CITY OF RANCHO PALOS VERDES
ADMINISTRATION DEPARTMENT
CITY MANAGER'S OFFICE

March 17, 2025

Via email and Grants Portal

Mr. Robert Fenton
FEMA District No. 9 Administrator

Robert Larsen, Public Assistance Officer
California Office of Emergency Services

Subject: Appeal of FEMA's Eligibility Determination, Project Number 753361
FEMA-4769-DR-CA, California's Severe Winter Storms, Tornadoes, Flooding, Landslides, and Mudslides (Damage Inventory No. 1386231)

Dear Messrs. Robert Fenton and Robert Larsen,

On April 13, 2024, the President declared a major disaster (**FEMA-DR-4769-CA**) in the State of California due to damages from severe winter storms, tornadoes, flooding, landslide and mudslides with an incident period of **January 31 through February 9, 2024**. The declared disaster by the President is similar to a federal disaster declared on April 3, 2023 for California Severe Winter Storms, Straight-Line Winds, Flooding, Landslides and Mudslides that occurred between **February 21, 2023 and July 10, 2023 (DR-4699-CA)**.

On May 9, 2024, the City of Rancho Palos Verdes (City) filed for disaster aid cost recovery for the City's response to the 2024 winter storms. In total, the City filed applications totaling $38.4 million.

On January 17, 2025, the City received FEMA's Eligibility Determination Memorandum **denying** in full the City's request for $5,375,000 to conduct roadway repairs to Palos Verdes Drive South damaged by the winter storms that occurred between January 31 and February 9, 2024. The denial cites the following reasons:

- Pre-disaster ground instability and on-going non-disaster related causes.
- Disaster damage was not a result of the declared disaster event.
- Pre-existing conditions of landslide.
- Roads are ineligible because of another Federal Agency is legally responsible.

According to Section 102.1 and 102.2 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, an "Emergency" means *any occasion or instance for which, in the determination of the President, Federal assistance is needed to supplement State and local efforts and capabilities to save lives and to protect property and public health and safety, or* ***to lessen or avert the threat of a catastrophe (emphasis added)*** *in any*

part of the United States. Moreover, a "Major Disaster" *means any natural catastrophe (including any hurricane, tornado, storm, high water, winddriven water, tidal wave, tsunami, earthquake, volcanic eruption,* ***landslide (emphasis added)****, mudslide, snowstorm, or drought), or, regardless of cause, any fire, flood, or explosion, in any part of the United States, which in the determination of the President causes damage of sufficient severity and magnitude to warrant major disaster assistance under this Act to* ***supplement the efforts and available resources of States, local governments, and disaster relief organizations in alleviating the damage, loss, hardship, or suffering caused thereby (emphasis added)****.*

The City's disaster recovery request was submitted to FEMA based on the aforementioned definitions found in the Stafford Act and the declared major disaster resulting from winter storms of 2024 that **contributed to a significant and documented acceleration of land movement caused by the activation of a <u>new</u> historic and previously dormant landslide known as the Altamira Landslide** within the Greater Portuguese Bend Landslide Complex (Landslide Complex).

According to the City Geologist's reports to the City Council in 2024, the **Altamira Landslide is a deeper slip plane that the Landslide Complex "rafted" on top of as a direct result of the unprecedented and record rainfall during the 2024 winter storm event resulting in the shallower slip plane of the Landslide Complex to move more than it ever did before in its documented history**. Contrary to FEMA's Eligibility Determination Memorandum, what is **not pre-existing** are the areal dimensions, depth of movement, velocity of movement, artesian and near-artesian groundwater pressures beneath it, and even direction of movement. The land movement experienced as a result of the 2024 winter storms is not just a simple **expansion** of the Landslide Complex, but is an **entirely different, larger and deeper landslide with much broader boundaries** (including the new coastline offshore at the Portuguese Bend Beach Club), nearly twice as deep in some areas, and unprecedented rates of movement. None of this was seen during the history of the City, nor during the approximately 70-year history of landslide studies, monitoring, and observations conducted in the area, contrary to what is noted in the Eligibility Determination Memorandum. It is the opinion of the City and its subject matter experts, that will be discussed in this appeal letter, that this is largely caused by "weather whiplash" (induced by climate change) starting in 2011.

The City respectfully requests that you, as FEMA's District No. 9 Administrator, reverse the eligibility denial and uphold the City's appeal based on facts, data and other pertinent information found in this appeal letter that will clearly demonstrate that a new landslide was activated causing an acceleration of land movement as a direct result of the 2024 winter storms resulting in costly and significant damage to the City's infrastructure. The City firmly believes that this **appeal letter** will demonstrate that the requested cost recovery work complies with Title 44 of C.F.R. Section 206.223(a)(1) in that the financial assistance requested is directly related to the winter storms of 2024. As such, the City is requesting **$5,375,000** to conduct roadway repairs to Palos Verdes Drive South damaged by the winter storms that occurred between January 31 and February 9, 2024.

Historic Background

As noted in the January 17, 2025 Eligibility Determination Memorandum and throughout various City records, the Landslide Complex is a known ancient landslide that was activated in 1956 when, prior to the City's 1973 incorporation, Los Angeles County was expanding Crenshaw Boulevard to Palos Verdes Drive South and its grading efforts combined with ground water, activated the Portuguese Bend Landslide. Land movement has not stopped since 1956 but has been managed at a slow creep to no movement for years through remediation efforts implemented by the City and its two geologic hazard abatement districts, Abalone Cove Landslide Abatement District (ACLAD) and Klondike Canyon Landslide Abatement District (KCLAD).

The Landslide Complex, historically existing for thousands of years, encompasses the following four sub-landslide areas in the City: the Portuguese Bend Landslide (PBL), the Abalone Cove Landslide (ACL), the Klondike Canyon Landslide (KCL), and the Beach Club Landslide (BCL). As noted above, in 1956, the PBL began moving, then in 1979, ACL and KCL began moving with the BCL, which is nested within the KCL and, while dormant itself, moves with the KCL. The Landslide Complex also includes areas outside of those known landslides, predominantly uphill from the PBL and ACL, within the ancient Landslide Complex as mapped by various agencies (i.e., U.S. Geological Survey and California Geological Survey) and other researchers. This fifth landslide is in the City of Rolling Hills and is known as the Flying Triangle Landslide.

According to a November 8, 2024 report prepared by the City Geologist, Mike Phipps of Cotton Shires and Associates (CSA) (Attached), the PBL has been continuously active since reactivation in 1956 with many areas of the landslide having moved hundreds of feet seaward over the ensuing seven decades. The ACL was active from 1979 **until the late 1990's**, involving only several feet of movement, when dewatering and other mitigation efforts largely halted movement. An **imperceptible creep movement** of the ACL has occurred over the past 25 years **following rainy seasons that were significantly above average rainfall amounts.** The KCL has been episodically active in 1979-1983 and 2005-2006, experiencing only several inches of movement, typically in response to significantly above average rainfall. Landslide movements throughout the Landslide Complex **outside of the historical boundaries of** the ACL and PBL previously exhibited low rates of creep movement, or movement at or near the instrument precision range, in the 11-year monitoring period of 2007-2018.

Impacts of Rainwater

These landslides are deep translational-type failures within seaward-dipping strata of the Monterey Formation, with the landslide slip surfaces occurring within very weak bentonitic clay beds. Historically, the movement behavior of these landslides routinely exhibited high sensitivity to increased groundwater pore pressure, and increased rates of land

movement which have been **correlative with 6-to-12-months of antecedent rainfall that was well above average**. Similarly, land movement decreased during below average rainy seasons or multi-year periods of drought.

Simply stated, numerous studies conducted over approximately seven decades all point to water as being the primary contributor to land movement, particularly rainwater. Rainwater runoff is known to penetrate the ground through fissures during a rain event and recharge the ground water table. During particular significant rain events or seasons, runoff that enters the ground may take months to show signs of land movement. Depending on where rain runoff enters the ground, it can settle below the slip plane thereby resulting in artesian pressure or settle above the slip plane, which is made up of volcanic ash known as bentonite and lubricates the slip plane resulting in horizontal movement.

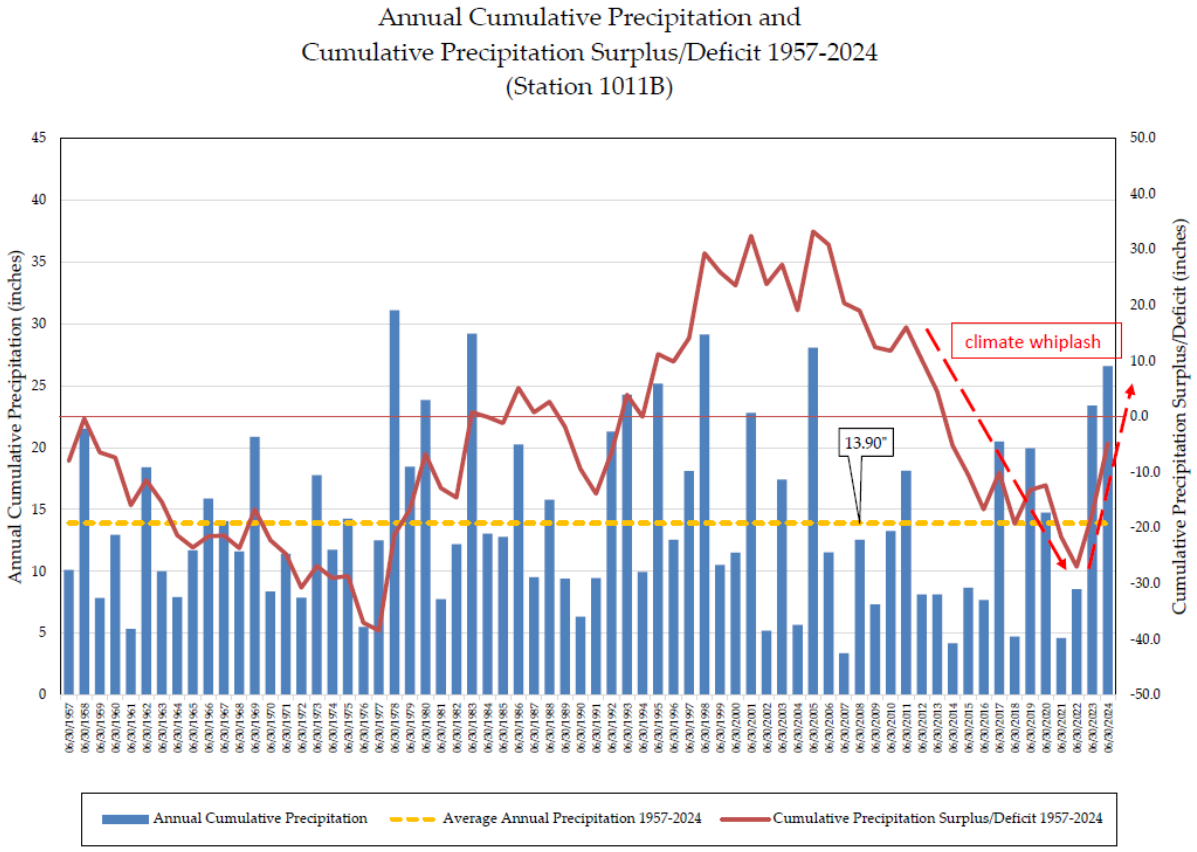
Changes in climate over the years, now commonly referred to as “weather whiplash” has resulted in extreme weather in Southern California including extended periods of dry weather followed by severe wet weather in the form of atmospheric rivers as experienced in 2023 and 2024. This extraordinary wet weather resulted in the President declaring a major federal disaster in both 2023 and 2024. Underscoring how extreme weather has become over the years, in August 2023, California, particularly Southern California, experienced days of record rain in August 2023 as a result of Tropical Storm Hillary.

Extreme wet weather patterns have proven to contribute towards the change in behavior of the Landslide Complex. Beginning in 2021, the City Geologist began reviewing Global Positioning Satellite (GPS) monitoring data for survey monuments within the entire Landslide Complex. Review of GPS monitoring data from 2007 through 2024 indicated that land movement acceleration initially began between 2018 and 2019. This acceleration was correlative with significantly above-normal rainfall in two out of three prior rainfall seasons (2016-17 and 2018-19) which followed five consecutive drier than normal rainfall seasons (2011-12 through 2015-16).

Another way to look at this is to analyze annual rainfall deviations from the mean, and tally up those cumulative deviations over time, as a measure of *precipitation* surplus/deficit that is impacting the area. According to the graphic on the following page, in which the dark red line shows the precipitation surplus/deficit over time, note the precipitous drop particularly from 2011-2022, which whipsaws back to a steep climb from 2022-2024. Weather whiplash is illustrated by the red arrows, showing the impact of the dry years (rapidly declining surplus/deficit curve) quickly reversing to a steep inclining surplus/deficit curve. It doesn't matter that this all happened in *deficit* territory on the graph, because it followed a two-decade long period of precipitation surplus. It is reasonable to say that two decades of precipitation surplus between 1991 and 2011 might have contributed to **strain-softening** of the Altamira failure surface clays, as the landslide imperceptibly crept and stretched out. It follows that this generally prolonged period of drying commencing in 2011, followed by a short, huge pulse of wetting between 2022-2024, is what **triggered** the massive previously inactive Altamira Landslide to move in

2024.

It is also worth noting that 8.29 inches of rain fell at the Rolling Hills Fire Station rain gauge during the 10-day FEMA disaster window. Keep in mind, the mean (average) for the 57-year rainfall data set is currently 13.88 inches/year and the standard deviation of the entire 57-year dataset is a whopping 7 inches/year, indicating very high variability in annual rainfall. In other words, more rain fell in the 10-day FEMA disaster window than the standard deviation for the entire 57-year rainfall data set. Underscoring that this wet weather behavior was an extraordinary event.



Significant accelerations in movement velocity were documented in May 2023 following major storm sequences in January, February and March of 2023, which added to cumulative seasonal rainfall totals exceeding 193% of average rainfall. Approximately 87% of this rain fell prior to June 18, 2023. Most of this rainfall occurred from three significant atmospheric river-type storm sequences occurring on January 9-16 (3.59 inches), February 23-March 1 (3.79 inches) and March 10-15 (4.12 inches). Land movement velocities further increased as of the July 15, 2023 monitoring. An anomalous tropical storm (Tropical Storm Hillary) dropped an additional 3.05 inches of rain on August 19 through August 20, 2023, resulting in further land movement acceleration as of the October 10, 2023 monitoring.

Furthermore, accelerated ground movement occurred throughout the Landslide Complex during and following the 2022-23 rainy season which was more than 220% of the historical average rainfall. Based upon the GPS monitoring survey on January 13, 2024, average land movement velocities within the Landslide Complex since October 10, 2023 have accelerated by a factor of three to four times compared to the previous 12 month (Oct 2022-Oct 2023) monitoring period. Expressed another way, the total movement over the 3 month period of October 2023 through January 2024 is nearly equal to, and in some cases exceeds, the total movement over the previous entire year's monitoring period (i.e., October 2022 through October 2023). Movement of this magnitude has not been previously observed or documented in the ancient landslide complex north of the historical boundaries of the ACL, PBL and KCL.

An example of this is highlighted by six GPS monitoring points in the upper ancient landslide area, in the vicinity of upper Narcissa Drive and uphill from it. These survey monuments have experienced average displacements of 4.07 feet over the past 15 months (3.26 feet on an annualized basis). Average displacements for these six points over the prior annual monitoring period (Sept 28, 2021-Oct 10, 2022) were 0.36 feet. This represents approximately a 9-fold increase in total land movement on an annualized basis. **Two GPS monitoring points near the toe of the Abalone Cove Landslide moved an average of 0.76 feet (Sept 2021-Oct 2022) to 7.30 feet (Oct 2022-Jan 2024) over the same periods, a 9.6-fold increase in displacement**.

Activation of the New Altamira Landslide

According to the City Geologist's Memorandum dated November 8, 2024 and March 16, 2025 (Attached), total landslide movements in the upper ancient landslide area are significant and greatly exceed what has been observed over the past seven decades. The Altamira Landslide is a **newly** active landslide that has occurred within a previously mapped ancient Landslide Complex (most recently labeled the "Ancient Altamira Landslide Complex" which was a name modification of the "Ancient Portuguese Bend Landslide" identified on the California Geological Survey's Landslide Inventory Map (CGS, 2007) which is referred to as the Landslide Complex in this appeal letter). See map on the following page.

It is important to make this distinction for consistency and to avoid confusion, because the Altamira Landslide is, in fact, a new member of the historically active Landslide Complex but largely **underlies it** and occupies an area of active land movement >700 acres and extends to more than 500 feet off of the coastline, whereas the shallower historically active Landslide Complex only occupied about 380 acres.

The Altamira Landslide in Rancho Palos Verdes is therefore a recently identified large landslide that largely underlies (and therefore largely encompasses but exceeds the area of) the previously understood active Landslide Complex containing the four historically active landslides. The Altamira Landslide includes large areas outside of the historically mapped boundaries of these known landslides, predominantly upslope and downslope

from the historically mapped PBL and ACL, within, but smaller than, the Landslide Complex as shown on the map on the following page.

To provide an example of the change in size, the dimensions from head to toe of the previously historical ACL is 2,250 feet and the width up to 1,450 feet wide. The dimensions from head to toe of the Altamira Landslide, underlying and extending up and down slope from both the PBL and the ACL, is 5,800 feet (more than double that of the ACL) with a width of up to 7,400 feet wide (more than five times as wide as the ACL).

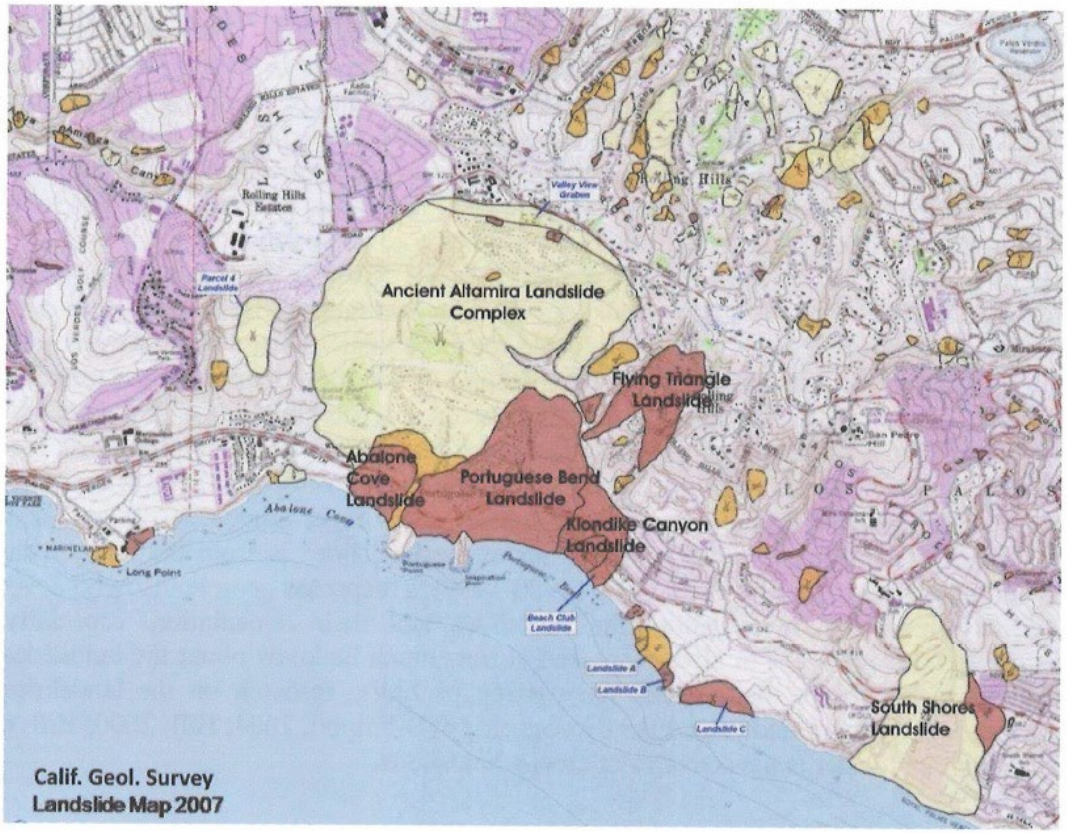


Figure 1. Landslide map of a portion of the south flank of the Palos Verdes Peninsula prepared by the California Geological Survey (2007). The major and some minor landslides are identified. Light yellow indicates that the landslide is inactive, red is active and orange is dormant.

While previous geotechnical investigators identified inactive deep failure surfaces in both the historically active and ancient landslide areas, none of them mapped or identified as active the entire depth or breadth of movement that has recently impacted the area, nor did they opine that such an event would occur in historic times. The areal dimensions, depth of movement, velocity of movement, artesian and near-artesian groundwater pressures beneath it, and even the direction of movement, are different than the ACL, PBL, and KCL landslides, collectively referred to as the Landslide Complex. The distinction to be made then, is that the Altamira Landslide is not just simple *expansion* of an existing group of landslides, **it is an entirely different, larger and deeper landslide**

with much broader boundaries (including the new coastline offshore), nearly twice as deep as the depth of historic landslide movement in some areas, and with unprecedented rates of movement (which were not seen in the early LA County Engineer surveys, the Charles Abbott Associates surveys beginning in 1994, nor the McGee surveys since 2007). None of this was experienced during the history of the City, and the Altamira Landslide is a unique landslide not characterized in its current dimensions during the over 70-year history of landslide investigations, exploratory borings, monitoring and observations being conducted in the area.

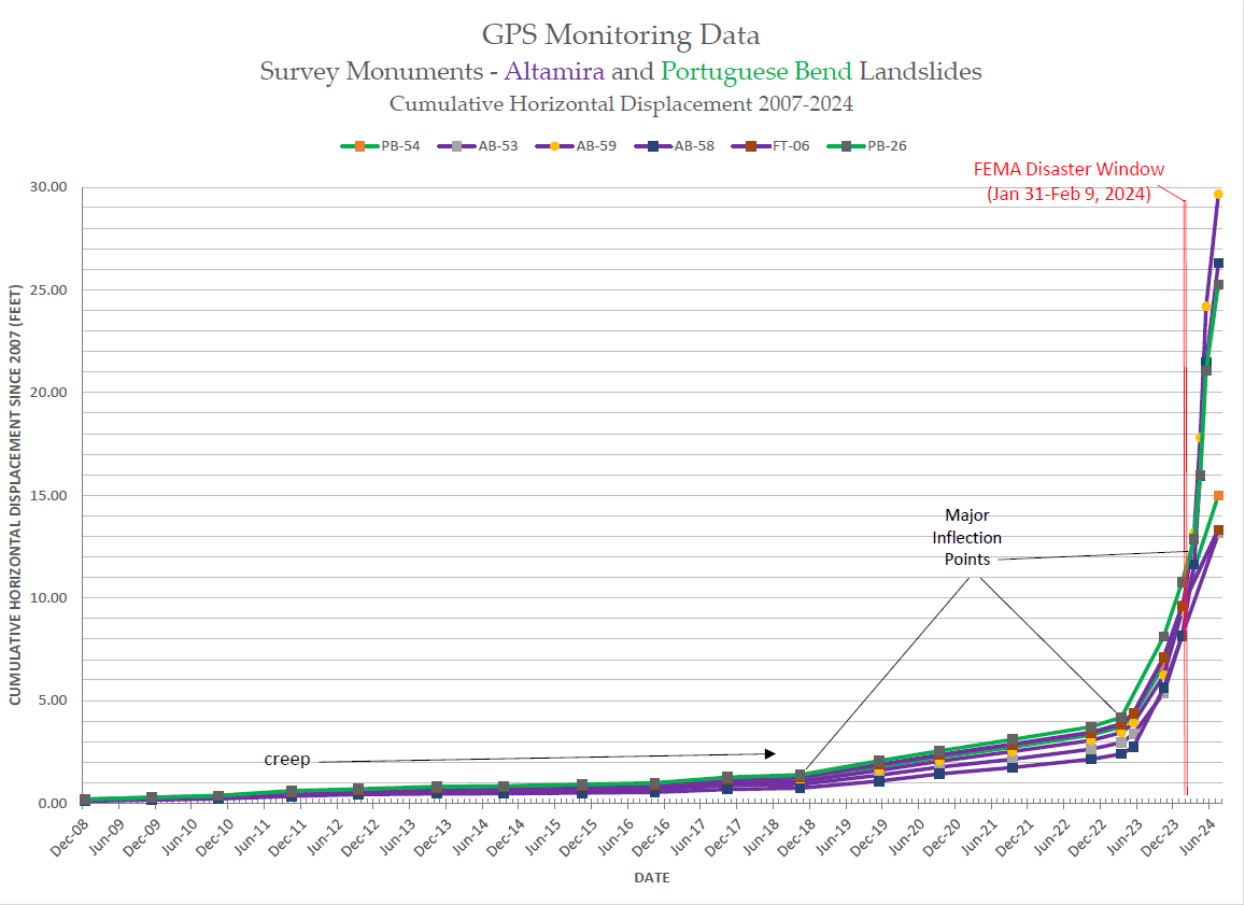
Land movement correlated to the Altamira Landslide continues to manifest at the ground surface in the form of landslide scarps, fissures, grabens/sinkholes, tensional cracking, and shear zones. Field mapping corroborates the GPS monitoring data, indicating that a large portion of the ancient Altamira Landslide above the historically mapped Landslide Complex (PBL, ACL and KCL boundaries) is now involved in significant active landslide movement that is impacting trails, roads, drainage facilities, and private property and continues to have the potential to impact above and below ground utility infrastructure (i.e., utility lines, gas lines, water lines, communication lines, etc.).

Causation

The activation of the Altamira Landslide was largely caused by "climate whiplash" (also more technically described as hydroclimate volatility) induced by climate change, particularly starting in 2011, with five years of drought, and eight out of eleven years significantly below normal rainfall from 2011-2022, followed by two consecutive extraordinarily heavy rain seasons that dropped approximately 4 feet of rainfall on the landslide and surrounding areas draining into the landslide on the south flank of the Palos Verdes Hills.

The graphic on the following page depicts *cumulative horizontal displacement* of select GPS survey monitoring points, including some of the fastest moving points in the Altamira Landslide and a couple of representative points in the PBL (which overlies the Altamira Landslide). There are three significant inflection points indicated in the graph. Prior to the first inflection point, the cumulative displacement lines indicate that the GPS monitoring points within the Altamira Landslide were creeping quite slowly (imperceptibly, near the range of instrument precision) for a number of years extending back before 2011. There was no observed or documented surface manifestation of this minor creep movement at the ground surface; however, this movement is believed to have caused deformation (elongation or stretching out of the earth materials comprising the subsurface which in turn causes additional fracturing of those earth materials) of the Altamira Landslide body, which increased secondary permeability within the rock mass allowing rainfall at the ground surface to percolate more readily into the deep subsurface, raising groundwater levels to a point where they result in high pore pressures that contribute to landslide movement. Between October 2018 and October 2019 GPS readings (first inflection point), an acceleration of creep movement is evident. Then following the multiple atmospheric river rains of January and February 2023 (second inflection point), a further acceleration

of creep movement is evident, which would have resulted in further stretching out and opening up of the landslide mass. The final inflection point around March, 2024 (immediately following the FEMA declared disaster of January 31-February 9 wherein 8.29 inches of rain fell) shows a dramatic acceleration and **represents the triggering of major movement of the Altamira Landslide**, as reflected by some of the graphed points going very steep and nearly vertical on the graph. The graph includes GPS monitoring point AB-59, which has been the fastest moving point and is not surprisingly located in the center of the entire Altamira Landslide mass.

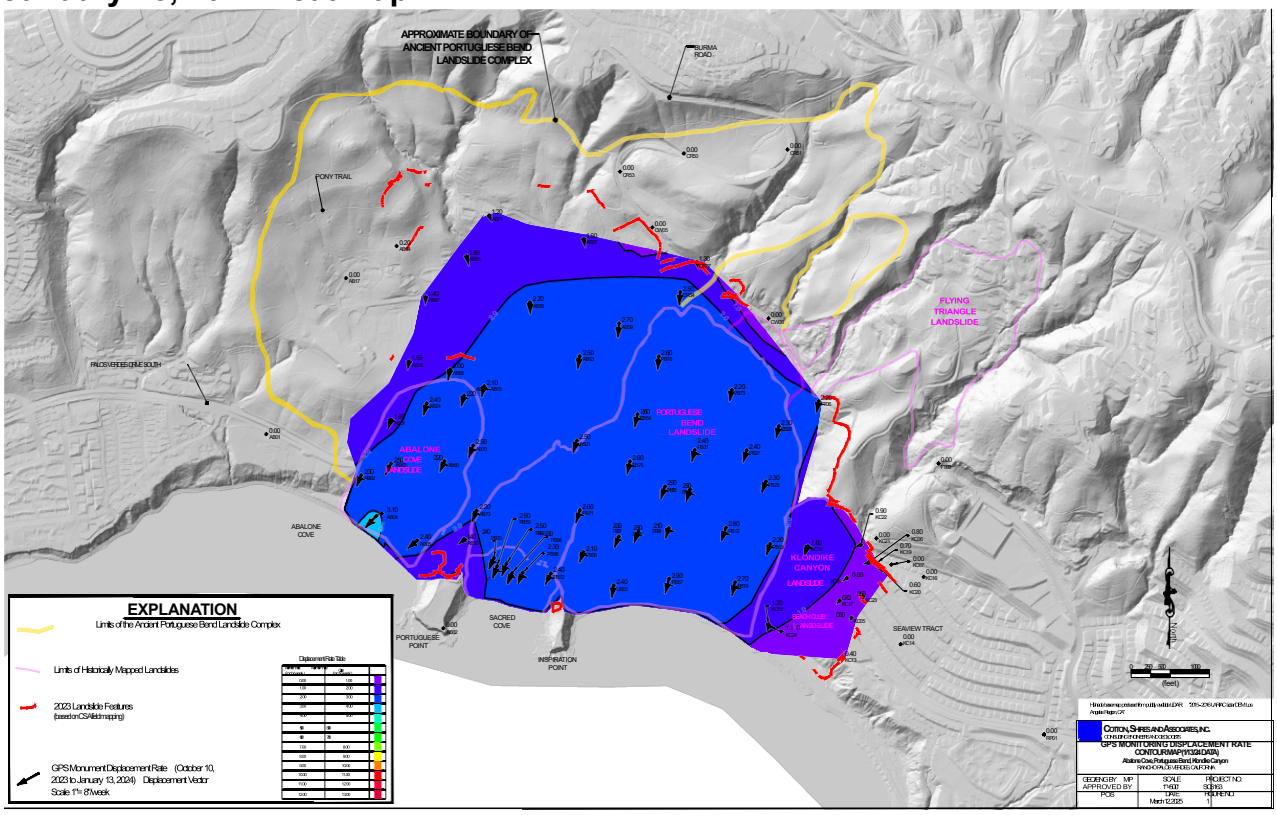


The change in ground movement rates before January 31 and after February 9, 2024 is significant. Based on a comprehensive review of the McGee GPS survey monitoring, the rates of Altamira Landslide ground movement in the Abalone Cove area (for points north of the previously active ACL) as of January 13, 2024 ranged from 1.2 inches per week (at the periphery) up to 2.7 inches per week (in the body of the landslide). After that intense period of rainfall, plus additional rainfall resulting in a total of over 11 inches in February, as of the GPS survey completed on March 8, 2024, the rates increased to 1.5 (at the periphery) to 5.9 (main body) inches per week, more than doubling in the body of the landslide, and then increased dramatically to as much as 13.5 inches per week in the body of the landslide by July 1, 2024, probably as a slightly delayed reaction to the rainfall as it took time for the water to convert from rainfall absorption to higher groundwater pore

pressures where it could have the greatest driving force impact on landslide movement.

The following graphics are “heat maps” that illustrate in color contours the rates at which the ground was moving based on the GPS survey monuments for January 13, 2024, March 8, 2024 and July 1, 2024, respectively. The heat maps include the City’s on-ground geologic mapping of visible land movement features, which started as tension cracks or narrow fissures that were discontinuous (as of December 2023 mapping and are shown on the January 13, 2024 heat map), but these features further developed into more continuous/connected tension cracks and fissures, which have now developed into large scarps, grabens and well-developed boundary features. It wasn’t until March 2024 that the City Geologist’s first drew a boundary (dashed green line) around the “Area of Major Land Movement”, because prior to that time, the surface manifestation of movement was poorly developed and inconsistent and there was not sufficient development of the landslide to develop a boundary.

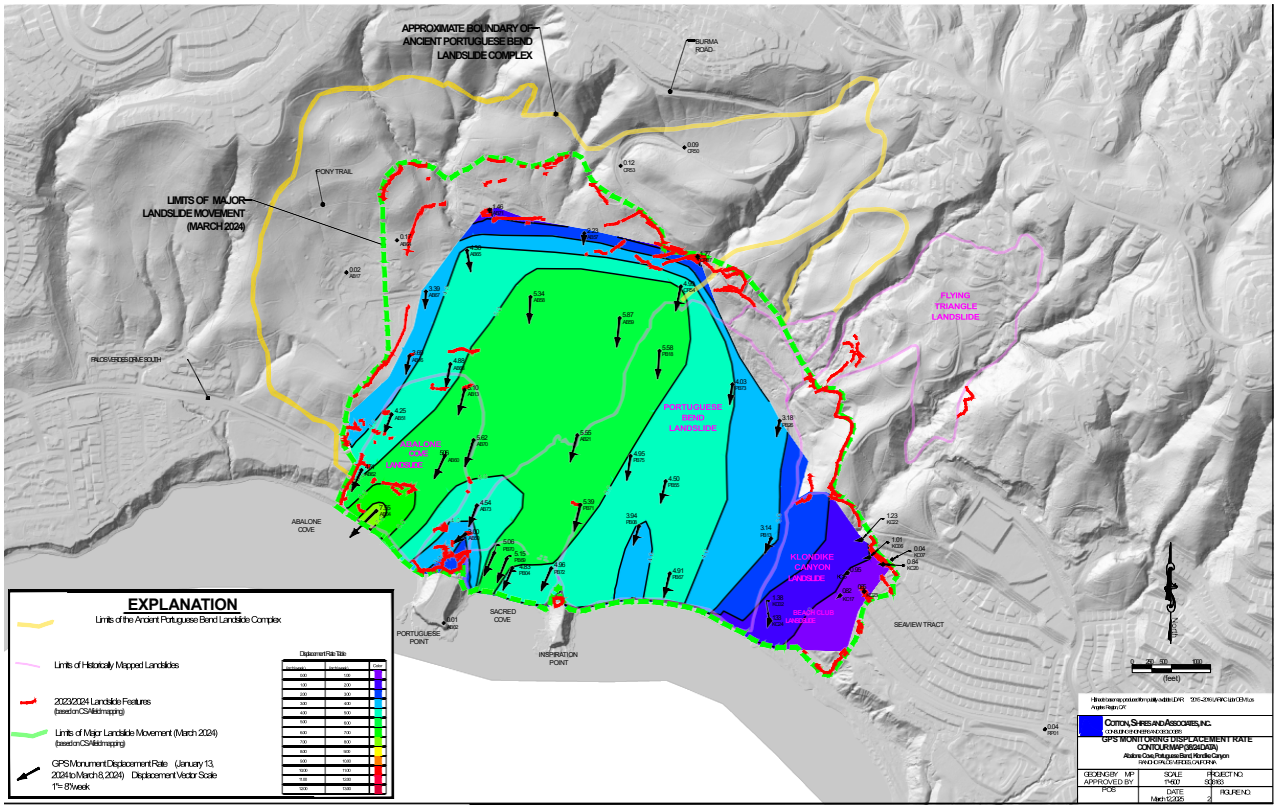
January 13, 2024 Heat Map



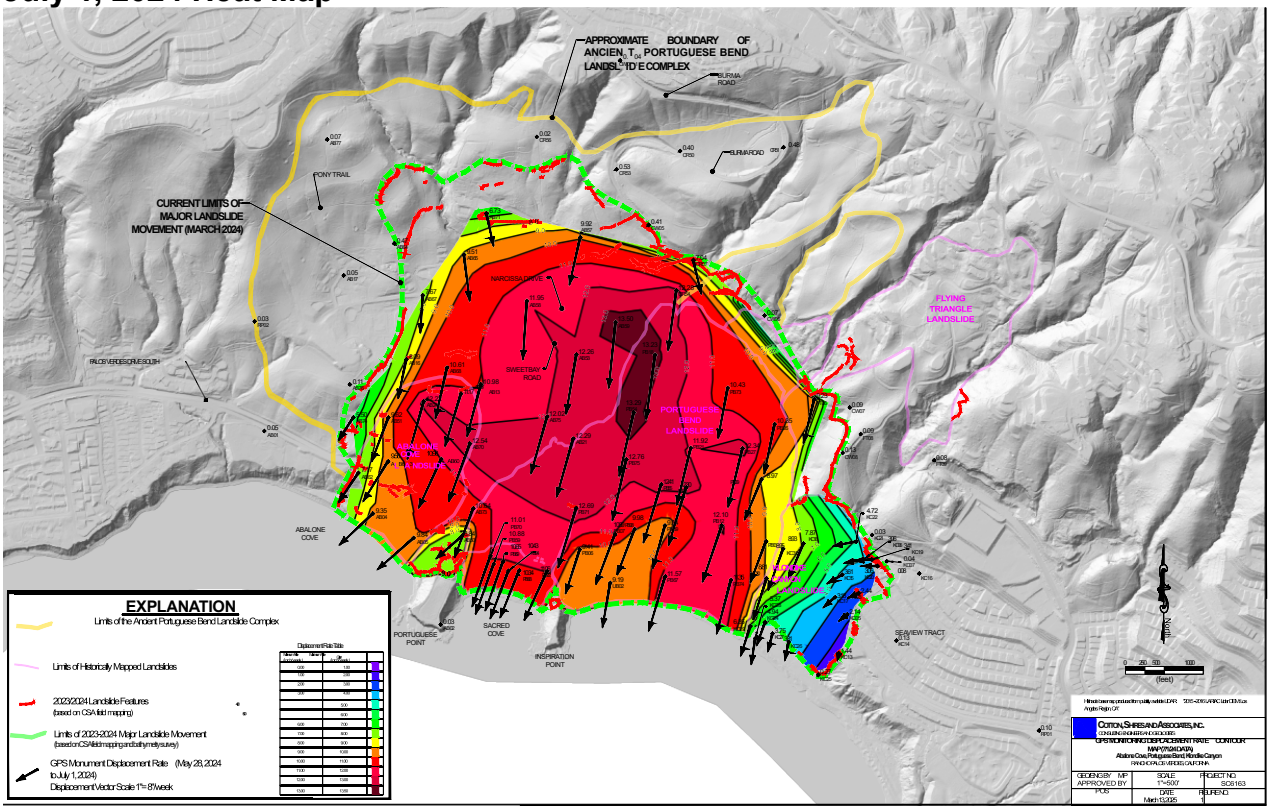
By March 2024, with further mapping and the extraordinary acceleration of numerous GPS monitoring points, a boundary defining the “Area of Major Land Movement” was delineated. Today, following many tens of feet of movement since early 2024, the boundary of the Altamira Landslide is well-defined. North of Palos Verdes Drive South, the Altamira boundary extends significantly farther west of the historical ACL boundary (resulting in the destruction of the landmark Wayfarer’s Chapel), upslope through the York

property (6001 PV Drive South), and north of the historical ACL boundary through the Portuguese Bend Riding Club Area, crossing upper Narcissa Drive, through and north of residences on upper Cinnamon Lane, and eventually turning east across Altamira Canyon, extending through the Vanderlip Estate (100 Vanderlip Drive), destroying Vanderlip Drive and adjacent properties, and ultimately continuing northeast to the lower stretch of Burma Road Trail in the Portuguese Bend Reserve. The Altamira Landslide also created never before seen deformation where it underlies and now extends south of the KCL, including formation of a more seaward toe accompanied by uplifting ground that trended southwest through the beach area of the Portuguese Bend Beach Club and extending up to 500 feet or more offshore where it emerged through the sea floor and formed a new rocky coastline above sea level, generally east of Inspiration Point. The emergence of the new land offshore from the previous coastline was first reported to, and was subsequently observed by, the City Geologist in late February of 2024, consistent with the triggering of major movement of the Altamira Landslide described above.

March 8, 2024 Heat Map



July 1, 2024 Heat Map



<u>Impacts of Movement of The Altamira Landslide</u>

As of this date, the major land movement of the Altamira Landslide has resulted in the red-tagging (Unsafe to Enter/Occupy) and yellow-tagging (Limited Entry) of dozens of residential and commercial structures. It has also caused major destructive impacts to public and private roads, damages to drainage facilities and utility infrastructure (water, sewer, gas, electricity and cable), causing certain utilities to be shut-off, and closure of certain Preserve land that is otherwise heavily accessed by the public for hiking, biking, equestrian, and other purposes.

To reiterate, the damage the City sustained as a result of the winter storms of 2024 is attributed to the activation of the deeper slip plane, known as the Altamira Landslide, that has historically been inactive until the 2024 winter storms. The activation of this new landslide that carried the shallower landslide, referred to as the Landslide Complex herein, is **not** pre-existing and therefore invalidates the reason for denying the City's disaster cost recovery request.

The only practical mitigation measure available to address a landslide with such a colossal scale is relieving groundwater pore pressures through pumping of groundwater,

but it has to be done on a large enough scale to be effective at reducing the movement to an acceptable level. This technique has proven effective for the east side of the Altamira Landslide where deep dewatering wells have been installed, maintained and the rate of ground movement monitored such that a correlation between increased pumping of groundwater and reduction in the rate of ground movement has been confirmed.

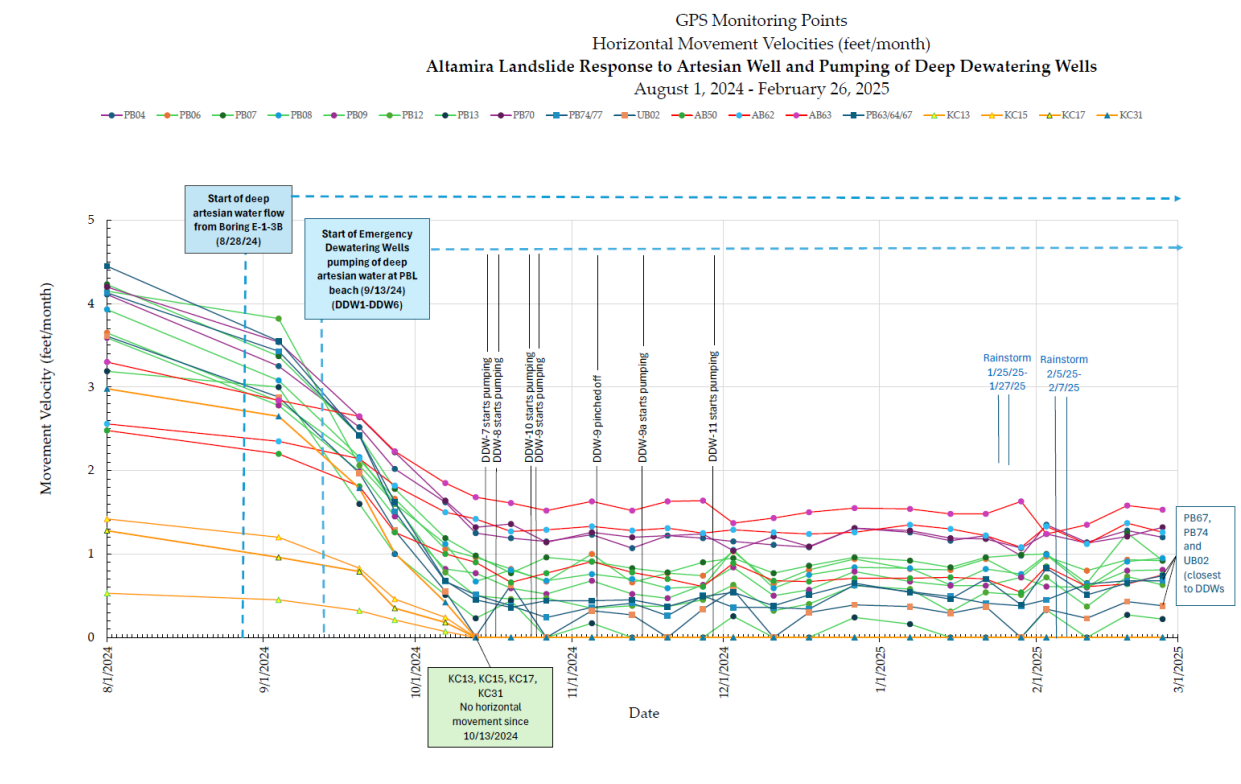
Emergency Measures

Emergency measures taken by the City and abatement districts (ACLAD and KCLAD) to date have included drilling, pumping and monitoring deep dewatering wells, winterization measures including lining channels and installing culverts to reduce the amount of surface water percolating into the groundwater regime from upslope drainages/canyons, and filling of and establishing drainage for fissures and grabens that, if left unmitigated, facilitate surface water intrusion into the groundwater regime. This strategy has proven to be effective in reducing the rate of movement of the Altamira Landslide and even stopping movement of the eastern portion of the landslide in the area of the KCL. Because piezometers installed in deep borings that penetrated the base of the Altamira Landslide indicated high groundwater pore pressures beneath the landslide (some areas were found to have near-artesian or artesian groundwater pressures – pressures higher than the ground surface), a pilot program strategy was pursued by the City that involved drilling a series of deep dewatering wells at the toe of coast below the base of movement of the Altamira Landslide slip plan and pumping to dewater the high groundwater pressures beneath the landslide. This strategy turned out to be more successful than originally contemplated because the movement of the landslide slowed quickly in response to the initial dewatering efforts and the deep wells continued to function for weeks or months before re-drilling was necessary.

The chart on the following page illustrates the timing of artesian water being encountered in one of the test borings (Boring E-1-3B, which was retrofitted to function as an artesian well), the installation of the deep dewatering wells, and the deceleration of the Altamira Landslide in response to the dewatering efforts.

Additional deep dewatering wells are also needed in order to reduce the movement of the middle and eastern portions of the Altamira Landslide to the level experienced prior to the impact of climate whiplash. However, the cost of drilling, pumping, maintaining and re-drilling requires significant funding which the City is unable to fund underscoring the significance of the requested disaster cost recovery – to return land movement to pre-2024 winter storm disaster rates.

Continued on the next page



Federal Agency Responsibility

According to the City's General Plan, Palos Verdes Drive South is a major arterial roadway that supports approximately 15,000 vehicle trips per day and is an identified evacuation route for the south portion of the Palos Verdes Peninsula and the City in the event of a disaster. The roadway is under City ownership and has been maintained through City funds. The U.S. Department of Transportation Federal Highway Administration identifies does identify Palos Verdes Drive South as part of the National Highway System. However, in past conversation with FHWA, it has been conveyed to the City that repairs to existing roadways are not covered, only new projects. The City is seeking reimbursement for the costs incurred as a direct result of the 2024 winter storms and the activation of the Altamira Landslide as described in this appeal letter.

Natural Disaster Cost Recovery

The cost to respond to this natural disaster has been immeasurable to City and its limited resources. To date, the City's estimated expenditures responding to land movement between October 2022 and June 2025 is approximately $47.5 million with approximately $36.3 million being spent this fiscal year (2024-25). Overall, the $36.3 million reflects a 290% increase from the prior year. These costs include emergency response efforts such as test boreholes, deep dewatering wells, maintenance of the deep dewatering wells until June 30, 2025, winterization, fissure filling, road repairs, sewer repairs, and drainage

repairs to name a few.

Similar to the entire state of California, and in fact, the entire United States, there are known pre-existing conditions that lend themselves to natural disasters, such as wildfires, earthquakes, floods, hurricanes, tornadoes, etc. When one of these pre-existing conditions result in a natural disaster such as the recent devastating Palisades and Eaton wildfires, FEMA does not turn their back on those communities in need citing this area is mapped and known to be a Very High Fire Severity Zones. Similarly, FEMA and the federal government do not reject financial aid in known areas of earthquakes, floods, and hurricanes. That same principle should be applied to Rancho Palos Verdes and the recent acceleration of land movement resulting from the atmospheric river storms of 2023 and 2024, and the activation of the new landslide, Altamira Landslide. Moreover, **nowhere in the Stafford Act does it state that pre-existing conditions are ineligible for disaster recovery.** In fact, the Stafford Act clearly cites the **intent** of Congress, by this Act, is to provide an orderly and continuing means of **assistance** by the Federal Government to State and **local governments** in carrying out their responsibilities to alleviate the suffering and damage which result from such disasters by (1) revising and broadening the scope of existing disaster relief programs; (2) encouraging the development of comprehensive disaster preparedness and assistance plans, programs, capabilities, and organizations by the States and by local governments; (3) achieving greater coordination and responsiveness of disaster preparedness and relief programs; (4) encouraging individuals, States, and local governments to protect themselves by obtaining insurance coverage to supplement or replace governmental assistance; (5) encouraging hazard mitigation measures to reduce losses from disasters, including development of land use and construction regulations; (6) **providing Federal assistance programs for both public and private losses sustained in disasters**; and (7) identifying and improving the climate and natural hazard resilience of vulnerable communities.

<u>Clarification to FEMA's Document Descriptions</u>

In addition to the above, the City provides the following responses for context purposes to the some of the documents citied in the Eligibility Determination Memorandum. As you will see, the extracted statements used to deny the City's request do not accurately support nor justify the denial because they are taken out of context of the overall document and do not provide an accurate analysis of the reason for the land movement and the basis for denial as stated earlier in this appeal letter. The City's position remains that the 2024 winter storms triggered the activation of the **new Altamira Landslide** which carried, at an accelerated rate of movement, the greater Landslide Complex which up until recently has been managed.

1. June 7, 2023 City Letter to Los Angeles County Fourth District Supervisor Hahn

   FEMA's determination letter references the City's June 7, 2023 letter to Los Angeles County Fourth District Supervisor Hahn (Sup. Hahn) as the basis for emphasizing its position that the requested damage recovery for water control features traverses a

pre-existing landslide and that the City "continuously repairs and maintains these drainage pipes." The determination letter also states that "the damages claimed are a result of decades of pre-disaster ground instability and ongoing non-disaster related causes" which the City does not believe is accurate based on the information provided in this appeal letter.

The City's letter to Sup. Hahn quotes a few words that when taken out of context gives a very different meaning to the reader. The letter was sent to Sup. Hahn requesting $6 million to help the City fund its matching portion of FEMA's Building Resiliency Infrastructure Communities (BRIC) Grant for the Portuguese Bend Landslide Remediation Project. The letter to Sup. Hahn includes data on the average rate of movement for context purposes to garner her advocacy and financial support needed to develop and implement a remediation plan as a **preventive measure** to a potential imminent threat to public health and safety.

The Portuguese Bend Landslide Remediation project, concentrated within the PBL, was developed by the City to **prevent** the acceleration of land movement by addressing rainwater runoff from entering the ground and recharging the water table, which occurred during the rain events of 2023 and 2024.

The Stafford Act states that pre-existing conditions are not eligible for disaster recovery but rather that to be eligible it has to be directly related to an incident per Title 44 of C.F.R. 206.223(a)(1). However, as noted earlier, the behavior of this slow moving landslide noticeably changed in response to the Winter Storms of 2023 and 2024, and that the extreme wet weather activated a **new** landslide, Altamira Landslide, and should therefore not be considered pre-existing, the point to this appeal.

2. Cotton Shires and Associates (CSA) Geologic Report dated September 9, 2023

   According to your determination letter, the City's Geotechnical Engineer's September 9, 2023 memo is cited as one of the basis for denying the City's recovery request because "*the work claimed is not required as a result of the declared disaster and the applicant cannot demonstrate the damage was directly caused by FEMA-DR-4769-CA. Rather these damages are a result of long-term creep displacement and recent years acceleration of earth movement from non-disaster causes as documented in the multiple reports.*"

   As previously noted, the City respectfully disagrees with these statements and in fact, can demonstrate that the winter storms of 2023 and 2024 correlated to climate change and seasonal changes in weather patterns are the reasons the City experienced a noticeable behavioral **change** in the landslide rate of movement with the activation of the dormant and inactive Altamira Landslide. Moreover, the Eligibility Determination Memorandum neglects to cite relevant and pertinent information in the CSA's September 9, 2023 memo emphasizing the following significant and noticeable change in the behavior of the landslide:

GPS Survey Monitoring Data Review: GPS monitoring of survey monuments throughout the Landslide Complex area has been performed tri-annually since 2007 by McGee Surveying Consulting. In their June 6, 2023 Survey Report, McGee stated:

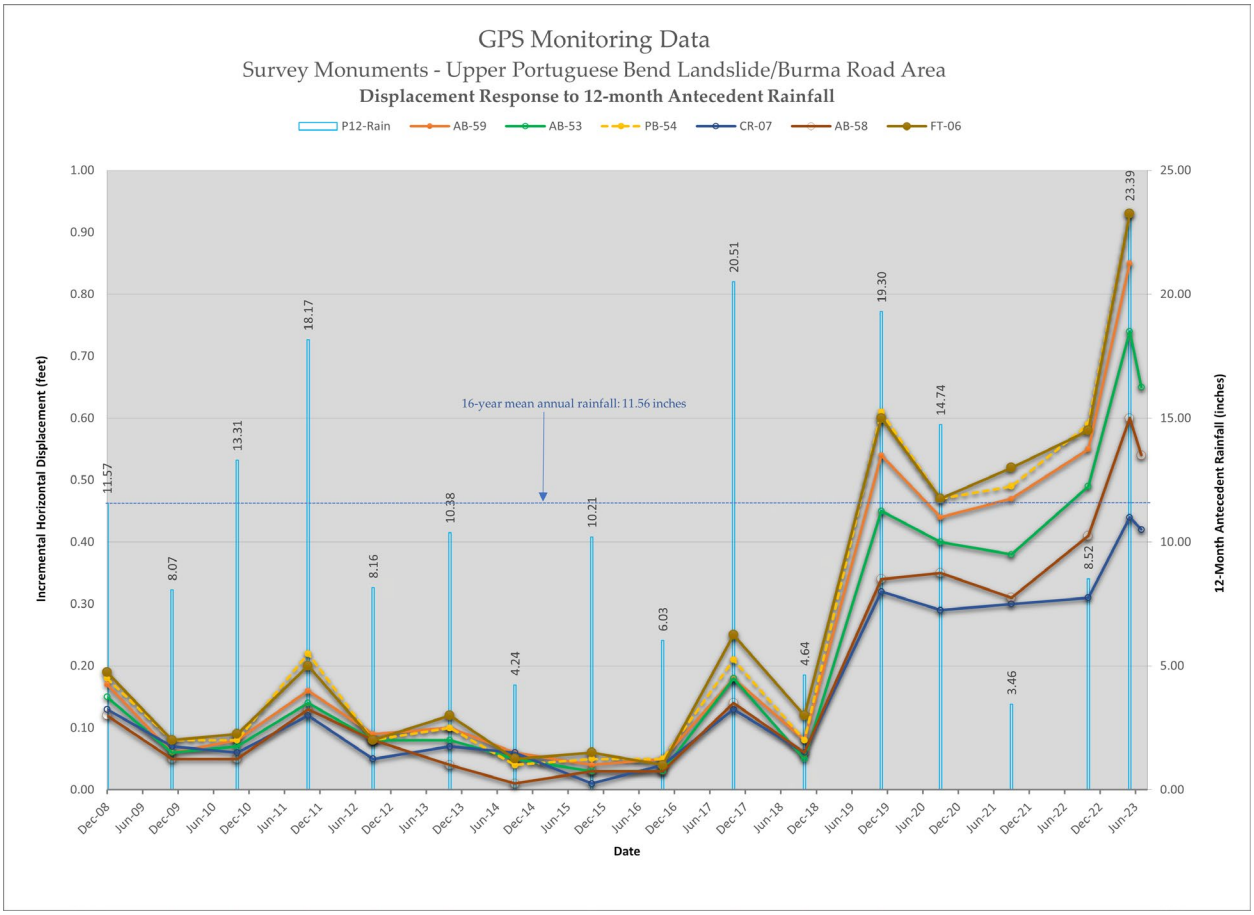
"*In the last seven months the movement velocities have accelerated over the average velocity for the previous four years which saw an acceleration over the previous 15-20 years……**Velocities were stable** prior to 2018. After the Fall of 2018 they increased about 3 to 6 fold at most points and remained stable to the Fall of 2022. In the last seven months since the **Fall of 2022** the velocities generally have **doubled more or less**.*" (emphasis added)

This is a significant and important observation from the surveyor, and comports with the past several years of field observations by CSA staff of roadway distress and trail distress within the PBR, as well as reports of street distress, building distress and utility line breaks throughout the various known landslide areas.

Several graphics based upon CSA's own analysis of the GPS survey monitoring data further illustrate what is happening with the landslide ground movement. According to Figure 2 in CSA's September 9, 2023 memo, depict horizontal displacements (in feet) and ground displacement vectors for 12 selected GPS survey monuments mostly located in the mid and upper Landslide Complex. These figures are based upon McGee's GPS monitoring of the survey monuments from October 2018 to May 2023 (with the exception of two monuments which were last read in October 2022, PB18 and AB71). Four of these monuments were also read in mid-July, 2023 and those movement data are also presented. Two of the monuments, CR07 and FT06 are located on Burma Road outside of the PBL and indicate 1.67 feet and 3.09 feet of horizontal displacement over the ~4.5-year period. The CR07 point moved an additional 0.42 feet in two months (through July 15, 2023), which translates to ground movement velocity of about 2.5 feet per year. Most of the other points on this figure are in the Landslide Complex (and mostly in LMA Zone 2) and are indicating total displacements of approximately 1 to 3 feet (or average velocities of about 0.22 to 0.67 feet/year across the ~4.5-year period). Several of these points in LMA Zone 2 that were also monitored in July, 2023 showed continued acceleration from May to July 2023, with calculated velocities of ~1.25 feet/year at AB67 to ~3.9 feet/year at AB53. These are extraordinary rates of landslide movement that, to the City Geologist's knowledge, have not been previously documented in the LMA Zone 2 area.

Incremental displacement has been analyzed of these points versus 12-month antecedent rainfall, as a measure of the landslide response to rainfall. A graph of cumulative displacement of these points since 2007 is presented on the following page. This graphed movement data indicates a clear acceleration of movement beginning in late 2018 (as noted in the area labeled inflection point).

Accelerated landslide movements since late 2018 appear to be correlative with significantly above normal rainfall in three out of four rainfall seasons (2016-17, 2018-19 and 2019-20) which followed five consecutive drier than normal rainfall seasons (2011-12 through 2015-16). **The extraordinary rainy season of 2022-23, where rainfall totals were more than 200% of average, has resulted in further acceleration**.



It is imperative to bring to your attention that the City Geologist recently provided an updated memorandums dated November 8, 2024 and March 16, 2025 (attached) that further underscores the impacts and damage caused by FEMA-DR-4769-CA also known as the winter storms of January 31 through February 9, 2024, as documented earlier in this appeal letter.

3. Rancho Palos Verdes Geo-Logic Associates (GLA) Report Dated December 2019

   According to the Eligibility Determination Letter, a December 2019 report prepared by GLA, a geotechnical engineering firm, hired by the City to prepare its Portuguese Bend Landslide Remediation project is cited. This report cites, as one

of the basis to determine that the requested disaster damage recovery occurred in a pre-existing landslide area and not related to the storms citing the following:

"the landslide complex includes approximately 239 acres with ground movement varying across the site ranging up to approximately 11 feet per year."

This very citation supports the City's request and claim that the damage sustained occurred as a result of the winter storms in 2023 and 2024 based on the following:

As noted earlier, the Landslide Complex is generally comprised of 5 subslides. The 239 acres noted above is limited to the PBL. This is because the study area for the Landslide Complex was specific to the PBL. In fact, the City Geologist's November 8, 2024 memo states since 2024, this significantly greater depth of movement has resulted in a broader footprint of active land movement at the ground surface and offshore, and expansion of the historical land movement area from approximately 380 acres to **over 700 acres**.

Furthermore, as previously stated, according to the City Geologist's March 16, 2025 memo (attached), the Altamira Landslide is a newly active landslide that has occurred within a previously mapped ancient landslide complex. It is important to make this distinction for consistency and to avoid confusion, because the Altamira Landslide is, in fact, a new member of the historically active PBL/ACL/KCL Landslide Complex but largely **underlies it** and occupies an area of active land movement >700 acres and extends to more than 500 feet off of the coastline, whereas the shallower historically active PBL/ACL/KCL Landslide Complex only occupied about 380 acres. While previous geotechnical investigators identified inactive deep failure surfaces in both the historically active and ancient landslide areas, none of them mapped or identified as active the entire depth or breadth of movement that has recently impacted the area, nor did they opine that such an event would occur in historic times. The active Altamira Landslide currently involves major land movement comprising an area of over 700 acres landward of the coast and extends to approximately 500 feet or more off the coastline. The areal dimensions, depth of movement, velocity of movement, artesian and near-artesian groundwater pressures beneath it, and even the direction of movement, are different than the Landslide Complex. The distinction to be made then, is that the Altamira Landslide is not just simple *expansion* of an existing group of landslides, it is an entirely different, larger and deeper landslide with much broader boundaries (including the new coastline offshore), nearly twice as deep as the depth of historic landslide movement in some areas, and with unprecedented rates of movement (which were not seen in the early LA County Engineer surveys, the Charles Abbott Associates surveys beginning in 1994, nor the McGee surveys since 2007).

None of this was experienced during the history of the City, and the Altamira Landslide is a unique landslide not characterized in its current dimensions during

the over 70-year history of landslide investigations, exploratory borings, monitoring and observations being conducted in the area.

4. Landslide Working Group November 1, 2023 Meeting Notes

   The FEMA Eligibility Determination Memorandum cites that the City has a pre-disaster active task force called the RPV Landslide Complex Working Group which meets to continue to address ongoing landslide problems, and that is **not** correct.

   As previously noted, on October 3, 2023, the City Council declared a local state of emergency in response to the rapid and significant acceleration in land movement. As a result, the Council directed staff to working with community stakeholders including utilities, geologists, HOA representatives and residents to collaborate the City's and community's response to the declared local state of emergency. It was four months later when the then-mayor sent a letter to the Governor requesting he declare a state of emergency and request the President declare a federal disaster in response to the land movement resulting from the winter storms of 2023 and 2024 (attached)

5. Michael McGee's 2007 GPS Technical Report

   In 2007, the City began using GPS technology to track on-ground movement of the Landslide Complex. No one is denying that the shallower Landslide Complex has been moving since 1956, what is evident in the data FEMA's analysts overlooked is that there is a significant and noticeable change in the behavior of the landslide and the rate of movement in response to rain events as clearly demonstrated in the charts earlier in this letter. Moreover, a new, previously dormant landslide was activated in response to the 2024 Winter Storm event.

   To reiterate, the City Geologist has clearly documented that the rain events of 2023, and particularly 2024, have contributed to the accelerated rate of movement and the damage sustained by the City and its infrastructure. The point that warrants a reconsideration of reversing the denial is that there is a clear change in the rate of movement based on the GPS monitoring points cited in your memo between 2023 and present.

<u>Additional Information - Land Movement and the Monks Lawsuit</u>

In 1978, the City enacted an ordinance imposing a moratorium on the construction of new homes in the vicinity where accelerated landslides had recently occurred. The so-called "Monks" plaintiffs owned 16 vacant lots impacted by the moratorium. Some of these property owners claimed to have been waiting over 30 years to build homes on their properties on land that has not showed signs of movement. The lots in question were otherwise zoned for single-family dwellings.

Eventually, these property owners filed suit against the City seeking to invalidate the moratorium criteria and alleging a claim for inverse condemnation based on the state takings clause because, as the plaintiffs asserted, the land was not moving and suitable for development. The trial court denied their request and ultimately found in the City's favor. The property owners appealed.

The Court of Appels ruled in favor of the plaintiffs citing that the City's ordinance requiring owners of land in specific zones within the Landslide Complex to present data demonstrating to satisfaction of city geologist that the gross geotechnical factor of safety where their lots were located was at least 1.5 in order to build on their lots deprived the land of all economically beneficial use, and resulted in a permanent categorical taking. **The Courts ruled that the plaintiffs could build on their lots.** (*Monks v. City of Rancho Palos Verdes*, 167 Cal.App.4th 263 (2008)

Conclusion

The basis for denying the City's disaster recovery on a pre-existing condition is not a valid reason when, as demonstrated in this appeal letter and supporting attachments, it is clear that a **new, inactive** for hundreds of years, landslide was activated in response to the 2024 Winter Storm event that led to the federal disaster declaration (FEMA-DR-4769-CA). The activation of the Altamira Landslide resulted in significant damage to the City's infrastructure including, but not limited to, Palos Verdes Drive South and the City is seeking $5,375,000 to cover costs to repair this major arterial roadway. It is now known that the activation of the Altamira Landslide carried the subslides of ACL, PBL, and KCL which is clearly demonstrated in this appeal letter that the rate of movement significantly increased along with the behavior of the land movement as a result of the 2023 and 2024 Winter Storm Events.

It is for the reasons cited throughout this appeal letter that disaster recovery financial assistance be provided for the destruction resulting from the activation of the Altamira Landslide caused by the extraordinary rain events of 2024. The weather whiplash over the years has adversely impacted the City, its residents and businesses, and its economics. Overturning the denial and providing the disaster recovery assistance requested will enable the City to properly respond to the activation of the new Altamira Landslide by stabilizing land movement and repairing damaged and critical infrastructure.

On behalf of the Rancho Palos Verdes City Council and residents, we thank you for your consideration of this appeal letter.

Sincerely,

Ara Michael Mihranian, AICP
City Manager

Attachments:

- September 9, 2023 CSA Memo
- November 8, 2024 CSA Memo
- March 16, 2025 CSA Memo
- February 20, 2024 Letter to Governor Newsom

c. Rep. Ted Lieu
Senator Adam Schiff
Senator Alex Padilla
State Senator Ben Allen
Asm. Al Muratsuchi
Rancho Palos Verdes Mayor Bradley and City Council
William Wynder, Rancho Palos Verdes City Attorney
Catherine Jun, Rancho Palos Verdes Deputy City Manager
Ramzi Awwad, Rancho Palos Verdes Director of Public Works
Vina Ramos, Rancho Palos Verdes Director of Finance

COTTON, SHIRES AND ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS

CITY OF RANCHO PALOS VERDES

CSA Project No. SC6022

MEMORANDUM

TO: Katie Lozano, Open Space Manager
CC: Ara Mihranian, City Manager
William Wynder, Elena Gerli, and John Fox, City Attorneys
Cory Linder, Director of Recreation and Parks
Ramzi Awwad, Public Works Director
Taylor Fox, Senior Park Ranger
FROM: Michael Phipps, CEG 1832, Contract City Geologist
Christopher Dean, CEG 1751, Contract City Geologist
Matthew Janousek, GE 3005, Contract City Geotechnical Engineer
RE: **Preliminary Geotechnical Assessment of Recent Land Movement in the Portuguese Bend Reserve and Impacts to Burma Road Trail, Rancho Palos Verdes**
DATE: September 29, 2023

INTRODUCTION

In accordance with your request, this memorandum has been prepared to provide a preliminary geotechnical assessment of recent land movement within the Portuguese Bend Reserve (PBR) with a specific focus on the impacts of land movement to the Burma Road Trail. We understand that the PBR is one of the City's most popular land reserves, it is heavily used by the public for recreation and is also used by public utilities including Southern California Edison and California Water Service Company. A portion of the PBR is underlain by the historically active Portuguese Bend Landslide (active since 1955-56) as well as the Ancient Portuguese Bend Landslide Complex. Some areas of the Reserve are now experiencing significant land movement and ground surface manifestation that is beyond the limits of the historically active and previously mapped Portuguese Bend Landslide, resulting in damage to trails and fire roads which provide access for public safety, utilities, maintenance, conservation, and public recreation. Cotton, Shires and Associates, Inc. (CSA) geologists have been requested by the City to observe various landslide-related issues in the Reserve involving damage to trails since 2021 and the SCE transmission lines along Burma Road since the summer of 2022. In 2021 we also began a detailed review of Global Positioning Satellite (GPS) monitoring data for survey monuments both within and outside the PBR, including points within the Abalone Cove Landslide, Klondike Canyon Landslide, and elsewhere within the Ancient Portuguese Bend Landslide Complex.

A comprehensive reconnaissance of the PBR was conducted by vehicle with City staff on June 28, 2023. Following this field visit, the City's Open Space Manager requested a report addressing the following items:

DRAFT

- Information and a map presenting our observations of where new landslide scarps are forming;
- An evaluation of whether Burma Road is currently able to accommodate vehicles, ranging from smaller Park Ranger trucks to heavy equipment used by utility companies and fire department, and if it is currently able to accommodate vehicles, an estimate of how long the road will remain stable;
- Recommendations for re-routing Burma Road (if necessary) to areas less prone to land movement as the fire road is needed for the City, fire department, and utility companies;
- Consideration of recommendations for additional warning signage due to the increased land movement to warn recreational users (hikers, bikers, horseback riders) and authorized outside agency personnel who drive the Reserve fire roads;
- Recommendations for a maintenance plan to fill fissures and keep Burma Road passable to pedestrians and vehicles, as the fissures have become too significant for park rangers to fill in with shovels.

This memorandum will address these requested items, based upon our field observations and geologic mapping, analysis of GPS monitoring data, background knowledge of the area, and professional experience.

PREVIOUS WORK

Previous City-requested reconnaissance and observation of trail conditions in the PBR performed by CSA geologists have included the following:

- 8/27/21: Burma Road trail reconnaissance (fissures/ground movement)
- 9/29/21: Burma Road and Garden Trail reconnaissance (fissures/ground movement)
- 1/5/22: Burma Road trail reconnaissance (fissures/ground movement)
- 8/31/22: Burma Road trail reconnaissance, meeting with SCE contractor and City staff, (regarding power pole relocation due to fissures, ground movement)
- 3/8/22: Upper Burma Road trail reconnaissance (rockfall hazards)
- 4/5/23: Burma Road Trail, Garden Trail, and Rim Trail reconnaissance (fissures/ground movement)

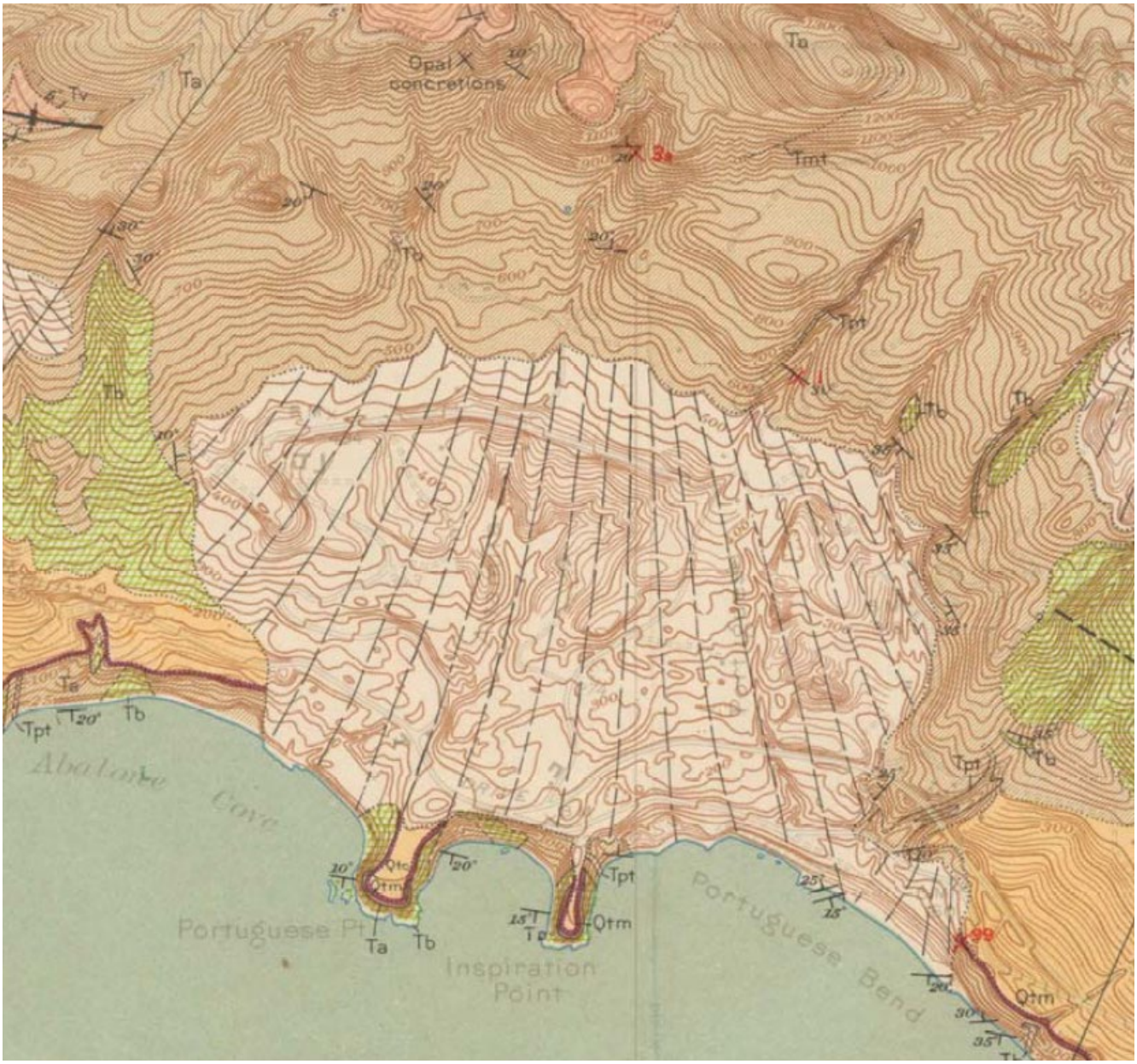
Findings and recommendations from these field visits have been routinely documented by either memoranda or email addressed to City staff. Recent published documents include memoranda dated February 9, 2022 (Burma Road/Rim Trail Junction) and May 19, 2023 (SCE Power Pole Relocation, Burma Road).

Preliminary geologic mapping of the upper limits of active landsliding along the Burma Road trail and vicinity was performed on June 28, 2023 and supplemented on September 22, 2023; however, this work is incomplete and requires additional field effort. Because of the steep terrain, large mapping area, and thick (inaccessible) vegetation in some areas, we have supplemented our field mapping with photo-geologic mapping utilizing high-resolution Nearmap (vertical aerial) imagery captured on January 17, 2023 and June 17, 2023.

DRAFT

FINDINGS

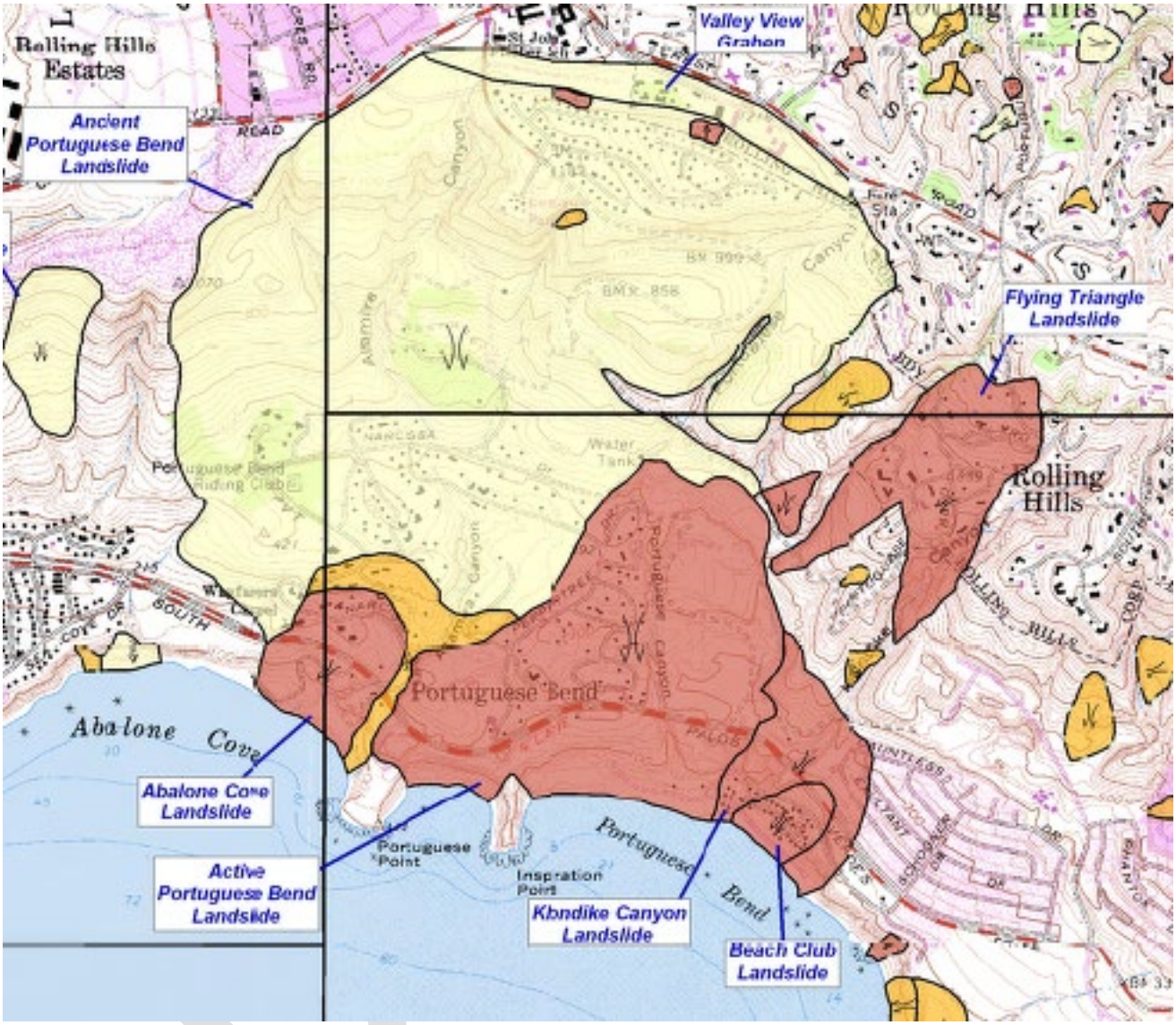
Geologic Mapping: The Ancient Portuguese Bend Landslide Complex (APBLC) was first mapped by the U.S. Department of the Interior Geological Survey (aka, USGS) in 1946 (shown as white area with black dashed lines in the image below) and occupies a broad area on the south side of the Palos Verdes Peninsula from the crest of peninsula to the Pacific Ocean.



U.S. Department of the Interior, 1946, Portion of Geologic Map of the Palos Verdes Hills, Los Angeles County, California

Within the APBLC, several large landslide masses have reactivated since the 1950s, including the Portuguese Bend Landslide, Abalone Cove Landslide, Klondike Canyon Landslide, and Beach Club Landslide. The Flying Triangle Landslide is in similar but higher terrain northeast of the Portuguese

Bend Landslide but is not considered part of the APBLC on regional geologic maps. These landslides are depicted on the California Geological Survey's Landslide Inventory Map of the Palos Verdes Peninsula (2007, image below).



California Geological Survey, 2007, portion of Landslide Inventory Map of the Palos Verdes Peninsula

Burma Road (and Trail) is located along what was previously proposed to be the Crenshaw Boulevard Extension, until the Portuguese Bend Landslide reactivated in 1956. The lower reach of Burma Road trends southeast immediately uphill from the headscarp of the Portuguese Bend Landslide. Previous site visits by our staff to the Burma Road area within the PBR beginning in 2021 were primarily in response to reported "fissures" forming in multiple locations across trails. We understand that City ranger staff have been routinely filling in the fissures with soil using hand tools. At other times heavier grading equipment has been reportedly used by Cal Water to fill fissures and maintain the Burma Road access to their facilities. Recent field mapping and GPS data suggest that these fissures are in fact the incipient manifestations of headward enlargement of the Portuguese Bend Landslide as well as an upslope manifestation of accelerated movement of a portion of the Ancient Portuguese Bend Landslide

Complex west of the active Portuguese Bend Landslide boundary. Four significant landslide scarps, which initially manifested as ground cracking and small fissures in Burma Road, have now formed across Burma Road, generally between the Eagle's Nest Trail intersection on the west and the Rim Trail intersection on the east.

Figure 1 (attached) was prepared on a Nearmap vertical color image taken January 17, 2023. The approximate limits of the active Portuguese Bend Landslide are depicted in red. The upper area of recent headward enlargement of the Portuguese Bend Landslide is depicted with yellow lines delineating landslide scarps which can be seen crossing Burma Road in at least seven locations. While the Burma Road trail has been repeatedly maintained by minor grading-leveling across these features, the scarps have grown in height and width adjacent to the road over time, and in some locations, grabens (wide pull-apart fissures) have formed in response to significant landslide movement. If not maintained in this manner over the past several years, landslide scarps ranging from 1 to 8 feet in height would extend across the road making it impassable to vehicles, cyclists, and even pedestrians. The most severe location is the western (and uppermost, elevation-wise) scarp located between the Water Tank trail and Eagle's Nest Trail intersection with Burma Road. The landslide displacement at this location has produced a scarp 6 to 8 feet in height and significantly displaced an SCE power pole that is now leaning approximately 35-40 degrees out of plumb. Other scarps across Burma Road southeast of this location are smaller, generally ranging from 1 to 4 feet in height adjacent to the road. Of note is that these scarps have grown substantially in size since our June 28, 2023 reconnaissance.

The downslope limits of the new landslide scarps (yellow contacts on Figure 1) appear to be directly connected to the Portuguese Bend Landslide at the eastern end; however, at the western end they are not well-defined at the ground surface and additional field mapping is necessary to further delineate the western margin. The western margin was observed crossing Kubota Trail and trending toward the Vanderlip Trail, where it was lost in heavy vegetation. It is important to note that the western extent of this new landslide movement is somewhat west of the head of the Portuguese Bend Landslide. It is our interpretation that the western extent of this new landslide movement is occurring in response to long-term creep displacement and recent acceleration of movement of the Ancient Portuguese Bend Landslide Complex (APBLC) since October 2018.

GPS Survey Monitoring Data Review: GPS monitoring of survey monuments throughout the APBLC area has been performed tri-annually since 2007 by McGee Surveying Consulting. In their June 6, 2023 Survey Report, McGee stated:

"*In the last seven months the movement velocities have accelerated over the average velocity for the previous four years which saw an acceleration over the previous 15-20 years……Velocities were stable prior to 2018. After the Fall of 2018 they increased about 3 to 6 fold at most points and remained stable to the Fall of 2022. In the last seven months since the Fall of 2022 the velocities generally have doubled more or less*."

This is a significant and important observation from the surveyor and comports with the past several years of field observations by CSA staff of roadway distress and trail distress within the PBR, as well as reports of street distress, building distress and utility line breaks throughout the various known landslide areas. We have prepared several graphics based upon our own analysis of the GPS survey

DRAFT

monitoring data to further illustrate what is happening with the landslide ground movement. Figure 2 (attached) depicts horizontal displacements (in feet) and ground displacement vectors, for 12 selected GPS survey monuments mostly located in the mid and upper Ancient Portuguese Bend Landslide Complex. These figures are based upon McGee's GPS monitoring of the survey monuments from October 2018 to May 2023 (with the exception of two monuments which were last read in October 2022, PB18 and AB71). Four of these monuments were also read in mid-July, 2023 and those movement data are also presented. Two of the monuments, CR07 and FT06 are located on Burma Road outside of the Portuguese Bend Landslide and indicate 1.67 feet and 3.09 feet of horizontal displacement over the ~4.5-year period. The CR07 point moved an additional 0.42 feet in two months (through July 15, 2023), which translates to ground movement velocity of about 2.5 feet per year. Most of the other points on this figure are in the Ancient Portuguese Bend Landslide Complex (and mostly in LMA Zone 2) and are indicating total displacements of approximately 1 to 3 feet (or average velocities of about 0.22 to 0.67 feet/year across the ~4.5-year period). Several of these points in LMA Zone 2 that were also monitored in July, 2023 showed continued acceleration from May to July 2023, with calculated velocities of ~1.25 feet/year at AB67 to ~3.9 feet/year at AB53. These are extraordinary rates of landslide movement that, to our knowledge, have not been previously documented in the LMA Zone 2 area.

We have also reviewed and analyzed cumulative and incremental displacements from 2007-2023 for six select survey monitoring points that are generally in the upper Portuguese Bend Landslide/Burma Road area, including three points that are in the Ancient Portuguese Bend Landslide Complex west of the historically active Portuguese Bend Landslide (i.e., in Landslide Moratorium Area Zone 2). These six points are identified as:

- CR07 adjacent to Burma Road Trail;
- PB54 located within the "Landward Subslide" of the Portuguese Bend Landslide Complex;
- AB53, AB58 and AB59 located within the Ancient Portuguese Bend Landslide Complex (Landslide Moratorium Zone 2); and
- FT06 adjacent to Burma Road Trail southeast of the Rim Trail intersection.

We have analyzed incremental displacement of these points versus 12-month antecedent rainfall, as a measure of the landslide response to rainfall (Figure 3). A graph of cumulative displacement of these points since 2007 is also presented in Figure 4. This graphed movement data indicates a clear acceleration of movement beginning in late 2018 (as noted in the area labeled inflection point).

Accelerated landslide movements since late 2018 appear to be correlative with significantly above-normal rainfall in three out of four rainfall seasons (2016-17, 2018-19 and 2019-20) which followed five consecutive drier than normal rainfall seasons (2011-12 through 2015-16). The extraordinary rainy season of 2022-23, where rainfall totals were more than 200% of average, has resulted in further acceleration based upon limited monitoring data. A significant concern is that the movement velocities have not declined back to the pre-2018 levels despite two significantly below-normal rainy seasons (2020-21, one of the driest on record, and 2021-22). Also of note is that our rainfall data do not include the impacts from Tropical Storm Hilary which dropped several inches of rain across most of southern California in August, 2023.

DRAFT

CONCLUSIONS AND RECOMMENDATIONS

Landslide movements throughout the Ancient Portuguese Bend Landslide Complex *outside of the historical boundary of the Portuguese Bend Landslide* previously exhibited relatively low rates of creep movement in the 11-year monitoring period of 2007-2018 for which we have readily available data. Beginning in late 2018, and through the present, the survey data indicate a significant acceleration of landslide movement. The movement of the Portuguese Bend Landslide also accelerated in this timeframe. The cumulative displacements over this time have now manifested as headward enlargement of the Portuguese Bend Landslide as well as new active landslide masses forming northwest of the Portuguese Bend Landslide crown in Landslide Moratorium Area Zone 1, upslope from LMA Zone 2. These new actively moving landslide masses are directly impacting Burma Road and threaten future accessibility.

We understand this issue is also exceeding current resources (i.e., ranger staff) to monitor and maintain the safety of the trails; primarily the heavily used Burma Road Trail. At this time, we consider this to be a critical and evolving situation that poses risks to the general public who are accessing the PBR for recreation, to utility infrastructure that traverses the landslide area, and to accessibility for other stakeholders including conservation groups and the fire department. It is evolving because we are days from entering the rainy season and most meteorologists and climatologists that we follow are citing development of El Nino conditions in the Eastern Pacific Ocean and these are frequently associated with wetter-than-normal rainfall conditions in southern California. We are also awaiting receipt of the fall GPS survey data which are typically gathered in early October.

To address the City's specific items, we offer the following:

Landslide Maps: For the purposes of this memorandum, a landslide overview map (Figure 1, attached) was prepared to illustrate the entire affected area and impacts to Burma Road. We conducted field mapping on much larger scale maps which allow for presentation of detailed observations; however, these were not formally drafted and produced due to time constraints. We recommend that additional field mapping be performed in an effort to further define the limits of active landsliding. Drafted larger scale maps will be provided if necessary and/or upon request, to provide details in specific areas.

Burma Road Conditions and Maintenance Considerations: Given the current landslide movement velocities, the newly identified landslides impacting Burma Road are active and considered unstable. Burma Road only remains passable because of the reported efforts of other stakeholders to level the ground surface across the landslide areas with larger equipment, in response to the creeping landslide movement. We anticipate that the landslide movement will continue and is likely to be exacerbated by the 2023-24 rainy season regardless of whether it is wetter or drier than historical averages. The filling of fissures crossing the road with manual labor (by park rangers) has become untenable and such measures are reportedly proving to be short-lived. The fissures, which are developing landslide scarps, have widened and deepened in some areas due to significant ground movement. Smaller vehicles (ranger trucks) are typically 2-3 tons and present lower risks when crossing the landslide areas;

DRAFT

however, larger, heavier vehicles including fire trucks which typically weigh 10 to 20 tons present a much larger transient load across the landslides, thus presenting a relatively greater risk.

Currently it is our opinion that Burma Road Trail should be closed to the public across the landslide area *unless it can be monitored on a daily basis by the park rangers*. This is due to active landslide movement directly impacting the road and posing significant risks to pedestrians, cyclists and horseback riders. Ground leveling efforts to keep the road passable for vehicles may continue; however, crews should avoid placing earth fill directly on the landslides because it adds weight and is a driving force of landslide movement. Continued notching (lowering) of the trail approaches to the landslide scarps may be the only effective solution in the short-term to maintain passage of vehicles. Care should also be given to avoid ground-alterations that would direct more Burma Road drainage directly into the landslide areas.

Burma Road Re-routing Considerations: Burma Road and trail occupy a portion of wider, leveled ground graded during the proposed Crenshaw Boulevard extension (circa 1955-56). Several of the new landslide scarps extend to near the north edge of the previously leveled area, thus, there does not appear to be a feasible location to re-route the road through these areas. Furthermore, we do not see an opportunity to completely re-route Burma Road outside of the former graded area without consideration of massive grading and drainage improvements in steeply sloping areas, some of which may also be in sensitive habitat area. There are also slope stability concerns north of Burma Road for any considered re-route, and we are currently lacking information due to a lack of GPS monitoring points north of Burma Road. The depth of movement of the new landslides is also unknown and at best could only be estimated based on previous studies of the Portuguese Bend Landslide.

Consideration could be given to stabilizing the affected portions of Burma Road in its current location; however, this would require an extensive geotechnical investigation, including geologic mapping, installation of instrumented borings (e.g., slope inclinometer casings and piezometers), laboratory soil testing, extensive slope stability analyses, and design of possible stabilization alternatives. Stabilization, if technically feasible, might require a combination of extensive in-ground structural measures (i.e., steel-reinforced concrete shear pins with tiebacks) and grading. Based upon our experience, such mitigation would likely have a cost in the millions of dollars.

Additional Warning Signage: Additional warning signage due to the increased land movement, to warn recreational users (hikers, bikers, horseback riders) and authorized outside agencies who drive the Reserve fire roads, is reasonable and appropriate from a geotechnical perspective, particularly if the City is going to keep Burma Road Trail and other potentially affected trails open to the public. As mentioned above, the new landslide areas impacting Burma Road and Trail are currently unstable. The landslide areas are currently moving (creeping) at velocities that are generally imperceptible to humans and may seem innocuous from that perspective; however, over short periods of time the movement creates significant hazards to trail users due to differential ground movement with associated ground cracking and fissuring within the landslide masses as well as scarp formation at the movement boundaries.

DRAFT

Additional Recommendations: In addition to the specific items requested to be addressed by the City, we have the following comments and recommendations:

- CSA previously issued a memorandum regarding the proposed SCE power pole relocation (May 19, 2023). At that time, we noted that the upslope extent of active landsliding had not been geologically mapped (to our knowledge), the depth of landslide movement is unknown, and there is a lack of GPS survey monitoring points north of Burma Road between Portuguese and Paintbrush Canyons. We subsequently stated that due to this lack of information, it was difficult to assess the impacts of future land movements on the proposed power pole relocation areas. It is our understanding that SCE may be considering a larger scale relocation of their transmission line(s) that are currently within the active landslide area, in lieu of the relocation project that we previously reviewed. The existing transmission line along Burma Road is partially supported by power poles located in actively moving landslides and at least two of the power poles have now been severely compromised. This transmission line poses a significant risk if not de-energized.

- The above-ground water main which trends along Burma Road traverses portions of the new landslide areas and is lacking ground support (i.e., the pipe is in the air) in some isolated areas. Our concern is that the pipe *may* not have been designed for such conditions. This should be further evaluated by the utility company responsible for the water main.

- Additional geologic mapping (on ground, possibly supplemented with drone photogrammetry) should be performed in an effort to further define the areal extent of new active landsliding. This information will be beneficial to the City for future evaluation of the safety of Burma Road and other trails within the Portuguese Bend Reserve, and also useful to other stakeholders.

- Additional GPS monitoring points should be established north of Burma Road, between Portuguese Canyon and Paintbrush Canyon. CSA will assist with recommended locations for these points if requested by the City. We also recommend that the tri-annual GPS monitoring be performed on <u>all</u> monuments in each monitoring session, in lieu of the partial monitoring that has been historically performed in two of the three sessions per year.

- Periodic closures of the trail system within the PBR during and immediately after significant rainfall events, as has been the policy of the City, should continue to allow for safety assessment of the trails by ranger staff.

- Where feasible, park ranger staff should continue to do routine monitoring and filling of ground fissures on other trails to keep the trails relatively safe; otherwise, the trails should be closed.

We hope this memorandum provides the City of Rancho Palos Verdes with the requested information and recommendations regarding Burma Road within the Portuguese Bend Reserve at this time. Please contact us if you have further questions or concerns.

