Survey Report

of the

Portuguese Bend Land Movement 2020-2021 Monitoring Surveys

Date: October 5, 2021; Revised May 11, 2022

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 early Fall 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 - September 28, 2021 Full Monitoring Survey No. 31
Second Survey - February 8, 2022 Partial Monitoring Survey No. 32
Third Survey - April 26, 2022 Partial Monitoring Survey No. 33

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ATTACHMENT: “PB MOVEMENT DATA POSTING 2007-2021.9.xlsx” (Overall & Annual Movements)

Survey Report
of the
Portuguese Bend Land Movement Monitoring Survey
Initial 2021-2022 Monitoring No. 31 September 28, 2021
for the
City of Rancho Palos Verdes
by
McGee Surveying Consulting

PROJECT OVERVIEW:

McGee Surveying Consulting (MSC) performs the Portuguese Bend tri-annual land movement monitoring surveys on behalf of the City of Rancho Palos Verdes. The monitoring program was assumed by MSC in 2007. This was the first of three surveys in the 2021-2022 campaign occurring in September 2021. Partial surveys of a sub-set of about 38 points occurred in February and April of 2022 reported as Addendum No. 1 and Addendum No. 2 to this Report. The surveys were planned, coordinated, and executed by Michael McGee, PLS3945 of MSC who is responsible for the field surveys, processing observations, network adjustments, analysis, and reports.

These surveys determine precise positions on an array of monitoring points to assess their periodic and overall movements in the 12-month period beginning in late September. The methods, procedures and results are described in this Report with movements and coordinates listed in the attached spreadsheet titled "PB MOVEMENT DATA POSTING 2007-202#.#.xlsx". These annual reports are similar but different in that they document the evolution of the monitoring program and process over time. Some points have "overall" movements reported back to 1994 based on data by others prior to 2007; otherwise, movements are reported since 2007 by these surveys. Some monuments shown in prior Reports are no longer monitored. The monitored points are listed below.

The Global Navigation Satellite System (GNSS) technology is used to measure the positions of points for its accuracy and efficiency. GNSS, formerly referred to as GPS (USA) now includes Galileo (European), Glonass (Russian) and Beidue (Chinese) satellite navigation systems. 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) reference frames. From 2007 to 2018, the surveys were referenced to monuments known as California CGPS (Continuous GPS) Stations which are permanently mounted GPS and GNSS receivers tracking satellites 24 hours a day for monitoring regional seismic activity. In 2019 the reference frame remained the same, but the methods used to recover the reference frame was modified as described below under "Reference Network".

The accuracy standard for monitoring surveys follows. Points that generally move 5 centimeters (0.16 feet or 2 inches) or less per year are surveyed to meet a relative accuracy standard of one-centimeter (0.033 feet) at the 95% Level of Confidence. Movements greater than 5 centimeters are held to a two-centimeter (0.066 feet) accuracy standard at the 95% Level of Confidence. Methods and procedures discussed in detail in previous Reports are designed to accomplish this purpose and QAQC processes are incorporated to verify these accuracies are attained. Actual accuracies approach half these standards.

GENERAL HISTORY

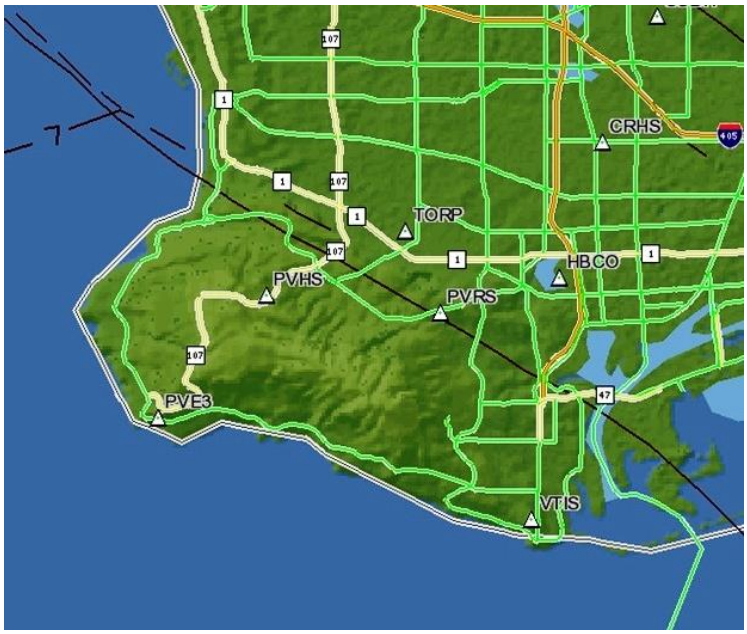
These monitoring surveys are a continuation of a program initiated by the County of Los Angeles in the late 1950's and taken over by the City of Rancho Palos Verdes circa 1994. McGee Surveying Consulting has conducted the field surveys and reporting since September 2007. The monitoring surveys occurred annually from 2007 to 2011, twice a year from 2012 to 2013 and three times a year beginning in September 2014. Survey Reports are filed annually with the City Engineering Department. The status of the points presently monitored is provided in "ACTIVE MONITORING POINT LIST". See the September 2007 Survey Report for a brief history of the prior survey process by others between 1994 and 2006. 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". Due to its large size the file was attached as an electronic file to the 2007 Survey Report.

Prior to September 2007, successive coordinate differences were used by others to compute movements; however, arithmetic differences do not provide statistical information about the accuracies of relative movements. Beginning with the 2007 survey the temporal movements (movements between two points over time) and their statistical data are based on a rigorous simultaneous least-squares adjustment of multiple observations at two different epochs to develop Movement Uncertainties at the 95% Confidence Level.

PROJECT DATUMS - REFERENCE FRAME - PROJECTION

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 2007 Adjustment of NAD83 at Epoch 2007.00 is one of a series of national adjustments of the NAD83 Datum since its adoption in 1986 and is the realization used for the Rancho Palos Verdes Portuguese Bend Monitoring Surveys beginning in 2007. The current national realization of NAD83 is the 2011 Adjustment published by the NGS and referred to as the NAD83 (2011) Epoch 2010.00. The California Spatial Reference Center (CSRC) published an updated adjustment of the California Spatial Reference Network (CSRN) for the CGPS Stations referred to as NAD83(2011) Epoch 2017.50 Adjustment. The difference in these epochs relates to about a 4.4 centimeter shift per year in the Pacific Plate position of points relative to the North American Plate. However, the peninsula is moving as a whole, as demonstrated below in "Datum Stability". 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 within the peninsula over time.

Reference Network: Between 2007 and 2018 the surveys were referenced by the CGPS (continuously operating GPS) Stations PVE3, PVHS, PVRS and VTIS detailed in previous Survey Reports and shown here. The CGPS in California are comparable to the national CORS (Continuously Operated Reference Stations) Network. As of May 2019, point AB02 (on Portuguese Point) and PVE3RP (near City Hall) were substituted as the primary reference monuments for recovery of the Reference Frame as noted below. PVE3RP is a reference point set on the base of CGPS Station PVE3.



CGPS Stations and Fault Lines (north up)

Vertical Datum: The North American Vertical Datum of 1988 (NAVD88) published by the NGS in 1991.
Reference Network: The elevation of CGPS Station VTIS (Second Order Benchmark) was transferred by GNSS measurements combined with the Geoid03 model to CGPS Station PVE3 and thereby to the site as detailed in previous Reports and discussed below.
Geoid Model: The NGS Geoid03 is used to model orthometric heights (elevations) based on measured ellipsoid heights. Geoid03 was available at the time of the initial 2007 survey. Over the years, the NGS has created geoid models Geoid09 (2009), Geoid12B (2012), Geoid18 (2019) and a proposed geoid in 2022. However, Geoid03 is retained to be consistent with prior reported heights and the primary purpose of determining relative height changes over time.
Projection: The latitudes and longitudes determined by GNSS measurements are projected into NAD83 California State Plane Coordinates Zone 5 in US Survey 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 and would be divided by the above Combined Grid Factor to obtain ground distances. Grid bearings resulting from this survey must be rotated left by a Convergence Angle to obtain geodetic (true) bearings. The average convergence angle is -0°12’30” (rotate grid bearings 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 in the NAD83 Datum 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 the Portuguese Bend Landslide. This region is moving at a constant rate as exhibited below by the similar ITRF north, east and up velocities obtained from SOPAC for the four CGPS Stations (see above plot) surrounding the Portuguese Bend Landslide. The table below indicates the CGPS stations, and thereby the peninsula has remained stable in a relative sense for the period indicated.

