 survey, a buried partially illegible brass cap in concrete stamped "COUNTY ENGINEER RE8869 1956 STA ??IELDS" was found S31°29'W 1.48 feet from the 1" IP used by this survey in the initial September 2007 and subsequent surveys. The original 1994 position of KC01 was re-referenced to the 1" IP, resulting in correct overall reported movements.

In the December 2008 Report, it was noted that AB05 had been disturbed by a mowing machine. AB05 was found chipped and leaning to southerly about 0.4'. The movement reporting resumed in 2009. Analysis of the movement and historic data made it possible to estimate the disturbance to within 0.05'. The original 1995 position of AB05 was re-referenced S14°02'E 0.29' to be consistent with the disturbed position, resulting in correct overall reported movements.

In 2009, PB64 was set east of the Archery Range to replace PB63 (set 2007) which had become unsafe to access and was lost in 2010. PB64 was reported for the first time in October 2010.

In 2010, points AB03 and BB25 were discontinued. AB03 is on the edge of a cliff 192 feet west-southwest of AB61 making it redundant, and BB25 is on a freestanding rock susceptible to disturbance by wave action. In the summer of 2010, PB62 was destroyed by road construction. In October 2010, PB65 was set 24' south-southwest of PB62 and reported for the first time in October 2011. The following points may have been disturbed prior to the October 2010 survey. AB05 appears to have been disturbed by mower machinery, AB15 (½" GIP in a meter box) is driven over by vehicles occasionally accessing an adjacent field, and KC02 (½" GIP in a meter box) is occasionally parked on by vehicles accessing the beach.

In October 2011, new points AB62 and AB63 (initially referred to as AB62R and AB63R) were set to replace AB06 and AB07 which were hazardous to occupy due to their location near the traveled way of Palos Verde Drive South.

Prior to initiating the September 2012 survey, eight new monuments AB64, AB65, AB66, AB67, AB68, CR53, KC17 and PB66 were constructed to replace AB54, AB18, AB52, AB55, AB15, CR52, KC04 and PB53 respectively. The monuments were replaced because of poor sky visibility except for KC04 which was difficult to access and AB55 which was destroyed by trenching in the past year. Monuments were set with the following design. Monuments set in soil are 1" x 5' GIP driven flush and encase in a 6" PVC pipe sitting on a concrete collar down about 18". Monuments set in asphalt are 1/2" x 2' rebar driven below the surface inside a free floating 2" concrete collar.

In September 2012, points AB15, AB18, AB52, AB54, CR52, KC04 and PB53 were surveyed for the last time and discontinued in October 2013.

In April 2014, PB64 was monitored for the last time due to unsafe conditions for access and PB67 (a 5' t-bar steel post driven 3' into the ground) was set about 300' northerly as a replacement and reported for the first time in September 2014. BB52 is on a freestanding rock susceptible to disturbance by wave action and was monitored for the last time and discontinued.

In the September 2014 survey, two of the four CGPS Stations PVHS and VTIS were not operating. PB67 was reported for the first time but only for 4.5 months since the April 2014 survey whereas, all other points in the "Movement Data Posting" are reported for the 11.5 months since October 2013. See the "Monitoring Point Status" in the Appendix for the present status of monitoring points.

ADJUSTMENTS & ANALYSIS

Adjustment 1: Minimally Constrained Adjustment processed to develop NAD83 (2007) 2007.00 Epoch Geodetic, Ellipsoid and State Plane Coordinates.
Fixed Control: CGPS Station PVE3 was fixed at its published NAD83 (2007) position in a Minimally Constrained Adjustment to determine positions and verify its stability relative to other CGPS stations. PVE3 is located 1.8 miles west of and outside the influence of the slide area. PVE3 has been fixed in all adjustments since 2007. The CSRC publishes a Time Series for the horizontal and vertical stability of PVE3 which indicate the position has been stable prior to 2007. The primary base station AB61 and one other operating CGPS Stations was measured relative to PVE3 and used to assess stability of the survey reference frame. The positions are based on 4 to 10 hour measurements collected over six days. The coordinate differences from previous positions to the present are listed below in feet.

10/2013 Positions to 09/2014

Station	dN	dE	dZ	
PVE3	0.000	0.000	0.000	< Fixed >
PVRS	-0.011	-0.011	-0.003	
AB17	0.004	0.029	-0.078	
AB61	0.019	-0.005	-0.005	<Base Station>
CR51	0.001	-0.006	-0.047	
KC16	0.004	-0.023	-0.038	

9/2007 Positions to 09/2014

Station	dN	dE	dZ
PVE3	0.000	0.000	0.000
PVRS	-0.005	0.009	-0.016
AB17	-0.019	-0.005	-0.062
AB61	0.002	0.004	-0.054
CR51	-0.038	0.010	-0.129
KC16	-0.001	-0.013	-0.058

The following is noted: The base station AB61 has no indication of movement horizontally since 2007 and well as the CGPS Station PVRS relative to CGPS Station PVE3. Both CGPS Stations are well outside the slide areas. The vertical differences at several stations are larger than seen in past years for which there is no explanation at this time. The survey reference frame is deemed stable and successfully recovered at the level of 0.01 feet horizontally by 0.02 feet vertically as indicated. An adjustment constrained to the other CGPS Stations is not preferred or necessary because the purpose here is to track their positions over time to test the stability of the reference frame. See the "COORDINATE LIST" in the Appendix for a list of coordinates resulting from this adjustment. See prior Survey Reports for coordinates resulting from earlier surveys.

Adjustment 2: Minimally Constrained Adjustment to develop Orthometric Heights (Elevations) in NAVD88
Fixed Control: The CGPS Station PVE3 was fixed horizontally and vertically at its NAVD88 orthometric height determined in the September 2007 survey. The 2007 height was based on the published 2nd Order NAVD88 Height of CGPS Station VTIS. This Adjustment combined the measured ellipsoid height differences with the NGS Geoid 03 (models the separation between the ellipsoid and geoid surfaces) to determine NAVD88 orthometric heights of the other CGPS Stations and the monitoring points. See the Adjustment #1 above for vertical differences at key points in this survey.

ACCURACY

These surveys conform to the intent of the Federal Geodetic Control Subcommittee (FGCS) "Specifications for GPS Relative Positioning" (1988) and the California Geodetic Control Committee (CGCC) "Specifications for High-Production GPS Surveying Techniques" (1993).

Vector Residuals: The number of vectors, vector lengths, two dimensional residuals and the absolute value of the vertical residuals resulting from Adjustment #1 are listed below in feet. Thirty-four vectors to single occupied monitoring points are not included because they have no residuals and would optimistically skew the results. The statistics given below are applicable to all points.

		Vector Lengths		Two Dimensional Residuals			Vertical Residuals (absolute)		
Network	No.	Vary	Average	Average	Std.Dev.	Maximum	Average	Std.Dev.	Range
Monitoring	186	479-7182	3320	0.007	0.004	0.021	0.008	0.007	-0.031 to +0.028
CGPS	29	13-20692	14203	0.005	0.004	0.018	0.011	0.010	-0.023 to +0.034

Local Accuracy: The precisions and accuracy of vectors resulting from the minimally constrained adjustment at the 95% Level of Confidence are listed below in feet.

	Relative Distance Error		
Network	Average	Maximum	Av.Precision
Monitoring	0.008	0.010	1: 474,000
CGPS	0.004	0.004	1:2,841,000

The precision ratio, based on the averages for vectors connecting the Monitoring Points, exceeds the criteria for a First Order (C-1) by a factor of 4.7. The precision ratio for vectors connecting AB61, AB20 and the CGPS Stations exceeds the criteria for a B Order survey by a factor of 2.8 per the FGCS requirements for the former classification system.

Coordinate Accuracy: The Standard Deviations (68% Level of Confidence) of the coordinates derived from Adjustment #1, relative to the CGPS Station PVE3 follow in feet.

	Monitoring Point			CGPS Stations		
	North	East	Up	North	East	Up
Average Standard Deviation	0.004	0.003	0.009	0.002	0.002	0.005
Average 95% Error	0.009	0.008	0.017	0.002	0.002	0.005
Maximum Standard Deviation	0.005	0.004	0.012	0.002	0.002	0.005

At the 95% confidence level, the average coordinate has a horizontal radius of circular error is 0.009 feet and a vertical of 0.016 feet with a max of 0.011 and 0.024 feet respectively.

Network Accuracy: The network accuracy (absolute accuracy relative to the reference frame) is expected to be less than 0.02 feet horizontal relative to the NAD83 Datum based on the CGPS Stations.

NAVD88 Heights: The North American Vertical Datum of 1988 orthometric heights resulting from Adjustment #2 are derived from the difference in ellipsoid heights combined with the Geoid 03 model and constrained to the height of PVE3 determined in 2007. The average relative accuracy of the heights is 0.03 feet at the 95% level of confidence but may be greater at obstructed sites. The absolute accuracy of the heights relative to the datum is dependent on the published value on the CGPS Station VTIS. Although relative elevation accuracies can be within 0.03 feet, up until October 2011 there were no requirements for vertical accuracies. In October 2011, a preference of 0.03 foot relative vertical accuracy was instigated for the following points: AB17, AB57, CR07, CR50 and CR51. In the September 2012 and subsequent surveys the criteria was extended to all points.

Movement Accuracy: For this period, 48 points moved less than 0.30 feet with an average movement of 0.03 feet and a range of 0.01 to 0.08 feet. The relative error at the 95% Level of Confidence averaged 0.015 feet with a range of 0.006 to 0.028 feet. Overall, the estimated 95% relative movement error averaged 0.016 feet with a range of 0.006 to 0.028 feet. No movement is considered detected unless the movement exceeds the 95% Error

for individual points. See the attached "MOVEMENT DATA POSTING" for the estimated relative movement errors at the 95% Level of Confidence for individual points for any period.

QUALITY CONTROL - QUALITY ASSURANCE (QAQC) ANALYSIS

To ensure the accuracy and validity of the measurement systems used in these GNSS monitoring surveys, an independent test was made using conventional terrestrial based instruments as reported in the "QAQC ANALYSIS" section of the September 2007 Monitoring Survey Report. Comparing the results of the GNSS systems with conventional instrumentation found horizontal measurements agreed 0.01 feet on average. In November of 2011 the GNSS instruments and fixed height poles used in this survey were calibrated on the Santa Maria National Geodetic Survey Baseline and found to agree with published distances 0.003 to 0.006 feet.

To validate the radial survey method used in these surveys to position points from base stations AB61 and AB20, independent GNSS cross connections were measured and compared with the stand alone computed inverse distances in the 2007, 2008 and 2009 surveys. The results found the two dimensional accuracy to agree 0.01 feet on average, indicating the radial method of measurements is reliable and the additional labor cost of measuring cross connection between points is not warranted. See the "QAQC ANALYSIS" section of the September 2007 and the December 2008 Monitoring Survey Reports for detailed analysis.

Deflection Analysis is a method established by this surveyor to assess the consistency of the direction of movements reported from period to period. Assuming that movements are generally linear for points moving less than a ½ foot, the separation or the deflection between the direction of the previous and present periods taken over the moved distance implies the accuracy obtained with the equipment, methods and procedures. Analysis of individual deflections indicates that for points with multiple occupations the separations varied 0.01 to 0.02 feet.

SUMMARY

Prior to September 2007, successive coordinate differences were used to compute movements which do not provide statistical information about the relative movement accuracies. Beginning with the initial 2007 survey, field and office procedures were designed to assure the accuracy and reliability of measurements and provide for queries between epochs that include statistical information about the relative precisions of the reported movements. Thereafter, measurement of temporal movements are based on a rigorous simultaneous least squares adjustment of multiple observations at two different epochs for each point.

The results of the October 4, 2013 to September 19, 2014 monitoring period indicates the relative accuracy of the reported movements average 0.016 feet at the 95% Level of Confidence. Statistically, the probability at the 95% level of confidence is that movement (signal) has occurred at a point when the horizontal distance between two epochs is greater than the 95% Error (noise). See the "Movement Data Posting" for a listing of the 95% Error estimates (range 0.006 to 0.028 feet). Applying this criteria, 17 points have not moved.

Between October 4, 2013 to September 19, 2014 (11.5 months), points moved 0.02 to 1.65 feet and 4.6 feet for 4.5 months at PB67s in the Portuguese Bend Landslide (PB##), 0.01 to 0.06 feet in the Abalone Cove Landslide (AB##), and 0.01 to 0.05 in the Klondike Canyon (KC##). See the Contours of Horizontal Movement in the Appendix for a graphical representation of the movements.

See the attached "MOVEMENT DATA POSTING" spreadsheet for overall and periodic movements of each point. The movements are given in north, east and up or down as well as a vector of distance and direction relative to north. The direction is given as an azimuth in degrees where 0° is north and increases clockwise (90° East, 180° South, 270° West). The overall movements are from the beginning position of each point which varies between 1994 and the present for newly established points.

The present listing and status of monitored points is provided in the Appendix under "Monitoring Point Status". The historical status of all monitoring points is provided in the September 2007 Survey Report. The historical 1994-2006 positions of all points are listed in the Charles Abbott Associates Inc. file "ALL POINTS MOST RECENT OBSERVED POSITION AS OF SEPTEMBER 15, 2006.xls" attached as an electronic file to the 2007 Report.

RECOMMENDATION

An ongoing re-location program for monuments has long term benefits resulting in better accuracy lower cost surveys due to improved sky visibility for tracking satellites. In this September 2014 survey, no monuments were re-located. Points AB16, AB24 and AB58 have limited sky visibility and should be re-located or deleted. AB12 is in a horse corral and has limited access

Attachments: The following document is attached to this Report.
"PB MOVEMENT DATA POSTING" lists the coordinates of the initial positions, the overall and periodic movements of monitoring point since 2007 and the NAD83(2007.00) State Plane Coordinates and NAVD88 Heights.

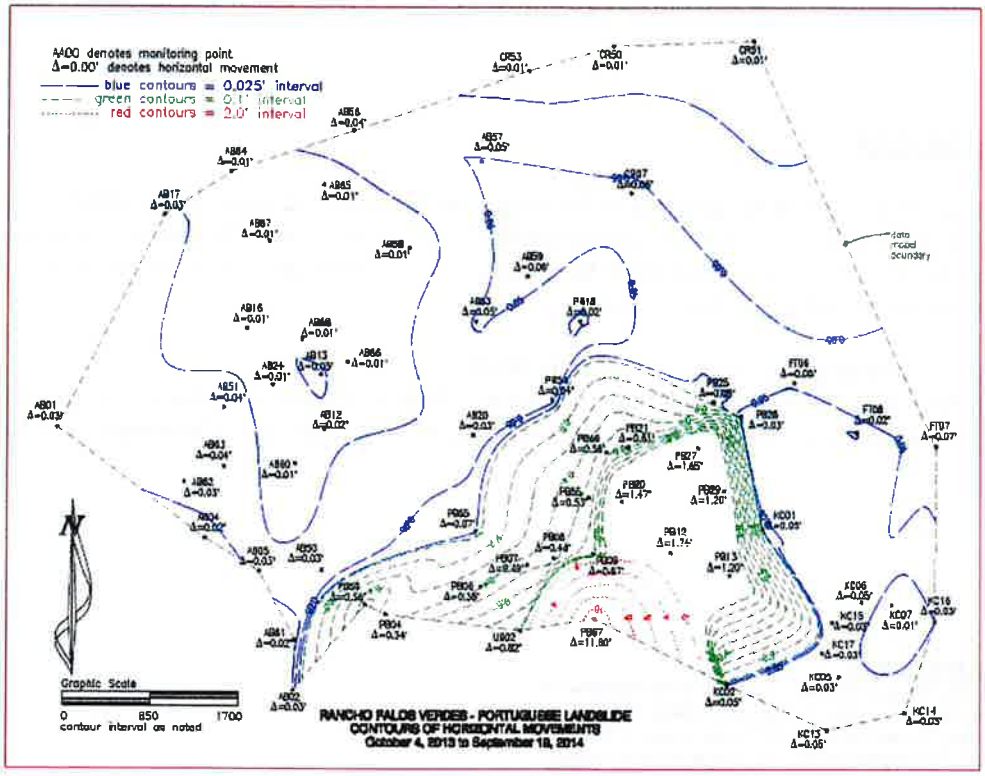
SURVEYOR'S STATEMENT
This Report on the criteria, procedures and results of the September 19, 2014 City of Rancho Palos Verdes Portuguese Landslide Monitoring Survey was prepared by me January 7, 2015 at the request of Ron Dragoo, Assistant City Engineer of the City of Rancho Palos Verdes.

Michael R. McGee P.L.S. 3945

APPENDIX

12- Contours of Horizontal Movements
13- Aerial Photo and Oblique Aerial View of Monitoring Points
14- Monitoring Point Status
15- Coordinate List- Sept. 19, 2014 Survey NAD83(2007) Geodetic, Grid Coordinates, NAVD88
17- Addendum Report for the February 7, 2015 Partial Monitoring Survey

Contours of Horizontal Movements Oct. 4, 2013 to Sept. 19, 2014



Contour of Horizontal Movements Overlayed on an Aerial Photo

Aerial View of Monitoring Points – (Photography Dated 04/23/2014) (north up)

Oblique Aerial View of Monitoring Points (looking north)

MCGEE SURVEYING CONSULTING							
RANCHO PALOS VERDES - PORTUGUESE LAND SLIDE MONITORING POINT STATUS for 2015 Prepared 12/06/2014							
Notes:	162+/- Monitoring Points established since 1994						
09/01/07	71 Points Surveyed 60 old points found with 52 monitored plus 19 new points						
12/01/08	67 Points Surveyed AB09, KC11, PB51 discontinued; BB53 destroyed; AB05 disturbed						
11/01/09	68 Points Surveyed Set PB64 to replace PB63 destroyed subsequently						
10/01/10	65 Points Surveyed Discontinued AB03, BB25; set PB65 to replace PB62 destroyed by paving						
10/03/11	69 Points Surveyed; Set AB62 & AB63 to replace AB06 & AB07						
09/14/12	72 Points Surveyed; Discontinued AB06, AB07; AB55 destroyed by trenching; Added 8 new points						
10/06/13	65 Points Surveyed; Discontinued AB15, AB18, AB52, AB54, CR52, KC04, PB53						
9/19/14	64 Points Surveyed; Discontinued BB52, PB67 set in April 2014; Added PVE3RP (reference to PVE3 antenna)						
12/17/13	28-30 Points to Survey in Jan-Feb 2015 and April-May 2015						
Pt ID	Last Obs'd	Comments	GNSS	Pt ID	Last Obs'd	Comments	GNSS
AB01	9/19/2014	Base 1994-2006	G	FT07	9/19/2014		G
AB02	9/19/2014		G	FT08	9/19/2014		G
AB04	9/19/2014		G				
AB05	9/19/2014		G	KC01	9/19/2014	NE'ly/2 pipes 1.5' apart	G
AB12	9/19/2014		G	KC02	9/19/2014		G
AB13	9/19/2014		F	KC05	9/19/2014		G
AB16	9/19/2014		P	KC06	9/19/2014		G
AB17	9/19/2014		F	KC07	9/19/2014		G
AB20	9/19/2014	NE'ly/ 2 monuments	G	KC13	9/19/2014		G
AB24	9/19/2014		F	KC14	9/19/2014		G
AB50	9/19/2014		G	KC15	9/19/2014		F
AB51	9/19/2014		G	KC16	9/19/2014		G
AB53	9/19/2014		F	KC17	9/19/2014	Replaced KC04	G
AB56	9/19/2014		F				
AB57	9/19/2014		G	PB04	9/19/2014		G
AB58	9/19/2014		P	PB06	9/19/2014		G
AB59	9/19/2014		G	PB07	9/19/2014		G
AB60	9/19/2014		G	PB08	9/19/2014		G
AB61	9/19/2014	BASE since 2007	G	PB09	9/19/2014		G
AB62	9/19/2014	Replaced AB06	G	PB12	9/19/2014		G
AB63	9/19/2014	Replaced AB07	G	PB13	9/19/2014		G
AB64	9/19/2014	Replaced AB54	G	PB18	9/19/2014		G
AB65	9/19/2014	Replaced AB18	G	PB20	9/19/2014	S'ly/ 2 pipes 5.3' apart	G
AB66	9/19/2014	Replaced AB52	G	PB21	9/19/2014		F
AB67	9/19/2014	Replaced AB55	G	PB25	9/19/2014		G
AB68	9/19/2014	Replaced AB15	G	PB26	9/19/2014		F
				PB27	9/19/2014		G
BB52	10/4/2013	Discontinued	G	PB29	9/19/2014		G
				PB54	9/19/2014		F
CR07	9/19/2014		F	PB55	9/19/2014		F
CR50	9/19/2014		G	PB59	9/19/2014		G
CR51	9/19/2014		G	PB64	9/19/2014	Replaced PB63	G
CR53	9/19/2014	Replaced CR52	F	PB65	9/19/2014	Replaced PB62	G
				PB66	9/19/2014	Replaced PB53	G
FT06	9/19/2014		G	PB67	9/19/2014	Replaced PB64	G
				UB02	9/19/2014		G
GNSS column indicates site is Good, Fair or Poor for Satellite Visibility Conditions							

COORDINATE LIST

Portuguese Landslide 09/19/2014 Monitoring Survey

Prepared by McGee Surveying Consulting: Document Date: 12/31/2015

Datum: Horizontal & EH NAD83 (2007) Epoch; California State Plane Zone 5; Vertical: NAVD88

Note, Fixed CGPS Station PVE3 at Record 3D Position & Orthometric Height per 09/2007 Survey; See 2007 and subsequent Survey Reports

Point	Latitude	Longitude	EH (ft)	North (ft)	East (ft)	OrthoHt(ft)	Description
AB01	33-44-38.30243	118-22-53.05172	60.02	1729427.54	6445709.57	178.50	Punched 1/2" GIP in meter box
AB02	33-44-13.84871	118-22-26.19225	-2.06	1726946.97	6447968.70	116.44	4" BC "SAN PEDRO 1936" on conc. block
AB04	33-44-28.09124	118-22-36.28725	-51.31	1728389.94	6447121.49	67.15	BC "CO ENG STA Q2.." on 2"GIP in mass of conc.
AB05	33-44-24.99015	118-22-30.09124	-38.00	1728074.49	6447643.60	80.45	BC "CO ENG STA Q3.." on 2"GIP in mass of conc.
AB12	33-44-38.27505	118-22-22.72074	164.81	1729415.16	6448271.06	283.15	BC "CO ENG STA 7A.." in mass of conc.
AB13	33-44-43.34520	118-22-23.16126	246.10	1729927.85	6448235.76	364.42	Punched 1/2" GIP in meter box
AB16	33-44-47.57976	118-22-31.51220	258.05	1730358.55	6447532.12	376.38	Punched 1/2" GIP in meter box
AB17	33-44-58.06065	118-22-41.08410	324.40	1731421.10	6446727.77	442.73	Punched 1/2" GIP in meter box
AB20	33-44-37.77487	118-22-05.96625	277.92	1729359.38	6449685.82	396.19	BC "CO ENG STA W. FIX 1956.." in mass of conc.
AB24	33-44-42.35411	118-22-28.79487	217.35	1729829.43	6447759.63	335.71	Cotton spindle in conc. In road
AB50	33-44-25.11152	118-22-22.94543	63.57	1728084.52	6448247.15	181.99	Nail & shiner in conc. collar of well
AB51	33-44-40.22977	118-22-34.15185	186.74	1729616.36	6447306.42	305.12	PK mag nail in plastic plug "LS6957" in 1"GIP
AB53	33-44-48.36803	118-22-05.70038	234.58	1730430.17	6449712.20	352.80	Chisled + on s edge conc. Vault
AB56	33-45-05.96970	118-22-19.59257	453.32	1732213.86	6448545.61	571.53	6" mag nail & washer in conc. in 2"x 36" GIP
AB57	33-45-03.17002	118-22-05.20569	446.55	1731926.37	6449759.45	564.71	6" mag nail & washer in conc. in 2"x 36" GIP
AB58	33-44-55.14428	118-22-13.27637	287.31	1731117.54	6449074.94	405.53	Punched RR spike on s side road
AB59	33-44-52.54061	118-21-59.79460	316.00	1730850.16	6450212.47	434.18	6" mag nail & washer in conc. in 2"x 36" GIP
AB60	33-44-35.04165	118-22-26.06505	60.93	1729089.34	6447987.41	179.31	6" mag nail & washer in conc. in 2"x 28" GIP
AB61	33-44-18.57321	118-22-25.95801	21.94	1727424.50	6447990.26	140.41	6" mag nail & washer in conc. in 2"x 24" GIP
AB62	33-44-33.23061	118-22-38.63206	24.53	1728910.23	6446925.41	142.96	6" mag nail & washer in conc. in 1"x 24" GIP
AB63	33-44-34.71811	118-22-34.12085	62.36	1729059.18	6447306.96	180.77	Punched 1/2 x 48" rebar
AB64	33-45-02.13633	118-22-33.46077	413.88	1731830.70	6447373.07	532.16	2" mag nail on NE side 2' conc. Collar/Well B12
AB65	33-45-00.93229	118-22-22.90390	340.23	1731705.66	6448264.09	458.47	2" mag nail & washer in conc. in 1"x 60" GIP
AB66	33-44-44.53550	118-22-20.14990	255.91	1730047.23	6448490.52	374.21	1/2" x 24" punched rebar 1" below AC conc. collar
AB67	33-44-55.71729	118-22-29.06589	286.99	1731180.41	6447741.78	405.28	1/2" x 24" punched rebar 1" below AC conc. collar
AB68	33-44-46.61264	118-22-25.31209	275.09	1730258.83	6448055.35	393.41	1/2" x 24" punched rebar 1" below AC conc. collar
CR07	33-45-00.26892	118-21-48.09426	513.96	1731627.83	6451203.37	632.06	6" mag nail & washer in conc. in old 1" IP
CR50	33-45-13.97061	118-21-50.11946	754.54	1733013.57	6451037.36	872.60	Tack & shiner on lower rock wall
CR51	33-45-14.49679	118-21-34.43625	858.13	1733062.00	6452361.87	976.12	Tack & shiner on conc pad
CR53	33-45-11.63388	118-21-59.73920	662.60	1732780.30	6450224.19	780.70	2" mag nail & washer in conc. in 1"x 60" GIP
FT06	33-44-42.78549	118-21-29.58563	370.54	1729854.81	6452760.04	488.62	6" mag nail & washer in conc. in 2"x 36" GIP
FT07	33-44-36.87025	118-21-13.65923	470.56	1729252.07	6454102.93	588.60	6" mag nail & washer in conc. in 2"x 36" GIP
FT08	33-44-38.19502	118-21-22.57436	540.33	1729388.65	6453350.50	658.40	6" mag nail & washer in conc. in 2"x 36" GIP
KC01	33-44-29.13375	118-21-33.10882	194.08	1728475.80	6452457.57	312.26	6" mag nail & washer in conc. in old 1" IP
KC02	33-44-14.54748	118-21-37.05751	-104.56	1727002.45	6452118.80	13.71	Punched 1/2" GIP in meter box
KC05	33-44-15.37058	118-21-24.50986	109.26	1727081.88	6453178.85	227.46	Punched 1/2" GIP in meter box
KC06	33-44-22.33190	118-21-21.96636	181.67	1727784.84	6453396.17	299.83	Punched 1/2" GIP in meter box
KC07	33-44-22.09046	118-21-18.55886	195.30	1727759.42	6453683.86	313.44	Punched 1/2" GIP in meter box
KC13	33-44-10.41212	118-21-25.78288	72.83	1726581.00	6453069.56	191.06	Cotton spindle in AC turnout
KC14	33-44-12.03493	118-21-17.07063	141.70	1726742.45	6453805.97	259.89	Punched spike in center road
KC15	33-44-20.39789	118-21-25.21724	168.83	1727590.31	6453120.91	287.01	Cotton spindle in cul-de-sac
KC16	33-44-20.55016	118-21-13.64621	208.72	1727602.25	6454098.22	326.85	Punched spike in intersection
KC17	33-44-17.55010	118-21-26.32443	97.00	1727302.75	6453026.38	215.20	2" mag nail & washer in conc. in 1"x 50" GIP
PB04	33-44-20.97495	118-22-15.80836	48.11	1727664.12	6448848.37	166.52	Nail & tag "RCE26120" in conc. in 3" pipe
PB06	33-44-23.67725	118-22-05.05061	58.70	1727933.95	6449757.93	177.04	Punched cap on 2" GIP
PB07	33-44-25.66040	118-21-59.68621	79.04	1728132.78	6450211.72	197.35	Brass tag "LA CO DPW" in conc. in 2" GIP
PB08	33-44-26.30225	118-21-56.71928	75.96	1728196.75	6450462.53	194.25	Punched cap on 2" GIP
PB09	33-44-26.76704	118-21-52.15074	70.18	1728242.33	6450848.53	188.45	Punched cap on 2" GIP in cable box
PB12	33-44-26.87598	118-21-43.46342	65.00	1728250.70	6451582.26	183.23	Punched cap on 2" GIP in cable box
PB13	33-44-24.80452	118-21-36.77345	88.20	1728039.26	6452146.51	206.42	Punched cap on 2" GIP in cable box
PB18	33-44-48.41020	118-21-53.76788	244.73	1730430.76	6450719.90	362.90	Punched 1/2" GIP in meter box
PB20	33-44-31.67750	118-21-48.91649	113.15	1728737.75	6451123.48	231.38	Punched cap on 2" GIP in cable box
PB21	33-44-36.63950	118-21-48.28309	153.69	1729239.17	6451178.78	271.89	Punched cap on 2" GIP in cable box
PB25	33-44-40.93116	118-21-38.74096	207.78	1729670.12	6451986.19	325.91	Punched cap on 2" GIP in cable box
PB26	33-44-39.63753	118-21-35.58685	164.76	1729538.39	6452252.09	282.88	Brass tag "LA CO DPW" in conc. in 2" GIP
PB27	33-44-36.66094	118-21-40.42476	152.40	1729238.94	6451842.44	270.56	Punched cap on 2" GIP in cable box
PB29	33-44-32.70392	118-21-37.45680	51.32	1728838.03	6452091.66	169.49	Brass tag "LA CO DPW" in conc. in 2" GIP
PB54	33-44-41.07907	118-21-56.95047	239.40	1729690.63	6450448.44	357.61	PK mag nail in plastic plug "LS6957" in 1"GIP
PB55	33-44-32.00869	118-21-52.73494	120.97	1728772.40	6450801.12	239.21	PK mag nail in plastic plug "LS6957" in 1"GIP
PB59	33-44-21.88238	118-22-18.05185	39.91	1727756.55	6448659.23	158.33	PK mag nail in plastic plug "LS?" in 1" GIP
PB65	33-44-28.81974	118-22-05.66827	169.29	1728454.01	6449707.67	287.61	2" alum. cap "MCGEE SURVE.." on 5/8"x24"rebar
PB66	33-44-36.20569	118-21-50.75356	169.89	1729196.07	6450969.99	288.10	2" mag nail & washer in conc. in 1"x 60" GIP
PB67	33-44-20.75176	118-21-52.01724	-42.91	1727634.20	6450857.60	75.40	4' high T-bar steel fence post
UB02	33-44-19.54913	118-22-00.47239	-55.78	1727515.23	6450143.07	62.57	PK mag nail in plastic plug "?" in 1"GIP
PVE3	33-44-35.85329	118-24-15.26904	235.42	1729207.09	6438765.18	354.36	CGPS Pos. Fixed in 2007 and subsequent surveys
PVE3RP	33-44-35.74229	118-24-15.27455	227.93	1729195.87	6438764.67	346.87	Mag Nail in Concrete Base 11' S/ PVE3
PVRS	33-46-25.89198	118-19-14.06724	198.58	1740239.30	6464237.89	316.29	CGPS Pos. Determined 10/04/2013 Survey

McGEE SURVEYING CONSULTING
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First Addendum Report
February 7, 2015 Partial Monitoring Survey
Portuguese Bend Landslide
for the
City of Rancho Palos Verdes
by
McGee Surveying Consulting
February 12, 2015, Revised June 10, 2015

Overview:

This Addendum Report describes the first tri-annual partial monitoring survey in February 2015 at Portuguese Bend. This survey included a sub-set of 27 points of the full monitoring set and one temporary point AB69 set as a backup to AB12. This survey follows the procedures described in the above Report on the September 19, 2014 full monitoring. The detailed results of this survey are reported on Page 11 of the attached spreadsheet titled "PB MOVEMENT DATA POSTING 2007-2015.2" listing the coordinates, and periodic movements of points between September 19, 2014 and February 7, 2015 and the overall movement since 2007.

The movements reported between September 19, 2014 and February 7, 2015 (4.5 months) statistically attained an average accuracy of 0.012 feet at the 95% Level of Confidence as demonstrated by the measured vector residuals, repeatability of measurements at points considered stable, and the analysis of movement deflections. For a detailed history of the program and surveys see "History" above and previous Reports back to 2007. The field survey took place between February 6 and February 8, 2015. The Field Surveys, Equipment, Data Collection and Network Design were as described in the above Report. The survey included two onsite base stations and 26 onsite points each connected with two to six vectors. Three continuously operating GPS stations (CGPS) were connected to this survey with six vectors each. The Adjustments followed the process as described in the above Report with the following results.

Adjustment: Minimally Constrained Adjustment processed to develop NAD83 (2007) 2007.00 Epoch Geodetic, Ellipsoid and State Plane Coordinates in feet. CGPS Station PVE3 was fixed and the difference are listed in feet from the September 19, 2014 to the February 7, 2015 positions for the CGPS stations and points considered to mostly stable.

09/2014 Positions to 02/2015

Station	dN	dE	dZ	
AB17	-0.002	0.001	0.002	
AB61	-0.005	-0.006	-0.019	<Base Station
CR50	-0.004	0.001	0.014	
KC16	-0.007	-0.009	-0.013	
KC17	-0.002	-0.008	0.002	
PVE3	-0.000	-0.000	-0.000	< Fixed
PVRS	-0.009	-0.009	0.014	

The adjustment was constrained as a standard procedure to the CGPS station PVE3 which finds CGPS station PVRS in agreement with the September 2014 horizontal position at 0.01 feet. AB61, AB17 and KC16 are historically stable and continue to be so. The survey reference frame was deemed stable and successfully recovered.

Summary of Movements: Between September 19, 2014 to the February 7, 2015 (4.5 months), points in this subset moved 0.03 to 3.36 feet in the Portuguese Bend Landslide (PB##), 0.03 to 0.07 feet in the Abalone Cove Landslide (AB##), and 0.02 feet in the Klondike Canyon (KC##). See the attached spreadsheet titled "PB MOVEMENT DATA POSTING 2007-2015.4" for the periodic movements of each point.

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Second Addendum Report
April 16, 2015 Partial Monitoring Survey
Portuguese Bend Landslide
for the
City of Rancho Palos Verdes
by
McGee Surveying Consulting
June 10, 2015

Overview:

This Addendum Report describes the second tri-annual partial monitoring survey in April 2015 at Portuguese Bend. This survey included a sub-set of 27 points of the full monitoring set, temporary points AB69 set in February, temporary point AB70 set as a backup to AB12 which has challenging access in a horse corral, and three new points PB68, PB69 and PB70 set along PVDS. This survey followed the procedures described in the above September 19, 2014 full monitoring Report. The detailed results of this survey are reported on Page 12 of the attached spreadsheet titled "PB MOVEMENT DATA POSTING 2007-2015.4" listing the coordinates, and periodic movements of points between February 7 and April17, 2015 and the overall movement since 2007.

The movements reported between February 7, 2015 and April 16, 2015 (2.3 months) statistically attained an average accuracy of 0.015 feet at the 95% Level of Confidence as demonstrated by the measured vector residuals, repeatability of measurements at points considered stable, and the analysis of movement deflections. For a detailed history of the program and surveys see "History" above and previous Reports back to 2007. The field survey took place between April 15 and April 18, 2015. The Field Surveys, Equipment, Data Collection and Network Design were as described in the above Report. The survey included two onsite base stations and 30 onsite points each connected with two to six vectors. Three continuously operating GPS stations (CGPS) were connected to this survey with seven vectors each. The Adjustments followed the process as described in the above Report with the following results. It is to be noted that solar activity was high during the survey resulting in somewhat noisy data collection.

Adjustment: Minimally Constrained Adjustment processed to develop NAD83 (2007) 2007.00 Epoch Geodetic, Ellipsoid and State Plane Coordinates in feet. CGPS Station PVE3 was fixed and the difference are listed in feet from the September 19, 2014 to the February 7, 2015 positions for the CGPS stations and points considered to mostly stable.

09/2014 Positions to 02/2015

Station	dN	dE	dZ	
AB17	-0.014	-0.033	0.102	
AB50	-0.002	0.010	0.019	
AB61	0.002	0.013	0.008	Primary Base Station
CR50	0.014	0.002	0.072	
KC16	-0.000	0.022	0.023	
PVE3	-0.000	-0.000	-0.000	Fixed CGPS Station
PVRS	0.037	0.031	-0.029	CGPS Station
VTIS	0.003	0.017	0.024	CGPS Station

The adjustment was constrained as a standard procedure to the CGPS station PVE3 which finds CGPS station VTIS and the base station AB61 in agreement with the September 2014 and February 2015 position as expected. CGPS station PVRS is larger than expected and to be watched. The AB17 and KC16 historically don't move, however, AB17 has began to move based on the last several monitoring surveys. The survey reference frame was deemed stable and successfully recovered.

Summary of Movements: Between February 7, 2015 to April 16, 2014 (2.3 months), points in this subset moved 0.13 to 1.45 feet in the Portuguese Bend Landslide (PB##), and 0.03 to 0.04 feet in the Abalone Cove Landslide (AB##), 0.02-0.03 feet in the Klondike Canyon (KC##). See the attached spreadsheet titled "PB MOVEMENT DATA POSTING 2007-2015.4" for the periodic movements of each point. See the Table below for a condensed summary of movements and elevation changes.

PORTUGUESE BEND LANDSLIDE MONITORING MOVEMENTS IN FEET FOR SEPTEMBER 2014 to APRL 2015						
	Sept. 19, 2014 to Feb. 7, 2015		Feb. 7, 2015 to April 16, 2015		Sept. 19, 2014 to April 16, 2015	
Point ID	Movement	Elevation	Movement	Elevation	Movement	Elevation
	Distance	Change	Distance	Change	Distance	Change
AB04	0.05	0.01	0.01	-0.02	0.06	-0.01
AB12	0.03	-0.02	0.03	0.02	0.06	0.00
AB16	0.00	-0.02	0.02	0.05	0.02	0.03
AB17	0.00	0.00	0.04	0.10	0.04	0.10
AB20	0.01	-0.01	0.01	0.04	0.02	0.03
AB50	0.02	-0.02	0.01	0.02	0.03	0.00
AB59	0.02	0.00	0.02	0.05	0.04	0.05
AB60	0.02	-0.02	0.02	0.00	0.05	-0.02
AB61	0.01	-0.02	0.01	0.01	0.02	-0.01
AB65	0.07	-0.03	0.02	0.05	0.09	0.03
CR07	0.03	0.00	0.02	0.06	0.05	0.06
CR50	0.00	0.01	0.01	0.07	0.02	0.08
FT06	0.03	-0.04	0.02	0.05	0.05	0.02
FT07	0.03	0.00	0.01	0.06	0.04	0.06
KC06	0.00	-0.01	0.03	0.02	0.03	0.01
KC07	0.02	0.00	0.01	0.02	0.02	0.02
KC13	0.02	0.00	0.02	0.01	0.04	0.01
KC16	0.01	-0.01	0.02	0.02	0.03	0.01
KC17	0.01	0.00	0.03	0.02	0.04	0.02
PB04	0.42	-0.14	0.12	-0.05	0.54	-0.19
PB12	0.74	-0.19	0.30	-0.04	1.04	-0.23
PB13	0.51	-0.05	0.18	-0.01	0.70	-0.06
PB18	0.03	-0.04	0.01	0.05	0.04	0.01
PB26	0.04	-0.03	0.01	0.07	0.05	0.04
PB59	0.65	-0.33	0.21	-0.09	0.86	-0.42
PB66	0.31	-0.06	0.13	0.04	0.44	-0.01
PB67	3.36	-0.45	1.45	-0.17	4.80	-0.61
Note: Given the accuracies of the measurements, only Movements & Elevation Changes exceeding 0.02 feet (1/4") and 0.04 feet (1/2") respectively are deemed to have actually moved.						
See "PB MOVEMENT DATA POSTING 2007-2015.4.xlsx" for more details.						

PORTUGUESE BEND LANDSLIDE MONITORING - MOVEMENT DATA POSTING as of September 24, 2007

Prepared by McGee Surveying Consulting

MONITORING POINTS

NAD83(2007) STATE PLANE COORDINATES & NAVD88 ELEVATIONS of Original Positions, 2007 & Post 2007 Positions

Notes: # Indicates stable points, not moving

* Indicates no signal of horizontal movement detected in the last period at the 95% level of confidence

1= 2005 and prior surveys used a nearby monument 531-29W 1.48', the original position is adjustad here to be relative to the 1" IP used presently, resulting in correct Overall Movements, see Reports

9/24/2007(1994) Indicates the 2007 position was used for overall; see the 2011 Report for original 1994 positions

		Original Positions			Sept. 24, 2007 Positions			Overall Movements (US Feet) Original Position to Sept. 24, 2007					
		NAD83 SPC Zone 5 (Ft)		NAVD88	NAD83 SPC Zone 5 (Ft)		NAVD88						
Point	Date	North (ft)	East (ft)	Elev(ft)	North (ft)	East (ft)	Elev(ft)	North	East	Height	Azim.°	Dist.	Note
AB01	12/1/1994	1729427.58	6445709.61	178.62	1729427.55	6445709.64	178.62	-0.03	0.03	0.00	138	0	#
AB02	9/24/2007(1994)	1726946.98	6447968.69	116.48	1726946.98	6447968.69	116.48						
AB03	12/1/1994	1727338.34	6447818.82	139.60	1727338.39	6447818.81	139.59	0.04	-0.01	-0.01	351	0.04	#
AB04	11/30/1994	1728391.99	6447133.34	67.57	1728390.55	6447122.03	67.31	-1.44	-1.32	-0.26	222	1.95	
AB05	3/14/1995	1728075.72	6447645.17	80.90	Disturbed between 2007-2008								
AB06	4/27/1995	1729059.73	6446976.26	165.28	1729058.58	6446975.91	164.91	-1.15	-0.35	-0.37	197	1.21	
AB07	11/30/1994	1728982.79	6447358.41	159.92	1728981.51	6447357.74	159.40	-1.28	-0.67	-0.52	208	1.44	
AB12	11/30/1994	1729416.49	6448271.64	283.43	1729415.67	6448271.30	283.19	-0.82	-0.35	-0.24	203	0.89	
AB13	11/30/1994	1729928.90	6448236.04	365.03	1729928.25	6448235.90	364.54	-0.65	-0.13	-0.49	192	0.66	
AB15	11/30/1994	1730312.09	6448099.38	397.28	1730311.64	6448099.31	396.90	-0.45	-0.07	-0.38	189	0.45	
AB16	11/30/1994	1730359.09	6447532.12	376.62	1730358.70	6447532.17	376.44	-0.19	0.04	-0.18	168	0.19	
AB17	9/24/2007(1994)	1731421.12	6446727.77	442.80	1731421.12	6446727.77	442.80						
AB18	12/1/1994	1731602.62	6448187.49	457.19	1731602.37	6448187.58	456.93	-0.26	0.09	-0.26	162	0.27	
AB20	3/16/1995	1729360.63	6449686.27	396.43	1729360.00	6449686.03	396.23	-0.62	-0.23	-0.20	201	0.67	
AB24	3/12/1997	1729830.35	6447759.96	335.92	1729829.83	6447759.82	335.74	-0.52	-0.14	-0.18	195	0.54	
AB50	1/16/1998	1728085.00	6448248.18	181.98	1728084.71	6448247.54	182.03	-0.29	-0.65	0.05	245	0.71	
AB51	3/22/2002	1729617.01	6447306.54	305.42	1729616.73	6447306.52	305.25	-0.28	-0.02	-0.17	184	0.28	
AB52	3/22/2002	1730016.10	6448624.44	368.61	1730015.79	6448624.36	368.39	-0.31	-0.08	-0.22	195	0.32	
AB53	3/22/2002	1730431.11	6449712.37	353.13	1730430.77	6449712.33	352.90	-0.34	-0.04	-0.23	187	0.34	
AB54	9/24/2007	1731111.94	6447047.87	407.31	1731111.94	6447047.87	407.31						
AB55	9/24/2007	1731174.77	6447753.57	405.38	1731174.77	6447753.57	405.38						
AB56	9/24/2007	1732214.31	6448545.46	571.65	1732214.31	6448545.46	571.65						
AB57	9/24/2007	1731926.91	6449759.36	564.93	1731926.91	6449759.36	564.93						
AB58	9/24/2007	1731118.02	6449074.93	405.67	1731118.02	6449074.93	405.67						
AB59	9/24/2007	1730850.87	6450212.56	434.37	1730850.87	6450212.56	434.37						
AB60	9/24/2007	1729089.70	6447987.57	179.45	1729089.70	6447987.57	179.45						
AB61	9/24/2007	1727424.50	6447990.26	140.47	1727424.50	6447990.26	140.47						
AB62	11/13/2011	1728910.35	6446925.46	143.01	Replacement for AB06								
AB63	11/13/2011	1729059.30	6447307.03	180.84	Replacement for AB07								
AB64	9/14/2012	1731930.69	6447373.08	532.25	Replacement for AB54								
AB65	9/14/2012	1731705.674	6448264.07	458.53	Replacement for AB18								
AB66	9/14/2012	1730047.285	6448490.53	374.28	Replacement for AB52								
AB67	9/14/2012	1731180.409	6447741.76	405.33	Replacement for AB55								
AB68	9/14/2012	1730258.855	6448055.37	393.45	Replacement for AB15								
BB25	11/4/1998	1727200.54	6449932.73	3.81	1727200.25	6449932.73	4.12	-0.29	-0.01	0.31	183	0.29	
BB52	9/24/2007	1726996.36	6451384.38	3.83	1726996.36	6451384.38	3.83						
BB53	9/24/2007	1726831.16	6451840.89	13.81	1726831.16	6451840.89	13.81						
CR07	11/30/1994	1731628.78	6451203.19	633.28	1731628.37	6451203.29	632.48	-0.41	0.10	-0.80	166	0.42	
CR50	9/24/2007(1998)	1733013.62	6451037.38	872.66	1733013.62	6451037.38	872.66						
CR51	9/24/2007(1998)	1733062.03	6452361.86	976.25	1733062.03	6452361.86	976.25						
CR52	9/24/2007(1998)	1732867.58	6450239.32	779.63	1732867.58	6450239.32	779.63						
CR53	9/14/2012	1732780.275	6450224.19	780.72	Replacement for CR52								
FT06	9/24/2007	1729855.61	6452760.21	489.06	1729855.61	6452760.21	489.06						
FT07	9/24/2007	1729253.24	6454104.75	589.01	1729253.24	6454104.75	589.01						
FT08	9/24/2007	1729388.68	6453350.51	658.44	1729388.68	6453350.51	658.44						
KC01	11/30/1994	1728476.78	6452458.23	312.98	1728476.36	6452457.91	312.42	-0.42	-0.32	-0.46	217	0.52	1
KC02	3/14/1995	1727002.89	6452118.99	13.84	1727002.74	6452118.89	13.74	-0.15	-0.11	-0.10	216	0.18	
KC04	3/14/1995	1727559.56	6452667.24	238.84	1727559.46	6452667.09	238.51	-0.10	-0.15	-0.33	236	0.19	
KC05	11/30/1994	1727082.00	6453179.09	227.86	1727082.01	6453178.94	227.53	0.01	-0.15	-0.33	273	0.15	
KC06	11/30/1994	1727784.91	6453386.67	300.35	1727784.94	6453386.40	299.97	0.03	-0.26	-0.38	276	0.26	
KC07	11/30/1994	1727759.19	6453683.92	313.83	1727759.37	6453683.85	313.51	0.18	-0.07	-0.32	340	0.19	
KC13	9/24/2007	1726581.16	6453069.63	191.20	1726581.16	6453069.63	191.20						
KC14	9/24/2007	1726742.44	6453806.05	259.94	1726742.44	6453806.05	259.94						
KC15	9/24/2007	1727590.45	6453121.10	287.10	1727590.45	6453121.10	287.10						
KC16	9/24/2007	1727602.25	6454098.23	326.90	1727602.25	6454098.23	326.90						
KC17	9/14/2012	1727302.764	6453026.42	215.25	Replacement for KC04								
PB04	11/30/1994	1727675.94	6448851.74	170.52	1727667.25	6448849.17	167.49	-8.69	-2.57	-3.03	196	9.06	
PB06	3/15/1995	1727968.45	6449761.84	183.06	1727941.12	6449758.81	178.35	-27.33	-3.03	-4.81	186	27.50	
PB07	3/14/1995	1728175.93	6450219.76	200.21	1728141.60	6450213.44	198.02	-34.32	-6.32	-2.19	190	34.90	
PB08	12/1/1994	1728237.51	6450469.80	193.68	1728204.81	6450463.98	194.09	-32.70	-5.82	0.41	190	33.21	
PB09	11/30/1994	1728288.58	6450851.02	192.52	1728252.20	6450849.11	189.84	-36.38	-1.91	-2.68	183	36.43	
PB12	11/30/1994	1728330.49	6451604.57	193.29	1728268.52	6451587.83	186.93	-61.97	-16.74	-6.36	195	64.19	
PB13	3/14/1995	1728085.97	6452164.34	210.54	1728050.44	6452151.18	207.21	-35.53	-13.16	-3.33	200	37.89	
PB18	3/15/1995	1730446.88	6450711.00	367.58	1730431.80	6450719.76	363.24	-15.08	8.77	-4.34	150	17.44	
PB20	3/14/1995	1728812.77	6451135.67	243.54	1728753.50	6451126.32	234.48	-59.27	-9.16	-9.06	189	59.97	
PB21	3/14/1995	1729298.22	6451172.05	280.02	1729249.90	6451177.92	273.29	-48.32	5.87	-6.73	173	48.68	
PB25	12/1/1994	1729702.31	6451985.65	328.99	1729671.12	6451986.48	326.10	-31.19	0.83	-2.89	178	31.20	
PB26	3/14/1995	1729562.65	6452249.56	285.34	1729539.22	6452252.23	282.95	-23.42	2.67	-2.39	174	23.58	
PB27	3/14/1995	1729339.34	6451836.06	284.42	1729257.91	6451842.02	273.51	-81.43	5.96	-10.91	176	81.65	
PB29	3/15/1995	1728888.95	6452120.49	185.93	1728849.88	6452097.03	173.39	-39.09	-23.46	-12.54	211	45.58	
PB53	12/4/1997	1729252.77	6450753.92	297.75	1729224.25	6450754.60	291.85	-28.52	0.67	-5.90	179	28.53	
PB54	12/4/1997	1729694.90	6450448.69	359.62	1729691.38	6450448.62	357.73	-3.52	-0.07	-0.99	181	3.52	
PB55	1/21/1998	1728812.28	6450804.04	246.33	1728782.51	6450801.87	241.07	-29.77	-2.18	-5.26	184	29.85	
PB59	6/26/2001	1727766.36	6448661.57	163.39	1727761.30	6448660.42	160.61	-5.07	-1.24	-2.78	194	5.22	
PB62	9/24/2007	1728476.64	6449717.56	287.25	1728476.64	6449717.56	287.25						
PB63	9/24/2007	1727734.04	6451488.11	126.06	1727734.04	6451488.11	126.06						
PB64	11/18/2009	1727466.29	6450946.95	72.76	Replacement for PB63								
PB65	10/25/2010	1728454.67	6449707.82	287.75	Replacement for PB62								
PB66	9/14/2012	1729197.647	6450969.92	288.33	Replacement for PB53								
PB67	4/7/2014	1727638.73	6450850.18	76.01	Replacement for PB64								
U902	7/23/1997	1727501.11	6450133.78	67.15	1727534.46	6450140.57	63.20	-46.66	6.78	-3.95	172	47.15	

PORTUGUESE BEND LANDSLIDE MONITORING - MOVEMENT DATA POSTING as of December 10, 2008

Prepared by McDee Surveying Consulting

FULL ANNUAL MONITORING

Notes:

\# Indicates stable points, not moving

* Indicates no signal of horizontal movement detected in the last period

2 = Hit by mower sometime between 09/07 and 12/08 with an estimated displacement S14E 0.29', the original position is adjusted here to be relative to monitored position used presently, resulting in correct Overall Movements, see Rpt

	Dec. 10, 2008 Positions			Overall Movements (US Feet)						Periodic (14.5 months) Movements (US Feet)						
	NAD83 SPC Zone 5 (Ft)		NAVD88	Original Position to Dec. 10, 2008						Sept. 24, 2007 Position to Dec. 10, 2008						
Point	North (ft)	East (ft)	Elev(ft)	North	East	Height	Azim.°	Dist.	Note	North	East	Height	Azim.°	Dist.	95%Err	Note
AB01	1729427.54	6445709.63	178.59	-0.05	0.02	-0.03	161	0.05	#	-0.01	-0.01	-0.03	231	0.02	0.02	#
AB02	1726946.99	6447968.68	116.46	0.00	-0.01	-0.02	297	0.01	#	0.00	-0.01	-0.02	297	0.01	0.02	#
AB03	1727336.39	6447818.91	139.58	0.04	-0.01	-0.02	348	0.04	#	0.00	0.00	-0.01	270	0.00	0.02	#
AB04	1728390.43	6447121.92	67.27	-1.56	-1.43	-0.30	222	2.12		-0.12	-0.11	-0.04	222	0.16	0.02	
AB05	1728074.86	6447644.04	80.59	-0.86	-1.13	-0.31	233	1.42	2							2
AB06	1729058.49	6446975.88	164.85	-1.24	-0.38	-0.43	197	1.30		-0.09	-0.03	-0.06	198	0.09	0.02	
AB07	1728981.40	6447357.70	159.34	-1.39	-0.71	-0.58	207	1.56		-0.11	-0.04	-0.08	202	0.12	0.02	
AB12	1729415.57	6448271.26	283.19	-0.92	-0.38	-0.24	203	0.99		-0.10	-0.03	0.00	199	0.11	0.02	
AB13	1729928.17	6448235.89	364.54	-0.73	-0.15	-0.49	192	0.74		-0.08	-0.01	0.00	191	0.08	0.02	
AB15	1730311.56	6448099.30	398.88	-0.53	-0.08	-0.40	189	0.53		-0.08	-0.01	-0.02	188	0.08	0.02	
AB16	1730358.65	6447532.17	376.46	-0.24	0.05	-0.16	168	0.24		-0.05	0.01	0.02	170	0.05	0.02	
AB17	1731421.12	6446727.77	442.79	0.00	0.00	-0.01	194	0.00	#	0.00	0.00	-0.01	194	0.00	0.02	#
AB18	1731602.31	6448187.61	456.91	-0.32	0.11	-0.28	160	0.34		-0.06	0.03	-0.02	155	0.07	0.02	
AB20	1729359.84	6449685.99	396.23	-0.79	-0.28	-0.20	199	0.83		-0.16	-0.04	0.00	195	0.17	0.01	
AB24	1729829.75	6447759.77	335.76	-0.61	-0.19	-0.16	197	0.63		-0.09	-0.04	0.02	205	0.10	0.02	
AB30	1728084.66	6448247.47	181.98	-0.34	-0.71	0.00	245	0.79		-0.05	-0.07	-0.05	235	0.08	0.02	
AB31	1729616.65	6447306.51	305.26	-0.36	-0.03	-0.16	185	0.36		-0.09	-0.01	0.01	190	0.09	0.02	
AB32	1730015.70	6448624.32	388.38	-0.40	-0.12	-0.23	196	0.42		-0.10	-0.03	-0.01	200	0.10	0.03	
AB33	1730430.62	6449712.30	352.90	-0.49	-0.07	-0.23	188	0.50		-0.15	-0.03	0.00	189	0.15	0.03	
AB34	1731111.93	6447047.87	407.30	-0.01	0.00	-0.01	165	0.01	*	-0.01	0.00	-0.01	165	0.01	0.03	*
AB35	1731174.72	6447753.58	405.39	-0.05	0.01	0.01	166	0.05		-0.05	0.01	0.01	166	0.05	0.02	
AB36	1732214.21	6448545.49	571.64	-0.10	0.03	-0.01	161	0.11		-0.10	0.03	-0.01	161	0.11	0.02	
AB37	1731926.78	6449759.40	564.90	-0.13	0.03	-0.03	166	0.13		-0.13	0.03	-0.03	166	0.13	0.02	
AB38	1731117.90	6449074.93	405.65	-0.12	0.00	-0.02	178	0.12		-0.12	0.00	-0.02	178	0.12	0.02	
AB39	1730850.70	6450212.53	434.35	-0.17	-0.02	-0.02	188	0.17		-0.17	-0.02	-0.02	188	0.17	0.02	
AB60	1729089.63	6447987.54	179.39	-0.08	-0.03	-0.06	200	0.08		-0.08	-0.03	-0.06	200	0.08	0.02	
AB61	1727424.49	6447990.27	140.43	-0.01	0.01	-0.04	114	0.01	*	-0.01	0.01	-0.04	114	0.01	0.00	#
BB25	1727200.25	6449932.58	4.15	-0.29	-0.16	0.34	208	0.33		0.00	-0.15	0.03	269	0.15	0.02	
BB52	1726996.24	6451384.35	3.83	-0.12	-0.03	0.00	194	0.13		-0.12	-0.03	0.00	194	0.13	0.02	
BB53	Destroyed															
CR07	1731628.24	6451203.32	632.36	-0.54	0.13	-0.92	166	0.55		-0.13	0.03	-0.12	168	0.13	0.02	
CR50	1733013.62	6451037.38	872.71	0.01	0.01	0.05	45	0.01		0.01	0.01	0.05	45	0.01	0.02	*
CR51	1733062.02	6452361.86	976.24	-0.01	0.00	-0.01	171	0.01		-0.01	0.00	-0.01	171	0.01	0.02	*
CR52	1732867.58	6450239.31	779.64	0.00	-0.01	0.01	258	0.01		0.00	-0.01	0.01	258	0.01	0.02	*
FT06	1729055.42	6452760.17	488.97	-0.19	-0.04	-0.09	192	0.19		-0.19	-0.04	-0.09	192	0.19	0.03	
FT07	1729253.01	6454104.39	588.99	-0.23	-0.36	-0.02	237	0.43		-0.23	-0.36	-0.02	237	0.43	0.02	
FT08	1729388.67	6453350.53	658.47	-0.01	0.02	0.03	114	0.02		-0.01	0.02	0.03	114	0.02	0.02	*
KC01	1728476.25	6452457.85	312.38	-0.53	-0.38	-0.50	215	0.66	1	-0.12	-0.06	-0.04	208	0.13	0.02	
KC02	1727002.67	6452118.88	13.72	-0.22	-0.11	-0.12	207	0.25		-0.07	-0.01	-0.02	185	0.07	0.02	
KC04	1727559.42	6452667.06	238.47	-0.14	-0.18	-0.37	233	0.23		-0.04	-0.04	-0.04	223	0.05	0.02	
KC05	1727081.98	6453178.94	227.52	-0.02	-0.15	-0.34	261	0.15		-0.03	0.00	-0.01	180	0.03	0.02	
KC06	1727784.92	6453396.36	299.93	0.01	-0.30	-0.42	273	0.30		-0.01	-0.04	-0.04	252	0.05	0.02	
KC07	1727759.38	6453683.87	313.50	0.18	-0.05	-0.33	346	0.19		0.00	0.02	-0.01	84	0.02	0.02	*
KC13	1726581.12	6453069.62	191.23	-0.04	-0.01	0.03	194	0.04		-0.04	-0.01	0.03	194	0.04	0.02	
KC14	1726742.44	6453806.04	259.91	0.00	-0.02	-0.03	259	0.02	*	0.00	-0.02	-0.03	259	0.02	0.02	*
KC15	1727590.41	6453121.06	287.13	-0.05	-0.04	0.03	220	0.06		-0.05	-0.04	0.03	220	0.06	0.02	
KC16	1727602.24	6454098.24	326.92	-0.01	0.00	0.02	135	0.01	*	-0.01	0.00	0.02	135	0.01	0.02	*
PB04	1727666.83	6448849.07	167.37	-9.10	-2.67	-3.15	196	9.49		-0.41	-0.10	-0.12	194	0.43	0.02	
PB06	1727939.65	6449758.62	177.96	-28.80	-3.22	-5.10	196	28.98		-1.47	-0.18	-0.29	187	1.48	0.02	
PB07	1728139.83	6450313.09	197.88	-36.10	-6.67	-2.33	190	36.72		-1.78	-0.35	-0.14	191	1.82	0.02	
PB08	1728203.20	6450463.68	194.13	-34.31	-6.12	0.45	190	34.85		-1.61	-0.30	0.04	190	1.64	0.02	
PB09	1728250.32	6450848.98	189.58	-38.26	-2.04	-2.94	183	38.31		-1.88	-0.13	-0.26	184	1.88	0.02	
PB12	1728265.36	6451586.01	186.31	-65.13	-17.76	-6.98	195	67.51		-3.16	-1.03	-0.62	198	3.32	0.02	
PB13	1728048.48	6452159.38	207.09	-37.49	-13.96	-3.45	200	40.01		-1.96	-0.80	-0.12	202	2.12	0.02	
PB18	1730431.47	6450719.84	363.19	-15.41	8.85	-4.40	150	17.77		-0.33	0.08	-0.06	166	0.34	0.02	
PB20	1728759.65	6451126.05	233.99	-62.12	-9.63	-9.55	189	62.86		-2.85	-0.47	-0.49	189	2.89	0.02	
PB21	1729247.73	6451178.08	273.02	-50.49	6.03	-7.00	173	50.85		-2.17	0.16	-0.27	176	2.17	0.02	
PB25	1729670.88	6451986.42	326.07	-31.44	0.77	-2.92	179	31.45		-0.25	-0.07	-0.03	195	0.26	0.02	
PB26	1729539.03	6452252.21	282.94	-23.62	2.65	-2.40	174	23.77		-0.20	-0.02	-0.01	187	0.20	0.02	
PB27	1729254.41	6451842.14	272.98	-84.93	6.08	-11.44	176	85.15		-3.50	0.13	-0.53	178	3.50	0.02	
PB29	1728847.75	6452096.03	172.60	-41.20	-24.46	-13.33	211	47.91		-2.11	-1.01	-0.69	205	2.34	0.02	
PB53	1729222.48	6450754.60	291.44	-30.29	0.69	-6.31	179	30.29		-1.76	0.00	-0.41	180	1.76	0.02	
PB54	1729691.20	6450448.59	357.73	-3.70	-0.11	-0.89	182	3.70		-0.18	-0.04	0.00	193	0.18	0.02	
PB55	1728780.51	6450801.66	240.62	-31.77	-2.38	-5.71	184	31.86		-2.01	-0.21	-0.45	186	2.02	0.03	
PB59	1727760.70	6449660.26	160.34	-5.66	-1.39	-3.05	194	5.83		-0.59	-0.15	-0.27	194	0.61	0.02	
PB62	1728476.42	6449717.52	207.22	-0.21	-0.04	-0.03	192	0.22		-0.21	-0.04	-0.03	192	0.22	0.02	
PB63	1727724.58	6451485.79	121.78	-9.45	-2.32	-4.28	194	9.73		-9.45	-2.32	-4.28	194	9.73	0.02	
UB02	1727530.48	6450141.10	63.00	-50.63	7.31	-4.15	172	51.16		-3.97	0.53	-0.20	172	4.01	0.02	

PORTUGUESE BEND LANDSLIDE MONITORING - MOVEMENT DATA POSTING as of November 18, 2009

Prepared by McGee Surveying Consulting

FULL ANNUAL MONITORING

Notes:
# Indicates stable points, not moving
* Indicates no signal of horizontal movement detected in the last period

	Nov. 18, 2009 Positions			Overall Movements (US Feet)						Periodic (11.3 months) Movements (US Feet)						
	NAD83 SPC Zone 5 (Ft)		NAVD88	Original Position to Nov. 18, 2009						Dec. 10, 2008 Position to Nov. 18, 2009						
Point	North (ft)	East (ft)	Elev(ft)	North	East	Height	Azim.°	Dist.	Note	North	East	Height	Azim.°	Dist.	95%Err	Note
AB01	1729427.54	6445709.62	178.540	-0.04	0.01	-0.08	167	0.04		0.00	-0.01	-0.05	304	0.01	0.02	#
AB02	1726946.97	6447968.68	116.460	-0.02	0.00	-0.02	198	0.02	*	-0.02	0.00	0.00	171	0.02	0.02	#
AB03	1727338.38	6447818.92	139.570	0.04	0.00	-0.03	4	0.04		-0.01	0.01	-0.01	117	0.01	0.02	#
AB04	1728390.36	6447121.86	67.250	-1.63	-1.48	-0.32	222	2.20		-0.08	-0.08	-0.02	226	0.11	0.02	
AB05	1728074.78	6447643.96	80.570	-0.94	-1.21	-0.33	232	1.53		-0.06	-0.01	-0.01	191	0.06	0.02	
AB06	1729058.43	6446975.87	164.840	-1.31	-0.39	-0.44	197	1.36		-0.05	-0.03	-0.01	207	0.06	0.02	
AB07	1728981.35	6447357.67	159.330	-1.44	-0.74	-0.59	207	1.62		-0.07	-0.03	0.00	202	0.07	0.02	
AB12	1729415.50	6448271.24	283.190	-0.98	-0.41	-0.24	203	1.07		-0.04	-0.02	0.00	201	0.04	0.02	
AB13	1729928.13	6448235.87	364.540	-0.77	-0.16	-0.49	192	0.78		-0.05	0.00	0.00	180	0.05	0.03	
AB15	1730311.51	6448099.30	398.880	-0.57	-0.08	-0.40	188	0.58		-0.01	-0.01	-0.01	303	0.02	0.02	*
AB16	1730358.64	6447532.17	376.450	-0.25	0.04	-0.17	170	0.25		-0.01	-0.01	-0.01	303	0.02	0.02	#
AB17	1731431.11	6446727.77	442.800	-0.01	0.00	0.00	186	0.01	*	0.00	0.00	0.01	180	0.00	0.02	#
AB18	1731602.26	6448187.60	456.870	-0.36	0.11	-0.32	163	0.38		-0.04	-0.01	-0.04	189	0.04	0.03	
AB20	1729359.78	6449685.97	396.230	-0.85	-0.30	-0.20	199	0.90		-0.06	-0.02	0.00	200	0.06	0.01	
AB24	1729829.68	6447759.75	335.760	-0.67	-0.21	-0.16	197	0.70		-0.06	-0.02	0.00	198	0.07	0.02	
AB30	1728084.64	6448247.44	182.000	-0.36	-0.74	0.02	244	0.83		-0.02	-0.03	0.02	238	0.04	0.03	
AB31	1729616.60	6447306.48	305.250	-0.41	-0.06	-0.17	188	0.41		-0.04	-0.02	-0.01	208	0.05	0.02	
AB32	1730015.65	6448624.32	368.350	-0.45	-0.12	-0.26	195	0.47		-0.05	0.00	-0.03	181	0.05	0.03	
AB33	1730430.55	6449712.28	352.890	-0.55	-0.09	-0.24	189	0.56		-0.06	-0.02	-0.01	198	0.06	0.03	
AB34	1731111.92	6447047.87	407.360	-0.03	0.00	0.05	178	0.03	*	-0.02	0.00	0.06	187	0.02	0.03	*
AB35	1731174.68	6447753.58	405.390	-0.09	0.02	0.01	169	0.09		-0.04	0.01	0.00	171	0.04	0.02	
AB36	1732214.16	6448545.51	571.690	-0.15	0.05	0.04	162	0.16		-0.05	0.02	0.05	164	0.05	0.02	
AB37	1731926.73	6449759.41	564.860	-0.18	0.04	-0.07	166	0.18		-0.05	0.01	-0.04	167	0.05	0.02	
AB38	1731117.85	6449074.94	405.640	-0.17	0.01	-0.03	175	0.17		-0.05	0.01	-0.01	168	0.05	0.02	
AB39	1730850.64	6450212.52	434.340	-0.23	-0.03	-0.03	188	0.23		-0.04	-0.01	0.00	196	0.05	0.02	
AB60	1729089.58	6447987.53	179.390	-0.12	-0.04	-0.06	199	0.13		-0.04	-0.01	-0.01	190	0.06	0.02	
AB61	1727424.49	6447990.27	140.420	-0.01	0.01	-0.05	128	0.02	*	0.00	0.00	-0.01	158	0.01	0.00	#
BB25	1727200.19	6449932.57	4.210	-0.35	-0.16	0.40	204	0.39		-0.06	0.00	0.06	183	0.06	0.02	
BB52	1726996.18	6451384.34	3.860	-0.18	-0.04	0.03	193	0.19		-0.06	-0.01	0.03	191	0.06	0.03	
CR07	1731628.18	6451203.34	632.390	-0.60	0.15	-0.89	166	0.62		-0.06	0.02	0.03	161	0.07	0.02	
CR50	1733013.61	6451037.39	872.690	-0.01	0.01	0.03	119	0.01		-0.01	0.00	-0.02	162	0.02	0.02	*
CR51	1733062.01	6452361.87	976.220	-0.02	0.01	-0.03	155	0.03		-0.01	0.01	-0.02	143	0.03	0.02	*
CR52	1732067.56	6450239.31	779.730	-0.02	-0.01	0.10	217	0.02	*	-0.01	0.00	0.09	176	0.01	0.03	*
FT06	1729855.34	6452760.16	488.920	-0.27	-0.05	-0.14	191	0.28		-0.08	-0.01	-0.05	189	0.08	0.02	
FT07	1729252.92	6454104.25	588.900	-0.33	-0.51	-0.11	237	0.60		-0.10	-0.14	-0.09	236	0.17	0.02	
FT08	1729388.69	6453350.52	658.480	0.00	0.02	0.04	74	0.02	*	0.01	0.00	0.01	340	0.01	0.03	#
KC01	1728476.18	6452457.91	312.350	-0.60	-0.42	-0.53	215	0.74		-0.07	-0.04	-0.03	209	0.08	0.02	
KC02	1727002.64	6452118.86	13.690	-0.26	-0.13	-0.15	207	0.29		-0.03	-0.02	-0.02	216	0.04	0.02	
KC04	1727539.39	6452667.04	238.450	-0.17	-0.20	-0.39	231	0.27		-0.01	-0.02	-0.01	244	0.03	0.02	
KC05	1727081.97	6453178.92	327.510	-0.03	-0.17	-0.35	259	0.18		-0.02	-0.03	-0.02	227	0.04	0.03	
KC06	1727784.90	6453396.33	299.910	-0.01	-0.33	-0.44	268	0.33		0.00	0.00	-0.03	256	0.00	0.02	*
KC07	1727759.37	6453683.87	313.470	0.18	-0.05	-0.36	344	0.19		-0.01	0.00	-0.05	153	0.01	0.02	*
KC13	1726581.11	6453069.63	191.180	-0.04	-0.01	-0.02	198	0.04		-0.01	0.00	-0.01	247	0.01	0.02	*
KC14	1726743.43	6453806.03	259.920	-0.01	-0.03	-0.02	253	0.03	*	0.00	-0.01	0.01	247	0.01	0.02	*
KC15	1727590.38	6453121.03	287.090	-0.07	-0.06	-0.01	222	0.09		-0.02	-0.02	-0.04	226	0.03	0.03	
KC16	1727602.24	6454098.24	326.870	-0.01	0.00	-0.03	159	0.01	*	0.00	0.00	-0.05	214	0.00	0.02	#
PB04	1727666.56	6448848.99	167.310	-9.38	-2.75	-3.21	196	9.77		-0.27	-0.07	-0.06	195	0.28	0.02	
PB06	1727938.80	6449758.52	177.820	-29.65	-3.32	-5.24	186	29.83		-0.85	-0.10	-0.14	187	0.85	0.02	
PB07	1728138.83	6450212.89	197.800	-37.09	-6.86	-2.41	190	37.72		-0.99	-0.19	-0.08	191	1.01	0.02	
PB08	1728202.31	6450463.52	194.120	-35.20	-6.28	0.44	190	35.75		-0.89	-0.16	-0.01	190	0.90	0.02	
PB09	1728249.30	6450848.91	189.460	-39.28	-2.11	-3.06	183	39.34		-1.02	-0.07	-0.12	184	1.02	0.02	
PB12	1728263.70	6451586.25	185.940	-66.79	-18.32	-7.35	195	69.25		-1.66	-0.35	-0.37	199	1.75	0.02	
PB13	1728047.43	6452149.98	206.980	-38.54	-14.36	-3.56	200	41.13		-1.05	-0.41	-0.11	201	1.12	0.02	
PB18	1730431.35	6450719.86	363.140	-15.53	8.87	-4.44	150	17.89		-0.12	0.02	-0.04	170	0.12	0.02	
PB20	1728749.18	6451125.82	233.690	-63.59	-9.86	-9.85	189	64.35		-1.47	-0.23	-0.30	189	1.49	0.02	
PB21	1729246.60	6451178.17	272.840	-51.62	5.12	-7.18	173	51.98		-1.13	0.09	-0.18	175	1.14	0.02	
PB25	1729670.78	6451986.39	326.040	-31.53	0.74	-2.95	179	31.54		-0.09	-0.02	-0.03	194	0.10	0.02	
PB26	1729538.93	6452252.19	282.930	-23.71	2.63	-2.41	174	23.86		-0.09	-0.02	-0.01	190	0.10	0.02	
PB27	1729252.59	6451842.20	272.730	-86.75	6.14	-11.69	176	86.97		-1.82	0.06	-0.25	178	1.82	0.03	
PB29	1728846.62	6452095.51	172.230	-42.32	-24.98	-13.70	211	49.15		-1.13	-0.52	-0.37	205	1.24	0.02	
PB53	1729221.54	6450754.61	291.200	-31.22	0.68	-6.55	179	31.23		-0.94	0.01	-0.24	180	0.94	0.03	
PB54	1729691.12	6450448.57	357.710	-3.78	-0.12	-0.91	182	3.78		-0.08	-0.01	-0.02	188	0.08	0.02	
PB55	1728779.41	6450801.58	240.500	-32.87	-2.47	-5.83	184	32.97		-1.10	-0.08	-0.12	184	1.10	0.03	
PB59	1727760.31	6448660.19	160.160	-6.05	-1.48	-3.23	194	6.23		-0.39	-0.09	-0.18	193	0.40	0.02	
PB62	1728476.31	6449717.49	287.200	-0.32	-0.07	-0.05	192	0.33		-0.11	-0.02	-0.02	193	0.11	0.02	
PB63	1727717.72	6451483.29	116.990	-16.31	-4.82	-9.07	196	17.01		-6.86	-2.30	-4.79	300	7.30	0.02	
PB64	1727466.29	6450946.95	72.760	Replacement for PB63												
UB02	1727527.87	6450141.46	62.920	-53.24	7.67	-4.23	172	53.79		-2.61	0.36	-0.08	172	2.64	0.02	

PORTUGUESE BEND LANDSLIDE MONITORING - MOVEMENT DATA POSTING as of October 25, 2010

Prepared by McGee Surveying Consulting

FULL ANNUAL MONITORING

Notes:

* Indicates no signal of horizontal movement detected in the last period

	Oct. 25, 2010 Positions			Overall Movements (US Feet)						Periodic (11.1 months) Movements (US Feet)						
	NAD83 SPC Zone 5 (Ft)		NAVD88	Original Position to Oct. 25, 2010						Nov. 18, 2009 Position to Oct. 25, 2010						
Point	North (ft)	East (ft)	Elev(ft)	North	East	Height	Azim.°	Dist.	Note	North	East	Height	Azim.°	Dist.	95%Err	Note
AB01	1729427.53	6445709.61	178.52	-0.05	-0.01	-0.10	187	0.05		-0.01	-0.02	-0.02	241	0.02	0.03	*
AB02	1726946.97	6447968.66	116.45	-0.02	-0.03	-0.03	243	0.03	*	0.00	-0.02	-0.01	270	0.02	0.02	*
AB03	Discontinued															
AB04	1728390.27	6447121.79	67.25	-1.72	-1.56	-0.32	222	2.32		-0.09	-0.08	0.00	220	0.12	0.02	
AB05	1728074.67	6447643.89	80.53	-1.05	-1.28	-0.37	231	1.66		-0.12	-0.07	-0.04	211	0.14	0.03	
AB06	1729058.36	6446975.83	164.82	-1.37	-0.43	-0.46	197	1.44		-0.07	-0.03	-0.02	207	0.07	0.03	
AB07	1728981.28	6447357.64	159.31	-1.51	-0.77	-0.61	207	1.70		-0.07	-0.03	-0.02	207	0.08	0.03	
AB12	1729415.46	6448271.20	283.20	-1.03	-0.44	-0.23	203	1.12		-0.04	-0.04	0.01	219	0.06	0.02	
AB13	1729928.09	6448235.85	364.53	-0.81	-0.19	-0.30	193	0.83		-0.04	-0.02	-0.01	208	0.05	0.02	
AB15	1730311.47	6448099.25	396.86	-0.62	-0.14	-0.42	192	0.63		-0.04	-0.05	-0.02	232	0.07	0.02	
AB16	1730358.61	6447532.16	376.46	-0.20	0.03	-0.16	173	0.28		-0.03	-0.01	0.01	197	0.03	0.03	*
AB17	1731421.10	6446727.76	442.80	-0.02	-0.01	0.00	205	0.02		-0.01	-0.01	0.00	217	0.01	0.02	*
AB18	1731602.22	6448187.61	456.82	-0.40	0.12	-0.37	164	0.42		-0.04	0.01	-0.05	165	0.04	0.03	
AB20	1729359.72	6449685.94	396.23	-0.90	-0.32	-0.20	200	0.96		-0.06	-0.02	0.00	203	0.06	0.01	
AB24	1729829.65	6447759.73	335.77	-0.71	-0.23	-0.15	198	0.75		-0.04	-0.02	0.01	212	0.04	0.02	
AB50	1728084.62	6448247.38	182.00	-0.38	-0.80	0.02	244	0.89		-0.02	-0.06	0.00	247	0.06	0.03	
AB51	1729616.56	6447306.49	305.24	-0.45	-0.05	-0.18	186	0.45		-0.05	0.01	-0.01	172	0.05	0.02	
AB52	1730015.61	6448624.30	368.38	-0.49	-0.14	-0.23	196	0.51		-0.04	-0.02	0.03	209	0.04	0.04	
AB53	1730430.49	6449712.26	352.91	-0.61	-0.11	-0.22	190	0.62		-0.06	-0.02	0.02	196	0.07	0.03	
AB54	1731111.92	6447047.87	407.34	-0.02	0.00	0.03	102	0.02		0.00	0.00	-0.02	326	0.00	0.04	*
AB55	1731174.66	6447753.58	405.40	-0.11	0.02	0.02	171	0.11		-0.02	0.00	0.01	183	0.02	0.02	*
AB56	1732214.12	6448545.51	371.63	-0.19	0.05	-0.02	165	0.20		-0.04	0.00	-0.06	179	0.04	0.03	
AB57	1731926.67	6449759.42	564.92	-0.23	0.06	-0.01	165	0.24		-0.05	0.01	0.06	164	0.06	0.03	
AB58	1731117.80	6449074.93	495.69	-0.22	0.00	0.02	180	0.22		-0.05	-0.01	0.05	196	0.05	0.03	
AB59	1730850.56	6450212.51	434.35	-0.31	-0.04	-0.02	188	0.31		-0.08	-0.01	0.01	185	0.08	0.03	
AB60	1729089.53	6447987.50	179.42	-0.17	-0.07	-0.03	201	0.18		-0.05	-0.02	0.03	207	0.06	0.03	
AB61	1727424.48	6447990.27	140.47	-0.02	0.01	0.00	150	0.02	*	-0.01	0.00	0.05	193	0.01	0.00	*
BB25	Discontinued															
BB52	1726996.13	6451384.34	3.85	-0.23	-0.04	0.02	190	0.24		-0.05	0.00	-0.01	180	0.05	0.03	
BB53	Destroyed															
CR07	1731628.12	6451203.32	632.33	-0.56	0.13	-0.95	169	0.67		-0.06	-0.02	-0.06	202	0.06	0.03	
CR50	1733013.59	6451037.17	872.67	-0.03	0.00	0.01	184	0.03		-0.02	-0.02	-0.02	217	0.03	0.02	
CR51	1733062.01	6452361.88	976.18	-0.02	0.02	-0.07	144	0.03		0.00	0.01	-0.04	98	0.01	0.03	*
CR52	1732847.55	6450239.31	779.65	-0.03	-0.01	0.02	207	0.03	*	-0.01	0.00	-0.08	186	0.01	0.03	*
FT06	1729855.25	6452760.13	488.89	-0.35	-0.08	-0.17	193	0.36		-0.08	-0.03	-0.03	199	0.09	0.02	
FT07	1729252.76	6454104.00	588.85	-0.49	-0.75	-0.16	237	0.90		-0.16	-0.25	-0.05	237	0.30	0.03	
FT08	1729388.66	6453350.51	658.43	-0.02	0.00	-0.01	166	0.02	*	-0.02	-0.01	-0.05	206	0.03	0.03	*
KC01	1728476.12	6452457.77	312.38	-0.47	-0.46	-0.50	215	0.81		-0.06	-0.04	0.03	216	0.07	0.02	
KC02	1727002.62	6452118.86	13.72	-0.28	-0.14	-0.12	206	0.31		-0.02	-0.01	0.03	197	0.02	0.03	*
KC04	1727559.36	6452667.01	230.44	-0.20	-0.23	-0.40	229	0.30		-0.03	-0.02	-0.01	215	0.04	0.03	
KC05	1727081.96	6453178.92	227.47	-0.04	-0.17	-0.39	256	0.18		-0.01	0.00	-0.04	180	0.01	0.03	*
KC06	1727784.89	6453396.32	299.89	-0.02	-0.35	-0.46	266	0.35		-0.01	-0.02	-0.02	233	0.02	0.03	*
KC07	1727759.39	6453683.87	313.47	0.19	-0.04	-0.36	347	0.20		0.01	0.01	0.00	32	0.01	0.03	*
KC13	1726581.08	6453069.61	191.18	-0.07	-0.02	-0.02	195	0.08		-0.03	-0.01	0.00	204	0.03	0.02	
KC14	1726742.43	6453806.02	259.89	-0.01	-0.03	-0.05	258	0.03	*	0.00	0.00	-0.03	333	0.00	0.04	*
KC15	1727590.38	6453121.02	287.10	-0.07	-0.07	0.00	227	0.10		0.00	-0.01	0.01	265	0.01	0.03	*
KC16	1727602.23	6454090.24	326.88	-0.02	0.01	-0.02	148	0.02	*	-0.01	0.01	0.01	139	0.01	0.02	*
PB04	1727665.94	6448848.86	167.11	-9.99	-2.88	-3.41	196	10.40		-0.62	-0.13	-0.20	192	0.63	0.03	
PB06	1727937.25	6449758.35	177.58	-31.19	-3.49	-5.48	186	31.39		-1.55	-0.17	-0.24	186	1.56	0.03	
PB07	1728127.09	6450212.59	197.66	-38.93	-7.18	-2.55	190	39.58		-1.83	-0.32	-0.14	190	1.86	0.03	
PB08	1728200.66	6450463.24	194.16	-36.85	-6.56	0.48	190	37.43		-1.65	-0.28	0.04	190	1.67	0.03	
PB09	1728247.35	6450848.79	189.24	-41.23	-2.24	-3.28	183	41.29		-1.95	-0.13	-0.22	184	1.95	0.03	
PB12	1728260.50	6451585.29	185.30	-89.99	-19.28	-7.99	195	72.60		-3.20	-0.96	-0.64	197	3.35	0.03	
PB13	1728045.47	6452149.17	206.87	-40.50	-15.17	-3.67	201	43.25		-1.96	-0.81	-0.11	202	2.12	0.03	
PB18	1730431.24	6450719.88	363.10	-15.54	8.89	-4.48	150	17.99		-0.11	0.02	-0.04	169	0.11	0.02	
PB20	1729746.32	6451125.33	233.20	-66.45	-10.35	-10.34	189	67.25		-2.86	-0.49	-0.49	190	2.91	0.04	
PB21	1729244.44	6451178.35	272.60	-53.78	6.30	-7.42	173	54.14		-2.15	0.18	-0.24	175	2.16	0.03	
PB25	1729670.68	6451986.36	326.01	-31.64	0.71	-2.98	179	31.64		-0.10	-0.03	-0.03	196	0.11	0.02	
PB26	1729538.86	6452252.16	282.99	-23.79	2.60	-2.35	174	23.93		-0.08	-0.03	0.06	200	0.09	0.03	
PB27	1729249.12	6451842.31	272.17	-90.22	6.25	-12.25	176	90.44		-3.47	0.11	-0.56	178	3.47	0.03	
PB29	1728844.53	6452094.53	171.59	-44.42	-25.96	-14.34	210	51.45		-2.10	-0.97	-0.64	205	2.31	0.03	
PB53	1729219.01	6450754.71	290.67	-32.96	0.78	-7.08	179	32.97		-1.73	0.10	-0.53	177	1.74	0.03	
PB54	1729691.04	6450449.55	357.73	-3.86	-0.13	-0.89	192	3.87		-0.09	-0.02	0.02	191	0.09	0.03	
PB55	1728777.36	6450801.45	240.18	-34.92	-2.59	-6.15	184	35.02		-2.05	-0.13	-0.32	184	2.05	0.04	
PB59	1727759.39	6448659.97	159.70	-6.98	-1.69	-3.69	194	7.18		-0.93	-0.21	-0.47	193	0.95	0.03	
PB62	Destroyed															
PB63	Destroyed															
PB64	1727439.04	6450942.07	89.69	-27.25	-4.88	-3.08	190	27.68		-27.25	-4.88	-3.08	190	27.68	0.03	
PB65	1728454.67	6449707.82	287.75	Replacement for PB62												
UB02	1727522.77	6450142.13	62.75	-58.34	8.34	-4.40	172	58.94		-5.10	0.67	-0.17	173	5.14	0.03	

PORTUGUESE BEND LANDSLIDE MONITORING - MOVEMENT DATA POSTING as of October 03, 2011

Prepared by McGee Surveying Consulting

FULL ANNUAL MONITORING

Notes:

* Indicates no signal of horizontal movement detected in the last period

	Oct. 03, 2011 Positions			Overall Movements (US Feet)						Periodic (11.3 months) Movements (US Feet)						
	NAD83 SPC Zone 5 (Ft)		NAVD88	Original Position to Oct. 03, 2011						Oct. 25, 2010 Position to Oct. 03, 2011						
Point	North (ft)	East (ft)	Elev(ft)	North	East	Height	Azim.°	Dist.	Note	North	East	Height	Azim.°	Dist.	95%Err	Note
AB01	1729427.55	6445709.59	178.50	-0.04	-0.02	-0.12	213	0.04		0.02	-0.02	-0.02	313	0.02	0.03	*
AB02	1726946.97	6447960.70	116.45	-0.01	0.01	-0.03	124	0.01		0.01	0.04	0.00	81	0.04	0.02	
AB04	1728390.04	6447121.39	67.21	-1.95	-1.75	-0.36	222	2.62		-0.23	-0.20	-0.03	221	0.30	0.02	
AB05	1728074.57	6447643.73	80.49	-1.15	-1.45	-0.41	232	1.84		-0.09	-0.16	-0.04	240	0.19	0.03	
AB06	1729050.21	6446975.77	164.77	-1.53	-0.49	-0.51	198	1.60		-0.15	-0.06	-0.05	202	0.17	0.03	
AB07	1728981.13	6447357.52	159.24	-1.66	-0.89	-0.68	208	1.88		-0.15	-0.12	-0.06	218	0.19	0.04	
AB12	1729415.28	6448271.12	283.19	-1.21	-0.52	-0.24	203	1.32		-0.18	-0.08	-0.01	204	0.20	0.03	
AB13	1729927.96	6448235.79	364.50	-0.93	-0.25	-0.53	195	0.97		-0.12	-0.06	-0.03	205	0.14	0.03	
AB15	1730311.37	6448099.26	396.87	-0.72	-0.13	-0.41	190	0.73		-0.10	0.01	0.00	174	0.10	0.03	
AB16	1730350.55	6447532.15	376.44	-0.34	0.03	-0.18	175	0.34		-0.06	0.00	-0.02	185	0.06	0.03	
AB17	1731421.09	6446727.74	442.78	-0.03	-0.04	-0.02	228	0.05		-0.01	-0.03	-0.02	246	0.03	0.04	*
AB18	1731602.16	6446187.62	456.84	-0.46	0.13	-0.35	165	0.48		-0.06	0.01	0.01	173	0.06	0.03	
AB20	1729359.56	6449685.89	396.23	-1.07	-0.38	-0.20	200	1.13		-0.16	-0.06	0.00	199	0.17	0.03	
AB24	1729829.52	6447759.68	335.77	-0.84	-0.28	-0.15	198	0.88		-0.13	-0.04	0.01	200	0.13	0.02	
AB50	1728084.56	6448247.27	182.01	-0.44	-0.92	0.03	244	1.02		-0.06	-0.11	0.02	243	0.13	0.03	
AB51	1729616.46	6447306.45	305.17	-0.55	-0.09	-0.25	189	0.56		-0.10	-0.04	-0.07	200	0.11	0.03	
AB52	1730015.49	6448624.26	368.35	-0.61	-0.18	-0.26	197	0.64		-0.12	-0.04	-0.03	200	0.13	0.04	
AB53	1730430.36	6449712.24	352.87	-0.75	-0.13	-0.26	190	0.76		-0.14	-0.02	-0.04	189	0.14	0.03	
AB54	1731111.92	6447047.87	407.31	-0.02	0.01	0.00	164	0.03	*	0.00	0.01	-0.02	97	0.01	0.03	*
AB55	1731174.61	6447753.58	405.37	-0.15	0.02	-0.01	173	0.16		-0.04	0.00	-0.03	179	0.04	0.03	
AB56	1732214.00	6448545.55	571.57	-0.31	0.09	-0.08	164	0.32		-0.12	0.04	-0.06	162	0.12	0.03	
AB57	1731926.54	6449759.46	564.83	-0.37	0.09	-0.10	166	0.38		-0.14	0.03	-0.10	166	0.14	0.03	
AB58	1731117.67	6449074.94	405.64	-0.35	0.00	-0.03	179	0.35		-0.13	0.00	-0.05	178	0.13	0.04	
AB59	1730850.40	6450212.51	434.27	-0.47	-0.05	-0.10	186	0.47		-0.16	-0.01	-0.07	182	0.16	0.03	
AB60	1729089.38	6447987.45	179.39	-0.32	-0.12	-0.06	200	0.34		-0.15	-0.05	-0.03	199	0.16	0.03	
AB61	1727424.48	6447990.26	140.43	-0.02	0.00	-0.04	177	0.02	*	0.00	-0.01	-0.04	259	0.01	0.01	*
AB62	1728910.35	6446925.46	143.01	Replacement for AB06												
AB63	1729059.30	6447307.03	180.84	Replacement for AB07												
BM52	1726995.98	6451384.33	3.89	-0.38	-0.06	0.06	188	0.39		-0.15	-0.01	0.04	185	0.15	0.03	
CR07	1731628.00	6451203.34	632.26	-0.78	0.15	-1.02	169	0.79		-0.12	0.02	-0.07	171	0.12	0.03	
CR50	1733013.59	6451037.37	872.65	-0.03	-0.01	-0.01	197	0.03		0.00	-0.01	-0.02	234	0.01	0.03	*
CR51	1733062.00	6452361.87	976.18	-0.04	0.01	-0.07	164	0.04		-0.01	-0.01	0.00	216	0.01	0.03	*
CR52	1732867.53	6450239.26	779.68	-0.05	-0.06	0.05	232	0.08		-0.02	-0.05	0.02	247	0.05	0.05	
FT06	1729855.05	6452760.09	488.79	-0.55	-0.12	-0.27	192	0.57		-0.20	-0.04	-0.11	191	0.20	0.03	
FT07	1729252.33	6454103.33	588.72	-0.91	-1.42	-0.29	237	1.69		-0.43	-0.87	-0.13	230	0.79	0.03	
FT08	1729388.67	6453350.48	658.45	-0.01	-0.02	0.01	251	0.02	*	0.01	-0.03	0.03	293	0.03	0.02	*
XC01	1728475.98	6452457.69	312.35	-0.80	-0.54	-0.53	214	0.97		-0.14	-0.08	-0.03	211	0.16	0.03	
XC02	1727002.55	6452118.84	13.73	-0.34	-0.16	-0.11	205	0.38		-0.07	-0.02	0.01	199	0.07	0.03	
XC04	1727559.31	6452666.95	238.46	-0.25	-0.29	-0.38	229	0.38		-0.05	-0.06	0.03	230	0.08	0.03	
XC05	1727081.92	6453178.90	227.47	-0.08	-0.19	-0.39	248	0.21		-0.03	-0.02	0.00	210	0.04	0.03	
XC06	1727784.89	6453396.26	299.88	-0.02	-0.41	-0.47	268	0.41		0.01	-0.06	-0.01	277	0.06	0.03	
XC07	1727759.39	6453643.87	313.48	0.20	-0.05	-0.35	346	0.21		0.01	-0.01	0.01	315	0.01	0.03	*
XC13	1726581.05	6453069.58	191.13	-0.11	-0.05	-0.07	206	0.12		-0.04	-0.03	-0.05	222	0.05	0.03	
XC14	1726742.44	6453806.00	259.92	0.00	-0.05	-0.02	271	0.05		0.01	-0.02	0.02	288	0.02	0.03	*
XC15	1727590.34	6453120.97	287.06	-0.11	-0.13	-0.04	229	0.17		-0.04	-0.05	-0.04	233	0.07	0.03	
XC16	1727602.24	6454098.22	326.88	-0.01	-0.01	-0.02	233	0.02	*	0.01	-0.02	0.00	288	0.02	0.03	*
PB04	1727665.23	6448848.66	166.92	-10.71	-3.08	-3.60	196	11.14		-0.71	-0.21	-0.19	196	0.74	0.04	
PB06	1727935.82	6449758.16	177.36	-32.63	-3.68	-8.70	186	32.84		-1.44	-0.20	-0.22	188	1.45	0.04	
PB07	1728135.18	6450212.21	197.54	-40.74	-7.55	-2.67	190	41.44		-1.82	-0.37	-0.12	191	1.86	0.04	
PB08	1728199.00	6450462.93	194.19	-38.50	-6.87	0.51	190	39.11		-1.66	-0.31	0.03	191	1.69	0.04	
PB09	1728245.34	6450848.65	188.99	-43.24	-2.37	-3.53	183	43.30		-2.01	-0.13	-0.25	184	2.01	0.04	
PB12	1728257.11	6451584.30	184.73	-73.38	-20.27	-8.56	195	76.13		-3.39	-0.99	-0.57	196	3.53	0.04	
PB13	1728043.37	6452148.28	206.76	-42.60	-16.06	-3.78	201	45.53		-2.10	-0.89	-0.11	203	2.28	0.03	
PB18	1730430.95	6450719.94	363.04	-15.94	8.95	-4.54	151	18.28		-0.30	0.06	-0.06	169	0.30	0.03	
PB20	1728743.25	6451124.73	232.60	-69.51	-10.95	-10.95	189	70.37		-3.06	-0.60	-0.60	191	3.12	0.04	
PB21	1729242.22	6451178.53	272.35	-55.99	6.48	-7.67	173	56.37		-2.22	0.18	-0.25	175	2.23	0.04	
PB25	1729670.41	6451986.30	326.01	-31.90	0.45	-2.98	179	31.91		-0.27	-0.06	0.01	193	0.28	0.03	
PB26	1729538.62	6452252.15	282.96	-24.02	2.59	-2.38	174	24.16		-0.23	-0.02	-0.03	184	0.23	0.04	
PB27	1729245.47	6451843.40	271.66	-93.87	6.34	-12.76	176	94.09		-3.65	0.09	-0.51	179	3.65	0.06	
PB29	1728842.25	6452093.51	170.88	-46.69	-26.98	-15.05	210	53.93		-2.28	-1.02	-0.71	204	2.49	0.04	
PB53	1729217.92	6450754.81	290.10	-34.85	0.89	-7.65	179	34.86		-1.89	0.10	-0.57	177	1.89	0.05	
PB54	1729690.83	6450440.49	357.73	-4.07	-0.20	-0.89	183	4.09		-0.21	-0.06	0.00	197	0.22	0.03	
PB55	1728775.28	6450801.26	239.73	-37.00	-2.78	-6.60	184	37.11		-2.08	-0.19	-0.45	185	2.09	0.04	
PB59	1727758.34	6448659.68	159.21	-8.02	-1.99	-4.18	194	8.27		-1.04	-0.30	-0.48	196	1.09	0.04	
PB64	1727417.65	6450937.67	67.14	-48.64	-9.27	-5.62	191	49.51		-21.39	-4.40	-2.55	192	21.03	0.04	
PB65	1728454.34	6449707.76	287.70	-0.32	-0.06	-0.05	191	0.33		-0.32	-0.06	-0.05	191	0.33	0.03	
UB02	1727519.20	6450142.56	62.65	-61.91	8.78	-4.51	172	62.53		-3.57	0.44	-0.10	173	3.60	0.04	

PORTUGUESE BEND LANDSLIDE MONITORING - MOVEMENT DATA POSTING as of September 14, 2012

Prepared by McDee Surveying Consulting - Document Date: 09/30/2013

Monitoring Point Movements

FULL ANNUAL MONITORING

Notes:

* Indicates no signal of horizontal movement detected in the last period

	Sept. 14, 2012 Positions			Overall Movements (US Feet)						Periodic (11.4 months) Movements (US Feet)						
	NAD83 SPC Zone 5 (Ft)		NAVD88	Original Position to Sept. 14, 2012						Oct. 03, 2011 Position to Sept. 14, 2012						
Point	North (ft)	East (ft)	Elev(ft)	North	East	Height	Azim.°	Dist.	Year	North	East	Height	Azim.°	Dist.	95%Err	Note
AB01	1729427.54	6445709.59	178.54	-0.04	-0.02	-0.08	209	0.05	1994	-0.01	0.00	0.04	180	0.01	0.02	*
AB02	1726946.97	6447968.68	116.47	-0.01	-0.01	-0.01	221	0.01	2007	0.00	-0.02	0.02	270	0.02	0.01	*
AB04	1728389.97	6447131.52	67.21	-2.02	-1.82	-0.36	222	2.72	1994	-0.07	-0.07	-0.01	223	0.10	0.02	
AB05	1728074.51	6447643.66	80.50	-1.21	-1.51	-0.40	231	1.93	1994	-0.06	-0.06	0.01	225	0.09	0.02	
AB12	1729415.22	6448271.10	283.19	-1.27	-0.55	-0.24	203	1.38	1994	-0.06	-0.03	0.01	203	0.07	0.02	
AB13	1729927.91	6448235.78	364.47	-0.99	-0.25	-0.56	194	1.02	1994	-0.05	-0.01	-0.03	188	0.06	0.03	
AB15	1730511.31	6448099.25	396.83	-0.77	-0.13	-0.45	190	0.78	1994	-0.05	0.00	-0.04	183	0.05	0.03	
AB16	1730058.55	6447532.13	376.41	-0.33	0.01	-0.21	179	0.33	1994	0.00	-0.02	-0.03	281	0.02	0.02	*
AB17	1731421.09	6446727.75	442.80	-0.03	-0.02	0.00	219	0.04	2007	0.00	0.01	0.01	72	0.01	0.03	*
AB18	1731602.11	6448187.62	456.86	-0.52	0.13	-0.33	166	0.53	1994	-0.05	0.00	0.02	181	0.05	0.03	
AB20	1729359.49	6449685.87	396.22	-1.13	-0.39	-0.21	199	1.20	1995	-0.07	-0.02	-0.01	194	0.07	0.02	
AB24	1729029.45	6447759.65	335.75	-0.91	-0.31	-0.17	199	0.96	1997	-0.07	-0.04	-0.03	206	0.08	0.02	
AB50	1728084.54	6448247.22	182.03	-0.46	-0.96	0.05	244	1.07	1998	-0.02	-0.05	0.01	246	0.05	0.02	
AB51	1729616.41	6447306.43	305.16	-0.60	-0.11	-0.26	191	0.61	2002	-0.05	-0.02	-0.01	208	0.05	0.02	
AB52	1730015.44	6448624.25	368.33	-0.66	-0.19	-0.28	196	0.68	2002	-0.05	-0.01	-0.02	187	0.05	0.04	
AB53	1730430.28	6449712.23	352.86	-0.82	-0.14	-0.27	190	0.84	2002	-0.07	-0.01	-0.01	191	0.08	0.03	
AB54	1731111.89	6447047.88	407.38	-0.05	0.01	0.07	165	0.06	2007	-0.03	0.01	0.07	166	0.03	0.04	*
AB56	1732213.96	6448545.53	571.57	-0.35	0.09	-0.08	165	0.36	2007	-0.04	0.00	0.00	173	0.04	0.02	
AB57	1731926.47	6449759.45	564.78	-0.43	0.09	-0.15	169	0.44	2007	-0.06	-0.01	-0.04	187	0.06	0.02	
AB58	1731117.59	6449074.92	405.65	-0.43	-0.01	-0.02	181	0.43	2007	-0.08	-0.01	0.01	190	0.08	0.04	
AB59	1730850.31	6450212.50	434.26	-0.55	-0.06	-0.11	186	0.56	2007	-0.08	-0.01	-0.02	187	0.09	0.03	
AB60	1729089.34	6447987.41	179.37	-0.36	-0.16	-0.08	204	0.39	2007	-0.04	-0.04	-0.02	226	0.06	0.02	
AB61	1727424.49	6447990.26	140.45	-0.01	0.01	-0.02	145	0.01	2007	0.01	0.01	0.02	29	0.01	0.01	*
AB62	1728910.29	6446925.43	143.02	-0.06	-0.03	0.01	206	0.07	2011	-0.06	-0.03	0.01	206	0.07	0.02	
AB63	1729059.24	6447306.99	180.82	-0.06	-0.04	-0.02	214	0.07	2011	-0.06	-0.04	-0.02	214	0.07	0.02	
AB64	1731830.69	6447373.08	532.25	Replacement for AB54					2012							
AB65	1731705.67	6448264.07	458.53	Replacement for AB18					2012							
AB66	1730047.29	6448490.53	374.28	Replacement for AB53					2012							
AB67	1731180.41	6447741.76	405.33	Replacement for AB55					2012							
AB68	1730258.86	6448055.37	393.45	Replacement for AB15					2012							
BB52	1726995.94	6451384.30	3.87	-0.42	-0.08	0.04	191	0.43	2007	-0.04	-0.03	-0.02	214	0.05	0.03	
CR07	1731627.96	6451203.36	632.17	-0.82	0.17	-1.11	168	0.84	1994	-0.04	0.02	-0.09	153	0.05	0.03	
CR50	1733013.60	6451037.36	872.62	-0.02	-0.01	-0.04	218	0.02	1998	0.01	-0.01	-0.03	336	0.01	0.03	*
CR51	1733062.00	6452361.87	976.15	-0.03	0.01	-0.10	162	0.03	1998	0.01	0.00	-0.03	0	0.01	0.02	*
CR53	1732867.50	6450239.27	779.60	-0.08	-0.05	-0.03	212	0.09	1998	-0.03	0.01	-0.00	161	0.03	0.06	*
CR53	1732780.28	6450224.19	780.72	Replacement for CR52					2012							
FT06	1729854.97	6452760.07	488.72	-0.64	-0.14	-0.34	192	0.65	2007	-0.08	-0.01	-0.07	190	0.08	0.02	
FT07	1729252.18	6454103.12	588.67	-1.06	-1.63	-0.34	237	1.95	2007	-0.15	-0.21	-0.05	235	0.26	0.02	
FT08	1729388.67	6453350.49	658.44	-0.02	-0.01	-0.01	219	0.02	2007	-0.01	0.01	-0.01	122	0.01	0.02	*
KC01	1728475.91	6452457.65	312.34	-0.87	-0.58	-0.54	213	1.05	1994	-0.07	-0.03	-0.01	205	0.08	0.02	
KC02	1727002.51	6452118.83	13.73	-0.39	-0.16	-0.11	203	0.42	1995	-0.04	0.00	0.00	185	0.04	0.02	
KC04	1727559.28	6452666.96	238.43	-0.29	-0.29	-0.41	225	0.40	1995	-0.04	0.00	-0.03	178	0.04	0.02	
KC05	1727081.89	6453178.89	227.49	-0.11	-0.20	-0.37	242	0.23	1994	-0.03	-0.01	0.02	196	0.03	0.02	
KC06	1727784.85	6453396.22	299.88	-0.06	-0.45	-0.47	263	0.45	1994	-0.04	-0.04	0.00	228	0.06	0.02	
KC07	1727759.39	6453683.85	313.49	0.20	-0.06	-0.34	342	0.21	1994	0.00	-0.01	0.01	278	0.01	0.03	*
KC13	1726581.02	6453069.58	191.10	-0.14	-0.05	-0.10	201	0.15	2007	-0.03	0.00	-0.03	182	0.03	0.02	
KC14	1726742.42	6453805.98	259.91	-0.02	-0.07	-0.03	252	0.08	2007	-0.03	-0.02	-0.01	224	0.03	0.02	
KC15	1727590.32	6453120.95	287.06	-0.13	-0.14	-0.04	227	0.20	2007	-0.02	-0.02	0.00	216	0.03	0.02	
KC16	1727602.23	6454098.23	326.87	-0.01	0.00	-0.03	180	0.01	2007	0.00	0.01	-0.01	113	0.01	0.03	*
KC17	1727302.76	6453026.42	215.25	Replacement for KC04					2012							
PB04	1727664.82	6448848.57	166.81	-11.12	-3.17	-3.71	196	11.56	1994	-0.41	-0.09	-0.12	192	0.42	0.04	
PB06	1727934.92	6449758.07	177.24	-33.52	-3.77	-5.82	196	33.73	1995	-0.89	-0.09	-0.12	186	0.90	0.03	
PB07	1728134.07	6450211.98	197.49	-41.85	-7.78	-3.72	191	42.57	1995	-1.11	-0.23	-0.05	192	1.13	0.03	
PB08	1728197.95	6450462.75	194.24	-39.56	-7.05	0.56	190	40.18	1994	-1.05	-0.18	0.05	190	1.07	0.03	
PB09	1728244.01	6450848.59	188.79	-44.57	-2.44	-3.74	183	44.64	1994	-1.33	-0.07	-0.20	183	1.33	0.03	
PB12	1728254.64	6451503.54	184.21	-75.85	-21.03	-9.08	195	78.71	1994	-2.47	-0.76	-0.53	197	2.59	0.03	
PB13	1728041.82	6452147.64	206.67	-44.15	-16.70	-3.87	201	47.20	1995	-1.55	-0.64	-0.10	202	1.67	0.02	
PB18	1730430.87	6450719.92	363.01	-16.01	8.93	-4.57	151	18.33	1995	-0.07	-0.02	-0.03	197	0.08	0.03	
PB20	1728741.10	6451124.30	232.16	-71.67	-11.38	-11.38	189	72.56	1995	-2.15	-0.43	-0.44	191	2.20	0.03	
PB21	1729240.85	6451178.60	272.17	-57.37	6.55	-7.85	173	57.74	1995	-1.38	0.07	-0.18	177	1.38	0.03	
PB25	1729670.31	6451986.28	325.97	-32.00	0.63	-3.02	179	32.01	1994	-0.10	-0.02	-0.04	192	0.10	0.03	
PB26	1729538.54	6452252.11	282.93	-24.11	2.55	-2.41	174	24.24	1995	-0.09	-0.03	-0.03	202	0.09	0.04	
PB27	1729242.88	6451842.42	271.21	-96.46	6.36	-13.21	176	96.67	1995	-2.58	0.02	-0.45	180	2.58	0.06	
PB29	1728840.65	6452092.79	170.41	-48.30	-27.70	-15.52	210	55.67	1995	-1.60	-0.72	-0.48	204	1.76	0.03	
PB53	1729216.82	6450754.85	289.90	-35.95	0.93	-7.85	179	35.96	1997	-1.10	0.04	-0.20	178	1.10	0.05	
PB54	1729690.75	6450449.48	357.70	-4.15	-0.21	-0.92	183	4.15	1997	-0.07	-0.01	-0.02	191	0.08	0.02	
PB55	1728774.00	6450801.18	239.55	-38.28	-2.86	-6.78	184	38.39	1998	-1.28	-0.08	-0.18	183	1.28	0.03	
PB59	1727757.70	6448659.52	158.92	-8.66	-2.15	-4.47	194	8.93	2001	-0.64	-0.16	-0.29	194	0.66	0.03	
PB64	1727394.56	6450932.96	63.68	-71.73	-13.99	-9.08	191	73.08	2009	-23.09	-4.72	-3.46	192	23.57	0.03	
PB65	1728454.20	6449707.73	287.69	-0.47	-0.09	-0.06	191	0.47	2010	-0.14	-0.03	-0.01	191	0.14	0.02	
PB66	1729197.547	6450969.92	288.33	Replacement for PB53					2012							
UH02	1727517.18	6450142.82	62.66	-63.94	9.03	-4.49	172	64.57	1997	-2.02	0.26	0.01	173	2.04	0.03	

PORTUGUESE BEND LANDSLIDE MONITORING - MOVEMENT DATA POSTING as of April 18, 2013

Prepared by McGee Surveying Consulting - Document Date: 09/30/2013 Revised 03/05/2014

Monitoring Point Movements

PARTIAL MID-YEAR MONITORING

Notes:

* Indicates no signal of horizontal movement detected in the last period at the 95% level of confidence

	April 18, 2013 Positions			Overall Movements (US Feet)						Periodic (7.1 months) Movements (US Feet)						
	NAD83 SPC Zone 5 (Ft)		NAVD88	Original Position to April 18, 2013						Sept. 14, 2012 Position to April 18, 2013						
Point	North (ft)	East (ft)	Elev(ft)	North	East	Height	Azim.°	Dist.	Year	North	East	Height	Azim.°	Dist.	95%Err	Note
AB04	1728389.95	6447121.48	67.17	-2.04	-1.86	-0.40	222	2.76	1994	-0.02	-0.04	-0.04	246	0.04	0.01	
AB12	1729415.20	6448271.07	283.17	-1.29	-0.58	-0.26	204	1.41	1994	-0.02	-0.03	-0.02	232	0.03	0.01	
AB16	1730358.57	6447532.13	376.44	-0.32	0.01	-0.18	178	0.32	1994	0.01	0.00	0.02	8	0.02	0.02	*
AB17	1731421.09	6446727.75	442.78	-0.03	-0.02	-0.02	219	0.03	2007	0.00	0.00	-0.02	45	0.00	0.01	*
AB20	1729359.43	6449685.84	396.21	-1.19	-0.42	-0.22	200	1.26	1995	-0.06	-0.03	-0.01	205	0.07	0.01	
AB50	1728084.51	6448247.18	182.00	-0.49	-1.01	0.02	244	1.12	1998	-0.03	-0.04	-0.03	236	0.05	0.01	
AB59	1730850.25	6450212.49	434.24	-0.62	-0.07	-0.13	186	0.62	2007	-0.06	-0.01	-0.01	192	0.07	0.01	
AB60	1729089.33	6447987.40	179.32	-0.37	-0.17	-0.13	204	0.41	2007	-0.02	-0.01	-0.05	215	0.02	0.01	
AB61	1727424.49	6447990.26	140.41	-0.01	0.00	-0.06	135	0.01	2007	0.00	0.00	-0.04	338	0.01	0.00	*
AB65	1731705.66	6448264.06	458.53	-0.01	0.00	-0.01	194	0.01	2012	-0.01	0.00	-0.01	194	0.01	0.02	*
CR07	1731627.92	6451203.36	632.18	-0.86	0.17	-1.10	169	0.87	1994	-0.04	0.00	0.01	183	0.04	0.02	
CR50	1733013.59	6451037.36	872.66	-0.02	-0.01	0.00	214	0.03	1998	0.00	0.00	0.05	194	0.00	0.01	*
FT06	1729854.91	6452760.05	488.68	-0.70	-0.16	-0.38	193	0.72	2007	-0.06	-0.02	-0.04	201	0.07	0.01	
FT07	1729252.14	6454103.03	588.65	-1.10	-1.72	-0.36	237	2.04	2007	-0.04	-0.09	-0.02	246	0.10	0.02	
KC06	1727784.86	6453396.20	299.84	-0.05	-0.47	-0.51	264	0.47	1994	0.00	-0.02	-0.04	284	0.02	0.01	
KC07	1727759.41	6453683.87	313.46	0.22	-0.05	-0.37	346	0.23	1994	0.02	0.01	-0.02	31	0.02	0.01	
KC13	1726581.02	6453069.56	191.09	-0.14	-0.07	-0.11	208	0.16	2007	0.00	-0.02	-0.02	276	0.02	0.01	
KC16	1727602.23	6454098.23	326.88	-0.02	0.00	-0.02	188	0.02	2007	0.00	0.00	0.01	243	0.00	0.01	*
KC17	1727302.74	6453026.40	215.33	-0.02	-0.02	-0.02	229	0.03	2012	-0.02	-0.02	-0.02	229	0.03	0.01	
PB04	1727664.58	6448048.49	166.69	-11.36	-3.25	-3.83	196	11.82	1994	-0.24	-0.08	-0.12	198	0.25	0.02	
PB12	1728253.25	6451583.09	183.84	-77.23	-21.48	-9.45	196	80.17	1994	-1.39	-0.45	-0.37	198	1.46	0.01	
PB13	1728040.95	6452147.25	206.54	-45.02	-17.10	-4.00	201	48.16	1995	-0.87	-0.39	-0.13	204	0.95	0.02	
PB18	1730430.79	6450719.89	362.96	-16.09	8.89	-4.62	151	18.39	1995	-0.08	-0.03	-0.05	200	0.09	0.02	
PB26	1729538.46	6452252.09	282.90	-24.18	2.53	-2.44	174	24.32	1995	-0.07	-0.02	-0.03	197	0.08	0.01	
PB59	1727757.34	6448659.41	158.71	-9.03	-2.25	-4.68	194	9.30	2001	-0.36	-0.11	-0.21	197	0.38	0.07	
PB64	1727382.15	6450930.51	60.16	-84.14	-16.44	-12.60	191	85.73	2009	-12.41	-2.45	-3.53	191	12.65	0.02	
PB66	1729197.003	6450969.91	288.22	-0.64	-0.01	-0.10	181	0.64	2012	-0.64	-0.01	-0.10	181	0.64	0.01	