-o-

DRAFT

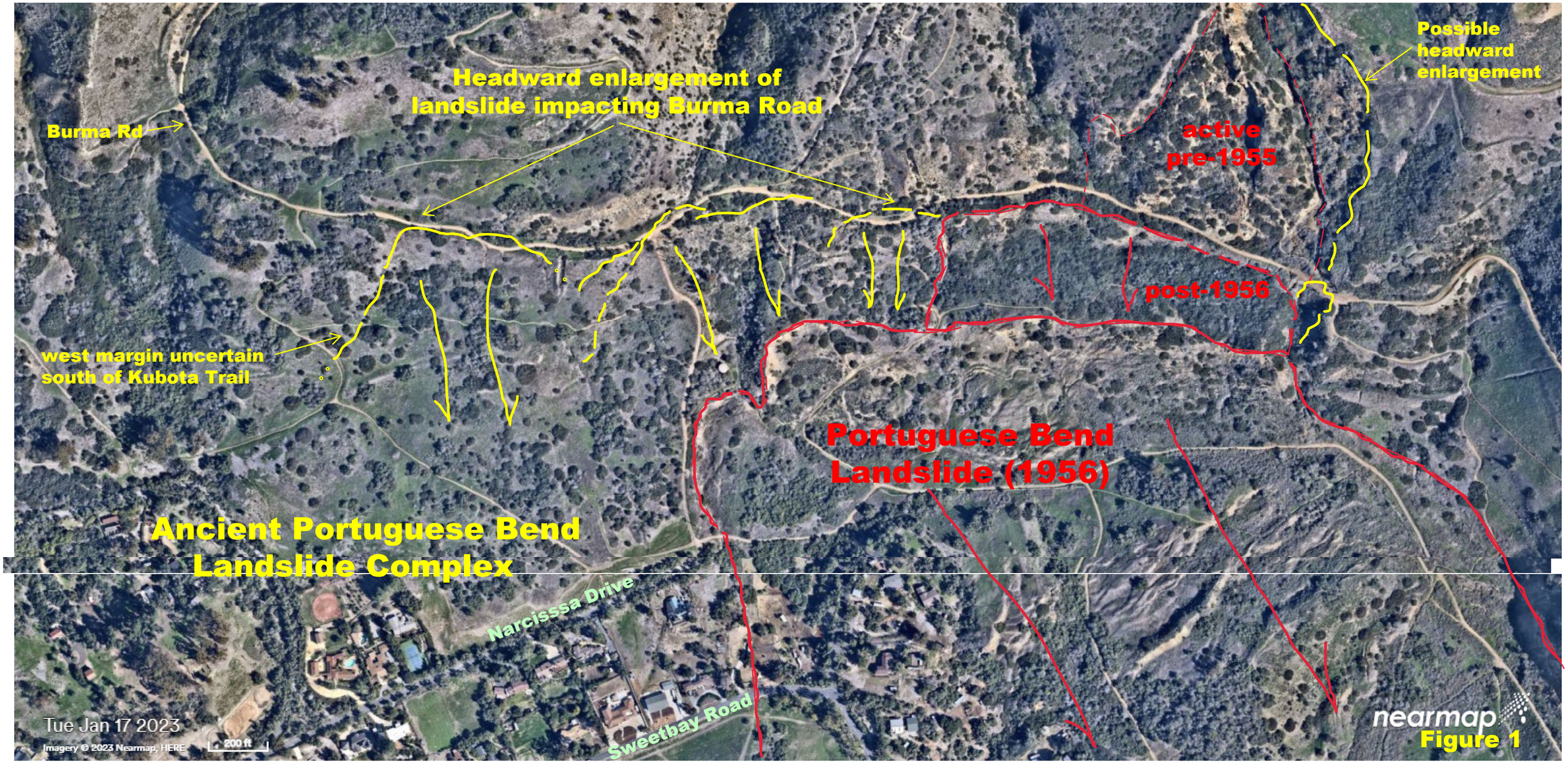
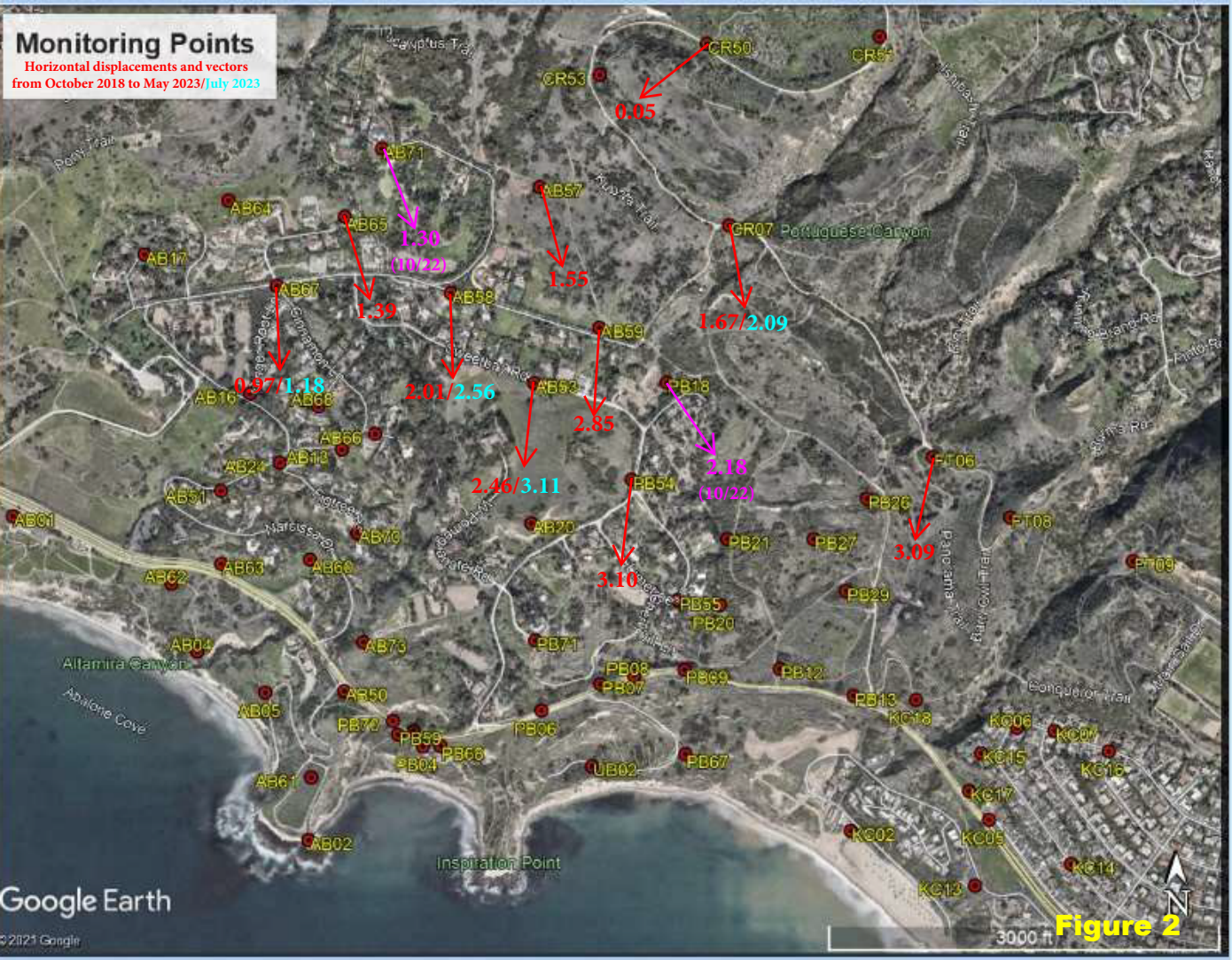

Headward enlargement of
landslide impacting Burma Road
Burma Rd
Possible
headward
enlargement
active
pre-1955
post-1956
west margin uncertain
south of Kubota Trail
Portuguese Bend
Landslide (1956)
Ancient Portuguese Bend
Landslide Complex
Narcisssa Drive
Sweetbay Road
Tue Jan 17 2023
Imagery © 2023 Nearmap, HERE
200 ft
nearmap

Figure 1


Monitoring Points
Horizontal displacements and vectors
from October 2018 to May 2023/July 2023
CR50
CR53
CR54
0.05
AB71
AB64
AB65
1.30
(10/22)
AB57
1.55
CR07
Portuguese Canyon
AB17
AB67
1.39
AB58
1.67/2.09
AB59
0.97/1.18
AB16
AB68
2.01/2.56
AB53
2.85
PB18
AB66
AB13
AB24
2.18
(10/22)
PT06
2.46/3.11
PB54
AB51
PB26
AB01
AB70
AB20
PB21
PB27
3.09
PT08
AB02
AB63
AB69
3.10
PT09
PB29
PB55
PB20
AB04
AB73
PB71
Altamira Canyon
PB08
PB07
PB69
PB12
Conqueror Trail
Abalone Cove
AB05
AB50
PB13
KC18
KC06
KC07
PB70
PB59
PB06
PB66
PB04
KC15
KC16
PB67
UB02
AB61
KC17
KC02
KC05
AB02
KC14
Inspiration Point
KC13
Google Earth
©2021 Google
3000 ft
N
Figure 2

GPS Monitoring Data

Survey Monuments - Upper Portuguese Bend Landslide/Burma Road Area

Displacement Response to 12-month Antecedent Rainfall

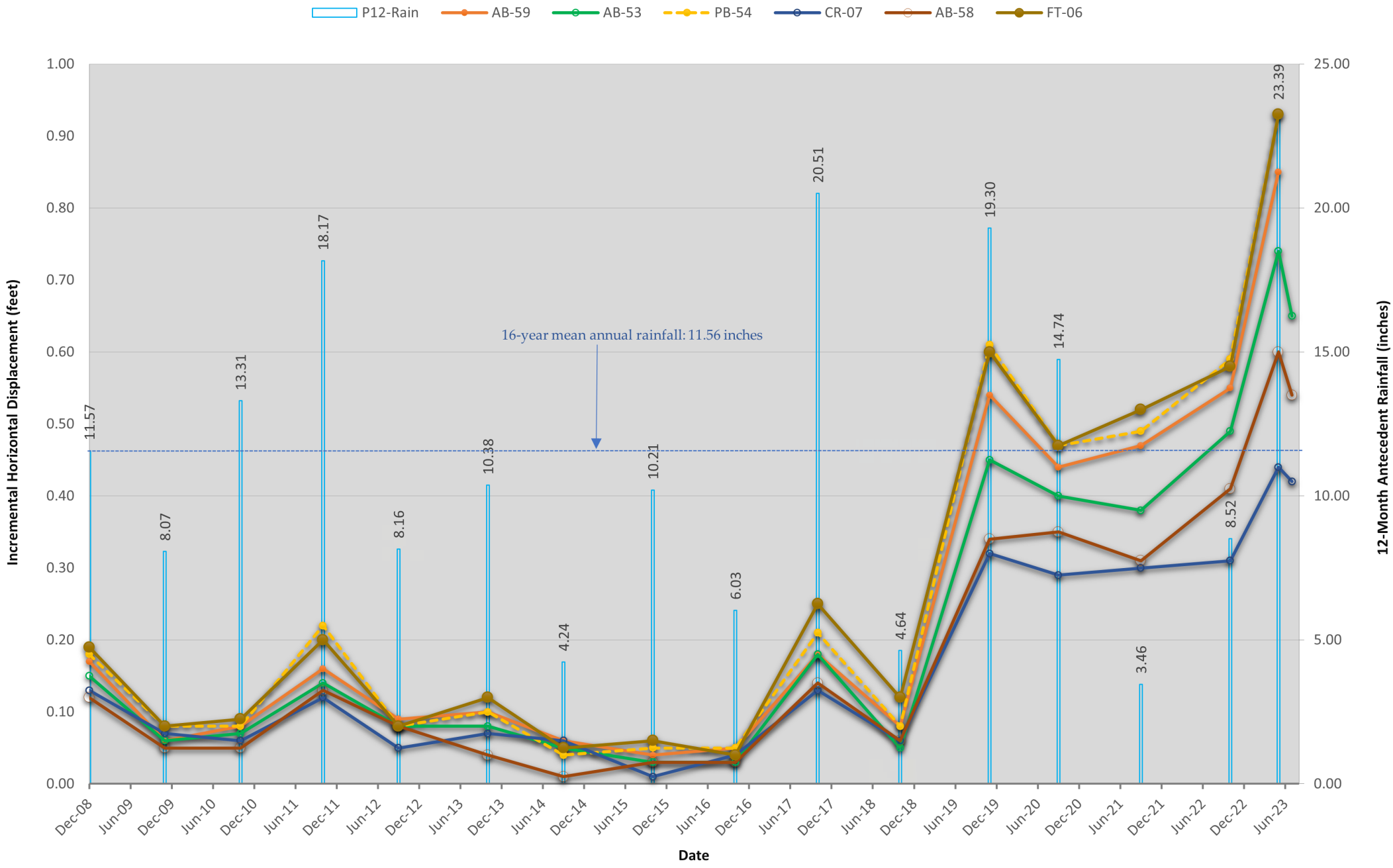


Figure 3

GPS Monitoring Data

Survey Monuments - Upper Portuguese Bend Landslide/Burma Road Area

Cumulative Horizontal Displacement 2007-2023

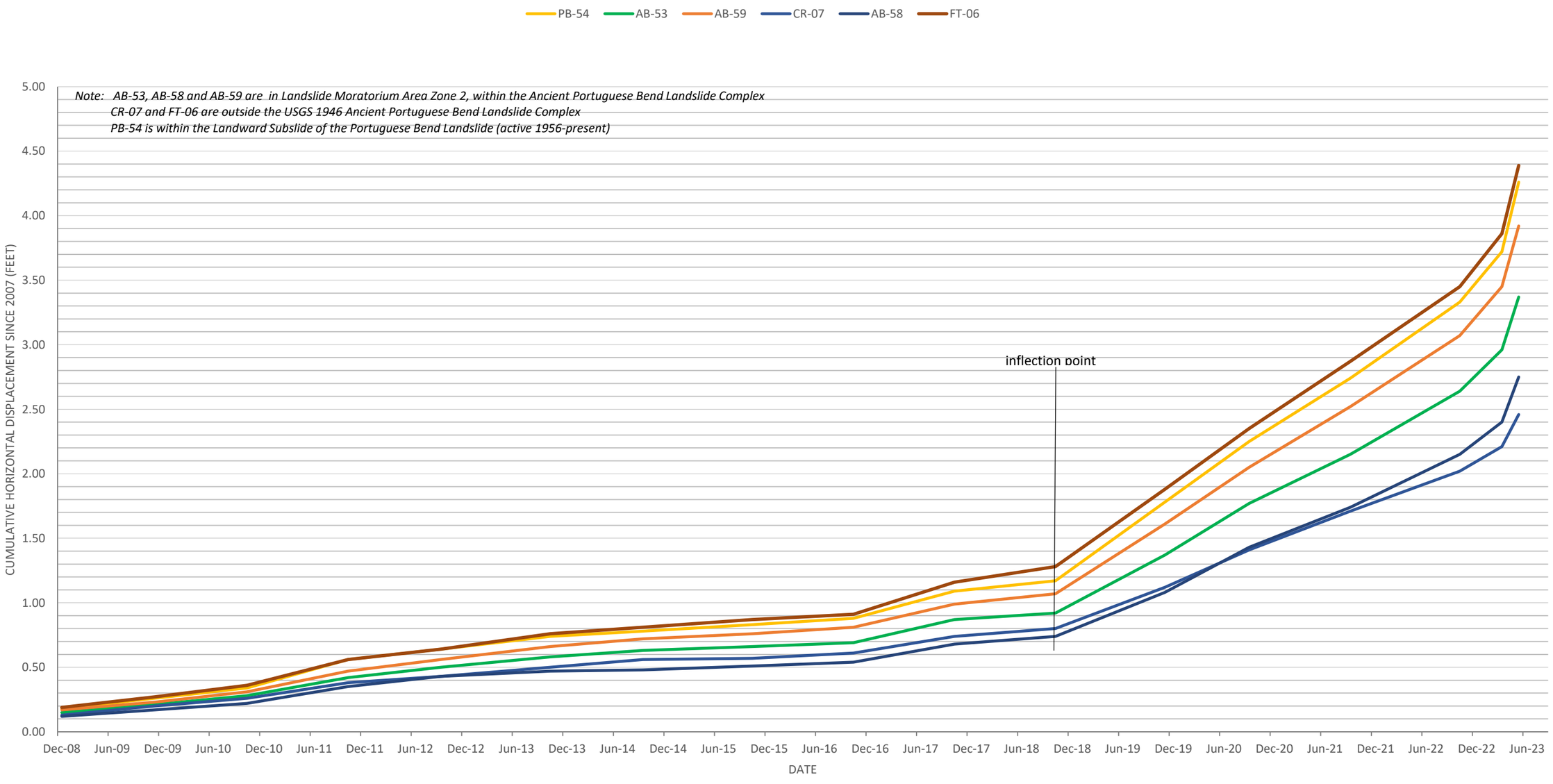


Figure 4

COTTON, SHIRES AND ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS

CITY OF RANCHO PALOS VERDES

CSA Project No: SC6163

MEMORANDUM

TO: Brandy Forbes, Community Development Director
CC: Ara Mihranian, City Manager
Ramzi Awwad, Public Works Director
FROM: Michael Phipps, CEG 1832, Contract City Geologist
Patrick Shires, GE 770, Contract City Geotechnical Engineer
RE: **Movement of the Altamira (Greater Portuguese Bend) Landslide Complex and Related Impacts, Rancho Palos Verdes, California**
DATE: November 8, 2024

INTRODUCTION

In this memorandum Cotton, Shires and Associates, Inc. (CSA) summarizes our evaluation of land movement of the Altamira Landslide Complex (previously referred to as the Greater Portuguese Bend Landslide Complex or Ancient Portuguese Bend Landslide Complex in past correspondence) from 2022-2024, with specific focus on the impacts of the land movement to private property, residential structures, and infrastructure. The active Altamira Landslide Complex currently involves major land movement comprising an area of over 700 acres landward of the coast. As of this date, the major land movement has resulted in the red-tagging (Unsafe to Enter/Occupy) of 18 residential structures and 2 commercial structures (at Wayfarer's Chapel), and the yellow-tagging (Limited Entry) of 38 other residential structures. It has also caused major impacts to public and private roads (some requiring closure), damages to utility infrastructure (water, sewer, gas, electricity and cable) causing certain utilities to be shut-off, and closure of certain Preserve land that is heavily accessed by the public for hiking, biking, equestrian, and other purposes.

BACKGROUND

The Altamira Landslide Complex in Rancho Palos Verdes includes four historically active, previously identified landslide areas: the Portuguese Bend Landslide (PBL) which began moving in 1956, the Abalone Cove Landslide (ACL) which began moving in 1979, the Klondike Canyon Landslide (KCL) which also began moving in 1979, and the Beach Club Landslide (BCL) which is nested within the KCL and, while dormant itself, moves with the KCL. It also now includes areas outside of the historically mapped boundaries of these known landslides, predominantly upslope from the historically mapped Portuguese Bend and Abalone Cove Landslides, within the Ancient Portuguese Bend Landslide Complex as mapped by various agencies (i.e., U.S. Geological Survey, California Geological Survey and other researchers (see attached Figure 1 - Landslide Area Map).

Based upon historically mapped boundaries, the ACL, PBL and KCL previously comprised an area of approximately 380 acres and affected portions of neighborhoods known as the Portuguese Bend Community, the Seaview Community and the Portuguese Bend Beach Club, as well as City-owned land within the Portuguese Bend Reserve (a sub-area of the greater Palos Verdes Nature Preserve). The

PBL has been continuously active since reactivation in 1956 with many areas of the landslide having moved hundreds of feet seaward over the ensuing six-plus decades. The ACL was active from 1979 until the late 1990's, involving only several feet of movement, when dewatering and other mitigation efforts largely halted movement. Creep movement of the ACL has occurred over the past 25 years following rainy seasons that were significantly above average rainfall amounts. The KCL has been episodically active in 1979-1983 and 2005-2006, experiencing only several inches of movement, typically in response to significantly above average rainfall. Landslide movements throughout the Ancient Portuguese Bend Landslide Complex *outside of the historical boundaries of* the ACL and PBL previously exhibited low rates of creep movement, or movement at or near the instrument precision range, in the 11-year monitoring period of 2007-2018 for which we have readily available data. These landslides are deep translational-type failures within seaward-dipping strata of the Monterey Formation, with the landslide slip surfaces occurring within very weak bentonitic clay beds. Historically, the movement behavior of these landslides routinely exhibited high sensitivity to increased groundwater pore pressure, and increased rates of land movement were correlative with 6-to-12-month antecedent rainfall that was well above average. Similarly, land movement decreased during below average rainy seasons or multi-year periods of drought.

Beginning in 2021, CSA geologists were requested by the City of Rancho Palos Verdes to observe reported distress (ground cracking and fissures) to trails in the Portuguese Bend Reserve. At that time, we also began reviewing Global Positioning Satellite (GPS) monitoring data for survey monuments within the entire Ancient Portuguese Bend Landslide Complex or Altamira Landslide Complex. In the summer of 2022, CSA was also asked to evaluate distress to an SCE transmission line along Burma Road within the Portuguese Bend Reserve. Subsequent geologic mapping of the Reserve area revealed that headward and lateral enlargement of the Portuguese Bend Landslide was occurring. We were also receiving reports of underground water line breaks occurring within the Portuguese Bend Community Association area and the Seaview Community. Review of GPS monitoring data from 2007 through 2023 indicated that land movement acceleration initially began between 2018 and 2019. We postulated that this acceleration was correlative with significantly above-normal rainfall in two out of three prior rainfall seasons (2016-17 and 2018-19) which followed five consecutive drier than normal rainfall seasons (2011-12 through 2015-16) (see attached Figure 2 – GPS Monitoring Data, Ancient Portuguese Bend Landslide: Displacement Response to 12-Month Antecedent Rainfall, December 2008-January 2024). One notable item, however, is that the land movement velocities did not decline back to the pre-2018 levels despite two significantly below-normal rainy seasons (2020-21, one of the driest on record, and 2021-22).

RAINFALL IMPACTS – 2022 THROUGH 2024

Further acceleration of land movement occurred throughout the Altamira Landslide Complex during and following the 2022-23 rain season, and the rainfall impacts from mid- to late-winter storms significantly contributed to the increased ground movements. Significant accelerations in movement velocity were documented in May 2023 following major storm sequences in January, February and March of 2023, which added to cumulative seasonal rainfall totals exceeding 193% of average rainfall. Approximately 87% of this rain fell prior to June 18, 2023. Most of this rainfall occurred from three significant atmospheric river-type storm sequences occurring on January 9-16 (3.59 inches), February 23-March 1 (3.79 inches) and March 10-15 (4.12 inches). Land movement velocities further increased as of the July 15, 2023 monitoring. An anomalous tropical storm dropped an additional 3.05 inches of

rain on August 19-20, 2023, resulting in further land movement acceleration as of the October 10, 2023 monitoring. The multiple increases in landslide velocities (i.e., accelerations) resulted in additional mappable ground surface expressions of the uphill limits of active landsliding, including the formation of landslide scarps, fissures, grabens, tensional cracking and shear zones, including areas north, west and east of the historically known landslide boundaries. Field geologic mapping and photo-geologic mapping performed in mid to late 2023 corroborated the GPS monitoring data findings that a large portion of the Ancient Portuguese Bend Landslide Complex (Altamira Landslide Complex) above the historically mapped PBL, ACL and KCL boundaries was involved in significant active landslide movement. The boundary of that major land movement has been updated through November 2024 and is depicted by the green dashed line on the attached Figure 1 – Landslide Area Map.

The 2023-2024 rainfall season total of more than 23 inches was 170% of the long-term average and had a compounding effect on the previous season's extraordinary rainfall. This rainfall season was characterized by additional atmospheric river type storms, including a sequence of storms that resulted in a Federally declared disaster from January 30 - February 9, 2024. The February 2024 rainfall total of 11.22 was the second wettest February in the 67-year history of recorded data for the Palos Verdes Peninsula. The landslide response to these rains was almost immediate and we observed continued accelerating land movement in the GPS monitoring data through August 1, 2024. A peak land movement velocity of >13 inches/week occurred in the center of the landslide as of the May 28, 2024 monitoring period. Movement velocities appeared to peak across the breadth of the landslide in the July 1 - August 1, 2024 monitoring period with the majority of stations moving >10 inches/week and peak movements >12 inches per week. Attached Figures 3, 4, 5 and 6 – GPS Monitoring Displacement Rate Contour Maps, are landslide movement velocity contour maps produced from GPS monitoring data through August 1, 2024, September 4, 2024, October 8, 2024 and October 29, 2024, respectively.

For reference, rainfall data utilized for this evaluation are from the Los Angeles County Department of Public Works - Hydrology Division Station 1011B, located at the Rolling Hills Fire Station No. 56. This rainfall station serves as a reasonable proxy for rainfall impacts to the southern face of the Palos Verdes Peninsula due to its elevation, which should reflect some orographic effect for storms approaching the Palos Verdes Peninsula from the west, southwest, and south, compared to coastal stations such as Point Vicente which may underestimate rain totals in the higher reaches of the landslide complex and watershed.

TOTAL LAND MOVEMENT – OCTOBER 2022 THROUGH OCTOBER 2024

Since October 10, 2022, total horizontal land movement throughout the Altamira Landslide Complex has ranged from approximately 27 to 39 feet in most areas, with the exception being approximately 6 to 21 feet of horizontal land movement in the Klondike Canyon Landslide area. Vertical displacements have ranged from 1 - 10 feet in most areas over this same period. This land movement has had a destructive and devastating effect on numerous residential and commercial properties and structures, private and public roadways, and utility infrastructure. In addition to the 18 red-tagged and 38 yellow-tagged structures, dozens of homes are experiencing varying amounts of distress and inaccessibility due to differential land movements, and electricity and gas service has been cut off from the majority of these properties. The most significant damage is to structures on or adjacent to the landslide boundaries, or those located on boundaries between subslides (blocks) within the Altamira Landslide Complex that are moving at different rates.

Since June 2024, the City has undertaken emergency mitigation measures including 18 deep geotechnical test borings with sophisticated instrumentation to detect the depth(s) of land movement and groundwater pore pressures within and beneath the active landslide mass(es). The instrumented geotechnical test borings revealed that the basal slip surface of the Altamira Landslide Complex beneath the Portuguese Bend Landslide portion of the Altamira complex is up to twice as deep as previously/historically modeled, and moving at a much faster rate than the shallower PBL slip surface. This significantly greater depth of movement has resulted in a broader footprint of active land movement at the ground surface and offshore, and expansion of the historical land movement area from approximately 380 acres to over 700 acres. The test borings also indicated that artesian or near-artesian groundwater pressure is present beneath the Altamira slip surface, and confined groundwater under significant pressure is present between the Altamira and PBL slip surfaces. High unconfined groundwater levels were also determined within the historically modeled Portuguese Bend and Abalone Cove landslide bodies. Beginning September 13, 2024, the first of 10 deep dewatering wells came online. The ten wells, all located near the toe, or lower 1/3 of the landslide complex, are currently extracting approximately 1 million gallons per day of groundwater within and beneath the landslide.

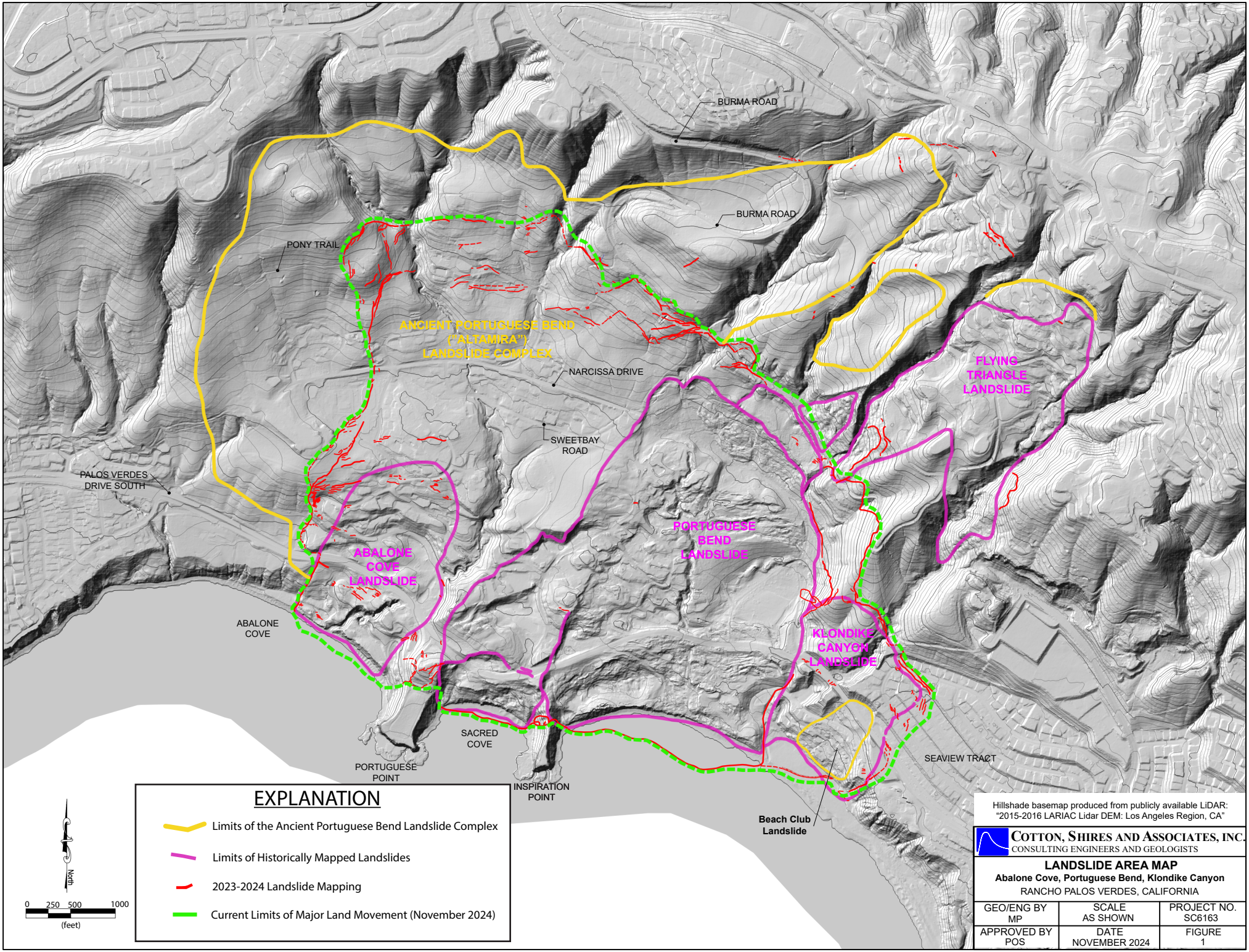
FUTURE LAND MOVEMENT POTENTIAL

As described above, major movement of the Altamira Landslide Complex ranging from 6 to 39 feet horizontally and 1 to 10 feet vertically has occurred since October 2022, with the majority of that movement occurring during and following the 2023-24 rainy season. The highest observed movement rates have exceeded 12 inches per week. While emergency dewatering mitigation efforts and 6 months without any rainfall recharge have reduced movements in most areas to a current level of 0.5 to 6 inches per week, there are many uncertainties regarding the longevity and long-term effectiveness of the deep dewatering wells that have been installed, including the availability of additional funding needed to maintain them and keep them operational. There is also uncertainty regarding the quantity of dewatering wells needed to maintain landslide movements at low (creep) movement levels, and whether funding for additional wells can be obtained. Given the emergency measures that are in place, the future response of the landslide to seasonal rains, including the severity of those rains is unknown; however, historical land movement data demonstrates increases in land movement with above-average rainy seasons despite the operation of past dewatering facilities operated by private geologic hazard abatement districts such as ACLAD and KCLAD.

-o-

Attachments:

Figure 1 – Landslide Area Map
Figure 2 – GPS Monitoring Data, Displacement Response to 12-Month Antecedent Rainfall, December 2008-January 2024
Figure 3 – GPS Monitoring Displacement Rate Contour Map (8/1/2024 Data)
Figure 4 – GPS Monitoring Displacement Rate Contour Map (9/4/2024 Data)
Figure 5 – GPS Monitoring Displacement Rate Contour Map (10/8/2024 Data)
Figure 6 – GPS Monitoring Displacement Rate Contour Map (10/29/2024 Data)

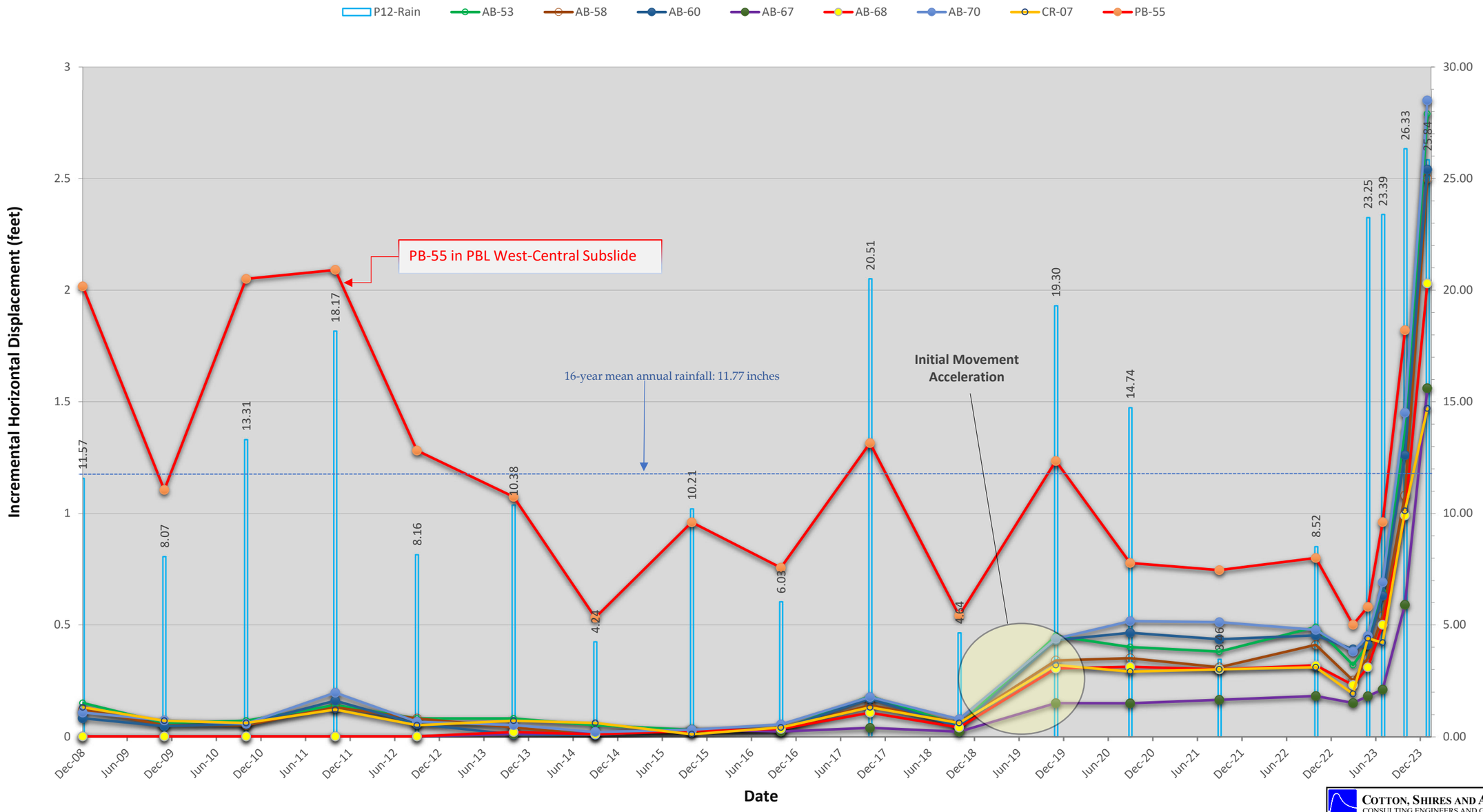

BURMA ROAD
BURMA ROAD
PONY TRAIL
ANCIENT PORTUGUESE BEND ("ALTAMIRA") LANDSLIDE COMPLEX
NARCISSA DRIVE
SWEETBAY ROAD
PALOS VERDES DRIVE SOUTH
FLYING TRIANGLE LANDSLIDE
PORTUGUESE BEND LANDSLIDE
ABALONE COVE LANDSLIDE
KLONDIKE CANYON LANDSLIDE
ABALONE COVE
SACRED COVE
PORTUGUESE POINT
INSPIRATION POINT
SEAVIEW TRACT
Beach Club Landslide
EXPLANATION
Limits of the Ancient Portuguese Bend Landslide Complex
Limits of Historically Mapped Landslides
2023-2024 Landslide Mapping
Current Limits of Major Land Movement (November 2024)
North
0 250 500 1000
(feet)
Hillshade basemap produced from publicly available LiDAR: "2015-2016 LARIAC Lidar DEM: Los Angeles Region, CA"
COTTON, SHIRES AND ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS
LANDSLIDE AREA MAP
Abalone Cove, Portuguese Bend, Klondike Canyon
RANCHO PALOS VERDES, CALIFORNIA
GEO/ENG BY MP
SCALE AS SHOWN
PROJECT NO. SC6163
APPROVED BY POS
DATE NOVEMBER 2024
FIGURE 1

GPS Monitoring Data

Survey Monuments - ACL, PBL and Upper Ancient Landslide Complex

Displacement Response to 12-month Antecedent Rainfall

December 2008-January 2024



COTTON, SHIRES AND ASSOCIATES, INC. CONSULTING ENGINEERS AND GEOLOGISTS	
GPS Monitoring Data Survey Monuments- ACL, PBL, and Upper Ancient Landslide Complex Displacement Response to 12-month Antecedent Rainfall Rancho Palos Verdes, California	
GEO/ENG BY MP	SCALE
APPROVED BY POS	DATE NOVEMBER 2024

PROJECT NO. SC6163

FIGURE 2

APPROXIMATE BOUNDARY OF ANCIENT PORTUGUESE BEND LANDSLIDE COMPLEX

"Creeping Area" Approximately 0.5 inch/week

CURRENT LIMITS OF MAJOR LANDSLIDE MOVEMENT (AUGUST 2024)

PONY TRAIL

BURMA ROAD

PALOS VERDES DRIVE SOUTH

ABALONE COVE

PORTUGUESE POINT

SACRED COVE

INSPIRATION POINT

SEAVIEW TRACT

PORTUGUESE BEND LANDSLIDE

ABALONE COVE LANDSLIDE

FLYING TRIANGLE LANDSLIDE

KLONDIKE CANYON LANDSLIDE

0.06 CW01
0.08 AB77
0.07 CR56
0.33 CR50
0.47 CR51
0.49 CR53
0.52 CW05
0.00 AB71 no data
0.00 CR57 no data
0.48 AB64
0.01 AB17
0.03 RP02
0.05 CW06
0.24 AB76
0.06 AB01
0.04 CW07
0.02 FT08
0.05 CW08
0.01 FT09
0.02 FT00
0.06 AB02
0.08 KC14
0.02 RP01
0.23 KC25
0.46 KC13
4.09 KC22
0.04 KC21
3.84 KC33
3.89 KC06
3.40 KC19
0.03 KC07
0.03 KC16
3.45 KC20
3.91 KC15
2.72 KC23
3.53 KC17
2.41 KC05
5.68 KC28
5.16 KC24
3.88 KC27
4.09 KC26
6.48 KC29
9.21 KC30
8.82 PB13
8.23 KC31
7.84 KC18
11.39 PB74
11.45 PB12
9.87 PB26
9.36 PB29
10.91 PB27
9.39 PB73
11.89 PB54
10.41 PB21
11.54 PB75
11.13 PB55
10.83 PB20
10.84 PB08
9.92 PB09
11.68 PB07
12.96 PB71
12.29 PB67
9.98 UB02
11.36 PB59
11.13 PB69
11.58 PB70
11.34 PB04
11.15 PB68
11.81 PB72
10.07 PB06
10.75 AB73
11.99 AB75
12.43 AB21
11.69 AB70
10.19 AB60
9.11 AB63
7.08 AB62
9.20 AB04
8.55 AB05
6.86 AB50
5.16 AB74
8.95 AB51
11.23 AB24
10.64 AB13
10.10 AB66
9.79 AB68
7.49 AB16
7.48 AB67
8.88 AB65
9.39 AB57
11.00 AB58
12.65 AB59
11.80 CR54
11.29 AB53
11.89 PB18
0.00 AB71 no data
7.0
8.0
9.0
10.0
11.0
12.0

EXPLANATION

- Limits of the Ancient Portuguese Bend Landslide Complex
- Limits of Historically Mapped Landslides
- 2023/2024 Landslide Mapping
- Current Limits of Major Landslide Movement (August 2024)
- GPS Monument Displacement!Rate (July 1, 2024 to August 1, 2024) Displacement Vector! Scale 1"= 8"/week

Displacement Rate Table

Minimum Rate (inch/week)	Maximum Rate (inch/week)	Color
0.00	1.00	
1.00	2.00	
2.00	3.00	
3.00	4.00	
4.00	5.00	
5.00	6.00	
6.00	7.00	
7.00	8.00	
8.00	9.00	
9.00	10.00	
10.00	11.00	
11.00	12.00	
12.00	13.00	

North

0 250 500 1000 (feet)

Hillshade basemap produced from publicly available LiDAR: "2015 - 2016 LARIAC Lidar DEM: Los Angeles Region, CA"

COTTON, SHIRES AND ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS

GPS MONITORING DISPLACEMENT RATE CONTOUR MAP (8/1/24 DATA)
Abalone Cove, Portuguese Bend, Klondike Canyon
RANCHO PALOS VERDES, CALIFORNIA

GEO/ENG BY	SCALE	PROJECT NO.
MP	1"=500'	SC6163
APPROVED BY	DATE	FIGURE NO.
POS	November 8, 2024	3

APPROXIMATE BOUNDARY OF ANCIENT PORTUGUESE BEND LANDSLIDE COMPLEX

CURRENT LIMITS OF MAJOR LANDSLIDE MOVEMENT (SEPTEMBER 2024)

"Creeping Area" Approximately 0.5 inch/week

BURMA ROAD

PONY TRAIL

PALOS VERDES DRIVE SOUTH

PORTUGUESE BEND LANDSLIDE

ABALONE COVE LANDSLIDE

KLONDIKE CANYON LANDSLIDE

FLYING TRIANGLE LANDSLIDE

ABALONE COVE

SACRED COVE

PORTUGUESE POINT

INSPIRATION POINT

SEAVIEW TRACT

EXPLANATION

- Limits of the Ancient Portuguese Bend Landslide Complex
- Limits of Historically Mapped Landslides
- 2023/2024 Landslide Mapping
- Current Limits of Major Landslide Movement (September 2024)
- GPS Monument Displacement Rate (August 1, 2024 to September 4, 2024) Displacement Vector Scale 1"= 8"/week

Displacement Rate Table

Minimum Rate (inch/week)	Maximum Rate (inch/week)	Color
0.00	1.00	
1.00	2.00	
2.00	3.00	
3.00	4.00	
4.00	5.00	
5.00	6.00	
6.00	7.00	
7.00	8.00	
8.00	9.00	
9.00	10.00	
10.00	11.00	
11.00	12.00	
12.00	13.00	

North

0 250 500 1000 (feet)

Hillshade basemap produced from publicly available LiDAR: "2015 - 2016 LARIAC Lidar DEM: Los Angeles Region, CA"

COTTON, SHIRES AND ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS

GPS MONITORING DISPLACEMENT RATE CONTOUR MAP (9/4/24 DATA)
Abalone Cove, Portuguese Bend, Klondike Canyon
RANCHO PALOS VERDES, CALIFORNIA

GEO/ENG BY	SCALE	PROJECT NO.
MP	1"=500'	SC6163
APPROVED BY	DATE	FIGURE NO.
POS	November 8, 2024	4

APPROXIMATE BOUNDARY OF ANCIENT PORTUGUESE BEND LANDSLIDE COMPLEX

CURRENT LIMITS OF MAJOR LANDSLIDE MOVEMENT (OCTOBER 2024)

"Creeping Area" Approximately 0.5 inch/week

BURMA ROAD

PONY TRAIL

PALOS VERDES DRIVE SOUTH

ABALONE COVE

SACRED COVE

PORTUGUESE POINT

INSPIRATION POINT

SEAVIEW TRACT

ABALONE COVE LANDSLIDE

PORTUGUESE BEND LANDSLIDE

KLONDIKE CANYON LANDSLIDE

FLYING TRIANGLE LANDSLIDE

0.04 AB80
0.04 AB79
0.03 CW01
0.06 AB77
0.07 CR56
0.35 CR50
0.44 CR51
0.00 CR60
0.43 CR53
0.36 CR58
1.78 AB78
6.17 AB57
0.47 CW05
0.03 CR59
0.12 AB64
6.14 AB65
0.11 CR57
0.04 AB17
5.09 AB67
6.86 CR54
7.44 AB58
0.00 RP03
0.07 CW06
7.90 AB59
0.03 FT10
5.42 AB16
6.82 AB68
7.37 AB53
6.95 PB18
0.11 AB76
6.91 AB66
7.23 AB13
3.84 PB76
7.88 AB24
7.18 AB75
6.99 PB54
4.01 PB26
0.05 AB01
3.66 AB74
6.18 AB51
7.85 AB70
7.29 AB21
0.03 FT08
4.96 PB21
5.05 PB27
0.02 CW08
6.23 AB69
6.74 AB69
6.28 PB75
0.04 FT09
5.03 AB62
5.26 PB55
3.42 PB29
4.99 PB20
0.04 KC21
6.09 AB04
7.08 PB71
6.04 AB73
6.03 PB70
5.88 PB59
1.57 KC06
3.88 AB50
5.64 PB69
4.62 PB08
4.08 PB09
4.21 PB12
3.04 PB13
1.80 KC22
1.35 KC19
5.11 PB07
5.74 PB04
3.23 KC31
2.49 KC18
0.04 KC07
4.58 PB06
1.67 KC33
1.29 KC20
0.02 KC16
5.71 PB68
5.77 PB72
4.63 PB67
4.54 PB74
3.38 KC30
1.53 KC15
3.74 UB02
1.34 KC17
1.05 KC23
1.05 KC05
2.27 KC29
1.75 KC24
2.47 KC38
1.98 KC28
1.34 KC26
0.55 KC13
0.05 KC35
0.05 KC14
0.05 KC34
0.03 KC36
0.08 KC25
0.04 KC37
0.04 RP01

5.0
6.0
7.0
4.0
3.0
2.0
1.0

EXPLANATION

- Limits of the Ancient Portuguese Bend Landslide Complex
- Limits of Historically Mapped Landslides
- 2023/2024 Landslide Mapping
- Current Limits of Major Landslide Movement (October 2024)
- GPS Monument Displacement Rate (September 4, 2024 to October 8, 2024) Displacement Vector Scale 1"= 8"/week

Displacement Rate Table

Minimum Rate (inch/week)	Maximum Rate (inch/week)	Color
0.00	1.00	
1.00	2.00	
2.00	3.00	
3.00	4.00	
4.00	5.00	
5.00	6.00	
6.00	7.00	
7.00	8.00	
8.00	9.00	
9.00	10.00	
10.00	11.00	
11.00	12.00	
12.00	13.00	

North

0 250 500 1000
(feet)

Hillshade basemap produced from publicly available LiDAR: "2015 - 2016 LARIAC Lidar DEM: Los Angeles Region, CA"

COTTON, SHIRES AND ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS

GPS MONITORING DISPLACEMENT RATE CONTOUR MAP (10/8/24 DATA)
Abalone Cove, Portuguese Bend, Klondike Canyon
RANCHO PALOS VERDES, CALIFORNIA

GEO/ENG BY	SCALE	PROJECT NO.
MP	1"=500'	SC6163
APPROVED BY	DATE	FIGURE NO.
POS	November 8, 2024	5

APPROXIMATE BOUNDARY OF ANCIENT PORTUGUESE BEND LANDSLIDE COMPLEX

CURRENT LIMITS OF MAJOR LANDSLIDE MOVEMENT (NOVEMBER 2024)

BURMA ROAD

PONY TRAIL

PALOS VERDES DRIVE SOUTH

ABALONE COVE

PORTUGUESE POINT

SACRED COVE

INSPIRATION POINT

ABALONE COVE LANDSLIDE

PORTUGUESE BEND LANDSLIDE

KLONDIKE CANYON LANDSLIDE

FLYING TRIANGLE LANDSLIDE

SEAVIEW TRACT

0.07 AB80 · 0.12 AB79 · 0.02 CW01 · 0.06 AB77 · 0.04 CR56 · 0.08 CR50 · 0.10 CR51 · 0.03 CR60 · 0.01 CR53 · 0.07 CR58 · 0.13 AB78 · 0.08 CW05 · 0.08 CR59 · 0.62 AB64 · 4.83 AB57 · 4.21 AB65 · 0.09 CR57 · 0.09 AB17 · 3.61 AB67 · 4.0 · 5.10 AB58 · 4.68 CR54 · 5.0 · 5.04 AB59 · 0.01 RP03 · 0.08 CW06 · 3.91 AB16 · 4.51 AB53 · 4.01 PB18 · 0.07 FT10 · 4.72 AB68 · 4.74 AB66 · 0.11 AB76 · 3.32 AB76 · 1.55 PB76 · 5.64 AB24 · 0.13 AB01 · 3.06 AB74 · 4.17 AB51 · 4.70 AB75 · 4.23 PB54 · 0.56 PB26 · 0.04 FT08 · 4.63 AB21 · 2.48 PB21 · 2.08 PB27 · 0.16 GW08 · 0.06 FT09 · 5.46 AB70 · 4.37 AB69 · 5.29 AB60 · 3.49 PB75 · 3.64 AB62 · 2.88 PB55 · 0.36 PB29 · 4.0 · 4.36 PB71 · 2.03 PB20 · 4.32 AB04 · 3.53 AB73 · 1.97 PB08 · 2.0 · 0.04 KC21 · 0.22 KC06 · 3.47 PB70 · 3.38 PB59 · 1.67 PB09 · 1.23 PB12 · 0.38 PB13 · 3.0 · 2.46 PB07 · 3.63 PB69 · 0.22 KC31 · 0.14 KC18 · 0.19 KC22 · 0.28 KC19 · 2.07 AB50 · 2.21 PB06 · 3.25 PB04 · 0.24 KC33 · 0.11 KC07 · 3.25 PB68 · 3.22 PB72 · 1.0 · 0.68 UB02 · 1.14 PB67 · 0.97 PB74 · 0.16 KC20 · 0.13 KC16 · 0.16 KC30 · 0.19 KC15 · 0.11 KC17 · 0.20 KC23 · 0.19 KC05 · 0.12 KC29 · 0.11 KC24 · 0.22 KC38 · 0.17 KC28 · 0.08 KC26 · 0.12 KC13 · 0.09 KC25 · 0.11 KC14 · 0.12 KC35 · 0.14 KC34 · 0.10 KC36 · 0.16 KC37 · 0.11 RP01

EXPLANATION

- Limits of the Ancient Portuguese Bend Landslide Complex
- Limits of Historically Mapped Landslides
- 2023/2024 Landslide Mapping
- Current Limits of Major Landslide Movement (November 2024)
- GPS Monument Displacement Rate (October 8, 2024 to October 29, 2024) Displacement Vector Scale 1"= 8"/week

Displacement Rate Table

Minimum Rate (inch/week)	Maximum Rate (inch/week)	Color
0.00	1.00	
1.00	2.00	
2.00	3.00	
3.00	4.00	
4.00	5.00	
5.00	6.00	
6.00	7.00	
7.00	8.00	
8.00	9.00	
9.00	10.00	
10.00	11.00	
11.00	12.00	
12.00	13.00	

North

0 250 500 1000 (feet)

Hillshade basemap produced from publicly available LiDAR: "2015 - 2016 LARIAC Lidar DEM: Los Angeles Region, CA"

COTTON, SHIRES AND ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS

GPS MONITORING DISPLACEMENT RATE CONTOUR MAP (10/29/24 DATA)
Abalone Cove, Portuguese Bend, Klondike Canyon
RANCHO PALOS VERDES, CALIFORNIA

GEO/ENG BY	SCALE	PROJECT NO.
MP	1"=500'	SC6163
APPROVED BY	DATE	FIGURE NO.
POS	November 8, 2024	6

COTTON, SHIRES AND ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS

CITY OF RANCHO PALOS VERDES

CSA Project No: SC6163

MEMORANDUM

TO: Ara Mihranian, City Manager
CC: Ramzi Awwad, Public Works Director

FROM: Michael Phipps, CEG 1832, Contract City Geologist
Patrick Shires, GE 770, Contract City Geotechnical Engineer
RE: **Movement of the Altamira Landslide: Characterization, Related Impacts, Causation, and Emergency Measures, Rancho Palos Verdes, California**
DATE: March 16, 2025

INTRODUCTION

In this memorandum Cotton, Shires and Associates, Inc. (CSA) summarizes our evaluation of movement of the Altamira Landslide, with specific focus on the characteristics, differences, and causation of movement of this new landslide, distinguishing it from the known historically active Landslide Complex that is comprised of the Portuguese Bend Landslide (PBL), Abalone Cove Landslide (ACL), Klondike Canyon Landslide (KCL) and Beach Club Landslide (BCL). We include the BCL as part of the KCL, because it is, in itself, dormant and nested within (or rafts upon) the KCL. Also discussed are impacts of the Altamira Landslide movement to private property, residential structures, and infrastructure in the landslide area.

DISTINGUISHING THE ALTAMIRA LANDSLIDE

For definition purposes, the Altamira Landslide is a newly active landslide that has occurred within a previously mapped ancient landslide complex, most recently labeled the "Ancient Altamira Landslide Complex" (Douglas, 2013) which was a name modification of the "Ancient Portuguese Bend Landslide" identified on the California Geological Survey's Landslide Inventory Map (CGS, 2007). See the excerpted Figure 1 from Douglas (2013) on the following page for this clarification. It is important to make this distinction for consistency and to avoid confusion, because the Altamira Landslide is, in fact, a new member of the historically active PBL/ACL/KCL Landslide Complex but largely **underlies it** and occupies an area of active land movement >700 acres and extends to more than 500 feet off of the coastline, whereas the shallower historically active PBL/ACL/KCL complex only occupied about 380 acres.

The Altamira Landslide in Rancho Palos Verdes is therefore a recently identified large landslide that largely underlies (and therefore largely encompasses, but exceeds the area of) the previously understood active Landslide Complex containing the four historically active landslides: the PBL which historically began moving in 1956, the ACL which began moving in 1979, the KCL which also began moving in 1979, and the BCL which is nested within the KCL and, while dormant itself, moves along with the KCL. The Altamira Landslide includes large areas outside of the historically mapped boundaries of these known landslides, predominantly upslope and downslope from the historically

mapped PBL and ACL, within, but smaller than, the Ancient Altamira Landslide Complex as defined above. To provide an example of the change in size, the dimensions from head to toe of the previously historical ACL is 2,250 feet and the width up to 1,450 feet wide. The dimensions from head to toe of the Altamira Landslide, underlying and extending up and down slope from both the PBL and the ACL, is 5,800 feet (more than double that of the ACL) with a width of up to 7,400 feet wide (more than five times as wide as the ACL).

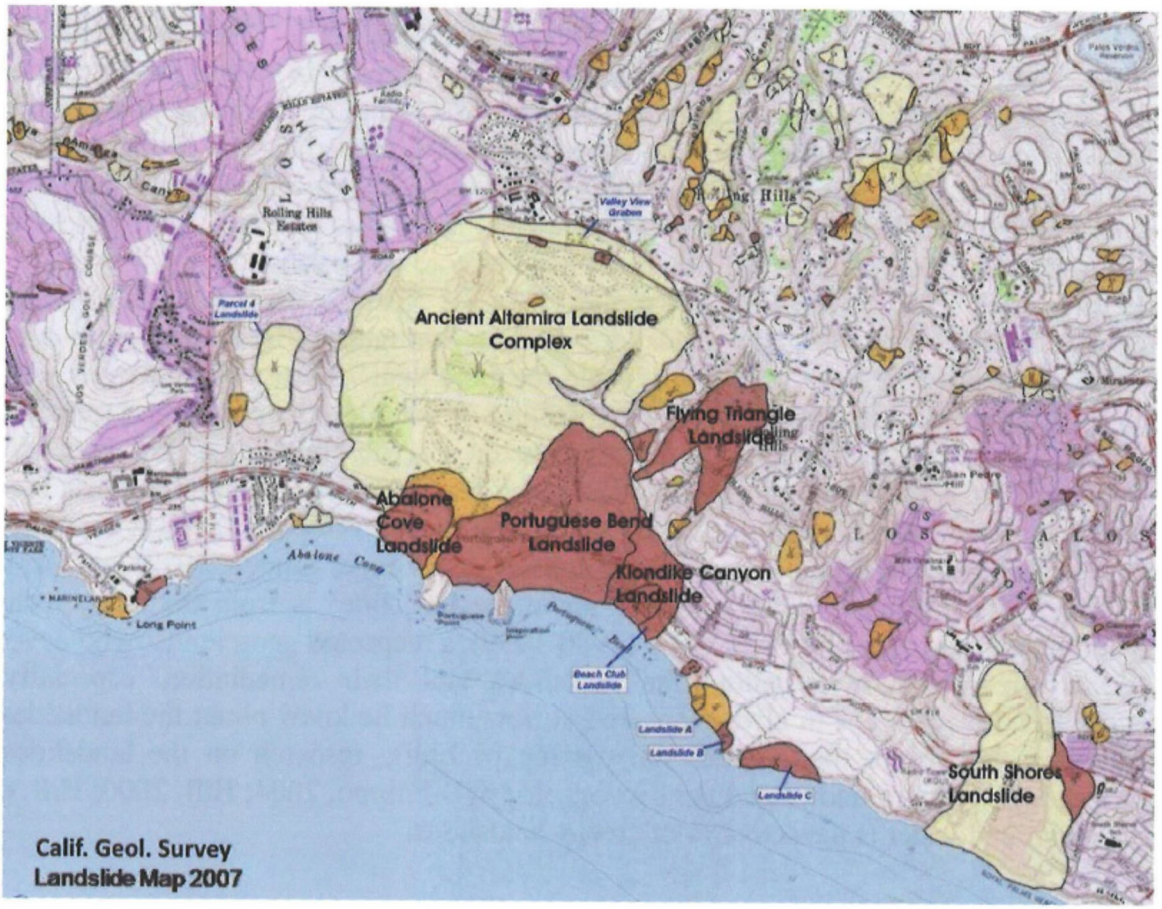


Figure 1. Landslide map of a portion of the south flank of the Palos Verdes Peninsula prepared by the California Geological Survey (2007). The major and some minor landslides are identified. Light yellow indicates that the landslide is inactive, red is active and orange is dormant.

While previous geotechnical investigators identified inactive deep failure surfaces in both the historically active and ancient landslide areas, none of them mapped or identified as active the entire depth or breadth of movement that has recently impacted the area, nor did they opine that such an event would occur in historic times. The active Altamira Landslide currently involves major land movement comprising an area of over 700 acres landward of the coast and extends to approximately 500 feet or more off the coastline. The areal dimensions, depth of movement, velocity of movement, artesian and near-artesian groundwater pressures beneath it, and even the direction of movement, are different than the Abalone Cove, Portuguese Bend, and Klondike Canyon landslides. The distinction to be made then, is that the Altamira Landslide is not just simple *expansion* of an existing group of landslides, it is an entirely different, larger and deeper landslide with much broader boundaries (including the new coastline offshore), nearly twice as deep as the depth of historic landslide movement in some areas, and with unprecedented rates of movement (which were not seen in the early LA County

Engineer surveys, the Charles Abbott Associates surveys beginning in 1994, nor the McGee surveys since 2007). None of this was experienced during the history of the City, and the Altamira Landslide is a unique landslide not characterized in its current dimensions during the over 70-year history of landslide investigations, exploratory borings, monitoring and observations being conducted in the area.

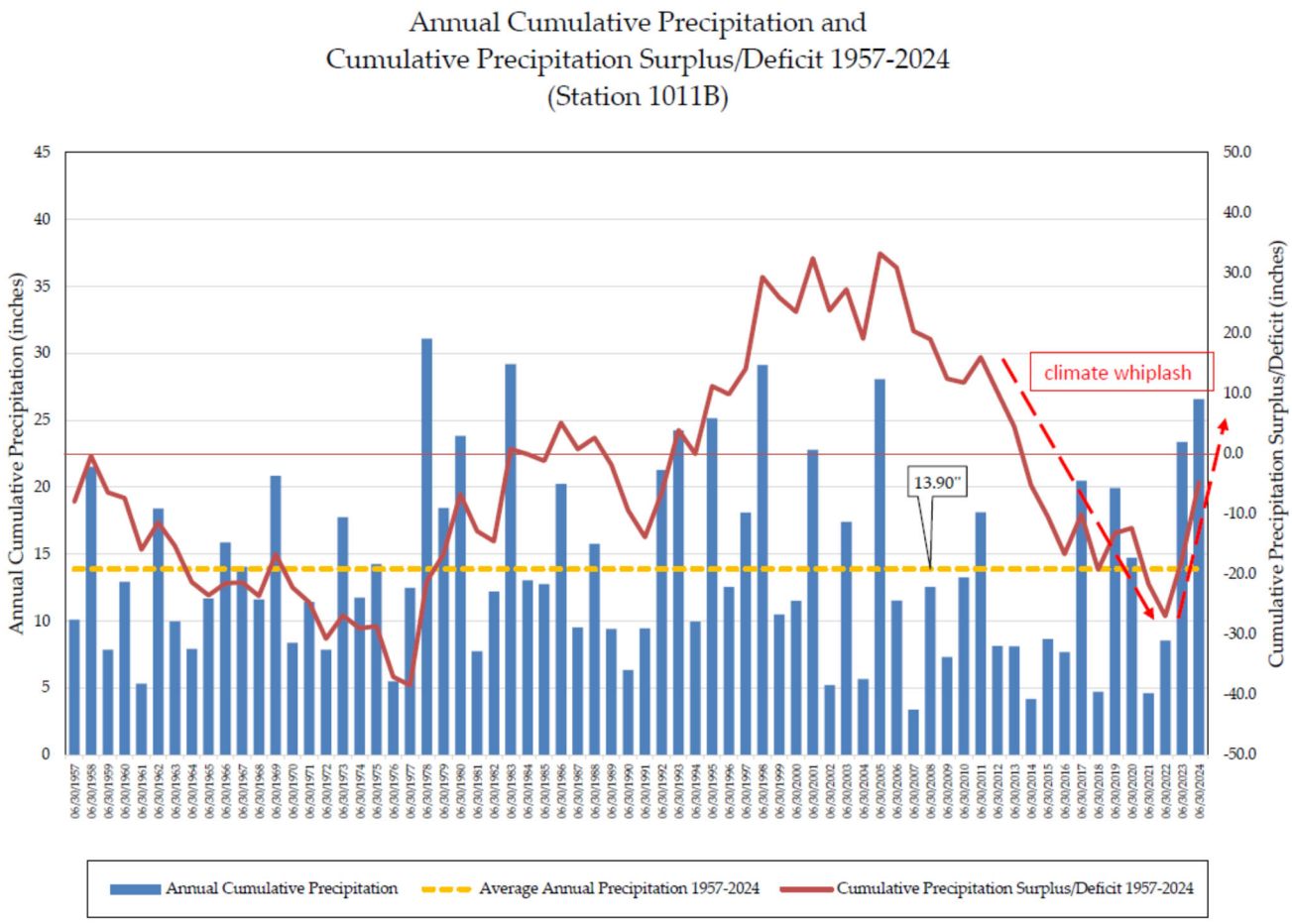
IMPACTS OF MOVEMENT OF THE ALTAMIRA LANDSLIDE

As of this date, the major land movement of the Altamira Landslide has resulted in the red-tagging (Unsafe to Enter/Occupy) and yellow tagging (Limited Entry) of several residential and commercial structures. It has also caused major destructive impacts to public and private roads, damages to utility infrastructure (water, sewer, gas, electricity and cable), causing certain utilities to be shut-off, and closure of certain Preserve land that is otherwise heavily accessed by the public for hiking, biking, equestrian, and other purposes. The only practical mitigation measure available to address a landslide with such a colossal scale is relieving groundwater pore pressures through pumping of groundwater, but it has to be done on a large enough scale to be effective at reducing the movement to an acceptable level. This technique has proven effective for the east side of the Altamira Landslide where deep dewatering wells have been installed, maintained and the rate of ground movement monitored such that a correlation between increased pumping of groundwater and reduction in the rate of ground movement has been confirmed.

CAUSATION

It is our opinion that the activation of the Altamira Landslide was largely caused by "climate whiplash" (also more technically described as hydroclimate volatility) induced by climate change, particularly starting in 2011, with five years of drought, and eight out of eleven years significantly below normal rainfall from 2011-2022, followed by two consecutive extraordinarily heavy rain seasons that dropped approximately 4 feet of rainfall on the landslide and surrounding areas draining into the landslide on the south flank of the Palos Verdes Hills.

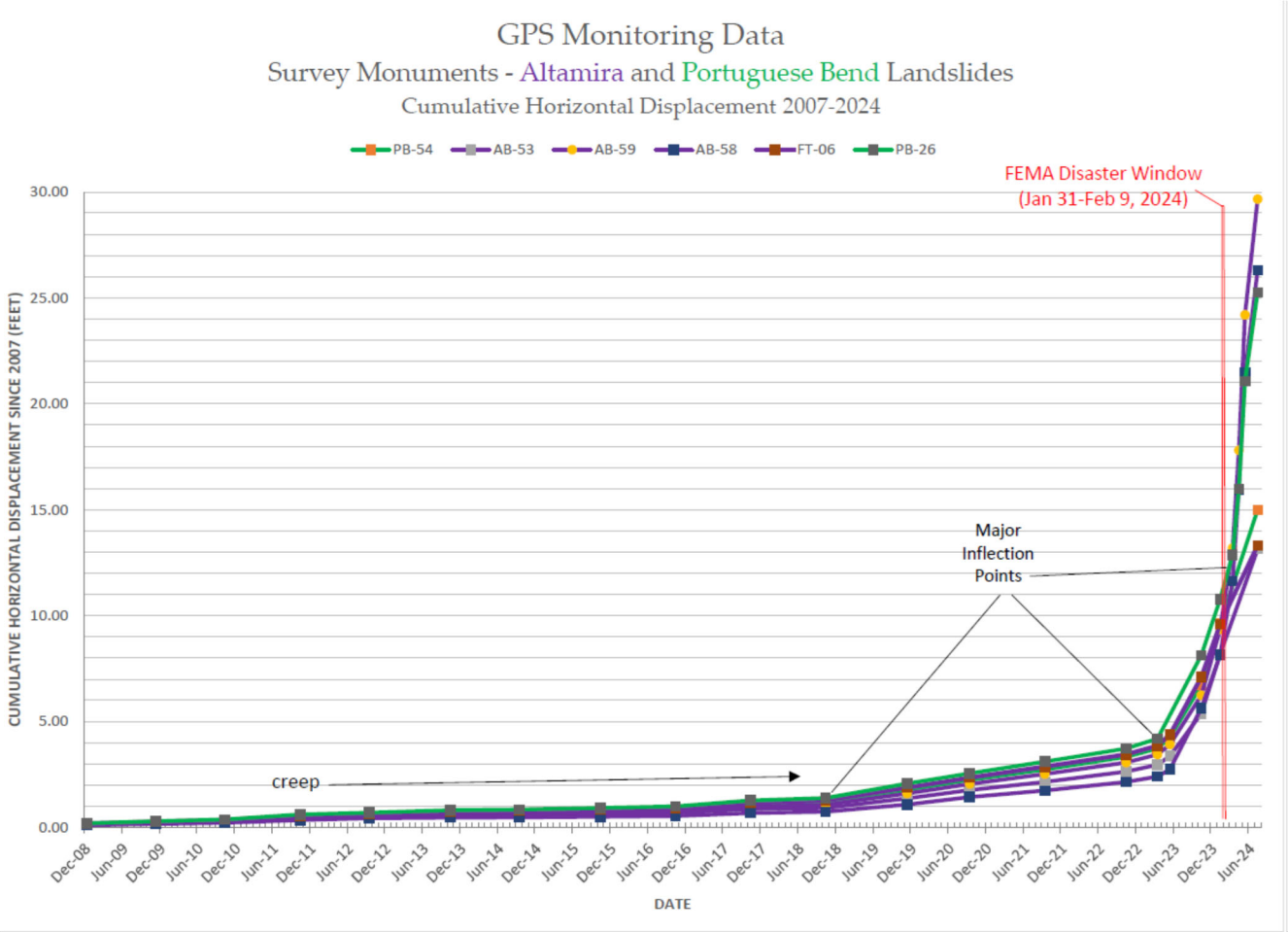
As illustrated in the following graphic, using data gathered by Los Angeles County Department of Public Works Stormwater Engineering Division, we analyzed annual rainfall deviations from the mean, and tallied up those cumulative deviations over time, as a measure of *precipitation surplus/deficit* that has impacted the area. The dark red line on the graphic shows the precipitation surplus/deficit over time. A precipitous drop is noted in the surplus/deficit line, particularly from 2011-2022, which whipsaws back to a steep climb from 2022 through 2024. Climate whiplash is illustrated by the red dashed arrows, showing the impact of the dry years (on a rapidly declining surplus/deficit curve) quickly reversing to a steeply inclining surplus/deficit curve. It is not important that this whiplash or volatility occurred in *deficit* territory on the graph, because it followed a two-decade long period of significant precipitation surplus. Two decades of precipitation surplus between 1991 and 2011 likely contributed to *strain-softening* of the Altamira Landslide failure surface clays, as the landslide began imperceptibly creeping and elongating/stretching out over a prolonged period. It follows that this generally prolonged period of drying commencing in 2011, followed by a large pulse of wetting from 2022 through the winter of 2024, and culminating in an intense barrage of rainfall from January 31st through February 9th 2024, triggered the massive Altamira movement and accelerated the landslide to unprecedented rates of movement.



Of note is that 8.29 inches of rain fell at the Rolling Hills Fire Station rain gauge from January 31st through February 9th 2024. The mean (average) rainfall for the Rolling Hills Fire Station's 57-year rainfall data set is currently 13.88 inches/year and the standard deviation of the entire 57-year dataset is 7 inches/year, indicating very high variability in annual rainfall. More rain fell between January 31st and February 9th 2024 than the standard deviation for the entire 57-year rainfall data set, indicating that this storm sequence was a statistically rare, outlier event.

The following graphic depicts *cumulative horizontal displacement* of select GPS survey monitoring points, including some of the fastest moving points in the Altamira Landslide and a couple of representative points in the PBL (which overlies the Altamira Landslide). There are three significant inflection points indicated in the graph. Prior to the first inflection point, the cumulative displacement lines indicate that the GPS monitoring points within the Altamira Landslide were creeping quite slowly (imperceptibly, near the range of instrument precision) for a number of years extending back before 2011. There was no observed or documented surface manifestation of this minor creep movement at the ground surface; however, this movement is believed to have caused deformation (elongation or stretching out of the earth materials comprising the subsurface which in turn causes additional

fracturing of those earth materials) of the Altamira Landslide body, which increased secondary permeability within the rock mass allowing rainfall at the ground surface to percolate more readily into the deep subsurface, raising groundwater levels to a point where they result in high pore pressures that contribute to landslide movement. Between the October 2018 and October 2019 GPS readings (first inflection point), an acceleration of creep movement is evident. Then following the multiple atmospheric river rains of January and February 2023 (second inflection point), a further acceleration of creep movement is evident, which would have resulted in further stretching out and opening up of the landslide mass. The final inflection point around March, 2024 (immediately following the FEMA-declared disaster of January 31-February 9 wherein 8.29 inches of rain fell) shows a dramatic acceleration and **represents the triggering of major movement of the Altamira Landslide**, as reflected by some of the graphed points going very steep and nearly vertical on the graph. The graph includes GPS monitoring point AB-59, which has been the fastest moving point and is not surprisingly located in the center of the entire Altamira Landslide mass.



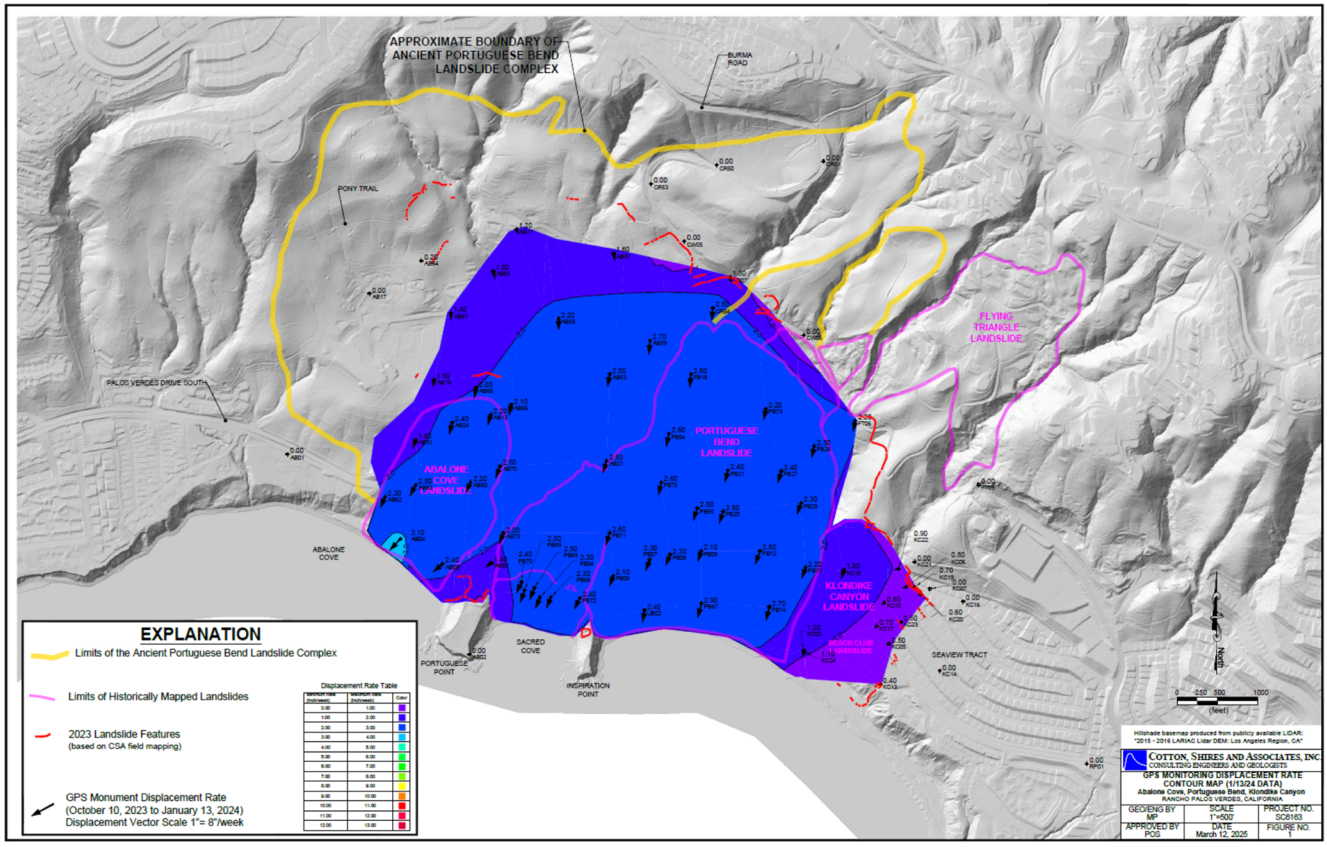
The change in ground movement rates before January 31st and after February 9th 2024 is significant. Based on our comprehensive review of the McGee GPS survey monitoring, the rates of

Altamira Landslide ground movement in the Abalone Cove area (for points north of the previously active ACL) as of January 13, 2024 ranged from 1.2 inches per week (at the periphery) up to 2.7 inches per week (in the body of the landslide). After that intense period of rainfall, plus additional rainfall resulting in a total of over 11 inches in February, as of the GPS survey completed on March 8, 2024, the rates increased to 1.5 (at the periphery) to 5.9 (main body) inches per week, more than doubling in the body of the landslide, and then increased dramatically to as much as 13.5 inches per week in the body of the landslide by July 1, 2024, probably as a slightly delayed reaction to the rainfall as it took time for the water to convert from rainfall absorption to higher groundwater pore pressures where it could have the greatest driving force impact on landslide movement.

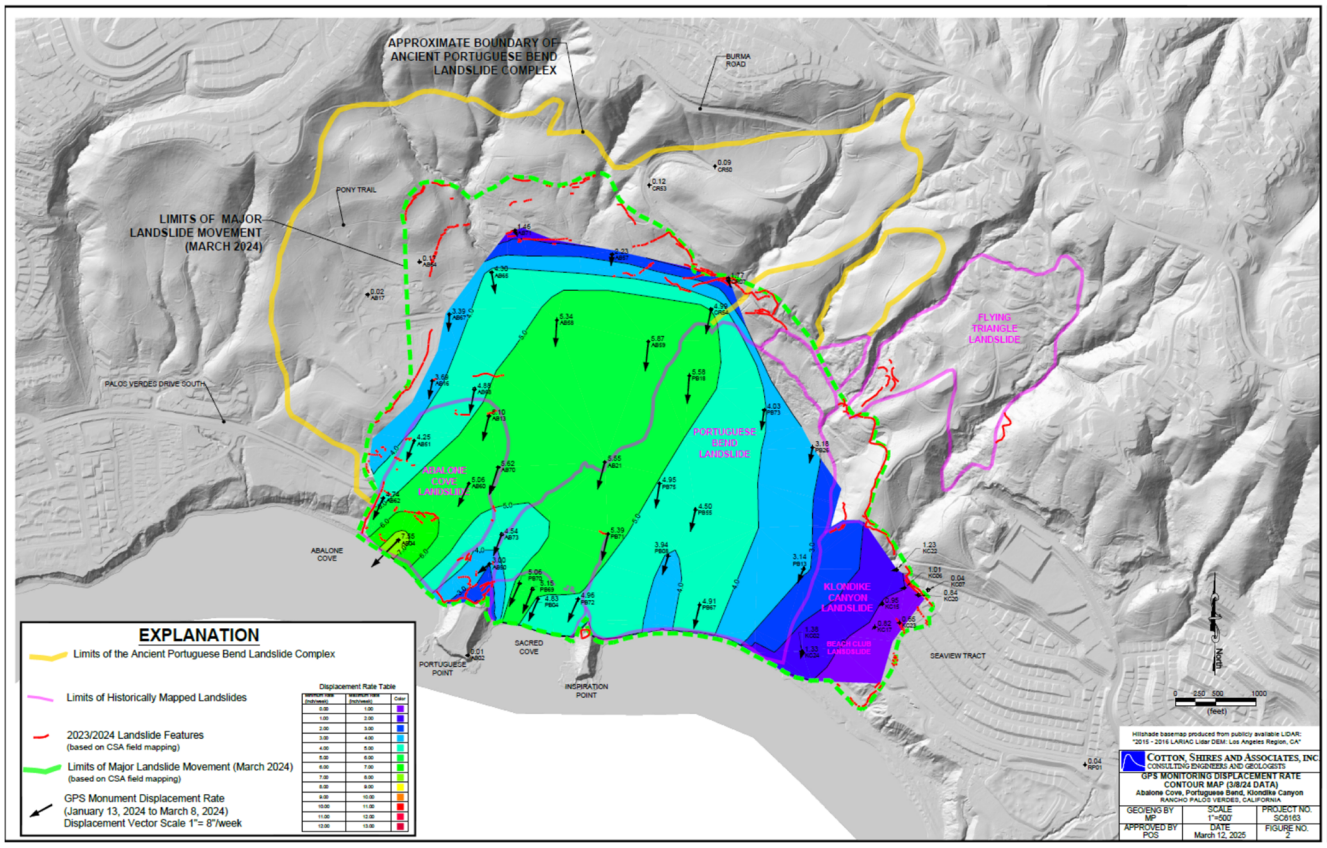
The graphics on the following two pages are "heat maps" that illustrate in color contours the rates at which the ground was moving based on the GPS survey monuments for January 13, 2024, March 8, 2024 and July 1, 2024, respectively. The heat maps include our on-ground geologic mapping of visible land movement features, which started as tension cracks or narrow fissures that were discontinuous (as of December 2023 mapping and are shown on the January 13, 2024 heat map), but these features further developed into more continuous/connected tension cracks and fissures, which have now developed into large scarps, grabens and well-developed boundary features. It wasn't until March 2024 that we first drew a boundary (dashed green line) around the "Area of Major Land Movement", because prior to that time, the surface manifestation of movement was poorly developed and inconsistent and there was not sufficient development of the landslide to develop a boundary. By March 2024, with further mapping and the extraordinary acceleration of numerous GPS monitoring points, a boundary defining the "Area of Major Land Movement" was delineated. Today, following many tens of feet of movement since early 2024, the boundary of the Altamira Landslide is well-defined. North of PV Drive South, the Altamira boundary extends significantly further west of the historical ACL boundary (resulting in the destruction of the landmark Wayfarer's Chapel), upslope through the York property (6001 PV Drive South), and north of the historical ACL boundary through the Portuguese Bend Riding Club Area, crossing upper Narcissa Drive, through and north of residences on upper Cinnamon Lane, and eventually turning east across Altamira Canyon, extending through the Vanderlip Estate (100 Vanderlip Drive), destroying Vanderlip Drive and adjacent properties, and ultimately continuing northeast to the lower stretch of Burma Road Trail in the Portuguese Bend Reserve.

The Altamira Landslide movement also created never-before-seen deformation where it underlies and now extends south of the KCL, including formation of a more seaward toe accompanied by uplifting ground that trended southwest through the beach area of the Portuguese Bend Beach Club and extending up to 500 feet or more offshore where it emerged through the sea floor and formed a new rocky coastline above sea level, generally east of Inspiration Point. The emergence of the new land offshore from the previous coastline was first reported to, and was subsequently observed by the City Geologist in late February of 2024, consistent with the triggering of major movement of the Altamira Landslide described above.

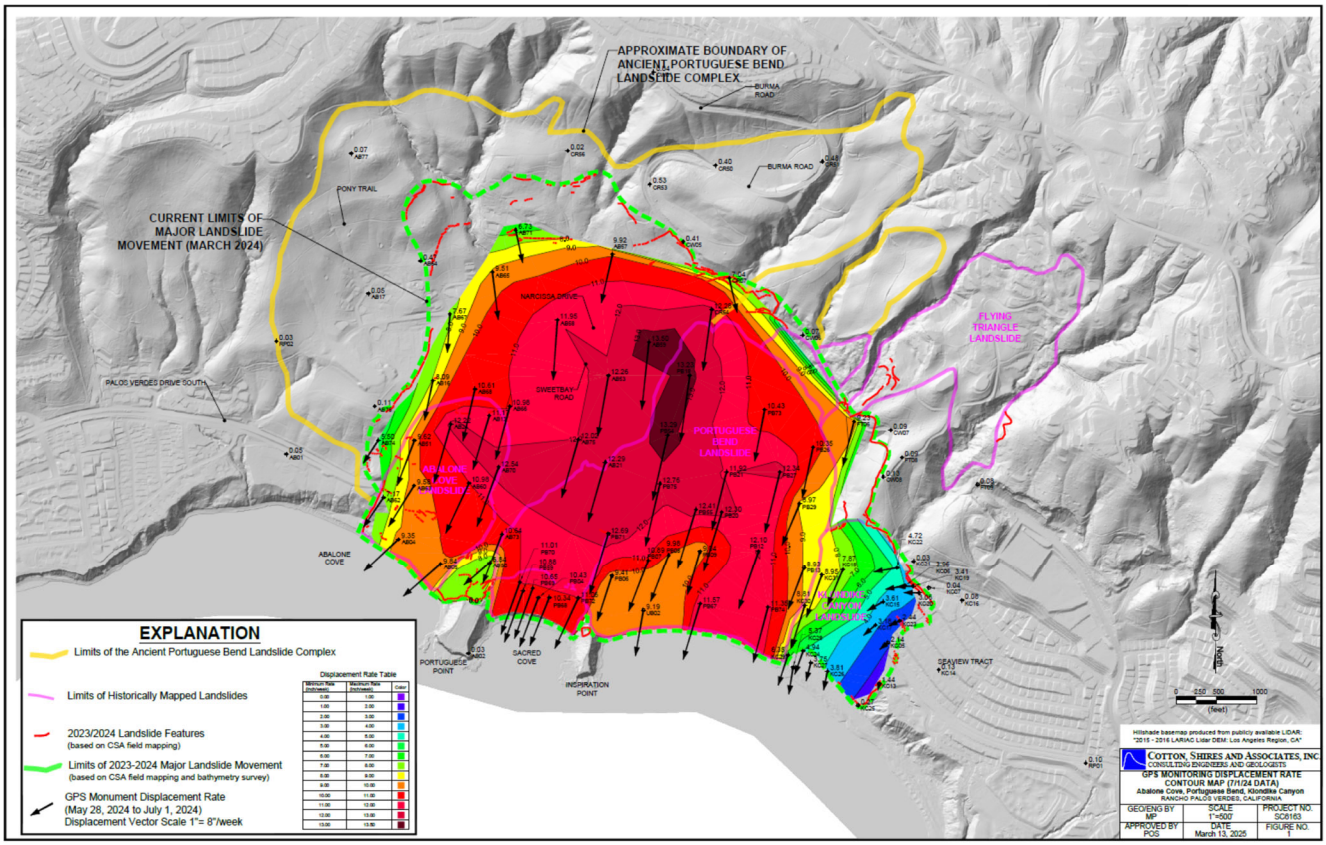
1/13/2024 Heat Map



3/8/2024 Heat Map



7/1/2024 Heat Map

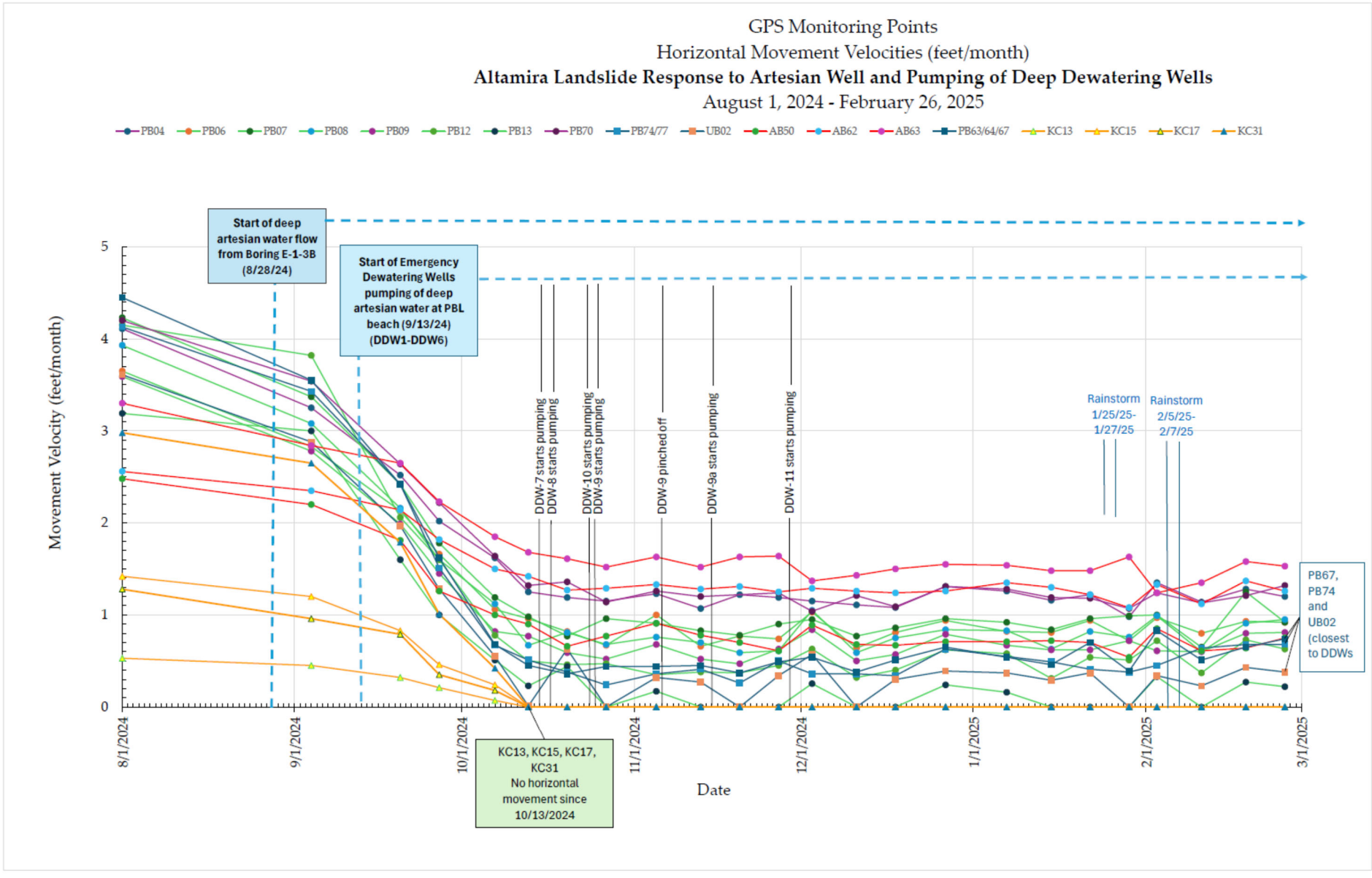


EMERGENCY MEASURES

Emergency measures taken by the City and abatement districts (ACLAD and KCLAD) to date have included drilling, pumping and monitoring deep dewatering wells, winterization measures including lining channels and installing culverts to reduce the amount of surface water percolating into the groundwater regime from upslope drainages/canyons, and filling of and establishing drainage for fissures and grabens that, if left unmitigated, facilitate surface water intrusion into the groundwater regime. This strategy has proven to be effective in reducing the rate of movement of the Altamira Landslide and even stopping movement of the eastern portion of the landslide in the area of the KCL. Because piezometers installed in deep borings that penetrated the base of the Altamira Landslide indicated high groundwater pore pressures beneath the landslide (some areas were found to have near-artesian or artesian groundwater pressures – pressures higher than the ground surface), a pilot program strategy was pursued that involved drilling a series of five deep dewatering wells near the coast to approximately 50 feet below the base of movement and pumping the wells until the landslide movement sheared off the well casings at depth and then re-drilling them to approximately 50 feet beneath the landslide to re-establish the wells so that they could continue to be pumped to dewater the high groundwater pressures beneath the landslide. This strategy turned out to be more successful than originally contemplated because the movement of the landslide slowed quickly in response to the initial dewatering efforts and the deep wells continued to function for weeks or months before re-drilling was necessary.

The chart on the following page illustrates the timing of artesian water being encountered in one of the test borings (Boring E-1-3B, which was retrofitted to function as an artesian well), the installation of the deep dewatering wells, and the deceleration of the Altamira Landslide in response to the dewatering efforts.

Based on the success of the deep dewatering program, we now know that this strategy works. Consequently, the City agreed to loan the landslide abatement districts funding so that they could re-establish wells that were no longer functioning and to establish deep dewatering wells at additional locations as well as to establish additional measures to reduce infiltration of surface water. Additional wells are also needed in the areas that the City controls. Unfortunately the cost of drilling, pumping, maintaining and re-drilling requires significant funding which the City was able to keep up with to a point, but now needs additional funding assistance to keep the wells that have already been established functioning and to establish additional deep dewatering wells in order to reduce the movement of the middle and eastern portions of the Altamira Landslide to the level experienced prior to the impact of climate whiplash.


GPS Monitoring Points
Horizontal Movement Velocities (feet/month)
Altamira Landslide Response to Artesian Well and Pumping of Deep Dewatering Wells
August 1, 2024 - February 26, 2025
PB04 PB06 PB07 PB08 PB09 PB12 PB13 PB70 PB74/77 UB02 AB50 AB62 AB63 PB63/64/67 KC13 KC15 KC17 KC31
Start of deep artesian water flow from Boring E-1-3B (8/28/24)
Start of Emergency Dewatering Wells pumping of deep artesian water at PBL beach (9/13/24) (DDW1-DDW6)
DDW-7 starts pumping
DDW-8 starts pumping
DDW-10 starts pumping
DDW-9 starts pumping
DDW-9 pinched off
DDW-9a starts pumping
DDW-11 starts pumping
Rainstorm 1/25/25-1/27/25
Rainstorm 2/5/25-2/7/25
PB67, PB74 and UB02 (closest to DDWs
KC13, KC15, KC17, KC31 No horizontal movement since 10/13/2024
Movement Velocity (feet/month)
Date
0
1
2
3
4
5
8/1/2024
9/1/2024
10/1/2024
11/1/2024
12/1/2024
1/1/2025
2/1/2025
3/1/2025

City of Rancho Palos Verdes

John Cruikshank, Mayor
Eric Alegria, Mayor Pro Tem
David L. Bradley, Councilmember
Barbara Ferraro, Councilmember
Paul Seo, Councilmember

February 20, 2024

California Office of Emergency Services Disaster Analysis Unit
3650 Schriever Avenue
Mather, CA 95655

SUBJECT: REQUEST FOR A STATE OF EMERGENCY FOR THE GREATER PORTUGUESE BEND LANDSLIDE COMPLEX

To whom it may concern:

On behalf of the approximately 42,000 residents of Rancho Palos Verdes and the approximately 67,000 residents of the Palos Verdes Peninsula, the Rancho Palos Verdes City Council is requesting Governor Newsom invoke his emergency powers pursuant to the Emergency Services Act, Gov't Code § 8550 et seq., and proclaim a State of Emergency for the Palos Verdes Peninsula region to assist the City to stabilize land movement in the greater Portuguese Bend Landslide Complex (Landslide). For reference, see attached map to show the boundaries of the Landslide.

As a result of the 2023 and 2024 winter storms, the City of Rancho Palos Verdes has been impacted by substantial precipitation that has caused an unprecedented acceleration of land movement equating to an annualized rate of 10 feet per year. This significant and sudden increase in land movement is causing severe damage to Palos Verdes Drive South – a major arterial roadway and evacuation route for the Palos Verdes Peninsula; damage and disruption to utility infrastructure including water, sewer, gas line and utility pole breaks; closures of approximately 8 miles of public trails due to slope instability; fissures and sink holes throughout the Palos Verdes Nature Preserve; the closure of residential intersections due to sink holes and ground separation; the temporary closure of the Wayfarers Chapel - a federal and state designated historic landmark; and the red-tagging of homes with many more homes on a watch list due to foundation and structural damage.

On October 3, 2023, the Rancho Palos Verdes City Council adopted a Local Declaration

of Emergency pursuant to Section 8630 of the Government Code, which has been renewed several times as required by that law; the Local Emergency is still in effect.[1] This action was intended to provide immediate access to resources and to assist in expediting remediation measures to stabilize and manage land movement that poses an imminent threat to the public's health, safety, and property. The City's Geologist and Geotechnical Engineering team and the two state-recognized Geologic Hazard Abatement Districts' geologists (Abalone Cove Landslide Abatement District and Klondike Canyon Landslide Abatement District) propose to stabilize land movement by immediately implementing the following:

- Filling fissures to prevent surface water from directly recharging the water table and further lubricating the slip plane.
- Constructing drainage swales, lining certain canyons with non-penetrable membrane, and/or installing flexible drainage pipes to properly convey surface water to the ocean and/or sanitary lines to prevent recharging the water table.
- Installing dewatering wells in the form of horizontal hydraugers and/or vertical dewatering wells to extract groundwater from the slip plane and reducing the local water table.

As the City continues its response and recovery operations, we have determined that these remediation measures must be implemented immediately to minimize the threat to the public's health, safety, and property. Therefore, the City Council requests, pursuant to the authority provided by the Act, and specifically by Sections 8571 and 8625 of the Government Code, that the Governor declare a State of Emergency for the City of Rancho Palos Verdes, waive and/or suspend certain state laws and permits required by local and state agencies that include, but are not limited to, the California Coastal Commission, the California Department of Fish and Wildlife, the Regional Water Quality Control Board, the State Water Resources Control Board, the South Coast Air Quality Management District, and other State agency permits or review processes. Finally, the City Council requests the Governor waive any requirements under the California Environmental Quality Act and its implementing regulations related to the approval and implementation of the remediation measures set forth above. Additionally, the City is requesting that the Governor submit a request to the President of the United States for a Federal Emergency Declaration pursuant to the Stafford Act, 42 U.S.C. §§ 5121-5207.

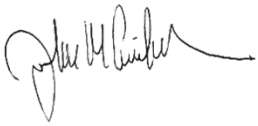
The City has identified that permits would be required by the aforementioned state agencies prior to proceeding any landslide stabilization work. Suspension of these requirements will allow the City and the Geologic Hazard Abatement Districts to immediately proceed with construction and installation of the enumerated measures to stabilize the Landslide without the costs and time delays typically experienced with obtaining permits. It is imperative that the City and two Geologic Hazard Abatement Districts are able to expedite the installation of dewatering wells and surface drains knowing that we are in an El Niño winter pattern with repeated atmospheric rivers

[1] The City also adopted an Interim Urgency Ordinance pursuant to Section 65958 of the Government Code, which effected a moratorium on all construction in the Landslide, with some limited exceptions.

forecasted to extend into spring, and every rain event is exacerbating the rate of land movement.

Please contact City Manager Ara Mihranian at aram@rpvca.gov or by telephone at 310-544-5202.