	ANNUAL *ITRF VELOCITIES (mtrs)			ANALYSIS PERIOD	
SITE	N	E	Up	START -	DATE - END
PVE3	0.019	-0.039	-0.000	2000.73	2021.76
PVHS	0.019	-0.039	0.000	1999.51	2021.76
PVRS	0.019	-0.039	-0.000	1999.09	2021.76
VTIS	0.019	-0.039	-0.001	1998.94	2021.76

*ITRF =International Terrestrial Reference Frame

Reference Network - 2019 Modification: The CGPS Stations provided a rigid reference frame to recover and validate the stability of the monitoring network and accurately report relative land movement from 2007 to 2018. During this 11-year period, points AB02 and AB61 on Portuguese Point were observed to not have moved relative to CGPS Station PVE3 and the other CGPS Stations as noted in the 2007-2018 Survey Reports on file with the City. This is attributed to a basalt geological formation underlying Portuguese Point. The positions of AB02 relative to PVE3 in 2007 and 2018 are listed below. The differences are 0.008’ horizontal by 0.012’ vertical which are insignificant measurement noise and demonstrates their long-term stability.

Pt#	Latitude	Longitude	EH(ft)	Source
AB02	33-44-13.84886	118-22-26.19243	-2.015	Oct. 2007 position
AB02	33-44-13.84878	118-22-26.19243	-2.027	Oct. 2018 position

The NAVD88 Orthometric Height (feet) of AB02 analyzed over the 11-year period follows:

AB02 = 116.48 Oct. 2007
AB02 = 116.47 Oct. 2018
AB02 = 116.47 11 Year Average with a Std. Dev. of 0.01' (except a 2017 outlier)

Given the proven stability of AB02 relative to PVE3, the method for recovering the reference frame was modified in April 2019 to improve the efficiency and simplify the monitoring survey. The process for the recovery of the reference frame was modified by fixing point AB02, instead of PVE3, and checking to PVE3RP (PK Nail set in 2015 in the concrete base of PVE3). Point AB61 was included for additional on-site validation of stability. Beginning in the fall of 2019, the network adjustments were constrained to the 2018 NAD83 position and NAVD88 Height of AB02 checking to PVE3RP and AB61 listed below.

Pt#	Latitude	Longitude	NAVD88 Ht	Source)
AB02	33-44-13.84878	118-22-26.19243	116.47 ft	Oct. 2018 position
PVE3RP	33-44-35.74239	118-24-15.27451	346.88 ft	Average of 5 years
AB61	33-44-18.5730	118-22-25.9580	140.43 ft	Average since 2007

FIELD SURVEYS, DATA COLLECTION, EQUIPMENT & PROCESSING

This September 28, 2021 survey is the 31st Monitoring Survey. For data management purposes during the field survey and data processing, the occupation point names are prefixed with a sequential number to distinguish between surveys. For example, on the 16th monitoring survey AB61 was named M16AB61 where M16 indicates the sequence number since the initial M01 Monitoring Survey in September 2007. The prefix is stripped in the attached "PB MOVEMENT DATA POSTING" document.

Point AB61, established in September 2007 on Portuguese Point, was used as the primary base station through October 2018. In January 2019, Point AB20 was adopted as the primary base station through February 2020. A new base station AB73 was established in April 2020 in a secure area on the US Pony Club property and not likely to be disturbed by others. Permission to enter is confirmed prior to each survey. Strict driving protocols are observed.

Sixty-seven monitoring points were occupied and reported in this survey. The field survey commenced each day by setting a receiver on the base station. A roving receiver operating in RTK mode collected observations at the remaining points. Site photographs and recovery sheets detailing the location, character of the monuments and obstructions were updated.

Prior to January 2019, static Leica GS15 geodetic grade GNSS receivers/antennas (listed in prior Reports) were mounted on two-meter fixed height poles collecting satellite signal data. Beginning in January 2019, a Leica GS15 RTK base with a GS18T Rover operating in real-time with an FM radio system was used to measure positions of monitoring points. The GS18 receiver incorporates an Inertial Measurement Unit and tracks the Global Navigation Satellite Systems (GNSS) including GPS, GLONASS, Galileo and Beidue Satellites.

Points with annual movements less than 5 centimeters were measured with two or more independent occupations with the roving receiver resulting in a minimum of two vectors from the base station and two positions for each point. Independent occupations are defined as occupations separated by an hour or more in time (under a different constellation of satellites) usually on a different day. Differences in the two measured vectors are accepted if they fall within 0.03 feet (1 cm) horizontally; otherwise, additional measurements are necessary. Experience has shown the measurements generally agree 0.02 feet or less. Points in the active areas with annual movements greater than 5 centimeters were single occupied and a comparison made with the linear movements from prior years (Deflection Analysis) to verify the accuracy of the measurements.

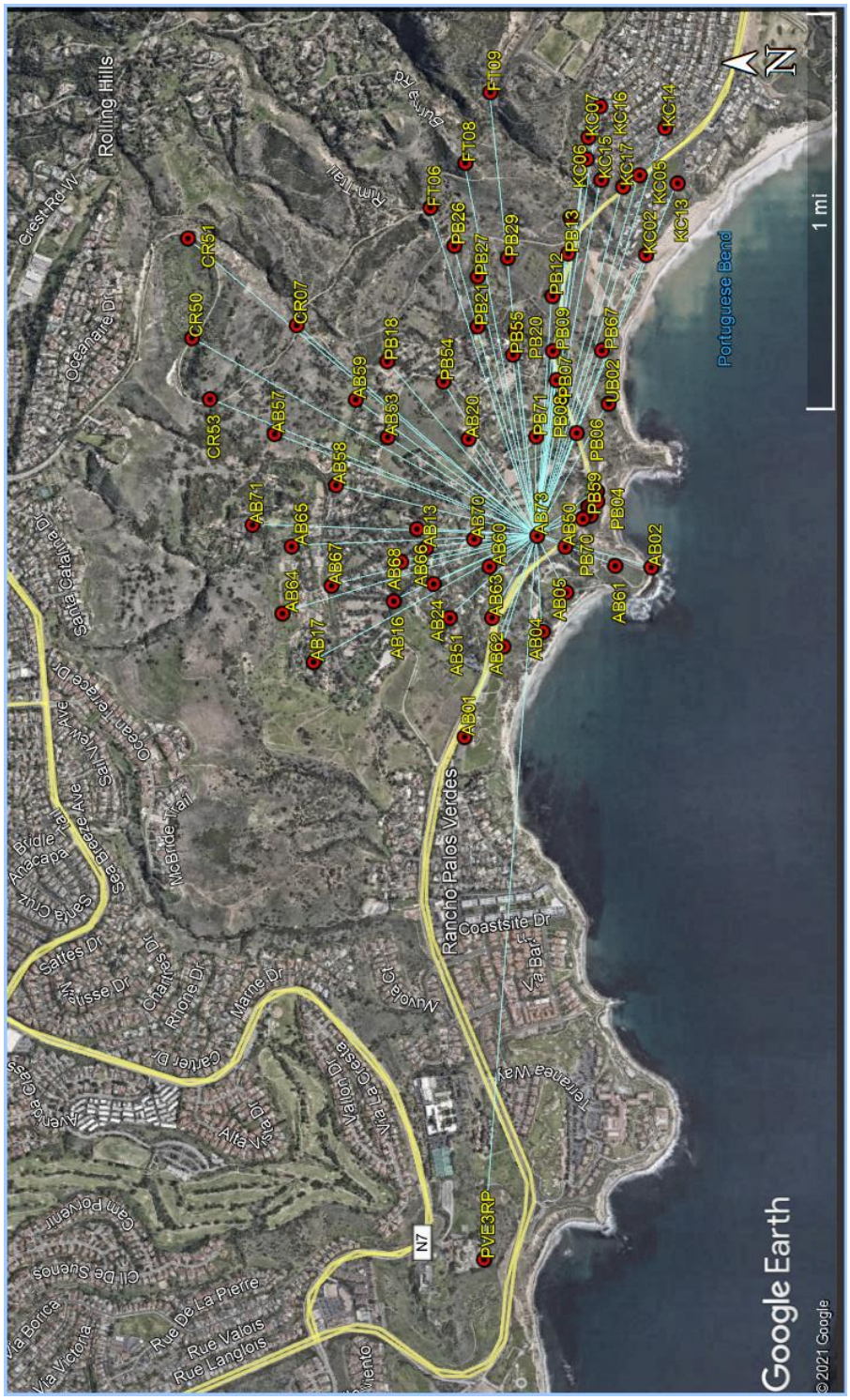
Trees and foliage that over-shadow points interfere with signals received from satellites and hinder the quality of measurements. To improve the accuracy of the measurements, satellites that are obstructed by trees and foliage may be turned off during the observation. Generally, the number of available satellites vary 15-30 throughout the day supporting the RTK type solution. 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.