PORTUGUESE BEND LANDSLIDE MONITORING - MOVEMENT DATA POSTING as of October 4, 2013

Prepared by McGee Surveying Consulting - Document Date: 12/18/2013

Monitoring Point Movements

FULL ANNUAL MONITORING

Notes:

* Indicates no signal of horizontal movement detected in the last period at the 95% level of confidence

	October 4, 2013 Positions			Overall Movements (US Feet)						Periodic (12.7 months) Movements (US Feet)						
	NAD83 SPC Zone 5 (Ft)		NAVD88	Original Position to October 4, 2013						Sept. 14, 2012 Position to October 4, 2013						
Point	North (ft)	East (ft)	Elev(ft)	North	East	Height	Azim.°	Dist.	Year	North	East	Height	Azim.°	Dist.	95%Err	Note
AB01	1729427.56	6445709.60	178.51	-0.02	-0.01	-0.11	206	0.03	1994	0.02	0.01	-0.03	33	0.02	0.02	*
AB02	1726946.99	6447968.69	116.45	0.01	0.01	-0.03	34	0.01	2007	0.02	0.01	-0.02	37	0.02	0.02	*
AB04	1728389.95	6447121.51	67.16	-2.04	-1.84	-0.41	222	2.75	1994	-0.02	-0.02	-0.04	223	0.03	0.02	
AB05	1728074.49	6447643.63	80.46	-1.23	-1.54	-0.44	231	1.97	1994	-0.02	-0.04	-0.04	237	0.04	0.02	
AB12	1729415.18	6448271.06	283.16	-1.30	-0.58	-0.27	204	1.43	1994	-0.04	-0.03	-0.03	223	0.05	0.02	
AB13	1729927.87	6448235.79	364.46	-1.03	-0.25	-0.57	194	1.06	1994	-0.04	0.00	-0.01	177	0.04	0.02	
AB16	1730358.34	6447532.13	376.39	-0.35	0.00	-0.23	180	0.35	1994	-0.02	-0.01	-0.02	202	0.02	0.03	*
AB17	1731421.10	6446727.74	442.81	-0.02	-0.04	0.01	237	0.04	2007	0.01	-0.01	0.01	293	0.01	0.03	*
AB20	1729359.40	6449685.84	396.20	-1.22	-0.42	-0.23	199	1.29	1995	-0.09	-0.03	-0.02	197	0.10	0.01	
AB24	1729829.42	6447759.63	335.73	-0.94	-0.33	-0.19	200	1.00	1997	-0.03	-0.02	-0.02	217	0.04	0.02	
AB50	1728084.51	6448247.18	182.00	-0.49	-1.00	0.02	244	1.11	1998	-0.02	-0.04	-0.02	237	0.04	0.02	
AB51	1729616.40	6447306.45	305.14	-0.61	-0.09	-0.28	189	0.62	2002	-0.01	0.02	-0.02	122	0.03	0.02	
AB53	1730430.21	6449712.24	352.86	-0.90	-0.13	-0.27	188	0.91	2002	-0.08	0.01	0.01	173	0.08	0.04	
AB56	1732213.90	6448543.59	571.55	-0.41	0.13	-0.10	162	0.43	2007	-0.06	0.04	-0.01	150	0.07	0.02	
AB57	1731926.41	6449759.48	564.78	-0.50	0.12	-0.15	167	0.51	2007	-0.06	0.03	-0.01	153	0.07	0.02	
AB58	1731117.55	6449074.93	405.68	-0.47	0.00	0.00	180	0.47	2007	-0.04	0.01	0.03	167	0.04	0.05	*
AB59	1730850.22	6450212.49	434.22	-0.65	-0.07	-0.15	186	0.65	2007	-0.10	-0.01	-0.03	186	0.10	0.02	
AB60	1729089.34	6447987.41	179.33	-0.37	-0.16	-0.12	203	0.40	2007	-0.01	0.00	-0.04	166	0.01	0.02	*
AB61	1727424.48	6447990.27	140.42	-0.02	0.01	-0.05	152	0.02	2007	-0.01	0.00	-0.03	164	0.01	0.01	*
AB62	1728910.26	6446925.42	142.98	-0.09	-0.04	-0.03	204	0.10	2011	-0.03	-0.01	-0.04	200	0.03	0.02	
AB63	1729059.22	6447306.97	180.79	-0.08	-0.07	-0.05	218	0.10	2011	-0.02	-0.02	-0.03	229	0.03	0.02	
AB64	1731030.71	6447373.07	532.21	0.02	-0.01	-0.04	321	0.02	2012	0.02	-0.01	-0.04	321	0.02	0.02	*
AB65	1731705.66	6448264.09	458.54	-0.02	0.02	0.00	130	0.03	2013	-0.02	0.02	0.00	130	0.03	0.02	
AB66	1730047.23	6448490.52	374.29	-0.05	-0.01	0.01	186	0.05	2012	-0.05	-0.01	0.01	186	0.05	0.02	
AB67	1731180.40	6447741.76	405.31	-0.01	0.01	-0.01	153	0.01	2012	-0.01	0.01	-0.01	153	0.01	0.02	*
AB68	1730258.84	6448055.36	393.40	-0.02	-0.01	-0.04	204	0.02	2012	-0.02	-0.01	-0.04	204	0.02	0.02	*
BB52	1726995.63	6451384.31	3.91	-0.54	-0.07	0.09	187	0.54	2007	-0.11	0.01	0.04	173	0.11	0.04	
CR07	1731627.89	6451203.35	632.11	-0.89	0.16	-1.17	170	0.91	1994	-0.07	0.00	-0.06	184	0.07	0.02	
CR50	1733013.57	6451037.37	872.64	-0.04	0.00	-0.02	184	0.04	1998	-0.03	0.01	0.02	156	0.03	0.02	
CR51	1733061.99	6452361.88	976.17	-0.04	0.02	-0.08	159	0.04	1998	-0.01	0.01	0.02	149	0.01	0.02	*
CR53	1732780.29	6450224.19	780.73	0.01	0.00	0.00			2012	0.01	0.00	0.00	0	0.01	0.02	*
FT06	1729854.86	6452760.05	488.65	-0.75	-0.16	-0.42	192	0.77	2007	-0.11	-0.02	-0.08	190	0.12	0.02	
FT07	1729252.12	6454102.96	388.63	-1.12	-1.79	-0.38	238	2.11	2007	-0.06	-0.16	-0.04	249	0.17	0.03	
FT08	1729388.67	6453350.51	658.41	-0.02	0.01	-0.03	151	0.02	2007	0.00	0.02	-0.02	93	0.02	0.02	*
KC01	1728475.83	6452457.62	312.28	-0.95	-0.61	-0.60	213	1.13	1994	-0.08	-0.04	-0.05	205	0.09	0.02	
KC02	1727002.47	6452118.84	13.70	-0.42	-0.15	-0.14	200	0.45	1995	-0.03	0.01	-0.02	160	0.04	0.02	
KC05	1727081.99	6453178.88	227.46	-0.11	-0.21	-0.40	242	0.24	1994	-0.01	-0.01	-0.03	240	0.01	0.02	*
KC06	1727784.85	6453396.21	299.85	-0.06	-0.46	-0.50	263	0.46	1994	0.00	-0.01	-0.03	236	0.01	0.02	*
KC07	1727759.41	6453683.86	313.47	0.22	-0.06	-0.36	346	0.23	1994	0.02	0.01	-0.01	22	0.02	0.02	*
KC13	1726580.98	6453069.60	191.06	-0.17	-0.03	-0.14	191	0.18	2007	-0.03	0.02	-0.04	147	0.04	0.02	
KC14	1726742.44	6453806.00	259.90	0.00	-0.05	-0.04	268	0.06	2007	0.02	0.02	-0.01	41	0.03	0.02	?
KC15	1727590.29	6453120.94	287.03	-0.16	-0.16	-0.07	225	0.23	2007	-0.02	-0.02	-0.03	213	0.03	0.02	
KC16	1727602.24	6454098.24	326.88	-0.01	0.01	-0.02	131	0.01	2007	0.01	0.01	0.01	51	0.01	0.02	*
KC17	1727302.74	6453026.41	215.24	-0.02	-0.01	-0.02	216	0.03	2012	-0.02	-0.01	-0.02	216	0.03	0.02	
PB04	1727664.44	6448848.46	166.65	-11.50	-3.28	-3.87	198	11.95	1994	-0.38	-0.11	-0.15	196	0.39	0.03	
PB06	1727934.33	6449757.99	177.13	-34.12	-3.85	-5.93	186	34.34	1995	-0.60	-0.08	-0.11	188	0.60	0.02	
PB07	1728113.56	6450211.87	187.18	-49.47	-7.94	-9.83	191	41.46	1995	-0.81	-0.16	-0.09	191	0.81	0.02	
PB08	1728197.20	6450462.60	194.26	-40.30	-7.19	0.58	190	40.94	1994	-0.75	-0.15	0.02	191	0.76	0.03	
PB09	1728243.00	6450848.55	188.58	-45.58	-2.47	-3.94	183	45.65	1994	-1.01	-0.04	-0.20	182	1.01	0.03	
PB12	1728252.35	6451582.81	183.67	-78.14	-21.76	-9.62	196	81.11	1994	-2.29	-0.73	-0.54	198	2.41	0.02	
PB13	1728040.35	6452147.01	206.52	-45.62	-17.33	-4.02	201	48.80	1995	-1.47	-0.63	-0.15	203	1.60	0.02	
PB18	1730430.78	6450719.92	362.94	-16.11	8.92	-4.64	151	18.41	1995	-0.10	0.00	-0.06	183	0.10	0.02	
PB20	1728739.17	6451123.87	231.72	-73.60	-11.81	-11.82	189	74.54	1995	-1.94	-0.43	-0.44	192	1.98	0.02	
PB21	1729239.78	6451178.72	271.99	-58.44	6.66	-8.03	173	58.82	1995	-1.07	0.12	-0.18	174	1.07	0.02	
PB25	1729670.19	6451986.23	325.94	-32.13	0.58	-3.05	179	32.13	1994	-0.13	-0.05	-0.03	202	0.13	0.01	
PB26	1729538.42	6452252.10	282.89	-24.23	2.54	-2.45	174	24.36	1995	-0.12	-0.01	-0.03	184	0.12	0.02	
PB27	1729240.60	6451842.46	270.83	-98.74	6.39	-13.60	176	98.95	1995	-2.29	0.04	-0.39	179	2.29	0.02	
PB29	1728839.12	6452092.15	169.87	-49.82	-28.34	-16.06	210	57.32	1995	-1.52	-0.64	-0.54	203	1.65	0.03	
PB54	1729690.65	6450448.46	357.73	-4.24	-0.23	-0.89	183	4.25	1997	-0.10	-0.02	0.02	190	0.10	0.03	
PB55	1728772.93	6450801.16	239.47	-39.35	-2.88	-6.86	184	39.46	1998	-1.07	-0.02	-0.08	181	1.07	0.05	
PB59	1727757.09	6448659.36	158.60	-9.38	-2.31	-4.79	194	9.56	2001	-0.61	-0.16	-0.32	195	0.63	0.03	
PB64	1727369.21	6450928.11	56.84	-97.08	-18.83	-15.92	191	98.89	2009	-25.35	-4.84	-6.84	191	25.81	0.05	
PB65	1728454.06	6449707.70	287.66	-0.60	-0.12	-0.09	191	0.62	2010	-0.14	-0.03	-0.03	192	0.14	0.02	
PB66	1729196.66	6450969.95	288.19	-0.99	0.03	-0.13	178	0.99	2012	-0.99	0.03	-0.13	178	0.99	0.02	
UB02	1727516.04	6450142.94	62.62	-65.08	9.16	-4.54	172	65.72	1997	-1.14	0.12	-0.04	174	1.14	0.02	

PORTUGUESE BEND LANDSLIDE MONITORING - MOVEMENT DATA POSTING as of April 7, 2014

Prepared by McGee Surveying Consulting - Document date: 05/14/2014

Monitoring Point Movements

PARTIAL MID-YEAR MONITORING

Notes:

* Indicates no signal of horizontal movement detected in the last period at the 95% level of confidence

	April 7, 2014 Positions			Overall Movements (US Feet)						Periodic (6.0 months) Movements (US Feet)						
	NAD83 SPC Zone 5 (Ft)		NAVD88	Original Position to April 7, 2014						October 4, 2013 Position to April 7, 2014						
Point	North (ft)	East (ft)	Elev(ft)	North	East	Height	Azim.°	Dist.	Year	North	East	Height	Azim.°	Dist.	95%Err	Note
AB04	1728389.93	6447121.48	67.19	-2.07	-1.87	-0.38	222	2.78	1994	-0.02	####	0.03	232	0.04	0.02	
AB12	1729415.17	6448271.07	283.20	-1.31	-0.58	-0.23	204	1.43	1994	-0.01	0.01	0.03	138	0.01	0.02	*
AB16	1730358.55	6447532.14	376.47	-0.34	0.01	-0.15	178	0.34	1994	0.01	0.01	0.08	41	0.02	0.03	*
AB17	1731421.11	6446727.74	442.97	-0.01	-0.04	0.07	259	0.04	2007	0.02	0.00	0.06	353	0.02	0.04	*
AB20	1729359.39	6449685.84	396.23	-1.24	-0.43	-0.20	199	1.31	1995	-0.01	####	0.02	215	0.02	0.01	
AB50	1729084.51	6448247.16	182.02	-0.49	-1.02	0.04	244	1.13	1998	0.00	####	0.01	264	0.02	0.03	*
AB59	1730850.20	6450212.50	434.25	-0.67	-0.05	-0.12	184	0.67	2007	-0.02	0.01	0.03	142	0.02	0.02	*
AB60	1729089.34	6447987.40	179.36	-0.36	-0.17	-0.09	204	0.40	2007	0.00	####	0.02	283	0.01	0.02	*
AB61	1727424.48	6447990.26	140.44	-0.02	0.01	-0.03	155	0.02	2007	0.00	0.00	0.02	315	0.00	0.01	*
AB65	1731705.65	6449264.08	458.55	-0.03	0.01	0.02	153	0.03	2012	-0.01	####	0.02	218	0.01	0.02	*
CR07	1731627.89	6451203.36	632.19	-0.89	0.17	-1.09	169	0.91	1994	0.00	0.01	0.08	69	0.01	0.02	*
CR50	1733013.59	6451037.37	872.75	-0.02	0.00	0.09	191	0.02	1998	0.02	0.00	0.11	357	0.02	0.03	*
FT06	1729854.93	6452760.04	488.69	-0.78	-0.17	-0.37	192	0.80	2007	-0.03	####	0.05	210	0.03	0.02	
FT07	1729252.10	6454102.96	588.67	-1.14	-1.79	-0.34	238	2.12	2007	-0.02	0.00	0.04	180	0.02	0.04	*
KC06	1727784.84	6453396.19	299.87	-0.07	-0.47	-0.48	262	0.48	1994	-0.01	####	0.01	246	0.02	0.02	*
KC07	1727759.41	6453683.86	313.51	0.22	-0.05	-0.32	346	0.22	1994	0.00	0.00	0.03	153	0.00	0.03	*
KC13	1726581.00	6453069.59	191.10	-0.16	-0.05	-0.10	196	0.17	2007	0.01	####	0.04	315	0.02	0.02	*
KC16	1727602.24	6454098.23	336.87	-0.01	0.00	-0.03	191	0.01	2007	0.00	####	-0.01	275	0.01	0.03	*
KC17	1727302.74	6453026.38	215.23	-0.02	-0.04	-0.02	243	0.05	2012	0.00	####	0.00	266	0.03	0.02	
PB04	1727664.28	6448848.42	166.62	-11.65	-3.32	-3.90	196	12.12	1994	-0.16	####	-0.03	193	0.16	0.03	
PB12	1728251.48	6451582.51	183.42	-79.01	-22.06	-9.87	196	82.03	1994	-0.86	####	-0.25	199	0.92	0.03	
PB13	1728039.80	6452146.77	206.46	-46.17	-17.57	-4.08	201	49.40	1995	-0.55	####	-0.05	203	0.60	0.03	
PB18	1730430.76	6450719.91	362.98	-16.12	8.92	-4.60	151	18.42	1995	-0.01	0.00	0.04	189	0.01	0.02	
PB26	1729538.39	6452252.10	282.92	-24.26	2.54	-2.42	174	24.39	1995	-0.03	0.00	0.02	178	0.03	0.02	
PB59	1727756.85	6448659.33	158.51	-9.51	-2.34	-4.88	194	9.80	2001	-0.24	####	-0.09	188	0.24	0.04	
PB64	1727352.77	6450925.28	55.04	-113.52	-21.67	-17.72	191	115.57	2009	#####	####	-1.80	190	####	0.06	
PB66	1729196.34	6450969.95	288.15	-1.30	0.02	-0.10	179	1.30	2012	-0.32	0.00	-0.04	181	0.32	0.03	
PB67	1727638.73	6450858.18	76.01	Replacement for PB64					2014							

PORTUGUESE BEND LANDSLIDE MONITORING - MOVEMENT DATA POSTING as of September 19, 2014

Prepared by McGee Surveying Consulting - Document Date: 12/06/2014

Monitoring Point Movements

FULL ANNUAL MONITORING

Notes:

* Indicates no signal of horizontal movement detected in the last period at the 95% level of confidence

	September 19, 2014 Positions			Overall Movements (US Feet)						Periodic (11.5 months) Movements (US Feet)						
	NAD83 SPC Zone 5 (Ft)		NAVD88	Original Position to September 19, 2014						October 4, 2013 Position to Sept. 19, 2014						
Point	North (ft)	East (ft)	Elev(ft)	North	East	Height	Azim.°	Dist.	Year	North	East	Height	Azim.°	Dist.	95%Err	Note
AB01	1729427.84	6445709.57	178.50	-0.04	-0.04	-0.12	#####	0.06	1994	-0.02	####	-0.01	242	0.03	0.018	
AB02	1726946.97	6447968.70	116.44	-0.02	0.02	-0.04	#####	0.02	2007	-0.02	0.01	-0.01	159	0.03	0.014	
AB04	1728389.94	6447121.49	67.15	-2.05	-1.86	-0.42	#####	2.76	1994	-0.01	####	-0.01	248	0.02	0.013	
AB05	1728074.49	6447643.60	80.45	-1.23	-1.57	-0.45	#####	1.99	1994	0.01	####	-0.01	283	0.03	0.013	
AB12	1729415.16	6448271.06	283.15	-1.32	-0.58	-0.28	#####	1.45	1994	-0.02	0.00	-0.01	180	0.02	0.014	
AB13	1729927.85	6448235.76	364.42	-1.05	-0.28	-0.61	#####	1.08	1994	-0.02	####	-0.04	225	0.03	0.014	
AB16	1730358.55	6447532.12	376.38	-0.34	0.00	-0.24	#####	0.34	1994	0.01	0.00	-0.01	342	0.01	0.010	*
AB17	1731421.10	6446727.77	442.73	-0.02	-0.01	-0.07	#####	0.02	2007	0.00	0.03	-0.08	82	0.03	0.020	
AB20	1729359.38	6449685.82	396.19	-1.25	-0.44	-0.24	#####	1.32	1995	-0.02	####	-0.01	224	0.03	0.007	
AB24	1729829.43	6447759.63	335.71	-0.93	-0.33	-0.22	#####	0.99	1997	0.01	0.00	-0.02	13	0.01	0.015	*
AB50	1728084.52	6448247.15	181.99	-0.48	-1.03	0.01	#####	1.14	1998	0.00	####	-0.02	277	0.03	0.016	
AB51	1729616.36	6447306.42	305.12	-0.65	-0.12	-0.30	#####	0.66	2002	-0.03	####	-0.02	218	0.04	0.014	
AB53	1730430.17	6449712.20	352.80	-0.93	-0.17	-0.33	#####	0.95	2002	-0.03	####	-0.06	230	0.05	0.023	
AB56	1732213.86	6448545.61	571.53	-0.45	0.15	-0.12	#####	0.47	2007	-0.04	0.02	-0.02	155	0.04	0.017	
AB57	1731926.37	6449759.45	564.71	-0.54	0.09	-0.22	#####	0.55	2007	-0.04	####	-0.07	214	0.05	0.016	
AB58	1731117.54	6449074.94	405.53	-0.48	0.01	-0.14	#####	0.48	2007	-0.01	0.01	-0.14	131	0.01	0.028	*
AB59	1730850.16	6450212.47	434.18	-0.71	0.08	-0.19	#####	0.71	2007	-0.06	####	-0.05	194	0.06	0.014	
AB60	1729089.34	6447987.41	179.31	-0.36	-0.16	-0.14	#####	0.39	2007	0.01	0.00	-0.03	8	0.01	0.013	*
AB61	1727424.50	6447990.26	140.41	0.00	0.00	-0.06	63.43	0.00	2007	0.02	0.00	0.00	345	0.02	0.006	*
AB62	1728910.23	6446925.41	142.96	-0.12	-0.05	-0.05	#####	0.13	2011	-0.03	####	-0.02	198	0.03	0.013	
AB63	1729059.18	6447306.96	180.77	-0.12	-0.08	-0.07	#####	0.14	2011	-0.04	####	-0.02	197	0.04	0.013	
AB64	1731830.70	6447373.07	532.16	0.01	-0.01	-0.09	#####	0.02	2012	-0.01	0.00	-0.05	171	0.01	0.016	*
AB65	1731705.66	6447264.09	458.47	-0.01	0.03	-0.06	#####	0.03	2012	0.01	0.01	-0.07	58	0.01	0.014	*
AB66	1730047.23	6448490.52	374.21	-0.05	-0.01	-0.07	#####	0.05	2012	0.00	####	-0.08	270	0.01	0.015	*
AB67	1731180.41	6447741.78	405.28	0.00	0.02	-0.05	96.71	0.02	2012	0.01	0.01	-0.04	56	0.01	0.014	*
AB68	1730258.81	6448055.76	391.41	-0.02	-0.01	-0.04	#####	0.03	2012	-0.01	####	0.00	221	0.01	0.014	*
BB52	Discontinued															
CR07	1731627.83	6451203.37	632.06	-0.95	0.18	-1.22	#####	0.96	1994	-0.05	0.01	-0.05	167	0.06	0.016	
CR50	1733013.57	6451037.36	872.60	-0.05	-0.01	-0.06	#####	0.05	1998	0.00	####	-0.05	250	0.01	0.015	*
CR51	1733062.00	6452361.87	976.12	-0.04	0.01	-0.13	#####	0.04	1998	0.00	####	-0.05	286	0.01	0.014	*
CR53	1732780.30	6450324.19	780.70	0.02	0.00	-0.03			2013	0.01	0.00	-0.03	351	0.01	0.017	*
FT06	1729854.81	6452760.04	488.62	-0.80	-0.17	-0.44	#####	0.82	2007	-0.05	####	-0.02	194	0.05	0.014	
FT07	1729252.07	6454102.93	588.60	-1.18	-1.83	-0.41	#####	2.17	2007	-0.06	####	-0.03	212	0.07	0.022	
FT08	1729388.65	6453350.50	658.40	-0.04	0.00	-0.04	#####	0.04	2007	-0.02	####	-0.01	215	0.02	0.014	
KC01	1728475.80	6452457.57	312.26	-0.98	-0.66	-0.62	#####	1.18	1994	-0.03	####	-0.02	235	0.05	0.015	
KC02	1727002.45	6452118.80	13.71	-0.44	-0.19	-0.13	#####	0.48	1995	-0.02	####	0.00	242	0.05	0.015	
KC05	1727081.88	6453178.85	227.45	-0.12	-0.24	-0.40	#####	0.27	1994	-0.01	####	0.00	254	0.03	0.016	
KC06	1727784.84	6453398.17	299.83	-0.07	-0.50	-0.52	#####	0.50	1994	-0.01	####	-0.02	262	0.05	0.014	
KC07	1727759.42	6453683.86	313.44	0.23	-0.05	-0.39	#####	0.23	1994	0.01	0.00	-0.03	22	0.01	0.018	*
KC13	1726581.00	6453069.56	191.06	-0.15	-0.08	-0.14	#####	0.17	2007	0.02	####	0.00	295	0.05	0.015	
KC14	1726742.45	6453805.97	259.89	0.01	-0.08	-0.05	#####	0.09	2007	0.01	####	-0.01	292	0.03	0.015	
KC15	1727590.31	6453120.91	287.01	-0.15	-0.18	-0.09	#####	0.23	2007	0.01	####	-0.03	302	0.02	0.016	*
KC16	1727602.25	6454098.22	326.85	0.00	-0.01	-0.05	#####	0.01	2007	0.01	####	-0.04	282	0.02	0.016	*
KC17	1727302.75	6453026.38	215.20	-0.01	-0.04	-0.05	#####	0.04	2012	0.01	####	-0.04	290	0.03	0.014	
PB04	1727564.12	6448848.37	166.52	-11.82	-3.37	-4.00	#####	12.29	1994	-0.33	####	-0.13	196	0.34	0.019	
PB06	1727933.95	6449757.93	177.04	-34.40	-3.91	-6.02	#####	34.71	1995	-0.37	####	-0.09	189	0.38	0.018	
PB07	1720132.70	6450211.72	157.35	-43.15	-8.04	-2.86	#####	43.80	1995	-0.48	####	-0.05	192	0.49	0.019	
PB08	1728196.75	6450462.53	194.25	-40.76	-7.27	0.57	#####	41.40	1994	-0.45	####	0.00	190	0.46	0.023	
PB09	1728242.33	6450848.53	188.45	-46.25	-2.49	-4.07	#####	46.32	1994	-0.67	####	-0.13	181	0.67	0.022	
PB12	1728250.70	6451582.26	183.23	-79.79	#####	#####	#####	82.85	1994	-1.65	####	-0.43	198	1.74	0.017	
PB13	1728039.26	6452146.51	206.42	-46.71	#####	-4.12	#####	50.00	1995	-1.09	####	-0.10	208	1.20	0.019	
PB18	1730430.78	6450719.90	362.90	-16.12	8.91	-4.68	#####	18.42	1995	-0.01	####	-0.04	225	0.02	0.015	*
PB20	1728737.75	6451123.48	231.38	-75.02	#####	#####	#####	76.00	1995	-1.42	####	-0.35	195	1.47	0.017	
PB21	1729239.17	6451178.78	271.89	-59.05	6.73	-8.13	#####	59.43	1995	-0.61	0.07	-0.10	174	0.61	0.018	
PB25	1729670.12	6451986.19	325.91	-32.20	0.55	-3.08	#####	32.20	1994	-0.07	####	-0.03	207	0.08	0.013	
PB26	1729538.39	6452252.09	282.88	-24.26	2.53	-2.46	#####	24.39	1995	-0.03	####	-0.01	194	0.03	0.014	
PB27	1729238.94	6451842.44	270.56	######	6.38	#####	#####	#####	1995	-1.65	####	-0.26	180	1.65	0.019	
PB29	1728838.03	6452091.66	169.49	-50.92	#####	#####	#####	58.51	1995	-1.10	####	-0.38	204	1.20	0.019	
PB54	1729690.63	6450448.44	357.61	-4.27	-0.25	-1.01	#####	4.28	1997	-0.03	####	-0.12	217	0.04	0.019	
PB55	1728772.40	6450801.12	239.21	-39.88	-2.93	-7.12	#####	39.99	1998	-0.53	####	-0.26	185	0.53	0.036	
PB59	1727756.55	6448659.23	158.33	-9.92	-2.44	-5.07	#####	10.11	2001	-0.54	####	-0.27	194	0.55	0.022	
PB64	Discontinued															
PB65	1728454.01	6449707.67	287.61	-0.66	-0.15	-0.14	#####	0.68	2010	-0.06	####	-0.05	208	0.07	0.014	
PB66	1729196.07	6450969.99	288.10	-1.58	0.07	-0.22	#####	1.58	2012	-0.59	0.04	-0.09	176	0.59	0.019	
PB67	1727634.20	6450857.60	75.40	-4.53	-0.58	-0.61	#####	4.56	2014	Overall = Periodic = 4.5 month					0.05	
UH02	1727515.23	6450143.07	62.57	-65.89	9.28	-4.58	#####	66.54	1997	-0.81	0.13	-0.05	171	0.82	0.018	

PORTUGUESE BEND LANDSLIDE MONITORING - MOVEMENT DATA POSTING as of February 7, 2015

Prepared by McGee Surveying Consulting - Document date: 02/12/2015

Monitoring Point Movements

PARTIAL MID-YEAR MONITORING

Notes:

* Indicates no signal of horizontal movement detected in the last period at the 95% level of confidence

	February 7, 2015 Positions			Overall Movements (US Feet)						Periodic (4.5 months) Movements (US Feet)						
	NAD83 SPC Zone 5 (Ft)		NAVD88	Original Position to February 7, 2015						Sept. 19, 2014 Position to Feb. 7, 2015						
Point	North (ft)	East (ft)	Elev(ft)	North	East	Height	Azim.°	Dist.	Year	North	East	Height	Azim.°	Dist.	95%Err	Note
AB04	1728389.92	6447121.45	67.16	-2.08	-1.89	-0.41	222	2.81	1994	####	####	0.01	234	0.05	0.011	
AB12	1729415.15	6448271.04	203.14	-1.34	-0.61	-0.29	204	1.47	1994	####	####	-0.02	236	0.03	0.013	
AB16	1730358.55	6447532.12	376.37	-0.34	0.00	-0.25	180	0.34	1994	0.00	0.00	-0.03	27	0.00	0.014	*
AB17	1731421.10	6446727.77	442.73	-0.02	0.00	-0.07	193	0.02	2007	0.00	0.00	0.00	153	0.00	0.013	*
AB20	1729359.37	6449685.81	396.18	-1.26	-0.45	-0.25	200	1.33	1995	####	####	-0.01	219	0.01	0.006	*
AB50	1728084.50	6448247.13	181.97	-0.50	-1.05	-0.01	245	1.17	1998	####	####	-0.02	232	0.02	0.012	
AB59	1730650.15	6450212.46	434.18	-0.72	-0.09	-0.19	187	0.73	2007	####	####	0.00	223	0.02	0.012	
AB60	1729089.32	6447987.41	179.29	-0.38	-0.16	-0.16	203	0.42	2007	####	####	-0.02	194	0.02	0.012	
AB61	1727424.49	6447990.25	140.39	0.00	0.00	-0.08	225	0.00	2007	0.00	####	-0.02	236	0.01	0.006	*
AB65	1731705.60	6448264.07	458.44	-0.08	0.01	-0.09	175	0.08	2012	####	####	-0.03	198	0.07	0.012	
CR07	1731627.84	6451203.40	632.06	-0.94	0.21	-1.22	168	0.96	1994	0.01	0.03	0.00	71	0.03	0.013	
CR50	1733013.57	6451037.36	672.61	-0.05	-0.01	-0.05	195	0.05	1998	0.00	0.00	0.01	162	0.00	0.013	*
FT06	1729854.78	6452760.02	488.59	-0.83	-0.19	-0.47	193	0.85	2007	####	####	-0.04	214	0.03	0.012	
FT07	1729252.07	6454102.90	588.60	-1.18	-1.86	-0.41	238	2.20	2007	0.00	####	0.00	270	0.03	0.016	
KC06	1727784.85	6453396.17	299.82	-0.06	-0.50	-0.53	263	0.50	1994	0.00	0.00	-0.01	63	0.00	0.012	*
KC07	1727759.43	6453683.88	313.44	0.23	-0.04	-0.39	350	0.24	1994	0.01	0.01	0.00	55	0.02	0.013	
KC13	1726581.01	6453069.57	191.06	-0.15	-0.06	-0.14	202	0.16	2007	0.00	0.02	0.00	79	0.02	0.011	
KC16	1727602.24	6454098.21	326.93	-0.01	-0.02	-0.07	249	0.02	2007	####	####	-0.01	228	0.01	0.013	*
KC17	1727302.75	6453026.37	215.20	-0.01	-0.05	-0.05	255	0.05	2012	0.00	####	0.00	249	0.01	0.013	*
PB04	1727652.70	6448849.31	166.38	#####	-3.43	-4.14	196	####	1994	####	####	-0.14	188	0.42	0.015	
PB12	1728250.00	6451582.01	183.04	#####	#####	#####	196	####	1994	####	####	-0.19	200	0.74	0.016	
PB13	1728038.79	6452146.31	206.37	#####	#####	-4.17	201	####	1995	####	####	-0.05	203	0.51	0.016	
PB18	1730430.74	6450719.89	362.86	#####	8.89	-4.72	151	####	1995	####	####	-0.04	214	0.03	0.014	
PB26	1729538.35	6452252.08	282.85	#####	2.52	-2.49	174	####	1995	####	####	-0.03	196	0.04	0.012	
PB59	1727755.91	6448659.11	158.00	#####	-2.56	-3.39	194	####	2001	####	####	-0.33	190	0.65	0.015	
PB66	1729195.76	6450970.00	288.04	-1.88	0.08	-0.28	178	1.89	2012	####	0.01	-0.06	177	0.31	0.015	
PB67	1727630.86	6450857.29	74.95	-7.87	-0.89	-1.06	185	7.92	2014	####	####	-0.45	185	3.36	0.016	

PORTUGUESE BEND LANDSLIDE MONITORING - MOVEMENT DATA POSTING as of April 16, 2015 — Page 12/12

Prepared by McGee Surveying Consulting - Document date: 06/10/2015

Monitoring Point Movements

PARTIAL MID-YEAR MONITORING

Notes:

* Indicates no signal of horizontal movement detected in the last period at the 95% level of confidence

	April 16, 2015 Positions			Overall Movements (US Feet)						Periodic (4.5 months) Movments (US Feet)						
	NAD83 SPC Zone 5 (Ft)		NAVD88	Original Position to April 16, 2015						February 7, 2015 Position to April 16, 201						
Point	North (ft)	East (ft)	Elev(ft)	North	East	Height	Azim.°	Dist.	Year	North	East	Height	Azim.°	Dist.	95%Err	Note
AB04	1720389.92	6447121.46	67.14	-2.07	-1.88	-0.43	222	2.80	1994	0.00	0.01	-0.02	72	0.01	0.01	*
AB12	1729415.16	6448271.06	283.15	-1.32	-0.58	-0.28	204	1.45	1994	0.02	0.03	0.02	58	0.03	0.02	
AB16	1730358.54	6447532.13	376.42	-0.35	0.00	-0.20	179	0.35	1994	####	0.01	0.05	157	0.02	0.02	*
AB17	1731421.09	6446727.74	442.84	-0.04	-0.04	0.03	227	0.05	2007	####	####	0.10	247	0.04	0.02	
AB20	1729359.37	6449685.83	396.22	-1.25	-0.44	-0.21	199	1.33	1995	0.00	0.01	0.04	75	0.01	0.01	*
AB50	1728084.50	6448247.14	181.99	-0.50	-1.04	0.01	244	1.16	1998	0.00	0.01	0.02	96	0.01	0.01	*
AB59	1730850.15	6450212.48	434.22	-0.72	-0.07	-0.15	186	0.72	2007	0.00	0.02	0.05	90	0.02	0.01	
AB60	1729089.36	6447987.42	179.29	-0.36	-0.15	-0.16	202	0.39	2007	0.02	0.01	0.00	30	0.02	0.02	*
AB61	1727424.50	6447990.27	140.40	0.00	0.01	-0.07	95	0.01	2007	0.00	0.01	0.01	86	0.01	0.01	*
AB65	1731705.61	6449264.10	458.50	-0.07	0.03	-0.04	157	0.08	2012	0.01	0.02	0.05	69	0.02	0.02	*
CR07	1731627.86	6451203.38	632.12	-0.92	0.19	-1.16	168	0.94	1994	0.02	####	0.06	331	0.02	0.02	*
CR50	1733013.58	6451037.36	872.68	-0.04	-0.01	0.02	197	0.04	1998	0.01	0.00	0.07	9	0.01	0.02	*
FT06	1729854.79	6452760.04	488.64	-0.82	-0.17	-0.42	192	0.84	2007	0.01	0.02	0.05	63	0.02	0.01	
FT07	1729252.07	6454102.89	588.66	-1.18	-1.87	-0.35	238	2.21	2007	0.00	####	0.06	288	0.01	0.02	*
KC06	1727784.86	6453396.19	299.84	-0.05	-0.47	-0.51	264	0.48	1994	0.01	0.02	0.02	60	0.03	0.01	
KC07	1727759.43	6453683.87	313.46	0.24	-0.04	-0.37	350	0.24	1994	0.01	0.00	0.02	329	0.01	0.02	*
KC13	1726580.98	6453069.57	191.07	-0.17	-0.06	-0.13	200	0.18	2007	####	0.00	0.01	188	0.02	0.01	
KC16	1727602.24	6454098.23	326.86	-0.01	0.00	-0.04	193	0.01	2007	0.00	0.02	0.02	90	0.02	0.01	
KC17	1727302.76	6453026.40	215.22	0.00	-0.02	-0.03	261	0.02	2012	0.01	0.03	0.02	70	0.03	0.02	
PB04	1727663.58	6448848.28	166.33	#####	-3.46	-4.19	196	####	1994	####	####	-0.05	196	0.12	0.02	
PB12	1729249.71	6451581.94	183.00	#####	#####	#####	196	####	1994	####	####	-0.04	194	0.30	0.02	
PB13	1728038.62	6452146.23	206.35	#####	#####	-4.19	201	####	1995	####	####	-0.01	200	0.18	0.03	
PB18	1730430.75	6450719.89	362.92	#####	8.90	-4.66	151	####	1995	0.01	0.00	0.05	20	0.01	0.02	*
PB26	1728538.34	6452252.09	282.92	#####	2.53	-2.42	174	####	1995	####	0.00	0.07	176	0.01	0.02	*
PB59	1727755.70	6448659.09	157.91	#####	-2.58	-5.48	194	####	2001	####	####	-0.09	187	0.21	0.02	
PB66	1729195.63	6450970.01	288.09	-2.01	0.09	-0.24	177	2.02	2012	####	0.01	0.04	177	0.13	0.03	
PB67	1727629.43	6450857.10	74.79	-9.30	-1.08	-1.23	187	9.36	2014	####	####	-0.17	188	1.45	0.02	

Survey Report
of the
Portuguese Bend Landslide Monitoring Survey
October 4, 2013 Full & April 7, 2014 Partial Monitoring
Revised May 24, 2014
for the
City of Rancho Palos Verdes
by
McGee Surveying Consulting

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Survey Report
of the
Portuguese Bend Landslide Monitoring Survey
October 4, 2013 Full Monitoring
(See Page 17 for the April 7, 2014 Partial Monitoring)
Revised May 24, 2014
for the
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by
McGee Surveying Consulting

PROJECT OVERVIEW:

McGee Surveying Consulting performed landslide monitoring and control surveys in October 2012 at Portuguese Bend in Los Angeles County, California on behalf of the City of Rancho Palos Verdes. The survey established positions on monitoring points to determine overall and periodic movements. The results of the survey are described in this Report and on an attached spreadsheet titled "Portuguese Bend Landslide Monitoring - Movement Data Posting" hereafter referred to as "Movement Data Posting".

The field survey was planned, coordinated and executed by Michael McGee, PLS3945 of McGee Surveying Consulting who was also responsible for the final processing of the observations, network adjustments, analysis and reports. The monitoring points cover a 1½ mile square area and are measured semi-annually to determine the rate and extent of ground movement. Global Navigation Satellite System (GNSS formerly referred to as GPS) technology was used to measure positions based on the North American Datum of 1983 (NAD83) and the North American Vertical Datum of 1988 (NAVD 88). This survey is referenced to the California CGPS (Continuous GPS) Stations in the region which are permanently mounted GPS receivers used for monitoring seismic activity. The CGPS in California are similar to the national CORS (Continuously Operated Reference Stations).

Points that move a few inches or less per year are required to meet an accuracy standard of one centimeter (0.033 feet) at the 95% Level of Confidence. In the active slide area where the movements exceed 0.5 feet per year (PB and UB points in the central area), the accuracy standard is two centimeters (0.066 feet). Field procedures are designed to accomplish this purpose and Quality Control-Quality Assurance (QAQC) processes discussed hereafter are incorporated to verify these accuracies are attained.

The movements reported between September 14, 2012 and October 4, 2013 (12.7 months) statistically attained an average accuracy of 0.02 feet at the 95% Level of Confidence. The actual accuracy of measurements held to the one centimeter standard are estimated to approach 0.01 feet as demonstrated by the vector residuals, repeatability of measurements at points considered stable, and the analysis of movement deflections. Refer to the sections titled ACCURACY and QAQC ANALYSIS in this Report for more information.

HISTORY

This monitoring survey is a continuation of a program initiated by the County of Los Angeles and taken over by the City of Rancho Palos Verdes circa 1994. McGee Surveying Consulting has conducted the field surveys and reporting since September 2007. See the September 2007 Survey Report for a history of the previous survey process between 1994 and 2007. See the subsequent annual Survey Reports for details of each monitoring campaign. Beginning with the 2012 rainy season (begins in September) full monitoring continued as usual and a partial monitoring was initiated in the spring.

PROJECT DATUMS, REFERENCE SYSTEM

Horizontal Datum: North American Datum of 1983 (NAD83) established by the National Geodetic Survey (NGS); **Epoch:** 2007.00 referred to as NAD83(2007); **Units:** Feet

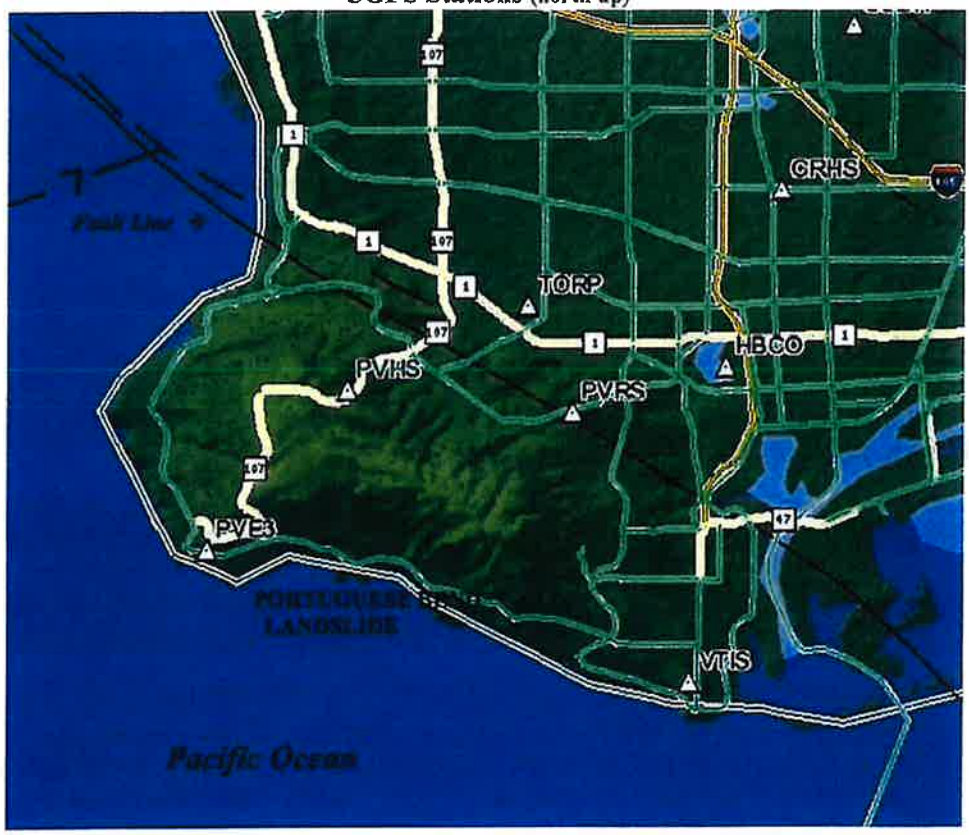
Reference Network: The survey is referenced to the CGPS Stations (continuously operating GNSS receivers). For more information see NGS Data Sheets for the PID's listed below (no data sheet exists for PVE3). The positions listed below were obtained in September 2007 from the California Spatial Reference Center (CSRC). The CSRC provides CA Public Resources Code sanctioned positions for the California CGPS Stations.

CGPS	Latitude(dms)	Longitude(dms)	EH(feet)	NGS PID	NAME
PVE3	33 44 35.853290	-118 24 15.269036	235.42	none	PALOS VERDES CORS
PVHS*	33 46 46.020150	-118 22 19.741258	853.99	AJ1915	PENINSULA HIGH SCH
PVRS**	33 46 25.891904	-118 19 14.067218	198.63	AJ1916	PALOS VERDES RES
VTIS	33 42 45.489584	-118 17 37.712290	197.52	AJ1936	MARINE EXCHANGE

* Not Operational During Survey

** Falls in the proximity of a Fault Line as shown below but appears unaffected to date

CGPS Stations (north up)



Vertical Datum: North American Vertical Datum of 1988 (NAVD88) established by the NGS.
Geoid Model: Geoid 03; note Geoid09 became available from the NGS in 2009 and Geoid12A in 2012; however, Geoid03 is retained to be consistent with prior reported heights and the primary purpose of determining relative changes over time.

Reference Network: CGPS Station VTIS is also a Second Order leveled benchmark and the original basis for the heights by this survey (see NGS Data Sheets for PID's listed above)

CGPS	NAVD88 Ht(feet)	
PVE3	none	
PVHS	972.1	Based on a Refined Geoid Model
PVRS	316.37	Based on Second Order Leveling by CSRC
VTIS	315.26	Based on Second Order Leveling by CSRC and original basis for this survey

Projection: NAD83 California State Plane Coordinates Zone 5: The State Plane Coordinate Parameters follow: The average Scale Factor is 1.00007543, the Height Reduction Factor based on the average ellipsoid heights is 0.99999092, and the average Combined Grid Factor is 1.00006635. Distances in this survey are grid. To obtain ground distances divide grid distances by the Combined Grid Factor. Grid bearings resulting from this survey must be rotated by a Convergence Angle to obtain geodetic (true) bearings. The average convergence angle is -0-12-30± (rotate left 0-12-30).

Datum Stability: The NAD83(2007) Epoch 2007.00 adjustment is one of a series of adjustments of NAD83 since its adoption in 1986 and is the realization used for the monitoring surveys since 2007. Rancho Palos Verdes sits on the Pacific Plate which is moving west-northwesterly relative to the North American Plate about 4 centimeters (0.14 feet) per year. The area southwesterly of the Fault Line shown on the above map includes the City and is moving at a constant rate as exhibited by the ITRF08 N, E, Up velocities of the CGPS Stations listed below. These CGPS Stations provide a rigid reference frame for the Portuguese Bend Landslide Monitoring Program that is validated during each monitoring campaign. See the Adjustment results on Page 9 and the September 2007 Monitoring Survey Report by McGee Surveying Consulting for additional information.

Annual Velocities in Feet
Reference Epoch 2013.75

CGPS	North	East	Up
PVE3	0.064	-0.131	-0.002
PVHS	0.063	-0.130	-0.002
PVRS	0.062	-0.129	0.001
VTIS	0.064	-0.130	0.000

FIELD SURVEYS, DATA COLLECTION, EQUIPMENT & PROCESSING

Three Leica geodetic GNSS receivers/antennas listed below were mounted on two meter fixed height poles to collect and store satellite signal data. The GS15 receivers tracked Navstar GPS and GLONASS satellites. Prior to initiating the field observations a calibration of the fixed height poles was conducted with a theodolite to verify their heights and plumb. The top of the poles were found to be plumb within 0.003 feet of the bottom consistent with prior years. Additional checks were made each day. There were no equipment failures.

Sixty-five monitoring points were occupied and reported in this survey. Site photographs and recovery sheets detailing the location, character of the monuments and obstructions were updated. See the Appendix for "Monitoring Point Status for 2014. Monument AB61, established in September 2007 on Portuguese Bend, is used as the primary base station because it sits on a stable basalt formation. AB61ECC serves as a reference to AB61. AB20 serves as a secondary base for the survey.

The field survey commenced each day by setting a Leica GS15 GNSS receiver on a fixed height pole on AB61 and AB20 while a third GS15 GNSS receiver roamed freely collecting observations on a fixed height pole at the other 63 points. All points were measured with two independent occupations resulting in four measured vectors to each point from AB81 and AB20. On each day over a six day period, vectors based on 4-11 hours of observations connected AB61, AB20 and the CGPS stations. Sixteen points, in the active areas, with annual movements greater than 0.3' (PB and UB areas) were single occupied. A linear comparison was made with movements from prior years to verify their accuracy met the 0.07 foot (2 cm) requirement. All other points were occupied twice under a different constellation of satellites on a different day. If the two measurements were within 0.03 feet (1 cm) horizontally they were accepted, otherwise a third measurement was obtained.

Many of the points are over-shadowed by mature trees and shrubberies which interfere with signals received from satellites and affect the quality of measurements. To obtain the best possible accuracies, the satellite constellation is compared with obstruction diagrams to estimate the best time for observing un-obstructed satellites. Satellites obstructed by foliage and trees are either turned off during the observation or noted for removal in post-processing. If six or more un-obstructed satellites with a GDOP (measure of the geometry of the constellation) of 4 or less are available, then the measurement commenced for a minimum of 15 minutes of data collection. If the geometry and number of satellites are insufficient then the receiver was moved to the next point and returned later when satellite availability improved.

Date of Survey: 10/01/13 to 10/06/13 (mean date 10/04/2013) between 0600-1800 PDST (+7 hrs for UTC).
GNSS Survey Parameters:
Constellation: 30 US NAVSTAR GPS satellites and 23 Russian GLONASS satellites.
Observables: GPS L1 & L2 Carrier Waves and Codes; GLONASS L1 & L2
Epoch Rate & Occupation Times: 10 seconds for 15 minutes and 4-11 hours for base stations
Satellites: 12-17; GDOP < 2.2; Elevation Mask for Data Collection 10° and Processing: 15°
Ephemeris: Rapid for Static Post-Processing for CGPS connections and Broadcast for onsite.
Weather: Generally clear skies, temperature 63°-91° F.
Space Weather: Boulder K Index was 1-3 except it reached 5 in the afternoon of 10/02/13 (gauges ionospheric activity on a scale of 0-9, <5 preferred).
Equipment:
GNSS Base Receiver Unit No.: M5, Operator: M. McGee, PLS; Station Occupied: AB61 (Base1)
Make & Model: Leica GS15; Antenna Leica GS15; Mount: Fixed Height Pole #1; Antenna Height: 1.803m
GNSS Rover Receiver Unit No.: M6, Operator: M. McGee, PLS;
Make & Model: Leica GS15; Antenna Leica GS15; Mount: Fixed Height Pole #3; Antenna Height: 1.800m
GNSS Rover Receiver Unit No.: M7, Operator: M. McGee, PLS, Station Occupied: AB20 (Base2)
Make & Model: Leica GS15; Antenna Leica GS15; Mount: Fixed Height Pole #2; Antenna Height: 1.803m

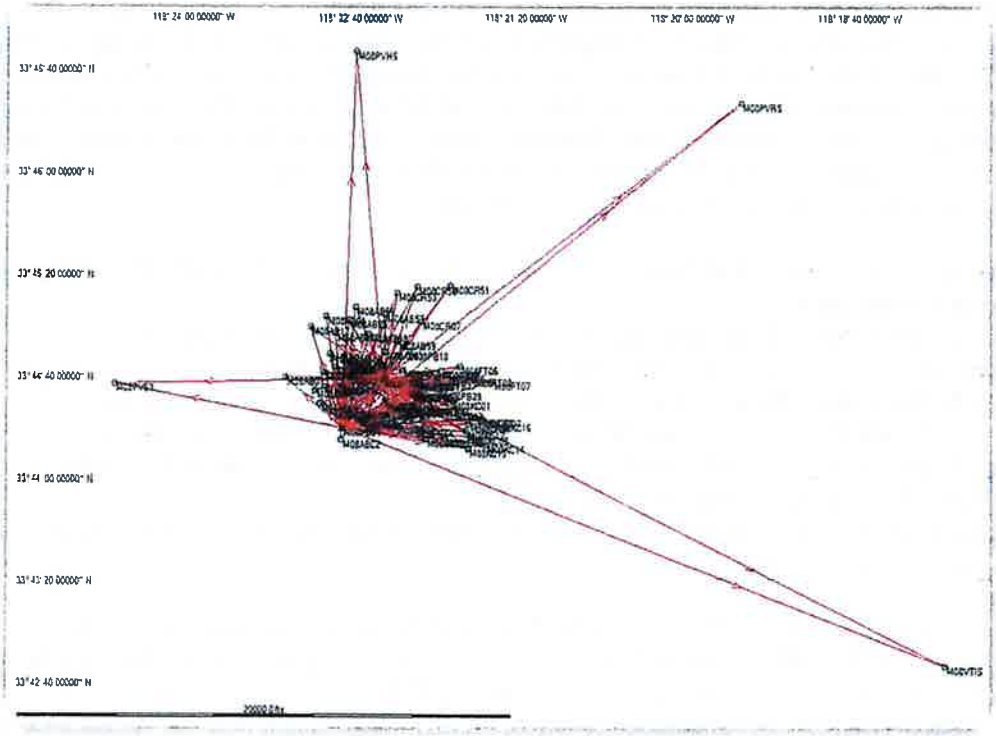
Vectors were processed using Leica LGO v8.1 post processing software. Analysis of residuals led to the rejection of 3 out of 50 vectors connecting the CGPS Stations to AB61 and AB20, and 10 out of 226 vectors connecting monitoring points. Network adjustments and analysis were performed with "Starnet-PRO" version 7.2.0.21 software. Rinex files of the satellite measurements for the CGPS Stations were downloaded from the SOPAC website. The Rapid Ephemeris and Absolute Antenna Models were downloaded from the NGS website.

NETWORK

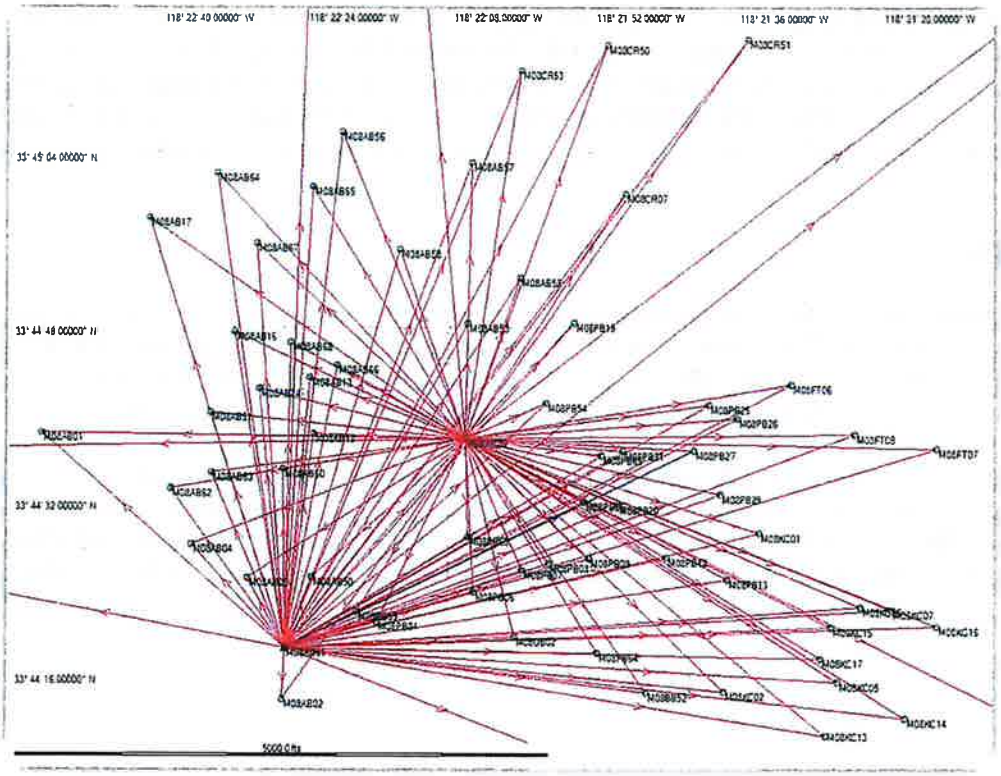
AB61, the primary Base Station, sits on Portuguese Bend and is the focal point of the static network connecting the monitoring points and CGPS Stations. AB20, the secondary Base Station is centrally located sitting on top of a high bluff overlooking Portuguese Bend. Sixty-five points and four CGPS Stations were connected with 263 redundant vectors. See the following Network Maps and the Aerial View in the Appendix.

The monitoring plan uses the CGPS Stations to verify the stability of the reference frame. The primary CGPS Station used to control this survey is PVE3 located just south of City Hall and 1.8 miles west-northwest of the Base Station AB61. CGPS Station PVHS is 2.8 miles north, PVRS is 3.9 miles northeast, and VTIS is 4.9 miles east-southeast of AB61, as shown on the Network diagram, are used to validate the stability of the network.

Monitoring Network with CGPS Stations (north up)



Monitoring Network (north up)



MONITORING POINT HISTORY and STATUS

For data management purposes during the field survey and data processing, the point names were prefixed with "M08" to distinguish between the different monitoring surveys i.e. AB61 was named M08AB61. M08 indicates this survey is the 8th monitoring since the initial September 2007 Monitoring Survey. The prefix is stripped in the COORDINATES LIST and MOVEMENT DATA POSTING.

Between 1994 and 2006, 149 monitoring points were established to monitor the Portuguese Bend Landslides, many of which were lost or destroyed. Sixty of the original points were recovered in 2007. Eight of the 60 points were deleted because they were in close proximity of other points better suited for GNSS satellite measurements leaving 52 points monitored and reported between September 2006 and September 2007. Three of the 52 points (AB09, KC11, PB51) were monitored in September 2007 for the last time because they were replaced by new points, set nearby and better suited for satellite observations. Eighteen new points were set in 2007 and had their movements reported for the first time in the following December 2008 survey. Therefore, in December 2008, 49 original and 18 new points were surveyed for a total of 67 monitoring points.

In the September 2007 Report, it was noted that KC01 was previously reported by others on 9/14/2006 to have moved N 29°E 1.24' from its 12/9/2005 position. In the 2008 survey, a buried partially illegible brass cap in concrete stamped "COUNTY ENGINEER RE8869 1956 STA ??IELDS" was found S31°29'W 1.48 feet from the 1" IP was used in the initial September 2007 and subsequent surveys. The original 1994 position of KC01 was re-referenced to the 1" IP, resulting in correct overall reported movements.

In the December 2008 Report, it was noted that AB05 had been disturbed by a mowing machine. AB05 was found chipped and leaning to southerly about 0.4'. The movement reporting resumed in 2009. Analysis of the movement and historic data made it possible to estimate the disturbance to within 0.05'. The original 1995 position of AB05 was re-referenced S14°02'E 0.29' to be consistent with the disturbed position, resulting in correct overall reported movements.

In 2009, PB64 was set east of the Archery Range to replace PB63 (set 2007) which had become unsafe to access and was lost in 2010.

In 2010, points AB03 and BB25 were discontinued. AB03 is on the edge of a cliff 192 feet west-southwest of AB61 making it redundant, and BB25 is on an unstable rock disturbed by wave action. In the summer of 2010, PB62 was destroyed by road construction. In October 2010, PB65 was set 24' south-southwest of PB62 and reported for the first time in October 2011. The following points may have been disturbed prior to the October 2010 survey. AB05 appears to have been disturbed by mower machinery, AB15 (½" GIP in a meter box) is being driven over by vehicles occasionally accessing an adjacent field, and KC02 (½" GIP in a meter box) is occasionally parked on by vehicles accessing the beach.

In October 2011, new points AB62 and AB63 (initially referred to as AB62R and AB63R) were set to replace AB06 and AB07 which were hazardous to occupy due to their location near the traveled way of Palos Verde Drive South.

Prior to initiating the September 2012 survey, eight new monuments AB64, AB65, AB66, AB67, AB68, CR53, KC17 and PB66 were constructed to replace AB54, AB18, AB52, AB55, AB15, CR52, KC04 and PB53 respectively. The monuments were replaced because of poor sky visibility except for KC04 which was difficult to access and AB55 which was destroyed by trenching in the past year. Monuments were set with the following design. Monuments set in soil are 1" x 5' GIP driven flush with a 6" PVC pipe sitting on a concrete collar down about 18". Monuments set in asphalt are 1/2" x 2' rebar driven below the surface inside a free floating concrete collar.

In September 2012 points AB15, AB18, AB52, AB54, CR52, KC04 and PB53 were surveyed for the last time and discontinued in October 2013. In April 2014 point PB64 was surveyed for the last time and PB67 (a 5' t-bar steel post driven 3' into the ground) was set as a replacement about 300' northerly to be reported in the fall 2014 survey. See the "Monitoring Point Status for 2014 Prepared December 17, 2013" for the present status of monitoring points in the Appendix.

ADJUSTMENTS & ANALYSIS

Adjustment 1: Minimally Constrained Adjustment processed to develop NAD83 (2007) 2007.00 Epoch Geodetic, Ellipsoid and State Plane Coordinates.
Fixed Control: CGPS Station PVE3 was fixed at its published NAD83 (2007) position in a Minimally Constrained Adjustment to determine positions and verify its stability relative to other CGPS stations. PVE3 is located 2 miles west of and outside the influence of the slide area. PVE3 has been fixed in all adjustments since 2007. The CSRC publishes a Time Series for the horizontal and vertical stability of PVE3 which indicate the position has been stable since 2007. The primary base station AB61 and three other CGPS Stations were measured relative to PVE3 and used to assess stability of the survey reference frame. The positions are based on 4 to 11 hour measurements collected on six consecutive days. The coordinate differences at the CGPS Stations from previous positions to the present are listed below in feet.

09/2012 Positions to 10/2013					9/2007 Positions to 09/2012			
Station	dN	dE	dZ		Station	dN	dE	dZ
PVE3	0.000	0.000	0.000	< Fixed >	PVE3	0.000	0.000	0.000
PVHS*	0.002	0.000	0.005					
PVRS	0.003	0.008	-0.052		PVRS	-0.003	0.013	0.039
VTIS	0.004	0.007	-0.069		VTIS	-0.009	0.004	0.012
AB61	-0.007	0.002	-0.034	<Base Station>	AB61	-0.011	0.006	-0.015
AB17	0.005	-0.012	0.013					
KC16	0.008	0.009	0.014					

* The position for PVHS is from November 2009.

The following is noted: (1) the two dimensional (2D) differences in the measured positions of the September 14, 2012 and October 4, 2013 of the three CGPS Stations range 0.002 to 0.008 feet and 0.007 feet at AB61; (2) the 2D differences of the CGPS Stations from the initial 2007 survey to the September 2012 survey range 0.010 to 0.013 feet and 0.012 feet at AB61; and (3) points AB17 and KC16 have a stable history when comparing their 2007 positions with this survey indicating a repeatability of approximately 0.01 feet as listed in the attached "MOVEMENT DATA POSTING". The vertical components are within 0.014 feet.

The vertical differences at PVRS and VTIS are larger than expected; however, AB17 and KC16 checks 0.014 feet indicating the vertical reference frame has been recovered on site. Equipment changes have occurred at the CGPS stations in the last year and may have contributed to the differences noted. At the next monitoring this issue will be investigated further.

The survey reference frame is deemed stable and successfully recovered at the level of 0.01 feet horizontally by 0.02 feet vertically as indicated. An adjustment constrained to the CGPS Stations is not preferred or necessary because the purpose here is to track their positions over time to test the stability of the reference frame. See the "COORDINATE LIST – October 4, 2013" in the Appendix for a list of coordinates resulting from this adjustment. See prior Survey Reports for coordinates resulting from earlier surveys.

Adjustment 2: Minimally Constrained Adjustment to develop Orthometric Heights (Elevations) in NAVD88
Fixed Control: The CGPS Station PVE3 was fixed horizontally and vertically at its NAVD88 orthometric height determined in the September 2007 survey. The 2007 height was based on the published 2nd Order NAVD88 Height of CGPS Station VTIS. This Adjustment combined the measured ellipsoid height differences with the NGS Geoid 03 (models the separation between the ellipsoid and geoid surfaces) to determine NAVD88

orthometric heights of the other CGPS Stations and the monitoring points. The differences for the CGPS stations from the previous survey to the heights determined in the present survey are listed below in feet.

09/2012 to 10/2013		10/2011 to 09/2012	
PVE3	-0.000 Fixed	PVE3	0.000 Fixed
PVHS	0.005		
PVRS	-0.052	PVRS	0.015
VTIS	-0.069	VTIS	-0.005

Note: As noted above the vertical differences at PVRS and VTIS will be investigated in the next monitoring; however, the differences at AB17 and KC16 verify the accuracy on site is at the level of 0.014 feet. See the "COORDINATE LIST – October 4, 2013" Survey" in the Appendix for a list of heights resulting from this survey.

ACCURACY

These surveys conform to the intent of the Federal Geodetic Control Subcommittee (FGCS) "Specifications for GPS Relative Positioning" (1988) and the California Geodetic Control Committee (CGCC) "Specifications for High-Production GPS Surveying Techniques" (1993).

Vectors & Residuals: The number of vectors, vector lengths, two dimensional residuals and the absolute value of the vertical residuals resulting from Adjustment #1 are listed below in feet.

		Vector Lengths		Two Dimensional Residuals			Vertical Residuals (absolute)		
Network	No.	Vary	Average	Average	Std.Dev.	Maximum	Average	Std.Dev.	Range
Monitoring	216	479-7182	3168	0.008	0.005	0.029	0.013	0.013	-0.09 to +0.05
CGPS	47	9397-26102	18031	0.011	0.007	0.029	0.031	0.022	-0.09 to +0.07

Local Accuracy: The precisions and accuracy of vectors resulting from the minimally constrained adjustment at the 95% Level of Confidence are listed below in feet.

	PPM Precisions	Relative Distance Error		
Network	Average	Average	Maximum	Av.Precision
Monitoring	8.5 ppm	0.019	0.066	1: 167,000
CGPS	0.4 ppm	0.005	0.007	1:3,606,000

The precision ratio, based on the averages for all vectors connecting the Monitoring Points, exceeds the criteria for a First Order (C-1) by a factor of 1.7. The precision ratio for vectors connecting AB61, AB20 and the CGPS Stations exceeds the criteria for a B Order survey by a factor of 3.6 per the FGCS requirements for the former classification system.

Coordinate Accuracy: The Standard Deviations (68% Level of Confidence) of the coordinates derived from Adjustment #1, relative to the CGPS Station PVE3 follow in feet.

	Monitoring Point			CGPS Stations		
	North	East	Up	North	East	Up
Average Standard Deviation	0.008	0.008	0.036	0.003	0.003	0.010
Maximum Standard Deviation	0.021	0.024	0.101	0.003	0.004	0.012

Network Accuracy: The network accuracy (absolute accuracy) is expected to be less than 0.02 feet horizontal relative to the NAD83 Datum based on the CGPS Station PVE3 fixed in Adjustment #1.

NAVD88 Heights: The North American Vertical Datum of 1988 orthometric heights resulting from Adjustment #2 are derived from the difference in ellipsoid heights combined with the Geoid 03 model and constrained to the height of PVE3 determined in 2007. The measured ellipsoid heights relative to PVE3 are expected to be less than 0.04 feet but may be greater at obstructed sites. The absolute accuracy of the heights relative to the datum is dependent on the published value on the CGPS Station VTIS.

Although relative elevation accuracies can be within 0.03 feet, up until October 2011 there were no requirements for vertical accuracies. In October 2011, a preference of 0.03 foot relative vertical accuracy was instigated for the following points: AB17, AB57, CR07, CR50 and CR51. In the September 2012 and subsequent surveys the criteria has been extended to all points.

Movement Accuracy: For this period, 49 points moved less than 0.30 feet with an average of 0.05 feet. The relative error at the 95% Level of Confidence averaged 0.020 feet with a standard deviation of 0.008 feet and a range of 0.005 to 0.054 feet. Overall, the estimated relative movement error averaged 0.022 feet with a standard deviation of 0.009 feet and a range of 0.005 to 0.054 feet. No movement is considered detected unless the movement exceeds the 95% Error for individual points. See Page 8 of the attached "MOVEMENT DATA POSTING" for the estimated relative movement errors at the 95% Level of Confidence for individual points for the period.

QUALITY CONTROL - QUALITY ASSURANCE (QAQC) ANALYSIS

To ensure the accuracy and validity of the measurement systems used in these GNSS monitoring surveys, an independent test was made using conventional terrestrial based instruments as reported in the "QAQC ANALYSIS" section of the September 2007 Monitoring Survey Report. Comparing the results of the GNSS systems with conventional instrumentation found horizontal measurements agreed 0.01 feet on average. In November of 2011 the GNSS instruments and fixed height poles used in this survey were calibrated on the Santa Maria National Geodetic Survey Baseline and found to agree with published distances 0.003 to 0.006 feet.

To validate the radial survey method used in these surveys to position points from base stations AB61 and AB20, independent GNSS cross connections were measured and compared with the stand alone computed inverse distances in the 2007, 2008 and 2009 surveys. The results found the two dimensional accuracy to agree 0.01 feet on average, indicating the radial method of measurements is reliable and the additional labor cost of measuring cross connection between points is not warranted. See the "QAQC ANALYSIS" section of the September 2007 and the December 2008 Monitoring Survey Reports for detailed analysis.

Deflection Analysis is a method established by this surveyor to assess the consistency of the direction of movements reported from period to period. Assuming that movements are generally linear for points moving less than a ½ foot, the separation or the deflection between the direction of the previous and present periods taken over the moved distance implies the accuracy obtained with the equipment, methods and procedures. Analysis of individual deflections indicates that for points with multiple occupations the separations varied 0.01 to 0.02 feet.

SUMMARY

Prior to September 2007, successive coordinate differences were used to compute movements which did not provide statistical information about the relative movement accuracies. Beginning with the initial 2007 survey, field and office procedures were designed to assure the accuracy and reliability of measurements and provide for queries between epochs that include statistical information about the relative precisions of the reported movements. Thereafter, measurement of temporal movements are based on a rigorous simultaneous least squares adjustment of multiple observations at two different epochs for each point.

The results of the September 14, 2012 to October 4, 2013 monitoring period indicates the relative accuracy of the reported movements average 0.022 feet at the 95% Level of Confidence. Statistically, the probability at the 95% level of confidence is that movement (signal) has occurred at a point when the horizontal distance between two epochs is greater than the 95% Error (noise). See the "Movement Data Posting" for a listing of the 95% Error estimates (range 0.005 to 0.054 feet). Applying this criteria, 17 points have not moved.

Between September 14, 2012 and October 4, 2013 (12.7 months), the differences reported in the Portuguese Bend Landslide (PB points) were 0.10 to 25.81 feet; in the Abalone Cove Landslide (AB points) west of the Portuguese Bend Landslide were 0.01 to 0.10 feet; and in the Klondike Canyon (KC points) east of the Portuguese Bend Landslide were 0.01 and 0.09 feet. See the Contours of Horizontal Movement in the Appendix for a graphical representation of the movements across the site.

See the attached "MOVEMENT DATA POSTING" spreadsheet for overall and periodic movements of each point. The movements are given in north, east and up or down as well as a vector of distance and direction relative to north. The direction is given as an azimuth in degrees where 0° is north and increases clockwise (90° East, 180° South, 270° West). The overall movements are from the beginning position of each point which varies between 1994 and 2012.

The present listing and status of monitored points is provided in the Appendix under "Monitoring Point Status for 2014 Prepared 12/17/2013". The historical status of all monitoring points is provided in the September 2007 Survey Report. The historical 1994-2006 positions of all points are listed in the Charles Abbott Associates Inc. file "ALL POINTS MOST RECENT OBSERVED POSITION AS OF SEPTEMBER 15, 2006.xls" attached as an electronic file to the 2007 Report.

RECOMMENDATION

An ongoing re-location program for monuments has long term benefits resulting in better accuracy lower cost surveys due to improved sky visibility for tracking satellites. In this October 2013 survey, no monuments were re-located. Points AB16, AB24 and AB58 are becoming increasingly blocked by trees and should be considered for deletion or re-location in 2014. PB64 is in a precarious location and may not be accessible in 2014. In 2011, a program was proposed to set or replace monitoring points with deep set monuments (as much as 10 feet) to better detect sub-surface movements.

Attachment: The document "PORTUGUESE BEND LANDSLIDE MONITORING - MOVEMENT DATA POSTING" is attached to this Report and lists the coordinates, overall and periodic movements of monitoring point since 2007.

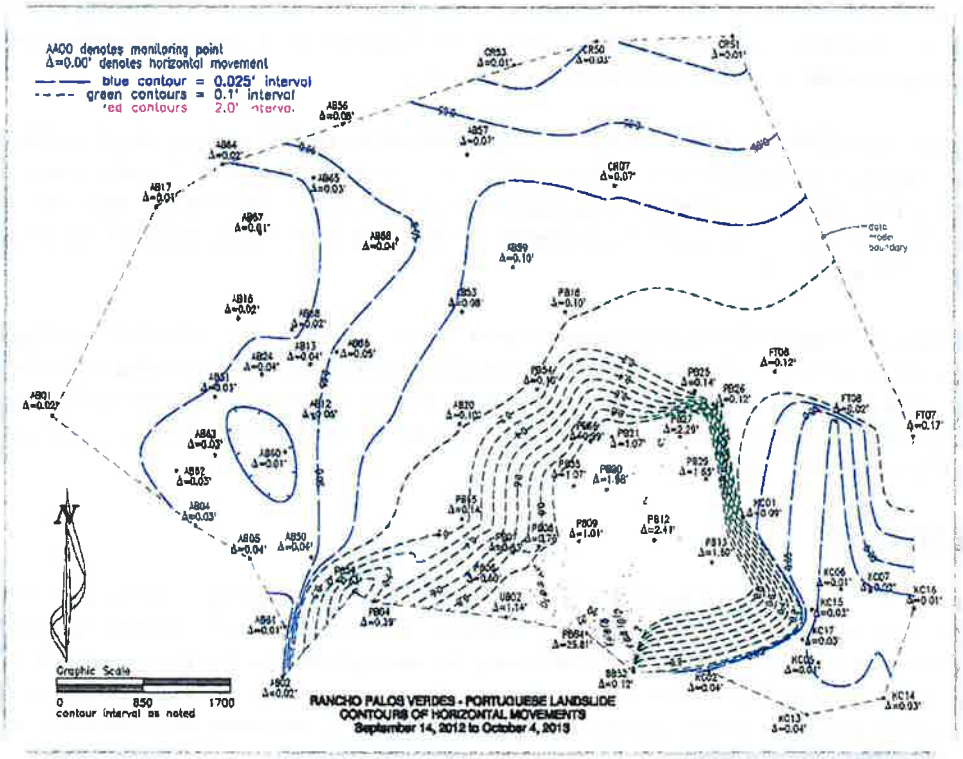
SURVEYOR'S STATEMENT

This Report on the criteria, procedures and results of the October 4, 2013 City of Rancho Palos Verdes Portuguese Landslide Monitoring Survey was prepared by me March 12, 2014 at the request of Ron Dragoo, Assistant City Engineer of the City of Rancho Palos Verdes.

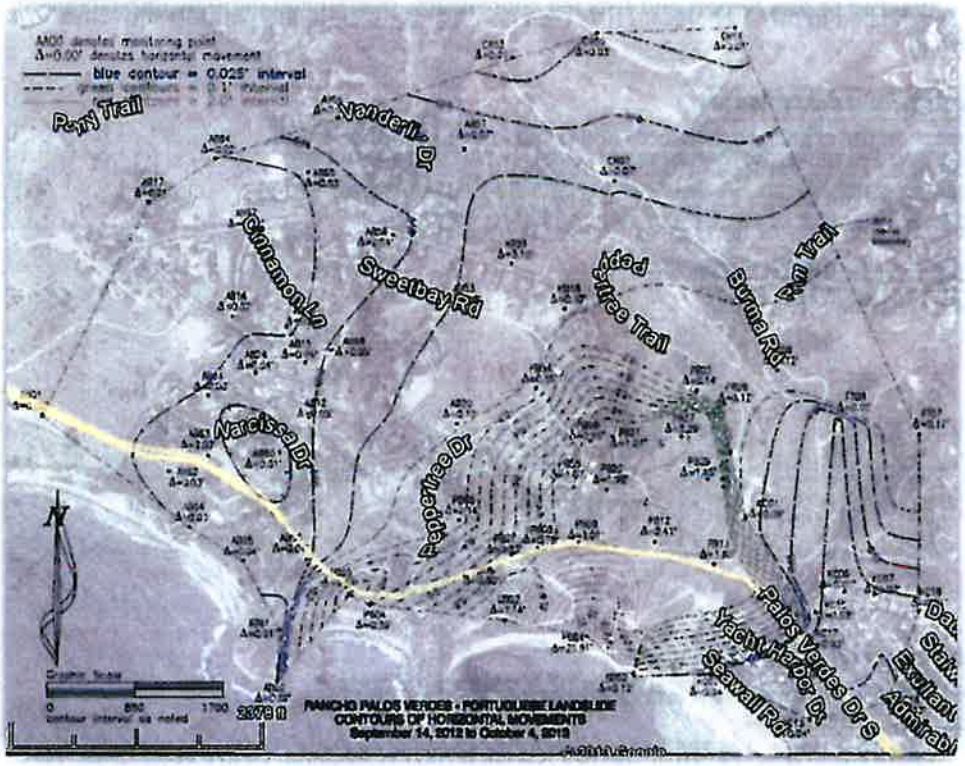
Michael R. McGee P.L.S. 3945

APPENDIX

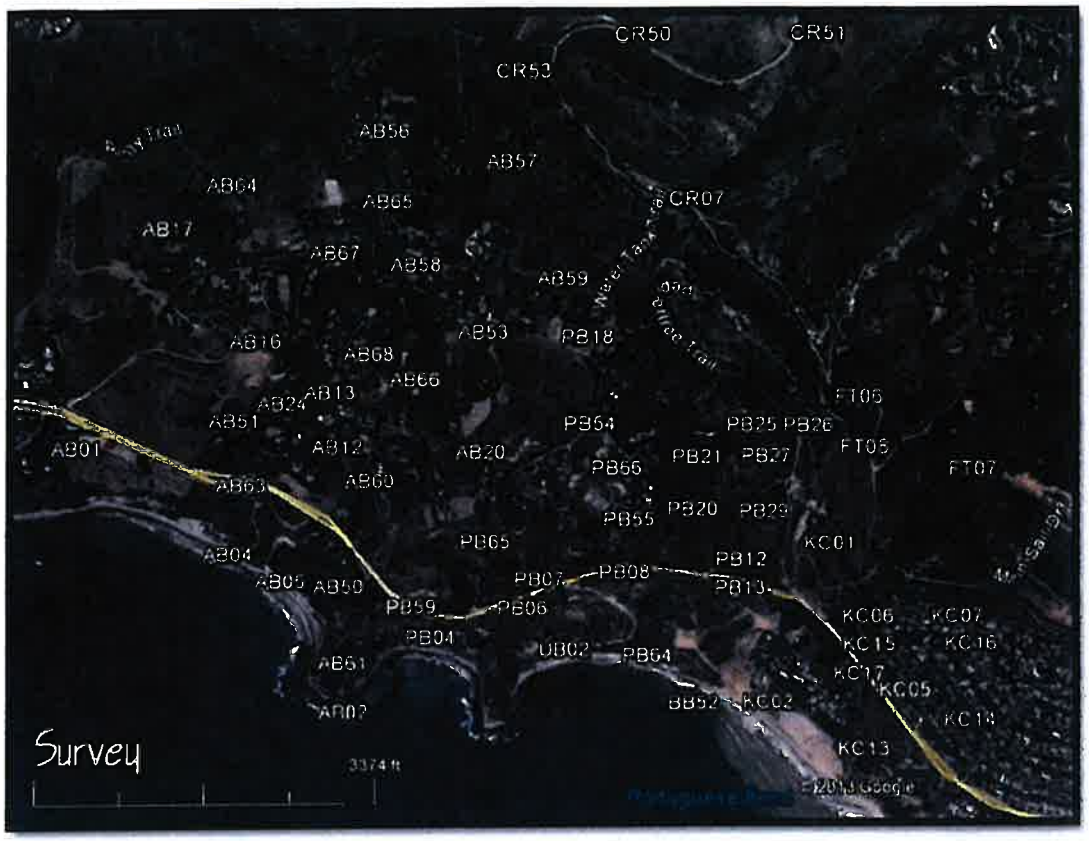
Contours of Horizontal Movements Sept. 14, 2012 to Oct. 4, 2013



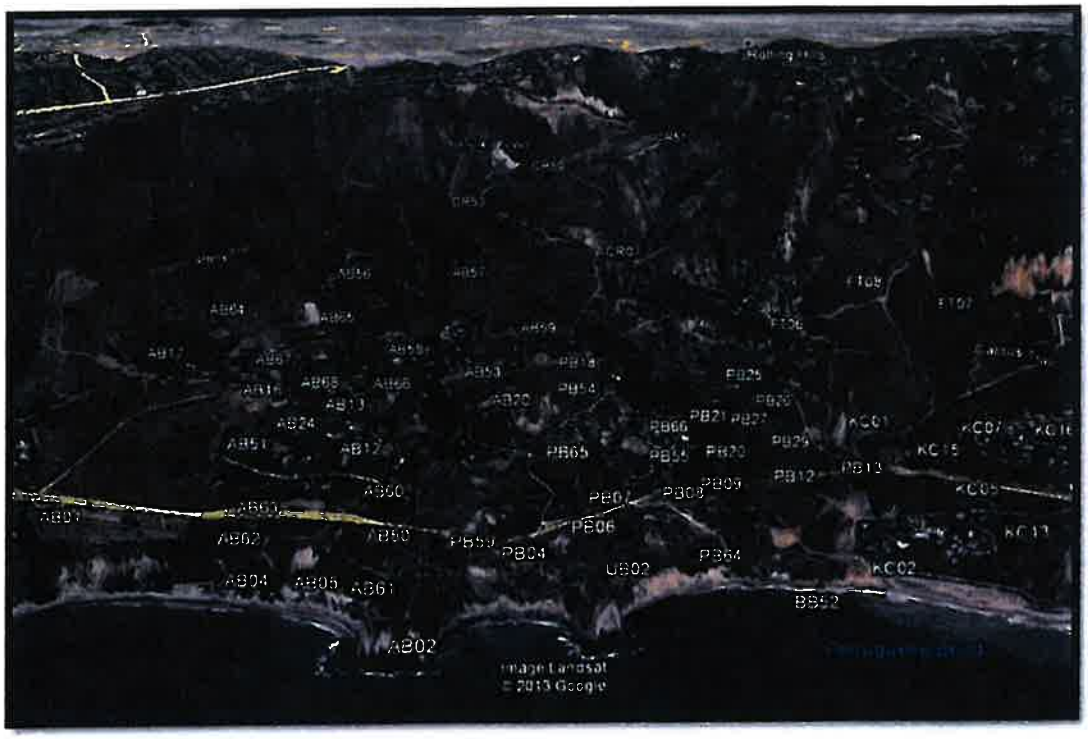
Contour Representation of Movements with Aerial Photo Overlay



Aerial View of Monitoring Points – (Photography Dated 04/16/2013) (north up)



Oblique Aerial View of Monitoring Points (looking north)



RANCHO PALOS VERDES - PORTUGUESE BEND LAND SLIDE							
Monitoring Point Status for 2014 Prepared 12/17/2013 Revised 05/10/2014							
Prepared By MCGEE SURVEYING CONSULTING							
Notes:	162+/- Monitoring Points established since 1994						
09/01/07	71 Points Surveyed 60 old points found with 52 monitored plus 19 new points						
12/01/08	67 Points Surveyed AB09, KC11, PB51 discontinued; BB53 destroyed; AB05 disturbed						
11/01/09	68 Points Surveyed Set PB64 to replace PB63 destroyed subsequently						
10/01/10	65 Points Surveyed Discontinued AB03, BB25; set PB65 to replace PB62 destroyed by paving						
10/03/11	69 Points Surveyed; Set AB62 & AB63 to replace AB06 & AB07						
09/14/12	72 Points Surveyed; Discontinued AB06, AB07; AB55 destroyed by trenching; Added 8 new points						
10/06/13	65 Points Surveyed; Discontinued AB15, AB18, AB52, AB54, CR52, KC04, PB53						
04/07/14	27 Points Surveyed; 65 to survey in Sept. 2014						
Pt ID	Last Obs'd	Comments	GNSS	Pt ID	Last Obs'd	Comments	GNSS
AB01	10/4/2013	Base 1994-2006	G	FT07	9/14/2012		G
AB02	10/4/2013		G	FT08	9/14/2012		G
AB04	10/4/2013		G				
AB05	10/4/2013		G	KC01	9/14/2012	NE'ly of 2 pipes 1.5' apart	G
AB12	10/4/2013		G	KC02	9/14/2012		G
AB13	10/4/2013		F	KC05	9/14/2012		G
AB16	10/4/2013		P	KC06	9/14/2012		G
AB17	10/4/2013		P	KC07	9/14/2012		G
AB20	10/4/2013	NE'ly of 2 pipes	G	KC13	9/14/2012		G
AB24	10/4/2013		F	KC14	9/14/2012		G
AB50	10/4/2013		G	KC15	9/14/2012		F
AB51	10/4/2013		G	KC16	9/14/2012		G
AB53	10/4/2013		F	KC17	9/14/2012	Replaced KC04	G
AB56	10/4/2013		F				
AB57	10/4/2013		G	PB04	9/14/2012		G
AB58	10/4/2013		P	PB06	9/14/2012		G
AB59	10/4/2013		G	PB07	9/14/2012		G
AB60	10/4/2013		G	PB08	9/14/2012		G
AB61	10/4/2013	BASE since 2007	G	PB09	9/14/2012		G
AB62	10/4/2013	Replaced AB06	G	PB12	9/14/2012		G
AB63	10/4/2013	Replaced AB07	G	PB13	9/14/2012		G
AB64	10/4/2013	Replaced AB54	G	PB18	9/14/2012		G
AB65	10/4/2013	Replaced AB18	G	PB20	9/14/2012	S'ly of 2 pipes 5.3' apart	G
AB66	10/4/2013	Replaced AB52	G	PB21	9/14/2012		F
AB67	10/4/2013	Replaced AB55	G	PB25	9/14/2012		G
AB68	10/4/2013	Replaced AB15	G	PB26	9/14/2012		F
				PB27	9/14/2012		G
BB52	10/4/2013		G	PB29	9/14/2012		G
				PB54	9/14/2012		F
CR07	10/4/2013		F	PB55	9/14/2012		P
CR50	10/4/2013		G	PB59	9/14/2012		G
CR51	10/4/2013		G	PB64	9/14/2012	Replaced PB63	G
CR53	10/4/2013	Replaced CR52	F	PB65	9/14/2012	Replaced PB62	G
				PB66	9/14/2012	Replaced PB53	G
FT06	9/14/2012		G	PB67	4/07/2014	Replaced PB64	G
				UB02	9/14/2012		G
GNSS column indicates site is Good, Fair or Poor for Satellite Visibility Conditions							

McGEE SURVEYING CONSULTING

October 4, 2013 COORDINATE LIST

Portuguese Bend Landslide 10/04/2013 Monitoring Survey

Prepared by McGee Surveying Consulting: Document Date: 12/31/2013

Datum: Horizontal & EH NAD83 (2007) Epoch; California State Plane Zone 5; Vertical: NAVD88

Note, Fixed CGPS Station PVE3 at Record 3D Position & Orthometric Height per 09/2007 Survey; See 2007 and subsequent Survey Reports

Point	Latitude	Longitude	EH (ft)	North (ft)	East (ft)	OrthoHt(ft)	Description
AB01	33-44-38.30259	118-22-53.05136	60.026	1729427.558	6445709.599	178.508	Punched 1/2" GIP in meter box
AB02	33-44-13.84895	118-22-26.19236	-2.043	1726946.991	6447968.691	116.451	4" BC "SAN PEDRO 1936" on conc. block
AB04	33-44-28.09131	118-22-36.28705	-51.297	1728389.950	6447121.505	67.161	BC "CO ENG STA Q2.." on 2"GIP in mass of conc.
AB05	33-44-24.99009	118-22-30.09092	-37.986	1728074.488	6447643.627	80.460	BC "CO ENG STA Q3.." on 2"GIP in mass of conc.
AB12	33-44-38.27525	118-22-22.72074	164.818	1729415.182	6448271.061	283.163	BC "CO ENG STA 7A.." in mass of conc.
AB13	33-44-43.34544	118-22-23.16096	246.136	1729927.871	6448235.786	364.458	Punched 1/2" GIP in meter box
AB16	33-44-47.57963	118-22-31.51214	258.054	1730358.536	6447532.125	376.390	Punched 1/2" GIP in meter box
AB17	33-44-58.06061	118-22-41.08444	324.479	1731421.097	6446727.738	442.813	Punched 1/2" GIP in meter box
AB20	33-44-37.77509	118-22-05.96599	277.932	1729359.403	6449685.844	396.204	BC "CO ENG STA W. FIX 1956.." in mass of conc.
AB24	33-44-42.35402	118-22-28.79489	217.374	1729829.417	6447759.626	335.726	Cotton spindle in conc. In road
AB50	33-44-25.11149	118-22-22.94503	63.585	1728084.514	6448247.181	182.004	Nail & shiner in conc. collar of well
AB51	33-44-40.23009	118-22-34.15156	186.760	1729616.396	6447306.449	305.143	PK mag nail in plastic plug "LS6957" in 1"GIP
AB53	33-44-48.36836	118-22-05.69991	234.643	1730430.205	6449712.238	352.864	Chisled + on s edge conc. Vault
AB56	33-45-05.97007	118-22-19.59279	453.344	1732213.899	6448545.587	571.551	6" mag nail & washer in conc. in 2"x 36" GIP
AB57	33-45-03.17045	118-22-05.20535	446.619	1731926.409	6449759.483	564.775	6" mag nail & washer in conc. in 2"x 36" GIP
AB58	33-44-55.14435	118-22-13.27646	287.451	1731117.547	6449074.930	405.675	Punched RR spike on s side road
AB59	33-44-52.54120	118-21-59.79442	316.047	1730850.218	6450212.489	434.224	6" mag nail & washer in conc. in 2"x 36" GIP
AB60	33-44-35.04157	118-22-26.06506	60.958	1729089.336	6447987.412	179.334	6" mag nail & washer in conc. in 2"x 28" GIP
AB61	33-44-18.57302	118-22-25.95795	21.949	1727424.479	6447990.265	140.417	6" mag nail & washer in conc. in 2"x 24" GIP
AB62	33-44-33.23091	118-22-38.63194	24.541	1728910.260	6446925.419	142.980	6" mag nail & washer in conc. in 1"x 24" GIP
AB63	33-44-34.71851	118-22-34.12071	62.378	1729059.215	6447306.969	180.788	Punched 1/2 x 48" rebar
AB64	33-45-02.13640	118-22-33.46078	413.929	1731830.707	6447373.068	532.210	2" mag nail on NE side 2' conc. Collar/Well B12
AB65	33-45-00.93224	118-22-22.90399	340.295	1731705.657	6448264.086	458.537	2" mag nail & washer in conc. in 1"x 60" GIP
AB66	33-44-44.53549	118-22-20.14982	255.988	1730047.231	6448490.524	374.291	1/2" x 24" punched rebar 1" below AC conc. collar
AB67	33-44-55.71720	118-22-29.06604	287.023	1731180.399	6447741.764	405.314	1/2" x 24" punched rebar 1" below AC conc. collar
AB68	33-44-46.61271	118-22-25.31203	275.086	1730258.837	6448055.357	393.402	1/2" x 24" punched rebar 1" below AC conc. collar
BB52	33-44-14.45583	118-21-45.75365	-114.397	1726995.826	6451384.308	3.910	PK mag nail in drill hole top large rock mass
CR07	33-45-00.26946	118-21-48.09440	514.017	1731627.887	6451203.354	632.113	6" mag nail & washer in conc. in old 1" IP
CR50	33-45-13.97065	118-21-50.11933	754.585	1733013.572	6451037.372	872.641	Tack & shiner on lower rock wall
CR51	33-45-14.49678	118-21-34.43617	858.176	1733061.993	6452361.877	976.169	Tack & shiner on conc pad
CR53	33-45-11.63376	118-21-59.73918	662.624	1732780.286	6450224.193	780.726	2" mag nail & washer in conc. in 1"x 60" GIP
FT06	33-44-42.78600	118-21-29.58547	370.560	1729854.857	6452760.053	488.645	6" mag nail & washer in conc. in 2"x 36" GIP
FT07	33-44-36.87084	118-21-13.65881	470.587	1729252.123	6454102.963	588.630	6" mag nail & washer in conc. in 2"x 36" GIP
FT08	33-44-38.19522	118-21-22.57420	540.338	1729388.666	6453350.514	658.413	6" mag nail & washer in conc. in 2"x 36" GIP
KC01	33-44-29.13405	118-21-33.10831	194.108	1728475.829	6452457.616	312.284	6" mag nail & washer in conc. in old 1" IP
KC02	33-44-14.54770	118-21-37.05703	-104.564	1727002.472	6452118.844	13.704	Punched 1/2" GIP in meter box
KC05	33-44-15.37066	118-21-24.50953	109.258	1727081.886	6453178.881	227.459	Punched 1/2" GIP in meter box

KC06	33-44-22.33196	118-21-21.96583	181.699	1727784.850	6453396.210	299.854	Punched 1/2" GIP in meter box
KC07	33-44-22.09041	118-21-18.55888	195.331	1727759.413	6453683.862	313.473	Punched 1/2" GIP in meter box
KC13	33-44-10.41192	118-21-25.78238	72.832	1726580.983	6453069.597	191.064	Cotton spindle in AC turnout
KC14	33-44-12.03482	118-21-17.07028	141.714	1726742.438	6453805.997	259.898	Punched spike in center road
KC15	33-44-20.39775	118-21-25.21700	168.855	1727590.293	6453120.935	287.034	Cotton spindle in cul-de-sac
KC16	33-44-20.55012	118-21-13.64593	208.756	1727602.240	6454098.244	326.884	Punched spike in intersection
KC17	33-44-17.55000	118-21-26.32410	97.038	1727302.743	6453026.409	215.236	2" mag nail & washer in conc. in 1"x 50" GIP
PB04	33-44-20.97817	118-22-15.80728	48.245	1727664.441	6448848.460	166.654	Nail & tag "RCE26120" in conc. in 3" pipe
PB06	33-44-23.68093	118-22-05.04995	58.782	1727934.326	6449757.988	177.128	Punched cap on 2" GIP
PB07	33-44-25.66517	118-21-59.68503	79.082	1728133.260	6450211.818	197.394	Brass tag "LA CO DPW" in conc. in 2" GIP
PB08	33-44-26.30674	118-21-56.71838	75.963	1728197.204	6450462.604	194.259	Punched cap on 2" GIP
PB09	33-44-26.77362	118-21-52.15057	70.310	1728242.999	6450848.549	188.583	Punched cap on 2" GIP in cable box
PB12	33-44-26.89232	118-21-43.45701	65.432	1728252.346	6451582.807	183.666	Punched cap on 2" GIP in cable box
PB13	33-44-24.81532	118-21-36.76755	88.303	1728040.349	6452147.013	206.517	Punched cap on 2" GIP in cable box
PB18	33-44-48.41035	118-21-53.76770	244.775	1730430.775	6450719.916	362.944	Punched 1/2" GIP in meter box
PB20	33-44-31.69153	118-21-48.91194	113.499	1728739.166	6451123.866	231.723	Punched cap on 2" GIP in cable box
PB21	33-44-36.64552	118-21-48.28393	153.795	1729239.778	6451178.715	271.993	Punched cap on 2" GIP in cable box
PB25	33-44-40.93188	118-21-38.74054	207.806	1729670.187	6451986.230	325.943	Punched cap on 2" GIP in cable box
PB26	33-44-39.63784	118-21-35.58676	164.765	1729538.417	6452252.102	282.894	Brass tag "LA CO DPW" in conc. in 2" GIP
PB27	33-44-36.67728	118-21-40.42470	152.661	1729240.596	6451842.455	270.825	Punched cap on 2" GIP in cable box
PB29	33-44-32.71481	118-21-37.45104	51.698	1728839.124	6452092.152	169.866	Brass tag "LA CO DPW" in conc. in 2" GIP
PB54	33-44-41.07936	118-21-56.95021	239.513	1729690.654	6450448.459	357.728	PK mag nail in plastic plug "LS6957" in 1"GIP
PB55	33-44-32.01393	118-21-52.73443	121.230	1728772.927	6450801.161	239.470	PK mag nail in plastic plug "LS6957" in 1"GIP
PB59	33-44-21.88771	118-22-18.05032	40.182	1727757.088	6448659.361	158.596	PK mag nail in plastic plug "LS?" in 1" GIP
PB64	33-44-18.13304	118-21-51.17100	-61.472	1727369.214	6450928.114	56.841	2" alum. cap "MCGEE SURVEYING.." on 1"x36"GIP
PB65	33-44-28.82032	118-22-05.66789	169.338	1728454.064	6449707.703	287.661	2" alum. cap "MCGEE SURVE.." on 5/8"x24"rebar
PB66	33-44-36.21154	118-21-50.75404	169.980	1729196.661	6450969.949	288.191	2" mag nail & washer in conc. in 1"x 60" GIP
UB02	33-44-19.55718	118-22-00.47391	-55.732	1727516.039	6450142.940	62.615	PK mag nail in plastic plug "?" in 1"GIP
PVE3	33-44-35.85329	118-24-15.26904	235.421	1729207.091	6438765.184	354.360	CGPS Pos. Fixed in 2007 and subsequent surveys
PVHS	33-46-46.02021	118-22-19.74134	854.039	1742328.084	6448570.489	972.054	CGPS Pos. Determined 10/04/2013 Survey
PVRS	33-46-25.89209	118-19-14.06711	198.583	1740239.308	6464237.897	316.290	CGPS Pos. Determined 10/04/2013 Survey
VTIS	33-42-45.48962	118-17-37.71219	197.456	1717933.681	6472307.232	315.202	CGPS Pos. Determined 10/04/2013 Survey

Portuguese Bend Landslide

April 7, 2014 Partial Monitoring Survey Addendum Report

Revised May 24, 2014

for the

City of Rancho Palos Verdes

by

McGee Surveying Consulting

Overview:

This Addendum Report describes a mid-year partial monitoring survey of a sub-set of 27 points in April 2014 at Portuguese Bend. This survey follows the procedures described in the above Report on the October 4, 2013 full monitoring. The results of this survey are reported on Page 9 of the attached spreadsheet titled "PORTUGUESE BEND LANDSLIDE MONITORING - MOVEMENT DATA POSTING" listing the coordinates, overall and periodic movements of points.

The movements reported between October 4, 2013 and April 7, 2014 (6.0 months) statistically attained an overall average accuracy of 0.02 feet at the 95% Level of Confidence as demonstrated by the measured vector residuals, repeatability of measurements at points considered stable, and the analysis of movement deflections. For a detailed history of the program and surveys see "History" above. The field survey took place April 6-9, 2014. The Field Surveys, Equipment, Data Collection and Network Design were as described in the above Report. The survey included 28 on site points and 3 CGPS Stations each connected with two to seven vectors. In April 2014 point PB64 was surveyed for the last time and PB67 (a 5' t-bar steel post driven 3' into the ground) was set as a replacement about 300' northerly to be reported in the fall 2014 survey.

The Adjustments followed the process as described in the above report with the following results.

Adjustment: Minimally Constrained Adjustment processed to develop NAD83 (2007) 2007.00 Epoch Geodetic, Ellipsoid and State Plane Coordinates in feet. CGPS Station PVE3 was fixed and the difference are listed in feet from the October 4, 2013 positions to the CGPS stations and points considered to mostly stable.

10/2013 Positions to 04/2014

Station	dN	dE	dZ	
AB17	0.016	-0.002	0.061	
AB61	0.002	-0.002	0.023	<Base Station
CR50	0.021	-0.001	0.111	
KC16	0.001	-0.010	-0.014	
PVE3	-0.000	-0.000	-0.000	< Fixed
PVRS	-0.017	0.004	0.014	
VTIS	-0.020	0.007	0.121	

The adjustment was constrained as a standard procedure to the CGPS (continuous GPS) station PVE3 which finds CGPS stations PVRS and VTIS in agreement with the October 2013 positions at 0.02 feet. Previous surveys general have been in agreement less than 0.01 feet; however, the satellite data collected at these stations was noisy during this survey resulting in less precise solutions. SOPAC and the USGS are investigating the issue. AB61, AB17 and KC16 are historically stable and continue to be so. The survey reference frame was deemed stable and successfully recovered. The plus vertical differences at AB17, CR50 and others listed in the "MOVEMENT DATA POSTING" are unexpected; however, redundant survey measurements agree at 0.01 to 0.02 feet and all indications are the relative accuracy is 0.03 feet.

Summary of Movements: Between October 4, 2013 and April 7, 2014 (6.0 months) points in the Portuguese Bend Landslide (PB points) moved 0.03 to 16.69 feet; points in the Abalone Cove Landslide (AB points) west of the Portuguese Bend Landslide moved 0.02 to 0.04 feet; and points in the Klondike Canyon (KC points) east of the Portuguese Bend Landslide moved 0.03 and 0.16 feet.