Sincerely,



John Cruikshank
Mayor

Attachments:

- Portuguese Bend Landslide Complex Map
- Information on the Portuguese Bend Landslide including resolutions adopting and extending the City's Proclaimed Local Emergency can be found on the City's website at: www.rpvca.gov/landslide

cc:

Laphonza Butler, U.S. Senator, California
Alex Padilla, U.S. Senator, California
Ted Lieu, U.S. Representative, 36th Congressional District
Ben Allen, Senator, 24th State Senate District
Al Muratsuchi, Assemblymember, 66th Assembly District
Janice Hahn, L.A. County Supervisor, 4th District
Kevin McGowan, Director, L.A. County Office of Emergency Management
Brandy Villaneuva, Disaster Manager Area Coordinator, L.A. County Area G
Rancho Palos Verdes City Council

CREST ROAD

BURMA ROAD

PONY TRAIL

ANCIENT PORTUGUESE BEND LANDSLIDE COMPLEX

NARCISSA DRIVE

FLYING TRIANGLE LANDSLIDE

PALOS VERDES DRIVE SOUTH

SWEETBAY ROAD

ABALONE COVE LANDSLIDE

PORTUGUESE BEND LANDSLIDE

KLONDIKE CANYON LANDSLIDE

ABALONE COVE

SACRED COVE

PORTUGUESE POINT

INSPIRATION POINT

SEAVIEW TRACT

North

0 250 500 1000

(feet)

EXPLANATION

- Limits of the Ancient Portuguese Bend Landslide Complex
- Limits of Historically Mapped Landslides
- 2023 Landslide Mapping
- Current Limits of Major Landslide Movement (February 2024)

Hillshade basemap produced from publicly available LiDAR: "2015 - 2016 LARIAC Lidar DEM: Los Angeles Region, CA"

COTTON, SHIRES AND ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS

LANDSLIDE MAPPING UPDATE 2/20/24
Abalone Cove, Portuguese Bend, Klondike Canyon
RANCHO PALOS VERDES, CALIFORNIA

GEO/ENG BY	SCALE	PROJECT NO.
MP	1"=500'	SC6163
APPROVED BY	DATE	FIGURE NO.
POS	February 2024	1

CITY OF RANCHO PALOS VERDES
ADMINISTRATION DEPARTMENT
CITY MANAGER'S OFFICE

March 17, 2025

Via email and Grants Portal

Mr. Robert Fenton
FEMA District No. 9 Administrator

Robert Larsen, Public Assistance Officer
California Office of Emergency Services

Subject: Appeal of FEMA's Eligibility Determination, Project Number 753364
FEMA-4769-DR-CA, California's Severe Winter Storms, Tornadoes, Flooding, Landslides, and Mudslides (Damage Inventory No. 1386234)

Dear Messrs. Robert Fenton and Robert Larsen,

On April 13, 2024, the President declared a major disaster (**FEMA-DR-4769-CA**) in the State of California due to damages from severe winter storms, tornadoes, flooding, landslide and mudslides with an incident period of **January 31 through February 9, 2024**. The declared disaster by the President is similar to a federal disaster declared on April 3, 2023 for California Severe Winter Storms, Straight-Line Winds, Flooding, Landslides and Mudslides that occurred between **February 21, 2023 and July 10, 2023 (DR-4699-CA)**.

On May 9, 2024, the City of Rancho Palos Verdes (City) filed for disaster aid cost recovery for the City's response to the 2024 winter storms. In total, the City filed applications totaling $38.4 million.

On January 17, 2025, the City received FEMA's Eligibility Determination Memorandum **denying** in full the City's request for $9 million to conduct emergency protective measures consisting of increased monitoring, installation of directionally drilled dewatering wells (hydraugers), deep dewatering wells, and fissure repairs in canyons, hillsides and slopes in response to the winter storms that occurred between January 31 and February 9, 2024. The denial cites the following reasons:

- Pre-disaster ground instability and on-going non-disaster related causes.
- Disaster damage was not a result of the declared disaster event.
- Pre-existing conditions of landslide.

According to Section 102.1 and 102.2 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, an "Emergency" means *any occasion or instance for which, in the determination of the President, Federal assistance is needed to supplement State and local efforts and capabilities to save lives and to protect property and public health and safety, or* ***to lessen or avert the threat of a catastrophe (emphasis added)*** *in any*

part of the United States. Moreover, a "Major Disaster" *means any natural catastrophe (including any hurricane, tornado, storm, high water, winddriven water, tidal wave, tsunami, earthquake, volcanic eruption,* ***landslide (emphasis added)****, mudslide, snowstorm, or drought), or, regardless of cause, any fire, flood, or explosion, in any part of the United States, which in the determination of the President causes damage of sufficient severity and magnitude to warrant major disaster assistance under this Act to* ***supplement the efforts and available resources of States, local governments, and disaster relief organizations in alleviating the damage, loss, hardship, or suffering caused thereby (emphasis added)****.*

The City's disaster recovery request was submitted to FEMA based on the aforementioned definitions found in the Stafford Act and the declared major disaster resulting from winter storms of 2024 that **contributed to a significant and documented acceleration of land movement caused by the activation of a <u>new</u> historic and previously dormant landslide known as the Altamira Landslide** within the Greater Portuguese Bend Landslide Complex (Landslide Complex).

According to the City Geologist's reports to the City Council in 2024, the **Altamira Landslide is a deeper slip plane that the Landslide Complex "rafted" on top of as a direct result of the unprecedented and record rainfall during the 2024 winter storm event resulting in the shallower slip plane of the Landslide Complex to move more than it ever did before in its documented history**. Contrary to FEMA's Eligibility Determination Memorandum, what is **not pre-existing** are the areal dimensions, depth of movement, velocity of movement, artesian and near-artesian groundwater pressures beneath it, and even direction of movement. The land movement experienced as a result of the 2024 winter storms is not just a simple **expansion** of the Landslide Complex, but is an **entirely different, larger and deeper landslide with much broader boundaries** (including the new coastline offshore at the Portuguese Bend Beach Club), nearly twice as deep in some areas, and unprecedented rates of movement. None of this was seen during the history of the City, nor during the approximately 70-year history of landslide studies, monitoring, and observations conducted in the area, contrary to what is noted in the Eligibility Determination Memorandum. It is the opinion of the City and its subject matter experts, that will be discussed in this appeal letter, that this is largely caused by "weather whiplash" (induced by climate change) starting in 2011.

The City respectfully requests that you, as FEMA's District No. 9 Administrator, reverse the eligibility denial and uphold the City's appeal based on facts, data and other pertinent information found in this appeal letter that will clearly demonstrate that a new landslide was activated causing an acceleration of land movement as a direct result of the 2024 winter storms resulting in costly and significant damage to the City's infrastructure. The City firmly believes that this **appeal letter** will demonstrate that the requested cost recovery work complies with Title 44 of C.F.R. Section 206.223(a)(1) in that the financial assistance requested is directly related to the winter storms of 2024. As such, the City is requesting **$**9 **million** to conduct emergency protective measures consisting of increased monitoring, installation of directionally drilled dewatering wells (hydraugers), deep

dewatering wells, and fissure repairs in canyons, hillsides and slopes for damage sustained to its drainage infrastructure and the need to install deep dewatering wells to relieve artesian pressure through the extraction of groundwater to stabilize land movement.

Historic Background

As noted in the January 17, 2025 Eligibility Determination Memorandum and throughout various City records, the Landslide Complex is a known ancient landslide that was activated in 1956 when, prior to the City's 1973 incorporation, Los Angeles County was expanding Crenshaw Boulevard to Palos Verdes Drive South and its grading efforts combined with ground water, activated the Portuguese Bend Landslide. Land movement has not stopped since 1956 but has been managed at a slow creep to no movement for years through remediation efforts implemented by the City and its two geologic hazard abatement districts, Abalone Cove Landslide Abatement District (ACLAD) and Klondike Canyon Landslide Abatement District (KCLAD).

The Landslide Complex, historically existing for thousands of years, encompasses the following four sub-landslide areas in the City: the Portuguese Bend Landslide (PBL), the Abalone Cove Landslide (ACL), the Klondike Canyon Landslide (KCL), and the Beach Club Landslide (BCL). As noted above, in 1956, the PBL began moving, then in 1979, ACL and KCL began moving with the BCL, which is nested within the KCL and, while dormant itself, moves with the KCL. The Landslide Complex also includes areas outside of those known landslides, predominantly uphill from the PBL and ACL, within the ancient Landslide Complex as mapped by various agencies (i.e., U.S. Geological Survey and California Geological Survey) and other researchers. This fifth landslide is in the City of Rolling Hills and is known as the Flying Triangle Landslide.

According to a November 8, 2024 report prepared by the City Geologist, Mike Phipps of Cotton Shires and Associates (CSA) (Attached), the PBL has been continuously active since reactivation in 1956 with many areas of the landslide having moved hundreds of feet seaward over the ensuing seven decades. The ACL was active from 1979 **until the late 1990's**, involving only several feet of movement, when dewatering and other mitigation efforts largely halted movement. An **imperceptible creep movement** of the ACL has occurred over the past 25 years **following rainy seasons that were significantly above average rainfall amounts.** The KCL has been episodically active in 1979-1983 and 2005-2006, experiencing only several inches of movement, typically in response to significantly above average rainfall. Landslide movements throughout the Landslide Complex **outside of the historical boundaries of** the ACL and PBL previously exhibited low rates of creep movement, or movement at or near the instrument precision range, in the 11-year monitoring period of 2007-2018.

Impacts of Rainwater

These landslides are deep translational-type failures within seaward-dipping strata of the

Monterey Formation, with the landslide slip surfaces occurring within very weak bentonitic clay beds. Historically, the movement behavior of these landslides routinely exhibited high sensitivity to increased groundwater pore pressure, and increased rates of land movement which have been **correlative with 6-to-12-months of antecedent rainfall that was well above average**. Similarly, land movement decreased during below average rainy seasons or multi-year periods of drought.

Simply stated, numerous studies conducted over approximately seven decades all point to water as being the primary contributor to land movement, particularly rainwater. Rainwater runoff is known to penetrate the ground through fissures during a rain event and recharge the ground water table. During particular significant rain events or seasons, runoff that enters the ground may take months to show signs of land movement. Depending on where rain runoff enters the ground, it can settle below the slip plane thereby resulting in artesian pressure or settle above the slip plane, which is made up of volcanic ash known as bentonite and lubricates the slip plane resulting in horizontal movement.

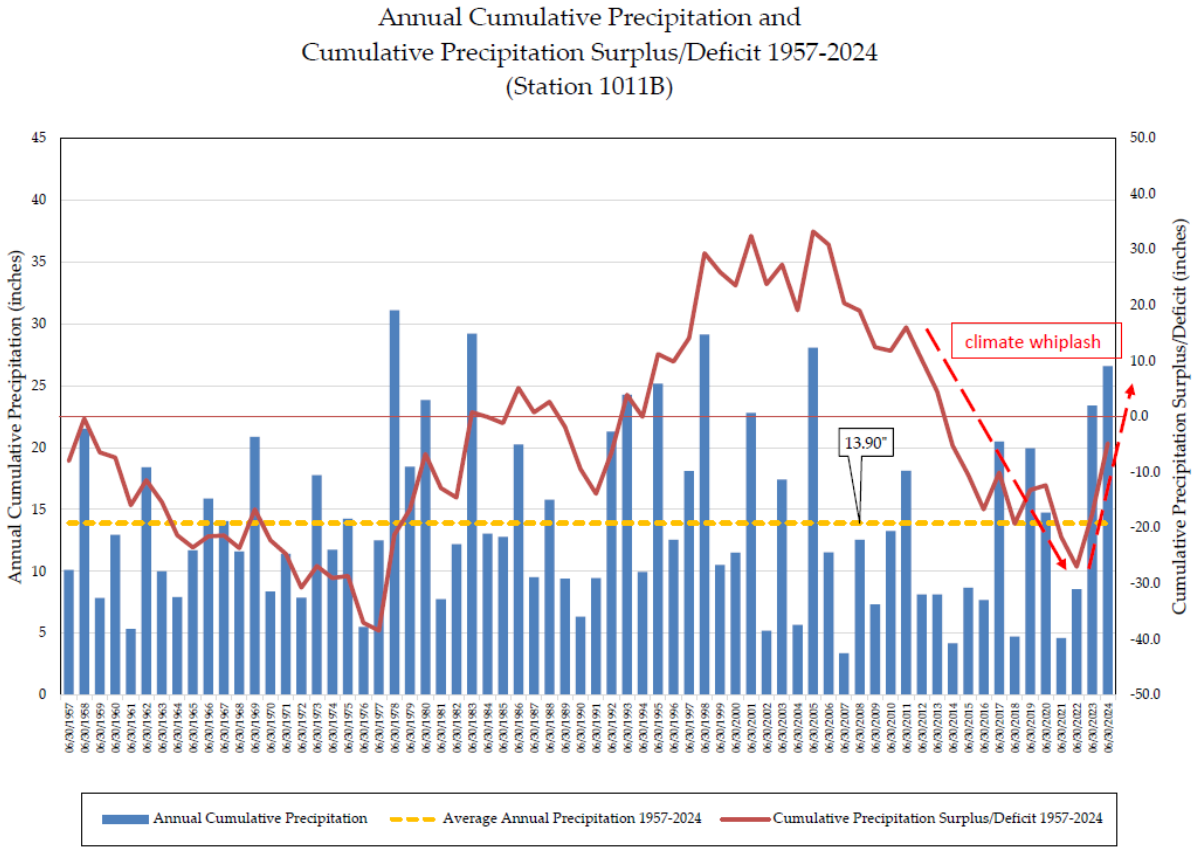
Changes in climate over the years, now commonly referred to as “weather whiplash” has resulted in extreme weather in Southern California including extended periods of dry weather followed by severe wet weather in the form of atmospheric rivers as experienced in 2023 and 2024. This extraordinary wet weather resulted in the President declaring a major federal disaster in both 2023 and 2024. Underscoring how extreme weather has become over the years, in August 2023, California, particularly Southern California, experienced days of record rain in August 2023 as a result of Tropical Storm Hillary.

Extreme wet weather patterns have proven to contribute towards the change in behavior of the Landslide Complex. Beginning in 2021, the City Geologist began reviewing Global Positioning Satellite (GPS) monitoring data for survey monuments within the entire Landslide Complex. Review of GPS monitoring data from 2007 through 2024 indicated that land movement acceleration initially began between 2018 and 2019. This acceleration was correlative with significantly above-normal rainfall in two out of three prior rainfall seasons (2016-17 and 2018-19) which followed five consecutive drier than normal rainfall seasons (2011-12 through 2015-16).

Another way to look at this is to analyze annual rainfall deviations from the mean, and tally up those cumulative deviations over time, as a measure of *precipitation* surplus/deficit that is impacting the area. According to the graphic on the following page, in which the dark red line shows the precipitation surplus/deficit over time, note the precipitous drop particularly from 2011-2022, which whipsaws back to a steep climb from 2022-2024. Weather whiplash is illustrated by the red arrows, showing the impact of the dry years (rapidly declining surplus/deficit curve) quickly reversing to a steep inclining surplus/deficit curve. It doesn't matter that this all happened in *deficit* territory on the graph, because it followed a two-decade long period of precipitation surplus. It is reasonable to say that two decades of precipitation surplus between 1991 and 2011 might have contributed to **strain-softening** of the Altamira failure surface clays, as the landslide

imperceptibly crept and stretched out. It follows that this generally prolonged period of drying commencing in 2011, followed by a short, huge pulse of wetting between 2022-2024, is what **triggered** the massive previously inactive Altamira Landslide to move in 2024.

It is also worth noting that 8.29 inches of rain fell at the Rolling Hills Fire Station rain gauge during the 10-day FEMA disaster window. Keep in mind, the mean (average) for the 57-year rainfall data set is currently 13.88 inches/year and the standard deviation of the entire 57-year dataset is a whopping 7 inches/year, indicating very high variability in annual rainfall. In other words, more rain fell in the 10-day FEMA disaster window than the standard deviation for the entire 57-year rainfall data set. Underscoring that this wet weather behavior was an extraordinary event.



Significant accelerations in movement velocity were documented in May 2023 following major storm sequences in January, February and March of 2023, which added to cumulative seasonal rainfall totals exceeding 193% of average rainfall. Approximately 87% of this rain fell prior to June 18, 2023. Most of this rainfall occurred from three significant atmospheric river-type storm sequences occurring on January 9-16 (3.59 inches), February 23-March 1 (3.79 inches) and March 10-15 (4.12 inches). Land movement velocities further increased as of the July 15, 2023 monitoring. An anomalous tropical storm (Tropical Storm Hillary) dropped an additional 3.05 inches of rain on August

19 through August 20, 2023, resulting in further land movement acceleration as of the October 10, 2023 monitoring.

Furthermore, accelerated ground movement occurred throughout the Landslide Complex during and following the 2022-23 rainy season which was more than 220% of the historical average rainfall. Based upon the GPS monitoring survey on January 13, 2024, average land movement velocities within the Landslide Complex since October 10, 2023 have accelerated by a factor of three to four times compared to the previous 12 month (Oct 2022-Oct 2023) monitoring period. Expressed another way, the total movement over the 3 month period of October 2023 through January 2024 is nearly equal to, and in some cases exceeds, the total movement over the previous entire year's monitoring period (i.e., October 2022 through October 2023). Movement of this magnitude has not been previously observed or documented in the ancient landslide complex north of the historical boundaries of the ACL, PBL and KCL.

An example of this is highlighted by six GPS monitoring points in the upper ancient landslide area, in the vicinity of upper Narcissa Drive and uphill from it. These survey monuments have experienced average displacements of 4.07 feet over the past 15 months (3.26 feet on an annualized basis). Average displacements for these six points over the prior annual monitoring period (Sept 28, 2021-Oct 10, 2022) were 0.36 feet. This represents approximately a 9-fold increase in total land movement on an annualized basis. **Two GPS monitoring points near the toe of the Abalone Cove Landslide moved an average of 0.76 feet (Sept 2021-Oct 2022) to 7.30 feet (Oct 2022-Jan 2024) over the same periods, a 9.6-fold increase in displacement**.

Activation of the New Altamira Landslide

According to the City Geologist's Memorandum dated November 8, 2024 and March 16, 2025 (Attached), total landslide movements in the upper ancient landslide area are significant and greatly exceed what has been observed over the past seven decades. The Altamira Landslide is a **newly** active landslide that has occurred within a previously mapped ancient Landslide Complex (most recently labeled the "Ancient Altamira Landslide Complex" which was a name modification of the "Ancient Portuguese Bend Landslide" identified on the California Geological Survey's Landslide Inventory Map (CGS, 2007) which is referred to as the Landslide Complex in this appeal letter). See map on the following page.

It is important to make this distinction for consistency and to avoid confusion, because the Altamira Landslide is, in fact, a new member of the historically active Landslide Complex but largely **underlies it** and occupies an area of active land movement >700 acres and extends to more than 500 feet off of the coastline, whereas the shallower historically active Landslide Complex only occupied about 380 acres.

The Altamira Landslide in Rancho Palos Verdes is therefore a recently identified large landslide that largely underlies (and therefore largely encompasses but exceeds the area

of) the previously understood active Landslide Complex containing the four historically active landslides. The Altamira Landslide includes large areas outside of the historically mapped boundaries of these known landslides, predominantly upslope and downslope from the historically mapped PBL and ACL, within, but smaller than, the Landslide Complex as shown on the map on the following page.

To provide an example of the change in size, the dimensions from head to toe of the previously historical ACL is 2,250 feet and the width up to 1,450 feet wide. The dimensions from head to toe of the Altamira Landslide, underlying and extending up and down slope from both the PBL and the ACL, is 5,800 feet (more than double that of the ACL) with a width of up to 7,400 feet wide (more than five times as wide as the ACL).

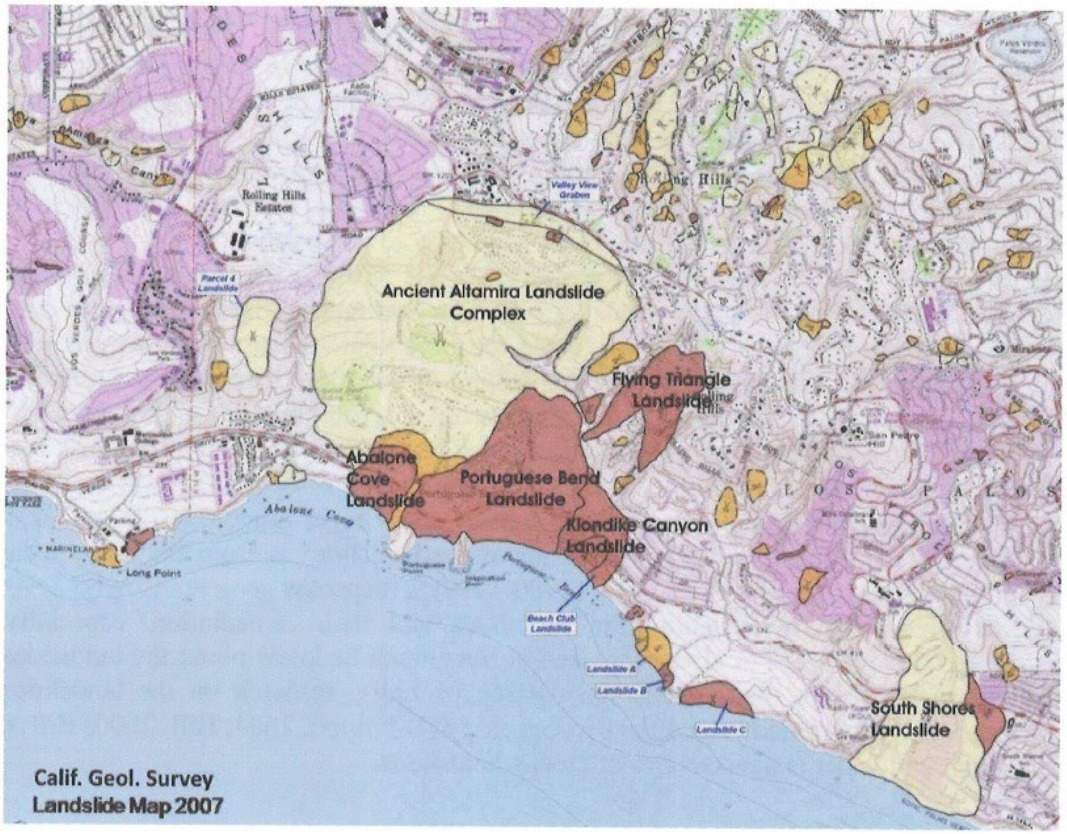


Figure 1. Landslide map of a portion of the south flank of the Palos Verdes Peninsula prepared by the California Geological Survey (2007). The major and some minor landslides are identified. Light yellow indicates that the landslide is inactive, red is active and orange is dormant.

While previous geotechnical investigators identified inactive deep failure surfaces in both the historically active and ancient landslide areas, none of them mapped or identified as active the entire depth or breadth of movement that has recently impacted the area, nor did they opine that such an event would occur in historic times. The areal dimensions, depth of movement, velocity of movement, artesian and near-artesian groundwater pressures beneath it, and even the direction of movement, are different than the ACL,

PBL, and KCL landslides, collectively referred to as the Landslide Complex. The distinction to be made then, is that the Altamira Landslide is not just simple *expansion* of an existing group of landslides, **it is an entirely different, larger and deeper landslide with much broader boundaries (including the new coastline offshore), nearly twice as deep as the depth of historic landslide movement in some areas, and with unprecedented rates of movement (which were not seen in the early LA County Engineer surveys, the Charles Abbott Associates surveys beginning in 1994, nor the McGee surveys since 2007)**. None of this was experienced during the history of the City, and the Altamira Landslide is a unique landslide not characterized in its current dimensions during the over 70-year history of landslide investigations, exploratory borings, monitoring and observations being conducted in the area.

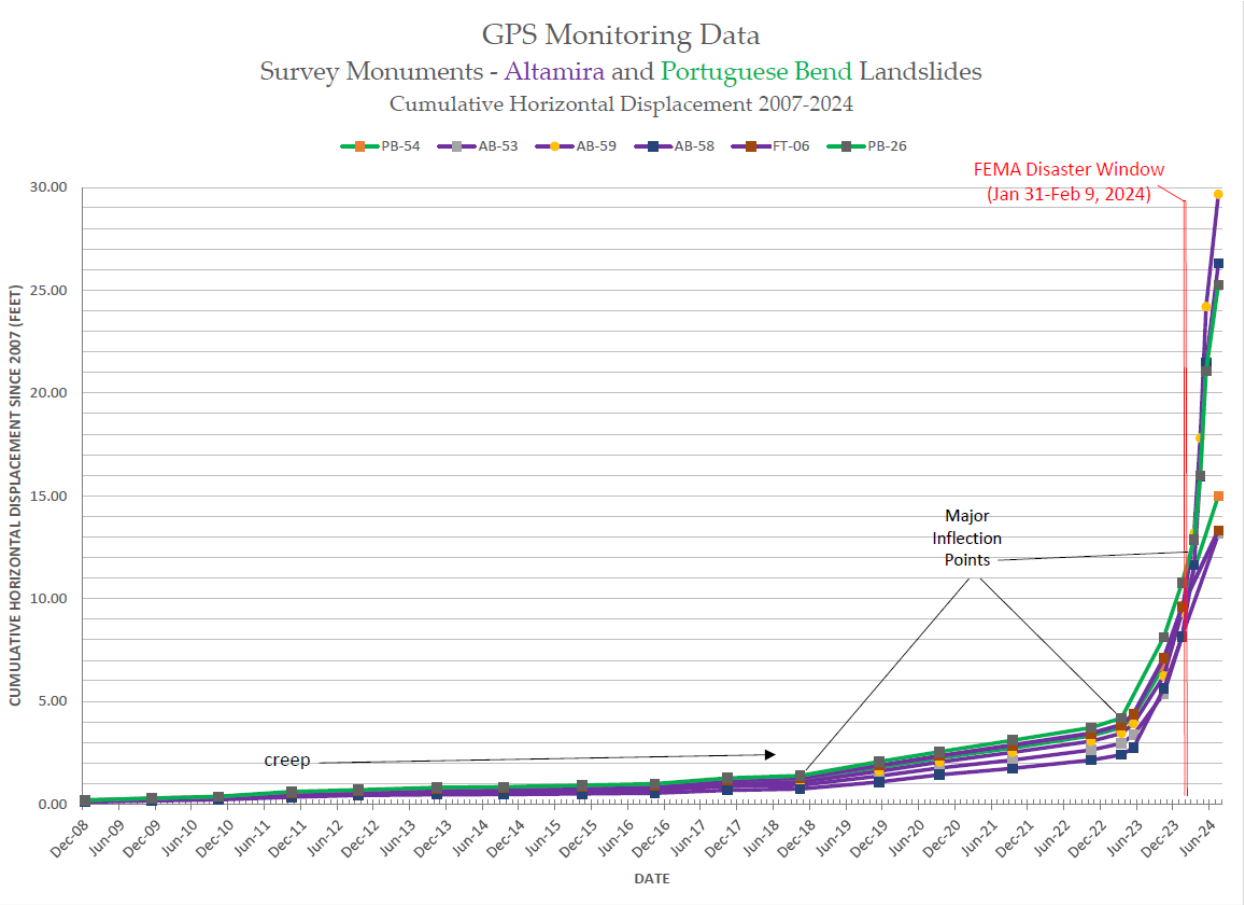
Land movement correlated to the Altamira Landslide continues to manifest at the ground surface in the form of landslide scarps, fissures, grabens/sinkholes, tensional cracking, and shear zones. Field mapping corroborates the GPS monitoring data, indicating that a large portion of the ancient Altamira Landslide above the historically mapped Landslide Complex (PBL, ACL and KCL boundaries) is now involved in significant active landslide movement that is impacting trails, roads, drainage facilities, and private property and continues to have the potential to impact above and below ground utility infrastructure (i.e., utility lines, gas lines, water lines, communication lines, etc.).

Causation

The activation of the Altamira Landslide was largely caused by "climate whiplash" (also more technically described as hydroclimate volatility) induced by climate change, particularly starting in 2011, with five years of drought, and eight out of eleven years significantly below normal rainfall from 2011-2022, followed by two consecutive extraordinarily heavy rain seasons that dropped approximately 4 feet of rainfall on the landslide and surrounding areas draining into the landslide on the south flank of the Palos Verdes Hills.

The graphic on the following page depicts *cumulative horizontal displacement* of select GPS survey monitoring points, including some of the fastest moving points in the Altamira Landslide and a couple of representative points in the PBL (which overlies the Altamira Landslide). There are three significant inflection points indicated in the graph. Prior to the first inflection point, the cumulative displacement lines indicate that the GPS monitoring points within the Altamira Landslide were creeping quite slowly (imperceptibly, near the range of instrument precision) for a number of years extending back before 2011. There was no observed or documented surface manifestation of this minor creep movement at the ground surface; however, this movement is believed to have caused deformation (elongation or stretching out of the earth materials comprising the subsurface which in turn causes additional fracturing of those earth materials) of the Altamira Landslide body, which increased secondary permeability within the rock mass allowing rainfall at the ground surface to percolate more readily into the deep subsurface, raising groundwater levels to a point where they result in high pore pressures that contribute to landslide

movement. Between October 2018 and October 2019 GPS readings (first inflection point), an acceleration of creep movement is evident. Then following the multiple atmospheric river rains of January and February 2023 (second inflection point), a further acceleration of creep movement is evident, which would have resulted in further stretching out and opening up of the landslide mass. The final inflection point around March, 2024 (immediately following the FEMA declared disaster of January 31-February 9 wherein 8.29 inches of rain fell) shows a dramatic acceleration and **represents the triggering of major movement of the Altamira Landslide**, as reflected by some of the graphed points going very steep and nearly vertical on the graph. The graph includes GPS monitoring point AB-59, which has been the fastest moving point and is not surprisingly located in the center of the entire Altamira Landslide mass.

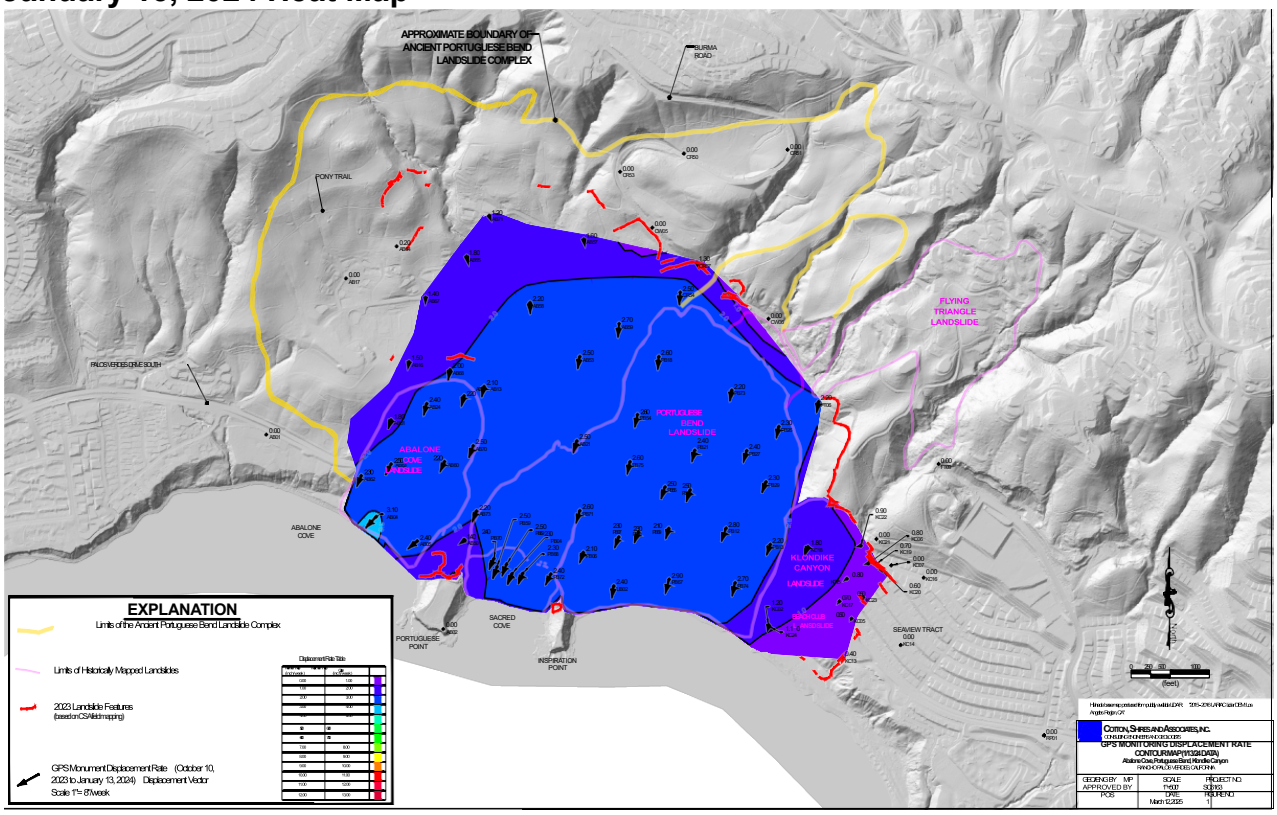


The change in ground movement rates before January 31 and after February 9, 2024 is significant. Based on a comprehensive review of the McGee GPS survey monitoring, the rates of Altamira Landslide ground movement in the Abalone Cove area (for points north of the previously active ACL) as of January 13, 2024 ranged from 1.2 inches per week (at the periphery) up to 2.7 inches per week (in the body of the landslide). After that intense period of rainfall, plus additional rainfall resulting in a total of over 11 inches in February, as of the GPS survey completed on March 8, 2024, the rates increased to 1.5 (at the periphery) to 5.9 (main body) inches per week, more than doubling in the body of the

landslide, and then increased dramatically to as much as 13.5 inches per week in the body of the landslide by July 1, 2024, probably as a slightly delayed reaction to the rainfall as it took time for the water to convert from rainfall absorption to higher groundwater pore pressures where it could have the greatest driving force impact on landslide movement.

The following graphics are "heat maps" that illustrate in color contours the rates at which the ground was moving based on the GPS survey monuments for January 13, 2024, March 8, 2024 and July 1, 2024, respectively. The heat maps include the City's on-ground geologic mapping of visible land movement features, which started as tension cracks or narrow fissures that were discontinuous (as of December 2023 mapping and are shown on the January 13, 2024 heat map), but these features further developed into more continuous/connected tension cracks and fissures, which have now developed into large scarps, grabens and well-developed boundary features. It wasn't until March 2024 that the City Geologist's first drew a boundary (dashed green line) around the "Area of Major Land Movement", because prior to that time, the surface manifestation of movement was poorly developed and inconsistent and there was not sufficient development of the landslide to develop a boundary.

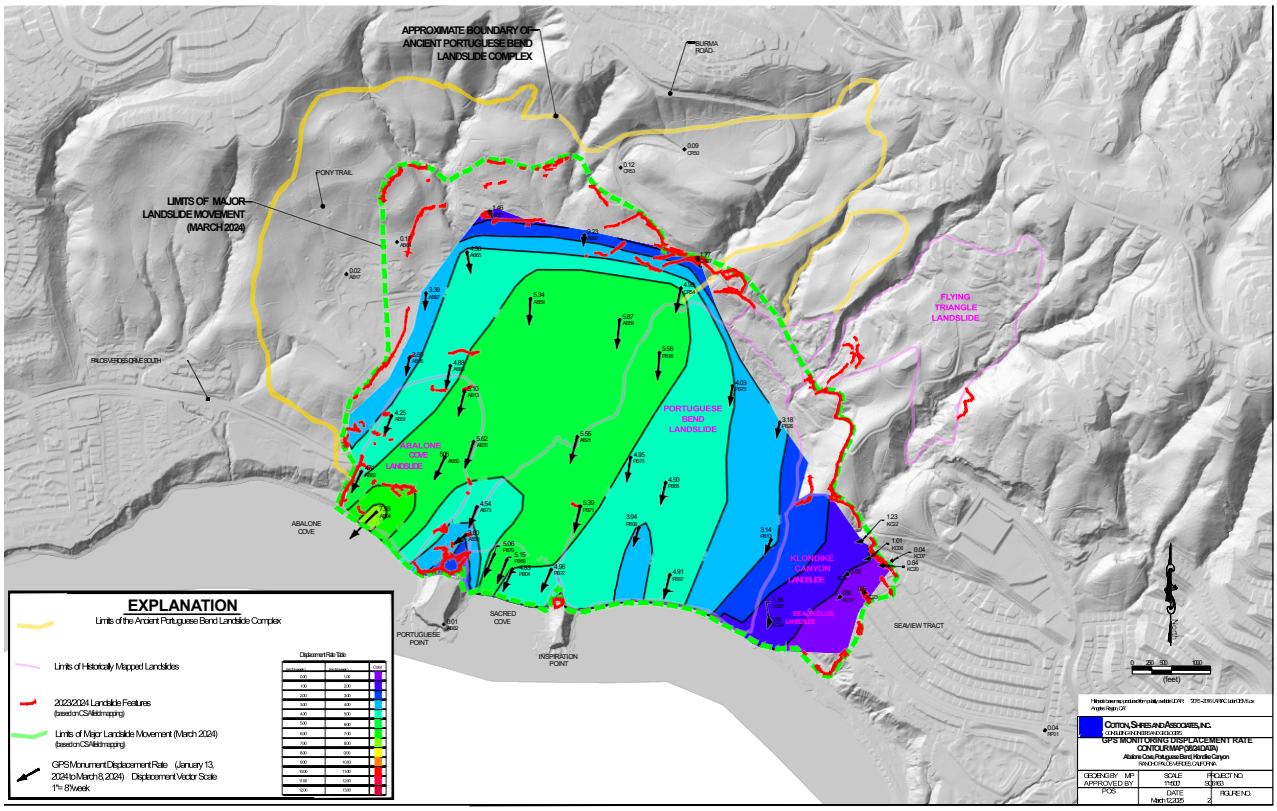
January 13, 2024 Heat Map



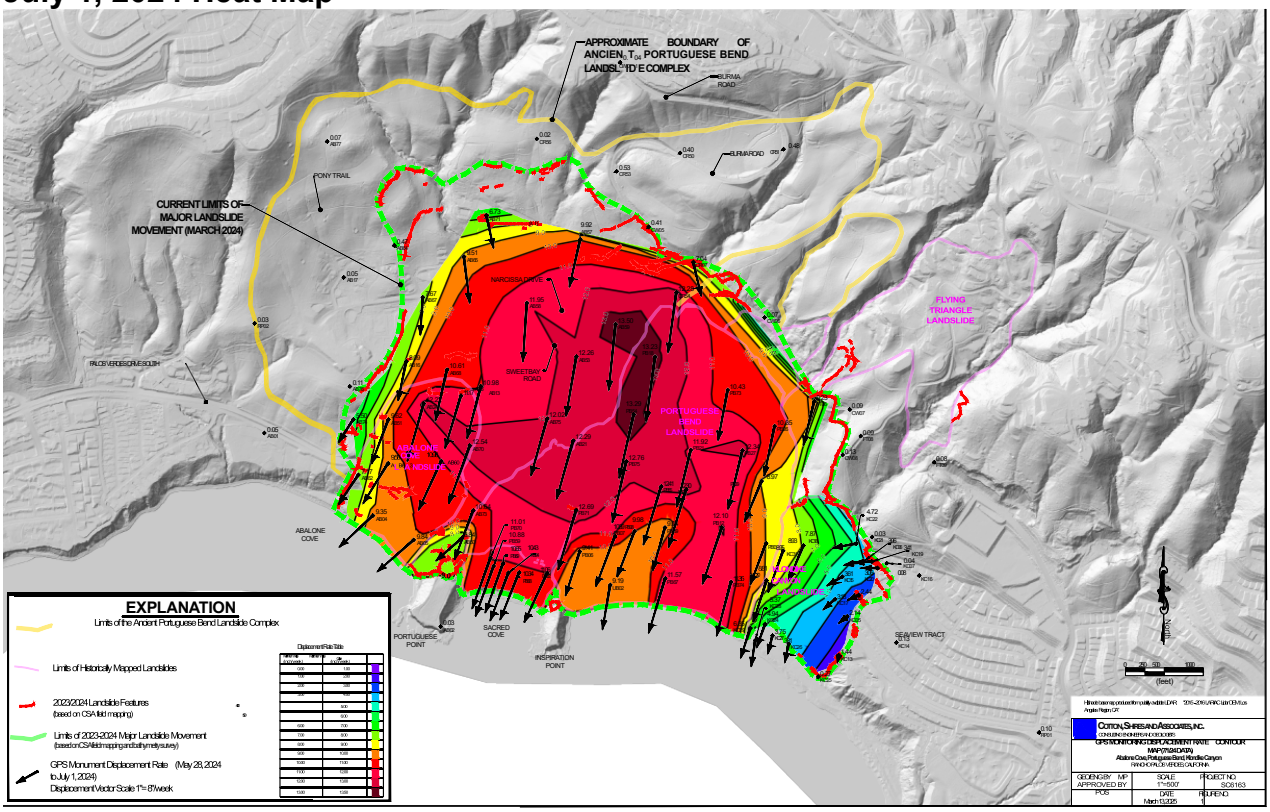
By March 2024, with further mapping and the extraordinary acceleration of numerous GPS monitoring points, a boundary defining the "Area of Major Land Movement" was delineated. Today, following many tens of feet of movement since early 2024, the

boundary of the Altamira Landslide is well-defined. North of Palos Verdes Drive South, the Altamira boundary extends significantly farther west of the historical ACL boundary (resulting in the destruction of the landmark Wayfarer's Chapel), upslope through the York property (6001 PV Drive South), and north of the historical ACL boundary through the Portuguese Bend Riding Club Area, crossing upper Narcissa Drive, through and north of residences on upper Cinnamon Lane, and eventually turning east across Altamira Canyon, extending through the Vanderlip Estate (100 Vanderlip Drive), destroying Vanderlip Drive and adjacent properties, and ultimately continuing northeast to the lower stretch of Burma Road Trail in the Portuguese Bend Reserve. The Altamira Landslide also created never before seen deformation where it underlies and now extends south of the KCL, including formation of a more seaward toe accompanied by uplifting ground that trended southwest through the beach area of the Portuguese Bend Beach Club and extending up to 500 feet or more offshore where it emerged through the sea floor and formed a new rocky coastline above sea level, generally east of Inspiration Point. The emergence of the new land offshore from the previous coastline was first reported to, and was subsequently observed by, the City Geologist in late February of 2024, consistent with the triggering of major movement of the Altamira Landslide described above.

March 8, 2024 Heat Map



July 1, 2024 Heat Map



<u>Impacts of Movement of The Altamira Landslide</u>

As of this date, the major land movement of the Altamira Landslide has resulted in the red-tagging (Unsafe to Enter/Occupy) and yellow-tagging (Limited Entry) of dozens of residential and commercial structures. It has also caused major destructive impacts to public and private roads, damages to drainage facilities and utility infrastructure (water, sewer, gas, electricity and cable), causing certain utilities to be shut-off, and closure of certain Preserve land that is otherwise heavily accessed by the public for hiking, biking, equestrian, and other purposes.

To reiterate, the damage the City sustained as a result of the winter storms of 2024 is attributed to the activation of the deeper slip plane, known as the Altamira Landslide, that has historically been inactive until the 2024 winter storms. The activation of this new landslide that carried the shallower landslide, referred to as the Landslide Complex herein, is **not** pre-existing and therefore invalidates the reason for denying the City's disaster cost recovery request.

The only practical mitigation measure available to address a landslide with such a colossal scale is relieving groundwater pore pressures through pumping of groundwater, but it has to be done on a large enough scale to be effective at reducing the movement to an acceptable level. This technique has proven effective for the east side of the Altamira Landslide where deep dewatering wells have been installed, maintained and the rate of ground movement monitored such that a correlation between increased pumping of groundwater and reduction in the rate of ground movement has been confirmed.

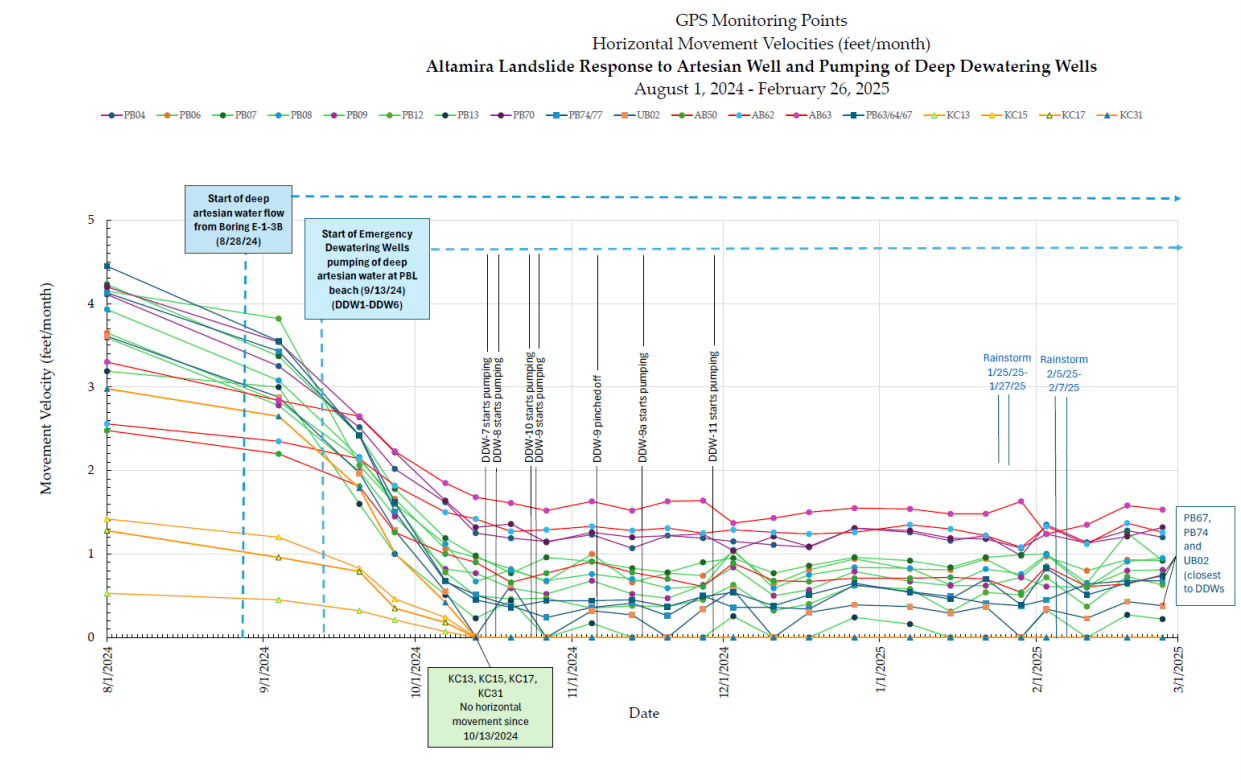
Emergency Measures

Emergency measures taken by the City and abatement districts (ACLAD and KCLAD) to date have included drilling, pumping and monitoring deep dewatering wells, winterization measures including lining channels and installing culverts to reduce the amount of surface water percolating into the groundwater regime from upslope drainages/canyons, and filling of and establishing drainage for fissures and grabens that, if left unmitigated, facilitate surface water intrusion into the groundwater regime. This strategy has proven to be effective in reducing the rate of movement of the Altamira Landslide and even stopping movement of the eastern portion of the landslide in the area of the KCL. Because piezometers installed in deep borings that penetrated the base of the Altamira Landslide indicated high groundwater pore pressures beneath the landslide (some areas were found to have near-artesian or artesian groundwater pressures – pressures higher than the ground surface), a pilot program strategy was pursued by the City that involved drilling a series of deep dewatering wells at the toe of coast below the base of movement of the Altamira Landslide slip plan and pumping to dewater the high groundwater pressures beneath the landslide. This strategy turned out to be more successful than originally contemplated because the movement of the landslide slowed quickly in response to the initial dewatering efforts and the deep wells continued to function for weeks or months before re-drilling was necessary.

The chart on the following page illustrates the timing of artesian water being encountered in one of the test borings (Boring E-1-3B, which was retrofitted to function as an artesian well), the installation of the deep dewatering wells, and the deceleration of the Altamira Landslide in response to the dewatering efforts.

Additional deep dewatering wells are also needed in order to reduce the movement of the middle and eastern portions of the Altamira Landslide to the level experienced prior to the impact of climate whiplash. However, the cost of drilling, pumping, maintaining and re-drilling requires significant funding which the City is unable to fund underscoring the significance of the requested disaster cost recovery – to return land movement to pre-2024 winter storm disaster rates.

Continued on the next page



Natural Disaster Cost Recovery

The cost to respond to this natural disaster has been immeasurable to City and its limited resources. To date, the City's estimated expenditures responding to land movement between October 2022 and June 2025 is approximately $47.5 million with approximately $36.3 million being spent this fiscal year (2024-25). Overall, the $36.3 million reflects a 290% increase from the prior year. These costs include emergency response efforts such as test boreholes, deep dewatering wells, maintenance of the deep dewatering wells until June 30, 2025, winterization, fissure filling, road repairs, sewer repairs, and drainage repairs to name a few.

Similar to the entire state of California, and in fact, the entire United States, there are known pre-existing conditions that lend themselves to natural disasters, such as wildfires, earthquakes, floods, hurricanes, tornadoes, etc. When one of these pre-existing conditions result in a natural disaster such as the recent devastating Palisades and Eaton wildfires, FEMA does not turn their back on those communities in need citing this area is mapped and known to be a Very High Fire Severity Zones. Similarly, FEMA and the federal government do not reject financial aid in known areas of earthquakes, floods, and hurricanes. That same principle should be applied to Rancho Palos Verdes and the recent acceleration of land movement resulting from the atmospheric river storms of 2023 and 2024, and the activation of the new landslide, Altamira Landslide. Moreover, **nowhere in the Stafford Act does it state that pre-existing conditions are ineligible for disaster**

recovery. In fact, the Stafford Act clearly cites the **intent** of Congress, by this Act, is to provide an orderly and continuing means of **assistance** by the Federal Government to State and **local governments** in carrying out their responsibilities to alleviate the suffering and damage which result from such disasters by (1) revising and broadening the scope of existing disaster relief programs; (2) encouraging the development of comprehensive disaster preparedness and assistance plans, programs, capabilities, and organizations by the States and by local governments; (3) achieving greater coordination and responsiveness of disaster preparedness and relief programs; (4) encouraging individuals, States, and local governments to protect themselves by obtaining insurance coverage to supplement or replace governmental assistance; (5) encouraging hazard mitigation measures to reduce losses from disasters, including development of land use and construction regulations; (6) **providing Federal assistance programs for both public and private losses sustained in disasters**; and (7) identifying and improving the climate and natural hazard resilience of vulnerable communities.

Clarification to FEMA's Document Descriptions

In addition to the above, the City provides the following responses for context purposes to the some of the documents citied in the Eligibility Determination Memorandum. As you will see, the extracted statements used to deny the City's request do not accurately support nor justify the denial because they are taken out of context of the overall document and do not provide an accurate analysis of the reason for the land movement and the basis for denial as stated earlier in this appeal letter. The City's position remains that the 2024 winter storms triggered the activation of the **new Altamira Landslide** which carried, at an accelerated rate of movement, the greater Landslide Complex which up until recently has been managed.

1. June 7, 2023 City Letter to Los Angeles County Fourth District Supervisor Hahn

   FEMA's determination letter references the City's June 7, 2023 letter to Los Angeles County Fourth District Supervisor Hahn (Sup. Hahn) as the basis for emphasizing its position that the requested damage recovery for water control features traverses a pre-existing landslide and that the City "continuously repairs and maintains these drainage pipes." The determination letter also states that "the damages claimed are a result of decades of pre-disaster ground instability and ongoing non-disaster related causes" which the City does not believe is accurate based on the information provided in this appeal letter.

   The City's letter to Sup. Hahn quotes a few words that when taken out of context gives a very different meaning to the reader. The letter was sent to Sup. Hahn requesting $6 million to help the City fund its matching portion of FEMA's Building Resiliency Infrastructure Communities (BRIC) Grant for the Portuguese Bend Landslide Remediation Project. The letter to Sup. Hahn includes data on the average rate of movement for context purposes to garner her advocacy and financial support needed

to develop and implement a remediation plan as a **preventive measure** to a potential imminent threat to public health and safety.

The Portuguese Bend Landslide Remediation project, concentrated within the PBL, was developed by the City to **prevent** the acceleration of land movement by addressing rainwater runoff from entering the ground and recharging the water table, which occurred during the rain events of 2023 and 2024.

The Stafford Act states that pre-existing conditions are not eligible for disaster recovery but rather that to be eligible it has to be directly related to an incident per Title 44 of C.F.R. 206.223(a)(1). However, as noted earlier, the behavior of this slow moving landslide noticeably changed in response to the Winter Storms of 2023 and 2024, and that the extreme wet weather activated a **new** landslide, Altamira Landslide, and should therefore not be considered pre-existing, the point to this appeal.

2. Cotton Shires and Associates (CSA) Geologic Report dated September 9, 2023

   According to your determination letter, the City's Geotechnical Engineer's September 9, 2023 memo is cited as one of the basis for denying the City's recovery request because "*the work claimed is not required as a result of the declared disaster and the applicant cannot demonstrate the damage was directly caused by FEMA-DR-4769-CA. Rather these damages are a result of long-term creep displacement and recent years acceleration of earth movement from non-disaster causes as documented in the multiple reports."*

   As previously noted, the City respectfully disagrees with these statements and in fact, can demonstrate that the winter storms of 2023 and 2024 correlated to climate change and seasonal changes in weather patterns are the reasons the City experienced a noticeable behavioral **change** in the landslide rate of movement with the activation of the dormant and inactive Altamira Landslide. Moreover, the Eligibility Determination Memorandum neglects to cite relevant and pertinent information in the CSA's September 9, 2023 memo emphasizing the following significant and noticeable change in the behavior of the landslide:

   GPS Survey Monitoring Data Review: GPS monitoring of survey monuments throughout the Landslide Complex area has been performed tri-annually since 2007 by McGee Surveying Consulting. In their June 6, 2023 Survey Report, McGee stated:

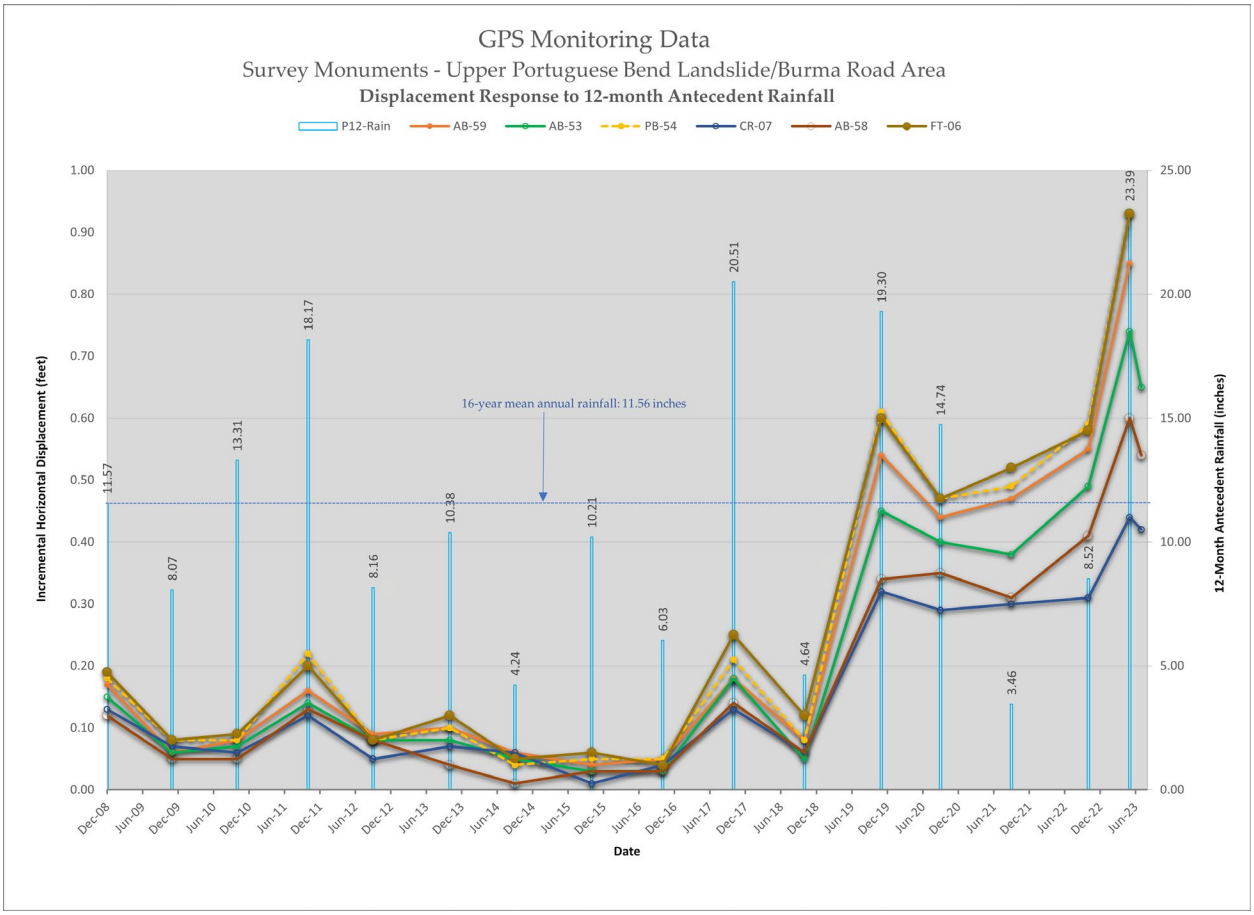
   "*In the last seven months the movement velocities have accelerated over the average velocity for the previous four years which saw an acceleration over the previous 15-20 years……**Velocities were stable** prior to 2018. After the Fall of 2018 they increased about 3 to 6 fold at most points and remained stable to the Fall of 2022. In the last seven months since the **Fall of 2022** the velocities generally have **doubled more or less***." (emphasis added)

This is a significant and important observation from the surveyor, and comports with the past several years of field observations by CSA staff of roadway distress and trail distress within the PBR, as well as reports of street distress, building distress and utility line breaks throughout the various known landslide areas.

Several graphics based upon CSA's own analysis of the GPS survey monitoring data further illustrate what is happening with the landslide ground movement. According to Figure 2 in CSA's September 9, 2023 memo, depict horizontal displacements (in feet) and ground displacement vectors for 12 selected GPS survey monuments mostly located in the mid and upper Landslide Complex. These figures are based upon McGee's GPS monitoring of the survey monuments from October 2018 to May 2023 (with the exception of two monuments which were last read in October 2022, PB18 and AB71). Four of these monuments were also read in mid-July, 2023 and those movement data are also presented. Two of the monuments, CR07 and FT06 are located on Burma Road outside of the PBL and indicate 1.67 feet and 3.09 feet of horizontal displacement over the ~4.5-year period. The CR07 point moved an additional 0.42 feet in two months (through July 15, 2023), which translates to ground movement velocity of about 2.5 feet per year. Most of the other points on this figure are in the Landslide Complex (and mostly in LMA Zone 2) and are indicating total displacements of approximately 1 to 3 feet (or average velocities of about 0.22 to 0.67 feet/year across the ~4.5-year period). Several of these points in LMA Zone 2 that were also monitored in July, 2023 showed continued acceleration from May to July 2023, with calculated velocities of ~1.25 feet/year at AB67 to ~3.9 feet/year at AB53. These are extraordinary rates of landslide movement that, to the City Geologist's knowledge, have not been previously documented in the LMA Zone 2 area.

Incremental displacement has been analyzed of these points versus 12-month antecedent rainfall, as a measure of the landslide response to rainfall. A graph of cumulative displacement of these points since 2007 is presented on the following page. This graphed movement data indicates a clear acceleration of movement beginning in late 2018 (as noted in the area labeled inflection point).

Accelerated landslide movements since late 2018 appear to be correlative with significantly above normal rainfall in three out of four rainfall seasons (2016-17, 2018-19 and 2019-20) which followed five consecutive drier than normal rainfall seasons (2011-12 through 2015-16). **The extraordinary rainy season of 2022-23, where rainfall totals were more than 200% of average, has resulted in further acceleration**.



It is imperative to bring to your attention that the City Geologist recently provided an updated memorandums dated November 8, 2024 and March 16, 2025 (attached) that further underscores the impacts and damage caused by FEMA-DR-4769-CA also known as the winter storms of January 31 through February 9, 2024, as documented earlier in this appeal letter.

3. Rancho Palos Verdes Geo-Logic Associates (GLA) Report Dated December 2019

   According to the Eligibility Determination Letter, a December 2019 report prepared by GLA, a geotechnical engineering firm, hired by the City to prepare its Portuguese Bend Landslide Remediation project is cited. This report cites, as one of the basis to determine that the requested disaster damage recovery occurred in a pre-existing landslide area and not related to the storms citing the following:

   "the landslide complex includes approximately 239 acres with ground movement varying across the site ranging up to approximately 11 feet per year."

   This very citation supports the City's request and claim that the damage sustained occurred as a result of the winter storms in 2023 and 2024 based on the following:

As noted earlier, the Landslide Complex is generally comprised of 5 subslides. The 239 acres noted above is limited to the PBL. This is because the study area for the Landslide Complex was specific to the PBL. In fact, the City Geologist's November 8, 2024 memo states since 2024, this significantly greater depth of movement has resulted in a broader footprint of active land movement at the ground surface and offshore, and expansion of the historical land movement area from approximately 380 acres to **over 700 acres**.

Furthermore, as previously stated, according to the City Geologist's March 16, 2025 memo (attached), the Altamira Landslide is a newly active landslide that has occurred within a previously mapped ancient landslide complex. It is important to make this distinction for consistency and to avoid confusion, because the Altamira Landslide is, in fact, a new member of the historically active PBL/ACL/KCL Landslide Complex but largely **underlies it** and occupies an area of active land movement >700 acres and extends to more than 500 feet off of the coastline, whereas the shallower historically active PBL/ACL/KCL Landslide Complex only occupied about 380 acres. While previous geotechnical investigators identified inactive deep failure surfaces in both the historically active and ancient landslide areas, none of them mapped or identified as active the entire depth or breadth of movement that has recently impacted the area, nor did they opine that such an event would occur in historic times. The active Altamira Landslide currently involves major land movement comprising an area of over 700 acres landward of the coast and extends to approximately 500 feet or more off the coastline. The areal dimensions, depth of movement, velocity of movement, artesian and near-artesian groundwater pressures beneath it, and even the direction of movement, are different than the Landslide Complex. The distinction to be made then, is that the Altamira Landslide is not just simple *expansion* of an existing group of landslides, it is an entirely different, larger and deeper landslide with much broader boundaries (including the new coastline offshore), nearly twice as deep as the depth of historic landslide movement in some areas, and with unprecedented rates of movement (which were not seen in the early LA County Engineer surveys, the Charles Abbott Associates surveys beginning in 1994, nor the McGee surveys since 2007).

None of this was experienced during the history of the City, and the Altamira Landslide is a unique landslide not characterized in its current dimensions during the over 70-year history of landslide investigations, exploratory borings, monitoring and observations being conducted in the area.

4. Landslide Working Group November 1, 2023 Meeting Notes

   The FEMA Eligibility Determination Memorandum cites that the City has a pre-disaster active task force called the RPV Landslide Complex Working Group which meets to continue to address ongoing landslide problems, and that is **not** correct.

As previously noted, on October 3, 2023, the City Council declared a local state of emergency in response to the rapid and significant acceleration in land movement. As a result, the Council directed staff to working with community stakeholders including utilities, geologists, HOA representatives and residents to collaborate the City's and community's response to the declared local state of emergency. It was four months later when the then-mayor sent a letter to the Governor requesting he declare a state of emergency and request the President declare a federal disaster in response to the land movement resulting from the winter storms of 2023 and 2024 (attached)

5. Michael McGee's 2007 GPS Technical Report

   In 2007, the City began using GPS technology to track on-ground movement of the Landslide Complex. No one is denying that the shallower Landslide Complex has been moving since 1956, what is evident in the data FEMA's analysts overlooked is that there is a significant and noticeable change in the behavior of the landslide and the rate of movement in response to rain events as clearly demonstrated in the charts earlier in this letter. Moreover, a new, previously dormant landslide was activated in response to the 2024 Winter Storm event.

   To reiterate, the City Geologist has clearly documented that the rain events of 2023, and particularly 2024, have contributed to the accelerated rate of movement and the damage sustained by the City and its infrastructure. The point that warrants a reconsideration of reversing the denial is that there is a clear change in the rate of movement based on the GPS monitoring points cited in your memo between 2023 and present.

<u>Additional Information - Land Movement and the Monks Lawsuit</u>

In 1978, the City enacted an ordinance imposing a moratorium on the construction of new homes in the vicinity where accelerated landslides had recently occurred. The so-called "Monks" plaintiffs owned 16 vacant lots impacted by the moratorium. Some of these property owners claimed to have been waiting over 30 years to build homes on their properties on land that has not showed signs of movement. The lots in question were otherwise zoned for single-family dwellings.

Eventually, these property owners filed suit against the City seeking to invalidate the moratorium criteria and alleging a claim for inverse condemnation based on the state takings clause because, as the plaintiffs asserted, the land was not moving and suitable for development. The trial court denied their request and ultimately found in the City's favor. The property owners appealed.

The Court of Appels ruled in favor of the plaintiffs citing that the City's ordinance requiring owners of land in specific zones within the Landslide Complex to present data demonstrating to satisfaction of city geologist that the gross geotechnical factor of safety

where their lots were located was at least 1.5 in order to build on their lots deprived the land of all economically beneficial use, and resulted in a permanent categorical taking. **The Courts ruled that the plaintiffs could build on their lots.** (*Monks v. City of Rancho Palos Verdes*, 167 Cal.App.4th 263 (2008)

Conclusion

The basis for denying the City's disaster recovery on a pre-existing condition is not a valid reason when, as demonstrated in this appeal letter and supporting attachments, it is clear that a **new, inactive** for hundreds of years, landslide was activated in response to the 2024 Winter Storm event that led to the federal disaster declaration (FEMA-DR-4769-CA). The activation of the Altamira Landslide resulted in significant damage to the City's infrastructure and the City is requesting $9 million to conduct emergency protective measures consisting of increased monitoring, installation of directionally drilled dewatering wells (hydraugers), deep dewatering wells, and fissure repairs in canyons, hillsides and slopes. It is now known that the activation of the Altamira Landslide carried the subslides of ACL, PBL, and KCL which is clearly demonstrated in this appeal letter that the rate of movement significantly increased along with the behavior of the land movement as a result of the 2023 and 2024 Winter Storm Events.

It is for the reasons cited throughout this appeal letter that disaster recovery financial assistance be provided for the destruction resulting from the activation of the Altamira Landslide caused by the extraordinary rain events of 2024. The weather whiplash over the years has adversely impacted the City, its residents and businesses, and its economics. Overturning the denial and providing the disaster recovery assistance requested will enable the City to properly respond to the activation of the new Altamira Landslide by stabilizing land movement and repairing damaged and critical infrastructure.

On behalf of the Rancho Palos Verdes City Council and residents, we thank you for your consideration of this appeal letter.

Sincerely,

Ara Michael Mihranian, AICP
City Manager

Attachments:

- September 9, 2023 CSA Memo
- November 8, 2024 CSA Memo
- March 16, 2025 CSA Memo
- February 20, 2024 Letter to Governor Newsom

c. Rep. Ted Lieu

Senator Adam Schiff
Senator Alex Padilla
State Senator Ben Allen
Asm. Al Muratsuchi
Rancho Palos Verdes Mayor Bradley and City Council
William Wynder, Rancho Palos Verdes City Attorney
Catherine Jun, Rancho Palos Verdes Deputy City Manager
Ramzi Awwad, Rancho Palos Verdes Director of Public Works
Vina Ramos, Rancho Palos Verdes Director of Finance

COTTON, SHIRES AND ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS

CITY OF RANCHO PALOS VERDES

CSA Project No. SC6022

MEMORANDUM

TO: Katie Lozano, Open Space Manager
CC: Ara Mihranian, City Manager
William Wynder, Elena Gerli, and John Fox, City Attorneys
Cory Linder, Director of Recreation and Parks
Ramzi Awwad, Public Works Director
Taylor Fox, Senior Park Ranger
FROM: Michael Phipps, CEG 1832, Contract City Geologist
Christopher Dean, CEG 1751, Contract City Geologist
Matthew Janousek, GE 3005, Contract City Geotechnical Engineer
RE: **Preliminary Geotechnical Assessment of Recent Land Movement in the Portuguese Bend Reserve and Impacts to Burma Road Trail, Rancho Palos Verdes**
DATE: September 29, 2023

INTRODUCTION

In accordance with your request, this memorandum has been prepared to provide a preliminary geotechnical assessment of recent land movement within the Portuguese Bend Reserve (PBR) with a specific focus on the impacts of land movement to the Burma Road Trail. We understand that the PBR is one of the City's most popular land reserves, it is heavily used by the public for recreation and is also used by public utilities including Southern California Edison and California Water Service Company. A portion of the PBR is underlain by the historically active Portuguese Bend Landslide (active since 1955-56) as well as the Ancient Portuguese Bend Landslide Complex. Some areas of the Reserve are now experiencing significant land movement and ground surface manifestation that is beyond the limits of the historically active and previously mapped Portuguese Bend Landslide, resulting in damage to trails and fire roads which provide access for public safety, utilities, maintenance, conservation, and public recreation. Cotton, Shires and Associates, Inc. (CSA) geologists have been requested by the City to observe various landslide-related issues in the Reserve involving damage to trails since 2021 and the SCE transmission lines along Burma Road since the summer of 2022. In 2021 we also began a detailed review of Global Positioning Satellite (GPS) monitoring data for survey monuments both within and outside the PBR, including points within the Abalone Cove Landslide, Klondike Canyon Landslide, and elsewhere within the Ancient Portuguese Bend Landslide Complex.

A comprehensive reconnaissance of the PBR was conducted by vehicle with City staff on June 28, 2023. Following this field visit, the City's Open Space Manager requested a report addressing the following items:

DRAFT

- Information and a map presenting our observations of where new landslide scarps are forming;
- An evaluation of whether Burma Road is currently able to accommodate vehicles, ranging from smaller Park Ranger trucks to heavy equipment used by utility companies and fire department, and if it is currently able to accommodate vehicles, an estimate of how long the road will remain stable;
- Recommendations for re-routing Burma Road (if necessary) to areas less prone to land movement as the fire road is needed for the City, fire department, and utility companies;
- Consideration of recommendations for additional warning signage due to the increased land movement to warn recreational users (hikers, bikers, horseback riders) and authorized outside agency personnel who drive the Reserve fire roads;
- Recommendations for a maintenance plan to fill fissures and keep Burma Road passable to pedestrians and vehicles, as the fissures have become too significant for park rangers to fill in with shovels.

This memorandum will address these requested items, based upon our field observations and geologic mapping, analysis of GPS monitoring data, background knowledge of the area, and professional experience.

PREVIOUS WORK

Previous City-requested reconnaissance and observation of trail conditions in the PBR performed by CSA geologists have included the following:

- 8/27/21: Burma Road trail reconnaissance (fissures/ground movement)
- 9/29/21: Burma Road and Garden Trail reconnaissance (fissures/ground movement)
- 1/5/22: Burma Road trail reconnaissance (fissures/ground movement)
- 8/31/22: Burma Road trail reconnaissance, meeting with SCE contractor and City staff, (regarding power pole relocation due to fissures, ground movement)
- 3/8/22: Upper Burma Road trail reconnaissance (rockfall hazards)
- 4/5/23: Burma Road Trail, Garden Trail, and Rim Trail reconnaissance (fissures/ground movement)

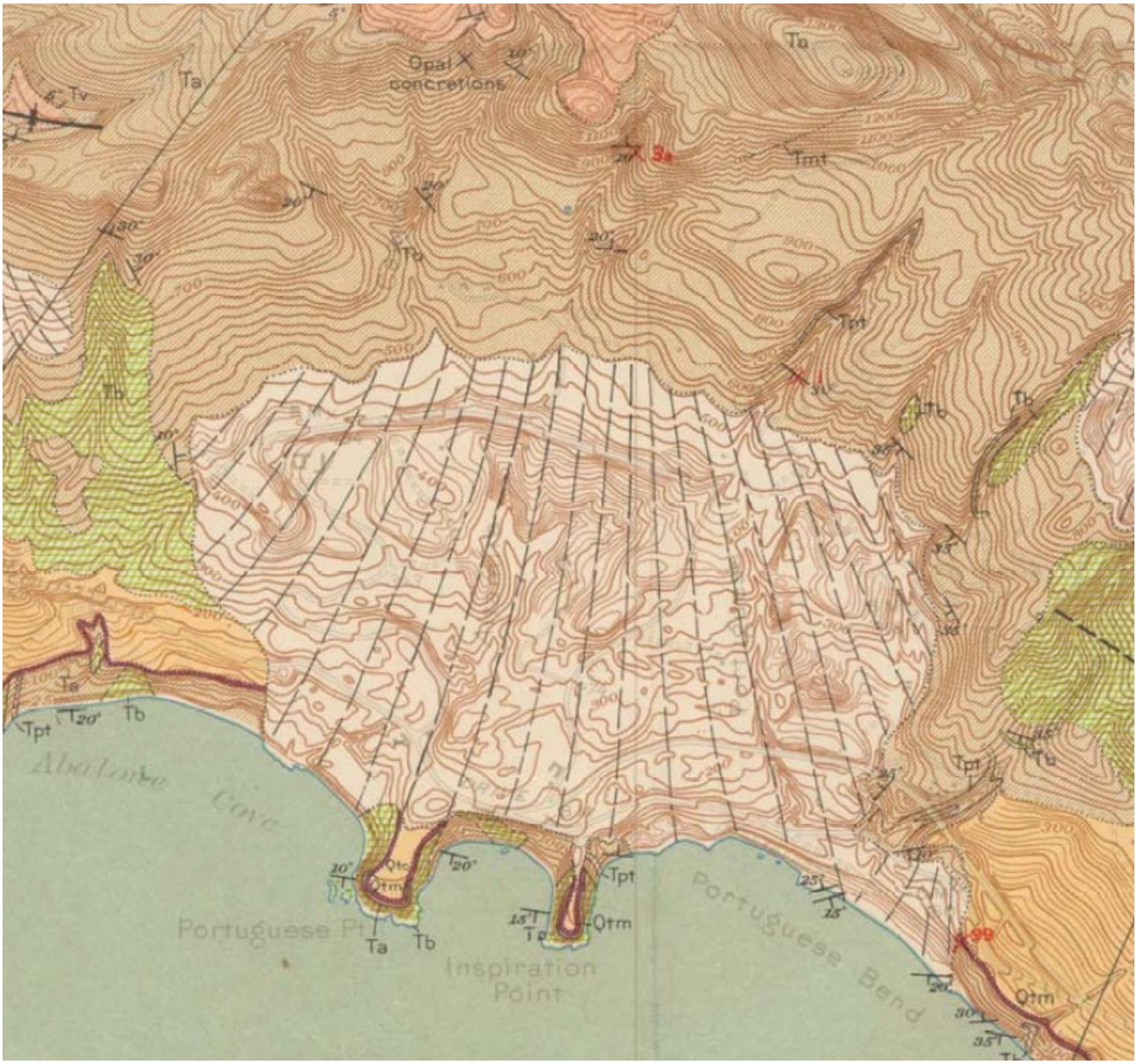
Findings and recommendations from these field visits have been routinely documented by either memoranda or email addressed to City staff. Recent published documents include memoranda dated February 9, 2022 (Burma Road/Rim Trail Junction) and May 19, 2023 (SCE Power Pole Relocation, Burma Road).

Preliminary geologic mapping of the upper limits of active landsliding along the Burma Road trail and vicinity was performed on June 28, 2023 and supplemented on September 22, 2023; however, this work is incomplete and requires additional field effort. Because of the steep terrain, large mapping area, and thick (inaccessible) vegetation in some areas, we have supplemented our field mapping with photo-geologic mapping utilizing high-resolution Nearmap (vertical aerial) imagery captured on January 17, 2023 and June 17, 2023.

DRAFT

FINDINGS

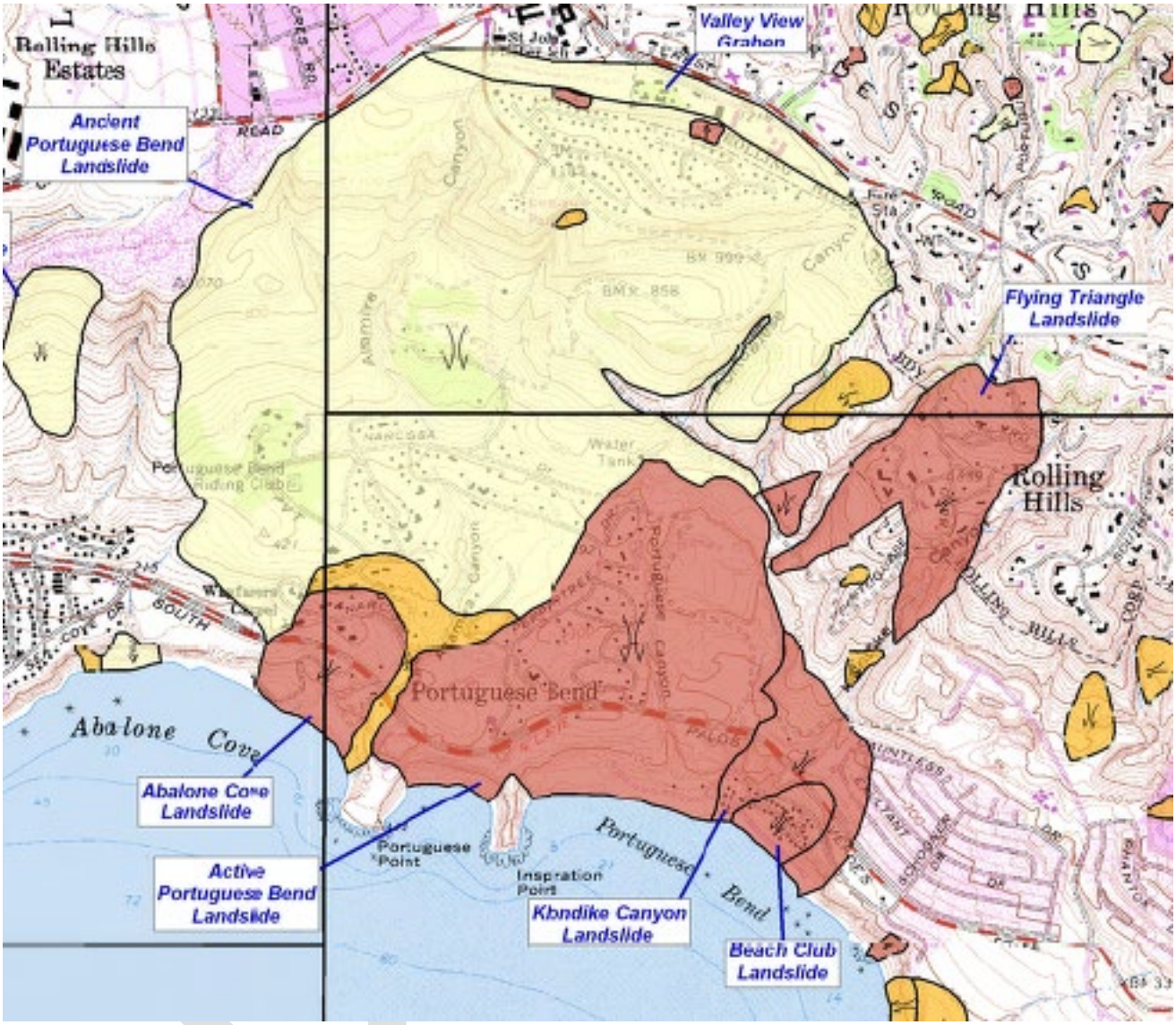
Geologic Mapping: The Ancient Portuguese Bend Landslide Complex (APBLC) was first mapped by the U.S. Department of the Interior Geological Survey (aka, USGS) in 1946 (shown as white area with black dashed lines in the image below) and occupies a broad area on the south side of the Palos Verdes Peninsula from the crest of peninsula to the Pacific Ocean.



U.S. Department of the Interior, 1946, Portion of Geologic Map of the Palos Verdes Hills, Los Angeles County, California

Within the APBLC, several large landslide masses have reactivated since the 1950s, including the Portuguese Bend Landslide, Abalone Cove Landslide, Klondike Canyon Landslide, and Beach Club Landslide. The Flying Triangle Landslide is in similar but higher terrain northeast of the Portuguese

Bend Landslide but is not considered part of the APBLC on regional geologic maps. These landslides are depicted on the California Geological Survey's Landslide Inventory Map of the Palos Verdes Peninsula (2007, image below).



California Geological Survey, 2007, portion of Landslide Inventory Map of the Palos Verdes Peninsula

Burma Road (and Trail) is located along what was previously proposed to be the Crenshaw Boulevard Extension, until the Portuguese Bend Landslide reactivated in 1956. The lower reach of Burma Road trends southeast immediately uphill from the headscarp of the Portuguese Bend Landslide. Previous site visits by our staff to the Burma Road area within the PBR beginning in 2021 were primarily in response to reported "fissures" forming in multiple locations across trails. We understand that City ranger staff have been routinely filling in the fissures with soil using hand tools. At other times heavier grading equipment has been reportedly used by Cal Water to fill fissures and maintain the Burma Road access to their facilities. Recent field mapping and GPS data suggest that these fissures are in fact the incipient manifestations of headward enlargement of the Portuguese Bend Landslide as well as an upslope manifestation of accelerated movement of a portion of the Ancient Portuguese Bend Landslide

Complex west of the active Portuguese Bend Landslide boundary. Four significant landslide scarps, which initially manifested as ground cracking and small fissures in Burma Road, have now formed across Burma Road, generally between the Eagle's Nest Trail intersection on the west and the Rim Trail intersection on the east.

Figure 1 (attached) was prepared on a Nearmap vertical color image taken January 17, 2023. The approximate limits of the active Portuguese Bend Landslide are depicted in red. The upper area of recent headward enlargement of the Portuguese Bend Landslide is depicted with yellow lines delineating landslide scarps which can be seen crossing Burma Road in at least seven locations. While the Burma Road trail has been repeatedly maintained by minor grading-leveling across these features, the scarps have grown in height and width adjacent to the road over time, and in some locations, grabens (wide pull-apart fissures) have formed in response to significant landslide movement. If not maintained in this manner over the past several years, landslide scarps ranging from 1 to 8 feet in height would extend across the road making it impassable to vehicles, cyclists, and even pedestrians. The most severe location is the western (and uppermost, elevation-wise) scarp located between the Water Tank trail and Eagle's Nest Trail intersection with Burma Road. The landslide displacement at this location has produced a scarp 6 to 8 feet in height and significantly displaced an SCE power pole that is now leaning approximately 35-40 degrees out of plumb. Other scarps across Burma Road southeast of this location are smaller, generally ranging from 1 to 4 feet in height adjacent to the road. Of note is that these scarps have grown substantially in size since our June 28, 2023 reconnaissance.

The downslope limits of the new landslide scarps (yellow contacts on Figure 1) appear to be directly connected to the Portuguese Bend Landslide at the eastern end; however, at the western end they are not well-defined at the ground surface and additional field mapping is necessary to further delineate the western margin. The western margin was observed crossing Kubota Trail and trending toward the Vanderlip Trail, where it was lost in heavy vegetation. It is important to note that the western extent of this new landslide movement is somewhat west of the head of the Portuguese Bend Landslide. It is our interpretation that the western extent of this new landslide movement is occurring in response to long-term creep displacement and recent acceleration of movement of the Ancient Portuguese Bend Landslide Complex (APBLC) since October 2018.

GPS Survey Monitoring Data Review: GPS monitoring of survey monuments throughout the APBLC area has been performed tri-annually since 2007 by McGee Surveying Consulting. In their June 6, 2023 Survey Report, McGee stated:

"*In the last seven months the movement velocities have accelerated over the average velocity for the previous four years which saw an acceleration over the previous 15-20 years……Velocities were stable prior to 2018. After the Fall of 2018 they increased about 3 to 6 fold at most points and remained stable to the Fall of 2022. In the last seven months since the Fall of 2022 the velocities generally have doubled more or less*."

This is a significant and important observation from the surveyor and comports with the past several years of field observations by CSA staff of roadway distress and trail distress within the PBR, as well as reports of street distress, building distress and utility line breaks throughout the various known landslide areas. We have prepared several graphics based upon our own analysis of the GPS survey

DRAFT

monitoring data to further illustrate what is happening with the landslide ground movement. Figure 2 (attached) depicts horizontal displacements (in feet) and ground displacement vectors, for 12 selected GPS survey monuments mostly located in the mid and upper Ancient Portuguese Bend Landslide Complex. These figures are based upon McGee's GPS monitoring of the survey monuments from October 2018 to May 2023 (with the exception of two monuments which were last read in October 2022, PB18 and AB71). Four of these monuments were also read in mid-July, 2023 and those movement data are also presented. Two of the monuments, CR07 and FT06 are located on Burma Road outside of the Portuguese Bend Landslide and indicate 1.67 feet and 3.09 feet of horizontal displacement over the ~4.5-year period. The CR07 point moved an additional 0.42 feet in two months (through July 15, 2023), which translates to ground movement velocity of about 2.5 feet per year. Most of the other points on this figure are in the Ancient Portuguese Bend Landslide Complex (and mostly in LMA Zone 2) and are indicating total displacements of approximately 1 to 3 feet (or average velocities of about 0.22 to 0.67 feet/year across the ~4.5-year period). Several of these points in LMA Zone 2 that were also monitored in July, 2023 showed continued acceleration from May to July 2023, with calculated velocities of ~1.25 feet/year at AB67 to ~3.9 feet/year at AB53. These are extraordinary rates of landslide movement that, to our knowledge, have not been previously documented in the LMA Zone 2 area.

We have also reviewed and analyzed cumulative and incremental displacements from 2007-2023 for six select survey monitoring points that are generally in the upper Portuguese Bend Landslide/Burma Road area, including three points that are in the Ancient Portuguese Bend Landslide Complex west of the historically active Portuguese Bend Landslide (i.e., in Landslide Moratorium Area Zone 2). These six points are identified as:

- CR07 adjacent to Burma Road Trail;
- PB54 located within the "Landward Subslide" of the Portuguese Bend Landslide Complex;
- AB53, AB58 and AB59 located within the Ancient Portuguese Bend Landslide Complex (Landslide Moratorium Zone 2); and
- FT06 adjacent to Burma Road Trail southeast of the Rim Trail intersection.

We have analyzed incremental displacement of these points versus 12-month antecedent rainfall, as a measure of the landslide response to rainfall (Figure 3). A graph of cumulative displacement of these points since 2007 is also presented in Figure 4. This graphed movement data indicates a clear acceleration of movement beginning in late 2018 (as noted in the area labeled inflection point).

Accelerated landslide movements since late 2018 appear to be correlative with significantly above-normal rainfall in three out of four rainfall seasons (2016-17, 2018-19 and 2019-20) which followed five consecutive drier than normal rainfall seasons (2011-12 through 2015-16). The extraordinary rainy season of 2022-23, where rainfall totals were more than 200% of average, has resulted in further acceleration based upon limited monitoring data. A significant concern is that the movement velocities have not declined back to the pre-2018 levels despite two significantly below-normal rainy seasons (2020-21, one of the driest on record, and 2021-22). Also of note is that our rainfall data do not include the impacts from Tropical Storm Hilary which dropped several inches of rain across most of southern California in August, 2023.

DRAFT

CONCLUSIONS AND RECOMMENDATIONS

Landslide movements throughout the Ancient Portuguese Bend Landslide Complex *outside of the historical boundary of the Portuguese Bend Landslide* previously exhibited relatively low rates of creep movement in the 11-year monitoring period of 2007-2018 for which we have readily available data. Beginning in late 2018, and through the present, the survey data indicate a significant acceleration of landslide movement. The movement of the Portuguese Bend Landslide also accelerated in this timeframe. The cumulative displacements over this time have now manifested as headward enlargement of the Portuguese Bend Landslide as well as new active landslide masses forming northwest of the Portuguese Bend Landslide crown in Landslide Moratorium Area Zone 1, upslope from LMA Zone 2. These new actively moving landslide masses are directly impacting Burma Road and threaten future accessibility.

We understand this issue is also exceeding current resources (i.e., ranger staff) to monitor and maintain the safety of the trails; primarily the heavily used Burma Road Trail. At this time, we consider this to be a critical and evolving situation that poses risks to the general public who are accessing the PBR for recreation, to utility infrastructure that traverses the landslide area, and to accessibility for other stakeholders including conservation groups and the fire department. It is evolving because we are days from entering the rainy season and most meteorologists and climatologists that we follow are citing development of El Nino conditions in the Eastern Pacific Ocean and these are frequently associated with wetter-than-normal rainfall conditions in southern California. We are also awaiting receipt of the fall GPS survey data which are typically gathered in early October.

To address the City's specific items, we offer the following:

Landslide Maps: For the purposes of this memorandum, a landslide overview map (Figure 1, attached) was prepared to illustrate the entire affected area and impacts to Burma Road. We conducted field mapping on much larger scale maps which allow for presentation of detailed observations; however, these were not formally drafted and produced due to time constraints. We recommend that additional field mapping be performed in an effort to further define the limits of active landsliding. Drafted larger scale maps will be provided if necessary and/or upon request, to provide details in specific areas.

Burma Road Conditions and Maintenance Considerations: Given the current landslide movement velocities, the newly identified landslides impacting Burma Road are active and considered unstable. Burma Road only remains passable because of the reported efforts of other stakeholders to level the ground surface across the landslide areas with larger equipment, in response to the creeping landslide movement. We anticipate that the landslide movement will continue and is likely to be exacerbated by the 2023-24 rainy season regardless of whether it is wetter or drier than historical averages. The filling of fissures crossing the road with manual labor (by park rangers) has become untenable and such measures are reportedly proving to be short-lived. The fissures, which are developing landslide scarps, have widened and deepened in some areas due to significant ground movement. Smaller vehicles (ranger trucks) are typically 2-3 tons and present lower risks when crossing the landslide areas;

DRAFT

however, larger, heavier vehicles including fire trucks which typically weigh 10 to 20 tons present a much larger transient load across the landslides, thus presenting a relatively greater risk.

Currently it is our opinion that Burma Road Trail should be closed to the public across the landslide area *unless it can be monitored on a daily basis by the park rangers*. This is due to active landslide movement directly impacting the road and posing significant risks to pedestrians, cyclists and horseback riders. Ground leveling efforts to keep the road passable for vehicles may continue; however, crews should avoid placing earth fill directly on the landslides because it adds weight and is a driving force of landslide movement. Continued notching (lowering) of the trail approaches to the landslide scarps may be the only effective solution in the short-term to maintain passage of vehicles. Care should also be given to avoid ground-alterations that would direct more Burma Road drainage directly into the landslide areas.

Burma Road Re-routing Considerations: Burma Road and trail occupy a portion of wider, leveled ground graded during the proposed Crenshaw Boulevard extension (circa 1955-56). Several of the new landslide scarps extend to near the north edge of the previously leveled area, thus, there does not appear to be a feasible location to re-route the road through these areas. Furthermore, we do not see an opportunity to completely re-route Burma Road outside of the former graded area without consideration of massive grading and drainage improvements in steeply sloping areas, some of which may also be in sensitive habitat area. There are also slope stability concerns north of Burma Road for any considered re-route, and we are currently lacking information due to a lack of GPS monitoring points north of Burma Road. The depth of movement of the new landslides is also unknown and at best could only be estimated based on previous studies of the Portuguese Bend Landslide.

Consideration could be given to stabilizing the affected portions of Burma Road in its current location; however, this would require an extensive geotechnical investigation, including geologic mapping, installation of instrumented borings (e.g., slope inclinometer casings and piezometers), laboratory soil testing, extensive slope stability analyses, and design of possible stabilization alternatives. Stabilization, if technically feasible, might require a combination of extensive in-ground structural measures (i.e., steel-reinforced concrete shear pins with tiebacks) and grading. Based upon our experience, such mitigation would likely have a cost in the millions of dollars.

Additional Warning Signage: Additional warning signage due to the increased land movement, to warn recreational users (hikers, bikers, horseback riders) and authorized outside agencies who drive the Reserve fire roads, is reasonable and appropriate from a geotechnical perspective, particularly if the City is going to keep Burma Road Trail and other potentially affected trails open to the public. As mentioned above, the new landslide areas impacting Burma Road and Trail are currently unstable. The landslide areas are currently moving (creeping) at velocities that are generally imperceptible to humans and may seem innocuous from that perspective; however, over short periods of time the movement creates significant hazards to trail users due to differential ground movement with associated ground cracking and fissuring within the landslide masses as well as scarp formation at the movement boundaries.

DRAFT

Additional Recommendations: In addition to the specific items requested to be addressed by the City, we have the following comments and recommendations:

- CSA previously issued a memorandum regarding the proposed SCE power pole relocation (May 19, 2023). At that time, we noted that the upslope extent of active landsliding had not been geologically mapped (to our knowledge), the depth of landslide movement is unknown, and there is a lack of GPS survey monitoring points north of Burma Road between Portuguese and Paintbrush Canyons. We subsequently stated that due to this lack of information, it was difficult to assess the impacts of future land movements on the proposed power pole relocation areas. It is our understanding that SCE may be considering a larger scale relocation of their transmission line(s) that are currently within the active landslide area, in lieu of the relocation project that we previously reviewed. The existing transmission line along Burma Road is partially supported by power poles located in actively moving landslides and at least two of the power poles have now been severely compromised. This transmission line poses a significant risk if not de-energized.

- The above-ground water main which trends along Burma Road traverses portions of the new landslide areas and is lacking ground support (i.e., the pipe is in the air) in some isolated areas. Our concern is that the pipe *may* not have been designed for such conditions. This should be further evaluated by the utility company responsible for the water main.

- Additional geologic mapping (on ground, possibly supplemented with drone photogrammetry) should be performed in an effort to further define the areal extent of new active landsliding. This information will be beneficial to the City for future evaluation of the safety of Burma Road and other trails within the Portuguese Bend Reserve, and also useful to other stakeholders.

- Additional GPS monitoring points should be established north of Burma Road, between Portuguese Canyon and Paintbrush Canyon. CSA will assist with recommended locations for these points if requested by the City. We also recommend that the tri-annual GPS monitoring be performed on <u>all</u> monuments in each monitoring session, in lieu of the partial monitoring that has been historically performed in two of the three sessions per year.

- Periodic closures of the trail system within the PBR during and immediately after significant rainfall events, as has been the policy of the City, should continue to allow for safety assessment of the trails by ranger staff.

- Where feasible, park ranger staff should continue to do routine monitoring and filling of ground fissures on other trails to keep the trails relatively safe; otherwise, the trails should be closed.

We hope this memorandum provides the City of Rancho Palos Verdes with the requested information and recommendations regarding Burma Road within the Portuguese Bend Reserve at this time. Please contact us if you have further questions or concerns.