GNSS Survey Parameters and Metadata
Date of Initial Annual Survey: M31 – September 28, 2021 (mean date) between 0700-1800 PDST (+7 hrs for UTC).
Constellations: 31 US NAVSTAR GPS Satellites, 23 Russian GLONASS, 23 Galileo and 24 Beidue.
Observables: L1 & L2 Carrier Waves on GPS, GLONASS and Beidue; and four Carrier Waves on Galileo Satellites
Data Epoch Rate - 0.2 seconds (20HZ) at the GS18 RTK Rover; 1 second RTK & 15 second static at the GS15 Base
Satellites: 15-30; **GDOP:** < 3; **Elevation Mask:** 0° at the Rover and Base Station
Ephemeris: Rapid for Static Post-Processing and Broadcast for RTK baselines.
Weather: Mostly calm clear skies, temperature 65-75° F, no significant weather.
Space Weather: Boulder K Index 2-4 averaging 3 (gauges ionospheric activity on a scale of 0-9; less than 6 preferred)
Equipment:
GNSS Base Receiver Unit No.: M11, Operator: M. McGee, PLS; Occupied Base Station: AB73
Make & Model: Leica GS18 with integrated Antenna; Mount: Tribrach on Tripod
GNSS Rover Receiver Unit No.: M10, Operator: M. McGee, PLS
Make & Model: Leica GS18T with integrated Antenna; Mount: Fixed Height Pole #4
Processing & Adjustments: Leica Infinity v3.4 and "Starnet-PRO" version 9.2.6 Software

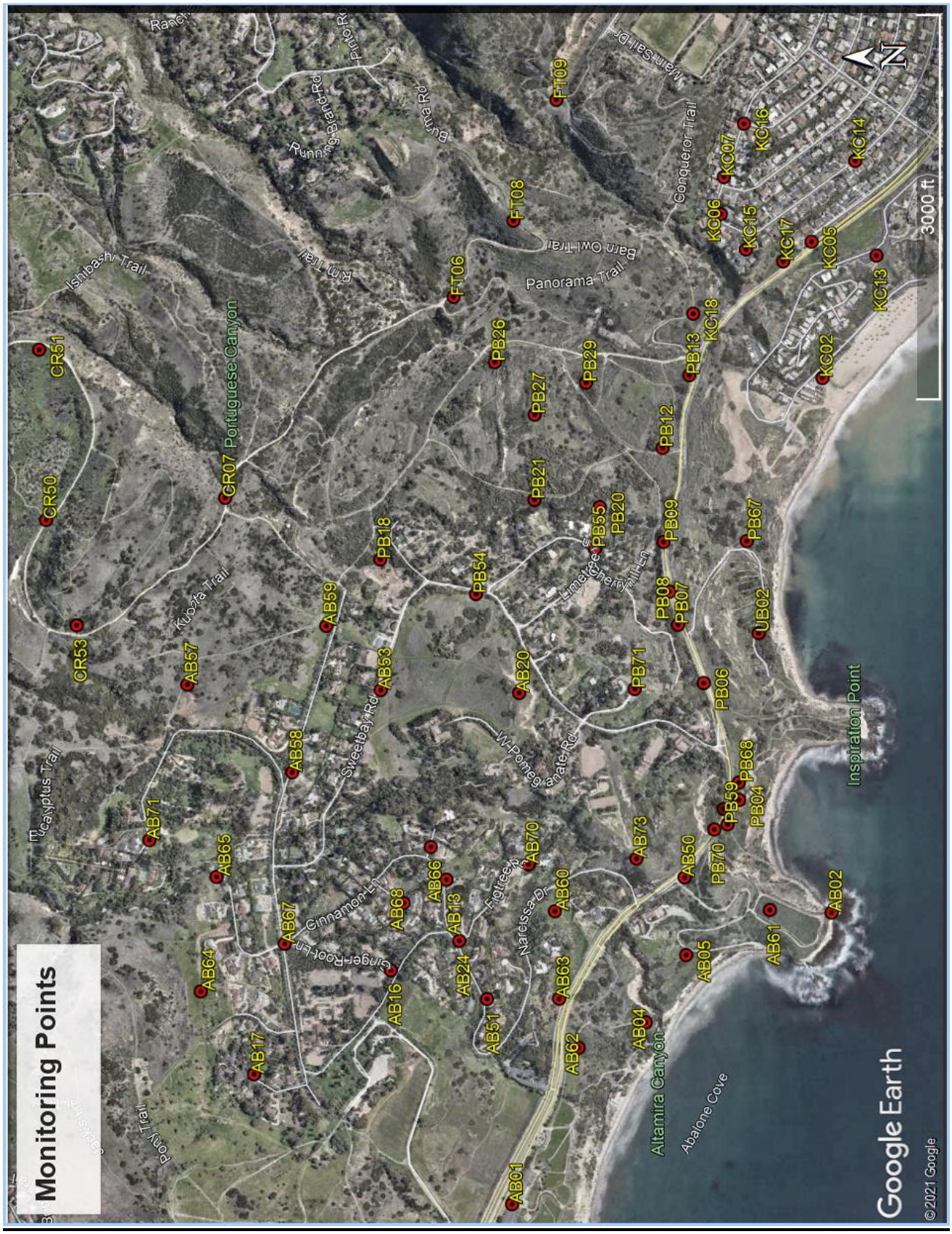
GNSS SURVEY MONITORING NETWORK

AB61 was the primary GNSS Base Station and focal point of the network connecting the monitoring points and CGPS Stations since 2007. AB61 was replaced by AB20 in 2019. AB20 was replaced by AB73 as the Base Station location in April 2020. As stated above, up until 2019 the monitoring plan directly utilized the CGPS Stations to recover and verify the stability of the reference frame with PVE3 (located south of RPV City Hall outside the slide area) being the primary fixed control for these surveys. Over the years there have been occasional issues with antenna/receiver changes and obtaining data for the CGPS stations which inhibits the confirmation of the reference frame recovery and stability. After 11 years of monitoring the network, the relative positions of PVE3, AB61 and AB02 are unchanged as explained above. In 2015 a reference point (PK Nail) was set 11' southerly of PVE3 on its concrete base referred to as PVE3RP. Beginning with the October 2019 survey, the 2018 position of AB02 (located at the southeast edge of Portuguese Point) was fixed and the stability of the reference frame is now confirmed by measurements to PVE3RP (CGPS Station) and AB61.

September 2021 (M31) Monitoring Network



September 2021 – M31 Monitoring Points



ADJUSTMENTS & ANALYSIS

Network Adjustment: A minimally constrained adjustment was computed to develop NAD83 (2007) 2007.00 Epoch Zone 5 State Plane Coordinates and NAVD88 Heights by fixing Point AB02 at the 2018 position listed above to determine coordinates and elevations of the monitoring points. The NAVD88 orthometric heights (elevations) were determined by combining the measured ellipsoid heights with the Geoid03 Model. The stability of AB02 which is unaffected by the land movement was verified relative to PVE3RP (base of CGPS Station) located 2 miles westerly of and outside the influence of the slide area. The absolute movements of all points are listed in the attached file "PB MOVEMENT DATA POSTING 2007-202#.#.xlsx". Listed here are the differences from the known stable positions to the measured positions by this survey with their north, east and vertical components in feet.