PORTUGUESE BEND LANDSLIDE MONITORING - MOVEMENT DATA POSTING as of September 24, 2007

Prepared by McGee Surveying Consulting

MONITORING POINTS

NAD83(2007) STATE PLANE COORDINATES & NAVD88 ELEVATIONS of Original Positions, 2007 & Post 2007 Positions

Notes # Indicates stable points, not moving

* Indicates no signal of horizontal movement detected in the last period at the 95% level of confidence

1= 2005 and prior surveys used a nearby monument S31-29W 1.48', the original position is adjusted here to be relative to the 1" IP used presently, resulting in correct Overall Movements, see Reports

9/24/2007(1994) Indicates the 2007 position was used for overall; see the 2011 Report for original 1994 positions

	Original Positions				Sept. 24, 2007 Positions			Overall Movements (US Feet)					
		NAD83 SPC Zone 5 (ft)		NAVD88	NAD83 SPC Zone 5 (ft)		NAVD88	Original Position to Sept. 24, 2007					
Point	Date	North (ft)	East (ft)	Elev(ft)	North (ft)	East (ft)	Elev(ft)	North	East	Height	Azim.°	Dist.	Note
AB01	12/1/1994	1729427.58	6445709.61	178.62	1729427.55	6445709.64	178.62	-0.03	0.03	0.00	138	0	#
AB02	9/24/2007(1994)	1726946.98	6447968.69	116.48	1726946.98	6447968.69	116.48						
AB03	12/1/1994	1727338.34	6447818.82	139.60	1727338.39	6447818.81	139.59	0.04	-0.01	-0.01	351	0.04	#
AB04	11/30/1994	1728391.99	6447123.34	67.57	1728390.55	6447122.03	67.31	-1.44	-1.32	-0.26	222	1.95	
AB05	3/14/1995	1728075.72	6447645.17	80.90	Disturbed between 2007-2008								
AB06	4/27/1995	1729059.73	6446976.26	165.28	1729058.58	6446975.91	164.91	-1.15	-0.35	-0.37	197	1.21	
AB07	11/30/1994	1728982.79	6447380.41	159.92	1728981.51	6447357.74	159.40	-1.28	-0.67	-0.52	208	1.44	
AB12	11/30/1994	1729416.49	6448271.64	283.43	1729415.67	6448271.30	283.19	-0.82	-0.35	-0.24	203	0.89	
AB13	11/30/1994	1729928.90	6448236.04	365.03	1729928.25	6448235.90	364.54	-0.65	-0.13	-0.49	192	0.66	
AB15	11/30/1994	1730312.09	6448099.38	397.28	1730311.64	6448099.31	396.90	-0.45	-0.07	-0.38	189	0.45	
AB16	11/30/1994	1730358.89	6447532.12	376.62	1730358.70	6447532.17	376.44	-0.19	0.04	-0.18	168	0.19	
AB17	9/24/2007(1994)	1731421.12	6446727.77	442.80	1731421.12	6446727.77	442.80						
AB18	12/1/1994	1731602.62	6448187.49	457.19	1731602.37	6448187.58	456.93	-0.26	0.09	-0.26	162	0.27	
AB20	3/16/1995	1729360.63	6449686.27	396.43	1729360.00	6449686.03	396.23	-0.62	-0.23	-0.20	201	0.67	
AB24	3/12/1997	1729830.35	6447759.96	335.92	1729829.83	6447759.82	335.74	-0.52	-0.14	-0.18	196	0.54	
AB50	1/16/1998	1728085.00	6448248.18	181.98	1728084.71	6448247.54	182.03	-0.29	-0.65	0.05	246	0.71	
AB51	3/22/2002	1729617.01	6447306.54	305.42	1729616.73	6447306.52	305.25	-0.28	-0.02	-0.17	184	0.28	
AB52	3/22/2002	1730016.10	6448624.44	368.61	1730015.79	6448624.36	368.39	-0.31	-0.08	-0.22	195	0.32	
AB53	3/22/2002	1730431.11	6449712.37	353.13	1730430.77	6449712.33	352.90	-0.34	-0.04	-0.23	187	0.34	
AB54	9/24/2007	1731111.94	6447047.87	407.31	1731111.94	6447047.87	407.31						
AB55	9/24/2007	1731174.77	6447753.57	405.38	1731174.77	6447753.57	405.38						
AB56	9/24/2007	1732214.31	6448545.46	571.65	1732214.31	6448545.46	571.65						
AB57	9/24/2007	1731926.91	6449759.36	564.93	1731926.91	6449759.36	564.93						
AB58	9/24/2007	1731118.02	6449074.93	405.67	1731118.02	6449074.93	405.67						
AB59	9/24/2007	1730850.87	6450212.56	434.37	1730850.87	6450212.56	434.37						
AB60	9/24/2007	1729089.70	6447987.57	179.45	1729089.70	6447987.57	179.45						
AB61	9/24/2007	1727424.50	6447990.26	140.47	1727424.50	6447990.26	140.47						
AB62	11/13/2011	1728910.35	6446925.46	143.01	Replacement for AB06								
AB63	11/13/2011	1729059.30	6447307.03	180.84	Replacement for AB07								
AB64	9/14/2012	1731830.69	6447373.08	532.25	Replacement for AB54								
AB65	9/14/2012	1731705.67	6448264.07	458.53	Replacement for AB18								
AB66	9/14/2012	1730047.29	6448490.53	374.28	Replacement for AB52								
AB67	9/14/2012	1731180.41	6447741.76	405.33	Replacement for AB55								
AB68	9/14/2012	1730258.86	6448055.37	393.45	Replacement for AB15								
BB25	11/4/1998	1727200.54	6449932.73	3.81	1727200.25	6449932.73	4.12	-0.29	-0.01	0.31	182	0.29	
BB52	9/24/2007	1726996.36	6451384.38	3.83	1726996.36	6451384.38	3.83						
BB53	9/24/2007	1726831.16	6451840.89	13.81	1726831.16	6451840.89	13.81						
CR07	11/30/1994	1731628.79	6451203.19	633.28	1731628.37	6451203.29	632.48	-0.41	0.10	-0.80	166	0.42	
CR50	9/24/2007(1998)	1733013.62	6451037.38	872.66	1733013.62	6451037.38	872.66						
CR51	9/24/2007(1998)	1733062.03	6452361.86	976.25	1733062.03	6452361.86	976.25						
CR52	9/24/2007(1998)	1732867.58	6450239.32	779.63	1732867.58	6450239.32	779.63						
CR53	9/14/2012	1732780.28	6450224.19	780.72	Replacement for CR52								
FT06	9/24/2007	1729855.61	6452760.21	489.06	1729855.61	6452760.21	489.06						
FT07	9/24/2007	1729253.24	6454104.75	589.01	1729253.24	6454104.75	589.01						
FT08	9/24/2007	1729388.68	6453350.51	658.44	1729388.68	6453350.51	658.44						
KC01	11/30/1994	1728476.78	6452458.23	312.88	1728476.36	6452457.91	312.42	-0.42	-0.32	-0.46	217	0.52	1
KC02	3/14/1995	1727002.89	6452118.99	13.84	1727002.74	6452118.89	13.74	-0.15	-0.11	-0.10	216	0.18	
KC04	3/14/1995	1727559.56	6452667.24	238.84	1727559.46	6452667.09	238.51	-0.10	-0.15	-0.33	236	0.18	
KC05	11/30/1994	1727082.00	6453179.09	227.86	1727082.01	6453178.94	227.53	0.01	-0.15	-0.33	273	0.15	
KC06	11/30/1994	1727784.91	6453396.67	300.35	1727784.94	6453396.40	299.97	0.03	-0.26	-0.38	276	0.26	
KC07	11/30/1994	1727759.19	6453683.92	313.83	1727759.37	6453683.85	313.51	0.18	-0.07	-0.32	340	0.19	
KC13	9/24/2007	1726581.16	6453069.63	191.20	1726581.16	6453069.63	191.20						
KC14	9/24/2007	1726742.44	6453806.05	259.94	1726742.44	6453806.05	259.94						
KC15	9/24/2007	1727590.45	6453121.10	287.10	1727590.45	6453121.10	287.10						
KC16	9/24/2007	1727602.25	6454098.23	326.90	1727602.25	6454098.23	326.90						
KC17	9/14/2012	1727302.76	6453026.42	215.25	Replacement for KC04								
PB04	11/30/1994	1727675.94	6448851.74	170.52	1727667.25	6448849.17	167.49	-8.69	-2.57	-3.03	196	9.06	
PB05	3/15/1995	1727968.45	6449761.84	183.06	1727941.12	6449758.81	178.25	-27.33	-3.03	-4.81	186	27.50	
PB07	3/14/1995	1728175.93	6450219.76	200.21	1728141.60	6450213.44	198.02	-34.32	-6.32	-2.19	190	34.90	
PB08	12/1/1994	1728237.51	6450469.80	193.68	1728204.81	6450463.98	194.09	-32.70	-5.82	0.41	190	33.21	
PB09	11/30/1994	1728288.58	6450851.02	192.52	1728252.20	6450849.11	189.84	-36.38	-1.91	-2.68	183	36.43	
PB12	11/30/1994	1728330.49	6451604.57	193.29	1728268.52	6451587.83	186.93	-61.97	-16.74	-6.36	195	64.19	
PB13	3/14/1995	1728085.97	6452164.34	210.54	1728050.44	6452151.18	207.21	-35.53	-13.16	-3.33	200	37.89	
PB18	3/15/1995	1730446.88	6450711.00	367.58	1730431.80	6450719.76	363.24	-15.08	8.77	-4.34	150	17.44	
PB20	3/14/1995	1728812.77	6451135.67	243.54	1728753.50	6451126.52	234.48	-59.27	-9.16	-9.06	189	59.97	
PB21	3/14/1995	1729298.22	6451172.05	280.02	1729249.90	6451177.92	273.29	-48.32	5.87	-6.73	173	48.68	
PB25	12/1/1994	1729702.31	6451985.65	328.99	1729671.12	6451986.48	326.10	-31.19	0.83	-2.89	178	31.20	
PB26	3/14/1995	1729562.65	6452249.56	285.34	1729539.22	6452252.23	282.95	-23.42	2.67	-2.39	174	23.58	
PB27	3/14/1995	1729339.34	6451836.06	284.42	1729257.91	6451842.02	273.51	-81.43	5.96	-10.91	176	81.65	
PB29	3/15/1995	1728888.95	6452120.49	185.93	1728849.86	6452097.03	173.29	-39.08	-23.46	-12.64	211	45.58	
PB53	12/4/1997	1729252.77	6450753.92	297.75	1729224.25	6450754.60	291.85	-28.52	0.67	-5.90	179	28.53	
PB54	12/4/1997	1729694.90	6450448.69	358.62	1729691.38	6450448.62	357.73	-3.52	-0.07	-0.89	181	3.52	
PB55	1/21/1998	1728812.28	6450804.04	246.33	1728782.51	6450801.87	241.07	-29.77	-2.18	-5.26	184	29.85	
PB59	6/26/2001	1727766.36	6448661.67	163.39	1727761.30	6448660.42	160.61	-5.07	-1.24	-2.78	194	5.22	
PB62	9/24/2007	1728476.64	6449717.56	287.25	1728476.64	6449717.56	287.25						
PB63	9/24/2007	1727734.04	6451488.11	126.06	1727734.04	6451488.11	126.06						
PB64	11/18/2009	1727466.29	6450946.95	72.76	Replacement for PB63								
PB65	10/25/2010	1728454.67	6449707.82	287.75	Replacement for PB62								
PB66	9/14/2012	1729197.65	6450969.92	288.33	Replacement for PB53								
PB67	4/7/2014	1727638.73	6450858.18	76.01	Replacement for PB64								
UB02	7/23/1997	1727581.11	6450133.78	67.15	1727534.46	6450140.57	63.20	-46.66	6.78	-3.95	172	47.15	

PORTUGUESE BEND LANDSLIDE MONITORING - MOVEMENT DATA POSTING as of December 10, 2008
Prepared by McGee Surveying Consulting
FULL ANNUAL MONITORING

Notes:
# Indicates stable points, not moving
* Indicates no signal of horizontal movement detected in the last period
2 = Hit by mower sometime between 09/07 and 12/08 with an estimated displacement S14E 0.29', the original position is adjusted here to be relative to monitored position used presently, resulting in correct Overall Movements, see Rpt

	Dec. 10, 2008 Positions			Overall Movements (US Feet)						Periodic (14.5 months) Movements (US Feet)						
	NAD83 SPC Zone 5 (Ft)		NAVD88	Original Position to Dec. 10, 2008						Sept. 24, 2007 Position to Dec. 10, 2008						
Point	North (ft)	East (ft)	Elev(ft)	North	East	Height	Azim.°	Dist.	Note	North	East	Height	Azim.°	Dist.	95%Err	Note
AB01	1729427.54	6445709.63	178.59	-0.05	0.02	-0.03	161	0.05	#	-0.01	-0.01	-0.03	231	0.02	0.02	#
AB02	1726946.99	6447968.68	116.46	0.00	-0.01	-0.02	297	0.01	#	0.00	-0.01	-0.02	297	0.01	0.02	#
AB03	1727338.39	6447818.81	139.58	0.04	-0.01	-0.02	348	0.04	#	0.00	0.00	-0.01	270	0.00	0.02	#
AB04	1728390.43	6447121.92	67.27	-1.56	-1.43	-0.30	222	2.12		-0.12	-0.11	-0.04	222	0.16	0.02	
AB05	1728074.86	6447644.04	80.59	-0.86	-1.13	-0.31	233	1.42	2							2
AB06	1729058.49	6446975.88	164.85	-1.24	-0.38	-0.43	197	1.30		-0.09	-0.03	-0.06	198	0.09	0.02	
AB07	1728981.40	6447357.70	159.34	-1.39	-0.71	-0.58	207	1.56		-0.11	-0.04	-0.06	202	0.12	0.02	
AB12	1729415.57	6448271.26	283.19	-0.92	-0.38	-0.24	203	0.99		-0.10	-0.03	0.00	199	0.11	0.02	
AB13	1729928.17	6448235.89	364.54	-0.73	-0.15	-0.49	192	0.74		-0.08	-0.01	0.00	191	0.08	0.02	
AB15	1730311.56	6448099.30	396.88	-0.53	-0.08	-0.40	189	0.53		-0.08	-0.01	-0.02	188	0.08	0.02	
AB16	1730358.65	6447532.17	376.46	-0.24	0.05	-0.16	168	0.24		-0.05	0.01	0.02	170	0.05	0.02	
AB17	1731421.12	6446727.77	442.79	0.00	0.00	-0.01	194	0.00	#	0.00	0.00	-0.01	194	0.00	0.02	#
AB18	1731602.31	6448187.61	456.91	-0.32	0.11	-0.28	160	0.34		-0.06	0.03	-0.02	158	0.07	0.02	
AB20	1729359.84	6449685.99	396.23	-0.79	-0.28	-0.20	199	0.83		-0.16	-0.04	0.00	195	0.17	0.01	
AB24	1729829.75	6447759.77	335.76	-0.61	-0.19	-0.16	197	0.63		-0.09	-0.04	0.02	205	0.10	0.02	
AB50	1728084.66	6448247.47	181.98	-0.34	-0.71	0.00	245	0.79		-0.05	-0.07	-0.05	235	0.08	0.02	
AB51	1729616.65	6447306.51	305.26	-0.36	-0.03	-0.16	185	0.36		-0.09	-0.01	0.01	190	0.09	0.02	
AB52	1730015.70	6448624.32	368.38	-0.40	-0.12	-0.23	196	0.42		-0.10	-0.03	-0.01	200	0.10	0.03	
AB53	1730430.62	6449712.30	352.90	-0.49	-0.07	-0.23	188	0.50		-0.15	-0.03	0.00	189	0.15	0.03	
AB54	1731111.93	6447047.87	407.30	-0.01	0.00	-0.01	165	0.01	*	-0.01	0.00	-0.01	165	0.01	0.03	*
AB55	1731174.72	6447753.58	405.39	-0.05	0.01	0.01	166	0.05		-0.05	0.01	0.01	166	0.05	0.02	
AB56	1732214.21	6448545.49	571.64	-0.10	0.03	-0.01	161	0.11		-0.10	0.03	-0.01	161	0.11	0.02	
AB57	1731926.78	6449759.40	564.90	-0.13	0.03	-0.03	166	0.13		-0.13	0.03	-0.03	166	0.13	0.02	
AB58	1731117.90	6449074.93	405.65	-0.12	0.00	-0.02	178	0.12		-0.12	0.00	-0.02	178	0.12	0.02	
AB59	1730850.70	6450212.53	---	-0.17	-0.02	-0.02	188	0.17		-0.17	-0.02	-0.02	188	0.17	0.02	
AB60	1729089.63	6447987.54	179.39	-0.08	-0.03	-0.06	200	0.08		-0.08	-0.03	-0.06	200	0.08	0.02	
AB61	1727424.49	6447990.27	140.43	-0.01	0.01	-0.04	114	0.01	*	-0.01	0.01	-0.04	114	0.01	0.00	#
BB25	1727200.25	6449932.58	4.15	-0.29	-0.16	0.34	208	0.33		0.00	-0.15	0.03	269	0.15	0.02	
BB52	1726996.24	6451384.35	3.83	-0.12	-0.03	0.00	194	0.13		-0.12	-0.03	0.00	194	0.13	0.02	
BB53	Destroyed															
CR07	1731628.24	6451203.32	632.36	-0.54	0.13	-0.92	166	0.55		-0.13	0.03	-0.12	168	0.13	0.02	
CR50	1733013.62	6451037.38	872.71	0.01	0.01	0.05	45	0.01		0.01	0.01	0.05	45	0.01	0.02	*
CR51	1733062.02	6452361.86	976.24	-0.01	0.00	-0.01	171	0.01		-0.01	0.00	-0.01	171	0.01	0.02	*
CR52	1732867.58	6450239.31	779.64	0.00	-0.01	0.01	258	0.01		0.00	-0.01	0.01	258	0.01	0.02	*
FT06	1729855.42	6452760.17	488.97	-0.19	-0.04	-0.09	192	0.19		-0.19	-0.04	-0.09	192	0.19	0.03	
FT07	1729253.01	6454104.39	588.99	-0.23	-0.36	-0.02	237	0.43		-0.23	-0.36	-0.02	237	0.43	0.02	
FT08	1729388.67	6453350.53	658.47	-0.01	0.02	0.03	114	0.02		-0.01	0.02	0.03	114	0.02	0.02	*
KC01	1728476.25	6452457.85	312.38	-0.53	-0.38	-0.50	215	0.66	1	-0.12	-0.06	-0.04	208	0.13	0.02	
KC02	1727002.67	6452118.80	13.72	-0.22	-0.11	-0.12	207	0.25		-0.07	-0.01	-0.02	185	0.07	0.02	
KC04	1727559.42	6452667.06	238.47	-0.14	-0.18	-0.37	233	0.23		-0.04	-0.04	-0.04	223	0.05	0.02	
KC05	1727081.98	6453178.94	227.52	-0.02	-0.15	-0.34	261	0.15		-0.03	0.00	-0.01	180	0.03	0.02	
KC06	1727784.92	6453396.36	299.93	0.01	-0.30	-0.42	273	0.30		-0.01	-0.04	-0.04	252	0.05	0.02	
KC07	1727759.38	6453683.87	313.50	0.18	-0.05	-0.33	346	0.19		0.00	0.02	-0.01	84	0.02	0.02	*
KC13	1726581.12	6453069.62	191.23	-0.04	-0.01	0.03	194	0.04		-0.04	-0.01	0.03	194	0.04	0.02	
KC14	1726742.44	6453806.04	259.91	0.00	-0.02	-0.03	259	0.02	*	0.00	-0.02	-0.03	259	0.02	0.02	*
KC15	1727590.41	6453121.06	287.13	-0.05	-0.04	0.03	220	0.06		-0.05	-0.04	0.03	220	0.06	0.02	
KC16	1727602.24	6454098.24	326.92	-0.01	0.00	0.02	135	0.01	*	-0.01	0.00	0.02	135	0.01	0.02	*
PB04	1727666.83	6448849.07	167.37	-9.10	-2.67	-3.15	196	9.49		-0.41	-0.10	-0.12	194	0.43	0.02	
PB06	1727939.65	6449758.62	177.96	-28.80	-3.22	-5.10	186	28.98		-1.47	-0.18	-0.29	187	1.48	0.02	
PB07	1728139.82	6450213.09	197.88	-36.10	-6.67	-2.33	190	36.72		-1.78	-0.35	-0.14	191	1.82	0.02	
PB08	1728203.20	6450463.68	194.13	-34.31	-6.12	0.45	190	34.85		-1.61	-0.30	0.04	190	1.64	0.02	
PB09	1728250.32	6450848.98	189.58	-38.26	-2.04	-2.94	183	38.31		-1.88	-0.13	-0.26	184	1.88	0.02	
PB12	1728265.36	6451586.81	186.31	-65.13	-17.76	-6.98	195	67.51		-3.16	-1.03	-0.62	198	3.32	0.02	
PB13	1728048.48	6452150.38	207.09	-37.49	-13.96	-3.45	200	40.01		-1.96	-0.80	-0.12	202	2.12	0.02	
PB18	1730431.47	6450719.84	363.18	-15.41	8.85	-4.40	150	17.77		-0.33	0.08	-0.06	166	0.34	0.02	
PB20	1728750.65	6451126.05	233.99	-62.12	-9.63	-9.55	189	62.86		-2.85	-0.47	-0.49	189	2.89	0.02	
PB21	1729247.73	6451178.08	273.02	-50.49	6.03	-7.00	173	50.85		-2.17	0.16	-0.27	176	2.17	0.02	
PB25	1729670.88	6451986.42	326.07	-31.44	0.77	-2.92	179	31.45		-0.25	-0.07	-0.03	195	0.26	0.02	
PB26	1729539.03	6452252.21	282.94	-23.62	2.65	-2.40	174	23.77		-0.20	-0.02	-0.01	187	0.20	0.02	
PB27	1729254.41	6451842.14	272.98	-84.93	6.08	-11.44	176	85.15		-3.50	0.13	-0.53	178	3.50	0.02	
PB29	1728847.75	6452096.03	172.60	-41.20	-24.46	-13.33	211	47.91		-2.11	-1.01	-0.69	205	2.34	0.02	
PB53	1729222.48	6450754.60	291.44	-30.28	0.68	-6.31	179	30.29		-1.76	0.00	-0.41	180	1.76	0.02	
PB54	1729691.20	6450448.58	357.73	-3.70	-0.11	-0.89	182	3.70		-0.18	-0.04	0.00	193	0.18	0.02	
PB55	1728780.51	6450801.66	240.62	-31.77	-2.38	-5.71	184	31.86		-2.01	-0.21	-0.45	186	2.02	0.03	
PB59	1727760.70	6448660.28	160.34	-5.66	-1.39	-3.05	194	5.83		-0.59	-0.15	-0.27	194	0.61	0.02	
PB62	1728476.42	6449717.52	287.22	-0.21	-0.04	-0.03	192	0.22		-0.21	-0.04	-0.03	192	0.22	0.02	
PB63	1727724.58	6451485.79	121.78	-9.45	-2.32	-4.28	194	9.73		-9.45	-2.32	-4.28	194	9.73	0.02	
UD02	1727530.48	6450141.10	63.00	-50.63	7.31	-4.15	172	51.16		-3.97	0.53	-0.20	172	4.01	0.02	

PORTUGUESE BEND LANDSLIDE MONITORING - MOVEMENT DATA POSTING as of November 18, 2009
Prepared by McGee Surveying Consulting
FULL ANNUAL MONITORING

Notes:
# Indicates stable points, not moving
* Indicates no signal of horizontal movement detected in the last period

	Nov. 18, 2009 Positions			Overall Movements (US Feet)						Periodic (11.3 months) Movements (US Feet)						
	NAD83 SPC Zone 5 (Ft)		NAVD88	Original Position to Nov. 18, 2009						Dec. 10, 2008 Position to Nov. 18, 2009						
Point	North (ft)	East (ft)	Elev(ft)	North	East	Height	Azim.°	Dist.	Note	North	East	Height	Azim.°	Dist.	95%Err	Note
AB01	1729427.54	6445709.62	178.540	-0.04	0.01	-0.08	167	0.04		0.00	-0.01	-0.05	304	0.01	0.02	#
AB02	1726946.97	6447968.68	116.460	-0.02	0.00	-0.02	198	0.02	*	-0.02	0.00	0.00	171	0.02	0.02	#
AB03	1727338.38	6447818.82	139.570	0.04	0.00	-0.03	4	0.04		-0.01	0.01	-0.01	117	0.01	0.02	#
AB04	1728390.36	6447121.86	67.250	-1.63	-1.48	-0.32	222	2.20		-0.07	-0.05	-0.02	217	0.09	0.02	
AB05	1728074.78	6447643.96	80.570	-0.94	-1.21	-0.33	232	1.53		-0.08	-0.08	-0.02	226	0.11	0.02	
AB06	1729058.43	6446975.87	164.840	-1.31	-0.39	-0.44	197	1.36		-0.06	-0.01	-0.01	191	0.06	0.02	
AB07	1728981.35	6447357.67	159.330	-1.44	-0.74	-0.59	207	1.62		-0.05	-0.03	-0.01	207	0.06	0.02	
AB12	1729415.50	6448271.24	283.190	-0.98	-0.41	-0.24	203	1.07		-0.07	-0.03	0.00	202	0.07	0.02	
AB13	1729928.13	6448235.87	364.540	-0.77	-0.16	-0.49	192	0.78		-0.04	-0.02	0.00	201	0.04	0.02	
AB15	1730311.51	6448099.30	396.880	-0.57	-0.08	-0.40	188	0.58		-0.05	0.00	0.00	180	0.05	0.03	
AB16	1730358.64	6447532.17	376.450	-0.25	0.04	-0.17	170	0.25		-0.01	-0.01	-0.01	203	0.02	0.02	*
AB17	1731421.11	6446727.77	442.800	-0.01	0.00	0.00	186	0.01	*	0.00	0.00	0.01	180	0.00	0.02	#
AB18	1731602.26	6448187.60	456.870	-0.36	0.11	-0.32	163	0.38		-0.04	-0.01	-0.04	189	0.04	0.03	
AB20	1729359.78	6449685.97	396.230	-0.85	-0.30	-0.20	199	0.90		-0.06	-0.02	0.00	200	0.06	0.01	
AB24	1729829.68	6447759.75	335.760	-0.67	-0.21	-0.16	197	0.70		-0.06	-0.02	0.00	198	0.07	0.02	
AB50	1728084.64	6448247.44	182.000	-0.36	-0.74	0.02	244	0.83		-0.02	-0.03	0.02	238	0.04	0.02	
AB51	1729616.60	6447306.48	305.250	-0.41	-0.06	-0.17	188	0.41		-0.04	-0.02	-0.01	208	0.05	0.02	
AB52	1730015.65	6448624.32	368.350	-0.45	-0.12	-0.26	195	0.47		-0.05	0.00	-0.03	181	0.05	0.03	
AB53	1730430.55	6449712.28	352.890	-0.55	-0.09	-0.24	189	0.56		-0.06	-0.02	-0.01	198	0.06	0.03	
AB54	1731111.92	6447047.87	407.360	-0.03	0.00	0.05	178	0.03	*	-0.02	0.00	0.06	187	0.02	0.03	*
AB55	1731174.68	6447753.58	405.390	-0.09	0.02	0.01	169	0.09		-0.04	0.01	0.00	171	0.04	0.02	
AB56	1732214.16	6448545.51	571.690	-0.15	0.05	0.04	162	0.16		-0.05	0.02	0.05	164	0.05	0.02	
AB57	1731926.73	6449759.41	564.860	-0.18	0.04	-0.07	166	0.18		-0.05	0.01	-0.04	167	0.05	0.02	
AB58	1731117.85	6449074.94	405.640	-0.17	0.01	-0.03	175	0.17		-0.05	0.01	-0.01	168	0.05	0.02	
AB59	1730850.64	6450212.52	434.340	-0.23	-0.03	-0.03	188	0.23		-0.06	-0.01	-0.01	190	0.06	0.02	
AB60	1729089.58	6447987.53	179.390	-0.12	-0.04	-0.06	199	0.13		-0.04	-0.01	0.00	196	0.05	0.02	
AB61	1727424.49	6447990.27	140.420	-0.01	0.01	-0.05	128	0.02	*	0.00	0.00	-0.01	158	0.01	0.00	#
BB25	1727200.19	6449932.57	4.210	-0.35	-0.16	0.40	204	0.39		-0.06	0.00	0.06	183	0.06	0.02	
BB52	1726996.18	6451384.34	3.860	-0.18	-0.04	0.03	193	0.19		-0.06	-0.01	0.03	191	0.06	0.02	
CR07	1731628.18	6451203.34	632.390	-0.60	0.15	-0.89	166	0.62		-0.06	0.02	0.03	161	0.07	0.02	
CR50	1733013.61	6451037.39	872.690	-0.01	0.01	0.03	118	0.01		-0.01	0.00	-0.02	162	0.02	0.02	*
CR51	1733062.01	6452361.87	976.220	-0.02	0.01	-0.03	155	0.03		-0.01	0.01	-0.02	143	0.02	0.02	*
CR52	1732867.56	6450239.31	779.730	-0.02	-0.01	0.10	217	0.02	*	-0.01	0.00	0.09	176	0.01	0.03	*
FT06	1729855.34	6452760.16	488.920	-0.27	-0.05	-0.14	191	0.28		-0.08	-0.01	-0.05	189	0.08	0.02	
FT07	1729252.92	6454104.25	588.900	-0.33	-0.51	-0.11	237	0.60		-0.10	-0.14	-0.09	236	0.17	0.02	
FT08	1729398.69	6453350.52	658.480	0.00	0.02	0.04	74	0.02	*	0.01	0.00	0.01	348	0.01	0.03	#
KC01	1728476.18	6452457.81	312.350	-0.60	-0.42	-0.53	215	0.74		-0.07	-0.04	-0.03	209	0.08	0.02	
KC02	1727002.64	6452118.86	13.690	-0.26	-0.13	-0.15	207	0.29		-0.03	-0.02	-0.03	207	0.04	0.02	
KC04	1727559.39	6452667.04	238.450	-0.17	-0.20	-0.39	231	0.27		-0.03	-0.02	-0.02	216	0.04	0.02	
KC05	1727081.97	6453178.92	227.510	-0.03	-0.17	-0.35	259	0.18		-0.01	-0.02	-0.01	244	0.03	0.02	
KC06	1727784.90	6453396.33	299.910	-0.01	-0.33	-0.44	268	0.33		-0.02	-0.03	-0.02	227	0.04	0.03	
KC07	1727759.37	6453683.87	313.470	0.18	-0.05	-0.36	344	0.19		0.00	0.00	-0.03	256	0.00	0.02	*
KC13	1726581.11	6453069.63	191.180	-0.04	-0.01	-0.02	188	0.04		-0.01	0.00	-0.05	153	0.01	0.02	*
KC14	1726742.43	6453806.03	259.920	-0.01	-0.03	-0.02	253	0.03	*	0.00	-0.01	0.01	247	0.01	0.02	*
KC15	1727590.38	6453121.03	287.090	-0.07	-0.06	-0.01	222	0.09		-0.02	-0.02	-0.04	226	0.03	0.03	
KC16	1727602.24	6454098.24	326.870	-0.01	0.00	-0.03	159	0.01	*	0.00	0.00	-0.05	214	0.00	0.02	#
PB04	1727666.56	6448848.99	167.310	-9.38	-2.75	-3.21	196	9.77		-0.27	-0.07	-0.06	195	0.28	0.02	
PB06	1727938.80	6449758.52	177.820	-29.65	-3.32	-5.24	186	29.83		-0.85	-0.10	-0.14	187	0.85	0.02	
PB07	1728138.83	6450212.89	197.800	-37.09	-6.86	-2.41	190	37.72		-0.99	-0.19	-0.08	191	1.01	0.02	
PB08	1728202.31	6450463.52	194.120	-35.20	-6.28	0.44	190	35.75		-0.89	-0.16	-0.01	190	0.90	0.02	
PB09	1728249.30	6450848.91	189.460	-39.28	-2.11	-3.06	183	39.34		-1.02	-0.07	-0.12	184	1.02	0.02	
PB12	1728263.70	6451586.25	185.940	-66.79	-18.32	-7.35	195	69.25		-1.66	-0.55	-0.37	199	1.75	0.02	
PB13	1728047.43	6452149.98	206.980	-38.54	-14.36	-3.56	200	41.13		-1.05	-0.41	-0.11	201	1.12	0.02	
PB18	1730431.35	6450719.96	363.140	-15.53	8.87	-4.44	150	17.89		-0.12	0.02	-0.04	170	0.12	0.02	
PB20	1728749.18	6451125.82	233.690	-63.59	-9.86	-9.85	189	64.35		-1.47	-0.23	-0.30	189	1.49	0.02	
PB21	1729246.60	6451178.17	272.840	-51.62	6.12	-7.18	173	51.98		-1.13	0.09	-0.18	175	1.14	0.02	
PB25	1729670.78	6451986.39	326.040	-31.53	0.74	-2.95	179	31.54		-0.09	-0.02	-0.03	194	0.10	0.02	
PB26	1729538.93	6452252.19	282.930	-23.71	2.63	-2.41	174	23.86		-0.09	-0.02	-0.01	190	0.10	0.02	
PB27	1729252.59	6451842.20	272.730	-86.75	6.14	-11.69	176	86.97		-1.82	0.06	-0.25	178	1.82	0.03	
PB29	1728846.62	6452095.51	172.230	-42.32	-24.98	-13.70	211	49.15		-1.13	-0.52	-0.37	205	1.24	0.02	
PB53	1729221.54	6450754.61	291.200	-31.22	0.68	-6.55	179	31.23		-0.94	0.01	-0.24	180	0.94	0.03	
PB54	1729691.12	6450448.57	357.710	-3.78	-0.12	-0.91	182	3.78		-0.08	-0.01	-0.02	180	0.08	0.02	
PB55	1728779.41	6450801.58	240.500	-32.87	-2.47	-5.83	184	32.97		-1.10	-0.08	-0.12	184	1.10	0.03	
PB59	1727760.31	6448660.19	160.160	-6.05	-1.48	-3.23	194	6.23		-0.39	-0.09	-0.18	193	0.40	0.02	
PB62	1728476.31	6449717.49	287.200	-0.32	-0.07	-0.05	192	0.33		-0.11	-0.02	-0.02	193	0.11	0.02	
PB63	1727717.72	6451483.29	116.990	-16.31	-4.82	-9.07	196	17.01		-6.86	-2.50	-4.79	200	7.30	0.02	
PB64	1727466.29	6450946.95	72.760	Replacement for PB63												
UB02	1727527.87	6450141.46	62.920	-53.24	7.67	-4.23	172	53.79		-2.61	0.36	-0.08	172	2.64	0.02	

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FULL ANNUAL MONITORING

Notes:

* Indicates no signal of horizontal movement detected in the last period

	Oct. 25, 2010 Positions			Overall Movements (US Feet)						Periodic (11.1 months) Movements (US Feet)						
	NAD83 SPC Zone 5 (Ft)		NAVD88	Original Position to Oct. 25, 2010						Nov. 18, 2009 Position to Oct. 25, 2010						
Point	North (ft)	East (ft)	Elev(ft)	North	East	Height	Azim.*	Dist.	Note	North	East	Height	Azim.*	Dist.	95%Err	Note
AB01	1729427.53	6445709.61	178.52	-0.05	-0.01	-0.10	187	0.05		-0.01	-0.02	-0.02	241	0.02	0.03	*
AB02	1726946.97	6447968.66	116.45	-0.02	-0.03	-0.03	243	0.03	*	0.00	-0.02	-0.01	270	0.02	0.02	*
AB03	Discontinued															
AB04	1728390.27	6447121.79	67.25	-1.72	-1.56	-0.32	222	2.32		-0.09	-0.08	0.00	220	0.12	0.02	
AB05	1728074.67	6447643.89	80.53	-1.05	-1.28	-0.37	231	1.66		-0.12	-0.07	-0.04	211	0.14	0.03	
AB06	1729058.36	6446975.83	164.82	-1.37	-0.43	-0.46	197	1.44		-0.07	-0.03	-0.02	207	0.07	0.03	
AB07	1728981.28	6447357.64	159.31	-1.51	-0.77	-0.61	207	1.70		-0.07	-0.03	-0.02	207	0.08	0.03	
AB12	1729415.46	6448271.20	283.20	-1.03	-0.44	-0.23	203	1.12		-0.04	-0.04	0.01	219	0.06	0.02	
AB13	1729928.09	6448235.85	364.53	-0.81	-0.19	-0.50	193	0.83		-0.04	-0.02	-0.01	208	0.05	0.02	
AB15	1730311.47	6448099.25	396.86	-0.62	-0.14	-0.42	192	0.63		-0.04	-0.05	-0.02	232	0.07	0.02	
AB16	1730358.61	6447532.16	376.46	-0.28	0.03	-0.16	173	0.28		-0.03	-0.01	0.01	197	0.03	0.03	*
AB17	1731421.10	6446727.76	442.90	-0.02	-0.01	0.00	205	0.02		-0.01	-0.01	0.00	217	0.01	0.02	*
AB18	1731602.22	6448187.61	456.82	-0.40	0.12	-0.37	164	0.42		-0.04	0.01	-0.05	165	0.04	0.03	
AB20	1729359.72	6449685.94	396.23	-0.90	-0.32	-0.20	200	0.96		-0.06	-0.02	0.00	203	0.06	0.01	
AB24	1729829.65	6447759.73	335.77	-0.71	-0.23	-0.15	198	0.75		-0.04	-0.02	0.01	212	0.04	0.02	
AB50	1728084.62	6448247.38	182.00	-0.38	-0.80	0.02	244	0.89		-0.02	-0.06	0.00	247	0.06	0.03	
AB51	1729616.56	6447306.49	305.24	-0.45	-0.05	-0.18	186	0.45		-0.05	0.01	-0.01	172	0.05	0.02	
AB52	1730015.61	6448624.30	368.38	-0.49	-0.14	-0.23	196	0.51		-0.04	-0.02	0.03	209	0.04	0.04	
AB53	1730430.49	6449712.26	352.91	-0.61	-0.11	-0.22	190	0.62		-0.06	-0.02	0.02	196	0.07	0.03	
AB54	1731111.92	6447047.87	407.34	-0.02	0.00	0.03	182	0.02		0.00	0.00	-0.02	326	0.00	0.04	*
AB55	1731174.66	6447753.58	405.40	-0.11	0.02	0.02	171	0.11		-0.02	0.00	0.01	183	0.02	0.02	*
AB56	1732214.12	6448545.51	571.63	-0.19	0.05	-0.02	165	0.20		-0.04	0.00	-0.06	179	0.04	0.03	
AB57	1731926.67	6449759.42	564.92	-0.23	0.06	-0.01	165	0.24		-0.05	0.01	0.06	164	0.06	0.03	
AB58	1731117.80	6449074.93	405.69	-0.22	0.00	0.02	180	0.22		-0.05	-0.01	0.05	196	0.05	0.03	
AB59	1730850.56	6450212.51	434.35	-0.31	-0.04	-0.02	188	0.31		-0.08	-0.01	0.01	185	0.08	0.03	
AB60	1729089.53	6447987.50	179.42	-0.17	-0.07	-0.03	201	0.18		-0.05	-0.02	0.03	207	0.06	0.02	
AB61	1727424.48	6447990.27	140.47	-0.02	0.01	0.00	150	0.02	*	-0.01	0.00	0.05	193	0.01	0.00	*
BB25	Discontinued															
BB52	1726996.13	6451384.34	3.85	-0.23	-0.04	0.02	190	0.24		-0.05	0.00	-0.01	180	0.05	0.03	
BB53	Destroyed															
CR07	1731628.12	6451203.32	632.33	-0.66	0.13	-0.95	169	0.67		-0.06	-0.02	-0.06	202	0.06	0.03	
CR50	1733013.59	6451037.37	872.67	-0.03	0.00	0.01	184	0.03		-0.02	-0.02	-0.02	217	0.03	0.02	
CR51	1733062.01	6452361.88	976.18	-0.02	0.02	-0.07	144	0.03		0.00	0.01	-0.04	98	0.01	0.03	*
CR52	1732867.55	6450239.31	779.65	-0.03	-0.01	0.02	207	0.03	*	-0.01	0.00	-0.08	186	0.01	0.03	*
FT06	1729855.25	6452760.13	488.89	-0.35	-0.08	-0.17	193	0.36		-0.08	-0.03	-0.03	199	0.09	0.02	
FT07	1729252.76	6454104.00	589.85	-0.49	-0.75	-0.16	237	0.90		-0.16	-0.25	-0.05	237	0.30	0.03	
FT08	1729388.66	6453350.51	658.43	-0.02	0.00	-0.01	166	0.02	*	-0.02	-0.01	-0.05	206	0.03	0.03	*
KC01	1728476.12	6452457.77	312.38	-0.67	-0.46	-0.50	215	0.81		-0.06	-0.04	0.03	216	0.07	0.02	
KC02	1727002.62	6452118.86	13.72	-0.28	-0.14	-0.12	206	0.31		-0.02	-0.01	0.03	197	0.02	0.03	*
KC04	1727559.36	6452667.01	238.44	-0.20	-0.23	-0.40	228	0.30		-0.03	-0.02	-0.01	215	0.04	0.03	
KC05	1727081.96	6453178.92	227.47	-0.04	-0.17	-0.39	256	0.18		-0.01	0.00	-0.04	180	0.01	0.03	*
KC06	1727784.89	6453396.32	299.89	-0.02	-0.35	-0.46	266	0.35		-0.01	-0.02	-0.02	233	0.02	0.03	*
KC07	1727759.39	6453683.87	313.47	0.19	-0.04	-0.36	347	0.20		0.01	0.01	0.00	32	0.01	0.03	*
KC13	1726581.08	6453069.61	191.18	-0.07	-0.02	-0.02	195	0.08		-0.03	-0.01	0.00	204	0.03	0.02	
KC14	1726742.43	6453806.02	259.89	-0.01	-0.03	-0.05	258	0.03	*	0.00	0.00	-0.03	333	0.00	0.04	*
KC15	1727590.38	6453121.02	287.10	-0.07	-0.07	0.00	227	0.10		0.00	-0.01	0.01	265	0.01	0.03	*
KC16	1727602.23	6454098.24	326.88	-0.02	0.01	-0.02	148	0.02	*	-0.01	0.01	0.01	139	0.01	0.02	*
PB04	1727665.94	6448840.86	167.11	-9.99	-2.88	-3.41	196	10.40		-0.62	-0.13	-0.20	192	0.63	0.03	
PB06	1727937.25	6449758.35	177.58	-31.19	-3.49	-5.48	186	31.39		-1.55	-0.17	-0.24	186	1.56	0.03	
PB07	1728137.00	6450212.58	197.66	-38.93	-7.18	-2.55	190	39.58		-1.83	-0.32	-0.14	190	1.86	0.03	
PB08	1728200.66	6450463.24	194.16	-36.85	-6.56	0.48	190	37.43		-1.65	-0.28	0.04	190	1.67	0.03	
PB09	1728247.35	6450848.79	189.24	-41.23	-2.24	-3.28	183	41.29		-1.95	-0.13	-0.22	184	1.95	0.03	
PB12	1728260.50	6451585.29	185.30	-69.99	-19.28	-7.99	195	72.60		-3.20	-0.96	-0.64	197	3.35	0.03	
PB13	1728045.47	6452149.17	206.87	-40.50	-15.17	-3.67	201	43.25		-1.96	-0.81	-0.11	202	2.12	0.03	
PB18	1730431.24	6450719.98	363.10	-15.64	8.89	-4.48	150	17.99		-0.11	0.02	-0.04	169	0.11	0.02	
PB20	1728746.32	6451125.33	233.20	-66.45	-10.35	-10.34	189	67.25		-2.86	-0.49	-0.49	190	2.91	0.04	
PB21	1729244.44	6451178.35	272.60	-53.78	6.30	-7.42	173	54.14		-2.15	0.18	-0.24	175	2.16	0.03	
PB25	1729670.68	6451986.36	326.01	-31.64	0.71	-2.98	179	31.64		-0.10	-0.03	-0.03	196	0.11	0.02	
PB26	1729538.86	6452252.16	282.99	-23.79	2.60	-2.35	174	23.93		-0.08	-0.03	0.06	200	0.08	0.03	
PB27	1729249.12	6451842.31	272.17	-90.22	6.25	-12.25	176	90.44		-3.47	0.11	-0.56	178	3.47	0.03	
PB29	1728844.53	6452094.53	171.59	-44.42	-25.96	-14.34	210	51.45		-2.10	-0.97	-0.64	205	2.31	0.03	
PB53	1729219.81	6450754.71	290.67	-32.96	0.78	-7.08	179	32.97		-1.73	0.10	-0.53	177	1.74	0.03	
PB54	1729691.04	6450448.55	357.73	-3.86	-0.13	-0.89	182	3.87		-0.08	-0.02	0.02	191	0.08	0.03	
PB55	1728777.36	6450801.45	240.18	-34.92	-2.59	-6.15	184	35.02		-2.05	-0.13	-0.32	184	2.05	0.04	
PB59	1727759.39	6448659.97	159.70	-6.98	-1.69	-3.69	194	7.18		-0.93	-0.21	-0.47	193	0.95	0.03	
PB62	Destroyed															
PB63	Destroyed															
PB64	1727439.04	6450942.07	69.69	-27.25	-4.88	-3.08	190	27.68		-27.25	-4.88	-3.08	190	27.68	0.03	
PB65	1728454.67	6449707.82	287.75	Replacement for PB62												
UB02	1727922.77	6450111.13	62.75	-88.34	9.34	-4.40	177	58.84		-5.10	0.67	-0.17	173	5.14	0.03	

Prepared by McGee Surveying Consulting

FULL ANNUAL MONITORING

Notes:

* Indicates no signal of horizontal movement detected in the last period

	Oct. 03, 2011 Positions			Overall Movements (US Feet)						Periodic (11.3 months) Movements (US Feet)						
	NAD83 SPC Zone 5 (Ft)		NAVD88	Original Position to Oct. 03, 2011						Oct. 25, 2010 Position to Oct. 03, 2011						
Point	North (ft)	East (ft)	Elev(ft)	North	East	Height	Azim.*	Dist.	Note	North	East	Height	Azim.*	Dist.	95%Err	Note
AB01	1729427.55	6445709.59	178.50	-0.04	-0.02	-0.12	213	0.04		0.02	-0.02	-0.02	313	0.02	0.03	*
AB02	1726946.97	6447968.70	116.45	-0.01	0.01	-0.03	124	0.01		0.01	0.04	0.00	81	0.04	0.02	
AB04	1728390.04	6447121.59	67.21	-1.95	-1.75	-0.36	222	2.62		-0.23	-0.20	-0.03	221	0.30	0.02	
AB05	1728074.57	6447643.73	80.49	-1.15	-1.45	-0.41	232	1.84		-0.09	-0.16	-0.04	240	0.19	0.03	
AB06	1729058.21	6446975.77	164.77	-1.53	-0.49	-0.51	198	1.60		-0.16	-0.06	-0.05	202	0.17	0.03	
AB07	1728981.13	6447357.52	159.24	-1.66	-0.89	-0.68	208	1.88		-0.15	-0.12	-0.06	218	0.19	0.04	
AB12	1729415.28	6448271.12	283.19	-1.21	-0.52	-0.24	203	1.32		-0.18	-0.08	-0.01	204	0.20	0.03	
AB13	1729927.96	6448235.79	364.50	-0.93	-0.25	-0.53	195	0.97		-0.12	-0.06	-0.03	205	0.14	0.03	
AB15	1730311.37	6448099.26	396.87	-0.72	-0.13	-0.41	190	0.73		-0.10	0.01	0.00	174	0.10	0.03	
AB16	1730358.55	6447532.15	376.44	-0.34	0.03	-0.18	175	0.34		-0.06	0.00	-0.02	185	0.06	0.03	
AB17	1731421.09	6446727.74	442.78	-0.03	-0.04	-0.02	228	0.05		-0.01	-0.03	-0.02	246	0.03	0.04	*
AB18	1731602.16	6448187.62	456.84	-0.46	0.13	-0.35	165	0.48		-0.06	0.01	0.01	173	0.06	0.03	
AB20	1729359.56	6449685.89	396.23	-1.07	-0.38	-0.20	200	1.13		-0.16	-0.06	0.00	199	0.17	0.03	
AB24	1729829.52	6447759.68	335.77	-0.84	-0.28	-0.15	198	0.88		-0.13	-0.04	0.01	200	0.13	0.02	
AB50	1728084.56	6448247.27	182.01	-0.44	-0.92	0.03	244	1.02		-0.06	-0.11	0.02	243	0.13	0.03	
AB51	1729616.46	6447306.45	305.17	-0.55	-0.09	-0.25	189	0.56		-0.10	-0.04	-0.07	200	0.11	0.03	
AB52	1730015.49	6448624.26	368.35	-0.61	-0.18	-0.26	197	0.64		-0.12	-0.04	-0.03	200	0.13	0.04	
AB53	1730430.36	6449712.24	352.87	-0.75	-0.13	-0.26	190	0.76		-0.14	-0.02	-0.04	189	0.14	0.03	
AB54	1731111.92	6447047.87	407.31	-0.02	0.01	0.00	164	0.03	*	0.00	0.01	-0.02	97	0.01	0.03	*
AB55	1731174.61	6447753.58	405.37	-0.15	0.02	-0.01	173	0.16		-0.04	0.00	-0.03	179	0.04	0.03	
AB56	1732214.00	6448545.55	571.57	-0.31	0.09	-0.08	164	0.32		-0.12	0.04	-0.06	162	0.12	0.03	
AB57	1731926.54	6449759.46	564.83	-0.37	0.09	-0.10	166	0.38		-0.14	0.03	-0.10	166	0.14	0.03	
AB58	1731117.67	6449074.94	405.64	-0.35	0.00	-0.03	179	0.35		-0.13	0.00	-0.05	178	0.13	0.04	
AB59	1730850.40	6450212.51	434.27	-0.47	-0.05	-0.10	186	0.47		-0.16	-0.01	-0.07	182	0.16	0.03	
AB60	1729089.38	6447987.45	179.39	-0.32	-0.12	-0.06	200	0.34		-0.15	-0.05	-0.03	199	0.16	0.03	
AB61	1727424.48	6447990.26	140.43	-0.02	0.00	-0.04	177	0.02	*	0.00	-0.01	-0.04	259	0.01	0.01	*
AB62	1728910.35	6446925.46	143.01	Replacement for AB06												
AB63	1729059.30	6447307.03	180.84	Replacement for AB07												
BB52	1726995.98	6451384.32	3.89	-0.38	-0.06	0.06	188	0.39		-0.15	-0.01	0.04	185	0.15	0.03	
CR07	1731628.00	6451203.34	632.26	-0.78	0.15	-1.02	169	0.79		-0.12	0.02	-0.07	171	0.12	0.03	
CR50	1733013.59	6451037.37	872.65	-0.03	-0.01	-0.01	197	0.03		0.00	-0.01	-0.02	254	0.01	0.03	*
CR51	1733062.00	6452361.87	976.18	-0.04	0.01	-0.07	164	0.04		-0.01	-0.01	0.00	216	0.01	0.03	*
CR52	1732867.53	6450239.26	779.68	-0.05	-0.06	0.05	232	0.08		-0.02	-0.05	0.02	247	0.05	0.05	
FT06	1729855.05	6452760.09	488.79	-0.55	-0.12	-0.27	192	0.57		-0.20	-0.04	-0.11	191	0.20	0.03	
FT07	1729252.33	6454103.33	588.72	-0.91	-1.42	-0.29	237	1.69		-0.43	-0.67	-0.13	238	0.79	0.03	
FT08	1729388.67	6453350.48	658.45	-0.01	-0.02	0.01	251	0.02	*	0.01	-0.03	0.02	293	0.03	0.02	*
KC01	1728475.98	6452457.69	312.35	-0.80	-0.54	-0.53	214	0.97		-0.14	-0.08	-0.03	211	0.16	0.03	
KC02	1727002.55	6452110.84	13.73	-0.34	-0.16	-0.11	205	0.38		-0.07	-0.02	0.01	199	0.07	0.03	
KC04	1727559.31	6452666.95	238.46	-0.25	-0.29	-0.38	229	0.38		-0.05	-0.06	0.02	230	0.08	0.03	
KC05	1727081.92	6453178.90	227.47	-0.08	-0.19	-0.39	248	0.21		-0.03	-0.02	0.00	210	0.04	0.03	
KC06	1727784.89	6453396.26	299.88	-0.02	-0.41	-0.47	268	0.41		0.01	-0.06	-0.01	277	0.06	0.03	
KC07	1727759.39	6453683.87	313.46	0.20	-0.05	-0.35	346	0.21		0.01	-0.01	0.01	315	0.01	0.03	*
KC13	1726581.05	6453069.58	191.13	-0.11	-0.05	-0.07	206	0.12		-0.04	-0.03	-0.05	222	0.05	0.03	
KC14	1726742.44	6453806.00	259.92	0.00	-0.05	-0.02	271	0.05		0.01	-0.02	0.02	288	0.02	0.03	*
KC15	1727590.34	6453120.97	287.06	-0.11	-0.13	-0.04	229	0.17		-0.04	-0.05	-0.04	233	0.07	0.03	
KC16	1727602.24	6454098.22	326.88	-0.01	-0.01	-0.02	233	0.02	*	0.01	-0.02	0.00	288	0.02	0.03	*
PB04	1727665.23	6448848.66	166.92	-10.71	-3.08	-3.60	196	11.14		-0.71	-0.21	-0.19	196	0.74	0.04	
PB06	1727935.82	6449758.16	177.36	-32.63	-3.68	-5.70	186	32.84		-1.44	-0.20	-0.22	188	1.45	0.04	
PB07	1728135.18	6450212.21	197.54	-40.74	-7.55	-2.67	190	41.44		-1.82	-0.37	-0.12	191	1.86	0.04	
PB08	1728199.00	6450462.93	194.19	-38.50	-6.97	0.51	190	39.11		-1.66	-0.31	0.03	191	1.69	0.04	
PB09	1728245.34	6450848.65	188.99	-43.24	-2.37	-3.53	183	43.30		-2.01	-0.13	-0.25	184	2.01	0.04	
PB12	1728257.11	6451584.30	184.73	-73.38	-20.27	-8.56	195	76.13		-3.39	-0.99	-0.57	196	3.53	0.04	
PB13	1728043.37	6452148.28	206.76	-42.60	-16.06	-3.78	201	45.53		-2.10	-0.89	-0.11	203	2.28	0.03	
PB18	1730430.95	6450719.94	363.04	-15.94	8.95	-4.54	151	18.28		-0.30	0.06	-0.06	169	0.30	0.03	
PB20	1728743.25	6451124.73	232.60	-69.51	-10.95	-10.95	189	70.37		-3.06	-0.60	-0.60	191	3.12	0.04	
PB21	1729242.22	6451178.53	272.35	-55.99	6.48	-7.67	173	56.37		-2.22	0.18	-0.25	175	2.23	0.04	
PB25	1729670.41	6451906.30	326.01	-31.90	0.65	-2.98	179	31.91		-0.27	-0.06	0.01	193	0.28	0.03	
PB26	1729538.62	6452252.15	282.96	-24.02	2.59	-2.38	174	24.16		-0.23	-0.02	-0.03	184	0.23	0.04	
PB27	1729245.47	6451842.40	271.66	-93.87	6.34	-12.76	176	94.09		-3.65	0.09	-0.51	179	3.65	0.06	
PB29	1728842.25	6452093.51	170.88	-46.69	-26.98	-15.05	210	53.93		-2.28	-1.02	-0.71	204	2.49	0.04	
PB53	1729217.92	6450754.81	290.10	-34.85	0.89	-7.65	179	34.86		-1.89	0.10	-0.57	177	1.89	0.05	
PB54	1729690.83	6450448.49	357.73	-4.07	-0.20	-0.89	183	4.08		-0.21	-0.06	0.00	197	0.22	0.03	
PB55	1728775.28	6450801.26	239.73	-37.00	-2.78	-6.60	184	37.11		-2.08	-0.19	-0.45	185	2.09	0.04	
PB59	1727758.34	6448659.68	159.21	-8.02	-1.99	-4.18	194	8.27		-1.04	-0.30	-0.49	196	1.09	0.04	
PB64	1727417.65	6450937.67	67.14	-48.64	-9.27	-5.62	191	49.51		-21.39	-4.40	-2.55	192	21.83	0.04	
PB65	1728454.34	6449707.76	287.70	-0.32	-0.06	-0.05	191	0.33		-0.32	-0.06	-0.05	191	0.33	0.03	
UB02	1727519.20	6450142.56	62.65	-61.91	8.78	-4.51	172	62.53		-3.57	0.44	-0.10	173	3.60	0.04	

PORTUGUESE BEND LANDSLIDE MONITORING - MOVEMENT DATA POSTING as of September 14, 2012
Prepared by McGee Surveying Consulting - Document Date: 09/30/2013
Monitoring Point Movements
FULL ANNUAL MONITORING

Notes:
* Indicates no signal of horizontal movement detected in the last period

	Sept. 14, 2012 Positions			Overall Movements (US Feet)						Periodic (11.4 months) Movements (US Feet)						
	NAD83 SPC Zone 5 (ft)		NAVD88	Original Position to Sept. 14, 2012						Oct. 03, 2011 Position to Sept. 14, 2012						
Point	North (ft)	East (ft)	Elev(ft)	North	East	Height	Azim.*	Dist.	Year	North	East	Height	Azim.*	Dist.	95%Err	Note
AB01	1729427.54	6445709.59	178.54	-0.04	-0.02	-0.08	209	0.05	1994	-0.01	0.00	0.04	180	0.01	0.02	*
AB02	1726946.97	6447968.68	116.47	-0.01	-0.01	-0.01	221	0.01	2007	0.00	-0.02	0.02	270	0.02	0.01	*
AB04	1728389.97	6447121.52	67.21	-2.02	-1.82	-0.36	222	2.72	1994	-0.07	-0.07	-0.01	223	0.10	0.02	
AB05	1728074.51	6447643.66	80.50	-1.21	-1.51	-0.40	231	1.93	1994	-0.06	-0.06	0.01	225	0.09	0.02	
AB12	1729415.22	6448271.10	283.19	-1.27	-0.55	-0.24	203	1.38	1994	-0.06	-0.03	0.01	203	0.07	0.02	
AB13	1729927.91	6448235.78	364.47	-0.99	-0.25	-0.56	194	1.02	1994	-0.05	-0.01	-0.03	188	0.06	0.03	
AB15	1730311.31	6448099.25	396.83	-0.77	-0.13	-0.45	190	0.78	1994	-0.05	0.00	-0.04	183	0.05	0.03	
AB16	1730358.55	6447532.13	376.41	-0.33	0.01	-0.21	179	0.33	1994	0.00	-0.02	-0.03	281	0.02	0.02	*
AB17	1731421.09	6446727.75	442.80	-0.03	-0.02	0.00	219	0.04	2007	0.00	0.01	0.01	72	0.01	0.03	*
AB18	1731602.11	6448187.62	456.86	-0.52	0.13	-0.33	166	0.53	1994	-0.05	0.00	0.02	181	0.05	0.03	
AB20	1729359.49	6449685.87	396.22	-1.13	-0.39	-0.21	199	1.20	1995	-0.07	-0.02	-0.01	194	0.07	0.02	
AB24	1729829.45	6447759.65	335.75	-0.91	-0.31	-0.17	199	0.96	1997	-0.07	-0.04	-0.03	206	0.08	0.02	
AB50	1728084.54	6448247.22	182.03	-0.46	-0.96	0.05	244	1.07	1998	-0.02	-0.05	0.01	246	0.05	0.02	
AB51	1729616.41	6447306.43	305.16	-0.60	-0.11	-0.26	191	0.61	2002	-0.05	-0.02	-0.01	208	0.05	0.02	
AB52	1730015.44	6448624.25	368.33	-0.66	-0.19	-0.28	196	0.68	2002	-0.05	-0.01	-0.02	187	0.05	0.04	
AB53	1730430.28	6449712.23	352.86	-0.82	-0.14	-0.27	190	0.84	2002	-0.07	-0.01	-0.01	191	0.08	0.03	
AB54	1731111.89	6447047.88	407.38	-0.05	0.01	0.07	165	0.06	2007	-0.03	0.01	0.07	166	0.03	0.04	*
AB56	1732213.96	6448545.55	571.57	-0.35	0.09	-0.08	165	0.36	2007	-0.04	0.00	0.00	173	0.04	0.02	
AB57	1731926.47	6449759.45	564.78	-0.43	0.09	-0.15	169	0.44	2007	-0.06	-0.01	-0.04	187	0.06	0.02	
AB58	1731117.59	6449074.92	405.65	-0.43	-0.01	-0.02	181	0.43	2007	-0.08	-0.01	0.01	190	0.08	0.04	
AB59	1730850.31	6450212.50	434.26	-0.55	-0.06	-0.11	186	0.56	2007	-0.08	-0.01	-0.02	187	0.09	0.03	
AB60	1729089.34	6447987.41	179.37	-0.36	-0.16	-0.08	204	0.39	2007	-0.04	-0.04	-0.02	226	0.06	0.02	
AB61	1727424.49	6447990.26	140.45	-0.01	0.01	-0.02	145	0.01	2007	0.01	0.01	0.02	29	0.01	0.01	*
AB62	1728910.29	6446925.43	143.02	-0.06	-0.03	0.01	206	0.07	2011	-0.06	-0.03	0.01	206	0.07	0.02	
AB63	1729059.24	6447306.99	180.82	-0.06	-0.04	-0.02	214	0.07	2011	-0.06	-0.04	-0.02	214	0.07	0.02	
AB64	1731830.69	6447373.08	532.25	Replacement for AB54					2012							
AB65	1731705.67	6448264.07	458.53	Replacement for AB18					2012							
AB66	1730047.29	6448490.53	374.28	Replacement for AB52					2012							
AB67	1731180.41	6447741.76	405.33	Replacement for AB55					2012							
AB68	1730258.86	6448055.37	393.45	Replacement for AB15					2012							
BB52	1726995.94	6451384.30	3.87	-0.42	-0.08	0.04	191	0.43	2007	-0.04	-0.03	-0.02	214	0.05	0.03	
CR07	1731627.96	6451203.36	632.17	-0.82	0.17	-1.11	168	0.84	1994	-0.04	0.02	-0.09	153	0.05	0.03	
CR50	1733013.60	6451037.36	872.62	-0.02	-0.01	-0.04	218	0.02	1998	0.01	-0.01	-0.03	336	0.01	0.03	*
CR51	1733062.00	6452361.87	976.15	-0.03	0.01	-0.10	162	0.03	1998	0.01	0.00	-0.03	0	0.01	0.02	*
CR52	1732867.50	6450239.27	779.60	-0.08	-0.05	-0.03	212	0.09	1998	-0.03	0.01	-0.08	161	0.03	0.06	*
CR53	1732780.28	6450224.19	780.72	Replacement for CR52					2012							
FT06	1729854.97	6452760.07	488.72	-0.64	-0.14	-0.34	192	0.65	2007	-0.08	-0.01	-0.07	190	0.08	0.02	
FT07	1729252.18	6454103.12	588.67	-1.06	-1.63	-0.34	237	1.95	2007	-0.15	-0.21	-0.05	235	0.26	0.02	
FT08	1729388.67	6453350.49	658.44	-0.02	-0.01	-0.01	219	0.02	2007	-0.01	0.01	-0.01	122	0.01	0.02	*
KC01	1728475.91	6452457.65	312.34	-0.87	-0.58	-0.54	213	1.05	1994	-0.07	-0.03	-0.01	205	0.08	0.02	
KC02	1727002.51	6452118.83	13.73	-0.39	-0.16	-0.11	203	0.42	1995	-0.04	0.00	0.00	185	0.04	0.02	
KC04	1727559.28	6452666.96	238.43	-0.29	-0.28	-0.41	225	0.40	1995	-0.04	0.00	-0.03	178	0.04	0.02	
KC05	1727081.89	6453178.89	227.49	-0.11	-0.20	-0.37	242	0.23	1994	-0.03	-0.01	0.02	196	0.03	0.02	
KC06	1727784.85	6453396.22	299.88	-0.06	-0.45	-0.47	263	0.45	1994	-0.04	-0.04	0.00	228	0.06	0.02	
KC07	1727759.39	6453683.85	313.49	0.20	-0.06	-0.34	342	0.21	1994	0.00	-0.01	0.01	278	0.01	0.03	*
KC13	1726581.02	6453069.58	191.10	-0.14	-0.05	-0.10	201	0.15	2007	-0.03	0.00	-0.03	182	0.03	0.02	
KC14	1726742.42	6453805.98	259.91	-0.02	-0.07	-0.03	252	0.08	2007	-0.03	-0.02	-0.01	224	0.03	0.02	
KC15	1727590.32	6453120.95	287.06	-0.13	-0.14	-0.04	227	0.20	2007	-0.02	-0.02	0.00	216	0.03	0.02	
KC16	1727602.23	6454098.23	326.87	-0.01	0.00	-0.03	180	0.01	2007	0.00	0.01	-0.01	113	0.01	0.03	*
KC17	1727302.76	6453026.42	215.25	Replacement for KC04					2012							
PB04	1727664.82	6448048.57	166.81	-11.12	-3.17	-3.71	196	11.56	1994	-0.41	-0.09	-0.12	192	0.42	0.04	
PB06	1727934.92	6449758.07	177.24	-33.52	-3.77	-5.82	186	33.73	1995	-0.89	-0.09	-0.12	186	0.90	0.03	
PB07	1728134.07	6450211.98	197.49	-41.85	-7.78	-2.72	191	42.57	1995	-1.11	-0.23	-0.05	192	1.13	0.03	
PB08	1728197.95	6450462.75	194.24	-39.56	-7.05	0.56	190	40.18	1994	-1.05	-0.18	0.05	190	1.07	0.03	
PB09	1728244.01	6450848.59	188.79	-44.57	-2.44	-3.74	183	44.64	1994	-1.33	-0.07	-0.20	183	1.33	0.03	
PB12	1728254.64	6451583.54	184.21	-75.85	-21.03	-9.08	195	78.71	1994	-2.47	-0.76	-0.53	197	2.59	0.03	
PB13	1728041.82	6452147.64	206.67	-44.15	-16.70	-3.87	201	47.20	1995	-1.55	-0.64	-0.10	202	1.67	0.02	
PB18	1730430.87	6450719.92	363.01	-16.01	8.93	-4.57	151	18.33	1995	-0.07	-0.02	-0.03	197	0.08	0.03	
PB20	1728741.10	6451124.30	232.16	-71.67	-11.38	-11.38	189	72.56	1995	-2.15	-0.43	-0.44	191	2.20	0.03	
PB21	1729240.85	6451178.60	272.17	-57.37	6.55	-7.85	173	57.74	1995	-1.38	0.07	-0.18	177	1.38	0.03	
PB25	1729670.31	6451986.28	325.97	-32.00	0.63	-3.02	179	32.01	1994	-0.10	-0.02	-0.04	192	0.10	0.03	
PB26	1729538.54	6452252.11	282.93	-24.11	2.55	-2.41	174	24.24	1995	-0.09	-0.03	-0.03	202	0.09	0.04	
PB27	1729242.88	6451842.42	271.21	-96.46	6.36	-13.21	176	96.67	1995	-2.58	0.02	-0.45	180	2.58	0.06	
PB29	1728940.65	6452092.79	170.41	-48.30	-27.70	-15.52	210	55.67	1995	-1.60	-0.72	-0.48	204	1.76	0.03	
PB53	1729216.82	6450754.85	289.90	-35.95	0.93	-7.85	179	35.96	1997	-1.10	0.04	-0.20	178	1.10	0.05	
PB54	1729690.75	6450448.48	357.70	-4.15	-0.21	-0.92	183	4.15	1997	-0.07	-0.01	-0.02	191	0.08	0.02	
PB55	1728774.00	6450801.18	239.55	-38.28	-2.86	-6.78	184	38.39	1998	-1.28	-0.08	-0.18	183	1.28	0.03	
PB59	1727757.70	6448659.52	158.92	-8.66	-2.15	-4.47	194	8.93	2001	-0.64	-0.16	-0.29	194	0.66	0.03	
PB64	1727394.56	6450932.96	63.68	-71.73	-13.99	-9.08	191	73.08	2009	-23.09	-4.72	-3.46	192	23.57	0.03	
PB65	1728454.20	6449707.73	287.69	-0.47	-0.09	-0.06	191	0.47	2010	-0.14	-0.03	-0.01	191	0.14	0.02	
PB66	1729197.65	6450969.92	288.33	Replacement for PB53					2012							
UB02	1727517.18	6450142.02	62.66	63.94	9.03	1.49	173	64.67	1997	-2.02	0.26	0.01	173	2.04	0.03	

PORTUGUESE BEND LANDSLIDE MONITORING - MOVEMENT DATA POSTING as of April 18, 2013
Prepared by McGee Surveying Consulting - Document Date: 09/30/2013 Revised 03/05/2014
Monitoring Point Movements
PARTIAL MID-YEAR MONITORING

Notes:
* Indicates no signal of horizontal movement detected in the last period at the 95% level of confidence

	April 18, 2013 Positions			Overall Movements (US Feet)						Periodic (7.1 months) Movements (US Feet)						
	NAD83 SPC Zone 5 (Ft)		NAVD88	Original Position to April 18, 2013						Sept. 14, 2012 Position to April 18, 2013						
Point	North (ft)	East (ft)	Elev(ft)	North	East	Height	Azim.°	Dist.	Year	North	East	Height	Azim.°	Dist.	95%Err	Note
AB04	1728389.95	6447121.48	67.17	-2.04	-1.86	-0.40	222	2.76	1994	-0.02	-0.04	-0.04	246	0.04	0.01	
AB12	1729415.20	6448271.07	283.17	-1.29	-0.58	-0.26	204	1.41	1994	-0.02	-0.03	-0.02	232	0.03	0.01	
AB16	1730358.57	6447532.13	376.44	-0.32	0.01	-0.18	178	0.32	1994	0.01	0.00	0.02	8	0.02	0.02	*
AB17	1731421.09	6446727.75	442.78	-0.03	-0.02	-0.02	219	0.03	2007	0.00	0.00	-0.02	45	0.00	0.01	*
AB20	1729359.43	6449685.84	396.21	-1.19	-0.42	-0.22	200	1.26	1995	-0.06	-0.03	-0.01	205	0.07	0.01	
AB50	1728084.51	6448247.18	182.00	-0.49	-1.01	0.02	244	1.12	1998	-0.03	-0.04	-0.03	236	0.05	0.01	
AB59	1730850.25	6450212.49	434.24	-0.62	-0.07	-0.13	186	0.62	2007	-0.06	-0.01	-0.01	192	0.07	0.01	
AB60	1729089.33	6447987.40	179.32	-0.37	-0.17	-0.13	204	0.41	2007	-0.02	-0.01	-0.05	215	0.02	0.01	
AB61	1727424.49	6447990.26	140.41	-0.01	0.00	-0.06	135	0.01	2007	0.00	0.00	-0.04	338	0.01	0.00	*
AB65	1731705.66	6448264.06	458.53	-0.01	0.00	-0.01	194	0.01	2012	-0.01	0.00	-0.01	194	0.01	0.02	*
CR07	1731627.92	6451203.36	632.18	-0.86	0.17	-1.10	169	0.87	1994	-0.04	0.00	0.01	183	0.04	0.02	
CR50	1733013.59	6451037.36	872.66	-0.02	-0.01	0.00	214	0.03	1998	0.00	0.00	0.05	194	0.00	0.01	*
FT06	1729854.91	6452760.05	486.68	-0.70	-0.16	-0.38	193	0.72	2007	-0.06	-0.02	-0.04	201	0.07	0.01	
FT07	1729252.14	6454103.03	588.65	-1.10	-1.72	-0.36	237	2.04	2007	-0.04	-0.09	-0.02	246	0.10	0.02	
KC06	1727784.86	6453396.20	299.84	-0.05	-0.47	-0.51	264	0.47	1994	0.00	-0.02	-0.04	284	0.02	0.01	
KC07	1727759.41	6453683.87	313.46	0.22	-0.05	-0.37	346	0.23	1994	0.02	0.01	-0.02	31	0.02	0.01	
KC13	1726581.02	6453069.56	191.09	-0.14	-0.07	-0.11	208	0.16	2007	0.00	-0.02	-0.02	276	0.02	0.01	
KC16	1727602.23	6454098.23	326.80	-0.02	0.00	-0.02	188	0.02	2007	0.00	0.00	0.01	243	0.00	0.01	*
KC17	1727302.74	6453026.40	215.23	-0.02	-0.02	-0.02	229	0.03	2012	-0.02	-0.02	-0.02	229	0.03	0.01	
PB04	1727664.58	6448848.49	166.69	-11.36	-3.25	-3.83	196	11.82	1994	-0.24	-0.08	-0.12	198	0.25	0.02	
PB12	1728253.25	6451583.09	183.84	-77.23	-21.48	-9.45	196	80.17	1994	-1.39	-0.45	-0.37	198	1.46	0.01	
PB13	1728040.95	6452147.25	206.54	-45.02	-17.10	-4.00	201	48.16	1995	-0.87	-0.39	-0.13	204	0.95	0.02	
PB18	1730430.79	6450719.89	362.96	-16.09	8.89	-4.62	151	18.39	1995	-0.08	-0.03	-0.05	200	0.09	0.02	
PB26	1729538.46	6452252.09	282.90	-24.18	2.53	-2.44	174	24.32	1995	-0.07	-0.02	-0.03	197	0.08	0.01	
PB59	1727757.34	6448659.41	158.71	-9.03	-2.25	-4.68	194	9.30	2001	-0.36	-0.11	-0.21	197	0.38	0.07	
PB64	1727382.15	6450930.51	60.16	-84.14	-16.44	-12.60	191	85.73	2009	-12.41	-2.45	-3.53	191	12.65	0.02	
PB66	1729197	6450969.91	288.22	-0.64	-0.01	-0.10	181	0.64	2012	-0.64	-0.01	-0.10	181	0.64	0.01	

PORTUGUESE BEND LANDSLIDE MONITORING - MOVEMENT DATA POSTING as of October 4, 2013
Prepared by McGee Surveying Consulting - Document Date: 12/18/2013
Monitoring Point Movements
FULL ANNUAL MONITORING

Notes:
* Indicates no signal of horizontal movement detected in the last period at the 95% level of confidence

	October 4, 2013 Positions		Overall Movements (US Feet)						Periodic (12.7 months) Movements (US Feet)						
	NAD83 SPC Zone 5 (Ft)	NAVD88	Original Position to October 4, 2013						Sept. 14, 2012 Position to October 4, 2013						
Point	North (ft) East (ft)	Elev(ft)	North	East	Height	Azim.*	Dist.	Year	North	East	Height	Azim.*	Dist.	95%Err	Note
AB01	1729427.56 6445709.60	178.51	-0.02	-0.01	-0.11	206	0.03	1994	0.02	0.01	-0.03	33	0.02	0.02	*
AB02	1726946.99 6447968.69	116.45	0.01	0.01	-0.03	34	0.01	2007	0.02	0.01	-0.02	37	0.02	0.02	*
AB04	1728389.95 6447121.51	67.16	-2.04	-1.84	-0.41	222	2.75	1994	-0.02	-0.02	-0.04	223	0.03	0.02	
AB05	1728074.49 6447643.63	80.46	-1.23	-1.54	-0.44	231	1.97	1994	-0.02	-0.04	-0.04	237	0.04	0.02	
AB12	1729415.18 6448271.06	283.16	-1.30	-0.58	-0.27	204	1.43	1994	-0.04	-0.03	-0.03	223	0.05	0.02	
AB13	1729927.87 6448235.79	364.46	-1.03	-0.25	-0.57	194	1.06	1994	-0.04	0.00	-0.01	177	0.04	0.02	
AB16	1730358.54 6447532.13	376.39	-0.35	0.00	-0.23	180	0.35	1994	-0.02	-0.01	-0.02	202	0.02	0.03	*
AB17	1731421.10 6446727.74	442.81	-0.02	-0.04	0.01	237	0.04	2007	0.01	-0.01	0.01	293	0.01	0.03	*
AB20	1729359.40 6449685.84	396.20	-1.22	-0.42	-0.23	199	1.29	1995	-0.09	-0.03	-0.02	197	0.10	0.01	
AB24	1729829.42 6447759.63	335.73	-0.94	-0.33	-0.19	200	1.00	1997	-0.03	-0.02	-0.02	217	0.04	0.02	
AB50	1728084.51 6448247.18	182.00	-0.49	-1.00	0.02	244	1.11	1998	-0.02	-0.04	-0.02	237	0.04	0.02	
AB51	1729616.40 6447306.45	305.14	-0.61	-0.09	-0.28	189	0.62	2002	-0.01	0.02	-0.02	122	0.03	0.02	
AB53	1730430.21 6449712.24	352.86	-0.90	-0.13	-0.27	188	0.91	2002	-0.08	0.01	0.01	173	0.08	0.04	
AB56	1732213.90 6448545.59	571.55	-0.41	0.13	-0.10	162	0.43	2007	-0.06	0.04	-0.01	150	0.07	0.02	
AB57	1731926.41 6449759.48	564.78	-0.50	0.12	-0.15	167	0.51	2007	-0.06	0.03	-0.01	153	0.07	0.02	
AB58	1731117.55 6449074.93	405.68	-0.47	0.00	0.00	180	0.47	2007	-0.04	0.01	0.03	167	0.04	0.05	*
AB59	1730850.22 6450212.49	434.22	-0.65	-0.07	-0.15	186	0.65	2007	-0.10	-0.01	-0.03	186	0.10	0.02	
AB60	1729089.34 6447987.41	179.33	-0.37	-0.16	-0.12	203	0.40	2007	-0.01	0.00	-0.04	166	0.01	0.02	*
AB61	1727424.48 6447990.27	140.42	-0.02	0.01	-0.05	152	0.02	2007	-0.01	0.00	-0.03	164	0.01	0.01	*
AB62	1728910.26 6446925.42	142.98	-0.09	-0.04	-0.03	204	0.10	2011	-0.03	-0.01	-0.04	200	0.03	0.02	
AB63	1729059.22 6447306.97	180.79	-0.08	-0.07	-0.05	218	0.10	2011	-0.02	-0.02	-0.03	229	0.03	0.02	
AB64	1731830.71 6447373.07	532.21	0.02	-0.01	-0.04	321	0.02	2012	0.02	-0.01	-0.04	321	0.02	0.02	*
AB65	1731705.66 6448264.09	458.54	-0.02	0.02	0.00	130	0.03	2012	-0.02	0.02	0.00	130	0.03	0.02	
AB66	1730047.23 6448490.52	374.29	-0.05	-0.01	0.01	186	0.05	2012	-0.05	-0.01	0.01	186	0.05	0.02	
AB67	1731180.40 6447741.76	405.31	-0.01	0.01	-0.01	153	0.01	2012	-0.01	0.01	-0.01	153	0.01	0.02	*
AB68	1730258.84 6448055.36	393.40	-0.02	-0.01	-0.04	204	0.02	2012	-0.02	-0.01	-0.04	204	0.02	0.02	*
BB52	1726995.83 6451384.31	3.91	-0.54	-0.07	0.08	187	0.54	2007	-0.11	0.01	0.04	173	0.11	0.04	
CR07	1731627.89 6451203.35	632.11	-0.89	0.16	-1.17	170	0.91	1994	-0.07	0.00	-0.06	184	0.07	0.02	
CR50	1733013.57 6451037.37	872.64	-0.04	0.00	-0.02	184	0.04	1998	-0.03	0.01	0.02	156	0.03	0.02	
CR51	1733061.99 6452361.88	976.17	-0.04	0.02	-0.08	159	0.04	1998	-0.01	0.01	0.02	149	0.01	0.02	*
CR53	1732780.29 6450224.19	780.73	0.01	0.00	0.00			2012	0.01	0.00	0.00	0	0.01	0.02	*
FT06	1729854.86 6452760.05	488.65	-0.75	-0.16	-0.42	192	0.77	2007	-0.11	-0.02	-0.08	190	0.12	0.02	
FT07	1729252.12 6454102.96	588.63	-1.12	-1.79	-0.38	238	2.11	2007	-0.06	-0.16	-0.04	249	0.17	0.03	
FT08	1729388.67 6453350.51	658.41	-0.02	0.01	-0.03	151	0.02	2007	0.00	0.02	-0.02	93	0.02	0.02	*
KC01	1728475.83 6452457.62	312.28	-0.95	-0.61	-0.60	213	1.13	1994	-0.08	-0.04	-0.05	205	0.09	0.02	
KC02	1727002.47 6452118.84	13.70	-0.42	-0.15	-0.14	200	0.45	1995	-0.03	0.01	-0.02	160	0.04	0.02	
KC05	1727081.89 6453178.88	227.46	-0.11	-0.21	-0.40	242	0.24	1994	-0.01	-0.01	-0.03	240	0.01	0.02	*
KC06	1727784.85 6453396.21	299.85	-0.06	-0.46	-0.50	263	0.46	1994	0.00	-0.01	-0.03	236	0.01	0.02	*
KC07	1727759.41 6453683.86	313.47	0.22	-0.06	-0.36	346	0.23	1994	0.02	0.01	-0.01	22	0.02	0.02	*
KC13	1726580.98 6453069.60	191.06	-0.17	-0.03	-0.14	191	0.18	2007	-0.03	0.02	-0.04	147	0.04	0.02	
KC14	1726742.44 6453806.00	259.90	0.00	-0.05	-0.04	268	0.06	2007	0.02	0.02	-0.01	41	0.03	0.02	?
KC15	1727590.29 6453120.94	287.03	-0.16	-0.16	-0.07	225	0.23	2007	-0.02	-0.02	-0.03	213	0.03	0.02	
KC16	1727602.24 6454098.24	326.88	-0.01	0.01	-0.02	121	0.01	2007	0.01	0.01	0.01	51	0.01	0.02	*
KC17	1727302.74 6453026.41	215.24	-0.02	-0.01	-0.02	216	0.03	2012	-0.02	-0.01	-0.02	216	0.03	0.02	
PB04	1727664.44 6448848.46	166.65	-11.50	-3.28	-3.87	196	11.95	1994	-0.38	-0.11	-0.15	196	0.39	0.03	
PB06	1727934.33 6449757.99	177.13	-34.12	-3.85	-5.93	186	34.34	1995	-0.60	-0.08	-0.11	188	0.60	0.02	
PB07	1728133.26 6450211.82	197.39	-42.67	-7.94	-2.82	191	43.40	1995	-0.81	-0.16	-0.09	191	0.83	0.02	
PB08	1728197.20 6450452.60	194.26	-40.30	-7.19	0.58	190	40.94	1994	-0.75	-0.15	0.02	191	0.76	0.03	
PB09	1728243.00 6450848.55	188.58	-45.58	-2.47	-3.94	183	45.65	1994	-1.01	-0.04	-0.20	182	1.01	0.03	
PB12	1728252.35 6451582.81	183.67	-78.14	-21.76	-9.62	196	81.11	1994	-2.29	-0.73	-0.54	198	2.41	0.02	
PB13	1728040.35 6452147.01	206.52	-45.62	-17.33	-4.02	201	48.80	1995	-1.47	-0.63	-0.15	203	1.60	0.02	
PB18	1730430.78 6450719.92	362.94	-16.11	8.92	-4.64	151	18.41	1995	-0.10	0.00	-0.06	183	0.10	0.02	
PB20	1728739.17 6451123.87	231.72	-73.60	-11.81	-11.82	189	74.54	1995	-1.94	-0.43	-0.44	192	1.98	0.02	
PB21	1729239.78 6451178.72	271.99	-58.44	6.66	-8.03	173	58.82	1995	-1.07	0.12	-0.18	174	1.07	0.02	
PB25	1729670.19 6451986.23	325.94	-32.13	0.58	-3.05	179	32.13	1994	-0.13	-0.05	-0.03	202	0.13	0.01	
PB26	1729538.42 6452252.10	282.89	-24.23	2.54	-2.45	174	24.36	1995	-0.12	-0.01	-0.03	184	0.12	0.02	
PB27	1729240.60 6451842.46	270.83	-98.74	6.39	-13.60	176	98.95	1995	-2.29	0.04	-0.39	179	2.29	0.02	
PB29	1728839.12 6452092.15	169.87	-49.82	-28.34	-16.06	210	57.32	1995	-1.52	-0.64	-0.54	203	1.65	0.03	
PB54	1729690.65 6450448.46	357.73	-4.24	-0.23	-0.89	183	4.25	1997	-0.10	-0.02	0.02	190	0.10	0.03	
PB55	1728772.93 6450801.16	239.47	-39.35	-2.88	-6.86	184	39.46	1998	-1.07	-0.02	-0.08	181	1.07	0.05	
PB59	1727757.09 6448659.36	158.60	-9.28	-2.31	-4.79	194	9.56	2001	-0.61	-0.16	-0.32	195	0.63	0.03	
PB64	1727369.21 6450928.11	56.84	-97.08	-18.83	-15.92	191	98.89	2009	-25.35	-4.84	-6.84	191	25.81	0.05	
PB65	1728454.06 6449707.70	287.66	-0.60	-0.12	-0.09	191	0.62	2010	-0.14	-0.03	-0.03	192	0.14	0.02	
PB66	1729196.66 6450969.95	288.19	-0.99	0.03	-0.13	178	0.99	2012	-0.99	0.03	-0.13	178	0.99	0.02	
UB02	1727516.04 6450142.94	67.67	-65.08	9.16	-4.54	172	65.72	1997	-1.14	0.12	-0.04	174	1.14	0.02	

PORTUGUESE BEND LANDSLIDE MONITORING - MOVEMENT DATA POSTING as of April 7, 2014
Prepared by McGee Surveying Consulting - Document date: 05/14/2014
Monitoring Point Movements
PARTIAL MID-YEAR MONITORING

Notes:
* Indicates no signal of horizontal movement detected in the last period at the 95% level of confidence

	April 7, 2014 Positions			Overall Movements (US Feet)						Periodic (6.0 months) Movements (US Feet)						
	NAD83 SPC Zone 5 (ft)		NAVD88	Original Position to April 7, 2014						October 4, 2013 Position to April 7, 2014						
Point	North (ft)	East (ft)	Elev(ft)	North	East	Height	Azim.*	Dist.	Year	North	East	Height	Azim.*	Dist.	95%Err	Note
AB04	1728389.93	6447121.48	67.19	-2.07	-1.87	-0.38	222	2.78	1994	-0.02	-0.03	0.03	232	0.04	0.02	
AB12	1729415.17	6448271.07	283.20	-1.31	-0.58	-0.23	204	1.43	1994	-0.01	0.01	0.03	138	0.01	0.02	*
AB16	1730358.55	6447532.14	376.47	-0.34	0.01	-0.15	178	0.34	1994	0.01	0.01	0.08	41	0.02	0.03	*
AB17	1731421.11	6446727.74	442.87	-0.01	-0.04	0.07	259	0.04	2007	0.02	0.00	0.06	353	0.02	0.04	*
AB20	1729359.39	6449685.84	396.23	-1.24	-0.43	-0.20	199	1.31	1995	-0.01	-0.01	0.02	215	0.02	0.01	
AB50	1728084.51	6448247.16	182.02	-0.49	-1.02	0.04	244	1.13	1998	0.00	-0.02	0.01	264	0.02	0.03	*
AB59	1730850.20	6450212.50	434.25	-0.67	-0.05	-0.12	184	0.67	2007	-0.02	0.01	0.02	142	0.02	0.02	*
AB60	1729089.34	6447987.40	179.36	-0.36	-0.17	-0.09	204	0.40	2007	0.00	-0.01	0.02	283	0.01	0.02	*
AB61	1727424.48	6447990.26	140.44	-0.02	0.01	-0.03	155	0.02	2007	0.00	0.00	0.02	315	0.00	0.01	*
AB65	1731705.65	6448264.08	458.55	-0.03	0.01	0.02	153	0.03	2012	-0.01	-0.01	0.02	218	0.01	0.02	*
CR07	1731627.89	6451203.36	632.19	-0.89	0.17	-1.09	169	0.91	1994	0.00	0.01	0.08	69	0.01	0.02	*
CR50	1733013.59	6451037.37	872.75	-0.02	0.00	0.09	191	0.02	1998	0.02	0.00	0.11	357	0.02	0.03	*
PT06	1729854.83	6452760.04	486.69	-0.78	-0.17	-0.37	192	0.80	2007	-0.03	-0.02	0.05	210	0.03	0.02	
PT07	1729252.10	6454102.96	588.67	-1.14	-1.79	-0.34	238	2.12	2007	-0.02	0.00	0.04	180	0.02	0.04	*
KC06	1727784.84	6453396.19	299.87	-0.07	-0.47	-0.48	262	0.48	1994	-0.01	-0.02	0.01	246	0.02	0.02	*
KC07	1727759.41	6453683.86	313.51	0.22	-0.05	-0.32	346	0.22	1994	0.00	0.00	0.03	153	0.00	0.03	*
KC13	1726581.00	6453069.59	191.10	-0.16	-0.05	-0.10	196	0.17	2007	0.01	-0.01	0.04	315	0.02	0.02	*
KC16	1727602.24	6454098.23	326.87	-0.01	0.00	-0.03	191	0.01	2007	0.00	-0.01	-0.01	275	0.01	0.03	*
KC17	1727302.74	6453026.38	215.23	-0.02	-0.04	-0.02	243	0.05	2012	0.00	-0.03	0.00	266	0.03	0.02	
PB04	1727664.28	6448848.42	166.62	-11.65	-3.32	-3.90	196	12.12	1994	-0.16	-0.04	-0.03	193	0.16	0.03	
PB12	1728251.48	6451582.51	183.42	-79.01	-22.06	-9.87	196	82.03	1994	-0.86	-0.30	-0.25	199	0.92	0.03	
PB13	1728039.80	6452146.77	206.46	-46.17	-17.57	-4.08	201	49.40	1995	-0.55	-0.24	-0.05	203	0.60	0.03	
PB18	1730430.76	6450719.91	362.98	-16.12	8.92	-4.60	151	18.42	1995	-0.01	0.00	0.04	189	0.01	0.02	
PB26	1729538.39	6452252.10	282.92	-24.26	2.54	-2.42	174	24.39	1995	-0.03	0.00	0.02	178	0.03	0.02	
PB59	1727756.85	6448659.33	158.51	-9.51	-2.34	-4.88	194	9.80	2001	-0.24	-0.03	-0.09	188	0.24	0.04	
PB64	1727352.77	6450925.28	55.04	-113.52	-21.67	-17.72	191	115.57	2009	-16.45	-2.84	-1.80	190	16.69	0.06	
PB66	1729196.34	6450969.95	288.15	-1.30	0.02	-0.18	179	1.30	2012	-0.32	0.00	-0.04	181	0.32	0.03	
PB67	1727638.73	6450858.18	76.01	Replacement for PB64					2014							

Survey Report
of the
Portuguese Landslide Monitoring Survey
September 14, 2012 Full & April 18, 2013 Partial Monitoring
for the
City of Rancho Palos Verdes
by
McGee Surveying Consulting

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Survey Report
for the
Portuguese Landslide Monitoring Survey
September 14, 2012
(See Page 16 for the April 18, 2013 Partial Monitoring)
for the
City of Rancho Palos Verdes
by
McGee Surveying Consulting

Client: City of Rancho Palos Verdes;
Surveyed by: McGee Surveying Consulting
Project Name: Portuguese Bend Landslide Monitoring Program
Location: City of Rancho Palos Verdes, California; **County:** Los Angeles; **State:** California

PROJECT OVERVIEW:

On behalf of the City of Rancho Palos Verdes, McGee Surveying Consulting performed slide monitoring and control surveys at Portuguese Bend in September 2012 and a partial monitoring in April 2013. The purpose of the survey was to establish accurate positions on monitoring points to determine overall and periodic movements. The results of the survey are described in this Report and reported on attached spreadsheets titled "Full Data Posting". The April 2013 partial monitoring is addressed at the end of this Report.

The field survey was planned, coordinated and executed by Michael McGee, PLS3945 of McGee Surveying Consulting. Michael McGee, PLS is responsible for the final processing of the observations, network adjustments, analysis and reports. The monitoring points cover approximately a 1½ mile square area and are measured annually or more often as necessary to determine the rate and extent of ground movement. Global Navigation Satellite System (GNSS formerly referred to as GPS) technology was used to measure positions based on the North American Datum of 1983 (NAD83) and the North American Vertical Datum of 1988 (NAVD 88). This survey is referenced to the California CGPS (Continuous GPS) Stations in the region which are permanently mounted GNSS receivers used for monitoring seismic activity. The CGPS in California are similar to the national CORS (Continuously Operated Reference Stations).

Many of the points move a few inches or less per year; therefore, the requirement is to meet an accuracy standard of one centimeter (0.033 feet) at the 95% Level of Confidence. In the active slide area where the movements approach a foot or more per year (PB and UB points in the central portion), the accuracy standard is two centimeters (0.066 feet). Field procedures are designed to accomplish this purpose and Quality Control-Quality Assurance (QAQC) processes discussed hereafter are incorporated to verify these accuracies are attained.

The movements reported between October 3, 2011 and September 14, 2012 (11.4 months) statistically attained an overall average accuracy of 0.027 feet at the 95% Level of Confidence. The actual accuracies of these measurements is estimated to be 0.02 feet as demonstrated by the measured vector residuals, repeatability of measurements at points considered stable, and the analysis of movement deflections. Refer to the sections titled ACCURACY, DEFLECTION ANALYSIS and SUMMARY at the end of this Report for more information.

HISTORY

This survey is a continuation of a monitoring survey program initiated by the County of Los Angeles and taken over by the City of Rancho Palos Verdes circa 1994. McGee Surveying Consulting has conducted the field surveys and reporting since September 2007. See the September 2007 Survey Report for a history of the previous survey process between 1994 and 2007. See the subsequent Survey Reports for the December 2008, November 2009, October 2010 and October 2011 campaigns.

PROJECT DATUMS, REFERENCE SYSTEM

Horizontal Datum: North American Datum of 1983 (NAD83) established by the National Geodetic Survey (NGS); **Epoch:** 2007.00 referred to as NAD83(2007).; **Units:** Feet

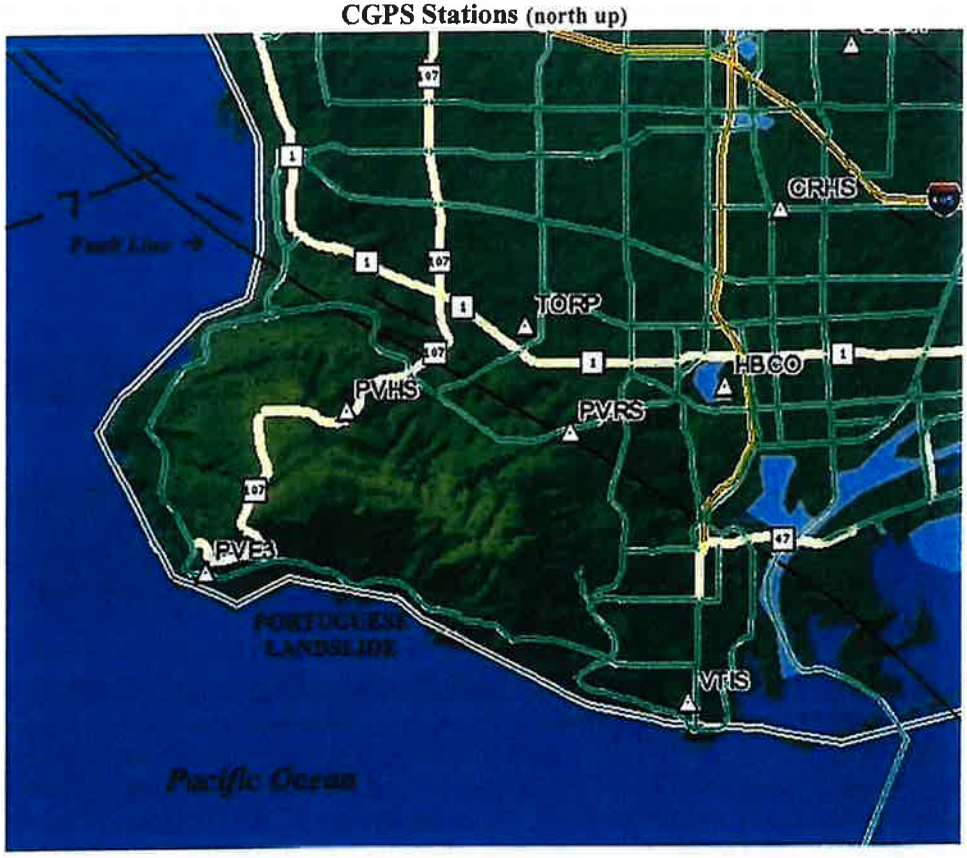
Reference Network: The survey is referenced to the CGPS Stations (continuously operating GNSS receivers) mounted on a stabile platform. For more information see NGS Data Sheets for the PID's listed below (no data sheet exists for PVE3). The positions listed below were obtained in September 2007 from the California Spatial Reference Center (CSRC). The CSRC provides CA Public resources Code sanctioned positions for the California CGPS Stations.

CGPS	Latitude(dms)	Longitude(dms)	EH(feet)	NGS PID	NAME
PVE3	33 44 35.853290	-118 24 15.269036	235.42	none	PALOS VERDES CORS
PVHS*	33 46 46.020150	-118 22 19.741258	853.99	AJ1915	PENINSULA HIGH SCH
PVRS**	33 46 25.891904	-118 19 14.067218	198.63	AJ1916	PALOS VERDES RES
VTIS	33 42 45.489584	-118 17 37.712290	197.52	AJ1936	MARINE EXCHANGE

* Station not operating during this survey

** Falls in the proximity of a Fault Line as shown below but appears unaffected to date

CGPS Stations (north up)



Vertical Datum: North American Vertical Datum of 1988 (NAVD88) established by the NGS
Geoid Model: Geoid 03; note Geoid09 became available from the NGS in 2009 and Geoid12A in 2012; however, Geoid03 is retained to be consistent with prior reported heights and the primary purpose of determining relative changes over time.

Reference Network: CGPS Station VTIS is also a Second Order leveled benchmark and the original basis for the heights by this survey (see NGS Data Sheets, PID's listed above)

CGPS	NAVD 88 Ht(feet)	
PVE3	none	
PVHS	972.1	Based on a Refined Geoid Model
PVRS	316.37	Based on Second Order Leveling by CSRC
VTIS	315.26	Based on Second Order Leveling by CSRC and original basis for this survey

Projection: NAD83 California State Plane Coordinates Zone 5: The State Plane Coordinate Parameters follow. The average Scale Factor is 1.00007543, the Ellipsoid Height Reduction Factor based on the average ellipsoid heights is 0.99999092, and the average Combined Grid Factor is 1.00006635. Distances in this survey are grid. To obtain ground distances divide grid distances by the Combined Grid Factor. Grid bearings resulting from this survey must be rotated by a Convergence Angle to obtain geodetic (true) bearings. The average convergence angle is -0-12-30± (rotate left 0-12-30).

Datum Stability: The NAD83(2007), 2007.00 Epoch adjustment is one of a series of adjustments of NAD83 since its adoption in 1986 and is the datum used for the monitoring surveys since 2007. Rancho Palos Verdes sits on the Pacific Plate which is moving west-northwesterly relative to the North American Plate about 4 centimeters (0.14 feet) per year. The area southwesterly of the Fault Line shown on the above map includes the City and is moving at a constant rate as exhibited by the N, E, Up velocities of the CGPS Stations listed below. These CGPS Stations provide a rigid reference frame for the Portuguese Landslide Monitoring Program that is validated during each monitoring campaign. See the Adjustment results on Page 8 and the September 2007 Monitoring Survey Report by McGee Surveying Consulting for additional information.

Annual Velocities in Feet
Reference Epoch 2012.7

CGPS	North	East	Up
PVE3	0.061	-0.134	-0.004
PVHS	0.059	-0.130	-0.007
PVRS	0.057	-0.131	0.001
VTIS	0.061	-0.131	-0.004

FIELD SURVEYS, DATA COLLECTION, EQUIPMENT & PROCESSING

72 monitoring points were occupied and reported in this survey. Site photographs and recovery sheets detailing the location, character of the monuments and obstructions were updated. See the Appendix for "Monitoring Point Status for 2013 Prepared 12/09/2012"

Monument AB61 was established in September 2007 on Portuguese Point and is used as the primary base station for Monitoring Surveys. The location is secured behind a locked gate, has a mostly clear horizon above 10 degrees, and sits on a stable basalt geological formation. A 5/8" x 2' rebar with a plastic cap and tack named "AB61ECC" was set for a reference monument on 10/23/2010 to test the local stability of AB61.

The field survey commenced each day by setting a GNSS receiver on a fixed height pole on AB61 and AB20 while a GNSS receiver roamed freely collecting observations on a fixed height pole at 71 points. This results in two measured vectors to each point. Beginning this year, points in the active central area with annual movements greater than 0.3' (PB and UB areas) were occupied a single time and a linear comparison was made with movements from prior years to verify the accuracy meets the 0.07 foot requirement. Otherwise, all other points were occupied twice under a different constellation of satellites on a different day. If the two measurements were within 0.03 feet they were accepted, otherwise a third measurement was obtained.

Many of the points are over-shadowed by mature trees and shrubberies which interfere with signals received from satellites and can affect the quality of measurements. To obtain the best possible accuracies, the satellite constellation is compared with obstruction diagrams to estimate the best time for observing a point. On site, those satellites obstructed by foliage and trees are either turned off or noted for removal in post-processing. If six or more un-obstructed satellites with a GDOP (measure of the geometry of the constellation) of 4 or less are available, then the measurement commenced for a minimum of 15 minutes of data collection. If the geometry and number of satellites are insufficient then the receiver is moved to the next point and returned later when satellite availability improves

Three Leica geodetic GNSS receivers and antennas listed below were utilized to collect, and store satellite signal data. Three, 2 meter fixed height poles were set at the base stations and for the observations of the monitoring points. Prior to initiating the field observations a calibration of the fixed height poles was conducted with a theodolite to verify their heights and plumb. The top of the poles were found to be plumb within 0.004 feet of the bottom consistent with prior years. Additional checks were made each day. There were no equipment failures.

GNSS Survey Parameters:

Date of Field Surveys: 09/10/12 to 09/16/12 (09/14/2012 mean date) 0600-1800 PDST (+7 hrs for UTC).
Constellation: 30 NAVSTAR GPS satellites and 23 GLONASS satellites.
Observables: L1 & L2 Carrier Waves and Codes
Epoch Rate & Occupation Times: 10 seconds for 15 minutes and 4-11 hours for CGPS connections.
Minimum Satellites: 11; GDOP < 4 ; Elevation Mask for Data Collection and Processing: 15 degrees;
Ephemeris: Rapid for Static Post-Processing for CGPS connections and Broadcast for on site.
Weather conditions: Generally clear skies and mild temperatures.
Space Weather: Boulder K Index was 1-3 on a scale of 0-9 (<5 preferred) which gauges ionospheric activity.
Equipment:
GNSS Base Receiver Unit No.: M5, Operator: M. McGee, PLS; Station Occupied: AB61 (Base1)
Make & Model: Leica GS15; Antenna Leica GS15; Mount: Fixed Height Pole #2; Antenna Height: 2.086m
GNSS Rover Receiver Unit No.: M6, Operator: M. McGee, PLS;
Make & Model: Leica GS15; Antenna Leica GS15; Mount: Fixed Height Pole #1; Antenna Height: 2.087m
GNSS Rover Receiver Unit No.: M7, Operator: M. McGee, PLS, Station Occupied: AB20 (Base2)
Make & Model: Leica GS15; Antenna Leica GS15; Mount: Fixed Height Pole #3; Antenna Height: 2.085m

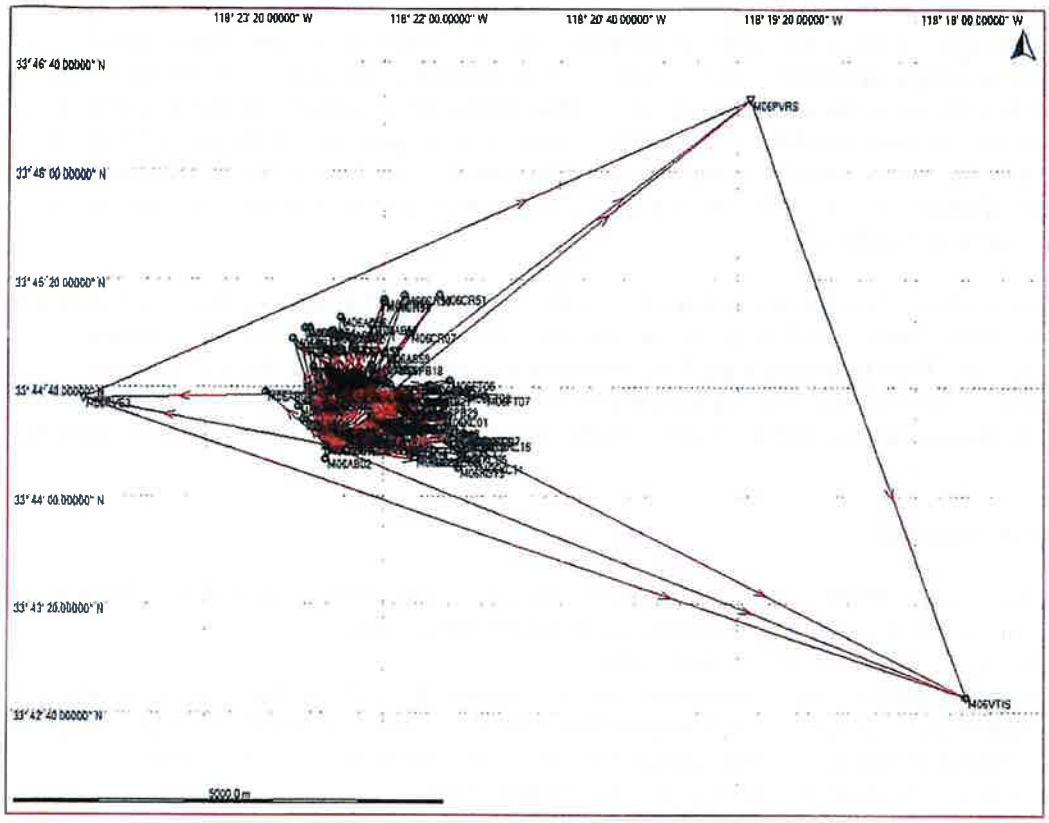
Vectors were processed using Leica LGO v8.1 post processing software. Analysis of residuals led to the rejection of 3 out of 47 vectors connecting the CGPS Stations and AB61, and 6 out of 251 vectors connecting monitoring points. Network adjustments and analysis were performed with "Starnet-PRO" version 7.0 software. Rinex files of the satellite measurements for the CGPS Stations were downloaded from the SOPAC website. The Rapid Ephemeris and Absolute Antenna Models were downloaded from the NGS website. The Absolute Antenna Models published by the NGS replaced the Relative Models used prior to 2011.

NETWORK

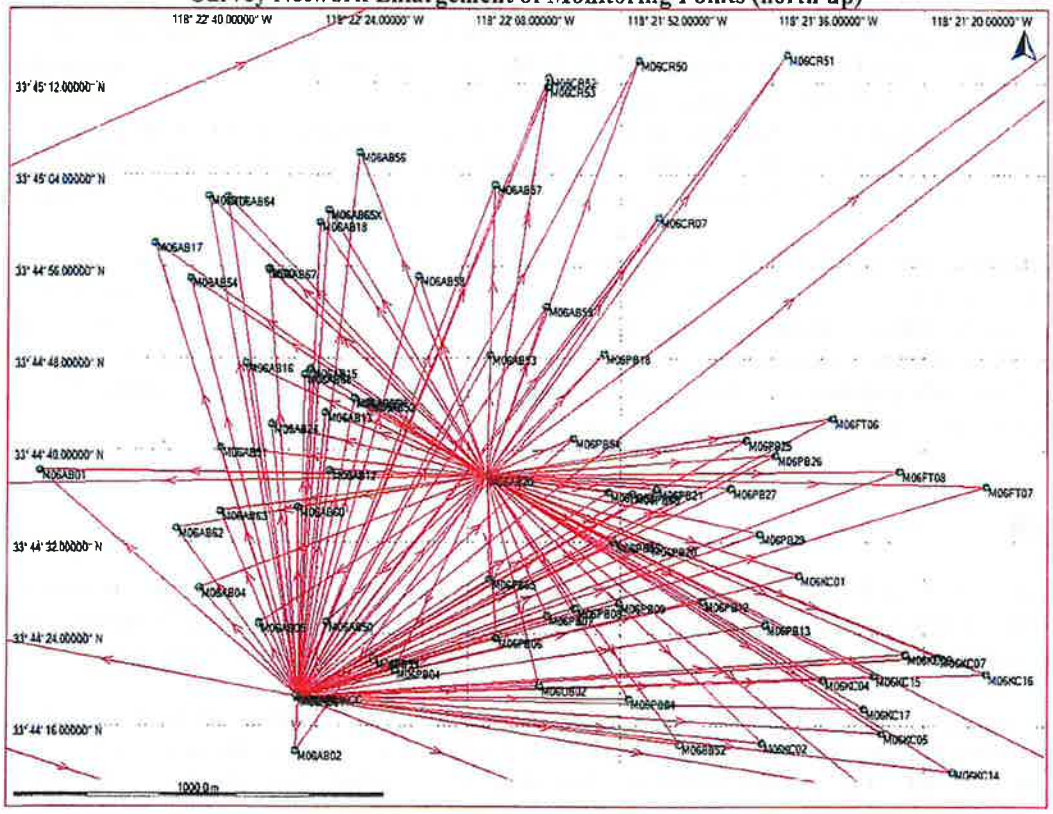
AB61, the primary Base Station, sits on Portuguese Point and is the focal point of the static network connecting the monitoring points and CGPS Stations. 72 on site points and 3 CGPS Stations were connected with 298 vectors measured 1-3 times. See the Network Maps on the next page and the Aerial View in the Appendix.

The monitoring plan uses the CGPS Stations to verify the stability of the reference frame. During the time of this survey PVHS was not available. The primary CGPS Station used to control this survey is PVE3 located just south of City Hall and 1.8 miles west-northwest of the Base Station AB61. CGPS Station PVRS is 3.9 miles northeast, and VTIS is 4.9 miles east-southeast of AB61 as shown on the Network diagram.

Survey Network with CGPS Stations (north up)



Survey Network Enlargement of Monitoring Points (north up)



MONITORING POINT HISTORY and STATUS

For data management purposes during the field survey and data processing, the point names were prefixed with "M06" to distinguish between different monitoring surveys i.e. AB61 was named M06AB61. M06 indicates this survey is the sixth monitoring since the initial September 2007 Monitoring Survey. The prefix is stripped in the final Report.

Between 1994 and 2006, 149 monitoring points were established to monitor the Portuguese Bend Landslides, many of which are lost or destroyed. Sixty of the original points were recovered in 2007. Eight of the 60 points were deleted because they were in close proximity of other points better suited for GNSS leaving 52 points monitored and reported between September 2006 and September 2007. Three of the 52 points (AB09, KC11, PB51) were monitored in September 2007 for the last time because they were replaced by new points, set nearby and better suited for satellite observations. Eighteen new points were set in 2007 and had their movements reported for the first time in the following December 2008 survey. Therefore, in December 2008, 49 original and 18 new points were surveyed for a total of 67 monitoring points.

In the September 2007 Report, it was noted that KC01 was previously reported by others on 9/14/2006 to have moved N 29°E 1.24' from its 12/9/2005 position. In the 2008 survey, a buried partially illegible brass cap in concrete stamped "COUNTY ENGINEER RE8869 1956 STA ??IELDS" was found S31°29'W 1.48 feet from the 1" IP that was used in the initial September 2007 and subsequent surveys. The original 1994 position of KC01 was re-referenced to the 1" IP, resulting in correct overall reported movements.

In the December 2008 Report, it was noted that AB05 had been disturbed by a mowing machine. AB05 was found chipped and leaning to southerly about 0.4'. The movement reporting resumed in 2009. Analysis of the movement and historic data made it possible to estimate the disturbance to within 0.05'. The original 1995 position of AB05 was re-referenced S14°02'E 0.29' to be consistent with the disturbed position, resulting in correct overall reported movements.

In 2009, PB64 was set east of the Archery Range to replace PB63 (set 2007) which had become unsafe to access and was lost in 2010.

In 2010, points AB03 and BB25 were discontinued. AB03 is on the edge of a cliff 192 feet west-southwest of AB61 making it redundant, and BB25 is on an unstable rock disturbed by wave action. In the summer of 2010, PB62 was destroyed by road construction. In October 2010, PB65 was set 24' south-southwest of PB62 and reported for the first time in October 2011. The following points may have been disturbed as of October 2010. AB05 appears to have been disturbed by mower machinery, AB15 (½" GIP in a meter box) is being driven over by vehicles occasionally accessing an adjacent field, and KC02 (½" GIP in a meter box) is occasionally parked on by vehicles accessing the beach.

In October 2011, new points AB62R and AB63R (now referred to as AB62 and AB63) were set to replace AB06 and AB07 which were hazardous to occupy due to their location near the traveled way of Palos Verde Drive South. A deep set permanent monument is planned to be constructed in the future near AB62 and AB63.

Prior to initiating the September 2012 survey, eight new monuments AB64, AB65, AB66, AB67, AB68, CR53, KC17 and PB66 were constructed to replace AB54, AB18, AB52, AB55, AB15, CR52, KC04 and PB53 respectively. The monuments were replaced because of poor sky visibility except for KC04 which was difficult to access and AB55 which was destroyed by trenching in the past year. Interim monuments were set with the following design. Monuments set in soil are 1" x 5' GIP driven flush with a 6" PVC pipe sitting on a concrete collar down about 18". Monuments set in asphalt are 1/2" x 2' rebar driven below the surface inside a free floating concrete collar. See the "Monitoring Point Status for 2013 Prepared December 09, 2012" in the Appendix.

ADJUSTMENTS & ANALYSIS

Adjustment 1: Minimally Constrained Adjustment processed to develop NAD83 (2007) 2007.00 Epoch Geodetic, Ellipsoid and State Plane Coordinates.
Fixed Control: CGPS Station PVE3 was fixed at its published NAD83 (2007) position in a Minimally Constrained Adjustment to determine positions of points in this survey and to check its stability relative to other CGPS stations. PVE3 is located 2 miles west of the slide area has been fixed in all adjustments since 2007. The CSRC publishes a Time Series for the horizontal and vertical stability of PVE3 which indicate the position has been stable over a ten year period to date. The primary base station AB61 and two other CGPS Stations were measured relative to PVE3 and used to assess stability of the reference frame. The positions are based on 9 to 11 hour measurements collected on six days. The coordinate differences at the CGPS Stations from previous positions to the present are listed below in feet.

10/2011 Positions to 09/2012

Station	dN	dE	dZ	
PVE3	0.000	0.000	0.000	< Fixed >
PVRS	0.000	0.000	0.015	
VTIS	-0.008	-0.006	-0.005	
AB61	0.011	0.005	0.017	<Base Station>

9/2007 Positions to 09/2012

Station	dN	dE	dZ
PVE3	0.000	0.000	0.000
PVRS	-0.003	0.013	0.039
VTIS	-0.009	0.004	0.012
AB61	-0.011	0.006	-0.015

The following is noted: (1) the two dimensional (2D) differences in the measured positions from the October 3, 2011 to the September 14, 2012 of the two CGPS Stations range 0.000 to 0.010 feet and 0.012 feet at AB61; (2) the 2D differences of the CGPS Stations since the initial 2007 survey to the present, range 0.012 to 0.013 feet and 0.012 feet at AB61; and (3) points AB17, CR50, FT08, KC07 and KC16 have a stable history when comparing their 2007 positions with this survey indicating a repeatability of less than 0.02 feet as listed in the attached "FULL DATA POSTING". The vertical components are within 0.02 feet.

Therefore, the survey reference frame is deemed stable and successfully recovered at the level of 0.01 feet horizontally by 0.02 feet vertically as indicated. An adjustment constrained to the CGPS Stations is not preferred or necessary because the purpose here is to track their relative positions over time to test the stability of the reference frame. See the attached file "COORDINATE LIST – September 14, 2012" for a list of coordinates resulting from this adjustment. See prior Reports for coordinates resulting from earlier surveys.

Adjustment 2: Minimally Constrained Adjustment to develop Orthometric Heights (Elevations) in NAVD88
Fixed Control: The CGPS Station PVE3 was fixed horizontally and vertically at its NAVD88 orthometric height determined in the September 2007 survey. The 2007 height was based on the published 2nd Order NAVD88 Height of CGPS Station VTIS. This Adjustment combined the measured ellipsoid height differences with the NGS Geoid 03 (models the separation between the ellipsoid and geoid surfaces) to determine NAVD88 orthometric heights of the other CGPS Stations and the monitoring points. The differences from the previous survey to the heights determined in the present survey are listed below in feet.

10/2011 to 09/2012

PVE3	0.000	Fixed
PVRS	0.015	
VTIS	-0.005	

Note: This survey's measurements from PVE3 to VTIS check the 2011 height -0.005 feet, same as the ellipsoid height check above and very acceptable for GNSS considering the distance. In October 2011, the NGS First Order Benchmark S1053 located at the intersection of Rancho Palos Verdes South with Hawthorne Boulevard was found -0.016 feet from its records position validating the height of PVE3 based on VTIS and the Geoid03 Model. See the attached file "COORDINATE LIST - September 14, 2012" Survey" for a list of heights resulting from this survey.

ACCURACY

These surveys conform to the intent of the Federal Geodetic Control Subcommittee (FGCS) "Specifications for GPS Relative Positioning" (1988) and the California Geodetic Control Committee (CGCC) "Specifications for High-Production GPS Surveying Techniques" (1993). The vector residuals at each point and the closures on stable control points discussed in "Adjustment 1" are good indications of the accuracies obtained by this survey

Vector Residuals: The two dimensional vector residuals and the absolute value of the vertical residuals resulting from Adjustment #1 are listed below in feet.

		Two Dimensional Residuals			Vertical Residuals (absolute values)		
	No.	Average	Std.Dev.	Maximum	Average	Std.Dev.	Range
Monitoring Pts	245	0.008	0.006	0.035	0.010	0.008	-0.03 to +0.03
CGPS Stations	44	0.008	0.006	0.022	0.010	0.008	-0.03 to +0.02

Vector Accuracy: The lengths, precisions and relative distance errors resulting from the adjustment at the 95% Level of Confidence for the vectors (baselines) are listed below in feet.

	Lengths		PPM Precisions		Relative Dist.Error		
	Vary	Average	Vary	Average	Average	Maximum	Precision
Monitoring Pts	479-7182	3191	0.7-25	4.1 ppm	0.010	0.030	1: 319,000
CGPS Stations	9397-26102	18357	0.2-0.4	0.3 ppm	0.004	0.005	1:4,589,000

The precision ratio based on the averages for the vectors connecting the Monitoring Points exceeds the criteria for a First Order (C-1) by a factor of 3.2, and the vectors connecting AB61 and the CGPS Stations exceeds the criteria for a B Order survey by a factor of 4.6 per the FGCS requirements for the former classification system.

Coordinate Accuracy: The Standard Deviations (68% Level of Confidence) of the coordinates derived from Adjustment #1, relative to the CGPS Station PVE3 follow in feet.

	Monitoring Point			CGPS Stations		
	North	East	Up	North	East	Up
Average Standard Deviation	0.004	0.004	0.012	0.002	0.002	0.006
Maximum Standard Deviation	0.011	0.011	0.046	0.002	0.002	0.006

Absolute Coordinate Accuracy: The network accuracy is expected to be less than 0.02 feet horizontal relative to the NAD83 Datum based on the CGPS Station PVE3 fixed in Adjustment #1.

NAVD88 Heights: The North American Vertical Datum of 1988 orthometric heights resulting from Adjustment #2 are derived from the difference in ellipsoid heights combined with the Geoid 03 model and constrained to the height of PVE3 determined in 2007 based on VTIS. The measured ellipsoid heights relative to PVE3 are expected to be within 0.03 feet but may be greater at obstructed sites. The absolute accuracy of the heights relative to the datum is dependent on the published value on the CGPS Station VTIS.

Although relative elevation accuracies can be within 0.03 feet, up until October 2011 there were no requirements for vertical accuracies. In October 2011, a preference of 0.03 foot relative vertical accuracy was instigated for the following points: AB17, AB57, CR07, CR50 and CR51. In this survey campaign, the criteria has been extended to all points.

Movement Accuracy: For this period, 48 points moved less than 0.30 feet with an average of 0.06 feet. The relative error at the 95% Level of Confidence averaged 0.024 feet with a standard deviation of 0.008 feet and a range of 0.006 to 0.039 feet and one at 0.057 feet at a severely obstructed site. Overall, the relative error averaged 0.027 feet with a standard deviation of 0.009 feet and a range of 0.006 to 0.058 feet. No movement is considered detected unless the movement exceeds the 95% Error for individual points. See Page 6 of the attached "FULL DATA POSTING" for the estimated relative error at the 95% Level of Confidence for individual points.

QUALITY CONTROL - QUALITY ASSURANCE (QAQC) ANALYSIS

To ensure the accuracy and validity of the systems used to obtain the accuracies reported in these GNSS control surveys, an independent test was made using conventional terrestrial based instruments as reported in the "QAQC ANALYSIS" section of the September 2007 Monitoring Survey Report. Comparing the results of the GNSS systems with conventional instrumentation found horizontal measurements agreed 0.01 feet on average. In November of 2011 the GNSS instruments and fixed height poles used in this survey were calibrated on the Santa Maria National Geodetic Survey Baseline and found to agree with published values 0.003 to 0.006 feet.

To validate the radial survey method used in these surveys to position points from a single base station (AB61), independent GNSS cross connections were measured and compared with the computed inverse distances in the 2007, 2008 and 2009 surveys. The results found the two dimensional accuracy to agree 0.01 feet on average, indicating the radial method of measurements is reliable and the extra labor cost of measuring cross connection between points is not warranted. See the "QAQC ANALYSIS" section of the September 2007 and the December 2008 Monitoring Survey Reports for detailed analysis.

DEFLECTION ANALYSIS

Deflection Analysis is a method established by this surveyor to assess the consistency of the direction of movements reported from period to period. Assuming that movements are generally linear, the separation or the deflection between the direction of the previous and present periods taken over the moved distance, is an implied indication of the accuracy obtained with the current measurement technology and a method to detect blunders. Analysis of individual deflections in this survey campaign indicates that for points with multiple occupations the separations varied 0.01 to 0.02 feet, and for single occupied points the separations varied 0.03 to 0.04 feet.

SUMMARY

Prior to September 2007, successive coordinate differences were used to compute movements which did not provide statistical information about the relative accuracies. An upgrading of field procedures and processing techniques began with the initial September 2007 survey. Thereafter, measurement of temporal movements are based on a rigorous simultaneous least squares adjustment of multiple observations at two different epochs for each point.

The results of the October 3, 2011 to September 14, 2012 monitoring period indicates the relative accuracy of the reported movements average 0.027 feet at the 95% Level of Confidence. Statistically, the probability at the 95% level of confidence is that movement (signal) has occurred at a point when the horizontal distance between two epochs is greater than the 95% Error (noise). See the "Full Data Posting" for a listing of the 95% Error estimates (range 0.006 to 0.058 feet). Applying this criteria, 12 points have not moved.