-o-

DRAFT

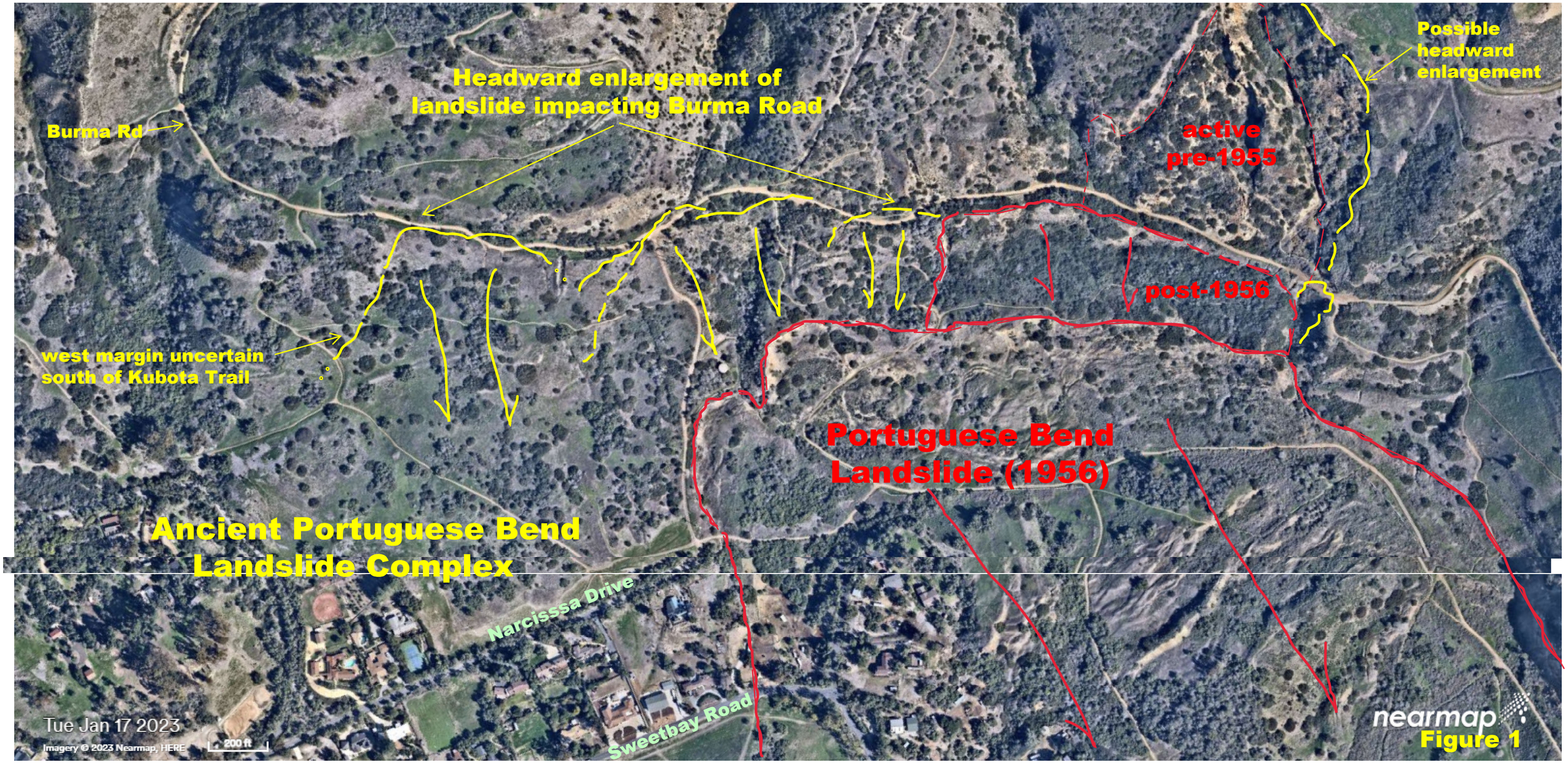
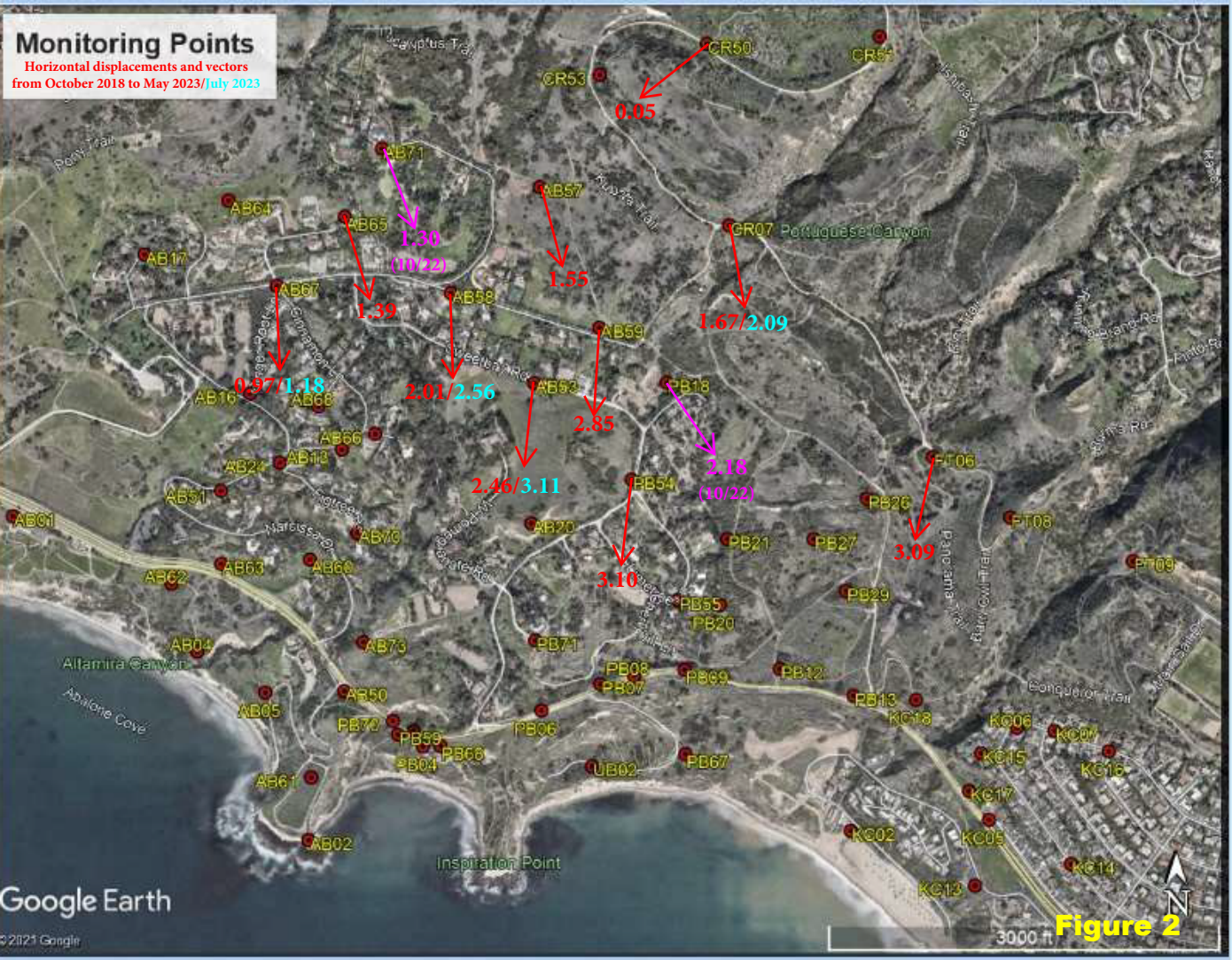

Headward enlargement of
landslide impacting Burma Road
Burma Rd
Possible
headward
enlargement
active
pre-1955
post-1956
west margin uncertain
south of Kubota Trail
Portuguese Bend
Landslide (1956)
Ancient Portuguese Bend
Landslide Complex
Narcisssa Drive
Sweetbay Road
Tue Jan 17 2023
Imagery © 2023 Nearmap, HERE
200 ft
nearmap

Figure 1


Monitoring Points
Horizontal displacements and vectors
from October 2018 to May 2023/July 2023
CR50
CR53
CR54
0.05
AB71
AB64
AB65
1.30
(10/22)
AB57
1.55
CR07
Portuguese Canyon
AB17
AB67
1.39
AB58
1.67/2.09
AB59
0.97/1.18
AB16
AB68
2.01/2.56
AB53
2.85
PB18
AB66
AB13
AB24
2.18
(10/22)
PT06
2.46/3.11
PB54
AB51
PB26
AB01
AB70
AB20
PB21
PB27
3.09
PT08
AB02
AB63
AB69
3.10
PT09
PB29
PB55
PB20
AB04
AB73
PB71
Altamira Canyon
PB08
PB07
PB69
PB12
Conqueror Trail
Abalone Cove
AB05
AB50
PB13
KC18
KC06
KC07
PB70
PB59
PB06
PB66
PB04
KC15
KC16
PB67
UB02
AB61
KC17
KC02
KC05
AB02
KC14
Inspiration Point
KC13
Google Earth
©2021 Google
3000 ft
N
Figure 2

GPS Monitoring Data

Survey Monuments - Upper Portuguese Bend Landslide/Burma Road Area

Displacement Response to 12-month Antecedent Rainfall

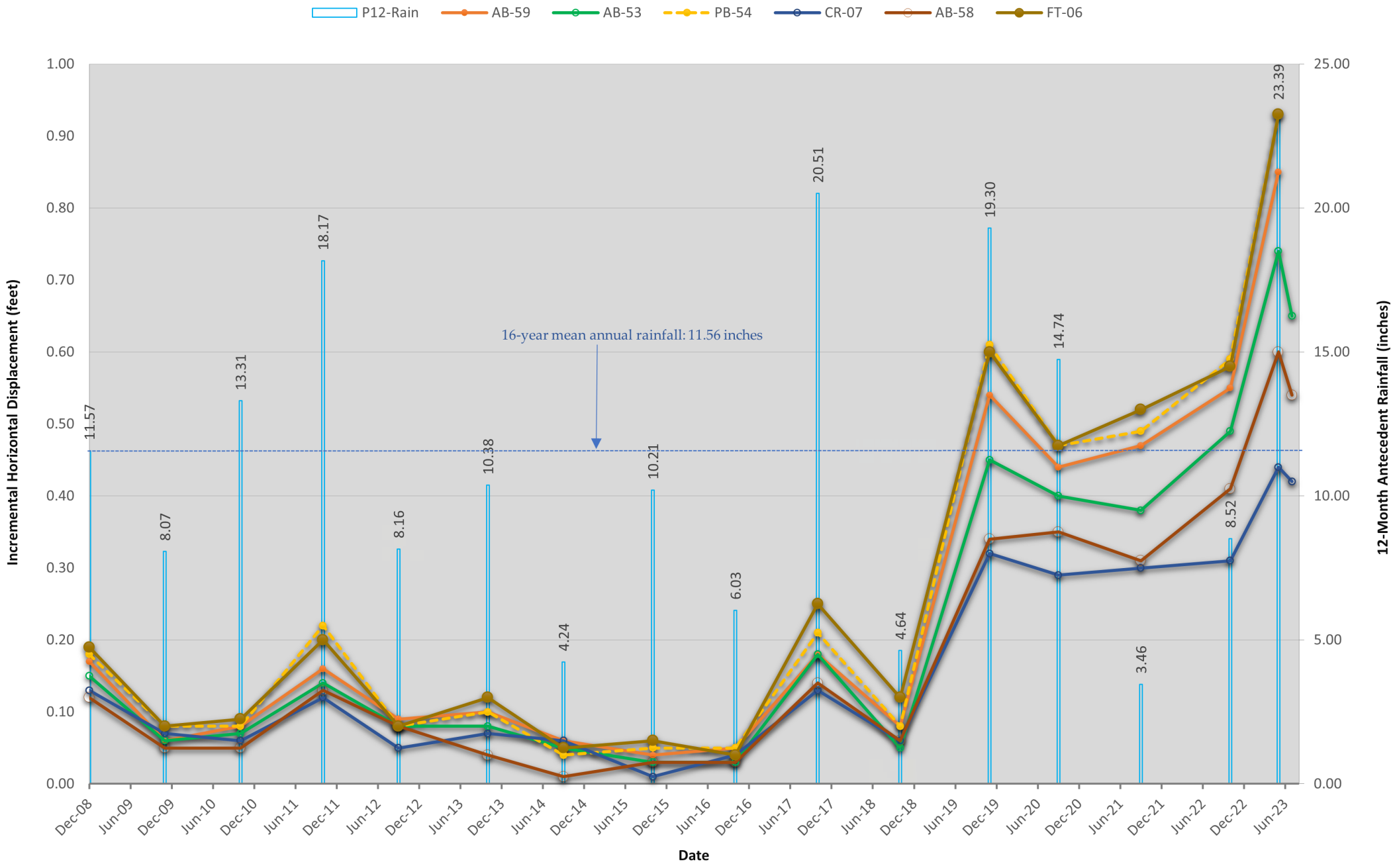


Figure 3

GPS Monitoring Data

Survey Monuments - Upper Portuguese Bend Landslide/Burma Road Area

Cumulative Horizontal Displacement 2007-2023

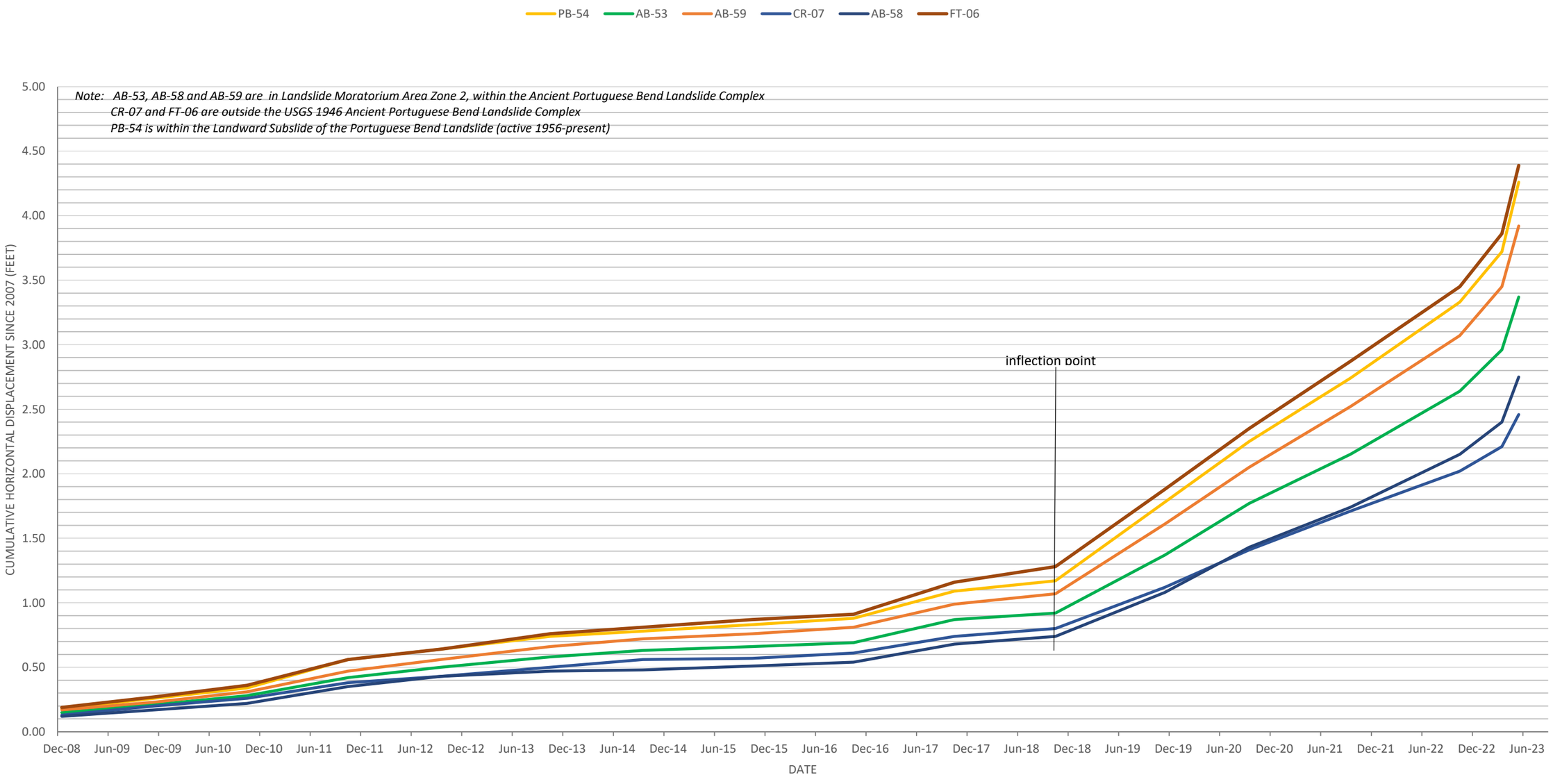


Figure 4

COTTON, SHIRES AND ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS

CITY OF RANCHO PALOS VERDES

CSA Project No: SC6163

MEMORANDUM

TO: Brandy Forbes, Community Development Director
CC: Ara Mihranian, City Manager
Ramzi Awwad, Public Works Director
FROM: Michael Phipps, CEG 1832, Contract City Geologist
Patrick Shires, GE 770, Contract City Geotechnical Engineer
RE: **Movement of the Altamira (Greater Portuguese Bend) Landslide Complex and Related Impacts, Rancho Palos Verdes, California**
DATE: November 8, 2024

INTRODUCTION

In this memorandum Cotton, Shires and Associates, Inc. (CSA) summarizes our evaluation of land movement of the Altamira Landslide Complex (previously referred to as the Greater Portuguese Bend Landslide Complex or Ancient Portuguese Bend Landslide Complex in past correspondence) from 2022-2024, with specific focus on the impacts of the land movement to private property, residential structures, and infrastructure. The active Altamira Landslide Complex currently involves major land movement comprising an area of over 700 acres landward of the coast. As of this date, the major land movement has resulted in the red-tagging (Unsafe to Enter/Occupy) of 18 residential structures and 2 commercial structures (at Wayfarer's Chapel), and the yellow-tagging (Limited Entry) of 38 other residential structures. It has also caused major impacts to public and private roads (some requiring closure), damages to utility infrastructure (water, sewer, gas, electricity and cable) causing certain utilities to be shut-off, and closure of certain Preserve land that is heavily accessed by the public for hiking, biking, equestrian, and other purposes.

BACKGROUND

The Altamira Landslide Complex in Rancho Palos Verdes includes four historically active, previously identified landslide areas: the Portuguese Bend Landslide (PBL) which began moving in 1956, the Abalone Cove Landslide (ACL) which began moving in 1979, the Klondike Canyon Landslide (KCL) which also began moving in 1979, and the Beach Club Landslide (BCL) which is nested within the KCL and, while dormant itself, moves with the KCL. It also now includes areas outside of the historically mapped boundaries of these known landslides, predominantly upslope from the historically mapped Portuguese Bend and Abalone Cove Landslides, within the Ancient Portuguese Bend Landslide Complex as mapped by various agencies (i.e., U.S. Geological Survey, California Geological Survey and other researchers (see attached Figure 1 - Landslide Area Map).

Based upon historically mapped boundaries, the ACL, PBL and KCL previously comprised an area of approximately 380 acres and affected portions of neighborhoods known as the Portuguese Bend Community, the Seaview Community and the Portuguese Bend Beach Club, as well as City-owned land within the Portuguese Bend Reserve (a sub-area of the greater Palos Verdes Nature Preserve). The

PBL has been continuously active since reactivation in 1956 with many areas of the landslide having moved hundreds of feet seaward over the ensuing six-plus decades. The ACL was active from 1979 until the late 1990's, involving only several feet of movement, when dewatering and other mitigation efforts largely halted movement. Creep movement of the ACL has occurred over the past 25 years following rainy seasons that were significantly above average rainfall amounts. The KCL has been episodically active in 1979-1983 and 2005-2006, experiencing only several inches of movement, typically in response to significantly above average rainfall. Landslide movements throughout the Ancient Portuguese Bend Landslide Complex *outside of the historical boundaries of* the ACL and PBL previously exhibited low rates of creep movement, or movement at or near the instrument precision range, in the 11-year monitoring period of 2007-2018 for which we have readily available data. These landslides are deep translational-type failures within seaward-dipping strata of the Monterey Formation, with the landslide slip surfaces occurring within very weak bentonitic clay beds. Historically, the movement behavior of these landslides routinely exhibited high sensitivity to increased groundwater pore pressure, and increased rates of land movement were correlative with 6-to-12-month antecedent rainfall that was well above average. Similarly, land movement decreased during below average rainy seasons or multi-year periods of drought.

Beginning in 2021, CSA geologists were requested by the City of Rancho Palos Verdes to observe reported distress (ground cracking and fissures) to trails in the Portuguese Bend Reserve. At that time, we also began reviewing Global Positioning Satellite (GPS) monitoring data for survey monuments within the entire Ancient Portuguese Bend Landslide Complex or Altamira Landslide Complex. In the summer of 2022, CSA was also asked to evaluate distress to an SCE transmission line along Burma Road within the Portuguese Bend Reserve. Subsequent geologic mapping of the Reserve area revealed that headward and lateral enlargement of the Portuguese Bend Landslide was occurring. We were also receiving reports of underground water line breaks occurring within the Portuguese Bend Community Association area and the Seaview Community. Review of GPS monitoring data from 2007 through 2023 indicated that land movement acceleration initially began between 2018 and 2019. We postulated that this acceleration was correlative with significantly above-normal rainfall in two out of three prior rainfall seasons (2016-17 and 2018-19) which followed five consecutive drier than normal rainfall seasons (2011-12 through 2015-16) (see attached Figure 2 – GPS Monitoring Data, Ancient Portuguese Bend Landslide: Displacement Response to 12-Month Antecedent Rainfall, December 2008-January 2024). One notable item, however, is that the land movement velocities did not decline back to the pre-2018 levels despite two significantly below-normal rainy seasons (2020-21, one of the driest on record, and 2021-22).

RAINFALL IMPACTS – 2022 THROUGH 2024

Further acceleration of land movement occurred throughout the Altamira Landslide Complex during and following the 2022-23 rain season, and the rainfall impacts from mid- to late-winter storms significantly contributed to the increased ground movements. Significant accelerations in movement velocity were documented in May 2023 following major storm sequences in January, February and March of 2023, which added to cumulative seasonal rainfall totals exceeding 193% of average rainfall. Approximately 87% of this rain fell prior to June 18, 2023. Most of this rainfall occurred from three significant atmospheric river-type storm sequences occurring on January 9-16 (3.59 inches), February 23-March 1 (3.79 inches) and March 10-15 (4.12 inches). Land movement velocities further increased as of the July 15, 2023 monitoring. An anomalous tropical storm dropped an additional 3.05 inches of

rain on August 19-20, 2023, resulting in further land movement acceleration as of the October 10, 2023 monitoring. The multiple increases in landslide velocities (i.e., accelerations) resulted in additional mappable ground surface expressions of the uphill limits of active landsliding, including the formation of landslide scarps, fissures, grabens, tensional cracking and shear zones, including areas north, west and east of the historically known landslide boundaries. Field geologic mapping and photo-geologic mapping performed in mid to late 2023 corroborated the GPS monitoring data findings that a large portion of the Ancient Portuguese Bend Landslide Complex (Altamira Landslide Complex) above the historically mapped PBL, ACL and KCL boundaries was involved in significant active landslide movement. The boundary of that major land movement has been updated through November 2024 and is depicted by the green dashed line on the attached Figure 1 – Landslide Area Map.

The 2023-2024 rainfall season total of more than 23 inches was 170% of the long-term average and had a compounding effect on the previous season's extraordinary rainfall. This rainfall season was characterized by additional atmospheric river type storms, including a sequence of storms that resulted in a Federally declared disaster from January 30 - February 9, 2024. The February 2024 rainfall total of 11.22 was the second wettest February in the 67-year history of recorded data for the Palos Verdes Peninsula. The landslide response to these rains was almost immediate and we observed continued accelerating land movement in the GPS monitoring data through August 1, 2024. A peak land movement velocity of >13 inches/week occurred in the center of the landslide as of the May 28, 2024 monitoring period. Movement velocities appeared to peak across the breadth of the landslide in the July 1 - August 1, 2024 monitoring period with the majority of stations moving >10 inches/week and peak movements >12 inches per week. Attached Figures 3, 4, 5 and 6 – GPS Monitoring Displacement Rate Contour Maps, are landslide movement velocity contour maps produced from GPS monitoring data through August 1, 2024, September 4, 2024, October 8, 2024 and October 29, 2024, respectively.

For reference, rainfall data utilized for this evaluation are from the Los Angeles County Department of Public Works - Hydrology Division Station 1011B, located at the Rolling Hills Fire Station No. 56. This rainfall station serves as a reasonable proxy for rainfall impacts to the southern face of the Palos Verdes Peninsula due to its elevation, which should reflect some orographic effect for storms approaching the Palos Verdes Peninsula from the west, southwest, and south, compared to coastal stations such as Point Vicente which may underestimate rain totals in the higher reaches of the landslide complex and watershed.

TOTAL LAND MOVEMENT – OCTOBER 2022 THROUGH OCTOBER 2024

Since October 10, 2022, total horizontal land movement throughout the Altamira Landslide Complex has ranged from approximately 27 to 39 feet in most areas, with the exception being approximately 6 to 21 feet of horizontal land movement in the Klondike Canyon Landslide area. Vertical displacements have ranged from 1 - 10 feet in most areas over this same period. This land movement has had a destructive and devastating effect on numerous residential and commercial properties and structures, private and public roadways, and utility infrastructure. In addition to the 18 red-tagged and 38 yellow-tagged structures, dozens of homes are experiencing varying amounts of distress and inaccessibility due to differential land movements, and electricity and gas service has been cut off from the majority of these properties. The most significant damage is to structures on or adjacent to the landslide boundaries, or those located on boundaries between subslides (blocks) within the Altamira Landslide Complex that are moving at different rates.

Since June 2024, the City has undertaken emergency mitigation measures including 18 deep geotechnical test borings with sophisticated instrumentation to detect the depth(s) of land movement and groundwater pore pressures within and beneath the active landslide mass(es). The instrumented geotechnical test borings revealed that the basal slip surface of the Altamira Landslide Complex beneath the Portuguese Bend Landslide portion of the Altamira complex is up to twice as deep as previously/historically modeled, and moving at a much faster rate than the shallower PBL slip surface. This significantly greater depth of movement has resulted in a broader footprint of active land movement at the ground surface and offshore, and expansion of the historical land movement area from approximately 380 acres to over 700 acres. The test borings also indicated that artesian or near-artesian groundwater pressure is present beneath the Altamira slip surface, and confined groundwater under significant pressure is present between the Altamira and PBL slip surfaces. High unconfined groundwater levels were also determined within the historically modeled Portuguese Bend and Abalone Cove landslide bodies. Beginning September 13, 2024, the first of 10 deep dewatering wells came online. The ten wells, all located near the toe, or lower 1/3 of the landslide complex, are currently extracting approximately 1 million gallons per day of groundwater within and beneath the landslide.

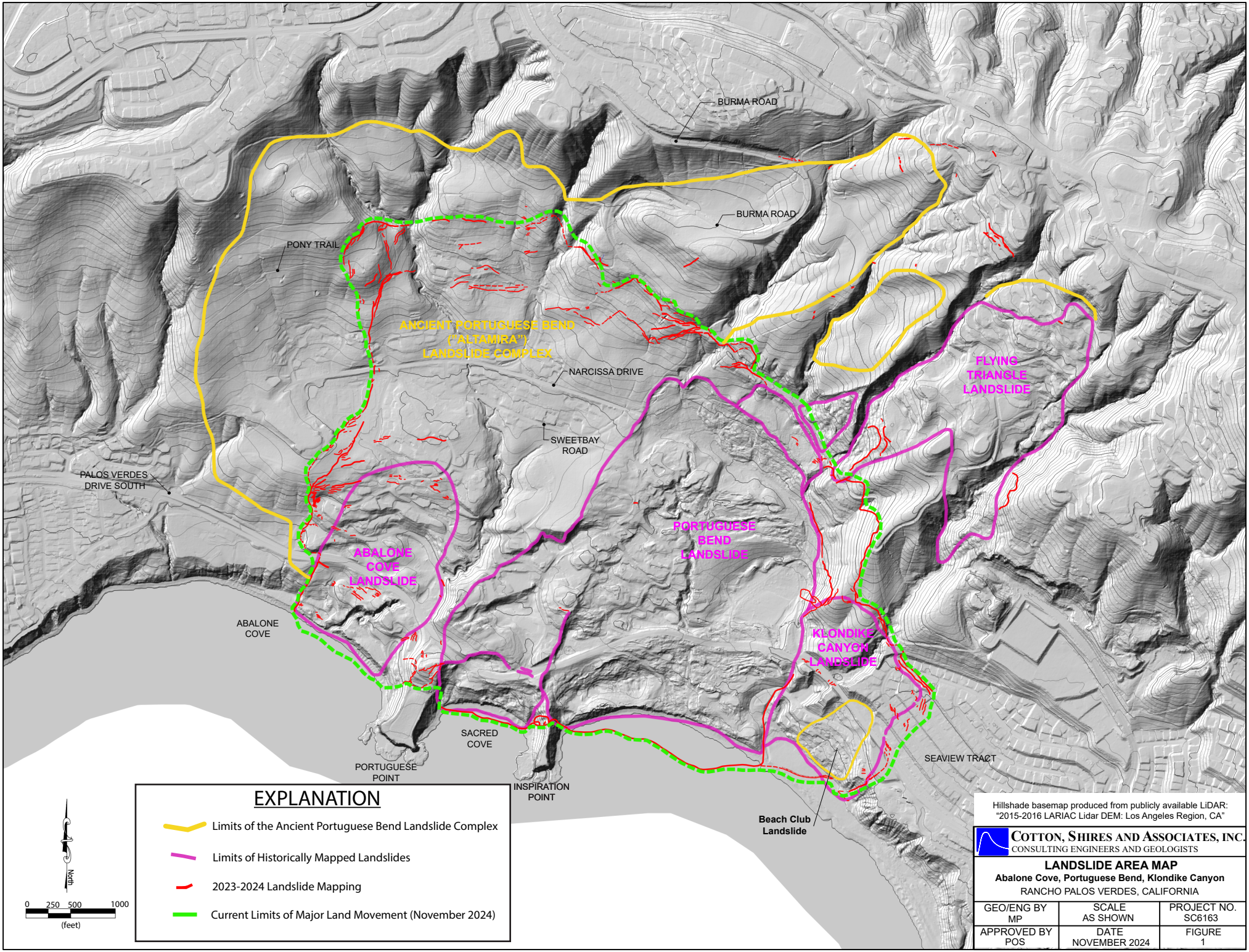
FUTURE LAND MOVEMENT POTENTIAL

As described above, major movement of the Altamira Landslide Complex ranging from 6 to 39 feet horizontally and 1 to 10 feet vertically has occurred since October 2022, with the majority of that movement occurring during and following the 2023-24 rainy season. The highest observed movement rates have exceeded 12 inches per week. While emergency dewatering mitigation efforts and 6 months without any rainfall recharge have reduced movements in most areas to a current level of 0.5 to 6 inches per week, there are many uncertainties regarding the longevity and long-term effectiveness of the deep dewatering wells that have been installed, including the availability of additional funding needed to maintain them and keep them operational. There is also uncertainty regarding the quantity of dewatering wells needed to maintain landslide movements at low (creep) movement levels, and whether funding for additional wells can be obtained. Given the emergency measures that are in place, the future response of the landslide to seasonal rains, including the severity of those rains is unknown; however, historical land movement data demonstrates increases in land movement with above-average rainy seasons despite the operation of past dewatering facilities operated by private geologic hazard abatement districts such as ACLAD and KCLAD.

-o-

Attachments:

Figure 1 – Landslide Area Map
Figure 2 – GPS Monitoring Data, Displacement Response to 12-Month Antecedent Rainfall, December 2008-January 2024
Figure 3 – GPS Monitoring Displacement Rate Contour Map (8/1/2024 Data)
Figure 4 – GPS Monitoring Displacement Rate Contour Map (9/4/2024 Data)
Figure 5 – GPS Monitoring Displacement Rate Contour Map (10/8/2024 Data)
Figure 6 – GPS Monitoring Displacement Rate Contour Map (10/29/2024 Data)

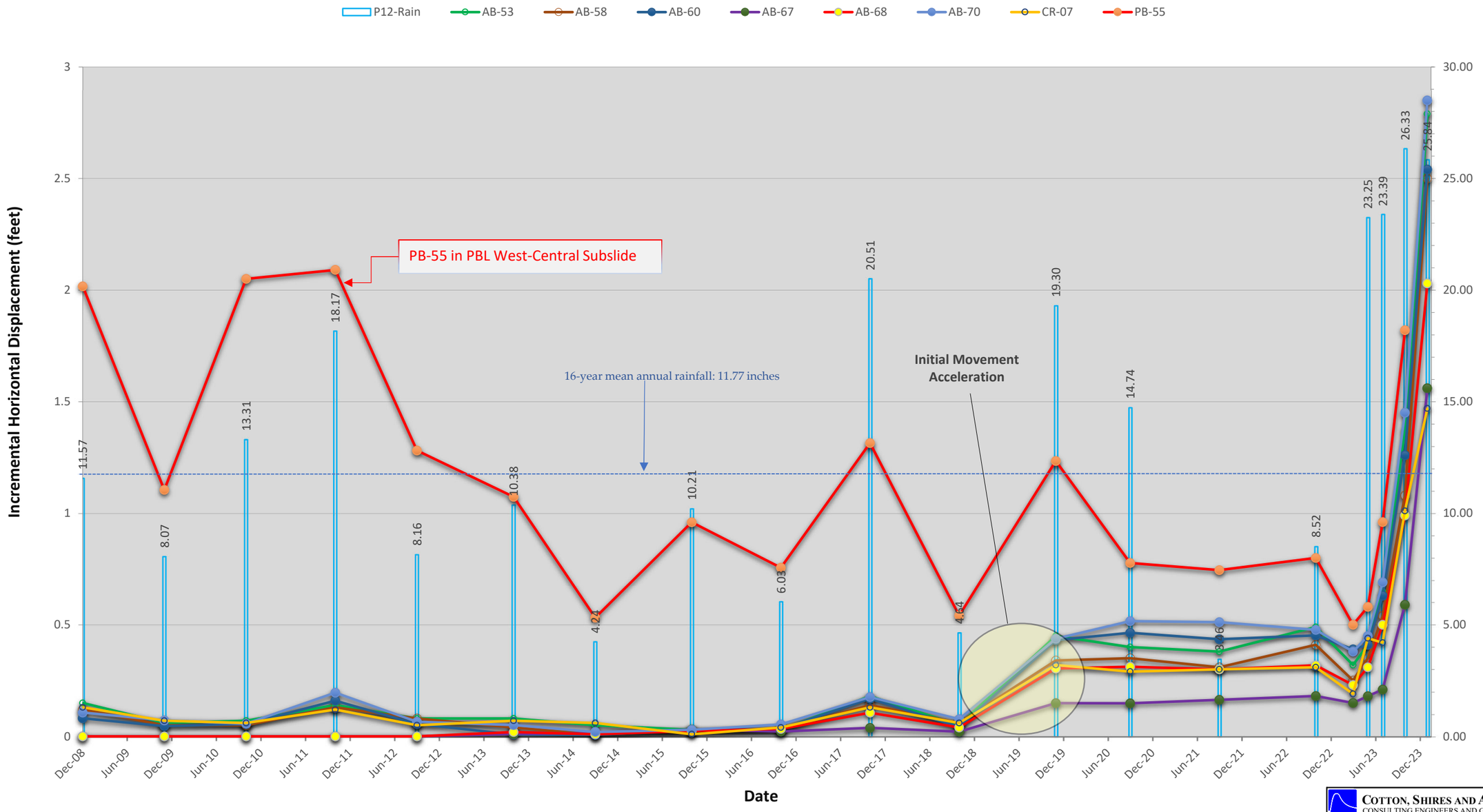

BURMA ROAD
BURMA ROAD
PONY TRAIL
ANCIENT PORTUGUESE BEND ("ALTAMIRA") LANDSLIDE COMPLEX
NARCISSA DRIVE
SWEETBAY ROAD
PALOS VERDES DRIVE SOUTH
FLYING TRIANGLE LANDSLIDE
PORTUGUESE BEND LANDSLIDE
ABALONE COVE LANDSLIDE
KLONDIKE CANYON LANDSLIDE
ABALONE COVE
SACRED COVE
PORTUGUESE POINT
INSPIRATION POINT
SEAVIEW TRACT
Beach Club Landslide
EXPLANATION
Limits of the Ancient Portuguese Bend Landslide Complex
Limits of Historically Mapped Landslides
2023-2024 Landslide Mapping
Current Limits of Major Land Movement (November 2024)
North
0 250 500 1000
(feet)
Hillshade basemap produced from publicly available LiDAR: "2015-2016 LARIAC Lidar DEM: Los Angeles Region, CA"
COTTON, SHIRES AND ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS
LANDSLIDE AREA MAP
Abalone Cove, Portuguese Bend, Klondike Canyon
RANCHO PALOS VERDES, CALIFORNIA
GEO/ENG BY MP
SCALE AS SHOWN
PROJECT NO. SC6163
APPROVED BY POS
DATE NOVEMBER 2024
FIGURE 1

GPS Monitoring Data

Survey Monuments - ACL, PBL and Upper Ancient Landslide Complex

Displacement Response to 12-month Antecedent Rainfall

December 2008-January 2024



COTTON, SHIRES AND ASSOCIATES, INC. CONSULTING ENGINEERS AND GEOLOGISTS	
GPS Monitoring Data Survey Monuments- ACL, PBL, and Upper Ancient Landslide Complex Displacement Response to 12-month Antecedent Rainfall Rancho Palos Verdes, California	
GEO/ENG BY MP	SCALE
APPROVED BY POS	DATE NOVEMBER 2024

PROJECT NO. SC6163

FIGURE 2

APPROXIMATE BOUNDARY OF ANCIENT PORTUGUESE BEND LANDSLIDE COMPLEX

"Creeping Area" Approximately 0.5 inch/week

CURRENT LIMITS OF MAJOR LANDSLIDE MOVEMENT (AUGUST 2024)

PONY TRAIL

BURMA ROAD

PALOS VERDES DRIVE SOUTH

ABALONE COVE

PORTUGUESE POINT

SACRED COVE

INSPIRATION POINT

SEAVIEW TRACT

PORTUGUESE BEND LANDSLIDE

ABALONE COVE LANDSLIDE

FLYING TRIANGLE LANDSLIDE

KLONDIKE CANYON LANDSLIDE

0.06 CW01
0.08 AB77
0.07 CR56
0.33 CR50
0.47 CR51
0.49 CR53
0.52 CW05
0.00 AB71 no data
0.00 CR57 no data
0.48 AB64
0.01 AB17
0.03 RP02
0.05 CW06
0.24 AB76
0.06 AB01
0.04 CW07
0.02 FT08
0.05 CW08
0.01 FT09
0.02 FT00
0.06 AB02
0.08 KC14
0.02 RP01
0.23 KC25
0.46 KC13
4.09 KC22
0.04 KC21
3.84 KC33
3.89 KC06
3.40 KC19
0.03 KC07
0.03 KC16
3.45 KC20
3.91 KC15
2.72 KC23
3.53 KC17
2.41 KC05
5.68 KC28
5.16 KC24
3.88 KC27
4.09 KC26
6.48 KC29
9.21 KC30
8.82 PB13
8.23 KC31
7.84 KC18
11.39 PB74
11.45 PB12
9.87 PB26
9.36 PB29
10.91 PB27
9.39 PB73
11.89 PB54
10.41 PB21
11.54 PB75
11.13 PB55
10.83 PB20
10.84 PB08
9.92 PB09
11.68 PB07
12.96 PB71
12.29 PB67
9.98 UB02
11.36 PB59
11.13 PB69
11.58 PB70
11.34 PB04
11.15 PB68
11.81 PB72
10.07 PB06
10.75 AB73
11.99 AB75
12.43 AB21
11.69 AB70
10.19 AB60
9.11 AB63
7.08 AB62
9.20 AB04
8.55 AB05
6.86 AB50
5.16 AB74
8.95 AB51
11.23 AB24
10.64 AB13
10.10 AB66
9.79 AB68
7.49 AB16
7.48 AB67
8.88 AB65
9.39 AB57
11.00 AB58
12.65 AB59
11.80 CR54
11.29 AB53
11.89 PB18
0.00 AB71 no data
7.0
8.0
9.0
10.0
11.0
12.0

EXPLANATION

- Limits of the Ancient Portuguese Bend Landslide Complex
- Limits of Historically Mapped Landslides
- 2023/2024 Landslide Mapping
- Current Limits of Major Landslide Movement (August 2024)
- GPS Monument Displacement!Rate (July 1, 2024 to August 1, 2024) Displacement Vector! Scale 1"= 8"/week

Displacement Rate Table

Minimum Rate (inch/week)	Maximum Rate (inch/week)	Color
0.00	1.00	
1.00	2.00	
2.00	3.00	
3.00	4.00	
4.00	5.00	
5.00	6.00	
6.00	7.00	
7.00	8.00	
8.00	9.00	
9.00	10.00	
10.00	11.00	
11.00	12.00	
12.00	13.00	

North

0 250 500 1000 (feet)

Hillshade basemap produced from publicly available LiDAR: "2015 - 2016 LARIAC Lidar DEM: Los Angeles Region, CA"

COTTON, SHIRES AND ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS

GPS MONITORING DISPLACEMENT RATE CONTOUR MAP (8/1/24 DATA)
Abalone Cove, Portuguese Bend, Klondike Canyon
RANCHO PALOS VERDES, CALIFORNIA

GEO/ENG BY	SCALE	PROJECT NO.
MP	1"=500'	SC6163
APPROVED BY	DATE	FIGURE NO.
POS	November 8, 2024	3

APPROXIMATE BOUNDARY OF ANCIENT PORTUGUESE BEND LANDSLIDE COMPLEX

CURRENT LIMITS OF MAJOR LANDSLIDE MOVEMENT (SEPTEMBER 2024)

"Creeping Area" Approximately 0.5 inch/week

BURMA ROAD

PONY TRAIL

PALOS VERDES DRIVE SOUTH

PORTUGUESE BEND LANDSLIDE

ABALONE COVE LANDSLIDE

KLONDIKE CANYON LANDSLIDE

FLYING TRIANGLE LANDSLIDE

ABALONE COVE

SACRED COVE

PORTUGUESE POINT

INSPIRATION POINT

SEAVIEW TRACT

EXPLANATION

- Limits of the Ancient Portuguese Bend Landslide Complex
- Limits of Historically Mapped Landslides
- 2023/2024 Landslide Mapping
- Current Limits of Major Landslide Movement (September 2024)
- GPS Monument Displacement Rate (August 1, 2024 to September 4, 2024) Displacement Vector Scale 1"= 8"/week

Displacement Rate Table

Minimum Rate (inch/week)	Maximum Rate (inch/week)	Color
0.00	1.00	
1.00	2.00	
2.00	3.00	
3.00	4.00	
4.00	5.00	
5.00	6.00	
6.00	7.00	
7.00	8.00	
8.00	9.00	
9.00	10.00	
10.00	11.00	
11.00	12.00	
12.00	13.00	

North

0 250 500 1000 (feet)

Hillshade basemap produced from publicly available LiDAR: "2015 - 2016 LARIAC Lidar DEM: Los Angeles Region, CA"

COTTON, SHIRES AND ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS

GPS MONITORING DISPLACEMENT RATE CONTOUR MAP (9/4/24 DATA)
Abalone Cove, Portuguese Bend, Klondike Canyon
RANCHO PALOS VERDES, CALIFORNIA

GEO/ENG BY	SCALE	PROJECT NO.
MP	1"=500'	SC6163
APPROVED BY	DATE	FIGURE NO.
POS	November 8, 2024	4

APPROXIMATE BOUNDARY OF ANCIENT PORTUGUESE BEND LANDSLIDE COMPLEX

CURRENT LIMITS OF MAJOR LANDSLIDE MOVEMENT (OCTOBER 2024)

"Creeping Area" Approximately 0.5 inch/week

BURMA ROAD

PONY TRAIL

PALOS VERDES DRIVE SOUTH

ABALONE COVE

SACRED COVE

PORTUGUESE POINT

INSPIRATION POINT

SEAVIEW TRACT

ABALONE COVE LANDSLIDE

PORTUGUESE BEND LANDSLIDE

KLONDIKE CANYON LANDSLIDE

FLYING TRIANGLE LANDSLIDE

0.04 AB80
0.04 AB79
0.03 CW01
0.06 AB77
0.07 CR56
0.35 CR50
0.44 CR51
0.00 CR60
0.43 CR53
0.36 CR58
1.78 AB78
6.17 AB57
0.47 CW05
0.03 CR59
0.12 AB64
6.14 AB65
0.11 CR57
0.04 AB17
5.09 AB67
6.86 CR54
7.44 AB58
0.00 RP03
0.07 CW06
7.90 AB59
0.03 FT10
5.42 AB16
6.82 AB68
7.37 AB53
6.95 PB18
0.11 AB76
6.91 AB66
7.23 AB13
3.84 PB76
7.88 AB24
7.18 AB75
6.99 PB54
4.01 PB26
0.05 AB01
3.66 AB74
6.18 AB51
7.85 AB70
7.29 AB21
0.03 FT08
4.96 PB21
5.05 PB27
0.02 CW08
6.23 AB69
6.74 AB69
6.28 PB75
0.04 FT09
5.03 AB62
5.26 PB55
3.42 PB29
4.99 PB20
0.04 KC21
6.09 AB04
7.08 PB71
6.04 AB73
6.03 PB70
5.88 PB59
1.57 KC06
3.88 AB50
5.64 PB69
4.62 PB08
4.08 PB09
4.21 PB12
3.04 PB13
1.80 KC22
1.35 KC19
5.11 PB07
5.74 PB04
3.23 KC31
2.49 KC18
0.04 KC07
4.58 PB06
1.67 KC33
1.29 KC20
0.02 KC16
5.71 PB68
5.77 PB72
4.63 PB67
4.54 PB74
3.38 KC30
1.53 KC15
3.74 UB02
1.34 KC17
1.05 KC23
1.05 KC05
2.27 KC29
1.75 KC24
2.47 KC38
1.98 KC28
1.34 KC26
0.55 KC13
0.05 KC35
0.05 KC14
0.05 KC34
0.03 KC36
0.08 KC25
0.04 KC37
0.04 RP01

5.0
6.0
7.0
4.0
3.0
2.0
1.0

EXPLANATION

- Limits of the Ancient Portuguese Bend Landslide Complex
- Limits of Historically Mapped Landslides
- 2023/2024 Landslide Mapping
- Current Limits of Major Landslide Movement (October 2024)
- GPS Monument Displacement Rate (September 4, 2024 to October 8, 2024) Displacement Vector Scale 1"= 8"/week

Displacement Rate Table

Minimum Rate (inch/week)	Maximum Rate (inch/week)	Color
0.00	1.00	
1.00	2.00	
2.00	3.00	
3.00	4.00	
4.00	5.00	
5.00	6.00	
6.00	7.00	
7.00	8.00	
8.00	9.00	
9.00	10.00	
10.00	11.00	
11.00	12.00	
12.00	13.00	

North

0 250 500 1000
(feet)

Hillshade basemap produced from publicly available LiDAR: "2015 - 2016 LARIAC Lidar DEM: Los Angeles Region, CA"

COTTON, SHIRES AND ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS

GPS MONITORING DISPLACEMENT RATE CONTOUR MAP (10/8/24 DATA)
Abalone Cove, Portuguese Bend, Klondike Canyon
RANCHO PALOS VERDES, CALIFORNIA

GEO/ENG BY	SCALE	PROJECT NO.
MP	1"=500'	SC6163
APPROVED BY	DATE	FIGURE NO.
POS	November 8, 2024	5

APPROXIMATE BOUNDARY OF ANCIENT PORTUGUESE BEND LANDSLIDE COMPLEX

CURRENT LIMITS OF MAJOR LANDSLIDE MOVEMENT (NOVEMBER 2024)

BURMA ROAD

PONY TRAIL

PALOS VERDES DRIVE SOUTH

ABALONE COVE

PORTUGUESE POINT

SACRED COVE

INSPIRATION POINT

ABALONE COVE LANDSLIDE

PORTUGUESE BEND LANDSLIDE

KLONDIKE CANYON LANDSLIDE

FLYING TRIANGLE LANDSLIDE

SEAVIEW TRACT

0.07 AB80 · 0.12 AB79 · 0.02 CW01 · 0.06 AB77 · 0.04 CR56 · 0.08 CR50 · 0.10 CR51 · 0.03 CR60 · 0.01 CR53 · 0.07 CR58 · 0.13 AB78 · 0.08 CW05 · 0.08 CR59 · 0.62 AB64 · 4.83 AB57 · 4.21 AB65 · 0.09 CR57 · 0.09 AB17 · 3.61 AB67 · 4.0 · 5.10 AB58 · 4.68 CR54 · 5.0 · 5.04 AB59 · 0.01 RP03 · 0.08 CW06 · 3.91 AB16 · 4.51 AB53 · 4.01 PB18 · 0.07 FT10 · 4.72 AB68 · 4.74 AB66 · 0.11 AB76 · 3.32 AB76 · 1.55 PB76 · 5.64 AB24 · 0.13 AB01 · 3.06 AB74 · 4.17 AB51 · 4.70 AB75 · 4.23 PB54 · 0.56 PB26 · 0.04 FT08 · 4.63 AB21 · 2.48 PB21 · 2.08 PB27 · 0.16 GW08 · 0.06 FT09 · 5.46 AB70 · 4.37 AB69 · 5.29 AB60 · 3.49 PB75 · 3.64 AB62 · 2.88 PB55 · 0.36 PB29 · 4.0 · 4.36 PB71 · 2.03 PB20 · 4.32 AB04 · 3.53 AB73 · 1.97 PB08 · 2.0 · 0.04 KC21 · 0.22 KC06 · 3.47 PB70 · 3.38 PB59 · 1.67 PB09 · 1.23 PB12 · 0.38 PB13 · 3.0 · 2.46 PB07 · 3.63 PB69 · 0.22 KC31 · 0.14 KC18 · 0.19 KC22 · 0.28 KC19 · 2.07 AB50 · 2.21 PB06 · 3.25 PB04 · 0.24 KC33 · 0.11 KC07 · 3.25 PB68 · 3.22 PB72 · 1.0 · 0.68 UB02 · 1.14 PB67 · 0.97 PB74 · 0.16 KC20 · 0.13 KC16 · 0.16 KC30 · 0.19 KC15 · 0.11 KC17 · 0.20 KC23 · 0.19 KC05 · 0.12 KC29 · 0.11 KC24 · 0.22 KC38 · 0.17 KC28 · 0.08 KC26 · 0.12 KC13 · 0.09 KC25 · 0.11 KC14 · 0.12 KC35 · 0.14 KC34 · 0.10 KC36 · 0.16 KC37 · 0.11 RP01

EXPLANATION

- Limits of the Ancient Portuguese Bend Landslide Complex
- Limits of Historically Mapped Landslides
- 2023/2024 Landslide Mapping
- Current Limits of Major Landslide Movement (November 2024)
- GPS Monument Displacement Rate (October 8, 2024 to October 29, 2024) Displacement Vector Scale 1"= 8"/week

Displacement Rate Table

Minimum Rate (inch/week)	Maximum Rate (inch/week)	Color
0.00	1.00	
1.00	2.00	
2.00	3.00	
3.00	4.00	
4.00	5.00	
5.00	6.00	
6.00	7.00	
7.00	8.00	
8.00	9.00	
9.00	10.00	
10.00	11.00	
11.00	12.00	
12.00	13.00	

North

0 250 500 1000 (feet)

Hillshade basemap produced from publicly available LiDAR: "2015 - 2016 LARIAC Lidar DEM: Los Angeles Region, CA"

COTTON, SHIRES AND ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS

GPS MONITORING DISPLACEMENT RATE CONTOUR MAP (10/29/24 DATA)
Abalone Cove, Portuguese Bend, Klondike Canyon
RANCHO PALOS VERDES, CALIFORNIA

GEO/ENG BY	SCALE	PROJECT NO.
MP	1"=500'	SC6163
APPROVED BY	DATE	FIGURE NO.
POS	November 8, 2024	6

COTTON, SHIRES AND ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS

CITY OF RANCHO PALOS VERDES

CSA Project No: SC6163

MEMORANDUM

TO: Ara Mihranian, City Manager
CC: Ramzi Awwad, Public Works Director

FROM: Michael Phipps, CEG 1832, Contract City Geologist
Patrick Shires, GE 770, Contract City Geotechnical Engineer
RE: **Movement of the Altamira Landslide: Characterization, Related Impacts, Causation, and Emergency Measures, Rancho Palos Verdes, California**
DATE: March 16, 2025

INTRODUCTION

In this memorandum Cotton, Shires and Associates, Inc. (CSA) summarizes our evaluation of movement of the Altamira Landslide, with specific focus on the characteristics, differences, and causation of movement of this new landslide, distinguishing it from the known historically active Landslide Complex that is comprised of the Portuguese Bend Landslide (PBL), Abalone Cove Landslide (ACL), Klondike Canyon Landslide (KCL) and Beach Club Landslide (BCL). We include the BCL as part of the KCL, because it is, in itself, dormant and nested within (or rafts upon) the KCL. Also discussed are impacts of the Altamira Landslide movement to private property, residential structures, and infrastructure in the landslide area.

DISTINGUISHING THE ALTAMIRA LANDSLIDE

For definition purposes, the Altamira Landslide is a newly active landslide that has occurred within a previously mapped ancient landslide complex, most recently labeled the "Ancient Altamira Landslide Complex" (Douglas, 2013) which was a name modification of the "Ancient Portuguese Bend Landslide" identified on the California Geological Survey's Landslide Inventory Map (CGS, 2007). See the excerpted Figure 1 from Douglas (2013) on the following page for this clarification. It is important to make this distinction for consistency and to avoid confusion, because the Altamira Landslide is, in fact, a new member of the historically active PBL/ACL/KCL Landslide Complex but largely **underlies it** and occupies an area of active land movement >700 acres and extends to more than 500 feet off of the coastline, whereas the shallower historically active PBL/ACL/KCL complex only occupied about 380 acres.

The Altamira Landslide in Rancho Palos Verdes is therefore a recently identified large landslide that largely underlies (and therefore largely encompasses, but exceeds the area of) the previously understood active Landslide Complex containing the four historically active landslides: the PBL which historically began moving in 1956, the ACL which began moving in 1979, the KCL which also began moving in 1979, and the BCL which is nested within the KCL and, while dormant itself, moves along with the KCL. The Altamira Landslide includes large areas outside of the historically mapped boundaries of these known landslides, predominantly upslope and downslope from the historically

mapped PBL and ACL, within, but smaller than, the Ancient Altamira Landslide Complex as defined above. To provide an example of the change in size, the dimensions from head to toe of the previously historical ACL is 2,250 feet and the width up to 1,450 feet wide. The dimensions from head to toe of the Altamira Landslide, underlying and extending up and down slope from both the PBL and the ACL, is 5,800 feet (more than double that of the ACL) with a width of up to 7,400 feet wide (more than five times as wide as the ACL).

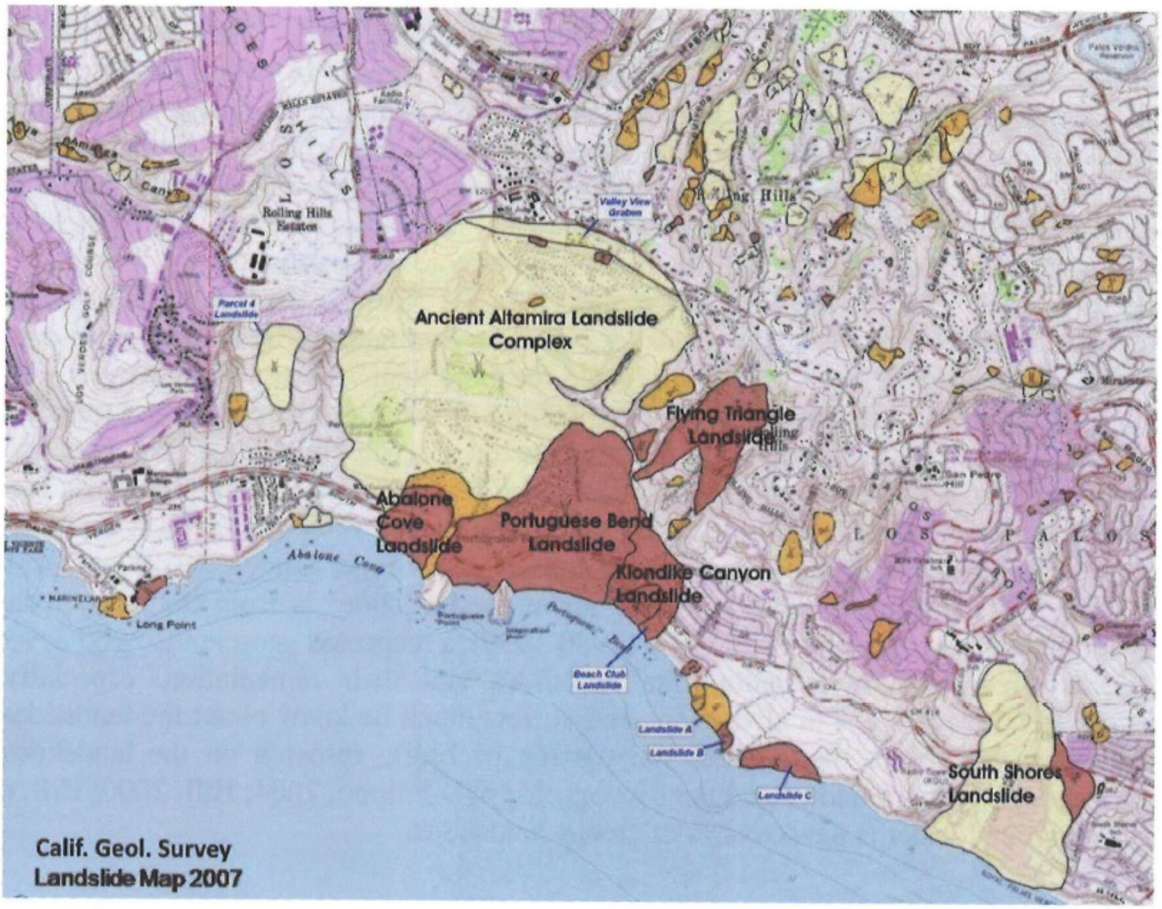


Figure 1. Landslide map of a portion of the south flank of the Palos Verdes Peninsula prepared by the California Geological Survey (2007). The major and some minor landslides are identified. Light yellow indicates that the landslide is inactive, red is active and orange is dormant.

While previous geotechnical investigators identified inactive deep failure surfaces in both the historically active and ancient landslide areas, none of them mapped or identified as active the entire depth or breadth of movement that has recently impacted the area, nor did they opine that such an event would occur in historic times. The active Altamira Landslide currently involves major land movement comprising an area of over 700 acres landward of the coast and extends to approximately 500 feet or more off the coastline. The areal dimensions, depth of movement, velocity of movement, artesian and near-artesian groundwater pressures beneath it, and even the direction of movement, are different than the Abalone Cove, Portuguese Bend, and Klondike Canyon landslides. The distinction to be made then, is that the Altamira Landslide is not just simple *expansion* of an existing group of landslides, it is an entirely different, larger and deeper landslide with much broader boundaries (including the new coastline offshore), nearly twice as deep as the depth of historic landslide movement in some areas, and with unprecedented rates of movement (which were not seen in the early LA County

Engineer surveys, the Charles Abbott Associates surveys beginning in 1994, nor the McGee surveys since 2007). None of this was experienced during the history of the City, and the Altamira Landslide is a unique landslide not characterized in its current dimensions during the over 70-year history of landslide investigations, exploratory borings, monitoring and observations being conducted in the area.

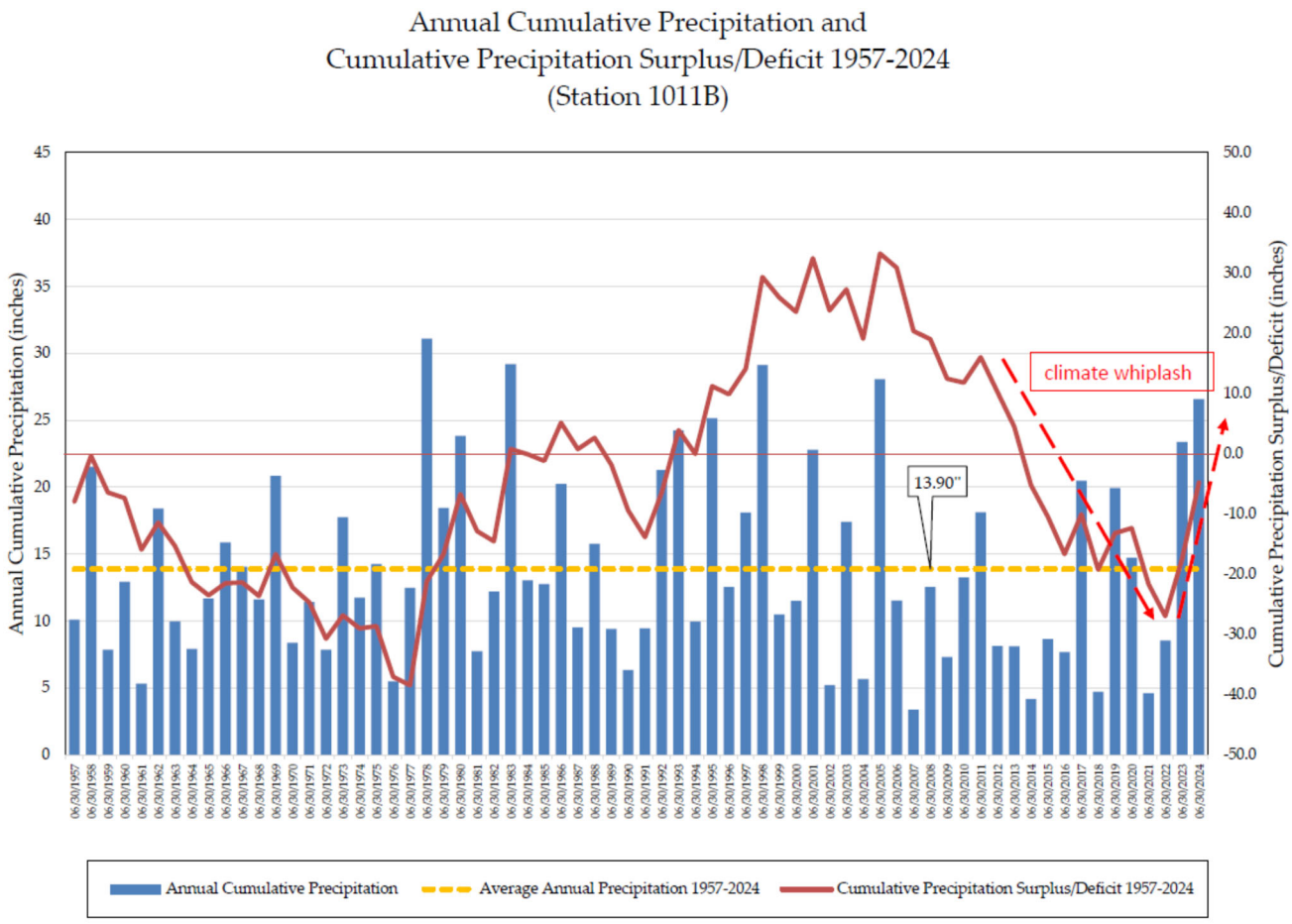
IMPACTS OF MOVEMENT OF THE ALTAMIRA LANDSLIDE

As of this date, the major land movement of the Altamira Landslide has resulted in the red-tagging (Unsafe to Enter/Occupy) and yellow tagging (Limited Entry) of several residential and commercial structures. It has also caused major destructive impacts to public and private roads, damages to utility infrastructure (water, sewer, gas, electricity and cable), causing certain utilities to be shut-off, and closure of certain Preserve land that is otherwise heavily accessed by the public for hiking, biking, equestrian, and other purposes. The only practical mitigation measure available to address a landslide with such a colossal scale is relieving groundwater pore pressures through pumping of groundwater, but it has to be done on a large enough scale to be effective at reducing the movement to an acceptable level. This technique has proven effective for the east side of the Altamira Landslide where deep dewatering wells have been installed, maintained and the rate of ground movement monitored such that a correlation between increased pumping of groundwater and reduction in the rate of ground movement has been confirmed.

CAUSATION

It is our opinion that the activation of the Altamira Landslide was largely caused by "climate whiplash" (also more technically described as hydroclimate volatility) induced by climate change, particularly starting in 2011, with five years of drought, and eight out of eleven years significantly below normal rainfall from 2011-2022, followed by two consecutive extraordinarily heavy rain seasons that dropped approximately 4 feet of rainfall on the landslide and surrounding areas draining into the landslide on the south flank of the Palos Verdes Hills.

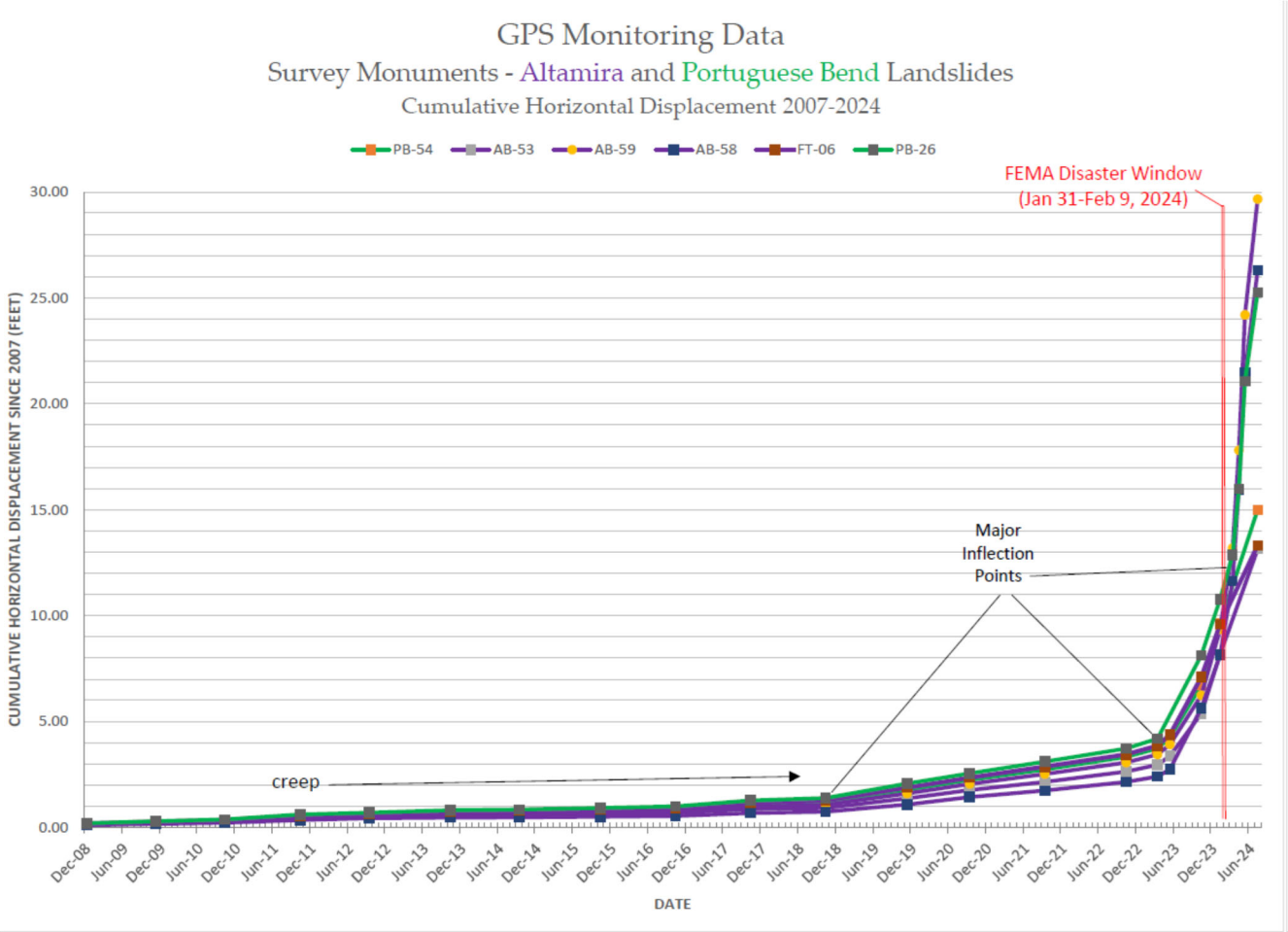
As illustrated in the following graphic, using data gathered by Los Angeles County Department of Public Works Stormwater Engineering Division, we analyzed annual rainfall deviations from the mean, and tallied up those cumulative deviations over time, as a measure of *precipitation surplus/deficit* that has impacted the area. The dark red line on the graphic shows the precipitation surplus/deficit over time. A precipitous drop is noted in the surplus/deficit line, particularly from 2011-2022, which whipsaws back to a steep climb from 2022 through 2024. Climate whiplash is illustrated by the red dashed arrows, showing the impact of the dry years (on a rapidly declining surplus/deficit curve) quickly reversing to a steeply inclining surplus/deficit curve. It is not important that this whiplash or volatility occurred in *deficit* territory on the graph, because it followed a two-decade long period of significant precipitation surplus. Two decades of precipitation surplus between 1991 and 2011 likely contributed to *strain-softening* of the Altamira Landslide failure surface clays, as the landslide began imperceptibly creeping and elongating/stretching out over a prolonged period. It follows that this generally prolonged period of drying commencing in 2011, followed by a large pulse of wetting from 2022 through the winter of 2024, and culminating in an intense barrage of rainfall from January 31st through February 9th 2024, triggered the massive Altamira movement and accelerated the landslide to unprecedented rates of movement.



Of note is that 8.29 inches of rain fell at the Rolling Hills Fire Station rain gauge from January 31st through February 9th 2024. The mean (average) rainfall for the Rolling Hills Fire Station's 57-year rainfall data set is currently 13.88 inches/year and the standard deviation of the entire 57-year dataset is 7 inches/year, indicating very high variability in annual rainfall. More rain fell between January 31st and February 9th 2024 than the standard deviation for the entire 57-year rainfall data set, indicating that this storm sequence was a statistically rare, outlier event.

The following graphic depicts *cumulative horizontal displacement* of select GPS survey monitoring points, including some of the fastest moving points in the Altamira Landslide and a couple of representative points in the PBL (which overlies the Altamira Landslide). There are three significant inflection points indicated in the graph. Prior to the first inflection point, the cumulative displacement lines indicate that the GPS monitoring points within the Altamira Landslide were creeping quite slowly (imperceptibly, near the range of instrument precision) for a number of years extending back before 2011. There was no observed or documented surface manifestation of this minor creep movement at the ground surface; however, this movement is believed to have caused deformation (elongation or stretching out of the earth materials comprising the subsurface which in turn causes additional

fracturing of those earth materials) of the Altamira Landslide body, which increased secondary permeability within the rock mass allowing rainfall at the ground surface to percolate more readily into the deep subsurface, raising groundwater levels to a point where they result in high pore pressures that contribute to landslide movement. Between the October 2018 and October 2019 GPS readings (first inflection point), an acceleration of creep movement is evident. Then following the multiple atmospheric river rains of January and February 2023 (second inflection point), a further acceleration of creep movement is evident, which would have resulted in further stretching out and opening up of the landslide mass. The final inflection point around March, 2024 (immediately following the FEMA-declared disaster of January 31-February 9 wherein 8.29 inches of rain fell) shows a dramatic acceleration and **represents the triggering of major movement of the Altamira Landslide**, as reflected by some of the graphed points going very steep and nearly vertical on the graph. The graph includes GPS monitoring point AB-59, which has been the fastest moving point and is not surprisingly located in the center of the entire Altamira Landslide mass.



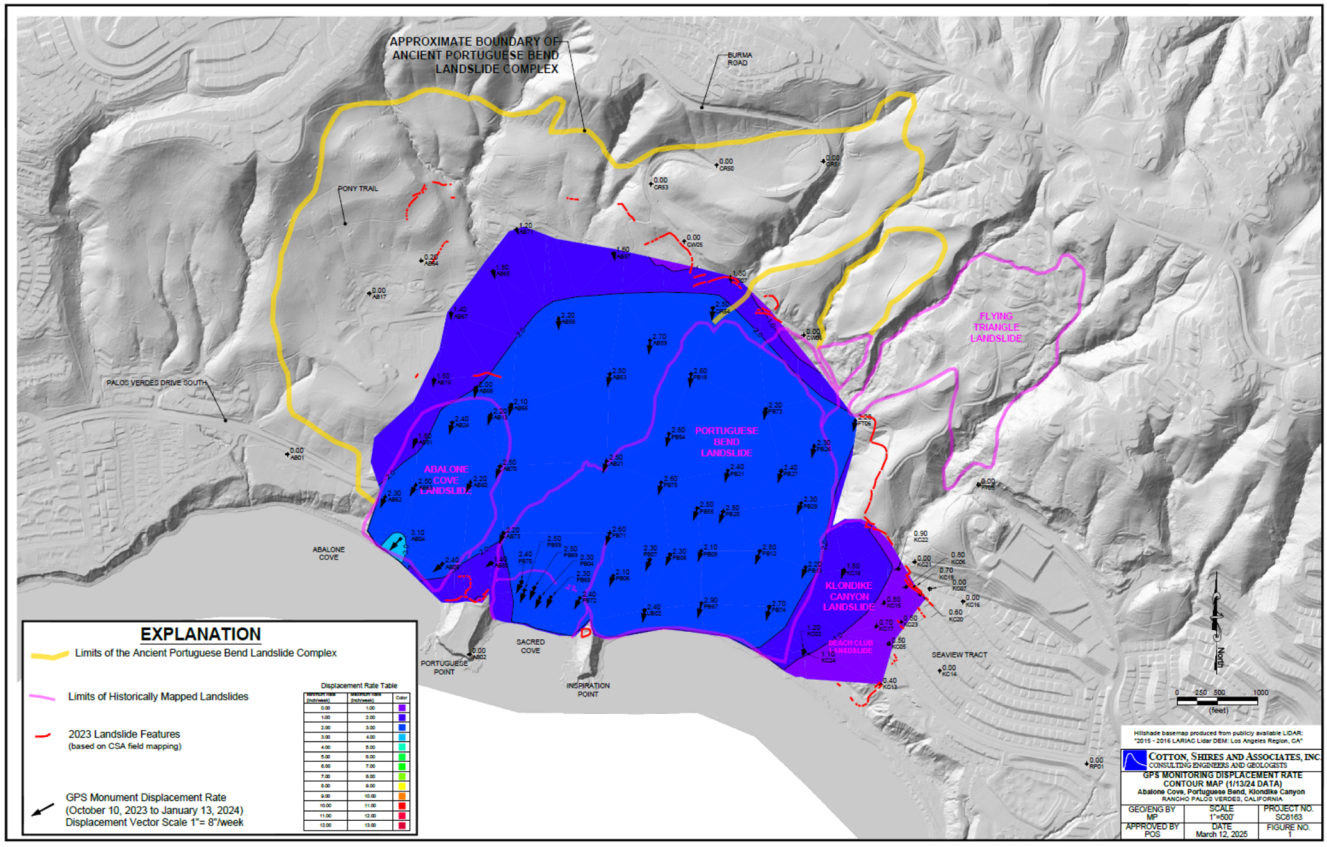
The change in ground movement rates before January 31st and after February 9th 2024 is significant. Based on our comprehensive review of the McGee GPS survey monitoring, the rates of

Altamira Landslide ground movement in the Abalone Cove area (for points north of the previously active ACL) as of January 13, 2024 ranged from 1.2 inches per week (at the periphery) up to 2.7 inches per week (in the body of the landslide). After that intense period of rainfall, plus additional rainfall resulting in a total of over 11 inches in February, as of the GPS survey completed on March 8, 2024, the rates increased to 1.5 (at the periphery) to 5.9 (main body) inches per week, more than doubling in the body of the landslide, and then increased dramatically to as much as 13.5 inches per week in the body of the landslide by July 1, 2024, probably as a slightly delayed reaction to the rainfall as it took time for the water to convert from rainfall absorption to higher groundwater pore pressures where it could have the greatest driving force impact on landslide movement.

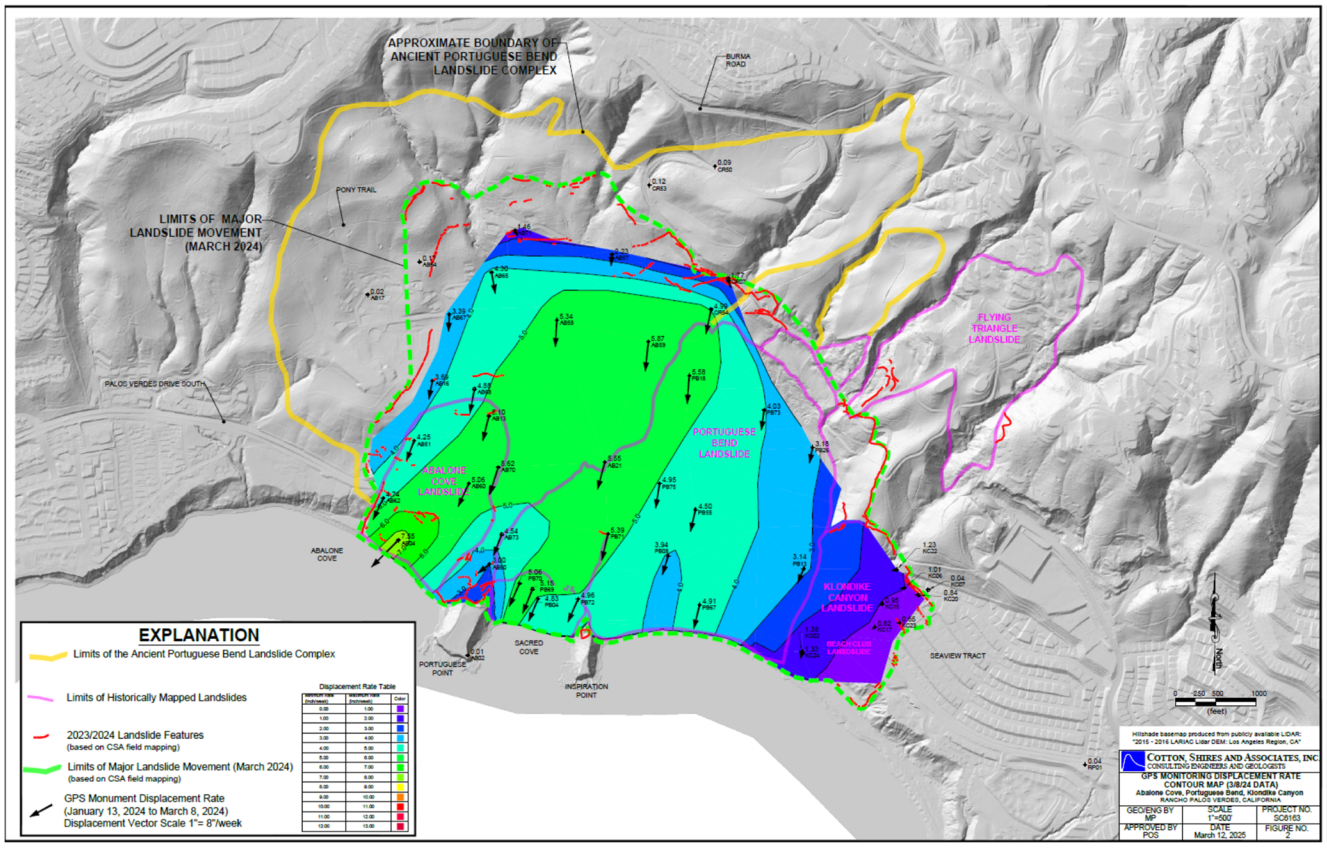
The graphics on the following two pages are "heat maps" that illustrate in color contours the rates at which the ground was moving based on the GPS survey monuments for January 13, 2024, March 8, 2024 and July 1, 2024, respectively. The heat maps include our on-ground geologic mapping of visible land movement features, which started as tension cracks or narrow fissures that were discontinuous (as of December 2023 mapping and are shown on the January 13, 2024 heat map), but these features further developed into more continuous/connected tension cracks and fissures, which have now developed into large scarps, grabens and well-developed boundary features. It wasn't until March 2024 that we first drew a boundary (dashed green line) around the "Area of Major Land Movement", because prior to that time, the surface manifestation of movement was poorly developed and inconsistent and there was not sufficient development of the landslide to develop a boundary. By March 2024, with further mapping and the extraordinary acceleration of numerous GPS monitoring points, a boundary defining the "Area of Major Land Movement" was delineated. Today, following many tens of feet of movement since early 2024, the boundary of the Altamira Landslide is well-defined. North of PV Drive South, the Altamira boundary extends significantly further west of the historical ACL boundary (resulting in the destruction of the landmark Wayfarer's Chapel), upslope through the York property (6001 PV Drive South), and north of the historical ACL boundary through the Portuguese Bend Riding Club Area, crossing upper Narcissa Drive, through and north of residences on upper Cinnamon Lane, and eventually turning east across Altamira Canyon, extending through the Vanderlip Estate (100 Vanderlip Drive), destroying Vanderlip Drive and adjacent properties, and ultimately continuing northeast to the lower stretch of Burma Road Trail in the Portuguese Bend Reserve.

The Altamira Landslide movement also created never-before-seen deformation where it underlies and now extends south of the KCL, including formation of a more seaward toe accompanied by uplifting ground that trended southwest through the beach area of the Portuguese Bend Beach Club and extending up to 500 feet or more offshore where it emerged through the sea floor and formed a new rocky coastline above sea level, generally east of Inspiration Point. The emergence of the new land offshore from the previous coastline was first reported to, and was subsequently observed by the City Geologist in late February of 2024, consistent with the triggering of major movement of the Altamira Landslide described above.

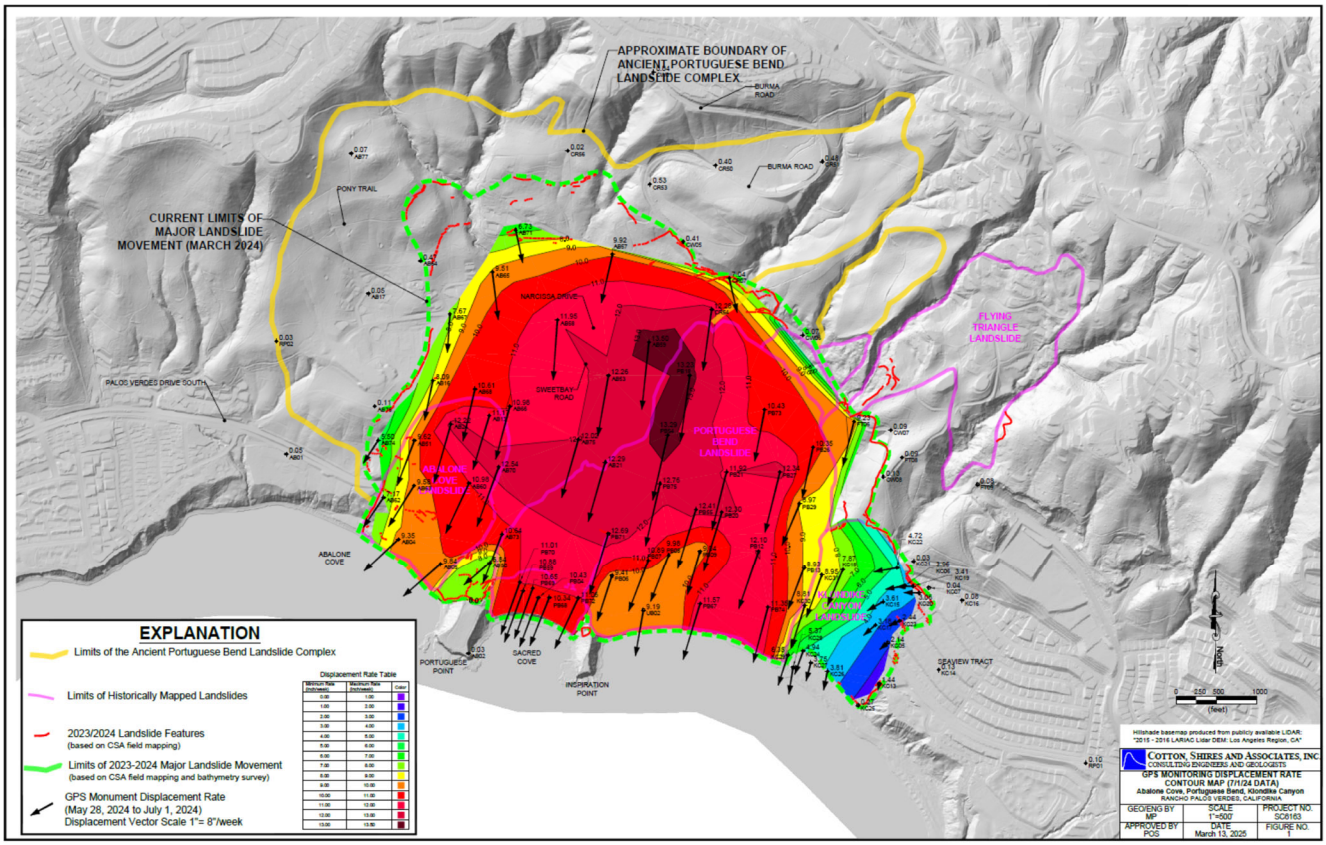
1/13/2024 Heat Map



3/8/2024 Heat Map



7/1/2024 Heat Map

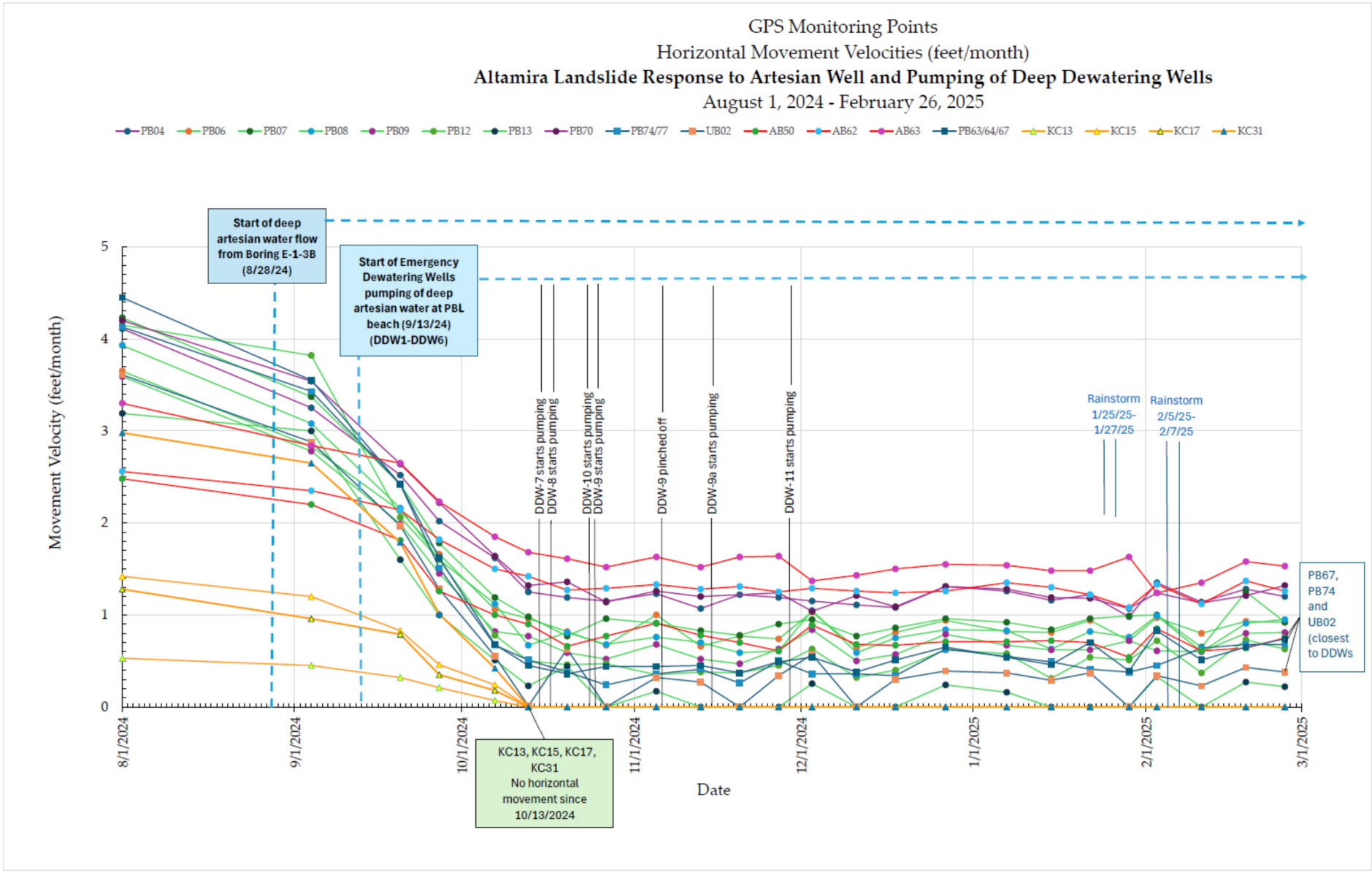


EMERGENCY MEASURES

Emergency measures taken by the City and abatement districts (ACLAD and KCLAD) to date have included drilling, pumping and monitoring deep dewatering wells, winterization measures including lining channels and installing culverts to reduce the amount of surface water percolating into the groundwater regime from upslope drainages/canyons, and filling of and establishing drainage for fissures and grabens that, if left unmitigated, facilitate surface water intrusion into the groundwater regime. This strategy has proven to be effective in reducing the rate of movement of the Altamira Landslide and even stopping movement of the eastern portion of the landslide in the area of the KCL. Because piezometers installed in deep borings that penetrated the base of the Altamira Landslide indicated high groundwater pore pressures beneath the landslide (some areas were found to have near-artesian or artesian groundwater pressures – pressures higher than the ground surface), a pilot program strategy was pursued that involved drilling a series of five deep dewatering wells near the coast to approximately 50 feet below the base of movement and pumping the wells until the landslide movement sheared off the well casings at depth and then re-drilling them to approximately 50 feet beneath the landslide to re-establish the wells so that they could continue to be pumped to dewater the high groundwater pressures beneath the landslide. This strategy turned out to be more successful than originally contemplated because the movement of the landslide slowed quickly in response to the initial dewatering efforts and the deep wells continued to function for weeks or months before re-drilling was necessary.

The chart on the following page illustrates the timing of artesian water being encountered in one of the test borings (Boring E-1-3B, which was retrofitted to function as an artesian well), the installation of the deep dewatering wells, and the deceleration of the Altamira Landslide in response to the dewatering efforts.

Based on the success of the deep dewatering program, we now know that this strategy works. Consequently, the City agreed to loan the landslide abatement districts funding so that they could re-establish wells that were no longer functioning and to establish deep dewatering wells at additional locations as well as to establish additional measures to reduce infiltration of surface water. Additional wells are also needed in the areas that the City controls. Unfortunately the cost of drilling, pumping, maintaining and re-drilling requires significant funding which the City was able to keep up with to a point, but now needs additional funding assistance to keep the wells that have already been established functioning and to establish additional deep dewatering wells in order to reduce the movement of the middle and eastern portions of the Altamira Landslide to the level experienced prior to the impact of climate whiplash.


GPS Monitoring Points
Horizontal Movement Velocities (feet/month)
Altamira Landslide Response to Artesian Well and Pumping of Deep Dewatering Wells
August 1, 2024 - February 26, 2025
PB04 PB06 PB07 PB08 PB09 PB12 PB13 PB70 PB74/77 UB02 AB50 AB62 AB63 PB63/64/67 KC13 KC15 KC17 KC31
Start of deep artesian water flow from Boring E-1-3B (8/28/24)
Start of Emergency Dewatering Wells pumping of deep artesian water at PBL beach (9/13/24) (DDW1-DDW6)
DDW-7 starts pumping
DDW-8 starts pumping
DDW-10 starts pumping
DDW-9 starts pumping
DDW-9 pinched off
DDW-9a starts pumping
DDW-11 starts pumping
Rainstorm 1/25/25-1/27/25
Rainstorm 2/5/25-2/7/25
PB67, PB74 and UB02 (closest to DDWs
KC13, KC15, KC17, KC31 No horizontal movement since 10/13/2024
Movement Velocity (feet/month)
Date
0
1
2
3
4
5
8/1/2024
9/1/2024
10/1/2024
11/1/2024
12/1/2024
1/1/2025
2/1/2025
3/1/2025

City of Rancho Palos Verdes

John Cruikshank, Mayor
Eric Alegria, Mayor Pro Tem
David L. Bradley, Councilmember
Barbara Ferraro, Councilmember
Paul Seo, Councilmember

February 20, 2024

California Office of Emergency Services Disaster Analysis Unit
3650 Schriever Avenue
Mather, CA 95655

SUBJECT: REQUEST FOR A STATE OF EMERGENCY FOR THE GREATER PORTUGUESE BEND LANDSLIDE COMPLEX

To whom it may concern:

On behalf of the approximately 42,000 residents of Rancho Palos Verdes and the approximately 67,000 residents of the Palos Verdes Peninsula, the Rancho Palos Verdes City Council is requesting Governor Newsom invoke his emergency powers pursuant to the Emergency Services Act, Gov't Code § 8550 et seq., and proclaim a State of Emergency for the Palos Verdes Peninsula region to assist the City to stabilize land movement in the greater Portuguese Bend Landslide Complex (Landslide). For reference, see attached map to show the boundaries of the Landslide.

As a result of the 2023 and 2024 winter storms, the City of Rancho Palos Verdes has been impacted by substantial precipitation that has caused an unprecedented acceleration of land movement equating to an annualized rate of 10 feet per year. This significant and sudden increase in land movement is causing severe damage to Palos Verdes Drive South – a major arterial roadway and evacuation route for the Palos Verdes Peninsula; damage and disruption to utility infrastructure including water, sewer, gas line and utility pole breaks; closures of approximately 8 miles of public trails due to slope instability; fissures and sink holes throughout the Palos Verdes Nature Preserve; the closure of residential intersections due to sink holes and ground separation; the temporary closure of the Wayfarers Chapel - a federal and state designated historic landmark; and the red-tagging of homes with many more homes on a watch list due to foundation and structural damage.

On October 3, 2023, the Rancho Palos Verdes City Council adopted a Local Declaration

of Emergency pursuant to Section 8630 of the Government Code, which has been renewed several times as required by that law; the Local Emergency is still in effect.[1] This action was intended to provide immediate access to resources and to assist in expediting remediation measures to stabilize and manage land movement that poses an imminent threat to the public's health, safety, and property. The City's Geologist and Geotechnical Engineering team and the two state-recognized Geologic Hazard Abatement Districts' geologists (Abalone Cove Landslide Abatement District and Klondike Canyon Landslide Abatement District) propose to stabilize land movement by immediately implementing the following:

- Filling fissures to prevent surface water from directly recharging the water table and further lubricating the slip plane.
- Constructing drainage swales, lining certain canyons with non-penetrable membrane, and/or installing flexible drainage pipes to properly convey surface water to the ocean and/or sanitary lines to prevent recharging the water table.
- Installing dewatering wells in the form of horizontal hydraugers and/or vertical dewatering wells to extract groundwater from the slip plane and reducing the local water table.