Differences in Feet

ID	dN(ft)	dE(ft)	dZ(ft)	
AB02	0.000	0.000	0.000	Fixed
AB61	-0.005	-0.006	0.010	Stable Check Point on Portuguese Point
PVE3RP	-0.013	-0.001	0.020	Stable Check Point at City Hall

Comments: Fixing AB02 finds no horizontal differences at PVE3RP or AB61 other than insignificant random measurement noise. Given that AB02, PVE3RP and AB61 are in good relative agreement, the survey reference frame is deemed stable and successfully recovered.

ACCURACY STATEMENTS

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, estimated two dimensional residuals and the absolute value of the vertical residuals of 116 vectors are listed below in feet. Due to the nature of how observations are obtained with the GS18T Receiver, each vector represents the average of six measurements used to derive an independent position of a point. The vector residuals are estimated based on the independent point positions.

Vector Lengths(ft)		Two Dimensional Residuals			Absolute Vertical Residuals		
Vary	Average	Average	Std.Dev.	Maximum	Average	Std.Dev.	Range
419-9657	3218	0.007	0.003	0.014	0.009	0.008	-0.02 to +0.03

Movement Accuracy: A point is deemed to have moved if, at the 95% level of confidence the horizontal movement (signal) of a point between two epochs is greater than the 95% Error (noise). Re-stated, no movement is considered detected unless the movement distance exceeds the 95% Error of that distance. Based on dual and triple occupied points, the horizontal (2D) movements reported between September 2020 (M28) and September 2021 (M31) statistically attained a relative average accuracy of 0.024 feet at the 95% Level of Confidence with a Standard Deviation of 0.002 feet and a Range of 0.015 to 0.029 feet. See the attached file "PB MOVEMENT DATA POSTING 2007-202#.#.xlsx" for movements and errors estimates.

QUALITY CONTROL - QUALITY ASSURANCE (QAQC)

Multiple methods using terrestrial instruments, comparisons with NGS Calibration Baselines and a method known as Deflection Analysis have been used since 2007 to validate the accuracy of the methods, equipment, and results of these surveys. The analysis implies an absolute measured movement accuracy of 0.01 to 0.02 feet at 95% confidence. See 2007 and subsequent Survey Reports for discussions.

ANNUAL MOVEMENTS M28 to M31

Sept. 24, 2020 to Sept. 28, 2021 (12.0 months)

Two Dimensional Horizontal Movements in Feet Are Indicated by the "+" Sign

Movement Direction is Generally South to Southwest, See Page 11 for Individual Point Directions

MOVEMENT SUMMARY by ZONES

Range of movement by Landslide Zones listed in feet:

AB## 0.01-0.78
CR## 0.01-0.30
FT## 0.01-0.52
KC## 0.01-0.36
PB## 0.46-1.02
& 1.78@PB67
UB02 0.82

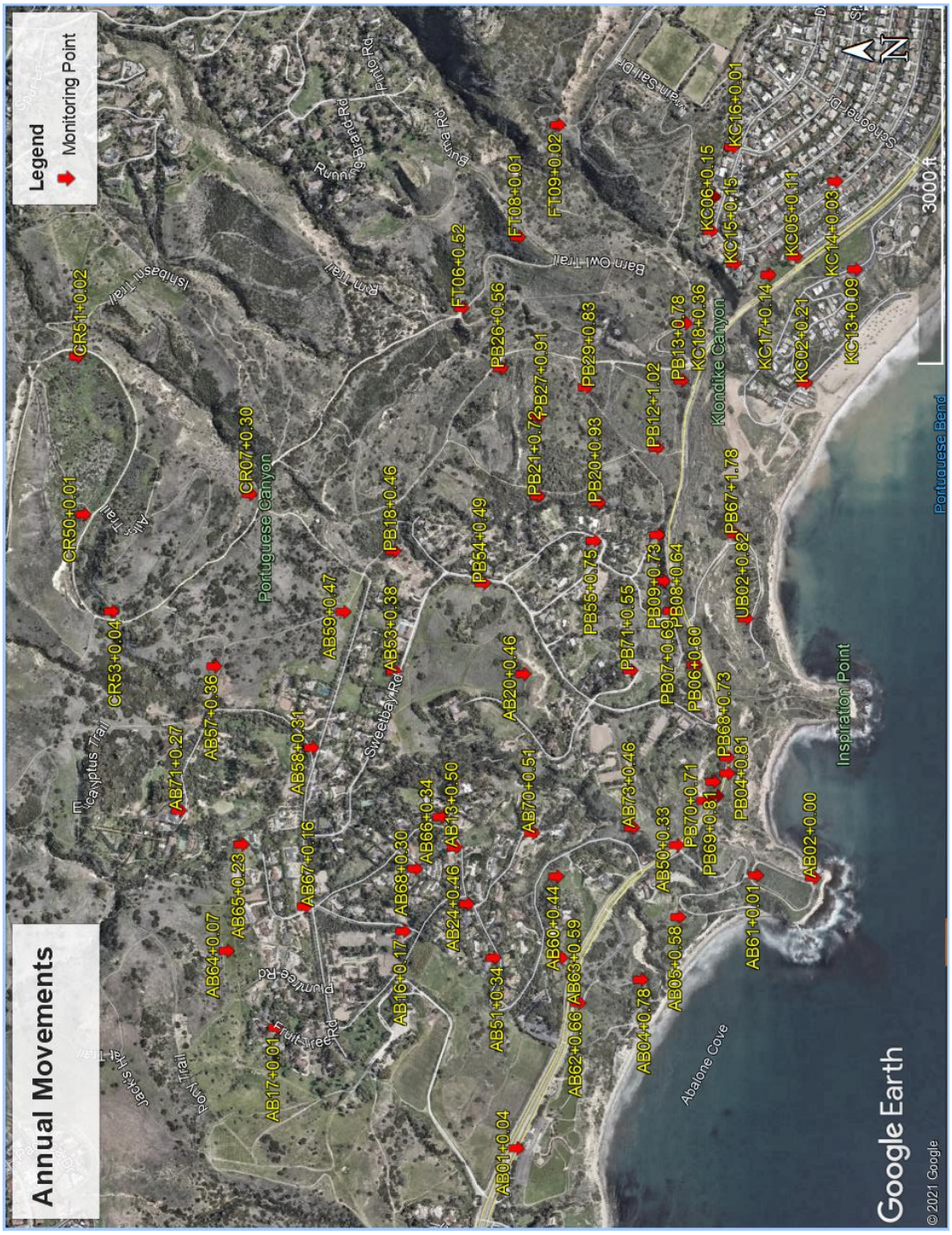


Table of Annual Movements of Monitoring Points
Portuguese Bend Landslide Monitoring

2D Horizontal and Vertical Movements in Feet
September 24, 2020 (M28) to September 28, 2021 (M31) = 12.0 Months

Listed below are the two-dimensional horizontal movements and vertical (elevation) changes during the last annual period. See the attached spreadsheet "PB MOVEMENT DATA POSTING 2007-20##.xlsx" and this periods results copied on the next page for more details. Note: The horizontal measurement confidence is estimated at 0.024' (1/4"); therefore, movements of 0.02' or less are deemed statistically to not have moved. The estimated vertical measurement confidence is 0.04' (1/2").