Between October 3, 2011 to September 14, 2012 (11.4 months), points in the Portuguese Bend Landslide (PB points) moved 0.08 to 23.57 feet; points in the Abalone Cove Landslide (AB points) west of the Portuguese Bend Landslide moved 0.04 to 0.10 feet; and points in the Klondike Canyon (KC points) east of the Portuguese Bend Landslide moved 0.04 and 0.08 feet. See the Contours of Horizontal Movement in the Appendix for a graphical representation of the movements across the site.

Velocity Analysis: Overall in the present period (11.4 month), points with an indicated movement greater than 0.04 feet except for PB64 have moved on average 54% of the previous period (11.3 months). PB64 moved 108%. The City Geologist should be referred to for assessment and interpretation of the movements.

See the attached "FULL DATA POSTING" spreadsheet for overall and periodic movements of each point. The movements are given in north, east and up or down as well as a vector of distance and direction relative to north. The direction is given as an azimuth in degrees where 0° is north and increases clockwise (180° is south). The overall movements are from the beginning position of each point which varies between 1994 and 2011.

The present listing and status of monitored points is provided in the Appendix under "Monitoring Point Status for 2013 Prepared 12/09/2012". The historical status of all monitoring points is provided in the September 2007 Survey Report. The historical 1994-2006 positions of all points are listed in the Charles Abbott Associates Inc. file "ALL POINTS MOST RECENT OBSERVED POSITION AS OF SEPTEMBER 15, 2006.xls" attached as an electronic file to the 2007 Report.

RECOMMENDATION

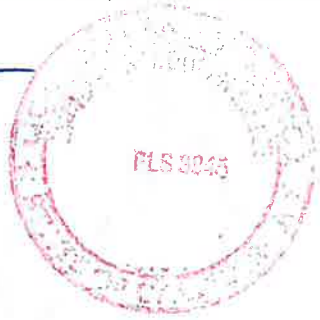
An ongoing re-location program for monuments has long term benefits resulting in better accuracy lower cost surveys. In this survey seven monuments were re-located for improved sky visibility for tracking satellites. A program agreed on in the 2011 Planning Meeting calls for the establishment or replacement of monitoring points with deep set monuments to better detect sub-surface movements. These monuments are expected to be as deep as 10 feet with the upper 4 feet separated from surface motion.

Attachment: Find the following document as an attached to this Report.
"FULL DATA POSTING" lists the coordinates of the initial positions and the overall and periodic movements of monitoring point since 2007 in NAD83(2007.00) State Plane Coordinates and NAVD88 Heights.

SURVEYOR'S STATEMENT

This Report on the criteria, procedures and results of the September 2012 Rancho Palos Verdes Portuguese Landslide Monitoring Survey was prepared by me January 10, 2013 and revised to include the April 2013 Partial Monitoring on March 12, 2014 at the request of Ron Dragoo, Assistant City Engineer of the City of Rancho Palos Verdes.

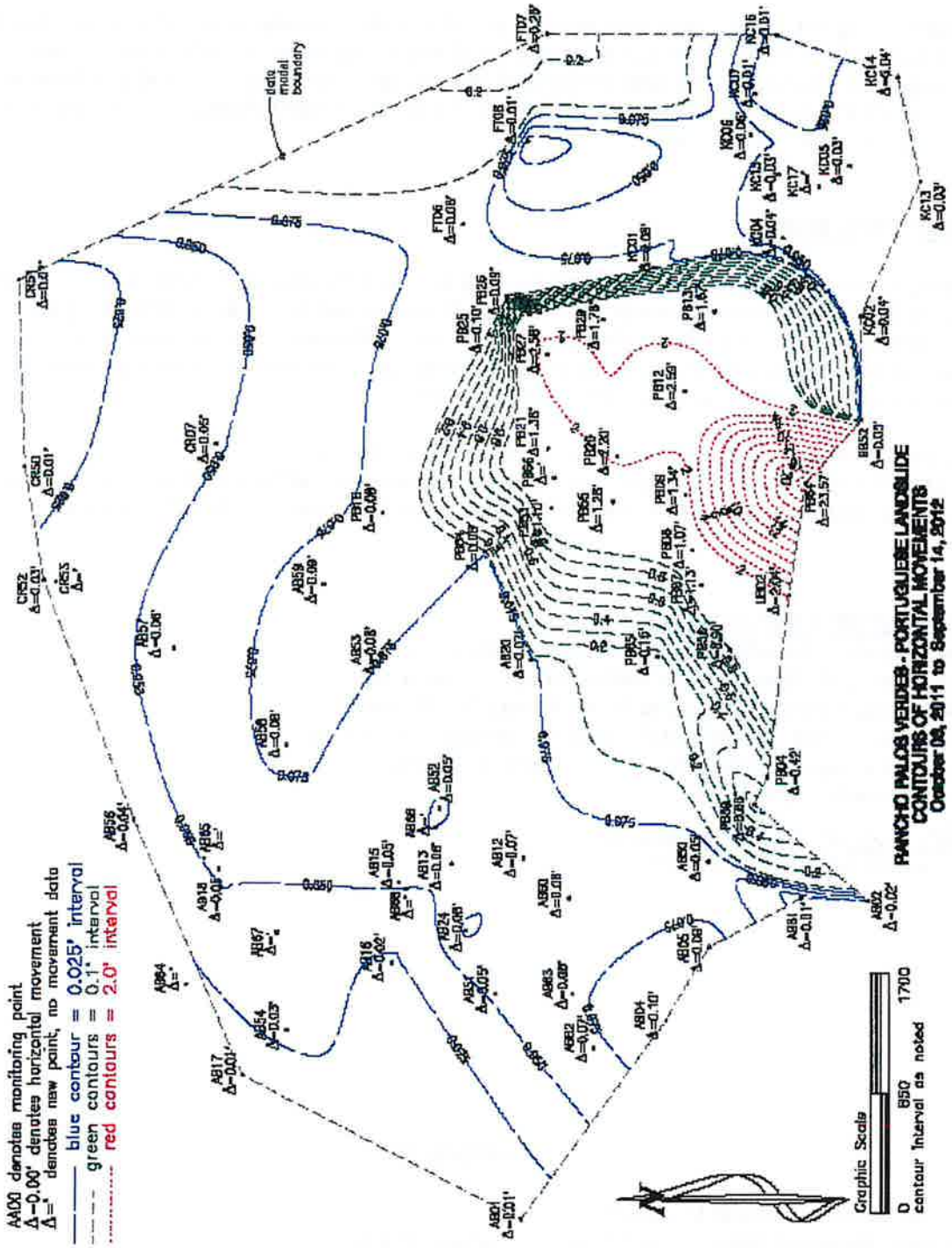
Michael R. McGee P.L.S. 3945



APPENDIX

12- Contours of Horizontal Movements
13- Aerial Photo and Oblique Aerial View of Monitoring Points
14- Monitoring Point Status
15- Coordinate List- Sept. 14, 2012 Survey NAD83(2007) Geodetic, Grid Coordinates, NAVD88
16 Addendum Report for the April 18, 2013 Partial Monitoring Survey

1- Contours of Horizontal Movements (north is left) Oct. 2011 to Sept. 2012 (Contours at 0.025, 0.10 and 2.00 feet provide a general graphical representation of movements; see the Full Data Posting for actual movements; see the City Geologist for interpretation of movements)



2- Aerial Photo View of Monitoring Points – (Photography Dated 03/07/2011) (north up)

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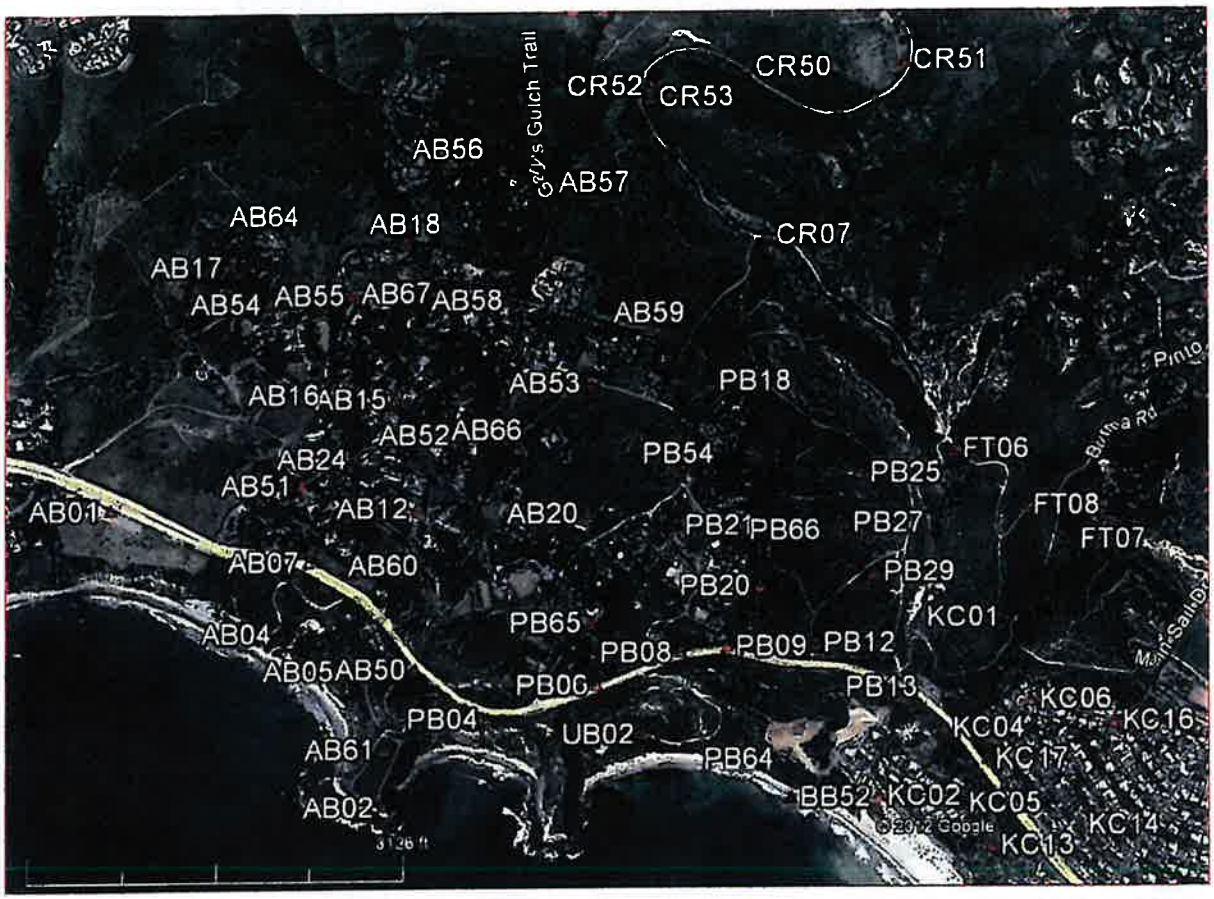

3- Oblique Aerial View of Monitoring Points (looking north)

Monitoring Point Status for 2013 Prepared 12/09/2012

RANCHO PALOS VERDES - PORTUGUESE LAND SLIDE MONITORING

Notes:	162+/- Monitoring Points established since 1994
09/01/07	71 Points Surveyed 60 old points found with 52 monitored plus 19 new points
12/01/08	67 Points Surveyed AB09, KC11, PB51 discontinued; BB53 destroyed; AB05 disturbed
11/01/09	68 Points Surveyed Set PB64 to replace PB63 destroyed subsequently
10/01/10	65 Points Surveyed Discontinued AB03, BB25; set PB65 to replace PB62 destroyed by paving
10/03/11	69 Points Surveyed; Set AB62 & AB63 to replace AB06 & AB07
09/14/12	72 Points Surveyed; Discontinued AB06, AB07; AB55 destroyed by trenching; Added 8 new points
2013	65 Points to Survey; Discontinue AB15, AB18, AB52, AB54, CR52, KC04, PB53

Pt ID	Last Obs'd	Comments	GNSS	Pt ID	Last Obs'd	Comments	GNSS
AB01	9/14/2012	Base 1994-2006	G	**FT06**	9/14/2012		G
AB02	9/14/2012		G	**FT07**	9/14/2012		G
AB04	9/14/2012		G	**FT08**	9/14/2012		G
AB05	9/14/2012		G				
AB12	9/14/2012		G	**KC01**	9/14/2012	NE'ly of 2 pipes 1.5' apart	G
AB13	9/14/2012		F	**KC02**	9/14/2012		G
AB15	9/14/2012	Discontinued	F	**KC04**	9/14/2012	Discontinued	G
AB16	9/14/2012		P	**KC05**	9/14/2012		G
AB17	9/14/2012		F	**KC06**	9/14/2012		G
AB18	9/14/2012	Discontinued	P	**KC07**	9/14/2012		G
AB20	9/14/2012	NE'ly of 2 pipes	G	**KC13**	9/14/2012		G
AB24	9/14/2012		F	**KC14**	9/14/2012		G
AB50	9/14/2012		G	**KC15**	9/14/2012		F
AB51	9/14/2012		G	**KC16**	9/14/2012		G
AB52	9/14/2012	Discontinued	P	**KC17**	9/14/2012	Replaced KC04	G
AB53	9/14/2012		F				
AB54	9/14/2012	Discontinued	P	**PB04**	9/14/2012		G
AB55	10/3/2011	Destroyed by trenching	G	**PB06**	9/14/2012		G
AB56	9/14/2012		F	**PB07**	9/14/2012		G
AB57	9/14/2012		G	**PB08**	9/14/2012		G
AB58	9/14/2012		P	**PB09**	9/14/2012		G
AB59	9/14/2012		G	**PB12**	9/14/2012		G
AB60	9/14/2012		G	**PB13**	9/14/2012		G
AB61	9/14/2012	BASE since 2007	G	**PB18**	9/14/2012		G
AB62	9/14/2012	Replaced AB06	G	**PB20**	9/14/2012	S'ly of 2 pipes 5.3' apart	G
AB63	9/14/2012	Replaced AB07	G	**PB21**	9/14/2012		F
AB64	9/14/2012	Replaced AB54	G	**PB25**	9/14/2012		G
AB65	9/14/2012	Replaced AB18	G	**PB26**	9/14/2012		F
AB66	9/14/2012	Replaced AB52	G	**PB27**	9/14/2012		G
AB67	9/14/2012	Replaced AB55	G	**PB29**	9/14/2012		G
AB68	9/14/2012	Replaced AB15	G	**PB53**	9/14/2012	Discontinued	P
				PB54	9/14/2012		F
BB52	9/14/2012		G	**PB55**	9/14/2012		F
				PB59	9/14/2012		G
CR07	9/14/2012		F	**PB64**	9/14/2012	Replaced PB63	G
CR50	9/14/2012		G	**PB65**	9/14/2012	Replaced PB62	G
CR51	9/14/2012		G	**PB66**	9/14/2012	Replaced PB53	G
CR52	9/14/2012	Discontinued	P				
CR53	9/14/2012	Replaced CR52	F	**UB02**	9/14/2012		G

GNSS column indicates site is Good, Fair or Poor for Satellite Visibility Conditions

COORDINATE LIST
Portuguese Landslide 09/14/2012 Monitoring Survey
Prepared by McGee Surveying Consulting Document Date 12/15/2012

Datum Horizontal & EH NAD83 (2007) Epoch, California State Plane Zone 5, Vertical NAVD88
Note, Fixed CGPS Station PVEJ at Record 3D Position & Orthometric Height per 09/2007 Survey. See 2007 and subsequent Survey Reports

Point	Latitude	Longitude	EH (ft)	North (ft)	East (ft)	OrthoHt(ft)	Description
AB01	33-44-38 30242	118-22-53 05149	60 060	1729427 541	6445709 588	178 542	Punched 1/2" GIP in meter box
AB02	33-44-13 84878	118-22-26 19251	-2 021	1726946 974	6447968 678	116 473	4" BC "SAN PEDRO 1936" on conc block
AB04	33-44-28 09149	118-22-36 28683	-51 253	1728389 969	6447121 523	67 205	BC "CO ENG STA Q2 " on 2"GIP in mass of conc
AB05	33-44-24 99032	118-22-30 09048	-37 942	1728074 511	6447643 663	80 504	BC "CO ENG STA Q3 " on 2"GIP in mass of conc
AB12	33-44-38 27561	118-22-22 72035	164 848	1729415 219	6448271 095	283 192	BC "CO ENG STA 7A " in mass of conc
AB13	33-44-43 34581	118-22-23 16100	246 150	1729927 908	6448235 784	364 471	Punched 1/2" GIP in meter box
AB15	33-44-47 13339	118-22-24 79453	278 514	1730311 311	6448099 254	396 825	Punched 1/2" GIP in meter box
AB16	33-44-47 57981	118-22-31 51207	258 077	1730358 553	6447532 132	376 414	Punched 1/2" GIP in meter box
AB17	33-44-58 06056	118-22-41 08430	324 466	1731421 092	6446727 750	442 799	Punched 1/2" GIP in meter box
AB18	33-44-59 90513	118-22-23 80495	338 604	1731602 107	6448187 619	456 855	Punched spike in center cul-de-sac
AB20	33-44-37 77599	118-22-05 96566	277 949	1729359 494	6449685 872	396 220	BC "CO ENG STA W FIX 1956 " in mass of conc
AB24	33-44-42 35433	118-22-28 79462	217 396	1729829 448	6447759 649	335 748	Cotton spindle in conc In road
AB50	33-44-25 11172	118-22-22 94461	63 607	1728084 537	6448247 217	182 026	Nail & shiner in conc collar of well
AB51	33-44-40 23022	118-22-34 15182	186 778	1729616 410	6447306 427	305 161	PK mag nail in plastic plug "LS6957" in 1"GIP
AB52	33-44-44 22592	118-22-18 56492	250 035	1730015 441	6448624 253	368 332	Punched spike in center cul-de-sac
AB53	33-44-48 36912	118-22-05 70004	234 635	1730430 282	6449712 228	352 856	Chisled + on s edge conc Vault
AB54	33-44-55 01385	118-22-37 27969	289 054	1731111 890	6447047 880	407 383	Cotton spindle in intersection
AB56	33-45-05 97072	118-22-19 59323	453 358	1732213 964	6448545 550	571 566	6" mag nail & washer in conc in 2"x 36" GIP
AB57	33-45-03 17109	118-22-05 20574	446 626	1731926 474	6449759 450	564 783	6" mag nail & washer in conc in 2"x 36" GIP
AB58	33-44-55 14474	118-22-13 27657	287 423	1731117 587	6449074 921	405 648	Punched RR spike on s side road
AB59	33-44-52 54214	118-21-59 79431	316 079	1730850 314	6450212 499	434 256	6" mag nail & washer in conc in 2"x 36" GIP
AB60	33-44-35 04165	118-22-26 06508	60 998	1729089 344	6447987 410	179 373	6" mag nail & washer in conc in 2"x 28" GIP
AB61	33-44-18 57309	118-22-25 95798	21 983	1727424 486	6447990 263	140 451	6" mag nail & washer in conc in 2"x 24" GIP
AB61Ecc	33-44-18 71691	118-22-26 13993	22 638	1727439 082	6447974 950	141 106	Tack in plastic plug in 5/8 x 24" rebar
AB62	33-44-33 23117	118-22-38 63182	24 579	1728910 287	6446925 429	143 018	6" mag nail & washer in conc in 1"x 24" GIP
AB63	33-44-34 71870	118-22-34 12043	62 410	1729059 235	6447306 992	180 820	Punched 1/2 x 48" rebar
AB64	33-45-02 13623	118-22-33 46062	413 970	1731830 690	6447373 082	532 251	2" mag nail on NE side 2' conc Collar/Well B12
AB65	33-45-00 93242	118-22-22 90422	340 291	1731705 674	6448264 066	458 533	2" mag nail & washer in conc in 1"x 60" GIP
AB66	33-44-44 53603	118-22-20 14975	255 980	1730047 285	6448490 530	374 283	1/2" x 24" punched rebar 1" below AC conc collar
AB67	33-44-55 71730	118-22-29 06609	287 034	1731180 409	6447741 759	405 326	1/2" x 24" punched rebar 1" below AC conc collar
AB68	33-44-46 61289	118-22-25 31193	275 128	1730258 855	6448055 365	393 445	1/2" x 24" punched rebar 1" below AC conc collar
BB52	33-44-14 45696	118-21-45 75380	-114 435	1726995 940	6451384 295	3 872	PK mag nail in drill hole top large rock mass
CR07	33-45-00 27016	118-21-48 09434	514 075	1731627 959	6451203 359	632 171	6" mag nail & washer in conc in old 1" IP
CR50	33-45-13 97090	118-21-50 11946	754 562	1733013 597	6451037 361	872 617	Tack & shiner on lower rock wall
CR51	33-45-14 49687	118-21-34 43623	858 158	1733062 003	6452361 871	976 151	Tack & shiner on conc pad
CR52	33-45-12 49701	118-21-59 56435	661 502	1732867 499	6450239 274	779 601	Tackail & shiner on rock retaining wall
CR53	33-45-11 63365	118-21-59 73918	662 622	1732780 275	6450224 193	780 724	2" mag nail & washer in conc in 1"x 60" GIP
FT06	33-44-42 78714	118-21-29 58523	370 636	1729854 972	6452760 074	488 720	6" mag nail & washer in conc in 2"x 36" GIP
FT07	33-44-36 87144	118-21-13 65695	470 626	1729252 184	6454103 120	588 669	6" mag nail & washer in conc in 2"x 36" GIP
FT08	33-44-38 19523	118-21-22 57445	540 361	1729388 667	6453350 493	658 435	6" mag nail & washer in conc in 2"x 36" GIP
KC01	33-44-29 13482	118-21-33 10787	194 161	1728475 907	6452457 653	312 338	6" mag nail & washer in conc in old 1" IP
KC02	33-44-14 54805	118-21-37 05718	-104 538	1727002 507	6452118 831	13 729	Punched 1/2" GIP in meter box
KC04	33-44-20 07495	118-21-30 59091	120 218	1727559 275	6452666 955	238 428	BC "CO ENG STA K6 " on 2"GIP in mass of conc
KC05	33-44-15 37073	118-21-24 50939	109 289	1727081 893	6453178 893	227 491	Punched 1/2" GIP in meter box
KC06	33-44-22 33201	118-21-21 96577	181 724	1727784 854	6453396 216	299 880	Punched 1/2" GIP in meter box
KC07	33-44-22 09021	118-21-18 55897	195 343	1727759 393	6453683 854	313 485	Punched 1/2" GIP in meter box
KC13	33-44-10 41224	118-21-25 78264	72 871	1726581 015	6453069 576	191 103	Cotton spindle in AC turnout
KC14	33-44-12 03461	118-21-17 07050	141 724	1726742 416	6453805 978	259 909	Punched spike in center road
KC15	33-44-20 39801	118-21-25 21681	168 883	1727590 318	6453120 951	287 062	Cotton spindle in cul-de-sac
KC16	33-44-20 55004	118-21-13 64604	208 742	1727602 232	6454098 234	326 870	Punched spike in intersection
KC17	33-44-17 55021	118-21-26 32392	97 055	1727302 764	6453026 424	215 253	2" mag nail & washer in conc in 1"x 50" GIP
PB04	33-44-20 98188	118-22-15 80602	48 399	1727664 816	6448848 568	166 808	Nail & tag "RCE26120" in conc in 3" pipe
PB06	33-44-23 68685	118-22-05 04904	58 889	1727934 924	6449758 067	177 236	Punched cap on 2" GIP
PB07	33-44-25 67320	118-21-59 68316	79 173	1728134 071	6450211 979	197 485	Brass tag "LA CO DPW" in conc in 2" GIP
PB08	33-44-26 31413	118-21-56 71665	75 948	1728197 950	6450462 752	194 243	Punched cap on 2" GIP
PB09	33-44-26 78362	118-21-52 15018	70 512	1728244 010	6450848 586	188 785	Punched cap on 2" GIP in cable box
PB12	33-44-26 91503	118-21-43 44847	65 972	1728254 638	6451583 537	184 205	Punched cap on 2" GIP in cable box
PB13	33-44-24 82988	118-21-36 76019	88 452	1728041 819	6452147 640	206 666	Punched cap on 2" GIP in cable box
PB18	33-44-48 41130	118-21-53 76765	244 840	1730430 871	6450719 921	363 009	Punched 1/2" GIP in meter box
PB20	33-44-31 71070	118-21-48 90695	113 935	1728741 102	6451124 295	232 159	Punched cap on 2" GIP in cable box
PB21	33-44-36 65608	118-21-48 28533	153 971	1729240 846	6451178 600	272 169	Punched cap on 2" GIP in cable box
PB25	33-44-40 93311	118-21-38 73996	207 836	1729670 312	6451986 280	325 972	Punched cap on 2" GIP in cable box
PB26	33-44-39 63904	118-21-35 58666	164 797	1729538 538	6452252 111	282 926	Brass tag "LA CO DPW" in conc in 2" GIP
PB27	33-44-36 69991	118-21-40 42526	153 050	1729242 884	6451842 417	271 213	Punched cap on 2" GIP in cable box
PB29	33-44-32 72992	118-21-37 44352	52 239	1728840 649	6452092 792	170 408	Brass tag "LA CO DPW" in conc in 2" GIP
PB53	33-44-36 40318	118-21-53 30186	171 681	1729216 815	6450754 850	289 903	PK mag nail in plastic plug "LS6957" in 1"GIP
PB54	33-44-41 08033	118-21-56 95000	239 489	1729690 752	6450448 477	357 704	PK mag nail in plastic plug "LS6957" in 1"GIP
PB55	33-44-32 02454	118-21-52 73423	121 312	1728774 000	6450801 182	239 552	PK mag nail in plastic plug "LS6957" in 1"GIP
PB59	33-44-21 89377	118-22-18 04845	40 505	1727757 700	6448659 521	158 919	PK mag nail in plastic plug "LS?" in 1" GIP
PB64	33-44-18 38396	118-21-51 11477	-54 630	1727394 562	6450932 955	63 681	2" alum cap "MCGEE SURVEYING " on 1"x36"GIP
PB65	33-44-28 82169	118-22-05 66754	169 369	1728454 202	6449707 733	287 692	2" alum cap "MCGEE SURVE " on 5/8"x24"rebar
PB66	33-44-36 22129	118-21-50 75440	170 114	1729197 647	6450969 922	288 325	2" mag nail & washer in conc in 1"x 60" GIP
UB02	33-44-19 56843	118-22-00 47541	-55 689	1727517 176	6450142 818	62 658	PK mag nail in plastic plug "?" in 1"GIP
PVE3	33-44-35 85329	118-24-15 26904	235 421	1729207 091	6438765 184	354 360	CGPS Pos Determined 09/14/2012 Survey
PVRS	33-46-25 89206	118-19-14 06720	198 635	1740239 306	6464237 890	316 342	CGPS Pos Determined 09/14/2012 Survey
VTIS	33-42-45 48958	118-17-37 71227	197 525	1717933 676	6472307 224	315 271	CGPS Pos Determined 09/14/2012 Survey

Addendum Report
for the
April 18, 2013 Partial Monitoring Survey
of the
Portuguese Landslide
for the
City of Rancho Palos Verdes
by
McGee Surveying Consulting

Overview:

This Addendum Report describes a mid-year partial monitoring survey in April 2013 at Portuguese Bend. A sub-set of 27 monitoring points were included in this survey. This survey follows the procedures described in the above Report on the September 14, 2012 full monitoring. The results of the survey are reported in the attached spreadsheet titled "FULL DATA POSTING" listing the coordinates, overall and periodic movements of points listed on Page 7.

The movements reported between September 14, 2012 and April 18, 2013 (7.0 months) statistically attained an overall average accuracy of 0.014 feet at the 95% Level of Confidence as demonstrated by the measured vector residuals, repeatability of measurements at points considered stable, and the analysis of movement deflections. For a detailed history of the program and surveys see "History" above. The field survey took place April 16-19 and on April 26, 2013. The Field Surveys, Equipment, Data Collection and Network Design were as described in the above Report. The survey included 27 on site points and 3 CGPS Stations each connected with two to eight vectors for a total of 124 vectors. The Adjustments followed the process as described above with similar results.

Adjustments

Adjustment 1: Minimally Constrained Adjustment processed to develop NAD83 (2007) 2007.00 Epoch Geodetic, Ellipsoid and State Plane Coordinates in feet. **Fixed Control**: CGPS Station PVE3. Difference are in feet from the previous positions shown.

09/2012 Positions to 04/2013

Station	dN	dE	dZ	
PVE3	0.000	0.000	0.000	< Fixed >
PVRS	-0.019	-0.006	-0.046	
VTIS	-0.006	-0.004	-0.034	
AB61	0.004	-0.002	0.044	<Base Station>

The survey reference frame was deemed stable and successfully recovered.

Summary of Movements: Between September 14, 2012 and April 18, 2013 (7.0 months) points in the Portuguese Bend Landslide (PB points) moved 0.07 to 12.63 feet; points in the Abalone Cove Landslide (AB points) west of the Portuguese Bend Landslide moved 0.01 to 0.06 feet; and points in the Klondike Canyon (KC points) east of the Portuguese Bend Landslide moved 0.01 and 0.02 feet. See the attached "FULL DATA POSTING".

Prepared by McGee Surveying Consulting - Document Date: 9/30/2013, Page 7 Rev.03/05/14

MONITORING POINTS

NAD83(2007) STATE PLANE COORDINATES & NAVD88 ELEVATIONS of Original Positions, 2007 & Post 2007 Positions

Notes: # Indicates stable points, not moving
* Indicates no signal of horizontal movement detected in the last period at the 95% level of confidence
1= 2005 and prior surveys used a nearby monument S31-29W 1.48', the original position is adjusted here to be relative to the 1" IP used presently, resulting in correct Overall Movements, see Reports
9/24/2007(1994) Indicates the 2007 position was used for overall; see the 2011 Report for original positions in 1994

	Original Positions				Sept. 24, 2007 Positions			Overall Movements (US Feet)					
		NAD83 SPC Zone 5 (Ft)		NAVD88	NAD83 SPC Zone 5 (Ft)		NAVD88	Original Position to Sept. 24, 2007					
Point	Date	North (ft)	East (ft)	Elev(ft)	North (ft)	East (ft)	Elev(ft)	North	East	Height	Azim.°	Dist.	Note
AB01	12/1/1994	1729427.58	6445709.61	178.62	1729427.55	6445709.64	178.62	-0.03	0.03	0.00	138	0	#
AB02	9/24/2007(1994)	1726946.98	6447968.69	116.48	1726946.98	6447968.69	116.48						
AB03	12/1/1994	1727338.34	6447818.82	139.60	1727338.39	6447818.81	139.59	0.04	-0.01	-0.01	351	0.04	#
AB04	11/30/1994	1728391.99	6447123.34	67.57	1728390.55	6447122.03	67.31	-1.44	-1.32	-0.26	222	1.95	
AB05	3/14/1995	1728075.72	6447645.17	80.90	Disturbed between 2007-2008								
AB06	4/27/1995	1729059.73	6446976.26	165.28	1729058.58	6446975.91	164.91	-1.15	-0.35	-0.37	197	1.21	
AB07	11/30/1994	1728982.79	6447358.41	159.92	1728981.51	6447357.74	159.40	-1.28	-0.67	-0.52	208	1.44	
AB12	11/30/1994	1729416.49	6448271.64	283.43	1729415.67	6448271.30	283.19	-0.82	-0.35	-0.24	203	0.89	
AB13	11/30/1994	1729928.90	6448236.04	365.03	1729928.25	6448235.90	364.54	-0.65	-0.13	-0.49	192	0.66	
AB15	11/30/1994	1730312.09	6448099.38	397.28	1730311.64	6448099.31	396.90	-0.45	-0.07	-0.38	189	0.45	
AB16	11/30/1994	1730358.89	6447532.12	376.62	1730358.70	6447532.17	376.44	-0.19	0.04	-0.18	168	0.19	
AB17	9/24/2007(1994)	1731421.12	6446727.77	442.80	1731421.12	6446727.77	442.80						
AB18	12/1/1994	1731602.62	6448187.49	457.19	1731602.37	6448187.58	456.93	-0.26	0.09	-0.26	162	0.27	
AB20	3/16/1995	1729360.63	6449686.27	396.43	1729360.00	6449686.03	396.23	-0.62	-0.23	-0.20	201	0.67	
AB24	3/12/1997	1729830.35	6447759.96	335.92	1729829.83	6447759.82	335.74	-0.52	-0.14	-0.18	196	0.54	
AB50	1/16/1998	1728085.00	6448248.18	181.98	1728084.71	6448247.54	182.03	-0.29	-0.65	0.05	246	0.71	
AB51	3/22/2002	1729617.01	6447306.54	305.42	1729616.73	6447306.52	305.25	-0.28	-0.02	-0.17	184	0.28	
AB52	3/22/2002	1730016.10	6448624.44	368.61	1730015.79	6448624.36	368.39	-0.31	-0.08	-0.22	195	0.32	
AB53	3/22/2002	1730431.11	6449712.37	353.13	1730430.77	6449712.33	352.90	-0.34	-0.04	-0.23	187	0.34	
AB54	9/24/2007	1731111.94	6447047.87	407.31	1731111.94	6447047.87	407.31						
AB55	9/24/2007	1731174.77	6447753.57	405.38	1731174.77	6447753.57	405.38						
AB56	9/24/2007	1732214.31	6448545.46	571.65	1732214.31	6448545.46	571.65						
AB57	9/24/2007	1731926.91	6449759.36	564.93	1731926.91	6449759.36	564.93						
AB58	9/24/2007	1731118.02	6449074.93	405.67	1731118.02	6449074.93	405.67						
AB59	9/24/2007	1730850.87	6450212.56	434.37	1730850.87	6450212.56	434.37						
AB60	9/24/2007	1729089.70	6447987.57	179.45	1729089.70	6447987.57	179.45						
AB61	9/24/2007	1727424.50	6447990.26	140.47	1727424.50	6447990.26	140.47						
AB62	11/13/2011	1728910.35	6446925.46	143.01	Replacement for AB06								
AB63	11/13/2011	1729059.30	6447307.03	180.84	Replacement for AB07								
AB64	9/14/2012	1731830.69	6447373.08	532.25	Replacement for AB54								
AB65	9/14/2012	1731705.674	6448264.07	458.53	Replacement for AB18								
AB66	9/14/2012	1730047.285	6448490.53	374.28	Replacement for AB52								
AB67	9/14/2012	1731180.409	6447741.76	405.33	Replacement for AB55								
AB68	9/14/2012	1730258.855	6448055.37	393.45	Replacement for AB15								
BB25	11/4/1998	1727200.54	6449932.73	3.81	1727200.25	6449932.73	4.12	-0.29	-0.01	0.31	182	0.29	
BB52	9/24/2007	1726996.36	6451384.38	3.83	1726996.36	6451384.38	3.83						
BB53	9/24/2007	1726831.16	6451840.89	13.81	1726831.16	6451840.89	13.81						
CR07	11/30/1994	1731628.78	6451203.19	633.28	1731628.37	6451203.29	632.48	-0.41	0.10	-0.80	166	0.42	
CR50	9/24/2007(1998)	1733013.62	6451037.38	872.66	1733013.62	6451037.38	872.66						
CR51	9/24/2007(1998)	1733062.03	6452361.86	976.25	1733062.03	6452361.86	976.25						
CR52	9/24/2007(1998)	1732867.58	6450239.32	779.63	1732867.58	6450239.32	779.63						
CR53	9/14/2012	1732780.275	6450224.19	780.72	Replacement for CR52								
FT06	9/24/2007	1729855.61	6452760.21	489.06	1729855.61	6452760.21	489.06						
FT07	9/24/2007	1729253.24	6454104.75	589.01	1729253.24	6454104.75	589.01						
FT08	9/24/2007	1729388.68	6453350.51	658.44	1729388.68	6453350.51	658.44						
KC01	11/30/1994	1728476.78	6452458.23	312.88	1728476.36	6452457.91	312.42	-0.42	-0.32	-0.46	217	0.52	1
KC02	3/14/1995	1727002.89	6452118.99	13.84	1727002.74	6452118.89	13.74	-0.15	-0.11	-0.10	216	0.18	
KC04	3/14/1995	1727559.56	6452667.24	238.84	1727559.46	6452667.09	238.51	-0.10	-0.15	-0.33	236	0.18	
KC05	11/30/1994	1727082.00	6453179.09	227.86	1727082.01	6453178.94	227.53	0.01	-0.15	-0.33	273	0.15	
KC06	11/30/1994	1727784.91	6453396.67	300.35	1727784.94	6453396.40	299.97	0.03	-0.26	-0.38	276	0.26	
KC07	11/30/1994	1727759.19	6453683.92	313.83	1727759.37	6453683.85	313.51	0.18	-0.07	-0.32	340	0.19	
KC13	9/24/2007	1726581.16	6453069.63	191.20	1726581.16	6453069.63	191.20						
KC14	9/24/2007	1726742.44	6453806.05	259.94	1726742.44	6453806.05	259.94						
KC15	9/24/2007	1727590.45	6453121.10	287.10	1727590.45	6453121.10	287.10						
KC16	9/24/2007	1727602.25	6454098.23	326.90	1727602.25	6454098.23	326.90						
KC17	9/14/2012	1727302.764	6453026.42	215.25	Replacement for KC04								
PB04	11/30/1994	1727675.94	6448851.74	170.52	1727667.25	6448849.17	167.49	-8.69	-2.57	-3.03	196	9.06	
PB06	3/15/1995	1727968.45	6449761.84	183.06	1727941.12	6449758.81	178.25	-27.33	-3.03	-4.81	186	27.50	
PB07	3/14/1995	1728175.93	6450219.76	200.21	1728141.60	6450213.44	198.02	-34.32	-6.32	-2.19	190	34.90	
PB08	12/1/1994	1728237.51	6450469.80	193.68	1728204.81	6450463.98	194.09	-32.70	-5.82	0.41	190	33.21	
PB09	11/30/1994	1728288.58	6450851.02	192.52	1728252.20	6450849.11	189.84	-36.38	-1.91	-2.68	183	36.43	
PB12	11/30/1994	1728330.49	6451604.57	193.29	1728268.52	6451587.83	186.93	-61.97	-16.74	-6.36	195	64.19	
PB13	3/14/1995	1728085.97	6452164.34	210.54	1728050.44	6452151.18	207.21	-35.53	-13.16	-3.33	200	37.89	
PB18	3/15/1995	1730446.88	6450711.00	367.58	1730431.80	6450719.76	363.24	-15.08	8.77	-4.34	150	17.44	
PB20	3/14/1995	1728812.77	6451135.67	243.54	1728753.50	6451126.52	234.48	-59.27	-9.16	-9.06	189	59.97	
PB21	3/14/1995	1729298.22	6451172.05	280.02	1729249.90	6451177.92	273.29	-48.32	5.87	-6.73	173	48.68	
PB25	12/1/1994	1729702.31	6451985.65	328.99	1729671.12	6451986.48	326.10	-31.19	0.83	-2.89	178	31.20	
PB26	3/14/1995	1729562.65	6452249.56	285.34	1729539.22	6452252.23	282.95	-23.42	2.67	-2.39	174	23.58	
PB27	3/14/1995	1729339.34	6451836.06	284.42	1729257.91	6451842.02	273.51	-81.43	5.96	-10.91	176	81.65	
PB29	3/15/1995	1728888.95	6452120.49	185.93	1728849.86	6452097.03	173.29	-39.08	-23.46	-12.64	211	45.58	
PB53	12/4/1997	1729252.77	6450753.92	297.75	1729224.25	6450754.60	291.85	-28.52	0.67	-5.90	179	28.53	
PB54	12/4/1997	1729694.90	6450448.69	358.62	1729691.38	6450448.62	357.73	-3.52	-0.07	-0.89	181	3.52	
PB55	1/21/1998	1728812.28	6450804.04	246.33	1728782.51	6450801.87	241.07	-29.77	-2.18	-5.26	184	29.85	
PB59	6/26/2001	1727766.36	6448661.67	163.39	1727761.30	6448660.42	160.61	-5.07	-1.24	-2.78	194	5.22	
PB62	9/24/2007	1728476.64	6449717.56	287.25	1728476.64	6449717.56	287.25						
PB63	9/24/2007	1727734.04	6451488.11	126.06	1727734.04	6451488.11	126.06						
PB64	11/18/2009	1727466.29	6450946.95	72.76	Replacement for PB63								
PB65	10/25/2010	1728454.67	6449707.82	287.75	Replacement for PB62								
PB66	9/14/2012	1729197.647	6450969.92	288.33	Replacement for PB53								
UB02	7/23/1997	1727501.11	6450133.78	67.15	1727534.46	6450140.67	63.20	-46.66	6.78	-3.95	172	47.15	

Notes:
# Indicates stable points, not moving
* Indicates no signal of horizontal movement detected in the last period
2 = Hit by mower sometime between 09/07 and 12/08 with an estimated displacement S14E 0.29', the original position is adjusted here to be relative to monitored position used presently, resulting in correct Overall Movements, see Rpt

	Dec. 10, 2008 Positions			Overall Movements (US Feet)						Periodic (14.5 months) Movements (US Feet)						
	NAD83 SPC Zone 5 (Ft)		NAVD88	Original Position to Dec. 10, 2008						Sept. 24, 2007 Position to Dec. 10, 2008						
Point	North (ft)	East (ft)	Elev(ft)	North	East	Height	Azim.*	Dist.	Note	North	East	Height	Azimuth*	Distance	95%Error	Note
AB01	1729427.54	6445709.63	178.59	-0.05	0.02	-0.03	161	0.05	#	-0.01	-0.01	-0.03	231	0.02	0.017	#
AB02	1726946.99	6447968.68	116.46	0.00	-0.01	-0.02	297	0.01	#	0.00	-0.01	-0.02	297	0.01	0.016	#
AB03	1727338.39	6447818.81	139.58	0.04	-0.01	-0.02	348	0.04	#	0.00	0.00	-0.01	270	0.00	0.015	#
AB04	1728390.43	6447121.92	67.27	-1.56	-1.43	-0.30	222	2.12		-0.12	-0.11	-0.04	222	0.16	0.016	
AB05	1728074.86	6447644.04	80.59	-0.86	-1.13	-0.31	233	1.42	2							2
AB06	1729058.49	6446975.88	164.85	-1.24	-0.38	-0.43	197	1.30		-0.09	-0.03	-0.06	198	0.09	0.019	
AB07	1728981.40	6447357.70	159.34	-1.39	-0.71	-0.58	207	1.56		-0.11	-0.04	-0.06	202	0.12	0.021	
AB12	1729415.57	6448271.26	283.19	-0.92	-0.38	-0.24	203	0.99		-0.10	-0.03	0.00	199	0.11	0.018	
AB13	1729928.17	6448235.89	364.54	-0.73	-0.15	-0.49	192	0.74		-0.08	-0.01	0.00	191	0.08	0.019	
AB15	1730311.56	6448099.30	396.88	-0.53	-0.08	-0.40	189	0.53		-0.08	-0.01	-0.02	188	0.08	0.024	
AB16	1730358.65	6447532.17	376.46	-0.24	0.05	-0.16	168	0.24		-0.05	0.01	0.02	170	0.05	0.024	
AB17	1731421.12	6446727.77	442.79	0.00	0.00	-0.01	194	0.00	#	0.00	0.00	-0.01	194	0.00	0.020	#
AB18	1731602.31	6446197.61	456.91	-0.32	0.11	-0.28	160	0.34		-0.06	0.03	-0.02	155	0.07	0.023	
AB20	1729359.84	6449685.99	396.23	-0.79	-0.28	-0.20	199	0.83		-0.16	-0.04	0.00	195	0.17	0.012	
AB24	1729829.75	6447759.77	335.76	-0.61	-0.19	-0.16	197	0.63		-0.09	-0.04	0.02	205	0.10	0.022	
AB50	1728084.66	6448247.47	181.98	-0.34	-0.71	0.00	245	0.79		-0.05	-0.07	-0.05	235	0.08	0.019	
AB51	1729616.65	6447306.51	305.26	-0.36	-0.03	-0.16	185	0.36		-0.09	-0.01	0.01	190	0.09	0.019	
AB52	1730015.70	6448624.32	368.38	-0.40	-0.12	-0.23	196	0.42		-0.10	-0.03	-0.01	200	0.10	0.028	
AB53	1730430.62	6449712.30	352.90	-0.49	-0.07	-0.23	188	0.50		-0.15	-0.03	0.00	189	0.15	0.028	
AB54	1731111.93	6447047.87	407.30	-0.01	0.00	-0.01	165	0.01	*	-0.01	0.00	-0.01	165	0.01	0.028	*
AB55	1731174.72	6447753.58	405.39	-0.05	0.01	0.01	166	0.05		-0.05	0.01	0.01	166	0.05	0.018	
AB56	1732214.21	6448545.49	571.64	-0.10	0.03	-0.01	161	0.11		-0.10	0.03	-0.01	161	0.11	0.018	
AB57	1731926.78	6449759.40	564.90	-0.13	0.03	-0.03	166	0.13		-0.13	0.03	-0.03	166	0.13	0.018	
AB58	1731117.90	6449074.93	405.65	-0.12	0.00	-0.02	178	0.12		-0.12	0.00	-0.02	178	0.12	0.020	
AB59	1730850.70	6450212.53	434.35	-0.17	-0.02	-0.02	188	0.17		-0.17	-0.02	-0.02	188	0.17	0.020	
AB60	1729089.63	6447987.54	179.39	-0.08	-0.03	-0.06	200	0.08		-0.08	-0.03	-0.06	200	0.08	0.021	
AB61	1727424.49	6447990.27	140.43	-0.01	0.01	-0.04	114	0.01	*	-0.01	0.01	-0.04	114	0.01	0.003	#
BB25	1727200.25	6449932.58	4.15	-0.29	-0.16	0.34	208	0.33		0.00	-0.15	0.03	269	0.15	0.017	
BB52	1726996.24	6451384.35	3.83	-0.12	-0.03	0.00	194	0.13		-0.12	-0.03	0.00	194	0.13	0.024	
BB53	Destroyed															
CR07	1731628.24	6451203.32	632.36	-0.54	0.13	-0.92	166	0.55		-0.13	0.03	-0.12	168	0.13	0.024	
CR50	1733013.62	6451037.38	872.71	0.01	0.01	0.05	45	0.01		0.01	0.01	0.05	45	0.01	0.017	*
CR51	1733062.02	6452361.86	976.24	-0.01	0.00	-0.01	171	0.01		-0.01	0.00	-0.01	171	0.01	0.019	*
CR52	1732867.58	6450239.31	779.64	0.00	-0.01	0.01	258	0.01		0.00	-0.01	0.01	258	0.01	0.023	*
FT06	1729855.42	6452760.17	488.97	-0.19	-0.04	-0.09	192	0.19		-0.19	-0.04	-0.09	192	0.19	0.025	
FT07	1729253.01	6454104.39	588.99	-0.23	-0.36	-0.02	237	0.43		-0.23	-0.36	-0.02	237	0.43	0.015	
FT08	1729388.67	6453350.53	658.47	-0.01	0.02	0.03	114	0.02		-0.01	0.02	0.03	114	0.02	0.015	*
KC01	1728476.25	6452457.85	312.38	-0.53	-0.38	-0.50	215	0.66	1	-0.12	-0.06	-0.04	208	0.13	0.020	
KC02	1727002.67	6452118.88	13.72	-0.22	-0.11	-0.12	207	0.25		-0.07	-0.01	-0.02	185	0.07	0.021	
KC04	1727559.42	6452667.06	238.47	-0.14	-0.18	-0.37	233	0.23		-0.04	-0.04	-0.04	223	0.05	0.017	
KC05	1727081.98	6453178.94	227.52	-0.02	-0.15	-0.34	261	0.15		-0.03	0.00	-0.01	180	0.03	0.020	
KC06	1727784.92	6453396.36	299.93	0.01	-0.30	-0.42	273	0.30		-0.01	-0.04	-0.04	252	0.05	0.021	
KC07	1727759.38	6453683.87	313.50	0.18	-0.05	-0.33	346	0.19		0.00	0.02	-0.01	84	0.02	0.018	*
KC13	1726581.12	6453069.62	191.23	-0.04	-0.01	0.03	194	0.04		-0.04	-0.01	0.03	194	0.04	0.018	
KC14	1726742.44	6453806.04	259.91	0.00	-0.02	-0.03	259	0.02	*	0.00	-0.02	-0.03	259	0.02	0.020	*
KC15	1727590.41	6453121.06	287.13	-0.05	-0.04	0.03	220	0.06		-0.05	-0.04	0.03	220	0.06	0.022	
KC16	1727602.24	6454098.24	326.92	-0.01	0.00	0.02	135	0.01	*	-0.01	0.00	0.02	135	0.01	0.016	*
PB04	1727666.83	6448849.07	167.37	-9.10	-2.67	-3.15	196	9.49		-0.41	-0.10	-0.12	194	0.43	0.017	
PB06	1727939.65	6449758.62	177.96	-28.80	-3.22	-5.10	186	28.98		-1.47	-0.18	-0.29	187	1.48	0.021	
PB07	1728139.82	6450213.09	197.88	-36.10	-6.67	-2.33	190	36.72		-1.78	-0.35	-0.14	191	1.82	0.020	
PB08	1728203.20	6450463.68	194.13	-34.31	-6.12	0.45	190	34.85		-1.61	-0.30	0.04	190	1.64	0.024	
PB09	1728250.32	6450848.98	189.58	-38.26	-2.04	-2.94	183	38.31		-1.88	-0.13	-0.26	184	1.88	0.021	
PB12	1728265.36	6451586.81	186.31	-65.13	-17.76	-6.98	195	67.51		-3.16	-1.03	-0.62	198	3.32	0.019	
PB13	1728048.48	6452150.38	207.09	-37.49	-13.96	-3.45	200	40.01		-1.96	-0.80	-0.12	202	2.12	0.019	
PB18	1730431.47	6450719.84	363.18	-15.41	8.85	-4.40	150	17.77		-0.33	0.08	-0.06	166	0.34	0.020	
PB20	1728750.65	6451126.05	233.99	-62.12	-9.63	-9.55	189	62.86		-2.85	-0.47	-0.49	189	2.89	0.020	
PB21	1729247.73	6451178.08	273.02	-50.49	6.03	-7.00	173	50.85		-2.17	0.16	-0.27	176	2.17	0.021	
PB25	1729670.88	6451986.42	326.07	-31.44	0.77	-2.92	179	31.45		-0.25	-0.07	-0.03	195	0.26	0.019	
PB26	1729539.03	6452252.21	282.94	-23.62	2.65	-2.40	174	23.77		-0.20	-0.02	-0.01	187	0.20	0.018	
PB27	1729254.41	6451842.14	272.98	-84.93	6.08	-11.44	176	85.15		-3.50	0.13	-0.53	178	3.50	0.023	
PB29	1728847.75	6452096.03	172.60	-41.20	-24.46	-13.33	211	47.91		-2.11	-1.01	-0.69	205	2.34	0.020	
PB53	1729222.48	6450754.60	291.44	-30.28	0.68	-6.31	179	30.29		-1.76	0.00	-0.41	180	1.76	0.024	
PB54	1729691.20	6450448.58	357.73	-3.70	-0.11	-0.89	182	3.70		-0.18	-0.04	0.00	193	0.18	0.019	
PB55	1728780.51	6450801.66	240.62	-31.77	-2.38	-5.71	184	31.86		-2.01	-0.21	-0.45	186	2.02	0.031	
PB59	1727760.70	6448660.28	160.34	-5.66	-1.39	-3.05	194	5.83		-0.59	-0.15	-0.27	194	0.61	0.017	
PB62	1728476.42	6449717.52	287.22	-0.21	-0.04	-0.03	192	0.22		-0.21	-0.04	-0.03	192	0.22	0.016	
PB63	1727724.58	6451485.79	121.78	-9.45	-2.32	-4.28	194	9.73		-9.45	-2.32	-4.28	194	9.73	0.020	
UB02	1727530.48	6450141.10	63.00	-50.63	7.31	-4.15	172	51.16		-3.97	0.53	-0.20	172	4.01	0.023	

Prepared by McGee Surveying Consulting - Document Date: 9/30/2013

Notes:
# Indicates stable points, not moving
* Indicates no signal of horizontal movement detected in the last period

	Nov. 18, 2009 Positions			Overall Movements (US Feet)						Periodic (11.3 months) Movements (US Feet)						
	NAD83 SPC Zone 5 (Ft)		NAVD88	Original Position to Nov. 18, 2009						Dec. 10, 2008 Position to Nov. 18, 2009						
Point	North (ft)	East (ft)	Elev(ft)	North	East	Height	Azim.°	Dist.	Note	North	East	Height	Azim.°	Dist.	95%Error	Note
AB01	1729427.54	6445709.62	178.540	-0.04	0.01	-0.08	167	0.04		0.00	-0.01	-0.05	304	0.01	0.020	#
AB02	1726946.97	6447968.68	116.460	-0.02	0.00	-0.02	198	0.02	*	-0.02	0.00	0.00	171	0.02	0.020	#
AB03	1727338.38	6447818.82	139.570	0.04	0.00	-0.03	4	0.04		-0.01	0.01	-0.01	117	0.01	0.017	#
AB04	1728390.36	6447121.86	67.250	-1.63	-1.48	-0.32	222	2.20		-0.07	-0.05	-0.02	217	0.09	0.019	
AB05	1728074.78	6447643.96	80.570	-0.94	-1.21	-0.33	232	1.53		-0.08	-0.08	-0.02	226	0.11	0.018	
AB06	1729058.43	6446975.87	164.840	-1.31	-0.39	-0.44	197	1.36		-0.06	-0.01	-0.01	191	0.06	0.019	
AB07	1728981.35	6447357.67	159.330	-1.44	-0.74	-0.59	207	1.62		-0.05	-0.03	-0.01	207	0.06	0.022	
AB12	1729415.50	6448271.24	283.190	-0.98	-0.41	-0.24	203	1.07		-0.07	-0.03	0.00	202	0.07	0.019	
AB13	1729928.13	6448235.87	364.540	-0.77	-0.16	-0.49	192	0.78		-0.04	-0.02	0.00	201	0.04	0.020	
AB15	1730311.51	6448099.30	396.880	-0.57	-0.08	-0.40	188	0.58		-0.05	0.00	0.00	180	0.05	0.026	
AB16	1730358.64	6447532.17	376.450	-0.25	0.04	-0.17	170	0.25		-0.01	-0.01	-0.01	203	0.02	0.021	*
AB17	1731421.11	6446727.77	442.800	-0.01	0.00	0.00	186	0.01	*	0.00	0.00	0.01	180	0.00	0.019	#
AB18	1731602.26	6448187.60	456.870	-0.36	0.11	-0.32	163	0.38		-0.04	-0.01	-0.04	189	0.04	0.025	
AB20	1729359.78	6449685.97	396.230	-0.85	-0.30	-0.20	199	0.90		-0.06	-0.02	0.00	200	0.06	0.013	
AB24	1729829.68	6447759.75	335.760	-0.67	-0.21	-0.16	197	0.70		-0.06	-0.02	0.00	198	0.07	0.024	
AB50	1728084.64	6448247.44	182.000	-0.36	-0.74	0.02	244	0.83		-0.02	-0.03	0.02	238	0.04	0.024	
AB51	1729616.60	6447306.48	305.250	-0.41	-0.06	-0.17	188	0.41		-0.04	-0.02	-0.01	208	0.05	0.020	
AB52	1730015.65	6448624.32	368.350	-0.45	-0.12	-0.26	195	0.47		-0.05	0.00	-0.03	181	0.05	0.031	
AB53	1730430.55	6449712.28	352.890	-0.55	-0.09	-0.24	189	0.56		-0.06	-0.02	-0.01	198	0.06	0.026	
AB54	1731111.92	6447047.87	407.360	-0.03	0.00	0.05	178	0.03	*	-0.02	0.00	0.06	187	0.02	0.029	*
AB55	1731174.68	6447753.58	405.390	-0.09	0.02	0.01	169	0.09		-0.04	0.01	0.00	171	0.04	0.017	
AB56	1732214.16	6448545.51	571.690	-0.15	0.05	0.04	162	0.16		-0.05	0.02	0.05	164	0.05	0.024	
AB57	1731926.73	6449759.41	564.860	-0.18	0.04	-0.07	166	0.18		-0.05	0.01	-0.04	167	0.05	0.022	
AB58	1731117.85	6449074.94	405.640	-0.17	0.01	-0.03	175	0.17		-0.05	0.01	-0.01	168	0.05	0.022	
AB59	1730850.64	6450212.52	434.340	-0.23	-0.03	-0.03	188	0.23		-0.06	-0.01	-0.01	190	0.06	0.022	
AB60	1729089.58	6447987.53	179.390	-0.12	-0.04	-0.06	199	0.13		-0.04	-0.01	0.00	196	0.05	0.019	
AB61	1727424.49	6447990.27	140.420	-0.01	0.01	-0.05	128	0.02	*	0.00	0.00	-0.01	158	0.01	0.004	#
BB25	1727200.19	6449932.57	4.210	-0.35	-0.16	0.40	204	0.39		-0.06	0.00	0.06	183	0.06	0.024	
BB52	1726996.18	6451384.34	3.860	-0.18	-0.04	0.03	193	0.19		-0.06	-0.01	0.03	191	0.06	0.019	
CR07	1731628.18	6451203.34	632.390	-0.60	0.15	-0.89	166	0.62		-0.06	0.02	0.03	161	0.07	0.024	
CR50	1733013.61	6451037.39	872.690	-0.01	0.01	0.03	118	0.01		-0.01	0.00	-0.02	162	0.02	0.022	*
CR51	1733062.01	6452361.87	976.220	-0.02	0.01	-0.03	155	0.03		-0.01	0.01	-0.02	143	0.02	0.024	*
CR52	1732867.56	6450239.31	779.730	-0.02	-0.01	0.10	217	0.02	*	-0.01	0.00	0.09	176	0.01	0.026	*
FT06	1729855.34	6452760.16	488.920	-0.27	-0.05	-0.14	191	0.28		-0.08	-0.01	-0.05	189	0.08	0.020	
FT07	1729252.92	6454104.25	588.900	-0.33	-0.51	-0.11	237	0.60		-0.10	-0.14	-0.09	236	0.17	0.020	
FT08	1729388.69	6453350.52	658.480	0.00	0.02	0.04	74	0.02	*	0.01	0.00	0.01	348	0.01	0.027	#
KC01	1728476.18	6452457.81	312.350	-0.60	-0.42	-0.53	215	0.74		-0.07	-0.04	-0.03	209	0.08	0.019	
KC02	1727002.64	6452118.86	13.690	-0.26	-0.13	-0.15	207	0.29		-0.03	-0.02	-0.03	207	0.04	0.021	
KC04	1727559.39	6452667.04	238.450	-0.17	-0.20	-0.39	231	0.27		-0.03	-0.02	-0.02	216	0.04	0.019	
KC05	1727081.97	6453178.92	227.510	-0.03	-0.17	-0.35	259	0.18		-0.01	-0.02	-0.01	244	0.03	0.020	
KC06	1727784.90	6453396.33	299.910	-0.01	-0.33	-0.44	268	0.33		-0.02	-0.03	-0.02	227	0.04	0.025	
KC07	1727759.37	6453683.87	313.470	0.18	-0.05	-0.36	344	0.19		0.00	0.00	-0.03	256	0.00	0.021	*
KC13	1726581.11	6453069.63	191.180	-0.04	-0.01	-0.02	188	0.04		-0.01	0.00	-0.05	153	0.01	0.017	*
KC14	1726742.43	6453806.03	259.920	-0.01	-0.03	-0.02	253	0.03	*	0.00	-0.01	0.01	247	0.01	0.023	*
KC15	1727590.38	6453121.03	287.090	-0.07	-0.06	-0.01	222	0.09		-0.02	-0.02	-0.04	226	0.03	0.027	
KC16	1727602.24	6454098.24	326.870	-0.01	0.00	-0.03	159	0.01	*	0.00	0.00	-0.05	214	0.00	0.018	#
PB04	1727666.56	6448848.99	167.310	-9.38	-2.75	-3.21	196	9.77		-0.27	-0.07	-0.06	195	0.28	0.020	
PB06	1727938.80	6449758.52	177.820	-29.65	-3.32	-5.24	186	29.83		-0.85	-0.10	-0.14	187	0.85	0.022	
PB07	1728138.83	6450212.89	197.800	-37.09	-6.86	-2.41	190	37.72		-0.99	-0.19	-0.08	191	1.01	0.019	
PB08	1728202.31	6450463.52	194.120	-35.20	-6.28	0.44	190	35.75		-0.89	-0.16	-0.01	190	0.90	0.020	
PB09	1728249.30	6450848.91	189.460	-39.28	-2.11	-3.06	183	39.34		-1.02	-0.07	-0.12	184	1.02	0.022	
PB12	1728263.70	6451586.25	185.940	-66.79	-18.32	-7.35	195	69.25		-1.66	-0.55	-0.37	199	1.75	0.022	
PB13	1728047.43	6452149.98	206.980	-38.54	-14.36	-3.56	200	41.13		-1.05	-0.41	-0.11	201	1.12	0.019	
PB18	1730431.35	6450719.86	363.140	-15.53	8.87	-4.44	150	17.89		-0.12	0.02	-0.04	170	0.12	0.021	
PB20	1728749.18	6451125.82	233.690	-63.59	-9.86	-9.85	189	64.35		-1.47	-0.23	-0.30	189	1.49	0.022	
PB21	1729246.60	6451178.17	272.840	-51.62	6.12	-7.18	173	51.98		-1.13	0.09	-0.18	175	1.14	0.024	
PB25	1729670.78	6451986.39	326.040	-31.53	0.74	-2.95	179	31.54		-0.09	-0.02	-0.03	194	0.10	0.022	
PB26	1729538.93	6452252.19	282.930	-23.71	2.63	-2.41	174	23.86		-0.09	-0.02	-0.01	190	0.10	0.022	
PB27	1729252.59	6451842.20	272.730	-86.75	6.14	-11.69	176	86.97		-1.82	0.06	-0.25	178	1.82	0.026	
PB29	1728846.62	6452095.51	172.230	-42.32	-24.98	-13.70	211	49.15		-1.13	-0.52	-0.37	205	1.24	0.022	
PB53	1729221.54	6450754.61	291.200	-31.22	0.68	-6.55	179	31.23		-0.94	0.01	-0.24	180	0.94	0.026	
PB54	1729691.12	6450448.57	357.710	-3.78	-0.12	-0.91	182	3.78		-0.08	-0.01	-0.02	188	0.08	0.023	
PB55	1728779.41	6450801.58	240.500	-32.87	-2.47	-5.83	184	32.97		-1.10	-0.08	-0.12	184	1.10	0.030	
PB59	1727760.31	6448660.19	160.160	-6.05	-1.48	-3.23	194	6.23		-0.39	-0.09	-0.18	193	0.40	0.020	
PB62	1728476.31	6449717.49	287.200	-0.32	-0.07	-0.05	192	0.33		-0.11	-0.02	-0.02	193	0.11	0.017	
PB63	1727717.72	6451483.29	116.990	-16.31	-4.82	-9.07	196	17.01		-6.96	-2.50	-4.79	200	7.30	0.022	
PB64	1727466.29	6450946.95	72.760	Replacement for PB63												
UB02	1727527.87	6450141.46	62.920	-53.24	7.67	-4.23	172	53.79		-2.61	0.36	-0.08	172	2.64	0.022	

Notes:
* Indicates no signal of horizontal movement detected in the last period

	Oct. 25, 2010 Positions			Overall Movements (US Feet)						Periodic (11.1 months) Movements (US Feet)						
	NAD83 SPC Zone 5 (Ft)		NAVD88	Original Position to Oct. 25, 2010						Nov. 18, 2009 Position to Oct. 25, 2010						
Point	North (ft)	East (ft)	Elev(ft)	North	East	Height	Azim.°	Dist.	Note	North	East	Height	Azim.°	Dist.	95%Error	Note
AB01	1729427.53	6445709.61	178.52	-0.05	-0.01	-0.10	187	0.05		-0.01	-0.02	-0.02	241	0.02	0.032	*
AB02	1726946.97	6447968.66	116.45	-0.02	-0.03	-0.03	243	0.03	*	0.00	-0.02	-0.01	270	0.02	0.024	*
AB03	Discontinued															
AB04	1728390.27	6447121.79	67.25	-1.72	-1.56	-0.32	222	2.32		-0.09	-0.08	0.00	220	0.12	0.023	
AB05	1728074.67	6447643.89	80.53	-1.05	-1.28	-0.37	231	1.66		-0.12	-0.07	-0.04	211	0.14	0.026	
AB06	1729058.36	6446975.83	164.82	-1.37	-0.43	-0.46	197	1.44		-0.07	-0.03	-0.02	207	0.07	0.026	
AB07	1728981.28	6447357.64	159.31	-1.51	-0.77	-0.61	207	1.70		-0.07	-0.03	-0.02	207	0.08	0.032	
AB12	1729415.46	6448271.20	283.20	-1.03	-0.44	-0.23	203	1.12		-0.04	-0.04	0.01	219	0.06	0.017	
AB13	1729928.09	6448235.85	364.53	-0.81	-0.19	-0.50	193	0.83		-0.04	-0.02	-0.01	208	0.05	0.021	
AB15	1730311.47	6448099.25	396.86	-0.62	-0.14	-0.42	192	0.63		-0.04	-0.05	-0.02	232	0.07	0.023	
AB16	1730358.61	6447532.16	376.46	-0.28	0.03	-0.16	173	0.28		-0.03	-0.01	0.01	197	0.03	0.028	*
AB17	1731421.10	6446727.76	442.80	-0.02	-0.01	0.00	205	0.02		-0.01	-0.01	0.00	217	0.01	0.021	*
AB18	1731602.22	6448187.61	456.82	-0.40	0.12	-0.37	164	0.42		-0.04	0.01	-0.05	165	0.04	0.031	
AB20	1729359.72	6449685.94	396.23	-0.90	-0.32	-0.20	200	0.96		-0.06	-0.02	0.00	203	0.06	0.012	
AB24	1729829.65	6447759.73	335.77	-0.71	-0.23	-0.15	198	0.75		-0.04	-0.02	0.01	212	0.04	0.024	
AB50	1728084.62	6448247.38	182.00	-0.38	-0.80	0.02	244	0.89		-0.02	-0.06	0.00	247	0.06	0.031	
AB51	1729616.56	6447306.49	305.24	-0.45	-0.05	-0.18	186	0.45		-0.05	0.01	-0.01	172	0.05	0.022	
AB52	1730015.61	6448624.30	368.38	-0.49	-0.14	-0.23	196	0.51		-0.04	-0.02	0.03	209	0.04	0.037	
AB53	1730430.49	6449712.26	352.91	-0.61	-0.11	-0.22	190	0.62		-0.06	-0.02	0.02	196	0.07	0.027	
AB54	1731111.92	6447047.87	407.34	-0.02	0.00	0.03	182	0.02		0.00	0.00	-0.02	326	0.00	0.036	*
AB55	1731174.66	6447753.58	405.40	-0.11	0.02	0.02	171	0.11		-0.02	0.00	0.01	183	0.02	0.018	*
AB56	1732214.12	6448545.51	571.63	-0.19	0.05	-0.02	165	0.20		-0.04	0.00	-0.06	179	0.04	0.028	
AB57	1731926.67	6449759.42	564.92	-0.23	0.06	-0.01	165	0.24		-0.05	0.01	0.06	164	0.06	0.027	
AB58	1731117.80	6449074.93	405.69	-0.22	0.00	0.02	180	0.22		-0.05	-0.01	0.05	196	0.05	0.026	
AB59	1730850.56	6450212.51	434.35	-0.31	-0.04	-0.02	188	0.31		-0.08	-0.01	0.01	185	0.08	0.028	
AB60	1729089.53	6447987.50	179.42	-0.17	-0.07	-0.03	201	0.18		-0.05	-0.02	0.03	207	0.06	0.020	
AB61	1727424.48	6447990.27	140.47	-0.02	0.01	0.00	150	0.02	*	-0.01	0.00	0.05	193	0.01	0.005	*
BB25	Discontinued															
BB52	1726996.13	6451384.34	3.85	-0.23	-0.04	0.02	190	0.24		-0.05	0.00	-0.01	180	0.05	0.029	
BB53	Destroyed															
CR07	1731628.12	6451203.32	632.33	-0.66	0.13	-0.95	169	0.67		-0.06	-0.02	-0.06	202	0.06	0.027	
CR50	1733013.59	6451037.37	872.67	-0.03	0.00	0.01	184	0.03		-0.02	-0.02	-0.02	217	0.03	0.023	
CR51	1733062.01	6452361.88	976.18	-0.02	0.02	-0.07	144	0.03		0.00	0.01	-0.04	98	0.01	0.026	*
CR52	1732867.55	6450239.31	779.65	-0.03	-0.01	0.02	207	0.03	*	-0.01	0.00	-0.08	186	0.01	0.031	*
FT06	1729855.25	6452760.13	488.89	-0.35	-0.08	-0.17	193	0.36		-0.08	-0.03	-0.03	199	0.09	0.019	
FT07	1729252.76	6454104.00	588.85	-0.49	-0.75	-0.16	237	0.90		-0.16	-0.25	-0.05	237	0.30	0.026	
FT08	1729388.66	6453350.51	658.43	-0.02	0.00	-0.01	186	0.02	*	-0.02	-0.01	-0.05	206	0.03	0.028	*
KC01	1728476.12	6452457.77	312.38	-0.67	-0.46	-0.50	215	0.81		-0.06	-0.04	0.03	216	0.07	0.023	
KC02	1727002.62	6452118.86	13.72	-0.28	-0.14	-0.12	206	0.31		-0.02	-0.01	0.03	197	0.02	0.033	*
KC04	1727559.36	6452667.01	238.44	-0.20	-0.23	-0.40	228	0.30		-0.03	-0.02	-0.01	215	0.04	0.027	
KC05	1727081.96	6453178.92	227.47	-0.04	-0.17	-0.39	256	0.18		-0.01	0.00	-0.04	180	0.01	0.029	*
KC06	1727784.89	6453396.32	299.89	-0.02	-0.35	-0.46	266	0.35		-0.01	-0.02	-0.02	233	0.02	0.027	*
KC07	1727759.39	6453683.87	313.47	0.19	-0.04	-0.36	347	0.20		0.01	0.01	0.00	32	0.01	0.031	*
KC13	1726581.08	6453069.61	191.18	-0.07	-0.02	-0.02	195	0.08		-0.03	-0.01	0.00	204	0.03	0.021	
KC14	1726742.43	6453806.02	259.89	-0.01	-0.03	-0.05	258	0.03	*	0.00	0.00	-0.03	333	0.00	0.036	*
KC15	1727590.38	6453121.02	287.10	-0.07	-0.07	0.00	227	0.10		0.00	-0.01	0.01	265	0.01	0.027	*
KC16	1727602.23	6454098.24	326.98	-0.02	0.01	-0.02	148	0.02	*	-0.01	0.01	0.01	139	0.01	0.023	*
PB04	1727655.94	6448848.86	167.11	-9.99	-2.88	-3.41	196	10.40		-0.62	-0.13	-0.20	192	0.63	0.030	
PB06	1727937.25	6449758.35	177.58	-31.19	-3.49	-5.48	186	31.39		-1.55	-0.17	-0.24	186	1.56	0.032	
PB07	1728137.00	6450212.58	197.66	-38.93	-7.18	-2.55	190	39.58		-1.83	-0.32	-0.14	190	1.86	0.030	
PB08	1728200.66	6450463.24	194.16	-36.85	-6.56	0.48	190	37.43		-1.65	-0.28	0.04	190	1.67	0.033	
PB09	1728247.35	6450848.79	189.24	-41.23	-2.24	-3.28	183	41.29		-1.95	-0.13	-0.22	184	1.95	0.032	
PB12	1728260.50	6451585.29	185.30	-69.99	-19.28	-7.99	195	72.60		-3.20	-0.96	-0.64	197	3.35	0.027	
PB13	1728045.47	6452149.17	206.87	-40.50	-15.17	-3.67	201	43.25		-1.96	-0.81	-0.11	202	2.12	0.025	
PB18	1730431.24	6450719.88	363.10	-15.64	8.89	-4.48	150	17.99		-0.11	0.02	-0.04	169	0.11	0.024	
PB20	1728746.32	6451125.33	233.20	-66.45	-10.35	-10.34	189	67.25		-2.86	-0.49	-0.49	190	2.91	0.038	
PB21	1729244.44	6451178.35	272.60	-53.78	6.30	-7.42	173	54.14		-2.15	0.18	-0.24	175	2.16	0.029	
PB25	1729670.68	6451986.36	326.01	-31.64	0.71	-2.98	179	31.64		-0.10	-0.03	-0.03	196	0.11	0.021	
PB26	1729538.86	6452252.16	282.99	-23.79	2.60	-2.35	174	23.93		-0.08	-0.03	0.06	200	0.08	0.028	
PB27	1729249.12	6451842.31	272.17	-90.22	6.25	-12.25	176	90.44		-3.47	0.11	-0.56	178	3.47	0.029	
PB29	1728844.53	6452094.53	171.59	-44.42	-25.96	-14.34	210	51.45		-2.10	-0.97	-0.64	205	2.31	0.032	
PB53	1729219.81	6450754.71	290.67	-32.96	0.78	-7.09	179	32.97		-1.73	0.10	-0.53	177	1.74	0.035	
PB54	1729691.04	6450448.55	357.73	-3.86	-0.13	-0.89	182	3.87		-0.08	-0.02	0.02	191	0.08	0.026	
PB55	1728777.36	6450801.45	240.18	-34.92	-2.59	-6.15	184	35.02		-2.05	-0.13	-0.32	184	2.05	0.044	
PB59	1727759.39	6448659.97	159.70	-6.98	-1.69	-3.69	194	7.18		-0.93	-0.21	-0.47	193	0.95	0.032	
PB62	Destroyed															
PB63	Destroyed															
PB64	1727439.04	6450942.07	69.69	-27.25	-4.88	-3.08	190	27.68		-27.25	-4.88	-3.08	190	27.68	0.031	
PB65	1728454.67	6449707.82	287.75	Replacement for PB62												
UB02	1727522.77	6450142.13	62.75	-58.34	8.34	-4.40	172	58.94		-5.10	0.67	-0.17	173	5.14	0.030	

Notes:
* Indicates no signal of horizontal movement detected in the last period

	Oct. 03, 2011 Positions			Overall Movements (US Feet)						Periodic (11.3 months) Movements (US Feet)						
	NAD83 SPC Zone 5 (Ft)		NAVD88	Original Position to Oct. 03, 2011						Oct. 25, 2010 Position to Oct. 03, 2011						
Point	North (ft)	East (ft)	Elev(ft)	North	East	Height	Azim.°	Dist.	Note	North	East	Height	Azim.°	Dist.	95%Error	Note
AB01	1729427.55	6445709.59	178.50	-0.04	-0.02	-0.12	213	0.04		0.02	-0.02	-0.02	313	0.02	0.030	*
AB02	1726946.97	6447968.70	116.45	-0.01	0.01	-0.03	124	0.01		0.01	0.04	0.00	81	0.04	0.023	
AB04	1728390.04	6447121.59	67.21	-1.95	-1.75	-0.36	222	2.62		-0.23	-0.20	-0.03	221	0.30	0.025	
AB05	1728074.57	6447643.73	80.49	-1.15	-1.45	-0.41	232	1.84		-0.09	-0.16	-0.04	240	0.19	0.027	
AB06	1729058.21	6446975.77	164.77	-1.53	-0.49	-0.51	198	1.60		-0.16	-0.06	-0.05	202	0.17	0.031	
AB07	1728981.13	6447357.52	159.24	-1.66	-0.89	-0.68	208	1.88		-0.15	-0.12	-0.06	218	0.19	0.041	
AB12	1729415.28	6448271.12	283.19	-1.21	-0.52	-0.24	203	1.32		-0.18	-0.08	-0.01	204	0.20	0.026	
AB13	1729927.96	6448235.79	364.50	-0.93	-0.25	-0.53	195	0.97		-0.12	-0.06	-0.03	205	0.14	0.033	
AB15	1730311.37	6448099.26	396.87	-0.72	-0.13	-0.41	190	0.73		-0.10	0.01	0.00	174	0.10	0.032	
AB16	1730358.55	6447532.15	376.44	-0.34	0.03	-0.18	175	0.34		-0.06	0.00	-0.02	185	0.06	0.029	
AB17	1731421.09	6446727.74	442.78	-0.03	-0.04	-0.02	228	0.05		-0.01	-0.03	-0.02	246	0.03	0.036	*
AB18	1731602.16	6448187.62	456.84	-0.46	0.13	-0.35	165	0.48		-0.06	0.01	0.01	173	0.06	0.032	
AB20	1729359.56	6449685.89	396.23	-1.07	-0.38	-0.20	200	1.13		-0.16	-0.06	0.00	199	0.17	0.026	
AB24	1729829.52	6447759.68	335.77	-0.84	-0.29	-0.15	198	0.88		-0.13	-0.04	0.01	200	0.13	0.024	
AB50	1728084.56	6448247.27	182.01	-0.44	-0.92	0.03	244	1.02		-0.06	-0.11	0.02	243	0.13	0.027	
AB51	1729616.46	6447306.45	305.17	-0.55	-0.09	-0.25	189	0.56		-0.10	-0.04	-0.07	200	0.11	0.025	
AB52	1730015.49	6448624.26	368.35	-0.61	-0.18	-0.26	197	0.64		-0.12	-0.04	-0.03	200	0.13	0.036	
AB53	1730430.36	6449712.24	352.87	-0.75	-0.13	-0.26	190	0.76		-0.14	-0.02	-0.04	189	0.14	0.028	
AB54	1731111.92	6447047.87	407.31	-0.02	0.01	0.00	164	0.03	*	0.00	0.01	-0.02	97	0.01	0.033	*
AB55	1731174.61	6447753.58	405.37	-0.15	0.02	-0.01	173	0.16		-0.04	0.00	-0.03	179	0.04	0.027	
AB56	1732214.00	6448545.55	571.57	-0.31	0.09	-0.08	164	0.32		-0.12	0.04	-0.06	162	0.12	0.026	
AB57	1731926.54	6449759.46	564.83	-0.37	0.09	-0.10	166	0.38		-0.14	0.03	-0.10	166	0.14	0.026	
AB58	1731117.67	6449074.94	405.64	-0.35	0.00	-0.03	179	0.35		-0.13	0.00	-0.05	178	0.13	0.038	
AB59	1730850.40	6450212.51	434.27	-0.47	-0.05	-0.10	186	0.47		-0.16	-0.01	-0.07	182	0.16	0.030	
AB60	1729089.38	6447987.45	179.39	-0.32	-0.12	-0.06	200	0.34		-0.15	-0.05	-0.03	199	0.16	0.025	
AB61	1727424.48	6447990.26	140.43	-0.02	0.00	-0.04	177	0.02	*	0.00	-0.01	-0.04	259	0.01	0.008	*
AB62	1728910.35	6446925.46	143.01	Replacement for AB06												
AB63	1729059.30	6447307.03	180.84	Replacement for AB07												
BB52	1726995.98	6451384.32	3.89	-0.38	-0.06	0.06	188	0.39		-0.15	-0.01	0.04	185	0.15	0.032	
CR07	1731628.00	6451203.34	632.26	-0.78	0.15	-1.02	169	0.79		-0.12	0.02	-0.07	171	0.12	0.034	
CR50	1733013.59	6451037.37	872.65	-0.03	-0.01	-0.01	197	0.03		0.00	-0.01	-0.02	254	0.01	0.032	*
CR51	1733062.00	6452361.87	976.18	-0.04	0.01	-0.07	164	0.04		-0.01	-0.01	0.00	216	0.01	0.031	*
CR52	1732867.53	6450239.26	779.68	-0.05	-0.05	0.05	232	0.08		-0.02	-0.05	0.02	247	0.05	0.047	
FT06	1729855.05	6452760.09	488.79	-0.55	-0.12	-0.27	192	0.57		-0.20	-0.04	-0.11	191	0.20	0.027	
FT07	1729252.33	6454103.33	588.72	-0.91	-1.42	-0.29	237	1.69		-0.43	-0.67	-0.13	238	0.79	0.027	
FT08	1729388.67	6453350.48	658.45	-0.01	-0.02	0.01	251	0.02	*	0.01	-0.03	0.02	293	0.03	0.024	*
KC01	1728475.98	6452457.69	312.35	-0.80	-0.54	-0.53	214	0.97		-0.14	-0.08	-0.03	211	0.16	0.028	
KC02	1727002.55	6452118.84	13.73	-0.34	-0.16	-0.11	205	0.38		-0.07	-0.02	0.01	199	0.07	0.030	
KC04	1727559.31	6452666.95	238.46	-0.25	-0.29	-0.38	229	0.38		-0.05	-0.06	0.02	230	0.08	0.030	
KC05	1727081.92	6453178.90	227.47	-0.08	-0.19	-0.39	248	0.21		-0.03	-0.02	0.00	210	0.04	0.028	
KC06	1727784.89	6453396.26	299.88	-0.02	-0.41	-0.47	268	0.41		0.01	-0.06	-0.01	277	0.06	0.030	
KC07	1727759.39	6453683.87	313.48	0.20	-0.05	-0.35	346	0.21		0.01	-0.01	0.01	315	0.01	0.034	*
KC13	1726581.05	6453069.58	191.13	-0.11	-0.05	-0.07	206	0.12		-0.04	-0.03	-0.05	222	0.05	0.029	
KC14	1726742.44	6453806.00	259.92	0.00	-0.05	-0.02	271	0.05		0.01	-0.02	0.02	288	0.02	0.032	*
KC15	1727590.34	6453120.97	287.06	-0.11	-0.13	-0.04	229	0.17		-0.04	-0.05	-0.04	233	0.07	0.025	
KC16	1727602.24	6454098.22	326.88	-0.01	-0.01	-0.02	233	0.02	*	0.01	-0.02	0.00	288	0.02	0.031	*
PB04	1727665.23	6448848.66	166.92	-10.71	-3.08	-3.60	196	11.14		-0.71	-0.21	-0.19	196	0.74	0.042	
PB06	1727935.82	6449758.16	177.36	-32.63	-3.68	-5.70	186	32.84		-1.44	-0.20	-0.22	188	1.45	0.042	
PB07	1728135.18	6450212.21	197.54	-40.74	-7.55	-2.67	190	41.44		-1.82	-0.37	-0.12	191	1.86	0.035	
PB08	1728199.00	6450462.93	194.19	-38.50	-6.87	0.51	190	39.11		-1.66	-0.31	0.03	191	1.69	0.035	
PB09	1728245.34	6450848.65	188.99	-43.24	-2.37	-3.53	183	43.30		-2.01	-0.13	-0.25	184	2.01	0.036	
PB12	1728257.11	6451584.30	184.73	-73.38	-20.27	-8.56	195	76.13		-3.39	-0.99	-0.57	196	3.53	0.037	
PB13	1728043.37	6452148.28	206.76	-42.60	-16.06	-3.78	201	45.53		-2.10	-0.89	-0.11	203	2.28	0.030	
PB18	1730430.95	6450719.94	363.04	-15.94	8.95	-4.54	151	18.28		-0.30	0.06	-0.06	169	0.30	0.033	
PB20	1728743.25	6451124.73	232.60	-69.51	-10.95	-10.95	189	70.37		-3.06	-0.60	-0.60	191	3.12	0.042	
PB21	1729242.22	6451178.53	272.35	-55.99	6.48	-7.67	173	56.37		-2.22	0.18	-0.25	175	2.23	0.041	
PB25	1729670.41	6451986.30	326.01	-31.90	0.65	-2.98	179	31.91		-0.27	-0.06	0.01	193	0.28	0.029	
PB26	1729538.62	6452252.15	282.96	-24.02	2.59	-2.38	174	24.16		-0.23	-0.02	-0.03	184	0.23	0.044	
PB27	1729245.47	6451842.40	271.66	-93.87	6.34	-12.76	176	94.09		-3.65	0.09	-0.51	179	3.65	0.062	
PB29	1728842.25	6452093.51	170.88	-46.69	-26.98	-15.05	210	53.93		-2.28	-1.02	-0.71	204	2.49	0.039	
PB53	1729217.92	6450754.81	290.10	-34.85	0.89	-7.65	179	34.86		-1.89	0.10	-0.57	177	1.89	0.047	
PB54	1729690.83	6450448.49	357.73	-4.07	-0.20	-0.89	183	4.09		-0.21	-0.06	0.00	197	0.22	0.029	
PB55	1728775.28	6450801.26	239.73	-37.00	-2.78	-6.60	184	37.11		-2.08	-0.19	-0.45	185	2.09	0.039	
PB59	1727758.34	6448659.68	159.21	-8.02	-1.99	-4.18	194	8.27		-1.04	-0.30	-0.48	196	1.09	0.040	
PB64	1727417.65	6450937.67	67.14	-48.64	-9.27	-5.62	191	49.51		-21.39	-4.40	-2.55	192	21.83	0.038	
PB65	1728454.34	6449707.76	287.70	-0.32	-0.06	-0.05	191	0.33		-0.32	-0.06	-0.05	191	0.33	0.025	
UB02	1727519.20	6450142.56	62.65	61.91	0.70	1.51	172	62.53		-1.57	0.44	-0.10	172	1.60	0.039	

Prepared by McGee Surveying Consulting - Document Date: 9/30/2013

Monitoring Point Movements

Notes:

* Indicates no signal of horizontal movement detected in the last period

	Sept. 14, 2012 Positions			Overall Movements (US Feet)						Periodic (11.4 months) Movements (US Feet)						
	NAD83 SPC Zone 5 (ft)		NAVD88	Original Position to Sept. 14, 2012						Oct. 03, 2011 Position to Sept. 14, 2012						
Point	North (ft)	East (ft)	Elev(ft)	North	East	Height	Azim.*	Dist.	Year	North	East	Height	Azim.*	Dist.	95%Error	Note
AB01	1729427.54	6445709.59	178.54	-0.04	-0.02	-0.08	209	0.05	1994	-0.01	0.00	0.04	180	0.01	0.025	*
AB02	1726946.97	6447968.68	116.47	-0.01	-0.01	-0.01	221	0.01	2007	0.00	-0.02	0.02	270	0.02	0.015	*
AB04	1728389.97	6447121.52	67.21	-2.02	-1.82	-0.36	222	2.72	1994	-0.07	-0.07	-0.01	223	0.10	0.020	
AB05	1728074.51	6447643.66	80.50	-1.21	-1.51	-0.40	231	1.93	1994	-0.06	-0.06	0.01	225	0.09	0.020	
AB12	1729415.22	6448271.10	283.19	-1.27	-0.55	-0.24	203	1.38	1994	-0.06	-0.03	0.01	203	0.07	0.022	
AB13	1729927.91	6448235.78	364.47	-0.99	-0.25	-0.56	194	1.02	1994	-0.05	-0.01	-0.03	188	0.06	0.030	
AB15	1730311.31	6448099.25	396.83	-0.77	-0.13	-0.45	190	0.78	1994	-0.05	0.00	-0.04	183	0.05	0.028	
AB16	1730358.55	6447532.13	376.41	-0.33	0.01	-0.21	179	0.33	1994	0.00	-0.02	-0.03	281	0.02	0.025	*
AB17	1731421.09	6446727.75	442.80	-0.03	-0.02	0.00	219	0.04	2007	0.00	0.01	0.01	72	0.01	0.033	*
AB18	1731602.11	6448187.62	456.86	-0.52	0.13	-0.33	166	0.53	1994	-0.05	0.00	0.02	181	0.05	0.030	
AB20	1729359.49	6449685.87	396.22	-1.13	-0.39	-0.21	199	1.20	1995	-0.07	-0.02	-0.01	194	0.07	0.020	
AB24	1729829.45	6447759.65	335.75	-0.91	-0.31	-0.17	199	0.96	1997	-0.07	-0.04	-0.03	206	0.08	0.018	
AB50	1728084.54	6448247.22	182.03	-0.46	-0.96	0.05	244	1.07	1998	-0.02	-0.05	0.01	246	0.05	0.020	
AB51	1729616.41	6447306.43	305.16	-0.60	-0.11	-0.26	191	0.61	2002	-0.05	-0.02	-0.01	208	0.05	0.019	
AB52	1730015.44	6448624.25	368.33	-0.66	-0.19	-0.28	196	0.68	2002	-0.05	-0.01	-0.02	187	0.05	0.035	
AB53	1730430.28	6449712.23	352.86	-0.82	-0.14	-0.27	190	0.84	2002	-0.07	-0.01	-0.01	191	0.08	0.025	
AB54	1731111.89	6447047.88	407.38	-0.05	0.01	0.07	185	0.08	2007	-0.03	0.01	0.07	186	0.03	0.038	*
AB56	1732213.96	6448545.55	571.57	-0.35	0.09	-0.08	165	0.36	2007	-0.04	0.00	0.00	173	0.04	0.021	
AB57	1731926.47	6449759.45	564.78	-0.43	0.09	-0.15	169	0.44	2007	-0.06	-0.01	-0.04	187	0.06	0.022	
AB58	1731117.59	6449074.92	405.65	-0.43	-0.01	-0.02	181	0.43	2007	-0.08	-0.01	0.01	190	0.08	0.036	
AB59	1730850.31	6450212.50	434.26	-0.55	-0.06	-0.11	186	0.56	2007	-0.08	-0.01	-0.02	187	0.09	0.025	
AB60	1729089.34	6447987.41	179.37	-0.36	-0.16	-0.08	204	0.39	2007	-0.04	-0.04	-0.02	226	0.06	0.017	
AB61	1727424.49	6447990.26	140.45	-0.01	0.01	-0.02	145	0.01	2007	0.01	0.01	0.02	29	0.01	0.006	*
AB62	1728910.29	6446925.43	143.02	-0.06	-0.03	0.01	206	0.07	2011	-0.06	-0.03	0.01	206	0.07	0.017	
AB63	1729059.24	6447306.99	180.82	-0.06	-0.04	-0.02	214	0.07	2011	-0.06	-0.04	-0.02	214	0.07	0.016	
AB64	1731830.69	6447373.08	532.25	Replacement for AB54					2012							
AB65	1731705.67	6448264.07	458.53	Replacement for AB18					2012							
AB66	1730047.29	6448490.53	374.28	Replacement for AB52					2012							
AB67	1731180.41	6447741.76	405.33	Replacement for AB55					2012							
AB68	1730258.86	6448055.37	393.45	Replacement for AB15					2012							
BB52	1726995.94	6451384.30	3.87	-0.42	-0.08	0.04	191	0.43	2007	-0.04	-0.03	-0.02	214	0.05	0.026	
CR07	1731627.96	6451203.36	632.17	-0.82	0.17	-1.11	168	0.84	1994	-0.04	0.02	-0.09	153	0.05	0.030	
CR50	1733013.60	6451037.36	872.62	-0.02	-0.01	-0.04	218	0.02	1998	0.01	-0.01	-0.03	336	0.01	0.027	*
CR51	1733062.00	6452361.87	976.15	-0.03	0.01	-0.10	162	0.03	1998	0.01	0.00	-0.03	0	0.01	0.024	*
CR52	1732867.50	6450239.27	779.60	-0.08	-0.05	-0.03	212	0.09	1998	-0.03	0.01	-0.08	161	0.03	0.057	*
CR53	1732780.28	6450224.19	780.72	Replacement for CR52					2012							
FT06	1729854.97	6452760.07	488.72	-0.64	-0.14	-0.34	192	0.65	2007	-0.08	-0.01	-0.07	190	0.08	0.023	
FT07	1729252.18	6454103.12	588.67	-1.06	-1.63	-0.34	237	1.95	2007	-0.15	-0.21	-0.05	235	0.26	0.022	
FT08	1729388.67	6453350.49	658.44	-0.02	-0.01	-0.01	219	0.02	2007	-0.01	0.01	-0.01	122	0.01	0.018	*
KC01	1728475.91	6452457.65	312.34	-0.87	-0.58	-0.54	213	1.05	1994	-0.07	-0.03	-0.01	205	0.08	0.024	
KC02	1727002.51	6452118.83	13.73	-0.39	-0.16	-0.11	203	0.42	1995	-0.04	0.00	0.00	185	0.04	0.017	
KC04	1727559.28	6452666.96	238.43	-0.29	-0.28	-0.41	225	0.40	1995	-0.04	0.00	-0.03	178	0.04	0.024	
KC05	1727081.89	6453178.89	227.49	-0.11	-0.20	-0.37	242	0.23	1994	-0.03	-0.01	0.02	196	0.03	0.021	
KC06	1727784.85	6453396.22	299.88	-0.06	-0.45	-0.47	263	0.45	1994	-0.04	-0.04	0.00	228	0.06	0.023	
KC07	1727759.39	6453683.85	313.49	0.20	-0.06	-0.34	342	0.21	1994	0.00	-0.01	0.01	278	0.01	0.025	*
KC13	1726581.02	6453069.58	191.10	-0.14	-0.05	-0.10	201	0.15	2007	-0.03	0.00	-0.03	182	0.03	0.025	
KC14	1726742.42	6453805.98	259.91	-0.02	-0.07	-0.03	252	0.08	2007	-0.03	-0.02	-0.01	224	0.03	0.024	
KC15	1727590.32	6453120.95	287.06	-0.13	-0.14	-0.04	227	0.20	2007	-0.02	-0.02	0.00	216	0.03	0.018	
KC16	1727602.23	6454098.23	326.87	-0.01	0.00	-0.03	180	0.01	2007	0.00	0.01	-0.01	113	0.01	0.025	*
KC17	1727302.76	6453026.42	215.25	Replacement for KC04					2012							
PB04	1727664.82	6448848.57	166.81	-11.12	-3.17	-3.71	196	11.56	1994	-0.41	-0.09	-0.12	192	0.42	0.036	
PB06	1727934.92	6449758.07	177.24	-33.52	-3.77	-5.82	186	33.73	1995	-0.89	-0.09	-0.12	186	0.90	0.035	
PB07	1728134.07	6450211.98	197.49	-41.85	-7.78	-2.72	191	42.57	1995	-1.11	-0.23	-0.05	192	1.13	0.028	
PB08	1728197.95	6450462.75	194.24	-39.56	-7.05	0.56	190	40.18	1994	-1.05	-0.18	0.05	190	1.07	0.027	
PB09	1728244.01	6450848.59	188.79	-44.57	-2.44	-3.74	183	44.64	1994	-1.33	-0.07	-0.20	183	1.33	0.029	
PB12	1728254.64	6451583.54	184.21	-75.85	-21.03	-9.08	195	78.71	1994	-2.47	-0.76	-0.53	197	2.59	0.031	
PB13	1728041.82	6452147.64	206.67	-44.15	-16.70	-3.87	201	47.20	1995	-1.55	-0.64	-0.10	202	1.67	0.023	
PB18	1730430.87	6450719.92	363.01	-16.01	8.93	-4.57	151	18.33	1995	-0.07	-0.02	-0.03	197	0.08	0.030	
PB20	1728741.10	6451124.30	232.16	-71.67	-11.38	-11.38	189	72.56	1995	-2.15	-0.43	-0.44	191	2.20	0.028	
PB21	1729240.85	6451178.60	272.17	-57.37	6.55	-7.85	173	57.74	1995	-1.38	0.07	-0.18	177	1.38	0.034	
PB25	1729670.31	6451986.28	325.97	-32.00	0.63	-3.02	179	32.01	1994	-0.10	-0.02	-0.04	192	0.10	0.026	
PB26	1729538.54	6452252.11	282.93	-24.11	2.55	-2.41	174	24.24	1995	-0.09	-0.03	-0.03	202	0.09	0.039	
PB27	1729242.88	6451842.42	271.21	-96.46	6.36	-13.21	176	96.67	1995	-2.58	0.02	-0.45	180	2.58	0.058	
PB29	1728840.65	6452092.79	170.41	-48.30	-27.70	-15.52	210	55.67	1995	-1.60	-0.72	-0.48	204	1.76	0.030	
PB53	1729216.82	6450754.85	289.90	-35.95	0.93	-7.85	179	35.96	1997	-1.10	0.04	-0.20	178	1.10	0.048	
PB54	1729690.75	6450448.48	357.70	-4.15	-0.21	-0.92	183	4.15	1997	-0.07	-0.01	-0.02	191	0.08	0.024	
PB55	1728774.00	6450801.18	239.55	-38.28	-2.86	-6.78	184	38.39	1998	-1.28	-0.08	-0.18	183	1.28	0.029	
PB59	1727757.70	6448659.52	158.92	-8.66	-2.15	-4.47	194	8.93	2001	-0.64	-0.16	-0.29	194	0.66	0.033	
PB64	1727394.56	6450932.96	63.68	-71.73	-13.99	-9.08	191	73.08	2009	-23.09	-4.72	-3.46	192	23.57	0.032	
PB65	1728454.20	6449707.73	207.69	-0.47	-0.09	-0.06	191	0.47	2010	-0.14	-0.03	-0.01	191	0.14	0.021	
PB66	1729197.65	6450969.92	288.33	Replacement for PB53					2012							
UB02	1727517.18	6450142.82	62.66	-63.94	9.03	-4.49	172	64.57	1997	-2.02	0.26	0.01	173	2.04	0.034	

PORTUGUESE POINT LANDSLIDE MONITORING - FULL DATA POSTING as of April 18, 2013
Prepared by McGee Surveying Consulting - Document Date: 9/30/2013 Rev.03/05/14
Monitoring Point Movements
PARTIAL MID-YEAR MONITORING

Notes:
* Indicates no signal of horizontal movement detected in the last period at the 95% level of confidence
\# Revised 03/05/14

	April 18, 2013 Positions			Overall Movements (US Feet)						Periodic (7.1 months) Movements (US Feet)						
	NAD83 SPC Zone 5 (Ft)		NAVD88 #	Original Position to April 18, 2013						Sept. 14, 2012 Position to April 18, 2013						
Point	North (ft)	East (ft)	Elev(ft)	North	East	Ht #	Azim.°	Dist.	Year	North	East	Ht #	Azim.°	Dist.	95%Error	Note
AB04	1728389.95	6447121.48	67.17	-2.04	-1.86	-0.40	222	2.76	1994	-0.02	-0.04	-0.04	246	0.04	0.01	
AB12	1729415.20	6448271.07	283.17	-1.29	-0.58	-0.26	204	1.41	1994	-0.02	-0.03	-0.02	232	0.03	0.01	
AB16	1730358.57	6447532.13	376.44	-0.32	0.01	-0.18	178	0.32	1994	0.01	0.00	0.02	8	0.02	0.02	*
AB17	1731421.09	6446727.75	442.78	-0.03	-0.02	-0.02	219	0.03	2007	0.00	0.00	-0.02	45	0.00	0.01	*
AB20	1729359.43	6449685.84	396.21	-1.19	-0.42	-0.22	200	1.26	1995	-0.06	-0.03	-0.01	205	0.07	0.01	
AB50	1728084.51	6448247.18	182.00	-0.49	-1.01	0.02	244	1.12	1998	-0.03	-0.04	-0.03	236	0.05	0.01	
AB59	1730850.25	6450212.49	434.24	-0.62	-0.07	-0.13	186	0.62	2007	-0.06	-0.01	-0.01	192	0.07	0.01	
AB60	1729089.33	6447987.40	179.32	-0.37	-0.17	-0.13	204	0.41	2007	-0.02	-0.01	-0.05	215	0.02	0.01	
AB61	1727424.49	6447990.26	140.41	-0.01	0.00	-0.06	135	0.01	2007	0.00	0.00	-0.04	338	0.01	0.00	*
AB65	1731705.66	6448264.06	458.53	-0.01	0.00	-0.01	194	0.01	2012	-0.01	0.00	-0.01	194	0.01	0.02	*
CR07	1731627.92	6451203.36	632.18	-0.86	0.17	-1.10	169	0.87	1994	-0.04	0.00	0.01	183	0.04	0.02	
CR50	1733013.59	6451037.36	872.66	-0.02	-0.01	0.00	214	0.03	1998	0.00	0.00	0.05	194	0.00	0.01	*
FT06	1729854.91	6452760.05	488.68	-0.70	-0.16	-0.38	193	0.72	2007	-0.06	-0.02	-0.04	201	0.07	0.01	
FT07	1729252.14	6454103.03	588.65	-1.10	-1.72	-0.36	237	2.04	2007	-0.04	-0.09	-0.02	246	0.10	0.02	
KC06	1727784.86	6453396.20	299.84	-0.05	-0.47	-0.51	264	0.47	1994	0.00	-0.02	-0.04	284	0.02	0.01	
KC07	1727759.41	6453683.87	313.46	0.22	-0.05	-0.37	346	0.23	1994	0.02	0.01	-0.02	31	0.02	0.01	
KC13	1726581.02	6453069.56	191.09	-0.14	-0.07	-0.11	208	0.16	2007	0.00	-0.02	-0.02	276	0.02	0.01	
KC16	1727602.23	6454098.23	326.88	-0.02	0.00	-0.02	188	0.02	2007	0.00	0.00	0.01	243	0.00	0.01	*
KC17	1727302.74	6453026.40	215.23	-0.02	-0.02	-0.02	229	0.03	2012	-0.02	-0.02	-0.02	229	0.03	0.01	
PB04	1727664.58	6448848.49	166.69	-11.36	-3.25	-3.83	196	11.82	1994	-0.24	-0.08	-0.12	198	0.25	0.02	
PB12	1728253.25	6451583.09	183.84	-77.23	-21.48	-9.45	196	80.17	1994	-1.39	-0.45	-0.37	198	1.46	0.01	
PB13	1728040.95	6452147.25	206.54	-45.02	-17.10	-4.00	201	48.16	1995	-0.87	-0.39	-0.13	204	0.95	0.02	
PB18	1730430.79	6450719.89	362.96	-16.09	8.89	-4.62	151	18.39	1995	-0.08	-0.03	-0.05	200	0.09	0.02	
PB26	1729538.46	6452252.09	282.90	-24.18	2.53	-2.44	174	24.32	1995	-0.07	-0.02	-0.03	197	0.08	0.01	
PB59	1727757.34	6448659.41	158.71	-9.03	-2.25	-4.68	194	9.30	2001	-0.36	-0.11	-0.21	197	0.38	0.07	
PB64	1727382.15	6450930.51	60.16	-84.14	-16.44	-12.60	191	85.73	2009	-12.41	-2.45	-3.53	191	12.65	0.02	
PB66	1729197.003	6450969.91	288.22	-0.64	-0.01	-0.10	181	0.64	2012	-0.64	-0.01	-0.10	181	0.64	0.01	

Survey Report
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Client: City of Rancho Palos Verdes;
Surveyed by: McGee Surveying Consulting
Project Name: Portuguese Bend Landslide Monitoring Program
Location: City of Rancho Palos Verdes, California; **County:** Los Angeles; **State:** California

PROJECT OVERVIEW:

McGee Surveying Consulting performed slide monitoring and control surveys in October 2011 at Portuguese Bend on behalf of the City of Rancho Palos Verdes. The purpose of the survey was to establish accurate positions on monitoring points to determine overall and periodic movements. The results of the survey are described in this Report and reported on spreadsheets attached hereto.

The field survey was planned, coordinated and executed by Michael McGee, PLS3945 of McGee Surveying Consulting, Santa Barbara, California. Michael McGee, PLS was responsible for the final processing of the observations, network adjustments, analysis and reports. The monitoring points cover approximately a 1½ mile square area and are measured annually or more often as necessary to determine the rate and extent of ground movement. Global Navigation Satellite System (GNSS formerly referred to as GPS) technology was used to measure positions based on the North American Datum of 1983 (NAD83) and the North American Vertical Datum of 1988 (NAVD 88) as referenced to the California CGPS (Continuous GPS) Stations in the region which are permanently mounted GNSS receivers for monitoring seismic activity. The CGPS in California are similar to the national CORS (Continuously Operated Reference Stations).

Many of the points move a few inches or less per year; therefore, the accuracy requirement is to meet a standard of one centimeter (0.033 feet) at the 95% Level of Confidence. In the active slide area where the movements approach a foot or more per year (PB and UB points in the central portion), two centimeters (0.066 feet) is sufficient. Field procedures are designed to accomplish this purpose and Quality Control-Quality Assurance (QAQC) processes discussed hereafter are incorporated to verify these accuracies are attained.

The movements reported between October 25, 2010 and October 3, 2011 (11.3 months) statistically attained an overall average accuracy of 0.03 feet at the 95% Level of Confidence. The actual accuracies of these measurements approach 0.02 feet as demonstrated by the measured vector residuals, repeatability of measurements at points considered stable, and the Deflection Analysis. Refer to the sections titled ACCURACY, DEFLECTION ANALYSIS and SUMMARY at the end of this Report for more information.

HISTORY

This survey is a continuation of a monitoring survey program initiated by the County of Los Angeles and taken over by the City of Rancho Palos Verdes circa 1994. McGee Surveying Consulting has conducted the field surveys and reporting since September 2007. See the September 2007 Survey Report for a detailed history of the previous survey process between 1994 and 2007. See the subsequent Survey Reports for the December 2008, November 2009 and October 2010 campaigns.

PROJECT DATUMS, REFERENCE SYSTEM

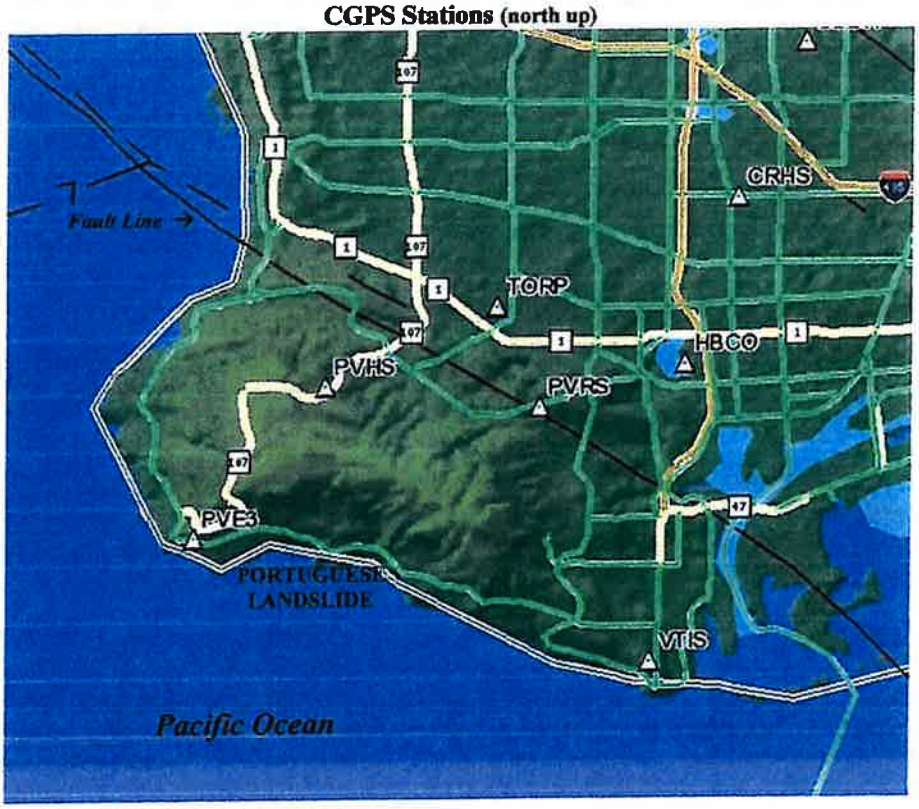
Horizontal Datum: North American Datum of 1983 (NAD83) established by the National Geodetic Survey (NGS); **Epoch:** 2007.00 referred to as NAD83(2007.00).; **Units:** Feet

Reference Network: The survey is referenced to the CGPS Stations (continuously operating GNSS receivers) mounted on a stabile platform. For more information see NGS Data Sheets for the PID's listed below (no data sheet exists for PVE3). The positions listed below were obtained from the California Spatial Reference Center (CSRC). CSRC provides NGS sanctioned positions for the California CGPS Stations.

CGPS	Latitude (dms)	Longitude (dms)	EH (feet)	NGS PID	NAME
PVE3	33 44 35.853290	-118 24 15.269036	235.42	none	PALOS VERDES CORS
PVHS	33 46 46.020150	-118 22 19.741258	853.99	AJ1915	PENINSULA HIGH SCH
PVRS	33 46 25.891904	-118 19 14.067218	198.63	AJ1916	PALOS VERDES RES
VTIS	33 42 45.489584	-118 17 37.712290	197.52	AJ1936	MARINE EXCHANGE

Note: PVRS falls in the proximity of a Fault Line as shown below but appears unaffected to date

CGPS Stations (north up)



Vertical Datum: North American Vertical Datum of 1988 (NAVD88) established by the NGS
Geoid Model: Geoid 03; note Geoid09 became available from the NGS in late 2009; however, Geoid03 is retained to be consistent with prior reported heights and the purpose of determining relative changes.

Reference Network: CGPS Station VTIS is also a Second Order leveled benchmark and the basis for the published heights by this survey (see NGS Data Sheets, PID's listed above)

CGPS	NAVD 88 Ht(feet)	
PVE3	none	
PVHS	972.1	Based on a Refined Geoid Model
PVRS	316.3	Based on a Refined Geoid Model
VTIS	315.26	Based on Second Order Leveling by CSRC and original basis for this survey

Projection: NAD83 California State Plane Coordinates Zone 5: The State Plane Coordinate Parameters follow. The average Scale Factor is 1.00007543, the Ellipsoid Height Reduction Factor based on the average ellipsoid heights is 0.99999092, and the average Combined Grid Factor is 1.00006635. Distances in this survey are grid. To obtain ground distances divide grid distances by the Combined Grid Factor. Grid bearings resulting from this survey must be rotated by a Convergence Angle to obtain geodetic (true) bearings. The average convergence angle is -0-12-30± (rotate left 0-12-30).

Datum Stability: The NAD83, 2007.00 Epoch adjustment is one of a series of adjustments of NAD83 since its adoption in 1986 and is the datum used for the monitoring surveys since 2007. Rancho Palos Verdes sits on the Pacific Plate which is moving west-northwesterly relative to the North American Plate about 4 centimeters (0.14 feet) per year. The area southwesterly of the Fault Line shown on the above map includes the City and is moving at a constant rate as exhibited by the N, E, Up velocities of the CGPS Stations listed below. These CGPS Stations provide a rigid reference frame for the Portuguese Landslide Monitoring Program that is validated during each monitoring campaign. See the Adjustment results on Page 8 and the September 2007 Monitoring Survey Report by McGee Surveying Consulting for additional information.

Annual Velocities in Feet
Reference Epoch 2011.55

CGPS	North	East	Up
PVE3	0.065	-0.130	-0.003
PVHS	0.064	-0.129	-0.005
PVRS	0.063	-0.129	0.000
VTIS	0.065	-0.129	-0.002

FIELD SURVEYS, DATA COLLECTION, EQUIPMENT & PROCESSING

Sixty-nine monitoring points were occupied and reported in this October 2011 survey. Site photographs and recovery sheets detailing the location, character of the monuments and obstructions were updated. See the Appendix for "Monitoring Point Status as of October 2011"

Monument AB61 was established in September 2007 on Portuguese Point and is used as the primary base station for Monitoring Surveys. The location is secured behind a locked gate, has a mostly clear horizon above 10 degrees, and sits on a stable basalt geological formation. A 5/8" x 2' rebar with a plastic cap and tack named "AB61ECC" was set for a reference monument on 10/23/2010 to test local stability of AB61.

The field survey commenced each day by setting a GNSS receiver on a fixed height pole on AB61 while two GNSS receivers roamed freely collecting observations on fixed height poles at 68 on-site points. Many of the points are over-shadowed by mature trees and shrubberies which interfere with signals received from satellites and can affect the quality of measurements. To obtain the best possible accuracies, the satellite constellation is compared with obstruction diagrams to estimate the best time for observing a point. On site, those satellites obstructed by foliage and trees are either turned off or noted for removal in post-processing. If 5 or more un-obstructed satellites with a GDOP (measure of the geometry of the constellation) of 4 or less are available, then the measurement commenced for a minimum of 10 minutes of data collection. If the geometry and number of

satellites are insufficient then the receiver is moved to the next point and returned later when satellite availability improves. This process is followed until all points are occupied twice under a different constellation of satellites on a different day. If the two measurements are within 0.03 feet in slow movement areas or 0.06 feet in active slide areas, then they are accepted, otherwise a third measurement is obtained.

Three Leica geodetic GNSS receivers and antennas listed below were utilized to collect, and store satellite signal data. Three, 2 meter fixed height poles were used at the base station and for the observations of the monitoring points. Prior to initiating the field observations a calibration of the fixed height poles was conducted with a theodolite to verify their height and plumb. The top of the poles were found to be plumb within 0.002 feet of the bottom consistent with prior years. Additional checks were made each day. There were no equipment failures.