As the City continues its response and recovery operations, we have determined that these remediation measures must be implemented immediately to minimize the threat to the public's health, safety, and property. Therefore, the City Council requests, pursuant to the authority provided by the Act, and specifically by Sections 8571 and 8625 of the Government Code, that the Governor declare a State of Emergency for the City of Rancho Palos Verdes, waive and/or suspend certain state laws and permits required by local and state agencies that include, but are not limited to, the California Coastal Commission, the California Department of Fish and Wildlife, the Regional Water Quality Control Board, the State Water Resources Control Board, the South Coast Air Quality Management District, and other State agency permits or review processes. Finally, the City Council requests the Governor waive any requirements under the California Environmental Quality Act and its implementing regulations related to the approval and implementation of the remediation measures set forth above. Additionally, the City is requesting that the Governor submit a request to the President of the United States for a Federal Emergency Declaration pursuant to the Stafford Act, 42 U.S.C. §§ 5121-5207.

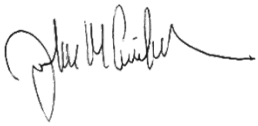
The City has identified that permits would be required by the aforementioned state agencies prior to proceeding any landslide stabilization work. Suspension of these requirements will allow the City and the Geologic Hazard Abatement Districts to immediately proceed with construction and installation of the enumerated measures to stabilize the Landslide without the costs and time delays typically experienced with obtaining permits. It is imperative that the City and two Geologic Hazard Abatement Districts are able to expedite the installation of dewatering wells and surface drains knowing that we are in an El Niño winter pattern with repeated atmospheric rivers

[1] The City also adopted an Interim Urgency Ordinance pursuant to Section 65958 of the Government Code, which effected a moratorium on all construction in the Landslide, with some limited exceptions.

forecasted to extend into spring, and every rain event is exacerbating the rate of land movement.

Please contact City Manager Ara Mihranian at aram@rpvca.gov or by telephone at 310-544-5202.

Sincerely,



John Cruikshank
Mayor

Attachments:

- Portuguese Bend Landslide Complex Map
- Information on the Portuguese Bend Landslide including resolutions adopting and extending the City's Proclaimed Local Emergency can be found on the City's website at: www.rpvca.gov/landslide

cc:

Laphonza Butler, U.S. Senator, California
Alex Padilla, U.S. Senator, California
Ted Lieu, U.S. Representative, 36th Congressional District
Ben Allen, Senator, 24th State Senate District
Al Muratsuchi, Assemblymember, 66th Assembly District
Janice Hahn, L.A. County Supervisor, 4th District
Kevin McGowan, Director, L.A. County Office of Emergency Management
Brandy Villaneuva, Disaster Manager Area Coordinator, L.A. County Area G
Rancho Palos Verdes City Council

CREST ROAD

BURMA ROAD

PONY TRAIL

ANCIENT PORTUGUESE BEND LANDSLIDE COMPLEX

NARCISSA DRIVE

FLYING TRIANGLE LANDSLIDE

PALOS VERDES DRIVE SOUTH

SWEETBAY ROAD

ABALONE COVE LANDSLIDE

PORTUGUESE BEND LANDSLIDE

KLONDIKE CANYON LANDSLIDE

ABALONE COVE

SACRED COVE

PORTUGUESE POINT

INSPIRATION POINT

SEAVIEW TRACT

North

0 250 500 1000

(feet)

EXPLANATION

- Limits of the Ancient Portuguese Bend Landslide Complex
- Limits of Historically Mapped Landslides
- 2023 Landslide Mapping
- Current Limits of Major Landslide Movement (February 2024)

Hillshade basemap produced from publicly available LiDAR: "2015 - 2016 LARIAC Lidar DEM: Los Angeles Region, CA"

COTTON, SHIRES AND ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS

LANDSLIDE MAPPING UPDATE 2/20/24
Abalone Cove, Portuguese Bend, Klondike Canyon
RANCHO PALOS VERDES, CALIFORNIA

GEO/ENG BY	SCALE	PROJECT NO.
MP	1"=500'	SC6163
APPROVED BY	DATE	FIGURE NO.
POS	February 2024	1

CITY OF RANCHO PALOS VERDES
ADMINISTRATION DEPARTMENT
CITY MANAGER'S OFFICE

March 17, 2025

Via email and Grants Portal

Mr. Robert Fenton
FEMA District No. 9 Administrator

Robert Larsen, Public Assistance Officer
California Office of Emergency Services

Subject: Appeal of FEMA's Eligibility Determination, Project Number 730185 FEMA-4769-DR-CA, California's Severe Winter Storms, Tornadoes, Flooding, Landslides, and Mudslides (Damage Inventory No. 1341784, 1341786)

Dear Messrs. Robert Fenton and Robert Larsen,

On April 13, 2024, the President declared a major disaster (**FEMA-DR-4769-CA**) in the State of California due to damages from severe winter storms, tornadoes, flooding, landslide and mudslides with an incident period of **January 31 through February 9, 2024**. The declared disaster by the President is similar to a federal disaster declared on April 3, 2023 for California Severe Winter Storms, Straight-Line Winds, Flooding, Landslides and Mudslides that occurred between **February 21, 2023 and July 10, 2023 (DR-4699-CA)**.

On May 9, 2024, the City of Rancho Palos Verdes (City) filed for disaster aid cost recovery for the City's response to the 2024 winter storms. In total, the City filed applications totaling $38.4 million.

On January 17, 2025, the City received FEMA's Eligibility Determination Memorandum **denying** in full the City's request for $11,415 to repair public trails (Peppertree, Burma Road, and Rim Trails) that sustained severe damage resulting in their indefinite closure, caused by the winter storms that occurred between January 31 and February 9, 2024. The denial cites the following reasons:

- Pre-disaster ground instability and on-going non-disaster related causes.
- Disaster damage was not a result of the declared disaster event.
- Pre-existing conditions of landslide.

According to Section 102.1 and 102.2 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, an "Emergency" means *any occasion or instance for which, in the determination of the President, Federal assistance is needed to supplement State and local efforts and capabilities to save lives and to protect property and public health and safety, or* ***to lessen or avert the threat of a catastrophe (emphasis added)*** *in any*

part of the United States. Moreover, a "Major Disaster" *means any natural catastrophe (including any hurricane, tornado, storm, high water, winddriven water, tidal wave, tsunami, earthquake, volcanic eruption,* ***landslide (emphasis added)****, mudslide, snowstorm, or drought), or, regardless of cause, any fire, flood, or explosion, in any part of the United States, which in the determination of the President causes damage of sufficient severity and magnitude to warrant major disaster assistance under this Act to* ***supplement the efforts and available resources of States, local governments, and disaster relief organizations in alleviating the damage, loss, hardship, or suffering caused thereby (emphasis added)****.*

The City's disaster recovery request was submitted to FEMA based on the aforementioned definitions found in the Stafford Act and the declared major disaster resulting from winter storms of 2024 that **contributed to a significant and documented acceleration of land movement caused by the activation of a <u>new</u> historic and previously dormant landslide known as the Altamira Landslide** within the Greater Portuguese Bend Landslide Complex (Landslide Complex).

According to the City Geologist's reports to the City Council in 2024, the **Altamira Landslide is a deeper slip plane that the Landslide Complex "rafted" on top of as a direct result of the unprecedented and record rainfall during the 2024 winter storm event resulting in the shallower slip plane of the Landslide Complex to move more than it ever did before in its documented history**. Contrary to FEMA's Eligibility Determination Memorandum, what is **not pre-existing** are the areal dimensions, depth of movement, velocity of movement, artesian and near-artesian groundwater pressures beneath it, and even direction of movement. The land movement experienced as a result of the 2024 winter storms is not just a simple **expansion** of the Landslide Complex, but is an **entirely different, larger and deeper landslide with much broader boundaries** (including the new coastline offshore at the Portuguese Bend Beach Club), nearly twice as deep in some areas, and unprecedented rates of movement. None of this was seen during the history of the City, nor during the approximately 70-year history of landslide studies, monitoring, and observations conducted in the area, contrary to what is noted in the Eligibility Determination Memorandum. It is the opinion of the City and its subject matter experts, that will be discussed in this appeal letter, that this is largely caused by "weather whiplash" (induced by climate change) starting in 2011.

The City respectfully requests that you, as FEMA's District No. 9 Administrator, reverse the eligibility denial and uphold the City's appeal based on facts, data and other pertinent information found in this appeal letter that will clearly demonstrate that a new landslide was activated causing an acceleration of land movement as a direct result of the 2024 winter storms resulting in costly and significant damage to the City's infrastructure. The City firmly believes that this **appeal letter** will demonstrate that the requested cost recovery work complies with Title 44 of C.F.R. Section 206.223(a)(1) in that the financial assistance requested is directly related to the winter storms of 2024. As such, the City is requesting **$11,415** for severe damage to public trails (Peppertree, Burma Road, and Rim Trails) resulting in their indefinite.

Historic Background

As noted in the January 17, 2025 Eligibility Determination Memorandum and throughout various City records, the Landslide Complex is a known ancient landslide that was activated in 1956 when, prior to the City's 1973 incorporation, Los Angeles County was expanding Crenshaw Boulevard to Palos Verdes Drive South and its grading efforts combined with ground water, activated the Portuguese Bend Landslide. Land movement has not stopped since 1956 but has been managed at a slow creep to no movement for years through remediation efforts implemented by the City and its two geologic hazard abatement districts, Abalone Cove Landslide Abatement District (ACLAD) and Klondike Canyon Landslide Abatement District (KCLAD).

The Landslide Complex, historically existing for thousands of years, encompasses the following four sub-landslide areas in the City: the Portuguese Bend Landslide (PBL), the Abalone Cove Landslide (ACL), the Klondike Canyon Landslide (KCL), and the Beach Club Landslide (BCL). As noted above, in 1956, the PBL began moving, then in 1979, ACL and KCL began moving with the BCL, which is nested within the KCL and, while dormant itself, moves with the KCL. The Landslide Complex also includes areas outside of those known landslides, predominantly uphill from the PBL and ACL, within the ancient Landslide Complex as mapped by various agencies (i.e., U.S. Geological Survey and California Geological Survey) and other researchers. This fifth landslide is in the City of Rolling Hills and is known as the Flying Triangle Landslide.

According to a November 8, 2024 report prepared by the City Geologist, Mike Phipps of Cotton Shires and Associates (CSA) (Attached), the PBL has been continuously active since reactivation in 1956 with many areas of the landslide having moved hundreds of feet seaward over the ensuing seven decades. The ACL was active from 1979 **until the late 1990's**, involving only several feet of movement, when dewatering and other mitigation efforts largely halted movement. An **imperceptible creep movement** of the ACL has occurred over the past 25 years **following rainy seasons that were significantly above average rainfall amounts.** The KCL has been episodically active in 1979-1983 and 2005-2006, experiencing only several inches of movement, typically in response to significantly above average rainfall. Landslide movements throughout the Landslide Complex **outside of the historical boundaries of** the ACL and PBL previously exhibited low rates of creep movement, or movement at or near the instrument precision range, in the 11-year monitoring period of 2007-2018.

Impacts of Rainwater

These landslides are deep translational-type failures within seaward-dipping strata of the Monterey Formation, with the landslide slip surfaces occurring within very weak bentonitic clay beds. Historically, the movement behavior of these landslides routinely exhibited high sensitivity to increased groundwater pore pressure, and increased rates of land movement which have been **correlative with 6-to-12-months of antecedent rainfall**

that was well above average. Similarly, land movement decreased during below average rainy seasons or multi-year periods of drought.

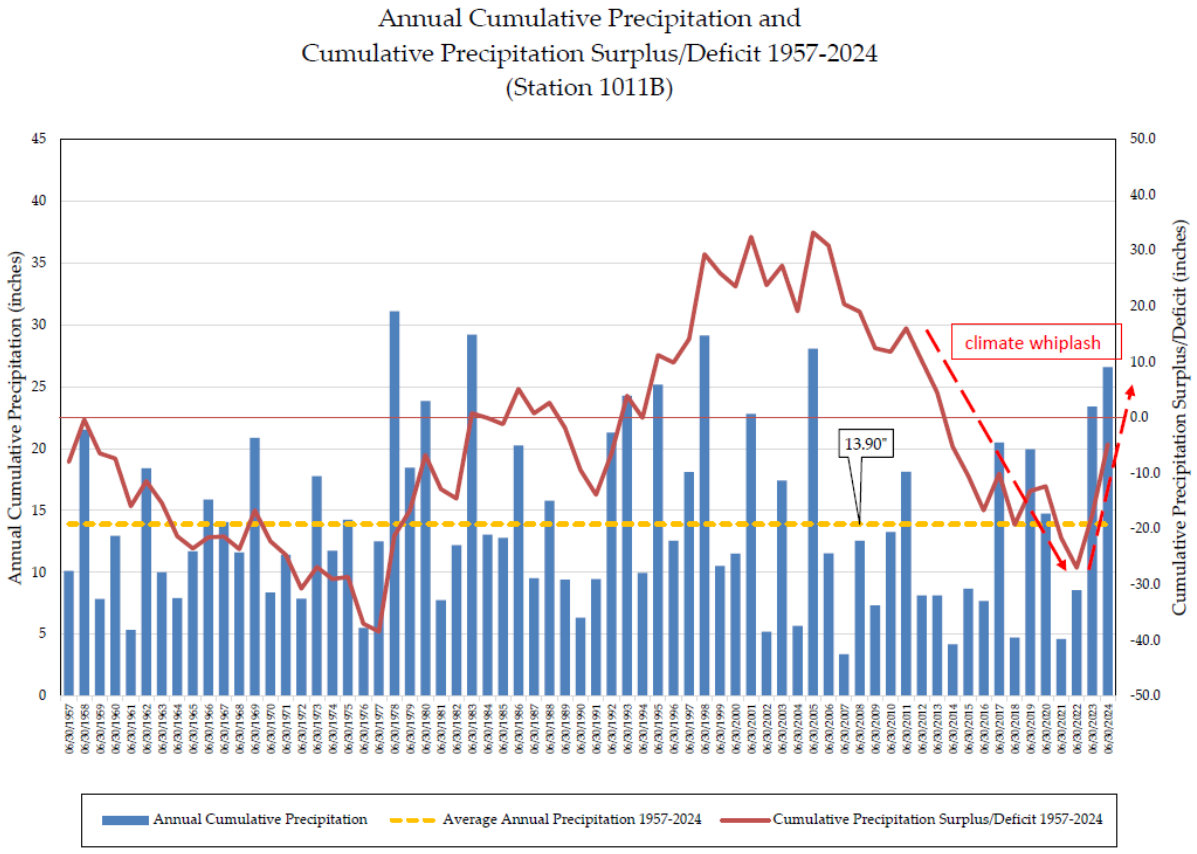
Simply stated, numerous studies conducted over approximately seven decades all point to water as being the primary contributor to land movement, particularly rainwater. Rainwater runoff is known to penetrate the ground through fissures during a rain event and recharge the ground water table. During particular significant rain events or seasons, runoff that enters the ground may take months to show signs of land movement. Depending on where rain runoff enters the ground, it can settle below the slip plane thereby resulting in artesian pressure or settle above the slip plane, which is made up of volcanic ash known as bentonite and lubricates the slip plane resulting in horizontal movement.

Changes in climate over the years, now commonly referred to as “weather whiplash” has resulted in extreme weather in Southern California including extended periods of dry weather followed by severe wet weather in the form of atmospheric rivers as experienced in 2023 and 2024. This extraordinary wet weather resulted in the President declaring a major federal disaster in both 2023 and 2024. Underscoring how extreme weather has become over the years, in August 2023, California, particularly Southern California, experienced days of record rain in August 2023 as a result of Tropical Storm Hillary.

Extreme wet weather patterns have proven to contribute towards the change in behavior of the Landslide Complex. Beginning in 2021, the City Geologist began reviewing Global Positioning Satellite (GPS) monitoring data for survey monuments within the entire Landslide Complex. Review of GPS monitoring data from 2007 through 2024 indicated that land movement acceleration initially began between 2018 and 2019. This acceleration was correlative with significantly above-normal rainfall in two out of three prior rainfall seasons (2016-17 and 2018-19) which followed five consecutive drier than normal rainfall seasons (2011-12 through 2015-16).

Another way to look at this is to analyze annual rainfall deviations from the mean, and tally up those cumulative deviations over time, as a measure of *precipitation* surplus/deficit that is impacting the area. According to the graphic on the following page, in which the dark red line shows the precipitation surplus/deficit over time, note the precipitous drop particularly from 2011-2022, which whipsaws back to a steep climb from 2022-2024. Weather whiplash is illustrated by the red arrows, showing the impact of the dry years (rapidly declining surplus/deficit curve) quickly reversing to a steep inclining surplus/deficit curve. It doesn't matter that this all happened in *deficit* territory on the graph, because it followed a two-decade long period of precipitation surplus. It is reasonable to say that two decades of precipitation surplus between 1991 and 2011 might have contributed to **strain-softening** of the Altamira failure surface clays, as the landslide imperceptibly crept and stretched out. It follows that this generally prolonged period of drying commencing in 2011, followed by a short, huge pulse of wetting between 2022-2024, is what **triggered** the massive previously inactive Altamira Landslide to move in 2024.

It is also worth noting that 8.29 inches of rain fell at the Rolling Hills Fire Station rain gauge during the 10-day FEMA disaster window. Keep in mind, the mean (average) for the 57-year rainfall data set is currently 13.88 inches/year and the standard deviation of the entire 57-year dataset is a whopping 7 inches/year, indicating very high variability in annual rainfall. In other words, more rain fell in the 10-day FEMA disaster window than the standard deviation for the entire 57-year rainfall data set. Underscoring that this wet weather behavior was an extraordinary event.



Significant accelerations in movement velocity were documented in May 2023 following major storm sequences in January, February and March of 2023, which added to cumulative seasonal rainfall totals exceeding 193% of average rainfall. Approximately 87% of this rain fell prior to June 18, 2023. Most of this rainfall occurred from three significant atmospheric river-type storm sequences occurring on January 9-16 (3.59 inches), February 23-March 1 (3.79 inches) and March 10-15 (4.12 inches). Land movement velocities further increased as of the July 15, 2023 monitoring. An anomalous tropical storm (Tropical Storm Hillary) dropped an additional 3.05 inches of rain on August 19 through August 20, 2023, resulting in further land movement acceleration as of the October 10, 2023 monitoring.

Furthermore, accelerated ground movement occurred throughout the Landslide Complex

during and following the 2022-23 rainy season which was more than 220% of the historical average rainfall. Based upon the GPS monitoring survey on January 13, 2024, average land movement velocities within the Landslide Complex since October 10, 2023 have accelerated by a factor of three to four times compared to the previous 12 month (Oct 2022-Oct 2023) monitoring period. Expressed another way, the total movement over the 3 month period of October 2023 through January 2024 is nearly equal to, and in some cases exceeds, the total movement over the previous entire year's monitoring period (i.e., October 2022 through October 2023). Movement of this magnitude has not been previously observed or documented in the ancient landslide complex north of the historical boundaries of the ACL, PBL and KCL.

An example of this is highlighted by six GPS monitoring points in the upper ancient landslide area, in the vicinity of upper Narcissa Drive and uphill from it. These survey monuments have experienced average displacements of 4.07 feet over the past 15 months (3.26 feet on an annualized basis). Average displacements for these six points over the prior annual monitoring period (Sept 28, 2021-Oct 10, 2022) were 0.36 feet. This represents approximately a 9-fold increase in total land movement on an annualized basis. **Two GPS monitoring points near the toe of the Abalone Cove Landslide moved an average of 0.76 feet (Sept 2021-Oct 2022) to 7.30 feet (Oct 2022-Jan 2024) over the same periods, a 9.6-fold increase in displacement**.

Activation of the New Altamira Landslide

According to the City Geologist's Memorandum dated November 8, 2024 and March 16, 2025 (Attached), total landslide movements in the upper ancient landslide area are significant and greatly exceed what has been observed over the past seven decades. The Altamira Landslide is a **newly** active landslide that has occurred within a previously mapped ancient Landslide Complex (most recently labeled the "Ancient Altamira Landslide Complex" which was a name modification of the "Ancient Portuguese Bend Landslide" identified on the California Geological Survey's Landslide Inventory Map (CGS, 2007) which is referred to as the Landslide Complex in this appeal letter). See map on the following page.

It is important to make this distinction for consistency and to avoid confusion, because the Altamira Landslide is, in fact, a new member of the historically active Landslide Complex but largely **underlies it** and occupies an area of active land movement >700 acres and extends to more than 500 feet off of the coastline, whereas the shallower historically active Landslide Complex only occupied about 380 acres.

The Altamira Landslide in Rancho Palos Verdes is therefore a recently identified large landslide that largely underlies (and therefore largely encompasses but exceeds the area of) the previously understood active Landslide Complex containing the four historically active landslides. The Altamira Landslide includes large areas outside of the historically mapped boundaries of these known landslides, predominantly upslope and downslope from the historically mapped PBL and ACL, within, but smaller than, the Landslide

Complex as shown on the map on the following page.

To provide an example of the change in size, the dimensions from head to toe of the previously historical ACL is 2,250 feet and the width up to 1,450 feet wide. The dimensions from head to toe of the Altamira Landslide, underlying and extending up and down slope from both the PBL and the ACL, is 5,800 feet (more than double that of the ACL) with a width of up to 7,400 feet wide (more than five times as wide as the ACL).

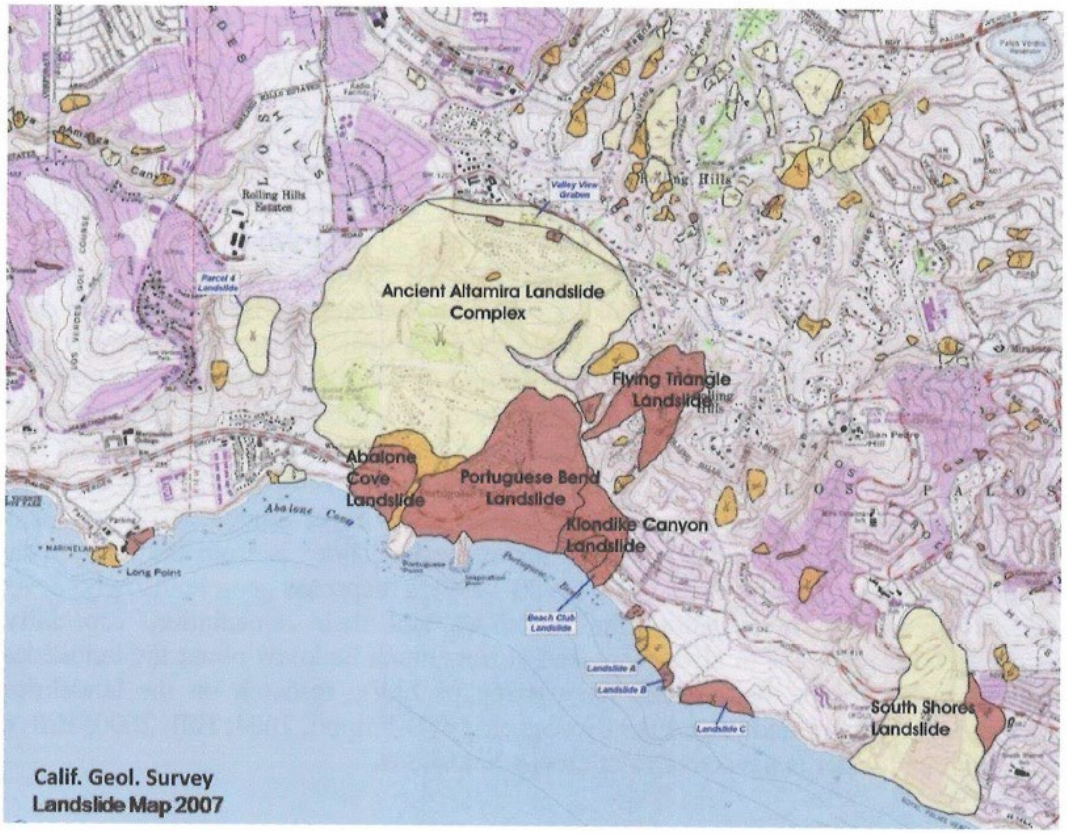


Figure 1. Landslide map of a portion of the south flank of the Palos Verdes Peninsula prepared by the California Geological Survey (2007). The major and some minor landslides are identified. Light yellow indicates that the landslide is inactive, red is active and orange is dormant.

While previous geotechnical investigators identified inactive deep failure surfaces in both the historically active and ancient landslide areas, none of them mapped or identified as active the entire depth or breadth of movement that has recently impacted the area, nor did they opine that such an event would occur in historic times. The areal dimensions, depth of movement, velocity of movement, artesian and near-artesian groundwater pressures beneath it, and even the direction of movement, are different than the ACL, PBL, and KCL landslides, collectively referred to as the Landslide Complex. The distinction to be made then, is that the Altamira Landslide is not just simple *expansion* of an existing group of landslides, **it is an entirely different, larger and deeper landslide with much broader boundaries (including the new coastline offshore), nearly twice**

as deep as the depth of historic landslide movement in some areas, and with unprecedented rates of movement (which were not seen in the early LA County Engineer surveys, the Charles Abbott Associates surveys beginning in 1994, nor the McGee surveys since 2007). None of this was experienced during the history of the City, and the Altamira Landslide is a unique landslide not characterized in its current dimensions during the over 70-year history of landslide investigations, exploratory borings, monitoring and observations being conducted in the area.

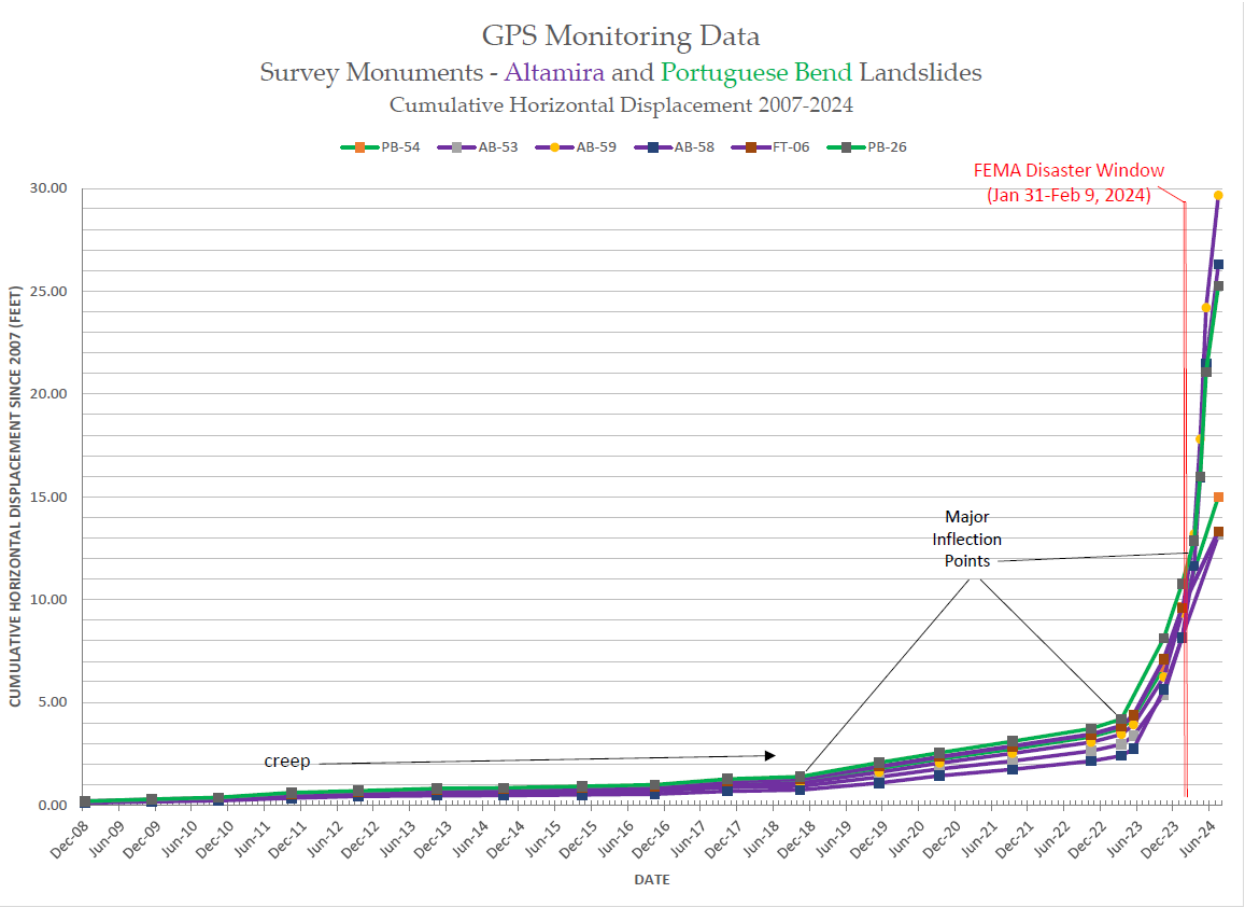
Land movement correlated to the Altamira Landslide continues to manifest at the ground surface in the form of landslide scarps, fissures, grabens/sinkholes, tensional cracking, and shear zones. Field mapping corroborates the GPS monitoring data, indicating that a large portion of the ancient Altamira Landslide above the historically mapped Landslide Complex (PBL, ACL and KCL boundaries) is now involved in significant active landslide movement that is impacting trails, roads, drainage facilities, and private property and continues to have the potential to impact above and below ground utility infrastructure (i.e., utility lines, gas lines, water lines, communication lines, etc.).

Causation

The activation of the Altamira Landslide was largely caused by "climate whiplash" (also more technically described as hydroclimate volatility) induced by climate change, particularly starting in 2011, with five years of drought, and eight out of eleven years significantly below normal rainfall from 2011-2022, followed by two consecutive extraordinarily heavy rain seasons that dropped approximately 4 feet of rainfall on the landslide and surrounding areas draining into the landslide on the south flank of the Palos Verdes Hills.

The graphic on the following page depicts *cumulative horizontal displacement* of select GPS survey monitoring points, including some of the fastest moving points in the Altamira Landslide and a couple of representative points in the PBL (which overlies the Altamira Landslide). There are three significant inflection points indicated in the graph. Prior to the first inflection point, the cumulative displacement lines indicate that the GPS monitoring points within the Altamira Landslide were creeping quite slowly (imperceptibly, near the range of instrument precision) for a number of years extending back before 2011. There was no observed or documented surface manifestation of this minor creep movement at the ground surface; however, this movement is believed to have caused deformation (elongation or stretching out of the earth materials comprising the subsurface which in turn causes additional fracturing of those earth materials) of the Altamira Landslide body, which increased secondary permeability within the rock mass allowing rainfall at the ground surface to percolate more readily into the deep subsurface, raising groundwater levels to a point where they result in high pore pressures that contribute to landslide movement. Between October 2018 and October 2019 GPS readings (first inflection point), an acceleration of creep movement is evident. Then following the multiple atmospheric river rains of January and February 2023 (second inflection point), a further acceleration of creep movement is evident, which would have resulted in further stretching out and

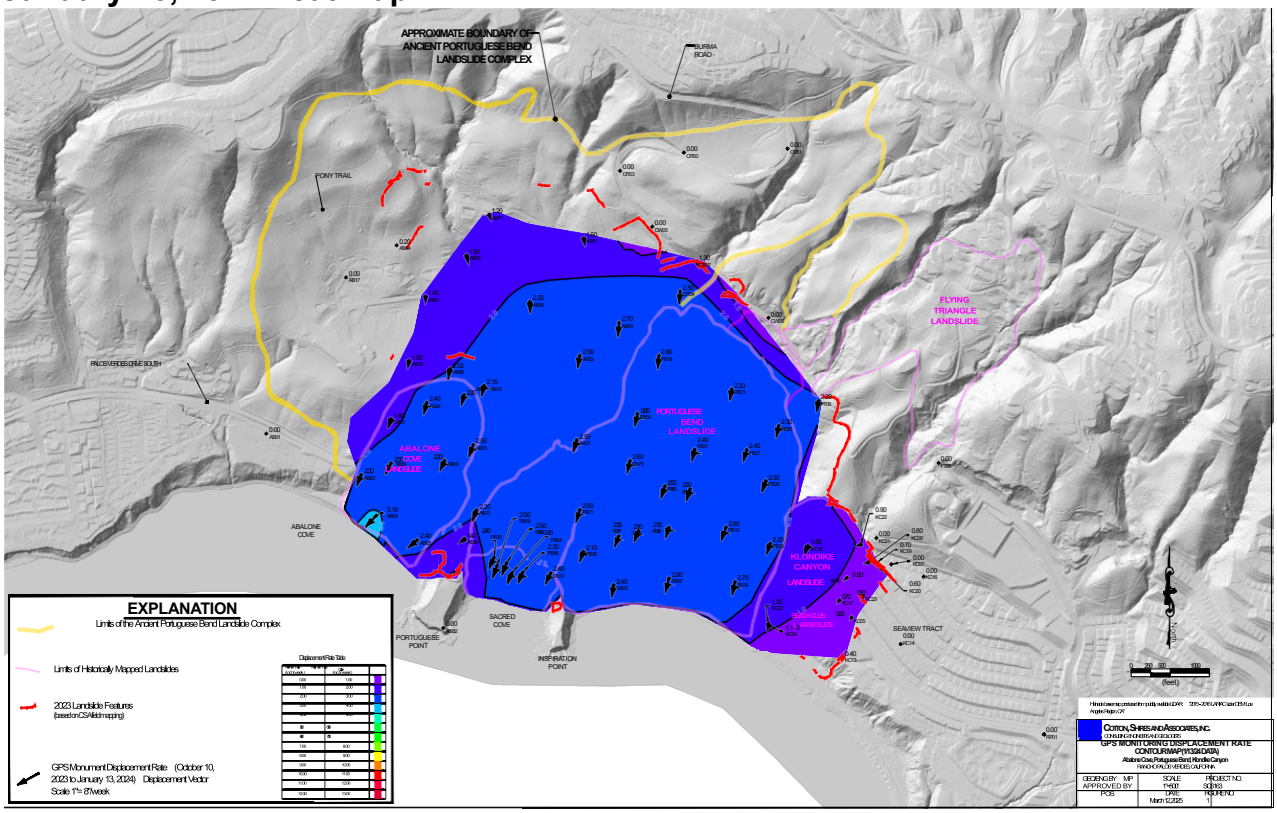
opening up of the landslide mass. The final inflection point around March, 2024 (immediately following the FEMA declared disaster of January 31-February 9 wherein 8.29 inches of rain fell) shows a dramatic acceleration and **represents the triggering of major movement of the Altamira Landslide**, as reflected by some of the graphed points going very steep and nearly vertical on the graph. The graph includes GPS monitoring point AB-59, which has been the fastest moving point and is not surprisingly located in the center of the entire Altamira Landslide mass.



The change in ground movement rates before January 31 and after February 9, 2024 is significant. Based on a comprehensive review of the McGee GPS survey monitoring, the rates of Altamira Landslide ground movement in the Abalone Cove area (for points north of the previously active ACL) as of January 13, 2024 ranged from 1.2 inches per week (at the periphery) up to 2.7 inches per week (in the body of the landslide). After that intense period of rainfall, plus additional rainfall resulting in a total of over 11 inches in February, as of the GPS survey completed on March 8, 2024, the rates increased to 1.5 (at the periphery) to 5.9 (main body) inches per week, more than doubling in the body of the landslide, and then increased dramatically to as much as 13.5 inches per week in the body of the landslide by July 1, 2024, probably as a slightly delayed reaction to the rainfall as it took time for the water to convert from rainfall absorption to higher groundwater pore pressures where it could have the greatest driving force impact on landslide movement.

The following graphics are “heat maps” that illustrate in color contours the rates at which the ground was moving based on the GPS survey monuments for January 13, 2024, March 8, 2024 and July 1, 2024, respectively. The heat maps include the City’s on-ground geologic mapping of visible land movement features, which started as tension cracks or narrow fissures that were discontinuous (as of December 2023 mapping and are shown on the January 13, 2024 heat map), but these features further developed into more continuous/connected tension cracks and fissures, which have now developed into large scarps, grabens and well-developed boundary features. It wasn’t until March 2024 that the City Geologist’s first drew a boundary (dashed green line) around the “Area of Major Land Movement”, because prior to that time, the surface manifestation of movement was poorly developed and inconsistent and there was not sufficient development of the landslide to develop a boundary.

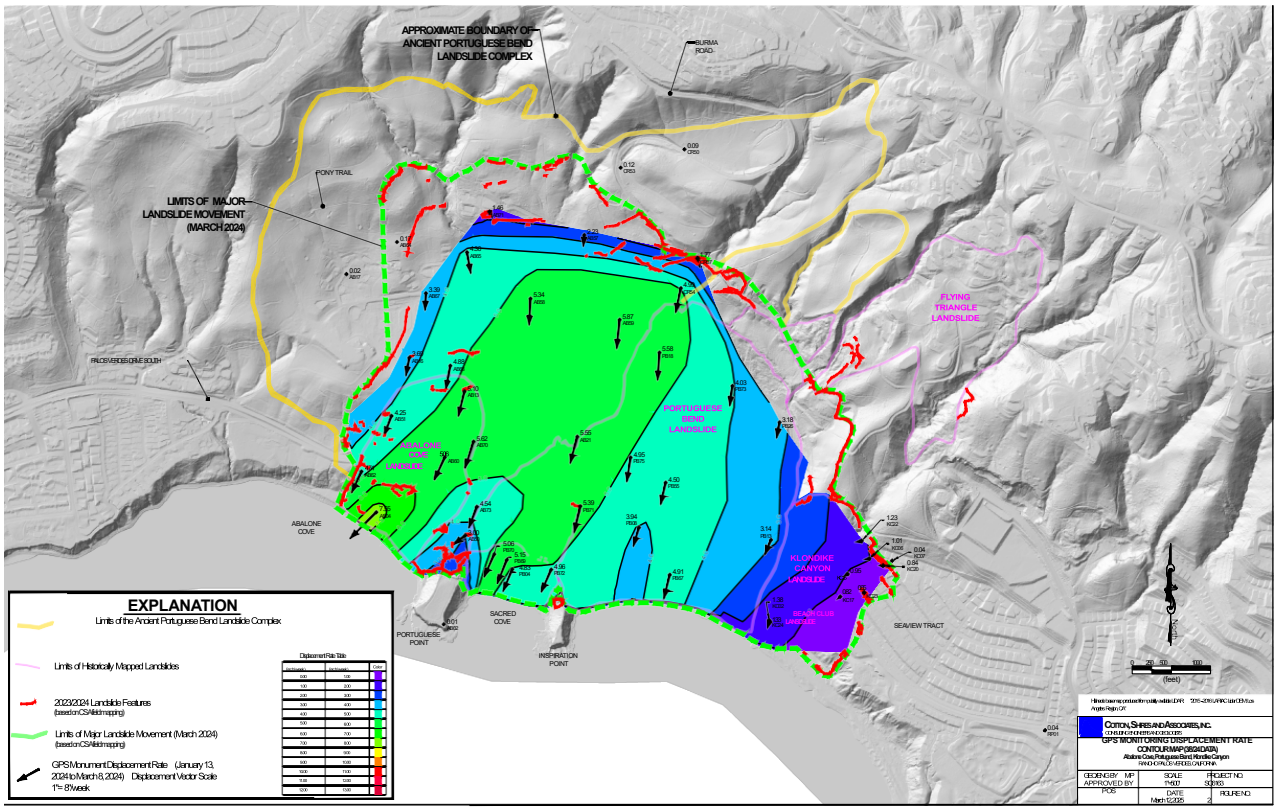
January 13, 2024 Heat Map



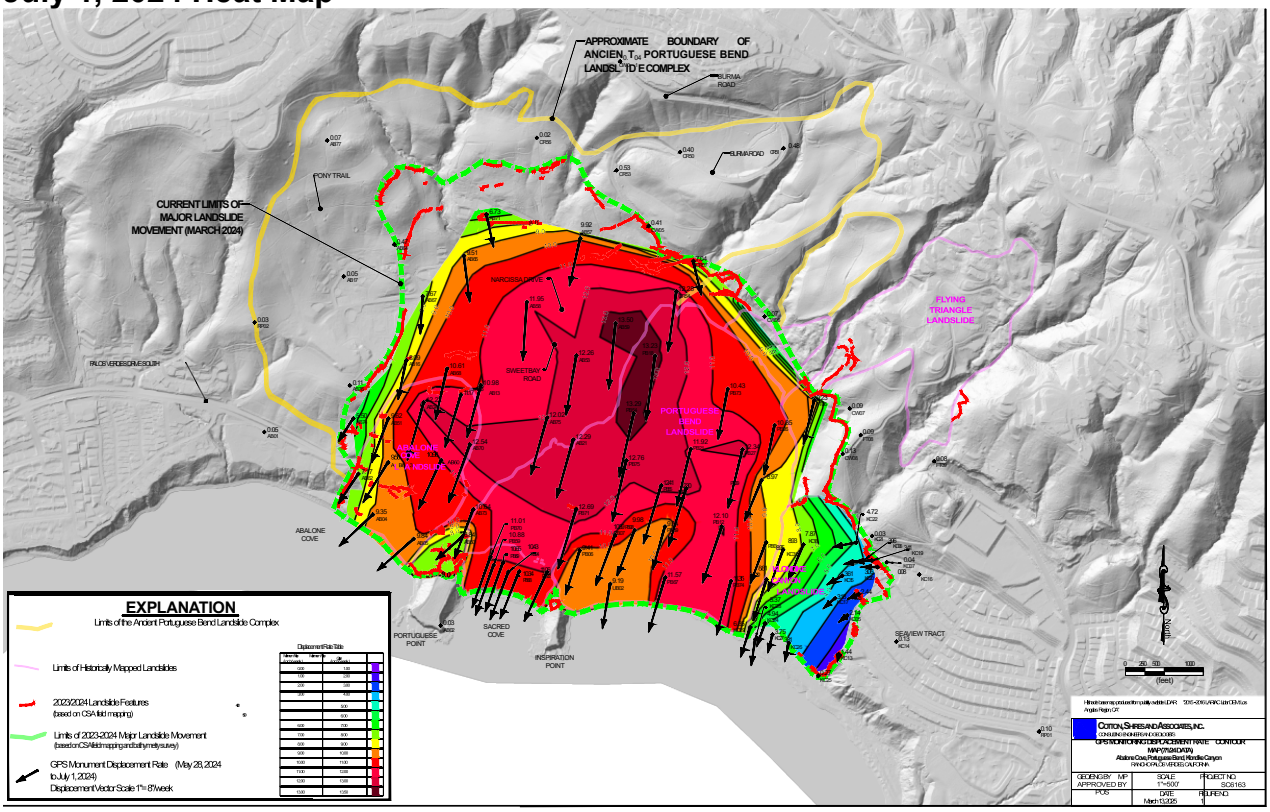
By March 2024, with further mapping and the extraordinary acceleration of numerous GPS monitoring points, a boundary defining the “Area of Major Land Movement” was delineated. Today, following many tens of feet of movement since early 2024, the boundary of the Altamira Landslide is well-defined. North of Palos Verdes Drive South, the Altamira boundary extends significantly farther west of the historical ACL boundary (resulting in the destruction of the landmark Wayfarer’s Chapel), upslope through the York property (6001 PV Drive South), and north of the historical ACL boundary through the

Portuguese Bend Riding Club Area, crossing upper Narcissa Drive, through and north of residences on upper Cinnamon Lane, and eventually turning east across Altamira Canyon, extending through the Vanderlip Estate (100 Vanderlip Drive), destroying Vanderlip Drive and adjacent properties, and ultimately continuing northeast to the lower stretch of Burma Road Trail in the Portuguese Bend Reserve. The Altamira Landslide also created never before seen deformation where it underlies and now extends south of the KCL, including formation of a more seaward toe accompanied by uplifting ground that trended southwest through the beach area of the Portuguese Bend Beach Club and extending up to 500 feet or more offshore where it emerged through the sea floor and formed a new rocky coastline above sea level, generally east of Inspiration Point. The emergence of the new land offshore from the previous coastline was first reported to, and was subsequently observed by, the City Geologist in late February of 2024, consistent with the triggering of major movement of the Altamira Landslide described above.

March 8, 2024 Heat Map



July 1, 2024 Heat Map



<u>Impacts of Movement of The Altamira Landslide</u>

As of this date, the major land movement of the Altamira Landslide has resulted in the red-tagging (Unsafe to Enter/Occupy) and yellow-tagging (Limited Entry) of dozens of residential and commercial structures. It has also caused major destructive impacts to public and private roads, damages to drainage facilities and utility infrastructure (water, sewer, gas, electricity and cable), causing certain utilities to be shut-off, and closure of certain Preserve land that is otherwise heavily accessed by the public for hiking, biking, equestrian, and other purposes.

To reiterate, the damage the City sustained as a result of the winter storms of 2024 is attributed to the activation of the deeper slip plane, known as the Altamira Landslide, that has historically been inactive until the 2024 winter storms. The activation of this new landslide that carried the shallower landslide, referred to as the Landslide Complex herein, is **not** pre-existing and therefore invalidates the reason for denying the City's disaster cost recovery request.

The only practical mitigation measure available to address a landslide with such a colossal scale is relieving groundwater pore pressures through pumping of groundwater, but it has to be done on a large enough scale to be effective at reducing the movement

to an acceptable level. This technique has proven effective for the east side of the Altamira Landslide where deep dewatering wells have been installed, maintained and the rate of ground movement monitored such that a correlation between increased pumping of groundwater and reduction in the rate of ground movement has been confirmed.

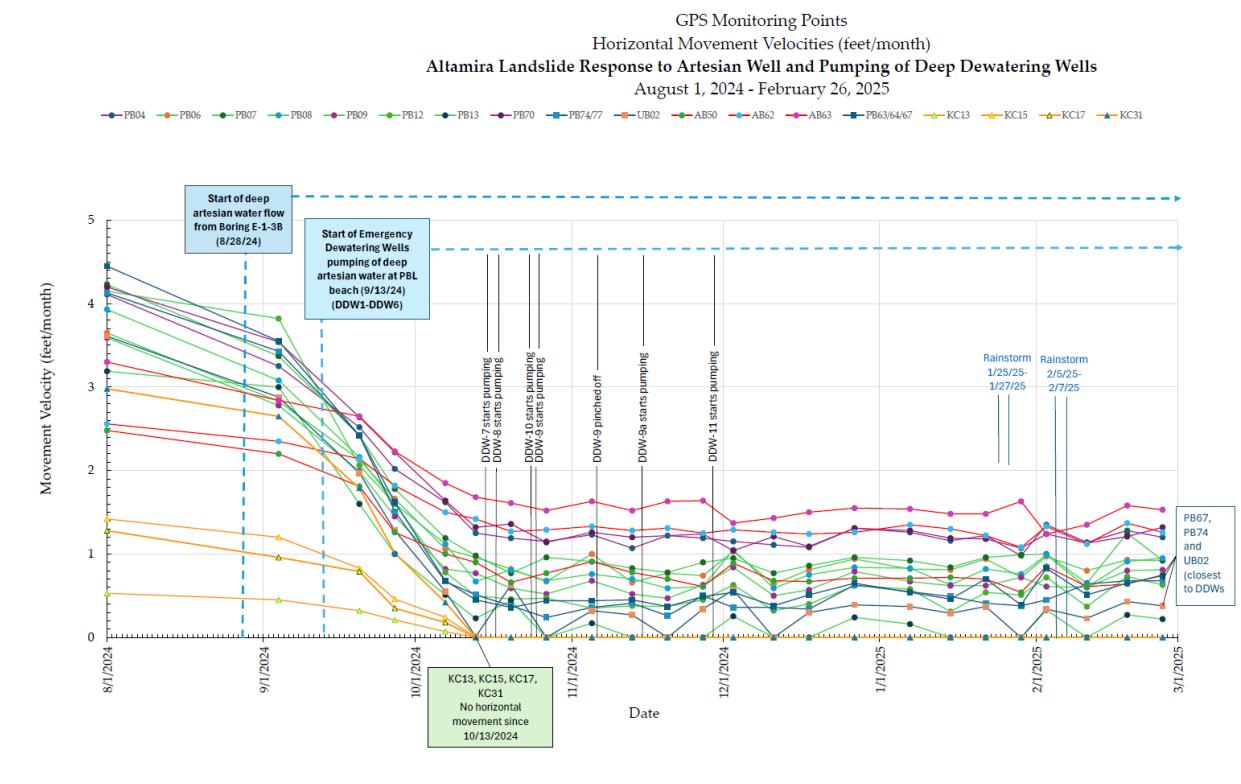
Emergency Measures

Emergency measures taken by the City and abatement districts (ACLAD and KCLAD) to date have included drilling, pumping and monitoring deep dewatering wells, winterization measures including lining channels and installing culverts to reduce the amount of surface water percolating into the groundwater regime from upslope drainages/canyons, and filling of and establishing drainage for fissures and grabens that, if left unmitigated, facilitate surface water intrusion into the groundwater regime. This strategy has proven to be effective in reducing the rate of movement of the Altamira Landslide and even stopping movement of the eastern portion of the landslide in the area of the KCL. Because piezometers installed in deep borings that penetrated the base of the Altamira Landslide indicated high groundwater pore pressures beneath the landslide (some areas were found to have near-artesian or artesian groundwater pressures – pressures higher than the ground surface), a pilot program strategy was pursued by the City that involved drilling a series of deep dewatering wells at the toe of coast below the base of movement of the Altamira Landslide slip plan and pumping to dewater the high groundwater pressures beneath the landslide. This strategy turned out to be more successful than originally contemplated because the movement of the landslide slowed quickly in response to the initial dewatering efforts and the deep wells continued to function for weeks or months before re-drilling was necessary.

The chart on the following page illustrates the timing of artesian water being encountered in one of the test borings (Boring E-1-3B, which was retrofitted to function as an artesian well), the installation of the deep dewatering wells, and the deceleration of the Altamira Landslide in response to the dewatering efforts.

Additional deep dewatering wells are also needed in order to reduce the movement of the middle and eastern portions of the Altamira Landslide to the level experienced prior to the impact of climate whiplash. However, the cost of drilling, pumping, maintaining and re-drilling requires significant funding which the City is unable to fund underscoring the significance of the requested disaster cost recovery – to return land movement to pre-2024 winter storm disaster rates.

Continued on the next page



Natural Disaster Cost Recovery

The cost to respond to this natural disaster has been immeasurable to City and its limited resources. To date, the City's estimated expenditures responding to land movement between October 2022 and June 2025 is approximately $47.5 million with approximately $36.3 million being spent this fiscal year (2024-25). Overall, the $36.3 million reflects a 290% increase from the prior year. These costs include emergency response efforts such as test boreholes, deep dewatering wells, maintenance of the deep dewatering wells until June 30, 2025, winterization, fissure filling, road repairs, sewer repairs, and drainage repairs to name a few.

Similar to the entire state of California, and in fact, the entire United States, there are known pre-existing conditions that lend themselves to natural disasters, such as wildfires, earthquakes, floods, hurricanes, tornadoes, etc. When one of these pre-existing conditions result in a natural disaster such as the recent devastating Palisades and Eaton wildfires, FEMA does not turn their back on those communities in need citing this area is mapped and known to be a Very High Fire Severity Zones. Similarly, FEMA and the federal government do not reject financial aid in known areas of earthquakes, floods, and hurricanes. That same principle should be applied to Rancho Palos Verdes and the recent acceleration of land movement resulting from the atmospheric river storms of 2023 and 2024, and the activation of the new landslide, Altamira Landslide. Moreover, **nowhere in the Stafford Act does it state that pre-existing conditions are ineligible for disaster**

recovery. In fact, the Stafford Act clearly cites the **intent** of Congress, by this Act, is to provide an orderly and continuing means of **assistance** by the Federal Government to State and **local governments** in carrying out their responsibilities to alleviate the suffering and damage which result from such disasters by (1) revising and broadening the scope of existing disaster relief programs; (2) encouraging the development of comprehensive disaster preparedness and assistance plans, programs, capabilities, and organizations by the States and by local governments; (3) achieving greater coordination and responsiveness of disaster preparedness and relief programs; (4) encouraging individuals, States, and local governments to protect themselves by obtaining insurance coverage to supplement or replace governmental assistance; (5) encouraging hazard mitigation measures to reduce losses from disasters, including development of land use and construction regulations; (6) **providing Federal assistance programs for both public and private losses sustained in disasters**; and (7) identifying and improving the climate and natural hazard resilience of vulnerable communities.

Clarification to FEMA's Document Descriptions

In addition to the above, the City provides the following responses for context purposes to the some of the documents citied in the Eligibility Determination Memorandum. As you will see, the extracted statements used to deny the City's request do not accurately support nor justify the denial because they are taken out of context of the overall document and do not provide an accurate analysis of the reason for the land movement and the basis for denial as stated earlier in this appeal letter. The City's position remains that the 2024 winter storms triggered the activation of the **new Altamira Landslide** which carried, at an accelerated rate of movement, the greater Landslide Complex which up until recently has been managed.

1. June 7, 2023 City Letter to Los Angeles County Fourth District Supervisor Hahn

   FEMA's determination letter references the City's June 7, 2023 letter to Los Angeles County Fourth District Supervisor Hahn (Sup. Hahn) as the basis for emphasizing its position that the requested damage recovery for water control features traverses a pre-existing landslide and that the City "continuously repairs and maintains these drainage pipes." The determination letter also states that "the damages claimed are a result of decades of pre-disaster ground instability and ongoing non-disaster related causes" which the City does not believe is accurate based on the information provided in this appeal letter.

   The City's letter to Sup. Hahn quotes a few words that when taken out of context gives a very different meaning to the reader. The letter was sent to Sup. Hahn requesting $6 million to help the City fund its matching portion of FEMA's Building Resiliency Infrastructure Communities (BRIC) Grant for the Portuguese Bend Landslide Remediation Project. The letter to Sup. Hahn includes data on the average rate of movement for context purposes to garner her advocacy and financial support needed

to develop and implement a remediation plan as a **preventive measure** to a potential imminent threat to public health and safety.

The Portuguese Bend Landslide Remediation project, concentrated within the PBL, was developed by the City to **prevent** the acceleration of land movement by addressing rainwater runoff from entering the ground and recharging the water table, which occurred during the rain events of 2023 and 2024.

The Stafford Act states that pre-existing conditions are not eligible for disaster recovery but rather that to be eligible it has to be directly related to an incident per Title 44 of C.F.R. 206.223(a)(1). However, as noted earlier, the behavior of this slow moving landslide noticeably changed in response to the Winter Storms of 2023 and 2024, and that the extreme wet weather activated a **new** landslide, Altamira Landslide, and should therefore not be considered pre-existing, the point to this appeal.

2. Cotton Shires and Associates (CSA) Geologic Report dated September 9, 2023

   According to your determination letter, the City's Geotechnical Engineer's September 9, 2023 memo is cited as one of the basis for denying the City's recovery request because "*the work claimed is not required as a result of the declared disaster and the applicant cannot demonstrate the damage was directly caused by FEMA-DR-4769-CA. Rather these damages are a result of long-term creep displacement and recent years acceleration of earth movement from non-disaster causes as documented in the multiple reports.*"

   As previously noted, the City respectfully disagrees with these statements and in fact, can demonstrate that the winter storms of 2023 and 2024 correlated to climate change and seasonal changes in weather patterns are the reasons the City experienced a noticeable behavioral **change** in the landslide rate of movement with the activation of the dormant and inactive Altamira Landslide. Moreover, the Eligibility Determination Memorandum neglects to cite relevant and pertinent information in the CSA's September 9, 2023 memo emphasizing the following significant and noticeable change in the behavior of the landslide:

   GPS Survey Monitoring Data Review: GPS monitoring of survey monuments throughout the Landslide Complex area has been performed tri-annually since 2007 by McGee Surveying Consulting. In their June 6, 2023 Survey Report, McGee stated:

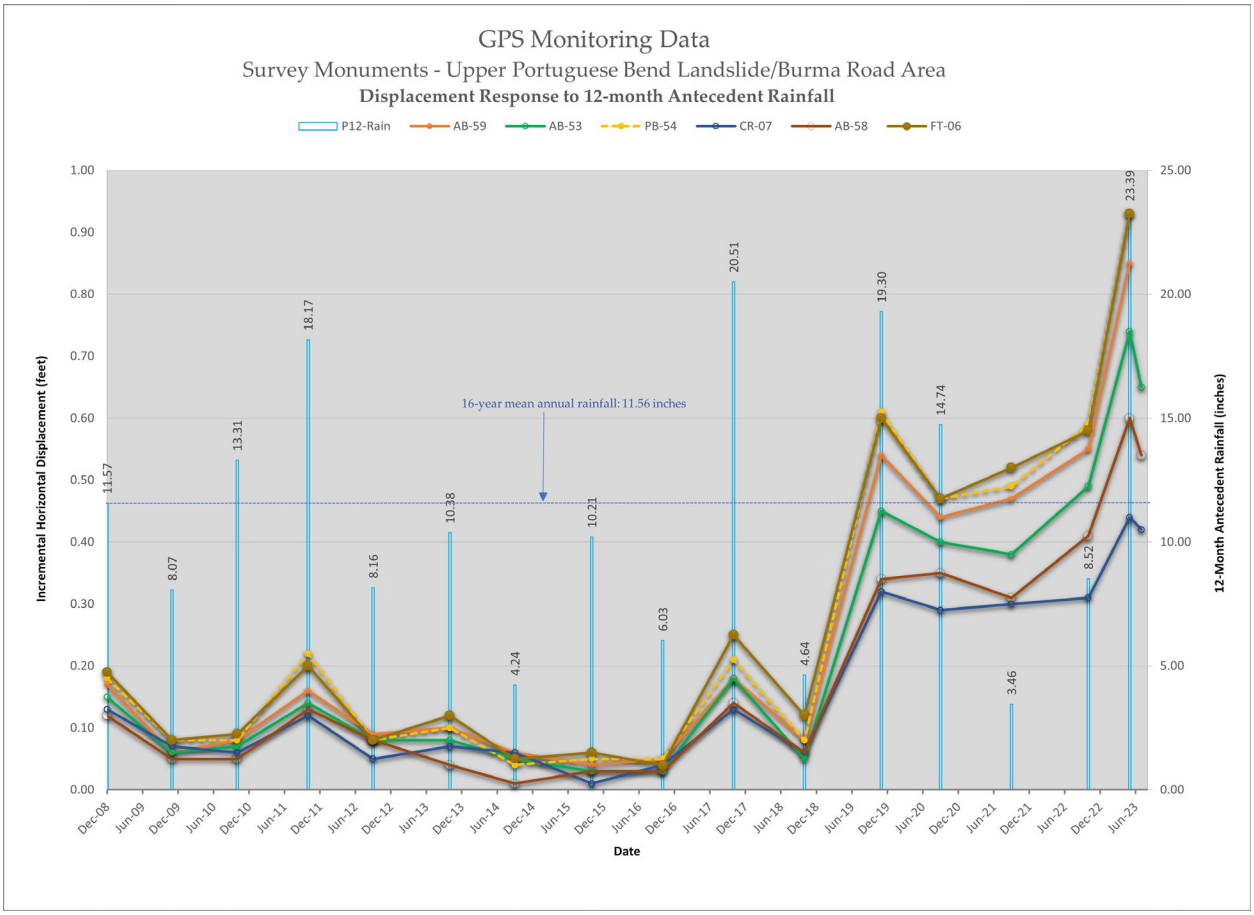
   "*In the last seven months the movement velocities have accelerated over the average velocity for the previous four years which saw an acceleration over the previous 15-20 years……**Velocities were stable** prior to 2018. After the Fall of 2018 they increased about 3 to 6 fold at most points and remained stable to the Fall of 2022. In the last seven months since the **Fall of 2022** the velocities generally have **doubled more or less***." (emphasis added)

This is a significant and important observation from the surveyor, and comports with the past several years of field observations by CSA staff of roadway distress and trail distress within the PBR, as well as reports of street distress, building distress and utility line breaks throughout the various known landslide areas.

Several graphics based upon CSA's own analysis of the GPS survey monitoring data further illustrate what is happening with the landslide ground movement. According to Figure 2 in CSA's September 9, 2023 memo, depict horizontal displacements (in feet) and ground displacement vectors for 12 selected GPS survey monuments mostly located in the mid and upper Landslide Complex. These figures are based upon McGee's GPS monitoring of the survey monuments from October 2018 to May 2023 (with the exception of two monuments which were last read in October 2022, PB18 and AB71). Four of these monuments were also read in mid-July, 2023 and those movement data are also presented. Two of the monuments, CR07 and FT06 are located on Burma Road outside of the PBL and indicate 1.67 feet and 3.09 feet of horizontal displacement over the ~4.5-year period. The CR07 point moved an additional 0.42 feet in two months (through July 15, 2023), which translates to ground movement velocity of about 2.5 feet per year. Most of the other points on this figure are in the Landslide Complex (and mostly in LMA Zone 2) and are indicating total displacements of approximately 1 to 3 feet (or average velocities of about 0.22 to 0.67 feet/year across the ~4.5-year period). Several of these points in LMA Zone 2 that were also monitored in July, 2023 showed continued acceleration from May to July 2023, with calculated velocities of ~1.25 feet/year at AB67 to ~3.9 feet/year at AB53. These are extraordinary rates of landslide movement that, to the City Geologist's knowledge, have not been previously documented in the LMA Zone 2 area.

Incremental displacement has been analyzed of these points versus 12-month antecedent rainfall, as a measure of the landslide response to rainfall. A graph of cumulative displacement of these points since 2007 is presented on the following page. This graphed movement data indicates a clear acceleration of movement beginning in late 2018 (as noted in the area labeled inflection point).

Accelerated landslide movements since late 2018 appear to be correlative with significantly above normal rainfall in three out of four rainfall seasons (2016-17, 2018-19 and 2019-20) which followed five consecutive drier than normal rainfall seasons (2011-12 through 2015-16). **The extraordinary rainy season of 2022-23, where rainfall totals were more than 200% of average, has resulted in further acceleration**.



It is imperative to bring to your attention that the City Geologist recently provided an updated memorandums dated November 8, 2024 and March 16, 2025 (attached) that further underscores the impacts and damage caused by FEMA-DR-4769-CA also known as the winter storms of January 31 through February 9, 2024, as documented earlier in this appeal letter.

3. Rancho Palos Verdes Geo-Logic Associates (GLA) Report Dated December 2019

   According to the Eligibility Determination Letter, a December 2019 report prepared by GLA, a geotechnical engineering firm, hired by the City to prepare its Portuguese Bend Landslide Remediation project is cited. This report cites, as one of the basis to determine that the requested disaster damage recovery occurred in a pre-existing landslide area and not related to the storms citing the following:

   "the landslide complex includes approximately 239 acres with ground movement varying across the site ranging up to approximately 11 feet per year."

   This very citation supports the City's request and claim that the damage sustained occurred as a result of the winter storms in 2023 and 2024 based on the following:

As noted earlier, the Landslide Complex is generally comprised of 5 subslides. The 239 acres noted above is limited to the PBL. This is because the study area for the Landslide Complex was specific to the PBL. In fact, the City Geologist's November 8, 2024 memo states since 2024, this significantly greater depth of movement has resulted in a broader footprint of active land movement at the ground surface and offshore, and expansion of the historical land movement area from approximately 380 acres to **over 700 acres**.

Furthermore, as previously stated, according to the City Geologist's March 16, 2025 memo (attached), the Altamira Landslide is a newly active landslide that has occurred within a previously mapped ancient landslide complex. It is important to make this distinction for consistency and to avoid confusion, because the Altamira Landslide is, in fact, a new member of the historically active PBL/ACL/KCL Landslide Complex but largely **underlies it** and occupies an area of active land movement >700 acres and extends to more than 500 feet off of the coastline, whereas the shallower historically active PBL/ACL/KCL Landslide Complex only occupied about 380 acres. While previous geotechnical investigators identified inactive deep failure surfaces in both the historically active and ancient landslide areas, none of them mapped or identified as active the entire depth or breadth of movement that has recently impacted the area, nor did they opine that such an event would occur in historic times. The active Altamira Landslide currently involves major land movement comprising an area of over 700 acres landward of the coast and extends to approximately 500 feet or more off the coastline. The areal dimensions, depth of movement, velocity of movement, artesian and near-artesian groundwater pressures beneath it, and even the direction of movement, are different than the Landslide Complex. The distinction to be made then, is that the Altamira Landslide is not just simple *expansion* of an existing group of landslides, it is an entirely different, larger and deeper landslide with much broader boundaries (including the new coastline offshore), nearly twice as deep as the depth of historic landslide movement in some areas, and with unprecedented rates of movement (which were not seen in the early LA County Engineer surveys, the Charles Abbott Associates surveys beginning in 1994, nor the McGee surveys since 2007).

None of this was experienced during the history of the City, and the Altamira Landslide is a unique landslide not characterized in its current dimensions during the over 70-year history of landslide investigations, exploratory borings, monitoring and observations being conducted in the area.

4. Landslide Working Group November 1, 2023 Meeting Notes

   The FEMA Eligibility Determination Memorandum cites that the City has a pre-disaster active task force called the RPV Landslide Complex Working Group which meets to continue to address ongoing landslide problems, and that is **not** correct.

As previously noted, on October 3, 2023, the City Council declared a local state of emergency in response to the rapid and significant acceleration in land movement. As a result, the Council directed staff to working with community stakeholders including utilities, geologists, HOA representatives and residents to collaborate the City's and community's response to the declared local state of emergency. It was four months later when the then-mayor sent a letter to the Governor requesting he declare a state of emergency and request the President declare a federal disaster in response to the land movement resulting from the winter storms of 2023 and 2024 (attached)

5. Michael McGee's 2007 GPS Technical Report

   In 2007, the City began using GPS technology to track on-ground movement of the Landslide Complex. No one is denying that the shallower Landslide Complex has been moving since 1956, what is evident in the data FEMA's analysts overlooked is that there is a significant and noticeable change in the behavior of the landslide and the rate of movement in response to rain events as clearly demonstrated in the charts earlier in this letter. Moreover, a new, previously dormant landslide was activated in response to the 2024 Winter Storm event.

   To reiterate, the City Geologist has clearly documented that the rain events of 2023, and particularly 2024, have contributed to the accelerated rate of movement and the damage sustained by the City and its infrastructure. The point that warrants a reconsideration of reversing the denial is that there is a clear change in the rate of movement based on the GPS monitoring points cited in your memo between 2023 and present.

<u>Additional Information - Land Movement and the Monks Lawsuit</u>

In 1978, the City enacted an ordinance imposing a moratorium on the construction of new homes in the vicinity where accelerated landslides had recently occurred. The so-called "Monks" plaintiffs owned 16 vacant lots impacted by the moratorium. Some of these property owners claimed to have been waiting over 30 years to build homes on their properties on land that has not showed signs of movement. The lots in question were otherwise zoned for single-family dwellings.

Eventually, these property owners filed suit against the City seeking to invalidate the moratorium criteria and alleging a claim for inverse condemnation based on the state takings clause because, as the plaintiffs asserted, the land was not moving and suitable for development. The trial court denied their request and ultimately found in the City's favor. The property owners appealed.

The Court of Appels ruled in favor of the plaintiffs citing that the City's ordinance requiring owners of land in specific zones within the Landslide Complex to present data demonstrating to satisfaction of city geologist that the gross geotechnical factor of safety

where their lots were located was at least 1.5 in order to build on their lots deprived the land of all economically beneficial use, and resulted in a permanent categorical taking. **The Courts ruled that the plaintiffs could build on their lots.** (*Monks v. City of Rancho Palos Verdes*, 167 Cal.App.4th 263 (2008)

Conclusion

The basis for denying the City's disaster recovery on a pre-existing condition is not a valid reason when, as demonstrated in this appeal letter and supporting attachments, it is clear that a **new, inactive** for hundreds of years, landslide was activated in response to the 2024 Winter Storm event that led to the federal disaster declaration (FEMA-DR-4769-CA). The activation of the Altamira Landslide resulted in significant damage to the City's infrastructure including, but not limited to, public trails (Peppertree, Burma Road, and Rim Trails) that sustained severe damage resulting in their indefinite closure. It is now known that the activation of the Altamira Landslide carried the subslides of ACL, PBL, and KCL which is clearly demonstrated in this appeal letter that the rate of movement significantly increased along with the behavior of the land movement as a result of the 2023 and 2024 Winter Storm Events.

It is for the reasons cited throughout this appeal letter that disaster recovery financial assistance be provided for the destruction resulting from the activation of the Altamira Landslide caused by the extraordinary rain events of 2024. The weather whiplash over the years has adversely impacted the City, its residents and businesses, and its economics. Overturning the denial and providing the disaster recovery assistance requested will enable the City to properly respond to the activation of the new Altamira Landslide by stabilizing land movement and repairing damaged and critical infrastructure.

On behalf of the Rancho Palos Verdes City Council and residents, we thank you for your consideration of this appeal letter.

Sincerely,

Ara Michael Mihranian, AICP
City Manager

Attachments:

- September 9, 2023 CSA Memo
- November 8, 2024 CSA Memo
- March 16, 2025 CSA Memo
- February 20, 2024 Letter to Governor Newsom

c. Rep. Ted Lieu
Senator Adam Schiff

Senator Alex Padilla
State Senator Ben Allen
Asm. Al Muratsuchi
Rancho Palos Verdes Mayor Bradley and City Council
William Wynder, Rancho Palos Verdes City Attorney
Catherine Jun, Rancho Palos Verdes Deputy City Manager
Ramzi Awwad, Rancho Palos Verdes Director of Public Works
Vina Ramos, Rancho Palos Verdes Director of Finance

COTTON, SHIRES AND ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS

CITY OF RANCHO PALOS VERDES

CSA Project No. SC6022

MEMORANDUM

TO: Katie Lozano, Open Space Manager
CC: Ara Mihranian, City Manager
William Wynder, Elena Gerli, and John Fox, City Attorneys
Cory Linder, Director of Recreation and Parks
Ramzi Awwad, Public Works Director
Taylor Fox, Senior Park Ranger
FROM: Michael Phipps, CEG 1832, Contract City Geologist
Christopher Dean, CEG 1751, Contract City Geologist
Matthew Janousek, GE 3005, Contract City Geotechnical Engineer
RE: **Preliminary Geotechnical Assessment of Recent Land Movement in the Portuguese Bend Reserve and Impacts to Burma Road Trail, Rancho Palos Verdes**
DATE: September 29, 2023

INTRODUCTION

In accordance with your request, this memorandum has been prepared to provide a preliminary geotechnical assessment of recent land movement within the Portuguese Bend Reserve (PBR) with a specific focus on the impacts of land movement to the Burma Road Trail. We understand that the PBR is one of the City's most popular land reserves, it is heavily used by the public for recreation and is also used by public utilities including Southern California Edison and California Water Service Company. A portion of the PBR is underlain by the historically active Portuguese Bend Landslide (active since 1955-56) as well as the Ancient Portuguese Bend Landslide Complex. Some areas of the Reserve are now experiencing significant land movement and ground surface manifestation that is beyond the limits of the historically active and previously mapped Portuguese Bend Landslide, resulting in damage to trails and fire roads which provide access for public safety, utilities, maintenance, conservation, and public recreation. Cotton, Shires and Associates, Inc. (CSA) geologists have been requested by the City to observe various landslide-related issues in the Reserve involving damage to trails since 2021 and the SCE transmission lines along Burma Road since the summer of 2022. In 2021 we also began a detailed review of Global Positioning Satellite (GPS) monitoring data for survey monuments both within and outside the PBR, including points within the Abalone Cove Landslide, Klondike Canyon Landslide, and elsewhere within the Ancient Portuguese Bend Landslide Complex.

A comprehensive reconnaissance of the PBR was conducted by vehicle with City staff on June 28, 2023. Following this field visit, the City's Open Space Manager requested a report addressing the following items:

DRAFT

- Information and a map presenting our observations of where new landslide scarps are forming;
- An evaluation of whether Burma Road is currently able to accommodate vehicles, ranging from smaller Park Ranger trucks to heavy equipment used by utility companies and fire department, and if it is currently able to accommodate vehicles, an estimate of how long the road will remain stable;
- Recommendations for re-routing Burma Road (if necessary) to areas less prone to land movement as the fire road is needed for the City, fire department, and utility companies;
- Consideration of recommendations for additional warning signage due to the increased land movement to warn recreational users (hikers, bikers, horseback riders) and authorized outside agency personnel who drive the Reserve fire roads;
- Recommendations for a maintenance plan to fill fissures and keep Burma Road passable to pedestrians and vehicles, as the fissures have become too significant for park rangers to fill in with shovels.

This memorandum will address these requested items, based upon our field observations and geologic mapping, analysis of GPS monitoring data, background knowledge of the area, and professional experience.

PREVIOUS WORK

Previous City-requested reconnaissance and observation of trail conditions in the PBR performed by CSA geologists have included the following:

- 8/27/21: Burma Road trail reconnaissance (fissures/ground movement)
- 9/29/21: Burma Road and Garden Trail reconnaissance (fissures/ground movement)
- 1/5/22: Burma Road trail reconnaissance (fissures/ground movement)
- 8/31/22: Burma Road trail reconnaissance, meeting with SCE contractor and City staff, (regarding power pole relocation due to fissures, ground movement)
- 3/8/22: Upper Burma Road trail reconnaissance (rockfall hazards)
- 4/5/23: Burma Road Trail, Garden Trail, and Rim Trail reconnaissance (fissures/ground movement)

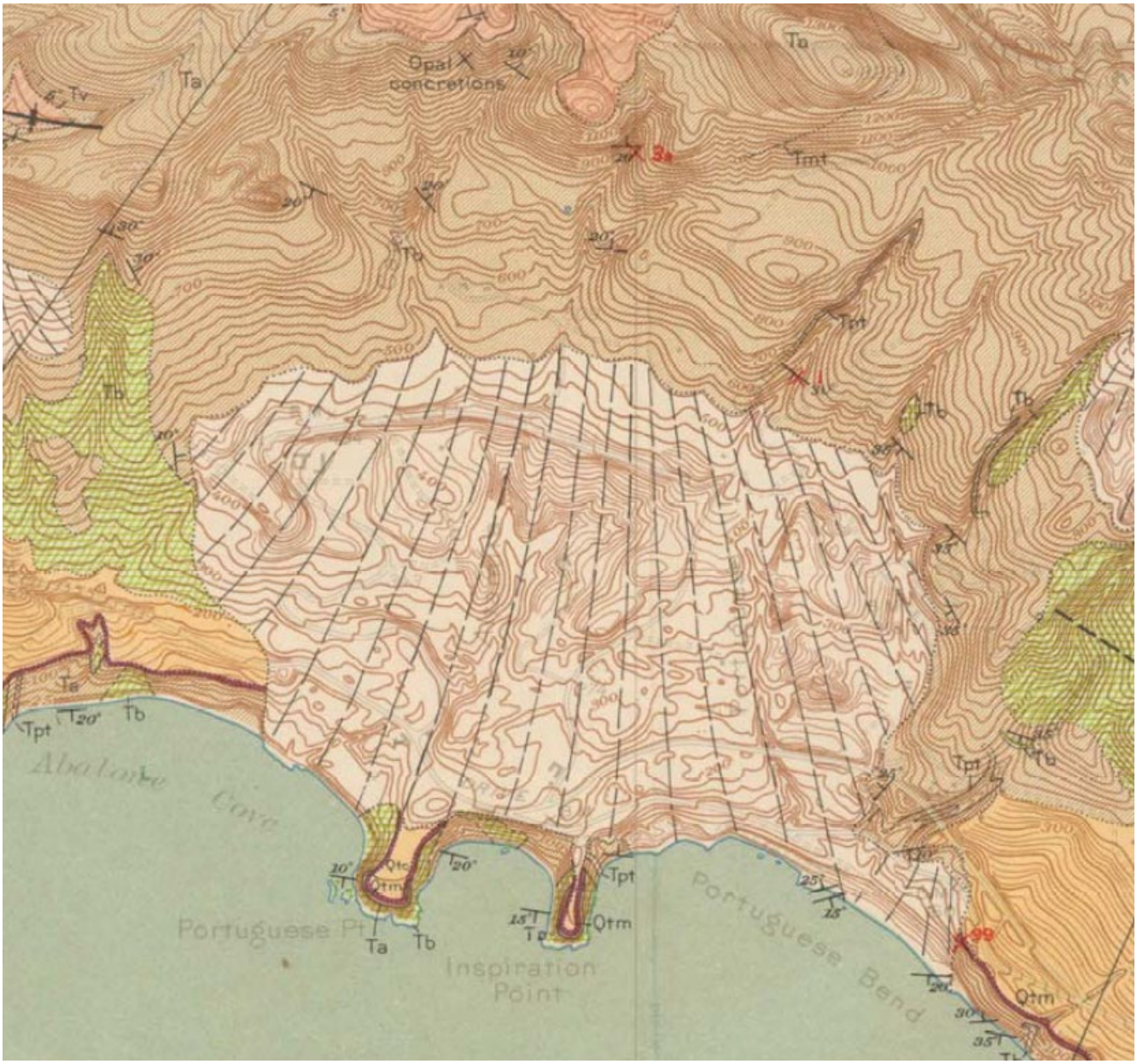
Findings and recommendations from these field visits have been routinely documented by either memoranda or email addressed to City staff. Recent published documents include memoranda dated February 9, 2022 (Burma Road/Rim Trail Junction) and May 19, 2023 (SCE Power Pole Relocation, Burma Road).

Preliminary geologic mapping of the upper limits of active landsliding along the Burma Road trail and vicinity was performed on June 28, 2023 and supplemented on September 22, 2023; however, this work is incomplete and requires additional field effort. Because of the steep terrain, large mapping area, and thick (inaccessible) vegetation in some areas, we have supplemented our field mapping with photo-geologic mapping utilizing high-resolution Nearmap (vertical aerial) imagery captured on January 17, 2023 and June 17, 2023.

DRAFT

FINDINGS

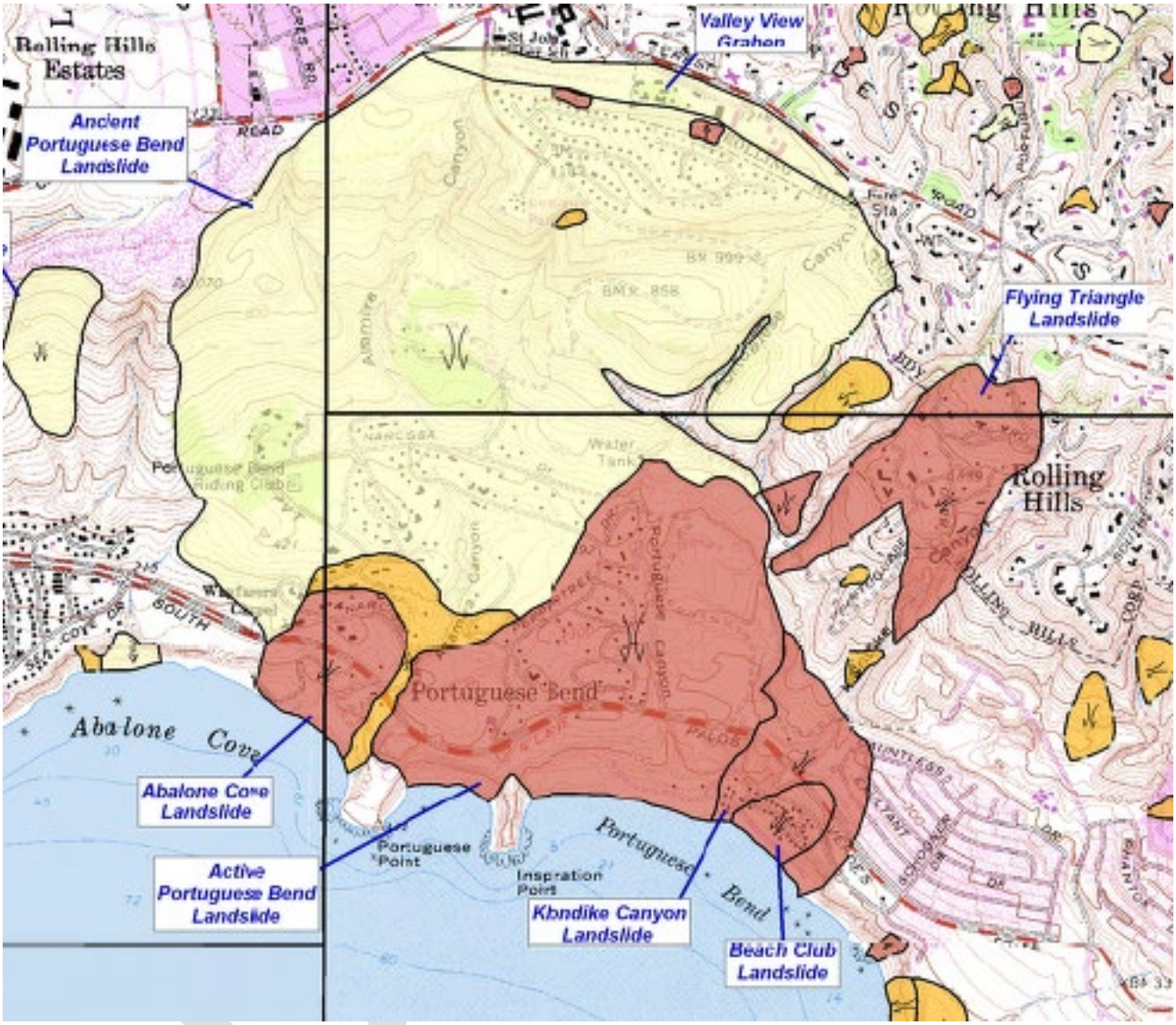
Geologic Mapping: The Ancient Portuguese Bend Landslide Complex (APBLC) was first mapped by the U.S. Department of the Interior Geological Survey (aka, USGS) in 1946 (shown as white area with black dashed lines in the image below) and occupies a broad area on the south side of the Palos Verdes Peninsula from the crest of peninsula to the Pacific Ocean.



U.S. Department of the Interior, 1946, Portion of Geologic Map of the Palos Verdes Hills, Los Angeles County, California

Within the APBLC, several large landslide masses have reactivated since the 1950s, including the Portuguese Bend Landslide, Abalone Cove Landslide, Klondike Canyon Landslide, and Beach Club Landslide. The Flying Triangle Landslide is in similar but higher terrain northeast of the Portuguese

Bend Landslide but is not considered part of the APBLC on regional geologic maps. These landslides are depicted on the California Geological Survey's Landslide Inventory Map of the Palos Verdes Peninsula (2007, image below).



California Geological Survey, 2007, portion of Landslide Inventory Map of the Palos Verdes Peninsula

Burma Road (and Trail) is located along what was previously proposed to be the Crenshaw Boulevard Extension, until the Portuguese Bend Landslide reactivated in 1956. The lower reach of Burma Road trends southeast immediately uphill from the headscarp of the Portuguese Bend Landslide. Previous site visits by our staff to the Burma Road area within the PBR beginning in 2021 were primarily in response to reported "fissures" forming in multiple locations across trails. We understand that City ranger staff have been routinely filling in the fissures with soil using hand tools. At other times heavier grading equipment has been reportedly used by Cal Water to fill fissures and maintain the Burma Road access to their facilities. Recent field mapping and GPS data suggest that these fissures are in fact the incipient manifestations of headward enlargement of the Portuguese Bend Landslide as well as an upslope manifestation of accelerated movement of a portion of the Ancient Portuguese Bend Landslide

Complex west of the active Portuguese Bend Landslide boundary. Four significant landslide scarps, which initially manifested as ground cracking and small fissures in Burma Road, have now formed across Burma Road, generally between the Eagle's Nest Trail intersection on the west and the Rim Trail intersection on the east.

Figure 1 (attached) was prepared on a Nearmap vertical color image taken January 17, 2023. The approximate limits of the active Portuguese Bend Landslide are depicted in red. The upper area of recent headward enlargement of the Portuguese Bend Landslide is depicted with yellow lines delineating landslide scarps which can be seen crossing Burma Road in at least seven locations. While the Burma Road trail has been repeatedly maintained by minor grading-leveling across these features, the scarps have grown in height and width adjacent to the road over time, and in some locations, grabens (wide pull-apart fissures) have formed in response to significant landslide movement. If not maintained in this manner over the past several years, landslide scarps ranging from 1 to 8 feet in height would extend across the road making it impassable to vehicles, cyclists, and even pedestrians. The most severe location is the western (and uppermost, elevation-wise) scarp located between the Water Tank trail and Eagle's Nest Trail intersection with Burma Road. The landslide displacement at this location has produced a scarp 6 to 8 feet in height and significantly displaced an SCE power pole that is now leaning approximately 35-40 degrees out of plumb. Other scarps across Burma Road southeast of this location are smaller, generally ranging from 1 to 4 feet in height adjacent to the road. Of note is that these scarps have grown substantially in size since our June 28, 2023 reconnaissance.

The downslope limits of the new landslide scarps (yellow contacts on Figure 1) appear to be directly connected to the Portuguese Bend Landslide at the eastern end; however, at the western end they are not well-defined at the ground surface and additional field mapping is necessary to further delineate the western margin. The western margin was observed crossing Kubota Trail and trending toward the Vanderlip Trail, where it was lost in heavy vegetation. It is important to note that the western extent of this new landslide movement is somewhat west of the head of the Portuguese Bend Landslide. It is our interpretation that the western extent of this new landslide movement is occurring in response to long-term creep displacement and recent acceleration of movement of the Ancient Portuguese Bend Landslide Complex (APBLC) since October 2018.

GPS Survey Monitoring Data Review: GPS monitoring of survey monuments throughout the APBLC area has been performed tri-annually since 2007 by McGee Surveying Consulting. In their June 6, 2023 Survey Report, McGee stated:

"*In the last seven months the movement velocities have accelerated over the average velocity for the previous four years which saw an acceleration over the previous 15-20 years……Velocities were stable prior to 2018. After the Fall of 2018 they increased about 3 to 6 fold at most points and remained stable to the Fall of 2022. In the last seven months since the Fall of 2022 the velocities generally have doubled more or less*."

This is a significant and important observation from the surveyor and comports with the past several years of field observations by CSA staff of roadway distress and trail distress within the PBR, as well as reports of street distress, building distress and utility line breaks throughout the various known landslide areas. We have prepared several graphics based upon our own analysis of the GPS survey

DRAFT

monitoring data to further illustrate what is happening with the landslide ground movement. Figure 2 (attached) depicts horizontal displacements (in feet) and ground displacement vectors, for 12 selected GPS survey monuments mostly located in the mid and upper Ancient Portuguese Bend Landslide Complex. These figures are based upon McGee's GPS monitoring of the survey monuments from October 2018 to May 2023 (with the exception of two monuments which were last read in October 2022, PB18 and AB71). Four of these monuments were also read in mid-July, 2023 and those movement data are also presented. Two of the monuments, CR07 and FT06 are located on Burma Road outside of the Portuguese Bend Landslide and indicate 1.67 feet and 3.09 feet of horizontal displacement over the ~4.5-year period. The CR07 point moved an additional 0.42 feet in two months (through July 15, 2023), which translates to ground movement velocity of about 2.5 feet per year. Most of the other points on this figure are in the Ancient Portuguese Bend Landslide Complex (and mostly in LMA Zone 2) and are indicating total displacements of approximately 1 to 3 feet (or average velocities of about 0.22 to 0.67 feet/year across the ~4.5-year period). Several of these points in LMA Zone 2 that were also monitored in July, 2023 showed continued acceleration from May to July 2023, with calculated velocities of ~1.25 feet/year at AB67 to ~3.9 feet/year at AB53. These are extraordinary rates of landslide movement that, to our knowledge, have not been previously documented in the LMA Zone 2 area.

We have also reviewed and analyzed cumulative and incremental displacements from 2007-2023 for six select survey monitoring points that are generally in the upper Portuguese Bend Landslide/Burma Road area, including three points that are in the Ancient Portuguese Bend Landslide Complex west of the historically active Portuguese Bend Landslide (i.e., in Landslide Moratorium Area Zone 2). These six points are identified as:

- CR07 adjacent to Burma Road Trail;
- PB54 located within the "Landward Subslide" of the Portuguese Bend Landslide Complex;
- AB53, AB58 and AB59 located within the Ancient Portuguese Bend Landslide Complex (Landslide Moratorium Zone 2); and
- FT06 adjacent to Burma Road Trail southeast of the Rim Trail intersection.

We have analyzed incremental displacement of these points versus 12-month antecedent rainfall, as a measure of the landslide response to rainfall (Figure 3). A graph of cumulative displacement of these points since 2007 is also presented in Figure 4. This graphed movement data indicates a clear acceleration of movement beginning in late 2018 (as noted in the area labeled inflection point).

Accelerated landslide movements since late 2018 appear to be correlative with significantly above-normal rainfall in three out of four rainfall seasons (2016-17, 2018-19 and 2019-20) which followed five consecutive drier than normal rainfall seasons (2011-12 through 2015-16). The extraordinary rainy season of 2022-23, where rainfall totals were more than 200% of average, has resulted in further acceleration based upon limited monitoring data. A significant concern is that the movement velocities have not declined back to the pre-2018 levels despite two significantly below-normal rainy seasons (2020-21, one of the driest on record, and 2021-22). Also of note is that our rainfall data do not include the impacts from Tropical Storm Hilary which dropped several inches of rain across most of southern California in August, 2023.

DRAFT

CONCLUSIONS AND RECOMMENDATIONS

Landslide movements throughout the Ancient Portuguese Bend Landslide Complex *outside of the historical boundary of the Portuguese Bend Landslide* previously exhibited relatively low rates of creep movement in the 11-year monitoring period of 2007-2018 for which we have readily available data. Beginning in late 2018, and through the present, the survey data indicate a significant acceleration of landslide movement. The movement of the Portuguese Bend Landslide also accelerated in this timeframe. The cumulative displacements over this time have now manifested as headward enlargement of the Portuguese Bend Landslide as well as new active landslide masses forming northwest of the Portuguese Bend Landslide crown in Landslide Moratorium Area Zone 1, upslope from LMA Zone 2. These new actively moving landslide masses are directly impacting Burma Road and threaten future accessibility.

We understand this issue is also exceeding current resources (i.e., ranger staff) to monitor and maintain the safety of the trails; primarily the heavily used Burma Road Trail. At this time, we consider this to be a critical and evolving situation that poses risks to the general public who are accessing the PBR for recreation, to utility infrastructure that traverses the landslide area, and to accessibility for other stakeholders including conservation groups and the fire department. It is evolving because we are days from entering the rainy season and most meteorologists and climatologists that we follow are citing development of El Nino conditions in the Eastern Pacific Ocean and these are frequently associated with wetter-than-normal rainfall conditions in southern California. We are also awaiting receipt of the fall GPS survey data which are typically gathered in early October.

To address the City's specific items, we offer the following:

Landslide Maps: For the purposes of this memorandum, a landslide overview map (Figure 1, attached) was prepared to illustrate the entire affected area and impacts to Burma Road. We conducted field mapping on much larger scale maps which allow for presentation of detailed observations; however, these were not formally drafted and produced due to time constraints. We recommend that additional field mapping be performed in an effort to further define the limits of active landsliding. Drafted larger scale maps will be provided if necessary and/or upon request, to provide details in specific areas.

Burma Road Conditions and Maintenance Considerations: Given the current landslide movement velocities, the newly identified landslides impacting Burma Road are active and considered unstable. Burma Road only remains passable because of the reported efforts of other stakeholders to level the ground surface across the landslide areas with larger equipment, in response to the creeping landslide movement. We anticipate that the landslide movement will continue and is likely to be exacerbated by the 2023-24 rainy season regardless of whether it is wetter or drier than historical averages. The filling of fissures crossing the road with manual labor (by park rangers) has become untenable and such measures are reportedly proving to be short-lived. The fissures, which are developing landslide scarps, have widened and deepened in some areas due to significant ground movement. Smaller vehicles (ranger trucks) are typically 2-3 tons and present lower risks when crossing the landslide areas;

DRAFT

however, larger, heavier vehicles including fire trucks which typically weigh 10 to 20 tons present a much larger transient load across the landslides, thus presenting a relatively greater risk.

Currently it is our opinion that Burma Road Trail should be closed to the public across the landslide area *unless it can be monitored on a daily basis by the park rangers*. This is due to active landslide movement directly impacting the road and posing significant risks to pedestrians, cyclists and horseback riders. Ground leveling efforts to keep the road passable for vehicles may continue; however, crews should avoid placing earth fill directly on the landslides because it adds weight and is a driving force of landslide movement. Continued notching (lowering) of the trail approaches to the landslide scarps may be the only effective solution in the short-term to maintain passage of vehicles. Care should also be given to avoid ground-alterations that would direct more Burma Road drainage directly into the landslide areas.

Burma Road Re-routing Considerations: Burma Road and trail occupy a portion of wider, leveled ground graded during the proposed Crenshaw Boulevard extension (circa 1955-56). Several of the new landslide scarps extend to near the north edge of the previously leveled area, thus, there does not appear to be a feasible location to re-route the road through these areas. Furthermore, we do not see an opportunity to completely re-route Burma Road outside of the former graded area without consideration of massive grading and drainage improvements in steeply sloping areas, some of which may also be in sensitive habitat area. There are also slope stability concerns north of Burma Road for any considered re-route, and we are currently lacking information due to a lack of GPS monitoring points north of Burma Road. The depth of movement of the new landslides is also unknown and at best could only be estimated based on previous studies of the Portuguese Bend Landslide.

Consideration could be given to stabilizing the affected portions of Burma Road in its current location; however, this would require an extensive geotechnical investigation, including geologic mapping, installation of instrumented borings (e.g., slope inclinometer casings and piezometers), laboratory soil testing, extensive slope stability analyses, and design of possible stabilization alternatives. Stabilization, if technically feasible, might require a combination of extensive in-ground structural measures (i.e., steel-reinforced concrete shear pins with tiebacks) and grading. Based upon our experience, such mitigation would likely have a cost in the millions of dollars.

Additional Warning Signage: Additional warning signage due to the increased land movement, to warn recreational users (hikers, bikers, horseback riders) and authorized outside agencies who drive the Reserve fire roads, is reasonable and appropriate from a geotechnical perspective, particularly if the City is going to keep Burma Road Trail and other potentially affected trails open to the public. As mentioned above, the new landslide areas impacting Burma Road and Trail are currently unstable. The landslide areas are currently moving (creeping) at velocities that are generally imperceptible to humans and may seem innocuous from that perspective; however, over short periods of time the movement creates significant hazards to trail users due to differential ground movement with associated ground cracking and fissuring within the landslide masses as well as scarp formation at the movement boundaries.

DRAFT

Additional Recommendations: In addition to the specific items requested to be addressed by the City, we have the following comments and recommendations:

- CSA previously issued a memorandum regarding the proposed SCE power pole relocation (May 19, 2023). At that time, we noted that the upslope extent of active landsliding had not been geologically mapped (to our knowledge), the depth of landslide movement is unknown, and there is a lack of GPS survey monitoring points north of Burma Road between Portuguese and Paintbrush Canyons. We subsequently stated that due to this lack of information, it was difficult to assess the impacts of future land movements on the proposed power pole relocation areas. It is our understanding that SCE may be considering a larger scale relocation of their transmission line(s) that are currently within the active landslide area, in lieu of the relocation project that we previously reviewed. The existing transmission line along Burma Road is partially supported by power poles located in actively moving landslides and at least two of the power poles have now been severely compromised. This transmission line poses a significant risk if not de-energized.

- The above-ground water main which trends along Burma Road traverses portions of the new landslide areas and is lacking ground support (i.e., the pipe is in the air) in some isolated areas. Our concern is that the pipe *may* not have been designed for such conditions. This should be further evaluated by the utility company responsible for the water main.

- Additional geologic mapping (on ground, possibly supplemented with drone photogrammetry) should be performed in an effort to further define the areal extent of new active landsliding. This information will be beneficial to the City for future evaluation of the safety of Burma Road and other trails within the Portuguese Bend Reserve, and also useful to other stakeholders.