Point ID	Horizontal Movements	Vertical Changes		Point ID	Horizontal Movements	Vertical Changes
AB01	0.04	-0.01		KC02	0.21	0.02
AB02	0.00	0.00		KC05	0.11	-0.02
AB04	0.78	-0.10		KC06	0.15	-0.05
AB05	0.58	-0.09		KC07	0.02	0.02
AB13	0.50	-0.15		KC13	0.09	-0.02
AB16	0.17	0.00		KC14	0.03	0.05
AB17	0.01	0.00		KC15	0.15	-0.05
AB20	0.46	-0.02		KC16	0.01	0.00
AB24	0.46	0.00		KC17	0.14	-0.05
AB50	0.33	0.02		KC18	0.36	-0.03
AB51	0.34	-0.05		PB04	0.81	-0.16
AB53	0.38	-0.08		PB06	0.60	-0.09
AB57	0.36	-0.17		PB07	0.69	0.12
AB58	0.31	-0.07		PB08	0.64	-0.02
AB59	0.47	-0.15		PB09	0.73	-0.11
AB60	0.44	-0.06		PB12	1.02	-0.19
AB61	0.01	0.01		PB13	0.78	-0.05
AB62	0.66	-0.09		PB18	0.46	-0.10
AB63	0.59	-0.17		PB20	0.93	-0.15
AB64	0.07	-0.07		PB21	0.72	-0.15
AB65	0.23	-0.07		PB26	0.56	-0.11
AB66	0.34	-0.11		PB27	0.91	-0.17
AB67	0.16	-0.01		PB29	0.83	-0.23
AB68	0.30	-0.13		PB54	0.49	-0.06
AB70	0.51	-0.01		PB55	0.75	-0.10
AB71	0.27	-0.12		PB59	0.95	-0.26
AB73	0.46	-0.03		PB67	1.78	-0.28
CR07	0.30	-0.30		PB68	0.73	-0.12
CR50	0.01	-0.03		PB69	0.81	-0.11
CR51	0.02	-0.08		PB70	0.71	-0.28
CR53	0.04	-0.04		PB71	0.55	-0.15
FT06	0.52	-0.25		UB02	0.82	0.02
FT08	0.01	-0.02		PVE3RP	0.01	0.02
FT09	0.02	0.02				

"PB MOVEMENT DATA POSTING" CURRENT SPREADSHEET and EXPLANATION

The image here is a copy of the current annual spreadsheet in the "PB MOVEMENT DATA POSTING 2007-2021.9.xlsx" spreadsheet attached to this Report. The spreadsheet lists the California State Plane Coordinates of the initial positions dating back to 1994 and subsequent positions of monitoring points with their annual and overall movements. 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 date. Some points indicated by date precede this Monitoring Program which began in 2007. For prior surveys, data by others as noted in the 2007 Survey Report were relied on for initial positions.

PB MOVEMENT DATA POSTING(Pg.19) 2020-2021 (M28-M31)

PORTUGUESE BEND LANDSLIDE MONITORING - MOVEMENT DATA POSTING as of Sept. 28, 2021 — Page 19/19
Prepared by McGee Surveying Consulting - Document Date: Oct. 5, 2021
Monitoring Point Movements
FULL ANNUAL MONITORING #31 (M31)