GNSS Survey Parameters:

Date of Field Surveys: 10/01/11 to 10/06/11 (10/03/2011 mean date) 0600-1800 PDST (+7 hrs for UTC).
Constellation: 30 NAVSTAR GPS satellites and 23 GLONASS satellites.
Observables: L1 & L2 Carrier Waves and Codes
Epoch Rate & Occupation Times: 10 seconds for 10-15 minutes and 4-11 hours for CGPS connections.
Minimum Satellites: 11; GDOP < 4 ; Elevation Mask for Data Collection and Processing: 15 degrees;
Ephemeris: Rapid for Static Post-Processing for CGPS connections and Broadcast for on site.
Weather conditions: Generally clear skies and mild temperatures.
Space Weather: Boulder K Index was 1-3 on a scale of 0-9 (<5 preferred) which gauges ionospheric activity.
Equipment:
GNSS Base Receiver Unit No.: M5, Operator: M. McGee, PLS; Station Identification: AB61 (Base)
Make & Model: Leica GS15; Antenna Leica GS15; Mount: Fixed Height Pole #2; Antenna Height: 2.086m
GNSS Rover Receiver Unit No.: M6, Operator: M. McGee, PLS;
Make & Model: Leica GS15; Antenna Leica GS15; Mount: Fixed Height Pole #1; Antenna Height: 2.087m
GNSS Rover Receiver Unit No.: M7, Operator: R. Reese, PLS,
Make & Model: Leica GS15; Antenna Leica GS15; Mount: Fixed Height Pole #3; Antenna Height: 2.085m

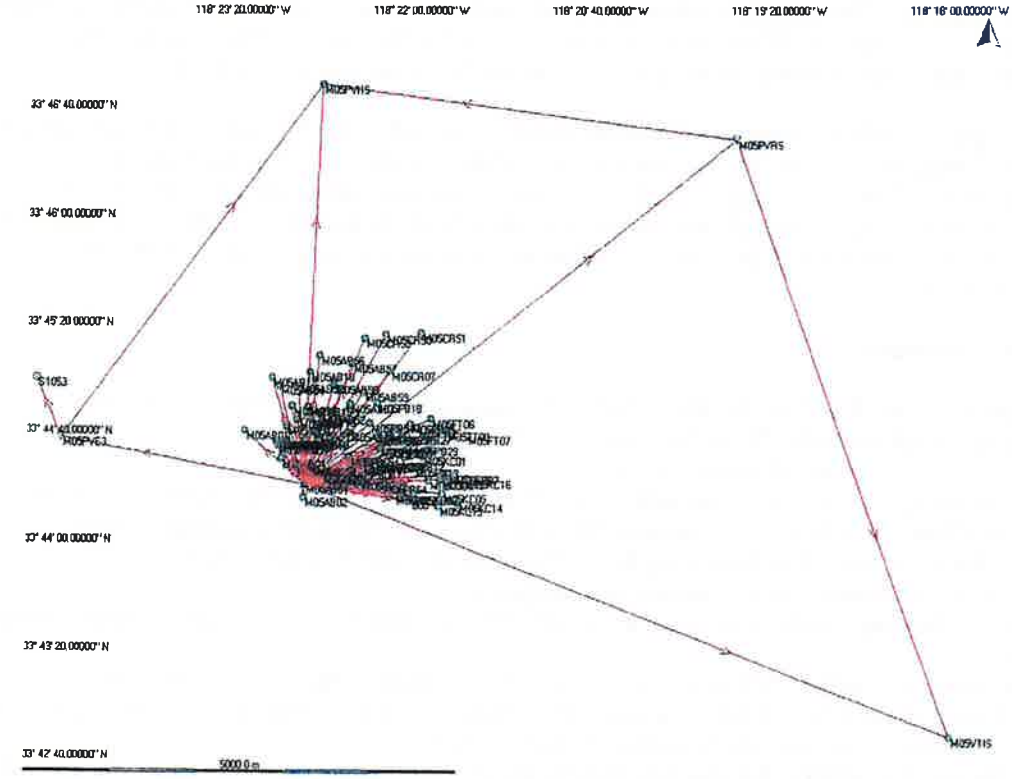
Vectors were processed using Leica LGO v8.1 post processing software. Analysis of residuals led to the rejection of 7 out of 37 vectors connecting the CGPS Stations and AB61, and 3 out of 129 vectors connecting monitoring points. Network adjustments and analysis were performed with "Starnet-PRO" version 6.0 software. Rinex files of the satellite measurements for the CGPS Stations were downloaded from the SOPAC website. The Rapid Ephemeris and Absolute Antenna Models were downloaded from the NGS website. The Absolute Antenna Models recently published by the NGS replaced the Relative Models used in previous years and were used for the first time in the processing of vectors.

NETWORK

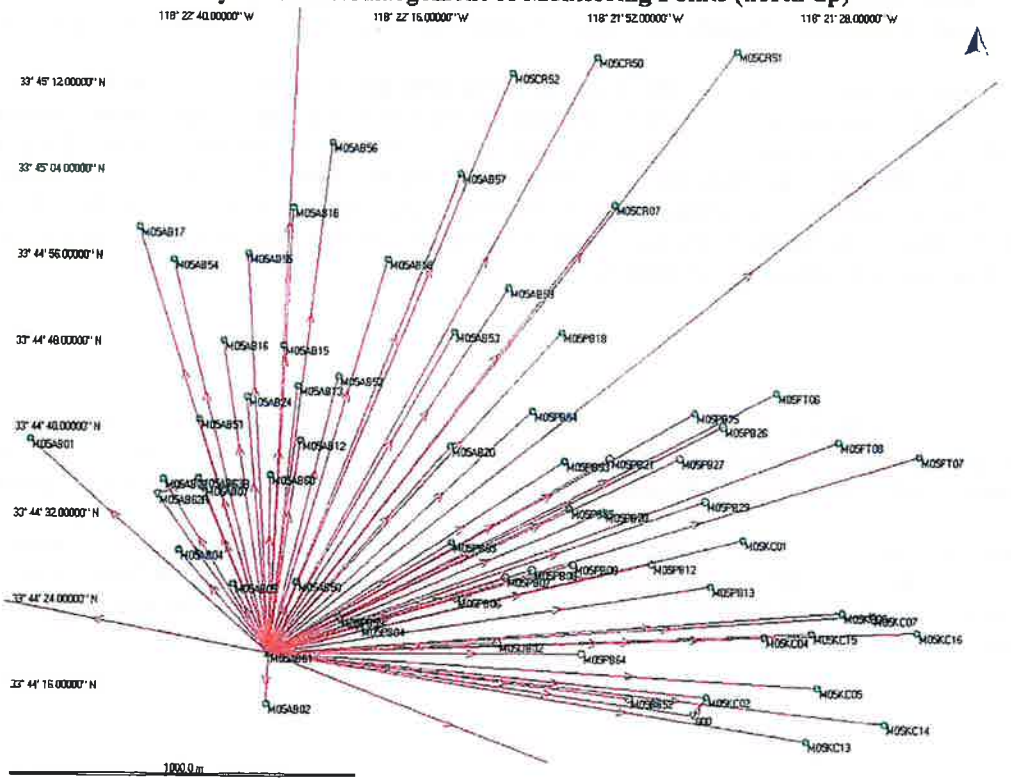
AB61, the primary Base Station, sits on Portuguese Point and is the focal point of the static network connecting the monitoring points and CGPS Stations. Sixty-nine on site points and 4 CGPS Stations were connected with 77 vectors measured 1-3 times. See the Network Maps on the next page and the Aerial View in the Appendix.

The monitoring plan uses the four CGPS Stations to verify the stability of the reference frame. The primary station is CGPS Station PVE3 located near City Hall 1.8 miles west-northwest of the on-site Base Station AB61. CGPS Station PVHS is 2.8 miles north, PVRS is 3.9 miles northeast, and VTIS is 4.9 miles east-southeast of AB61 as shown on the Network diagram.

Survey Network with CGPS Stations (north up)



Survey Network Enlargement of Monitoring Points (north up)



MONITORING POINT STATUS

For data management purposes during the field survey and data processing, the point names were prefixed with "M05" to distinguish between different monitoring surveys i.e. AB61 was named M05AB61. M05 indicates this survey is the fifth monitoring since the initial September 2007 Monitoring Survey. The prefix is stripped in the final Report. In the initial 2007 survey, the field and office procedures were modified to increase the accuracy and reliability of measurements and provide for queries between epochs that include statistical information about the precisions of the reported movements.

Between 1994 and 2006, 149 monitoring points were established to monitor Portuguese Bend Slides, many of which are lost or destroyed. Sixty of the original points were recovered in 2007. Eight of the 60 points were deleted because they were in close proximity of other points better suited for GNSS leaving 52 points monitored and reported between September 2006 and September 2007. Three of the 52 points (AB09, KC11, PB51) were monitored in September 2007 for the last time because they were replaced by new points, set nearby and better suited for satellite observations. Eighteen new points set in 2007 had their movements reported for the first time in the December 2008 survey. In December 2008, 49 original and 18 new points were surveyed for a total of 67 monitoring points.

In the September 2007 Report, it was noted that KC01 was previously reported by others on 9/14/2006 to have moved N 29°E 1.24' from its 12/9/2005 position. In the 2008 survey, a buried partially illegible brass cap in concrete stamped "COUNTY ENGINEER RE8869 1956 STA ??IELDS" was found S31°29'W 1.48 feet from the 1" IP that was found and used in the initial September 2007 and subsequent surveys. The original 1994 position of KC01 was adjusted to be consistent with the 1" IP, resulting in correct overall reported movements.

In the December 2008 Report, it was noted that AB05 had been disturbed by a mowing machine. AB05 was found chipped and leaning to southerly about 0.4'. The movement reporting resumed in 2009. Analysis of the movement and historic data made it possible to estimate the disturbance to within 0.05'. The original 1995 position of AB05 was adjusted S14°02'E 0.29' to be consistent with the disturbed position, resulting in correct overall reported movements.

In 2009, a new point PB64 was set on the east of the Archery Range to replace PB63 (set 2007) which had became unsafe to access was lost sometime in 2010. PB64 was reported for the first time in October 2010.

In 2010, points AB03 and BB25 were discontinued for the following reasons. AB03 is 192 feet west-southwest of AB61 on the edge of a cliff, and BB25 is on an unstable rock affected by the surf. In the summer of 2010, PB62 was destroyed by road construction. In October 2010, PB65 was set 24' south-southwest of PB62. Movement of PB65 is reported for the first time in October 2011. The following points may have been disturbed as of October 2010. AB05 appears to have been disturbed by mower machinery, AB15 (½" GIP in a meter box) is being driven over by vehicles occasionally accessing an adjacent field, and KC02 (½" GIP in a meter box) is occasionally parked on by vehicles occasionally accessing an adjacent field. Raising the boxes at AB15 and KC02 will eliminate this problem.

In October 2011, new temporary reference points named AB62R to replace AB06 and AB63R to replace AB07 were set. AB06 and AB07 will be discontinued due to their location within the traveled way of Palos Verde Drive South. A deep set permanent monument will be constructed in 2012 near AB62R and AB63R and the positions will be transferred.

The present list and status of monitored points is provided in the Appendix under "Monitoring Point Status as of October 2011".

ADJUSTMENTS & ANALYSIS

Adjustment 1: Minimally Constrained Adjustment processed to develop Geodetic, Ellipsoid and State Plane Coordinates in NAD83 (2007.00)
Fixed Control: CGPS Station PVE3 was fixed at its published position in a Minimally Constrained Adjustment to determine latitude, longitude, ellipsoid heights, state plane coordinates, and to check the stability of other points. PVE3 located 2 miles west of the slide area has been fixed in all adjustments since 2007. The CSRC publishes a Time Series for the horizontal and vertical stability of PVE3 which indicate the position has been stable over a ten year period to date. The primary base station AB61 and three other CGPS Station's are measured relative to PVE3 and used to assess stability of the reference frame. The positions are based on 4 to 11 hour measurements collected on six days. The coordinate differences at the CGPS Stations from previous positions to the present are listed below in feet.

10/2010 Positions to 10/2011					9/2007 Positions to 10/2011			
Station	dN	dE	dZ		Station	dN	dE	dZ
PVE3	0.000	0.000	0.000	Fixed 2010	PVE3	0.000	0.000	0.000
PVHS	0.004	0.004	0.001		PVHS	-0.001	0.010	0.012
PVRS	0.004	0.004	0.017		PVRS	-0.003	0.013	0.024
VTIS	0.004	0.006	0.019		VTIS	-0.001	0.010	0.018
AB61	-0.002	-0.010	-0.037	Base Station	AB61	-0.022	0.001	-0.032

In regard to the stability of the reference frame, the following is noted: (1) the two dimensional (2D) differences from the October 25, 2010 to the October 3, 2011 measured positions of the three free CGPS Stations range 0.006 to 0.007 feet and 0.010 feet at AB61, (2) the 2D differences of the CGPS Stations since the initial 2007 survey to the present, range 0.010 to 0.013 feet and 0.022 feet at AB61, (3) the CGPS, points AB54, AB61, CR50, KC07 and KC16 have a stable history and comparing their previous positions with this survey indicates repeatable stability at less than 0.02 feet as listed in the attached "FULL DATA POSTING".

The survey reference frame is deemed stable and successfully recovered at the level indicated. An adjustment constrained to the CGPS Stations is not necessary because the purpose here is to track their relative positions over time to test the stability of the reference frame. See the attached file "COORDINATE LIST–October 3, 2011" for a list of coordinates resulting from this adjustment. See prior Reports for coordinates resulting from earlier surveys.

Adjustment 2: Minimally Constrained Adjustment processed to develop Orthometric Heights (Elevations) in NAVD88
Fixed Control: The CGPS Station PVE3 was fixed horizontally and vertically at its NAVD88 orthometric height determined in the September 2007 survey. The 2007 height was based on the published 2nd Order NAVD88 Height of CGPS Station VTIS. This Adjustment combined the measured ellipsoid height differences with the NGS Geoid 03 (models the separation between the ellipsoid and geoid surfaces) to determine NAVD88 orthometric heights of other CGPS Stations and the monitoring points. The differences from prior surveys to the heights determined in the present survey are listed below in feet.

10/2010 to 10/2011			9/2007 to 10/2010	
PVE3	0.000	Fixed	PVE3	0.000
PVHS	0.001		PVHS	0.009
PVRS	0.017		PVRS	0.028
VTIS	0.018		VTIS	0.016

Note: This survey's measurements from PVE3 to VTIS check the 2010 height +0.018 feet and the 2007 survey +0.016 feet both very acceptable for GNSS considering the distance. The NGS Benchmark S1053 located at the intersection of Rancho Palos Verdes South with Hawthorne Blvd. was measured on another survey and found -0.016 feet from its records position validating the height of VTIS and the use of the Geoid03 Model. See the attached file "COORDINATE LIST-Oct 2011 Survey" for a list of heights resulting from this survey.

ACCURACY

These surveys conform to the intent of the Federal Geodetic Control Subcommittee (FGCS) "Specifications for GPS Relative Positioning" (1988) and the California Geodetic Control Committee (CGCC) "Specifications for High-Production GPS Surveying Techniques" (1993). The vector residuals at each point and the closures on stable control points discussed in "Adjustment 1" are good indications of the accuracies obtained by this survey

Vector Residuals: The two dimensional vector residuals and the absolute value of the vertical residuals resulting from Adjustment #1 are listed below in feet.

	Two Dimensional Residuals			Vertical Residuals (absolute values)		
	Average	Std.Dev.	Maximum	Average	Std.Dev.	Range
Monitoring Pts	0.009	0.007	0.036	0.011	0.011	-0.04 to +0.04
CGPS Stations	0.006	0.004	0.018	0.013	0.011	-0.03 to +0.04

Vector Accuracy: The lengths, precisions and relative distance errors resulting from the adjustment at the 95% Level of Confidence for the vectors (baselines) are listed below in feet.

	Lengths		PPM Precisions		Relative Dist.Error		
	Vary	Average	Vary	Average	Average	Maximum	Precision
Monitoring Pts	192-7134	3468	2.2-108	9.0 ppm	0.019	0.034	1: 183,000
CGPS Stations	9396-26103	18842	0.2-0.4	0.3 ppm	0.005	0.006	1:3,768,000

The precision ratio based on the averages for the vectors connecting the Monitoring Points exceeds the criteria for a First Order (C-1) by a factor of 1.8, and the vectors connecting AB61 and the CGPS Stations exceeds the criteria for a B Order survey by a factor of 3.8 per the FGCS requirements for the former classification system.

Coordinate Accuracy: The Standard Deviations (68% Level of Confidence) of the coordinates derived from Adjustment #1, relative to the CGPS Station PVE3 follow in feet.

	Monitoring Point			CGPS Stations		
	North	East	Up	North	East	Up
Average Standard Deviation	0.008	0.007	0.027	0.002	0.002	0.004
Maximum Standard Deviation	0.016	0.015	0.050	0.003	0.003	0.006

Absolute Coordinate Accuracy: The network accuracy is expected to be less than 0.02 feet horizontal relative to the NAD83 Datum based on the CGPS Station PVE3 fixed in Adjustment #1.

NAVD88 Heights: The North American Vertical Datum of 1988 orthometric heights resulting from Adjustment #2 are derived from the difference in ellipsoid heights combined with the Geoid 03 model and constrained to the height of PVE3 determined in 2007 based on VTIS. The measured ellipsoid heights relative to PVE3 are expected to be within 0.03 feet but may be greater at obstructed sites. The absolute accuracy of the heights relative to the datum is dependent on the published value on the CGPS Station VTIS.

Although relative elevation accuracies can be within 0.03 feet, up until October 2011 there were no requirements for vertical accuracies. In October 2011, a preference of 0.03 foot relative vertical accuracy was instigated for the following points: AB17, AB57, CR07, CR50 and CR51.

Movement Accuracy: For the movements reported in this period, the statistical analysis of points moving 0.30 feet or less returned an average relative error at the 95% Level of Confidence of 0.029 feet with a standard deviation of 0.006 feet and a range of 0.008 to 0.047 feet. Overall, the relative error averaged 0.031 feet with a standard deviation of 0.009 feet and a range of 0.008 to 0.062 feet. No movement is considered detected unless the movement exceeds the 95% Error for individual points. See Page 5 of the attached "FULL DATA POSTING" for the estimated relative error at the 95% Level of Confidence for individual points.

QUALITY CONTROL - QUALITY ASSURANCE (QAQC) ANALYSIS

To ensure the accuracy and validity of the systems used to obtain the accuracies reported in these GNSS surveys, an independent test was made using conventional terrestrial based instruments as reported in the "QAQC ANALYSIS" section of the September 2007 Monitoring Survey Report. Comparing the results of the GNSS systems with conventional instrumentation found horizontal measurements agreed 0.01 feet on average. In November of 2011 the GNSS instruments used in this survey were calibrated on the Santa Maria National Geodetic Survey Baseline and found to agree with published values 0.003 to 0.006 feet.

To validate the radial survey method used in these surveys to position points from a single base station (AB61), independent GNSS cross connections were measured and compared with the computed inverse distances in the 2007, 2008 and 2009 surveys. The results found the two dimensional accuracy to agree 0.01 feet on average, indicating the radial method of measurements is reliable and the extra labor cost of measuring cross connection between points is not warranted. See the "QAQC ANALYSIS" section of the September 2007 and the December 2008 Monitoring Survey Reports for detailed analysis.

DEFLECTION ANALYSIS

Deflection Analysis is a method established by this surveyor to assess the consistency of the direction of movements reported year over year. Not including points in the Portuguese Bend Landslide (UB and PB points) with movements larger than 0.7 feet, analysis of deflections indicate that: AB05 and AB15 were disturbed in the previous period as noted in the 2010 Report and have resumed their previous direction of movement.

It is noted that AB12, AB51, AB58 and CR07 exhibited inconsistent movement directions in previous periods which may be normal activity for these sites. This survey reports this as a matter of information and defers to the opinion of the City Geologist for the meaning of these findings.

Excluding the above points, for the remaining 37 points the movements averaged 0.09 feet with a maximum of 0.30 feet and the average separation was 0.02 feet with a standard deviation of 0.01 feet indicating for the most part small movements are linear. Additionally, assuming that movements are linear over small distances, the separation or the deflection between the direction of the previous and present periods taken over the moved distance, is an implied indication of the accuracy of the measurements.

SUMMARY

A modernization of field procedures and processing techniques began with the initial September 2007 survey. Thereafter, temporal movements are based on a rigorous simultaneous least squares adjustment of multiple observations at two different epochs on each point. The statistical results of the October 2010 to October 2011 monitoring period shows the relative accuracy of the reported movements averaged 0.032 feet at the 95% Level of Confidence. Prior to September 2007, successive coordinate differences were used to compute movements which did not provide statistical information about the relative accuracies.

Results of the adjustment indicate the probability at the 95% level of confidence that movement (signal) has occurred at a point when the horizontal distance between two epochs is greater than the 95% Error (noise). See the "Full Data Posting" for a listing of the 95% Error estimates (ranges 0.008 to 0.062 feet). Using these criteria, 9 points have not moved and 56 points have moved. Between October 25, 2010 and October 3, 2011 (11.3 months), points in the Portuguese Bend Landslide (PB points) moved between 0.22 and 21.83 feet. Points in the Abalone Cove Landslide (AB points) west of the Portuguese Bend Landslide moved between 0.04 and 0.30 feet. Points in the Klondike Canyon (KC points) east of the Portuguese Bend Landslide moved between 0.04 and 0.16 feet. See the Contours of Horizontal Movement in the Appendix for a graphical representation of the movements across the site.

Velocity Analysis: Points moving 0.06 to 0.30 feet in the present period (11.3 month) are on average 2.5 times the movements for the previous period (11.1 months) and range 1.5 to 6 times. Points moving 0.74 to 21.83 feet (mostly PB points) in the present period are on average 1.1 times the movements for the previous period and range 0.7 to 2.7 times. This is about double the velocity for the former and half for the latter as reported in the October 2010 Report. The City Geologist should be referred to for assessment and interpretation of the movements.

See the attached "FULL DATA POSTING" spreadsheet for overall and periodic movements of each point. The movements are given in north, east and up or down as well as a vector of distance and direction relative to north. The direction is given as an azimuth in degrees where 0° is north and increases clockwise (180° is south). The overall movements are from the beginning position of each point which varies between 1994 and 2010.

The present listing and status of monitored points is provided in the Appendix under "Monitoring Point Status as of October 2011". The historical status of all monitoring points is provided in the September 2007 Survey Report. The historical 1994-2006 positions of all points are listed in the Charles Abbott Associates Inc. file "ALL POINTS MOST RECENT OBSERVED POSITION AS OF SEPTEMBER 15, 2006.xls" attached as an electronic file to the 2007 Report.

RECOMMENDATION

A program was agreed on in the 2011 Planning Meeting for the establishment or replacement of monitoring points with deep set monuments to better detect sub-surface movements. An ongoing re-location program for monuments will have long term benefits resulting in lower survey costs and a better understanding of sub-surface movements. It is proposed that monuments as deep as 10 feet be constructed with the upper 4 feet separated from surface movement. Presently, monuments are believed to be within 2-4 feet of the surface. At the recommendation and direction of Robert Douglas, Geologist, 4 monuments will be constructed in the spring of 2012. A $6500 budget has been set aside for this work. As discussed on Page 7, a temporary monument was set during the present survey about 160' south-southwest of AB06 and 90' northwest of AB07. Deep set monuments will be constructed nearby to replace the temporary monuments. Additionally, a new monument is to be set about 440' south-southeast of AB07 and a replacement monument 800' north-northeast of AB54.

Attachments: Find the following documents attached to this Report.
"FULL DATA POSTING" lists the coordinates of the initial positions and the overall and periodic movements of monitoring point since 2007 in NAD83(2007.00) State Plane Coordinates and NAVD88 Heights.
"COORDINATE LIST- October 3, 2011 Survey" current NAD83 (2007.00) Geodetic, Grid Coordinates, NAVD88 Heights of all points

SURVEYOR'S STATEMENT

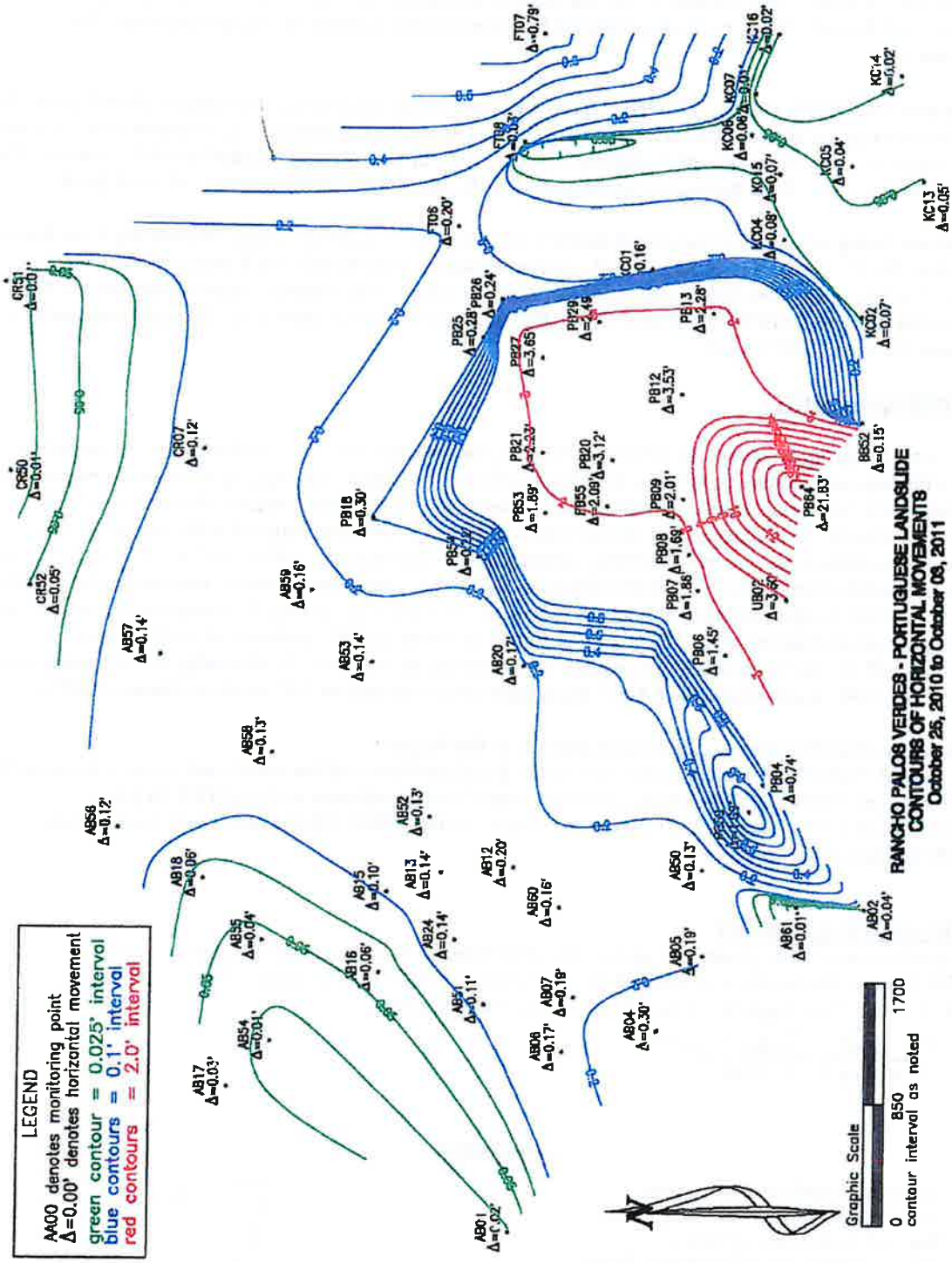
This Report on the criteria, procedures and results of the Rancho Palos Verdes Portuguese Landslide Monitoring Survey was prepared by me January 12, 2011 at the request of Ron Dragoo, Assistant City Engineer of the City of Rancho Palos Verdes.

Michael R. McGee P.L.S. 3945

APPENDIX

1- Contours of Horizontal Movements
2- Aerial Photo View of Monitoring Points
3- Regional Aerial View of Survey
4- Oblique Aerial View of Monitoring Points
5- Monitoring Point Status as of October 2011

1- Contours of Horizontal Movements (north left) Oct. 2010 to Oct. 2011 (Contours at 0.025, 0.10 and 2.00 feet providing a general visual representation of movements; see the City Geologist for interpretation of movements) (This is a general visual representation of movements; see the Full Data Posting for actual movements)



2- Aerial Photo View of Monitoring Points – (Photography Dated 03/08/2011) (north left)

3- Regional Aerial View of Monitoring Points and CGPS Stations (north up)

4- Oblique Aerial View of Monitoring Points (north up)

5- Monitoring Point Status as of October 2011

RANCHO PALOS VERDES - PORTUGUESE LAND SLIDE MONITORING							
Monitoring Point Status for 2012 Prepared 12/02/2011							
Notes:	154 Monitoring Points established since 1994						
Sep-07	71 Points Monitored: 60 old points found with 52 monitored plus 19 new points						
Dec-08	67 Points Monitored: AB09, KC11, PB51 discontinued; BB53 destroyed; AB05 disturbed						
Nov-09	68 Points Monitored: Set PB64 to replace PB63 destroyed subsequently						
Oct-10	65 Points Monitored: Discontinued AB03, BB25; set PB65 to replace PB62 destroyed by paving						
11-Oct	69 Points to Monitored: Set AB62R & AB63R to replace AB06 & AB07						
2012	67 Points to Monitor.; Discontinue AB06 & AB07; Add 2 new points AB62 & AB63						
Pt ID	**Last Obs'd**	**Comments**	**GNSS**	**Pt ID**	**Last Obs'd**	**Comments**	**GNSS**
AB01	10/3/2011	Base 1994-2006	G	**FT06**	10/3/2011		G
AB02	10/3/2011		G	**FT07**	10/3/2011		G
AB04	10/3/2011		G	**FT08**	10/3/2011		G
AB05	10/3/2011		G				
AB06	10/3/2011		G	**KC01**	10/3/2011	NE'ly of 2 pipes	G
AB07	10/3/2011		G	**KC02**	10/3/2011		G
AB12	10/3/2011		G	**KC04**	10/3/2011		G
AB13	10/3/2011		P	**KC05**	10/3/2011		G
AB15	10/3/2011		F	**KC06**	10/3/2011		G
AB16	10/3/2011		P	**KC07**	10/3/2011		G
AB17	10/3/2011		F	**KC13**	10/3/2011		G
AB18	10/3/2011		P	**KC14**	10/3/2011		G
AB20	10/3/2011	NE'ly of 2 pipes	G	**KC15**	10/3/2011		F
AB24	10/3/2011		F	**KC16**	10/3/2011		G
AB50	10/3/2011		G				
AB51	10/3/2011		G	**PB04**	10/3/2011		G
AB52	10/3/2011		P	**PB06**	10/3/2011		G
AB53	10/3/2011		F	**PB07**	10/3/2011		G
AB54	10/3/2011		P	**PB08**	10/3/2011		G
AB55	10/3/2011		G	**PB09**	10/3/2011		G
AB56	10/3/2011		F	**PB12**	10/3/2011		G
AB57	10/3/2011		G	**PB13**	10/3/2011		G
AB58	10/3/2011		P	**PB18**	10/3/2011		G
AB59	10/3/2011		G	**PB20**	10/3/2011	S'ly of 2 pipes	G
AB60	10/3/2011		G	**PB21**	10/3/2011		F
AB61	10/3/2011	BASE 2007+	G	**PB25**	10/3/2011		G
AB62R	11/13/2011	Replaces AB06	G	**PB26**	10/3/2011		F
AB63R	11/13/2011	Replaces AB07	G	**PB27**	10/3/2011		G
				PB29	10/3/2011		G
BB52	11/13/2011		G	**PB53**	10/3/2011		P
				PB54	10/3/2011		F
CR07	10/3/2011		F	**PB55**	10/3/2011		F
CR50	10/3/2011		G	**PB59**	10/3/2011		G
CR51	10/3/2011		G	**PB64**	10/3/2011	Replaced PB63	G
CR52	10/3/2011		P	**PB65**	10/3/2011	Replaced PB62	G
				UB02	10/3/2011		G
GNSS column indicates site is Good, Fair or Poor for Satellite Visibility Conditions							

Attachments

Find the following documents attachments to this Report

FULL DATA POSTING - Lists the overall and periodic movements of monitoring point including coordinates of the initial positions, 2007 and post 2007 positions in NAD83(2007.00) and NAVD88 Systems

COORDINATE LIST- Current NAD83(2007.00) Geodetic, Grid Coordinates, NAVD88 Heights of all points

PORTUGUESE POINT LANDSLIDE MONITORING - FULL DATA POSTING as of Sept.2007
Prepared by McGee Surveying Consulting - Document Date: 12/02/11

NAD83(2007) COORDINATES and NAVD88 ELEVATIONS of BEGINNING, 2007 & POST 2007 MONITORING POINT POSITIONS

Notes:
# Indicates stable points, not moving
* Indicates no movement detected
1= 2005 and prior surveys used a nearby monument S31-29W 1.48', the original position is adjusted here to be relative to the 1" IP used presently, resulting in correct Overall Movements, see Reports

	Original Positions				Sept. 24, 2007 Positions			Overall Movements (US Feet)					
		NAD83 SPC Zone 5 (Ft)		NAVD88	NAD83 SPC Zone 5 (Ft)		NAVD88	Original Position to Sept. 24, 2007					
Point	Date	North (ft)	East (ft)	Elev(ft)	North (ft)	East (ft)	Elev(ft)	North	East	Height	Azim.°	Dist.	Note
AB01	12/1/1994	1729427.58	6445709.61	178.62	1729427.55	6445709.64	178.62	-0.03	0.03	0.00	-	0	#
AB02	11/30/1994	1726946.97	6447968.65	116.45	1726946.98	6447968.69	116.48	0.01	0.04	0.03	72	0.04	#
AB03	12/1/1994	1727338.34	6447818.82	139.60	1727338.39	6447818.81	139.59	0.04	-0.01	-0.01	351	0.04	#
AB04	11/30/1994	1728391.99	6447123.34	67.57	1728390.55	6447122.03	67.31	-1.44	-1.32	-0.26	222	1.95	
AB05	3/14/1995	1728075.72	6447645.17	80.90									
AB06	4/27/1995	1729059.73	6446976.26	165.28	1729058.58	6446975.91	164.91	-1.15	-0.35	-0.37	197	1.21	
AB07	11/30/1994	1728982.79	6447358.41	159.92	1728981.51	6447357.74	159.40	-1.28	-0.67	-0.52	208	1.44	
AB12	11/30/1994	1729416.49	6448271.64	283.43	1729415.67	6448271.30	283.19	-0.82	-0.35	-0.24	203	0.89	
AB13	11/30/1994	1729928.90	6448236.04	365.03	1729928.25	6448235.90	364.54	-0.65	-0.13	-0.49	192	0.66	
AB15	11/30/1994	1730312.09	6448099.38	397.28	1730311.64	6448099.31	396.90	-0.45	-0.07	-0.38	189	0.45	
AB16	11/30/1994	1730358.89	6447532.12	376.62	1730358.70	6447532.17	376.44	-0.19	0.04	-0.18	168	0.19	
AB17	11/30/1994	1731421.14	6446727.77	443.05	1731421.12	6446727.77	442.80	-0.02	0.00	-0.25	167	0.02	#
AB18	12/1/1994	1731602.62	6448187.49	457.19	1731602.37	6448187.58	456.93	-0.26	0.09	-0.26	162	0.27	
AB20	3/16/1995	1729360.63	6449686.27	396.43	1729360.00	6449686.03	396.23	-0.62	-0.23	-0.20	201	0.67	
AB24	3/12/1997	1729830.35	6447759.96	335.92	1729829.83	6447759.82	335.74	-0.52	-0.14	-0.18	196	0.54	
AB50	1/16/1998	1728085.00	6448248.18	181.98	1728084.71	6448247.54	182.03	-0.29	-0.65	0.05	246	0.71	
AB51	3/22/2002	1729617.01	6447306.54	305.42	1729616.73	6447306.52	305.25	-0.28	-0.02	-0.17	184	0.28	
AB52	3/22/2002	1730016.10	6448624.44	368.61	1730015.79	6448624.36	368.39	-0.31	-0.08	-0.22	195	0.32	
AB53	3/22/2002	1730431.11	6449712.37	353.13	1730430.77	6449712.33	352.90	-0.34	-0.04	-0.23	187	0.34	
AB54	9/24/2007	1731111.94	6447047.87	407.31	1731111.94	6447047.87	407.31						
AB55	9/24/2007	1731174.77	6447753.57	405.38	1731174.77	6447753.57	405.38						
AB56	9/24/2007	1732214.31	6448545.46	571.65	1732214.31	6448545.46	571.65						
AB57	9/24/2007	1731926.91	6449759.36	564.93	1731926.91	6449759.36	564.93						
AB58	9/24/2007	1731118.02	6449074.93	405.67	1731118.02	6449074.93	405.67						
AB59	9/24/2007	1730850.87	6450212.56	434.37	1730850.87	6450212.56	434.37						
AB60	9/24/2007	1729089.70	6447987.57	179.45	1729089.70	6447987.57	179.45						
AB61	9/24/2007	1727424.50	6447990.26	140.47	1727424.50	6447990.26	140.47						
AB62	11/13/2011	Replacement for AB06											
AB63	11/13/2011	Replacement for AB07											
BB25	11/4/1998	1727200.54	6449932.73	3.81	1727200.25	6449932.73	4.12	-0.29	-0.01	0.31	182	0.29	
BB52	9/24/2007	1726996.36	6451384.38	3.83	1726996.36	6451384.38	3.83						
BB53	9/24/2007	1726831.16	6451840.89	13.81	1726831.16	6451840.89	13.81						
CR07	11/30/1994	1731628.78	6451203.19	633.28	1731628.37	6451203.29	632.48	-0.41	0.10	-0.80	166	0.42	
CR50	1/16/1998	1733013.55	6451037.38	873.04	1733013.62	6451037.38	872.66	0.07	0.00	-0.38	358	0.07	
CR51	1/16/1998	1733061.90	6452361.82	976.75	1733062.03	6452361.86	976.25	0.13	0.04	-0.50	17	0.14	
CR52	1/16/1998	1732867.54	6450239.34	780.01	1732867.58	6450239.32	779.63	0.03	-0.02	-0.38	333	0.04	#
FT06	9/24/2007	1729855.61	6452760.21	489.06	1729855.61	6452760.21	489.06						
FT07	9/24/2007	1729253.24	6454104.75	589.01	1729253.24	6454104.75	589.01						
FT08	9/24/2007	1729388.68	6453350.51	658.44	1729388.68	6453350.51	658.44						
KC01	11/30/1994	1728476.78	6452458.23	312.88	1728476.36	6452457.91	312.42	-0.42	-0.32	-0.46	217	0.52	1
KC02	3/14/1995	1727002.89	6452118.99	13.84	1727002.74	6452118.89	13.74	-0.15	-0.11	-0.10	216	0.18	
KC04	3/14/1995	1727559.56	6452667.24	238.84	1727559.46	6452667.09	238.51	-0.10	-0.15	-0.33	236	0.18	
KC05	11/30/1994	1727082.00	6453179.09	227.86	1727082.01	6453178.94	227.53	0.01	-0.15	-0.33	273	0.15	
KC06	11/30/1994	1727784.91	6453396.67	300.35	1727784.94	6453396.40	299.97	0.03	-0.26	-0.38	276	0.26	
KC07	11/30/1994	1727759.19	6453683.92	313.83	1727759.37	6453683.85	313.51	0.18	-0.07	-0.32	340	0.19	
KC13	9/24/2007	1726581.16	6453069.63	191.20	1726581.16	6453069.63	191.20						
KC14	9/24/2007	1726742.44	6453806.05	259.94	1726742.44	6453806.05	259.94						
KC15	9/24/2007	1727590.45	6453121.10	287.10	1727590.45	6453121.10	287.10						
KC16	9/24/2007	1727602.25	6454098.23	326.90	1727602.25	6454098.23	326.90						
PB04	11/30/1994	1727675.94	6448851.74	170.52	1727667.25	6448849.17	167.49	-8.69	-2.57	-3.03	196	9.06	
PB06	3/15/1995	1727968.45	6449761.84	183.06	1727941.12	6449758.81	178.25	-27.33	-3.03	-4.81	186	27.50	
PB07	3/14/1995	1728175.93	6450219.76	200.21	1728141.60	6450213.44	198.02	-34.32	-6.32	-2.19	190	34.90	
PB08	12/1/1994	1728237.51	6450469.80	193.68	1728204.81	6450463.98	194.09	-32.70	-5.82	0.41	190	33.21	
PB09	11/30/1994	1728288.58	6450851.02	192.52	1728252.20	6450849.11	189.84	-36.38	-1.91	-2.68	183	36.43	
PB12	11/30/1994	1728330.49	6451604.57	193.29	1728268.52	6451587.83	186.93	-61.97	-16.74	-6.36	195	64.19	
PB13	3/14/1995	1728085.97	6452164.34	210.54	1728050.44	6452151.18	207.21	-35.53	-13.16	-3.33	200	37.89	
PB18	3/15/1995	1730446.88	6450711.00	367.58	1730431.80	6450719.76	363.24	-15.08	8.77	-4.34	150	17.44	
PB20	3/14/1995	1728812.77	6451135.67	243.54	1728753.50	6451126.52	234.48	-59.27	-9.16	-9.06	189	59.97	
PB21	3/14/1995	1729298.22	6451172.05	280.02	1729249.90	6451177.92	273.29	-48.32	5.87	-6.73	173	48.68	
PB25	12/1/1994	1729702.31	6451985.65	328.99	1729671.12	6451986.48	326.10	-31.19	0.83	-2.89	178	31.20	
PB26	3/14/1995	1729562.65	6452249.56	285.34	1729539.22	6452252.23	282.95	-23.42	2.67	-2.39	174	23.58	
PB27	3/14/1995	1729339.34	6451836.06	284.42	1729257.91	6451842.02	273.51	-81.43	5.96	-10.91	176	81.65	
PB29	3/15/1995	1728888.95	6452120.49	185.93	1728849.86	6452097.03	173.29	-39.08	-23.46	-12.64	211	45.58	
PB53	12/4/1997	1729252.77	6450753.92	297.75	1729224.25	6450754.60	291.85	-28.52	0.67	-5.90	179	28.53	
PB54	12/4/1997	1729694.90	6450448.69	358.62	1729691.38	6450448.62	357.73	-3.52	-0.07	-0.89	181	3.52	
PB55	1/21/1998	1728812.28	6450804.04	246.33	1728782.51	6450801.87	241.07	-29.77	-2.18	-5.26	184	29.85	
PB59	6/26/2001	1727766.36	6448661.67	163.39	1727761.30	6448660.42	160.61	-5.07	-1.24	-2.78	194	5.22	
PB62	9/24/2007	1728476.64	6449717.56	287.25	1728476.64	6449717.56	287.25						
PB63	9/24/2007	1727734.04	6451488.11	126.06	1727734.04	6451488.11	126.06						
PB64	11/18/2009	1727466.29	6450946.95	72.76									
PB65	10/25/2010	1728454.67	6449707.82	287.75									
UB02	7/23/1997	1727581.11	6450133.78	67.15	1727534.46	6450140.57	63.20	-46.66	6.78	-3.95	172	47.15	

PORTUGUESE POINT LANDSLIDE MONITORING - FULL DATA POSTING as of Dec.2008

Prepared by McGee Surveying Consulting - Document Date: 12/02/11

Notes:

# Indicates stable points, not moving

* Indicates no movement detected

2 = Hit by mower sometime between 09/07 and 12/08 with an estimated displacement S14E 0.29', the original position is adjusted here to be relative to monitored position used presently, resulting in correct Overall Movements, see Rpt

	Dec. 10, 2008 Positions			Overall Movements (US Feet)						Periodic (14.5 months) Movements (US Feet)						
	NAD83 SPC Zone 5 (ft)		NAVD88	Original Position to Dec. 10, 2008						Sept. 24, 2007 Position to Dec. 10, 2008						
Point	North (ft)	East (ft)	Elev(ft)	North	East	Height	Azim.°	Dist.	Note	North	East	Height	Azimuth°	Distance	95%Error	Note
AB01	1729427.54	6445709.63	178.59	-0.05	0.02	-0.03	161	0.05	#	-0.01	-0.01	-0.03	231	0.02	0.017	#
AB02	1726946.99	6447968.68	116.46	0.02	0.03	0.01	61	0.03	#	0.00	-0.01	-0.02	297	0.01	0.016	#
AB03	1727338.39	6447818.81	139.58	0.04	-0.01	-0.02	348	0.04	#	0.00	0.00	-0.01	270	0.00	0.015	#
AB04	1728390.43	6447121.92	67.27	-1.56	-1.43	-0.30	222	2.12		-0.12	-0.11	-0.04	222	0.16	0.016	
AB05	1728074.86	6447644.04	80.59	-0.86	-1.13	-0.31	233	1.42	2							2
AB06	1729058.49	6446975.88	164.85	-1.24	-0.38	-0.43	197	1.30		-0.09	-0.03	-0.06	198	0.09	0.019	
AB07	1728981.40	6447357.70	159.34	-1.39	-0.71	-0.58	207	1.56		-0.11	-0.04	-0.06	202	0.12	0.021	
AB12	1729415.57	6448271.26	283.19	-0.92	-0.38	-0.24	203	0.99		-0.10	-0.03	0.00	199	0.11	0.018	
AB13	1729928.17	6448235.89	364.54	-0.73	-0.15	-0.49	192	0.74		-0.08	-0.01	0.00	191	0.08	0.019	
AB15	1730311.56	6448099.30	396.88	-0.53	-0.08	-0.40	189	0.53		-0.08	-0.01	-0.02	188	0.08	0.024	
AB16	1730358.65	6447532.17	376.46	-0.24	0.05	-0.16	168	0.24		-0.05	0.01	0.02	170	0.05	0.024	
AB17	1731421.12	6446727.77	442.79	-0.02	0.00	-0.26	171	0.02	#	0.00	0.00	-0.01	194	0.00	0.020	#
AB18	1731602.31	6448187.61	456.91	-0.32	0.11	-0.28	160	0.34		-0.06	0.03	-0.02	155	0.07	0.023	
AB20	1729359.84	6449685.99	396.23	-0.79	-0.28	-0.20	199	0.83		-0.16	-0.04	0.00	195	0.17	0.012	
AB24	1729829.75	6447759.77	335.76	-0.61	-0.19	-0.16	197	0.63		-0.09	-0.04	0.02	205	0.10	0.022	
AB50	1728084.66	6448247.47	181.98	-0.34	-0.71	0.00	245	0.79		-0.05	-0.07	-0.05	235	0.08	0.019	
AB51	1729616.65	6447306.51	305.26	-0.36	-0.03	-0.16	185	0.36		-0.09	-0.01	0.01	190	0.09	0.019	
AB52	1730015.70	6448624.32	368.38	-0.40	-0.12	-0.23	196	0.42		-0.10	-0.03	-0.01	200	0.10	0.028	
AB53	1730430.62	6449712.30	352.90	-0.49	-0.07	-0.23	188	0.50		-0.15	-0.03	0.00	189	0.15	0.028	
AB54	1731111.93	6447047.87	407.30	-0.01	0.00	-0.01	165	0.01	*	-0.01	0.00	-0.01	165	0.01	0.028	*
AB55	1731174.72	6447753.58	405.39	-0.05	0.01	0.01	166	0.05		-0.05	0.01	0.01	166	0.05	0.018	
AB56	1732214.21	6448545.49	571.64	-0.10	0.03	-0.01	161	0.11		-0.10	0.03	-0.01	161	0.11	0.018	
AB57	1731926.78	6449759.40	564.90	-0.13	0.03	-0.03	166	0.13		-0.13	0.03	-0.03	166	0.13	0.018	
AB58	1731117.90	6449074.93	405.65	-0.12	0.00	-0.02	178	0.12		-0.12	0.00	-0.02	178	0.12	0.020	
AB59	1730850.70	6450212.53	434.35	-0.17	-0.02	-0.02	188	0.17		-0.17	-0.02	-0.02	188	0.17	0.020	
AB60	1729089.63	6447987.54	179.39	-0.08	-0.03	-0.06	200	0.08		-0.08	-0.03	-0.06	200	0.08	0.021	
AB61	1727424.49	6447990.27	140.43	-0.01	0.01	-0.04	114	0.01	*	-0.01	0.01	-0.04	114	0.01	0.003	#
BB25	1727200.25	6449932.58	4.15	-0.29	-0.16	0.34	208	0.33		0.00	-0.15	0.03	269	0.15	0.017	
BB52	1726996.24	6451384.35	3.83	-0.12	-0.03	0.00	194	0.13		-0.12	-0.03	0.00	194	0.13	0.024	
BB53	Destroyed															
CR07	1731628.24	6451203.32	632.36	-0.84	0.13	-0.92	166	0.55		-0.13	0.03	-0.12	168	0.13	0.024	
CR50	1733013.62	6451037.38	872.71	0.08	0.01	-0.33	5	0.08		0.01	0.01	0.05	45	0.01	0.017	*
CR51	1733062.02	6452361.86	976.24	0.12	0.04	-0.51	20	0.13		-0.01	0.00	-0.01	171	0.01	0.019	*
CR52	1732867.58	6450239.31	779.64	0.03	-0.03	-0.37	315	0.04		0.00	-0.01	0.01	258	0.01	0.023	*
FT06	1729855.42	6452760.17	488.97	-0.19	-0.04	-0.09	192	0.19		-0.19	-0.04	-0.09	192	0.19	0.025	
FT07	1729253.01	6454104.39	588.99	-0.23	-0.36	-0.02	237	0.43		-0.23	-0.36	-0.02	237	0.43	0.015	
FT08	1729388.67	6453350.53	658.47	-0.01	0.02	0.03	114	0.02		-0.01	0.02	0.03	114	0.02	0.015	*
KC01	1728476.25	6452457.85	312.38	-0.53	-0.38	-0.50	215	0.66	1	-0.12	-0.06	-0.04	208	0.13	0.020	
KC02	1727002.67	6452118.88	13.72	-0.22	-0.11	-0.12	207	0.25		-0.07	-0.01	-0.02	195	0.07	0.021	
KC04	1727559.42	6452667.06	238.47	-0.14	-0.18	-0.37	233	0.23		-0.04	-0.04	-0.04	223	0.05	0.017	
KC05	1727081.98	6453178.94	227.52	-0.02	-0.15	-0.34	261	0.15		-0.03	0.00	-0.01	180	0.03	0.020	
KC06	1727784.92	6453396.36	299.93	0.01	-0.30	-0.42	273	0.30		-0.01	-0.04	-0.04	252	0.05	0.021	
KC07	1727759.38	6453683.87	313.50	0.18	-0.05	-0.33	346	0.19		0.00	0.02	-0.01	84	0.02	0.018	*
KC13	1726581.12	6453069.62	191.23	-0.04	-0.01	0.03	194	0.04		-0.04	-0.01	0.03	194	0.04	0.018	
KC14	1726742.44	6453806.04	259.91	0.00	-0.02	-0.03	259	0.02	*	0.00	-0.02	-0.03	259	0.02	0.020	*
KC15	1727590.41	6453121.06	287.13	-0.05	-0.04	0.03	220	0.06		-0.05	-0.04	0.03	220	0.06	0.022	
KC16	1727602.24	6454098.24	326.92	-0.01	0.00	0.02	135	0.01	*	-0.01	0.00	0.02	135	0.01	0.016	*
PB04	1727666.83	6448849.07	167.37	-9.10	-2.67	-3.15	196	9.49		-0.41	-0.10	-0.12	194	0.43	0.017	
PB06	1727939.65	6449758.62	177.96	-28.80	-3.22	-5.10	186	28.98		-1.47	-0.18	-0.29	187	1.48	0.021	
PB07	1728139.82	6450213.09	197.88	-36.10	-6.67	-2.33	190	36.72		-1.78	-0.35	-0.14	191	1.82	0.020	
PB08	1728203.20	6450463.68	194.13	-34.31	-6.12	0.45	190	34.85		-1.61	-0.30	0.04	190	1.64	0.024	
PB09	1728250.32	6450848.98	189.58	-38.26	-2.04	-2.94	183	38.31		-1.88	-0.13	-0.26	184	1.88	0.021	
PB12	1728265.36	6451586.81	186.31	-65.13	-17.76	-6.98	195	67.51		-3.16	-1.03	-0.62	198	3.32	0.019	
PB13	1728048.48	6452150.38	207.09	-37.49	-13.96	-3.45	200	40.01		-1.96	-0.80	-0.12	202	2.12	0.019	
PB18	1730431.47	6450719.84	363.18	-15.41	8.85	-4.40	150	17.77		-0.33	0.08	-0.06	166	0.34	0.020	
PB20	1728750.65	6451126.05	233.99	-62.12	-9.63	-9.55	189	62.86		-2.85	-0.47	-0.49	189	2.89	0.020	
PB21	1729247.73	6451178.08	273.02	-50.49	6.03	-7.00	173	50.85		-2.17	0.16	-0.27	176	2.17	0.021	
PB25	1729670.88	6451986.42	326.07	-31.44	0.77	-2.92	179	31.45		-0.25	-0.07	-0.03	195	0.26	0.019	
PB26	1729539.03	6452252.21	282.94	-23.62	2.65	-2.40	174	23.77		-0.20	-0.02	-0.01	187	0.20	0.018	
PB27	1729254.41	6451842.14	272.98	-84.93	6.08	-11.44	176	85.15		-3.50	0.13	-0.53	178	3.50	0.023	
PB29	1728847.75	6452096.03	172.60	-41.20	-24.46	-13.33	211	47.91		-2.11	-1.01	-0.69	205	2.34	0.020	
PB53	1729222.48	6450754.60	291.44	-30.28	0.68	-6.31	179	30.29		-1.76	0.00	-0.41	180	1.76	0.024	
PB54	1729691.20	6450448.58	357.73	-3.70	-0.11	-0.89	182	3.70		-0.18	-0.04	0.00	193	0.18	0.019	
PB55	1728780.51	6450801.66	240.62	-31.77	-2.38	-5.71	184	31.86		-2.01	-0.21	-0.45	186	2.02	0.031	
PB59	1727760.70	6448660.28	160.34	-5.66	-1.39	-3.05	194	5.83		-0.59	-0.15	-0.27	194	0.61	0.017	
PB62	1728476.42	6449717.52	287.22	-0.21	-0.04	-0.03	192	0.22		-0.21	-0.04	-0.03	192	0.22	0.016	
PB63	1727724.58	6451485.79	121.78	-9.45	-2.32	-4.28	194	9.73		-9.45	-2.32	-4.28	194	9.73	0.020	
UB02	1727530.48	6450141.10	63.00	-50.63	7.31	-4.15	172	51.16		-3.97	0.53	-0.20	172	4.01	0.023	

PORTUGUESE POINT LANDSLIDE MONITORING - FULL DATA POSTING as of Nov. 2009

Prepared by McGee Surveying Consulting - Document Date: 12/02/11

Notes:

\# Indicates stable points, not moving

* Indicates no movement detected

	Nov. 18, 2009 Positions			Overall Movements (US Feet)						Periodic (11.3 months) Movements (US Feet)						
	NAD83 SPC Zone 5 (Ft)		NAVD88	Original Position to Nov. 18, 2009						Dec. 10, 2008 Position to Nov. 18, 2009						
Point	North (ft)	East (ft)	Elev(ft)	North	East	Height	Azim.°	Dist.	Note	North	East	Height	Azim.°	Dist.	95%Error	Note
AB01	1729427.54	6445709.62	178.540	-0.04	0.01	-0.08	167	0.04		0.00	-0.01	-0.05	304	0.01	0.020	#
AB02	1726946.97	6447968.68	116.460	0.00	0.03	0.01	95	0.03	*	-0.02	0.00	0.00	171	0.02	0.020	#
AB03	1727338.38	6447818.82	139.570	0.04	0.00	-0.03	4	0.04		-0.01	0.01	-0.01	117	0.01	0.017	#
AB04	1728390.36	6447121.86	67.250	-1.63	-1.48	-0.32	222	2.20		-0.07	-0.05	-0.02	217	0.09	0.019	
AB05	1728074.78	6447643.96	80.570	-0.94	-1.21	-0.33	232	1.53		-0.08	-0.08	-0.02	226	0.11	0.018	
AB06	1729058.43	6446975.87	164.840	-1.31	-0.39	-0.44	197	1.36		-0.06	-0.01	-0.01	191	0.06	0.019	
AB07	1728981.35	6447357.67	159.330	-1.44	-0.74	-0.59	207	1.62		-0.05	-0.03	-0.01	207	0.06	0.022	
AB12	1729415.50	6448271.24	283.190	-0.98	-0.41	-0.24	203	1.07		-0.07	-0.03	0.00	202	0.07	0.019	
AB13	1729928.13	6448235.87	364.540	-0.77	-0.16	-0.49	192	0.78		-0.04	-0.02	0.00	201	0.04	0.020	
AB15	1730311.51	6448099.30	396.880	-0.57	-0.08	-0.40	188	0.58		-0.05	0.00	0.00	180	0.05	0.026	
AB16	1730358.64	6447532.17	376.450	-0.25	0.04	-0.17	170	0.25		-0.01	-0.01	-0.01	203	0.02	0.021	*
AB17	1731421.11	6446727.77	442.800	-0.03	0.00	-0.25	173	0.03	*	0.00	0.00	0.01	180	0.00	0.019	#
AB18	1731602.26	6448187.60	456.870	-0.36	0.11	-0.32	163	0.38		-0.04	-0.01	-0.04	189	0.04	0.025	
AB20	1729359.78	6449685.97	396.230	-0.85	-0.30	-0.20	199	0.90		-0.06	-0.02	0.00	200	0.06	0.013	
AB24	1729829.68	6447759.75	335.760	-0.67	-0.21	-0.16	197	0.70		-0.06	-0.02	0.00	198	0.07	0.024	
AB50	1728084.64	6448247.44	182.000	-0.36	-0.74	0.02	244	0.83		-0.02	-0.03	0.02	238	0.04	0.024	
AB51	1729616.60	6447306.48	305.250	-0.41	-0.06	-0.17	188	0.41		-0.04	-0.02	-0.01	208	0.05	0.020	
AB52	1730015.65	6448624.32	368.350	-0.45	-0.12	-0.26	195	0.47		-0.05	0.00	-0.03	181	0.05	0.031	
AB53	1730430.55	6449712.28	352.890	-0.55	-0.09	-0.24	189	0.56		-0.06	-0.02	-0.01	198	0.06	0.026	
AB54	1731111.92	6447047.87	407.360	-0.03	0.00	0.05	178	0.03	*	-0.02	0.00	0.06	187	0.02	0.029	*
AB55	1731174.68	6447753.58	405.390	-0.09	0.02	0.01	169	0.09		-0.04	0.01	0.00	171	0.04	0.017	
AB56	1732214.16	6448545.51	571.690	-0.15	0.05	0.04	162	0.16		-0.05	0.02	0.05	164	0.05	0.024	
AB57	1731926.73	6449759.41	564.860	-0.18	0.04	-0.07	166	0.18		-0.05	0.01	-0.04	167	0.05	0.022	
AB58	1731117.85	6449074.94	405.640	-0.17	0.01	-0.03	175	0.17		-0.05	0.01	-0.01	168	0.05	0.022	
AB59	1730850.64	6450212.52	434.340	-0.23	-0.03	-0.03	188	0.23		-0.06	-0.01	-0.01	190	0.06	0.022	
AB60	1729089.58	6447987.53	179.390	-0.12	-0.04	-0.06	199	0.13		-0.04	-0.01	0.00	196	0.05	0.019	
AB61	1727424.49	6447990.27	140.420	-0.01	0.01	-0.05	128	0.02	*	0.00	0.00	-0.01	158	0.01	0.004	#
BB25	1727200.19	6449932.57	4.210	-0.35	-0.16	0.40	204	0.39		-0.06	0.00	0.06	183	0.06	0.024	
BB52	1726996.18	6451384.34	3.860	-0.18	-0.04	0.03	193	0.19		-0.06	-0.01	0.03	191	0.06	0.019	
CR07	1731628.18	6451203.34	632.390	-0.60	0.15	-0.89	166	0.62		-0.06	0.02	0.03	161	0.07	0.024	
CR50	1733013.61	6451037.39	872.690	0.06	0.01	-0.35	10	0.06		-0.01	0.00	-0.02	162	0.02	0.022	*
CR51	1733062.01	6452361.87	976.220	0.11	0.05	-0.53	26	0.12		-0.01	0.01	-0.02	143	0.02	0.024	*
CR52	1732867.56	6450239.31	779.730	0.02	-0.03	-0.28	300	0.03	*	-0.01	0.00	0.09	176	0.01	0.026	*
FT06	1729855.34	6452760.16	488.920	-0.27	-0.05	-0.14	191	0.28		-0.08	-0.01	-0.05	189	0.08	0.020	
FT07	1729252.92	6454104.25	588.900	-0.33	-0.51	-0.11	237	0.60		-0.10	-0.14	-0.09	236	0.17	0.020	
FT08	1729388.69	6453350.52	658.480	0.00	0.02	0.04	74	0.02	*	0.01	0.00	0.01	348	0.01	0.027	#
KC01	1728476.18	6452457.81	312.350	-0.60	-0.42	-0.53	215	0.74		-0.07	-0.04	-0.03	209	0.08	0.019	
KC02	1727002.64	6452118.86	13.690	-0.26	-0.13	-0.15	207	0.29		-0.03	-0.02	-0.03	207	0.04	0.021	
KC04	1727559.39	6452667.04	238.450	-0.17	-0.20	-0.39	231	0.27		-0.03	-0.02	-0.02	216	0.04	0.019	
KC05	1727081.97	6453178.92	227.510	-0.03	-0.17	-0.35	259	0.18		-0.01	-0.02	-0.01	244	0.03	0.020	
KC06	1727784.90	6453396.33	299.910	-0.01	-0.33	-0.44	268	0.33		-0.02	-0.03	-0.02	227	0.04	0.025	
KC07	1727759.37	6453683.87	313.470	0.18	-0.05	-0.36	344	0.19		0.00	0.00	-0.03	256	0.00	0.021	*
KC13	1726581.11	6453069.63	191.180	-0.04	-0.01	-0.02	188	0.04		-0.01	0.00	-0.05	153	0.01	0.017	*
KC14	1726742.43	6453806.03	259.920	-0.01	-0.03	-0.02	253	0.03	*	0.00	-0.01	0.01	247	0.01	0.023	*
KC15	1727590.38	6453121.03	287.090	-0.07	-0.06	-0.01	222	0.09		-0.02	-0.02	-0.04	226	0.03	0.027	
KC16	1727602.24	6454098.24	326.870	-0.01	0.00	-0.03	159	0.01	*	0.00	0.00	-0.05	214	0.00	0.018	#
PB04	1727666.56	6448848.99	167.310	-9.38	-2.75	-3.21	196	9.77		-0.27	-0.07	-0.06	195	0.28	0.020	
PB06	1727938.80	6449758.52	177.820	-29.65	-3.32	-5.24	186	29.83		-0.85	-0.10	-0.14	187	0.85	0.022	
PB07	1728138.83	6450212.89	197.800	-37.09	-6.86	-2.41	190	37.72		-0.99	-0.19	-0.08	191	1.01	0.019	
PB08	1728202.31	6450463.52	194.120	-35.20	-6.28	0.44	190	35.75		-0.89	-0.16	-0.01	190	0.90	0.020	
PB09	1728249.30	6450848.91	189.460	-39.28	-2.11	-3.06	183	39.34		-1.02	-0.07	-0.12	184	1.02	0.022	
PB12	1728263.70	6451586.25	185.940	-66.79	-18.32	-7.35	195	69.25		-1.66	-0.55	-0.37	199	1.75	0.022	
PB13	1728047.43	6452149.98	206.980	-38.54	-14.36	-3.56	200	41.13		-1.05	-0.41	-0.11	201	1.12	0.019	
PB18	1730431.35	6450719.86	363.140	-15.53	8.87	-4.44	150	17.89		-0.12	0.02	-0.04	170	0.12	0.021	
PB20	1728749.18	6451125.82	233.690	-63.59	-9.86	-9.85	189	64.35		-1.47	-0.23	-0.30	189	1.49	0.022	
PB21	1729246.60	6451178.17	272.840	-51.62	6.12	-7.18	173	51.98		-1.13	0.09	-0.18	175	1.14	0.024	
PB25	1729670.78	6451986.39	326.040	-31.53	0.74	-2.95	179	31.54		-0.09	-0.02	-0.03	194	0.10	0.022	
PB26	1729538.93	6452252.19	282.930	-23.71	2.63	-2.41	174	23.86		-0.09	-0.02	-0.01	190	0.10	0.022	
PB27	1729252.59	6451842.20	272.730	-86.75	6.14	-11.69	176	86.97		-1.82	0.06	-0.25	178	1.82	0.026	
PB29	1728846.62	6452095.51	172.230	-42.32	-24.98	-13.70	211	49.15		-1.13	-0.52	-0.37	205	1.24	0.022	
PB53	1729221.54	6450754.61	291.200	-31.22	0.68	-6.55	179	31.23		-0.94	0.01	-0.24	180	0.94	0.026	
PB54	1729691.12	6450448.57	357.710	-3.78	-0.12	-0.91	182	3.78		-0.08	-0.01	-0.02	188	0.08	0.023	
PB55	1728779.41	6450801.58	240.500	-32.87	-2.47	-5.83	184	32.97		-1.10	-0.08	-0.12	184	1.10	0.030	
PB59	1727760.31	6448660.19	160.160	-6.05	-1.48	-3.23	194	6.23		-0.39	-0.09	-0.18	193	0.40	0.020	
PB62	1728476.31	6449717.49	287.200	-0.32	-0.07	-0.05	192	0.33		-0.11	-0.02	-0.02	193	0.11	0.017	
PB63	1727717.72	6451483.29	116.990	-16.31	-4.82	-9.07	196	17.01		-6.86	-2.50	-4.79	200	7.30	0.022	
PB64	1727466.29	6450946.95	72.760													
UB02	1727527.87	6450141.46	62.920	-53.24	7.67	-4.23	172	53.79		-2.61	0.36	-0.08	172	2.64	0.022	

PORTUGUESE POINT LANDSLIDE MONITORING - FULL DATA POSTING as of Oct. 2010

Prepared by McGee Surveying Consulting - Document Date: 12/02/11

Notes:

* Indicates no movement detected

	Oct. 25, 2010 Positions			Overall Movements (US Feet)						Periodic (11.1 months) Movements (US Feet)						
	NAD83 SPC Zone 5 (Ft)		NAVD88	Original Position to Oct. 25, 2010						Nov. 18, 2009 Position to Oct. 25, 2010						
Point	North (ft)	East (ft)	Elev(ft)	North	East	Height	Azim.°	Dist.	Note	North	East	Height	Azim.°	Dist.	95%Error	Note
AB01	1729427.53	6445709.61	178.52	-0.05	-0.01	-0.10	187	0.05		-0.01	-0.02	-0.02	241	0.02	0.032	*
AB02	1726946.97	6447968.66	116.45	0.00	0.01	0.00	111	0.01	*	0.00	-0.02	-0.01	270	0.02	0.024	*
AB03	Discontinued															
AB04	1728390.27	6447121.79	67.25	-1.72	-1.56	-0.32	222	2.32		-0.09	-0.08	0.00	220	0.12	0.023	
AB05	1728074.67	6447643.89	80.53	-1.05	-1.28	-0.37	231	1.66		-0.12	-0.07	-0.04	211	0.14	0.026	
AB06	1729058.36	6446975.83	164.82	-1.37	-0.43	-0.46	197	1.44		-0.07	-0.03	-0.02	207	0.07	0.026	
AB07	1728981.28	6447357.64	159.31	-1.51	-0.77	-0.61	207	1.70		-0.07	-0.03	-0.02	207	0.08	0.032	
AB12	1729415.46	6448271.20	283.20	-1.03	-0.44	-0.23	203	1.12		-0.04	-0.04	0.01	219	0.06	0.017	
AB13	1729928.09	6448235.85	364.53	-0.81	-0.19	-0.50	193	0.83		-0.04	-0.02	-0.01	208	0.05	0.021	
AB15	1730311.47	6448099.25	396.86	-0.62	-0.14	-0.42	192	0.63		-0.04	-0.05	-0.02	232	0.07	0.023	
AB16	1730358.61	6447532.16	376.46	-0.28	0.03	-0.16	173	0.28		-0.03	-0.01	0.01	197	0.03	0.028	*
AB17	1731421.10	6446727.76	442.80	-0.04	-0.01	-0.25	188	0.04		-0.01	-0.01	0.00	217	0.01	0.021	*
AB18	1731602.22	6448187.61	456.82	-0.40	0.12	-0.37	164	0.42		-0.04	0.01	-0.05	165	0.04	0.031	
AB20	1729359.72	6449685.94	396.23	-0.90	-0.32	-0.20	200	0.96		-0.06	-0.02	0.00	203	0.06	0.012	
AB24	1729829.65	6447759.73	335.77	-0.71	-0.23	-0.15	198	0.75		-0.04	-0.02	0.01	212	0.04	0.024	
AB50	1728084.62	6448247.38	182.00	-0.38	-0.80	0.02	244	0.89		-0.02	-0.06	0.00	247	0.06	0.031	
AB51	1729616.56	6447306.49	305.24	-0.45	-0.05	-0.18	186	0.45		-0.05	0.01	-0.01	172	0.05	0.022	
AB52	1730015.61	6448624.30	368.38	-0.49	-0.14	-0.23	196	0.51		-0.04	-0.02	0.03	209	0.04	0.037	
AB53	1730430.49	6449712.26	352.91	-0.61	-0.11	-0.22	190	0.62		-0.06	-0.02	0.02	196	0.07	0.027	
AB54	1731111.92	6447047.87	407.34	-0.02	0.00	0.03	182	0.02		0.00	0.00	-0.02	326	0.00	0.036	*
AB55	1731174.66	6447753.58	405.40	-0.11	0.02	0.02	171	0.11		-0.02	0.00	0.01	183	0.02	0.018	*
AB56	1732214.12	6449545.51	571.63	-0.19	0.05	-0.02	165	0.20		-0.04	0.00	-0.06	179	0.04	0.028	
AB57	1731926.67	6449759.42	564.92	-0.23	0.06	-0.01	165	0.24		-0.05	0.01	0.06	164	0.06	0.027	
AB58	1731117.80	6449074.93	405.69	-0.22	0.00	0.02	180	0.22		-0.05	-0.01	0.05	196	0.05	0.026	
AB59	1730850.56	6450212.51	434.35	-0.31	-0.04	-0.02	188	0.31		-0.08	-0.01	0.01	185	0.08	0.028	
AB60	1729089.53	6447987.50	179.42	-0.17	-0.07	-0.03	201	0.18		-0.05	-0.02	0.03	207	0.06	0.020	
AB61	1727424.48	6447990.27	140.47	-0.02	0.01	0.00	150	0.02	*	-0.01	0.00	0.05	193	0.01	0.005	*
BB25	Discontinued															
BB52	1726996.13	6451384.34	3.85	-0.23	-0.04	0.02	190	0.24		-0.05	0.00	-0.01	180	0.05	0.029	
BB53	Destroyed															
CR07	1731628.12	6451203.32	632.33	-0.66	0.13	-0.95	169	0.67		-0.06	-0.02	-0.06	202	0.06	0.027	
CR50	1733013.59	6451037.37	872.67	0.04	0.00	-0.37	354	0.04		-0.02	-0.02	-0.02	217	0.03	0.023	
CR51	1733062.01	6452361.88	976.18	0.11	0.06	-0.57	29	0.12		0.00	0.01	-0.04	98	0.01	0.026	*
CR52	1732867.55	6450239.31	779.65	0.01	-0.03	-0.36	283	0.03	*	-0.01	0.00	-0.08	186	0.01	0.031	*
FT06	1729855.25	6452760.13	488.89	-0.35	-0.08	-0.17	193	0.36		-0.08	-0.03	-0.03	199	0.09	0.019	
FT07	1729252.76	6454104.00	588.85	-0.49	-0.75	-0.16	237	0.90		-0.16	-0.25	-0.05	237	0.30	0.026	
FT08	1729388.66	6453350.51	659.43	-0.02	0.00	-0.01	166	0.02	*	-0.02	-0.01	-0.05	206	0.03	0.028	*
KC01	1728476.12	6452457.77	312.38	-0.67	-0.46	-0.50	215	0.81		-0.06	-0.04	0.03	216	0.07	0.023	
KC02	1727002.62	6452118.86	13.72	-0.28	-0.14	-0.12	206	0.31		-0.02	-0.01	0.03	197	0.02	0.033	*
KC04	1727559.36	6452667.01	238.44	-0.20	-0.23	-0.40	228	0.30		-0.03	-0.02	-0.01	215	0.04	0.027	
KC05	1727081.96	6453178.92	227.47	-0.04	-0.17	-0.39	256	0.18		-0.01	0.00	-0.04	180	0.01	0.029	*
KC06	1727784.89	6453396.32	299.89	-0.02	-0.35	-0.46	266	0.35		-0.01	-0.02	-0.02	233	0.02	0.027	*
KC07	1727759.39	6453683.87	313.47	0.19	-0.04	-0.36	347	0.20		0.01	0.01	0.00	32	0.01	0.031	*
KC13	1726581.08	6453069.61	191.18	-0.07	-0.02	-0.02	195	0.08		-0.03	-0.01	0.00	204	0.03	0.021	
KC14	1726742.43	6453806.02	259.89	-0.01	-0.03	-0.05	258	0.03	*	0.00	0.00	-0.03	333	0.00	0.036	*
KC15	1727590.38	6453121.02	287.10	-0.07	-0.07	0.00	227	0.10		0.00	-0.01	0.01	265	0.01	0.027	*
KC16	1727602.23	6454098.24	326.88	-0.02	0.01	-0.02	148	0.02	*	-0.01	0.01	0.01	139	0.01	0.023	*
PB04	1727665.94	6448848.86	167.11	-9.99	-2.88	-3.41	196	10.40		-0.62	-0.13	-0.20	192	0.63	0.030	
PB06	1727937.25	6449758.35	177.58	-31.19	-3.49	-5.48	186	31.39		-1.55	-0.17	-0.24	186	1.56	0.032	
PB07	1728137.00	6450212.58	197.66	-38.93	-7.18	-2.55	190	39.58		-1.83	-0.32	-0.14	190	1.86	0.030	
PB08	1728200.66	6450463.24	194.16	-36.85	-6.56	0.48	190	37.43		-1.65	-0.28	0.04	190	1.67	0.033	
PB09	1728247.35	6450848.79	189.24	-41.23	-2.24	-3.28	183	41.29		-1.95	-0.13	-0.22	184	1.95	0.032	
PB12	1728260.50	6451585.29	185.30	-69.99	-19.28	-7.99	195	72.60		-3.20	-0.96	-0.64	197	3.35	0.027	
PB13	1728045.47	6452149.17	206.87	-40.50	-15.17	-3.67	201	43.25		-1.96	-0.81	-0.11	202	2.12	0.025	
PB18	1730431.24	6450719.88	363.10	-15.64	8.89	-4.48	150	17.99		-0.11	0.02	-0.04	169	0.11	0.024	
PB20	1728746.32	6451125.33	233.20	-66.45	-10.35	-10.34	189	67.25		-2.86	-0.49	-0.49	190	2.91	0.038	
PB21	1729244.44	6451178.35	272.60	-53.78	6.30	-7.42	173	54.14		-2.15	0.18	-0.24	175	2.16	0.029	
PB25	1729670.68	6451986.36	326.01	-31.64	0.71	-2.98	179	31.64		-0.10	-0.03	-0.03	196	0.11	0.021	
PB26	1729538.86	6452252.16	282.99	-23.79	2.60	-2.35	174	23.93		-0.08	-0.03	0.06	200	0.08	0.028	
PB27	1729249.12	6451842.31	272.17	-90.22	6.25	-12.25	176	90.44		-3.47	0.11	-0.56	178	3.47	0.029	
PB29	1728844.53	6452094.53	171.59	-44.42	-25.96	-14.34	210	51.45		-2.10	-0.97	-0.64	205	2.31	0.032	
PB53	1729219.81	6450754.71	290.67	-32.96	0.78	-7.08	179	32.97		-1.73	0.10	-0.53	177	1.74	0.035	
PB54	1729691.04	6450448.55	357.73	-3.86	-0.13	-0.89	182	3.87		-0.08	-0.02	0.02	191	0.08	0.026	
PB55	1728777.36	6450801.45	240.18	-34.92	-2.59	-6.15	184	35.02		-2.05	-0.13	-0.32	184	2.05	0.044	
PB59	1727759.39	6448659.97	159.70	-6.98	-1.69	-3.69	194	7.18		-0.93	-0.21	-0.47	193	0.95	0.032	
PB62	Destroyed															
PB63	Destroyed															
PB64	1727439.04	6450942.07	69.69	-27.25	-4.88	-3.08	190	27.68		-27.25	-4.88	-3.08	190	27.68	0.031	
PB65	1728454.67	6449707.82	287.75													
UB02	1727522.77	6450142.13	62.75	-58.34	8.34	-4.40	172	58.94		-5.10	0.67	-0.17	173	5.14	0.030	

PORTUGUESE POINT LANDSLIDE MONITORING - FULL DATA POSTING as of Oct. 03, 2011
Prepared by McGee Surveying Consulting - Document Date: 12/02/11

Notes:
* Indicates no movement detected

	Oct. 03, 2011 Positions			Overall Movements (US Feet)						Periodic (11.3 months) Movements (US Feet)						
	NAD83 SPC Zone 5 (Ft)		NAVD88	Original Position to Oct. 03, 2011						Oct. 25, 2010 Position to Oct. 03, 2011						
Point	North (ft)	East (ft)	Elev(ft)	North	East	Height	Azim.°	Dist.	Note	North	East	Height	Azim.°	Dist.	95%Error	Note
AB01	1729427.55	6445709.59	178.50	-0.04	-0.02	-0.12	213	0.04		0.02	-0.02	-0.02	313	0.02	0.030	*
AB02	1726946.97	6447968.70	116.45	0.00	0.05	0.00	85	0.05		0.01	0.04	0.00	81	0.04	0.023	
AB04	1728390.04	6447121.59	67.21	-1.95	-1.75	-0.36	222	2.62		-0.23	-0.20	-0.03	221	0.30	0.025	
AB05	1728074.57	6447643.73	80.49	-1.15	-1.45	-0.41	232	1.84		-0.09	-0.16	-0.04	240	0.19	0.027	
AB06	1729058.21	6446975.77	164.77	-1.53	-0.49	-0.51	198	1.60		-0.16	-0.06	-0.05	202	0.17	0.031	
AB07	1728981.13	6447357.52	159.24	-1.66	-0.89	-0.68	208	1.88		-0.15	-0.12	-0.06	218	0.19	0.041	
AB12	1729415.28	6448271.12	283.19	-1.21	-0.52	-0.24	203	1.32		-0.18	-0.08	-0.01	204	0.20	0.026	
AB13	1729927.96	6448235.79	364.50	-0.93	-0.25	-0.53	195	0.97		-0.12	-0.06	-0.03	205	0.14	0.033	
AB15	1730311.37	6448099.26	396.87	-0.72	-0.13	-0.41	190	0.73		-0.10	0.01	0.00	174	0.10	0.032	
AB16	1730358.55	6447532.15	376.44	-0.34	0.03	-0.18	175	0.34		-0.06	0.00	-0.02	185	0.06	0.029	
AB17	1731421.09	6446727.74	442.78	-0.05	-0.03	-0.27	211	0.06		-0.01	-0.03	-0.02	246	0.03	0.036	*
AB18	1731602.16	6448187.62	456.84	-0.46	0.13	-0.35	165	0.48		-0.06	0.01	0.01	173	0.06	0.032	
AB20	1729359.56	6449685.89	396.23	-1.07	-0.38	-0.20	200	1.13		-0.16	-0.06	0.00	199	0.17	0.026	
AB24	1729829.52	6447759.68	335.77	-0.84	-0.28	-0.15	198	0.88		-0.13	-0.04	0.01	200	0.13	0.024	
AB50	1728084.56	6448247.27	182.01	-0.44	-0.92	0.03	244	1.02		-0.06	-0.11	0.02	243	0.13	0.027	
AB51	1729616.46	6447306.45	305.17	-0.55	-0.09	-0.25	189	0.56		-0.10	-0.04	-0.07	200	0.11	0.025	
AB52	1730015.49	6448624.26	368.35	-0.61	-0.18	-0.26	197	0.64		-0.12	-0.04	-0.03	200	0.13	0.036	
AB53	1730430.36	6449712.24	352.87	-0.75	-0.13	-0.26	190	0.76		-0.14	-0.02	-0.04	189	0.14	0.028	
AB54	1731111.92	6447047.87	407.31	-0.02	0.01	0.00	164	0.03	*	0.00	0.01	-0.02	97	0.01	0.033	*
AB55	1731174.61	6447753.58	405.37	-0.15	0.02	-0.01	173	0.16		-0.04	0.00	-0.03	179	0.04	0.027	
AB56	1732214.00	6448545.55	571.57	-0.31	0.09	-0.08	164	0.32		-0.12	0.04	-0.06	162	0.12	0.026	
AB57	1731926.54	6449759.46	564.83	-0.37	0.09	-0.10	166	0.38		-0.14	0.03	-0.10	166	0.14	0.026	
AB58	1731117.67	6449074.94	405.64	-0.35	0.00	-0.03	179	0.35		-0.13	0.00	-0.05	178	0.13	0.038	
AB59	1730850.40	6450212.51	434.27	-0.47	-0.05	-0.10	186	0.47		-0.16	-0.01	-0.07	182	0.16	0.030	
AB60	1729089.38	6447987.45	179.39	-0.32	-0.12	-0.06	200	0.34		-0.15	-0.05	-0.03	199	0.16	0.025	
AB61	1727424.48	6447990.26	140.43	-0.02	0.00	-0.04	177	0.02	*	0.00	-0.01	-0.04	259	0.01	0.008	*
AB62R																
AB63R																
BB52	1726995.98	6451384.32	3.89	-0.38	-0.06	0.06	198	0.39		-0.15	-0.01	0.04	185	0.15	0.032	
CR07	1731628.00	6451203.34	632.26	-0.78	0.15	-1.02	169	0.79		-0.12	0.02	-0.07	171	0.12	0.034	
CR50	1733013.59	6451037.37	872.65	0.04	-0.01	-0.39	344	0.04		0.00	-0.01	-0.02	254	0.01	0.032	*
CR51	1733062.00	6452361.87	976.18	0.09	0.05	-0.57	28	0.11		-0.01	-0.01	0.00	216	0.01	0.031	*
CR52	1732867.53	6450239.26	779.68	-0.01	-0.08	-0.33	261	0.08		-0.02	-0.05	0.02	247	0.05	0.047	
FT06	1729855.05	6452760.09	488.79	-0.55	-0.12	-0.27	192	0.57		-0.20	-0.04	-0.11	191	0.20	0.027	
FT07	1729252.33	6454103.33	588.72	-0.91	-1.42	-0.29	237	1.69		-0.43	-0.67	-0.13	238	0.79	0.027	
FT09	1729388.67	6453350.48	658.45	-0.01	-0.02	0.01	251	0.02	*	0.01	-0.03	0.02	293	0.03	0.024	*
KC01	1728475.98	6452457.69	312.35	-0.80	-0.54	-0.53	214	0.97		-0.14	-0.08	-0.03	211	0.16	0.028	
KC02	1727002.55	6452118.84	13.73	-0.34	-0.16	-0.11	205	0.38		-0.07	-0.02	0.01	199	0.07	0.030	
KC04	1727559.31	6452666.95	238.46	-0.25	-0.29	-0.38	229	0.38		-0.05	-0.06	0.02	230	0.08	0.030	
KC05	1727081.92	6453178.90	227.47	-0.08	-0.19	-0.39	248	0.21		-0.03	-0.02	0.00	210	0.04	0.028	
KC06	1727704.89	6453396.26	299.88	-0.02	-0.41	-0.47	268	0.41		0.01	-0.06	-0.01	277	0.06	0.030	
KC07	1727759.39	6453683.87	313.48	0.20	-0.05	-0.35	346	0.21		0.01	-0.01	0.01	315	0.01	0.034	*
KC13	1726581.05	6453069.58	191.13	-0.11	-0.05	-0.07	206	0.12		-0.04	-0.03	-0.05	222	0.05	0.029	
KC14	1726742.44	6453806.00	259.92	0.00	-0.05	-0.02	271	0.05		0.01	-0.02	0.02	288	0.02	0.032	*
KC15	1727590.34	6453120.97	287.06	-0.11	-0.13	-0.04	229	0.17		-0.04	-0.05	-0.04	233	0.07	0.025	
KC16	1727602.24	6454098.22	326.88	-0.01	-0.01	-0.02	233	0.02	*	0.01	-0.02	0.00	288	0.02	0.031	*
PB04	1727665.23	6448848.66	166.92	-10.71	-3.08	-3.60	196	11.14		-0.71	-0.21	-0.19	196	0.74	0.042	
PB06	1727935.82	6449758.16	177.36	-32.63	-3.68	-5.70	186	32.84		-1.44	-0.20	-0.22	188	1.45	0.042	
PB07	1728135.18	6450212.21	197.54	-40.74	-7.55	-2.67	190	41.44		-1.82	-0.37	-0.12	191	1.86	0.035	
PB08	1728199.00	6450462.93	194.19	-38.50	-6.87	0.51	190	39.11		-1.66	-0.31	0.03	191	1.69	0.035	
PB09	1728245.34	6450848.65	188.99	-43.24	-2.37	-3.53	183	43.30		-2.01	-0.13	-0.25	184	2.01	0.036	
PB12	1728257.11	6451584.30	184.73	-73.38	-20.27	-8.56	195	76.13		-3.39	-0.99	-0.57	196	3.53	0.037	
PB13	1728043.37	6452148.28	206.76	-42.60	-16.06	-3.78	201	45.53		-2.10	-0.89	-0.11	203	2.28	0.030	
PB18	1730430.95	6450719.94	363.04	-15.94	8.95	-4.54	151	18.28		-0.30	0.06	-0.06	169	0.30	0.033	
PB20	1728743.25	6451124.73	232.60	-69.51	-10.95	-10.95	189	70.37		-3.06	-0.60	-0.60	191	3.12	0.042	
PB21	1729242.22	6451178.53	272.35	-55.99	6.48	-7.67	173	56.37		-2.22	0.18	-0.25	175	2.23	0.041	
PB25	1729670.41	6451986.30	326.01	-31.90	0.65	-2.98	179	31.91		-0.27	-0.06	0.01	193	0.28	0.029	
PB26	1729538.62	6452252.15	282.96	-24.02	2.59	-2.38	174	24.16		-0.23	-0.02	-0.03	184	0.23	0.044	
PB27	1729245.47	6451842.40	271.66	-93.87	6.34	-12.76	176	94.09		-3.65	0.09	-0.51	179	3.65	0.062	
PB29	1728842.25	6452093.51	170.88	-46.69	-26.98	-15.05	210	53.93		-2.28	-1.02	-0.71	204	2.49	0.039	
PB53	1729217.92	6450754.81	290.10	-34.85	0.89	-7.65	179	34.86		-1.89	0.10	-0.57	177	1.89	0.047	
PB54	1729690.83	6450448.49	357.73	-4.07	-0.20	-0.89	183	4.08		-0.21	-0.06	0.00	197	0.22	0.029	
PB55	1728775.28	6450801.26	239.73	-37.00	-2.78	-6.60	184	37.11		-2.08	-0.19	-0.45	185	2.09	0.039	
PB59	1727758.34	6448659.68	159.21	-8.02	-1.99	-4.18	194	8.27		-1.04	-0.30	-0.48	196	1.09	0.040	
PB64	1727417.65	6450937.67	67.14	-48.64	-9.27	-5.62	191	49.51		-21.39	-4.40	-2.55	192	21.83	0.038	
PB65	1728454.34	6449707.76	287.70	-0.32	-0.06	-0.05	191	0.33		-0.32	-0.06	-0.05	191	0.33	0.025	
UB02	1727519.20	6450142.56	62.65	-61.91	8.78	-4.51	172	62.53		-3.57	0.44	-0.10	173	3.60	0.039	

Portuguese Landslide Monitoring Survey - COORDINATE LIST

Prepared by McGee Surveying Consulting for the October 03, 2011 Survey

Document Date: 01/12/2012

Datum: Horizontal & EH NAD83 (2007) Epoch; California State Plane Zone 5; Vertical: NAVD88

Note, Fixed CGPS Station EVE3 at Record 3D Position & Orthometric Height per 09/2007 Survey; See Survey Reports

Point	Latitude	Longitude	EH (ft)	North (ft)	East (ft)	OrthoHt(ft)	Description
M05AB01	33-44-38.30248	118-22-53.05149	60.02	1729427.55	6445709.59	178.50	Punched 1/2" GIP in meter box
M05AB02	33-44-13.84878	118-22-26.19229	-2.04	1726946.97	6447968.70	116.45	4" BC "SAN PEDRO 1936" on conc. block
M05AB04	33-44-28.09221	118-22-36.28605	-51.25	1728390.04	6447121.59	67.21	BC "CO ENG STA Q2.." on 2"GIP in mass of conc.
M05AB05	33-44-24.99094	118-22-30.08976	-37.95	1728074.57	6447643.73	80.49	BC "CO ENG STA Q3.." on 2"GIP in mass of conc.
M05AB06	33-44-34.69625	118-22-38.04233	46.34	1729058.21	6446975.77	164.77	PK Nail in top/curb in median
M05AB07	33-44-33.94797	118-22-33.51863	40.83	1728981.13	6447357.52	159.24	PK Nail in north top/curb
M05AB12	33-44-38.27621	118-22-22.72004	164.84	1729415.28	6448271.12	283.19	BC "CO ENG STA 7A.." in mass of conc.
M05AB13	33-44-43.34635	118-22-23.16090	246.18	1729927.96	6448235.79	364.50	Punched 1/2" GIP in meter box
M05AB15	33-44-47.13393	118-22-24.79450	278.56	1730311.37	6448099.26	396.87	Punched 1/2" GIP in meter box
M05AB16	33-44-47.57976	118-22-31.51182	258.11	1730358.55	6447532.15	376.44	Punched 1/2" GIP in meter box
M05AB17	33-44-58.06052	118-22-41.08444	324.45	1731421.09	6446727.74	442.78	Punched 1/2" GIP in meter box
M05AB18	33-44-59.90565	118-22-23.80493	338.59	1731602.16	6448187.62	456.84	Punched spike in center cul-de-sac
M05AB20	33-44-37.77664	118-22-05.96547	277.96	1729359.56	6449685.89	396.23	BC "CO ENG STA W. FIX 1956.." in mass of conc.
M05AB24	33-44-42.35504	118-22-28.79421	217.42	1729829.52	6447759.68	335.77	Cotton spindle in conc. In road
M05AB50	33-44-25.11194	118-22-22.94403	63.60	1728084.56	6448247.27	182.01	Nail & shiner in conc. collar of well
M05AB51	33-44-40.23069	118-22-34.15152	186.79	1729616.46	6447306.45	305.17	PK mag nail in plastic plug "LS6957" in 1"GIP
M05AB52	33-44-44.22639	118-22-18.56485	250.06	1730015.49	6448624.26	368.35	Punched spike in center cul-de-sac
M05AB53	33-44-48.36985	118-22-05.69987	234.65	1730430.36	6449712.24	352.87	Chisled + on s edge conc. Vault
M05AB54	33-44-55.01413	118-22-37.27977	288.98	1731111.92	6447047.87	407.31	Cotton spindle in intersection
M05AB55	33-44-55.66039	118-22-28.92581	287.08	1731174.61	6447753.58	405.37	Cotton spindle in intersection
M05AB56	33-45-05.97111	118-22-19.59328	453.36	1732214.00	6448545.55	571.57	6" mag nail & washer in conc. in 2"x 36" GIP
M05AB57	33-45-03.17170	118-22-05.20566	446.67	1731926.54	6449759.46	564.83	6" mag nail & washer in conc. in 2"x 36" GIP
M05AB58	33-44-55.14555	118-22-13.27642	287.42	1731117.67	6449074.94	405.64	Punched RR spike on s side road
M05AB59	33-44-52.54299	118-21-59.79419	316.10	1730850.40	6450212.51	434.27	6" mag nail & washer in conc. in 2"x 36" GIP
M05AB60	33-44-35.04203	118-22-26.06461	61.02	1729089.38	6447987.45	179.39	6" mag nail & washer in conc. in 2"x 28" GIP
M05AB61	33-44-18.57298	118-22-25.95804	21.97	1727424.48	6447990.26	140.43	6" mag nail & washer in conc. in 2"x 24" GIP
M05AB61ECC	33-44-18.71704	118-22-26.13970	22.64	1727439.10	6447974.97	141.10	Tack in plastic plug in 5/8 x 24" rebar
M05AB62R	33-44-33.23180	118-22-38.63146	24.57	1728910.35	6446925.46	143.01	6" mag nail & washer in conc. in 1"x 24" GIP
M05AB63R	33-44-34.71931	118-22-34.11995	62.43	1729059.30	6447307.03	180.84	Punched 1/2 x 48" rebar
M05BB52	33-44-14.45733	118-21-45.75350	-114.41	1726995.98	6451384.32	3.89	PK mag nail in drill hole top large rock mass
M05CR07	33-45-00.27059	118-21-48.09460	514.17	1731628.00	6451203.34	632.26	6" mag nail & washer in conc. in old 1" IP
M05CR50	33-45-13.97078	118-21-50.11940	754.59	1733013.59	6451037.37	872.65	Tack & shiner on lower rock wall
M05CR51	33-45-14.49682	118-21-34.43621	858.18	1733062.00	6452361.87	976.18	Tack & shiner on conc pad
M05CR52	33-45-12.49733	118-21-59.56449	661.58	1732867.53	6450239.26	779.68	Tackail & shiner on rock retaining wall
M05FT06	33-44-42.78794	118-21-29.58505	370.70	1729855.05	6452760.09	488.79	6" mag nail & washer in conc. in 2"x 36" GIP
M05FT07	33-44-36.87290	118-21-13.65447	470.67	1729252.33	6454103.33	588.72	6" mag nail & washer in conc. in 2"x 36" GIP
M05FT08	33-44-38.19530	118-21-22.57457	540.37	1729388.67	6453350.48	658.45	6" mag nail & washer in conc. in 2"x 36" GIP
M05KC01	33-44-29.13554	118-21-33.10747	194.18	1728475.98	6452457.69	312.35	6" mag nail & washer in conc. in old 1" IP
M05KC02	33-44-14.54847	118-21-37.05714	-104.54	1727002.55	6452118.84	13.73	Punched 1/2" GIP in meter box
M05KC04	33-44-20.07532	118-21-30.59092	120.25	1727559.31	6452666.95	238.46	BC "CO ENG STA K6.." on 2"GIP in mass of conc.
M05KC05	33-44-15.37101	118-21-24.50929	109.27	1727081.92	6453178.90	227.47	Punched 1/2" GIP in meter box
M05KC06	33-44-22.33239	118-21-21.96524	181.73	1727784.89	6453396.26	299.88	Punched 1/2" GIP in meter box
M05KC07	33-44-22.09019	118-21-18.55881	195.33	1727759.39	6453683.87	313.48	Punched 1/2" GIP in meter box
M05KC13	33-44-10.41253	118-21-25.78263	72.90	1726581.05	6453069.58	191.13	Cotton spindle in AC turnout
M05KC14	33-44-12.03485	118-21-17.07021	141.73	1726742.44	6453806.00	259.92	Punched spike in center road
M05KC15	33-44-20.39824	118-21-25.21660	168.88	1727590.34	6453120.97	287.06	Cotton spindle in cul-de-sac
M05KC16	33-44-20.55009	118-21-13.64619	208.75	1727602.24	6454098.22	326.88	Punched spike in intersection
M05PB04	33-44-20.98598	118-22-15.80500	48.52	1727665.23	6448848.66	166.92	Nail & tag "RCE26120" in conc. in 3" pipe
M05PB06	33-44-23.69567	118-22-05.04804	59.01	1727935.82	6449758.16	177.36	Punched cap on 2" GIP
M05PB07	33-44-25.68419	118-21-59.68050	79.23	1728135.18	6450212.21	197.54	Brass tag "LA CO DPW" in conc. in 2" GIP
M05PB08	33-44-26.32455	118-21-56.71460	75.90	1728199.00	6450462.93	194.19	Punched cap on 2" GIP
M05PB09	33-44-26.79680	118-21-52.14945	70.72	1728245.34	6450848.65	188.99	Punched cap on 2" GIP in cable box
M05PB12	33-44-26.93949	118-21-43.43952	66.50	1728257.11	6451584.30	184.73	Punched cap on 2" GIP in cable box
M05PB13	33-44-24.84521	118-21-36.75270	88.55	1728043.37	6452148.28	206.76	Punched cap on 2" GIP in cable box
M05PB18	33-44-48.41204	118-21-53.76737	244.87	1730430.95	6450719.94	363.04	Punched 1/2" GIP in meter box
M05PB20	33-44-31.73200	118-21-48.90191	114.37	1728743.25	6451124.73	232.60	Punched cap on 2" GIP in cable box
M05PB21	33-44-36.66969	118-21-48.28623	154.15	1729242.22	6451178.53	272.35	Punched cap on 2" GIP in cable box
M05PB25	33-44-40.93408	118-21-38.73971	207.87	1729670.41	6451986.30	326.01	Punched cap on 2" GIP in cable box
M05PB26	33-44-39.63989	118-21-35.58626	164.83	1729538.62	6452252.15	282.96	Brass tag "LA CO DPW" in conc. in 2" GIP
M05PB27	33-44-36.72546	118-21-40.42561	153.50	1729245.47	6451842.40	271.66	Punched cap on 2" GIP in cable box
M05PB29	33-44-32.74579	118-21-37.43505	52.72	1728842.25	6452093.51	170.88	Brass tag "LA CO DPW" in conc. in 2" GIP
M05PB53	33-44-36.41407	118-21-53.30237	171.88	1729217.92	6450754.81	290.10	PK mag nail in plastic plug "LS6957" in 1"GIP
M05PB54	33-44-41.08106	118-21-56.94984	239.51	1729690.83	6450448.49	357.73	PK mag nail in plastic plug "LS6957" in 1"GIP
M05PB55	33-44-32.03720	118-21-52.73339	121.49	1728775.28	6450801.26	239.73	PK mag nail in plastic plug "LS6957" in 1"GIP
M05PB59	33-44-21.90012	118-22-18.04664	40.80	1727758.34	6448659.68	159.21	PK mag nail in plastic plug "LS?" in 1" GIP
M05PB64	33-44-18.61255	118-21-51.05990	-51.17	1727417.65	6450937.67	67.14	2" alum. cap "MCGEE SURVEYING.." on 1"x36"GIP
M05PB65	33-44-28.82309	118-22-05.66722	169.38	1728454.34	6449707.76	287.70	2" alum. cap "MCGEE SURVE.." on 5/8"x24"rebar
M05UB02	33-44-19.58845	118-22-00.47852	-55.70	1727519.20	6450142.56	62.65	PK mag nail in plastic plug "?" in 1"GIP
M05PVE3	33-44-35.85329	118-24-15.26904	235.42	1729207.09	6438765.18	354.36	CGPS Record Position Fixed All Surveys
M05PVHS	33-46-46.02019	118-22-19.74134	854.03	1742328.08	6448570.49	972.05	CGPS Pos. Determined Oct. 2011 Survey
M05PVBS	33-46-25.89206	118-19-14.06720	198.62	1740239.31	6464237.89	316.33	CGPS Pos. Determined Oct. 2011 Survey
M05VTIS	33-42-45.48966	118-17-37.71220	197.53	1717933.68	6472307.23	315.28	CGPS Pos. Determined Oct. 2011 Survey

October 2010

Survey Report

for the

Monitoring and Control Surveys

of the

Rancho Palos Verdes Portuguese Landslide

By

McGee Surveying Consulting and Charles Abbott Associates, Inc.

INDEX

ATTACHMENTS

FULL DATA POSTING (Monitoring point overall movements and periodical movements)
COORDINATE LIST-Oct. 2010 Survey (Current NAD83 Geodetic, Grid Coordinates, NAVD88 Heights)

Survey Report
of the
Portuguese Landslide November October 2010 Monitoring Survey
for the
City of Rancho Palos Verdes
by
McGee Surveying Consulting

Surveyed by: McGee Surveying Consulting of Santa Barbara, CA, and Charles Abbott Associates, Inc.
Client: City of Rancho Palos Verdes; **Project Name**: Portuguese Bend Landslide Monitoring Program
Location: Rancho Palos Verdes, California; **County:** Los Angeles; **State:** California

PROJECT OVERVIEW:

McGee Surveying Consulting performed a slide monitoring and control survey in October 2010 at Portuguese Bend on behalf of the City of Rancho Palos Verdes. The purpose of the survey was to establish accurate positions on monitoring points to determine overall and periodic movements. The results of this Survey are described in this Report and reported on spreadsheets attached hereto.

The field survey was planned, coordinated and executed by Michael McGee, PLS3945 of McGee Surveying Consulting of Santa Barbara, California in coordination with Frederick (Rick) Jones, P.E., P.L.S., City Engineer, City of Rancho Palos Verdes. Michael McGee PLS was responsible for the final processing of the observations, network adjustments, analysis and reports. The monitoring points cover approximately a 1½ mile square area and are measured annually or more often as necessary to determine the rate and extent of ground movement. Global Positioning System (GPS) technology is used for the purpose of determining positions based on the North American Datum of 1983 (NAD83) and the North American Vertical Datum of 1988 (NAVD 88) as referenced to the California CGPS (Continuous GPS) Stations in the region which are permanently mounted GPS receivers for monitoring seismic activity. The CGPS in California are similar to the national CORS (Continuously Operated Reference Stations).

Given that many points move about an inch (0.08') or less per year, the requirement is to meet a relative accuracy standard of one centimeter (0.033 feet) at the 95% Level of Confidence. In the active slide area (central portion) where the movements are greater, two centimeters (0.066 feet) is sufficient. Field procedures are designed to accomplish this purpose and Quality Control-Quality Assurance (QAQC) processes discussed hereafter are incorporated to verify this accuracy is attained.

The movements reported between November 2009 and October 2010 (11.25 months) statistically attained an average accuracy of 0.027 feet at the 95% Level of Confidence overall as reported in the attached document "FULL DATA POSTING". The actual accuracies of these measurements are better by a factor of two as demonstrated by the measured vector residuals, repeatability of measurements at points considered stable, and the general consistency in the direction of the movements reported from one period to the next. Refer to the sections titled ACCURACY and SUMMARY at the end of this Report for more information.

HISTORY

This survey is a continuation of a monitoring survey program initiated by the County of Los Angeles and taken over by the City of Rancho Palos Verdes circa 1994. McGee Surveying Consulting has conducted the field surveys and reporting since September 2007. See the September 2007 Survey Report for a detailed history of the previous survey process between 1994 and 2007. See the subsequent Survey Reports for the December 2008 and November 2009 campaigns.

PROJECT DATUMS, REFERENCE SYSTEM

Horizontal Datum: North American Datum of 1983 (NAD83) per the National Geodetic Survey (NGS); **Epoch:** 2007.00 referred to as NAD83(2007.00).; **Units:** Feet

Reference Network: The survey is referenced to the CGPS Stations which are continuously operating reference GPS receivers mounted on a stabile platform (for more information see NGS Data Sheets for the PID's listed below). No data sheet exists for PVE3. The positions were obtained from the California Spatial Reference Center (CSRC). CSRC provides NGS sanctioned positions on the California CGPS Stations.

CGPS	Latitude (dms)	Longitude (dms)	EH (feet)	NGS PID	NAME
PVE3	33 44 35.853290	-118 24 15.269036	235.42	none	PALOS VERDES CORS
PVHS	33 46 46.020150	-118 22 19.741258	853.99	AJ1915	PENINSULA HIGH SCH
PVRS	33 46 25.891904	-118 19 14.067218	198.63	AJ1916	PALOS VERDES RES
VTIS	33 42 45.489584	-118 17 37.712290	197.52	AJ1936	MARINE EXCHANGE

Note: PVRS falls in the proximity of a Fault Line as shown below but appears unaffected to date

CGPS Stations (north is up)

Vertical Datum: North American Vertical Datum of 1988 (NAVD88) orthometric heights per NGS
Geoid Model: Geoid 03; Note, Geoid09 became available from the NGS in late 2009; however, Geoid03 is retained to be consistent with prior reported heights and the purpose of determining relative changes.

Reference Network: CGPS Station VTIS is the basis for this survey (see NGS Data Sheets)

CGPS	NAVD 88 Ht(feet)	
PVE3	none	
PVHS	972.1	Based on a Refined Geoid Model
PVRS	316.3	Based on a Refined Geoid Model
VTIS	315.26	Based on Second Order Leveling by CSRC and original basis for this survey

Projection: NAD83 California State Plane Coordinates Zone 5: The State Plane Coordinates Parameters for Zone Five follow. The average Scale Factor is 1.00007543, the Ellipsoid Height Reduction Factor based on the average ellipsoid heights is 0.99999092, and the average Combined Grid Factor is 1.00006635. Distances in this survey are grid. To obtain ground distance divide the grid distances by the Combined Grid Factor. Grid bearings resulting from this survey must be rotated by a Convergence Angle to obtain geodetic (true) bearings. The average convergence angle is -0-12-30.2± (rotate left 0-12-30).

Datum Stability: The NAD83, 2007.00 Epoch adjustment is one of a series of adjustments of NAD83 since its adoption in 1986 and is the datum used for the monitoring surveys since 2007. Rancho Palos Verdes sits on the Pacific Plate which is moving west-northwesterly relative to the North American Plate about 4 centimeters (0.14 feet) per year. The area southwesterly of the Fault Line shown on the above map includes the City and is moving at a constant rate as exhibited by the N, E, Up velocities of the CGPS Stations listed below. These CGPS Stations provide a rigid reference frame for the Portuguese Landslide Monitoring Program that is validated during each monitoring campaign. See the Adjustment results on Page 6 and the September 2007 Monitoring Survey Report by McGee Surveying Consulting for additional information.

Annual Velocities in Feet
Reference Epoch 2010.84

CGPS	North	East	Up
PVE3	0.064	-0.130	-0.002
PVHS	0.063	-0.129	-0.002
PVRS	0.062	-0.129	0.000
VTIS	0.065	-0.129	-0.002

FIELD SURVEYS, DATA COLLECTION, EQUIPMENT & PROCESSING

Sixty-five monitoring points were occupied and reported in October 2010. Site photographs and recovery sheets detailing the location, character of the monument and obstructions were updated. See the Appendix for "Monitoring Point Status as of October 2010" and "Monitoring Points Photo Update October 2010" for additional information. See prior Monitoring Survey Reports for all photos.

AB61 was established in September 2007 on Portuguese Point and is used as the primary base station because of its suitability for GPS observations. The location is secured behind a locked gate, has a clear horizon above 10 degrees, and sits on a stable basalt geological formation. A 5/8" x 2' rebar with a plastic cap and tack was set on 10/23/2010 for a reference monument named "AB61ECC" at 313-40 Azimuth, 21.155' at +0.641'.

The field survey commenced each day by setting a GPS receiver on a fixed height pole on AB61 while two GPS receivers roamed freely collecting observations on fixed height poles at the 64 on-site points. Many of the points are over-shadowed by mature trees and shrubbery which interfere with signals received from satellites and affect the quality of measurements. To obtain the highest possible accuracies, satellites are compared with obstruction diagrams to estimate the best time for observing a point. After arriving at a point to be observed, the GPS receiver is set up, and the location in the sky of each satellite is estimated with a compass and abney. Those satellites obstructed by foliage and trees are turned off. If 5 or more un-obstructed satellites with a

GDOP (measure of the geometry of the constellation) of 4.5 or less are available, then the measurement commenced for 10-25 minutes of data collection. If sufficient satellites and geometry are not available, then the receiver is moved to the next point and returned later when satellite availability improves. This process is followed until all points are occupied twice under a different constellation of satellites on a different day. If the two measurements are within 0.03 feet in slow movement areas or 0.06 feet in active slide areas, then they are accepted, otherwise a third measurement is obtained.

Three Leica geodetic GPS receivers and antennas listed below were utilized to collect, process and store satellite signal data. Three, 2.00 meter fixed height poles were used for the base station and for the observations of the monitoring points. Prior to initiating the field observations a calibration of the fixed height poles was conducted with a theodolite to verify their height and plumb. The top of the poles were found to be plumb within 0.003 feet of the bottom consistent with prior years. Additional checks were made each day. There were no equipment failures.

GPS Survey Parameters:
Date of Field Surveys: 10/23/10 to 10/28/10 (10/25/2010 mean date) 0600-1800 PST (+8 hrs for UTC).
Constellation: The NAVSTAR GPS constellation consisted of 31 Block II satellites.
GPS Observables: L1 & L2 Carrier Wave, C/A Code & P-Code; P-code was encrypted and SA off.
Epoch Rate & Occupation Times: 10 seconds for 10-25 minutes and 6-11 hours for CGPS connections.
Minimum Satellites: 5 ; GDOP < 4.5 ; Elevation Mask for Data Collection: 10 degrees;
Processing: 10 degrees except for connections to CGPS stations at 12 degrees.
Ephemeris: Precise for Static Post-Processing for all CGPS connections and Broadcast for on site.
Weather conditions: Generally clear skies and mild temperatures.
Space Weather: Boulder K Index was 4-2 on a scale of 0-9 and gauges ionospheric activity.
GPS Base Receiver Unit No.: M5, Operator: M. McGee, PLS; Station Identification: AB61
Make & Model: Leica GS15; Antenna Leica GS15; Mount: Fixed Height Pole #1; Antenna Height: 2.086m
GPS Rover Receiver Unit No.: M6, Operator: M. McGee, PLS;
Make & Model: Leica GS15; Antenna Leica GS15; Mount: Fixed Height Pole #2; Antenna Height: 2.086m
GPS Rover Receiver Unit No.: M3, Operator: R. Reese, PLS,
Make & Model: Leica 530; Antenna Leica AT502; Mount: Fixed Height Pole #3; Antenna Height: 2.083m

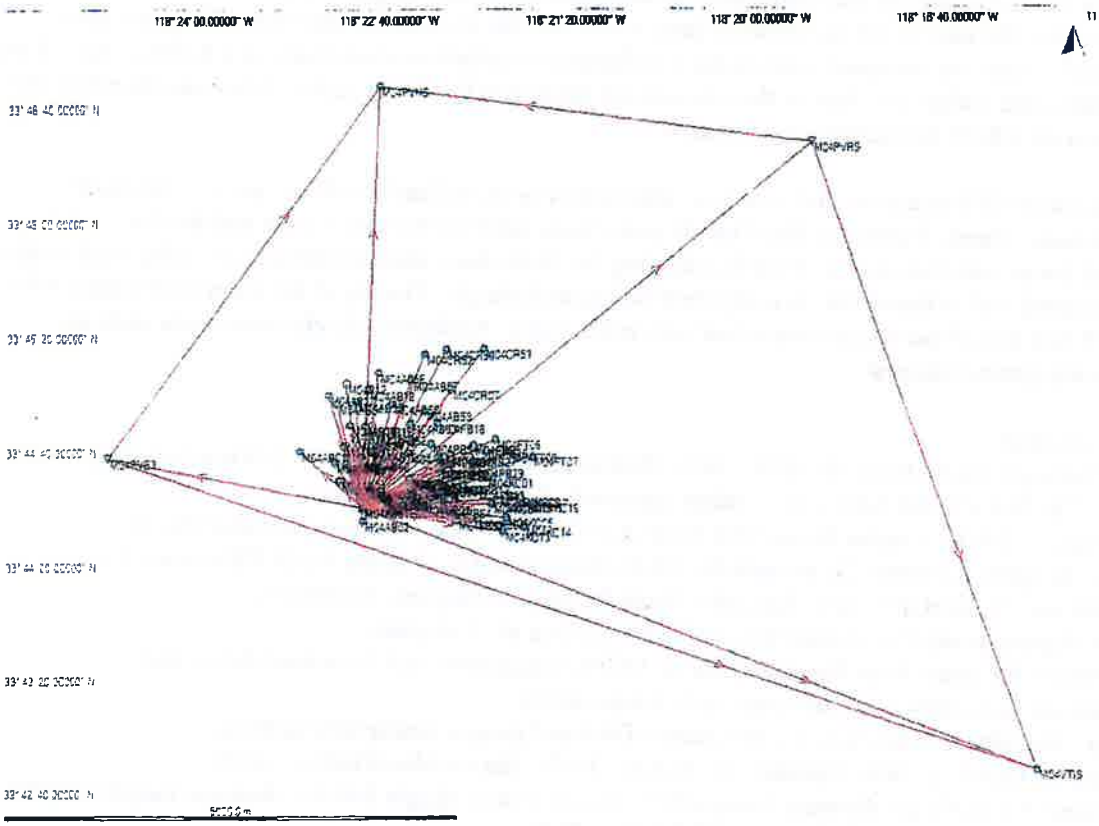
Data was processed using Leica LGO post processing software. The longer baseline connections to the CGPS were processed with a precise ephemeris at a cutoff vertical angle of 12° and the shorter monitoring network baselines were processed with a broadcast ephemeris at a cutoff vertical angle of 10°. Analysis of processing statistics and residuals led to the rejection of 3 vectors. Network adjustments and analysis were performed with "Starnet-PRO" version 6.0 software. Data files in the rinex format of the satellite measurements for the CGPS Stations were downloaded from the SOPAC website. The precise ephemeris and antenna models were downloaded from the NGS website. NGS Relative Antenna models were used to process connecting vectors to CGPS Stations.