- Additional GPS monitoring points should be established north of Burma Road, between Portuguese Canyon and Paintbrush Canyon. CSA will assist with recommended locations for these points if requested by the City. We also recommend that the tri-annual GPS monitoring be performed on <u>all</u> monuments in each monitoring session, in lieu of the partial monitoring that has been historically performed in two of the three sessions per year.

- Periodic closures of the trail system within the PBR during and immediately after significant rainfall events, as has been the policy of the City, should continue to allow for safety assessment of the trails by ranger staff.

- Where feasible, park ranger staff should continue to do routine monitoring and filling of ground fissures on other trails to keep the trails relatively safe; otherwise, the trails should be closed.

We hope this memorandum provides the City of Rancho Palos Verdes with the requested information and recommendations regarding Burma Road within the Portuguese Bend Reserve at this time. Please contact us if you have further questions or concerns.

-o-

DRAFT

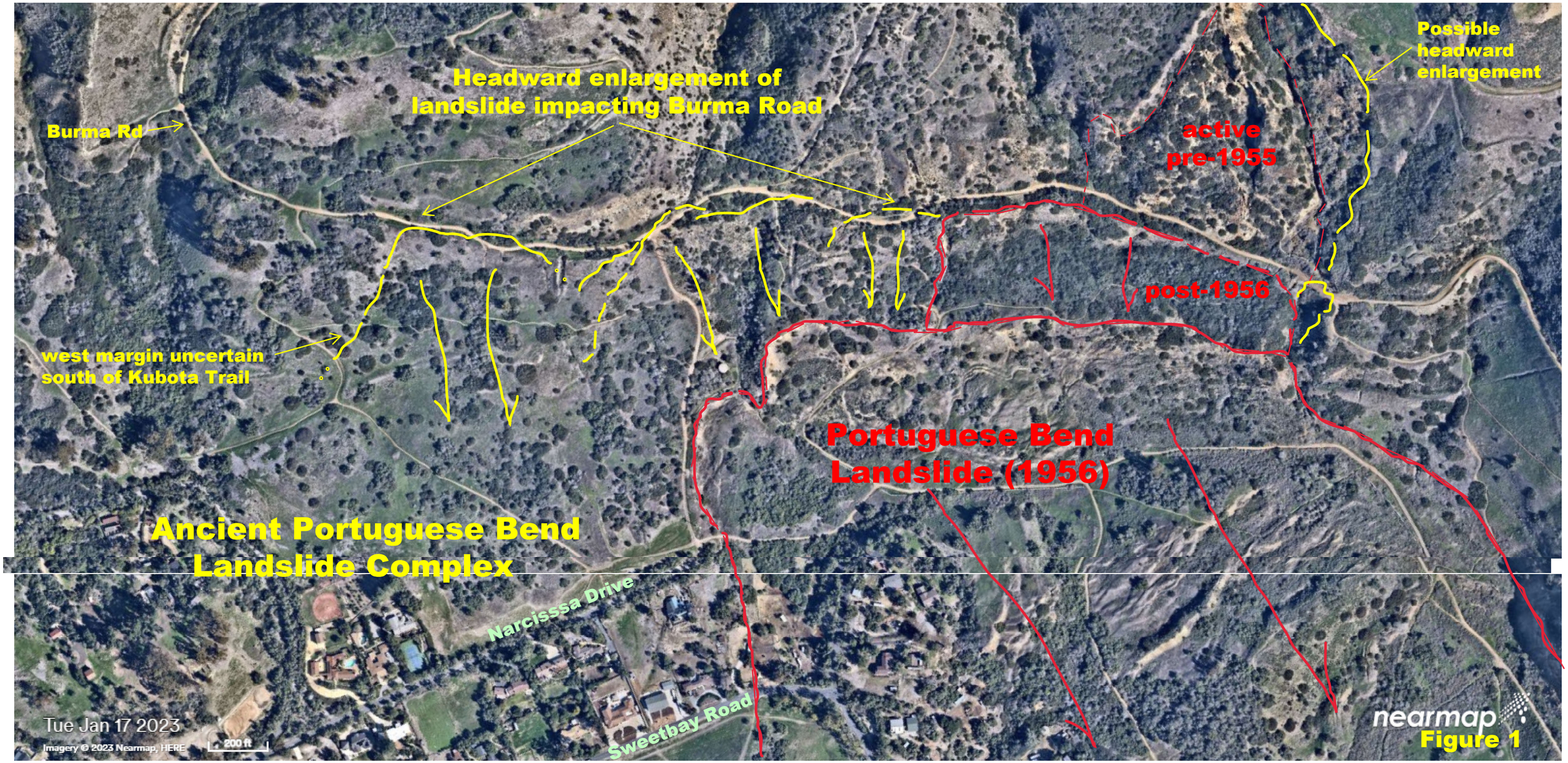
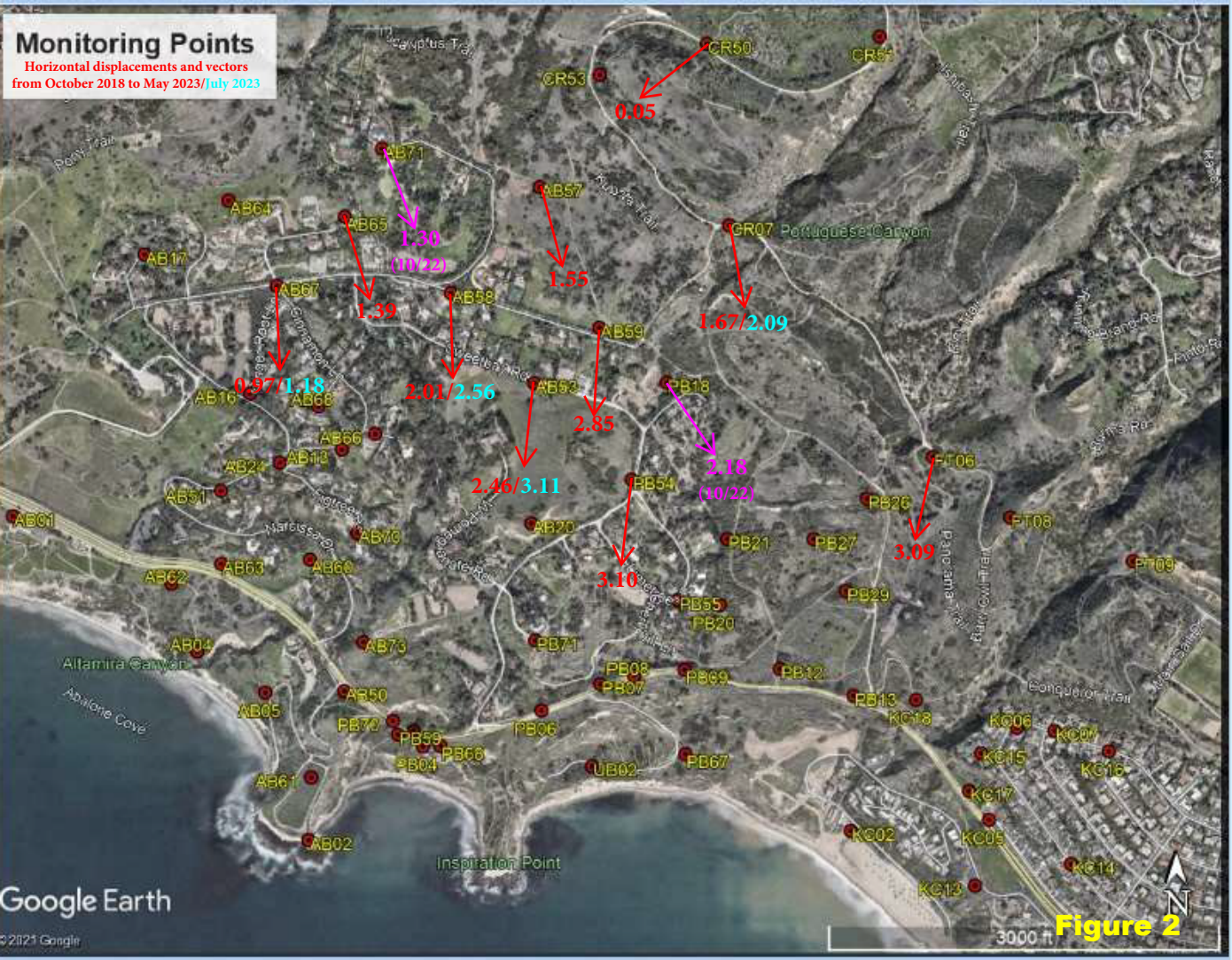

Headward enlargement of
landslide impacting Burma Road
Burma Rd
Possible
headward
enlargement
active
pre-1955
post-1956
west margin uncertain
south of Kubota Trail
Portuguese Bend
Landslide (1956)
Ancient Portuguese Bend
Landslide Complex
Narcisssa Drive
Sweetbay Road
Tue Jan 17 2023
Imagery © 2023 Nearmap, HERE
200 ft
nearmap

Figure 1


Monitoring Points
Horizontal displacements and vectors
from October 2018 to May 2023/July 2023
CR50
CR53
CR54
0.05
AB71
AB64
AB65
1.30
(10/22)
AB57
1.55
CR07
Portuguese Canyon
AB17
AB67
1.39
AB58
1.67/2.09
AB59
0.97/1.18
AB16
AB68
2.01/2.56
AB53
2.85
PB18
AB66
AB13
AB24
2.18
(10/22)
PT06
2.46/3.11
PB54
AB51
PB26
AB01
AB70
AB20
PB21
PB27
3.09
PT08
AB02
AB63
AB69
3.10
PT09
PB29
PB55
PB20
AB04
AB73
PB71
Altamira Canyon
PB08
PB07
PB69
PB12
Conqueror Trail
Abalone Cove
AB05
AB50
PB13
KC18
KC06
KC07
PB70
PB59
PB06
PB66
PB04
KC15
KC16
PB67
UB02
AB61
KC17
KC02
KC05
AB02
KC14
Inspiration Point
KC13
Google Earth
©2021 Google
3000 ft
N
Figure 2

GPS Monitoring Data

Survey Monuments - Upper Portuguese Bend Landslide/Burma Road Area

Displacement Response to 12-month Antecedent Rainfall

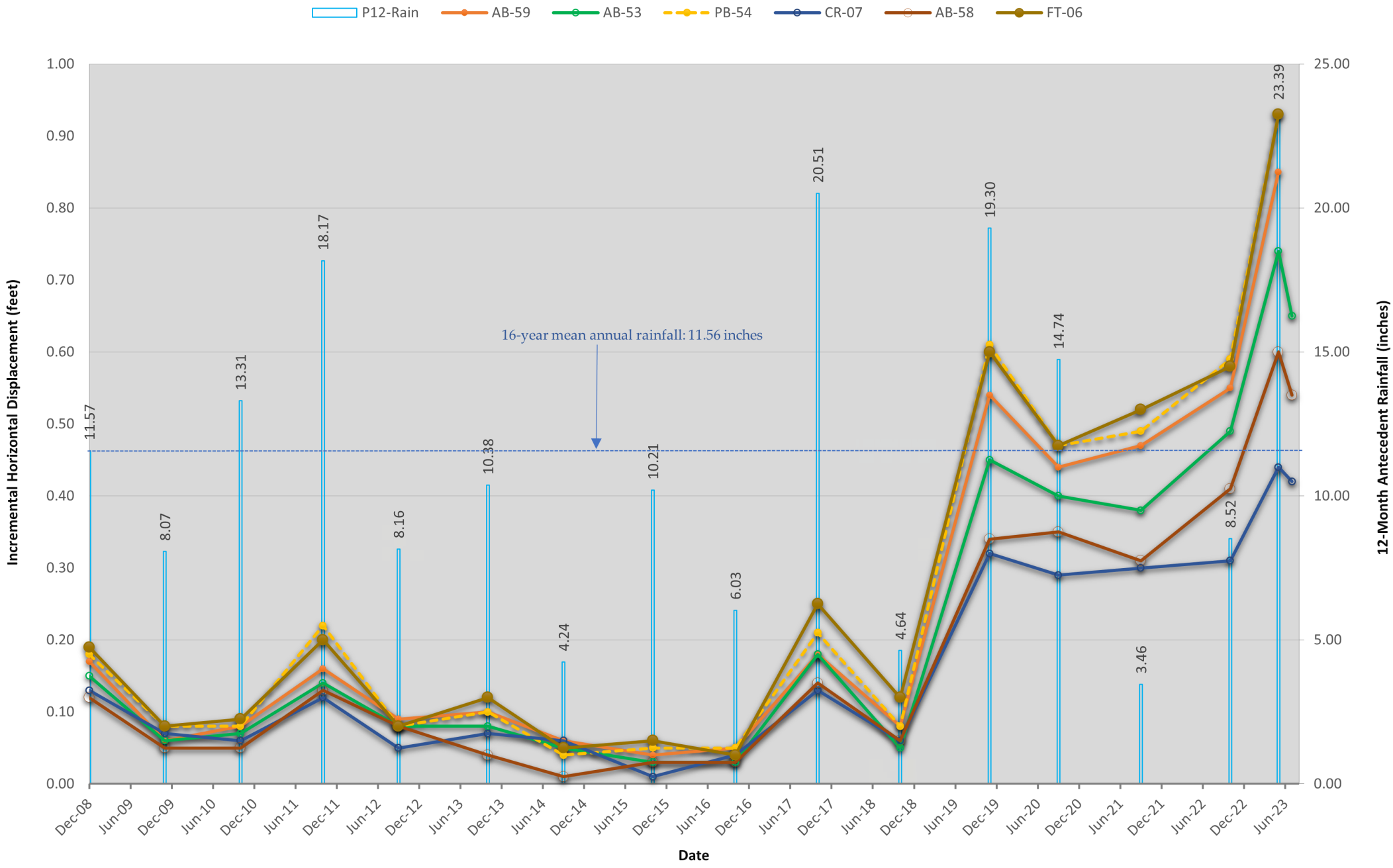


Figure 3

GPS Monitoring Data

Survey Monuments - Upper Portuguese Bend Landslide/Burma Road Area

Cumulative Horizontal Displacement 2007-2023

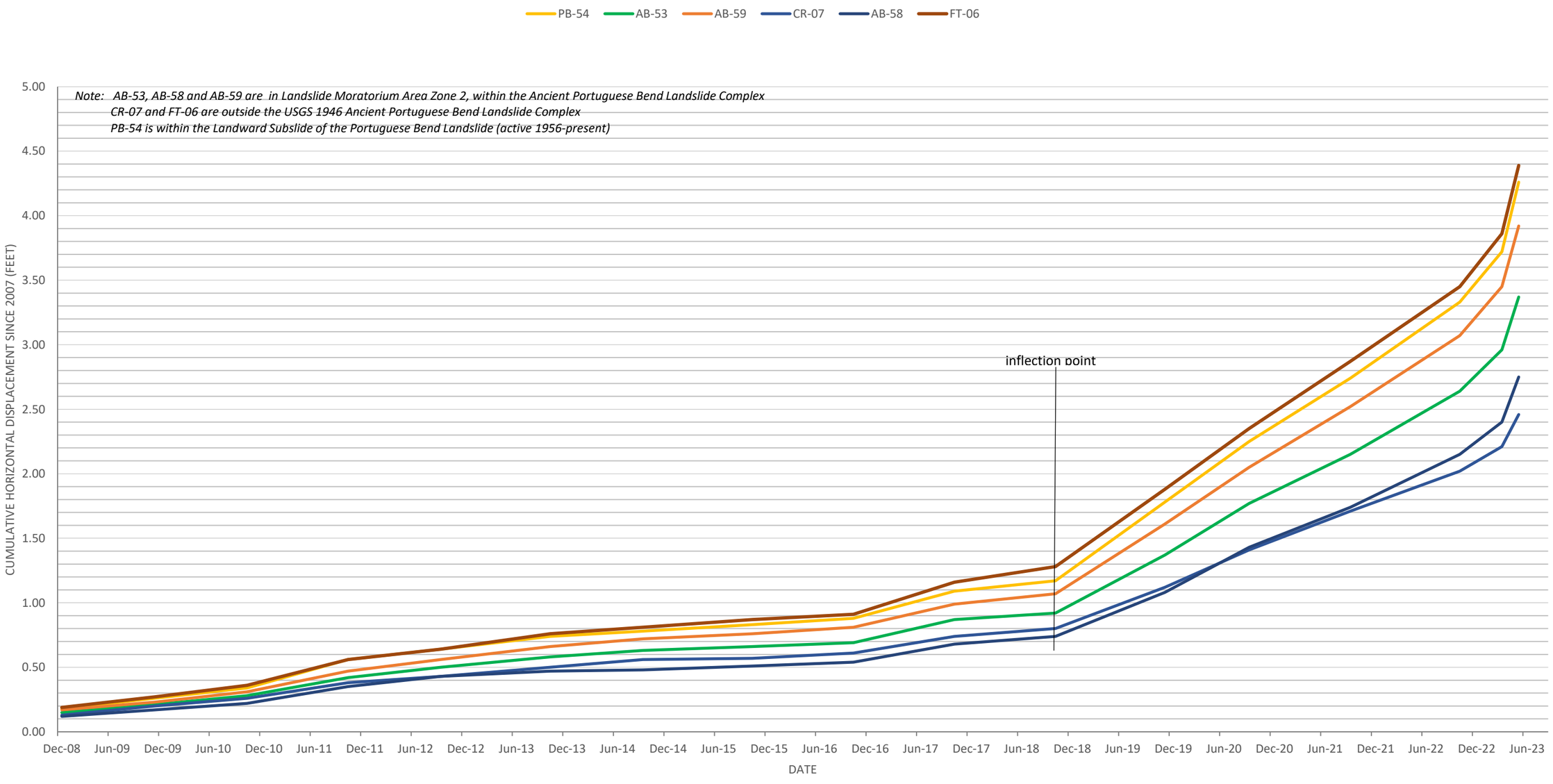


Figure 4

COTTON, SHIRES AND ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS

CITY OF RANCHO PALOS VERDES

CSA Project No: SC6163

MEMORANDUM

TO: Brandy Forbes, Community Development Director
CC: Ara Mihranian, City Manager
Ramzi Awwad, Public Works Director
FROM: Michael Phipps, CEG 1832, Contract City Geologist
Patrick Shires, GE 770, Contract City Geotechnical Engineer
RE: **Movement of the Altamira (Greater Portuguese Bend) Landslide Complex and Related Impacts, Rancho Palos Verdes, California**
DATE: November 8, 2024

INTRODUCTION

In this memorandum Cotton, Shires and Associates, Inc. (CSA) summarizes our evaluation of land movement of the Altamira Landslide Complex (previously referred to as the Greater Portuguese Bend Landslide Complex or Ancient Portuguese Bend Landslide Complex in past correspondence) from 2022-2024, with specific focus on the impacts of the land movement to private property, residential structures, and infrastructure. The active Altamira Landslide Complex currently involves major land movement comprising an area of over 700 acres landward of the coast. As of this date, the major land movement has resulted in the red-tagging (Unsafe to Enter/Occupy) of 18 residential structures and 2 commercial structures (at Wayfarer's Chapel), and the yellow-tagging (Limited Entry) of 38 other residential structures. It has also caused major impacts to public and private roads (some requiring closure), damages to utility infrastructure (water, sewer, gas, electricity and cable) causing certain utilities to be shut-off, and closure of certain Preserve land that is heavily accessed by the public for hiking, biking, equestrian, and other purposes.

BACKGROUND

The Altamira Landslide Complex in Rancho Palos Verdes includes four historically active, previously identified landslide areas: the Portuguese Bend Landslide (PBL) which began moving in 1956, the Abalone Cove Landslide (ACL) which began moving in 1979, the Klondike Canyon Landslide (KCL) which also began moving in 1979, and the Beach Club Landslide (BCL) which is nested within the KCL and, while dormant itself, moves with the KCL. It also now includes areas outside of the historically mapped boundaries of these known landslides, predominantly upslope from the historically mapped Portuguese Bend and Abalone Cove Landslides, within the Ancient Portuguese Bend Landslide Complex as mapped by various agencies (i.e., U.S. Geological Survey, California Geological Survey and other researchers (see attached Figure 1 - Landslide Area Map).

Based upon historically mapped boundaries, the ACL, PBL and KCL previously comprised an area of approximately 380 acres and affected portions of neighborhoods known as the Portuguese Bend Community, the Seaview Community and the Portuguese Bend Beach Club, as well as City-owned land within the Portuguese Bend Reserve (a sub-area of the greater Palos Verdes Nature Preserve). The

PBL has been continuously active since reactivation in 1956 with many areas of the landslide having moved hundreds of feet seaward over the ensuing six-plus decades. The ACL was active from 1979 until the late 1990's, involving only several feet of movement, when dewatering and other mitigation efforts largely halted movement. Creep movement of the ACL has occurred over the past 25 years following rainy seasons that were significantly above average rainfall amounts. The KCL has been episodically active in 1979-1983 and 2005-2006, experiencing only several inches of movement, typically in response to significantly above average rainfall. Landslide movements throughout the Ancient Portuguese Bend Landslide Complex *outside of the historical boundaries of* the ACL and PBL previously exhibited low rates of creep movement, or movement at or near the instrument precision range, in the 11-year monitoring period of 2007-2018 for which we have readily available data. These landslides are deep translational-type failures within seaward-dipping strata of the Monterey Formation, with the landslide slip surfaces occurring within very weak bentonitic clay beds. Historically, the movement behavior of these landslides routinely exhibited high sensitivity to increased groundwater pore pressure, and increased rates of land movement were correlative with 6-to-12-month antecedent rainfall that was well above average. Similarly, land movement decreased during below average rainy seasons or multi-year periods of drought.

Beginning in 2021, CSA geologists were requested by the City of Rancho Palos Verdes to observe reported distress (ground cracking and fissures) to trails in the Portuguese Bend Reserve. At that time, we also began reviewing Global Positioning Satellite (GPS) monitoring data for survey monuments within the entire Ancient Portuguese Bend Landslide Complex or Altamira Landslide Complex. In the summer of 2022, CSA was also asked to evaluate distress to an SCE transmission line along Burma Road within the Portuguese Bend Reserve. Subsequent geologic mapping of the Reserve area revealed that headward and lateral enlargement of the Portuguese Bend Landslide was occurring. We were also receiving reports of underground water line breaks occurring within the Portuguese Bend Community Association area and the Seaview Community. Review of GPS monitoring data from 2007 through 2023 indicated that land movement acceleration initially began between 2018 and 2019. We postulated that this acceleration was correlative with significantly above-normal rainfall in two out of three prior rainfall seasons (2016-17 and 2018-19) which followed five consecutive drier than normal rainfall seasons (2011-12 through 2015-16) (see attached Figure 2 – GPS Monitoring Data, Ancient Portuguese Bend Landslide: Displacement Response to 12-Month Antecedent Rainfall, December 2008-January 2024). One notable item, however, is that the land movement velocities did not decline back to the pre-2018 levels despite two significantly below-normal rainy seasons (2020-21, one of the driest on record, and 2021-22).

RAINFALL IMPACTS – 2022 THROUGH 2024

Further acceleration of land movement occurred throughout the Altamira Landslide Complex during and following the 2022-23 rain season, and the rainfall impacts from mid- to late-winter storms significantly contributed to the increased ground movements. Significant accelerations in movement velocity were documented in May 2023 following major storm sequences in January, February and March of 2023, which added to cumulative seasonal rainfall totals exceeding 193% of average rainfall. Approximately 87% of this rain fell prior to June 18, 2023. Most of this rainfall occurred from three significant atmospheric river-type storm sequences occurring on January 9-16 (3.59 inches), February 23-March 1 (3.79 inches) and March 10-15 (4.12 inches). Land movement velocities further increased as of the July 15, 2023 monitoring. An anomalous tropical storm dropped an additional 3.05 inches of

rain on August 19-20, 2023, resulting in further land movement acceleration as of the October 10, 2023 monitoring. The multiple increases in landslide velocities (i.e., accelerations) resulted in additional mappable ground surface expressions of the uphill limits of active landsliding, including the formation of landslide scarps, fissures, grabens, tensional cracking and shear zones, including areas north, west and east of the historically known landslide boundaries. Field geologic mapping and photo-geologic mapping performed in mid to late 2023 corroborated the GPS monitoring data findings that a large portion of the Ancient Portuguese Bend Landslide Complex (Altamira Landslide Complex) above the historically mapped PBL, ACL and KCL boundaries was involved in significant active landslide movement. The boundary of that major land movement has been updated through November 2024 and is depicted by the green dashed line on the attached Figure 1 – Landslide Area Map.

The 2023-2024 rainfall season total of more than 23 inches was 170% of the long-term average and had a compounding effect on the previous season's extraordinary rainfall. This rainfall season was characterized by additional atmospheric river type storms, including a sequence of storms that resulted in a Federally declared disaster from January 30 - February 9, 2024. The February 2024 rainfall total of 11.22 was the second wettest February in the 67-year history of recorded data for the Palos Verdes Peninsula. The landslide response to these rains was almost immediate and we observed continued accelerating land movement in the GPS monitoring data through August 1, 2024. A peak land movement velocity of >13 inches/week occurred in the center of the landslide as of the May 28, 2024 monitoring period. Movement velocities appeared to peak across the breadth of the landslide in the July 1 - August 1, 2024 monitoring period with the majority of stations moving >10 inches/week and peak movements >12 inches per week. Attached Figures 3, 4, 5 and 6 – GPS Monitoring Displacement Rate Contour Maps, are landslide movement velocity contour maps produced from GPS monitoring data through August 1, 2024, September 4, 2024, October 8, 2024 and October 29, 2024, respectively.

For reference, rainfall data utilized for this evaluation are from the Los Angeles County Department of Public Works - Hydrology Division Station 1011B, located at the Rolling Hills Fire Station No. 56. This rainfall station serves as a reasonable proxy for rainfall impacts to the southern face of the Palos Verdes Peninsula due to its elevation, which should reflect some orographic effect for storms approaching the Palos Verdes Peninsula from the west, southwest, and south, compared to coastal stations such as Point Vicente which may underestimate rain totals in the higher reaches of the landslide complex and watershed.

TOTAL LAND MOVEMENT – OCTOBER 2022 THROUGH OCTOBER 2024

Since October 10, 2022, total horizontal land movement throughout the Altamira Landslide Complex has ranged from approximately 27 to 39 feet in most areas, with the exception being approximately 6 to 21 feet of horizontal land movement in the Klondike Canyon Landslide area. Vertical displacements have ranged from 1 - 10 feet in most areas over this same period. This land movement has had a destructive and devastating effect on numerous residential and commercial properties and structures, private and public roadways, and utility infrastructure. In addition to the 18 red-tagged and 38 yellow-tagged structures, dozens of homes are experiencing varying amounts of distress and inaccessibility due to differential land movements, and electricity and gas service has been cut off from the majority of these properties. The most significant damage is to structures on or adjacent to the landslide boundaries, or those located on boundaries between subslides (blocks) within the Altamira Landslide Complex that are moving at different rates.

Since June 2024, the City has undertaken emergency mitigation measures including 18 deep geotechnical test borings with sophisticated instrumentation to detect the depth(s) of land movement and groundwater pore pressures within and beneath the active landslide mass(es). The instrumented geotechnical test borings revealed that the basal slip surface of the Altamira Landslide Complex beneath the Portuguese Bend Landslide portion of the Altamira complex is up to twice as deep as previously/historically modeled, and moving at a much faster rate than the shallower PBL slip surface. This significantly greater depth of movement has resulted in a broader footprint of active land movement at the ground surface and offshore, and expansion of the historical land movement area from approximately 380 acres to over 700 acres. The test borings also indicated that artesian or near-artesian groundwater pressure is present beneath the Altamira slip surface, and confined groundwater under significant pressure is present between the Altamira and PBL slip surfaces. High unconfined groundwater levels were also determined within the historically modeled Portuguese Bend and Abalone Cove landslide bodies. Beginning September 13, 2024, the first of 10 deep dewatering wells came online. The ten wells, all located near the toe, or lower 1/3 of the landslide complex, are currently extracting approximately 1 million gallons per day of groundwater within and beneath the landslide.

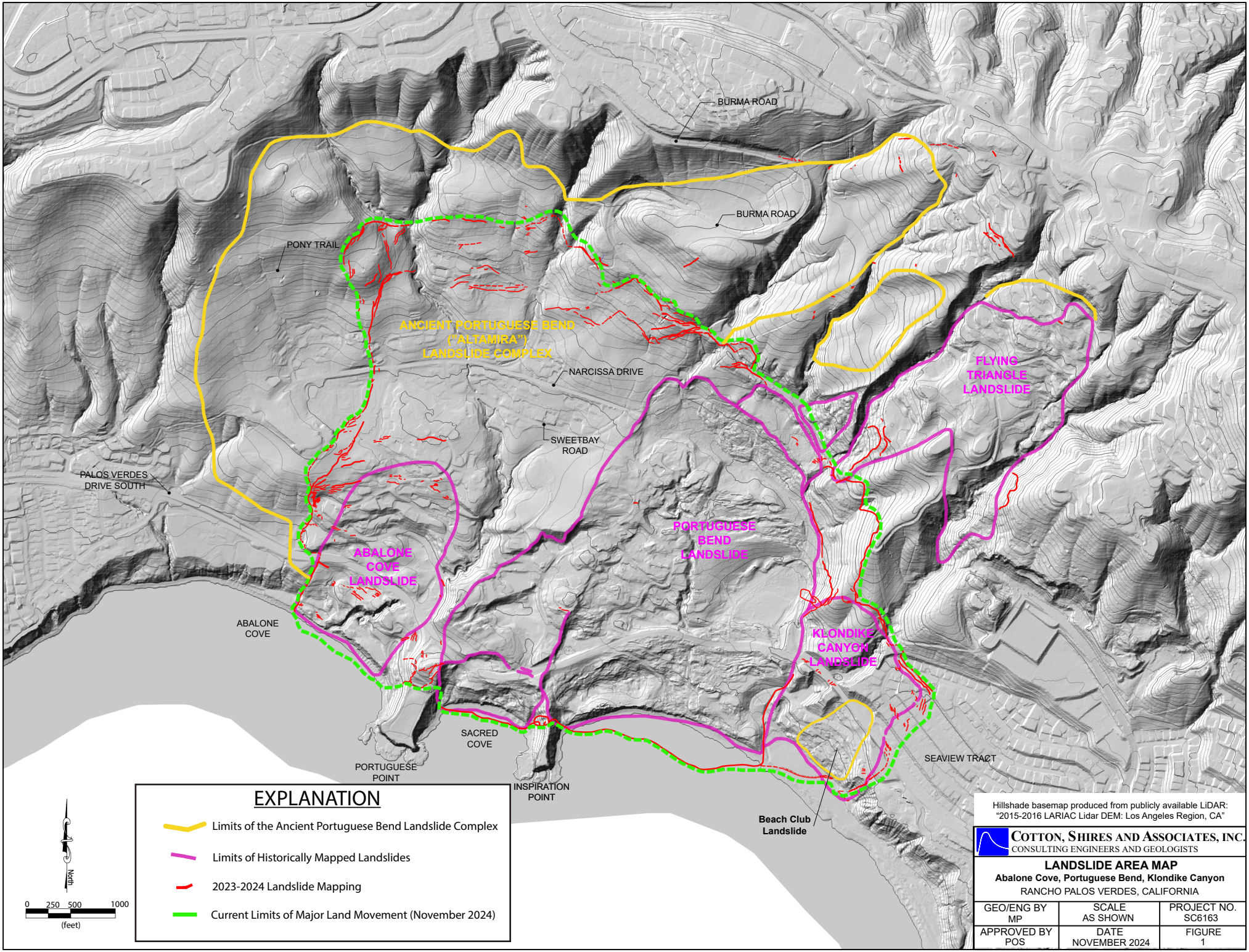
FUTURE LAND MOVEMENT POTENTIAL

As described above, major movement of the Altamira Landslide Complex ranging from 6 to 39 feet horizontally and 1 to 10 feet vertically has occurred since October 2022, with the majority of that movement occurring during and following the 2023-24 rainy season. The highest observed movement rates have exceeded 12 inches per week. While emergency dewatering mitigation efforts and 6 months without any rainfall recharge have reduced movements in most areas to a current level of 0.5 to 6 inches per week, there are many uncertainties regarding the longevity and long-term effectiveness of the deep dewatering wells that have been installed, including the availability of additional funding needed to maintain them and keep them operational. There is also uncertainty regarding the quantity of dewatering wells needed to maintain landslide movements at low (creep) movement levels, and whether funding for additional wells can be obtained. Given the emergency measures that are in place, the future response of the landslide to seasonal rains, including the severity of those rains is unknown; however, historical land movement data demonstrates increases in land movement with above-average rainy seasons despite the operation of past dewatering facilities operated by private geologic hazard abatement districts such as ACLAD and KCLAD.

-o-

Attachments:

Figure 1 – Landslide Area Map
Figure 2 – GPS Monitoring Data, Displacement Response to 12-Month Antecedent Rainfall, December 2008-January 2024
Figure 3 – GPS Monitoring Displacement Rate Contour Map (8/1/2024 Data)
Figure 4 – GPS Monitoring Displacement Rate Contour Map (9/4/2024 Data)
Figure 5 – GPS Monitoring Displacement Rate Contour Map (10/8/2024 Data)
Figure 6 – GPS Monitoring Displacement Rate Contour Map (10/29/2024 Data)

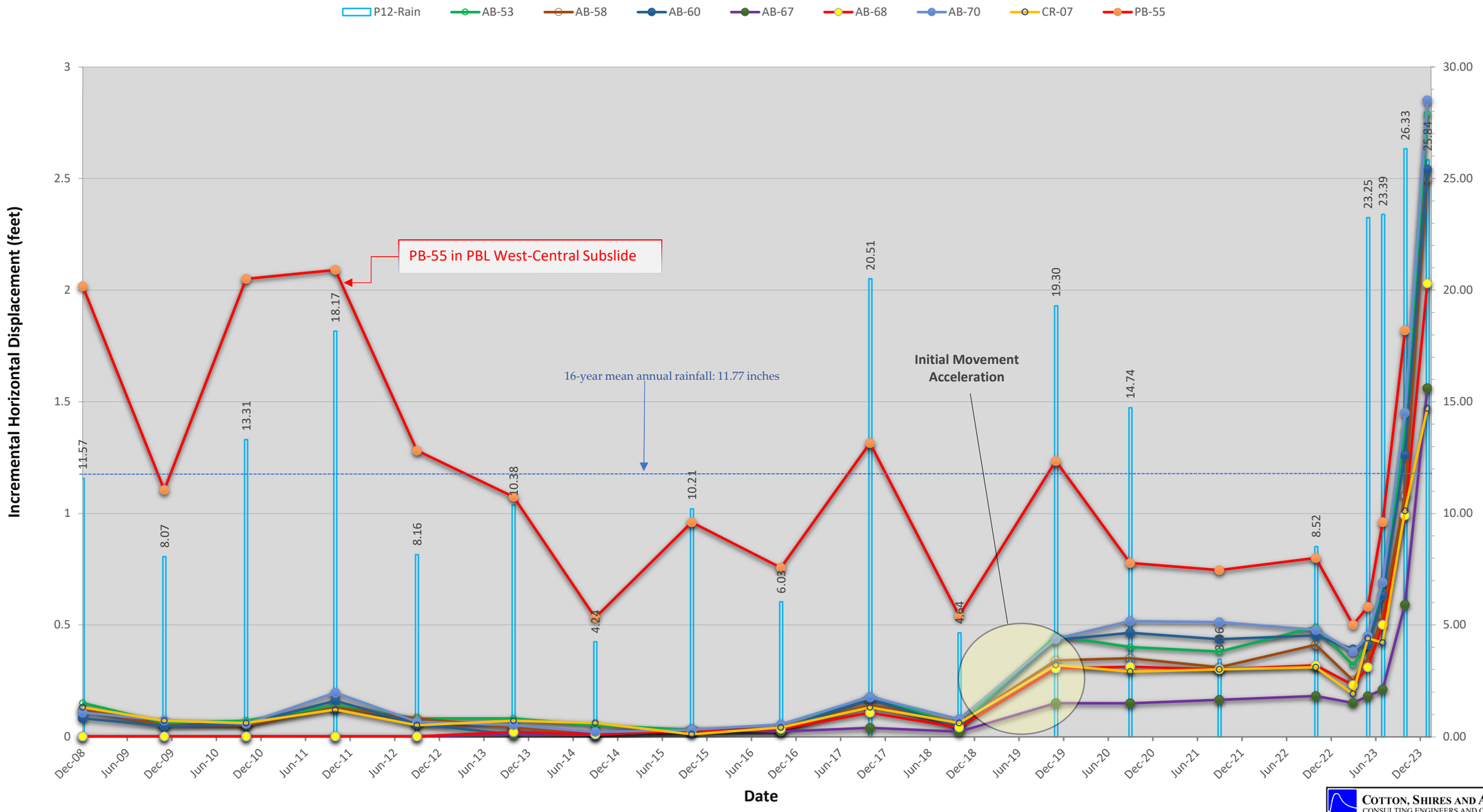

BURMA ROAD
BURMA ROAD
PONY TRAIL
ANCIENT PORTUGUESE BEND ("ALTAMIRA") LANDSLIDE COMPLEX
NARCISSA DRIVE
SWEETBAY ROAD
PALOS VERDES DRIVE SOUTH
FLYING TRIANGLE LANDSLIDE
PORTUGUESE BEND LANDSLIDE
ABALONE COVE LANDSLIDE
KLONDIKE CANYON LANDSLIDE
ABALONE COVE
SACRED COVE
PORTUGUESE POINT
INSPIRATION POINT
SEAVIEW TRACT
Beach Club Landslide
EXPLANATION
Limits of the Ancient Portuguese Bend Landslide Complex
Limits of Historically Mapped Landslides
2023-2024 Landslide Mapping
Current Limits of Major Land Movement (November 2024)
North
0 250 500 1000
(feet)
Hillshade basemap produced from publicly available LiDAR: "2015-2016 LARIAC Lidar DEM: Los Angeles Region, CA"
COTTON, SHIRES AND ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS
LANDSLIDE AREA MAP
Abalone Cove, Portuguese Bend, Klondike Canyon
RANCHO PALOS VERDES, CALIFORNIA
GEO/ENG BY MP
SCALE AS SHOWN
PROJECT NO. SC6163
APPROVED BY POS
DATE NOVEMBER 2024
FIGURE 1

GPS Monitoring Data

Survey Monuments - ACL, PBL and Upper Ancient Landslide Complex

Displacement Response to 12-month Antecedent Rainfall

December 2008-January 2024



COTTON, SHIRES AND ASSOCIATES, INC. CONSULTING ENGINEERS AND GEOLOGISTS	
GPS Monitoring Data Survey Monuments- ACL, PBL, and Upper Ancient Landslide Complex Displacement Response to 12-month Antecedent Rainfall Rancho Palos Verdes, California	
GEO/ENG BY MP	SCALE
APPROVED BY POS	DATE NOVEMBER 2024

PROJECT NO. SC6163

FIGURE 2

APPROXIMATE BOUNDARY OF ANCIENT PORTUGUESE BEND LANDSLIDE COMPLEX

"Creeping Area" Approximately 0.5 inch/week

CURRENT LIMITS OF MAJOR LANDSLIDE MOVEMENT (AUGUST 2024)

PONY TRAIL

BURMA ROAD

PALOS VERDES DRIVE SOUTH

ABALONE COVE

PORTUGUESE POINT

SACRED COVE

INSPIRATION POINT

SEAVIEW TRACT

PORTUGUESE BEND LANDSLIDE

ABALONE COVE LANDSLIDE

FLYING TRIANGLE LANDSLIDE

KLONDIKE CANYON LANDSLIDE

0.06 CW01
0.08 AB77
0.07 CR56
0.33 CR50
0.47 CR51
0.49 CR53
0.52 CW05
0.00 AB71 no data
0.00 CR57 no data
0.48 AB64
0.01 AB17
0.03 RP02
0.05 CW06
0.24 AB76
0.06 AB01
0.04 CW07
0.02 FT08
0.05 CW08
0.01 FT09
0.02 FT00
0.06 AB02
0.08 KC14
0.02 RP01
0.23 KC25
0.46 KC13
4.09 KC22
0.04 KC21
3.84 KC33
3.89 KC06
3.40 KC19
0.03 KC07
0.03 KC16
3.45 KC20
3.91 KC15
2.72 KC23
3.53 KC17
2.41 KC05
5.68 KC28
5.16 KC24
3.88 KC27
4.09 KC26
6.48 KC29
9.21 KC30
8.82 PB13
8.23 KC31
7.84 KC18
11.39 PB74
11.45 PB12
9.87 PB26
9.36 PB29
10.91 PB27
9.39 PB73
11.89 PB54
10.41 PB21
11.54 PB75
11.13 PB55
10.83 PB20
10.84 PB08
9.92 PB09
11.68 PB07
12.96 PB71
12.29 PB67
9.98 UB02
11.36 PB59
11.13 PB69
11.58 PB70
11.34 PB04
11.15 PB68
11.81 PB72
10.07 PB06
10.75 AB73
11.99 AB75
12.43 AB21
11.69 AB70
10.19 AB60
9.11 AB63
7.08 AB62
9.20 AB04
8.55 AB05
6.86 AB50
5.16 AB74
8.95 AB51
11.23 AB24
10.64 AB13
10.10 AB66
9.79 AB68
7.49 AB16
7.48 AB67
8.88 AB65
9.39 AB57
11.00 AB58
12.65 AB59
11.80 CR54
11.29 AB53
11.89 PB18
0.00 AB71 no data
7.0
8.0
9.0
10.0
11.0
12.0

EXPLANATION

- Limits of the Ancient Portuguese Bend Landslide Complex
- Limits of Historically Mapped Landslides
- 2023/2024 Landslide Mapping
- Current Limits of Major Landslide Movement (August 2024)
- GPS Monument Displacement!Rate (July 1, 2024 to August 1, 2024) Displacement Vector! Scale 1"= 8"/week

Displacement Rate Table

Minimum Rate (inch/week)	Maximum Rate (inch/week)	Color
0.00	1.00	
1.00	2.00	
2.00	3.00	
3.00	4.00	
4.00	5.00	
5.00	6.00	
6.00	7.00	
7.00	8.00	
8.00	9.00	
9.00	10.00	
10.00	11.00	
11.00	12.00	
12.00	13.00	

North

0 250 500 1000 (feet)

Hillshade basemap produced from publicly available LiDAR: "2015 - 2016 LARIAC Lidar DEM: Los Angeles Region, CA"

COTTON, SHIRES AND ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS

GPS MONITORING DISPLACEMENT RATE CONTOUR MAP (8/1/24 DATA)
Abalone Cove, Portuguese Bend, Klondike Canyon
RANCHO PALOS VERDES, CALIFORNIA

GEO/ENG BY	SCALE	PROJECT NO.
MP	1"=500'	SC6163
APPROVED BY	DATE	FIGURE NO.
POS	November 8, 2024	3

APPROXIMATE BOUNDARY OF ANCIENT PORTUGUESE BEND LANDSLIDE COMPLEX

CURRENT LIMITS OF MAJOR LANDSLIDE MOVEMENT (SEPTEMBER 2024)

"Creeping Area" Approximately 0.5 inch/week

BURMA ROAD

PONY TRAIL

PALOS VERDES DRIVE SOUTH

PORTUGUESE BEND LANDSLIDE

ABALONE COVE LANDSLIDE

KLONDIKE CANYON LANDSLIDE

FLYING TRIANGLE LANDSLIDE

ABALONE COVE

SACRED COVE

PORTUGUESE POINT

INSPIRATION POINT

SEAVIEW TRACT

EXPLANATION

- Limits of the Ancient Portuguese Bend Landslide Complex
- Limits of Historically Mapped Landslides
- 2023/2024 Landslide Mapping
- Current Limits of Major Landslide Movement (September 2024)
- GPS Monument Displacement Rate (August 1, 2024 to September 4, 2024) Displacement Vector Scale 1"= 8"/week

Displacement Rate Table

Minimum Rate (inch/week)	Maximum Rate (inch/week)	Color
0.00	1.00	
1.00	2.00	
2.00	3.00	
3.00	4.00	
4.00	5.00	
5.00	6.00	
6.00	7.00	
7.00	8.00	
8.00	9.00	
9.00	10.00	
10.00	11.00	
11.00	12.00	
12.00	13.00	

North

0 250 500 1000 (feet)

Hillshade basemap produced from publicly available LiDAR: "2015 - 2016 LARIAC Lidar DEM: Los Angeles Region, CA"

COTTON, SHIRES AND ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS

GPS MONITORING DISPLACEMENT RATE CONTOUR MAP (9/4/24 DATA)
Abalone Cove, Portuguese Bend, Klondike Canyon
RANCHO PALOS VERDES, CALIFORNIA

GEO/ENG BY	SCALE	PROJECT NO.
MP	1"=500'	SC6163
APPROVED BY	DATE	FIGURE NO.
POS	November 8, 2024	4

APPROXIMATE BOUNDARY OF ANCIENT PORTUGUESE BEND LANDSLIDE COMPLEX

CURRENT LIMITS OF MAJOR LANDSLIDE MOVEMENT (OCTOBER 2024)

"Creeping Area" Approximately 0.5 inch/week

BURMA ROAD

PONY TRAIL

PALOS VERDES DRIVE SOUTH

ABALONE COVE

SACRED COVE

PORTUGUESE POINT

INSPIRATION POINT

SEAVIEW TRACT

ABALONE COVE LANDSLIDE

PORTUGUESE BEND LANDSLIDE

KLONDIKE CANYON LANDSLIDE

FLYING TRIANGLE LANDSLIDE

0.04 AB80
0.04 AB79
0.03 CW01
0.06 AB77
0.07 CR56
0.35 CR50
0.44 CR51
0.00 CR60
0.43 CR53
0.36 CR58
1.78 AB78
6.17 AB57
0.47 CW05
0.03 CR59
0.12 AB64
6.14 AB65
0.11 CR57
0.04 AB17
5.09 AB67
6.86 CR54
7.44 AB58
0.00 RP03
0.07 CW06
7.90 AB59
0.03 FT10
5.42 AB16
6.82 AB68
7.37 AB53
6.95 PB18
0.11 AB76
6.91 AB66
7.23 AB13
3.84 PB76
7.88 AB24
7.18 AB75
6.99 PB54
4.01 PB26
0.05 AB01
3.66 AB74
6.18 AB51
7.85 AB70
7.29 AB21
0.03 FT08
4.96 PB21
5.05 PB27
0.02 CW08
6.23 AB69
6.74 AB69
6.28 PB75
0.04 FT09
5.03 AB62
5.26 PB55
3.42 PB29
4.99 PB20
0.04 KC21
6.09 AB04
7.08 PB71
6.04 AB73
6.03 PB70
5.88 PB59
1.57 KC06
3.88 AB50
5.64 PB69
4.62 PB08
4.08 PB09
4.21 PB12
3.04 PB13
1.80 KC22
1.35 KC19
5.11 PB07
5.74 PB04
3.23 KC31
2.49 KC18
0.04 KC07
4.58 PB06
1.67 KC33
1.29 KC20
0.02 KC16
5.71 PB68
5.77 PB72
4.63 PB67
4.54 PB74
3.38 KC30
1.53 KC15
3.74 UB02
1.34 KC17
1.05 KC23
1.05 KC05
2.27 KC29
1.75 KC24
2.47 KC38
1.98 KC28
1.34 KC26
0.55 KC13
0.05 KC35
0.05 KC14
0.05 KC34
0.03 KC36
0.08 KC25
0.04 KC37
0.04 RP01

5.0
6.0
7.0
4.0
3.0
2.0
1.0

EXPLANATION

- Limits of the Ancient Portuguese Bend Landslide Complex
- Limits of Historically Mapped Landslides
- 2023/2024 Landslide Mapping
- Current Limits of Major Landslide Movement (October 2024)
- GPS Monument Displacement Rate (September 4, 2024 to October 8, 2024) Displacement Vector Scale 1"= 8"/week

Displacement Rate Table

Minimum Rate (inch/week)	Maximum Rate (inch/week)	Color
0.00	1.00	
1.00	2.00	
2.00	3.00	
3.00	4.00	
4.00	5.00	
5.00	6.00	
6.00	7.00	
7.00	8.00	
8.00	9.00	
9.00	10.00	
10.00	11.00	
11.00	12.00	
12.00	13.00	

North

0 250 500 1000
(feet)

Hillshade basemap produced from publicly available LiDAR: "2015 - 2016 LARIAC Lidar DEM: Los Angeles Region, CA"

COTTON, SHIRES AND ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS

GPS MONITORING DISPLACEMENT RATE CONTOUR MAP (10/8/24 DATA)
Abalone Cove, Portuguese Bend, Klondike Canyon
RANCHO PALOS VERDES, CALIFORNIA

GEO/ENG BY	SCALE	PROJECT NO.
MP	1"=500'	SC6163
APPROVED BY	DATE	FIGURE NO.
POS	November 8, 2024	5

APPROXIMATE BOUNDARY OF ANCIENT PORTUGUESE BEND LANDSLIDE COMPLEX

CURRENT LIMITS OF MAJOR LANDSLIDE MOVEMENT (NOVEMBER 2024)

BURMA ROAD

PONY TRAIL

PALOS VERDES DRIVE SOUTH

ABALONE COVE

PORTUGUESE POINT

SACRED COVE

INSPIRATION POINT

ABALONE COVE LANDSLIDE

PORTUGUESE BEND LANDSLIDE

KLONDIKE CANYON LANDSLIDE

FLYING TRIANGLE LANDSLIDE

SEAVIEW TRACT

0.07 AB80 · 0.12 AB79 · 0.02 CW01 · 0.06 AB77 · 0.04 CR56 · 0.08 CR50 · 0.10 CR51 · 0.03 CR60 · 0.01 CR53 · 0.07 CR58 · 0.13 AB78 · 0.08 CW05 · 0.08 CR59 · 0.62 AB64 · 4.83 AB57 · 4.21 AB65 · 0.09 CR57 · 0.09 AB17 · 3.61 AB67 · 4.0 · 5.10 AB58 · 4.68 CR54 · 5.0 · 5.04 AB59 · 0.01 RP03 · 0.08 CW06 · 3.91 AB16 · 4.51 AB53 · 4.01 PB18 · 0.07 FT10 · 4.72 AB68 · 4.74 AB66 · 0.11 AB76 · 3.32 AB76 · 1.55 PB76 · 5.64 AB24 · 0.13 AB01 · 3.06 AB74 · 4.17 AB51 · 4.70 AB75 · 4.23 PB54 · 0.56 PB26 · 0.04 FT08 · 4.63 AB21 · 2.48 PB21 · 2.08 PB27 · 0.16 GW08 · 0.06 FT09 · 5.46 AB70 · 4.37 AB69 · 5.29 AB60 · 3.49 PB75 · 3.64 AB62 · 2.88 PB55 · 0.36 PB29 · 4.0 · 4.36 PB71 · 2.03 PB20 · 4.32 AB04 · 3.53 AB73 · 1.97 PB08 · 2.0 · 0.04 KC21 · 0.22 KC06 · 3.47 PB70 · 3.38 PB59 · 1.67 PB09 · 1.23 PB12 · 0.38 PB13 · 3.0 · 2.46 PB07 · 3.63 PB69 · 0.22 KC31 · 0.14 KC18 · 0.19 KC22 · 0.28 KC19 · 2.07 AB50 · 2.21 PB06 · 3.25 PB04 · 0.24 KC33 · 0.11 KC07 · 3.25 PB68 · 3.22 PB72 · 1.0 · 0.68 UB02 · 1.14 PB67 · 0.97 PB74 · 0.16 KC20 · 0.13 KC16 · 0.16 KC30 · 0.19 KC15 · 0.11 KC17 · 0.20 KC23 · 0.19 KC05 · 0.12 KC29 · 0.11 KC24 · 0.22 KC38 · 0.17 KC28 · 0.08 KC26 · 0.12 KC13 · 0.09 KC25 · 0.11 KC14 · 0.12 KC35 · 0.14 KC34 · 0.10 KC36 · 0.16 KC37 · 0.11 RP01

EXPLANATION

- Limits of the Ancient Portuguese Bend Landslide Complex
- Limits of Historically Mapped Landslides
- 2023/2024 Landslide Mapping
- Current Limits of Major Landslide Movement (November 2024)
- GPS Monument Displacement Rate (October 8, 2024 to October 29, 2024) Displacement Vector Scale 1"= 8"/week

Displacement Rate Table

Minimum Rate (inch/week)	Maximum Rate (inch/week)	Color
0.00	1.00	
1.00	2.00	
2.00	3.00	
3.00	4.00	
4.00	5.00	
5.00	6.00	
6.00	7.00	
7.00	8.00	
8.00	9.00	
9.00	10.00	
10.00	11.00	
11.00	12.00	
12.00	13.00	

North

0 250 500 1000 (feet)

Hillshade basemap produced from publicly available LiDAR: "2015 - 2016 LARIAC Lidar DEM: Los Angeles Region, CA"

COTTON, SHIRES AND ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS

GPS MONITORING DISPLACEMENT RATE CONTOUR MAP (10/29/24 DATA)
Abalone Cove, Portuguese Bend, Klondike Canyon
RANCHO PALOS VERDES, CALIFORNIA

GEO/ENG BY	SCALE	PROJECT NO.
MP	1"=500'	SC6163
APPROVED BY	DATE	FIGURE NO.
POS	November 8, 2024	6

COTTON, SHIRES AND ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS

CITY OF RANCHO PALOS VERDES

CSA Project No: SC6163

MEMORANDUM

TO: Ara Mihranian, City Manager
CC: Ramzi Awwad, Public Works Director

FROM: Michael Phipps, CEG 1832, Contract City Geologist
Patrick Shires, GE 770, Contract City Geotechnical Engineer
RE: **Movement of the Altamira Landslide: Characterization, Related Impacts, Causation, and Emergency Measures, Rancho Palos Verdes, California**
DATE: March 16, 2025

INTRODUCTION

In this memorandum Cotton, Shires and Associates, Inc. (CSA) summarizes our evaluation of movement of the Altamira Landslide, with specific focus on the characteristics, differences, and causation of movement of this new landslide, distinguishing it from the known historically active Landslide Complex that is comprised of the Portuguese Bend Landslide (PBL), Abalone Cove Landslide (ACL), Klondike Canyon Landslide (KCL) and Beach Club Landslide (BCL). We include the BCL as part of the KCL, because it is, in itself, dormant and nested within (or rafts upon) the KCL. Also discussed are impacts of the Altamira Landslide movement to private property, residential structures, and infrastructure in the landslide area.

DISTINGUISHING THE ALTAMIRA LANDSLIDE

For definition purposes, the Altamira Landslide is a newly active landslide that has occurred within a previously mapped ancient landslide complex, most recently labeled the "Ancient Altamira Landslide Complex" (Douglas, 2013) which was a name modification of the "Ancient Portuguese Bend Landslide" identified on the California Geological Survey's Landslide Inventory Map (CGS, 2007). See the excerpted Figure 1 from Douglas (2013) on the following page for this clarification. It is important to make this distinction for consistency and to avoid confusion, because the Altamira Landslide is, in fact, a new member of the historically active PBL/ACL/KCL Landslide Complex but largely **underlies it** and occupies an area of active land movement >700 acres and extends to more than 500 feet off of the coastline, whereas the shallower historically active PBL/ACL/KCL complex only occupied about 380 acres.

The Altamira Landslide in Rancho Palos Verdes is therefore a recently identified large landslide that largely underlies (and therefore largely encompasses, but exceeds the area of) the previously understood active Landslide Complex containing the four historically active landslides: the PBL which historically began moving in 1956, the ACL which began moving in 1979, the KCL which also began moving in 1979, and the BCL which is nested within the KCL and, while dormant itself, moves along with the KCL. The Altamira Landslide includes large areas outside of the historically mapped boundaries of these known landslides, predominantly upslope and downslope from the historically

mapped PBL and ACL, within, but smaller than, the Ancient Altamira Landslide Complex as defined above. To provide an example of the change in size, the dimensions from head to toe of the previously historical ACL is 2,250 feet and the width up to 1,450 feet wide. The dimensions from head to toe of the Altamira Landslide, underlying and extending up and down slope from both the PBL and the ACL, is 5,800 feet (more than double that of the ACL) with a width of up to 7,400 feet wide (more than five times as wide as the ACL).

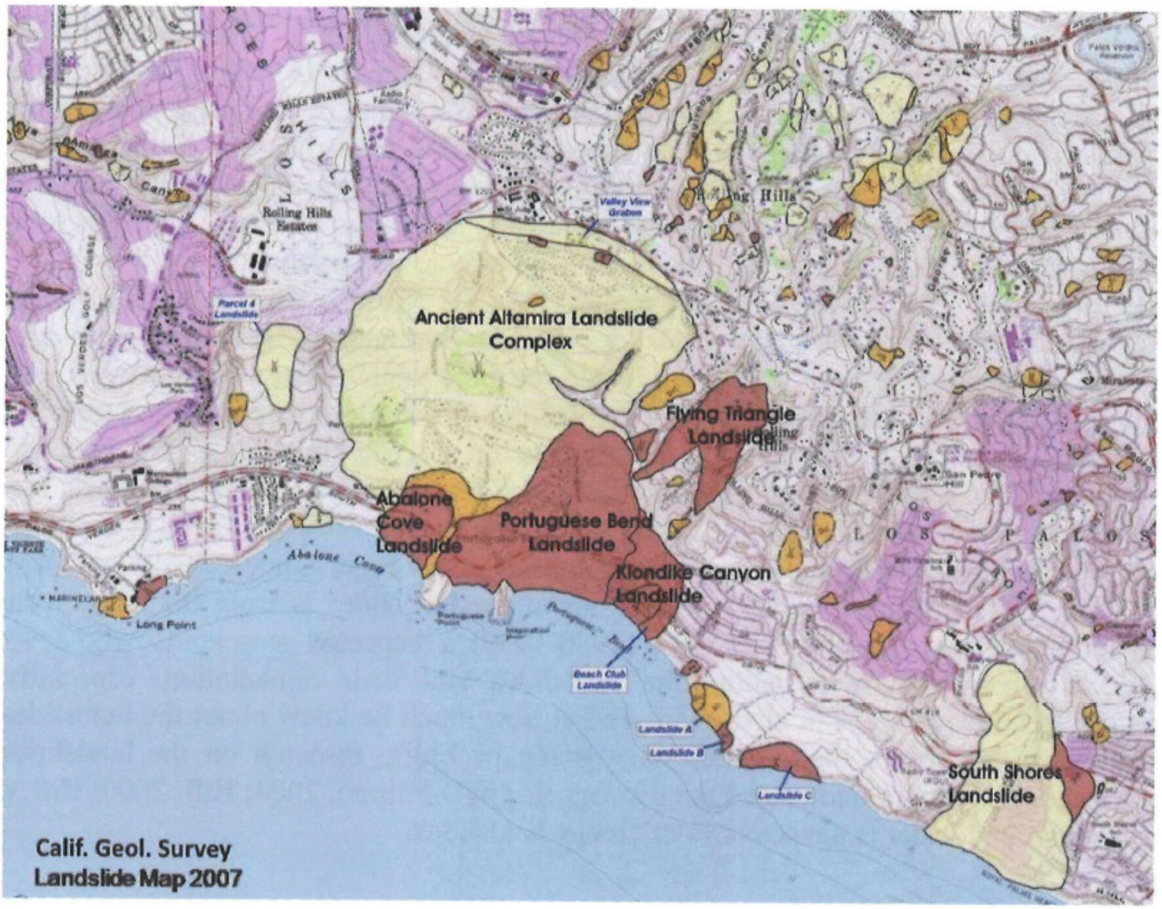


Figure 1. Landslide map of a portion of the south flank of the Palos Verdes Peninsula prepared by the California Geological Survey (2007). The major and some minor landslides are identified. Light yellow indicates that the landslide is inactive, red is active and orange is dormant.

While previous geotechnical investigators identified inactive deep failure surfaces in both the historically active and ancient landslide areas, none of them mapped or identified as active the entire depth or breadth of movement that has recently impacted the area, nor did they opine that such an event would occur in historic times. The active Altamira Landslide currently involves major land movement comprising an area of over 700 acres landward of the coast and extends to approximately 500 feet or more off the coastline. The areal dimensions, depth of movement, velocity of movement, artesian and near-artesian groundwater pressures beneath it, and even the direction of movement, are different than the Abalone Cove, Portuguese Bend, and Klondike Canyon landslides. The distinction to be made then, is that the Altamira Landslide is not just simple *expansion* of an existing group of landslides, it is an entirely different, larger and deeper landslide with much broader boundaries (including the new coastline offshore), nearly twice as deep as the depth of historic landslide movement in some areas, and with unprecedented rates of movement (which were not seen in the early LA County

Engineer surveys, the Charles Abbott Associates surveys beginning in 1994, nor the McGee surveys since 2007). None of this was experienced during the history of the City, and the Altamira Landslide is a unique landslide not characterized in its current dimensions during the over 70-year history of landslide investigations, exploratory borings, monitoring and observations being conducted in the area.

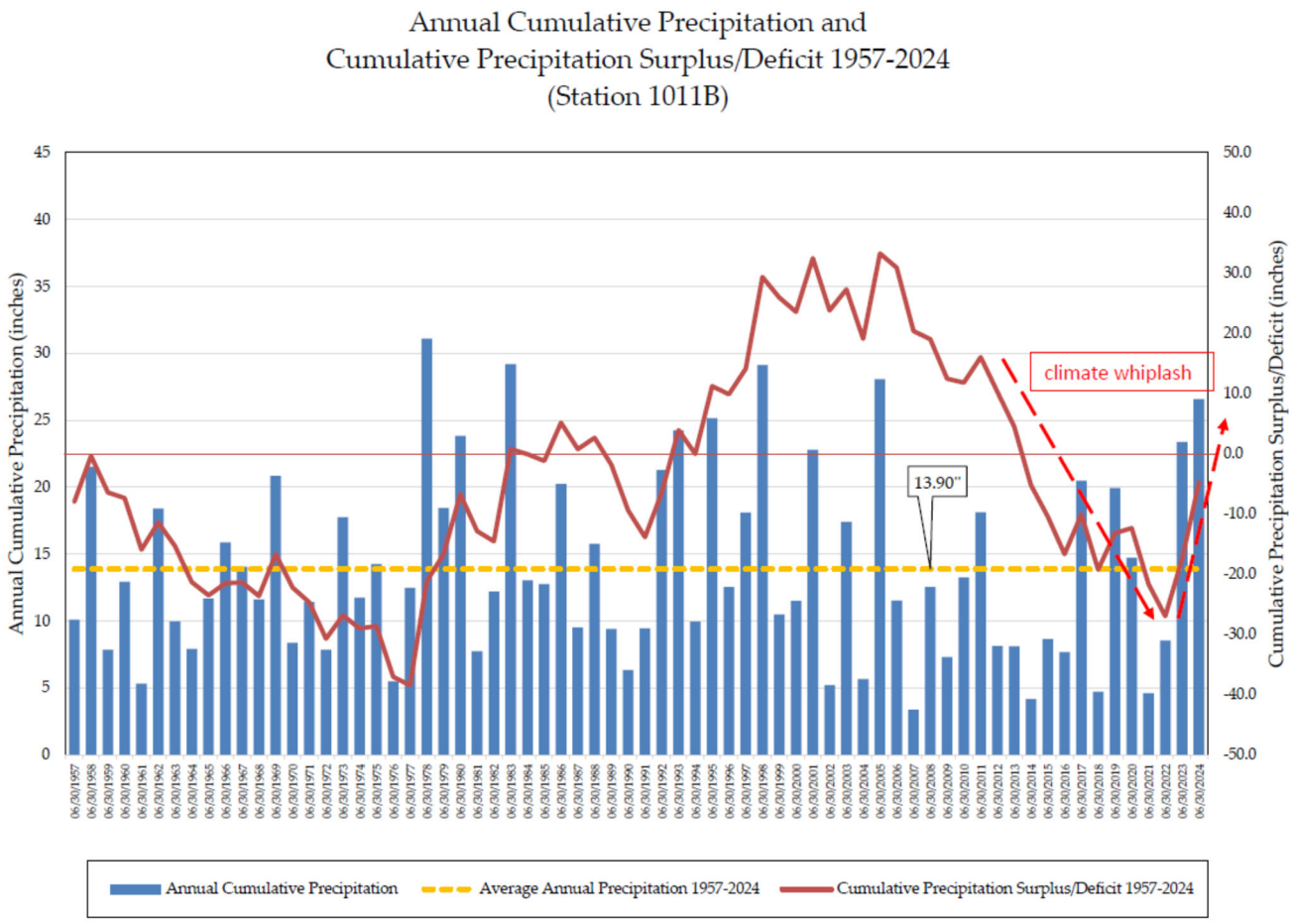
IMPACTS OF MOVEMENT OF THE ALTAMIRA LANDSLIDE

As of this date, the major land movement of the Altamira Landslide has resulted in the red-tagging (Unsafe to Enter/Occupy) and yellow tagging (Limited Entry) of several residential and commercial structures. It has also caused major destructive impacts to public and private roads, damages to utility infrastructure (water, sewer, gas, electricity and cable), causing certain utilities to be shut-off, and closure of certain Preserve land that is otherwise heavily accessed by the public for hiking, biking, equestrian, and other purposes. The only practical mitigation measure available to address a landslide with such a colossal scale is relieving groundwater pore pressures through pumping of groundwater, but it has to be done on a large enough scale to be effective at reducing the movement to an acceptable level. This technique has proven effective for the east side of the Altamira Landslide where deep dewatering wells have been installed, maintained and the rate of ground movement monitored such that a correlation between increased pumping of groundwater and reduction in the rate of ground movement has been confirmed.

CAUSATION

It is our opinion that the activation of the Altamira Landslide was largely caused by "climate whiplash" (also more technically described as hydroclimate volatility) induced by climate change, particularly starting in 2011, with five years of drought, and eight out of eleven years significantly below normal rainfall from 2011-2022, followed by two consecutive extraordinarily heavy rain seasons that dropped approximately 4 feet of rainfall on the landslide and surrounding areas draining into the landslide on the south flank of the Palos Verdes Hills.

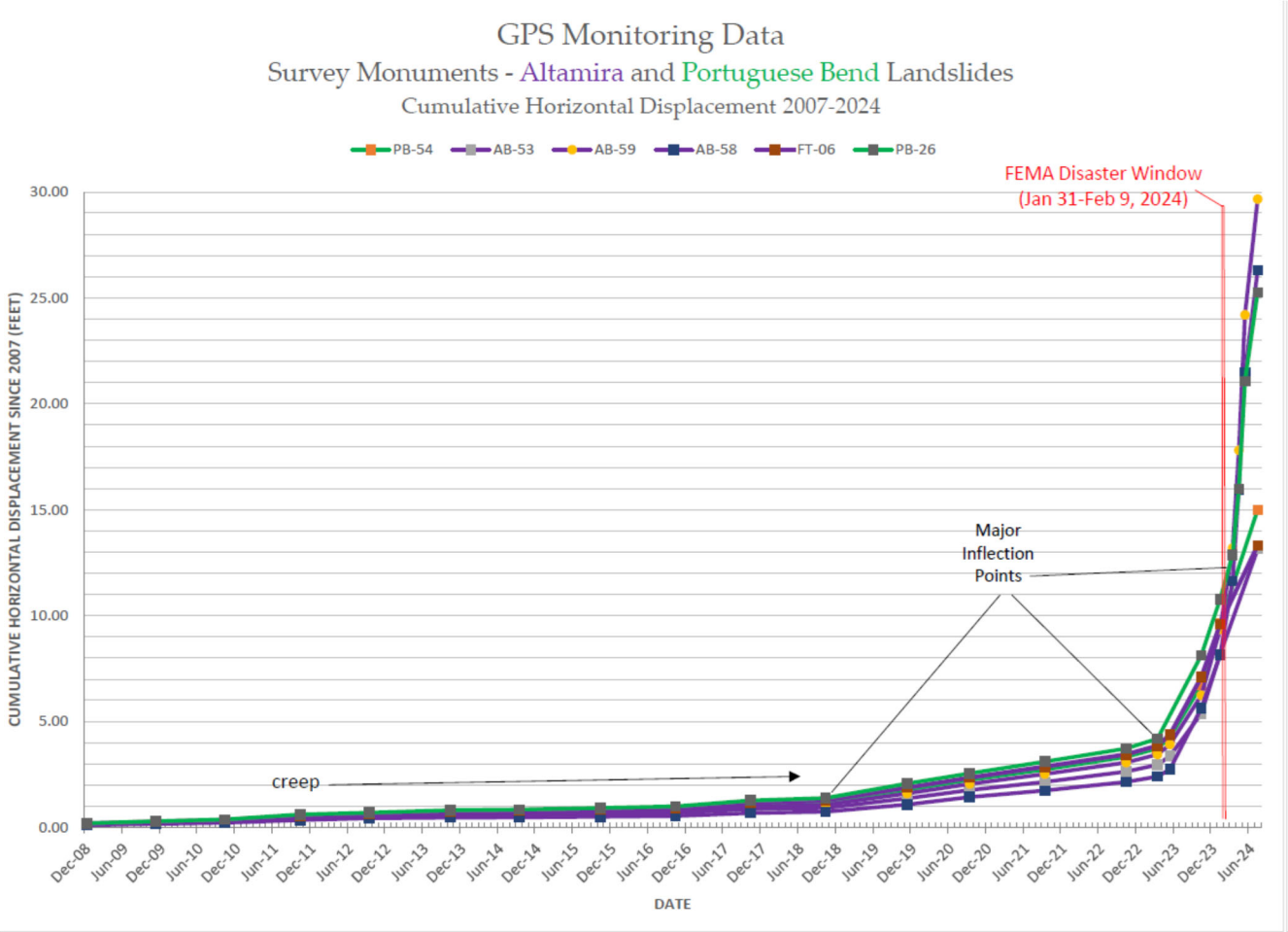
As illustrated in the following graphic, using data gathered by Los Angeles County Department of Public Works Stormwater Engineering Division, we analyzed annual rainfall deviations from the mean, and tallied up those cumulative deviations over time, as a measure of *precipitation surplus/deficit* that has impacted the area. The dark red line on the graphic shows the precipitation surplus/deficit over time. A precipitous drop is noted in the surplus/deficit line, particularly from 2011-2022, which whipsaws back to a steep climb from 2022 through 2024. Climate whiplash is illustrated by the red dashed arrows, showing the impact of the dry years (on a rapidly declining surplus/deficit curve) quickly reversing to a steeply inclining surplus/deficit curve. It is not important that this whiplash or volatility occurred in *deficit* territory on the graph, because it followed a two-decade long period of significant precipitation surplus. Two decades of precipitation surplus between 1991 and 2011 likely contributed to *strain-softening* of the Altamira Landslide failure surface clays, as the landslide began imperceptibly creeping and elongating/stretching out over a prolonged period. It follows that this generally prolonged period of drying commencing in 2011, followed by a large pulse of wetting from 2022 through the winter of 2024, and culminating in an intense barrage of rainfall from January 31st through February 9th 2024, triggered the massive Altamira movement and accelerated the landslide to unprecedented rates of movement.



Of note is that 8.29 inches of rain fell at the Rolling Hills Fire Station rain gauge from January 31st through February 9th 2024. The mean (average) rainfall for the Rolling Hills Fire Station's 57-year rainfall data set is currently 13.88 inches/year and the standard deviation of the entire 57-year dataset is 7 inches/year, indicating very high variability in annual rainfall. More rain fell between January 31st and February 9th 2024 than the standard deviation for the entire 57-year rainfall data set, indicating that this storm sequence was a statistically rare, outlier event.

The following graphic depicts *cumulative horizontal displacement* of select GPS survey monitoring points, including some of the fastest moving points in the Altamira Landslide and a couple of representative points in the PBL (which overlies the Altamira Landslide). There are three significant inflection points indicated in the graph. Prior to the first inflection point, the cumulative displacement lines indicate that the GPS monitoring points within the Altamira Landslide were creeping quite slowly (imperceptibly, near the range of instrument precision) for a number of years extending back before 2011. There was no observed or documented surface manifestation of this minor creep movement at the ground surface; however, this movement is believed to have caused deformation (elongation or stretching out of the earth materials comprising the subsurface which in turn causes additional

fracturing of those earth materials) of the Altamira Landslide body, which increased secondary permeability within the rock mass allowing rainfall at the ground surface to percolate more readily into the deep subsurface, raising groundwater levels to a point where they result in high pore pressures that contribute to landslide movement. Between the October 2018 and October 2019 GPS readings (first inflection point), an acceleration of creep movement is evident. Then following the multiple atmospheric river rains of January and February 2023 (second inflection point), a further acceleration of creep movement is evident, which would have resulted in further stretching out and opening up of the landslide mass. The final inflection point around March, 2024 (immediately following the FEMA-declared disaster of January 31-February 9 wherein 8.29 inches of rain fell) shows a dramatic acceleration and **represents the triggering of major movement of the Altamira Landslide**, as reflected by some of the graphed points going very steep and nearly vertical on the graph. The graph includes GPS monitoring point AB-59, which has been the fastest moving point and is not surprisingly located in the center of the entire Altamira Landslide mass.



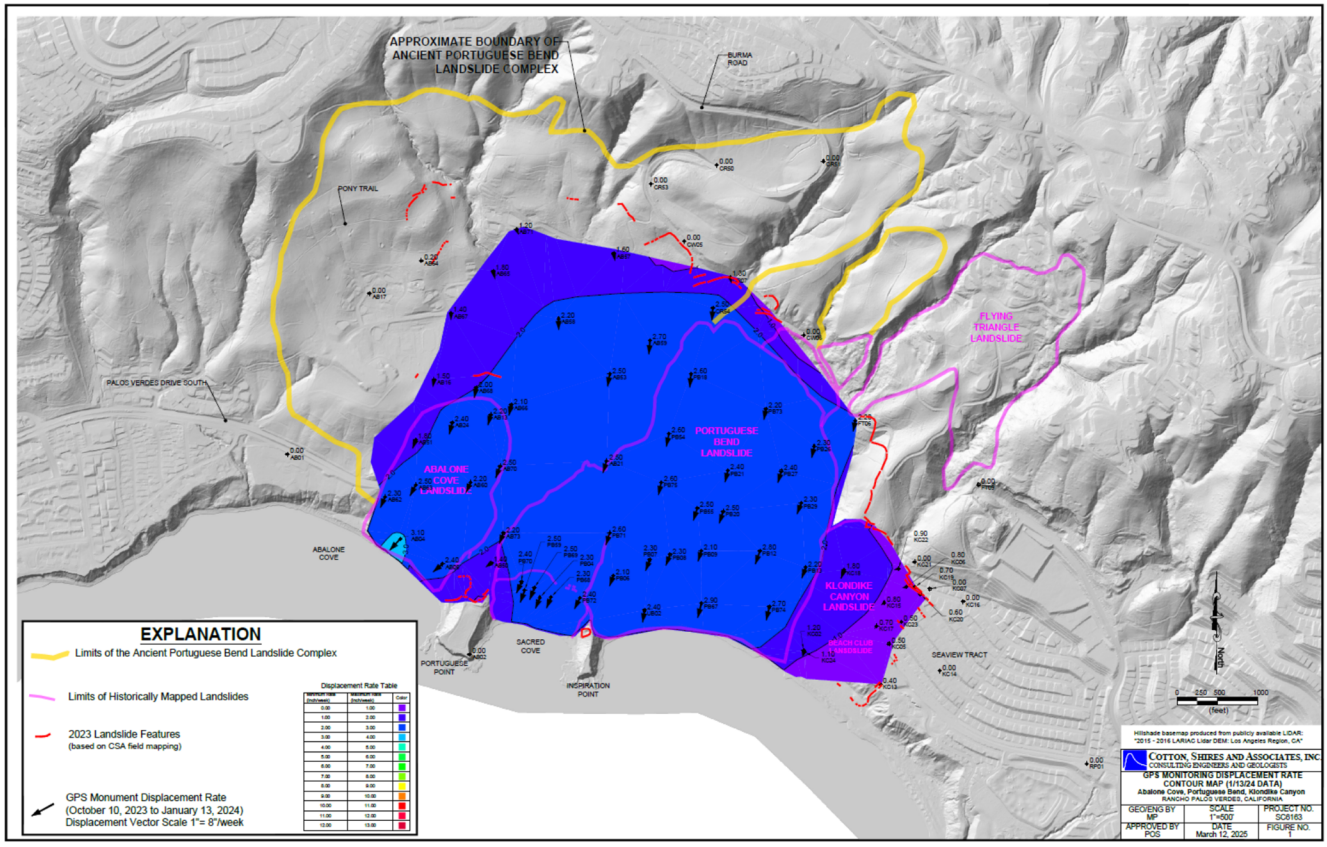
The change in ground movement rates before January 31st and after February 9th 2024 is significant. Based on our comprehensive review of the McGee GPS survey monitoring, the rates of

Altamira Landslide ground movement in the Abalone Cove area (for points north of the previously active ACL) as of January 13, 2024 ranged from 1.2 inches per week (at the periphery) up to 2.7 inches per week (in the body of the landslide). After that intense period of rainfall, plus additional rainfall resulting in a total of over 11 inches in February, as of the GPS survey completed on March 8, 2024, the rates increased to 1.5 (at the periphery) to 5.9 (main body) inches per week, more than doubling in the body of the landslide, and then increased dramatically to as much as 13.5 inches per week in the body of the landslide by July 1, 2024, probably as a slightly delayed reaction to the rainfall as it took time for the water to convert from rainfall absorption to higher groundwater pore pressures where it could have the greatest driving force impact on landslide movement.

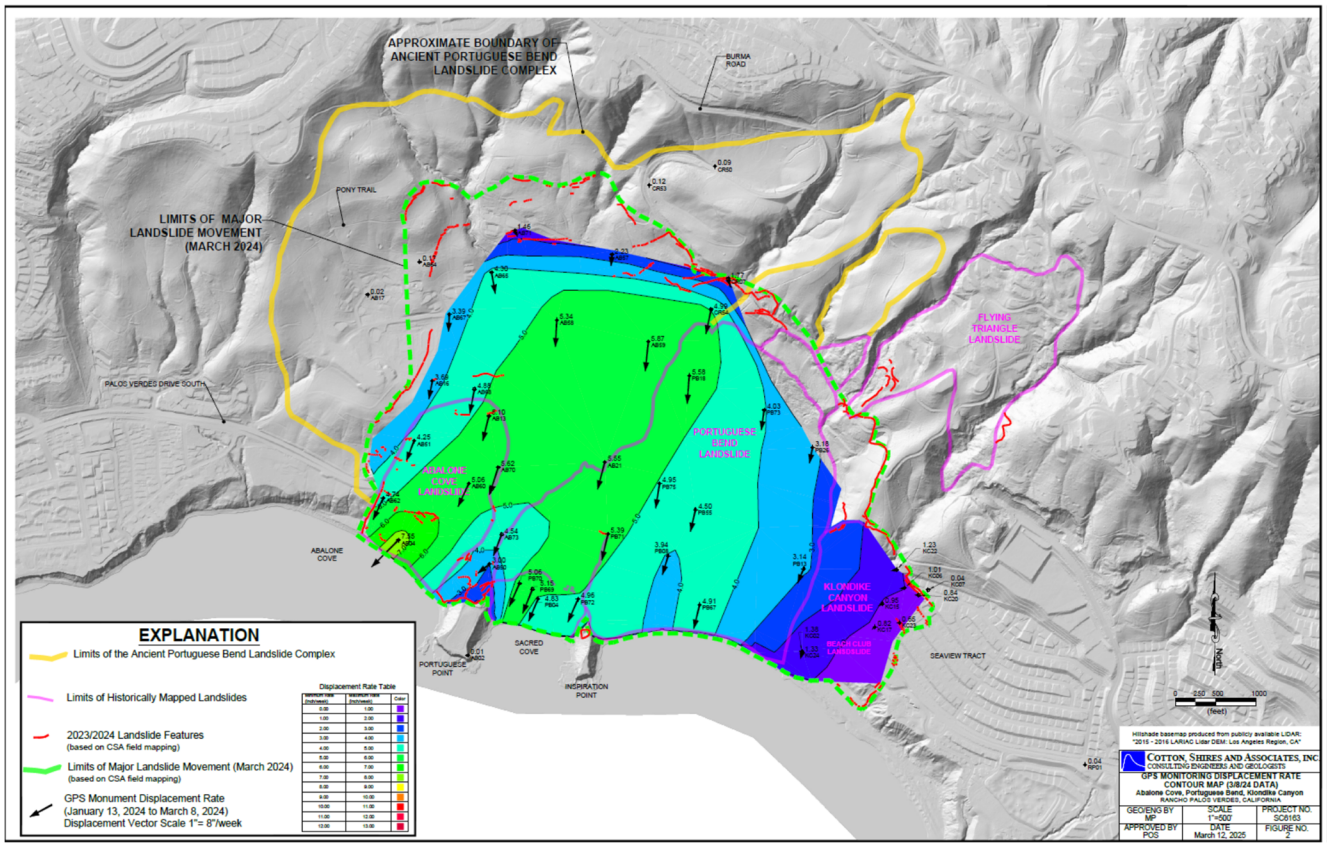
The graphics on the following two pages are "heat maps" that illustrate in color contours the rates at which the ground was moving based on the GPS survey monuments for January 13, 2024, March 8, 2024 and July 1, 2024, respectively. The heat maps include our on-ground geologic mapping of visible land movement features, which started as tension cracks or narrow fissures that were discontinuous (as of December 2023 mapping and are shown on the January 13, 2024 heat map), but these features further developed into more continuous/connected tension cracks and fissures, which have now developed into large scarps, grabens and well-developed boundary features. It wasn't until March 2024 that we first drew a boundary (dashed green line) around the "Area of Major Land Movement", because prior to that time, the surface manifestation of movement was poorly developed and inconsistent and there was not sufficient development of the landslide to develop a boundary. By March 2024, with further mapping and the extraordinary acceleration of numerous GPS monitoring points, a boundary defining the "Area of Major Land Movement" was delineated. Today, following many tens of feet of movement since early 2024, the boundary of the Altamira Landslide is well-defined. North of PV Drive South, the Altamira boundary extends significantly further west of the historical ACL boundary (resulting in the destruction of the landmark Wayfarer's Chapel), upslope through the York property (6001 PV Drive South), and north of the historical ACL boundary through the Portuguese Bend Riding Club Area, crossing upper Narcissa Drive, through and north of residences on upper Cinnamon Lane, and eventually turning east across Altamira Canyon, extending through the Vanderlip Estate (100 Vanderlip Drive), destroying Vanderlip Drive and adjacent properties, and ultimately continuing northeast to the lower stretch of Burma Road Trail in the Portuguese Bend Reserve.

The Altamira Landslide movement also created never-before-seen deformation where it underlies and now extends south of the KCL, including formation of a more seaward toe accompanied by uplifting ground that trended southwest through the beach area of the Portuguese Bend Beach Club and extending up to 500 feet or more offshore where it emerged through the sea floor and formed a new rocky coastline above sea level, generally east of Inspiration Point. The emergence of the new land offshore from the previous coastline was first reported to, and was subsequently observed by the City Geologist in late February of 2024, consistent with the triggering of major movement of the Altamira Landslide described above.

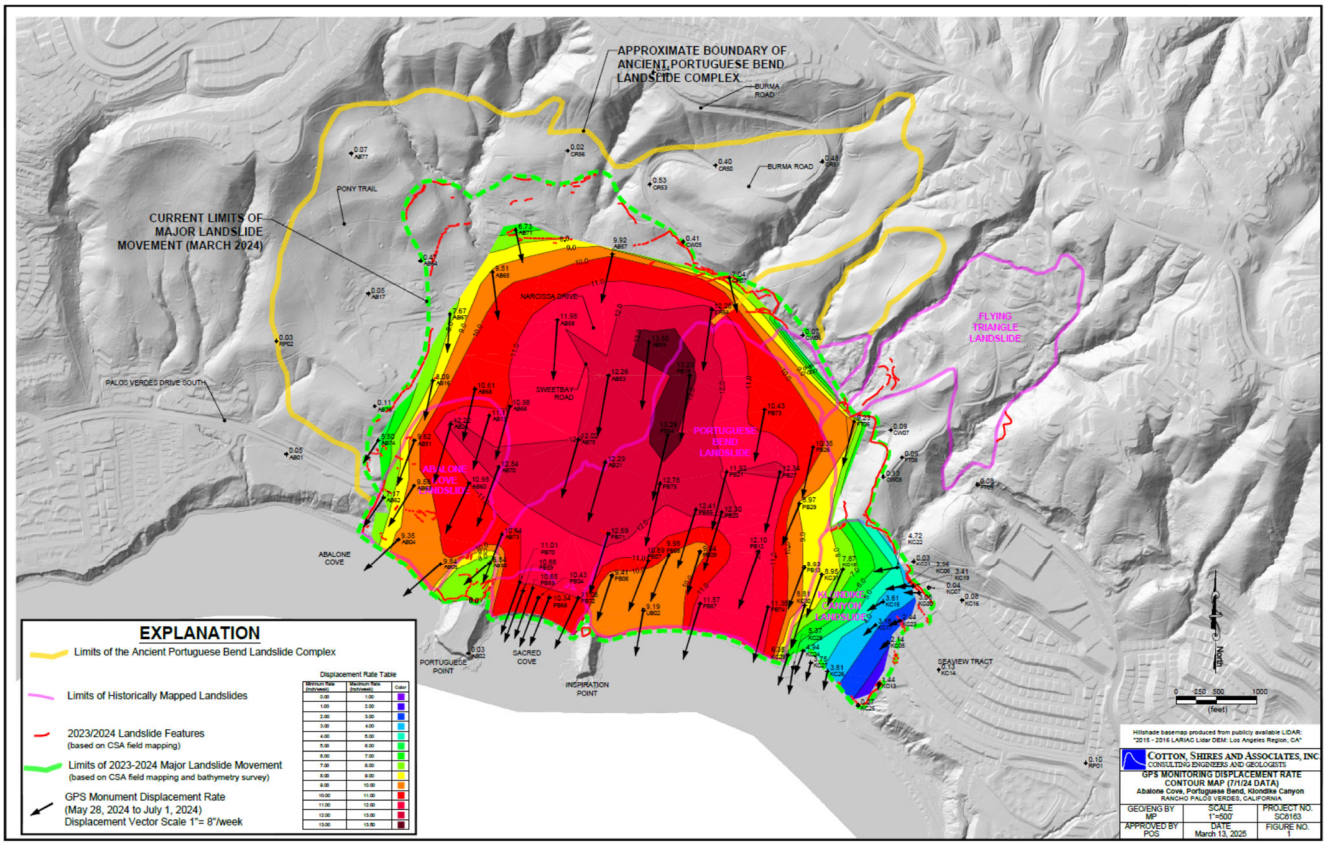
1/13/2024 Heat Map



3/8/2024 Heat Map



7/1/2024 Heat Map

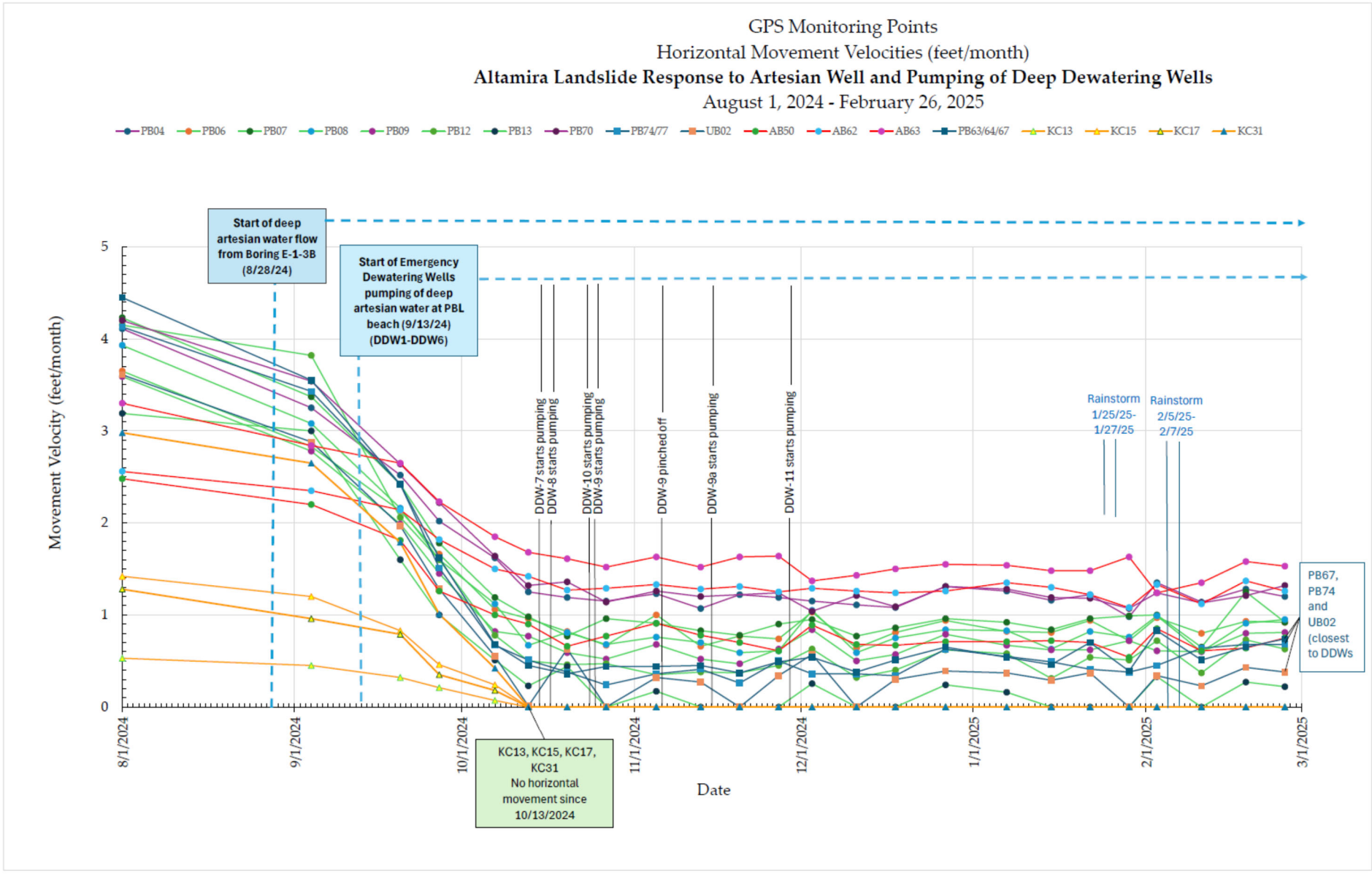


EMERGENCY MEASURES

Emergency measures taken by the City and abatement districts (ACLAD and KCLAD) to date have included drilling, pumping and monitoring deep dewatering wells, winterization measures including lining channels and installing culverts to reduce the amount of surface water percolating into the groundwater regime from upslope drainages/canyons, and filling of and establishing drainage for fissures and grabens that, if left unmitigated, facilitate surface water intrusion into the groundwater regime. This strategy has proven to be effective in reducing the rate of movement of the Altamira Landslide and even stopping movement of the eastern portion of the landslide in the area of the KCL. Because piezometers installed in deep borings that penetrated the base of the Altamira Landslide indicated high groundwater pore pressures beneath the landslide (some areas were found to have near-artesian or artesian groundwater pressures – pressures higher than the ground surface), a pilot program strategy was pursued that involved drilling a series of five deep dewatering wells near the coast to approximately 50 feet below the base of movement and pumping the wells until the landslide movement sheared off the well casings at depth and then re-drilling them to approximately 50 feet beneath the landslide to re-establish the wells so that they could continue to be pumped to dewater the high groundwater pressures beneath the landslide. This strategy turned out to be more successful than originally contemplated because the movement of the landslide slowed quickly in response to the initial dewatering efforts and the deep wells continued to function for weeks or months before re-drilling was necessary.

The chart on the following page illustrates the timing of artesian water being encountered in one of the test borings (Boring E-1-3B, which was retrofitted to function as an artesian well), the installation of the deep dewatering wells, and the deceleration of the Altamira Landslide in response to the dewatering efforts.

Based on the success of the deep dewatering program, we now know that this strategy works. Consequently, the City agreed to loan the landslide abatement districts funding so that they could re-establish wells that were no longer functioning and to establish deep dewatering wells at additional locations as well as to establish additional measures to reduce infiltration of surface water. Additional wells are also needed in the areas that the City controls. Unfortunately the cost of drilling, pumping, maintaining and re-drilling requires significant funding which the City was able to keep up with to a point, but now needs additional funding assistance to keep the wells that have already been established functioning and to establish additional deep dewatering wells in order to reduce the movement of the middle and eastern portions of the Altamira Landslide to the level experienced prior to the impact of climate whiplash.


GPS Monitoring Points
Horizontal Movement Velocities (feet/month)
Altamira Landslide Response to Artesian Well and Pumping of Deep Dewatering Wells
August 1, 2024 - February 26, 2025
PB04 PB06 PB07 PB08 PB09 PB12 PB13 PB70 PB74/77 UB02 AB50 AB62 AB63 PB63/64/67 KC13 KC15 KC17 KC31
Start of deep artesian water flow from Boring E-1-3B (8/28/24)
Start of Emergency Dewatering Wells pumping of deep artesian water at PBL beach (9/13/24) (DDW1-DDW6)
DDW-7 starts pumping
DDW-8 starts pumping
DDW-10 starts pumping
DDW-9 starts pumping
DDW-9 pinched off
DDW-9a starts pumping
DDW-11 starts pumping
Rainstorm 1/25/25-1/27/25
Rainstorm 2/5/25-2/7/25
PB67, PB74 and UB02 (closest to DDWs
KC13, KC15, KC17, KC31 No horizontal movement since 10/13/2024
Movement Velocity (feet/month)
Date
0
1
2
3
4
5
8/1/2024
9/1/2024
10/1/2024
11/1/2024
12/1/2024
1/1/2025
2/1/2025
3/1/2025

City of Rancho Palos Verdes

John Cruikshank, Mayor
Eric Alegria, Mayor Pro Tem
David L. Bradley, Councilmember
Barbara Ferraro, Councilmember
Paul Seo, Councilmember

February 20, 2024

California Office of Emergency Services Disaster Analysis Unit
3650 Schriever Avenue
Mather, CA 95655

SUBJECT: REQUEST FOR A STATE OF EMERGENCY FOR THE GREATER PORTUGUESE BEND LANDSLIDE COMPLEX

To whom it may concern:

On behalf of the approximately 42,000 residents of Rancho Palos Verdes and the approximately 67,000 residents of the Palos Verdes Peninsula, the Rancho Palos Verdes City Council is requesting Governor Newsom invoke his emergency powers pursuant to the Emergency Services Act, Gov't Code § 8550 et seq., and proclaim a State of Emergency for the Palos Verdes Peninsula region to assist the City to stabilize land movement in the greater Portuguese Bend Landslide Complex (Landslide). For reference, see attached map to show the boundaries of the Landslide.

As a result of the 2023 and 2024 winter storms, the City of Rancho Palos Verdes has been impacted by substantial precipitation that has caused an unprecedented acceleration of land movement equating to an annualized rate of 10 feet per year. This significant and sudden increase in land movement is causing severe damage to Palos Verdes Drive South – a major arterial roadway and evacuation route for the Palos Verdes Peninsula; damage and disruption to utility infrastructure including water, sewer, gas line and utility pole breaks; closures of approximately 8 miles of public trails due to slope instability; fissures and sink holes throughout the Palos Verdes Nature Preserve; the closure of residential intersections due to sink holes and ground separation; the temporary closure of the Wayfarers Chapel - a federal and state designated historic landmark; and the red-tagging of homes with many more homes on a watch list due to foundation and structural damage.