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

	September 28, 2021 Positions			Overall Movements (US Feet)						Periodic (10.8 months) Movements (US Feet)						
	NAD83 SPC Zone 5 (Ft)		NAVD88	Original Position to September 28, 2021						Sept. 24, 2020 to Sept.28, 2021						
Point	North (ft)	East (ft)	Elev(ft)	North	East	Height	Azim.°	Dist.	Year	North	East	Height	Azim.°	Dist.	95%Err	Note
AB01	1729427.52	6445709.63	178.67	-0.06	0.02	0.05	165	0.06	1994	-0.03	0.02	-0.01	142	0.04	0.02	
AB02	1726946.97	6447968.69	116.47	-0.01	0.00	-0.01	180	0.01	2007	0.00	0.00	0.00	180	0.00	0.02	FIXED
AB04	1728387.81	6447119.55	66.85	-4.19	-3.79	-0.72	222	5.65	1994	-0.58	-0.52	-0.10	222	0.78	0.02	
AB05	1728073.19	6447642.01	80.17	-2.53	-3.16	-0.73	231	4.05	1994	-0.38	-0.44	-0.09	229	0.58	0.02	
AB13	1729926.43	6448235.36	364.12	-2.46	-0.68	-0.91	195	2.55	1994	-0.49	-0.11	-0.15	193	0.50	0.03	
AB16	1730357.98	6447532.04	376.40	-0.91	-0.09	-0.22	185	0.91	1994	-0.17	-0.04	0.00	193	0.17	0.03	
AB17	1731421.06	6446727.73	442.79	-0.06	-0.04	-0.01	216	0.07	2007	-0.01	0.00	0.00	178	0.01	0.02	*
AB20	1729357.72	6449685.30	396.17	-2.91	-0.97	-0.26	198	3.07	1995	-0.44	-0.14	-0.02	197	0.46	0.03	
AB24	1729827.97	6447759.06	335.74	-2.38	-0.90	-0.18	201	2.55	1997	-0.43	-0.14	0.00	198	0.46	0.02	
AB50	1728083.79	6448246.11	182.07	-1.21	-2.07	0.09	240	2.40	1998	-0.19	-0.27	0.02	234	0.33	0.02	
AB51	1729615.31	6447306.04	304.84	-1.70	-0.50	-0.58	196	1.78	2002	-0.32	-0.11	-0.05	200	0.34	0.02	
AB53	1730428.68	6449711.93	352.65	-2.43	-0.44	-0.48	190	2.47	2002	-0.38	-0.06	-0.08	189	0.38	0.02	
AB57	1731925.05	6449759.78	564.27	-1.85	0.41	-0.66	167	1.90	2007	-0.35	0.09	-0.17	165	0.36	0.03	
AB58	1731116.28	6449074.92	405.45	-1.74	-0.01	-0.22	180	1.74	2007	-0.31	-0.02	-0.07	183	0.31	0.02	
AB59	1730848.37	6450212.35	433.78	-2.50	-0.20	-0.59	185	2.51	2007	-0.47	-0.04	-0.15	185	0.47	0.02	
AB60	1729087.90	6447986.73	179.17	-1.80	-0.84	-0.28	205	1.99	2007	-0.40	-0.18	-0.06	204	0.44	0.02	
AB61	1727424.47	6447990.25	140.45	-0.03	0.00	-0.02	188	0.03	2007	-0.01	-0.01	0.01	229	0.01	0.02	*
AB62	1728908.10	6446924.56	142.73	-2.25	-0.90	-0.28	202	2.42	2011	-0.62	-0.24	-0.09	202	0.66	0.02	
AB63	1729057.29	6447306.09	180.24	-2.01	-0.95	-0.61	205	2.22	2011	-0.54	-0.25	-0.17	205	0.59	0.02	
AB64	1731830.55	6447373.19	532.13	-0.14	0.11	-0.12	142	0.17	2012	-0.05	0.05	-0.07	135	0.07	0.03	
AB65	1731704.83	6448264.30	458.30	-0.85	0.23	-0.23	165	0.88	2012	-0.22	0.06	-0.07	164	0.23	0.02	
AB66	1730045.98	6448490.19	374.08	-1.31	-0.34	-0.20	195	1.35	2012	-0.32	-0.09	-0.11	195	0.34	0.02	
AB67	1731179.84	6447741.78	405.25	-0.57	0.02	-0.07	178	0.57	2012	-0.16	0.01	-0.01	177	0.16	0.02	
AB68	1730257.74	6448055.13	393.04	-1.12	-0.24	-0.40	192	1.14	2012	-0.29	-0.07	-0.13	194	0.30	0.02	
AB70	1729289.86	6448352.16	254.07	-1.62	-0.71	-0.07	204	1.77	2015	-0.47	-0.21	-0.01	204	0.51	0.02	
AB71	1732223.21	6448552.16	571.23	-0.91	0.35	-0.30	159	0.98	2016	-0.25	0.10	-0.12	158	0.27	0.03	
AB73	1728455.47	6448393.74	306.69	-0.57	-0.29	-0.02	207	0.64	2020	-0.42	-0.19	-0.03	204	0.46	0.02	
CR07	1731626.71	6451203.56	631.13	-2.07	0.37	-2.15	170	2.10	1994	-0.30	0.05	-0.30	170	0.30	0.03	
CR50	1733013.56	6451037.33	872.57	-0.05	-0.04	-0.09	219	0.07	2007	-0.01	0.00	-0.03	174	0.01	0.02	*
CR51	1733061.96	6452361.84	975.99	-0.07	-0.02	-0.26	193	0.08	2007	-0.02	-0.01	-0.08	217	0.02	0.03	*
CR53	1732780.16	6450224.07	780.59	-0.11	-0.13	-0.13	228	0.17	2012	-0.03	-0.02	-0.04	224	0.04	0.02	
FT06	1729852.81	6452759.64	487.63	-2.80	-0.57	-1.43	192	2.85	2007	-0.51	-0.10	-0.25	191	0.52	0.02	
FT08	1729388.64	6453350.51	658.39	-0.04	0.00	-0.05	177	0.04	2007	-0.01	0.01	-0.02	120	0.01	0.02	*
FT09	1729052.90	6454289.27	590.86	0.00	-0.03	0.03	270	0.03	2020	-0.02	0.00	0.02	192	0.02	0.03	*
KC02	1727001.65	6452118.63	13.76	-1.24	-0.36	-0.08	196	1.29	1995	-0.21	-0.04	0.02	191	0.21	0.02	
KC05	1727081.52	6453178.62	227.46	-0.48	-0.47	-0.40	224	0.67	1994	-0.09	-0.06	-0.02	214	0.11	0.02	
KC06	1727784.64	6453395.62	299.61	-0.27	-1.04	-0.74	256	1.08	1994	-0.05	-0.14	-0.05	251	0.15	0.02	
KC07	1727759.37	6453683.87	313.48	0.18	-0.05	-0.35	345	0.18	1994	-0.01	-0.01	0.02	207	0.02	0.02	*
KC13	1726580.64	6453069.49	191.06	-0.52	-0.15	-0.14	196	0.54	2007	-0.09	-0.02	-0.02	194	0.09	0.03	
KC14	1726742.40	6453805.89	260.07	-0.04	-0.16	0.13	256	0.16	2007	-0.02	-0.02	0.05	225	0.03	0.02	
KC15	1727589.88	6453120.45	286.84	-0.58	-0.65	-0.26	228	0.87	2007	-0.10	-0.11	-0.05	230	0.15	0.03	
KC16	1727602.23	6454098.23	327.23	-0.01	0.00	0.33	180	0.01	2007	0.00	-0.01	0.00	268	0.01	0.02	*
KC17	1727302.30	6453026.06	215.07	-0.46	-0.36	-0.18	218	0.59	2012	-0.11	-0.09	-0.05	222	0.14	0.02	
KC18	1727999.94	6452621.91	291.18	-0.56	-0.25	0.00	205	0.61	2019	-0.34	-0.14	-0.03	203	0.36	0.02	
PB04	1727658.52	6448846.77	164.93	-17.41	-4.96	-5.59	196	18.11	1994	-0.76	-0.28	-0.16	200	0.81	0.02	
PB06	1727929.03	6449757.10	176.38	-39.41	-4.74	-6.68	187	39.70	1995	-0.57	-0.17	-0.09	197	0.60	0.02	
PB07	1728127.00	6450210.32	197.14	-48.93	-9.44	-3.07	191	49.83	1995	-0.66	-0.19	0.12	196	0.69	0.03	
PB08	1728191.52	6450461.30	194.35	-45.99	-8.49	0.67	190	46.77	1994	-0.61	-0.20	-0.02	198	0.64	0.03	
PB09	1728235.93	6450847.99	187.44	-52.65	-3.04	-5.08	183	52.74	1994	-0.72	-0.13	-0.11	190	0.73	0.03	
PB12	1728239.82	6451578.60	180.96	-90.67	-25.97	-12.33	196	94.32	1994	-0.96	-0.34	-0.19	200	1.02	0.02	
PB13	1728031.84	6452143.23	205.95	-54.13	-21.11	-4.59	201	58.10	1995	-0.72	-0.29	-0.05	202	0.78	0.03	
PB18	1730428.88	6450719.61	362.48	-18.00	8.61	-5.10	154	19.95	1995	-0.45	-0.06	-0.10	187	0.46	0.03	
PB20	1728728.36	6451121.02	229.44	-84.41	-14.65	-14.10	190	85.68	1995	-0.89	-0.27	-0.15	197	0.93	0.03	
PB21	1729233.10	6451178.81	271.16	-65.12	6.76	-8.86	174	65.47	1995	-0.71	-0.12	-0.15	189	0.72	0.03	
PB26	1729536.17	6452251.68	282.69	-26.48	2.12	-2.65	175	26.56	1995	-0.55	-0.11	-0.11	191	0.56	0.04	
PB27	1729228.88	6451841.91	268.86	-110.46	5.84	-15.57	177	110.61	1995	-0.89	-0.18	-0.17	191	0.91	0.03	
PB29	1728830.44	6452088.62	167.36	-58.51	-31.87	-18.57	209	66.63	1995	-0.77	-0.31	-0.23	202	0.83	0.03	
PB54	1729688.72	6450447.96	357.61	-6.18	-0.73	-1.01	187	6.22	1997	-0.48	-0.10	-0.06	192	0.49	0.03	
PB55	1728766.14	6450800.31	238.20	-46.14	-3.73	-8.13	185	46.29	1998	-0.73	-0.14	-0.10	191	0.75	0.04	
PB59	1727748.35	6448657.49	155.17	-18.01	-4.17	-8.22	193	18.49	2001	-0.92	-0.26	-0.26	196	0.95	0.03	
PB67	1727590.28	6450852.41	69.09	-48.45	-5.76	-6.93	187	48.79	2014	-1.76	-0.26	-0.28	189	1.78	0.03	
PB68	1727661.01	6448982.22	171.82	-4.43	-0.77	-1.29	190	4.50	2015	-0.69	-0.22	-0.12	198	0.73	0.03	
PB69	1727778.37	6448776.79	163.31	-4.67	-1.80	-1.37	201	5.01	2015	-0.75	-0.29	-0.11	201	0.81	0.03	
PB70	1727850.99	6448617.67	152.40	-3.92	-1.92	-3.84	206	4.37	2015	-0.63	-0.34	-0.28	208	0.71	0.03	
PB71	1728463.63	6449712.76	287.10	-1.08	-0.27	-0.21	194	1.12	2019	-0.54	-0.13	-0.15	193	0.55	0.03	
UB02	1727502.60	6450144.38	62.64	-78.52	10.59	-4.51	172	79.23	1997	-0.82	-0.03	0.02	182	0.82	0.03	
PVE3RP	1729195.88	6438764.67	346.88	-0.01	-0.01	0.00	240	0.01	2015	-0.01	0.00	0.02	184	0.01	0.02	Check

ACTIVE POINT LIST - PORTUGUESE BEND LAND SLIDE MONITORING - Updated 10/05/2021

MCGEE SURVEYING CONSULTING

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
11/01/19	68 Points Surveyed; Set KC18, PB71; 34 Points Surveyed in Feb. 2020 and 35 in April 2020
09/24/20	68 Points Surveyed; Set AB73, FT09; 34 Points Surveyed in Feb. 2021 and 32 in April 2021
09/28/21	67 Points Surveyed; 39 Points Surveyed in Feb. 2022 and 39 in April 2022

Pt ID	PM	Comments	Pt ID	PM	Comments
AB01		Original Base Station 1994-2006	KC02		
AB02	*	Station Fixed for Position 2019	KC05		
AB04	*		KC06	*	
AB05			KC07	*	
AB13	% *		KC13	*	
AB16	% *		KC14		Raised 0.19' by others 11/2018
AB17	% *		KC15		
AB20	% *	Former Base Station	KC16	*	Raised 0.29' by others 10/2016
AB24	% *		KC17	*	
AB50	*		KC18		Oct. 2019 Replacement for KC01
AB51	%		PB04	* #	
AB53			PB06	#	
AB57			PB07	#	
AB58	% *		PB08	#	
AB59	*		PB09	#	
AB60	*		PB12	* #	
AB61	*	Check Point, Former Base Station 2007+	PB13	* #	
AB62			PB18	% *	
AB63			PB20	#	Using southerly of 2 monuments 5.3' apart
AB64			PB21	% #	
AB65	*		PB26	% *	
AB66	%		PB27	#	
AB67	*		PB29	#	
AB68	*		PB54	%	
AB70	% *	Replaced AB12 - 2019	PB55	% * #	
AB71		Replaced AB56 - 2016	PB59	* #	
AB73	*	Present Base Station - Set April 2020	PB67	* #	
CR07	*		PB68	* #	
CR50	*		PB69	* #	
CR51			PB70	* #	
CR53			PB71		Oct. 2019 Replacement for PB65
FT06	*		UB02	#	
FT08			PVE3RP	*	Reference to CGPS Sta. PVE3 - Check Point
FT09	* #	Apr. 2020 Replacement for FT07			

*** Monitored Points included in the February and April Partial Monitoring; # Single Occupied and verified by deflection analysis**

% Monitored Points with Obstructed Sites

MONITORING POINT MONUMENT NOTES & STATUS

2007: From 1994 to 2006, 149 monitoring points were established by others to monitor the Portuguese Bend Landslides, many of which have been 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 by MSM 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 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 uphill 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 SHIELDS" S31°W 1.48 feet from the 1" IP used on the 2005 and prior surveys. This explained the erroneous uphill movement. On the initial MSC September 2007 survey and all subsequent surveys MSC used the 1" IP for consistency. The original 1994 position of the KC01 brass cap was re-referenced to the 1" IP, resulting in correct overall movements.