NETWORK

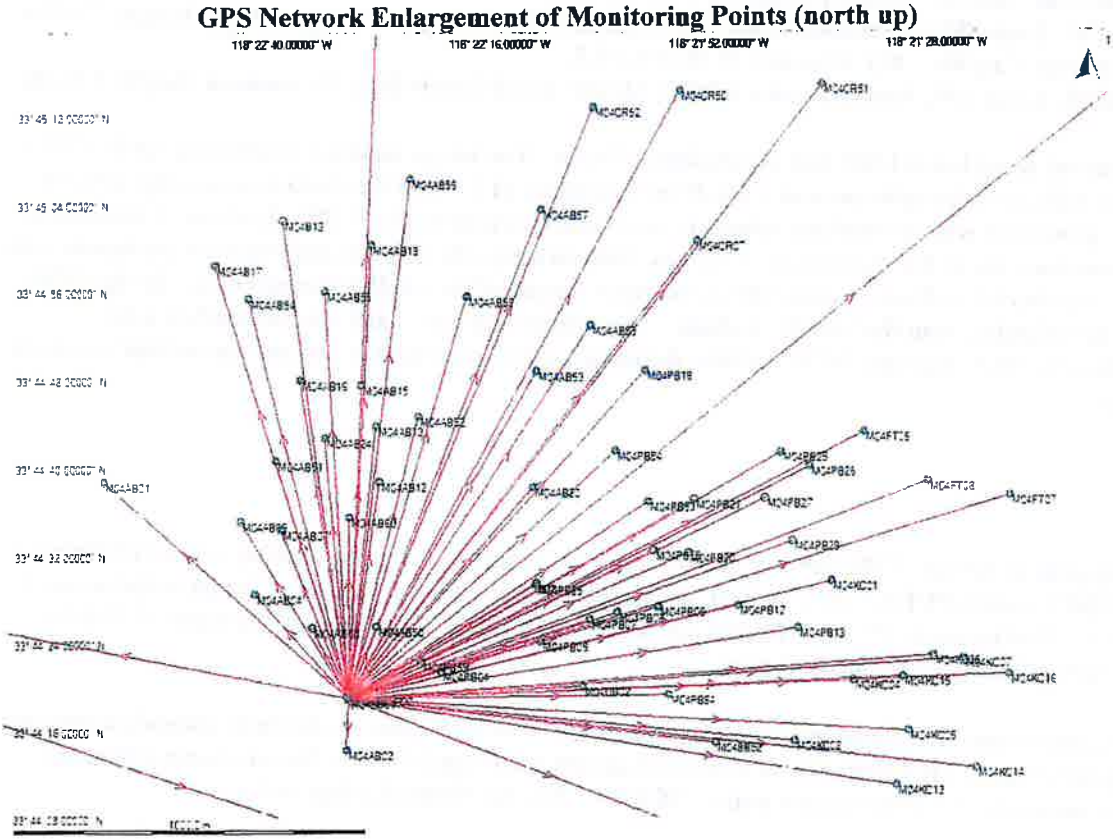
The monitoring plan uses four CGPS Stations and several local points to verify the stability of the reference system. The CGPS Station PVE3, near City Hall, is located 1.8 miles west-northwest of the base station point AB61. PVHS is 2.8 miles north, PVRS 3.9 miles northeast, and VTIS is 4.9 miles east-southeast of AB61 as shown on the Network diagram on the next page.

AB61, is the primary base station and sits on Portuguese Point. It is focal point of the static network connecting the monitoring points and CGPS Stations. A total of 65 on site points and 4 CGPS Stations were connected with 72 vectors measured 2-3 times to each point (159 total). See the Network Maps below.

GPS Network with CGPS Stations (north up)



GPS Network Enlargement of Monitoring Points (north up)



MONITORING POINT STATUS

For data management purposes during the field survey and data processing, the point names are prefixed with "M04" i.e. AB61 is M04AB61 to distinguish between different monitoring periods. M04 indicates this survey is the fourth monitoring since the initial September 2007 Monitoring Survey when the program was modernized. This allows queries between epochs that include statistical information about accuracies. The prefix is stripped in the reports.

Since 1994, 149 monitoring points have been established in the Portuguese Bend area, many of which are now lost or destroyed. Sixty of the original points were recovered in 2007. Eight of the 60 points were deleted because they were in close proximity of other better suited for GPS leaving 52 points monitored for movement between September 2006 and September 2007. Three of the 52 points (AB09, KC11, PB51) were monitored in September 2007 for the last time because they were replaced by new points, set nearby and better suited for GPS. Eighteen new points set in 2007 had their movements reported for the first time in the December 2008 survey. In December 2008, 49 original and 18 points set in September 2007 were surveyed for a total of 67 monitoring points.

In the September 2007 Report, it was noted that KC01 was reported by the previous survey on 9/14/2006 to have moved N 29°E 1.24' from its 12/9/2005 position. This surveyor found a buried brass cap in concrete stamped "COUNTY ENGINEER RE8869 1956 STA ??IELDS" S31°29'W 1.48 feet from the 1" IP with steel guard post that was found in September 2007 and used on subsequent surveys. The original position of KC01 is adjusted in this Report to be consistent with the 1" IP, resulting in correct overall reported movements.

In the December 2008 Report, it was noted that AB05 had been previously disturbed by a mowing machine. AB05 was found chipped and leaning to southerly about 0.4'. The movement reporting resumed in 2009. Analysis of the present movement and historic data makes it possible to estimate the disturbance to within 0.05'. The original position of AB05 is adjusted S14°02'E 0.29' in this Report to be consistent with the disturbed position, resulting in correct overall reported movements.

In 2009, a new point PB64 was set east of the Archery Range to replace PB63 which had become unsafe to access. PB64 is reported for the first time in 2010 and PB63 was destroyed sometime in 2010.

In 2010, points AB03 and BB25 were deleted from the survey. AB03 was redundant and not moving and BB25 is on an apparently unstable rock affected by the surf. In the summer of 2010, PB62 was destroyed by road construction, and a new point PB65 was set 24' south-southwest. Movement will be reported for the first time in 2011. The following points may have been slightly disturbed. AB05 may have been disturbed by mower machinery and AB15 (a ½" GIP in a meter box) has been driven over recently by vehicles occasionally accessing an adjacent field.

The present status of monitored points is provided in the Appendix under "Monitoring Point Status as of October 2010".

ADJUSTMENTS & ANALYSIS

Adjustment 1: Minimally Constrained Adjustment processed to develop Geodetic and Ellipsoid Coordinates in NAD83 (2007.00)
Fixed Control: The CGPS Station PVE3 was fixed at its published three dimensional position in a Minimally Constrained Adjustment to determine latitude, longitude, ellipsoid heights, state plane coordinates, and to check other known points. PVE3 has been fixed in all adjustments since 2007. The CSRC publishes a Time Series for the horizontal and vertical stability of PVE3 which indicate the position has been stable over a ten year

period to date. The other three CGPS Station positions determined by this and prior surveys relative to PVE3 are used to assess stability of the reference frame. The positions determined by this survey are based 6-11 hour measurement collected on four days over a six day period. The coordinate differences at other CGPS Stations from previous positions to the present are listed below in feet.

11/2009 Positions to 10/2010					9/2007 Positions to 10/2010			
Station	dN	dE	dZ		Station	dN	dE	dZ
PVE3	0.000	0.000	0.000	Fixed 2010	PVE3	0.000	0.000	0.000
PVHS	-0.002	0.001	-0.033		PVHS	-0.004	0.006	0.011
PVRS	-0.002	-0.001	-0.004		PVRS	-0.000	0.008	0.006
VTIS	-0.001	-0.003	0.005		VTIS	-0.003	0.005	-0.001
AB61	-0.009	-0.002	0.050	Base Station	AB61	-0.019	0.011	0.005

The two dimensional (2D) differences from the November 2009 to the October 2010 measured positions of the three free CGPS Stations range 0.002 to 0.003 feet and 0.009 feet at AB61. Since the initial survey in 2007, the 2D difference range 0.006 to 0.008 feet at the CGPS and 0.022 feet at AB61. For the purpose of this survey, a constrained adjustment is not preferred as the purpose here is to track their relative stability which is within 0.01 feet. In addition to the CGPS, points AB02, AB17, AB61, and KC16 have a stable history. Their prior positions when compared to this survey indicate repeatability at the level of 0.01 feet as listed in the "FULL DATA POSTING".

The survey reference frame is deemed stable and successfully recovered at the level indicated. See the attached file "COORDINATE LIST-Oct 2010" for a list of coordinates resulting from this adjustment. See prior Reports for coordinates resulting from earlier surveys.

Adjustment 2: Minimally Constrained Adjustment processed to develop Orthometric Heights (Elevations) in NAVD88

Fixed Control: The CGPS Station PVE3 was fixed horizontally and vertically. The NAVD88 orthometric height of PVE3 was determined in the September 2007 survey based on the published 2nd Order NAVD88 Height of CGPS Station VTIS located 4.9 miles east-southeasterly. The Adjustment combined the measured ellipsoid height differences with the NGS Geoid 03 (models the separation between the ellipsoid and geoid surfaces) to determine NAVD88 orthometric heights of other CGPS Stations. The differences from prior surveys to the heights determined in the present survey are listed below in feet.

11/2009 to 10/2010			9/2007 to 10/2010	
PVE3	-0.000	Fixed	PVE3	-0.000
PVHS	-0.033		PVHS	0.008
PVRS	-0.004		PVRS	0.010
VTIS	0.005		VTIS	-0.002

Note: This survey checks from PVE3 to VTIS 0.005 feet in the present survey and -0.002 feet with the 2007 survey. See the attached file "COORDINATE LIST-Oct 2010 Survey" for a list of heights resulting from this survey.

ACCURACY

Movement Accuracy: For the movements reported in this period, the statistical analysis of points moving less than 0.3 feet returned a relative error at the 95% Level of Confidence averaging 0.026 feet with a standard deviation of 0.006 feet and a range of 0.005 to 0.037 feet. Overall, the relative error averaged 0.027 feet with a standard deviation of 0.006 feet and a range of 0.005 to 0.044 feet. No movement is considered detected unless the movement exceeds the 95% Error. See Page 4 of the "FULL DATA POSTING" for listing.

Vector Residuals: 159 measured vectors were processed in Adjustment #1 resulting in 72 vectors connecting 69 points. The two dimensional residuals and the absolute value of the vertical residuals are listed below in feet.

	Two Dimensional Residuals			Vertical Residuals		
	Average	Std.Dev.	Maximum	Average	Std.Dev.	Range
Monitoring Pts	0.007	0.004	0.022	0.014	0.013	-0.05 to +0.06
CGPS Stations	0.005	0.003	0.012	0.023	0.022	-0.09 to +0.06

Note, if six of the twelve vectors connecting CGPS Station PVHS to the network were excluded the vertical residuals would range -0.027 to +0.032 feet for the other CGPS Stations indicating some signal interference is occurring; however, the horizontal position is considered reliable.

Vector Accuracy: The vector residuals at each point and the closures on stable control points discussed in "Adjustment 1" are good indications of the accuracies obtained by this survey. The lengths, precisions and relative distance errors resulting from the adjustment at the 95% Level of Confidence for the 72 vectors (baselines) are listed below in feet.

	Lengths		Precisions		Relative Dist.Error		
	Vary	Average	Vary	Average	Average	Maximum	Precision
Monitoring Pts	478-7134	3599	2.5-58.0	8.4 ppm	0.020	0.034	1: 180,000
CGPS Stations	9396-35386	22300	0.1- 0.4	0.2 ppm	0.004	0.004	1:5,575,000

The precision ratio based on the averages for the vectors connecting the Monitoring Points exceeds the criteria for a First Order (C-1) by a factor of 1.8, and the vectors connecting AB61 and the CGPS Stations exceeds the criteria for a B Order survey by a factor of 5.6 per the FGCS requirements for the former classification system.

Coordinate Accuracy: The Standard Deviations (68% Level of Confidence) the coordinates derived from Adjustment #1, relative to the CGPS Station PVE3 follow in feet.

	Monitoring Point			CGPS Stations		
	North	East	Up	North	East	Up
Standard Deviation Average	0.008	0.007	0.029	0.002	0.001	0.005
Standard Deviation Maximum	0.013	0.010	0.043	0.002	0.002	0.006

Absolute Coordinate Accuracy: The network accuracy is expected to be less than 0.02 feet horizontal relative to the NAD83 Datum based on the CGPS Station PVE3 fixed in Adjustment #1.

NAVD88 Heights: The North American Vertical Datum 1988 orthometric heights (elevations) resulting from Adjustment #2 are derived from the difference in ellipsoid heights combined with the Geoid 03 model and constrained to the orthometric height of PVE3. The ellipsoid heights are expected to be within 0.03 feet notwithstanding severely obstructed sites. The Geoid 03 model is expected to have a probable error of 1 part per million. Although relative elevation accuracies are expected to be 0.03+/- feet, there are no requirements for these surveys. The absolute accuracy of these heights is dependent on the published value on the CGPS Station VTIS.

This survey conforms to the intent of the Federal Geodetic Control Subcommittee (FGCS) Specifications for GPS Relative Positioning (1988) and the California Geodetic Control Committee (CGCC) Specifications for High-Production GPS Surveying Techniques (1993).

QAQC ANALYSIS

To ensure the accuracy and validity of the systems used to obtain the accuracies reported in these GPS surveys, an independent test was made using conventional terrestrial based instruments as reported in the "QAQC ANALYSIS" section of the September 2007 Monitoring Survey Report. The results found the GPS systems and conventional instrumentation horizontal measurements agreed 0.01 feet on average.

To validate the radial survey method of positioning points from a single base station (AB61), independent GPS cross connections were measured and compared with the computed inverse distances in 2007, 2008 and 2009

surveys. See the "QAQC ANALYSIS" section of the September 2007 and the December 2008 Monitoring Survey Reports for detailed analysis. The results found the two dimensional accuracy to agree 0.01 feet on average, indicating the radial method of measurements is reliable and the extra labor cost of measuring cross connection between points is not warranted.

Deflection Analysis is used to assess the consistency of movements reported on prior surveys. Assuming that movements are generally linear over short distances, the separation can be implied as an indication of the survey accuracy of the reported movements. If the deflection or separation between the direction for the previous and present periods is equal to or less than 0.02 feet then it is considered linear. Of the 48 points with detected movements, 46 have a history and 33 points meet this criteria. Their deflection between the direction for the previous and present periods, taken over the moved distance, returned an average separation of 0.009 feet with a standard deviation of 0.006 feet and a maximum of 0.024 feet. Significant deflections noted at the following points should be reviewed by the City Geologist: AB15 moved 0.07 feet deflecting +52 degree, and CR07 moved 0.06 feet deflecting +41 degree.

SUMMARY

A modernization of field procedures and processing techniques began with the September 2007 survey. Thereafter, temporal movements are based on a rigorous simultaneous least squares adjustment of multiple observations at two different epochs on each point. The statistical results of the November 2009 to October 2010 monitoring period show the relative accuracy of the reported movements averages 0.026 feet at the 95% Level of Confidence. Prior to September 2007, successive coordinate differences were used to compute movements which did not provide statistical information about the relative accuracies.

Results of the adjustment indicate the probability at the 95% level of confidence that movement (signal) has occurred at a point when the horizontal distance between two epochs is greater than the 95% Error (noise) listed in the "Full Data Posting" (ranges 0.005 to 0.044 feet). Using these criteria, 17 points have not moved and 48 points have moved. Between November 2009 and October 2010 (11.25 months), points in the Portuguese Bend Landslide moved between 0.08 and 27.7 feet. Points in the Abalone Cove Landslide west of the Portuguese Bend Landslide moved between 0.04 and 0.14 feet. Points in the Klondike Canyon east of the Portuguese Bend Landslide moved between 0.03 and 0.07 feet. See the Contours of Horizontal Movement in the Appendix for a graphical representation of the movements across the site.

Velocity Analysis: The movement distances for points moving less than 0.3 feet in the present period (11.25 month) are 111% on average (30% std. dev.) of the movements for the previous period (11.3 months). The movement distances for points moving greater than 0.6 feet in the present period (11.25 month) are 194% on average (16% std. dev.) of the movements for the previous period (11.3 months). The City Geologist should be referred to for assessment and interpretation of the movements.

See the attached "FULL DATA POSTING" spreadsheet for overall and periodic movements of each point. The movements are given in north, east and up or down as well as a vector of distance and direction relative to north. The direction is given as an azimuth in degrees where 0° is north and increases clockwise (180° is south). The overall movements are from the beginning position of each point which varies between 1994 and 2007.

The present status of monitored points is provided in the Appendix under "Monitoring Point Status as of October 2010". The historical status of all monitoring points is provided in the September 2007 Survey Report. The historical 1994-2006 positions of all points are listed in the Charles Abbott Associates Inc. file "ALL POINTS MOST RECENT OBSERVED POSITION AS OF SEPTEMBER 15, 2006.xls" attached to the 2007 Report.

RECOMMENDATION

A program was discussed in the 2010 Planning Meeting for the replacement of Monitoring Monuments. Presently, monuments are within several feet of the surface and it has been recommended that deeper monuments be set that would be more reliable in detecting sub-surface movements. Many of the points should be moved to locations with less overhead obstructions and therefore more suitable for GPS observations. A few locations have safety issues and require time consuming traffic control during the survey. A re-location program will have long term benefits resulting in lower survey costs and a better understanding of sub-surface movements. Monuments suitable to this purpose would be of a design approved by the City Geologist and ACLAD.

Attachments: Find the following documents attached to this Report.

FULL DATA POSTING - Lists the coordinates of the initial positions and the overall and periodic movements of monitoring point since 2007 in NAD83(2007.00) State Plane Coordinates and NAVD88 Heights.

COORDINATE LIST- October 2010 Survey - Current NAD83(2007.00) Geodetic, Grid Coordinates, NAVD88 Heights of all points

SURVEYOR'S STATEMENT

This Report on the criteria, procedures and results of the Rancho Palos Verdes Portuguese Landslide Monitoring Survey was prepared by me December 15, 2010 at the request of the City Engineer of the City of Rancho Palos Verdes.

Michael R. McGee
P.L.S. 3945

LICENSED LAND SURVEYOR MICHAEL RANDOLPH McGEE No. PLS 3945 STATE OF CALIFORNIA

Frederick (Rick) Jones
R.C.E. 36665, P.L.S. 5458

LICENSED LAND SURVEYOR FREDERICK R. JONES JR. NO. 5458 EXP. 9-30-2012 STATE OF CALIFORNIA

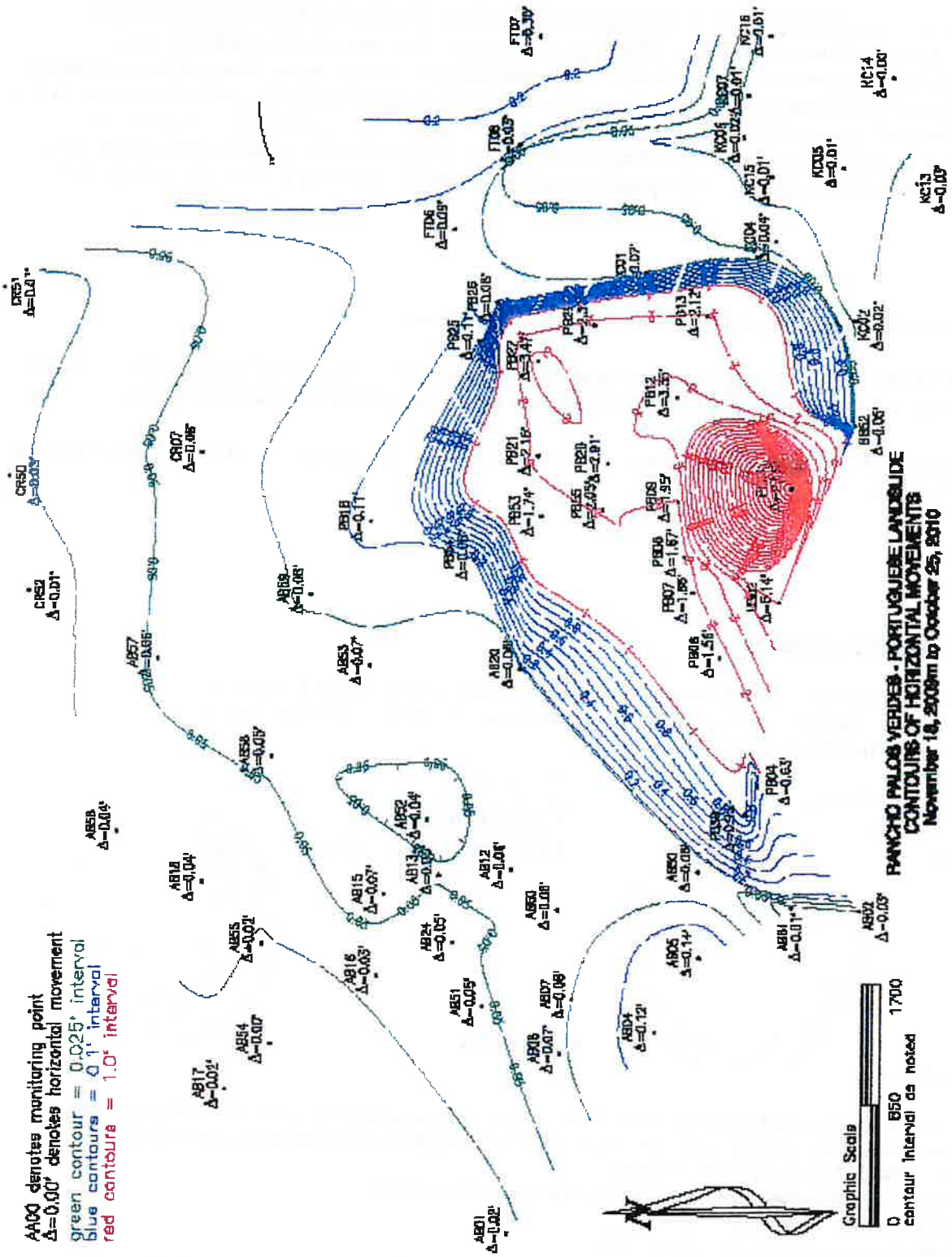
APPENDIX

Find the following:

1. Contours of Horizontal Movements –Nov. 2009 to Oct. 2010 (Contours at 0.025, 0.10 and 1.00 feet providing a general visual representation of movements; see the City Geologist for interpretation of movements)
2. Aerial Photo - Monitoring Point Locations
3. Aerial Photo – Regional View of Monitoring Points & CGPS Locations
4. Oblique View of Monitoring Points
5. Monitoring Point Status as of October 2010
6. Monitoring Points Photo Update October 2010 (Updated photos of changes since last Monitoring)

1. Contours of Horizontal Movements (north is left)

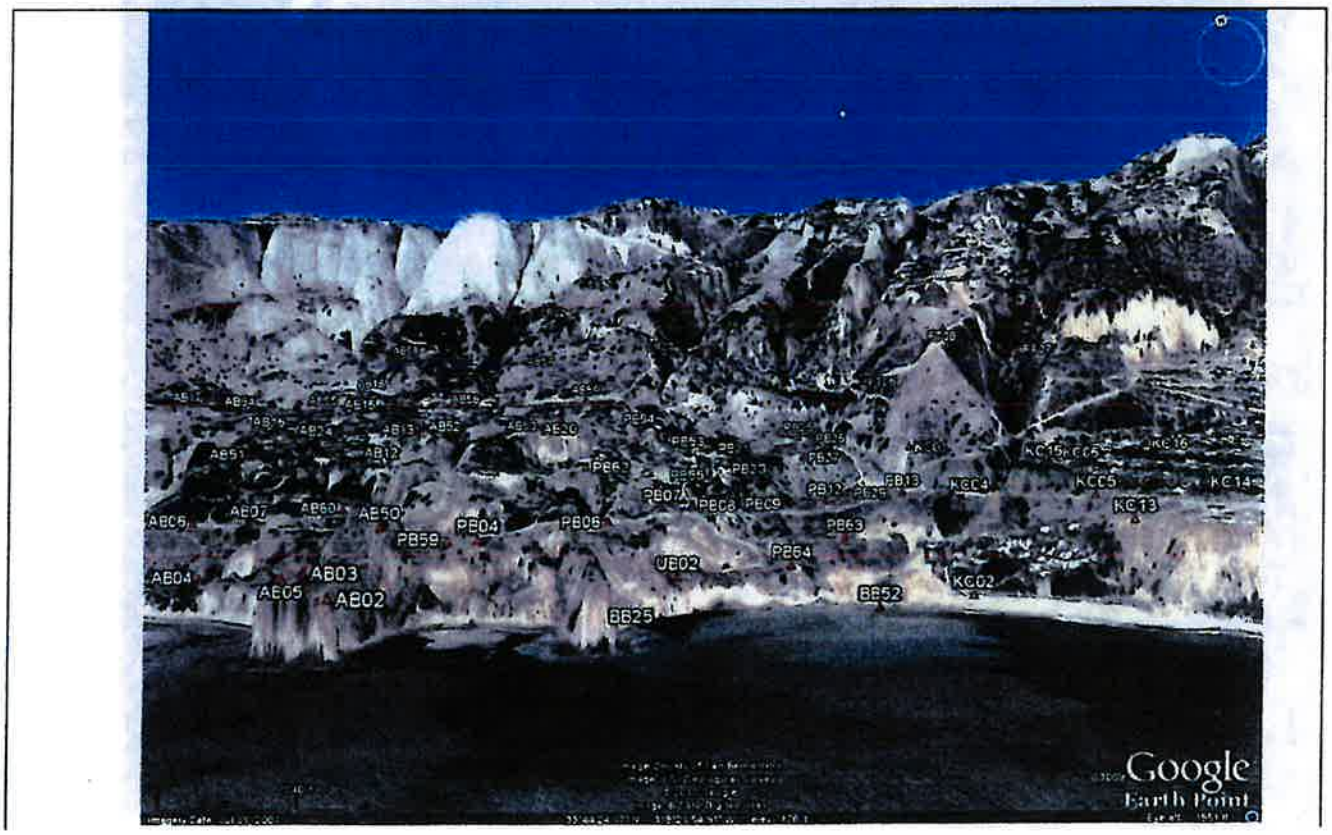
(This is a general visual representation of movements; see the Full Data Posting for actual movements)



2. Aerial Photo - Monitoring Point Locations - Photography Dated 11/15/2009 (north is left)

3. Aerial Photos – Regional View of Monitoring Points & CGPS Locations (north is up)

Oblique View of Monitoring Points (north is up)



4. Monitoring Point Status as of October 2010
RANCHO PALOS VERDES - PORTUGUESE LAND SLIDE MONITORING

Notes: 150 Monitoring Points established since 1994
09/2007 71 Points Monitored: 60 old points found with 52 monitored plus 19 new points
12/2008 67 Points Monitored: AB09, KC11, PB51 discontinued; BB53 destroyed; AB05 disturbed
11/2009 68 Points Monitored: Set PB64 new point to replace PB63
10/2010 65 Points Monitored: AB03 & BB25 Deleted, Set PB65 to Replace PB62 Destroyed

Pt ID	Last Obs'd	Comments	GPS
AB01	10/25/2010	1994-2006 Base	G
AB02	10/25/2010		G
AB03	10/25/2010	Deleted	G
AB04	10/25/2010		G
AB05	10/25/2010		G
AB06	10/25/2010		G
AB07	10/25/2010		G
AB12	10/25/2010		G
AB13	10/25/2010		P
AB15	10/25/2010		F
AB16	10/25/2010		P
AB17	10/25/2010		F
AB18	10/25/2010		P
AB20	10/25/2010	NE'ly of 2 pipes	G
AB24	10/25/2010		F
AB50	10/25/2010		G
AB51	10/25/2010		G
AB52	10/25/2010		P
AB53	10/25/2010		F
AB54	10/25/2010		P
AB55	10/25/2010		G
AB56	10/25/2010		F
AB57	10/25/2010		G
AB58	10/25/2010		P
AB59	10/25/2010		G
AB60	10/25/2010		G
AB61	10/25/2010	Base Station since 2007	G
BB25	10/25/2010	Deleted	G
BB52	10/25/2010		G
CR07	10/25/2010		F
CR50	10/25/2010		G
CR51	10/25/2010		G
CR52	10/25/2010		P

Pt ID	Last Obs'd	Comments	GPS
FT06	10/25/2010		G
FT07	10/25/2010		G
FT08	10/25/2010		G
KC01	10/25/2010	NE'ly of 2 pipes	G
KC02	10/25/2010		G
KC04	10/25/2010		G
KC05	10/25/2010		G
KC06	10/25/2010		G
KC07	10/25/2010		G
KC13	10/25/2010		G
KC14	10/25/2010		G
KC15	10/25/2010		F
KC16	10/25/2010		G
PB04	10/25/2010		G
PB06	10/25/2010		G
PB07	10/25/2010		G
PB08	10/25/2010		G
PB09	10/25/2010		G
PB12	10/25/2010		G
PB13	10/25/2010		G
PB18	10/25/2010		G
PB20	10/25/2010	S'ly of 2 pipes	G
PB21	10/25/2010		F
PB25	10/25/2010		G
PB26	10/25/2010		F
PB27	10/25/2010		G
PB29	10/25/2010		G
PB53	10/25/2010		P
PB54	10/25/2010		F
PB55	10/25/2010		P
PB59	10/25/2010		G
PB62	10/25/2010		G
PB64	10/25/2010	Replaces PB63	G
PB65	10/25/2010	Replaces PB62	G
UB02	10/25/2010		G

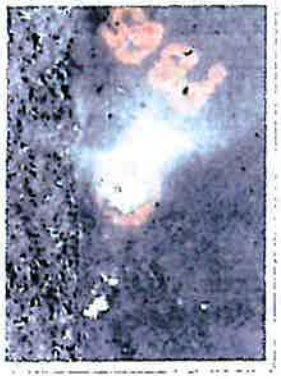
GPS indicated Good, Fair or Poor Obstruction Conditions

Revised 02/09/2010

5. Monitoring Points - Photo Update for October 2010

Update for Points, AB05, AB61ECC, BB52, PB53, PB55, PB64, PB65 (See prior Reports for all photos)

PB53-S.JPG



PB65-S-X3.JPG

BB52-E-X2.JPG

PB65-N.JPG

AB61ECC-E.JPG

PB64-W.JPG

AB05-W.JPG

PB55-W.JPG

FULL DATA POSTING as of Sept.2007

Document Date: 12/08/10

PORTUGUESE POINT LANDSLIDE MONITORING

NAD83(2007) COORDINATES and NAVD88 ELEVATIONS of BEGINNING, 2007 & POST 2007 MONITORING POINT POSITIONS

Notes:

\# Indicates stable points, not moving

* Indicates no movement detected

1= 2005 and prior surveys used a nearby monument S31-29W 1.48', the original position is adjusted here to be relative to the 1" IP used presently, resulting in correct Overall Movements, see Reports

		Original Positions			Sept. 24, 2007 Positions			Overall Movements (US Feet)					
		NAD83 SPC Zone 5 (Ft)		NAVD88	NAD83 SPC Zone 5 (Ft)		NAVD88	Original Position to Sept. 24, 2007					
Point	Date	North (ft)	East (ft)	Elev(ft)	North (ft)	East (ft)	Elev(ft)	North	East	Height	Azim.	Dist.	Note
AB01	12/1/1994	1729427.58	6445709.61	178.62	1729427.55	6445709.64	178.62	-0.03	0.03	0.00	-	0	#
AB02	11/30/1994	1726946.97	6447968.65	116.45	1726946.98	6447968.69	116.48	0.01	0.04	0.03	72	0.04	#
AB03	12/1/1994	1727338.34	6447818.82	139.60	1727338.39	6447818.81	139.59	0.04	-0.01	-0.01	351	0.04	#
AB04	11/30/1994	1728391.99	6447123.34	67.57	1728390.55	6447122.03	67.31	-1.44	-1.32	-0.26	222	1.95	
AB05	3/14/1995	1728075.72	6447645.17	80.90									
AB06	4/27/1995	1729059.73	6446976.26	165.28	1729058.58	6446975.91	164.91	-1.15	-0.35	-0.37	197	1.21	
AB07	11/30/1994	1728982.79	6447358.41	159.92	1728981.51	6447357.74	159.40	-1.28	-0.67	-0.52	208	1.44	
AB12	11/30/1994	1729416.49	6448271.64	283.43	1729415.67	6448271.30	283.19	-0.82	-0.35	-0.24	203	0.89	
AB13	11/30/1994	1729928.90	6448236.04	365.03	1729928.25	6448235.90	364.54	-0.65	-0.13	-0.49	192	0.66	
AB15	11/30/1994	1730312.09	6448099.38	397.28	1730311.64	6448099.31	396.90	-0.45	-0.07	-0.38	189	0.45	
AB16	11/30/1994	1730358.89	6447532.12	376.82	1730358.70	6447532.17	376.44	-0.19	0.04	-0.18	169	0.19	
AB17	11/30/1994	1731421.14	6446727.77	443.05	1731421.12	6446727.77	442.80	-0.02	0.00	-0.25	167	0.02	#
AB18	12/1/1994	1731602.62	6448187.49	457.19	1731602.37	6448187.58	456.93	-0.26	0.09	-0.26	162	0.27	
AB20	3/16/1995	1729360.63	6449686.27	396.43	1729360.00	6449686.03	396.23	-0.62	-0.23	-0.20	201	0.67	
AB24	3/12/1997	1729830.35	6447759.96	335.92	1729829.83	6447759.82	335.74	-0.52	-0.14	-0.18	196	0.54	
AB50	1/16/1998	1728085.00	6448248.18	181.98	1728084.71	6448247.54	182.03	-0.29	-0.65	0.05	246	0.71	
AB51	3/22/2002	1729617.01	6447306.54	305.42	1729616.73	6447306.52	305.25	-0.28	-0.02	-0.17	184	0.28	
AB52	3/22/2002	1730016.10	6448624.44	368.61	1730015.79	6448624.36	368.39	-0.31	-0.08	-0.22	195	0.32	
AB53	3/22/2002	1730431.11	6449712.37	353.13	1730430.77	6449712.33	352.90	-0.34	-0.04	-0.23	187	0.34	
AB54	9/24/2007	1731111.94	6447047.87	407.31	1731111.94	6447047.87	407.31						
AB55	9/24/2007	1731174.77	6447753.57	405.38	1731174.77	6447753.57	405.38						
AB56	9/24/2007	1732214.31	6448545.46	571.65	1732214.31	6448545.46	571.65						
AB57	9/24/2007	1731926.91	6449759.36	564.93	1731926.91	6449759.36	564.93						
AB58	9/24/2007	1731118.02	6449074.93	405.67	1731118.02	6449074.93	405.67						
AB59	9/24/2007	1730850.87	6450212.56	434.37	1730850.87	6450212.56	434.37						
AB60	9/24/2007	1729089.70	6447987.57	179.45	1729089.70	6447987.57	179.45						
AB61	9/24/2007	1727424.50	6447990.26	140.47	1727424.50	6447990.26	140.47						
BB25	11/4/1998	1727200.54	6449932.73	3.81	1727200.25	6449932.73	4.12	-0.29	-0.01	0.31	182	0.29	
BB52	9/24/2007	1726996.36	6451384.38	3.83	1726996.36	6451384.38	3.83						
BB53	9/24/2007	1726831.16	6451840.89	13.81	1726831.16	6451840.89	13.81						
CR07	11/30/1994	1731628.78	6451203.19	633.28	1731628.37	6451203.29	632.48	-0.41	0.10	-0.80	166	0.42	
CR50	1/16/1998	1733013.55	6451037.38	873.04	1733013.62	6451037.38	872.66	0.07	0.00	-0.38	358	0.07	
CR51	1/16/1998	1733061.90	6452361.82	976.75	1733062.03	6452361.86	976.25	0.13	0.04	-0.50	17	0.14	
CR52	1/16/1998	1732867.54	6450239.34	780.01	1732867.58	6450239.32	779.63	0.03	-0.02	-0.38	333	0.04	#
FT06	9/24/2007	1729855.61	6452760.21	489.06	1729855.61	6452760.21	489.06						
FT07	9/24/2007	1729253.24	6454104.75	589.01	1729253.24	6454104.75	589.01						
FT08	9/24/2007	1729388.68	6453350.51	658.44	1729388.68	6453350.51	658.44						
KC01	11/30/1994	1728476.78	6452458.23	312.88	1728476.36	6452457.91	312.42	-0.42	-0.32	-0.46	217	0.52	1
KC02	3/14/1995	1727002.89	6452118.99	13.84	1727002.74	6452118.89	13.74	-0.15	-0.11	-0.10	216	0.18	
KC04	3/14/1995	1727559.56	6452667.24	238.84	1727559.46	6452667.09	238.51	-0.10	-0.15	-0.33	236	0.18	
KC05	11/30/1994	1727082.00	6453179.09	227.86	1727082.01	6453178.94	227.53	0.01	-0.15	-0.33	273	0.15	
KC06	11/30/1994	1727784.91	6453396.67	300.35	1727784.94	6453396.40	299.97	0.03	-0.26	-0.38	276	0.26	
KC07	11/30/1994	1727759.19	6453683.92	313.83	1727759.37	6453683.85	313.51	0.18	-0.07	-0.32	340	0.19	
KC13	9/24/2007	1726581.16	6453069.63	191.20	1726581.16	6453069.63	191.20						
KC14	9/24/2007	1726742.44	6453806.05	259.94	1726742.44	6453806.05	259.94						
KC15	9/24/2007	1727590.45	6453121.10	287.10	1727590.45	6453121.10	287.10						
KC16	9/24/2007	1727602.25	6454098.23	326.90	1727602.25	6454098.23	326.90						
PB04	11/30/1994	1727675.94	6448851.74	170.52	1727667.25	6448849.17	167.49	-8.69	-2.57	-3.03	196	9.06	
PB06	3/15/1995	1727968.45	6449761.84	183.06	1727941.12	6449758.01	178.25	-27.33	-3.83	-4.81	186	27.50	
PB07	3/14/1995	1728175.93	6450219.76	200.21	1728141.60	6450213.44	198.02	-34.32	-6.32	-2.19	190	34.90	
PB08	12/1/1994	1728237.51	6450469.80	193.68	1728204.81	6450463.98	194.09	-32.70	-5.82	0.41	190	33.21	
PB09	11/30/1994	1728288.58	6450851.02	192.52	1728252.20	6450849.11	189.84	-36.38	-1.91	-2.68	183	36.43	
PB12	11/30/1994	1728330.49	6451604.57	193.29	1728268.52	6451587.83	186.93	-61.97	-16.74	-6.36	195	64.19	
PB13	3/14/1995	1728085.97	6452164.34	210.54	1728050.44	6452151.18	207.21	-35.53	-13.16	-3.33	200	37.89	
PB18	3/15/1995	1730446.88	6450711.00	367.58	1730431.80	6450719.76	363.24	-15.08	8.77	-4.34	150	17.44	
PB20	3/14/1995	1728812.77	6451135.67	243.54	1728753.50	6451126.52	234.48	-59.27	-9.16	-9.06	189	59.97	
PB21	3/14/1995	1729298.22	6451172.05	280.02	1729249.90	6451277.92	273.29	-48.32	5.87	-6.73	173	48.68	
PB25	12/1/1994	1729702.31	6451985.65	328.99	1729671.12	6451986.48	326.10	-31.19	0.83	-2.89	178	31.20	
PB26	3/14/1995	1729562.65	6452249.56	285.34	1729539.22	6452252.23	282.95	-23.42	2.67	-2.39	174	23.58	
PB27	3/14/1995	1729339.34	6451836.06	284.42	1729257.91	6451842.02	273.51	-81.43	5.96	-10.91	176	81.65	
PB29	3/15/1995	1728888.95	6452120.49	185.93	1728849.86	6452097.03	173.29	-39.08	-23.46	-12.64	211	45.58	
PB53	12/4/1997	1729252.77	6450753.92	297.75	1729224.25	6450754.60	291.85	-28.52	0.67	-5.90	179	28.53	
PB54	12/4/1997	1729694.90	6450448.69	358.62	1729691.38	6450448.62	357.73	-3.52	-0.07	-0.89	181	3.52	
PB55	1/21/1998	1728812.28	6450804.04	246.33	1728782.51	6450801.87	241.07	-29.77	-2.18	-5.26	184	29.85	
PB59	6/26/2001	1727766.36	6448661.67	163.39	1727761.30	6448660.42	160.61	-5.07	-1.24	-2.78	194	5.22	
PB62	9/24/2007	1728476.64	6449717.56	287.25	1728476.64	6449717.56	287.25						
PB63	9/24/2007	1727734.04	6451488.11	126.06	1727734.04	6451488.11	126.06						
PB64	11/18/2009	1727466.29	6450946.95	72.76									
PB65	10/25/2010	1728454.67	6449707.82	287.75									
UB02	7/23/1997	1727581.11	6450133.78	67.15	1727534.46	6450140.57	63.20	-46.66	6.78	-3.95	172	47.15	

FULL DATA POSTING as of Dec.2008

Document Date: 12/08/10

Notes:

\# Indicates stable points, not moving

* Indicates no movement detected

2 = Hit by mower sometime between 09/07 and 12/08 with an estimated displacement S14E 0.29', the original position is adjusted here to be relative to monitored position used presently, resulting in correct Overall Movements; see Rpt

	Dec. 10, 2008 Positions			Overall Movements (US Feet)						Periodic (14.5 months) Movements (US Feet)						
	NAD83 SPC Zone 5 (ft)		NAVD88	Original Position to Dec. 10, 2008						Sept. 24, 2007 Position to Dec. 10, 2008						
Point	North (ft)	East (ft)	Elev(ft)	North	East	Height	Azim.	Dist.	Note	North	East	Height	Azimuth	Distance	95%Error	Note
AB01	1729427.54	6445709.63	178.59	-0.05	0.02	-0.03	161	0.05	#	-0.01	-0.01	-0.03	231	0.02	0.017	#
AB02	1726946.99	6447968.68	116.46	0.02	0.03	0.01	61	0.03	#	0.00	-0.01	-0.02	297	0.01	0.016	#
AB03	1727338.39	6447819.81	139.58	0.04	-0.01	-0.02	348	0.04	#	0.00	0.00	-0.01	270	0.00	0.015	#
AB04	1728390.43	6447121.92	67.27	-1.56	-1.43	-0.30	222	2.12		-0.12	-0.11	-0.04	222	0.16	0.016	
AB05	1728074.86	6447644.04	80.59	-0.86	-1.13	-0.31	233	1.42	2							2
AB06	1729058.49	6446975.88	164.85	-1.24	-0.38	-0.43	197	1.30		-0.09	-0.03	-0.06	198	0.09	0.019	
AB07	1728981.40	6447357.70	159.34	-1.39	-0.71	-0.58	207	1.56		-0.11	-0.04	-0.06	202	0.12	0.021	
AB12	1729415.57	6448271.26	283.19	-0.92	-0.38	-0.24	203	0.99		-0.10	-0.08	0.00	199	0.11	0.018	
AB13	1729928.17	6448235.89	364.54	-0.73	-0.15	-0.49	192	0.74		-0.08	-0.01	0.00	191	0.08	0.019	
AB15	1730311.56	6448099.30	396.88	-0.53	-0.08	-0.40	189	0.53		-0.08	-0.01	-0.02	188	0.08	0.024	
AB16	1730358.65	6447532.17	376.46	-0.24	0.05	-0.16	168	0.24		-0.05	0.01	0.02	170	0.05	0.024	
AB17	1731421.12	6446727.77	442.79	-0.02	0.00	-0.26	171	0.02	#	0.00	0.00	-0.01	194	0.00	0.020	#
AB18	1731602.31	6448187.61	456.91	-0.32	0.11	-0.28	160	0.34		-0.06	0.03	-0.02	155	0.07	0.023	
AB20	1729359.84	6449685.99	396.23	-0.79	-0.28	-0.20	199	0.83		-0.16	-0.04	0.00	195	0.17	0.012	
AB24	1729829.75	6447759.77	335.76	-0.61	-0.19	-0.16	197	0.63		-0.09	-0.04	0.02	205	0.10	0.022	
AB50	1728084.66	6448247.47	181.98	-0.34	-0.71	0.00	245	0.79		-0.05	-0.07	-0.05	235	0.08	0.019	
AB51	1729616.65	6447306.51	305.26	-0.36	-0.03	-0.16	185	0.36		-0.09	-0.01	0.01	190	0.09	0.019	
AB52	1730015.70	6448624.82	368.38	-0.40	-0.12	-0.23	196	0.42		-0.10	-0.03	-0.01	200	0.10	0.028	
AB53	1730430.62	6449712.30	352.90	-0.49	-0.07	-0.23	188	0.50		-0.15	-0.03	0.00	189	0.15	0.028	
AB54	1731111.93	6447047.87	407.30	-0.01	0.00	-0.01	165	0.01	*	-0.01	0.00	-0.01	165	0.01	0.028	*
AB55	1731174.72	6447753.58	405.39	-0.05	0.01	0.01	166	0.05		-0.05	0.01	0.01	166	0.05	0.018	
AB56	1732214.21	6448545.49	571.64	-0.10	0.03	-0.01	161	0.11		-0.10	0.03	-0.01	161	0.11	0.018	
AB57	1731926.78	6449759.40	564.90	-0.13	0.03	-0.03	166	0.13		-0.13	0.03	-0.03	166	0.13	0.018	
AB58	1731117.90	6449074.93	405.65	-0.12	0.00	-0.02	178	0.12		-0.12	0.00	-0.02	178	0.12	0.020	
AB59	1730850.70	6450212.53	434.35	-0.17	-0.02	-0.02	188	0.17		-0.17	-0.02	-0.02	188	0.17	0.020	
AB60	1729089.63	6447987.54	179.39	-0.08	-0.03	-0.06	200	0.08		-0.08	-0.03	-0.06	200	0.08	0.021	
AB61	1727424.49	6447990.27	140.43	-0.01	0.01	-0.04	114	0.01	*	-0.01	0.01	-0.04	114	0.01	0.003	#
BB25	1727200.25	6449932.58	4.15	-0.29	-0.16	0.34	208	0.33		0.00	-0.15	0.03	269	0.15	0.017	
BB52	1726996.24	6451384.35	3.83	-0.12	-0.03	0.00	194	0.13		-0.12	-0.03	0.00	194	0.13	0.025	
BB53	Destroyed															
CR07	1731628.24	6451203.32	632.36	-0.54	0.13	-0.92	166	0.55		-0.13	0.03	-0.12	168	0.13	0.024	
CR50	1733013.62	6451037.38	872.71	0.08	0.01	-0.33	5	0.08		0.01	0.01	0.05	45	0.01	0.017	*
CR51	1733062.02	6452361.86	976.24	0.12	0.04	-0.51	20	0.13		-0.01	0.00	-0.01	171	0.01	0.019	*
CR52	1732867.58	6450239.31	779.64	0.03	-0.03	-0.37	315	0.04		0.00	-0.01	0.01	258	0.01	0.029	*
FT06	1729855.42	6452760.17	488.97	-0.19	-0.04	-0.09	192	0.19		-0.19	-0.04	-0.09	192	0.19	0.025	
FT07	1729253.01	6454104.39	588.99	-0.23	-0.36	-0.02	237	0.43		-0.23	-0.36	-0.02	237	0.43	0.015	
FT08	1729386.67	6453350.53	658.47	-0.01	0.02	0.03	114	0.02		-0.01	0.02	0.03	114	0.02	0.015	*
KC01	1728476.25	6452457.85	312.38	-0.53	-0.38	+0.50	215	0.66	1	-0.02	-0.06	-0.04	208	0.13	0.020	
KC02	1727002.67	6452118.88	13.72	-0.22	-0.11	-0.12	207	0.25		-0.07	-0.01	-0.02	185	0.07	0.021	
KC04	1727559.42	6452667.06	238.47	-0.14	-0.18	-0.37	233	0.23		-0.04	-0.04	-0.04	223	0.05	0.017	
KC05	1727081.98	6453178.94	227.52	-0.02	-0.15	-0.34	261	0.15		-0.03	0.00	-0.01	180	0.03	0.020	
KC06	1727784.92	6453396.86	299.93	0.01	-0.30	-0.42	273	0.30		-0.01	+0.04	-0.04	252	0.05	0.021	
KC07	1727759.38	6453683.97	313.50	0.18	-0.05	-0.33	346	0.19		0.00	0.02	-0.01	84	0.02	0.018	*
KC13	1726581.12	6453069.62	191.23	-0.04	-0.01	0.03	194	0.04		+0.04	-0.01	0.03	194	0.04	0.018	
KC14	1726742.44	6453806.04	259.91	0.00	-0.02	-0.03	259	0.02	*	0.00	+0.02	-0.03	259	0.02	0.020	*
KC15	1727590.41	6453121.06	287.13	-0.05	-0.04	0.03	220	0.06		-0.05	-0.04	0.03	220	0.06	0.022	
KC16	1727602.24	6454098.24	326.92	-0.01	0.00	0.02	135	0.01	*	-0.01	0.00	0.02	135	0.01	0.016	*
PB04	1727666.83	6448849.07	167.37	-9.10	-2.67	-3.15	196	9.49		-0.41	-0.10	-0.12	194	0.43	0.017	
PB06	1727939.65	6449758.62	177.96	-28.80	-3.22	-5.10	186	28.98		-1.47	-0.18	-0.29	187	1.48	0.021	
PB07	1728139.82	6450213.09	197.88	-36.10	-6.67	-2.33	190	36.72		-1.78	-0.35	-0.14	191	1.82	0.020	
PB08	1728203.20	6450463.68	194.13	-34.31	-6.12	0.45	190	34.85		-1.61	-0.30	0.04	190	1.64	0.024	
PB09	1728250.32	6450848.98	189.58	-38.26	-2.04	-2.94	183	38.31		-1.88	-0.13	-0.26	184	1.88	0.021	
PB12	1728265.36	6451586.81	186.31	-65.13	-17.76	-6.98	195	67.51		-3.16	-1.03	-0.62	198	3.32	0.019	
PB13	1728048.48	6452150.38	207.09	-37.49	-13.96	-3.45	200	40.01		-1.96	-0.80	-0.12	202	2.12	0.019	
PB18	1730431.47	6450719.84	363.18	-15.41	8.85	-4.40	150	17.77		-0.33	0.08	-0.06	166	0.34	0.020	
PB20	1728750.65	6451126.05	233.99	-62.12	-9.63	-9.65	189	62.86		-2.85	-0.47	-0.49	189	2.89	0.020	
PB21	1729247.73	6451118.08	273.02	-50.49	6.03	-7.90	173	50.85		-2.17	0.16	-0.27	176	2.17	0.021	
PB25	1729670.88	6451986.42	326.07	-31.44	0.77	-2.92	179	31.45		-0.25	-0.07	-0.03	195	0.26	0.019	
PB26	1729539.03	6452252.21	282.94	-23.62	2.65	-2.40	174	23.77		-0.20	-0.02	-0.01	187	0.20	0.018	
PB27	1729254.41	6451842.14	272.98	-84.03	6.08	-11.44	176	85.15		-3.50	0.13	-0.53	178	3.50	0.023	
PB29	1728847.75	6452096.03	172.60	-41.20	-24.46	-13.33	211	47.91		-2.11	-1.01	-0.69	205	2.34	0.020	
PB53	1729222.48	6450754.60	291.44	-30.28	0.68	-6.81	179	30.29		-1.76	0.00	-0.41	180	1.76	0.024	
PB54	1729691.20	6450448.58	357.73	-3.70	-0.11	-0.89	182	3.70		-0.18	-0.04	0.00	193	0.18	0.019	
PB55	1728780.51	6450801.66	240.62	-31.77	-2.38	-5.71	184	31.86		-2.01	-0.21	-0.45	186	2.02	0.031	
PB59	1727760.70	6448660.28	160.34	-5.66	-1.39	-3.05	194	5.83		-0.59	-0.15	-0.27	194	0.61	0.017	
PB62	1728476.42	6449717.52	287.22	-0.21	-0.04	-0.03	192	0.22		-0.21	-0.04	-0.03	192	0.22	0.016	
PB63	1727724.58	6451485.79	121.78	-9.45	-2.32	-4.28	194	9.73		-9.45	-2.32	-4.28	194	9.73	0.020	
UB02	1727530.48	6450141.10	63.00	-50.63	7.31	-4.25	172	51.16		-3.97	0.53	-0.20	172	4.01	0.023	

FULL DATA POSTING as of Nov. 2009

Document Date: 12/08/10

Notes:

# Indicates stable points, not moving

* Indicates no movement detected

	Nov. 18, 2009 Positions			Overall Movements (US Feet)						Periodic (11.3 months) Movements (US Feet)						
	NAD83 SPC Zone 5 (FT)		NAVD88	Original Position to Nov. 18, 2009						Dec. 10, 2008 Position to Nov. 18, 2009						
Point	North (ft)	East (ft)	Elev(ft)	North	East	Height	Azim.	Dist.	Note	North	East	Height	Azim.	Dist.	95%Error	Note
AB01	1729427.54	6445709.62	178.540	-0.04	0.01	-0.08	167	0.04		0.00	-0.01	-0.05	304	0.01	0.020	#
AB02	1726946.97	6447968.68	116.460	0.00	0.03	0.01	95	0.03	*	-0.02	0.00	0.00	171	0.02	0.020	#
AB03	1727338.38	6447818.82	139.570	0.04	0.00	-0.03	4	0.04		-0.01	0.01	-0.01	117	0.01	0.017	#
AB04	1728390.36	6447121.86	67.250	-1.63	-1.48	-0.32	222	2.20		-0.07	-0.05	-0.02	217	0.09	0.019	
AB05	1728074.78	6447643.96	80.570	-0.94	-1.21	-0.33	232	1.53		-0.08	-0.08	-0.02	226	0.11	0.018	
AB06	1729058.43	6446975.87	164.840	-1.31	-0.39	-0.44	197	1.36		-0.06	-0.01	-0.01	191	0.06	0.019	
AB07	1728981.35	6447357.67	159.330	-1.44	-0.74	-0.59	207	1.62		-0.05	-0.03	-0.01	207	0.06	0.022	
AB12	1729415.50	6448271.24	283.190	-0.98	-0.41	-0.24	203	1.07		-0.07	-0.03	0.00	202	0.07	0.019	
AB13	1729928.13	6448235.87	364.540	-0.77	-0.16	-0.49	192	0.78		-0.04	-0.02	0.00	201	0.04	0.020	
AB15	1730311.51	6448099.30	396.880	-0.57	-0.08	-0.40	188	0.58		-0.05	0.00	0.00	180	0.05	0.026	
AB16	1730358.64	6447532.17	376.450	-0.25	0.04	-0.17	170	0.25		-0.01	-0.01	-0.01	203	0.02	0.021	*
AB17	1731421.11	6446727.77	442.800	-0.03	0.00	-0.25	173	0.03	*	0.00	0.00	0.01	180	0.00	0.019	#
AB18	1731602.26	6448187.60	456.870	-0.36	0.11	-0.32	163	0.38		-0.04	-0.01	-0.04	189	0.04	0.025	
AB20	1729359.78	6449685.97	396.230	-0.85	-0.30	-0.20	199	0.90		-0.06	-0.02	0.00	200	0.06	0.013	
AB24	1729829.68	6447759.75	335.760	-0.67	-0.21	-0.16	197	0.70		-0.06	-0.02	0.00	198	0.07	0.024	
AB50	1728084.64	6448247.44	182.000	-0.36	-0.74	0.02	244	0.83		-0.02	-0.03	0.02	238	0.04	0.024	
AB51	1729616.60	6447306.48	305.250	-0.41	-0.06	-0.17	188	0.41		-0.04	-0.02	-0.01	208	0.05	0.020	
AB52	1730015.65	6448624.32	368.350	-0.45	-0.12	-0.26	195	0.47		-0.05	0.00	-0.03	181	0.05	0.031	
AB53	1730430.55	6449712.28	352.890	-0.55	-0.09	-0.24	189	0.56		-0.06	-0.02	-0.01	198	0.06	0.026	
AB54	1731111.92	6447047.87	407.360	-0.03	0.00	0.05	178	0.03	*	-0.02	0.00	0.06	187	0.02	0.029	*
AB55	1731174.68	6447753.58	405.390	-0.09	0.02	0.01	169	0.09		-0.04	0.01	0.00	171	0.04	0.017	
AB56	1732214.16	6448545.51	571.690	-0.15	0.05	0.04	162	0.16		-0.05	0.02	0.05	164	0.05	0.024	
AB57	1731926.73	6449759.41	564.860	-0.18	0.04	-0.07	166	0.18		-0.05	0.01	-0.04	167	0.05	0.022	
AB58	1731117.85	6449074.94	405.640	-0.17	0.01	-0.03	175	0.17		-0.05	0.01	-0.01	168	0.05	0.022	
AB59	1730850.64	6450212.52	434.340	-0.23	-0.03	-0.03	188	0.23		-0.06	-0.01	-0.01	190	0.06	0.022	
AB60	1729089.58	6447987.53	179.390	-0.12	-0.04	-0.06	199	0.13		-0.04	-0.01	0.00	196	0.05	0.019	
AB61	1727424.49	6447990.27	140.420	-0.01	0.01	-0.05	128	0.02	*	0.00	0.00	-0.01	158	0.01	0.004	#
BB25	1727200.19	6449932.57	4.210	-0.35	-0.16	0.40	204	0.39		-0.06	0.00	0.06	183	0.06	0.024	
BB52	1726996.18	6451384.34	3.860	-0.18	-0.04	0.03	193	0.19		-0.06	-0.01	0.03	191	0.06	0.019	
CR07	1731628.18	6451203.34	632.390	-0.60	0.15	-0.89	166	0.62		-0.06	0.02	0.03	161	0.07	0.024	
CR50	1733013.61	6451037.39	872.690	0.06	0.01	-0.35	10	0.06		-0.01	0.00	-0.02	162	0.02	0.022	*
CR51	1733062.01	6452361.87	976.220	0.11	0.05	-0.53	26	0.12		-0.01	0.01	-0.02	143	0.02	0.024	*
CR52	1732867.56	6450239.31	779.730	0.02	-0.03	-0.28	300	0.03	*	-0.01	0.00	0.09	176	0.01	0.026	*
FT06	1729855.34	6452760.16	488.920	-0.27	-0.05	-0.14	191	0.28		-0.08	-0.01	-0.05	189	0.08	0.020	
FT07	1729252.92	6454104.25	588.900	-0.33	-0.51	-0.11	237	0.60		-0.10	-0.14	-0.09	236	0.17	0.020	
FT08	1729388.69	6453350.52	658.480	0.00	0.02	0.04	74	0.02	*	0.01	0.00	0.01	348	0.01	0.027	#
KC01	1728476.18	6452457.81	312.350	-0.60	-0.42	-0.53	215	0.74		-0.07	-0.04	-0.03	209	0.08	0.019	
KC02	1727002.64	6452118.86	13.690	-0.26	-0.13	-0.15	207	0.29		-0.03	-0.02	-0.03	207	0.04	0.021	
KC04	1727559.39	6452667.04	238.450	-0.17	-0.20	-0.39	231	0.27		-0.03	-0.02	-0.02	216	0.04	0.019	
KC05	1727081.97	6453178.92	227.510	-0.03	-0.17	-0.35	259	0.18		-0.01	-0.02	-0.01	244	0.03	0.020	
KC06	1727784.90	6453396.33	299.910	-0.01	-0.33	-0.44	268	0.33		-0.02	-0.03	-0.02	227	0.04	0.025	
KC07	1727759.37	6453683.87	313.470	0.18	-0.05	-0.36	344	0.19		0.00	0.00	-0.03	256	0.00	0.021	*
KC13	1726581.11	6453069.63	191.180	-0.04	-0.01	-0.02	188	0.04		-0.01	0.00	-0.05	153	0.01	0.017	*
KC14	1726742.43	6453806.03	259.920	-0.01	-0.03	-0.02	253	0.03	*	0.00	-0.01	0.01	247	0.01	0.023	*
KC15	1727590.38	6453121.03	287.090	-0.07	-0.06	-0.01	222	0.09		-0.02	-0.02	-0.04	226	0.03	0.027	
KC16	1727602.24	6454098.24	326.870	-0.01	0.00	-0.03	159	0.01	*	0.00	0.00	-0.05	214	0.00	0.018	#
PB04	1727666.56	6448848.99	167.310	-9.38	-2.75	-3.21	196	9.77		-0.27	-0.07	-0.06	195	0.28	0.020	
PB06	1727938.80	6449758.52	177.820	-29.65	-3.32	-5.24	186	29.83		-0.85	-0.10	-0.14	187	0.85	0.022	
PB07	1728138.83	6450212.89	197.800	-37.09	-6.86	-2.41	190	37.72		-0.99	-0.19	-0.08	191	1.01	0.019	
PB08	1728202.31	6450463.52	194.120	-35.20	-6.28	0.44	190	35.75		-0.89	-0.16	-0.01	190	0.90	0.020	
PB09	1728249.30	6450848.91	189.460	-39.28	-2.11	-3.06	183	39.34		-1.02	-0.07	-0.12	184	1.02	0.022	
PB12	1728263.70	6451586.25	185.940	-66.79	-18.32	-7.35	195	69.25		-1.66	-0.55	-0.37	199	1.75	0.022	
PB13	1728047.43	6452149.98	206.980	-38.54	-14.36	-3.56	200	41.13		-1.05	-0.41	-0.11	201	1.12	0.019	
PB18	1730431.35	6450719.86	363.140	-15.53	8.87	-4.44	150	17.89		-0.12	0.02	-0.04	170	0.12	0.021	
PB20	1728749.18	6451125.82	233.690	-63.59	-9.86	-9.85	189	64.35		-1.47	-0.23	-0.30	189	1.49	0.022	
PB21	1729246.60	6451178.17	272.840	-51.62	6.12	-7.18	173	51.98		-1.13	0.09	-0.18	175	1.14	0.024	
PB25	1729670.78	6451986.39	326.040	-31.53	0.74	-2.95	179	31.54		-0.09	-0.02	-0.03	194	0.10	0.022	
PB26	1729538.93	6452252.19	282.930	-23.71	2.63	-2.41	174	23.86		-0.09	-0.02	-0.01	190	0.10	0.022	
PB27	1729252.59	6451842.20	272.730	-86.75	6.14	-11.69	176	86.97		-1.82	0.06	-0.25	178	1.82	0.026	
PB29	1728846.62	6452095.51	172.230	-42.32	-24.98	-13.70	211	49.15		-1.13	-0.52	-0.37	205	1.24	0.022	
PB53	1729221.54	6450754.61	291.200	-31.22	0.68	-6.55	179	31.23		-0.94	0.01	-0.24	180	0.94	0.026	
PB54	1729691.12	6450448.57	357.710	-3.78	-0.12	-0.91	182	3.78		-0.08	-0.01	-0.02	188	0.08	0.023	
PB55	1728779.41	6450801.58	240.500	-32.87	-2.47	-5.83	184	32.97		-1.10	-0.08	-0.12	184	1.10	0.030	
PB59	1727760.31	6448660.19	160.160	-6.05	-1.48	-3.23	194	6.23		-0.39	-0.09	-0.18	193	0.40	0.020	
PB62	1728476.31	6449717.49	287.200	-0.32	-0.07	-0.05	192	0.33		-0.11	-0.02	-0.02	193	0.11	0.017	
PB63	1727717.72	6451483.29	116.990	-16.31	-4.82	-9.07	196	17.01		-6.86	-2.50	-4.79	200	7.30	0.022	
PB64	1727466.29	6450946.95	72.760													
UB02	1727527.87	6450141.46	62.920	-53.24	7.67	-4.23	172	53.79		-2.61	0.36	-0.08	172	2.64	0.022	

Notes:
* Indicates no movement detected

	Oct. 25, 2010 Positions			Overall Movements (US Feet)						Periodic (11.1 months) Movements (US Feet)						
	NAD83 SPC Zone 5 (ft)		NAVD88	Original Position to Oct. 25, 2010						Nov. 18, 2009 Position to Oct. 25, 2010						
Point	North (ft)	East (ft)	Elev(ft)	North	East	Height	Azim.	Dist.	Note	North	East	Height	Azim.	Dist.	95%Error	Note
AB01	1729427.53	6445709.61	178.52	-0.05	-0.01	-0.10	187	0.05		-0.01	-0.02	-0.02	241	0.02	0.032	*
AB02	1726946.97	6447968.66	116.45	0.00	0.01	0.00	111	0.01	*	0.00	0.02	-0.01	270	0.02	0.024	*
AB03	Deleted															
AB04	1728390.27	6447121.79	67.25	-1.72	-1.56	-0.32	222	2.32		-0.09	-0.08	0.00	220	0.12	0.023	
AB05	1728074.67	6447643.89	80.53	-1.05	-1.28	-0.37	231	1.66		-0.12	-0.07	-0.04	241	0.14	0.026	
AB06	1729058.36	6446975.83	164.82	-1.37	-0.43	-0.46	197	1.44		-0.07	-0.03	-0.02	207	0.07	0.026	
AB07	1728981.28	6447357.64	159.31	-1.51	-0.77	-0.61	207	1.70		-0.07	-0.03	-0.02	207	0.08	0.032	
AB12	1729415.46	6448271.20	298.20	-1.03	-0.44	-0.23	203	1.12		-0.04	-0.04	0.01	219	0.06	0.017	
AB13	1729928.09	6448235.85	364.53	-0.81	-0.19	-0.50	193	0.83		-0.04	-0.02	-0.01	208	0.05	0.021	
AB15	1730311.47	6448099.25	396.86	-0.62	-0.14	-0.42	192	0.63		-0.04	-0.05	-0.02	232	0.07	0.023	
AB16	1730358.61	6447532.16	376.46	-0.28	0.03	-0.16	173	0.28		-0.03	-0.01	0.01	197	0.03	0.028	*
AB17	1731421.10	6446727.76	442.80	-0.04	-0.01	-0.25	188	0.04		-0.01	-0.01	0.00	217	0.01	0.021	*
AB18	1731602.22	6448187.61	456.82	-0.40	0.12	-0.37	164	0.42		-0.04	0.01	-0.05	165	0.04	0.031	
AB20	1729359.72	6449685.94	396.23	-0.90	-0.32	-0.20	200	0.96		-0.06	-0.02	0.00	203	0.06	0.022	
AB24	1729829.65	6447759.73	335.77	-0.71	-0.23	-0.15	198	0.75		-0.04	-0.02	0.01	212	0.04	0.024	
AB50	1728084.62	6448247.38	182.00	-0.38	-0.80	0.02	244	0.89		-0.02	-0.06	0.00	247	0.06	0.031	
AB51	1729616.56	6447306.49	305.24	-0.45	-0.05	-0.18	196	0.45		-0.05	0.01	-0.01	172	0.05	0.022	
AB52	1730015.61	6448624.30	368.38	-0.49	-0.14	-0.23	196	0.51		-0.04	-0.02	0.03	209	0.04	0.037	
AB53	1730430.49	6449712.26	352.91	-0.61	-0.11	-0.22	190	0.62		-0.06	-0.02	0.02	196	0.07	0.027	
AB54	1731111.92	6447047.87	407.34	-0.02	0.00	0.03	182	0.02		0.00	0.00	-0.02	326	0.00	0.036	*
AB55	1731174.66	6447753.58	405.40	-0.11	0.02	0.02	171	0.11		-0.02	0.00	0.01	183	0.02	0.018	*
AB56	1732214.12	6448545.51	571.63	-0.19	0.05	-0.02	165	0.20		-0.04	0.00	-0.06	179	0.04	0.028	
AB57	1731926.67	6449759.42	564.92	-0.23	0.06	-0.01	165	0.24		-0.05	0.01	0.06	164	0.06	0.027	
AB58	1731117.80	6449074.93	405.69	-0.22	0.00	0.02	180	0.22		-0.05	-0.01	0.05	196	0.05	0.026	
AB59	1730850.56	6450212.51	434.35	-0.31	-0.04	-0.02	188	0.31		-0.08	-0.01	0.01	185	0.08	0.028	
AB60	1729089.53	6447987.50	179.42	-0.17	-0.07	-0.03	201	0.18		-0.05	-0.02	0.03	207	0.06	0.020	
AB61	1727424.48	6447990.27	140.47	-0.02	0.01	0.00	150	0.02	*	-0.01	0.00	0.05	193	0.01	0.005	*
BB25	Deleted															
BB52	1726996.13	6451384.34	3.85	-0.23	-0.04	0.02	190	0.24		-0.05	0.00	-0.01	180	0.05	0.029	
BB53	Destroyed															
CR07	1731628.12	6451203.32	632.33	-0.66	0.13	-0.95	169	0.67		-0.06	-0.02	-0.06	202	0.06	0.027	
CR50	1733013.59	6451037.37	872.67	0.04	0.00	-0.37	354	0.04		-0.02	-0.02	-0.02	217	0.03	0.023	
CR51	1733062.01	6452361.88	976.18	0.11	0.06	-0.57	29	0.12		0.00	0.01	-0.04	98	0.01	0.026	*
CR52	1732867.55	6450239.31	779.65	0.01	-0.03	-0.36	283	0.03	*	-0.01	0.00	-0.08	186	0.01	0.031	*
FT06	1729855.25	6452760.13	488.89	-0.35	-0.08	-0.17	193	0.36		-0.08	-0.03	-0.03	199	0.09	0.019	
FT07	1729252.76	6454104.00	588.85	-0.49	-0.75	-0.16	237	0.90		-0.16	-0.25	-0.05	237	0.30	0.026	
FT08	1729388.66	6453350.51	658.43	-0.02	0.00	-0.01	166	0.02	*	-0.02	-0.01	-0.05	206	0.03	0.028	*
KC01	1728476.12	6452457.77	312.38	-0.67	-0.46	-0.50	215	0.81		-0.06	-0.04	0.03	216	0.07	0.023	
KC02	1727002.62	6452118.86	13.72	-0.28	-0.14	-0.12	206	0.31		-0.02	-0.01	0.03	197	0.02	0.033	*
KC04	1727559.36	6452667.01	288.44	-0.20	-0.23	-0.40	228	0.30		-0.03	-0.02	-0.01	215	0.04	0.027	
KC05	1727081.96	6453178.92	227.47	-0.04	-0.17	-0.39	256	0.18		-0.01	0.00	-0.04	180	0.01	0.029	*
KC06	1727784.89	6453396.32	299.89	-0.02	-0.35	-0.46	266	0.35		-0.01	-0.02	-0.02	233	0.02	0.027	*
KC07	1727759.39	6453683.87	313.47	0.19	0.04	-0.36	347	0.20		0.01	0.01	0.00	32	0.01	0.031	*
KC13	1726581.08	6453069.61	191.18	-0.07	-0.02	-0.02	195	0.08		-0.03	-0.01	0.00	204	0.03	0.021	
KC14	1726742.43	6453806.02	259.89	-0.01	-0.03	-0.05	258	0.03	*	0.00	0.00	-0.03	333	0.00	0.036	*
KC15	1727590.38	6453121.02	287.10	-0.07	-0.07	0.00	227	0.10		0.00	-0.01	0.01	265	0.01	0.027	*
KC16	1727602.23	6454098.24	326.88	-0.02	0.01	-0.02	148	0.02	*	-0.01	0.01	0.01	139	0.01	0.023	*
PB04	1727665.94	6448848.86	167.11	-9.99	-2.88	-3.41	196	10.40		-0.62	-0.13	-0.20	192	0.63	0.030	
PB06	1727937.25	6449758.35	177.58	-31.19	-3.49	-5.48	186	31.39		-1.55	-0.17	-0.24	186	1.56	0.032	
PB07	1728137.00	6450212.58	197.66	-38.93	-7.18	-2.55	190	39.58		-1.83	-0.32	-0.14	190	1.86	0.030	
PB08	1728200.56	6450463.24	194.16	-36.85	-6.56	0.48	190	37.43		-1.65	-0.28	0.04	190	1.67	0.033	
PB09	1728247.35	6450848.79	189.24	-41.23	-2.24	-3.28	183	41.29		-1.95	-0.13	-0.22	184	1.95	0.032	
PB12	1728260.50	6451585.29	185.30	-69.99	-19.28	-7.99	195	72.60		-3.20	-0.96	-0.64	197	3.35	0.027	
PB13	1728045.47	6452149.27	206.87	-40.50	-15.17	-3.67	201	43.25		-1.96	-0.81	-0.11	202	2.12	0.025	
PB18	1730431.24	6450719.88	363.10	-15.64	8.89	-4.48	150	17.99		-0.11	0.02	-0.04	169	0.11	0.024	
PB20	1728746.32	6451125.33	233.20	-66.45	-10.35	-10.34	189	67.25		-2.86	-0.49	-0.49	190	2.91	0.038	
PB21	1729244.44	6451178.35	272.60	-53.78	6.30	-7.42	173	54.14		-2.15	0.18	-0.24	175	2.16	0.029	
PB25	1729670.68	6451986.36	326.01	-31.64	0.71	-2.98	179	31.64		-0.10	-0.03	-0.03	196	0.11	0.021	
PB26	1729538.86	6452252.16	282.99	-23.79	2.60	-2.35	174	23.93		-0.08	-0.03	0.06	200	0.08	0.028	
PB27	1729249.12	6451842.31	272.17	-90.22	6.25	-12.25	176	90.44		-3.47	0.11	-0.56	178	3.47	0.029	
PB29	1729844.53	6452094.53	171.59	-44.42	-25.96	-14.34	210	51.45		-2.10	-0.97	-0.64	205	2.31	0.032	
PB53	1729219.81	6450754.71	290.67	-32.96	0.78	-7.08	179	32.97		-1.73	0.10	-0.53	177	1.74	0.035	
PB54	1729691.04	6450448.55	357.73	-3.86	-0.13	-0.89	182	3.87		-0.08	-0.02	0.02	191	0.08	0.026	
PB55	1728777.36	6450801.45	240.18	-34.92	-2.59	-6.15	184	35.02		-2.05	-0.13	-0.32	184	2.05	0.044	
PB59	1727759.39	6449659.97	159.70	-6.98	-1.69	-3.69	194	7.18		-0.93	-0.21	-0.47	193	0.95	0.032	
PB62	Destroyed															
PB63	Destroyed															
PB64	1727439.04	6450942.07	69.69	-27.25	-4.88	-3.08	190	27.68		-27.25	-4.88	-3.08	190	27.68	0.031	
PB65	1728454.67	6449707.82	287.75													
UB02	1727522.77	6450142.13	62.75	-58.34	8.34	-4.40	172	58.94		-5.10	0.67	-0.17	173	5.14	0.030	

COORDINATE LIST

Portuguese Landslide Monitoring Survey of October 25, 2010

Document Date: 12/11/2010

Datum: Horizontal & EH NAD83 (2007) Epoch; California State Plane Zone 5; Vertical: NAVD88

Note, Fixed CGPS Station PVE3 at Record 3D Position & Orthometric Height per 09/2007 Survey; See Survey Reports

Point	Latitude	Longitude	EH (ft)	North (ft)	East (ft)	OrthoHt(ft)	Description
AB01	33-44-38.30232	118-22-53.05130	60.040	1729427.531	6445709.605	178.522	Pre-2007 Base Stat.
AB02	33-44-13.84871	118-22-26.19279	-2.047	1726946.967	6447968.655	116.447	Monitoring Point
AB04	33-44-28.09447	118-22-36.28371	-51.213	1728390.269	6447121.788	67.245	Monitoring Point
AB05	33-44-24.99186	118-22-30.08784	-37.913	1728074.666	6447643.887	80.533	Monitoring Point
AB06	33-44-34.69781	118-22-38.04160	46.390	1729058.363	6446975.831	164.818	Monitoring Point
AB07	33-44-33.94944	118-22-33.51729	40.896	1728981.279	6447357.639	159.307	Monitoring Point
AB12	33-44-38.27798	118-22-22.71912	164.855	1729415.458	6448271.200	283.200	Monitoring Point
AB13	33-44-43.34756	118-22-23.16022	246.212	1729928.085	6448235.850	364.534	Monitoring Point
AB15	33-44-47.13495	118-22-24.79462	278.550	1730311.468	6448099.247	396.862	Monitoring Point
AB16	33-44-47.58034	118-22-31.51176	258.126	1730358.607	6447532.158	376.462	Monitoring Point
AB17	33-44-58.06063	118-22-41.08416	324.467	1731421.099	6446727.763	442.800	Stable Monitoring Point
AB18	33-44-59.90626	118-22-23.80503	338.571	1731602.221	6448187.612	456.821	Monitoring Point
AB20	33-44-37.77825	118-22-05.96482	277.959	1729359.722	6449685.944	396.230	Monitoring Point
AB24	33-44-42.35629	118-22-28.79368	217.416	1729829.646	6447759.729	335.768	Monitoring Point
AB50	33-44-25.11251	118-22-22.94269	63.579	1728084.617	6448247.379	181.999	Monitoring Point
AB51	33-44-40.23170	118-22-34.15108	186.852	1729616.559	6447306.490	305.236	Monitoring Point
AB52	33-44-44.22759	118-22-18.56433	250.086	1730015.610	6448624.303	368.383	Monitoring Point
AB53	33-44-48.37119	118-22-05.69962	234.685	1730430.491	6449712.263	352.906	Monitoring Point
AB54	33-44-55.01415	118-22-37.27987	289.010	1731111.920	6447047.865	407.339	Monitoring Point
AB55	33-44-55.66082	118-22-28.92583	287.104	1731174.655	6447753.583	405.396	Monitoring Point
AB56	33-45-05.97227	118-22-19.59373	453.419	1732214.121	6448545.508	571.626	Monitoring Point
AB57	33-45-03.17306	118-22-05.20607	446.764	1731926.674	6449759.424	564.921	Monitoring Point
AB58	33-44-55.14685	118-22-13.27648	287.468	1731117.800	6449074.930	405.693	Monitoring Point
AB59	33-44-52.54455	118-21-59.79413	316.169	1730850.557	6450212.514	434.346	Monitoring Point
AB60	33-44-35.04353	118-22-26.06400	61.045	1729089.533	6447987.502	179.420	Monitoring Point
AB61	33-44-18.57300	118-22-25.95793	22.003	1727424.477	6447990.267	140.471	Base Station
AB61ECC	33-44-18.71693	118-22-26.13974	22.644	1727439.084	6447974.966	141.112	Reference Monument
BB52	33-44-14.45880	118-21-45.75335	-114.455	1726996.127	6451384.335	3.852	Monitoring Point
CR07	33-45-00.27174	118-21-48.09482	514.236	1731628.119	6451203.319	632.332	Monitoring Point
CR50	33-45-13.97080	118-21-50.11932	754.616	1733013.588	6451037.373	872.672	Monitoring Point
CR51	33-45-14.49693	118-21-34.43614	858.187	1733062.009	6452361.879	976.180	Monitoring Point
CR52	33-45-12.49753	118-21-59.56393	661.553	1732867.551	6450239.310	779.652	Monitoring Point
FT06	33-44-42.78993	118-21-29.58458	370.810	1729855.254	6452760.129	488.894	Monitoring Point
FT07	33-44-36.87713	118-21-13.64657	470.804	1729252.756	6454103.999	588.847	Monitoring Point
FT08	33-44-38.19518	118-21-22.57424	540.357	1729388.662	6453350.510	658.432	Monitoring Point
KC01	33-44-29.13689	118-21-33.10653	194.203	1728476.115	6452457.767	312.379	Monitoring Point
KC02	33-44-14.54913	118-21-37.05687	-104.548	1727002.617	6452118.858	13.719	Monitoring Point
KC04	33-44-20.07579	118-21-30.59024	120.233	1727559.361	6452667.012	238.443	Monitoring Point
KC05	33-44-15.37135	118-21-24.50905	109.269	1727081.956	6453178.921	227.470	Monitoring Point
KC06	33-44-22.33232	118-21-21.96456	181.736	1727784.886	6453396.318	299.891	Monitoring Point
KC07	33-44-22.09013	118-21-18.55873	195.326	1727759.385	6453683.874	313.468	Monitoring Point
KC13	33-44-10.41291	118-21-25.78222	72.946	1726581.083	6453069.611	191.179	Monitoring Point
KC14	33-44-12.03479	118-21-17.06995	141.710	1726742.434	6453806.024	259.894	Monitoring Point
KC15	33-44-20.39864	118-21-25.21596	168.920	1727590.382	6453121.022	287.099	Monitoring Point
KC16	33-44-20.55002	118-21-13.64593	208.753	1727602.230	6454098.244	326.881	Stable Monitoring Point
PB04	33-44-20.99303	118-22-15.80258	48.702	1727665.942	6448848.863	167.111	Monitoring Point
PB06	33-44-23.70990	118-22-05.04575	59.232	1727937.253	6449758.353	177.578	Monitoring Point
PB07	33-44-25.70220	118-21-59.67620	79.348	1728137.000	6450212.577	197.660	Monitoring Point
PB08	33-44-26.34097	118-21-56.71098	75.864	1728200.661	6450463.241	194.160	Monitoring Point
PB09	33-44-26.81668	118-21-52.14795	70.969	1728247.352	6450848.786	189.241	Monitoring Point
PB12	33-44-26.97302	118-21-43.42797	67.069	1728260.495	6451585.289	185.302	Monitoring Point
PB13	33-44-24.86600	118-21-36.74222	88.661	1728045.466	6452149.170	206.874	Monitoring Point
PB18	33-44-48.41497	118-21-53.76810	244.928	1730431.242	6450719.884	363.096	Monitoring Point
PB20	33-44-31.76231	118-21-48.89495	114.972	1728746.316	6451125.327	233.196	Monitoring Point
PB21	33-44-36.69163	118-21-48.28842	154.399	1729244.441	6451178.352	272.597	Monitoring Point
PB25	33-44-40.93675	118-21-38.73901	207.870	1729670.679	6451986.361	326.006	Monitoring Point
PB26	33-44-39.64221	118-21-35.58607	164.860	1729538.858	6452252.161	282.988	Monitoring Point
PB27	33-44-36.76159	118-21-40.42681	154.007	1729249.120	6451842.307	272.170	Monitoring Point
PB29	33-44-32.76832	118-21-37.42306	53.422	1728844.526	6452094.534	171.591	Monitoring Point
PB53	33-44-36.43277	118-21-53.30366	172.446	1729219.807	6450754.709	290.667	Monitoring Point
PB54	33-44-41.08313	118-21-56.94910	239.515	1729691.035	6450448.554	357.731	Monitoring Point
PB55	33-44-32.05780	118-21-52.73124	121.940	1728777.361	6450801.447	240.180	Monitoring Point
PB59	33-44-21.91046	118-22-18.04317	41.281	1727759.386	6448659.973	159.695	Monitoring Point
PB64	33-44-18.82426	118-21-51.00873	-48.623	1727439.040	6450942.072	69.685	Monitoring Point
PB65	33-44-28.82629	118-22-05.66649	169.423	1728454.667	6449707.823	287.745	Monitoring Point: New 10/23/2010
UB02	33-44-19.62376	118-22-00.48384	-55.599	1727522.773	6450142.126	62.748	Monitoring Point
PVE3	33-44-35.85329	118-24-15.26904	235.421	1729207.091	6438765.185	354.360	CGPS Record Position Fixed All Surveys
PVHS	33-46-46.02015	118-22-19.74139	854.032	1742328.079	6448570.485	972.048	CGPS Pos. Determined Oct. 2010 Survey
PVRS	33-46-25.89202	118-19-14.06725	198.603	1740239.302	6464237.885	316.310	CGPS Pos. Determined Oct. 2010 Survey
VTIS	33-42-45.48967	118-17-37.71227	197.512	1717933.681	6472307.225	315.258	CGPS Pos. Determined Oct. 2010 Survey

November 2009

Survey Report

for the

Monitoring and Control Surveys

of the

Rancho Palos Verdes Portuguese Landslide

By

McGee Surveying Consulting and Charles Abbott Associates, Inc.

INDEX

Survey Report
of the
Portuguese Landslide November 2009 Monitoring Survey
for the
City of Rancho Palos Verdes
by
McGee Surveying Consulting

Surveyed by: McGee Surveying Consulting of Santa Barbara, CA, and Charles Abbott Associates, Inc.
Client: City of Rancho Palos Verdes; **Project Name**: Portuguese Bend Landslide Monitoring Program
Location: Rancho Palos Verdes, California; **County:** Los Angeles; **State:** California

PROJECT OVERVIEW:

McGee Surveying Consulting performed a slide monitoring and control survey at Portuguese Bend on behalf of the City of Rancho Palos Verdes in November 2009. The purpose of the survey was to establish accurate positions on monitoring points to determine overall and periodic movements. The results of this Survey are reported on spreadsheets described in this Report and attached hereto.

The field survey was planned, coordinated and executed by Michael McGee, PLS3945 of McGee Surveying Consulting of Santa Barbara, California in coordination with Frederick (Rick) Jones; P.E., P.L.S., City Engineer, City of Rancho Palos Verdes. Michael McGee PLS was responsible for the final processing of the observations, network adjustments, analysis and reports. The monitoring points cover approximately a 1½ mile square area and are measured annually or more often as necessary to determine the rate and extent of ground movement. Global Positioning System (GPS) technology is used for the purpose of determining positions based on the North American Datum of 1983 (NAD83) and the North American Vertical Datum of 1988 (NAVD 88) as referenced to the California CGPS (Continuous GPS) Stations in the region which are permanently mounted GPS receivers for monitoring seismic activity. The CGPS in California are similar to the national CORS (Continuously Operated Reference Stations).

Given that many points move an inch (0.08') or less per year, our requirement is to meet a relative accuracy standard of one centimeter (0.033 feet) at the 95% Level of Confidence. In the active slide area (central portion) where the movements are larger, two centimeters (0.066 feet) is sufficient. Field procedures are designed to accomplish this purpose and Quality Control-Quality Assurance (QAQC) processes discussed hereafter are incorporated to verify this accuracy is attained.

The movements reported between December 2008 and November 2009 (11.3 months) statistically attained accuracies of 0.02 feet at the 95% Level of Confidence as reported in the attached document "FULL DATA POSTING.xls". The actual accuracies of these measurements approach 0.01 feet in the horizontal as demonstrated by the measured vector residuals, repeatability of measurements at points considered stable, and the consistent direction of the movements reported from one period to the next. Refer to the sections titled ACCURACY and SUMMARY at the end of this Report for more details.

HISTORY

This survey is a continuation of a monitoring survey program initiated by the County of Los Angeles and taken over by the City of Rancho Palos Verdes circa 1994. McGee Surveying Consulting has conducted the field surveys and reporting since September 2007. See the Survey Reports for the September 2007 and December 2008 campaigns and the September 2007 Report for a detailed history of the previous survey process between 1994 and the September 2007.

PROJECT DATUMS, REFERENCE SYSTEM

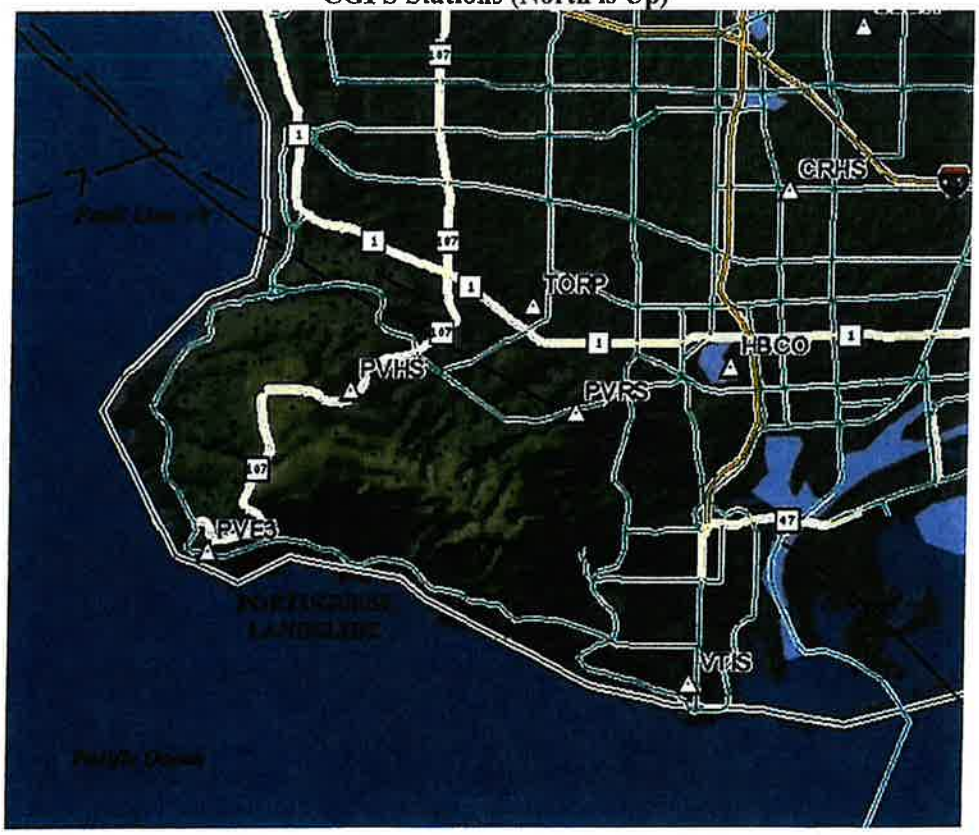
Horizontal Datum: North American Datum of 1983 (NAD83) per the National Geodetic Survey (NGS); **Epoch:** 2007.00 referred to as NAD83(2007.00).; **Units:** Feet

Reference Network: The survey is referenced to the CGPS Stations which are continuously operating reference GPS receivers mounted on a stabile platform (for more information see NGS Data Sheets for the PID's listed below). No data sheet exists for PVE3. The positions were obtained from the California Spatial Reference Center (CSRC). CSRC provides NGS sanctioned positions on all California CGPS Stations.

CGPS	Latitude(dms)	Longitude(dms)	EH(feet)	NGS PID	NAME
PVE3	33 44 35.853290	-118 24 15.269036	235.42	none	PALOS VERDES CORS
PVHS	33 46 46.020150	-118 22 19.741258	853.99	AJ1915	PENINSULA HIGH SCH
PVRS	33 46 25.891904	-118 19 14.067218	198.63	AJ1916	PALOS VERDES RES
VTIS	33 42 45.489584	-118 17 37.712290	197.52	AJ1936	MARINE EXCHANGE

Note: PVRS fall in the proximity of a Fault Line as shown below but appears unaffected to date

CGPS Stations (North is Up)



Vertical Datum: North American Vertical Datum of 1988 (NAVD88) orthometric heights per NGS
Geoid Model: Geoid 03 (Geoid09 became available from the NGS in late 2009; however, using Geoid09 would not affect the results and Geoid03 is retained to be consistent with prior reported heights and the purpose of determining relative changes)

Reference Network: CGPS Station VTIS is the basis for this survey (see NGS Data Sheets)

CGPS	NAVD 88 Ht(feet)	
PVE3	none	
PVHS	972.1	Based on a Refined Geoid Model
PVRS	316.3	Based on a Refined Geoid Model
VTIS	315.26	Based on Second Order Leveling by CSRC and basis for this survey

Projection: NAD83 California State Plane Coordinates Zone 5: The State Plane Coordinates Parameters for Zone Five follow. The average Scale Factor is 1.00007543, the Ellipsoid Height Reduction Factor based on the average ellipsoid heights is 0.99999092, and the average Combined Grid Factor is 1.00006635. Distances in this survey are grid. To obtain ground distance divide the grid distances by the Combined Grid Factor. Grid bearings resulting from this survey must be rotated by a Convergence Angle to obtain geodetic (true) bearings. The average convergence angle is -0-12-30.2± (rotate left 0-12-30).

Datum Stability: The NAD83, 2007.00 Epoch adjustment is the latest in a series of adjustments of NAD83 since its adoption in 1986 and is the datum used for monitoring surveys since 2007. Rancho Palos Verdes sits on the Pacific Plate which is moving west-northwesterly relative to the North American Plate about 4 centimeters (0.14 feet) per year. The area southwesterly of the Fault Line shown on the above map includes the City and is moving at a constant rate as exhibited by the N, E, Up velocities of the CGPS Stations used in this survey, listed below. The CGPS Stations provide a rigid reference frame for the Portuguese Landslide Monitoring Program that is validated during each monitoring campaign. See the Minimally Constrained Adjustment results on Page 7 and the September 2007 Monitoring Survey Report by McGee Surveying Consulting for additional information.

Annual Velocities in Feet (2000-2010.04)

CGPS	North	East	Up
PVE3	0.064	-0.130	-0.001
PVHS	0.064	-0.128	0.000
PVRS	0.062	-0.128	0.001
VTIS	0.064	-0.128	-0.001

FIELD SURVEYS, DATA COLLECTION, EQUIPMENT & PROCESSING

Sixty-seven monitoring points were occupied and reported in November 2009. Site photographs and recovery sheets detailing the location, character of the monument and obstructions were updated. See the Appendix for "Monitoring Point Status as of November 2009" and "Monitoring Points Photo Update November 2009" for additional information. See the September 2007 and December 2008 Monitoring Survey Reports for all photos.

AB61, established in 2007 on Portuguese Point was used as a Base Station because of its suitability for GPS observations. The location is secured behind a locked gate, has a clear horizon above 15 degrees, and sits on a stable basalt geological formation.

The field survey commenced each day by setting a GPS receiver on a fixed height pole on AB61 while two GPS receivers roamed freely collecting observations on fixed height poles at the 66 other on-site points. Many of the points are over-shadowed by mature trees and shrubbery which interfere with signals received from satellites and affect the quality of measurements. To obtain the highest possible accuracies, satellites are compared with obstruction diagrams to estimate the best time for observing a point. Upon arriving at a point to be observed, the receiver is set up, and the location in the sky of each satellite is estimated with a compass and abney. Those

satellites obstructed by foliage and trees are turned off. If 5 or more un-obstructed satellites with a GDOP (measure of the geometry of the constellation) of 4.5 or less are available, then the measurement commenced for 15-30 minutes of data collection. If sufficient satellites and geometry are not available, then the receiver is moved to the next point and returned later when satellite availability improves. This process is followed until all points are occupied twice under a different constellation of satellites on a different day. If the two measurements are within 0.03 feet in slow movement areas or 0.06 feet in active slide areas, then they are accepted, otherwise a third and sometimes fourth occupation is necessary.

Three Leica geodetic GPS receivers and antennas listed below were utilized to collect, process and store satellite signal data. Three, 2 meter fixed height poles were used for the base station and for the observations of the monitoring points. Prior to initiating the field observations a calibration of the fixed height poles was conducted with a theodolite to verify their height and plumb. The top of the poles were found to be plumb within 0.003 feet of the bottom consistent with prior years. Additional checks were made each day. There were no equipment failures.

GPS Survey Parameters:
Date of Field Surveys: 11/14/2009 to 11/20/2009 between 0700-1700 PST (+8 hrs for UTC).
Constellation: The NAVSTAR GPS constellation consisted of 30 Block II satellites.
GPS Observables: L1 & L2 Carrier Wave, C/A Code & P-Code; P-code was encrypted and SA off.
Epoch Rate & Occupation Times: 10 seconds for 15-30 minutes and 4-10 hours for CGPS connections.
Minimum Satellites: 5 ; GDOP < 4.5 ; Elevation Mask for Data Collection: 10 degrees; Processing: 10 deg.
Ephemeris: Broadcast and Precise for Static Post-Processing.
Weather conditions: Generally clear skies and mild temperatures.
Space Weather: Boulder K Index was 0-2 on a scale of 0-9 and gauges ionospheric activity.
GPS Base Receiver Unit No.: M1, Operator: M. McGee, PLS; Station Identification: AB61
Make & Model: Leica 530; Antenna Leica AT302; Mount: Fixed Height Pole #2; Antenna Height: 2.086m
GPS Rover Receiver Unit No.: M3, Operator: M. McGee, PLS;
Make & Model: Leica 530; Antenna Leica AT502; Mount: Fixed Height Pole #3; Antenna Height: 2.085m
GPS Rover Receiver Unit No.: M4, Operator: R. Reese, PLS,
Make & Model: Leica 530; Antenna Leica AT502; Mount: Fixed Height Pole #1; Antenna Height: 2.086m

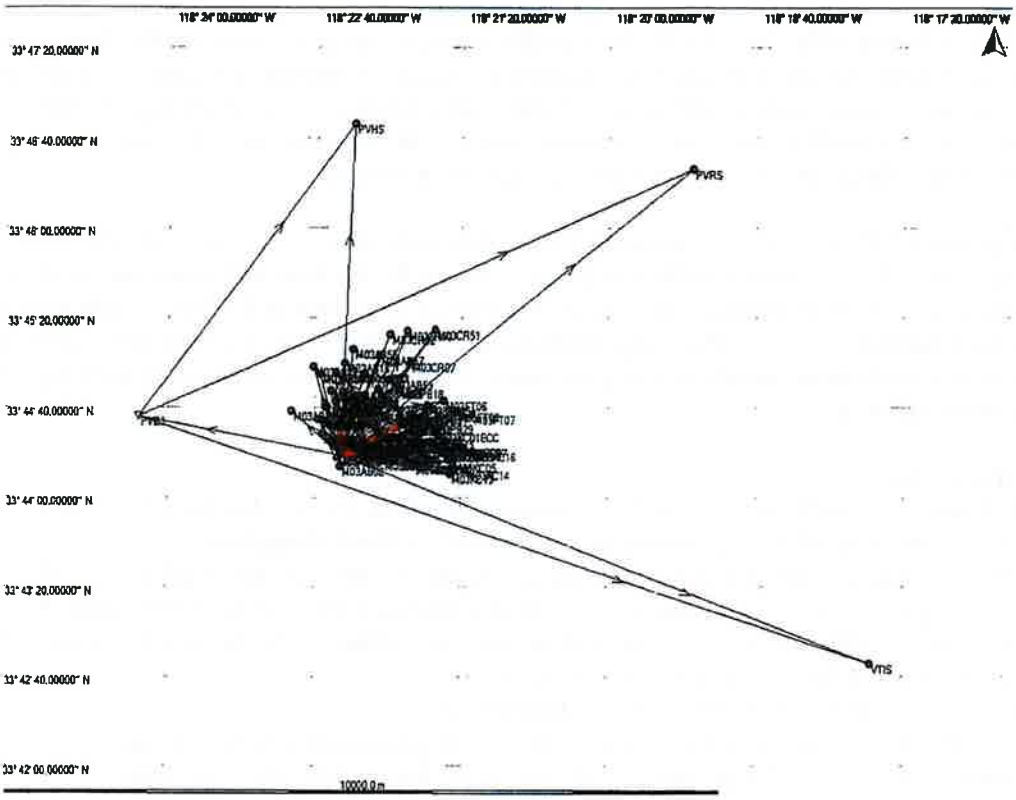
Data was processed using Leica LGO post processing software. The long baseline connections to the CGPS were processed with a precise ephemeris and the short monitoring network baselines were processed with a broadcast ephemeris, both at a cutoff vertical angle of 10°. Analysis of processing statistics and residuals led to the rejection of 4 vectors. Network adjustments and analysis were performed with "Starnet-PRO" version 6.0 software. Data files for the CGPS Stations were downloaded from the following websites: Rinex files from CSRC/SOPAC, rapid and precise ephemeris from the NGS, and antenna models from the NGS .

NETWORK

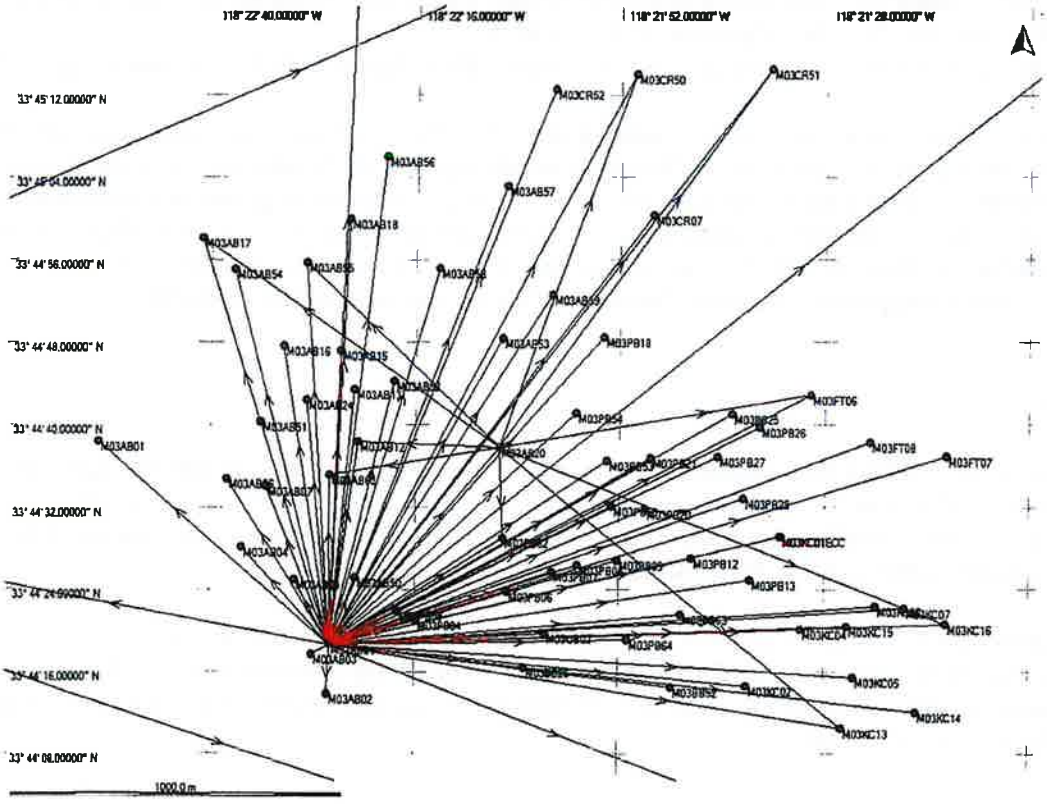
The monitoring plan uses the CGPS Stations and those points deemed to be stable to verify the stability of the reference system. Relative to the Base Station point AB61, the CGPS Station PVE3 is located 1.8 miles west-northwest near City Hall, PVHS is 2.8 miles north, PVRS 3.9 miles northeast near a fault line, and VTIS is 4.9 miles east-southeast as shown on the Network diagram on the next page.

AB61, is the primary Base Station and sits on Portuguese Point. It is focal point of the static network connecting the monitoring points and CGPS Stations. A total of 68 on site points and 4 CGPS Stations were connected with 83 vectors measured 2-4 times to each point (197 measured vectors total). See the Network Maps below for points and vectors.

GPS Network with CGPS Stations (North up)



GPS Network – Enlargement of Monitoring Points (North up)



MONITORING POINT STATUS

For data management purposes during the field survey and data processing, the point names are prefixed with "M03" i.e. AB61 is M03AB61 to distinguish between different monitoring periods. This indicates this survey is the third monitoring since the initial September 2007 Monitoring Survey when the Program was modernized. This allows queries between epochs that include statistical information about accuracies. The prefix is stripped in the coordinate and movement listing reports.

Since 1994, 149 monitoring points have been established in the Portuguese Bend area, many of which are now lost or destroyed. Sixty of the original points were recovered in 2007. Eight of the 60 points were deleted because they were in close proximity of other better suited for GPS leaving 52 points monitored for movement between September 2006 and September 2007. Three of the 52 points (AB09, KC11, PB51) were monitored in September 2007 for the last time because they were replaced by new points, set nearby and better suited for GPS. Eighteen new points set in 2007 had their movements reported for the first time in the December 2008 survey. In December 2008, 49 original and 18 points set in September 2007 were surveyed for a total of 67 monitoring points.

One new point PB64 was set east of the Archery Range to replace PB63 which has become unsafe to access over waffled terrain. At the next Monitoring PB63 will be discontinued.

In the September 2007 Report, it was noted that KC01 was reported by the previous survey on 9/14/2006 to have moved N 29°E 1.24' from its 12/9/2005 position. This surveyor found a buried brass cap in concrete stamped "COUNTY ENGINEER RE8869 1956 STA ??IELDS" S31°29'W 1.48 feet from the 1" IP with steel guard post that was found in September 2007 and used on subsequent surveys. The original position of KC01 is adjusted in this Report to be consistent with the 1" IP, resulting in correct overall reported movements.

In the December 2008 Report, it was noted that AB05 had been previously disturbed by a mowing machine. AB05 was found chipped and leaning to southerly about 0.4'. The movement reporting resumes with this survey. Analysis of the present movement and historic data makes it possible to estimate the disturbance to within 0.05'. The original position of AB05 is adjusted S14°02'E 0.29' in this Report to be consistent with the disturbed position, resulting in correct overall reported movements.

The present status of monitored points is provided in the Appendix under "Monitoring Point Status as of November 2009".

ADJUSTMENTS & ANALYSIS

Adjustment 1: Minimally Constrained to develop Geodetic and Ellipsoid Coordinates in NAD83(2007.00)
Fixed Control: The CGPS Station PVE3 was fixed at its published three dimensional position in a Minimally Constrained Adjustment to determine latitude, longitude, ellipsoid heights, and state plane coordinates, and check other known points. The CSRC publishes a Time Series for the horizontal and vertical stability of PVE3 which indicate the position has been stable over a ten year period to date. The coordinate differences at other CGPS Stations from previous positions to the present are listed below in feet. See the attached file "COORDINATE LIST–Nov 2009" for a list of coordinates resulting from this survey.

Record Positions Compared to 12/2008

Station	dN	dE	dZ	
PVE3	-0.000	-0.000	-0.000	Fixed
PVHS	0.004	-0.010	0.081	
PVRS	0.017	0.002	-0.015	
VTIS	0.005	0.006	-0.021	

9/2007 Positions Compared to 11/2009

Station	dN	dE	dZ	
PVE3	-0.000	-0.000	-0.000	Fixed
PVHS	-0.002	0.005	0.045	
PVRS	0.001	0.009	0.010	
VTIS	-0.003	0.007	-0.005	

12/2008 Positions Compared to 11/2009

Station	dN	dE	dZ	
PVE3	-0.000	-0.000	-0.000	Fixed
PVHS	-0.004	-0.001	0.015	
PVRS	0.003	0.001	0.006	
VTIS	-0.002	0.001	-0.002	
AB61	-0.005	0.002	-0.007	

The 2D differences from the December 2008 to the November 2009 measured positions of the CGPS Stations vary 0.002 to 0.004 feet, and for the purpose of this survey, a constrained adjustment is not preferred or necessary. The CGPS Station positions as determined by this and prior surveys relative to PVE3 are more useful than the record positions for determining the stability of PVE3. The positions determined by these surveys are based on a set of six measurement collected each day for about 10 hours over a six to seven day period during each campaign.

Points AB01, AB02, AB03, AB17, AB61, FT08, and KC16 are presently considered stable, given their history. The prior positions when compared to this survey indicate repeatability at the level of 0.01' as listed in the "FULL DATA POSTING". The survey reference frame is deemed stable and successfully recovered at the level indicated.

Adjustment 2: Minimally Constrained to develop Orthometric Heights (Elevations) in NAVD88
Fixed Control: The CGPS Station PVE3 was fixed horizontally and vertically at the NAVD88 height determined in September 2007 survey based on VTIS CGPS Station. The Adjustment combined the measured ellipsoid height differences with the NGS Geoid 03 (models the separation between the ellipsoid and geoid surfaces) to determine NAVD88 orthometric heights of all points. Prior surveys are compared with the heights determined in the present survey as listed below. See the attached file "COORDINATE LIST-Nov 2009 Survey" for a list of heights resulting from this survey.

09/2007 to 12/2008

Station	dZ(ft)
PVE3	0.000
PVHS	0.031
PVRS	0.006
VTIS	-0.001

12/2008 to 11/2009

Station	dZ(ft)
PVE3	-0.000
PVHS	0.010
PVRS	0.008
VTIS	-0.006

9/2007 to 11/2009

Station	dZ(ft)
PVE3	-0.000
PVHS	0.041
PVRS	0.014
VTIS	-0.007
AB61	-0.010

Note: The orthometric height of PVE3, established in September 2007 based on the published 2nd Order NAVD88 Height of VTIS located 35,386 feet east-southeasterly, is confirmed here at -0.007 feet.

ACCURACY

Coordinate Accuracy: In the Minimally Constrained Adjustment #1, the Standard Deviations (68% Level of Confidence) of the coordinates follow in feet.

	68 Monitoring Point				CGPS Stations		
	North	East	Up		North	East	Up
Average	0.006	0.005	0.021	Average	0.002	0.001	0.004
Maximum	0.009	0.008	0.032	Maximum	0.002	0.002	0.005

Absolute Coordinate Accuracy: The network accuracy is expected to be less than 0.02 feet horizontal relative to the NAD83 Datum based on the CGPS Station PVE3 fixed in Adjustment #1.

Relative Movement Accuracy: For the 67 movements reported here at the 95% Level of Confidence, the statistical analysis indicates the relative error averages 0.022 feet with a standard deviation of 0.004 feet and a range of 0.004 to 0.031 feet.

Vector Accuracy: 197 measured vectors were processed in Adjustment #1 resulting in 83 vectors connecting 72 points. The two dimensional residuals and the absolute value of the vertical residuals of the 197 vectors are listed below in feet. The vector residuals at each point and the closures on stable control points discussed in "Adjustment 1" are good indications of the accuracies obtained by this survey.

	Two Dimensional Residuals			Vertical Residuals		
	Average	Std.Dev.	Maximum	Average	Std.Dev.	Range
Monitoring Pts	0.006	0.004	0.020	0.01	0.01	-0.04 to +0.04
CGPS Stations	0.005	0.004	0.017	0.02	0.016	-0.06 to +0.04

The precisions and the relative distance errors resulting from the adjustment, at the 95% Level of Confidence, for the 83 vectors (baselines) connecting 72 points are listed below in feet.

	Lengths		Precisions		Relative Dist.Error		
	Vary	Average	Vary	Average	Average	Maximum	Precision
Monitoring Pts	192-7134	3484	1.5-63.0	5.9 ppm	0.013	0.023	1: 268,000
CGPS Stations	9396-35386	21519	0.1- 0.3	0.2 ppm	0.003	0.004	1:7,173,000

The precision ratio based on the averages for the vectors connecting the Monitoring points exceeds the criteria for a First Order (C-1) by a factor of 2.7, and the vectors connecting AB61 and the CGPS Stations exceeds the criteria for a B Order survey by a factor of 7.2 per the FGCS requirements for the former classification system.

NAVD88 Heights: The North American Vertical Datum 1988 orthometric heights (elevations) resulting from Adjustment #2 are derived from the difference in ellipsoid heights combined with the Geoid 03 model and constrained to the orthometric height of PVE3. The ellipsoid heights are expected to be within 0.03 feet. The Geoid 03 model is expected to have a probable error of 1 part per million. Although relative elevation accuracies are expected to be 0.03+/- feet, there are no requirements for these surveys. The absolute accuracy of these heights is dependent on the published values on the CGPS Station VTIS.

This survey conforms to the intent of the Federal Geodetic Control Subcommittee (FGCS) Specifications for GPS Relative Positioning (1988) and the California Geodetic Control Committee (CGCC) Specifications for High-Production GPS Surveying Techniques (1993).

QAQC ANALYSIS

To ensure the accuracy and validity of the systems used to obtain the accuracies reported in these GPS surveys, an independent test was made using conventional terrestrial based instruments as reported in the "QAQC ANALYSIS" section of the September 2007 Monitoring Survey Report. The results found the GPS systems and conventional instrumentation horizontal measurements agree 0.01 feet on average.

To validate the radial survey method of positioning points from a single base station (AB61), independent GPS cross connections were measured and compared with the computed inverse distances in the present and prior surveys as reported in the "QAQC ANALYSIS" section of the September 2007 and the December 2008 Monitoring Survey Report. The results find the two dimensional accuracy to agree 0.01 feet on average, indicating the radial method of measurements is reliable and the extra labor cost of measuring cross connection between all points is not warranted.

SUMMARY

A modernization of field procedures and processing techniques began with the September 2007 survey. The temporal movements are based on a rigorous simultaneous least squares adjustment of multiple observations on each point at two different epochs. The statistical results of the December 2008 to November 2009 monitoring period show the relative accuracy of the reported movements is 0.022 feet on average at the 95% Level of Confidence. Prior to September 2007, successive coordinates were used to compute movements which did not provide statistical information about the relative accuracy of the movements.