On October 3, 2023, the Rancho Palos Verdes City Council adopted a Local Declaration

of Emergency pursuant to Section 8630 of the Government Code, which has been renewed several times as required by that law; the Local Emergency is still in effect.[1] This action was intended to provide immediate access to resources and to assist in expediting remediation measures to stabilize and manage land movement that poses an imminent threat to the public's health, safety, and property. The City's Geologist and Geotechnical Engineering team and the two state-recognized Geologic Hazard Abatement Districts' geologists (Abalone Cove Landslide Abatement District and Klondike Canyon Landslide Abatement District) propose to stabilize land movement by immediately implementing the following:

- Filling fissures to prevent surface water from directly recharging the water table and further lubricating the slip plane.
- Constructing drainage swales, lining certain canyons with non-penetrable membrane, and/or installing flexible drainage pipes to properly convey surface water to the ocean and/or sanitary lines to prevent recharging the water table.
- Installing dewatering wells in the form of horizontal hydraugers and/or vertical dewatering wells to extract groundwater from the slip plane and reducing the local water table.

As the City continues its response and recovery operations, we have determined that these remediation measures must be implemented immediately to minimize the threat to the public's health, safety, and property. Therefore, the City Council requests, pursuant to the authority provided by the Act, and specifically by Sections 8571 and 8625 of the Government Code, that the Governor declare a State of Emergency for the City of Rancho Palos Verdes, waive and/or suspend certain state laws and permits required by local and state agencies that include, but are not limited to, the California Coastal Commission, the California Department of Fish and Wildlife, the Regional Water Quality Control Board, the State Water Resources Control Board, the South Coast Air Quality Management District, and other State agency permits or review processes. Finally, the City Council requests the Governor waive any requirements under the California Environmental Quality Act and its implementing regulations related to the approval and implementation of the remediation measures set forth above. Additionally, the City is requesting that the Governor submit a request to the President of the United States for a Federal Emergency Declaration pursuant to the Stafford Act, 42 U.S.C. §§ 5121-5207.

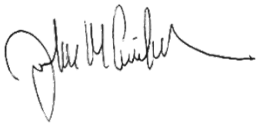
The City has identified that permits would be required by the aforementioned state agencies prior to proceeding any landslide stabilization work. Suspension of these requirements will allow the City and the Geologic Hazard Abatement Districts to immediately proceed with construction and installation of the enumerated measures to stabilize the Landslide without the costs and time delays typically experienced with obtaining permits. It is imperative that the City and two Geologic Hazard Abatement Districts are able to expedite the installation of dewatering wells and surface drains knowing that we are in an El Niño winter pattern with repeated atmospheric rivers

[1] The City also adopted an Interim Urgency Ordinance pursuant to Section 65958 of the Government Code, which effected a moratorium on all construction in the Landslide, with some limited exceptions.

forecasted to extend into spring, and every rain event is exacerbating the rate of land movement.

Please contact City Manager Ara Mihranian at aram@rpvca.gov or by telephone at 310-544-5202.

Sincerely,



John Cruikshank
Mayor

Attachments:

- Portuguese Bend Landslide Complex Map
- Information on the Portuguese Bend Landslide including resolutions adopting and extending the City's Proclaimed Local Emergency can be found on the City's website at: www.rpvca.gov/landslide

cc:

Laphonza Butler, U.S. Senator, California
Alex Padilla, U.S. Senator, California
Ted Lieu, U.S. Representative, 36th Congressional District
Ben Allen, Senator, 24th State Senate District
Al Muratsuchi, Assemblymember, 66th Assembly District
Janice Hahn, L.A. County Supervisor, 4th District
Kevin McGowan, Director, L.A. County Office of Emergency Management
Brandy Villaneuva, Disaster Manager Area Coordinator, L.A. County Area G
Rancho Palos Verdes City Council

CREST ROAD

BURMA ROAD

PONY TRAIL

ANCIENT PORTUGUESE BEND LANDSLIDE COMPLEX

NARCISSA DRIVE

FLYING TRIANGLE LANDSLIDE

PALOS VERDES DRIVE SOUTH

SWEETBAY ROAD

ABALONE COVE LANDSLIDE

PORTUGUESE BEND LANDSLIDE

KLONDIKE CANYON LANDSLIDE

ABALONE COVE

SACRED COVE

PORTUGUESE POINT

INSPIRATION POINT

SEAVIEW TRACT

North

0 250 500 1000

(feet)

EXPLANATION

- Limits of the Ancient Portuguese Bend Landslide Complex
- Limits of Historically Mapped Landslides
- 2023 Landslide Mapping
- Current Limits of Major Landslide Movement (February 2024)

Hillshade basemap produced from publicly available LiDAR: "2015 - 2016 LARIAC Lidar DEM: Los Angeles Region, CA"

COTTON, SHIRES AND ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS

LANDSLIDE MAPPING UPDATE 2/20/24
Abalone Cove, Portuguese Bend, Klondike Canyon
RANCHO PALOS VERDES, CALIFORNIA

GEO/ENG BY	SCALE	PROJECT NO.
MP	1"=500'	SC6163
APPROVED BY	DATE	FIGURE NO.
POS	February 2024	1

CITY OF RANCHO PALOS VERDES
ADMINISTRATION DEPARTMENT
CITY MANAGER'S OFFICE

March 17, 2025

Via email and Grants Portal

Mr. Robert Fenton
FEMA District No. 9 Administrator

Robert Larsen, Public Assistance Officer
California Office of Emergency Services

Subject: Appeal of FEMA's Eligibility Determination, Project Number 754845 FEMA-4769-DR-CA, California's Severe Winter Storms, Tornadoes, Flooding, Landslides, and Mudslides (Damage Inventory No. 1385920)

Dear Messrs. Robert Fenton and Robert Larsen,

On April 13, 2024, the President declared a major disaster (**FEMA-DR-4769-CA**) in the State of California due to damages from severe winter storms, tornadoes, flooding, landslide and mudslides with an incident period of **January 31 through February 9, 2024**. The declared disaster by the President is similar to a federal disaster declared on April 3, 2023 for California Severe Winter Storms, Straight-Line Winds, Flooding, Landslides and Mudslides that occurred between **February 21, 2023 and July 10, 2023 (DR-4699-CA)**.

On May 9, 2024, the City of Rancho Palos Verdes (City) filed for disaster aid cost recovery for the City's response to the 2024 winter storms. In total, the City filed applications totaling $38.4 million.

On January 17, 2025, the City received FEMA's Eligibility Determination Memorandum **denying** in full the City's request for **$200,000** to conduct permanent repairs to drainage/water control structures damaged by the winter storms that occurred between January 31 and February 9, 2024. The denial cites the following reasons:

- Pre-disaster ground instability and on-going non-disaster related causes.
- Disaster damage was not a result of the declared disaster event.
- Pre-existing conditions of landslide.

According to Section 102.1 and 102.2 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, an "Emergency" means *any occasion or instance for which, in the determination of the President, Federal assistance is needed to supplement State and local efforts and capabilities to save lives and to protect property and public health and safety, or* ***to lessen or avert the threat of a catastrophe (emphasis added)*** *in any part of the United States*. Moreover, a "Major Disaster" *means any natural catastrophe (including any hurricane, tornado, storm, high water, winddriven water, tidal wave,*

tsunami, earthquake, volcanic eruption, ***landslide (emphasis added)****, mudslide, snowstorm, or drought), or, regardless of cause, any fire, flood, or explosion, in any part of the United States, which in the determination of the President causes damage of sufficient severity and magnitude to warrant major disaster assistance under this Act to* ***supplement the efforts and available resources of States, local governments, and disaster relief organizations in alleviating the damage, loss, hardship, or suffering caused thereby (emphasis added)****.*

The City's disaster recovery request was submitted to FEMA based on the aforementioned definitions found in the Stafford Act and the declared major disaster resulting from winter storms of 2024 that **contributed to a significant and documented acceleration of land movement caused by the activation of a <u>new</u> historic and previously dormant landslide known as the Altamira Landslide** within the Greater Portuguese Bend Landslide Complex (Landslide Complex).

According to the City Geologist's reports to the City Council in 2024, the **Altamira Landslide is a deeper slip plane that the Landslide Complex "rafted" on top of as a direct result of the unprecedented and record rainfall during the 2024 winter storm event resulting in the shallower slip plane of the Landslide Complex to move more than it ever did before in its documented history**. Contrary to FEMA's Eligibility Determination Memorandum, what is **not pre-existing** are the areal dimensions, depth of movement, velocity of movement, artesian and near-artesian groundwater pressures beneath it, and even direction of movement. The land movement experienced as a result of the 2024 winter storms is not just a simple **expansion** of the Landslide Complex, but is an **entirely different, larger and deeper landslide with much broader boundaries** (including the new coastline offshore at the Portuguese Bend Beach Club), nearly twice as deep in some areas, and unprecedented rates of movement. None of this was seen during the history of the City, nor during the approximately 70-year history of landslide studies, monitoring, and observations conducted in the area, contrary to what is noted in the Eligibility Determination Memorandum. It is the opinion of the City and its subject matter experts, that will be discussed in this appeal letter, that this is largely caused by "weather whiplash" (induced by climate change) starting in 2011.

The City respectfully requests that you, as FEMA's District No. 9 Administrator, reverse the eligibility denial and uphold the City's appeal based on facts, data and other pertinent information found in this appeal letter that will clearly demonstrate that a new landslide was activated causing an acceleration of land movement as a direct result of the 2024 winter storms resulting in costly and significant damage to the City's infrastructure. The City firmly believes that this **appeal letter** will demonstrate that the requested cost recovery work complies with Title 44 of C.F.R. Section 206.223(a)(1) in that the financial assistance requested is directly related to the winter storms of 2024. As such, the City is requesting $200,000 for damage sustained to its drainage infrastructure and the need to install deep dewatering wells to relieve artesian pressure through the extraction of groundwater to stabilize land movement.

Historic Background

As noted in the January 17, 2025 Eligibility Determination Memorandum and throughout various City records, the Landslide Complex is a known ancient landslide that was activated in 1956 when, prior to the City's 1973 incorporation, Los Angeles County was expanding Crenshaw Boulevard to Palos Verdes Drive South and its grading efforts combined with ground water, activated the Portuguese Bend Landslide. Land movement has not stopped since 1956 but has been managed at a slow creep to no movement for years through remediation efforts implemented by the City and its two geologic hazard abatement districts, Abalone Cove Landslide Abatement District (ACLAD) and Klondike Canyon Landslide Abatement District (KCLAD).

The Landslide Complex, historically existing for thousands of years, encompasses the following four sub-landslide areas in the City: the Portuguese Bend Landslide (PBL), the Abalone Cove Landslide (ACL), the Klondike Canyon Landslide (KCL), and the Beach Club Landslide (BCL). As noted above, in 1956, the PBL began moving, then in 1979, ACL and KCL began moving with the BCL, which is nested within the KCL and, while dormant itself, moves with the KCL. The Landslide Complex also includes areas outside of those known landslides, predominantly uphill from the PBL and ACL, within the ancient Landslide Complex as mapped by various agencies (i.e., U.S. Geological Survey and California Geological Survey) and other researchers. This fifth landslide is in the City of Rolling Hills and is known as the Flying Triangle Landslide.

According to a November 8, 2024 report prepared by the City Geologist, Mike Phipps of Cotton Shires and Associates (CSA) (Attached), the PBL has been continuously active since reactivation in 1956 with many areas of the landslide having moved hundreds of feet seaward over the ensuing seven decades. The ACL was active from 1979 **until the late 1990's**, involving only several feet of movement, when dewatering and other mitigation efforts largely halted movement. An **imperceptible creep movement** of the ACL has occurred over the past 25 years **following rainy seasons that were significantly above average rainfall amounts.** The KCL has been episodically active in 1979-1983 and 2005-2006, experiencing only several inches of movement, typically in response to significantly above average rainfall. Landslide movements throughout the Landslide Complex **outside of the historical boundaries of** the ACL and PBL previously exhibited low rates of creep movement, or movement at or near the instrument precision range, in the 11-year monitoring period of 2007-2018.

Impacts of Rainwater

These landslides are deep translational-type failures within seaward-dipping strata of the Monterey Formation, with the landslide slip surfaces occurring within very weak bentonitic clay beds. Historically, the movement behavior of these landslides routinely exhibited high sensitivity to increased groundwater pore pressure, and increased rates of land movement which have been **correlative with 6-to-12-months of antecedent rainfall that was well above average**. Similarly, land movement decreased during below

average rainy seasons or multi-year periods of drought.

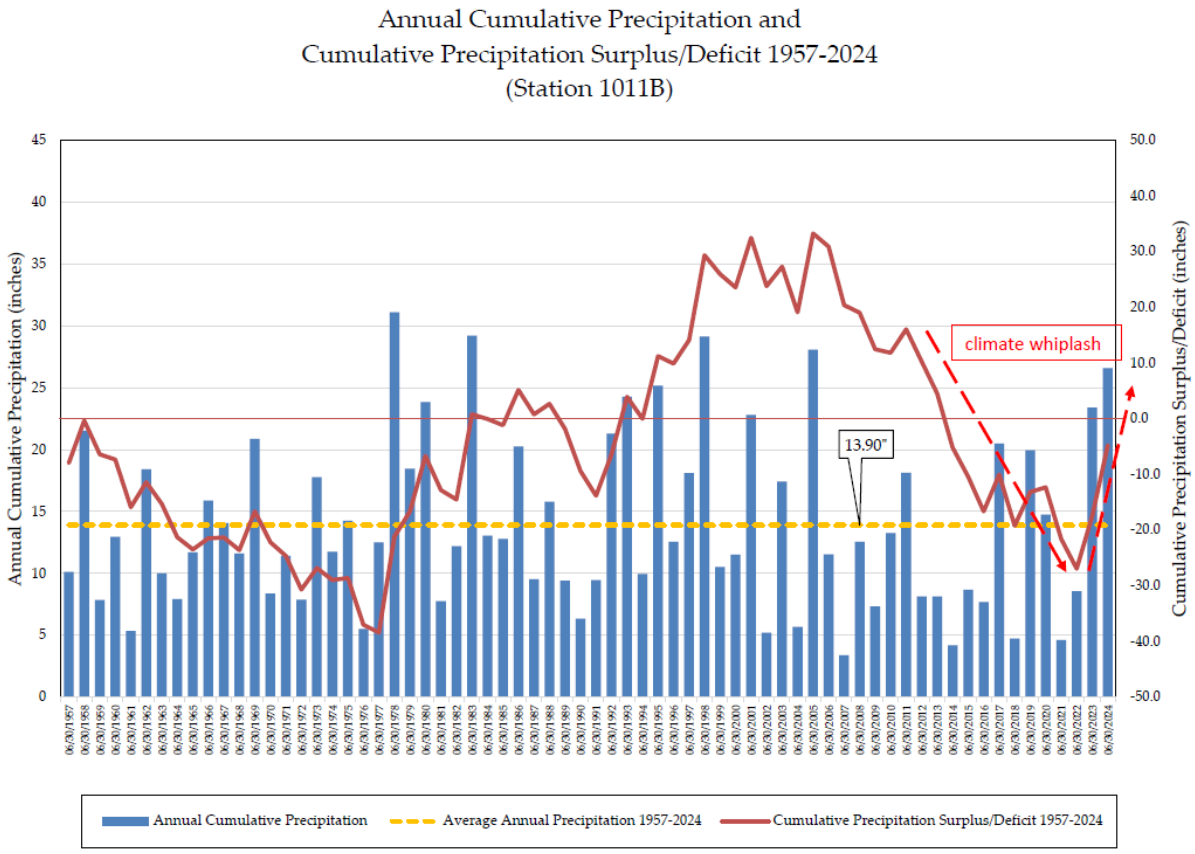
Simply stated, numerous studies conducted over approximately seven decades all point to water as being the primary contributor to land movement, particularly rainwater. Rainwater runoff is known to penetrate the ground through fissures during a rain event and recharge the ground water table. During particular significant rain events or seasons, runoff that enters the ground may take months to show signs of land movement. Depending on where rain runoff enters the ground, it can settle below the slip plane thereby resulting in artesian pressure or settle above the slip plane, which is made up of volcanic ash known as bentonite and lubricates the slip plane resulting in horizontal movement.

Changes in climate over the years, now commonly referred to as “weather whiplash” has resulted in extreme weather in Southern California including extended periods of dry weather followed by severe wet weather in the form of atmospheric rivers as experienced in 2023 and 2024. This extraordinary wet weather resulted in the President declaring a major federal disaster in both 2023 and 2024. Underscoring how extreme weather has become over the years, in August 2023, California, particularly Southern California, experienced days of record rain in August 2023 as a result of Tropical Storm Hillary.

Extreme wet weather patterns have proven to contribute towards the change in behavior of the Landslide Complex. Beginning in 2021, the City Geologist began reviewing Global Positioning Satellite (GPS) monitoring data for survey monuments within the entire Landslide Complex. Review of GPS monitoring data from 2007 through 2024 indicated that land movement acceleration initially began between 2018 and 2019. This acceleration was correlative with significantly above-normal rainfall in two out of three prior rainfall seasons (2016-17 and 2018-19) which followed five consecutive drier than normal rainfall seasons (2011-12 through 2015-16).

Another way to look at this is to analyze annual rainfall deviations from the mean, and tally up those cumulative deviations over time, as a measure of *precipitation* surplus/deficit that is impacting the area. According to the graphic on the following page, in which the dark red line shows the precipitation surplus/deficit over time, note the precipitous drop particularly from 2011-2022, which whipsaws back to a steep climb from 2022-2024. Weather whiplash is illustrated by the red arrows, showing the impact of the dry years (rapidly declining surplus/deficit curve) quickly reversing to a steep inclining surplus/deficit curve. It doesn't matter that this all happened in *deficit* territory on the graph, because it followed a two-decade long period of precipitation surplus. It is reasonable to say that two decades of precipitation surplus between 1991 and 2011 might have contributed to **strain-softening** of the Altamira failure surface clays, as the landslide imperceptibly crept and stretched out. It follows that this generally prolonged period of drying commencing in 2011, followed by a short, huge pulse of wetting between 2022-2024, is what **triggered** the massive previously inactive Altamira Landslide to move in 2024.

It is also worth noting that 8.29 inches of rain fell at the Rolling Hills Fire Station rain gauge during the 10-day FEMA disaster window. Keep in mind, the mean (average) for the 57-year rainfall data set is currently 13.88 inches/year and the standard deviation of the entire 57-year dataset is a whopping 7 inches/year, indicating very high variability in annual rainfall. In other words, more rain fell in the 10-day FEMA disaster window than the standard deviation for the entire 57-year rainfall data set. Underscoring that this wet weather behavior was an extraordinary event.



Significant accelerations in movement velocity were documented in May 2023 following major storm sequences in January, February and March of 2023, which added to cumulative seasonal rainfall totals exceeding 193% of average rainfall. Approximately 87% of this rain fell prior to June 18, 2023. Most of this rainfall occurred from three significant atmospheric river-type storm sequences occurring on January 9-16 (3.59 inches), February 23-March 1 (3.79 inches) and March 10-15 (4.12 inches). Land movement velocities further increased as of the July 15, 2023 monitoring. An anomalous tropical storm (Tropical Storm Hillary) dropped an additional 3.05 inches of rain on August 19 through August 20, 2023, resulting in further land movement acceleration as of the October 10, 2023 monitoring.

Furthermore, accelerated ground movement occurred throughout the Landslide Complex during and following the 2022-23 rainy season which was more than 220% of the historical

average rainfall. Based upon the GPS monitoring survey on January 13, 2024, average land movement velocities within the Landslide Complex since October 10, 2023 have accelerated by a factor of three to four times compared to the previous 12 month (Oct 2022-Oct 2023) monitoring period. Expressed another way, the total movement over the 3 month period of October 2023 through January 2024 is nearly equal to, and in some cases exceeds, the total movement over the previous entire year's monitoring period (i.e., October 2022 through October 2023). Movement of this magnitude has not been previously observed or documented in the ancient landslide complex north of the historical boundaries of the ACL, PBL and KCL.

An example of this is highlighted by six GPS monitoring points in the upper ancient landslide area, in the vicinity of upper Narcissa Drive and uphill from it. These survey monuments have experienced average displacements of 4.07 feet over the past 15 months (3.26 feet on an annualized basis). Average displacements for these six points over the prior annual monitoring period (Sept 28, 2021-Oct 10, 2022) were 0.36 feet. This represents approximately a 9-fold increase in total land movement on an annualized basis. **Two GPS monitoring points near the toe of the Abalone Cove Landslide moved an average of 0.76 feet (Sept 2021-Oct 2022) to 7.30 feet (Oct 2022-Jan 2024) over the same periods, a 9.6-fold increase in displacement**.

Activation of the New Altamira Landslide

According to the City Geologist's Memorandum dated November 8, 2024 and March 16, 2025 (Attached), total landslide movements in the upper ancient landslide area are significant and greatly exceed what has been observed over the past seven decades. The Altamira Landslide is a **newly** active landslide that has occurred within a previously mapped ancient Landslide Complex (most recently labeled the "Ancient Altamira Landslide Complex" which was a name modification of the "Ancient Portuguese Bend Landslide" identified on the California Geological Survey's Landslide Inventory Map (CGS, 2007) which is referred to as the Landslide Complex in this appeal letter). See map on the following page.

It is important to make this distinction for consistency and to avoid confusion, because the Altamira Landslide is, in fact, a new member of the historically active Landslide Complex but largely **underlies it** and occupies an area of active land movement >700 acres and extends to more than 500 feet off of the coastline, whereas the shallower historically active Landslide Complex only occupied about 380 acres.

The Altamira Landslide in Rancho Palos Verdes is therefore a recently identified large landslide that largely underlies (and therefore largely encompasses but exceeds the area of) the previously understood active Landslide Complex containing the four historically active landslides. The Altamira Landslide includes large areas outside of the historically mapped boundaries of these known landslides, predominantly upslope and downslope from the historically mapped PBL and ACL, within, but smaller than, the Landslide Complex as shown on the map on the following page.

To provide an example of the change in size, the dimensions from head to toe of the previously historical ACL is 2,250 feet and the width up to 1,450 feet wide. The dimensions from head to toe of the Altamira Landslide, underlying and extending up and down slope from both the PBL and the ACL, is 5,800 feet (more than double that of the ACL) with a width of up to 7,400 feet wide (more than five times as wide as the ACL).

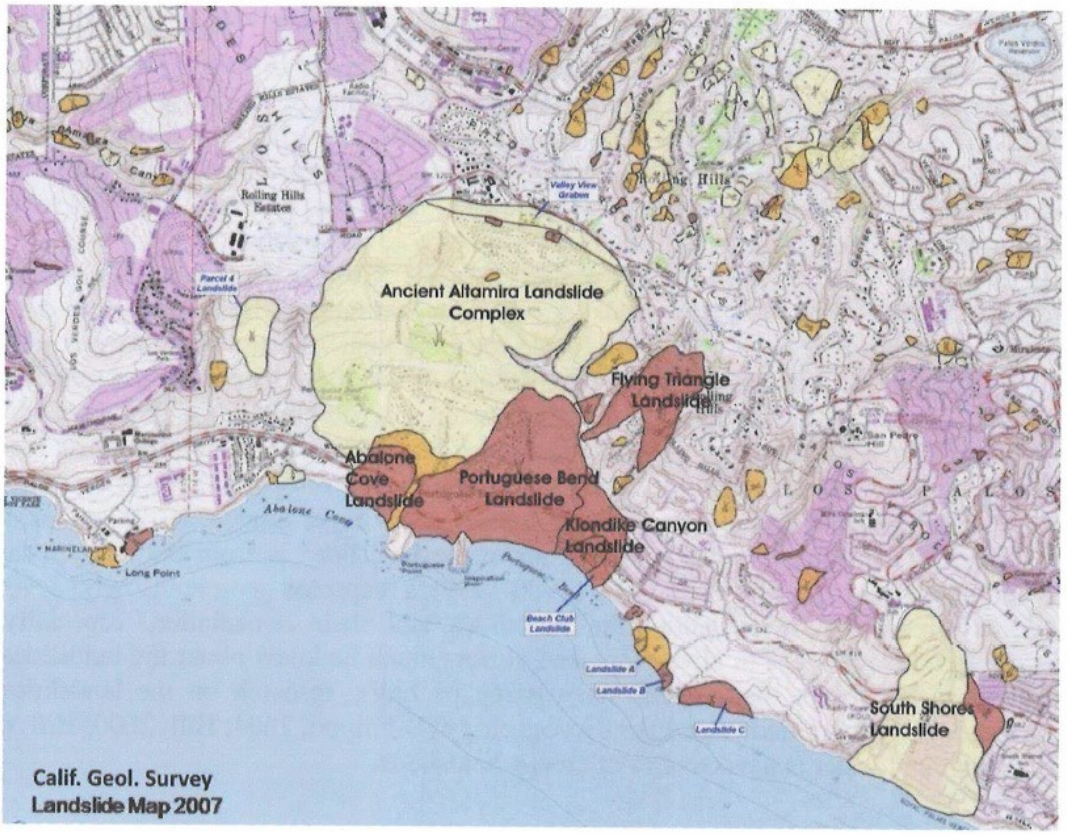


Figure 1. Landslide map of a portion of the south flank of the Palos Verdes Peninsula prepared by the California Geological Survey (2007). The major and some minor landslides are identified. Light yellow indicates that the landslide is inactive, red is active and orange is dormant.

While previous geotechnical investigators identified inactive deep failure surfaces in both the historically active and ancient landslide areas, none of them mapped or identified as active the entire depth or breadth of movement that has recently impacted the area, nor did they opine that such an event would occur in historic times. The areal dimensions, depth of movement, velocity of movement, artesian and near-artesian groundwater pressures beneath it, and even the direction of movement, are different than the ACL, PBL, and KCL landslides, collectively referred to as the Landslide Complex. The distinction to be made then, is that the Altamira Landslide is not just simple *expansion* of an existing group of landslides, **it is an entirely different, larger and deeper landslide with much broader boundaries (including the new coastline offshore), nearly twice as deep as the depth of historic landslide movement in some areas, and with**

unprecedented rates of movement (which were not seen in the early LA County Engineer surveys, the Charles Abbott Associates surveys beginning in 1994, nor the McGee surveys since 2007). None of this was experienced during the history of the City, and the Altamira Landslide is a unique landslide not characterized in its current dimensions during the over 70-year history of landslide investigations, exploratory borings, monitoring and observations being conducted in the area.

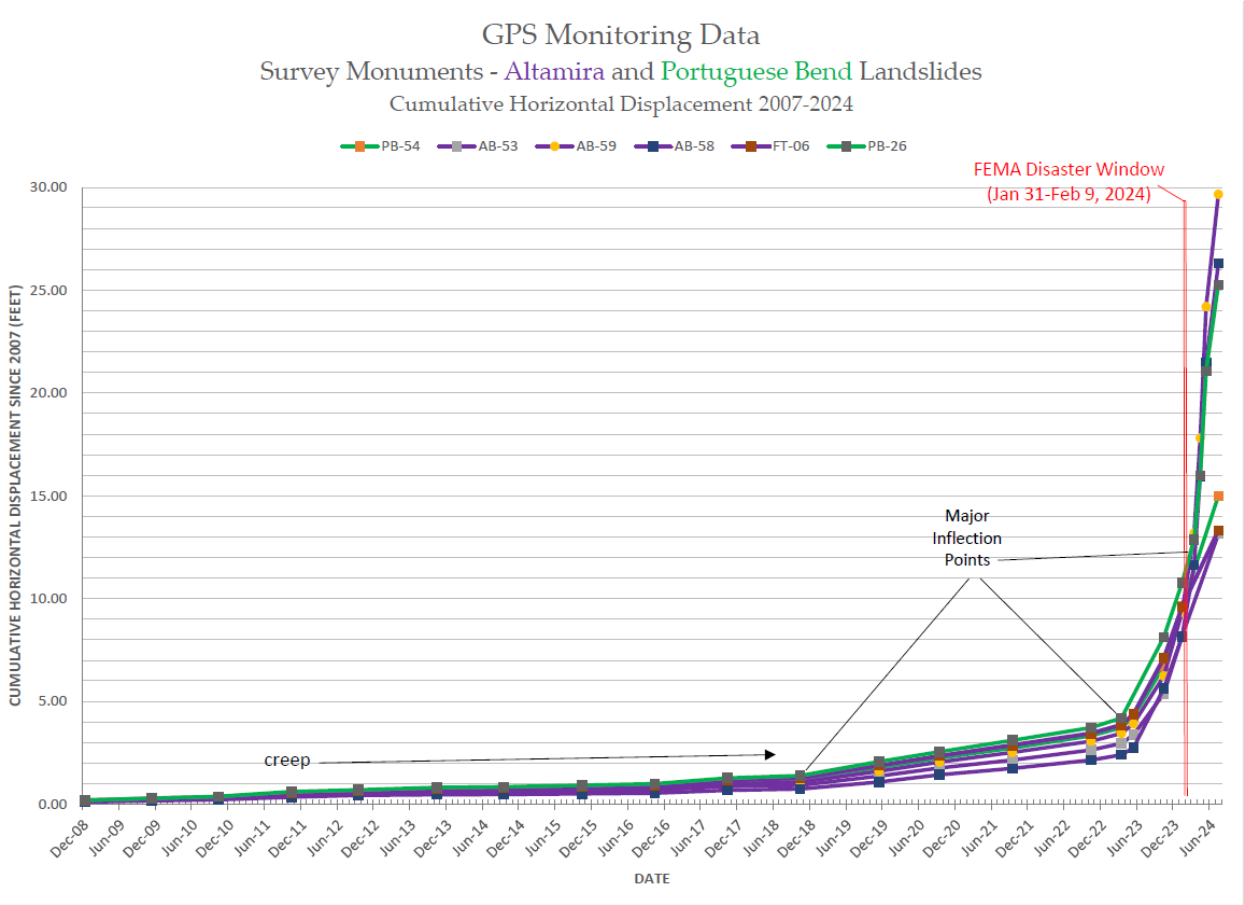
Land movement correlated to the Altamira Landslide continues to manifest at the ground surface in the form of landslide scarps, fissures, grabens/sinkholes, tensional cracking, and shear zones. Field mapping corroborates the GPS monitoring data, indicating that a large portion of the ancient Altamira Landslide above the historically mapped Landslide Complex (PBL, ACL and KCL boundaries) is now involved in significant active landslide movement that is impacting trails, roads, drainage facilities, and private property and continues to have the potential to impact above and below ground utility infrastructure (i.e., utility lines, gas lines, water lines, communication lines, etc.).

Causation

The activation of the Altamira Landslide was largely caused by "climate whiplash" (also more technically described as hydroclimate volatility) induced by climate change, particularly starting in 2011, with five years of drought, and eight out of eleven years significantly below normal rainfall from 2011-2022, followed by two consecutive extraordinarily heavy rain seasons that dropped approximately 4 feet of rainfall on the landslide and surrounding areas draining into the landslide on the south flank of the Palos Verdes Hills.

The graphic on the following page depicts *cumulative horizontal displacement* of select GPS survey monitoring points, including some of the fastest moving points in the Altamira Landslide and a couple of representative points in the PBL (which overlies the Altamira Landslide). There are three significant inflection points indicated in the graph. Prior to the first inflection point, the cumulative displacement lines indicate that the GPS monitoring points within the Altamira Landslide were creeping quite slowly (imperceptibly, near the range of instrument precision) for a number of years extending back before 2011. There was no observed or documented surface manifestation of this minor creep movement at the ground surface; however, this movement is believed to have caused deformation (elongation or stretching out of the earth materials comprising the subsurface which in turn causes additional fracturing of those earth materials) of the Altamira Landslide body, which increased secondary permeability within the rock mass allowing rainfall at the ground surface to percolate more readily into the deep subsurface, raising groundwater levels to a point where they result in high pore pressures that contribute to landslide movement. Between October 2018 and October 2019 GPS readings (first inflection point), an acceleration of creep movement is evident. Then following the multiple atmospheric river rains of January and February 2023 (second inflection point), a further acceleration of creep movement is evident, which would have resulted in further stretching out and opening up of the landslide mass. The final inflection point around March, 2024

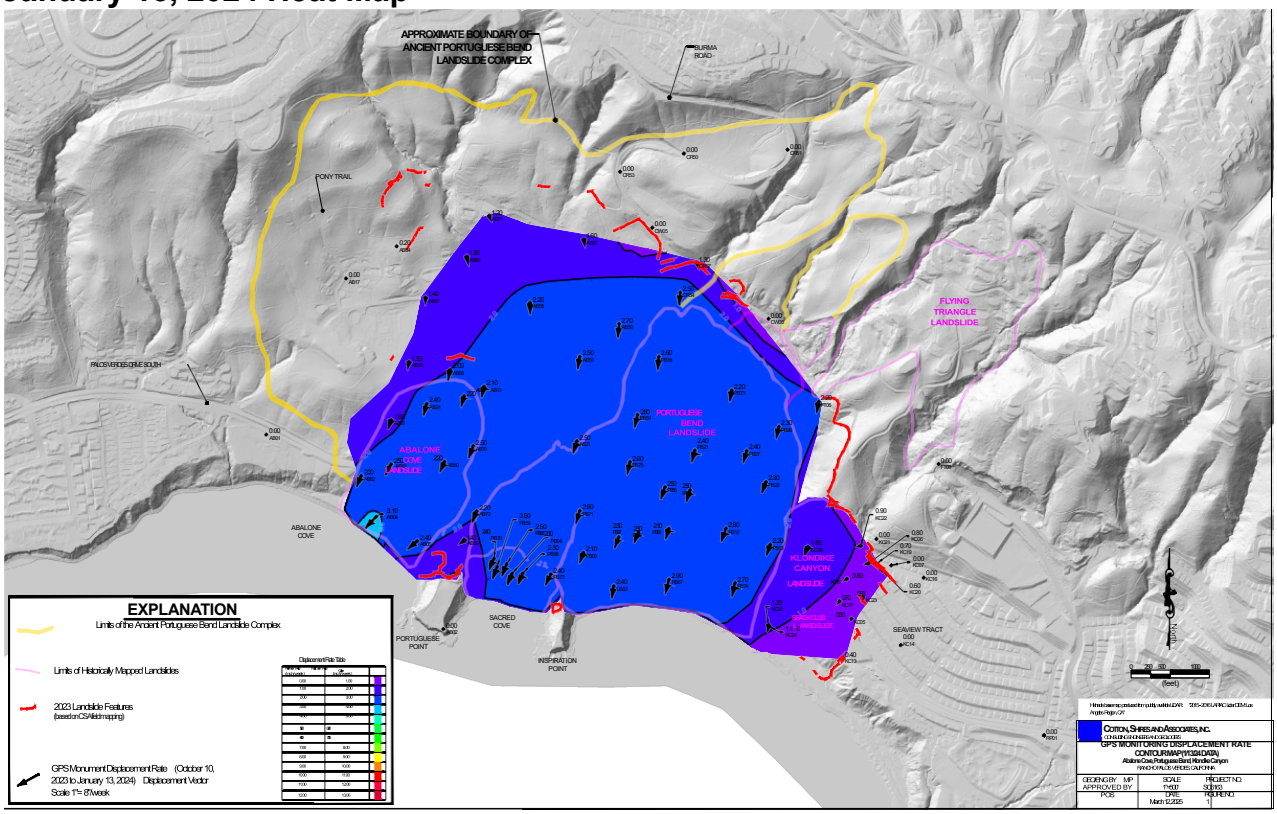
(immediately following the FEMA declared disaster of January 31-February 9 wherein 8.29 inches of rain fell) shows a dramatic acceleration and **represents the triggering of major movement of the Altamira Landslide**, as reflected by some of the graphed points going very steep and nearly vertical on the graph. The graph includes GPS monitoring point AB-59, which has been the fastest moving point and is not surprisingly located in the center of the entire Altamira Landslide mass.



The change in ground movement rates before January 31 and after February 9, 2024 is significant. Based on a comprehensive review of the McGee GPS survey monitoring, the rates of Altamira Landslide ground movement in the Abalone Cove area (for points north of the previously active ACL) as of January 13, 2024 ranged from 1.2 inches per week (at the periphery) up to 2.7 inches per week (in the body of the landslide). After that intense period of rainfall, plus additional rainfall resulting in a total of over 11 inches in February, as of the GPS survey completed on March 8, 2024, the rates increased to 1.5 (at the periphery) to 5.9 (main body) inches per week, more than doubling in the body of the landslide, and then increased dramatically to as much as 13.5 inches per week in the body of the landslide by July 1, 2024, probably as a slightly delayed reaction to the rainfall as it took time for the water to convert from rainfall absorption to higher groundwater pore pressures where it could have the greatest driving force impact on landslide movement.

The following graphics are “heat maps” that illustrate in color contours the rates at which the ground was moving based on the GPS survey monuments for January 13, 2024, March 8, 2024 and July 1, 2024, respectively. The heat maps include the City’s on-ground geologic mapping of visible land movement features, which started as tension cracks or narrow fissures that were discontinuous (as of December 2023 mapping and are shown on the January 13, 2024 heat map), but these features further developed into more continuous/connected tension cracks and fissures, which have now developed into large scarps, grabens and well-developed boundary features. It wasn’t until March 2024 that the City Geologist’s first drew a boundary (dashed green line) around the “Area of Major Land Movement”, because prior to that time, the surface manifestation of movement was poorly developed and inconsistent and there was not sufficient development of the landslide to develop a boundary.

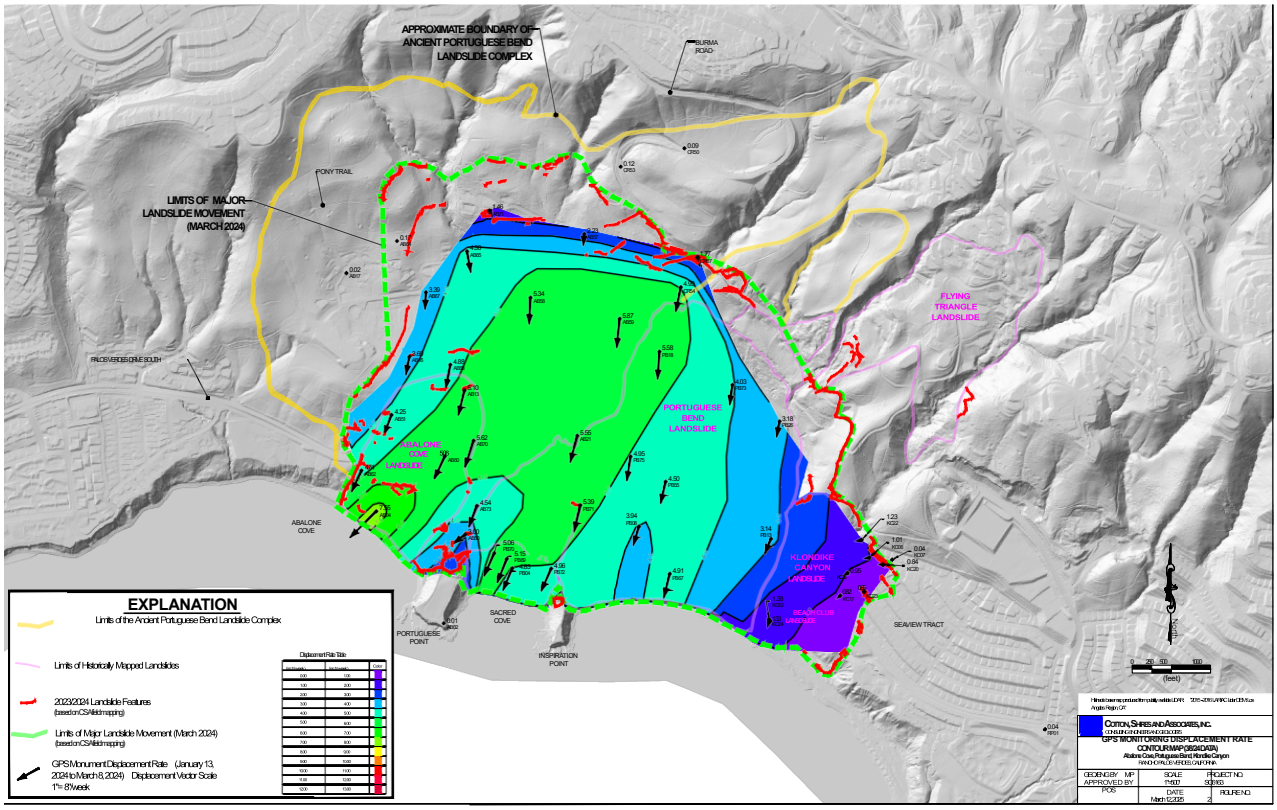
January 13, 2024 Heat Map



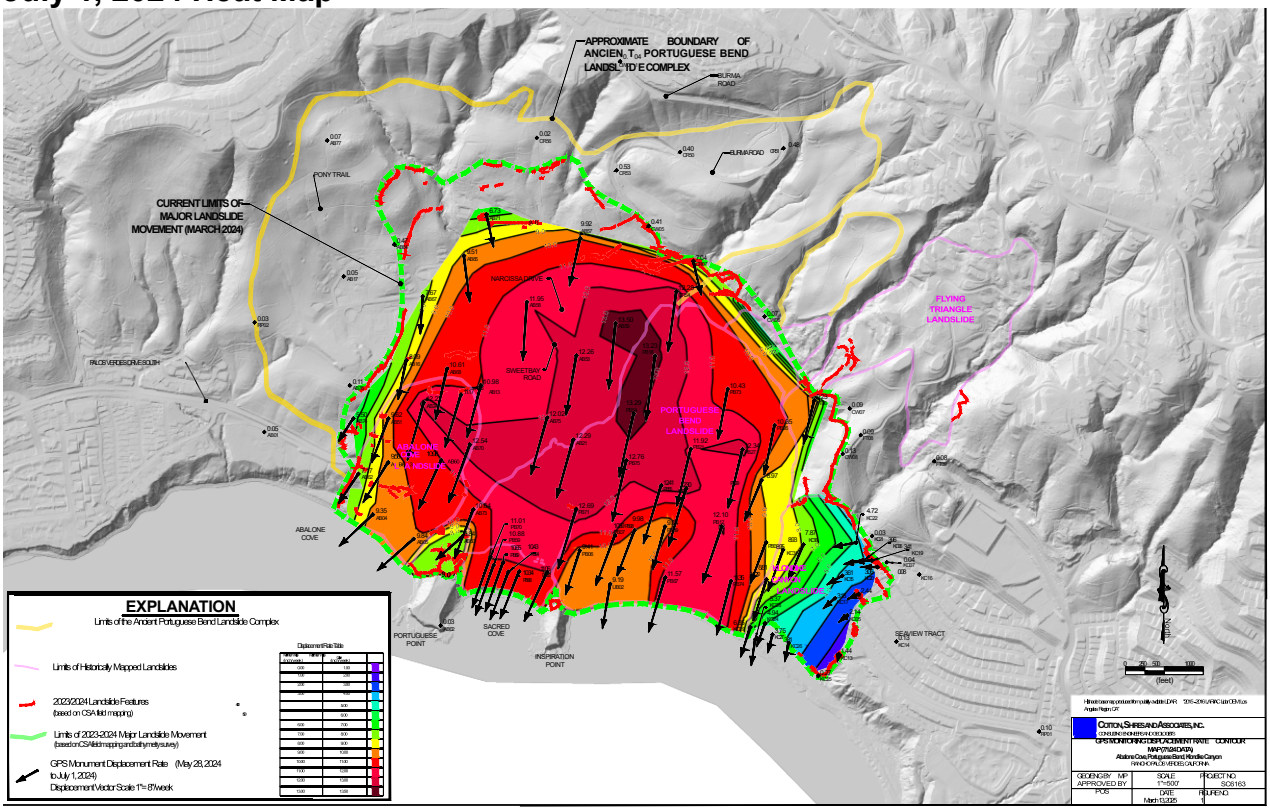
By March 2024, with further mapping and the extraordinary acceleration of numerous GPS monitoring points, a boundary defining the “Area of Major Land Movement” was delineated. Today, following many tens of feet of movement since early 2024, the boundary of the Altamira Landslide is well-defined. North of Palos Verdes Drive South, the Altamira boundary extends significantly farther west of the historical ACL boundary (resulting in the destruction of the landmark Wayfarer’s Chapel), upslope through the York property (6001 PV Drive South), and north of the historical ACL boundary through the Portuguese Bend Riding Club Area, crossing upper Narcissa Drive, through and north of

residences on upper Cinnamon Lane, and eventually turning east across Altamira Canyon, extending through the Vanderlip Estate (100 Vanderlip Drive), destroying Vanderlip Drive and adjacent properties, and ultimately continuing northeast to the lower stretch of Burma Road Trail in the Portuguese Bend Reserve. The Altamira Landslide also created never before seen deformation where it underlies and now extends south of the KCL, including formation of a more seaward toe accompanied by uplifting ground that trended southwest through the beach area of the Portuguese Bend Beach Club and extending up to 500 feet or more offshore where it emerged through the sea floor and formed a new rocky coastline above sea level, generally east of Inspiration Point. The emergence of the new land offshore from the previous coastline was first reported to, and was subsequently observed by, the City Geologist in late February of 2024, consistent with the triggering of major movement of the Altamira Landslide described above.

March 8, 2024 Heat Map



July 1, 2024 Heat Map



<u>Impacts of Movement of The Altamira Landslide</u>

As of this date, the major land movement of the Altamira Landslide has resulted in the red-tagging (Unsafe to Enter/Occupy) and yellow-tagging (Limited Entry) of dozens of residential and commercial structures. It has also caused major destructive impacts to public and private roads, damages to drainage facilities and utility infrastructure (water, sewer, gas, electricity and cable), causing certain utilities to be shut-off, and closure of certain Preserve land that is otherwise heavily accessed by the public for hiking, biking, equestrian, and other purposes.

To reiterate, the damage the City sustained as a result of the winter storms of 2024 is attributed to the activation of the deeper slip plane, known as the Altamira Landslide, that has historically been inactive until the 2024 winter storms. The activation of this new landslide that carried the shallower landslide, referred to as the Landslide Complex herein, is **not** pre-existing and therefore invalidates the reason for denying the City's disaster cost recovery request.

The only practical mitigation measure available to address a landslide with such a colossal scale is relieving groundwater pore pressures through pumping of groundwater, but it has to be done on a large enough scale to be effective at reducing the movement to an acceptable level. This technique has proven effective for the east side of the

Altamira Landslide where deep dewatering wells have been installed, maintained and the rate of ground movement monitored such that a correlation between increased pumping of groundwater and reduction in the rate of ground movement has been confirmed.

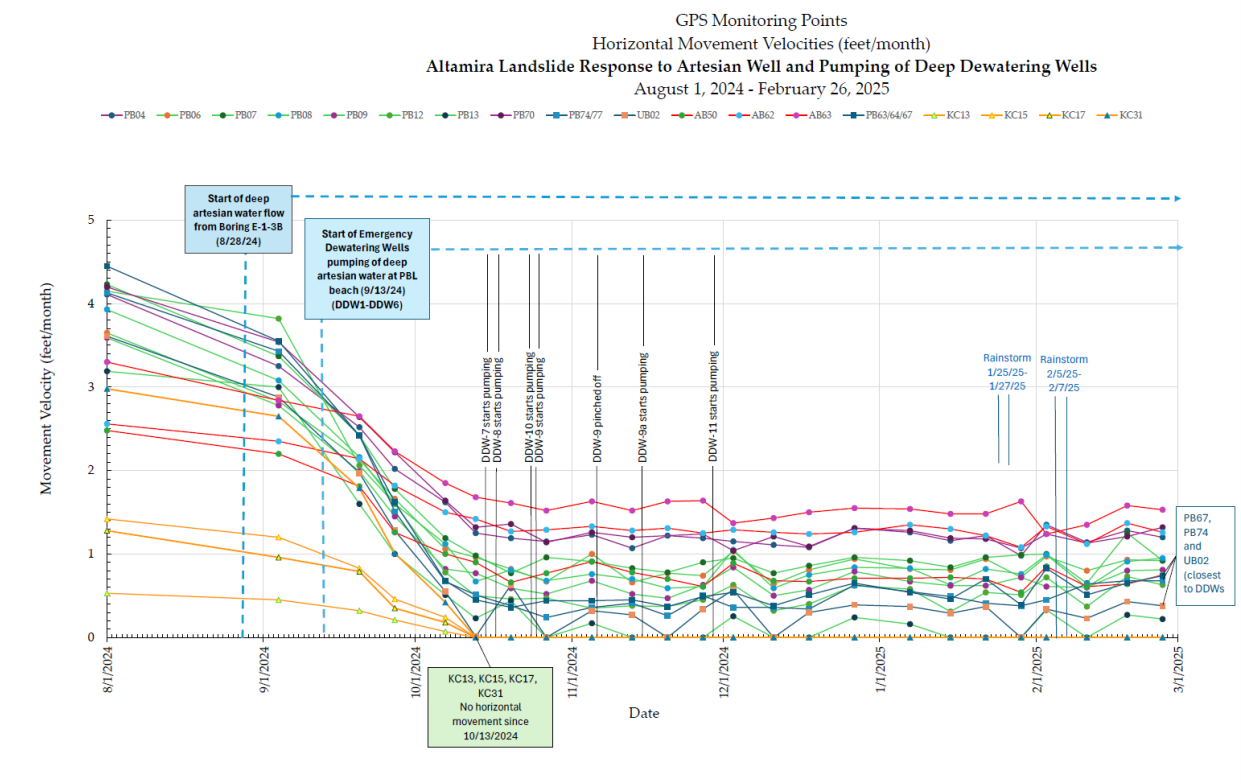
Emergency Measures

Emergency measures taken by the City and abatement districts (ACLAD and KCLAD) to date have included drilling, pumping and monitoring deep dewatering wells, winterization measures including lining channels and installing culverts to reduce the amount of surface water percolating into the groundwater regime from upslope drainages/canyons, and filling of and establishing drainage for fissures and grabens that, if left unmitigated, facilitate surface water intrusion into the groundwater regime. This strategy has proven to be effective in reducing the rate of movement of the Altamira Landslide and even stopping movement of the eastern portion of the landslide in the area of the KCL. Because piezometers installed in deep borings that penetrated the base of the Altamira Landslide indicated high groundwater pore pressures beneath the landslide (some areas were found to have near-artesian or artesian groundwater pressures – pressures higher than the ground surface), a pilot program strategy was pursued by the City that involved drilling a series of deep dewatering wells at the toe of coast below the base of movement of the Altamira Landslide slip plan and pumping to dewater the high groundwater pressures beneath the landslide. This strategy turned out to be more successful than originally contemplated because the movement of the landslide slowed quickly in response to the initial dewatering efforts and the deep wells continued to function for weeks or months before re-drilling was necessary.

The chart on the following page illustrates the timing of artesian water being encountered in one of the test borings (Boring E-1-3B, which was retrofitted to function as an artesian well), the installation of the deep dewatering wells, and the deceleration of the Altamira Landslide in response to the dewatering efforts.

Additional deep dewatering wells are also needed in order to reduce the movement of the middle and eastern portions of the Altamira Landslide to the level experienced prior to the impact of climate whiplash. However, the cost of drilling, pumping, maintaining and re-drilling requires significant funding which the City is unable to fund underscoring the significance of the requested disaster cost recovery – to return land movement to pre-2024 winter storm disaster rates.

Continued on the next page



Natural Disaster Cost Recovery

The cost to respond to this natural disaster has been immeasurable to City and its limited resources. To date, the City's estimated expenditures responding to land movement between October 2022 and June 2025 is approximately $47.5 million with approximately $36.3 million being spent this fiscal year (2024-25). Overall, the $36.3 million reflects a 290% increase from the prior year. These costs include emergency response efforts such as test boreholes, deep dewatering wells, maintenance of the deep dewatering wells until June 30, 2025, winterization, fissure filling, road repairs, sewer repairs, and drainage repairs to name a few.

Similar to the entire state of California, and in fact, the entire United States, there are known pre-existing conditions that lend themselves to natural disasters, such as wildfires, earthquakes, floods, hurricanes, tornadoes, etc. When one of these pre-existing conditions result in a natural disaster such as the recent devastating Palisades and Eaton wildfires, FEMA does not turn their back on those communities in need citing this area is mapped and known to be a Very High Fire Severity Zones. Similarly, FEMA and the federal government do not reject financial aid in known areas of earthquakes, floods, and hurricanes. That same principle should be applied to Rancho Palos Verdes and the recent acceleration of land movement resulting from the atmospheric river storms of 2023 and 2024, and the activation of the new landslide, Altamira Landslide. Moreover, **nowhere in the Stafford Act does it state that pre-existing conditions are ineligible for disaster**

recovery. In fact, the Stafford Act clearly cites the **intent** of Congress, by this Act, is to provide an orderly and continuing means of **assistance** by the Federal Government to State and **local governments** in carrying out their responsibilities to alleviate the suffering and damage which result from such disasters by (1) revising and broadening the scope of existing disaster relief programs; (2) encouraging the development of comprehensive disaster preparedness and assistance plans, programs, capabilities, and organizations by the States and by local governments; (3) achieving greater coordination and responsiveness of disaster preparedness and relief programs; (4) encouraging individuals, States, and local governments to protect themselves by obtaining insurance coverage to supplement or replace governmental assistance; (5) encouraging hazard mitigation measures to reduce losses from disasters, including development of land use and construction regulations; (6) **providing Federal assistance programs for both public and private losses sustained in disasters**; and (7) identifying and improving the climate and natural hazard resilience of vulnerable communities.

Clarification to FEMA's Document Descriptions

In addition to the above, the City provides the following responses for context purposes to the some of the documents citied in the Eligibility Determination Memorandum. As you will see, the extracted statements used to deny the City's request do not accurately support nor justify the denial because they are taken out of context of the overall document and do not provide an accurate analysis of the reason for the land movement and the basis for denial as stated earlier in this appeal letter. The City's position remains that the 2024 winter storms triggered the activation of the **new Altamira Landslide** which carried, at an accelerated rate of movement, the greater Landslide Complex which up until recently has been managed.

1. June 7, 2023 City Letter to Los Angeles County Fourth District Supervisor Hahn

   FEMA's determination letter references the City's June 7, 2023 letter to Los Angeles County Fourth District Supervisor Hahn (Sup. Hahn) as the basis for emphasizing its position that the requested damage recovery for water control features traverses a pre-existing landslide and that the City "continuously repairs and maintains these drainage pipes." The determination letter also states that "the damages claimed are a result of decades of pre-disaster ground instability and ongoing non-disaster related causes" which the City does not believe is accurate based on the information provided in this appeal letter.

   The City's letter to Sup. Hahn quotes a few words that when taken out of context gives a very different meaning to the reader. The letter was sent to Sup. Hahn requesting $6 million to help the City fund its matching portion of FEMA's Building Resiliency Infrastructure Communities (BRIC) Grant for the Portuguese Bend Landslide Remediation Project. The letter to Sup. Hahn includes data on the average rate of movement for context purposes to garner her advocacy and financial support needed

to develop and implement a remediation plan as a **preventive measure** to a potential imminent threat to public health and safety.

The Portuguese Bend Landslide Remediation project, concentrated within the PBL, was developed by the City to **prevent** the acceleration of land movement by addressing rainwater runoff from entering the ground and recharging the water table, which occurred during the rain events of 2023 and 2024.

The Stafford Act states that pre-existing conditions are not eligible for disaster recovery but rather that to be eligible it has to be directly related to an incident per Title 44 of C.F.R. 206.223(a)(1). However, as noted earlier, the behavior of this slow moving landslide noticeably changed in response to the Winter Storms of 2023 and 2024, and that the extreme wet weather activated a **new** landslide, Altamira Landslide, and should therefore not be considered pre-existing, the point to this appeal.

2. Cotton Shires and Associates (CSA) Geologic Report dated September 9, 2023

   According to your determination letter, the City's Geotechnical Engineer's September 9, 2023 memo is cited as one of the basis for denying the City's recovery request because "*the work claimed is not required as a result of the declared disaster and the applicant cannot demonstrate the damage was directly caused by FEMA-DR-4769-CA. Rather these damages are a result of long-term creep displacement and recent years acceleration of earth movement from non-disaster causes as documented in the multiple reports.*"

   As previously noted, the City respectfully disagrees with these statements and in fact, can demonstrate that the winter storms of 2023 and 2024 correlated to climate change and seasonal changes in weather patterns are the reasons the City experienced a noticeable behavioral **change** in the landslide rate of movement with the activation of the dormant and inactive Altamira Landslide. Moreover, the Eligibility Determination Memorandum neglects to cite relevant and pertinent information in the CSA's September 9, 2023 memo emphasizing the following significant and noticeable change in the behavior of the landslide:

   GPS Survey Monitoring Data Review: GPS monitoring of survey monuments throughout the Landslide Complex area has been performed tri-annually since 2007 by McGee Surveying Consulting. In their June 6, 2023 Survey Report, McGee stated:

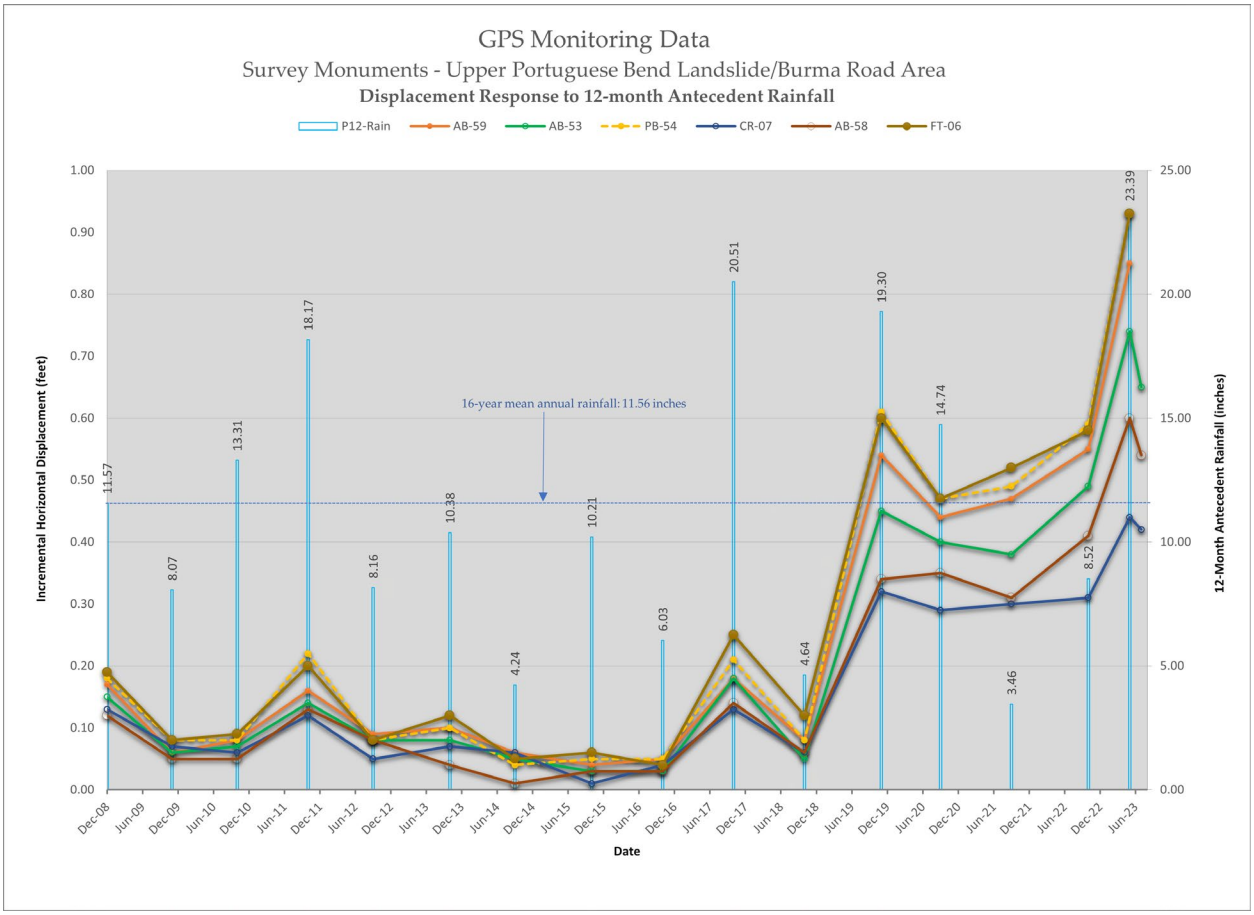
   "*In the last seven months the movement velocities have accelerated over the average velocity for the previous four years which saw an acceleration over the previous 15-20 years……**Velocities were stable** prior to 2018. After the Fall of 2018 they increased about 3 to 6 fold at most points and remained stable to the Fall of 2022. In the last seven months since the **Fall of 2022** the velocities generally have **doubled more or less***." (emphasis added)

This is a significant and important observation from the surveyor, and comports with the past several years of field observations by CSA staff of roadway distress and trail distress within the PBR, as well as reports of street distress, building distress and utility line breaks throughout the various known landslide areas.

Several graphics based upon CSA's own analysis of the GPS survey monitoring data further illustrate what is happening with the landslide ground movement. According to Figure 2 in CSA's September 9, 2023 memo, depict horizontal displacements (in feet) and ground displacement vectors for 12 selected GPS survey monuments mostly located in the mid and upper Landslide Complex. These figures are based upon McGee's GPS monitoring of the survey monuments from October 2018 to May 2023 (with the exception of two monuments which were last read in October 2022, PB18 and AB71). Four of these monuments were also read in mid-July, 2023 and those movement data are also presented. Two of the monuments, CR07 and FT06 are located on Burma Road outside of the PBL and indicate 1.67 feet and 3.09 feet of horizontal displacement over the ~4.5-year period. The CR07 point moved an additional 0.42 feet in two months (through July 15, 2023), which translates to ground movement velocity of about 2.5 feet per year. Most of the other points on this figure are in the Landslide Complex (and mostly in LMA Zone 2) and are indicating total displacements of approximately 1 to 3 feet (or average velocities of about 0.22 to 0.67 feet/year across the ~4.5-year period). Several of these points in LMA Zone 2 that were also monitored in July, 2023 showed continued acceleration from May to July 2023, with calculated velocities of ~1.25 feet/year at AB67 to ~3.9 feet/year at AB53. These are extraordinary rates of landslide movement that, to the City Geologist's knowledge, have not been previously documented in the LMA Zone 2 area.

Incremental displacement has been analyzed of these points versus 12-month antecedent rainfall, as a measure of the landslide response to rainfall. A graph of cumulative displacement of these points since 2007 is presented on the following page. This graphed movement data indicates a clear acceleration of movement beginning in late 2018 (as noted in the area labeled inflection point).

Accelerated landslide movements since late 2018 appear to be correlative with significantly above normal rainfall in three out of four rainfall seasons (2016-17, 2018-19 and 2019-20) which followed five consecutive drier than normal rainfall seasons (2011-12 through 2015-16). **The extraordinary rainy season of 2022-23, where rainfall totals were more than 200% of average, has resulted in further acceleration**.



It is imperative to bring to your attention that the City Geologist recently provided an updated memorandums dated November 8, 2024 and March 16, 2025 (attached) that further underscores the impacts and damage caused by FEMA-DR-4769-CA also known as the winter storms of January 31 through February 9, 2024, as documented earlier in this appeal letter.

3. Rancho Palos Verdes Geo-Logic Associates (GLA) Report Dated December 2019

   According to the Eligibility Determination Letter, a December 2019 report prepared by GLA, a geotechnical engineering firm, hired by the City to prepare its Portuguese Bend Landslide Remediation project is cited. This report cites, as one of the basis to determine that the requested disaster damage recovery occurred in a pre-existing landslide area and not related to the storms citing the following:

   "the landslide complex includes approximately 239 acres with ground movement varying across the site ranging up to approximately 11 feet per year."

   This very citation supports the City's request and claim that the damage sustained occurred as a result of the winter storms in 2023 and 2024 based on the following:

As noted earlier, the Landslide Complex is generally comprised of 5 subslides. The 239 acres noted above is limited to the PBL. This is because the study area for the Landslide Complex was specific to the PBL. In fact, the City Geologist's November 8, 2024 memo states since 2024, this significantly greater depth of movement has resulted in a broader footprint of active land movement at the ground surface and offshore, and expansion of the historical land movement area from approximately 380 acres to **over 700 acres**.

Furthermore, as previously stated, according to the City Geologist's March 16, 2025 memo (attached), the Altamira Landslide is a newly active landslide that has occurred within a previously mapped ancient landslide complex. It is important to make this distinction for consistency and to avoid confusion, because the Altamira Landslide is, in fact, a new member of the historically active PBL/ACL/KCL Landslide Complex but largely **underlies it** and occupies an area of active land movement >700 acres and extends to more than 500 feet off of the coastline, whereas the shallower historically active PBL/ACL/KCL Landslide Complex only occupied about 380 acres. While previous geotechnical investigators identified inactive deep failure surfaces in both the historically active and ancient landslide areas, none of them mapped or identified as active the entire depth or breadth of movement that has recently impacted the area, nor did they opine that such an event would occur in historic times. The active Altamira Landslide currently involves major land movement comprising an area of over 700 acres landward of the coast and extends to approximately 500 feet or more off the coastline. The areal dimensions, depth of movement, velocity of movement, artesian and near-artesian groundwater pressures beneath it, and even the direction of movement, are different than the Landslide Complex. The distinction to be made then, is that the Altamira Landslide is not just simple *expansion* of an existing group of landslides, it is an entirely different, larger and deeper landslide with much broader boundaries (including the new coastline offshore), nearly twice as deep as the depth of historic landslide movement in some areas, and with unprecedented rates of movement (which were not seen in the early LA County Engineer surveys, the Charles Abbott Associates surveys beginning in 1994, nor the McGee surveys since 2007).

None of this was experienced during the history of the City, and the Altamira Landslide is a unique landslide not characterized in its current dimensions during the over 70-year history of landslide investigations, exploratory borings, monitoring and observations being conducted in the area.

4. Landslide Working Group November 1, 2023 Meeting Notes

   The FEMA Eligibility Determination Memorandum cites that the City has a pre-disaster active task force called the RPV Landslide Complex Working Group which meets to continue to address ongoing landslide problems, and that is **not** correct.

As previously noted, on October 3, 2023, the City Council declared a local state of emergency in response to the rapid and significant acceleration in land movement. As a result, the Council directed staff to working with community stakeholders including utilities, geologists, HOA representatives and residents to collaborate the City's and community's response to the declared local state of emergency. It was four months later when the then-mayor sent a letter to the Governor requesting he declare a state of emergency and request the President declare a federal disaster in response to the land movement resulting from the winter storms of 2023 and 2024 (attached)

5. Michael McGee's 2007 GPS Technical Report

   In 2007, the City began using GPS technology to track on-ground movement of the Landslide Complex. No one is denying that the shallower Landslide Complex has been moving since 1956, what is evident in the data FEMA's analysts overlooked is that there is a significant and noticeable change in the behavior of the landslide and the rate of movement in response to rain events as clearly demonstrated in the charts earlier in this letter. Moreover, a new, previously dormant landslide was activated in response to the 2024 Winter Storm event.

   To reiterate, the City Geologist has clearly documented that the rain events of 2023, and particularly 2024, have contributed to the accelerated rate of movement and the damage sustained by the City and its infrastructure. The point that warrants a reconsideration of reversing the denial is that there is a clear change in the rate of movement based on the GPS monitoring points cited in your memo between 2023 and present.

<u>Additional Information - Land Movement and the Monks Lawsuit</u>

In 1978, the City enacted an ordinance imposing a moratorium on the construction of new homes in the vicinity where accelerated landslides had recently occurred. The so-called "Monks" plaintiffs owned 16 vacant lots impacted by the moratorium. Some of these property owners claimed to have been waiting over 30 years to build homes on their properties on land that has not showed signs of movement. The lots in question were otherwise zoned for single-family dwellings.

Eventually, these property owners filed suit against the City seeking to invalidate the moratorium criteria and alleging a claim for inverse condemnation based on the state takings clause because, as the plaintiffs asserted, the land was not moving and suitable for development. The trial court denied their request and ultimately found in the City's favor. The property owners appealed.

The Court of Appels ruled in favor of the plaintiffs citing that the City's ordinance requiring owners of land in specific zones within the Landslide Complex to present data demonstrating to satisfaction of city geologist that the gross geotechnical factor of safety

where their lots were located was at least 1.5 in order to build on their lots deprived the land of all economically beneficial use, and resulted in a permanent categorical taking. **The Courts ruled that the plaintiffs could build on their lots.** (*Monks v. City of Rancho Palos Verdes*, 167 Cal.App.4th 263 (2008)

Conclusion

The basis for denying the City's disaster recovery on a pre-existing condition is not a valid reason when, as demonstrated in this appeal letter and supporting attachments, it is clear that a **new, inactive** for hundreds of years, landslide was activated in response to the 2024 Winter Storm event that led to the federal disaster declaration (FEMA-DR-4769-CA). The activation of the Altamira Landslide resulted in significant damage to the City's infrastructure including, but not limited to, water control features such as drainage facilities, roads, trails, utilities, and structures to name a few. It is now known that the activation of the Altamira Landslide carried the subslides of ACL, PBL, and KCL which is clearly demonstrated in this appeal letter that the rate of movement significantly increased along with the behavior of the land movement as a result of the 2023 and 2024 Winter Storm Events.

It is for the reasons cited throughout this appeal letter that disaster recovery financial assistance be provided for the destruction resulting from the activation of the Altamira Landslide caused by the extraordinary rain events of 2024. The weather whiplash over the years has adversely impacted the City, its residents and businesses, and its economics. Overturning the denial and providing the disaster recovery assistance requested will enable the City to properly respond to the activation of the new Altamira Landslide by stabilizing land movement and repairing damaged and critical infrastructure.

On behalf of the Rancho Palos Verdes City Council and residents, we thank you for your consideration of this appeal letter.

Sincerely,

Ara Michael Mihranian, AICP
City Manager

Attachments:

- September 9, 2023 CSA Memo
- November 8, 2024 CSA Memo
- March 16, 2025 CSA Memo
- February 20, 2024 Letter to Governor Newsom

c. Rep. Ted Lieu
Senator Adam Schiff

Senator Alex Padilla
State Senator Ben Allen
Asm. Al Muratsuchi
Rancho Palos Verdes Mayor Bradley and City Council
William Wynder, Rancho Palos Verdes City Attorney
Catherine Jun, Rancho Palos Verdes Deputy City Manager
Ramzi Awwad, Rancho Palos Verdes Director of Public Works
Vina Ramos, Rancho Palos Verdes Director of Finance

COTTON, SHIRES AND ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS

CITY OF RANCHO PALOS VERDES

CSA Project No. SC6022

MEMORANDUM

TO: Katie Lozano, Open Space Manager
CC: Ara Mihranian, City Manager
William Wynder, Elena Gerli, and John Fox, City Attorneys
Cory Linder, Director of Recreation and Parks
Ramzi Awwad, Public Works Director
Taylor Fox, Senior Park Ranger
FROM: Michael Phipps, CEG 1832, Contract City Geologist
Christopher Dean, CEG 1751, Contract City Geologist
Matthew Janousek, GE 3005, Contract City Geotechnical Engineer
RE: **Preliminary Geotechnical Assessment of Recent Land Movement in the Portuguese Bend Reserve and Impacts to Burma Road Trail, Rancho Palos Verdes**
DATE: September 29, 2023

INTRODUCTION

In accordance with your request, this memorandum has been prepared to provide a preliminary geotechnical assessment of recent land movement within the Portuguese Bend Reserve (PBR) with a specific focus on the impacts of land movement to the Burma Road Trail. We understand that the PBR is one of the City's most popular land reserves, it is heavily used by the public for recreation and is also used by public utilities including Southern California Edison and California Water Service Company. A portion of the PBR is underlain by the historically active Portuguese Bend Landslide (active since 1955-56) as well as the Ancient Portuguese Bend Landslide Complex. Some areas of the Reserve are now experiencing significant land movement and ground surface manifestation that is beyond the limits of the historically active and previously mapped Portuguese Bend Landslide, resulting in damage to trails and fire roads which provide access for public safety, utilities, maintenance, conservation, and public recreation. Cotton, Shires and Associates, Inc. (CSA) geologists have been requested by the City to observe various landslide-related issues in the Reserve involving damage to trails since 2021 and the SCE transmission lines along Burma Road since the summer of 2022. In 2021 we also began a detailed review of Global Positioning Satellite (GPS) monitoring data for survey monuments both within and outside the PBR, including points within the Abalone Cove Landslide, Klondike Canyon Landslide, and elsewhere within the Ancient Portuguese Bend Landslide Complex.

A comprehensive reconnaissance of the PBR was conducted by vehicle with City staff on June 28, 2023. Following this field visit, the City's Open Space Manager requested a report addressing the following items:

DRAFT

- Information and a map presenting our observations of where new landslide scarps are forming;
- An evaluation of whether Burma Road is currently able to accommodate vehicles, ranging from smaller Park Ranger trucks to heavy equipment used by utility companies and fire department, and if it is currently able to accommodate vehicles, an estimate of how long the road will remain stable;
- Recommendations for re-routing Burma Road (if necessary) to areas less prone to land movement as the fire road is needed for the City, fire department, and utility companies;
- Consideration of recommendations for additional warning signage due to the increased land movement to warn recreational users (hikers, bikers, horseback riders) and authorized outside agency personnel who drive the Reserve fire roads;
- Recommendations for a maintenance plan to fill fissures and keep Burma Road passable to pedestrians and vehicles, as the fissures have become too significant for park rangers to fill in with shovels.

This memorandum will address these requested items, based upon our field observations and geologic mapping, analysis of GPS monitoring data, background knowledge of the area, and professional experience.

PREVIOUS WORK

Previous City-requested reconnaissance and observation of trail conditions in the PBR performed by CSA geologists have included the following:

- 8/27/21: Burma Road trail reconnaissance (fissures/ground movement)
- 9/29/21: Burma Road and Garden Trail reconnaissance (fissures/ground movement)
- 1/5/22: Burma Road trail reconnaissance (fissures/ground movement)
- 8/31/22: Burma Road trail reconnaissance, meeting with SCE contractor and City staff, (regarding power pole relocation due to fissures, ground movement)
- 3/8/22: Upper Burma Road trail reconnaissance (rockfall hazards)
- 4/5/23: Burma Road Trail, Garden Trail, and Rim Trail reconnaissance (fissures/ground movement)

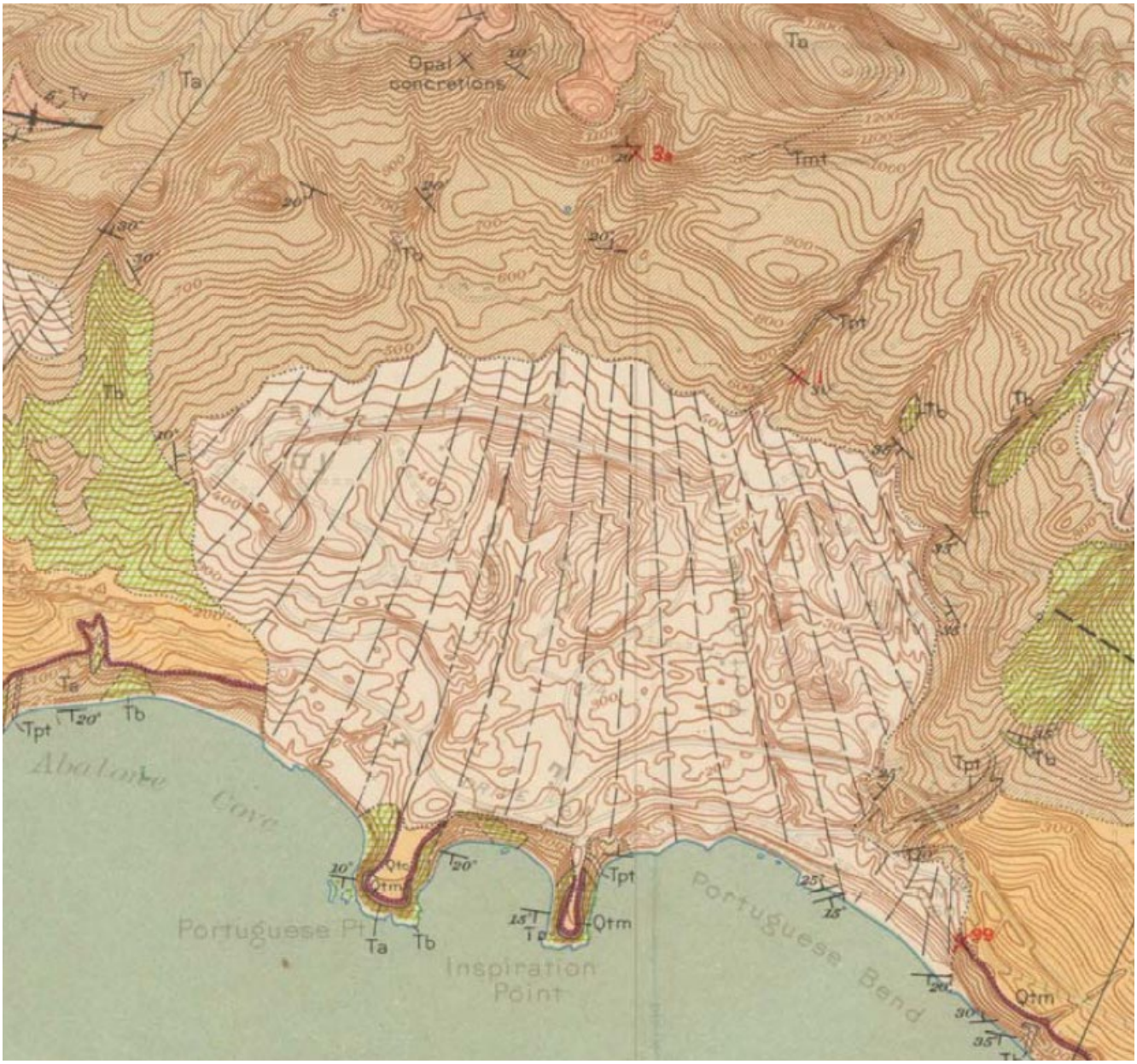
Findings and recommendations from these field visits have been routinely documented by either memoranda or email addressed to City staff. Recent published documents include memoranda dated February 9, 2022 (Burma Road/Rim Trail Junction) and May 19, 2023 (SCE Power Pole Relocation, Burma Road).

Preliminary geologic mapping of the upper limits of active landsliding along the Burma Road trail and vicinity was performed on June 28, 2023 and supplemented on September 22, 2023; however, this work is incomplete and requires additional field effort. Because of the steep terrain, large mapping area, and thick (inaccessible) vegetation in some areas, we have supplemented our field mapping with photo-geologic mapping utilizing high-resolution Nearmap (vertical aerial) imagery captured on January 17, 2023 and June 17, 2023.

DRAFT

FINDINGS

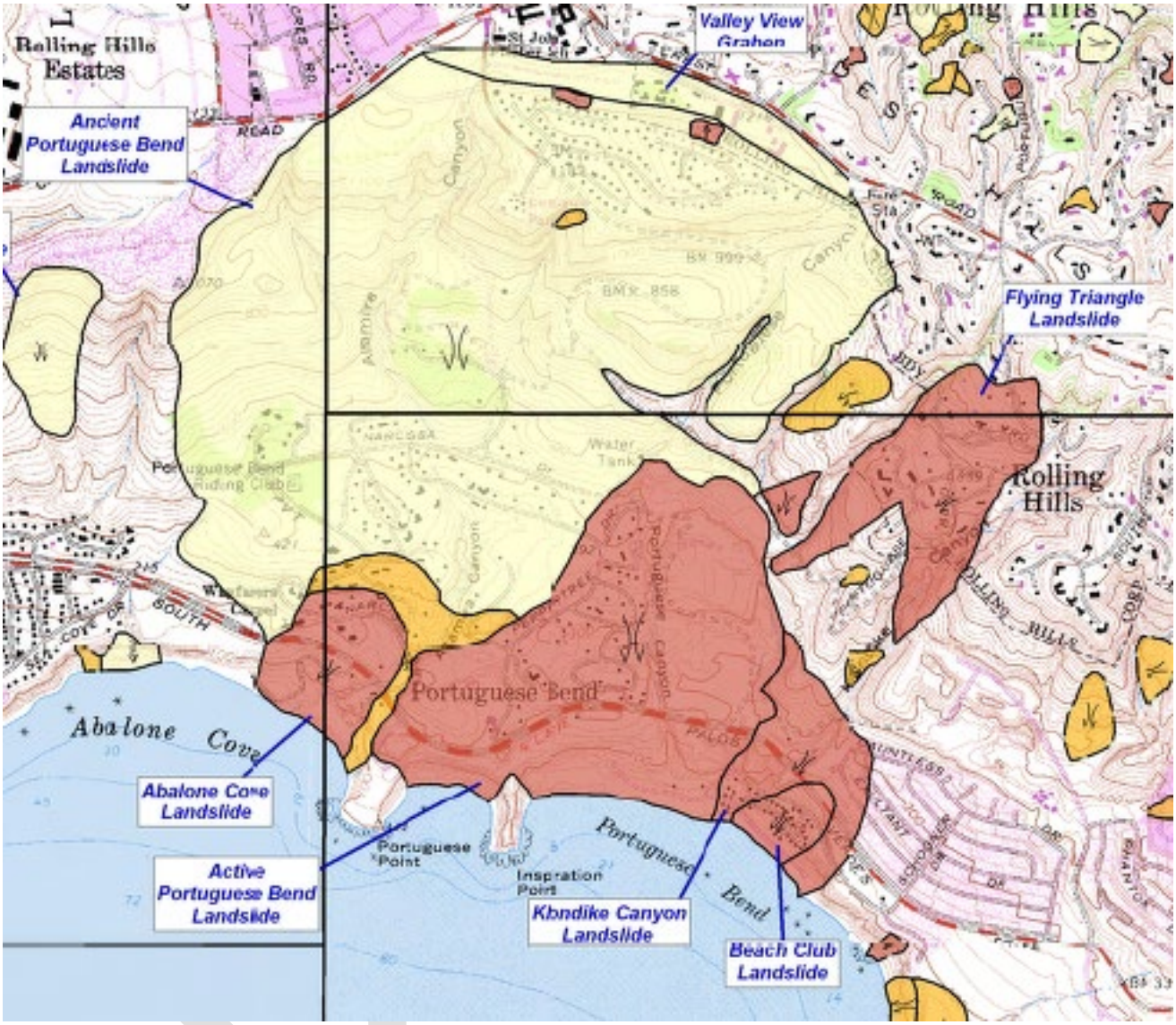
Geologic Mapping: The Ancient Portuguese Bend Landslide Complex (APBLC) was first mapped by the U.S. Department of the Interior Geological Survey (aka, USGS) in 1946 (shown as white area with black dashed lines in the image below) and occupies a broad area on the south side of the Palos Verdes Peninsula from the crest of peninsula to the Pacific Ocean.



U.S. Department of the Interior, 1946, Portion of Geologic Map of the Palos Verdes Hills, Los Angeles County, California

Within the APBLC, several large landslide masses have reactivated since the 1950s, including the Portuguese Bend Landslide, Abalone Cove Landslide, Klondike Canyon Landslide, and Beach Club Landslide. The Flying Triangle Landslide is in similar but higher terrain northeast of the Portuguese

Bend Landslide but is not considered part of the APBLC on regional geologic maps. These landslides are depicted on the California Geological Survey's Landslide Inventory Map of the Palos Verdes Peninsula (2007, image below).



California Geological Survey, 2007, portion of Landslide Inventory Map of the Palos Verdes Peninsula

Burma Road (and Trail) is located along what was previously proposed to be the Crenshaw Boulevard Extension, until the Portuguese Bend Landslide reactivated in 1956. The lower reach of Burma Road trends southeast immediately uphill from the headscarp of the Portuguese Bend Landslide. Previous site visits by our staff to the Burma Road area within the PBR beginning in 2021 were primarily in response to reported "fissures" forming in multiple locations across trails. We understand that City ranger staff have been routinely filling in the fissures with soil using hand tools. At other times heavier grading equipment has been reportedly used by Cal Water to fill fissures and maintain the Burma Road access to their facilities. Recent field mapping and GPS data suggest that these fissures are in fact the incipient manifestations of headward enlargement of the Portuguese Bend Landslide as well as an upslope manifestation of accelerated movement of a portion of the Ancient Portuguese Bend Landslide

Complex west of the active Portuguese Bend Landslide boundary. Four significant landslide scarps, which initially manifested as ground cracking and small fissures in Burma Road, have now formed across Burma Road, generally between the Eagle's Nest Trail intersection on the west and the Rim Trail intersection on the east.

Figure 1 (attached) was prepared on a Nearmap vertical color image taken January 17, 2023. The approximate limits of the active Portuguese Bend Landslide are depicted in red. The upper area of recent headward enlargement of the Portuguese Bend Landslide is depicted with yellow lines delineating landslide scarps which can be seen crossing Burma Road in at least seven locations. While the Burma Road trail has been repeatedly maintained by minor grading-leveling across these features, the scarps have grown in height and width adjacent to the road over time, and in some locations, grabens (wide pull-apart fissures) have formed in response to significant landslide movement. If not maintained in this manner over the past several years, landslide scarps ranging from 1 to 8 feet in height would extend across the road making it impassable to vehicles, cyclists, and even pedestrians. The most severe location is the western (and uppermost, elevation-wise) scarp located between the Water Tank trail and Eagle's Nest Trail intersection with Burma Road. The landslide displacement at this location has produced a scarp 6 to 8 feet in height and significantly displaced an SCE power pole that is now leaning approximately 35-40 degrees out of plumb. Other scarps across Burma Road southeast of this location are smaller, generally ranging from 1 to 4 feet in height adjacent to the road. Of note is that these scarps have grown substantially in size since our June 28, 2023 reconnaissance.

The downslope limits of the new landslide scarps (yellow contacts on Figure 1) appear to be directly connected to the Portuguese Bend Landslide at the eastern end; however, at the western end they are not well-defined at the ground surface and additional field mapping is necessary to further delineate the western margin. The western margin was observed crossing Kubota Trail and trending toward the Vanderlip Trail, where it was lost in heavy vegetation. It is important to note that the western extent of this new landslide movement is somewhat west of the head of the Portuguese Bend Landslide. It is our interpretation that the western extent of this new landslide movement is occurring in response to long-term creep displacement and recent acceleration of movement of the Ancient Portuguese Bend Landslide Complex (APBLC) since October 2018.

GPS Survey Monitoring Data Review: GPS monitoring of survey monuments throughout the APBLC area has been performed tri-annually since 2007 by McGee Surveying Consulting. In their June 6, 2023 Survey Report, McGee stated:

"*In the last seven months the movement velocities have accelerated over the average velocity for the previous four years which saw an acceleration over the previous 15-20 years……Velocities were stable prior to 2018. After the Fall of 2018 they increased about 3 to 6 fold at most points and remained stable to the Fall of 2022. In the last seven months since the Fall of 2022 the velocities generally have doubled more or less*."

This is a significant and important observation from the surveyor and comports with the past several years of field observations by CSA staff of roadway distress and trail distress within the PBR, as well as reports of street distress, building distress and utility line breaks throughout the various known landslide areas. We have prepared several graphics based upon our own analysis of the GPS survey

DRAFT

monitoring data to further illustrate what is happening with the landslide ground movement. Figure 2 (attached) depicts horizontal displacements (in feet) and ground displacement vectors, for 12 selected GPS survey monuments mostly located in the mid and upper Ancient Portuguese Bend Landslide Complex. These figures are based upon McGee's GPS monitoring of the survey monuments from October 2018 to May 2023 (with the exception of two monuments which were last read in October 2022, PB18 and AB71). Four of these monuments were also read in mid-July, 2023 and those movement data are also presented. Two of the monuments, CR07 and FT06 are located on Burma Road outside of the Portuguese Bend Landslide and indicate 1.67 feet and 3.09 feet of horizontal displacement over the ~4.5-year period. The CR07 point moved an additional 0.42 feet in two months (through July 15, 2023), which translates to ground movement velocity of about 2.5 feet per year. Most of the other points on this figure are in the Ancient Portuguese Bend Landslide Complex (and mostly in LMA Zone 2) and are indicating total displacements of approximately 1 to 3 feet (or average velocities of about 0.22 to 0.67 feet/year across the ~4.5-year period). Several of these points in LMA Zone 2 that were also monitored in July, 2023 showed continued acceleration from May to July 2023, with calculated velocities of ~1.25 feet/year at AB67 to ~3.9 feet/year at AB53. These are extraordinary rates of landslide movement that, to our knowledge, have not been previously documented in the LMA Zone 2 area.

We have also reviewed and analyzed cumulative and incremental displacements from 2007-2023 for six select survey monitoring points that are generally in the upper Portuguese Bend Landslide/Burma Road area, including three points that are in the Ancient Portuguese Bend Landslide Complex west of the historically active Portuguese Bend Landslide (i.e., in Landslide Moratorium Area Zone 2). These six points are identified as:

- CR07 adjacent to Burma Road Trail;
- PB54 located within the "Landward Subslide" of the Portuguese Bend Landslide Complex;
- AB53, AB58 and AB59 located within the Ancient Portuguese Bend Landslide Complex (Landslide Moratorium Zone 2); and
- FT06 adjacent to Burma Road Trail southeast of the Rim Trail intersection.

We have analyzed incremental displacement of these points versus 12-month antecedent rainfall, as a measure of the landslide response to rainfall (Figure 3). A graph of cumulative displacement of these points since 2007 is also presented in Figure 4. This graphed movement data indicates a clear acceleration of movement beginning in late 2018 (as noted in the area labeled inflection point).

Accelerated landslide movements since late 2018 appear to be correlative with significantly above-normal rainfall in three out of four rainfall seasons (2016-17, 2018-19 and 2019-20) which followed five consecutive drier than normal rainfall seasons (2011-12 through 2015-16). The extraordinary rainy season of 2022-23, where rainfall totals were more than 200% of average, has resulted in further acceleration based upon limited monitoring data. A significant concern is that the movement velocities have not declined back to the pre-2018 levels despite two significantly below-normal rainy seasons (2020-21, one of the driest on record, and 2021-22). Also of note is that our rainfall data do not include the impacts from Tropical Storm Hilary which dropped several inches of rain across most of southern California in August, 2023.

DRAFT

CONCLUSIONS AND RECOMMENDATIONS

Landslide movements throughout the Ancient Portuguese Bend Landslide Complex *outside of the historical boundary of the Portuguese Bend Landslide* previously exhibited relatively low rates of creep movement in the 11-year monitoring period of 2007-2018 for which we have readily available data. Beginning in late 2018, and through the present, the survey data indicate a significant acceleration of landslide movement. The movement of the Portuguese Bend Landslide also accelerated in this timeframe. The cumulative displacements over this time have now manifested as headward enlargement of the Portuguese Bend Landslide as well as new active landslide masses forming northwest of the Portuguese Bend Landslide crown in Landslide Moratorium Area Zone 1, upslope from LMA Zone 2. These new actively moving landslide masses are directly impacting Burma Road and threaten future accessibility.

We understand this issue is also exceeding current resources (i.e., ranger staff) to monitor and maintain the safety of the trails; primarily the heavily used Burma Road Trail. At this time, we consider this to be a critical and evolving situation that poses risks to the general public who are accessing the PBR for recreation, to utility infrastructure that traverses the landslide area, and to accessibility for other stakeholders including conservation groups and the fire department. It is evolving because we are days from entering the rainy season and most meteorologists and climatologists that we follow are citing development of El Nino conditions in the Eastern Pacific Ocean and these are frequently associated with wetter-than-normal rainfall conditions in southern California. We are also awaiting receipt of the fall GPS survey data which are typically gathered in early October.

To address the City's specific items, we offer the following:

Landslide Maps: For the purposes of this memorandum, a landslide overview map (Figure 1, attached) was prepared to illustrate the entire affected area and impacts to Burma Road. We conducted field mapping on much larger scale maps which allow for presentation of detailed observations; however, these were not formally drafted and produced due to time constraints. We recommend that additional field mapping be performed in an effort to further define the limits of active landsliding. Drafted larger scale maps will be provided if necessary and/or upon request, to provide details in specific areas.

Burma Road Conditions and Maintenance Considerations: Given the current landslide movement velocities, the newly identified landslides impacting Burma Road are active and considered unstable. Burma Road only remains passable because of the reported efforts of other stakeholders to level the ground surface across the landslide areas with larger equipment, in response to the creeping landslide movement. We anticipate that the landslide movement will continue and is likely to be exacerbated by the 2023-24 rainy season regardless of whether it is wetter or drier than historical averages. The filling of fissures crossing the road with manual labor (by park rangers) has become untenable and such measures are reportedly proving to be short-lived. The fissures, which are developing landslide scarps, have widened and deepened in some areas due to significant ground movement. Smaller vehicles (ranger trucks) are typically 2-3 tons and present lower risks when crossing the landslide areas;

DRAFT

however, larger, heavier vehicles including fire trucks which typically weigh 10 to 20 tons present a much larger transient load across the landslides, thus presenting a relatively greater risk.

Currently it is our opinion that Burma Road Trail should be closed to the public across the landslide area *unless it can be monitored on a daily basis by the park rangers*. This is due to active landslide movement directly impacting the road and posing significant risks to pedestrians, cyclists and horseback riders. Ground leveling efforts to keep the road passable for vehicles may continue; however, crews should avoid placing earth fill directly on the landslides because it adds weight and is a driving force of landslide movement. Continued notching (lowering) of the trail approaches to the landslide scarps may be the only effective solution in the short-term to maintain passage of vehicles. Care should also be given to avoid ground-alterations that would direct more Burma Road drainage directly into the landslide areas.

Burma Road Re-routing Considerations: Burma Road and trail occupy a portion of wider, leveled ground graded during the proposed Crenshaw Boulevard extension (circa 1955-56). Several of the new landslide scarps extend to near the north edge of the previously leveled area, thus, there does not appear to be a feasible location to re-route the road through these areas. Furthermore, we do not see an opportunity to completely re-route Burma Road outside of the former graded area without consideration of massive grading and drainage improvements in steeply sloping areas, some of which may also be in sensitive habitat area. There are also slope stability concerns north of Burma Road for any considered re-route, and we are currently lacking information due to a lack of GPS monitoring points north of Burma Road. The depth of movement of the new landslides is also unknown and at best could only be estimated based on previous studies of the Portuguese Bend Landslide.

Consideration could be given to stabilizing the affected portions of Burma Road in its current location; however, this would require an extensive geotechnical investigation, including geologic mapping, installation of instrumented borings (e.g., slope inclinometer casings and piezometers), laboratory soil testing, extensive slope stability analyses, and design of possible stabilization alternatives. Stabilization, if technically feasible, might require a combination of extensive in-ground structural measures (i.e., steel-reinforced concrete shear pins with tiebacks) and grading. Based upon our experience, such mitigation would likely have a cost in the millions of dollars.

Additional Warning Signage: Additional warning signage due to the increased land movement, to warn recreational users (hikers, bikers, horseback riders) and authorized outside agencies who drive the Reserve fire roads, is reasonable and appropriate from a geotechnical perspective, particularly if the City is going to keep Burma Road Trail and other potentially affected trails open to the public. As mentioned above, the new landslide areas impacting Burma Road and Trail are currently unstable. The landslide areas are currently moving (creeping) at velocities that are generally imperceptible to humans and may seem innocuous from that perspective; however, over short periods of time the movement creates significant hazards to trail users due to differential ground movement with associated ground cracking and fissuring within the landslide masses as well as scarp formation at the movement boundaries.