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) 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. Between 2018 and 2019 a miss-labeled steel covered vault (easterly of two vaults) was placed over the pipe.

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 encased 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 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 2015, PB64 was monitored for the last time due to conditions of unsafe access 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. In September, two new points AB69 located about 260' NE and AB70 located about 150' SE of AB12 were set as potential replacements for AB12. AB69 was destroyed by lot improvements and AB70 proved to be too obstructed for accurate results. In 2019, with improvements in GPS technology, AB70 replaced AB12.

2015: In April, new points PB68, PB69 and PB70 were set to monitor movements in the sag 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 Dr. Movement was reported for the first time in October 2017. Between the October 2016 1st & 2nd monitoring occupations, KC16 was raised about 0.29' to the surface of the road and replaced with a brass pin by others.

2018: On 11/15/17, KC14 was raised 0.19' to the surface of the road and replaced with a brass pin by others. PB25 was deleted from the monitoring since PB26 nearby provides the similar movement information.

2019: AB12 was difficult to access because it is buried in a horse corral on private land. AB70 was set in 2015 in the cul-de-sac at the southeast end of Figtree Road potentially to replace AB12. The introduction of new technology with the GS18T GNSS Receiver in January 2019 facilitated accurate measurements on moderately obstructed AB70 and therefore

replaced AB12. The difference in the measured movements of AB12 and AB70 between April 2015 and May 2019 differed by 0.03' north and 0.01' east indicating AB70 is a proper substitute for AB12 going forward. PB65 was not found apparently removed by road construction prior to October 2019. Point PB71, a cotton spindle was set the in the AC pavement as a nearby replacement for PB65. In October, KC18 was set about 500 feet south-southeasterly of KC01 as a replacement to avoid 600 feet of annual habitat clearing for access. Movements were reported for PB71 and KC18 in the spring of 2020.

2020: AB20 is in a semi-public location and may be lost if the bluff collapses. Therefore, in February 2020 a new point AB72 was set on the US Pony Club property as an alternate base station location for AB20. At the request of the US Pony Club, AB72 was destroyed and on April 29, 2020 a found 2" GIP/cap was taken as point AB73 for a new base station at the top of the hill about 300' northeast of Palos Verdes Drive South. In April, a new point FT09 was set as a replacement for FT07 to eliminate 300' of off-trail habitat damage. At KC02, a vault with a heavy steel cover has been placed over the monument by others (note KC02 is under the easterly of two vault covers marked "WELL" not the one marked "KC02").

2021: Note, PB20 moved 1.64' between 1995 and October of 2018 averaging 0.12' annually and moved 1.43' between October 2018 and September 2021 averaging 0.48' annually. Other points exhibited similar 4x-7x accelerated movements.

MONITORING POINT MONUMENT DESCRIPTIONS

For the NAD83 (2007) Epoch 2007.00 California State Plane Coordinates Zone 5 and
NAVD88 Heights see the attached file "PB MOVEMENT DATA POSTING 2007-202#.#.xlsx"

Point	Description
AB01	Punched 1/2" GIP in meter box (original pre-2007 Base Station)
AB02	4" BC "SAN PEDRO 1936" on conc. block
AB04	BC "CO ENG STA Q2.." on 2"GIP in mass of conc.
AB05	BC "CO ENG STA Q3.." on 2"GIP in mass of conc.
AB12	Brass Disc stamped "CO ENG STA 7A.." in mass of conc.
AB13	Punched 1/2" GIP in meter box
AB16	Punched 1/2" GIP in meter box
AB17	Punched 1/2" GIP in meter box
AB20	Brass Disc "CO ENG STA W. FIX 1956.." in mass of conc. (previous base)
AB24	Cotton spindle in conc. In road
AB50	Nail in conc. collar of well
AB51	Mag nail in plastic plug "LS6957" in 1"GIP
AB53	Chiseled + on s edge conc. Vault
AB56	2″ GIP destroyed by construction
AB57	6" mag nail & washer in conc. in 2"x 36" GIP
AB58	Punched RR spike on s side road
AB59	6" mag nail & washer in conc. in 2"x 36" GIP
AB60	6" mag nail & washer in conc. in 2"x 28" GIP
AB61	6" mag nail & washer in conc. in 2"x 24" GIP (previous base)
AB62	6" mag nail & washer in conc. in 1"x 24" GIP
AB63	Punched 1/2 x 48" rebar
AB64	2" mag nail on NE side 2' conc. Collar/Well B12
AB65	2" mag nail & washer in conc. in 1"x60" GIP (Destroyed prior to Survey)
AB66	1/2"x 24" punched rebar 1" below AC/collar
AB67	1/2"x 24" punched rebar 1" below AC/collar
AB68	1/2"x 24" punched rebar 1" below AC/collar
AB70	Mag nail and shiner in cul-de-sac at end of Figtree Rd.
AB71	Dimple on south side 2"screw & brass washer"PLS3945" on south side Vanderlip Dr.
AB73	Found 2″ IP with Brass Cap "CO ENGINEER RE5869 1975″ up 0.8′ on point of hill (New Base Apr.2020)
AB73RP	1″ PK Nail set in NE corner concrete base for bench for Reference Point and Check Point to AB73
CR07	6" mag nail & washer in conc. in old 1" IP
CR50	Tack & shiner on lower rock wall
CR51	Tack & shiner on conc. pad
CR53	2" mag nail & washer in conc. in 1"x 60" GIP
FT06	6" mag nail & washer in conc. in 2"x 36" GIP
FT07	6" mag nail & washer in conc. in 2"x 36" GIP
FT08	6" mag nail & washer in conc. in 2"x 36" GIP
FT09	1″ x 3′ GIP with Alum. Cap "MCGEE PLS3945″ 10′ east of trail
KC01	6" mag nail & washer in conc. in old 1" IP
KC02	Punched 1/2" GIP in meter box
KC05	Punched 1/2" GIP in meter box
KC06	Punched 1/2" GIP in meter box
KC07	Punched 1/2" GIP in meter box
KC13	Cotton spindle in AC turnout
KC14	Brass pin & washer "LS8773" set above spike in CL
KC15	Cotton spindle in cul-de-sac
KC16	Brass pin & washer "LS8773" set above spike in Xn
KC17	2" mag nail & washer in conc. in 1"x 50" GIP
KC18	2″ Mag nail in 1"x 36" GIP set over a ½″ x 4′ rebar 9′ south of road
PB04	Nail & tag "RCE26120" in conc. in 3" pipe
PB06	Punched cap on 2" GIP
PB07	Brass tag "LA CO DPW" in conc. in 2" GIP
PB08	Punched cap on 2" GIP
PB09	Punched cap on 2" GIP in cable box
PB12	Punched cap on 2" GIP in cable box
PB13	Punched cap on 2" GIP in cable box
PB18	Punched 1/2" GIP in meter box
PB20	Punched cap on 2" GIP in cable box
PB21	Punched cap on 2" GIP in cable box
PB26	Brass tag "LA CO DPW" in conc. in 2" GIP
PB27	Punched cap on 2" GIP in cable box
PB29	Brass tag "LA CO DPW" in conc. in 2" GIP
PB54	Mag Nail in plastic plug "LS6957" in 1"GIP
PB55	Mag Nail in plastic plug "LS6957" in 1"GIP
PB59	PK mag nail in plastic plug "LS?" in 1" GIP
PB65	2"alum.cap "PLS3945" on 5/8"x 24"rebar in AC destroyed prior to Oct. 2019