Analysis of the adjustment indicates the probability at the 95% level of confidence that movement (signal) has occurred at a point when the horizontal distance is greater than 0.02 feet (noise). Using these criteria, 15 points have not moved, BB25 moved in a direction inconsistent with the prior period, leaving 51 points that have moved. Between December 2008 and November 2009 (11.3 months), points in the Portuguese Bend Landslide moved between 0.10 and 7.30 feet. Points in the Abalone Cove Landslide west of the Portuguese Bend Landslide moved between 0.04 and 0.11 feet. Points in the Klondike Canyon east of the Portuguese Bend Landslide moved between 0.03 and 0.08 feet. See the Contours of Horizontal Movement in the Appendix for a graphical representation of the movements across the site.

Deflection Analysis: 49 of these points moved in a direction that was linear when compared with the previous period's direction of movement. The deflection or separation between the direction for the previous and present periods, taken over the moved distance, returned an average separation of 0.01 feet with a standard deviation of 0.01 feet. This implies the expectation that the direction of movement is linear unless acted upon by other forces. Furthermore, the 0.01 foot separation is an implied accuracy of the measurement of the reported movements.

Velocity Analysis: The movement distances for this period are 54% on average (12% standard deviation) of the movements for the last period; however, the 11.3 month period is 78% of the prior period. If the 54% average is normalized with the previous period (.54/.78=.68), then the movements have slowed about 1/3. The City Geologist should be referred to for assessment and interpretation of the movements.

See the spreadsheet "FULL DATA POSTING.xls" for overall and periodic movements of each point. The movements are given in north, east and up or down as well as a vector of distance and direction. The direction is given as an azimuth in degrees where 0° is north, 90° is east, 180° is south and 270° is west. The overall movements are from the beginning position of each point which varies between 1994 and 2007.

The present status of monitored points is provided in the Appendix under "Monitoring Point Status as of November 2009". The historical status of all monitoring points is provided in the September 2007 Survey Report. The historical 1994-2006 positions of all points are listed in the Charles Abbott Associates Inc. file "ALL POINTS MOST RECENT OBSERVED POSITION AS OF SEPTEMBER 15, 2006.xls" attached to the 2007 Report.

RECOMMENDATION

Monitoring Point AB03 on Portuguese Point should be deleted from the survey because it sits atop a high cliff subject to erosion and AB61 set nearby in 2007 is a suitable replacement. AB54 is one of the worst points for collecting GPS data. A suitable location may exist north-northeasterly about 300 feet on what may be City property. BB25 sits on a rock which appears to be unstable given its history of incongruous movements. It will be difficult to find a suitable nearby replacement along the shoreline.

Attachments: Find the following documents attached to this Report.

FULL DATA POSTING.xls - Lists the overall and periodic movements of monitoring point including coordinates of the initial positions, 2007 and post 2007 positions in NAD83(2007.00) and NAVD88 Systems

COORDINATE LIST-Nov 2009 Survey.xls - Current NAD83(2007.00) Geodetic, Grid Coordinates, NAVD88 Heights of all points

SURVEYOR'S STATEMENT

This Report on the criteria, procedures and results of the Rancho Palos Verdes Portuguese Landslide Monitoring Survey were prepared by me February 23, 2010 at the request of Frederick (Rick) Jones; P.E., P.L.S. of Charles Abbott Associates Inc. and City Engineer of the City of Rancho Palos Verdes.

Michael R. McGee
P.L.S. 3945

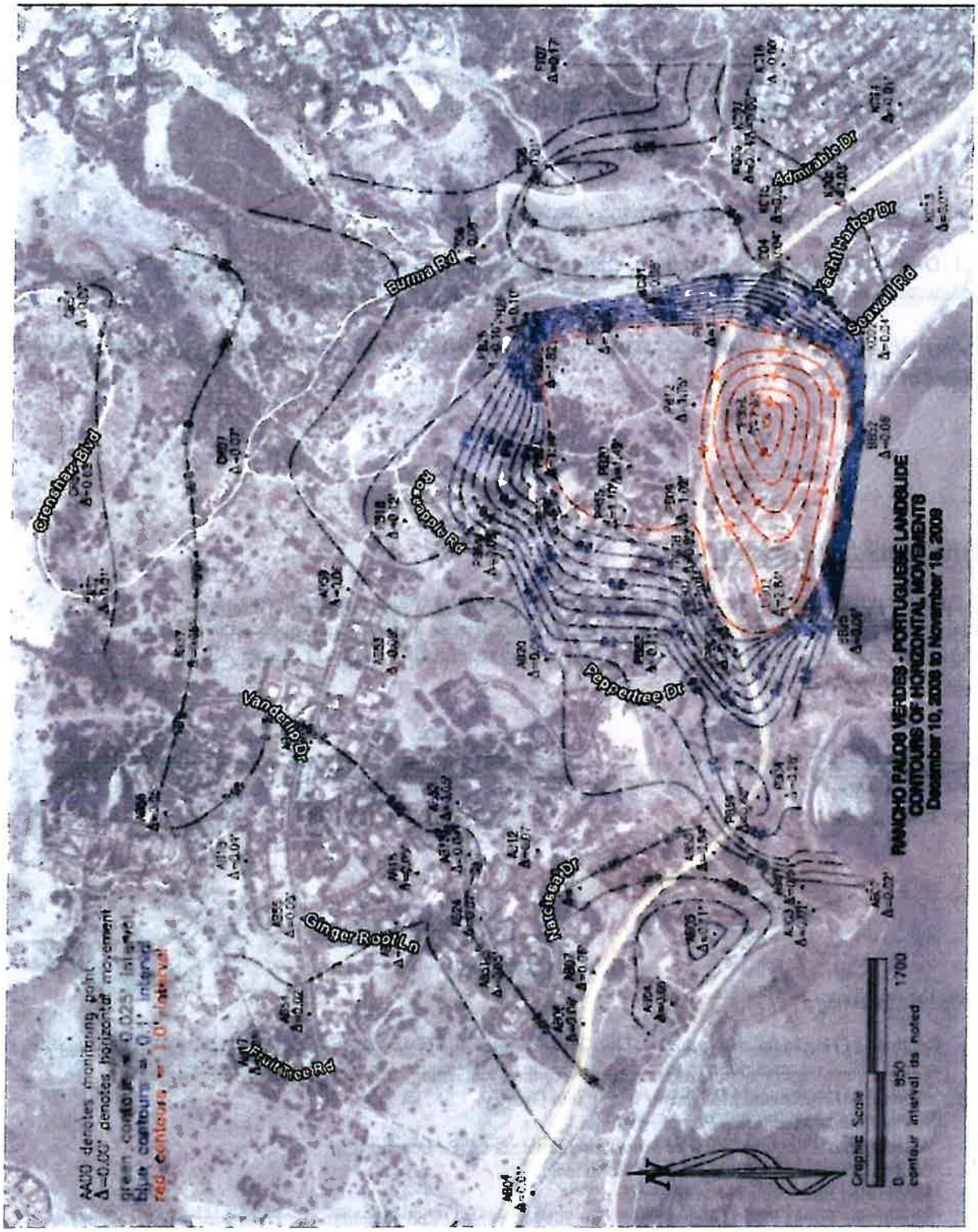
Frederick (Rick) Jones
R.C.E. 36665, P.L.S. 5458

APPENDIX

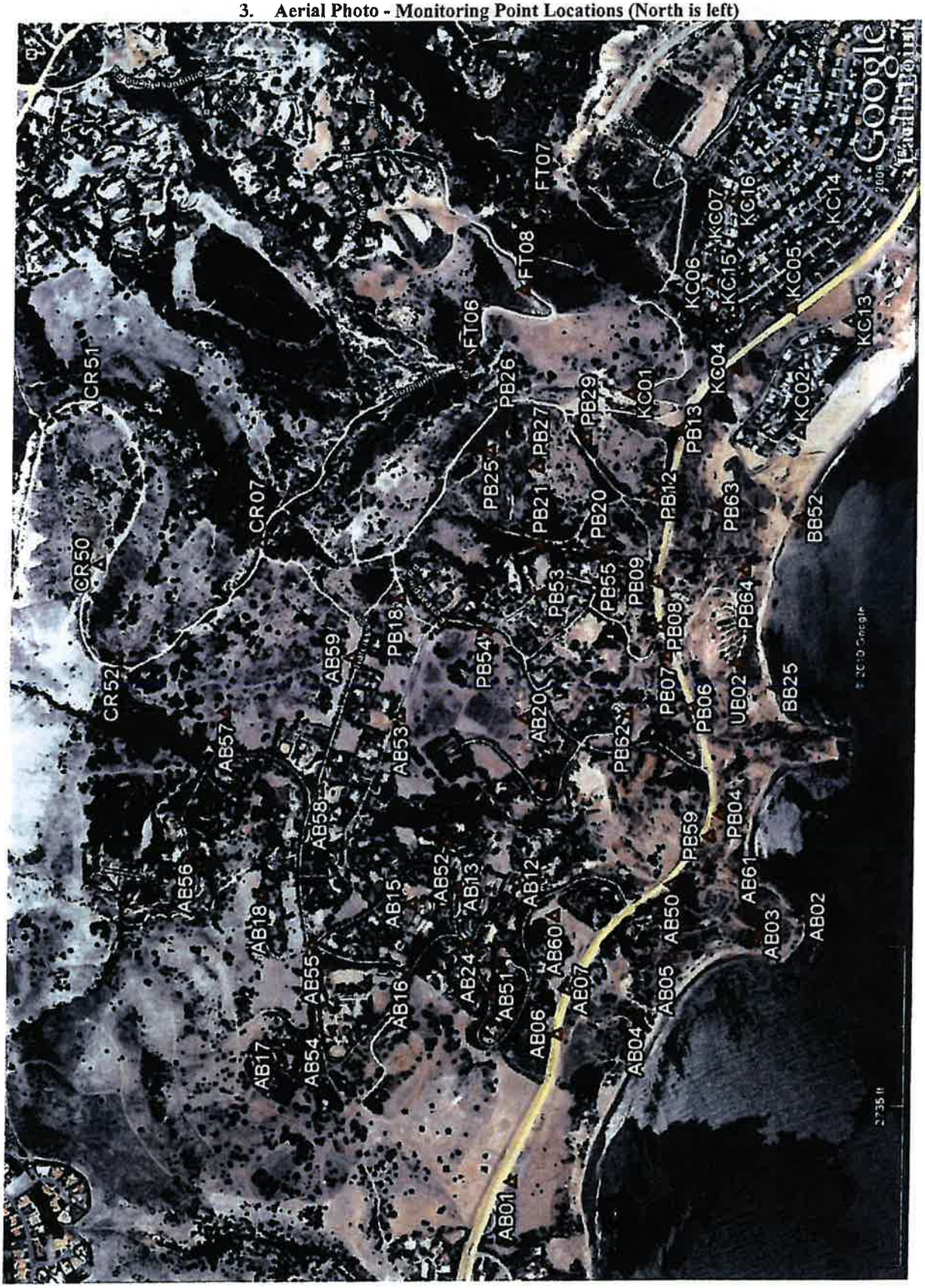
Find the following:

1. Contours of Horizontal Movements – Dec. 2008 to Nov. 2009 (Contours at 0.025, 0.10 and 1.00 feet providing a general visual representation of movements; see the City Geologist for interpretation of movements)
2. Contours of Horizontal Movements with Photo Overlay
3. Aerial Photo - Monitoring Point Locations
4. Aerial Photo – Regional View of Monitoring Points & CGPS Locations
5. Oblique View of Monitoring Points (North is up)
6. Monitoring Point Status as of November 2009
7. Monitoring Points Photo Update November 2009 (2 pages) (Updated photos for changes since Sept. 2007)

2. Contours of Horizontal Movements with Photo Overlay (North is left)
(This is a general visual representation of movements; see the Full Data Posting for actual movements)



3. Aerial Photo - Monitoring Point Locations (North is left)



4. Aerial Photo – Regional View of Monitoring Points & CGPS Locations (North is up)

5. Oblique View of Monitoring Points (North is up)

6. Monitoring Point Status as of November 2009

RANCHO PALOS VERDES - PORTUGUESE LAND SLIDE MONITORING

Notes: 150 Monitoring Points established since 1994
09/2007 71 Points Monitored: 60 old points found with 52 monitored plus 19 new points
12/2008 67 Points Monitored: AB09, KC11, PB51 discontinued; BB53 destroyed; AB05 disturbed
11/2009 68 Points Monitored: Set PB64 new point to replace PB63

Pt ID	Last Obs'd	Comments	GPS
AB01	11/18/2009	1994-2006 Base	G
AB02	11/18/2009		G
AB03	11/18/2009		G
AB04	11/18/2009		G
AB05	11/18/2009		G
AB06	11/18/2009		G
AB07	11/18/2009		G
AB12	11/18/2009		G
AB13	11/18/2009		P
AB15	11/18/2009		F
AB16	11/18/2009		P
AB17	11/18/2009		F
AB18	11/18/2009		P
AB20	11/18/2009	NE'ly of 2 pipes	G
AB24	11/18/2009		F
AB50	11/18/2009		G
AB51	11/18/2009		G
AB52	11/18/2009		P
AB53	11/18/2009		F
AB54	11/18/2009		P
AB55	11/18/2009		G
AB56	11/18/2009		F
AB57	11/18/2009		G
AB58	11/18/2009		P
AB59	11/18/2009		G
AB60	11/18/2009		G
AB61	11/18/2009	2007-2009 Base	G
BB25	11/18/2009		G
BB52	11/18/2009		G
CR07	11/18/2009		F
CR50	11/18/2009		G
CR51	11/18/2009		G
CR52	11/18/2009		P

Pt ID	Last Obs'd	Comments	GPS
FT06	11/18/2009		G
FT07	11/18/2009		G
FT08	11/18/2009		G
KC01	11/18/2009	NE'ly of 2 pipes	G
KC02	11/18/2009		G
KC04	11/18/2009		G
KC05	11/18/2009		G
KC06	11/18/2009		G
KC07	11/18/2009		G
KC13	11/18/2009		G
KC14	11/18/2009		G
KC15	11/18/2009		F
KC16	11/18/2009		G
PB04	11/18/2009		G
PB06	11/18/2009		G
PB07	11/18/2009		G
PB08	11/18/2009		G
PB09	11/18/2009		G
PB12	11/18/2009		G
PB13	11/18/2009		G
PB18	11/18/2009		G
PB20	11/18/2009	S'ly of 2 pipes	G
PB21	11/18/2009		F
PB25	11/18/2009		G
PB26	11/18/2009		F
PB27	11/18/2009		G
PB29	11/18/2009		G
PB53	11/18/2009		P
PB54	11/18/2009		F
PB55	11/18/2009		P
PB59	11/18/2009		G
PB62	11/18/2009		G
PB63	11/18/2009	Discontinue after 11/09	G
PB64	11/18/2009	Replaces PB63	G
UB02	11/18/2009		G

GPS indicated Good, Fair or Poor Obstruction Conditions

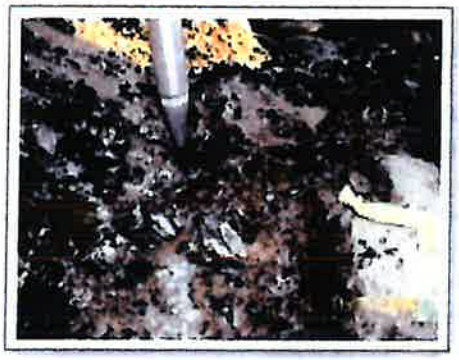
Revised 02/09/2010

7. Monitoring Points - Photo Update for November 2009

(See September 2007 and November 2009 Report for all photos)
Update for Points BB25, BB52, CR07, CR51, CR52, KC01, PB09, PB64, PVE3 CGPS Station

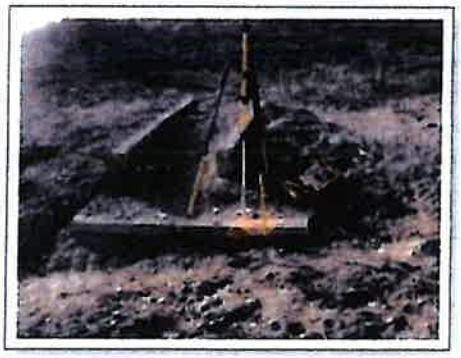
BB25-closeup1.JPG

BB25-se5.JPG



BB52-closeup3.JPG

CR07-N.JPG



CR51-W.JPG

CR52-X.JPG

KC01-NJPG

PB09-eJPG

PB64-S.JPG

PB64-S2JPG

PVE3-EJPG

Attachments

Find the following documents attachments to this Report

FULL DATA POSTING.xls - Lists the overall and periodic movements of monitoring point including coordinates of the initial positions, 2007 and post 2007 positions in NAD83(2007.00) and NAVD88 Systems

COORDINATE LIST-Nov 2009 Survey.xls - Current NAD83(2007.00) Geodetic, Grid Coordinates, NAVD88 Heights of all points

FULL DATA POSTING as of Dec.2008

Date: 02/09/10

PORTUGUESE POINT LANDSLIDE MONITORING

NAD83(2007) COORDINATES and NAVD88 ELEVATIONS of BEGINNING, 2007 & POST 2007 MONITORING POINT POSITIONS

Notes:

\# Indicates stable points, not moving

* Indicates no movement detected

1= 2005 and prior surveys used a nearby monument S31-29W 1.48', the original position is adjusted here to be relative to the 1" IP used presently, resulting in correct Overall Movements, see Reports

	Original Positions				Sept. 24, 2007 Positions			Overall Movements (US Feet)					
		NAD83 SPC Zone 5 (Ft)		NAVD88	NAD83 SPC Zone 5 (Ft)		NAVD88	Original Position to Sept. 24, 2007					
Point	Date	North (ft)	East (ft)	Elev(ft)	North (ft)	East (ft)	Elev(ft)	North	East	Height	Azim.°	Dist.	Note
AB01	12/1/1994	1729427.58	6445709.61	178.62	1729427.55	6445709.64	178.62	-0.03	0.03	0.00	-	0	#
AB02	11/30/1994	1726946.97	6447968.65	116.45	1726946.98	6447968.69	116.48	0.01	0.04	0.03	72	0.04	#
AB03	12/1/1994	1727338.34	6447818.82	139.60	1727338.39	6447818.81	139.59	0.04	-0.01	-0.01	351	0.04	#
AB04	11/30/1994	1728391.99	6447123.34	67.57	1728390.55	6447122.03	67.31	-1.44	-1.32	-0.26	222	1.95	
AB05	3/14/1995	1728075.72	6447645.17	80.90									
AB06	4/27/1995	1729059.73	6446976.26	165.28	1729058.58	6446975.91	164.91	-1.15	-0.35	-0.37	197	1.21	
AB07	11/30/1994	1728982.79	6447358.41	159.92	1728981.51	6447357.74	159.40	-1.28	-0.67	-0.52	208	1.44	
AB12	11/30/1994	1729416.49	6448271.64	283.43	1729415.67	6448271.30	283.19	-0.82	-0.35	-0.24	203	0.89	
AB13	11/30/1994	1729928.90	6448236.04	365.03	1729928.25	6448235.90	364.54	-0.65	-0.13	-0.49	192	0.66	
AB15	11/30/1994	1730312.09	6448099.38	397.28	1730311.64	6448099.31	396.90	-0.45	-0.07	-0.38	189	0.45	
AB16	11/30/1994	1730358.89	6447532.12	376.62	1730358.70	6447532.17	376.44	-0.19	0.04	-0.18	168	0.19	
AB17	11/30/1994	1731421.14	6446727.77	443.05	1731421.12	6446727.77	442.80	-0.02	0.00	-0.25	167	0.02	#
AB18	12/1/1994	1731602.62	6448187.49	457.19	1731602.37	6448187.58	456.93	-0.26	0.09	-0.26	162	0.27	
AB20	3/16/1995	1729360.63	6449686.27	396.43	1729360.00	6449686.03	396.23	-0.62	-0.23	-0.20	201	0.67	
AB24	3/12/1997	1729830.35	6447759.96	335.92	1729829.83	6447759.82	335.74	-0.52	-0.14	-0.18	196	0.54	
AB50	1/16/1998	1728085.00	6448248.18	181.98	1728084.71	6448247.54	182.03	-0.29	-0.65	0.05	246	0.71	
AB51	3/22/2002	1729617.01	6447306.54	305.42	1729616.73	6447306.52	305.25	-0.28	-0.02	-0.17	184	0.28	
AB52	3/22/2002	1730016.10	6448624.44	368.61	1730015.79	6448624.36	368.39	-0.31	-0.08	-0.22	195	0.32	
AB53	3/22/2002	1730431.11	6449712.37	353.13	1730430.77	6449712.33	352.90	-0.34	-0.04	-0.23	187	0.34	
AB54	9/24/2007	1731111.94	6447047.87	407.31	1731111.94	6447047.87	407.31						
AB55	9/24/2007	1731174.77	6447753.57	405.38	1731174.77	6447753.57	405.38						
AB56	9/24/2007	1732214.31	6448545.46	571.65	1732214.31	6448545.46	571.65						
AB57	9/24/2007	1731926.91	6449759.36	564.93	1731926.91	6449759.36	564.93						
AB58	9/24/2007	1731118.02	6449074.93	405.67	1731118.02	6449074.93	405.67						
AB59	9/24/2007	1730850.87	6450212.56	434.37	1730850.87	6450212.56	434.37						
AB60	9/24/2007	1729089.70	6447987.57	179.45	1729089.70	6447987.57	179.45						
AB61	9/24/2007	1727424.50	6447990.26	140.47	1727424.50	6447990.26	140.47						
BB25	11/4/1998	1727200.54	6449932.73	3.81	1727200.25	6449932.73	4.12	-0.29	-0.01	0.31	182	0.29	
BB52	9/24/2007	1726996.36	6451384.38	3.83	1726996.36	6451384.38	3.83						
BB53	9/24/2007	1726831.16	6451840.89	13.81	1726831.16	6451840.89	13.81						
CR07	11/30/1994	1731628.78	6451203.19	633.28	1731628.37	6451203.29	632.48	-0.41	0.10	-0.80	166	0.42	
CR50	1/16/1998	1733013.55	6451037.38	873.04	1733013.62	6451037.38	872.66	0.07	0.00	-0.38	358	0.07	
CR51	1/16/1998	1733061.90	6452361.82	976.75	1733062.03	6452361.86	976.25	0.13	0.04	-0.50	17	0.14	
CR52	1/16/1998	1732867.54	6450239.34	780.01	1732867.58	6450239.32	779.63	0.03	-0.02	-0.38	333	0.04	#
FT06	9/24/2007	1729855.61	6452760.21	489.06	1729855.61	6452760.21	489.06						
FT07	9/24/2007	1729253.24	6454104.75	589.01	1729253.24	6454104.75	589.01						
FT08	9/24/2007	1729388.68	6453350.51	658.44	1729388.68	6453350.51	658.44						
KC01	11/30/1994	1728476.78	6452458.23	312.88	1728476.36	6452457.91	312.42	-0.42	-0.32	-0.46	217	0.52	1
KC02	3/14/1995	1727002.89	6452118.99	13.84	1727002.74	6452118.89	13.74	-0.15	-0.11	-0.10	216	0.18	
KC04	3/14/1995	1727559.56	6452667.24	238.84	1727559.46	6452667.09	238.51	-0.10	-0.15	-0.33	236	0.18	
KC05	11/30/1994	1727082.00	6453179.09	227.86	1727082.01	6453178.94	227.53	0.01	-0.15	-0.33	273	0.15	
KC06	11/30/1994	1727784.91	6453396.67	300.35	1727784.94	6453396.40	299.97	0.03	-0.26	-0.38	276	0.26	
KC07	11/30/1994	1727759.19	6453683.92	313.83	1727759.37	6453683.85	313.51	0.18	-0.07	-0.32	340	0.19	
KC13	9/24/2007	1726581.16	6453069.63	191.20	1726581.16	6453069.63	191.20						
KC14	9/24/2007	1726742.44	6453806.05	259.94	1726742.44	6453806.05	259.94						
KC15	9/24/2007	1727590.45	6453121.10	287.10	1727590.45	6453121.10	287.10						
KC16	9/24/2007	1727602.25	6454098.23	326.90	1727602.25	6454098.23	326.90						
PB04	11/30/1994	1727675.94	6448851.74	170.52	1727667.25	6448849.17	167.49	-8.69	-2.57	-3.03	196	9.06	
PB06	3/15/1995	1727968.45	6449761.84	183.06	1727941.12	6449758.81	178.25	-27.33	-3.03	-4.81	186	27.50	
PB07	3/14/1995	1728175.93	6450219.76	200.21	1728141.60	6450213.44	198.02	-34.32	-6.32	-2.19	190	34.90	
PB08	12/1/1994	1728237.51	6450469.80	193.60	1728204.81	6450463.98	194.09	-32.70	-5.82	0.41	190	33.21	
PB09	11/30/1994	1728288.58	6450851.02	192.52	1728252.20	6450849.11	189.84	-36.38	-1.91	-2.68	183	36.43	
PB12	11/30/1994	1728330.49	6451604.57	193.29	1728260.52	6451587.83	186.93	-61.97	-16.74	-6.36	195	64.19	
PB13	3/14/1995	1728085.97	6452164.34	210.54	1728050.44	6452151.18	207.21	-35.53	-13.16	-3.33	200	37.89	
PB18	3/15/1995	1730446.88	6450711.00	367.58	1730431.80	6450719.76	363.24	-15.08	8.77	-4.34	150	17.44	
PB20	3/14/1995	1728812.77	6451135.67	243.54	1728753.50	6451126.52	234.48	-59.27	-9.16	-9.06	189	59.97	
PB21	3/14/1995	1729298.22	6451172.05	280.02	1729249.90	6451177.92	273.29	-48.32	5.87	-6.73	173	48.68	
PB25	12/1/1994	1729702.31	6451985.65	328.99	1729671.12	6451986.48	326.10	-31.19	0.83	-2.89	178	31.20	
PB26	3/14/1995	1729562.65	6452249.56	285.34	1729539.22	6452252.23	282.95	-23.42	2.67	-2.39	174	23.58	
PB27	3/14/1995	1729339.34	6451836.06	284.42	1729257.91	6451842.02	273.51	-81.43	5.96	-10.91	176	81.65	
PB29	3/15/1995	1728886.95	6452120.49	185.93	1728849.86	6452097.03	173.29	-39.08	-23.46	-12.64	211	45.58	
PB53	12/4/1997	1729252.77	6450753.92	297.75	1729224.25	6450754.60	291.85	-28.52	0.67	-5.90	179	28.53	
PB54	12/4/1997	1729694.90	6450448.69	358.62	1729691.38	6450448.62	357.73	-3.52	-0.07	-0.89	181	3.52	
PB55	1/21/1998	1728812.28	6450804.04	246.33	1728782.51	6450801.87	241.07	-29.77	-2.18	-5.26	184	29.85	
PB59	6/26/2001	1727766.36	6448661.67	163.39	1727761.30	6448660.42	160.61	-5.07	-1.24	-2.78	194	5.22	
PB62	9/24/2007	1728476.64	6449717.56	287.25	1728476.64	6449717.56	287.25						
PB63	9/24/2007	1727734.04	6451488.11	126.06	1727734.04	6451488.11	126.06						
PB64	11/18/2009	1727466.29	6450946.95	72.76									
UB02	7/23/1997	1727581.11	6450133.78	67.15	1727534.46	6450140.57	63.20	-46.66	6.78	-3.95	172	47.15	

FULL DATA POSTING as of Dec.2008

Date: 02/09/10

Notes:

\# Indicates stable points, not moving

* Indicates no movement detected

2 = Hit by mower sometime between 09/07 and 12/08 with an estimated displacement S14E 0.29', the original position is adjusted here to be relative to monitored position used presently, resulting in correct Overall Movements, see Rpt

	Dec. 10, 2008 Positions			Overall Movements (US Feet)						Periodic (14.5 months) Movements (US Feet)						
	NAD83 SPC Zone 5 (Ft)		NAVD88	Original Position to Dec. 10, 2008						Sept. 24, 2007 Position to Dec. 10, 2008						
Point	North (ft)	East (ft)	Elev(ft)	North	East	Height	Azim.°	Dist.	Note	North	East	Height	Azimuth°	Distance	95%Error	Note
AB01	1729427.54	6445709.63	178.59	-0.05	0.02	-0.03	161	0.05	#	-0.01	-0.01	-0.03	231	0.02	0.017	#
AB02	1726946.99	6447968.68	116.46	0.02	0.03	0.01	61	0.03	#	0.00	-0.01	-0.02	297	0.01	0.016	#
AB03	1727338.39	6447818.81	139.58	0.04	-0.01	-0.02	348	0.04	#	0.00	0.00	-0.01	270	0.00	0.015	#
AB04	1728390.43	6447121.92	67.27	-1.56	-1.43	-0.30	222	2.12		-0.12	-0.11	-0.04	222	0.16	0.016	
AB05	1728074.86	6447644.04	80.59	-0.86	-1.13	-0.31	233	1.42	2							2
AB06	1729058.49	6446975.88	164.85	-1.24	-0.38	-0.43	197	1.30		-0.09	-0.03	-0.06	198	0.09	0.019	
AB07	1728981.40	6447357.70	159.34	-1.39	-0.71	-0.58	207	1.56		-0.11	-0.04	-0.06	202	0.12	0.021	
AB12	1729415.57	6448271.26	283.19	-0.92	-0.38	-0.24	203	0.99		-0.10	-0.03	0.00	199	0.11	0.018	
AB13	1729928.17	6448235.89	364.54	-0.73	-0.15	-0.49	192	0.74		-0.08	-0.01	0.00	191	0.08	0.019	
AB15	1730311.56	6448099.30	396.88	-0.53	-0.08	-0.40	189	0.53		-0.08	-0.01	-0.02	188	0.08	0.024	
AB16	1730358.65	6447532.17	376.46	-0.24	0.05	-0.16	168	0.24		-0.05	0.01	0.02	170	0.05	0.024	
AB17	1731421.12	6446727.77	442.79	-0.02	0.00	-0.26	171	0.02	#	0.00	0.00	-0.01	194	0.00	0.020	#
AB18	1731602.31	6448187.61	456.91	-0.32	0.11	-0.28	160	0.34		-0.06	0.03	-0.02	155	0.07	0.023	
AB20	1729359.84	6449685.99	396.23	-0.79	-0.28	-0.20	199	0.83		-0.16	-0.04	0.00	195	0.17	0.012	
AB24	1729829.75	6447759.77	335.76	-0.61	-0.19	-0.16	197	0.63		-0.09	-0.04	0.02	205	0.10	0.022	
AB50	1728084.66	6448247.47	181.98	-0.34	-0.71	0.00	245	0.79		-0.05	-0.07	-0.05	235	0.08	0.019	
AB51	1729616.65	6447306.51	305.26	-0.36	-0.03	-0.16	185	0.36		-0.09	-0.01	0.01	190	0.09	0.019	
AB52	1730015.70	6448624.32	360.38	-0.40	-0.12	-0.23	196	0.42		-0.10	-0.03	-0.01	200	0.10	0.028	
AB53	1730430.62	6449712.30	352.90	-0.49	-0.07	-0.23	188	0.50		-0.15	-0.03	0.00	189	0.15	0.028	
AB54	1731111.93	6447047.87	407.30	-0.01	0.00	-0.01	165	0.01		-0.01	0.00	-0.01	165	0.01	0.028	*
AB55	1731174.72	6447753.58	405.39	-0.05	0.01	0.01	166	0.05		-0.05	0.01	0.01	166	0.05	0.018	
AB56	1732214.21	6448545.43	571.64	-0.10	0.03	-0.01	161	0.11		-0.10	0.03	-0.01	161	0.11	0.018	
AB57	1731926.78	6449759.40	564.90	-0.13	0.03	-0.03	166	0.13		-0.13	0.03	-0.03	166	0.13	0.018	
AB58	1731117.90	6449074.93	405.65	-0.12	0.00	-0.02	178	0.12		-0.12	0.00	-0.02	178	0.12	0.020	
AB59	1730850.70	6450212.53	434.35	-0.17	-0.02	-0.02	188	0.17		-0.17	-0.02	-0.02	188	0.17	0.020	
AB60	1729089.63	6447987.54	179.39	-0.08	-0.03	-0.06	200	0.08		-0.08	-0.03	-0.06	200	0.08	0.021	
AB61	1727424.49	6447990.27	140.43	-0.01	0.01	-0.04	114	0.01		-0.01	0.01	-0.04	114	0.01	0.003	#
BB25	1727200.25	6449932.58	4.15	-0.29	-0.16	0.34	208	0.33		0.00	-0.15	0.03	269	0.15	0.017	
BB52	1726996.24	6451384.35	3.83	-0.12	-0.03	0.00	194	0.13		-0.12	-0.03	0.00	194	0.13	0.024	
BB53	Destroyed															
CR07	1731628.24	6451203.32	632.36	-0.54	0.13	-0.92	166	0.55		-0.13	0.03	-0.12	168	0.13	0.024	
CR50	1733013.62	6451037.38	872.71	0.08	0.01	-0.33	5	0.08		0.01	0.01	0.05	45	0.01	0.017	*
CR51	1733062.02	6452361.86	976.24	0.12	0.04	-0.51	20	0.13		-0.01	0.00	-0.01	171	0.01	0.019	*
CR52	1732867.58	6450239.31	779.64	0.03	-0.03	-0.37	315	0.04		0.00	-0.01	0.01	258	0.01	0.023	*
FT06	1729855.42	6452760.17	488.97	-0.19	-0.04	-0.09	192	0.19		-0.19	-0.04	-0.09	192	0.19	0.025	
FT07	1729253.01	6454104.39	588.99	-0.23	-0.36	-0.02	237	0.43		-0.23	-0.36	-0.02	237	0.43	0.015	
FT08	1729388.67	6453350.53	658.47	-0.01	0.02	0.03	114	0.02		-0.01	0.02	0.03	114	0.02	0.015	*
KC01	1728476.25	6452457.85	312.38	-0.53	-0.38	-0.50	215	0.66	1	-0.12	-0.06	-0.04	208	0.13	0.020	
KC02	1727002.67	6452118.88	13.72	-0.22	-0.11	-0.12	207	0.25		-0.07	-0.01	-0.02	185	0.07	0.021	
KC04	1727559.42	6452667.06	238.47	-0.14	-0.18	-0.37	233	0.23		-0.04	-0.04	-0.04	223	0.05	0.017	
KC05	1727081.98	6453178.94	227.52	-0.02	-0.15	-0.34	261	0.15		-0.03	0.00	-0.01	180	0.03	0.020	
KC06	1727784.92	6453396.36	299.93	0.01	-0.30	-0.42	273	0.30		-0.01	-0.04	-0.04	252	0.05	0.021	
KC07	1727759.38	6453683.87	313.50	0.18	-0.05	-0.33	346	0.19		0.00	0.02	-0.01	84	0.02	0.018	*
KC13	1726581.12	6453069.62	191.23	-0.04	-0.01	0.03	194	0.04		-0.04	-0.01	0.03	194	0.04	0.018	
KC14	1726742.44	6453806.04	259.91	0.00	-0.02	-0.03	259	0.02		0.00	-0.02	-0.03	259	0.02	0.020	*
KC15	1727590.41	6453121.06	287.13	-0.05	-0.04	0.03	220	0.06		-0.05	-0.04	0.03	220	0.06	0.022	
KC16	1727602.24	6454098.24	326.92	-0.01	0.00	0.02	135	0.01		-0.01	0.00	0.02	135	0.01	0.016	*
PB04	1727666.83	6448849.07	167.37	-9.10	-2.67	-3.15	196	9.49		-0.41	-0.10	-0.12	194	0.43	0.017	
PB06	1727939.65	6449758.62	177.96	-28.80	-3.22	-5.10	186	28.98		-1.47	-0.18	-0.29	187	1.48	0.021	
PB07	1728139.82	6450213.09	197.88	-36.10	-6.67	-2.33	190	36.72		-1.78	-0.35	-0.14	191	1.82	0.020	
PB08	1728203.20	6450463.68	194.13	-34.31	-6.12	0.45	190	34.85		-1.61	-0.30	0.04	190	1.64	0.024	
PB09	1728250.32	6450848.98	189.58	-38.26	-2.04	-2.94	183	38.31		-1.88	-0.13	-0.26	184	1.88	0.021	
PB12	1728265.36	6451586.81	186.31	-65.13	-17.76	-6.98	195	67.51		-3.16	-1.03	-0.62	198	3.32	0.019	
PB13	1728048.48	6452150.38	207.09	-37.49	-13.96	-3.45	200	40.01		-1.96	-0.80	-0.12	202	2.12	0.019	
PB18	1730431.47	6450719.84	363.18	-15.41	8.85	-4.40	150	17.77		-0.33	0.08	-0.06	166	0.34	0.020	
PB20	1728750.65	6451126.05	233.99	-62.12	-9.63	-9.55	189	62.86		-2.85	-0.47	-0.49	189	2.89	0.020	
PB21	1729247.73	6451178.08	273.02	-50.49	6.03	-7.00	173	50.85		-2.17	0.16	-0.27	176	2.17	0.021	
PB25	1729670.88	6451986.42	326.07	-31.44	0.77	-2.92	179	31.45		-0.25	-0.07	-0.03	195	0.26	0.019	
PB26	1729539.03	6452252.21	282.94	-23.62	2.65	-2.40	174	23.77		-0.20	-0.02	-0.01	187	0.20	0.018	
PB27	1729254.41	6451842.14	272.98	-84.93	6.08	-11.44	176	85.15		-3.50	0.13	-0.53	178	3.50	0.023	
PB29	1728847.75	6452096.03	172.60	-41.20	-24.46	-13.33	211	47.91		-2.11	-1.01	-0.69	205	2.34	0.020	
PB53	1729222.48	6450754.60	291.44	-30.28	0.68	-6.31	179	30.29		-1.76	0.00	-0.41	180	1.76	0.024	
PB54	1729691.20	6450448.58	357.73	-3.70	-0.11	-0.89	182	3.70		-0.18	-0.04	0.00	193	0.18	0.019	
PB55	1728780.51	6450801.66	240.62	-31.77	-2.38	-5.71	184	31.86		-2.01	-0.21	-0.45	186	2.02	0.031	
PB59	1727760.70	6448660.28	160.34	-5.66	-1.39	-3.05	194	5.83		-0.59	-0.15	-0.27	194	0.61	0.017	
PB62	1728476.42	6449717.52	287.22	-0.21	-0.04	-0.03	192	0.22		-0.21	-0.04	-0.03	192	0.22	0.016	
PB63	1727724.58	6451485.79	121.78	-9.45	-2.32	-4.28	194	9.73		-9.45	-2.32	-4.28	194	9.73	0.020	
UB02	1727530.48	6450141.10	83.00	-50.63	7.31	-4.15	172	51.16		-3.97	0.53	-0.20	172	4.01	0.023	

FULL DATA POSTING as of Nov. 2009

Date: 02/09/10

Notes:

\# Indicates stable points, not moving

* Indicates no movement detected

	Nov. 18, 2009 Positions			Overall Movements (US Feet)						Periodic (11.3 months) Movements (US Feet)						
	NAD83 SPC Zone 5 (Ft)		NAVD88	Original Position to Nov. 18, 2009						Dec. 10, 2008 Position to Nov. 18, 2009						
Point	North (ft)	East (ft)	Elev(ft)	North	East	Height	Azim.°	Dist.	Note	North	East	Height	Azimuth°	Distance	95%Error	Note
AB01	1729427.54	6445709.62	178.540	-0.04	0.01	-0.08	167	0.04		0.00	-0.01	-0.05	304	0.01	0.020	#
AB02	1726946.97	6447968.68	116.460	0.00	0.03	0.01	95	0.03		-0.02	0.00	0.00	171	0.02	0.020	#
AB03	1727338.38	6447818.82	139.570	0.04	0.00	-0.03	4	0.04		-0.01	0.01	-0.01	117	0.01	0.017	#
AB04	1728390.36	6447121.86	67.250	-1.63	-1.48	-0.32	222	2.20		-0.07	-0.05	-0.02	217	0.09	0.019	
AB05	1728074.78	6447643.96	80.570	-0.94	-1.21	-0.33	232	1.53		-0.08	-0.08	-0.02	226	0.11	0.018	
AB06	1729058.43	6446975.87	164.840	-1.31	-0.39	-0.44	197	1.36		-0.06	-0.01	-0.01	191	0.06	0.019	
AB07	1728981.35	6447357.67	159.330	-1.44	-0.74	-0.59	207	1.62		-0.05	-0.03	-0.01	207	0.06	0.022	
AB12	1729415.50	6448271.24	283.190	-0.98	-0.41	-0.24	203	1.07		-0.07	-0.03	0.00	202	0.07	0.019	
AB13	1729928.13	6448235.87	364.540	-0.77	-0.16	-0.49	192	0.78		-0.04	-0.02	0.00	201	0.04	0.020	
AB15	1730311.51	6448099.30	396.880	-0.57	-0.08	-0.40	188	0.58		-0.05	0.00	0.00	180	0.05	0.026	
AB16	1730358.64	6447532.17	376.450	-0.25	0.04	-0.17	170	0.25		-0.01	-0.01	-0.01	203	0.02	0.021	*
AB17	1731421.11	6446727.77	442.800	-0.03	0.00	-0.25	173	0.03		0.00	0.00	0.01	180	0.00	0.019	#
AB18	1731602.26	6448187.60	456.870	-0.36	0.11	-0.32	163	0.38		-0.04	-0.01	-0.04	189	0.04	0.025	
AB20	1729359.78	6449685.97	396.230	-0.85	-0.30	-0.20	199	0.90		-0.06	-0.02	0.00	200	0.06	0.013	
AB24	1729829.68	6447759.75	335.760	-0.67	-0.21	-0.16	197	0.70		-0.06	-0.02	0.00	198	0.07	0.024	
AB50	1728084.64	6448247.44	182.000	-0.36	-0.74	0.02	244	0.83		-0.02	-0.03	0.02	238	0.04	0.024	
AB51	1729616.60	6447306.48	305.250	-0.41	-0.06	-0.17	188	0.41		-0.04	-0.02	-0.01	208	0.05	0.020	
AB52	1730015.65	6448624.32	368.350	-0.45	-0.12	-0.26	195	0.47		-0.05	0.00	-0.03	181	0.05	0.031	
AB53	1730430.55	6449712.28	352.890	-0.55	-0.09	-0.24	189	0.56		-0.06	-0.02	-0.01	198	0.06	0.026	
AB54	1731111.92	6447047.87	407.360	-0.03	0.00	0.05	178	0.03		-0.02	0.00	0.06	187	0.02	0.029	*
AB55	1731174.68	6447753.58	405.390	-0.09	0.02	0.01	169	0.09		-0.04	0.01	0.00	171	0.04	0.017	
AB56	1732214.16	6448545.51	571.690	-0.15	0.05	0.04	162	0.16		-0.05	0.02	0.05	164	0.05	0.024	
AB57	1731926.73	6449759.41	564.860	-0.18	0.04	-0.07	166	0.18		-0.05	0.01	-0.04	167	0.05	0.022	
AB58	1731117.85	6449074.94	405.640	-0.17	0.01	-0.03	175	0.17		-0.05	0.01	-0.01	168	0.05	0.022	
AB59	1730850.64	6450212.52	434.340	-0.23	-0.03	-0.03	188	0.23		-0.06	-0.01	-0.01	190	0.06	0.022	
AB60	1729089.58	6447987.53	179.390	-0.12	-0.04	-0.06	199	0.13		-0.04	-0.01	0.00	196	0.05	0.019	
AB61	1727424.49	6447990.27	140.420	-0.01	0.01	-0.05	128	0.02		0.00	0.00	-0.01	158	0.01	0.004	#
BB25	1727200.19	6449932.57	4.210	-0.35	-0.16	0.40	204	0.39		-0.06	0.00	0.06	183	0.06	0.024	
BB52	1726996.18	6451384.34	3.860	-0.18	-0.04	0.03	193	0.19		-0.06	-0.01	0.03	191	0.06	0.019	
BB53																
CR07	1731628.18	6451203.34	632.390	-0.60	0.15	-0.89	166	0.62		-0.06	0.02	0.03	161	0.07	0.024	
CR50	1733013.61	6451037.39	872.690	0.06	0.01	-0.35	10	0.06		-0.01	0.00	-0.02	162	0.02	0.022	*
CR51	1733062.01	6452361.87	976.220	0.11	0.05	-0.53	26	0.12		-0.01	0.01	-0.02	143	0.02	0.024	*
CR52	1732867.56	6450239.31	779.730	0.02	-0.03	-0.28	300	0.03		-0.01	0.00	0.09	176	0.01	0.026	*
FT06	1729855.34	6452760.16	488.920	-0.27	-0.05	-0.14	191	0.28		-0.08	-0.01	-0.05	189	0.08	0.020	
FT07	1729252.92	6454104.25	588.900	-0.33	-0.51	-0.11	237	0.60		-0.10	-0.14	-0.09	236	0.17	0.020	
FT08	1729388.69	6453350.52	658.480	0.00	0.02	0.04	74	0.02		0.01	0.00	0.01	348	0.01	0.027	#
KC01	1728476.18	6452487.81	312.350	-0.60	-0.42	-0.53	215	0.74		-0.07	-0.04	-0.03	209	0.08	0.019	
KC02	1727002.64	6452118.86	13.690	-0.26	-0.13	-0.15	207	0.29		-0.03	-0.02	-0.03	207	0.04	0.021	
KC04	1727559.39	6452667.04	238.450	-0.17	-0.20	-0.39	231	0.27		-0.03	-0.02	-0.02	216	0.04	0.019	
KC05	1727081.97	6453178.92	227.510	-0.03	-0.17	-0.35	259	0.18		-0.01	-0.02	-0.01	244	0.03	0.020	
KC06	1727784.90	6453396.33	299.910	-0.01	-0.33	-0.44	268	0.33		-0.02	-0.03	-0.02	227	0.04	0.025	
KC07	1727759.37	6453683.87	313.470	0.18	-0.05	-0.36	344	0.19		0.00	0.00	-0.03	256	0.00	0.021	*
KC13	1726581.11	6453069.63	191.180	-0.04	-0.01	-0.02	188	0.04		-0.01	0.00	-0.05	153	0.01	0.017	*
KC14	1726742.43	6453806.03	259.920	-0.01	-0.03	-0.02	253	0.03		0.00	-0.01	0.01	247	0.01	0.023	*
KC15	1727590.38	6453121.03	287.090	-0.07	-0.06	-0.01	222	0.09		-0.02	-0.02	-0.04	226	0.03	0.027	
KC16	1727602.24	6454098.24	326.870	-0.01	0.00	-0.03	159	0.01		0.00	0.00	-0.05	214	0.00	0.018	#
PB04	1727666.56	6448848.99	167.310	-9.38	-2.75	-3.21	196	9.77		-0.27	-0.07	-0.06	195	0.28	0.020	
PB06	1727938.80	6449758.52	177.820	-29.65	-3.32	-5.24	186	29.83		-0.85	-0.10	-0.14	187	0.85	0.022	
PB07	1728138.83	6450212.89	197.800	-37.09	-6.86	-2.41	190	37.72		-0.99	-0.19	-0.08	191	1.01	0.019	
PB08	1728202.31	6450463.52	194.120	-35.20	-6.28	0.44	190	35.75		-0.89	-0.16	-0.01	190	0.90	0.020	
PB09	1728249.30	6450848.91	189.460	-39.28	-2.11	-3.06	183	39.34		-1.02	-0.07	-0.12	184	1.02	0.022	
PB12	1728263.70	6451586.25	185.940	-66.79	-18.32	-7.35	195	69.25		-1.66	-0.55	-0.37	199	1.75	0.022	
PB13	1728047.43	6452149.98	206.980	-38.54	-14.36	-3.56	200	41.13		-1.05	-0.41	-0.11	201	1.12	0.019	
PB18	1730431.35	6450719.86	363.140	-15.53	8.87	-4.44	150	17.89		-0.12	0.02	-0.04	170	0.12	0.021	
PB20	1728749.18	6451125.82	233.690	-63.59	-9.86	-9.85	189	64.35		-1.47	-0.23	-0.30	189	1.49	0.022	
PB21	1729246.60	6451178.17	272.840	-51.62	6.12	-7.18	173	51.98		-1.13	0.09	-0.18	175	1.14	0.024	
PB25	1729670.78	6451986.39	326.040	-31.53	0.74	-2.95	179	31.54		-0.09	-0.02	-0.03	194	0.10	0.022	
PB26	1729538.93	6452252.19	282.930	-23.71	2.63	-2.41	174	23.86		-0.09	-0.02	-0.01	190	0.10	0.022	
PB27	1729252.59	6451842.20	272.730	-86.75	6.14	-11.69	176	86.97		-1.82	0.06	-0.25	178	1.82	0.026	
PB29	1728846.62	6452095.51	172.230	-42.32	-24.98	-13.70	211	49.15		-1.13	-0.52	-0.37	205	1.24	0.022	
PB53	1729221.54	6450754.61	291.200	-31.22	0.68	-6.55	179	31.23		-0.94	0.01	-0.24	180	0.94	0.026	
PB54	1729691.12	6450448.57	357.710	-3.78	-0.12	-0.91	182	3.78		-0.08	-0.01	-0.02	188	0.08	0.023	
PB55	1728779.41	6450801.58	240.500	-32.87	-2.47	-5.83	184	32.97		-1.10	-0.08	-0.12	184	1.10	0.030	
PB59	1727760.31	6448660.19	160.160	-6.05	-1.48	-3.23	194	6.23		-0.39	-0.09	-0.18	193	0.40	0.020	
PB62	1728476.31	6449717.49	287.200	-0.32	-0.07	-0.05	192	0.33		-0.11	-0.02	-0.02	193	0.11	0.017	
PB63	1727717.72	6451483.29	116.990	-16.31	-4.82	-9.07	196	17.01		-6.86	-2.50	-4.79	200	7.30	0.022	
PB64	1727466.29	6450946.95	72.760													
UB02	1727527.87	6450141.46	62.920	-53.24	7.67	-4.23	172	53.79		-2.61	0.36	-0.08	172	2.64	0.022	

COORDINATE LIST - Portuguese Landslide Monitoring Survey as of November 18, 2009

Date: 02/09/2010

Datum: Horizontal NAD83 (2007) Epoch: California State Plane Zone 5; Vertical: NAVD88

Note, Fixed CGPS Station PVE3 at Record 3D Position & Orthometric Height per 09/2007 Survey; See Survey Reports

Point	Latitude	Longitude	HE (ft)	North (ft)	East (ft)	OrthoHt(ft)	Description
AB01	33-44-38.30241	118-22-53.05110	60.05	1729427.540	6445709.621	178.54	Pre-2007 Base Stat.
AB02	33-44-13.84870	118-22-26.19249	-2.04	1726946.967	6447968.680	116.46	Monitoring Point
AB03	33-44-17.71502	118-22-27.98405	21.08	1727338.380	6447818.823	139.57	Monitoring Point
AB04	33-44-28.09536	118-22-36.28281	-51.20	1728390.359	6447121.864	67.25	Monitoring Point
AB05	33-44-24.99302	118-22-30.08703	-37.88	1728074.783	6447643.956	80.57	Monitoring Point
AB06	33-44-34.69846	118-22-38.04121	46.41	1729058.429	6446975.865	164.84	Monitoring Point
AB07	33-44-33.95010	118-22-33.51689	40.92	1728981.346	6447357.673	159.33	Monitoring Point
AB12	33-44-38.27842	118-22-22.71869	164.85	1729415.502	6448271.236	283.19	Monitoring Point
AB13	33-44-43.34801	118-22-23.15994	246.22	1729928.130	6448235.874	364.54	Monitoring Point
AB15	33-44-47.13537	118-22-24.79397	278.57	1730311.511	6448099.302	396.88	Monitoring Point
AB16	33-44-47.58063	118-22-31.51166	258.11	1730358.636	6447532.167	376.45	Monitoring Point
AB17	33-44-58.06075	118-22-41.08405	324.47	1731421.111	6446727.772	442.80	Stable Check Point
AB18	33-44-59.90666	118-22-23.80516	338.62	1731602.262	6448187.601	456.87	Monitoring Point
AB20	33-44-37.77882	118-22-05.96452	277.96	1729359.780	6449685.969	396.23	Monitoring Point
AB24	33-44-42.35667	118-22-28.79339	217.40	1729829.684	6447759.753	335.76	Monitoring Point
AB50	33-44-25.11276	118-22-22.94200	63.58	1728084.642	6448247.437	182.00	Monitoring Point
AB51	33-44-40.23214	118-22-34.15115	186.86	1729616.604	6447306.484	305.25	Monitoring Point
AB52	33-44-44.22795	118-22-18.56410	250.06	1730015.646	6448624.323	368.35	Monitoring Point
AB53	33-44-48.37182	118-22-05.69941	234.67	1730430.554	6449712.281	352.89	Monitoring Point
AB54	33-44-55.01411	118-22-37.27984	289.03	1731111.917	6447047.867	407.36	Monitoring Point
AB55	33-44-55.66103	118-22-28.92581	287.09	1731174.677	6447753.584	405.39	Monitoring Point
AB56	33-45-05.97265	118-22-19.59375	453.49	1732214.160	6448545.507	571.69	Monitoring Point
AB57	33-45-03.17359	118-22-05.20624	446.70	1731926.727	6449759.409	564.86	Monitoring Point
AB58	33-44-55.14735	118-22-13.27631	287.41	1731117.850	6449074.944	405.64	Monitoring Point
AB59	33-44-52.54532	118-21-59.79406	316.17	1730850.635	6450212.521	434.34	Monitoring Point
AB60	33-44-35.04401	118-22-26.06370	61.01	1729089.582	6447987.527	179.39	Monitoring Point
AB61	33-44-18.57309	118-22-25.95791	21.95	1727424.486	6447990.269	140.42	Base Station
BB25	33-44-16.42518	118-22-02.95102	-114.16	1727200.186	6449932.574	4.21	Monitoring Point
BB52	33-44-14.45930	118-21-45.75334	-114.45	1726996.177	6451384.335	3.86	Monitoring Point
BB53							Destroyed
CR07	33-45-00.27232	118-21-48.09456	514.29	1731628.177	6451203.342	632.39	Monitoring Point
CR50	33-45-13.97100	118-21-50.11915	754.63	1733013.608	6451037.388	872.69	Monitoring Point
CR51	33-45-14.49694	118-21-34.43622	858.23	1733062.010	6452361.872	976.22	Monitoring Point
CR52	33-45-12.49763	118-21-59.56393	661.63	1732867.561	6450239.311	779.73	Monitoring Point
FT06	33-44-42.79074	118-21-29.58424	370.84	1729855.336	6452760.158	488.92	Monitoring Point
FT07	33-44-36.87871	118-21-13.64363	470.85	1729252.915	6454104.248	588.90	Monitoring Point
FT08	33-44-38.19542	118-21-22.57410	540.41	1729388.687	6453350.522	658.48	Monitoring Point
KC01	33-44-29.13748	118-21-33.10602	194.17	1728476.175	6452457.811	312.35	Monitoring Point
KC02	33-44-14.54933	118-21-37.05680	-104.57	1727002.637	6452118.864	13.69	Monitoring Point
KC04	33-44-20.07612	118-21-30.58997	120.24	1727559.394	6452667.035	238.45	Monitoring Point
KC05	33-44-15.37144	118-21-24.50905	109.31	1727081.965	6453178.921	227.51	Monitoring Point
KC06	33-44-22.33244	118-21-21.96437	181.76	1727784.898	6453396.334	299.91	Monitoring Point
KC07	33-44-22.09003	118-21-18.55882	195.33	1727759.374	6453683.867	313.47	Monitoring Point
KC13	33-44-10.41322	118-21-25.78206	72.94	1726581.114	6453069.625	191.18	Monitoring Point
KC14	33-44-12.03476	118-21-17.06994	141.74	1726742.432	6453806.025	259.92	Monitoring Point
KC15	33-44-20.39865	118-21-25.21583	168.91	1727590.383	6453121.033	287.09	Monitoring Point
KC16	33-44-20.55010	118-21-13.64602	208.74	1727602.238	6454098.237	326.87	Monitoring Point
PB04	33-44-20.99916	118-22-15.80109	48.90	1727666.561	6448848.991	167.31	Monitoring Point
PB06	33-44-23.72521	118-22-05.04383	59.47	1727938.801	6449758.521	177.82	Monitoring Point
PB07	33-44-25.72033	118-21-59.67254	79.49	1728138.831	6450212.894	197.80	Monitoring Point
PB08	33-44-26.35728	118-21-56.70773	75.83	1728202.309	6450463.521	194.12	Monitoring Point
PB09	33-44-26.83597	118-21-52.14654	71.19	1728249.302	6450848.913	189.46	Monitoring Point
PB12	33-44-27.00476	118-21-43.41671	67.71	1728263.700	6451586.252	185.94	Monitoring Point
PB13	33-44-24.88543	118-21-36.73276	88.77	1728047.427	6452149.976	206.98	Monitoring Point
PB18	33-44-48.41603	118-21-53.76835	244.97	1730431.349	6450719.863	363.14	Monitoring Point
PB20	33-44-31.79067	118-21-48.88929	115.46	1728749.181	6451125.815	233.69	Monitoring Point
PB21	33-44-36.71294	118-21-48.29062	154.65	1729246.596	6451178.174	272.84	Monitoring Point
PB25	33-44-40.93775	118-21-38.73866	207.90	1729670.781	6451986.391	326.04	Monitoring Point
PB26	33-44-39.64296	118-21-35.58576	164.80	1729538.934	6452252.188	282.93	Monitoring Point
PB27	33-44-36.79592	118-21-40.42823	154.56	1729252.590	6451842.200	272.73	Monitoring Point
PB29	33-44-32.78909	118-21-37.41164	54.06	1728846.622	6452095.506	172.23	Monitoring Point
PB53	33-44-36.44993	118-21-53.30492	172.98	1729221.541	6450754.609	291.20	Monitoring Point
PB54	33-44-41.08394	118-21-56.94891	239.50	1729691.117	6450448.570	357.71	Monitoring Point
PB55	33-44-32.07805	118-21-52.72981	122.26	1728779.407	6450801.575	240.50	Monitoring Point
PB59	33-44-21.91966	118-22-18.04071	41.75	1727760.314	6448660.185	160.16	Monitoring Point
PB62	33-44-29.04074	118-22-05.55297	168.88	1728476.311	6449717.490	287.20	Monitoring Point
PB63	33-44-21.60033	118-21-44.61252	-1.28	1727717.724	6451483.290	116.99	Monitoring Point
PB64	33-44-19.09400	118-21-50.95218	-45.54	1727466.291	6450946.947	72.76	Monitoring Point: New 11/18/2009
UB02	33-44-19.67416	118-22-00.49201	-55.43	1727527.870	6450141.455	62.92	Monitoring Point
PVE3	33-44-35.85329	118-24-15.26904	235.42	1729207.091	6438765.185	354.36	CGPS Record Position Fixed All Surveys
PVES	33-46-46.02017	118-22-19.74140	854.07	1742328.081	6448570.484	972.08	CGPS Pos. Determined Nov. 2009 Survey
PVRS	33-46-25.89204	118-19-14.06724	198.61	1740239.304	6464237.887	316.31	CGPS Pos. Determined Nov. 2009 Survey
VTIS	33-42-45.48963	118-17-37.71224	197.51	1717933.681	6472307.227	315.25	CGPS Pos. Determined Nov. 2009 Survey

December 2008

Survey Report

for the

Monitoring and Control Surveys

of the

Rancho Palos Verdes Portuguese Landslide

By

McGee Surveying Consulting and Charles Abbott Associates, Inc.

INDEX

Survey Report

for the

Rancho Palos Verdes Portuguese Landslide December 2008 Monitoring and Control Survey

by

McGee Surveying Consulting

Surveyed by: McGee Surveying Consulting of Santa Barbara, CA, and Charles Abbott Associates, Inc.
Client: City of Rancho Palos Verdes; **Project Name**: Portuguese Bend Landslide Monitoring
Location: Rancho Palos Verdes, California; **County:** Los Angeles; **State:** California

PROJECT OVERVIEW:

McGee Surveying Consulting performed a ground slide monitoring and control survey at Portuguese Bend on behalf of the City of Rancho Palos Verdes in December 2008. The purpose of the survey was to establish high accuracy positions on monitoring points and determine the overall and periodical movements. This survey is a continuation of a monitoring survey program conducted by the City since 1994 and assumed by McGee Surveying Consulting in September 2007. The results of this Survey are reported on spreadsheets described in this Report and attached hereto.

The field survey was planned, coordinated and executed by Michael McGee, PLS3945 of McGee Surveying Consulting of Santa Barbara, California in coordination with Frederick (Rick) Jones; P.E., P.L.S., City Engineer, City of Rancho Palos Verdes. Michael McGee, PLS was responsible for the final processing of the observations, network adjustments and reports. The monitoring points cover approximately a 1½ square mile area and are measured annually or more often as necessary to determine the rate and extent of ground movement. Global Positioning System (GPS) technology was used for the purpose of determining positions based on the North American Datum of 1983 (NAD83) and the North American Vertical Datum of 1988 (NAVD 88) and are referenced to the CORS (Continuously Operated Reference Stations) which are permanently mounted GPS receivers. In California CORS are also referred to as CGPS or Continuous GPS stations.

This survey is required to meet a relative accuracy standard of two centimeters (0.066 feet) in the active slide area and one centimeter (0.033 feet) in other areas at the 95% Level of Confidence to ensure the reliability of the results. Field procedures are designed to accomplish this purpose and Quality Control-Quality Assurance (QAQC) processes are incorporated to verify this accuracy is attained. The movements reported between September 2007 and December 2008 (15 months) statistically attained accuracies of 0.02 feet at the 95% Level of Confidence. However, the results obtained at points believed to be stable and the fact that the directions of the present movements of the points are very similar to the overall movement directions are good indications that the accuracies of the movement measurements approach an unprecedented 0.01 feet in the horizontal.

HISTORY

This survey is a continuation of a monitoring program initiated by the County of Los Angeles and taken over by the City of Rancho Palos Verdes circa 1994. See the September 2007 Survey Report by McGee Surveying Consulting for a detailed History of the survey process between 1994 and the September 2007.

PROJECT DATUMS, REFERENCE SYSTEM

Horizontal Datum: North American Datum of 1983 (NAD83) per the National Geodetic Survey (NGS); **Epoch:** 2007.00 referred to as NAD83(2007).; **Units:** Feet

Reference Network: The survey is referenced to the CORS Stations which are continuously operating reference GPS receivers mounted on a stabile platform (for more information see NGS Data Sheets for the PID's listed below). No data sheet exists for PVE3. PVE3's position was downloaded from the California Spatial Reference Center (CSRC). CSRC provides NGS sanctioned positions on all California CORS.

		NAD83(2007)			
CORS	Latitude(dms)	Longitude(dms)	EH(feet)	NGS PID	NAME
PVE3	33 44 35.853290	-118 24 15.269036	235.42	none available	PALOS VERDES CORS
PVHS	33 46 46.020150	-118 22 19.741258	853.99	AJ1915	PENINSULA HIGH SCH
PVRS	33 46 25.891904	-118 19 14.067218	198.63	AJ1916	PALOS VERDES RES
VTIS	33 42 45.489584	-118 17 37.712290	197.52	AJ1936	MARINE EXCHANGE

Regional CORS

Vertical Datum: North American Vertical Datum of 1988 (NAVD88) orthometric heights per NGS
Geoid Model: Geoid 03

Reference Network: CORS Station VTIS (see NGS Data Sheets)

CORS	NAVD 88 Ht(feet)	
PVE3	none	
PVHS	972.1	Based on a Refined Geoid Model
PVRS	316.3	Based on a Refined Geoid Model
VTIS	315.26	Based on Second Order Leveling by CSRC and basis for this survey

Projection: NAD83 California State Plane Coordinates Zone 5: The State Plane Coordinates Parameters for Zone Five follow. The average Scale Factor is 1.00007543, the Ellipsoid Height Reduction Factor, based on the average ellipsoid heights is 0.99999092, therefore the average Combined Grid Factor is 1.00006635. Multiply the Combined Factor times ground distances to obtain grid distances relative to this survey. Grid bearings resulting from this survey must be rotated by a Convergence Angle to obtain geodetic (true) bearings. The average convergence angle is -0-12-30.2±.

Datum Notes: The NAD83, 2007.00 Epoch adjustment is the latest in a series of adjustments of NAD83 since its adoption in 1986 and is the datum for all monitoring surveys since 2007. Rancho Palos Verdes sits on the Pacific Plate which is moving west-northwesterly relative to the North American Plate about 4 centimeters (0.13 feet) per year; however, the City as a whole is moving at a constant rate as exhibited by the N, E, Up velocities of the CORS, shown below, which serve as a rigid reference frame for the Portuguese Landslide Monitoring. See the September 2007 Survey Report by McGee Surveying Consulting for additional information.

Annual Velocities in Feet

CORS	North	East	Up
PVE3	0.06	-0.13	-0.01
PVHS	0.06	-0.13	-0.01
PVRS	0.06	-0.13	-0.00
VTIS	0.06	-0.13	-0.01

FIELD SURVEYS, DATA COLLECTION, EQUIPMENT & PROCESSING

Sixty-seven monitoring points were occupied and reported in December 2008. Site photographs and recovery sheets detailing the location, character of the monument and obstructions were updated. See the Appendix for "Monitoring Point Status as of December 2008" and "Monitoring Point Photos - Update December 2008 in the for additional information. See the September 2007 Survey report for photos of all points.

AB61, established in 2007 on Portuguese Point as a permanent GPS Base Station, was occupied as a base for this survey. The location is secured behind a locked gate, has a clear horizon above 15 degrees, and sits on a stable basalt geological formation.

The field survey commenced each day by setting up a GPS receiver on a tripod at AB61 while two GPS receivers roamed freely collecting observations on fixed height poles at the 66 on-site points. Many of the points are surrounded by mature trees and plants which attenuate satellite signals passing through foliage degrading the measurement accuracies. To obtain the highest possible accuracies, available satellites are compared in real time with the obstruction diagrams to estimate the best time for observing a point. Upon arriving at a point to be observed, the receiver is set up, the location in the sky of each satellite is estimated with a compass and abney, and those satellites obstructed by foliage and trees are turned off. If 5 or more un-obstructed satellites with a GDOP (measure of the geometry of the constellation) of 4.5 or less were available then the measurement commenced for 15-30 minutes of data collection. If sufficient satellites and geometry were not available then the receiver was moved to the next point and the point was returned to later. This process was followed until all points were occupied twice under a different constellation of satellites. If the two measurements were not in agreement, then a third occupation was made.

Three Leica geodetic GPS receivers and antennas listed below were utilized to collect, process and store satellite signal data. Two, 2 meter fixed height poles were used for the field observations of the monitoring points with a base station receiver utilizing a tribrach on tripod setup. Prior to initiating the field observations a calibration of the tribrach and fixed height poles was conducted to verify the accuracy of the equipment. There were no equipment failures. See below for the GPS Survey Parameters.

Date of Field Surveys: 12/07/2008 to 12/13/2008 between 0700-1700 PST (+8 hrs for UTC).
Constellation: The NAVSTAR GPS constellation consisted of 31 Block II satellites.
GPS Observables: L1 & L2 Carrier Wave, C/A Code & P-Code; P-code was encrypted and SA off.
Epoch Rate & Occupation Times: 10 seconds for 15-30 minutes and 4-10 hours for CORS connections.
Minimum Satellites: 5 ; GDOP < 4.5 ; Elevation Mask for Data Collection: 15 degrees; Processing: 15 deg.
Ephemeris: Rapid for Static Post-Processing.
Weather conditions: Generally clear skies and mild temperatures.
Space Weather: Boulder K Index was 0-2 on a scale of 0-9 and gauges ionospheric activity.
GPS Base Receiver Unit No.: M1, Operator: M. McGee, PLS; Station Identification: AB61
Make & Model: Leica 530; Antenna Leica AT302; Mount: Tribrach on Tripod; Height: varies
GPS Rover Receiver Unit No.: M3, Operator: M. McGee, PLS;
Make & Model: Leica 530; Antenna Leica AT502; Mount: Fixed Height Pole #1; Antenna Height: 2.082m
GPS Rover Receiver Unit No.: M4, Operator: R. Reese, PLS,
Make & Model: Leica 530; Antenna Leica AT502; Mount: Fixed Height Pole #3; Antenna Height: 2.083m

A total of 67 on site points and 4 CORS were connected with 164 measured vectors. Data was processed using the Leica LGO post processing software. The baseline connections to the CORS were processed with a rapid ephemeris and the monitoring network baselines were processed with a broadcast ephemeris, both at a cutoff vertical angle of 15°. Analysis of processing statistics and residuals led to the rejection of 2 vectors. Network adjustments and analysis were performed with "Starnet-PRO" version 6.0 software. The CORS stations were included by downloading Rinex files from the NGS and using the NGS antenna models in the processing.

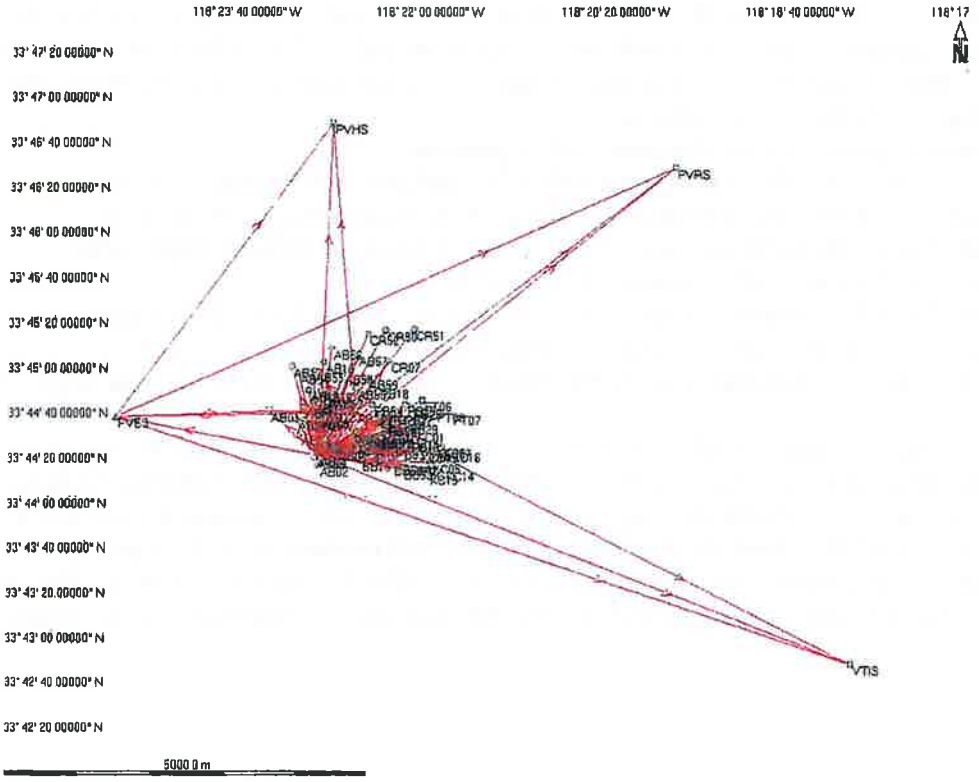
NETWORK

AB61 is the primary Base Station monument on Portuguese Point which is the focal point of a static network connecting the 67 monitoring points and four CORS control points as shown below. Since 1994, 149 monitoring points have been established in the Portuguese Bend area, many of which are now lost or destroyed. Sixty of the original points were recovered in 2007. Eight of the 60 points were deleted because they were in close proximity of other better suited for GPS leaving 52 points monitored for movement between September 2006 and September 2007. Three of the 52 points (AB09, KC11, PB51) were monitored in 2007 for the last time because they were replaced by new points, better suited for GPS, set nearby. Eighteen new points set in 2007 have their movements reported for the first time in this December 2008 survey. In December 2008, 49 original and 18 points set in September 2007 were surveyed for a total of 67 monitoring points.

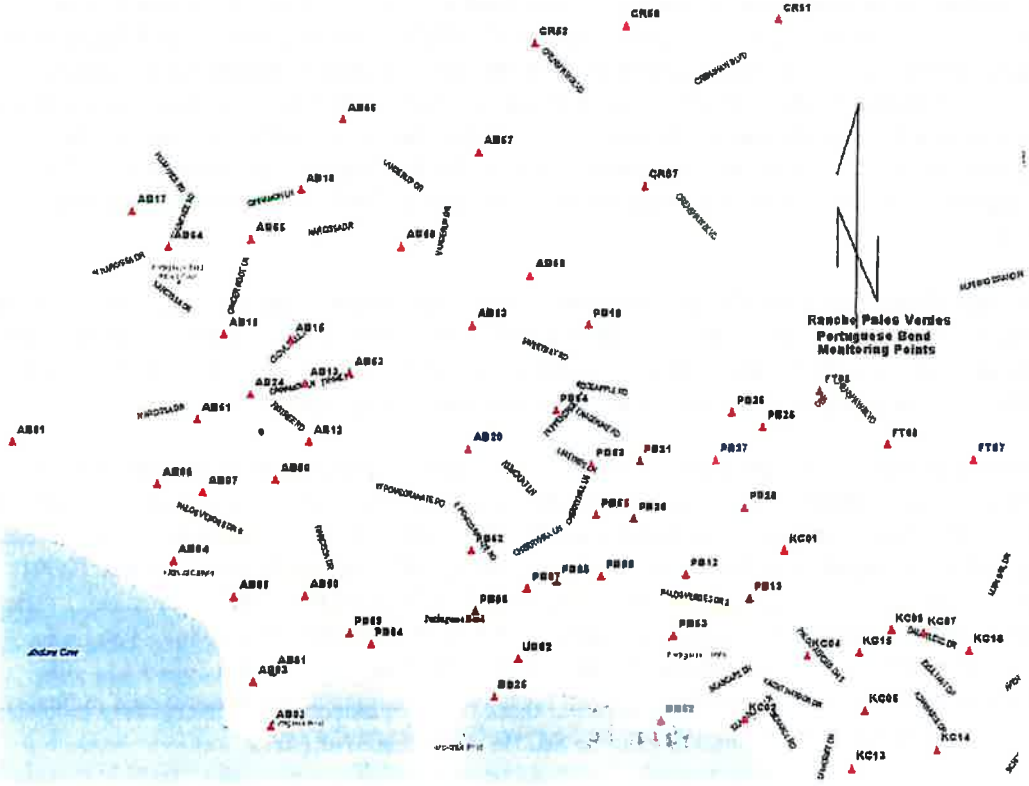
Monitoring Points: Points take their ID from previous surveys. For data management purposes the point ID's were prefixed in this survey with "M02" i.e. AB61 is M02AB61. This is to indicate the survey is the second monitoring since the initial September 2007 Monitoring Survey when the Monitoring Program was modernized. The prefix is stripped in the coordinate and movement listing reports.

BB53 was destroyed by wave action since the September 2007 Survey. The overall movement of point BB25 is referenced to the 11/04/1998 position because the position changed 6 feet west of its first reported position on 12/13/1997, further review of the history and the direction of its recent movement suggest that wave action may affect the stability of this point. In the September 2007 Report, it was noted that KC01 was reported by the previous surveyor on 9/14/2006 to be N29°E 1.24' from the 12/9/2005 position. After completion of this survey, a brass cap in concrete stamped "COUNTY ENGINEER RE8869 1956 STA ??IELDS" was found S46°W 1.47 feet from the 1" GIP found in 2007 and used for the 2007 and 2008 Reports. Analysis of the distance and direction between these two monuments, and historic data indicates the overall movement at this location since 1997 to be S63°W 0.78 feet +/-0.1 feet.

GPS – CORS Network



Monitoring Point Locations



Aerial Photo of Monitoring Point Locations

ADJUSTMENTS & ANALYSIS

Adjustment 1: Minimally Constrained to develop Geodetic and Ellipsoid Coordinates in NAD83(2007)
Fixed Control: The CORS PVE3 was fixed at its published three dimensional position in a Minimally Constrained Adjustment to determine latitude, longitude, ellipsoid heights, and state plane coordinates, and check other known points shown below. See the attached file "COORDINATE LIST–Dec 2008 Survey.xls" for a list of coordinates which are the basis for computing future movements.

The 3D and Ellipsoid Height adjustment results follow with coordinate differences (closures) from previous positions to the present in feet. The differences with the September 2007 positions determined by this surveyor are smaller than the differences with the record positions, and are a better indicator of the accuracy and repeatability of this survey. The differences with the record are similar to those reported in 2007.

Sept. 2007 to Dec. 2008

	Station	dN	dE	dZ
Fixed	PVE3	0.000	0.000	0.000
	PVHS	0.002	0.006	0.034
	PVRS	-0.002	0.007	0.002
	VTIS	-0.001	0.006	0.000

NGS Record Positions to Dec. 2008

	Station	dN	dE	dZ
Fixed	PVE3	0.000	0.000	0.000
	PVHS	0.006	-0.011	0.067
	PVRS	0.010	-0.004	-0.030
	VTIS	0.006	0.003	-0.012

Notes/Comments: Relative to the primary Base Station point AB61, the CORS station PVE3 is located 1.8 miles west-northwest, PVHS is 2.8 miles north, PVRS 3.9 miles northeast and VTIS is 4.9 miles east-southeast. The 2D closures on the CORS are 0.007 feet or less, and for the purpose of this survey a constrained adjustment was not computed. The monitoring plan is to use the CORS and those points deemed to be stable over time to verify the stability of the reference system.

Below are differences in feet from the September 2007 positions to the present surveyed positions of select points. Points believed to be stable are listed first, followed by those that did not appear to have moved because the difference is less than 0.02 feet. These points will be reviewed with the next monitoring. Points AB02, AB03 and AB17, considered stable, agree on average +0.000 north, -0.004 east, and -0.015 up. PVE3 was fixed in this adjustment because it is in better agreement with these three points than AB61 (Base) which is -0.005 north, +0.010 east, and -0.037 up. The survey reference frame is deemed stable and successfully recovered. AB61 will be watched.

Point	N	E	Up	
Stable Points				
AB01	-0.012	-0.015	-0.038	
AB02	0.004	-0.008	-0.019	
AB03	0.001	-0.002	-0.018	
AB17	-0.005	-0.001	-0.009	
CR52	-0.003	-0.014	0.009	
No Movement Detected				
AB54	-0.010	0.003	-0.015	
AB61	-0.005	0.010	-0.037	New Base Station Established in 2007
CR50	0.008	0.009	0.046	
CR51	-0.011	0.002	-0.013	
FT08	-0.009	0.020	0.032	
KC07	0.002	0.019	-0.002	
KC14	-0.003	-0.015	-0.025	
KC16	-0.005	0.005	0.015	

Adjustment 2: Minimally Constrained to develop Orthometric Heights (Elevations) in NAVD88
Fixed Control: The CORS PVE3 was fixed horizontally and vertically at the NAVD88 height determined in September 2007 survey, in a Minimally Constrained Adjustment that combined the measured ellipsoid height differences with the NGS Geoid 03 (models the undulations between the ellipsoid and geoid surfaces) to determine NAVD88 orthometric heights on all points. These results are compared with other known points shown below. See the attached file "COORDINATE LIST-Dec 2008 Survey.xls" for a list of heights which is the basis for computing future movements.

NAVD88 Orthometric Height adjustment results follow with the height differences (closures) from the September 2007 surveyed heights to the heights determined in the present survey.

Station	dZ(ft)	
PVE3	0.000	Fixed
PVHS	0.031	
PVRS	0.006	
VTIS	-0.001	

Notes/Comments: The orthometric height of PVE3 was established in September 2007 based on the published NAVD88 Height of VTIS, and is confirmed here at 0.001 feet.

ACCURACY

Relative Accuracy: On site the points are expected to be 0.02 feet or less at the 95% Level of Confidence.

Absolute Accuracy: The network accuracy is expected to be less than 0.02 feet horizontal relative to the NAD83 Datum based on the PVE3 CORS Station as fixed in Adjustment #1.

Vector Residuals: For the monitoring points in Adjustment #1, referred to above, the two dimensional horizontal residuals average 0.006 feet with a standard deviation of 0.004 feet and a maximum of 0.021 feet. The absolute value of the vertical residuals average 0.013 feet with a standard deviation of 0.013 feet and a range between -0.058 and +0.066 feet. For the CORS points, the two dimensional horizontal residuals average 0.005 feet with a standard deviation of 0.003 feet and a maximum of 0.012 feet. The absolute value of the vertical residuals average 0.018 feet with a standard deviation of 0.015 feet and a range between -0.047 and +0.059 feet.

NAVD88 Heights: The North American Vertical Datum 1988 orthometric heights (elevations) resulting from Adjustment #2 are derived from the GPS ellipsoid heights combined with the Geoid 03 model and constrained to known elevations. The ellipsoid heights are expected to be within 0.03 feet. The Geoid 03 model is expected to have a probable error of 1 part per million. Relative elevation accuracies are expected to be 0.03-0.04 feet. The absolute accuracy of these heights is dependent on the published values on the VTIS CORS.

Measurement Precisions: The vectors (baselines) for all points vary in length between 192 feet and 26,103 feet and averaging 3979 feet. The vector precisions at the 95% Level of Confidence (2 sigma) vary 0.2 ppm to 69 ppm and average 7.8 ppm. The relative distance error at the 95% Level of Confidence averages 0.018 feet with a maximum of 0.028 feet. The precision ratio based on the averages is 1:221,000 exceeding the criteria for a First Order (C-1) survey per the FGCS requirements by a factor of two under the former classification system.

The vectors connecting AB61 to the CORS vary in length between 9,395 and 26,103 feet and average 7,217 feet. The precisions, at the 95% Level of Confidence (2 sigma), vary 0.2 ppm to 0.4 ppm and average 0.3 ppm for 4 vectors measured over a 6 day period each. The relative distance error at the 95% Level of Confidence averages 0.004 feet with a maximum of 0.006 feet. The precision ratio is 1:1,800,000 exceeding the criteria for a B Order survey per the FGCS requirements for the former classification system..

The residuals and the closures between known control points discussed in the above Adjustments are good indications of the accuracies obtained by this survey. This survey conforms to the intent of the Federal Geodetic Control Subcommittee (FGCS) Specifications for GPS Relative Positioning (1988) and the California Geodetic Control Committee (CGCC) Specifications for High-Production GPS Surveying Techniques (1993).

QAQC ANALYSIS

To ensure the accuracy and validity of this process, an independent test of the methods used in these surveys was made by using conventional instrumentation. See the September 2007 Monitoring Survey Report under QAQC for the analysis and results that support the use of GPS techniques to obtain the accuracies reported in these surveys.

To validate the present survey, the inverse distance between the GPS positions of AB20 and four other points spread across the site were computed and then compared with the direct single independently measured GPS vectors as listed below.

Comparison of Computed GPS Distances v. Direct GPS Measurements

From-To	Calculated Bearing & Distance		Measured Bearing & Distance	
AB20-AB55	N46-47-47.3W	2651.040	N46-47-47.6W	2651.024
AB20-AB60	S80-57-37.2W	1719.811	S80-57-35.5W	1719.810
AB20-FT06	N80-50-32.4E	3113.870	N80-50-32.5E	3113.871
AB20-PB62	S02-02-37.4E	883.982	S02-02-37.0E	883.988

The difference in the distances average 0.006 feet with a maximum of 0.016 feet. The differences in the bearings are comparable. This test indicates the accuracies in a two dimensional sense are 0.009 feet or 0.017 feet at the 95% level of confidence. This test indicates the radial method of positioning monitoring points is reliable at 0.01 feet, more than sufficient for monitoring purposes.

SUMMARY

A modernization of field procedures and processing techniques began with the September 2007 survey. The present movements are based on a rigorous simultaneous adjustment of the September 2007 and the December 2008 surveys, resulting in measured movement reliability of 0.02 feet at the 95% Level of Confidence for this period. Statistical analysis of the data indicates the probability that movement has occurred when the distance is greater than 0.02 feet and the direction is consistent with the direction of the overall movement for a particular point. The results of this survey find the periodic movement direction to be generally within 10° of the overall movement direction. The overall and periodic movements are given in north, east and up or down as well as a vector of distance and direction. The direction is given as an azimuth in degrees where 0° is north, 90° is east, 180° is south and 270° is west. See the spreadsheet "FULL DATA POSTING.xls" for the overall and periodic movements, and the coordinates used to compute movements. The overall movements are from the beginning positions which vary between 1994 and 2005.

Between September 2007 and December 2008 (14.5 months) the points in the Portuguese Bend Landslide moved between 0.20 and 9.73 feet. Points in the Abalone Cove Landslide west of the Portuguese Bend Landslide moved between 0.05 and 0.17 feet. Points in the Klondike Canyon east of the Portuguese Bend Landslide moved between 0.03 and 0.13 feet. See the Contours of Horizontal Displacement in the Appendix for a graphical representation of the movements across the site. The City Geologist should be referred to for assessment and interpretation of the movements.

The present status of all monitoring points is given in the Appendix under "Monitoring Point Status as of December 2008". The historical status of all monitoring points is given in the September 2007 Survey Report. The historical 1994-2006 positions of all points are listed in the Charles Abbott Associates Inc. file "ALL POINTS MOST RECENT OBSERVED POSITION AS OF SEPTEMBER 15, 2006.xls".

Attachments: Find the following document attached to this Report as separate documents.

FULL DATA POSTING.xls (Monitoring point overall movements and periodical movements including coordinates of the initial positions, 2007 and post 2007 positions in NAD83 and NAVD88 Systems)

COORDINATE LIST-Dec 2008 Survey.xls (Current NAD83 Geodetic, Grid Coordinates, NAVD88 Heights of all points)

SURVEYOR'S STATEMENT

This Report on the criteria, procedures and results of the Rancho Palos Verdes Portuguese Landslide Monitoring Survey were prepared by me February 9, 2009 at the request of Frederick (Rick) Jones; P.E., P.L.S. of Charles Abbott Associates Inc. and City Engineer of the City of Rancho Palos Verdes.

Michael R. McGee
P.L.S. 3945

Frederick (Rick) Jones
R.C.E. 36665, P.L.S. 5458

APPENDIX

Find the following:

Monitoring Point Photo Update December 2008 (Updated photos for those points that changed since Sept. 2007)

Monitoring Point Status as of December 2008 (Status of all points ; last observed, comments)

Contours of Horizontal Displacement – Sept. 2007 to Dec. 2008 (Contours at 0.05 foot and 1.0 foot indicating the general horizontal movement across the site; refer to the City Geologist for assessment and interpretation of movements)

Monitoring Point Photos - Updated December 2008
(See September 2007 Report for all photos)

Points AB05, AB12, AB24, AB57, AB59, AB61, CR07, CR50, FT06, FT08, KC01, PB06, PB07, PB08, PB09, PB13, PBN26


AB05-W.JPG


AB05-X2.JPG


AB12-N.JPG


AB12-NW.JPG


AB12-X.JPG


AB24-REBUILTa.JPG


AB24-REBUILTb.JPG


AB57-S.JPG


AB59-NW.JPG


AB61-N.JPG


AB61-X3.JPG


CR07-N2.JPG


CR07-NW.JPG


CR50-N.JPG


CR50-X.JPG


FT06-W.JPG


FT08-N.JPG


FT08-X.JPG


KC01-ALTERNATE.JPG


KC01-E.JPG


KC01-N2.JPG


KC01-N3.JPG


KC01-N4.JPG


PB06-NE.JPG


PB07-E.JPG


PB08-NNE.JPG

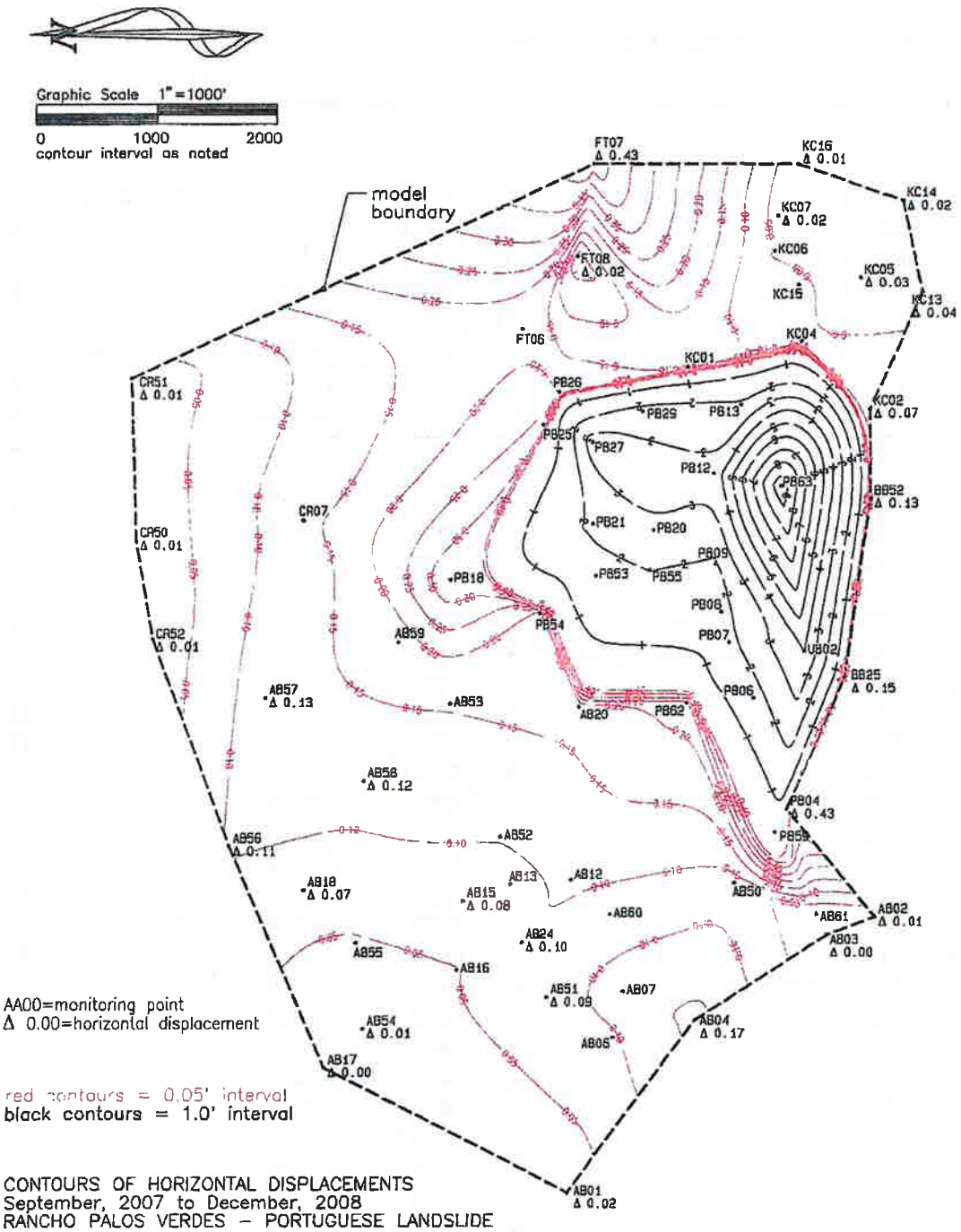

PB09-N.JPG

PB09-X.JPG


PB13-S.JPG


PB26-W.JPG

RANCHO PALOS VERDES - PORTUGUESE LAND SLIDE MONITORING							
Monitoring Point Status as of December 2008							
Notes:	149 Monitoring Points established since 1994						
2007	71 Points Monitored: 60 old points found with 52 monitored plus 19 new points						
2008	67 Points Monitored: AB09, KC11, PB51 discontinued; BB53 destroyed; AB05 disturbed						
2008							
Pt ID	**Last Obs'd**	**Comments**	**GPS**	**Pt ID**	**Last Obs'd**	**Comments**	**GPS**
AB01	12/10/2008	1994-2006 Base	**G**	**FT06**	12/10/2008		**G**
AB02	12/10/2008	Stable	**G**	**FT07**	12/10/2008		**G**
AB03	12/10/2008	Stable	**G**	**FT08**	12/10/2008		**G**
AB04	12/10/2008		**G**				
AB05	12/10/2008	Disturbed 09/07-12/08	**G**	**KC01**	12/10/2008	NE'ly of 2 pipes	**G**
AB06	12/10/2008		**G**	**KC02**	12/10/2008		**G**
AB07	12/10/2008		**G**	**KC04**	12/10/2008		**G**
AB12	12/10/2008		**G**	**KC05**	12/10/2008		**G**
AB13	12/10/2008		**P**	**KC06**	12/10/2008		**G**
AB15	12/10/2008		**F**	**KC07**	12/10/2008		**G**
AB16	12/10/2008		**P**	**KC13**	12/10/2008		**G**
AB17	12/10/2008	Stable	**F**	**KC14**	12/10/2008		**G**
AB18	12/10/2008		**P**	**KC15**	12/10/2008		**F**
AB20	12/10/2008	NE'ly of 2 pipes	**G**	**KC16**	12/10/2008		**G**
AB24	12/10/2008	rebuilt monument 12/08	**F**				
AB50	12/10/2008		**G**	**PB04**	12/10/2008		**G**
AB51	12/10/2008		**G**	**PB06**	12/10/2008		**G**
AB52	12/10/2008		**P**	**PB07**	12/10/2008		**G**
AB53	12/10/2008		**F**	**PB08**	12/10/2008		**G**
AB54	12/10/2008		**P**	**PB09**	12/10/2008		**G**
AB55	12/10/2008		**G**	**PB12**	12/10/2008		**G**
AB56	12/10/2008		**F**	**PB13**	12/10/2008		**G**
AB57	12/10/2008		**G**	**PB18**	12/10/2008		**G**
AB58	12/10/2008		**P**	**PB20**	12/10/2008	S'ly of 2 pipes	**G**
AB59	12/10/2008		**G**	**PB21**	12/10/2008		**F**
AB60	12/10/2008	added concrete collar	**G**	**PB25**	12/10/2008		**G**
AB61	12/10/2008	2007-2008 Base	**G**	**PB26**	12/10/2008		**F**
				PB27	12/10/2008		**G**
BB25	12/10/2008		**G**	**PB29**	12/10/2008		**G**
BB52	12/10/2008		**G**	**PB53**	12/10/2008		**P**
BB53	9/24/2007	Destroyed		**PB54**	12/10/2008		**F**
CR07	12/10/2008		**F**	**PB55**	12/10/2008		**F**
CR50	12/10/2008		**G**	**PB59**	12/10/2008		**G**
CR51	12/10/2008		**G**	**PB62**	12/10/2008		**G**
CR52	12/10/2008		**P**	**PB63**	12/10/2008		**G**
				UB02	12/10/2008		**G**
GPS indicated Good, Fair or Poor Obstruction Conditions						Prepared 01/20/2009	



AA00=monitoring point
Δ 0.00=horizontal displacement

red contours = 0.05' interval
black contours = 1.0' interval

CONTOURS OF HORIZONTAL DISPLACEMENTS
September, 2007 to December, 2008
RANCHO PALOS VERDES – PORTUGUESE LANDSLIDE

Attachments

Find the following document attached to this Report as separate documents.

FULL DATA POSTING.xls (Monitoring point overall movements and periodical movements including coordinates of the initial positions, 2007 and post 2007 positions in NAD83 and NAVD88 Systems)

COORDINATE LIST-Dec 2008 Survey.xls (Current NAD83 Geodetic, Grid Coordinates, NAVD88 Heights of all points)

FULL DATA POSTING as of Dec.2008

Date: 01/30/09

PORTUGUESE POINT LANDSLIDE MONITORING

NAD83(2007) COORDINATES and NAVD88 ELEVATIONS of BEGINNING, 2007 & POST 2007 MONITORING POINT POSITIONS

Notes:

\# Indicates stable points, not moving

* Indicates no movement detected

1= In 2005 and prior surveyors used a nearby monument, see Report and Station Recover Form

	Original Positions				Sept. 24, 2007 Positions			Overall Movements (US Feet)					
		NAD83 SPC Zone 5 (Ft)		NAVD88	NAD83 SPC Zone 5 (Ft)		NAVD88	Original Position to Sept. 24, 2007					
Point	Date	North (ft)	East (ft)	Elev(ft)	North (ft)	East (ft)	Elev(ft)	North	East	Height	Azim.°	Dist.	Note
AB01	12/1/1994	1729427.58	6445709.61	178.62	1729427.55	6445709.64	178.62	-0.03	0.03	0.00	-	0	#
AB02	11/30/1994	1726946.97	6447968.65	116.45	1726946.98	6447968.69	116.48	0.01	0.04	0.03	72	0.04	#
AB03	12/1/1994	1727338.34	6447818.82	139.60	1727338.39	6447818.81	139.59	0.04	-0.01	-0.01	351	0.04	#
AB04	11/30/1994	1728391.99	6447123.34	67.57	1728390.55	6447122.03	67.31	-1.44	-1.32	-0.26	222	1.95	
AB05	3/14/1995	1728076.00	6447645.10	80.90	1728075.30	6447644.13	80.67	-0.70	-0.98	-0.23	234	1.20	
AB06	4/27/1995	1729059.73	6446976.26	165.28	1729058.58	6446975.91	164.91	-1.15	-0.35	-0.37	197	1.21	
AB07	11/30/1994	1728982.79	6447358.41	159.92	1728981.51	6447357.74	159.40	-1.28	-0.67	-0.52	208	1.44	
AB12	11/30/1994	1729416.49	6448271.64	283.43	1729415.67	6448271.30	283.19	-0.82	-0.35	-0.24	203	0.89	
AB13	11/30/1994	1729928.90	6448236.04	365.03	1729928.25	6448235.90	364.54	-0.65	-0.13	-0.49	192	0.66	
AB15	11/30/1994	1730312.09	6448099.38	397.28	1730311.64	6448099.31	396.90	-0.45	-0.07	-0.38	189	0.45	
AB16	11/30/1994	1730358.89	6447532.12	376.62	1730358.70	6447532.17	376.44	-0.19	0.04	-0.18	168	0.19	
AB17	11/30/1994	1731421.14	6446727.77	443.05	1731421.12	6446727.77	442.80	-0.02	0.00	-0.25	167	0.02	#
AB18	12/1/1994	1731602.62	6448187.49	457.19	1731602.37	6448187.58	456.93	-0.26	0.09	-0.26	162	0.27	
AB20	3/16/1995	1729360.63	6449686.27	396.43	1729360.00	6449686.03	396.23	-0.62	-0.23	-0.20	201	0.67	
AB24	3/12/1997	1729830.35	6447759.96	335.92	1729829.83	6447759.82	335.74	-0.52	-0.14	-0.18	196	0.54	
AB50	1/16/1998	1728085.00	6448248.18	181.98	1728084.71	6448247.54	182.03	-0.29	-0.65	0.05	246	0.71	
AB51	3/22/2002	1729617.01	6447306.54	305.42	1729616.73	6447306.52	305.25	-0.28	-0.02	-0.17	184	0.28	
AB52	3/22/2002	1730016.10	6448624.44	368.61	1730015.79	6448624.36	368.39	-0.31	-0.08	-0.22	195	0.32	
AB53	3/22/2002	1730431.11	6449712.37	353.13	1730430.77	6449712.33	352.90	-0.34	-0.04	-0.23	187	0.34	
AB54	9/24/2007	1731111.94	6447047.87	407.31	1731111.94	6447047.87	407.31						
AB55	9/24/2007	1731174.77	6447753.57	405.38	1731174.77	6447753.57	405.38						
AB56	9/24/2007	1732214.31	6448545.46	571.65	1732214.31	6448545.46	571.65						
AB57	9/24/2007	1731926.91	6449759.36	564.93	1731926.91	6449759.36	564.93						
AB58	9/24/2007	1731118.02	6449074.93	405.67	1731118.02	6449074.93	405.67						
AB59	9/24/2007	1730850.87	6450212.56	434.37	1730850.87	6450212.56	434.37						
AB60	9/24/2007	1729089.70	6447987.57	179.45	1729089.70	6447987.57	179.45						
AB61	9/24/2007	1727424.50	6447990.26	140.47	1727424.50	6447990.26	140.47						
BB25	11/4/1998	1727200.54	6449932.73	3.81	1727200.25	6449932.73	4.12	-0.29	-0.01	0.31	182	0.29	
BB52	9/24/2007	1726996.36	6451384.38	3.83	1726996.36	6451384.38	3.83						
BB53	9/24/2007	1726831.16	6451840.89	13.81	1726831.16	6451840.89	13.81						
CR07	11/30/1994	1731628.78	6451203.19	633.28	1731628.37	6451203.29	632.48	-0.41	0.10	-0.80	166	0.42	
CR50	1/16/1998	1733013.55	6451037.38	873.04	1733013.62	6451037.38	872.66	0.07	0.00	-0.38	358	0.07	
CR51	1/16/1998	1733061.90	6452361.82	976.75	1733062.03	6452361.86	976.25	0.13	0.04	-0.50	17	0.14	
CR52	1/16/1998	1732867.54	6450239.34	780.01	1732867.58	6450239.32	779.63	0.03	-0.02	-0.38	333	0.04	#
FT06	9/24/2007	1729855.61	6452760.21	489.06	1729855.61	6452760.21	489.06						
FT07	9/24/2007	1729253.24	6454104.75	589.01	1729253.24	6454104.75	589.01						
FT08	9/24/2007	1729388.68	6453350.51	658.44	1729388.68	6453350.51	658.44						
KC01	11/30/1994	1728475.52	6452457.46	312.88	1728476.36	6452457.91	312.42	*0.84*	*0.45*	*-0.46*	*28*	*0.96*	* 1
KC02	3/14/1995	1727002.89	6452118.99	13.84	1727002.74	6452118.89	13.74	-0.15	-0.11	-0.10	216	0.18	
KC04	3/14/1995	1727559.56	6452667.24	238.84	1727559.46	6452667.09	238.51	-0.10	-0.15	-0.33	236	0.18	
KC05	11/30/1994	1727082.00	6453179.09	227.86	1727082.01	6453178.94	227.53	0.01	-0.15	-0.33	273	0.15	
KC06	11/30/1994	1727784.91	6453396.67	300.35	1727784.94	6453396.40	299.97	0.03	-0.26	-0.38	276	0.26	
KC07	11/30/1994	1727759.19	6453683.92	313.83	1727759.37	6453683.85	313.51	0.18	-0.07	-0.32	340	0.19	
KC13	9/24/2007	1726581.16	6453069.63	191.20	1726581.16	6453069.63	191.20						
KC14	9/24/2007	1726742.44	6453806.05	259.94	1726742.44	6453806.05	259.94						
KC15	9/24/2007	1727590.45	6453121.10	287.10	1727590.45	6453121.10	287.10						
KC16	9/24/2007	1727602.25	6454098.23	326.90	1727602.25	6454098.23	326.90						
PB04	11/30/1994	1727675.94	6448851.74	170.52	1727667.25	6448849.17	167.49	-8.69	-2.57	-3.03	196	9.06	
PB06	3/15/1995	1727968.45	6449761.84	183.06	1727941.12	6449758.81	178.25	-27.33	-3.03	-4.81	186	27.50	
PB07	3/14/1995	1728175.93	6450219.76	200.21	1728141.60	6450213.44	198.02	-34.32	-6.32	-2.19	190	34.90	
PB08	12/1/1994	1728237.51	6450469.80	193.68	1728204.81	6450463.98	194.09	-32.70	-5.82	0.41	190	33.21	
PB09	11/30/1994	1728288.58	6450851.02	192.52	1728252.20	6450849.11	189.84	-36.38	-1.91	-2.68	183	36.43	
PB12	11/30/1994	1728330.49	6451604.57	193.29	1728268.52	6451587.83	186.93	-61.97	-16.74	-6.36	195	64.19	
PB13	3/14/1995	1728085.97	6452164.34	210.54	1728050.44	6452151.18	207.21	-35.53	-13.16	-3.33	200	37.89	
PB18	3/15/1995	1730446.88	6450711.00	367.58	1730431.80	6450719.76	363.24	-15.08	8.77	-4.34	150	17.44	
PB20	3/14/1995	1728812.77	6451135.67	243.54	1728753.50	6451126.52	234.48	-59.27	-9.16	-9.06	189	59.97	
PB21	3/14/1995	1729298.22	6451172.05	280.02	1729249.90	6451177.92	273.29	-48.32	5.87	-6.73	173	48.68	
PB25	12/1/1994	1729702.31	6451985.65	328.99	1729671.12	6451986.48	326.10	-31.19	0.83	-2.89	178	31.20	
PB26	3/14/1995	1729562.65	6452249.56	285.34	1729539.22	6452252.23	282.95	-23.42	2.67	-2.39	174	23.58	
PB27	3/14/1995	1729339.34	6451836.06	284.42	1729257.91	6451842.02	273.51	-81.43	5.96	-10.91	176	81.65	
PB29	3/15/1995	1728888.95	6452120.49	185.93	1728849.86	6452097.03	173.29	-39.08	-23.46	-12.64	211	45.58	
PB53	12/4/1997	1729252.77	6450753.92	297.75	1729224.25	6450754.60	291.85	-28.52	0.67	-5.90	179	28.53	
PB54	12/4/1997	1729694.90	6450448.69	358.62	1729691.38	6450448.62	357.73	-3.52	-0.07	-0.89	181	3.52	
PB55	1/21/1998	1728812.28	6450804.04	246.33	1728782.51	6450801.87	241.07	-29.77	-2.18	-5.26	184	29.85	
PB59	6/26/2001	1727766.36	6448661.67	163.39	1727761.30	6448660.42	160.61	-5.07	-1.24	-2.78	194	5.22	
PB62	9/24/2007	1728476.64	6449717.56	287.25	1728476.64	6449717.56	287.25						
PB63	9/24/2007	1727734.04	6451488.11	126.06	1727734.04	6451488.11	126.06						
UB02	7/23/1997	1727581.11	6450133.78	67.15	1727534.46	6450140.57	63.20	-46.66	6.78	-3.95	172	47.15	

FULL DATA POSTING as of Dec.2008

Date: 01/30/09

Notes:

\# Indicates stable points, not moving

* Indicates no movement detected

Notes: 2 = Hit by mower between 09/07 and 12/08, displaced southerly about 0.4', to be reported next period

	Dec. 10, 2008 Positions			Overall Movements (US Feet)						Periodic (14.5 months) Movements (US Feet)						
	NAD83 SPC Zone 5 (Ft)		NAVD88	Original Position to Dec. 10, 2008						Sept. 24, 2007 Position to Dec. 10, 2008						
Point	North (ft)	East (ft)	Elev(ft)	North	East	Height	Azim.°	Dist.	Note	North	East	Height	Azimuth°	Distance	95% Error	Note
AB01	1729427.54	6445709.63	178.59	-0.05	0.02	-0.03	161	0.05	#	-0.01	-0.01	-0.03	231	0.02	0.02	#
AB02	1726946.99	6447968.68	116.46	0.02	0.03	0.01	61	0.03	#	0.00	-0.01	-0.02	297	0.01	0.02	#
AB03	1727338.39	6447818.81	139.58	0.04	-0.01	-0.02	348	0.04	#	0.00	0.00	-0.01	270	0.00	0.02	#
AB04	1728390.43	6447121.92	67.27	-1.56	-1.43	-0.30	222	2.12		-0.12	-0.11	-0.04	222	0.16	0.02	
AB05	1728074.86	6447644.04	80.59	*-1.14*	*-1.07*	*-0.31*	*223*	*1.56*	* 2	*-0.44*	*-0.09*	*-0.08*	*191*	*0.44*		* 2
AB06	1729058.49	6446975.88	164.85	-1.24	-0.38	-0.43	197	1.30		-0.09	-0.03	-0.06	198	0.09	0.02	
AB07	1728981.40	6447357.70	159.34	-1.39	-0.71	-0.58	207	1.56		-0.11	-0.04	-0.06	202	0.12	0.02	
AB12	1729415.57	6448271.26	283.19	-0.92	-0.38	-0.24	203	0.99		-0.10	-0.03	0.00	199	0.11	0.02	
AB13	1729928.17	6448235.89	364.54	-0.73	-0.15	-0.49	192	0.74		-0.08	-0.01	0.00	191	0.08	0.02	
AB15	1730311.56	6448099.30	396.88	-0.53	-0.08	-0.40	189	0.53		-0.08	-0.01	-0.02	188	0.08	0.02	
AB16	1730358.65	6447532.17	376.46	-0.24	0.05	-0.16	168	0.24		-0.05	0.01	0.02	170	0.05	0.02	
AB17	1731421.12	6446727.77	442.79	-0.02	0.00	-0.26	171	0.02	#	0.00	0.00	-0.01	194	0.00	0.02	#
AB18	1731602.31	6448187.61	456.91	-0.32	0.11	-0.28	160	0.34		-0.06	0.03	-0.02	155	0.07	0.02	
AB20	1729359.84	6449685.99	396.23	-0.79	-0.28	-0.20	199	0.83		-0.16	-0.04	0.00	195	0.17	0.01	
AB24	1729829.75	6447759.77	335.76	-0.61	-0.19	-0.16	197	0.63		-0.09	-0.04	0.02	205	0.10	0.02	
AB50	1728084.66	6448247.47	181.98	-0.34	-0.71	0.00	245	0.79		-0.05	-0.07	-0.05	235	0.08	0.02	
AB51	1729616.65	6447306.51	305.26	-0.36	-0.03	-0.16	185	0.36		-0.09	-0.01	0.01	190	0.09	0.02	
AB52	1730015.70	6448624.32	368.38	-0.40	-0.12	-0.23	196	0.42		-0.10	-0.03	-0.01	200	0.10	0.03	
AB53	1730430.62	6449712.30	352.90	-0.49	-0.07	-0.23	188	0.50		-0.15	-0.03	0.00	189	0.15	0.03	
AB54	1731111.93	6447047.87	407.30	-0.01	0.00	-0.01	165	0.01		-0.01	0.00	-0.01	165	0.01	0.03	*
AB55	1731174.72	6447753.58	405.39	-0.05	0.01	0.01	166	0.05		-0.05	0.01	0.01	166	0.05	0.02	
AB56	1732214.21	6448545.49	571.64	-0.10	0.03	-0.01	161	0.11		-0.10	0.03	-0.01	161	0.11	0.02	
AB57	1731926.78	6449759.40	564.90	-0.13	0.03	-0.03	166	0.13		-0.13	0.03	-0.03	166	0.13	0.02	
AB58	1731117.90	6449074.93	405.65	-0.12	0.00	-0.02	178	0.12		-0.12	0.00	-0.02	178	0.12	0.02	
AB59	1730850.70	6450212.53	434.35	-0.17	-0.02	-0.02	188	0.17		-0.17	-0.02	-0.02	188	0.17	0.02	
AB60	1729089.63	6447987.54	179.39	-0.08	-0.03	-0.06	200	0.08		-0.08	-0.03	-0.06	200	0.08	0.02	
AB61	1727424.49	6447990.27	140.43	-0.01	0.01	-0.04	114	0.01		-0.01	0.01	-0.04	114	0.01	0.00	#
BB25	1727200.25	6449932.58	4.15	-0.29	-0.16	0.34	208	0.33		0.00	-0.15	0.03	269	0.15	0.02	
BB52	1726996.24	6451384.35	3.83	-0.12	-0.03	0.00	194	0.13		-0.12	-0.03	0.00	194	0.13	0.02	
BB53	Destroyed															
CR07	1731628.24	6451203.32	632.36	-0.54	0.13	-0.92	166	0.55		-0.13	0.03	-0.12	168	0.13	0.02	
CR50	1733013.62	6451037.38	872.71	0.08	0.01	-0.33	5	0.08		0.01	0.01	0.05	45	0.01	0.02	*
CR51	1733062.02	6452361.86	976.24	0.12	0.04	-0.51	20	0.13		-0.01	0.00	-0.01	171	0.01	0.02	*
CR52	1732867.58	6450239.31	779.64	0.03	-0.03	-0.37	315	0.04		0.00	-0.01	0.01	258	0.01	0.02	*
FT06	1729855.42	6452760.17	488.97	-0.19	-0.04	-0.09	192	0.19		-0.19	-0.04	-0.09	192	0.19	0.03	
FT07	1729253.01	6454104.39	588.99	-0.23	-0.36	-0.02	237	0.43		-0.23	-0.36	-0.02	237	0.43	0.02	
FT08	1729388.67	6453350.53	658.47	-0.01	0.02	0.03	114	0.02		-0.01	0.02	0.03	114	0.02	0.02	*
KC01	1728476.25	6452457.85	312.38	*0.73*	*0.39*	*-0.50*	*28*	*0.82*	* 1	-0.12	-0.06	-0.04	208	0.13	0.02	
KC02	1727002.67	6452118.88	13.72	-0.22	-0.11	-0.12	207	0.25		-0.07	-0.01	-0.02	185	0.07	0.02	
KC04	1727559.42	6452667.06	238.47	-0.14	-0.18	-0.37	233	0.23		-0.04	-0.04	-0.04	223	0.05	0.02	
KC05	1727081.98	6453178.94	227.52	-0.02	-0.15	-0.34	261	0.15		-0.03	0.00	-0.01	180	0.03	0.02	
KC06	1727784.92	6453396.36	299.93	0.01	-0.30	-0.42	273	0.30		-0.01	-0.04	-0.04	252	0.05	0.02	
KC07	1727759.38	6453683.87	313.50	0.18	-0.05	-0.33	346	0.19		0.00	0.02	-0.01	84	0.02	0.02	*
KC13	1726581.12	6453069.62	191.23	-0.04	-0.01	0.03	194	0.04		-0.04	-0.01	0.03	194	0.04	0.02	
KC14	1726742.44	6453806.04	259.91	0.00	-0.02	-0.03	259	0.02		0.00	-0.02	-0.03	259	0.02	0.02	*
KC15	1727590.41	6453121.06	287.13	-0.05	-0.04	0.03	220	0.06		-0.05	-0.04	0.03	220	0.06	0.02	
KC16	1727602.24	6454098.24	326.92	-0.01	0.00	0.02	135	0.01		-0.01	0.00	0.02	135	0.01	0.02	*
PB04	1727666.83	6448849.07	167.37	-9.10	-2.67	-3.15	196	9.49		-0.41	-0.10	-0.12	194	0.43	0.02	
PB06	1727939.65	6449758.62	177.96	-28.80	-3.22	-5.10	186	28.98		-1.47	-0.18	-0.29	187	1.48	0.02	
PB07	1728139.82	6450213.09	197.88	-36.10	-6.67	-2.33	190	36.72		-1.78	-0.35	-0.14	191	1.82	0.02	
PB08	1728203.20	6450463.68	194.13	-34.31	-6.12	0.45	190	34.85		-1.61	-0.30	0.04	190	1.64	0.02	
PB09	1728250.32	6450848.98	189.58	-38.26	-2.04	-2.94	183	38.31		-1.88	-0.13	-0.26	184	1.88	0.02	
PB12	1728265.36	6451586.81	186.31	-65.13	-17.76	-6.98	195	67.51		-3.16	-1.03	-0.62	198	3.32	0.02	
PB13	1728048.48	6452150.38	207.09	-37.49	-13.96	-3.45	200	40.01		-1.96	-0.80	-0.12	202	2.12	0.02	
PB18	1730431.47	6450719.84	363.18	-15.41	8.85	-4.40	150	17.77		-0.33	0.08	-0.06	166	0.34	0.02	
PB20	1728750.65	6451126.05	233.99	-62.12	-9.63	-9.55	189	62.86		-2.85	-0.47	-0.49	189	2.89	0.02	
PB21	1729247.73	6451178.08	273.02	-50.49	6.03	-7.00	173	50.85		-2.17	0.16	-0.27	176	2.17	0.02	
PB25	1729670.88	6451986.42	326.07	-31.44	0.77	-2.92	179	31.45		-0.25	-0.07	-0.03	195	0.26	0.02	
PB26	1729539.03	6452252.21	282.94	-23.62	2.65	-2.40	174	23.77		-0.20	-0.02	-0.01	187	0.20	0.02	
PB27	1729254.41	6451842.14	272.98	-84.93	6.08	-11.44	176	85.15		-3.50	0.13	-0.53	178	3.50	0.02	
PB29	1728847.75	6452096.03	172.60	-41.20	-24.46	-13.33	211	47.91		-2.11	-1.01	-0.69	205	2.34	0.02	
PB53	1729222.48	6450754.60	291.44	-30.28	0.68	-6.31	179	30.29		-1.76	0.00	-0.41	180	1.76	0.02	
PB54	1729691.20	6450448.58	357.73	-3.70	-0.11	-0.89	182	3.70		-0.18	-0.04	0.00	193	0.18	0.02	
PB55	1728780.51	6450801.66	240.62	-31.77	-2.38	-5.71	184	31.86		-2.01	-0.21	-0.45	186	2.02	0.03	
PB59	1727760.70	6448660.28	160.34	-5.66	-1.39	-3.05	194	5.83		-0.59	-0.15	-0.27	194	0.61	0.02	
PB62	1728476.42	6449717.52	287.22	-0.21	-0.04	-0.03	192	0.22		-0.21	-0.04	-0.03	192	0.22	0.02	
PB63	1727724.58	6451485.79	121.78	-9.45	-2.32	-4.28	194	9.73		-9.45	-2.32	-4.28	194	9.73	0.02	
UB02	1727530.48	6450141.10	63.00	-50.63	7.31	-4.15	172	51.16		-3.97	0.53	-0.20	172	4.01	0.02	

COORDINATE LIST - December 2008 Survey

Date: 01/29/2009

Portuguese Landslide Monitoring of Dec. 10, 2008

Datum: Horizontal NAD83 (2007) Epoch: California State Plane Zone 5; Vertical: NAVD88

Note, Fixed PVE3 CORS for 3D Position and Orthometric Height consistent with 09/2007 Survey; See Survey Report

Point	Latitude	Longitude	HE (ft)	North (ft)	East (ft)	OrthoHt(ft)	Description
AB01	33-44-38.30237	118-22-53.05103	60.10	1729427.536	6445709.627	178.59	Stable Check Point, Pre-2007 BASE
AB02	33-44-13.84890	118-22-26.19252	-2.03	1726946.986	6447968.677	116.46	Stable Check Point
AB03	33-44-17.71508	118-22-27.98419	21.10	1727338.386	6447818.811	139.58	Stable Check Point
AB04	33-44-28.09606	118-22-36.28219	-51.19	1728390.429	6447121.917	67.27	Monitoring Point
AB05	33-44-24.99379	118-22-30.08606	-37.85	1728074.861	6447644.038	80.59	Monitoring Point
AB06	33-44-34.69907	118-22-38.04106	46.42	1729058.491	6446975.877	164.85	Monitoring Point
AB07	33-44-33.95061	118-22-33.51657	40.92	1728981.397	6447357.699	159.34	Monitoring Point
AB12	33-44-38.27908	118-22-22.71837	164.84	1729415.568	6448271.263	283.19	Monitoring Point
AB13	33-44-43.34841	118-22-23.15976	246.22	1729928.170	6448235.889	364.54	Monitoring Point
AB15	33-44-47.13585	118-22-24.79398	278.57	1730311.560	6448099.302	396.88	Monitoring Point
AB16	33-44-47.58076	118-22-31.51158	258.13	1730358.650	6447532.173	376.46	Monitoring Point
AB17	33-44-58.06080	118-22-41.08405	324.45	1731421.116	6446727.772	442.79	Stable Check Point
AB18	33-44-59.90708	118-22-23.80508	338.66	1731602.305	6448187.608	456.91	Monitoring Point
AB20	33-44-37.77942	118-22-05.96427	277.96	1729359.840	6449685.991	396.23	Monitoring Point
AB24	33-44-42.35730	118-22-28.79315	217.41	1729829.748	6447759.774	335.76	Monitoring Point
AB50	33-44-25.11295	118-22-22.94164	63.56	1728084.661	6448247.468	181.98	Monitoring Point
AB51	33-44-40.23259	118-22-34.15088	186.87	1729616.648	6447306.507	305.26	Monitoring Point
AB52	33-44-44.22846	118-22-18.56409	250.08	1730015.698	6448624.324	368.38	Stable Check Point
AB53	33-44-48.37242	118-22-05.69918	234.68	1730430.615	6449712.301	352.90	Monitoring Point
AB54	33-44-55.01428	118-22-37.27982	286.97	1731111.933	6447047.869	407.30	Monitoring Point
AB55	33-44-55.66147	118-22-28.92590	287.10	1731174.721	6447753.577	405.39	Monitoring Point
AB56	33-45-05.97315	118-22-19.59392	453.43	1732214.211	6448545.492	571.64	Monitoring Point
AB57	33-45-03.17408	118-22-05.20639	446.75	1731926.777	6449759.397	564.90	Monitoring Point
AB58	33-44-55.14782	118-22-13.27644	287.42	1731117.898	6449074.934	405.65	Monitoring Point
AB59	33-44-52.54592	118-21-59.79393	316.17	1730850.696	6450212.532	434.35	Monitoring Point
AB60	33-44-35.04445	118-22-26.06356	61.02	1729089.626	6447987.540	179.39	Monitoring Point
AB61	33-44-18.57314	118-22-25.95793	21.96	1727424.491	6447990.267	140.43	Stable Point, BASE 2007 forward
BB25	33-44-16.42576	118-22-02.95097	-114.22	1727200.245	6449932.577	4.15	Monitoring Point
BB52	33-44-14.45989	118-21-45.75320	-114.48	1726995.237	6451384.347	3.83	Monitoring Point
CR07	33-45-00.27294	118-21-48.09481	514.27	1731628.240	6451203.320	632.36	Monitoring Point
CR50	33-45-13.97115	118-21-50.11920	754.65	1733013.623	6451037.383	872.71	Monitoring Point
CR51	33-45-14.49707	118-21-34.43633	858.25	1733062.022	6452361.863	976.24	Monitoring Point
CR52	33-45-12.49776	118-21-59.56394	661.54	1732867.575	6450239.310	779.64	Monitoring Point
FT06	33-44-42.79156	118-21-29.58409	370.89	1729855.418	6452760.171	488.97	Monitoring Point
FT07	33-44-36.87967	118-21-13.64193	470.95	1729253.012	6454104.392	588.99	Monitoring Point
FT08	33-44-38.19528	118-21-22.57406	540.40	1729388.673	6453350.525	658.47	Monitoring Point
KC01	33-44-29.13817	118-21-33.10555	194.20	1728476.245	6452457.850	312.38	Monitoring Point
KC02	33-44-14.54965	118-21-37.05662	-104.55	1727002.669	6452118.880	13.72	Monitoring Point
KC04	33-44-20.07642	118-21-30.58970	120.26	1727559.424	6452667.057	238.47	Monitoring Point
KC05	33-44-15.37155	118-21-24.50878	109.32	1727081.976	6453178.944	227.52	Monitoring Point
KC06	33-44-22.33269	118-21-21.96405	181.78	1727784.923	6453396.361	299.93	Monitoring Point
KC07	33-44-22.09004	118-21-18.55878	195.36	1727759.375	6453683.871	313.50	Monitoring Point
KC13	33-44-10.41328	118-21-25.78209	72.99	1726581.120	6453069.622	191.23	Monitoring Point
KC14	33-44-12.03481	118-21-17.06980	141.73	1726742.437	6453806.037	259.91	Monitoring Point
KC15	33-44-20.39887	118-21-25.21556	168.95	1727590.405	6453121.056	287.13	Monitoring Point
KC16	33-44-20.55013	118-21-13.64599	208.79	1727602.241	6454098.239	326.92	Monitoring Point
PB04	33-44-21.00185	118-22-15.80022	48.96	1727666.833	6448849.065	167.37	Monitoring Point
PB05	33-44-23.73359	118-22-05.04268	59.62	1727939.647	6449758.622	177.96	Monitoring Point
PB07	33-44-25.73013	118-21-59.67029	79.57	1728139.821	6450213.087	197.88	Monitoring Point
PB08	33-44-26.36606	118-21-56.70592	75.84	1728203.196	6450463.678	194.13	Monitoring Point
PB09	33-44-26.84607	118-21-52.14581	71.30	1728250.322	6450848.978	189.58	Monitoring Point
PB12	33-44-27.02116	118-21-43.41020	68.08	1728265.356	6451586.807	186.31	Monitoring Point
PB13	33-44-24.89582	118-21-36.72798	88.87	1728048.475	6452150.384	207.09	Monitoring Point
PB18	33-44-48.41722	118-21-53.76861	245.01	1730431.470	6450719.842	363.18	Monitoring Point
PB20	33-44-31.80521	118-21-48.88652	115.76	1728750.650	6451126.046	233.99	Monitoring Point
PB21	33-44-36.72415	118-21-48.29178	154.82	1729247.729	6451178.080	273.02	Monitoring Point
PB25	33-44-40.93869	118-21-38.73837	207.93	1729670.875	6451986.415	326.07	Monitoring Point
PB26	33-44-39.64389	118-21-35.58556	164.81	1729539.028	6452252.205	282.94	Monitoring Point
PB27	33-44-36.81393	118-21-40.42901	154.82	1729254.412	6451842.141	272.98	Monitoring Point
PB29	33-44-32.80027	118-21-37.40553	54.43	1728847.750	6452096.026	172.60	Monitoring Point
PB53	33-44-36.45924	118-21-53.30505	173.22	1729222.483	6450754.601	291.44	Monitoring Point
PB54	33-44-41.08474	118-21-56.94879	239.52	1729691.198	6450448.581	357.73	Monitoring Point
PB55	33-44-32.08894	118-21-52.72886	122.38	1728780.508	6450801.660	240.62	Monitoring Point
PB59	33-44-21.92351	118-22-18.03964	41.92	1727760.703	6448660.276	160.34	Monitoring Point
PB62	33-44-29.04183	118-22-05.55267	168.89	1728476.421	6449717.515	287.22	Monitoring Point
PB63	33-44-21.66828	118-21-44.58322	3.51	1727724.584	6451485.789	121.78	Monitoring Point
UB02	33-44-19.69998	118-22-00.49638	-55.35	1727530.482	6450141.095	63.00	Monitoring Point

NGS Record Positions of CORS; NAVD88 Heights fixed at PVE3 based on VTIS as established in Sept. 2007 Survey

PVE3	33-44-35.85329	118-24-15.26904	235.42	1729207.091	6438765.185	354.36	CORS, Fixed (Ortho Ht 354.36 in 2008)
PVHS	33-46-46.02015	118-22-19.74126	853.99	1742328.078	6448570.496	972.04	CORS, (Ortho Ht 972.07 in 2008)
PVRS	33-46-25.89190	118-19-14.06722	198.63	1740239.290	6464237.888	316.30	CORS, (Ortho Ht 316.31 in 2008)
VTIS	33-42-45.48958	118-17-37.71229	197.52	1717933.677	6472307.223	315.26	CORS, (Ortho Ht 315.26 in 2008)

September 2007

Survey Report

for the

Monitoring and Control Surveys

of the

Rancho Palos Verdes Portuguese Landslide

By

McGee Surveying Consulting and Charles Abbott Associates, Inc.