PB67	1/2" x 3' rebar on 5′ x 20′ mound
PB68	2" Alum Cap "PLS3945" in 1"x 30" GIP S side of PVDS
PB69	2" Alum Cap "PLS3945" in 1"x 30" GIP N side of PVDS
PB70	2" Alum Cap "PLS3945" in 1"x 30" GIP N side of PVDS
PB71	Cotton spindle in pavement
UB02	Mag Nail in plastic plug in 1"GIP
PVE3RP	Mag Nail in SW Corner Conc. Base of CGPS station PVE3 for Reference Point

Addendum No. 1
Monitoring Survey No. M32 Report
Portuguese Bend Landslide Monitoring
February 8, 2022 Partial Monitoring Survey

Addendum No. 1: Report on the second of three annual Portuguese Bend Monitoring Surveys (M32). The average date of the field survey is February 8, 2022. This partial survey included 38 points which are a sub-set of the monitoring network. A minimally constrained adjustment was processed to develop NAD83 (2007) Epoch 2007.00 CA State Plane Coordinates and NAVD88 Heights. The estimated vector horizontal (2D) residuals at unobstructed sites averaged 0.007 feet with a Standard Deviation of 0.005 feet and a Range of 0.000 to 0.018 feet. The estimated absolute value of the vertical residuals averaged 0.010 feet with a Standard Deviation of 0.009 feet and a Range of -0.030 to +0.031 feet. At the 95% Level of Confidence, the horizontal (2D) movements reported below attained an estimated accuracy of 0.02 feet. The adjustment fixed AB02 and checked to AB61 and PVE3RP as shown below confirming the successful recovery of a stable reference frame (coordinate system). Differences from the known fixed positions to measured positions in this survey are listed here with their north, east and vertical components in feet.

Differences in Feet

ID	dN	dE	dZ	
AB02	0.000	0.000	0.000	Fixed
AB61	-0.008	0.009	0.052	Stable Check Point on Portuguese Point
PVE3RP	-0.007	-0.016	0.023	Stable Check Point at City Hall

Addendum No. 2
Monitoring Survey No. M33 Report
Portuguese Bend Landslide Monitoring
April 26, 2022 Partial Monitoring Survey

Addendum No. 2: Report on the third of three annual Portuguese Bend Monitoring Surveys (M33). The average date of the field survey is April 26, 2022. This partial survey included 38 points which are a sub-set of the monitoring network. A minimally constrained adjustment was processed to develop NAD83 (2007) Epoch 2007.00 State Plane Coordinates and NAVD88 Heights. The estimated vector horizontal (2D) residuals at unobstructed sites averaged 0.006 feet with a Standard Deviation of 0.003 feet and a Range of 0.001 to 0.013 feet. The estimated absolute value of the vertical residuals averaged 0.010 feet with a Standard Deviation of 0.006 feet and a Range of -0.026 to 0.012 feet. At the 95% Level of Confidence, the horizontal (2D) movements reported below attained an estimated accuracy of 0.02 feet. The adjustment fixed AB02 and checked to AB61 and PVE3RP, 0.01 feet or less confirming the successful recovery of a stable reference frame (coordinate system) as shown here. Differences from the known fixed positions to measured positions in this survey are listed here with their north, east and vertical components in feet.

Differences in Feet

ID	dN	dE	dZ	
AB02	0.000	0.000	0.000	Fixed
AB61	0.002	-0.006	0.022	Stable Check Point on Portuguese Point
PVE3RP	0.003	-0.024	-0.011	Stable Check Point at City Hall

The Field Surveys, Equipment, Data Collection and Network Design were as described the above Reporting for 2020-2021. Winter and Spring Horizontal (2D) and Vertical Movements are summarized in the “Periodic Horizontal & Vertical Movement in Feet” table below. The Direction of Movemnet is generally south to south-southwest. See “PB MOVEMENT DATA POSTING 2007-20##.xlsx” for the actual direction.

"Partial Monitoring" Movements
Periodic Horizontal & Vertical Movements in Feet

	Sept. 28, 2021 (M31) to Feb. 8, 2022 (M32) = 4.4 mo			Feb. 8, 2022 (M32) to Apr. 26, 2022 (M33) = 2.5 mo			Sept. 28, 2021 (M31) to Apr. 26, 2022 (M33) = 6.9 mo	
Monitoring Point	**Movement Distancs**	**Elevation Change**		**Movement Distance**	**Elevation Change**		**Movement Distance**	**Elevation Change**
AB02	0.00	0.00		0.00	0.00		0.00	0.00
AB04	0.37	-0.02		0.18	-0.06		0.55	-0.08
AB13	0.19	-0.02	*	0.10	-0.10		0.29	-0.11
AB16	0.08	0.05	*	0.05	-0.06		0.07	-0.01
AB17	0.02	0.08	*	0.03	-0.06		0.00	0.02
AB20	0.20	0.05		0.11	-0.04		0.31	0.01
AB24	0.16	0.03		0.07	-0.02		0.23	0.01
AB50	0.12	0.04		0.08	-0.02		0.20	0.03
AB58	0.17	0.01	*	0.08	-0.04		0.25	-0.03
AB59	0.22	-0.01		0.11	-0.05		0.32	-0.05
AB60	0.19	0.03		0.08	-0.05		0.26	-0.02
AB61	0.01	0.05		0.01	0.02		0.01	0.02
AB65	0.11	0.02		0.03	-0.06		0.14	-0.04
AB67	0.09	0.01		0.03	0.00		0.10	0.01
AB68	0.15	0.00		0.04	-0.04		0.18	-0.04
AB70	0.18	0.02		0.13	0.05		0.29	0.07
AB73	0.17	0.01		0.09	-0.03		0.26	-0.02
CR07	0.15	0.03		0.03	-0.11		0.17	-0.08
CR50	0.01	0.11		0.04	-0.03		0.03	0.08
FT06	0.24	-0.04		0.10	-0.06		0.34	-0.11
FT09	0.01	0.10		0.03	-0.08		0.03	0.02
KC06	0.06	0.00		0.05	-0.03		0.10	-0.03
KC07	0.02	0.02		0.02	0.00		0.01	0.02
KC13	0.05	0.04		0.02	-0.01		0.04	0.03
KC16	0.01	0.03		0.03	-0.01		0.02	0.02
KC17	0.05	0.01	*	0.03	-0.02		0.07	-0.02
PB04	0.32	-0.02		0.16	-0.07		0.48	-0.09
PB12	0.39	-0.05		0.17	-0.03		0.56	-0.09
PB13	0.30	0.01		0.12	-0.01		0.42	0.00
PB18	0.25	0.00	*	0.11	-0.08		0.36	-0.08
PB26	0.25	0.05		0.13	-0.02		0.37	0.03
PB55	0.34	-0.02	*	0.08	-0.09		0.42	-0.11
PB59	0.42	-0.07		0.20	-0.09		0.62	-0.16
PB67	0.57	-0.10		0.31	-0.07		0.88	-0.16
PB68	0.31	0.00		0.14	-0.08		0.45	-0.08
PB69	0.34	-0.03		0.17	-0.06		0.51	-0.09
PB70	0.28	-0.12		0.15	-0.09		0.43	-0.20
PVE3RP	0.02	0.02		0.02	-0.01		0.02	-0.01

Note: Movements greater than 0.02 feet (1/4") are deemed to have moved. See attached "PB MOVEMENT DATA POSTING" for a details.

Note: * Indicates substantially obstructed sites.

RECOMMENDATION

Re-locating monuments, or brush clearing and tree trimming sites results in improved accuracy and production due to improved sky visibility for tracking satellites. Points AB13, AB16, AB17, AB51, AB58 and PB18 have limited sky visibility due to surrounding trees and would benefit from annual tree trimming although trimming is not always a viable option. Fortunately, improvements in GNSS (GPS) instrumentations and constellations have helped mitigated these issues.

SURVEYOR'S STATEMENT

This is the 2021-2022 Report on the procedures, criteria and results of the City of Rancho Palos Verdes Portuguese Bend Landslide Monitoring Surveys. This survey was performed, and this Report prepared by me May 11, 2022 at the request of Ron Dragoo, Principal Engineer of the City of Rancho Palos Verdes.

Michael R. McGee, PLS3945