Surveyed by: McGee Surveying Consulting of Santa Barbara, CA, and Charles Abbott Associates, Inc.
Client: City of Rancho Palos Verdes; **Project Name**: Portuguese Bend Landslide Monitoring
Location: Rancho Palos Verdes, California; **County:** Los Angeles; **State:** California

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ATTACHMENTS

FULL DATA-THROUGH 2007-NAD27.xls (coordinates, overall movements and Sept. 2006 to Sept. 2007 movements)
FULL DATA POSTING-NAD83.xls (future reporting of coordinates and movements)
COORDINATE LIST-NAD83 2007 Survey.xls (current NAD83 Geodetic & Grid Coordinates, NAVD88 Heights)
COORDINATE LIST-NAD83 All Historical Pts.xls (coordinates of all points since 1994 in NAD83, NAVD88)
PHOTOS-SEP2007.doc (September 2007 photos of points)

Survey Report

for the

Rancho Palos Verdes Portuguese Landslide
September 2007 Monitoring and Control Survey

by

McGee Surveying Consulting

Surveyed by: McGee Surveying Consulting of Santa Barbara, CA, and Charles Abbott Associates, Inc.
Client: City of Rancho Palos Verdes; **Project Name**: Portuguese Bend Landslide Monitoring
Location: Rancho Palos Verdes, California; **County:** Los Angeles; **State:** California

PROJECT OVERVIEW:

McGee Surveying Consulting performed a ground slide monitoring control survey at Portuguese Bend on behalf of the City of Rancho Palos Verdes in September 2007. The purpose of the survey was to establish high accuracy positions on monitoring points, determine the overall and periodical movements and convert from the old North American Datum of 1927 to the new North American Datum of 1983 coordinate system. This survey is a continuation of a monitoring survey program conducted by the City since 1994 and assumed by McGee Surveying Consulting in September 2007. The results of this Survey are reported on spreadsheets described in this Report and attached hereto.

The field survey was planned, coordinated and executed by Michael McGee, PLS3945 of McGee Surveying Consulting of Santa Barbara, California in coordination with Frederick (Rick) Jones; P.E., P.L.S., City Engineer, City of Rancho Palos Verdes. Michael McGee, PLS was responsible for the final processing of the observations, network adjustments and reports. The monitoring points cover approximately a 1½ square mile area and are measured annually or more often as necessary to determine the rate and extent of ground movement. Global Positioning System (GPS) technology was used for the purpose of determining positions based on the North American Datum of 1983 (NAD83) and the North American Vertical Datum of 1988 (NAVD 88) and are referenced to the CORS (Continuously Operated Reference Stations) which are permanently mounted GPS receivers.

To ensure the accuracy of the process and results, this survey was required to meet a relative accuracy standard of two centimeters (0.066 feet) in the active slide area and one centimeter (0.033 feet) in other areas at the 95% Level of Confidence. Field procedures were designed for this purpose and Quality Control-Quality Assurance (QAQC) processes were incorporated to verify this accuracy was attained. The 2007 adjustment results discussed hereafter returned horizontal and vertical accuracies averaging 0.01 feet and relative accuracies of 0.02 feet at the 95% Level of Confidence.

HISTORY

This survey is a continuation of a monitoring program initiated by the County of Los Angeles and taken over by the City of Rancho Palos Verdes circa 1994. Between 1994 and September 2006, a GPS Base Station receiver was set at AB01 on the westerly side of the project while GPS receivers occupied other points during monitoring surveys. AB01 was fixed at a WGS84 position apparently based on a navigation position

discussed hereafter. The observations were processed in Leica software to develop geodetic coordinates of latitudes, longitudes and ellipsoid heights. These geodetic coordinates were imported into a Corps of Engineers software program called Corpscon as NAD83 geodetic coordinates and exported as NAD27 State Plane Coordinates System in Zone 7. Corpscon calls the program NADCON which uses a database of the nearest points with coordinates common to both the old NAD27 and new NAD83 system to compute a transformation. The NGS NADCON program has been used for this purpose up through 2007. Although the absolute accuracy of the NADCON conversions is a ½ foot or less, the local relative accuracies are about 0.05 feet. The NAD27 State Plane Coordinates were then compared year over year to report ground movements. See the "STATUS OF MONITORING POINTS" in the Appendix for a historical list of all monitoring points and their status as of September 2007.

PROJECT DATUMS, REFERENCE SYSTEM

This September 2007 Survey reports coordinates, elevations and movements in NAD27 (horizontal) and NGVD29 (vertical) for the last time, and in NAD83 and NAVD88 for the first time and going forward in time.

Datum for Reporting the 2007 and Future Surveys

Horizontal Datum: North American Datum of 1983 (NAD83) per the National Geodetic Survey (NGS) **Epoch:** 2007.00 referred to as NAD83(2007) or NAD83(NSRS2007); **Units:** Feet

Reference Network: The survey is referenced to the CORS Stations which are continuously operating reference GPS receivers mounted on a stabile platform (for more information see NGS Data Sheets for the PID's listed below). No data sheet exists for PVE3. PVE3's position was downloaded from the California Spatial Reference Center (CSRC). CSRC provides NGS sanctioned positions on all California CORS.

		NAD83(2007)			
CORS	Latitude(Dms)	Longitude(Dms)	EH(feet)	NGS PID	NAME
PVE3	33 44 35.853290	-118 24 15.269036	235.42	no data sheet	PALOS VERDES CORS
PVHS	33 46 46.020150	-118 22 19.741258	853.99	AJ1915	PENINSULA HIGH SCH
PVRS	33 46 25.891904	-118 19 14.067218	198.63	AJ1916	PALOS VERDES RES
VTIS	33 42 45.489584	-118 17 37.712290	197.52	AJ1936	MARINE EXCHANGE

Regional CORS in the Vicinity of Rancho Palos Verdes

Vertical Datum: NAVD88 per NGS
Geoid Model: Geoid 03

Reference Network: CORS Station VTIS (see NGS Data Sheets)

CORS	Elevation(feet)	
PVE3		Not Available
PVHS	972.1	Based on a Refined Geoid Model
PVRS	316.3	Based on a Refined Geoid Model
VTIS	315.26	Based on Second Order Leveling by CSRC

Projection: NAD83 California State Plane Coordinates Zone 5
State Plane Coordinates Parameters for Zone Five: The average Scale Factor is 1.00007543, the Ellipsoid Height Reduction Factor, based on the average ellipsoid heights is 0.99999092, therefore the average Combined Grid Factor is 1.00006635. Multiply the Combined Factor times ground distances to obtain grid distances relative to this survey. Grid bearings resulting from this survey must be rotated by a Convergence Angle to obtain geodetic (true) bearings. The average convergence angle is -0-12-30.2±.

Datum for Reporting the 2007 and Prior Surveys

Horizontal Datum: World Geodetic System of 1984 (WGS84)
Reference Network: AB01

Point	Latitude	Longitude	EH(feet)	
AB01	33-44-38.28119	-118-22-53.02044	34.065	Historical Record

Vertical Datum: National Geodetic Vertical Datum of 1929 (NGVD 29)
Reference Network: AB01

CORS	Elevation(feet)	
AB01	176.06	Historical Record

Projection: NAD27 Calif. State Plane Coordinates Zone 7
NAD27 State Plane Coordinates Parameters for Zone Seven: the average Scale Factor is 1.00001261, the Elevation Reduction Factor based on the average elevation above sea level is 0.99998585, the average Combined Grid Factor is 0.99999846. Multiply the Combined Factor times ground distances to obtain grid distances. Grid bearings are rotated by a Convergence Angle to obtain geodetic bearings. The average convergence angle is -0-01-05.3±.

Datum Notes/Comments:
Horizontal positions and ellipsoid heights are referenced to the North American Datum of 1983 (NAD83), 2007.00 Epoch adjustment of the National Spatial Reference System (NSRS) based on the four CORS listed above. NAD83 superseded the North American Datum of 1927 (NAD27) in 1986. The original NAD83 adjustment is based on earlier conventional survey measurements and triangulation networks referenced to a global network. With the advent of GPS technology, a High Precision Geodetic Network (HPGN) was established in California in 1991. The most recent realization of NAD83, used by this survey, is based on an extremely precise adjustment of the national CORS network. The shift from NAD27 to NAD83 in this vicinity is -6 feet in latitude and -275 feet in longitude.

Orthometric heights (elevations) are based on the North American Vertical Datum of 1988 (NAVD 88) as determined by the NGS on the CORS station "VTIS". The NAVD 88 vertical datum superseded the National Geodetic Vertical Datum of 1929 (NGVD 29) in 1991. The NGVD 29 datum was originally intended to approximate local sea level and differs from NAVD88 by about 3 feet in California. An NGS program called Vertcon computes the shift between datums with an estimated accuracy of about 2 centimeters (0.06 feet). The Vertcon computed shift from the NAVD 88 to NGVD 29 at AB01 is -2.43 feet (–0.741 meters), and the difference between the NGVD29 value used historically for AB01 and the NAVD88 determined by this survey is -2.56 feet.

RELATIONSHIPS: GPS positions are reported as coordinates in a three dimensional X, Y, Z Cartesian Coordinate System with the origin 0,0,0 being earth-centered and earth-fixed. These coordinates are converted for mapping purposes to geodetic coordinates of latitude, longitude and ellipsoid heights which are further converted to plane or grid coordinates for local applications. The GPS satellite positions are in the military World Geodetic System of 1984 (WGS84). The parameters and orientation of the ellipsoid for NAD83 and WGS84 are for practical purposes the same; however NAD83 unlike WGS84 is not geocentric and the same position in both systems will differ about 4 feet on the ground. NAD83 positions are realized by attaching WGS84 measured vectors to NAD83 reference points (CORS). As a matter of information, the WGS84 reference frame has migrated over the years to its present definition which is consistent with the International Terrestrial Reference Frame of 2000 (ITRF2000).

Multiple coordinates may exist for points by virtue of the changes in datums and re-adjustments over time of points on the Pacific Plate relative to the fixed North American Plate. The Pacific Plate is moving west-northwesterly relative to the North American Plate about 4 centimeters (0.13 feet) per year resulting in different positions being published for the same point on different epochs. The NAD83, 2007.00 Epoch adjustment is the latest in a series of adjustments of NAD83 since its adoption in 1986 and will be held fixed on future monitoring surveys. Although the Pacific Plate is moving relative to the North American Plate, this is not a problem for the purpose of this survey since the region of this survey is moving relatively the same as exhibited by the N, E, Up velocities on the CORS listed below as published by the CSRC.

Annual Velocities in Feet

CORS	North	East	Up
PVE3	0.06	-0.13	-0.01
PVHS	0.06	-0.13	-0.01
PVRS	0.06	-0.13	-0.00
VTIS	0.06	-0.13	-0.01

In summary, the City as a whole is moving at a constant rate and the four CORS listed above serve as a rigid reference frame for monitoring the Portuguese Landslide.

FIELD SURVEYS:

Prior to initiating the field surveys a reconnaissance of the area was performed to identify access, recover previous monitoring points and assess suitability. Sixty points were recovered from previous surveys dating back to 1994. Nineteen new points were set at locations determined by Glen Tofani, City Geologist. Fifty-two of the recovered points and nineteen new points (71 points total) were monitored and reported in 2007 (shown below). The monitoring points were documented with photographs and recovery sheets that detail the location, character of the monument and obstructions of GPS observations.

AB01 has been used since 1994 as the primary Base Station. Over the years a pine tree northeast of the point has become an obstruction; therefore, a new GPS Base Station was established on Portuguese Point known as AB61. The location is secured behind a locked gate, has a clear horizon above 15 degrees (ideal for collecting GPS observations from satellites), and sits on a stable geological formation (location approved by Glen Tofani, City Geologist).

The field survey commenced each day by setting up a GPS receiver on a tripod at AB61 while two GPS receivers roamed freely collecting observations on fixed height poles at 70 on-site monitoring points. Many of the points are surrounded by mature trees and plants which attenuate satellite signals passing through foliage degrading accuracies. To obtain the highest possible accuracies, available satellite were compared in real time with the obstruction diagrams to estimate the best time and sequence for observing points. Upon arriving at a point to be observed the receiver was set up, the location in the sky of each satellite was estimated with a compass and abney, and satellites obstructed by foliage and trees were turned off. If 5 or

more un-obstructed satellites with a GDOP (measure of the geometry of the constellation) of 5 or less were available then the measurement commenced for 15-30 minutes of data collection. If sufficient satellites and geometry were not available then the receiver was moved to the next point and the point was returned to later. This process was followed until all points were occupied twice and sometimes three times under a different constellation of satellites with the exception of BB52 which was occupied once for an extended time due to high tides. BB53 was set as a backup for BB52.

DATA COLLECTION: EQUIPMENT & PROCESSING

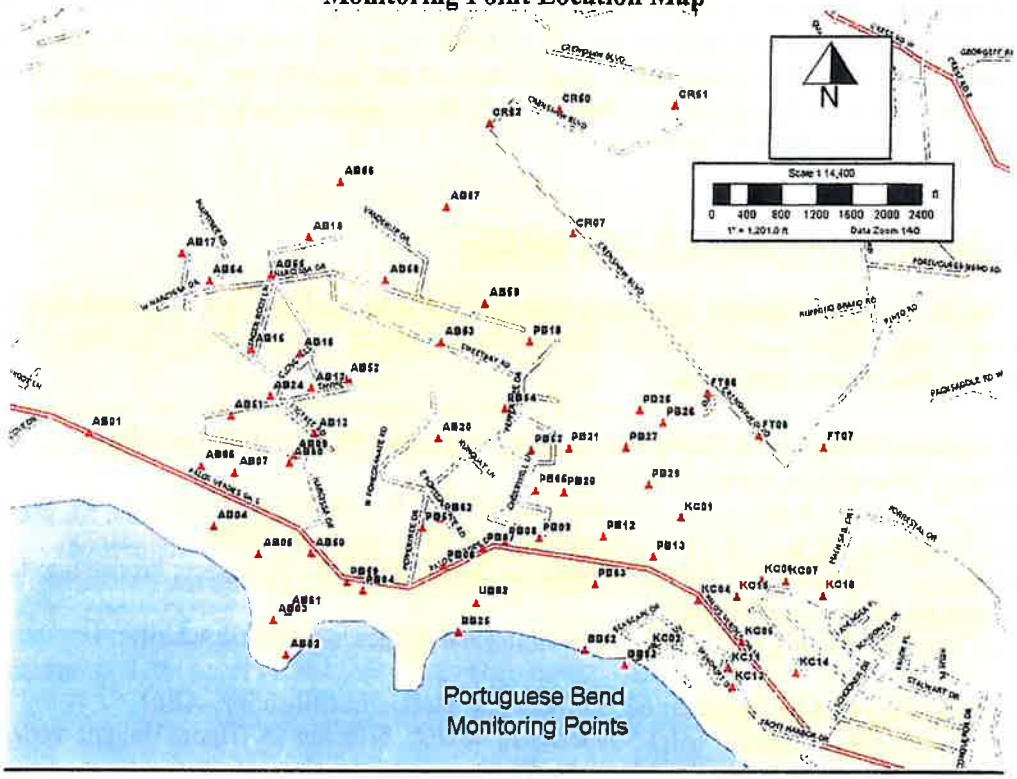
Description: Network Control and Data Collection were performed by establishing a base receiver at point AB61 while two roving receivers occupied all points in a radial fashion. There were no equipment failures. See below for the GPS Survey Parameters.

Date of Field Surveys: 09/22/2007 to 09/26/2007 between 0600-1800 PDST (+7 hrs for UTC).
GPS constellation: Consisted of 29 Block II satellites
GPS Observables: L1 & L2 Carrier wave, C/A Code and P-Code; P-code was encrypted and SA was off
Epoch Rate & Occupation Times: 10" for 15-30 minutes and 10-11 hours for CORS connections
Minimum Satellites: 5 ; GDOP=< 5 ; Elevation Mask for Data Collection: 15 degrees; Processing: 15 deg
Ephemeris: Rapid for Static Post-Processing
Space Weather: Boulder K Index was 1-2 on a scale of 0-9 and gauges ionospheric activity.

GPS Base Receiver Unit No. M2, Operator: M. McGee,PLS; Station Identification: AB61
Make & Model: Leica 399 ; Antenna: Leica 399 Internal, Mount: Tribrach on Tripod; Height: varies
GPS Rover Receiver Unit No. M3, Operator: R. Reese,PLS,
Make & Model: Leica 530; Antenna Leica AT502; Mount: Fixed Height Pole #1; Antenna Height: 2.083m
GPS Rover Receiver Unit No. M4, Operator: M. McGee,PLS;
Make & Model: Leica 530; Antenna Leica AT502; Mount: Fixed Height Pole #3; Antenna Height: 2.085m
Three Leica geodetic GPS receivers were utilized to collect, process and store satellite signal data. Units M3 and M4 components consisted of an Leica 530 receiver and AT502 antenna; and Unit M2 consists of a SR399 Sensor (antenna). Two, two meter fixed height poles were used for the field observations of the monitoring points with a base station receiver utilizing a tribrach on tripod setup. Prior to initiating the field observations a calibration of the tribrach and fixed height poles was conducted to verify the accuracy of the equipment. Weather conditions were generally clear skies and mild temperatures. Heavy showers occurred the evening before the field survey commenced, otherwise there was no precipitation for the many months since the rainy season. There were no equipment failures.

A total of 77 points (71 monitoring+2 miscellaneous+4 CORS) were connected with 181 measured vectors. Data was processed using the Leica "SKI-Pro" post processing software running in a Windows XP operating system. The baseline connections to the CORS were processed with a precise ephemeris at a cutoff vertical angle of 15° above the horizon. The network baselines were processed with a broadcast ephemeris at a cutoff vertical angle of 15°. Analysis of processing statistics and residuals led to the rejection of 5 vectors. Network adjustments and analysis were performed with "Starnet-PRO" version 6.0 software. The CORS stations were included by downloading Rinex files from the NGS and using the NGS antenna models in the processing.

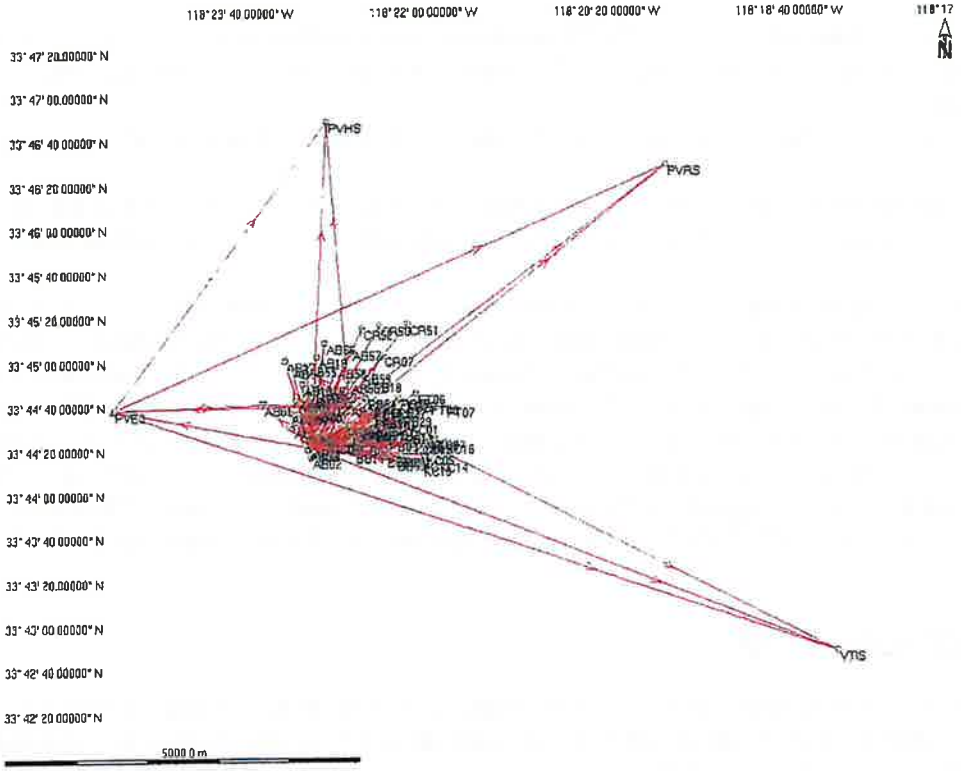
Monitoring Point Location Map



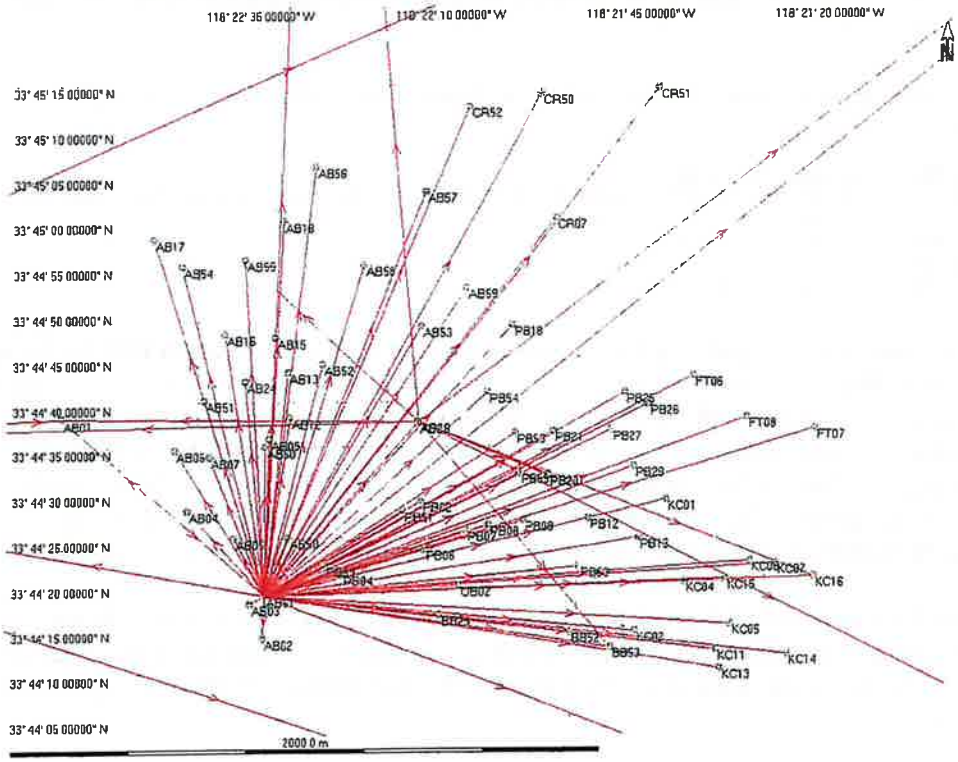
Monitoring Point Location on Aerial Photo

NETWORK

GPS Network



GPS Network Enlargement Showing Monitoring Points



Network: A new Base Station was established at point AB61 on Portuguese Point from which a static network was created including four CORS stations. The survey of was conducted as a radial static network from AB61.
Number of Points in Network: Four CORS, 71 monitoring points and two miscellaneous points (AB21 and PB201). These two points were located because they were in near proximity to monitoring points, but not used for monitoring.
Control Stations: Control stations are the four CORS taking their assigned four letter ID for use in this survey.
Point Status/Comments: Monitoring Points used in this survey take their ID from previous surveys. The ID of new points were assigned by the Glen Tofani, City Geologist consistent with prior naming conventions.

Since 1994, 149 monitoring points have been established in the Portuguese Bend area many of which are now lost or destroyed. Sixty of the original points were recovered in 2007. Eight of the 60 points were deleted because they were in close proximity of other better suited for GPS leaving 52 points monitored for movement between September 2006 and September 2007. Three of the 60 points (AB09, KC11, PB51) were monitored in 2007 for the last time and are replaced on future surveys by new points set nearby better suited for GPS measurements. Nineteen new points set in 2007 will have their movements reported beginning in 2008. In 2008, and moving forward, 49 original and 19 new points will be surveyed for a total of 68 monitoring points. See the "STATUS OF MONITORING POINTS" in the Appendix for information and status.

ADJUSTMENTS & ANALYSIS

Adjustment 1: Minimally Constrained to develop Geodetic and Ellipsoid Coordinates in NAD83(2007)
Fixed Control: The CORS PVE3 was fixed at its published three dimensional position in a Minimally Constrained Adjustment to determine latitude, longitude, ellipsoid heights, and State Plane Coordinates, and compare with other known points shown below. See the attached file "COORDINATE LIST-NAD83 2007 Survey.xls" for a list of points and coordinates resulting from this survey which will be the basis for computing future movements.

The 3D and Ellipsoid Height adjustment results follow with coordinate differences (closures) from record to computed in feet.

Station	dN	dE	dZ	
AB01	2.163	-2.560	26.077	Record WGS84 Position of historically Base Station
PVE3	0.000	0.000	0.000	Fixed
PVHS	0.004	-0.017	0.033	
PVRS	0.013	-0.011	-0.032	
VTIS	0.007	-0.003	-0.012	

Notes/Comments: Relative to the primary Base Station point AB61, the CORS station PVE3 is located 1.8 miles west-northwest, PVHS is 2.8 miles north, PVRS 3.9 miles northeast and VTIS is 4.9 miles east-southeast. The 2D closures on the CORS is 0.017 feet or less and for the purposes of this survey a constrained adjustment was not necessary as it would not change the values determined by this survey. Furthermore, the ongoing plan for the monitoring surveys is to fix AB61 and use the CORS to verify the stability of the reference system. The difference at AB01 indicates the position used historically is 2.16 feet S, 2.56 feet E and 26.08 feet lower than the NAD83 position determined by this survey.

The following lists the position of AB01 in datums of interest for this survey. Note, although AB01 is described in the historical records as a WGS84 position, it is 3.50 feet S, 6.69 feet E and 23.75 feet lower than its WGS84 position by the present definition. The historical WGS84 position of AB01 was apparently a navigation solution.

Point	Latitude	Longitude	EH (ft)	
AB01	33-44-38.30249	-118-22-53.05085	60.142	NAD83, 2007.00
AB01	33-44-38.31554	-118-22-53.09980	57.820	WGS84=ITRF2000
AB01	33-44-38.28119	-118-22-53.02044	34.065	Historical Record WGS84

Adjustment 2: Minimally Constrained to develop Orthometric Heights (Elevations) in NAVD88
Fixed Control: The CORS PVE3 was fixed horizontally and the CORS VTIS was fixed vertically in a Minimally Constrained Adjustment that combined the measured ellipsoid height differences with the NGS Geoid 03 (models the undulations between the ellipsoid and geoid surfaces) to determine NAVD88 orthometric heights on all points and compare with other known points shown below. See the attached file "COORDINATE LIST-NAD83 2007 Survey.xls" for a list of points and heights which will be the basis for computing future movements.

Orthometric Heights: The adjustment results follow with the height differences (closures) from record to computed listed.

Station	dZ (ft)	
AB01	2.56	NGVD29 Historical Record
PVE3		Not Available
PVHS	-0.1	
PVRS	0.0	
VTIS	0.00	Fixed NAVD88

Notes/Comments: The orthometric closure between VTIS (based on Second Order Leveling) and PVHS and PVRS is better than the stated accuracies of their published values. The difference at AB01 represents the shift from the historical record elevation on NGVD29 to the NAVD88 as determined by this survey. For the purposes of this survey a constrained adjustment is not necessary.

Adjustment 3: Minimally Constrained to develop Geodetic and Ellipsoid Coordinates in Psuedo-WGS84 (Duplicates 1994-2006 procedures)
Fixed Control: The historical record position of AB01 (33-44-38.28119, -118-22-53.02044, 34.065 feet) was fixed at its three dimensional position in a Minimally Constrained Adjustment to determine latitude, longitude and ellipsoid heights on the 52 points monitored in 2006 for processing in Corpscon. Consistent with prior processing methods, the results were imported to Corpscon v6 software as NAD83 positions and exported as NAD27 State Plane Coordinates Zone 7. See the attached file "FULL DATA-THROUGH 2007-NAD27.xls" for a list of grid coordinates and movements.

Adjustment 4: Minimally Constrained to develop Orthometric Heights (Elevations) in NGVD29 (Duplicates 1994-2006 procedures)
Fixed Control: The historical record elevation of AB01 (176.06 feet) was fixed vertically in a Minimally Constrained Adjustment that combined the measured ellipsoid height differences with Geoid 03 (models the undulations between the ellipsoid and geoid surfaces) to determine NGVD29 elevations on the 52 points monitored in 2006. See the attached file "FULL DATA-THROUGH 2007-NAD27.xls" for a list of elevations and movements.

Comment on Heights: Analysis of past records indicates as far back as 2000 ellipsoid heights were used to calculate elevations on monitoring points. In 2006 the Geoid 99 model was apparently used. This adjustment derives elevations consistent with past practices but used the newer Geoid03 model. The difference between Geoid99 and Geoid03 heights varies 0.02 to 0.04 feet; however the relative point to point differences affecting this survey are less than 0.011 feet in height and are ignored.

Comment on Recovery of Reference Frame: Points AB02, AB03, AB17 and CR52 are considered historically to be stable and the horizontal closures of 0.01 to 0.03 feet on the 2006 record positions (Adjustments #3 and #4), are listed below and indicate the previous survey reference frame relative to AB01 is stable at the level indicated and was recovered successfully.

Point	N	E	Up	
AB01	0.00	0.00	0.00	Fixed
AB02	0.00	-0.01	-0.08	
AB03	-0.03	0.00	0.00	
AB17	0.02	-0.02	0.00	
CR52	0.01	0.00	0.01	

ACCURACY

Relative Accuracy: On site the points are expected to be at 0.02 feet (<1 cm) horizontal at the 95% Level of Confidence.

Absolute Accuracy: The network is expected to be less than 0.02 feet (<1 cm) horizontal at the 95% Level of Confidence relative to the NAD83 Datum based on the PVE3 CORS as fixed in Adjustment #1.

Vector Residuals: Adjustment #1 referred to above was processed with the following results: the two dimensional horizontal residuals average 0.01 feet with a standard deviation of 0.01 feet and a maximum of 0.03 feet. The absolute value of the vertical residuals average 0.01 feet with a standard deviation of 0.01 feet and a maximum of 0.06 feet.

The North American Vertical Datum 1988 orthometric heights (elevations) resulting from Adjustment #2 are derived from the GPS ellipsoid heights combined with the Geoid 03 model and constrained to known elevations. The ellipsoid heights are expected to be within 0.03 feet. The Geoid 03 model is expected to have a probable error of 1 part per million. Relative elevation accuracies are expected to be 0.03 feet. The absolute accuracy of these heights is dependent on the published values on the VTIS CORS.

In the Minimally Constrained Adjustment #2 the average Standard Deviations (68% Level of Confidence) of the monitoring point coordinates follow in feet.

	North	East	Up
Average	0.008	0.006	0.017
Maximum	0.014	0.012	0.038
Minimum	0.002	0.002	0.003

Baseline (vector) precisions for the monitoring points, at the 95% Level of Confidence (2 sigma), vary 2 ppm to 77 ppm and average 7.5 ppm for 76 measured vectors varying in length between 192 feet and 7,182 feet and averaging 3500 feet. The relative distance error at the 95% Level of Confidence averages 0.017 feet with a maximum of 0.032 feet. The precision ratio based on the averages is 1:206,000 exceeding the criteria for a First Order (C-1) survey per the FGCS requirements by a factor of two under the former classification system.

Baseline (vector) precisions between AB61 and the CORS, at the 95% Level of Confidence (2 sigma), vary 0.1 ppm to 0.5 ppm and average 0.3 ppm for 7 measured connections varying in length between 9,395 and 35,385 feet and averaging 20,700 feet. The relative distance error at the 95% level of Confidence averages 0.005 feet with a maximum of 0.006 feet. The precision ratio is 1:7,000,000 exceeding the criteria for a B Order survey per the FGCS requirements for the former classification system..

CORS connections in feet

From	- To	Grid Distance	95%	PPM
AB61	PVE3	9395.7221	0.004	0.5
AB61	PVHS	14914.8779	0.006	0.4
AB61	PVRS	20693.1014	0.006	0.3
AB61	VTIS	26103.4525	0.005	0.2
PVE3	PVHS	16379.9943	0.005	0.3
PVE3	PVRS	27759.1021	0.005	0.2
PVE3	VTIS	35385.8424	0.005	0.1

The residuals and the closures between known control points discussed in the above Adjustments are good indications of the accuracies obtained by this survey. This survey conforms to the intent of the Federal Geodetic Control Subcommittee (FGCS) Specifications for GPS Relative Positioning (1988) and the California Geodetic Control Committee (CGCC) Specifications for High-Production GPS Surveying Techniques (1993).

QAQC ANALYSIS

To ensure the accuracy of GPS, an independent validation of the measurement system was performed by measuring the distance between a sampling of five inter-visible points with a conventional calibrated total station. The results are listed below in feet. Distances are horizontal ground distances and the "95%" column indicates the relative confidence of the computed GPS distances at 95%.

Comparison of Computed GPS Distances v. Direct Conventional Measurements (Total Station)

From - To	GPS Dist	95%	Total Station Distance	Difference
AB02 - AB61	477.964	0.016	477.973	-0.009
AB03 - AB61	191.838	0.015	191.854	-0.016
KC06 - KC07	288.562	0.020	288.577	-0.015
KC07 - KC16	443.143	0.019	443.149	-0.006
KC11 - KC13	219.804	0.027	219.814	-0.010
Averages		0.019		-0.011

The differences of the computed distances between positions obtained with GPS and distances obtained with direct conventional instruments average 0.011 feet. The maximum is 0.016 feet which is better than the average of 0.019 feet at the 95% Level of Confidence. This test indicates that GPS techniques are equivalent to conventional measurement systems that would require a much greater amount of time and costs to perform.

A second validation was made by computing the inverse distance between the GPS positions of AB20 and five other points spread across the site and then comparing with the directly measured GPS vectors introduced into the adjustment and comparing the change in the distance.

Comparison of Computed GPS Distances v. Direct GPS Measurements

From - To	Calc'd Dist	Direct Dist	Difference
AB20 - AB55	2651.000	2650.995	+0.005
AB20 - AB61	2573.293	2573.296	-0.003
AB20 - BB53	3322.413	3322.423	-0.010
AB20 - KC16	4749.444	4749.448	-0.004
AB20 - PB20	1562.957	1562.966	-0.009
		Average:	-0.004

The difference in the distances average -0.004 feet with a maximum of 0.010 feet. This test indicates relative accuracies are better than 0.010 feet. This test, consistent with the above test results, indicates the radial method of positioning monitoring points is reliable at 0.01 feet, more than sufficient for monitoring purposes.

SUMMARY

For the historical status of all monitoring points as of September 2007, see the "STATUS OF MONITORING POINTS" in the Appendix. The historical positions of all points between 1994-2006 are listed in the file "ALL POINTS MOST RECENT OBSERVED POSITION AS OF SEPTEMBER 15, 2006.xls" available on CD due it large size.

Generally, between 2006 and 2007 the points in the "Portuguese Bend Landslide" moved about ½ to 3½ feet. Points east and west of the "Portuguese Bend Landslide" moved about 0.1 feet or less. The movement for the present period between September 2006 to September 2007 for each monitored point is listed in "FULL DATA-THROUGH 2007-NAD27.xls". The overall movement since the beginning position (varies between 1994 and 2005) is also listed in the same document. The movements are given in north, east and up or down as well as a vector of distance and direction. The direction is given as an azimuth in degrees where 0° is north, 90° is east, 180° is south and 270° is west.

The overall movement of point BB25 is referenced to the 11/04/1998 position because the position changed 6 feet west of its first reported position on 12/13/1997 indicating a different point may have been used. At KC01 it was observed that the recent annual 2006-2007 movement was S19°E 0.05'; however, the 9/14/2006 position is N29°E 1.24' and down 1.8' from the 12/9/2005 position. The 12/9/2005 position is 1.5' higher than its previous position in 02/09/2005, otherwise the point has been stable between 1994 and 2005. This may indicate two points have been used for KC01 and will be resolved with the next survey.

Analysis of the historical data for AB02, AB03 and AB17 (considered stable points) indicates the probability that movement has occurred in the past reports when the distance is greater than 0.05 feet and the direction is consistent with the direction of the overall movement for a particular point.

The September 2007 survey used refined field procedures and processing techniques, the benefits of which will be realized at the completion of the 2008 monitoring survey. At that time, a rigorous simultaneous adjustment that combines the results of both surveys is expected to determine the movement reliability to better than 0.03 feet (1cm) at the 95% Level of Confidence. Beginning in 2008, the spreadsheet "FULL DATA POSTING 2007-NAD83.xls" will be used to report overall and period movements in the NAD83(2007) coordinate system.

Attachments: Find the following documents attached to this Report.

Report Spreadsheets

FULL DATA-THROUGH 2007-NAD27.xls (Reporting coordinates and elevations of the present monitoring points for the initial, 2006 and 2007 positions in the old NAD27 and NGVD29 Systems. Also listed are the overall movements and Sept. 2006 to Sept. 2007 movements. Note, going forward, positions and movements will be posted in the NAD83 and NAVD88 Systems in the file "FULL DATA POSTING-NAD83.xls")

FULL DATA POSTING-NAD83.xls (For future reporting of coordinates and movements of the monitoring points for the initial, 2007 and post 2007 positions in the NAD83 and NAVD88 Systems)

Coordinate Files

COORDINATE LIST-NAD83 2007 Survey.xls (Current NAD83 Geodetic & Grid Coordinates, NAVD88 Heights)

COORDINATE LIST-NAD83 All Historical Pts.xls (Beginning coordinates of all published points since 1994 transformed from NAD27 to NAD83, elevations shifted from NGVD29 to NAVD88)

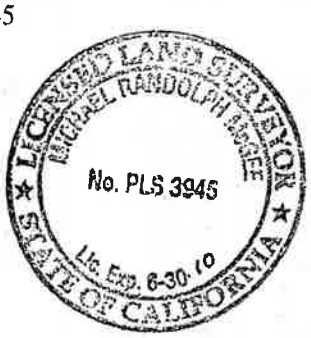
Photos

PHOTOS-SEP2007.doc (September 2007 photos of points)

SURVEYOR'S STATEMENT

This Report on the criteria, procedures and results of the Rancho Palos Verdes Portuguese Landslide Monitoring Survey were prepared by me March 30, 2008 at the request of Frederick (Rick) Jones; P.E., P.L.S. of Charles Abbott Associates Inc. and City Engineer of the City of Rancho Palos Verdes.

Michael R. McGee
P.L.S. 3945



Frederick (Rick) Jones
R.C.E. 36665, P.L.S. 5458

APPENDIX

STATUS OF MONITORING POINTS

Rancho Pales Verdes - Portuguese Landslide Monitoring Point Summary Status 2007

Prepared 09/17/07, Revised 1/31/08

Notes :

UPPER CASE notations indicate site visit comments in Sept. 2007

lower case notation from prior records

Comments column indicates if USED in Sept. 2007 and GPS suitability

149 Monitoring Points Since 1994

60 Old Points Found in 2007

52 Old Points Monitored in 2007

49 Old Points to be Monitored in 2008

19 New Points Set in 2007 to be Monitored in 2008

68 Total Points to Monitor in 2008

Pt ID	Last Obs'd	Status	Comments	Pt ID	Last Obs'd	Status	Comments
AB01	9/11/2006	FOUND	USED (OLD BASE)	**FT01**	year 2001	lost	
AB02	9/6/2006	FOUND	USED	**FT02**	year 2001	lost	
AB03	9/6/2006	FOUND	USED	**FT03**		destroyed	
AB04	9/6/2006	FOUND	USED	**FT04**	year 1995	lost	
AB05	9/6/2006	FOUND	USED	**FT05**	year 2001	lost	
AB06	9/8/2006	FOUND	USED	**FT06**	9/24/2007	NEW	USED
AB07	9/8/2006	FOUND	USED	**FT07**	9/24/2007	NEW	USED
AB08	9/6/2006	PAVED OVER		**FT08**	9/24/2007	NEW	USED
AB09	9/6/2006	FOUND	USED (REPLACE AB60)				
AB10	year 1998	destroyed		**KC01**	9/14/2006	FOUND	USED
AB11	year 1997	destroyed		**KC02**	9/14/2006	FOUND	USED
AB12	9/6/2006	FOUND	USED	**KC03**	2/26/2005	DESTROYED	
AB13	9/6/2006	FOUND	USED-POOR	**KC04**	9/15/2006	FOUND	USED
AB14	8/1/2000	destroyed		**KC05**	4/7/2006	FOUND	USED
AB15	9/11/2006	FOUND	USED-FAIR	**KC06**	9/15/2006	FOUND	USED
AB16	9/11/2006	FOUND	USED-POOR	**KC07**	9/15/2006	FOUND	USED
AB17	9/6/2006	FOUND	USED-FAIR	gap			
AB18	9/11/2006	FOUND	USED-POOR	**KC10**	9/15/2006	FOUND	DELETED
AB19	8/2/2000	destroyed		**KC11**	4/7/2006	FOUND	USED (REPLACE KC13
AB20	9/8/2006	FOUND	USED (NE'LY PIPE)	**KC12**	9/15/2006	FOUND	DELETED-BAD
AB21	9/8/2006	FOUND	DELETED (USED 20)	**KC13**	9/24/2007	NEW	USED
AB22	year 1997	destroyed		**KC14**	9/24/2007	NEW	USED
AB23	9/6/2006	FOUND	DELETED (USED 15)	**KC15**	9/24/2007	NEW	USED
AB24	9/6/2006	FOUND	USED-FAIR	**KC16**	9/24/2007	NEW	USED
gap							
AB28	year 1995	observed 1x		gap			
gap				**PB04**	9/8/2006	FOUND	USED
AB50	9/6/2006	FOUND	USED	**PB05**	10/1/1995	destroyed	
AB51	9/6/2006	FOUND	USED	**PB06**	9/8/2006	FOUND	USED
AB52	9/6/2006	FOUND	USED-POOR	**PB07**	9/8/2006	FOUND	USED
AB53	9/8/2006	FOUND	USED-FAIR	**PB08**	9/8/2006	FOUND	USED
gap				**PB09**	9/8/2006	FOUND	USED
AB54	9/24/2007	NEW	USED-POOR	**PB10**	year 2000	destroyed	
AB55	9/24/2007	NEW	USED	**PB11**	9/11/2006	DESTROYED	
AB56	9/24/2007	NEW	USED-FAIR	**PB12**	9/11/2006	FOUND	USED
AB57	9/24/2007	NEW	USED	**PB13**	9/11/2006	FOUND	USED

AB58	9/24/2007	NEW	USED-POOR
AB59	9/24/2007	NEW	USED
AB60	9/24/2007	NEW	USED
AB61	9/24/2007	NEW	USED (NEW BASE)
B06	1/19/2005	LOST	
BB00	year 1997	lost	
BB01	year 1997	observed 1x	
BB02	year 1997	lost	
BB03	year 1997	observed 2x	
BB04	year 1997	observed 1x	
BB05	year 1997	observed 1x	
BB06	year 2000	lost	
BB07	year 1997	observed 2x	
BB08	year 1997	lost	
BB09	year 1998	lost	
BB10	1/19/2005	destroyed	
gap			
BB20	1/10/2005	LOST	
BB21	1/10/2005	LOST	
BB22	year 1999	destroyed	
BB23	1/10/2005	LOST	
gap			
BB25	1/10/2005	FOUND	USED
gap			
BB50	1/19/2000	lost	
BB51	1/2/2003	LOST	
BB52	9/24/2007	NEW	USED
BB53	9/24/2007	NEW	USED
CR01	year 1997	destroyed	
CR02	year 1994	destroyed	
CR03	year 1997	destroyed	
CR04	year 1994	destroyed	
CR05	year 1997	destroyed	
CR06	year 1997	destroyed	
CR07	9/14/2006	FOUND	USED-FAIR
CR08	year 1995	destroyed	
gap			
CR12	year 1995	destroyed	
gap			
CR14	year 1995	destroyed	
gap			
CR50	9/14/2006	FOUND	USED
CR51	9/14/2006	FOUND	USED
CR52	9/14/2006	FOUND	USED-POOR
FIG2	year 1997	observed 1x	

PB14	year 1994	observed 1x	
PB15	year 1994	observed 1x	
PB16	year 1997	destroyed	
gap			
PB18	9/11/2006	FOUND	USED
PB19	9/11/2006	FOUND	DELETED-POOR
PB20	9/15/2006	FOUND	USED
PB21	9/14/2006	FOUND	USED-FAIR
PB22	9/14/2006	FOUND	DELETED-BAD
PB23	year 1997	destroyed	
PB24	9/11/2006	FOUND	DELETED-BAD
PB25	9/11/2006	FOUND	USED
PB26	9/11/2006	FOUND	USED-FAIR
PB27	9/14/2006	FOUND	USED
gap			
PB29	9/11/2006	FOUND	USED
gap			
PB34	year 1995	destroyed	
gap			
PB38	9/11/2006	LOST	
PB39	year 1995	observed 1x	
PB40	year 1996	destroyed	
PB41	year 1997	destroyed	
PB42	year 1995	lost	
PB43		destroyed	
PB44		destroyed	
PB45	1/27/2005	destroyed	
PB46	9/15/2006	destroyed	
gap			
PB51	9/8/2006	FOUND	USED (REPLACE PB62
PB52	year 1997	observed 1x	
PB53	9/8/2006	FOUND	USED-BAD
PB54	9/8/2006	FOUND	USED-FAIR
PB55	9/8/2006	FOUND	USED-FAIR
PB56	9/8/2006	FOUND	DELETED (USE 59)
PB57	9/8/2006	DESTROYED	
PB58	9/8/2006	DESTROYED	
PB59	9/8/2006	FOUND	USED
PB60	year 2002	DESTROYED	
PB61	2/9/2005	DESTROYED	
PB62	9/24/2007	NEW	USED
PB63	9/24/2007	NEW	USED
UB01	9/15/2006	DESTROYED	
UB02	9/15/2006	FOUND	USED
UB03	11/22/2005	LOST	
UB04	year 2002	destroyed	
UB05	11/22/2005	LOST	

Attachments

Find the following documents attached to this Report.

Report Spreadsheets

FULL DATA-THROUGH 2007-NAD27.xls (Reporting coordinates and elevations of the present monitoring points for the initial, 2006 and 2007 positions in the old NAD27 and NGVD29 Systems. Also listed are the overall movements and Sept. 2006 to Sept. 2007 movements. Note, going forward, positions and movements will be posted in the NAD83 and NAVD88 Systems in the file "FULL DATA POSTING-NAD83.xls")

FULL DATA POSTING-NAD83.xls (For future reporting of coordinates and movements of the monitoring points for the initial, 2007 and post 2007 positions in the NAD83 and NAVD88 Systems)

Coordinate Files

COORDINATE LIST-NAD83 2007 Survey.xls (Current NAD83 Geodetic & Grid Coordinates, NAVD88 Heights)

COORDINATE LIST-NAD83 All Historical Pts.xls (Beginning coordinates of all published points since 1994 transformed from NAD27 to NAD83, elevations shifted from NGVD29 to NAVD88)

Photos

PHOTOS-SEP2007.doc (September 2007 photos of points)

FULL DATA - THROUGH 2007 - NAD27

Date: 03/30/2008

PORTUGUESE POINT LANDSLIDE MONITORING

NAD27 COORDINATES & NGVD29 ELEVATIONS of HISTORICAL and 2007 MONITORING POINTS

(See FULL DATA REPORT NAD83 COORDINATES for POST 2007)

	Original Positions				Sept. 10, 2006 Positions		
		NAD27 SPC Zone 7		NGVD29	NAD27 SPC Zone 7		NGVD29
Point	Date	North (ft)	East (ft)	Elev(ft)	North (ft)	East (ft)	Elev(ft)
AB01	12/1/1994	4019232.49	4172356.65	176.06	4019232.49	4172356.65	176.06
AB02	11/30/1994	4016759.55	4174623.80	113.89	4016759.57	4174623.84	113.99
AB03	12/1/1994	4017150.40	4174472.68	137.04	4017150.48	4174472.67	137.03
AB04	11/30/1994	4018201.67	4173773.74	65.01	4018200.27	4173772.44	64.66
AB05	3/14/1995	4017887.43	4174296.52	78.34	4017886.80	4174295.58	78.11
AB06	4/27/1995	4018868.88	4173624.44	162.72	4018867.80	4173624.09	162.22
AB07	11/30/1994	4018793.21	4174006.83	157.36	4018791.95	4174006.14	156.82
AB09	11/30/1994	4018990.42	4174687.05	168.67	4018989.69	4174686.78	168.36
AB12	11/30/1994	4019229.92	4174918.56	280.87	4019229.09	4174918.14	280.57
AB13	11/30/1994	4019742.18	4174881.25	362.47	4019741.61	4174881.09	361.94
AB15	11/30/1994	4020124.89	4174743.33	394.72	4020124.39	4174743.28	394.34
AB16	11/30/1994	4020169.80	4174175.95	374.06	4020169.63	4174175.95	373.98
AB17	11/30/1994	4021229.31	4173368.11	440.49	4021229.29	4173368.08	440.23
AB18	12/1/1994	4021415.64	4174827.14	454.63	4021415.41	4174827.23	454.26
AB20	3/16/1995	4019178.77	4176333.28	393.87	4019178.10	4176333.03	393.72
AB24	3/12/1997	4019642.06	4174405.53	333.36	4019641.57	4174405.41	333.11
AB50	1/16/1998	4017898.44	4174899.53	179.42	4017898.18	4174898.95	179.29
AB51	3/22/2002	4019427.22	4173952.85	302.86	4019426.93	4173952.84	302.70
AB52	3/22/2002	4019830.67	4175269.34	366.05	4019830.40	4175269.25	365.82
AB53	3/22/2002	4020249.27	4176355.82	350.57	4020249.00	4176355.74	350.30
BB25	11/4/1998	4017019.64	4176586.92	1.25	4017019.50	4176586.93	1.37
CR07	11/30/1994	4021451.83	4177842.56	630.72	4021451.52	4177842.65	629.80
CR50	1/16/1998	4022835.96	4177672.15	870.48	4022835.91	4177672.02	870.20
CR51	1/16/1998	4022888.72	4178996.35	974.19	4022888.85	4178996.36	973.46
CR52	1/16/1998	4022687.31	4176874.65	777.45	4022687.29	4176874.60	777.06
KC01	11/30/1994	4018302.94	4179107.25	310.32	4018303.77	4179107.66	309.86
KC02	3/14/1995	4016829.28	4178773.70	11.28	4016829.20	4178773.63	10.91
KC04	3/14/1995	4017387.74	4179320.06	236.28	4017387.64	4179319.96	235.83
KC05	11/30/1994	4016911.91	4179833.47	225.30	4016911.92	4179833.38	224.97
KC06	11/30/1994	4017615.50	4180048.69	297.79	4017615.48	4180048.48	297.29
KC07	11/30/1994	4017590.74	4180336.01	311.27	4017590.86	4180335.97	310.89
KC11	12/4/2005	4016626.06	4179681.38	176.22	4016626.04	4179681.43	173.88
PB04	11/30/1994	4017491.41	4175504.41	167.96	4017483.14	4175501.98	165.02
PB06	3/15/1995	4017786.93	4176413.48	180.50	4017761.06	4176410.73	175.93
PB07	3/14/1995	4017995.92	4176870.68	197.65	4017963.32	4176864.77	195.55
PB08	12/1/1994	4018058.33	4177120.50	191.12	4018027.15	4177115.03	191.47
PB09	11/30/1994	4018110.67	4177501.53	189.96	4018076.05	4177499.82	187.37
PB12	11/30/1994	4018155.08	4178254.89	190.73	4018095.80	4178239.14	184.92
PB13	3/14/1995	4017912.44	4178815.44	207.98	4017878.45	4178803.03	204.74
PB18	3/15/1995	4020268.37	4177354.33	365.02	4020253.78	4177363.02	360.64
PB20	3/14/1995	4018635.77	4177784.42	240.98	4018578.98	4177775.63	232.53
PB21	3/14/1995	4019121.31	4177819.18	277.46	4019075.21	4177824.98	270.94
PB25	12/1/1994	4019528.09	4178631.38	326.43	4019497.39	4178632.34	323.68
PB26	3/14/1995	4019389.31	4178895.74	282.78	4019366.32	4178898.43	280.31
PB27	3/14/1995	4019164.64	4178483.01	281.86	4019086.51	4178489.03	271.31
PB29	3/15/1995	4018715.22	4178768.92	183.37	4018677.79	4178746.52	171.32
PB51	12/4/1997	4018186.05	4176168.20	234.08	4018183.59	4176167.79	233.48
PB53	12/4/1997	4019074.47	4177401.23	295.19	4019047.81	4177401.91	289.65
PB54	12/4/1997	4019515.56	4177094.54	356.06	4019512.11	4177094.51	355.23
PB55	1/21/1998	4018634.18	4177452.81	243.77	4018606.53	4177450.87	238.60
PB59	6/26/2001	4017581.20	4175314.05	160.83	4017576.80	4175313.01	158.22
UB02	7/23/1997	4017400.86	4176786.69	64.59	4017357.77	4176793.13	60.81

FULL DATA - THROUGH 2007 - NAD27

Date: 03/30/2008

PORTUGUESE POINT LANDSLIDE MONITORING

NAD27 COORDINATES & NGVD29 ELEVATIONS of HISTORICAL and 2007 MONITORING POINTS

(See FULL DATA REPORT NAD83 COORDINATES for POST 2007)

\# Indicates stable points

* Indicates movement unknown to be confirmed in 2008

	Sept.24, 2007 Positions			Overall Movements (US Feet)					
	NAD27 SPC Zone 7		NGVD29	Original Position to September 24, 2007					
Point	North (ft)	East (ft)	Elev(ft)	North	East	Height	Azimuth°	Distance	Moved
AB01	4019232.49	4172356.65	176.06	Fixed	Fixed	Fixed			#
AB02	4016759.57	4174623.83	113.91	0.02	0.03	0.02	61	0.04	#
AB03	4017150.45	4174472.67	137.03	0.05	-0.02	-0.01	344	0.05	#
AB04	4018200.24	4173772.41	64.74	-1.43	-1.33	-0.27	223	1.95	Moved
AB05	4017886.74	4174295.53	78.10	-0.69	-0.99	-0.24	235	1.21	Moved
AB06	4018867.74	4173624.07	162.35	-1.14	-0.37	-0.37	198	1.20	Moved
AB07	4018791.94	4174006.14	156.84	-1.27	-0.69	-0.52	209	1.44	Moved
AB09	4018989.67	4174686.75	168.40	-0.75	-0.30	-0.27	202	0.80	Moved
AB12	4019229.10	4174918.19	280.63	-0.82	-0.37	-0.24	204	0.90	Moved
AB13	4019741.53	4174881.09	361.98	-0.65	-0.16	-0.49	194	0.67	Moved
AB15	4020124.45	4174743.22	394.33	-0.45	-0.11	-0.39	193	0.46	Moved
AB16	4020169.62	4174175.95	373.87	-0.18	0.00	-0.19	179	0.18	Moved
AB17	4021229.31	4173368.07	440.23	0.00	-0.04	-0.26	275	0.05	#
AB18	4021415.39	4174827.18	454.37	-0.25	0.04	-0.26	171	0.26	Moved
AB20	4019178.13	4176333.02	393.66	-0.64	-0.26	-0.21	202	0.70	Moved
AB24	4019641.55	4174405.36	333.18	-0.52	-0.17	-0.18	199	0.54	Moved
AB50	4017898.15	4174898.87	179.47	-0.29	-0.66	0.05	246	0.72	Moved
AB51	4019426.96	4173952.80	302.69	-0.26	-0.05	-0.17	190	0.27	Moved
AB52	4019830.36	4175269.23	365.82	-0.31	-0.11	-0.23	200	0.33	Moved
AB53	4020248.91	4176355.74	350.33	-0.36	-0.08	-0.24	192	0.37	Moved
BB25	4017019.33	4176586.90	1.56	-0.31	-0.02	0.31	183	0.31	Moved
CR07	4021451.38	4177842.62	629.92	-0.45	0.06	-0.80	172	0.46	Moved
CR50	4022835.97	4177672.12	870.10	0.01	-0.03	-0.38	285	0.03	#
CR51	4022888.77	4178996.37	973.69	0.05	0.02	-0.50	20	0.05	#
CR52	4022687.30	4176874.60	777.07	-0.01	-0.05	-0.38	256	0.05	#
KC01	4018303.73	4179107.68	309.85	0.79	0.42	-0.47	28	0.89	*
KC02	4016829.08	4178773.58	11.17	-0.20	-0.12	-0.11	210	0.23	Moved
KC04	4017387.58	4179319.90	235.95	-0.16	-0.16	-0.33	225	0.23	Moved
KC05	4016911.85	4179833.31	224.97	-0.06	-0.16	-0.33	249	0.17	Moved
KC06	4017615.45	4180048.41	297.41	-0.05	-0.28	-0.38	260	0.28	Moved
KC07	4017590.84	4180335.93	310.94	0.10	-0.08	-0.33	321	0.13	*
KC11	4016625.96	4179681.33	174.18	-0.10	-0.05	-2.04	207	0.12	Moved
PB04	4017482.70	4175501.86	164.93	-8.71	-2.55	-3.03	196	9.07	Moved
PB06	4017759.57	4176410.52	175.68	-27.36	-2.96	-4.82	186	27.52	Moved
PB07	4017961.55	4176864.46	195.45	-34.37	-6.22	-2.20	190	34.92	Moved
PB08	4018025.58	4177114.77	191.53	-32.75	-5.73	0.41	190	33.25	Moved
PB09	4018074.25	4177499.72	187.28	-36.42	-1.81	-2.68	183	36.46	Moved
PB12	4018093.01	4178238.34	184.36	-62.07	-16.55	-6.37	195	64.24	Moved
PB13	4017876.81	4178802.38	204.64	-35.63	-13.06	-3.34	200	37.94	Moved
PB18	4020253.28	4177363.11	360.67	-15.09	8.78	-4.35	150	17.46	Moved
PB20	4018576.43	4177775.44	231.92	-59.34	-8.98	-9.06	189	60.02	Moved
PB21	4019072.97	4177825.18	270.72	-48.34	6.00	-6.74	173	48.71	Moved
PB25	4019496.85	4178632.29	323.54	-31.24	0.91	-2.89	178	31.25	Moved
PB26	4019365.84	4178898.46	280.39	-23.47	2.72	-2.39	173	23.63	Moved
PB27	4019083.18	4178489.21	270.95	-81.46	6.20	-10.91	176	81.69	Moved
PB29	4018676.01	4178745.57	170.72	-39.21	-23.35	-12.65	211	45.64	Moved
PB51	4018183.45	4176167.76	233.49	-2.60	-0.45	-0.59	190	2.64	Moved
PB53	4019045.92	4177401.97	289.28	-28.55	0.74	-5.91	179	28.56	Moved
PB54	4019512.01	4177094.46	355.17	-3.55	-0.08	-0.89	181	3.55	Moved
PB55	4018604.37	4177450.71	238.51	-29.81	-2.10	-5.26	184	29.88	Moved
PB59	4017576.13	4175312.81	158.04	-5.07	-1.24	-2.79	194	5.22	Moved
UB02	4017354.20	4176793.62	60.63	-46.66	6.93	-3.96	172	47.17	Moved

FULL DATA - THROUGH 2007 - NAD27

Date: 03/30/2008

PORTUGUESE POINT LANDSLIDE MONITORING

NAD27 COORDINATES & NGVD29 ELEVATIONS of HISTORICAL and 2007 MONITORING POINTS

(See FULL DATA REPORT NAD83 COORDINATES for POST 2007)

\# Indicates stable points

* Indicates movement unknown to be confirmed in 2008

	Periodic (12.5 months) Movements (US Feet) September 10, 2006 to September 24, 2007					
Point	North	East	Height	Azimuth°	Distance	Moved
AB01	Fixed	Fixed	Fixed			#
AB02	0.00	-0.01	-0.08	261	0.01	#
AB03	-0.03	0.00	0.00	190	0.03	#
AB04	-0.03	-0.03	0.08	223	0.04	Moved
AB05	-0.06	-0.05	-0.01	219	0.08	Moved
AB06	-0.06	-0.02	0.13	200	0.06	Moved
AB07	-0.01	0.00	0.02	180	0.01	*
AB09	-0.02	-0.03	0.04	243	0.03	Moved
AB12	0.01	0.05	0.06	76	0.05	*
AB13	-0.08	0.00	0.04	182	0.08	Moved
AB15	0.05	-0.06	-0.01	314	0.08	*
AB16	-0.01	0.00	-0.11	153	0.01	*
AB17	0.02	-0.02	0.00	328	0.03	#
AB18	-0.02	-0.05	0.11	245	0.06	Moved
AB20	0.03	-0.01	-0.06	333	0.03	*
AB24	-0.02	-0.06	0.07	246	0.06	Moved
AB50	-0.03	-0.08	0.18	248	0.09	Moved
AB51	0.03	-0.04	-0.01	306	0.05	*
AB52	-0.04	-0.02	0.00	211	0.05	Moved
AB53	-0.09	0.00	0.03	179	0.09	Moved
BB25	-0.17	-0.03	0.19	189	0.18	Moved
CR07	-0.14	-0.03	0.12	191	0.14	Moved
CR50	0.06	0.10	-0.10	60	0.12	*
CR51	-0.08	0.01	0.23	175	0.08	*
CR52	0.01	0.00	0.01	21	0.01	#
KC01	-0.04	0.01	-0.01	161	0.05	*
KC02	-0.12	-0.05	0.26	201	0.13	Moved
KC04	-0.06	-0.06	0.12	224	0.09	Moved
KC05	-0.07	-0.07	0.00	225	0.10	Moved
KC06	-0.03	-0.07	0.12	249	0.07	Moved
KC07	-0.02	-0.04	0.05	248	0.05	*
KC11	-0.08	-0.10	0.30	231	0.13	Moved
PB04	-0.44	-0.12	-0.09	196	0.45	Moved
PB06	-1.49	-0.21	-0.25	188	1.50	Moved
PB07	-1.77	-0.31	-0.10	190	1.79	Moved
PB08	-1.57	-0.26	0.06	189	1.59	Moved
PB09	-1.80	-0.10	-0.09	183	1.80	Moved
PB12	-2.79	-0.80	-0.56	196	2.90	Moved
PB13	-1.64	-0.65	-0.10	202	1.76	Moved
PB18	-0.50	0.09	0.03	170	0.51	Moved
PB20	-2.55	-0.19	-0.61	184	2.56	Moved
PB21	-2.24	0.20	-0.22	175	2.25	Moved
PB25	-0.54	-0.05	-0.14	185	0.54	Moved
PB26	-0.48	0.03	0.08	177	0.48	Moved
PB27	-3.33	0.18	-0.36	177	3.33	Moved
PB29	-1.78	-0.95	-0.60	208	2.02	Moved
PB51	-0.14	-0.04	0.01	194	0.14	Moved
PB53	-1.89	0.06	-0.37	178	1.89	Moved
PB54	-0.10	-0.05	-0.06	208	0.11	Moved
PB55	-2.16	-0.16	-0.09	184	2.16	Moved
PB59	-0.67	-0.20	-0.18	197	0.70	Moved
UB02	-3.57	0.49	-0.18	172	3.60	Moved

FULL DATA POSTING 2007 - NAD83

Date: 03/30/08

PORTUGUESE POINT LANDSLIDE MONITORING

NAD83(2007) COORDINATES and NAVD88 ELEVATIONS of BEGINNING, 2007 & POST 2007 MONITORING POINT POSITIONS

\# Indicates stable points

* Indicates movement unknown to be confirmed in 2008

	Original Positions				Sept. 24, 2007 Positions			Overall Movements (US Feet)					
		NAD83 SPC Zone 5 (Ft)		NAVD88	NAD83 SPC Zone 5 (Ft)		NAVD88	Original Position to September 24, 2007					
Point	Date	North (ft)	East (ft)	Elev(ft)	North (ft)	East (ft)	Elev(ft)	North	East	Height	Azimuth°	Distance	MOVED
AB01	12/1/1994	1729427.58	6445709.61	178.62	1729427.55	6445709.64	178.62	-0.03	0.03	0.00	-	0	#
AB02	11/30/1994	1726946.97	6447968.65	116.45	1726946.98	6447968.69	116.48	0.01	0.04	0.03	72	0.04	#
AB03	12/1/1994	1727338.34	6447818.82	139.60	1727338.39	6447818.81	139.59	0.04	-0.01	-0.01	351	0.04	#
AB04	11/30/1994	1728391.99	6447123.34	67.57	1728390.55	6447122.03	67.31	-1.44	-1.32	-0.26	222	1.95	MOVED
AB05	3/14/1995	1728076.00	6447645.10	80.90	1728075.30	6447644.13	80.67	-0.70	-0.98	-0.23	234	1.20	MOVED
AB06	4/27/1995	1729059.73	6446976.26	165.28	1729058.58	6446975.91	164.91	-1.15	-0.35	-0.37	197	1.21	MOVED
AB07	11/30/1994	1728982.79	6447358.41	159.92	1728981.51	6447357.74	159.40	-1.28	-0.67	-0.52	208	1.44	MOVED
AB12	11/30/1994	1729416.49	6448271.64	283.43	1729415.67	6448271.30	283.19	-0.82	-0.35	-0.24	203	0.89	MOVED
AB13	11/30/1994	1729928.90	6448236.04	365.03	1729928.25	6448235.90	364.54	-0.65	-0.13	-0.49	192	0.66	MOVED
AB15	11/30/1994	1730312.09	6448099.38	397.28	1730311.64	6448099.31	396.90	-0.45	-0.07	-0.38	189	0.45	MOVED
AB16	11/30/1994	1730358.89	6447532.12	376.62	1730358.70	6447532.17	376.44	-0.19	0.04	-0.18	168	0.19	MOVED
AB17	11/30/1994	1731421.14	6446727.77	443.05	1731421.12	6446727.77	442.80	-0.02	0.00	-0.25	167	0.02	#
AB18	12/1/1994	1731602.62	6448187.49	457.19	1731602.37	6448187.58	456.93	-0.26	0.09	-0.26	162	0.27	MOVED
AB20	3/16/1995	1729360.63	6449686.27	396.43	1729360.00	6449686.03	396.23	-0.62	-0.23	-0.20	201	0.67	MOVED
AB24	3/12/1997	1729830.35	6447759.96	335.92	1729829.83	6447759.82	335.74	-0.52	-0.14	-0.18	196	0.54	MOVED
AB50	1/16/1998	1728085.00	6448248.18	181.98	1728084.71	6448247.54	182.03	-0.29	-0.65	0.05	246	0.71	MOVED
AB51	3/22/2002	1729617.01	6447306.54	305.42	1729616.73	6447306.52	305.25	-0.28	-0.02	-0.17	184	0.28	MOVED
AB52	3/22/2002	1730016.10	6448624.44	368.61	1730015.79	6448624.36	368.39	-0.31	-0.08	-0.22	195	0.32	MOVED
AB53	3/22/2002	1730431.11	6449712.37	353.13	1730430.77	6449712.33	352.90	-0.34	-0.04	-0.23	187	0.34	MOVED
AB54	9/24/2007				1731111.94	6447047.87	407.31						
AB55	9/24/2007				1731174.77	6447753.57	405.38						
AB56	9/24/2007				1732214.31	6448545.46	571.65						
AB57	9/24/2007				1731926.91	6449759.36	564.93						
AB58	9/24/2007				1731118.02	6449074.93	405.67						
AB59	9/24/2007				1730850.87	6450212.56	434.37						
AB60	9/24/2007				1729089.70	6447987.57	179.45						
AB61	9/24/2007				1727424.50	6447990.26	140.47						
BB25	11/4/1998	1727200.54	6449932.73	3.81	1727200.25	6449932.73	4.12	-0.29	-0.01	0.31	182	0.29	MOVED
BB52	9/24/2007				1726996.36	6451384.38	3.83						
BB53	9/24/2007				1726831.16	6451840.89	13.81						
CR07	11/30/1994	1731628.78	6451203.19	633.28	1731628.37	6451203.29	632.48	-0.41	0.10	-0.80	166	0.42	MOVED
CR50	1/16/1998	1733013.55	6451037.38	873.04	1733013.62	6451037.38	872.66	0.07	0.00	-0.38	358	0.07	*
CR51	1/16/1998	1733061.90	6452361.82	976.75	1733062.03	6452361.86	976.25	0.13	0.04	-0.50	17	0.14	*
CR52	1/16/1998	1732867.54	6450239.34	780.01	1732867.58	6450239.32	779.63	0.03	-0.02	-0.38	333	0.04	#
FT06	9/24/2007				1729855.61	6452760.21	489.06						
FT07	9/24/2007				1729253.24	6454104.75	589.01						
FT08	9/24/2007				1729388.68	6453350.51	658.44						
KC01	11/30/1994	1728475.52	6452457.46	312.88	1728476.36	6452457.91	312.42	0.84	0.45	-0.46	28	0.96	*
KC02	3/14/1995	1727002.89	6452118.99	13.84	1727002.74	6452118.89	13.74	-0.15	-0.11	-0.10	216	0.18	MOVED
KC04	3/14/1995	1727559.56	6452667.24	238.84	1727559.46	6452667.09	238.51	-0.10	-0.15	-0.33	236	0.18	MOVED
KC05	11/30/1994	1727082.00	6453179.09	227.86	1727082.01	6453178.94	227.53	0.01	-0.15	-0.33	273	0.15	MOVED
KC06	11/30/1994	1727784.91	6453396.67	300.35	1727784.94	6453396.40	299.97	0.03	-0.26	-0.38	276	0.26	MOVED
KC07	11/30/1994	1727759.19	6453683.92	313.83	1727759.37	6453683.85	313.51	0.18	-0.07	-0.32	340	0.19	MOVED
KC13	9/24/2007				1726581.16	6453069.63	191.20						
KC14	9/24/2007				1726742.44	6453806.05	259.94						
KC15	9/24/2007				1727590.45	6453121.10	287.10						
KC16	9/24/2007				1727602.25	6454098.23	326.90						
PB04	11/30/1994	1727675.94	6448851.74	170.52	1727667.25	6448849.17	167.49	-8.69	-2.57	-3.03	196	9.06	MOVED
PB06	3/15/1995	1727968.45	6449761.84	183.06	1727941.12	6449758.81	178.25	-27.33	-3.03	-4.81	186	27.50	MOVED
PB07	3/14/1995	1728175.93	6450219.76	200.21	1728141.60	6450213.44	198.02	-34.32	-6.32	-2.19	190	34.90	MOVED
PB08	12/1/1994	1728237.51	6450469.80	193.68	1728204.81	6450463.98	194.09	-32.70	-5.82	0.41	190	33.21	MOVED
PB09	11/30/1994	1728288.58	6450851.02	192.52	1728252.20	6450849.11	189.84	-36.38	-1.91	-2.68	183	36.43	MOVED
PB12	11/30/1994	1728330.49	6451604.57	193.29	1728268.52	6451587.83	186.93	-61.97	-16.74	-6.36	195	64.19	MOVED
PB13	3/14/1995	1728085.97	6452164.34	210.54	1728050.44	6452151.18	207.21	-35.53	-13.16	-3.33	200	37.89	MOVED
PB18	3/15/1995	1730446.88	6450711.00	367.58	1730431.80	6450719.76	363.24	-15.08	8.77	-4.34	150	17.44	MOVED
PB20	3/14/1995	1728812.77	6451135.67	243.54	1728753.50	6451126.52	234.48	-59.27	-9.16	-9.06	189	59.97	MOVED
PB21	3/14/1995	1729298.22	6451172.05	280.02	1729249.90	6451177.92	273.29	-48.32	5.87	-6.73	173	48.68	MOVED
PB25	12/1/1994	1729702.31	6451985.65	328.99	1729671.12	6451986.48	326.10	-31.19	0.83	-2.89	178	31.20	MOVED
PB26	3/14/1995	1729562.65	6452249.56	285.34	1729539.22	6452252.23	282.95	-23.42	2.67	-2.39	174	23.58	MOVED
PB27	3/14/1995	1729339.34	6451836.06	284.42	1729257.91	6451842.02	273.51	-81.43	5.96	-10.91	176	81.65	MOVED
PB29	3/15/1995	1728888.95	6452120.49	185.93	1728849.86	6452097.03	173.29	-39.08	-23.46	-12.64	211	45.58	MOVED
PB53	12/4/1997	1729252.77	6450753.92	297.75	1729224.25	6450754.60	291.85	-28.52	0.67	-5.90	179	28.53	MOVED
PB54	12/4/1997	1729694.90	6450448.69	358.62	1729691.38	6450448.62	357.73	-3.52	-0.07	-0.89	181	3.52	MOVED
PB55	1/21/1998	1728812.28	6450804.04	246.33	1728782.51	6450801.87	241.07	-29.77	-2.18	-5.26	184	29.85	MOVED
PB59	6/26/2001	1727766.36	6448661.67	163.39	1727761.30	6448660.42	160.61	-5.07	-1.24	-2.78	194	5.22	MOVED
PB62	9/24/2007				1728476.64	6449717.56	287.25						
PB63	9/24/2007				1727734.04	6451488.11	126.06						
UB02	7/23/1997	1727581.11	6450133.78	67.15	1727534.46	6450140.57	63.20	-46.66	6.78	-3.95	172	47.15	MOVED

FULL DATA POSTING 2007 - NAD83

	??, 2008 Positions			Overall Movements (US Feet)						Periodic (7 months) Movements (US Feet)						
	NAD83 SPC Zone 5 (Ft)		NAVD88	Original Position to ??, 2008						September 24, 2007 Position to ??, 2008						
Point	North (ft)	East (ft)	Elev(ft)	North	East	Height	Azimuth°	Distance	MOVED	North	East	Height	Azimuth°	Distance	95% Error	MOVED
AB01																
AB02																
AB03																
AB04																
AB05																
AB06																
AB07																
AB12																
AB13																
AB15																
AB16																
AB17																
AB18																
AB20																
AB24																
AB50																
AB51																
AB52																
AB53																
AB54																
AB55																
AB56																
AB57																
AB58																
AB59																
AB60																
AB61																
BB25																
BB52																
BB53																
CR07																
CR50																
CR51																
CR52																
FT06																
FT07																
FT08																
KC01																
KC02																
KC04																
KC05																
KC06																
KC07																
KC13																
KC14																
KC15																
KC16																
PB04																
PB06																
PB07																
PB08																
PB09																
PB12																
PB13																
PB18																
PB20																
PB21																
PB25																
PB26																
PB27																
PB29																
PB53																
PB54																
PB55																
PB59																
PB62																
PB63																
UB02																

COORDINATE LIST-NAD83 2007 Survey

Date: 03/30/08

Portuguese Landslide Monitoring September 2007

Datum: Horizontal NAD83 (2007) Epoch: California State Plane Zone 5; Vertical: NAVD88

Note. Fixed PVE3 CORS for Position 3D, Fixed VTIS CORS for NAVD88 Height; See Survey Report

Point	Latitude	Longitude	HE (ft)	North (ft)	East (ft)	OrthoHt(ft)	Description
AB01	33-44-38.30249	118-22-53.05085	60.14	1729427.548	6445709.642	178.62	Stability Check Point/ Old BASE
AB02	33-44-13.84886	118-22-26.19243	-2.01	1726946.982	6447968.685	116.48	Stability Check Point
AB03	33-44-17.71508	118-22-27.98416	21.11	1727038.306	6447818.814	139.59	Stability Check Point
AB04	33-44-28.09727	118-22-36.28088	-51.15	1728390.551	6447122.028	67.31	Monitoring Point
AB05	33-44-24.99811	118-22-30.08505	-37.78	1728075.296	6447644.125	80.67	Monitoring Point
AB06	33-44-34.69996	118-22-38.04072	46.49	1729058.580	6446975.906	164.91	Monitoring Point
AB07	33-44-33.95173	118-22-33.51606	40.99	1728981.510	6447357.744	159.40	Monitoring Point
AB09	33-44-35.91060	118-22-25.45752	52.59	1729176.996	6448039.047	170.96	Monitoring Point/ Deleted after 2007
AB12	33-44-38.28007	118-22-22.71797	164.95	1729415.669	6448271.297	283.19	Monitoring Point
AB13	33-44-43.34918	118-22-23.15958	246.22	1729928.248	6448235.904	364.54	Monitoring Point
AB15	33-44-47.13663	118-22-24.79385	278.59	1730311.638	6448099.313	396.90	Monitoring Point
AB16	33-44-47.58124	118-22-31.51159	258.10	1730358.697	6447532.165	376.44	Monitoring Point
AB17	33-44-58.06084	118-22-41.08404	324.46	1731421.120	6446727.773	442.80	Stability Check Point
AB18	33-44-59.90770	118-22-23.80543	338.68	1731602.367	6448187.579	456.93	Monitoring Point
AB20	33-44-37.78101	118-22-05.96378	277.95	1729360.001	6449686.033	396.23	Monitoring Point
AB21	33-44-37.73183	118-22-06.09391	276.67	1729355.070	6449675.025	394.94	Deleted in 2007. Not for Monitoring
AB24	33-44-42.35815	118-22-26.79267	217.39	1729829.834	6447759.815	335.74	Monitoring Point
AB50	33-44-25.11342	118-22-22.94085	62.61	1728084.708	6448247.535	182.03	Monitoring Point
AB51	33-44-40.23343	118-22-34.15070	186.87	1729616.734	6447306.522	305.25	Monitoring Point
AB52	33-44-44.22942	118-22-18.56369	250.09	1730015.794	6448624.358	368.39	Monitoring Point
AB53	33-44-48.37391	118-22-05.69890	234.68	1730430.766	6449712.326	352.90	Monitoring Point
AB54	33-44-55.01438	118-22-37.27986	288.98	1731111.944	6447047.866	407.31	Monitoring Point/ New 2007
AB55	33-44-55.66191	118-22-28.92603	287.08	1731174.766	6447753.566	405.38	Monitoring Point/ New 2007
AB56	33-45-05.97414	118-22-19.59434	453.44	1732214.311	6448545.457	571.65	Monitoring Point/ New 2007
AB57	33-45-03.17535	118-22-05.20679	446.77	1731926.905	6449759.364	564.93	Monitoring Point/ New 2007
AB58	33-44-55.14904	118-22-13.27649	287.44	1731118.021	6449074.930	405.67	Monitoring Point/ New 2007
AB59	33-44-52.54762	118-21-59.79367	316.20	1730850.867	6450212.555	434.37	Monitoring Point/ New 2007
AB60	33-44-35.04520	118-22-26.06323	61.07	1729089.702	6447987.568	179.45	Monitoring Point/ New 2007
AB61	33-44-18.57319	118-22-25.95806	22.00	1727424.496	6447990.256	140.47	Monitoring Point/ New BASE 2007
BB25	33-44-16.42579	118-22-02.94923	-114.25	1727200.247	6449932.725	4.12	Monitoring Point
BB52	33-44-14.46112	118-21-45.75284	-114.48	1726996.361	6451384.378	3.83	Monitoring Point/ New 2007
BB53	33-44-12.84324	118-21-40.34074	-104.48	1726831.162	6451840.888	13.81	Monitoring Point/ New 2007
CR07	33-45-00.27423	118-21-48.09515	514.39	1731628.371	6451203.293	632.48	Monitoring Point
CR50	33-45-13.97107	118-21-50.11930	754.60	1733013.615	6451037.375	872.66	Monitoring Point
CR51	33-45-14.49718	118-21-34.43636	858.26	1733062.034	6452361.861	976.25	Monitoring Point
CR52	33-45-12.49780	118-21-59.56377	661.53	1732867.578	6450239.324	779.63	Monitoring Point
FT06	33-44-42.79344	118-21-29.58364	370.98	1729855.609	6452760.210	489.06	Monitoring Point/ New 2007
FT07	33-44-36.86198	118-21-13.63766	470.97	1729253.244	6454104.754	589.01	Monitoring Point/ New 2007
FT08	33-44-38.19538	118-21-22.57430	540.36	1729388.682	6453350.505	658.44	Monitoring Point/ New 2007
KC01	33-44-29.13935	118-21-33.10482	194.24	1728476.363	6452457.913	312.42	Monitoring Point
KC02	33-44-14.55038	118-21-37.05654	-104.53	1727002.743	6452118.886	13.74	Monitoring Point
KC04	33-44-20.07600	118-21-30.50930	120.30	1727559.462	6452667.092	238.51	Monitoring Point
KC05	33-44-15.37186	118-21-24.50879	109.33	1727082.007	6453178.944	227.53	Monitoring Point
KC06	33-44-22.33203	118-21-21.96354	181.81	1727784.937	6453396.404	299.97	Monitoring Point
KC07	33-44-22.09001	118-21-18.55901	195.36	1727759.373	6453683.851	313.51	Monitoring Point
KC11	33-44-12.54329	118-21-26.30762	58.53	1726796.603	6453026.002	176.75	Monitoring Point/ Deleted after 2007
KC13	33-44-10.41364	118-21-25.78199	72.96	1726581.157	6453069.631	191.20	Monitoring Point/ New 2007
KC14	33-44-12.03484	118-21-17.06962	141.75	1726742.440	6453806.052	259.94	Monitoring Point/ New 2007
KC15	33-44-20.39934	118-21-25.21509	168.92	1727590.452	6453121.096	287.10	Monitoring Point/ New 2007
KC16	33-44-20.55017	118-21-13.64605	208.78	1727602.246	6454098.234	326.90	Monitoring Point/ New 2007
PB04	33-44-21.00593	118-22-15.79904	49.08	1727667.246	6448849.167	167.49	Monitoring Point
PB06	33-44-23.74812	118-22-05.04057	59.90	1727941.116	6449758.805	178.25	Monitoring Point
PB07	33-44-25.74778	118-21-59.66623	79.71	1728141.604	6450213.437	198.02	Monitoring Point
PB08	33-44-26.38200	118-21-56.70246	75.80	1728204.807	6450463.976	194.09	Monitoring Point
PB09	33-44-26.86466	118-21-52.14433	71.57	1728252.202	6450849.110	189.84	Monitoring Point
PB12	33-44-27.05245	118-21-43.39819	68.69	1728268.516	6451587.833	186.93	Monitoring Point
PB13	33-44-24.91528	118-21-36.71062	89.00	1728050.440	6452151.181	207.21	Monitoring Point
PB18	33-44-48.42050	118-21-53.76957	245.07	1730431.801	6450719.762	363.24	Monitoring Point
PB20	33-44-31.83339	118-21-48.88119	116.26	1728753.497	6451126.515	234.48	Monitoring Point
PB201	33-44-31.88481	118-21-48.86932	116.53	1728758.692	6451127.536	234.75	Found 2" IP 5.3' N'ly of PB20
PB21	33-44-36.74557	118-21-48.29381	155.09	1729249.895	6451177.917	273.29	Monitoring Point
PB25	33-44-40.94115	118-21-38.73760	207.97	1729671.124	6451986.481	326.10	Monitoring Point
PB26	33-44-39.64582	118-21-35.58530	164.82	1729539.223	6452252.228	282.95	Monitoring Point
PB27	33-44-36.84852	118-21-40.43064	155.35	1729257.309	6451842.016	273.51	Monitoring Point
PB29	33-44-32.82121	118-21-37.39371	55.12	1728849.863	6452097.031	173.29	Monitoring Point
PB51	33-44-27.94054	118-22-07.91689	117.72	1728365.822	6449517.439	236.06	Monitoring Point/ Deleted after 2007
PB53	33-44-36.47668	118-21-53.30517	173.63	1729224.246	6450754.597	291.85	Monitoring Point
PB54	33-44-41.08653	118-21-56.94833	239.52	1729691.378	6450448.621	357.73	Monitoring Point
PB55	33-44-32.10879	118-21-52.72650	122.83	1728782.514	6450801.866	241.07	Monitoring Point
PB59	33-44-21.92940	118-22-18.03792	42.19	1727761.298	6448660.423	160.61	Monitoring Point
PB62	33-44-29.04396	118-22-05.55217	168.93	1728476.636	6449717.559	287.25	Monitoring Point
PB63	33-44-21.76186	118-21-44.55620	7.79	1727734.036	6451488.105	126.06	Monitoring Point
UB02	33-44-19.73928	118-22-00.50279	-55.15	1727534.456	6450140.568	63.20	Monitoring Point

NGS Record Positions of CORS (NAVD88 Heights determined by this survey except VTIS published by NGS)

PVE3	33-44-35.85329	118-24-15.26904	235.42	1729207.091	6438765.185	354.36	CORS
PVHS	33-46-46.02015	118-22-19.74126	853.99	1742328.078	6448570.496	972.04	CORS
PVRS	33-46-25.89190	118-19-14.06722	198.63	1740239.290	6464237.898	316.30	CORS
VTIS	33-42-45.48958	118-17-37.71229	197.52	1717933.677	6472307.223	315.26	CORS

COORDINATE LIST-NAD83 All Historical Pts

Date: 03/30/08

PORTUGUESE POINT LANDSLIDE MONITORING

COORDINATE LIST of the INITIAL POSITIONS of ALL HISTORICAL MONITORING POINTS in NAD83(2007)

Datum: Horizontal NAD83, 2007.00 Epoch; California State Plane Zone 5; Based on a 2D conformal transformation from NAD27 at points AB01,AB02,AB03,AB17,CR50,CR52 and KC11. Heights are translated from NGVD29 to NAVD88 at AB01

Point	Beginning Date	North (ft)	East (ft)	OrthoHt(ft)	Point	Beginning Date	North (ft)	East (ft)	OrthoHt(ft)
AB01	12/1/1994	1729427.58	6445709.61	178.62	FT04	3/14/1995	1729352.78	6454262.72	646.51
AB02	11/30/1994	1726946.97	6447968.65	116.45	FT05	11/30/1994	1729868.42	6452616.50	473.38
AB03	12/1/1994	1727338.34	6447818.82	139.60	FIG2	7/22/1997	1730170.59	6450513.14	374.93
AB04	11/30/1994	1728391.99	6447123.34	67.57	KC01	11/30/1994	1728478.52	6452457.46	312.88
AB05	3/14/1995	1728076.00	6447645.10	80.90	KC02	3/14/1995	1727002.89	6452118.99	13.84
AB06	4/27/1995	1729059.73	6446976.26	165.28	KC03	12/1/1994	1727582.62	6452181.63	138.15
AB07	11/30/1994	1728982.79	6447358.41	159.92	KC04	3/14/1995	1727559.56	6452667.24	238.84
AB08	10/28/1995	1728714.17	6447750.27	157.44	KC05	11/30/1994	1727082.00	6453179.09	227.86
AB09	11/30/1994	1729177.74	6448039.33	171.23	KC06	11/30/1994	1727784.91	6453396.67	300.35
AB10	3/15/1995	1729595.00	6447300.32	303.98	KC07	11/30/1994	1727759.19	6453683.92	313.83
AB11	3/15/1995	1729797.40	6447729.07	333.05	KC10	12/4/2005	1727775.79	6453569.10	311.68
AB12	11/30/1994	1729416.49	6448271.64	283.43	KC11	12/4/2005	1726796.64	6453026.04	178.78
AB13	11/30/1994	1729928.90	6448236.04	365.03	KC12	12/4/2005	1726866.18	6452986.46	171.19
AB14	11/30/1994	1730015.93	6448624.58	368.83	PB04	11/30/1994	1727675.94	6448851.74	170.52
AB15	11/30/1994	1730312.09	6448099.38	397.28	PB05	3/16/1995	1727498.39	6449836.88	66.42
AB16	11/30/1994	1730358.89	6447532.12	376.62	PB06	3/15/1995	1727968.45	6449761.84	183.06
AB17	11/30/1994	1731421.14	6446727.77	443.05	PB07	3/14/1995	1728175.93	6450219.76	200.21
AB18	12/1/1994	1731602.62	6448187.49	457.19	PB08	12/1/1994	1728237.51	6450469.80	193.68
AB19	11/30/1994	1730441.28	6449711.10	353.42	PB09	11/30/1994	1728288.58	6450851.02	192.52
AB20	3/16/1995	1729360.63	6449686.27	396.43	PB10	11/30/1994	1728262.72	6451142.22	185.51
AB21	13/16/1995	1729355.69	6449675.25	395.13	PB11	11/30/1994	1728143.66	6451215.09	185.96
AB22	212/1/1994	1728057.76	6448294.43	182.06	PB12	11/30/1994	1728330.49	6451604.57	193.29
AB23	9/17/1997	1730230.73	6448048.83	393.28	PB13	3/14/1995	1728085.97	6452164.34	210.54
AB24	3/12/1997	1729830.35	6447759.96	335.92	PB14	11/30/1994	1728433.44	6449713.99	291.51
AB28	10/19/1995	1728769.80	6447662.41	157.35	PB15	11/30/1994	1728993.40	6449817.21	292.43
AB50	1/16/1998	1728085.00	6448248.18	181.98	PB16	11/30/1994	1729229.77	6450615.90	307.01
AB51	3/22/2002	1729617.01	6447305.54	305.42	PB18	3/15/1995	1730446.88	6450711.00	367.58
AB52	3/22/2002	1730016.10	6448624.44	368.61	PB19	3/15/1995	1730469.17	6450996.77	351.56
AB53	3/22/2002	1730431.11	6449712.37	353.13	PB20	3/14/1995	1728812.77	6451135.67	243.54
B06	11/25/1996	1727191.89	6450862.88	4.87	PB21	3/14/1995	1729298.22	6451172.05	280.02
BB00	7/23/1997	1726794.32	6451614.25	1.96	PB22	3/14/1995	1729275.05	6451410.21	278.22
BB01	7/23/1997	1726898.96	6451649.03	3.11	PB23	3/14/1995	1729780.81	6451465.65	313.07
BB02	7/22/1997	1727005.23	6451392.98	0.63	PB24	3/14/1995	1729945.29	6451841.97	307.06
BB03	7/22/1997	1727089.38	6451212.84	1.72	PB25	12/1/1994	1729702.31	6451985.65	328.99
BB04	7/22/1997	1727199.46	6451047.44	0.55	PB26	3/14/1995	1729562.65	6452249.56	285.34
BB05	7/22/1997	1727211.83	6450855.10	2.42	PB27	3/14/1995	1729339.34	6451836.06	284.42
BB06	7/22/1997	1727245.20	6450653.56	1.85	PB29	3/15/1995	1728888.95	6452120.49	185.93
BB07	7/22/1997	1727275.44	6450435.68	2.34	PB34	10/19/1995	1728446.52	6449720.13	288.10
BB08	7/22/1997	1727251.79	6450239.05	0.72	PB38	12/4/1997	1729846.23	6451469.93	310.99
BB09	7/23/1997	1727199.78	6449938.44	4.91	PB39	3/16/1995	1729999.55	6450873.96	387.14
BB10	7/23/1997	1727052.39	6449676.19	2.32	PB40	3/15/1995	1727653.60	6451009.62	109.96
BB20	11/5/1998	1726890.96	6451591.35	0.53	PB41	3/15/1995	1729055.59	6452179.61	196.79
BB21	1/28/1998	1726995.83	6451383.35	4.44	PB42	3/15/1995	1728696.88	6451790.90	175.56
BB22	12/13/1997	1727090.32	6451142.64	4.10	PB43	9/28/1996	1727627.32	6451980.88	88.13
BB23	12/13/1997	1727241.64	6450197.10	3.94	PB44	9/28/1996	1727527.60	6451739.26	63.37
BB25	11/4/1998	1727200.54	6449932.73	3.81	PB45	1/21/1997	1727329.38	6451761.01	46.71
BB50	11/5/1998	1727233.94	6450408.76	-0.53	PB46	1/21/1997	1727558.90	6451762.73	67.09
BB51	1/29/1999	1726814.40	6451751.66	-0.39	PB51	12/4/1997	1728368.40	6449517.87	236.64
CR01	11/30/1994	1733539.52	6451913.86	1041.15	PB52	12/4/1997	1728818.45	6450805.25	247.46
CR03	11/30/1994	1733072.69	6452392.70	981.46	PB53	12/4/1997	1729252.77	6450753.92	297.75
CR04	11/30/1994	1732398.10	6451433.71	954.88	PB54	12/4/1997	1729694.90	6450448.69	358.62
CR05	11/30/1994	1733283.29	6451513.69	921.11	PB55	1/21/1998	1728812.28	6450804.04	246.33
CR06	11/30/1994	1732700.20	6450107.12	777.12	PB56	6/26/2001	1727863.19	6448618.64	161.39
CR07	11/30/1994	1731628.78	6451203.19	633.28	PB57	6/26/2001	1727848.51	6448529.49	164.34
CR08	11/30/1994	1731560.90	6452004.02	740.91	PB58	8/29/2001	1727805.71	6448591.96	157.57
CR12	10/19/1995	1732643.03	6453036.33	920.57	PB59	6/26/2001	1727766.36	6448661.67	163.39
CR14	10/19/1995	1732394.89	6451404.62	952.86	PB60	1/3/2002	1727532.49	6451952.56	84.02
CR50	1/16/1998	1733013.55	6451037.38	873.04	UB01	7/23/1997	1727492.14	6449837.89	66.02
CR51	1/16/1998	1733061.90	6452361.82	975.75	UB02	7/23/1997	1727581.11	6450133.78	67.15
CR52	1/16/1998	1732867.54	6450239.34	780.01	UB03	7/23/1997	1727481.43	6450567.95	86.94
FT01	11/30/1994	1729239.59	6453193.02	635.95	UB04	7/23/1997	1727615.24	6451004.68	97.20
FT02	3/14/1995	1728554.04	6453984.44	569.13	UB05	5/16/2002	1727475.93	6450890.20	81.96

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Points AB01 – AB16


AB01-ENE.JPG


AB01-SE.JPG


AB01-X1.JPG


AB01-X2.JPG


AB02-S.jpg


AB02-SE.JPG


AB02-X.JPG


AB02-X2.JPG


AB03-SW.jpg


AB03-WSW.JPG


AB03-X.JPG


AB04-E.JPG


AB04-X.JPG


AB04-X2.JPG


AB05-NW.JPG


AB05-X.JPG


AB05-X2.JPG


AB06-NW.JPG


AB06-SE.jpg


AB06-X.JPG


AB07-NW.JPG


AB07-X.JPG


AB09-NE.JPG


AB09-SE.JPG


AB09-X.JPG


AB09-X2.JPG


AB12-E.JPG


AB12-NE.JPG


AB12-X.JPG


AB12-X2.JPG


AB13-SSE.JPG


AB13-X.JPG


AB15-SW.JPG


AB15-X.JPG


AB16-NNE.JPG

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Points AB16 – AB56


AB16-NW.JPG


AB16-SSW.JPG


AB16-WNW.JPG


AB16-X.JPG


AB17-S.JPG


AB17-X.JPG


AB18-SW.JPG


AB18-X.JPG


AB20-AB21-SE.JPG


AB20-X.JPG


AB20-X2.JPG

AB21-X.JPG


AB23-SW.JPG


AB23-X.JPG


AB24-E.JPG


AB24-ENE.JPG


AB24-X.JPG


AB50-NW.JPG


AB50-X.JPG


AB50-XA.JPG


AB51-ENE.JPG


AB51-S.JPG


AB51-SE.JPG


AB51-X.JPG


AB51-XA.JPG


AB52-WNW.JPG


AB52-X.JPG


AB53-SW.JPG


AB53-X.JPG


AB54-NE.JPG


AB54-X.JPG


AB55-NE.JPG

AB55-X.JPG


AB56-E.JPG


AB56-SE.JPG

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Points AB56 – BB53


AB56-X.JPG


AB57-W.JPG


AB57-X.JPG


AB58-WSW.JPG


AB58-X.JPG


AB59-N.JPG


AB59-S.JPG


AB60-NW.JPG


AB60-SE.JPG


AB61.JPG


AB61-NE.JPG


AB61-NNE.JPG


AB61-NW SR399.jpg


AB61-SW.JPG


AB61-SW2.JPG


AB61-X.JPG


AB61-X-CONC COLLAR.JPG


BB10-SSW.JPG


BB25-NE.jpg


BB25-NE_2.jpg


BB25-S.JPG


BB25-SW.jpg


BB25-X.JPG


BB25-X1.jpg


BB25-X2.jpg


BB52-NNW from.JPG


BB52-S.JPG


BB52-SSW2.JPG


BB52-SSW3.JPG


BB52-X1.JPG


BB52-X2.JPG


BB52-X3.JPG


BB52-X4.JPG


BB52-X5.JPG


BB53-N.jpg

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Points BB53 – KC06


BB53-NW.jpg


BB53-SE.jpg


BB53-X.jpg


CR07.JPG


CR07-X.JPG


CR07-XA.JPG


CR50-NE.JPG


CR50-X.JPG


CR51-N.JPG


CR51-X.JPG


CR52-W.JPG


CR52-X.JPG


FT06-SW.JPG


FT06-W.JPG


FT07-closeup.jpg


FT07-closeup_3.jpg


FT07-E to.JPG


FT07-E.jpg


FT07-NW.jpg


FT07-S.jpg


FT08-S.JPG


FT08-W.JPG


FT08-X.JPG


KC01-N.JPG


KC01-X.JPG


KC02-SW.JPG


KC02-SW2.JPG


KC02-X.JPG


KC04-NE.JPG


KC04-X1.JPG


KC04-X2.JPG


KC05-SE.JPG


KC05-X1.JPG


KC05-X2.JPG


KC06-E.JPG

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Points KC06 – PB09


KC06-SE.JPG


KC06-X.JPG


KC07-N.JPG


KC07-X.JPG


KC07-X1.JPG


KC11-NW.JPG


KC11-X.JPG


KC12-NW.JPG


KC12-X.JPG


KC13.JPG


KC13-N.jpg


KC13-NW.jpg


KC13-SE.jpg


KC13-X.jpg


KC14-NW.JPG


KC14-X.JPG


KC15-NE.jpg


KC15-W.JPG


KC15-W2.jpg


KC15-X.jpg


KC16-S.JPG


KC16-X2.JPG


PB04-E.JPG


PB04-X.JPG


PB06-SW.JPG


PB06-X.JPG


PB07-E.JPG


PB07-N.JPG


PB07-X.JPG


PB08-E.JPG


PB08-X.JPG


PB09-E.JPG


PB09-NE.JPG


PB09-W.JPG


PB09-X.JPG

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Points PB12 – PB54


PB12-E.JPG


PB12-X.JPG


PB13-S.JPG


PB13-X.JPG


PB18-NW.JPG


PB18-X.JPG


PB19-E.JPG


PB19-SE.JPG


PB19-X.JPG


PB20-SW.JPG


PB20-X.JPG


PB20-X2.JPG


PB21-NW.JPG


PB21-X.JPG


PB22-N.JPG


PB22-X.JPG


PB24-S.JPG


PB24-X.JPG


PB25-E.JPG


PB25-X.JPG


PB26-W.JPG


PB26-X.JPG


PB27-W.JPG


PB27-X.JPG


PB29-NE.JPG


PB29-X.JPG


PB51-SE.JPG


PB51-X.JPG


PB51-XA.JPG


PB53-S.JPG


PB53-X.JPG


PB53-XA.JPG


PB54-S.JPG


PB54-X.JPG


PB54-XA.JPG

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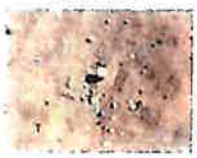
Points PB55 – UB02

PB55-NW.JPG

PB55-X.JPG

PB56-NW.JPG



PB56-X.JPG

PB59-S.JPG

PB59-SW.JPG

PB59-X.JPG

PB59-XA.jpg

PB63-NW.jpg

PB63-NW2.jpg

PB63-SE.jpg

PB63-W access.JPG

PB63-X.jpg

PVE3-CORS-S1.JPG

PVE3-CORS-S2.JPG

PVE3-CORS-X.JPG

UB02-E.JPG

UB02-X.JPG

UB02-XA.jpg