DRAFT

Additional Recommendations: In addition to the specific items requested to be addressed by the City, we have the following comments and recommendations:

- CSA previously issued a memorandum regarding the proposed SCE power pole relocation (May 19, 2023). At that time, we noted that the upslope extent of active landsliding had not been geologically mapped (to our knowledge), the depth of landslide movement is unknown, and there is a lack of GPS survey monitoring points north of Burma Road between Portuguese and Paintbrush Canyons. We subsequently stated that due to this lack of information, it was difficult to assess the impacts of future land movements on the proposed power pole relocation areas. It is our understanding that SCE may be considering a larger scale relocation of their transmission line(s) that are currently within the active landslide area, in lieu of the relocation project that we previously reviewed. The existing transmission line along Burma Road is partially supported by power poles located in actively moving landslides and at least two of the power poles have now been severely compromised. This transmission line poses a significant risk if not de-energized.

- The above-ground water main which trends along Burma Road traverses portions of the new landslide areas and is lacking ground support (i.e., the pipe is in the air) in some isolated areas. Our concern is that the pipe *may* not have been designed for such conditions. This should be further evaluated by the utility company responsible for the water main.

- Additional geologic mapping (on ground, possibly supplemented with drone photogrammetry) should be performed in an effort to further define the areal extent of new active landsliding. This information will be beneficial to the City for future evaluation of the safety of Burma Road and other trails within the Portuguese Bend Reserve, and also useful to other stakeholders.

- Additional GPS monitoring points should be established north of Burma Road, between Portuguese Canyon and Paintbrush Canyon. CSA will assist with recommended locations for these points if requested by the City. We also recommend that the tri-annual GPS monitoring be performed on <u>all</u> monuments in each monitoring session, in lieu of the partial monitoring that has been historically performed in two of the three sessions per year.

- Periodic closures of the trail system within the PBR during and immediately after significant rainfall events, as has been the policy of the City, should continue to allow for safety assessment of the trails by ranger staff.

- Where feasible, park ranger staff should continue to do routine monitoring and filling of ground fissures on other trails to keep the trails relatively safe; otherwise, the trails should be closed.

We hope this memorandum provides the City of Rancho Palos Verdes with the requested information and recommendations regarding Burma Road within the Portuguese Bend Reserve at this time. Please contact us if you have further questions or concerns.

-o-

DRAFT

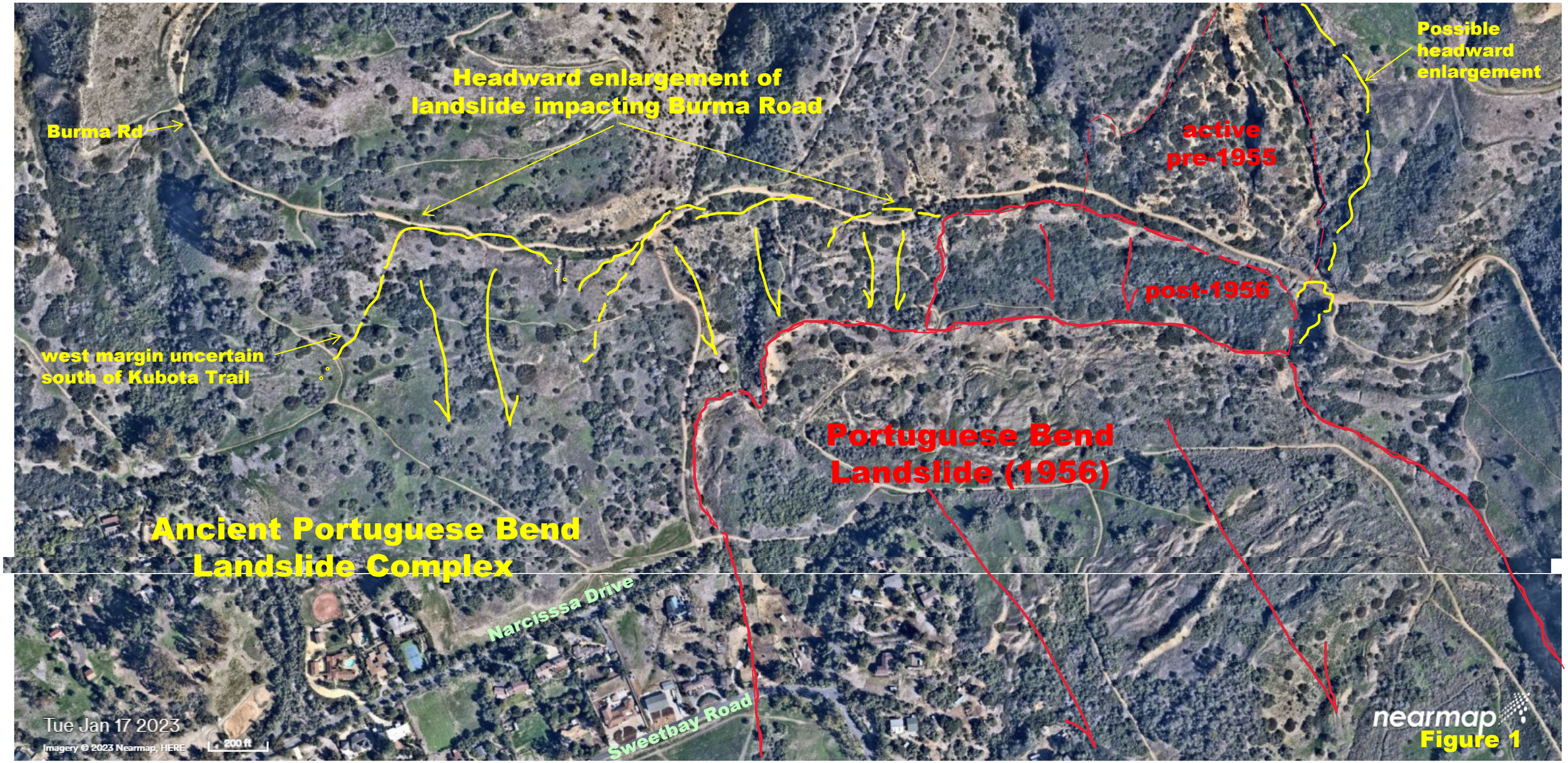
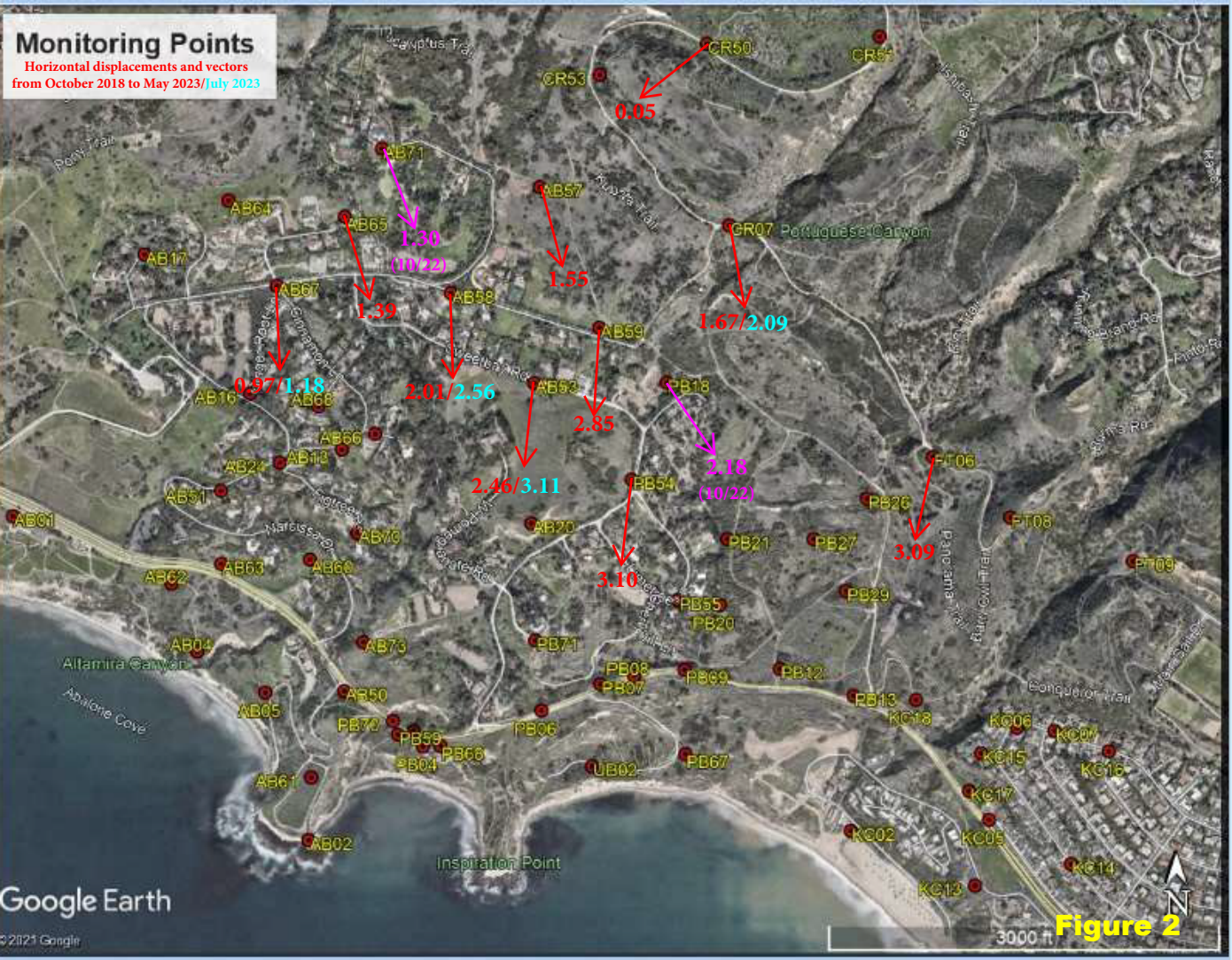

Headward enlargement of
landslide impacting Burma Road
Burma Rd
Possible
headward
enlargement
active
pre-1955
post-1956
west margin uncertain
south of Kubota Trail
Portuguese Bend
Landslide (1956)
Ancient Portuguese Bend
Landslide Complex
Narcisssa Drive
Sweetbay Road
Tue Jan 17 2023
Imagery © 2023 Nearmap, HERE
200 ft
nearmap

Figure 1


Monitoring Points
Horizontal displacements and vectors
from October 2018 to May 2023/July 2023
CR50
CR53
CR54
0.05
AB71
AB64
AB65
1.30
(10/22)
AB57
1.55
CR07
Portuguese Canyon
AB17
AB67
1.39
AB58
1.67/2.09
AB59
0.97/1.18
AB16
AB68
2.01/2.56
AB53
2.85
PB18
AB66
AB13
AB24
2.18
(10/22)
PT06
2.46/3.11
PB54
AB51
PB26
AB01
AB70
AB20
PB21
PB27
3.09
PT08
AB02
AB63
AB69
3.10
PT09
PB29
PB55
PB20
AB04
AB73
PB71
Altamira Canyon
PB08
PB07
PB69
PB12
Conqueror Trail
Abalone Cove
AB05
AB50
PB13
KC18
KC06
KC07
PB70
PB59
PB06
PB66
PB04
KC15
KC16
PB67
UB02
AB61
KC17
KC02
KC05
AB02
KC14
Inspiration Point
KC13
Google Earth
©2021 Google
3000 ft
N
Figure 2

GPS Monitoring Data

Survey Monuments - Upper Portuguese Bend Landslide/Burma Road Area

Displacement Response to 12-month Antecedent Rainfall

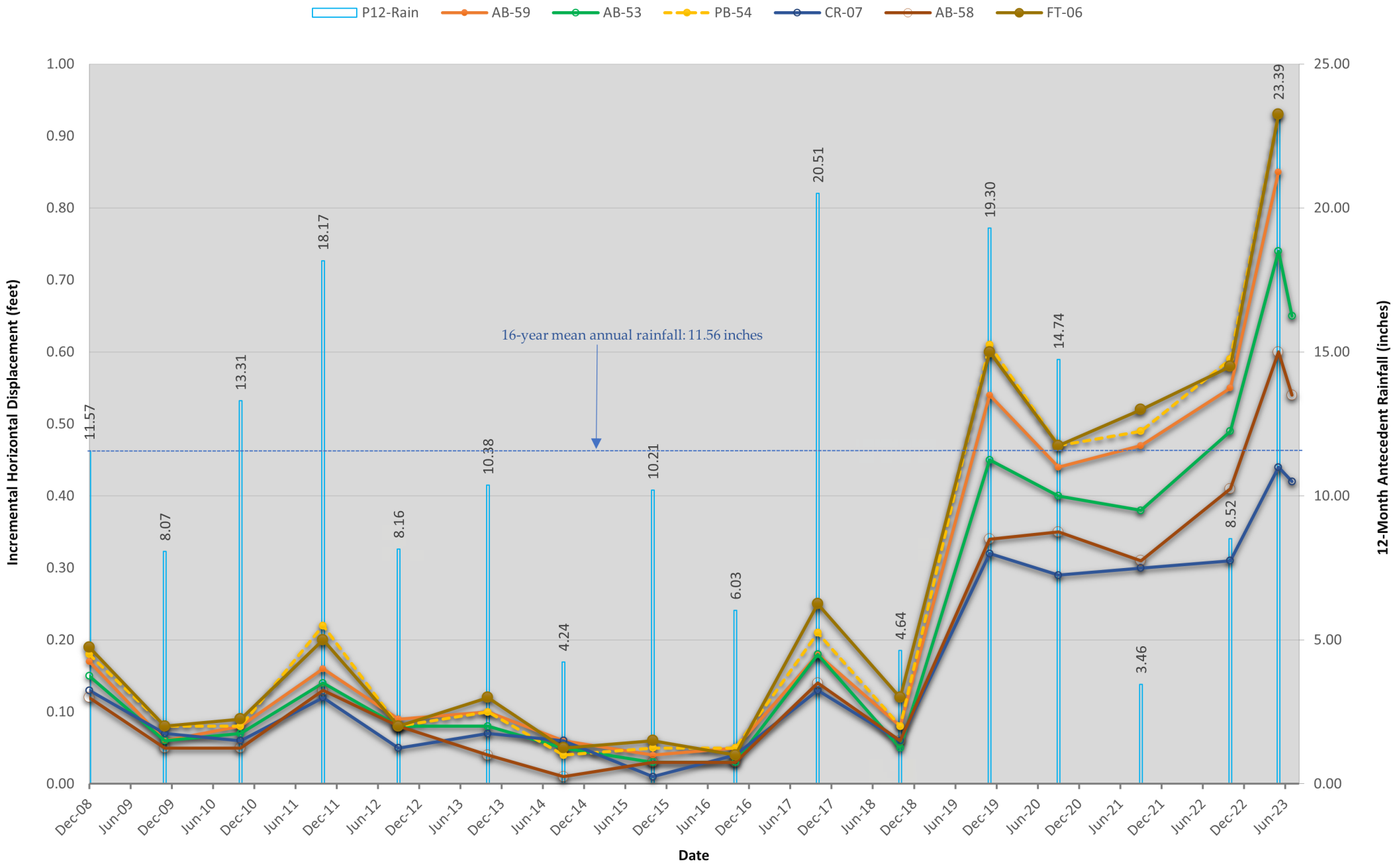


Figure 3

GPS Monitoring Data

Survey Monuments - Upper Portuguese Bend Landslide/Burma Road Area

Cumulative Horizontal Displacement 2007-2023

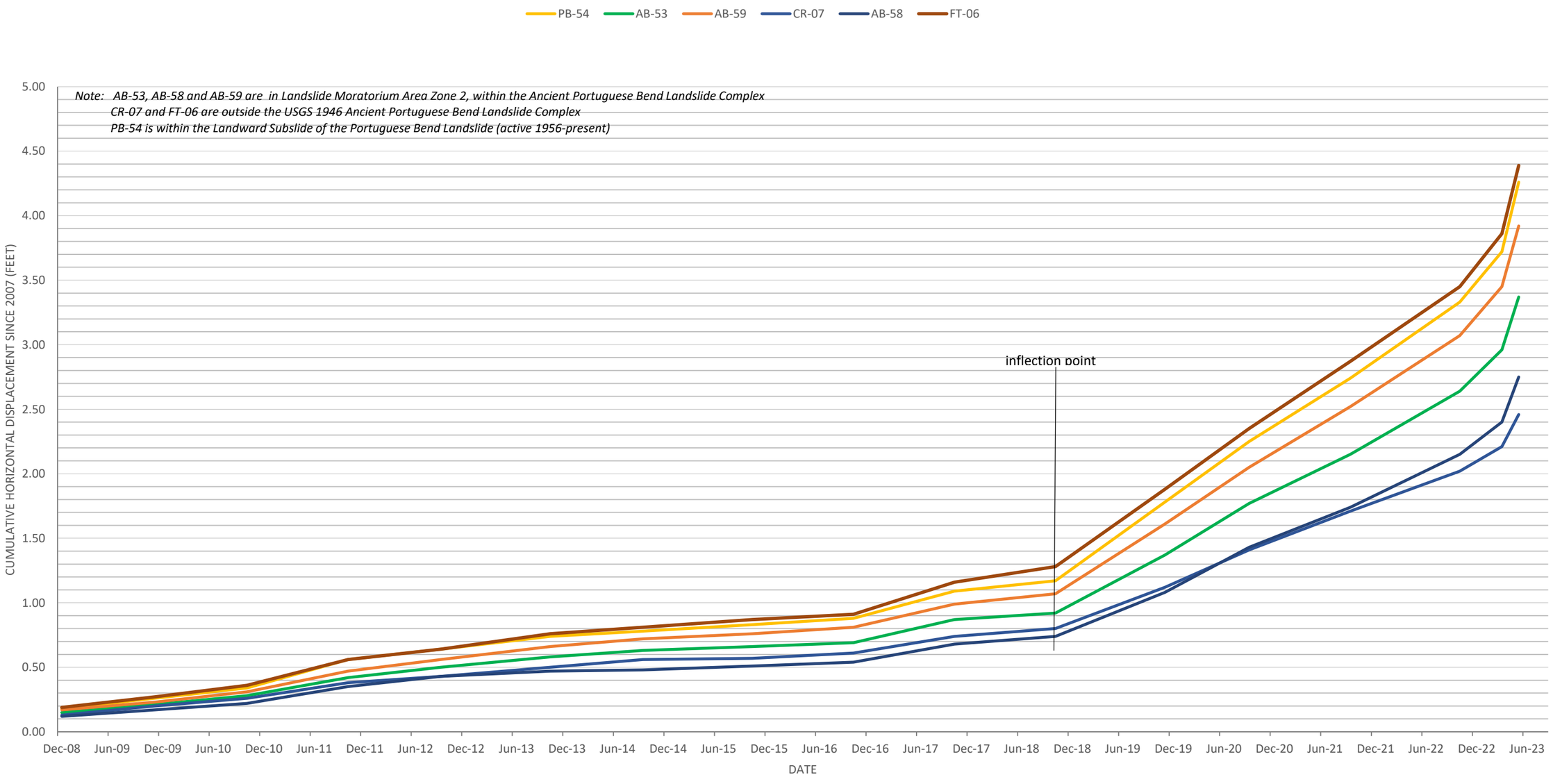


Figure 4

COTTON, SHIRES AND ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS

CITY OF RANCHO PALOS VERDES

CSA Project No: SC6163

MEMORANDUM

TO: Brandy Forbes, Community Development Director
CC: Ara Mihranian, City Manager
Ramzi Awwad, Public Works Director
FROM: Michael Phipps, CEG 1832, Contract City Geologist
Patrick Shires, GE 770, Contract City Geotechnical Engineer
RE: **Movement of the Altamira (Greater Portuguese Bend) Landslide Complex and Related Impacts, Rancho Palos Verdes, California**
DATE: November 8, 2024

INTRODUCTION

In this memorandum Cotton, Shires and Associates, Inc. (CSA) summarizes our evaluation of land movement of the Altamira Landslide Complex (previously referred to as the Greater Portuguese Bend Landslide Complex or Ancient Portuguese Bend Landslide Complex in past correspondence) from 2022-2024, with specific focus on the impacts of the land movement to private property, residential structures, and infrastructure. The active Altamira Landslide Complex currently involves major land movement comprising an area of over 700 acres landward of the coast. As of this date, the major land movement has resulted in the red-tagging (Unsafe to Enter/Occupy) of 18 residential structures and 2 commercial structures (at Wayfarer's Chapel), and the yellow-tagging (Limited Entry) of 38 other residential structures. It has also caused major impacts to public and private roads (some requiring closure), damages to utility infrastructure (water, sewer, gas, electricity and cable) causing certain utilities to be shut-off, and closure of certain Preserve land that is heavily accessed by the public for hiking, biking, equestrian, and other purposes.

BACKGROUND

The Altamira Landslide Complex in Rancho Palos Verdes includes four historically active, previously identified landslide areas: the Portuguese Bend Landslide (PBL) which began moving in 1956, the Abalone Cove Landslide (ACL) which began moving in 1979, the Klondike Canyon Landslide (KCL) which also began moving in 1979, and the Beach Club Landslide (BCL) which is nested within the KCL and, while dormant itself, moves with the KCL. It also now includes areas outside of the historically mapped boundaries of these known landslides, predominantly upslope from the historically mapped Portuguese Bend and Abalone Cove Landslides, within the Ancient Portuguese Bend Landslide Complex as mapped by various agencies (i.e., U.S. Geological Survey, California Geological Survey and other researchers (see attached Figure 1 - Landslide Area Map).

Based upon historically mapped boundaries, the ACL, PBL and KCL previously comprised an area of approximately 380 acres and affected portions of neighborhoods known as the Portuguese Bend Community, the Seaview Community and the Portuguese Bend Beach Club, as well as City-owned land within the Portuguese Bend Reserve (a sub-area of the greater Palos Verdes Nature Preserve). The

PBL has been continuously active since reactivation in 1956 with many areas of the landslide having moved hundreds of feet seaward over the ensuing six-plus decades. The ACL was active from 1979 until the late 1990's, involving only several feet of movement, when dewatering and other mitigation efforts largely halted movement. Creep movement of the ACL has occurred over the past 25 years following rainy seasons that were significantly above average rainfall amounts. The KCL has been episodically active in 1979-1983 and 2005-2006, experiencing only several inches of movement, typically in response to significantly above average rainfall. Landslide movements throughout the Ancient Portuguese Bend Landslide Complex *outside of the historical boundaries of* the ACL and PBL previously exhibited low rates of creep movement, or movement at or near the instrument precision range, in the 11-year monitoring period of 2007-2018 for which we have readily available data. These landslides are deep translational-type failures within seaward-dipping strata of the Monterey Formation, with the landslide slip surfaces occurring within very weak bentonitic clay beds. Historically, the movement behavior of these landslides routinely exhibited high sensitivity to increased groundwater pore pressure, and increased rates of land movement were correlative with 6-to-12-month antecedent rainfall that was well above average. Similarly, land movement decreased during below average rainy seasons or multi-year periods of drought.

Beginning in 2021, CSA geologists were requested by the City of Rancho Palos Verdes to observe reported distress (ground cracking and fissures) to trails in the Portuguese Bend Reserve. At that time, we also began reviewing Global Positioning Satellite (GPS) monitoring data for survey monuments within the entire Ancient Portuguese Bend Landslide Complex or Altamira Landslide Complex. In the summer of 2022, CSA was also asked to evaluate distress to an SCE transmission line along Burma Road within the Portuguese Bend Reserve. Subsequent geologic mapping of the Reserve area revealed that headward and lateral enlargement of the Portuguese Bend Landslide was occurring. We were also receiving reports of underground water line breaks occurring within the Portuguese Bend Community Association area and the Seaview Community. Review of GPS monitoring data from 2007 through 2023 indicated that land movement acceleration initially began between 2018 and 2019. We postulated that this acceleration was correlative with significantly above-normal rainfall in two out of three prior rainfall seasons (2016-17 and 2018-19) which followed five consecutive drier than normal rainfall seasons (2011-12 through 2015-16) (see attached Figure 2 – GPS Monitoring Data, Ancient Portuguese Bend Landslide: Displacement Response to 12-Month Antecedent Rainfall, December 2008-January 2024). One notable item, however, is that the land movement velocities did not decline back to the pre-2018 levels despite two significantly below-normal rainy seasons (2020-21, one of the driest on record, and 2021-22).

RAINFALL IMPACTS – 2022 THROUGH 2024

Further acceleration of land movement occurred throughout the Altamira Landslide Complex during and following the 2022-23 rain season, and the rainfall impacts from mid- to late-winter storms significantly contributed to the increased ground movements. Significant accelerations in movement velocity were documented in May 2023 following major storm sequences in January, February and March of 2023, which added to cumulative seasonal rainfall totals exceeding 193% of average rainfall. Approximately 87% of this rain fell prior to June 18, 2023. Most of this rainfall occurred from three significant atmospheric river-type storm sequences occurring on January 9-16 (3.59 inches), February 23-March 1 (3.79 inches) and March 10-15 (4.12 inches). Land movement velocities further increased as of the July 15, 2023 monitoring. An anomalous tropical storm dropped an additional 3.05 inches of

rain on August 19-20, 2023, resulting in further land movement acceleration as of the October 10, 2023 monitoring. The multiple increases in landslide velocities (i.e., accelerations) resulted in additional mappable ground surface expressions of the uphill limits of active landsliding, including the formation of landslide scarps, fissures, grabens, tensional cracking and shear zones, including areas north, west and east of the historically known landslide boundaries. Field geologic mapping and photo-geologic mapping performed in mid to late 2023 corroborated the GPS monitoring data findings that a large portion of the Ancient Portuguese Bend Landslide Complex (Altamira Landslide Complex) above the historically mapped PBL, ACL and KCL boundaries was involved in significant active landslide movement. The boundary of that major land movement has been updated through November 2024 and is depicted by the green dashed line on the attached Figure 1 – Landslide Area Map.

The 2023-2024 rainfall season total of more than 23 inches was 170% of the long-term average and had a compounding effect on the previous season's extraordinary rainfall. This rainfall season was characterized by additional atmospheric river type storms, including a sequence of storms that resulted in a Federally declared disaster from January 30 - February 9, 2024. The February 2024 rainfall total of 11.22 was the second wettest February in the 67-year history of recorded data for the Palos Verdes Peninsula. The landslide response to these rains was almost immediate and we observed continued accelerating land movement in the GPS monitoring data through August 1, 2024. A peak land movement velocity of >13 inches/week occurred in the center of the landslide as of the May 28, 2024 monitoring period. Movement velocities appeared to peak across the breadth of the landslide in the July 1 - August 1, 2024 monitoring period with the majority of stations moving >10 inches/week and peak movements >12 inches per week. Attached Figures 3, 4, 5 and 6 – GPS Monitoring Displacement Rate Contour Maps, are landslide movement velocity contour maps produced from GPS monitoring data through August 1, 2024, September 4, 2024, October 8, 2024 and October 29, 2024, respectively.

For reference, rainfall data utilized for this evaluation are from the Los Angeles County Department of Public Works - Hydrology Division Station 1011B, located at the Rolling Hills Fire Station No. 56. This rainfall station serves as a reasonable proxy for rainfall impacts to the southern face of the Palos Verdes Peninsula due to its elevation, which should reflect some orographic effect for storms approaching the Palos Verdes Peninsula from the west, southwest, and south, compared to coastal stations such as Point Vicente which may underestimate rain totals in the higher reaches of the landslide complex and watershed.

TOTAL LAND MOVEMENT – OCTOBER 2022 THROUGH OCTOBER 2024

Since October 10, 2022, total horizontal land movement throughout the Altamira Landslide Complex has ranged from approximately 27 to 39 feet in most areas, with the exception being approximately 6 to 21 feet of horizontal land movement in the Klondike Canyon Landslide area. Vertical displacements have ranged from 1 - 10 feet in most areas over this same period. This land movement has had a destructive and devastating effect on numerous residential and commercial properties and structures, private and public roadways, and utility infrastructure. In addition to the 18 red-tagged and 38 yellow-tagged structures, dozens of homes are experiencing varying amounts of distress and inaccessibility due to differential land movements, and electricity and gas service has been cut off from the majority of these properties. The most significant damage is to structures on or adjacent to the landslide boundaries, or those located on boundaries between subslides (blocks) within the Altamira Landslide Complex that are moving at different rates.

Since June 2024, the City has undertaken emergency mitigation measures including 18 deep geotechnical test borings with sophisticated instrumentation to detect the depth(s) of land movement and groundwater pore pressures within and beneath the active landslide mass(es). The instrumented geotechnical test borings revealed that the basal slip surface of the Altamira Landslide Complex beneath the Portuguese Bend Landslide portion of the Altamira complex is up to twice as deep as previously/historically modeled, and moving at a much faster rate than the shallower PBL slip surface. This significantly greater depth of movement has resulted in a broader footprint of active land movement at the ground surface and offshore, and expansion of the historical land movement area from approximately 380 acres to over 700 acres. The test borings also indicated that artesian or near-artesian groundwater pressure is present beneath the Altamira slip surface, and confined groundwater under significant pressure is present between the Altamira and PBL slip surfaces. High unconfined groundwater levels were also determined within the historically modeled Portuguese Bend and Abalone Cove landslide bodies. Beginning September 13, 2024, the first of 10 deep dewatering wells came online. The ten wells, all located near the toe, or lower 1/3 of the landslide complex, are currently extracting approximately 1 million gallons per day of groundwater within and beneath the landslide.

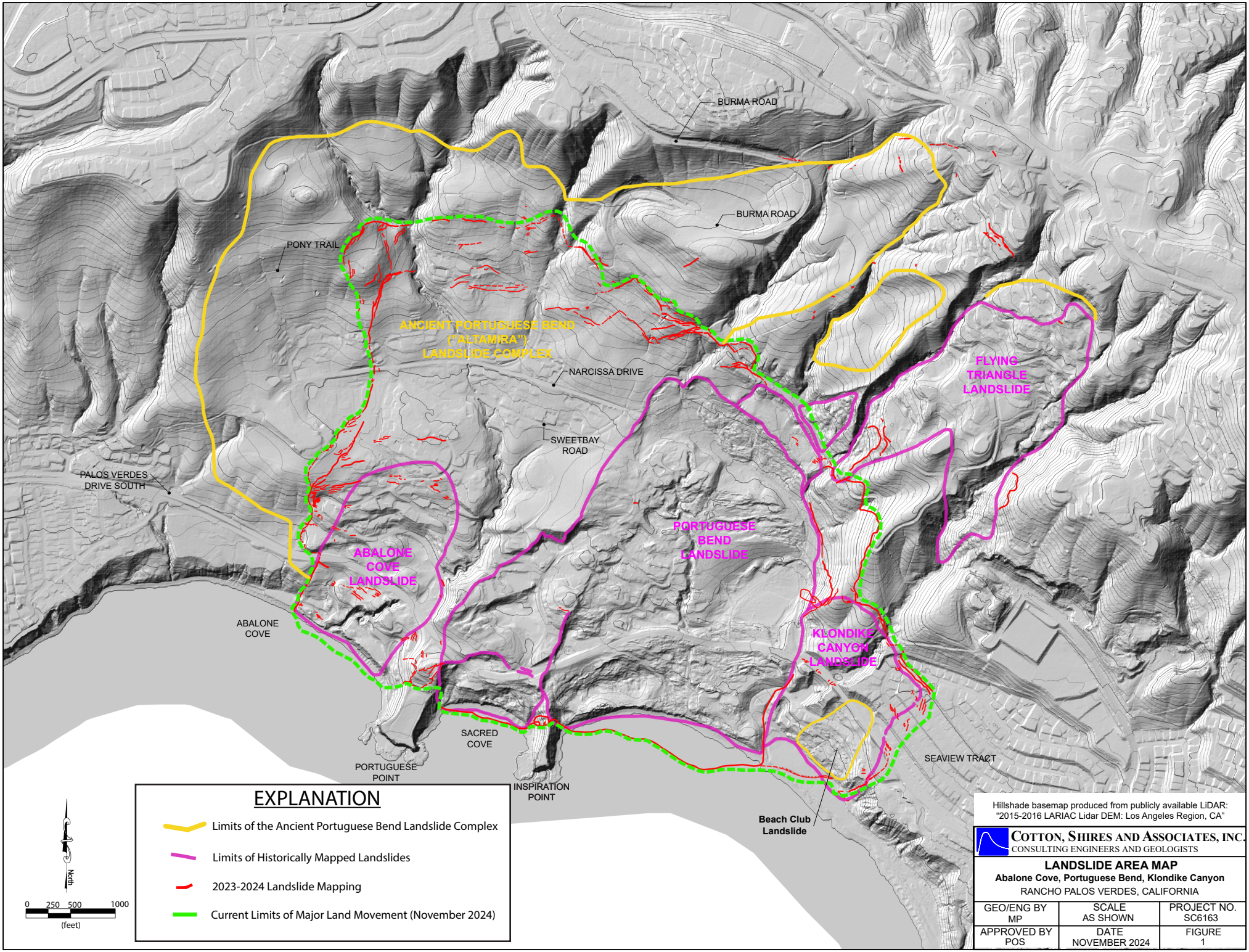
FUTURE LAND MOVEMENT POTENTIAL

As described above, major movement of the Altamira Landslide Complex ranging from 6 to 39 feet horizontally and 1 to 10 feet vertically has occurred since October 2022, with the majority of that movement occurring during and following the 2023-24 rainy season. The highest observed movement rates have exceeded 12 inches per week. While emergency dewatering mitigation efforts and 6 months without any rainfall recharge have reduced movements in most areas to a current level of 0.5 to 6 inches per week, there are many uncertainties regarding the longevity and long-term effectiveness of the deep dewatering wells that have been installed, including the availability of additional funding needed to maintain them and keep them operational. There is also uncertainty regarding the quantity of dewatering wells needed to maintain landslide movements at low (creep) movement levels, and whether funding for additional wells can be obtained. Given the emergency measures that are in place, the future response of the landslide to seasonal rains, including the severity of those rains is unknown; however, historical land movement data demonstrates increases in land movement with above-average rainy seasons despite the operation of past dewatering facilities operated by private geologic hazard abatement districts such as ACLAD and KCLAD.

-o-

Attachments:

Figure 1 – Landslide Area Map
Figure 2 – GPS Monitoring Data, Displacement Response to 12-Month Antecedent Rainfall, December 2008-January 2024
Figure 3 – GPS Monitoring Displacement Rate Contour Map (8/1/2024 Data)
Figure 4 – GPS Monitoring Displacement Rate Contour Map (9/4/2024 Data)
Figure 5 – GPS Monitoring Displacement Rate Contour Map (10/8/2024 Data)
Figure 6 – GPS Monitoring Displacement Rate Contour Map (10/29/2024 Data)

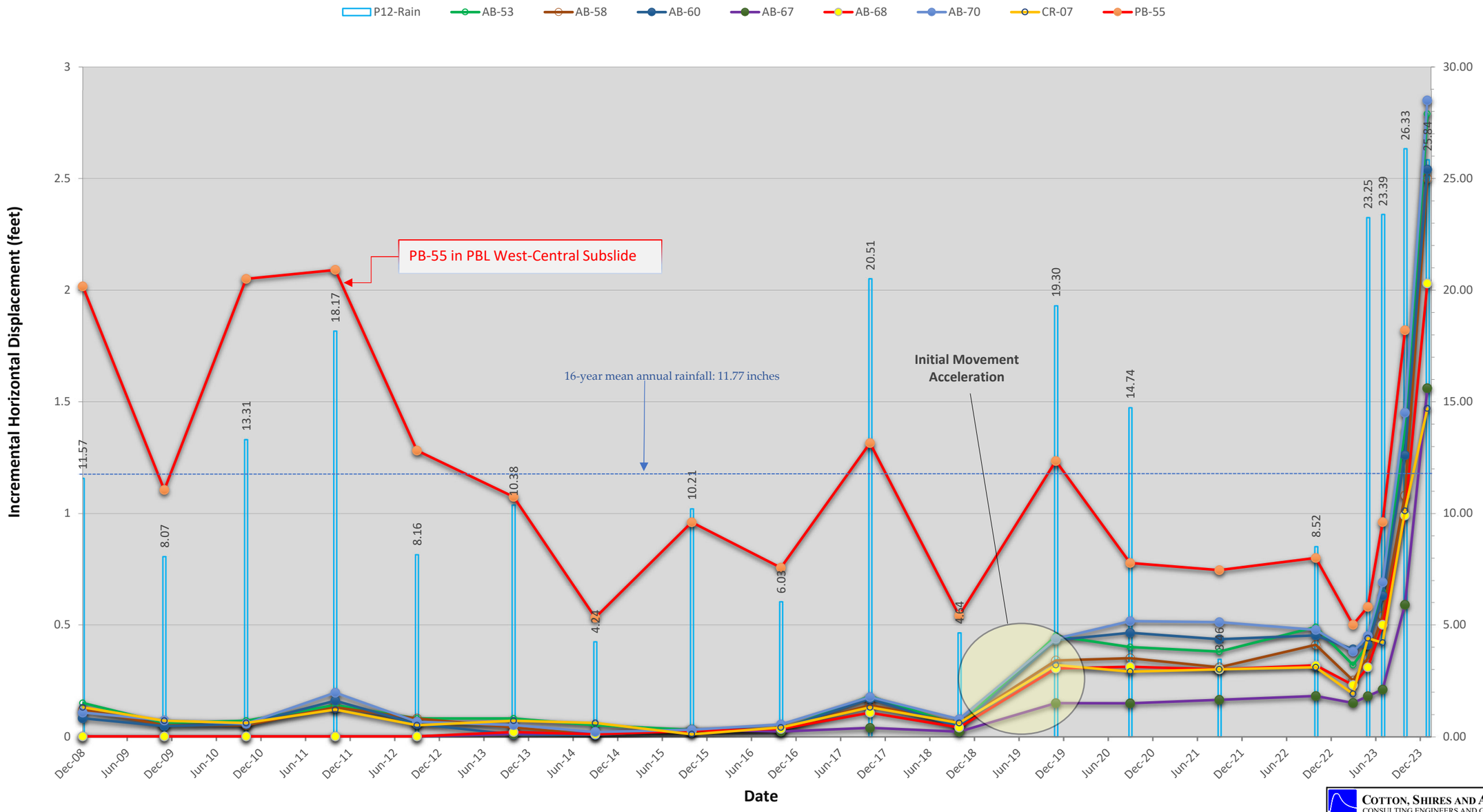

BURMA ROAD
BURMA ROAD
PONY TRAIL
ANCIENT PORTUGUESE BEND ("ALTAMIRA") LANDSLIDE COMPLEX
NARCISSA DRIVE
SWEETBAY ROAD
PALOS VERDES DRIVE SOUTH
FLYING TRIANGLE LANDSLIDE
PORTUGUESE BEND LANDSLIDE
ABALONE COVE LANDSLIDE
KLONDIKE CANYON LANDSLIDE
ABALONE COVE
SACRED COVE
PORTUGUESE POINT
INSPIRATION POINT
SEAVIEW TRACT
Beach Club Landslide
EXPLANATION
Limits of the Ancient Portuguese Bend Landslide Complex
Limits of Historically Mapped Landslides
2023-2024 Landslide Mapping
Current Limits of Major Land Movement (November 2024)
North
0 250 500 1000
(feet)
Hillshade basemap produced from publicly available LiDAR: "2015-2016 LARIAC Lidar DEM: Los Angeles Region, CA"
COTTON, SHIRES AND ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS
LANDSLIDE AREA MAP
Abalone Cove, Portuguese Bend, Klondike Canyon
RANCHO PALOS VERDES, CALIFORNIA
GEO/ENG BY MP
SCALE AS SHOWN
PROJECT NO. SC6163
APPROVED BY POS
DATE NOVEMBER 2024
FIGURE 1

GPS Monitoring Data

Survey Monuments - ACL, PBL and Upper Ancient Landslide Complex

Displacement Response to 12-month Antecedent Rainfall

December 2008-January 2024



COTTON, SHIRES AND ASSOCIATES, INC. CONSULTING ENGINEERS AND GEOLOGISTS	
GPS Monitoring Data Survey Monuments- ACL, PBL, and Upper Ancient Landslide Complex Displacement Response to 12-month Antecedent Rainfall Rancho Palos Verdes, California	
GEO/ENG BY MP	SCALE
APPROVED BY POS	DATE NOVEMBER 2024

PROJECT NO. SC6163

FIGURE 2

APPROXIMATE BOUNDARY OF ANCIENT PORTUGUESE BEND LANDSLIDE COMPLEX

"Creeping Area" Approximately 0.5 inch/week

CURRENT LIMITS OF MAJOR LANDSLIDE MOVEMENT (AUGUST 2024)

PONY TRAIL

BURMA ROAD

PALOS VERDES DRIVE SOUTH

ABALONE COVE

PORTUGUESE POINT

SACRED COVE

INSPIRATION POINT

SEAVIEW TRACT

PORTUGUESE BEND LANDSLIDE

ABALONE COVE LANDSLIDE

FLYING TRIANGLE LANDSLIDE

KLONDIKE CANYON LANDSLIDE

0.06 CW01
0.08 AB77
0.07 CR56
0.33 CR50
0.47 CR51
0.49 CR53
0.52 CW05
0.00 AB71 no data
0.00 CR57 no data
0.48 AB64
0.01 AB17
0.03 RP02
0.05 CW06
0.24 AB76
0.06 AB01
0.04 CW07
0.02 FT08
0.05 CW08
0.01 FT09
0.02 FT00
0.06 AB02
0.08 KC14
0.02 RP01
0.23 KC25
0.46 KC13
4.09 KC22
0.04 KC21
3.84 KC33
3.89 KC06
3.40 KC19
0.03 KC07
0.03 KC16
3.45 KC20
3.91 KC15
2.72 KC23
3.53 KC17
2.41 KC05
5.68 KC28
5.16 KC24
3.88 KC27
4.09 KC26
6.48 KC29
9.21 KC30
8.82 PB13
8.23 KC31
7.84 KC18
11.39 PB74
11.45 PB12
9.87 PB26
9.36 PB29
10.91 PB27
9.39 PB73
11.89 PB54
10.41 PB21
11.54 PB75
11.13 PB55
10.83 PB20
10.84 PB08
9.92 PB09
11.68 PB07
12.96 PB71
12.29 PB67
9.98 UB02
11.36 PB59
11.13 PB69
11.58 PB70
11.34 PB04
11.15 PB68
11.81 PB72
10.07 PB06
10.75 AB73
11.99 AB75
12.43 AB21
11.69 AB70
10.19 AB60
9.11 AB63
7.08 AB62
9.20 AB04
8.55 AB05
6.86 AB50
5.16 AB74
8.95 AB51
11.23 AB24
10.64 AB13
10.10 AB66
9.79 AB68
7.49 AB16
7.48 AB67
8.88 AB65
9.39 AB57
11.00 AB58
12.65 AB59
11.80 CR54
11.29 AB53
11.89 PB18
0.00 AB71 no data
7.0
8.0
9.0
10.0
11.0
12.0

EXPLANATION

- Limits of the Ancient Portuguese Bend Landslide Complex
- Limits of Historically Mapped Landslides
- 2023/2024 Landslide Mapping
- Current Limits of Major Landslide Movement (August 2024)
- GPS Monument Displacement!Rate (July 1, 2024 to August 1, 2024) Displacement Vector! Scale 1"= 8"/week

Displacement Rate Table

Minimum Rate (inch/week)	Maximum Rate (inch/week)	Color
0.00	1.00	
1.00	2.00	
2.00	3.00	
3.00	4.00	
4.00	5.00	
5.00	6.00	
6.00	7.00	
7.00	8.00	
8.00	9.00	
9.00	10.00	
10.00	11.00	
11.00	12.00	
12.00	13.00	

North

0 250 500 1000 (feet)

Hillshade basemap produced from publicly available LiDAR: "2015 - 2016 LARIAC Lidar DEM: Los Angeles Region, CA"

COTTON, SHIRES AND ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS

GPS MONITORING DISPLACEMENT RATE CONTOUR MAP (8/1/24 DATA)
Abalone Cove, Portuguese Bend, Klondike Canyon
RANCHO PALOS VERDES, CALIFORNIA

GEO/ENG BY	SCALE	PROJECT NO.
MP	1"=500'	SC6163
APPROVED BY	DATE	FIGURE NO.
POS	November 8, 2024	3

APPROXIMATE BOUNDARY OF ANCIENT PORTUGUESE BEND LANDSLIDE COMPLEX

CURRENT LIMITS OF MAJOR LANDSLIDE MOVEMENT (SEPTEMBER 2024)

"Creeping Area" Approximately 0.5 inch/week

BURMA ROAD

PONY TRAIL

PALOS VERDES DRIVE SOUTH

PORTUGUESE BEND LANDSLIDE

ABALONE COVE LANDSLIDE

KLONDIKE CANYON LANDSLIDE

FLYING TRIANGLE LANDSLIDE

ABALONE COVE

SACRED COVE

PORTUGUESE POINT

INSPIRATION POINT

SEAVIEW TRACT

EXPLANATION

- Limits of the Ancient Portuguese Bend Landslide Complex
- Limits of Historically Mapped Landslides
- 2023/2024 Landslide Mapping
- Current Limits of Major Landslide Movement (September 2024)
- GPS Monument Displacement Rate (August 1, 2024 to September 4, 2024) Displacement Vector Scale 1"= 8"/week

Displacement Rate Table

Minimum Rate (inch/week)	Maximum Rate (inch/week)	Color
0.00	1.00	
1.00	2.00	
2.00	3.00	
3.00	4.00	
4.00	5.00	
5.00	6.00	
6.00	7.00	
7.00	8.00	
8.00	9.00	
9.00	10.00	
10.00	11.00	
11.00	12.00	
12.00	13.00	

North

0 250 500 1000 (feet)

Hillshade basemap produced from publicly available LiDAR: "2015 - 2016 LARIAC Lidar DEM: Los Angeles Region, CA"

COTTON, SHIRES AND ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS

GPS MONITORING DISPLACEMENT RATE CONTOUR MAP (9/4/24 DATA)
Abalone Cove, Portuguese Bend, Klondike Canyon
RANCHO PALOS VERDES, CALIFORNIA

GEO/ENG BY	SCALE	PROJECT NO.
MP	1"=500'	SC6163
APPROVED BY	DATE	FIGURE NO.
POS	November 8, 2024	4

APPROXIMATE BOUNDARY OF ANCIENT PORTUGUESE BEND LANDSLIDE COMPLEX

CURRENT LIMITS OF MAJOR LANDSLIDE MOVEMENT (OCTOBER 2024)

"Creeping Area" Approximately 0.5 inch/week

BURMA ROAD

PONY TRAIL

PALOS VERDES DRIVE SOUTH

ABALONE COVE

SACRED COVE

PORTUGUESE POINT

INSPIRATION POINT

SEAVIEW TRACT

ABALONE COVE LANDSLIDE

PORTUGUESE BEND LANDSLIDE

KLONDIKE CANYON LANDSLIDE

FLYING TRIANGLE LANDSLIDE

0.04 AB80
0.04 AB79
0.03 CW01
0.06 AB77
0.07 CR56
0.35 CR50
0.44 CR51
0.00 CR60
0.43 CR53
0.36 CR58
1.78 AB78
6.17 AB57
0.47 CW05
0.03 CR59
0.12 AB64
6.14 AB65
0.11 CR57
0.04 AB17
5.09 AB67
6.86 CR54
7.44 AB58
0.00 RP03
0.07 CW06
7.90 AB59
0.03 FT10
5.42 AB16
6.82 AB68
7.37 AB53
6.95 PB18
0.11 AB76
6.91 AB66
7.23 AB13
3.84 PB76
7.88 AB24
7.18 AB75
6.99 PB54
4.01 PB26
0.05 AB01
3.66 AB74
6.18 AB51
7.85 AB70
7.29 AB21
0.03 FT08
4.96 PB21
5.05 PB27
0.02 CW08
6.23 AB69
6.74 AB69
6.28 PB75
0.04 FT09
5.03 AB62
5.26 PB55
3.42 PB29
4.99 PB20
0.04 KC21
6.09 AB04
7.08 PB71
6.04 AB73
6.03 PB70
5.88 PB59
1.57 KC06
3.88 AB50
5.64 PB69
4.62 PB08
4.08 PB09
4.21 PB12
3.04 PB13
1.80 KC22
1.35 KC19
5.11 PB07
5.74 PB04
3.23 KC31
2.49 KC18
0.04 KC07
4.58 PB06
1.67 KC33
1.29 KC20
0.02 KC16
5.71 PB68
5.77 PB72
4.63 PB67
4.54 PB74
3.38 KC30
1.53 KC15
3.74 UB02
1.34 KC17
1.05 KC23
1.05 KC05
2.27 KC29
1.75 KC24
2.47 KC38
1.98 KC28
1.34 KC26
0.55 KC13
0.05 KC35
0.05 KC14
0.05 KC34
0.03 KC36
0.08 KC25
0.04 KC37
0.04 RP01

5.0
6.0
7.0
4.0
3.0
2.0
1.0

EXPLANATION

- Limits of the Ancient Portuguese Bend Landslide Complex
- Limits of Historically Mapped Landslides
- 2023/2024 Landslide Mapping
- Current Limits of Major Landslide Movement (October 2024)
- GPS Monument Displacement Rate (September 4, 2024 to October 8, 2024) Displacement Vector Scale 1"= 8"/week

Displacement Rate Table

Minimum Rate (inch/week)	Maximum Rate (inch/week)	Color
0.00	1.00	
1.00	2.00	
2.00	3.00	
3.00	4.00	
4.00	5.00	
5.00	6.00	
6.00	7.00	
7.00	8.00	
8.00	9.00	
9.00	10.00	
10.00	11.00	
11.00	12.00	
12.00	13.00	

North

0 250 500 1000
(feet)

Hillshade basemap produced from publicly available LiDAR: "2015 - 2016 LARIAC Lidar DEM: Los Angeles Region, CA"

COTTON, SHIRES AND ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS

GPS MONITORING DISPLACEMENT RATE CONTOUR MAP (10/8/24 DATA)
Abalone Cove, Portuguese Bend, Klondike Canyon
RANCHO PALOS VERDES, CALIFORNIA

GEO/ENG BY	SCALE	PROJECT NO.
MP	1"=500'	SC6163
APPROVED BY	DATE	FIGURE NO.
POS	November 8, 2024	5

APPROXIMATE BOUNDARY OF ANCIENT PORTUGUESE BEND LANDSLIDE COMPLEX

CURRENT LIMITS OF MAJOR LANDSLIDE MOVEMENT (NOVEMBER 2024)

BURMA ROAD

PONY TRAIL

PALOS VERDES DRIVE SOUTH

ABALONE COVE

PORTUGUESE POINT

SACRED COVE

INSPIRATION POINT

ABALONE COVE LANDSLIDE

PORTUGUESE BEND LANDSLIDE

KLONDIKE CANYON LANDSLIDE

FLYING TRIANGLE LANDSLIDE

SEAVIEW TRACT

0.07 AB80 · 0.12 AB79 · 0.02 CW01 · 0.06 AB77 · 0.04 CR56 · 0.08 CR50 · 0.10 CR51 · 0.03 CR60 · 0.01 CR53 · 0.07 CR58 · 0.13 AB78 · 0.08 CW05 · 0.08 CR59 · 0.62 AB64 · 4.83 AB57 · 4.21 AB65 · 0.09 CR57 · 0.09 AB17 · 3.61 AB67 · 4.0 · 5.10 AB58 · 4.68 CR54 · 5.0 · 5.04 AB59 · 0.01 RP03 · 0.08 CW06 · 3.91 AB16 · 4.51 AB53 · 4.01 PB18 · 0.07 FT10 · 4.72 AB68 · 4.74 AB66 · 0.11 AB76 · 3.32 AB76 · 1.55 PB76 · 5.64 AB24 · 0.13 AB01 · 3.06 AB74 · 4.17 AB51 · 4.70 AB75 · 4.23 PB54 · 0.56 PB26 · 0.04 FT08 · 4.63 AB21 · 2.48 PB21 · 2.08 PB27 · 0.16 GW08 · 0.06 FT09 · 5.46 AB70 · 4.37 AB69 · 5.29 AB60 · 3.49 PB75 · 3.64 AB62 · 2.88 PB55 · 0.36 PB29 · 4.0 · 4.36 PB71 · 2.03 PB20 · 4.32 AB04 · 3.53 AB73 · 1.97 PB08 · 2.0 · 0.04 KC21 · 0.22 KC06 · 3.47 PB70 · 3.38 PB59 · 1.67 PB09 · 1.23 PB12 · 0.38 PB13 · 3.0 · 2.46 PB07 · 3.63 PB69 · 0.22 KC31 · 0.14 KC18 · 0.19 KC22 · 0.28 KC19 · 2.07 AB50 · 2.21 PB06 · 3.25 PB04 · 0.24 KC33 · 0.11 KC07 · 3.25 PB68 · 3.22 PB72 · 1.0 · 0.68 UB02 · 1.14 PB67 · 0.97 PB74 · 0.16 KC20 · 0.13 KC16 · 0.16 KC30 · 0.19 KC15 · 0.11 KC17 · 0.20 KC23 · 0.19 KC05 · 0.12 KC29 · 0.11 KC24 · 0.22 KC38 · 0.17 KC28 · 0.08 KC26 · 0.12 KC13 · 0.09 KC25 · 0.11 KC14 · 0.12 KC35 · 0.14 KC34 · 0.10 KC36 · 0.16 KC37 · 0.11 RP01

EXPLANATION

- Limits of the Ancient Portuguese Bend Landslide Complex
- Limits of Historically Mapped Landslides
- 2023/2024 Landslide Mapping
- Current Limits of Major Landslide Movement (November 2024)
- GPS Monument Displacement Rate (October 8, 2024 to October 29, 2024) Displacement Vector Scale 1"= 8"/week

Displacement Rate Table

Minimum Rate (inch/week)	Maximum Rate (inch/week)	Color
0.00	1.00	
1.00	2.00	
2.00	3.00	
3.00	4.00	
4.00	5.00	
5.00	6.00	
6.00	7.00	
7.00	8.00	
8.00	9.00	
9.00	10.00	
10.00	11.00	
11.00	12.00	
12.00	13.00	

North

0 250 500 1000 (feet)

Hillshade basemap produced from publicly available LiDAR: "2015 - 2016 LARIAC Lidar DEM: Los Angeles Region, CA"

COTTON, SHIRES AND ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS

GPS MONITORING DISPLACEMENT RATE CONTOUR MAP (10/29/24 DATA)
Abalone Cove, Portuguese Bend, Klondike Canyon
RANCHO PALOS VERDES, CALIFORNIA

GEO/ENG BY	SCALE	PROJECT NO.
MP	1"=500'	SC6163
APPROVED BY	DATE	FIGURE NO.
POS	November 8, 2024	6

COTTON, SHIRES AND ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS

CITY OF RANCHO PALOS VERDES

CSA Project No: SC6163

MEMORANDUM

TO: Ara Mihranian, City Manager
CC: Ramzi Awwad, Public Works Director

FROM: Michael Phipps, CEG 1832, Contract City Geologist
Patrick Shires, GE 770, Contract City Geotechnical Engineer
RE: **Movement of the Altamira Landslide: Characterization, Related Impacts, Causation, and Emergency Measures, Rancho Palos Verdes, California**
DATE: March 16, 2025

INTRODUCTION

In this memorandum Cotton, Shires and Associates, Inc. (CSA) summarizes our evaluation of movement of the Altamira Landslide, with specific focus on the characteristics, differences, and causation of movement of this new landslide, distinguishing it from the known historically active Landslide Complex that is comprised of the Portuguese Bend Landslide (PBL), Abalone Cove Landslide (ACL), Klondike Canyon Landslide (KCL) and Beach Club Landslide (BCL). We include the BCL as part of the KCL, because it is, in itself, dormant and nested within (or rafts upon) the KCL. Also discussed are impacts of the Altamira Landslide movement to private property, residential structures, and infrastructure in the landslide area.

DISTINGUISHING THE ALTAMIRA LANDSLIDE

For definition purposes, the Altamira Landslide is a newly active landslide that has occurred within a previously mapped ancient landslide complex, most recently labeled the "Ancient Altamira Landslide Complex" (Douglas, 2013) which was a name modification of the "Ancient Portuguese Bend Landslide" identified on the California Geological Survey's Landslide Inventory Map (CGS, 2007). See the excerpted Figure 1 from Douglas (2013) on the following page for this clarification. It is important to make this distinction for consistency and to avoid confusion, because the Altamira Landslide is, in fact, a new member of the historically active PBL/ACL/KCL Landslide Complex but largely **underlies it** and occupies an area of active land movement >700 acres and extends to more than 500 feet off of the coastline, whereas the shallower historically active PBL/ACL/KCL complex only occupied about 380 acres.

The Altamira Landslide in Rancho Palos Verdes is therefore a recently identified large landslide that largely underlies (and therefore largely encompasses, but exceeds the area of) the previously understood active Landslide Complex containing the four historically active landslides: the PBL which historically began moving in 1956, the ACL which began moving in 1979, the KCL which also began moving in 1979, and the BCL which is nested within the KCL and, while dormant itself, moves along with the KCL. The Altamira Landslide includes large areas outside of the historically mapped boundaries of these known landslides, predominantly upslope and downslope from the historically

mapped PBL and ACL, within, but smaller than, the Ancient Altamira Landslide Complex as defined above. To provide an example of the change in size, the dimensions from head to toe of the previously historical ACL is 2,250 feet and the width up to 1,450 feet wide. The dimensions from head to toe of the Altamira Landslide, underlying and extending up and down slope from both the PBL and the ACL, is 5,800 feet (more than double that of the ACL) with a width of up to 7,400 feet wide (more than five times as wide as the ACL).

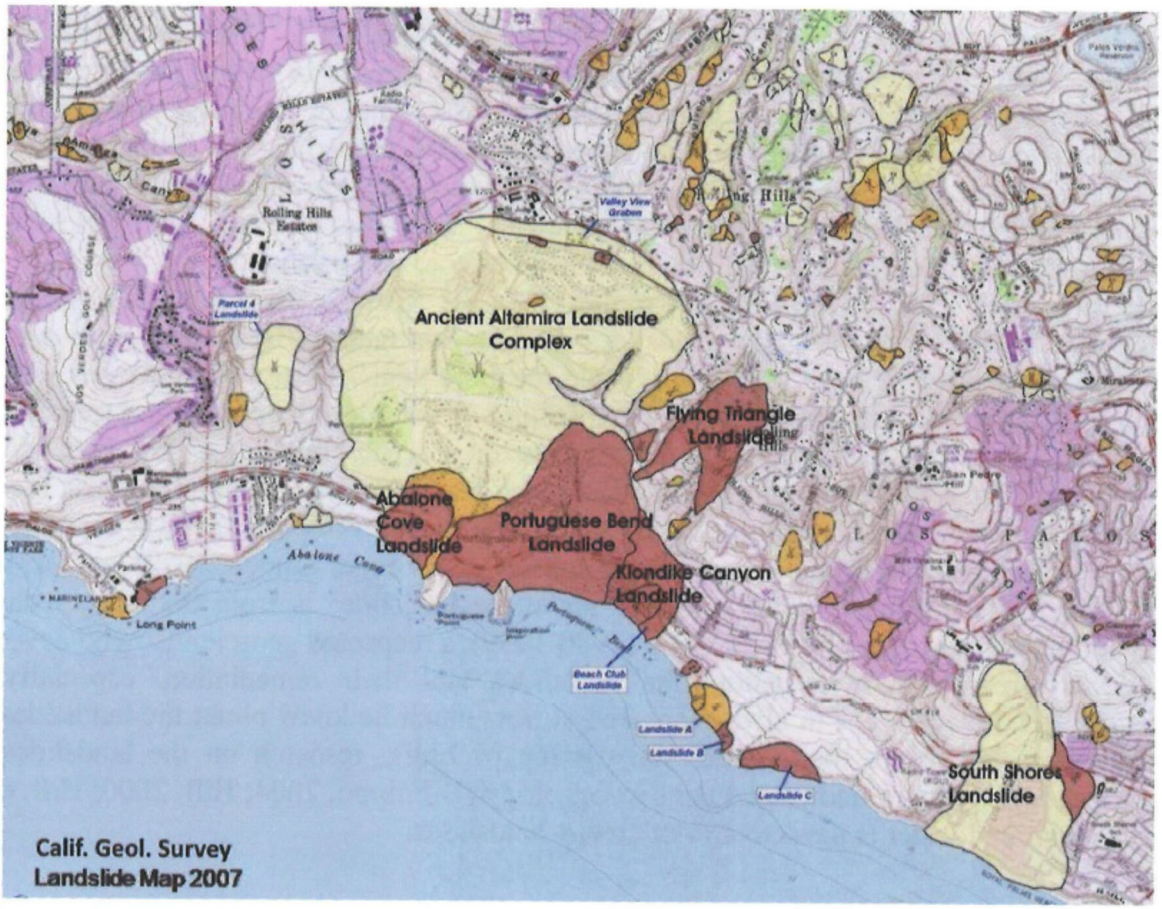


Figure 1. Landslide map of a portion of the south flank of the Palos Verdes Peninsula prepared by the California Geological Survey (2007). The major and some minor landslides are identified. Light yellow indicates that the landslide is inactive, red is active and orange is dormant.

While previous geotechnical investigators identified inactive deep failure surfaces in both the historically active and ancient landslide areas, none of them mapped or identified as active the entire depth or breadth of movement that has recently impacted the area, nor did they opine that such an event would occur in historic times. The active Altamira Landslide currently involves major land movement comprising an area of over 700 acres landward of the coast and extends to approximately 500 feet or more off the coastline. The areal dimensions, depth of movement, velocity of movement, artesian and near-artesian groundwater pressures beneath it, and even the direction of movement, are different than the Abalone Cove, Portuguese Bend, and Klondike Canyon landslides. The distinction to be made then, is that the Altamira Landslide is not just simple *expansion* of an existing group of landslides, it is an entirely different, larger and deeper landslide with much broader boundaries (including the new coastline offshore), nearly twice as deep as the depth of historic landslide movement in some areas, and with unprecedented rates of movement (which were not seen in the early LA County

Engineer surveys, the Charles Abbott Associates surveys beginning in 1994, nor the McGee surveys since 2007). None of this was experienced during the history of the City, and the Altamira Landslide is a unique landslide not characterized in its current dimensions during the over 70-year history of landslide investigations, exploratory borings, monitoring and observations being conducted in the area.

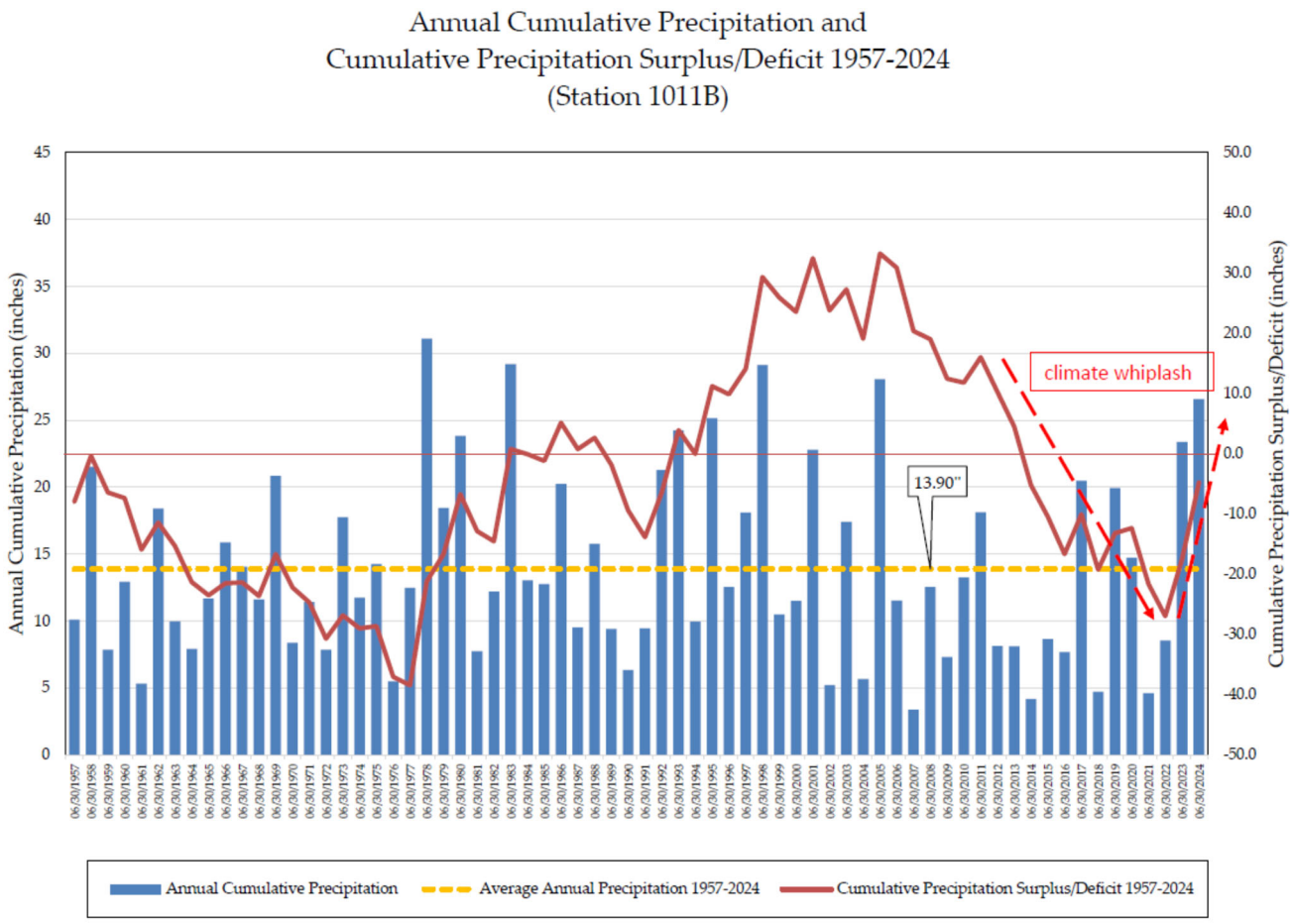
IMPACTS OF MOVEMENT OF THE ALTAMIRA LANDSLIDE

As of this date, the major land movement of the Altamira Landslide has resulted in the red-tagging (Unsafe to Enter/Occupy) and yellow tagging (Limited Entry) of several residential and commercial structures. It has also caused major destructive impacts to public and private roads, damages to utility infrastructure (water, sewer, gas, electricity and cable), causing certain utilities to be shut-off, and closure of certain Preserve land that is otherwise heavily accessed by the public for hiking, biking, equestrian, and other purposes. The only practical mitigation measure available to address a landslide with such a colossal scale is relieving groundwater pore pressures through pumping of groundwater, but it has to be done on a large enough scale to be effective at reducing the movement to an acceptable level. This technique has proven effective for the east side of the Altamira Landslide where deep dewatering wells have been installed, maintained and the rate of ground movement monitored such that a correlation between increased pumping of groundwater and reduction in the rate of ground movement has been confirmed.

CAUSATION

It is our opinion that the activation of the Altamira Landslide was largely caused by "climate whiplash" (also more technically described as hydroclimate volatility) induced by climate change, particularly starting in 2011, with five years of drought, and eight out of eleven years significantly below normal rainfall from 2011-2022, followed by two consecutive extraordinarily heavy rain seasons that dropped approximately 4 feet of rainfall on the landslide and surrounding areas draining into the landslide on the south flank of the Palos Verdes Hills.

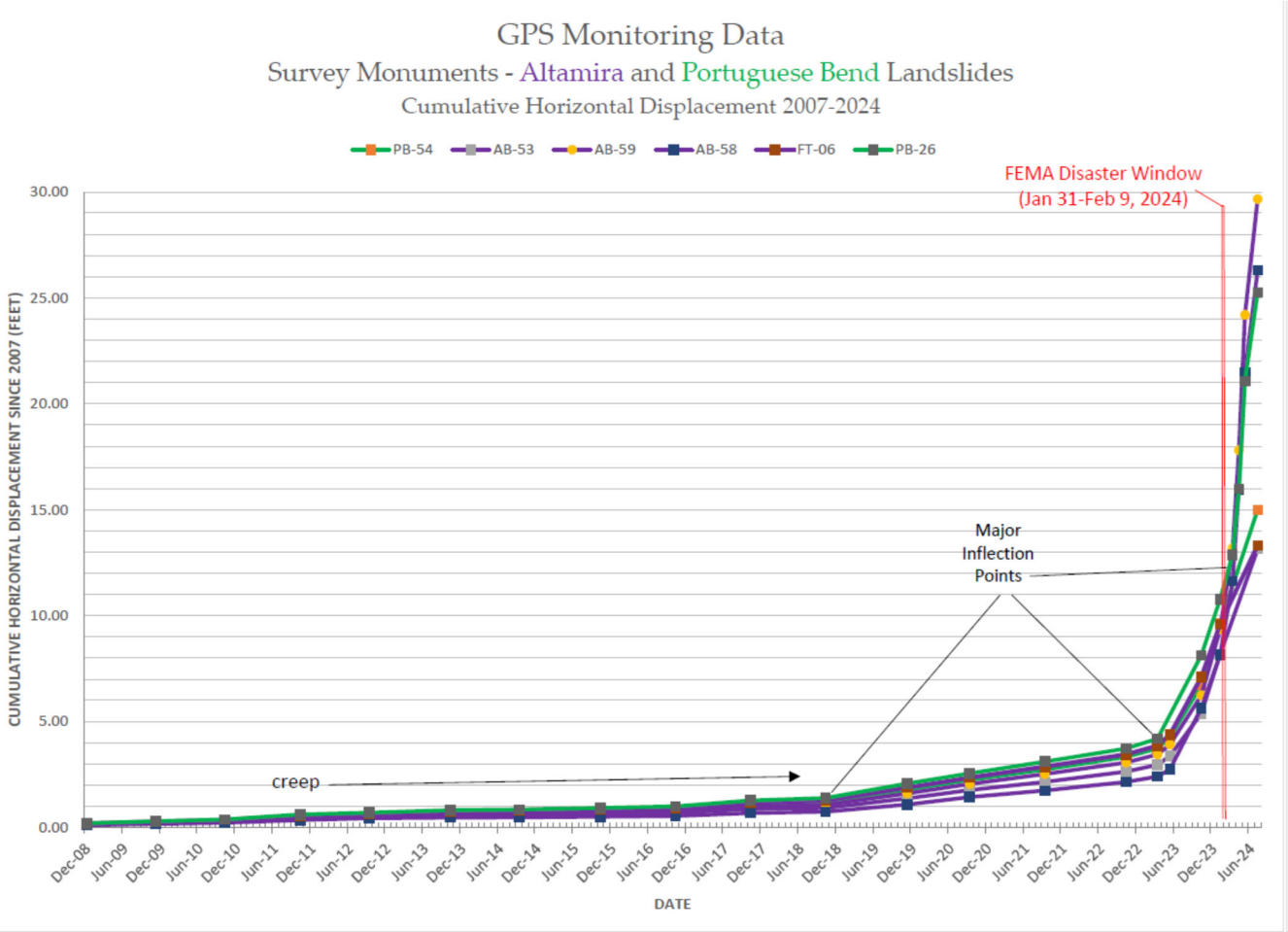
As illustrated in the following graphic, using data gathered by Los Angeles County Department of Public Works Stormwater Engineering Division, we analyzed annual rainfall deviations from the mean, and tallied up those cumulative deviations over time, as a measure of *precipitation surplus/deficit* that has impacted the area. The dark red line on the graphic shows the precipitation surplus/deficit over time. A precipitous drop is noted in the surplus/deficit line, particularly from 2011-2022, which whipsaws back to a steep climb from 2022 through 2024. Climate whiplash is illustrated by the red dashed arrows, showing the impact of the dry years (on a rapidly declining surplus/deficit curve) quickly reversing to a steeply inclining surplus/deficit curve. It is not important that this whiplash or volatility occurred in *deficit* territory on the graph, because it followed a two-decade long period of significant precipitation surplus. Two decades of precipitation surplus between 1991 and 2011 likely contributed to *strain-softening* of the Altamira Landslide failure surface clays, as the landslide began imperceptibly creeping and elongating/stretching out over a prolonged period. It follows that this generally prolonged period of drying commencing in 2011, followed by a large pulse of wetting from 2022 through the winter of 2024, and culminating in an intense barrage of rainfall from January 31st through February 9th 2024, triggered the massive Altamira movement and accelerated the landslide to unprecedented rates of movement.



Of note is that 8.29 inches of rain fell at the Rolling Hills Fire Station rain gauge from January 31st through February 9th 2024. The mean (average) rainfall for the Rolling Hills Fire Station's 57-year rainfall data set is currently 13.88 inches/year and the standard deviation of the entire 57-year dataset is 7 inches/year, indicating very high variability in annual rainfall. More rain fell between January 31st and February 9th 2024 than the standard deviation for the entire 57-year rainfall data set, indicating that this storm sequence was a statistically rare, outlier event.

The following graphic depicts *cumulative horizontal displacement* of select GPS survey monitoring points, including some of the fastest moving points in the Altamira Landslide and a couple of representative points in the PBL (which overlies the Altamira Landslide). There are three significant inflection points indicated in the graph. Prior to the first inflection point, the cumulative displacement lines indicate that the GPS monitoring points within the Altamira Landslide were creeping quite slowly (imperceptibly, near the range of instrument precision) for a number of years extending back before 2011. There was no observed or documented surface manifestation of this minor creep movement at the ground surface; however, this movement is believed to have caused deformation (elongation or stretching out of the earth materials comprising the subsurface which in turn causes additional

fracturing of those earth materials) of the Altamira Landslide body, which increased secondary permeability within the rock mass allowing rainfall at the ground surface to percolate more readily into the deep subsurface, raising groundwater levels to a point where they result in high pore pressures that contribute to landslide movement. Between the October 2018 and October 2019 GPS readings (first inflection point), an acceleration of creep movement is evident. Then following the multiple atmospheric river rains of January and February 2023 (second inflection point), a further acceleration of creep movement is evident, which would have resulted in further stretching out and opening up of the landslide mass. The final inflection point around March, 2024 (immediately following the FEMA-declared disaster of January 31-February 9 wherein 8.29 inches of rain fell) shows a dramatic acceleration and **represents the triggering of major movement of the Altamira Landslide**, as reflected by some of the graphed points going very steep and nearly vertical on the graph. The graph includes GPS monitoring point AB-59, which has been the fastest moving point and is not surprisingly located in the center of the entire Altamira Landslide mass.



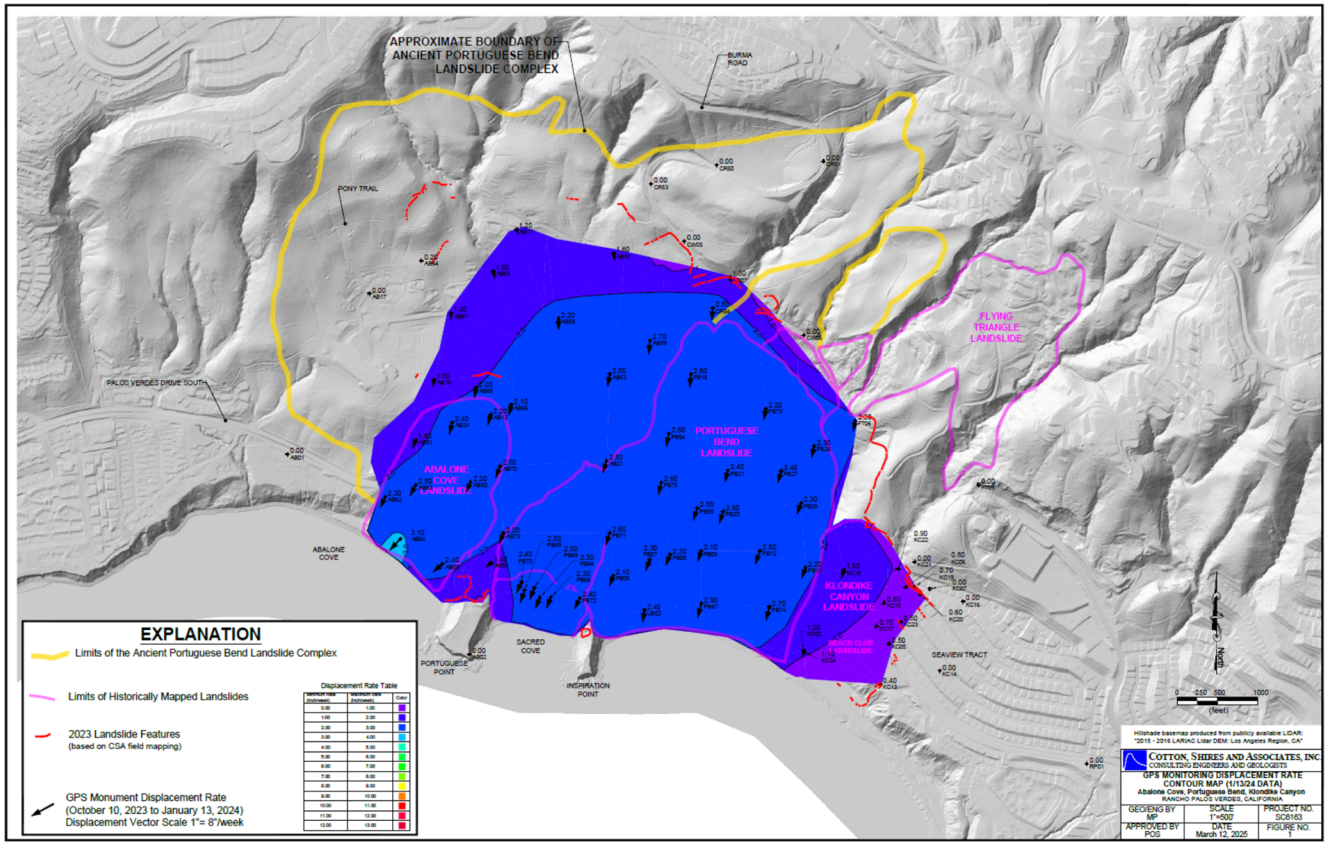
The change in ground movement rates before January 31st and after February 9th 2024 is significant. Based on our comprehensive review of the McGee GPS survey monitoring, the rates of

Altamira Landslide ground movement in the Abalone Cove area (for points north of the previously active ACL) as of January 13, 2024 ranged from 1.2 inches per week (at the periphery) up to 2.7 inches per week (in the body of the landslide). After that intense period of rainfall, plus additional rainfall resulting in a total of over 11 inches in February, as of the GPS survey completed on March 8, 2024, the rates increased to 1.5 (at the periphery) to 5.9 (main body) inches per week, more than doubling in the body of the landslide, and then increased dramatically to as much as 13.5 inches per week in the body of the landslide by July 1, 2024, probably as a slightly delayed reaction to the rainfall as it took time for the water to convert from rainfall absorption to higher groundwater pore pressures where it could have the greatest driving force impact on landslide movement.

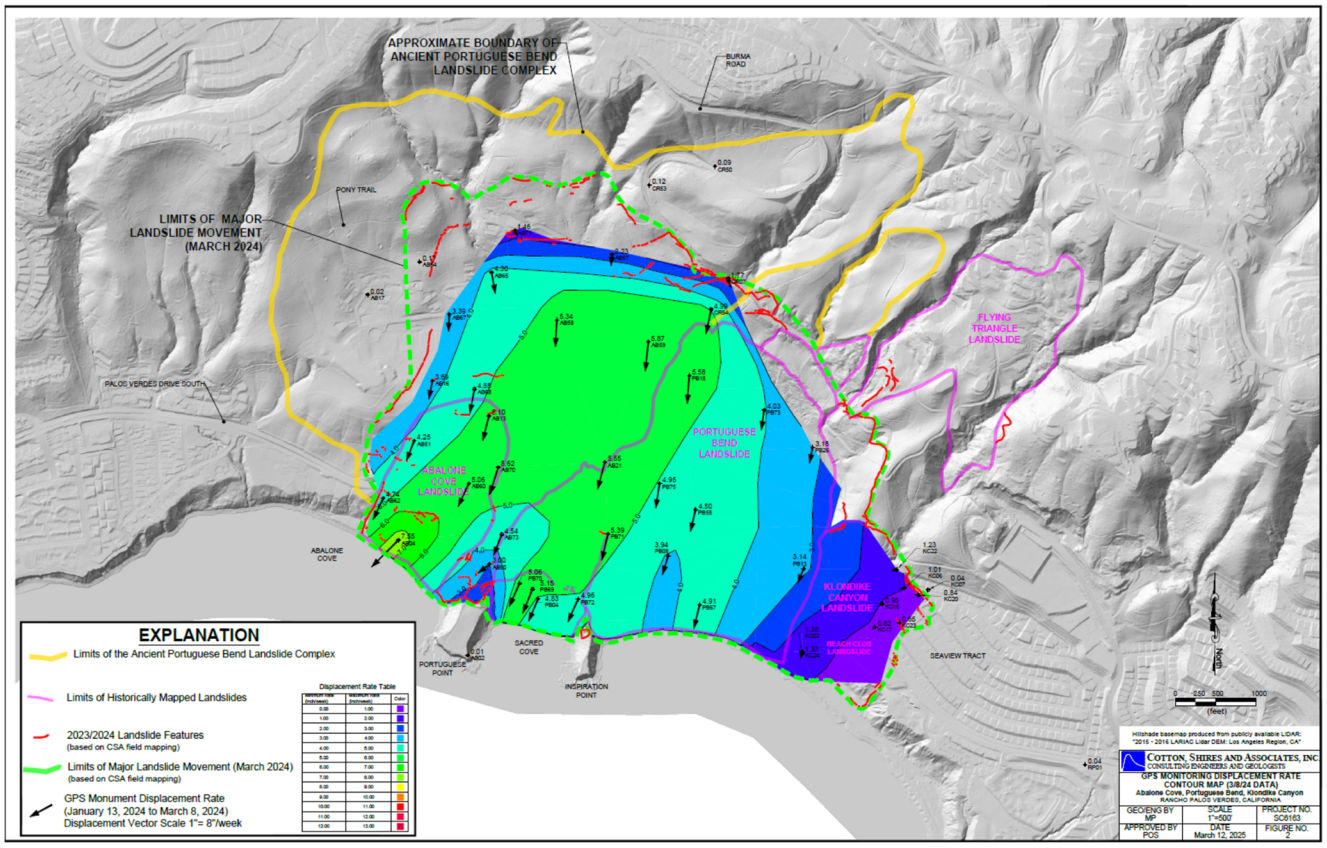
The graphics on the following two pages are "heat maps" that illustrate in color contours the rates at which the ground was moving based on the GPS survey monuments for January 13, 2024, March 8, 2024 and July 1, 2024, respectively. The heat maps include our on-ground geologic mapping of visible land movement features, which started as tension cracks or narrow fissures that were discontinuous (as of December 2023 mapping and are shown on the January 13, 2024 heat map), but these features further developed into more continuous/connected tension cracks and fissures, which have now developed into large scarps, grabens and well-developed boundary features. It wasn't until March 2024 that we first drew a boundary (dashed green line) around the "Area of Major Land Movement", because prior to that time, the surface manifestation of movement was poorly developed and inconsistent and there was not sufficient development of the landslide to develop a boundary. By March 2024, with further mapping and the extraordinary acceleration of numerous GPS monitoring points, a boundary defining the "Area of Major Land Movement" was delineated. Today, following many tens of feet of movement since early 2024, the boundary of the Altamira Landslide is well-defined. North of PV Drive South, the Altamira boundary extends significantly further west of the historical ACL boundary (resulting in the destruction of the landmark Wayfarer's Chapel), upslope through the York property (6001 PV Drive South), and north of the historical ACL boundary through the Portuguese Bend Riding Club Area, crossing upper Narcissa Drive, through and north of residences on upper Cinnamon Lane, and eventually turning east across Altamira Canyon, extending through the Vanderlip Estate (100 Vanderlip Drive), destroying Vanderlip Drive and adjacent properties, and ultimately continuing northeast to the lower stretch of Burma Road Trail in the Portuguese Bend Reserve.

The Altamira Landslide movement also created never-before-seen deformation where it underlies and now extends south of the KCL, including formation of a more seaward toe accompanied by uplifting ground that trended southwest through the beach area of the Portuguese Bend Beach Club and extending up to 500 feet or more offshore where it emerged through the sea floor and formed a new rocky coastline above sea level, generally east of Inspiration Point. The emergence of the new land offshore from the previous coastline was first reported to, and was subsequently observed by the City Geologist in late February of 2024, consistent with the triggering of major movement of the Altamira Landslide described above.

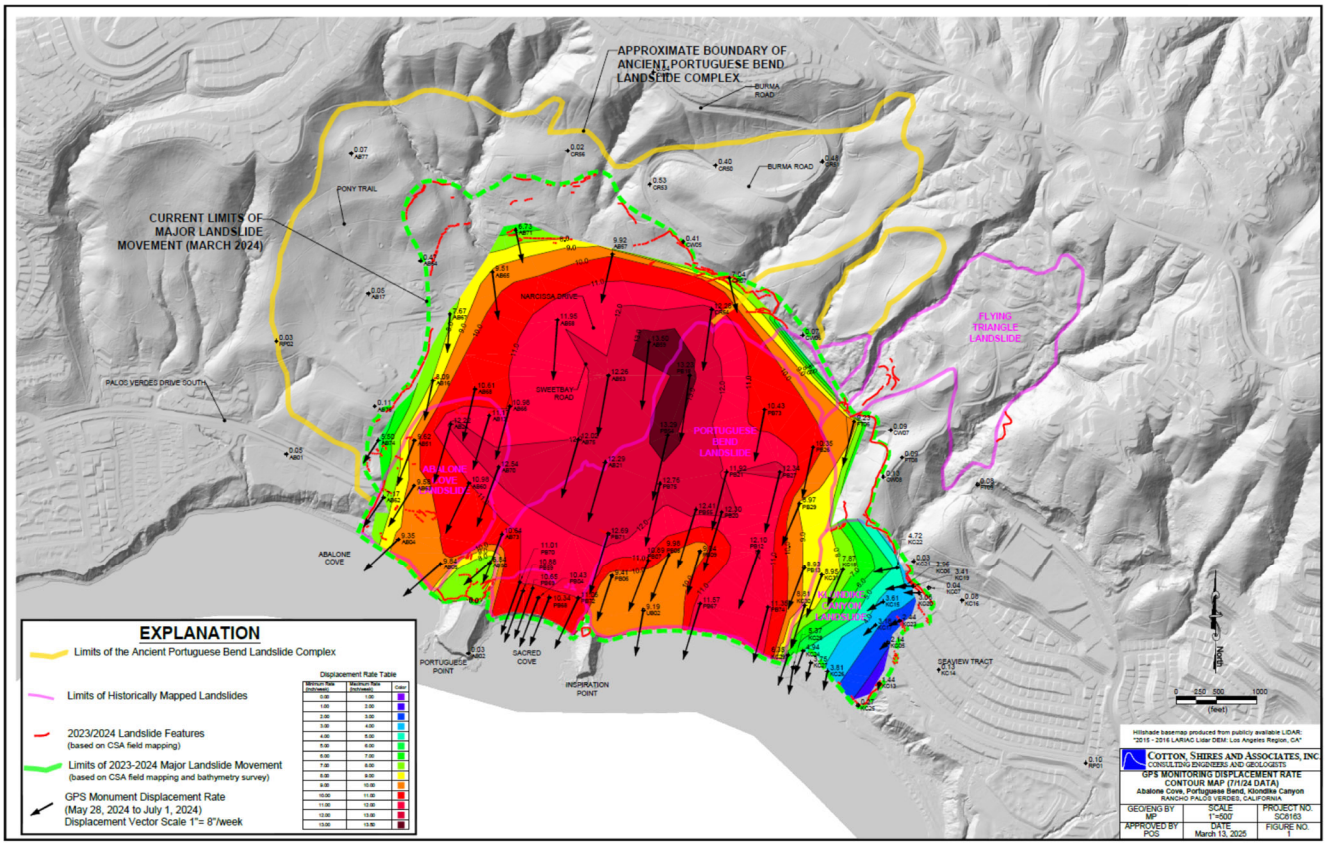
1/13/2024 Heat Map



3/8/2024 Heat Map



7/1/2024 Heat Map

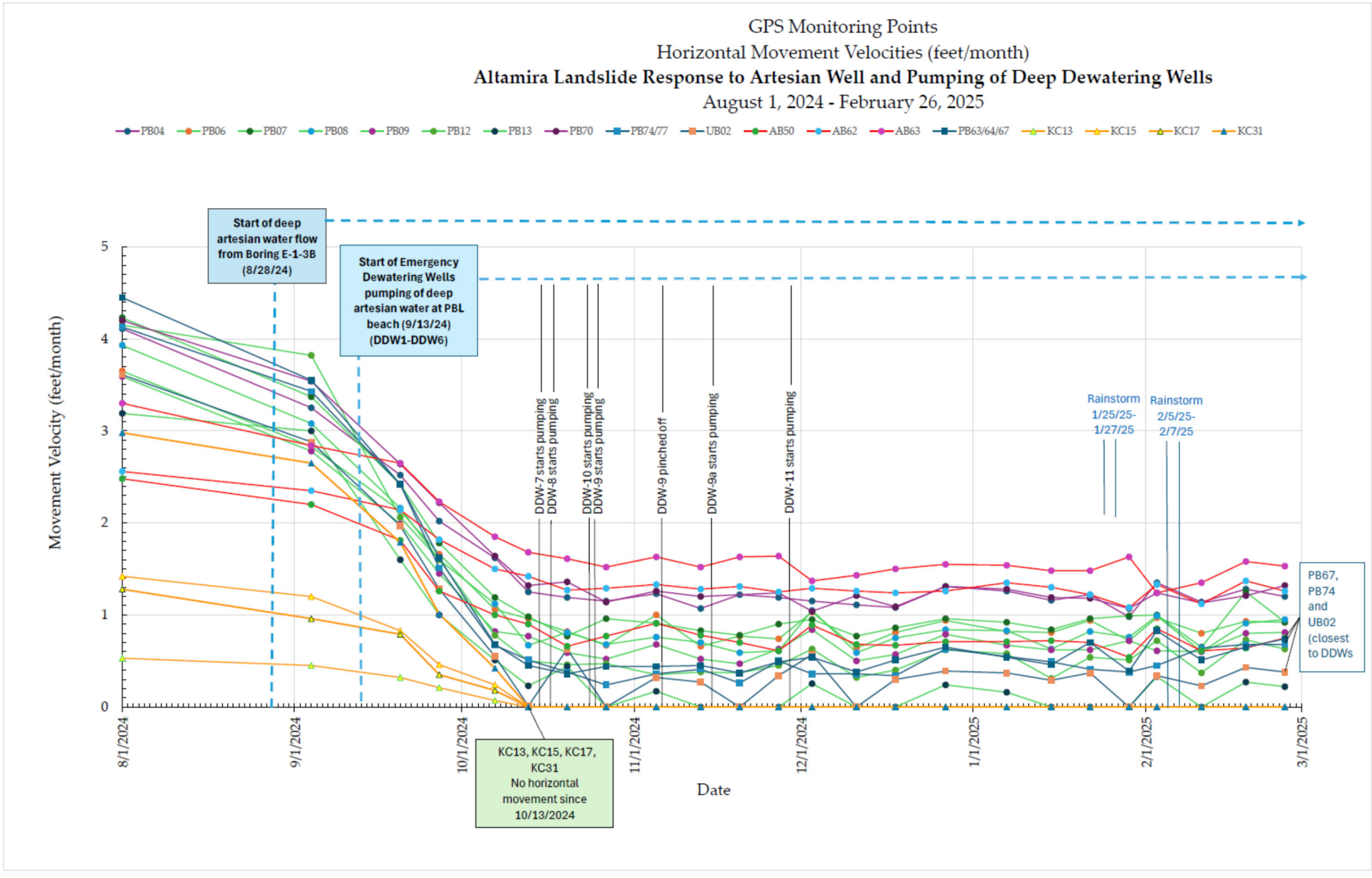


EMERGENCY MEASURES

Emergency measures taken by the City and abatement districts (ACLAD and KCLAD) to date have included drilling, pumping and monitoring deep dewatering wells, winterization measures including lining channels and installing culverts to reduce the amount of surface water percolating into the groundwater regime from upslope drainages/canyons, and filling of and establishing drainage for fissures and grabens that, if left unmitigated, facilitate surface water intrusion into the groundwater regime. This strategy has proven to be effective in reducing the rate of movement of the Altamira Landslide and even stopping movement of the eastern portion of the landslide in the area of the KCL. Because piezometers installed in deep borings that penetrated the base of the Altamira Landslide indicated high groundwater pore pressures beneath the landslide (some areas were found to have near-artesian or artesian groundwater pressures – pressures higher than the ground surface), a pilot program strategy was pursued that involved drilling a series of five deep dewatering wells near the coast to approximately 50 feet below the base of movement and pumping the wells until the landslide movement sheared off the well casings at depth and then re-drilling them to approximately 50 feet beneath the landslide to re-establish the wells so that they could continue to be pumped to dewater the high groundwater pressures beneath the landslide. This strategy turned out to be more successful than originally contemplated because the movement of the landslide slowed quickly in response to the initial dewatering efforts and the deep wells continued to function for weeks or months before re-drilling was necessary.

The chart on the following page illustrates the timing of artesian water being encountered in one of the test borings (Boring E-1-3B, which was retrofitted to function as an artesian well), the installation of the deep dewatering wells, and the deceleration of the Altamira Landslide in response to the dewatering efforts.

Based on the success of the deep dewatering program, we now know that this strategy works. Consequently, the City agreed to loan the landslide abatement districts funding so that they could re-establish wells that were no longer functioning and to establish deep dewatering wells at additional locations as well as to establish additional measures to reduce infiltration of surface water. Additional wells are also needed in the areas that the City controls. Unfortunately the cost of drilling, pumping, maintaining and re-drilling requires significant funding which the City was able to keep up with to a point, but now needs additional funding assistance to keep the wells that have already been established functioning and to establish additional deep dewatering wells in order to reduce the movement of the middle and eastern portions of the Altamira Landslide to the level experienced prior to the impact of climate whiplash.


GPS Monitoring Points
Horizontal Movement Velocities (feet/month)
Altamira Landslide Response to Artesian Well and Pumping of Deep Dewatering Wells
August 1, 2024 - February 26, 2025
PB04 PB06 PB07 PB08 PB09 PB12 PB13 PB70 PB74/77 UB02 AB50 AB62 AB63 PB63/64/67 KC13 KC15 KC17 KC31
Start of deep artesian water flow from Boring E-1-3B (8/28/24)
Start of Emergency Dewatering Wells pumping of deep artesian water at PBL beach (9/13/24) (DDW1-DDW6)
DDW-7 starts pumping
DDW-8 starts pumping
DDW-10 starts pumping
DDW-9 starts pumping
DDW-9 pinched off
DDW-9a starts pumping
DDW-11 starts pumping
Rainstorm 1/25/25-1/27/25
Rainstorm 2/5/25-2/7/25
PB67, PB74 and UB02 (closest to DDWs
KC13, KC15, KC17, KC31 No horizontal movement since 10/13/2024
Movement Velocity (feet/month)
Date
0
1
2
3
4
5
8/1/2024
9/1/2024
10/1/2024
11/1/2024
12/1/2024
1/1/2025
2/1/2025
3/1/2025

City of Rancho Palos Verdes

John Cruikshank, Mayor
Eric Alegria, Mayor Pro Tem
David L. Bradley, Councilmember
Barbara Ferraro, Councilmember
Paul Seo, Councilmember

February 20, 2024

California Office of Emergency Services Disaster Analysis Unit
3650 Schriever Avenue
Mather, CA 95655

SUBJECT: REQUEST FOR A STATE OF EMERGENCY FOR THE GREATER PORTUGUESE BEND LANDSLIDE COMPLEX

To whom it may concern:

On behalf of the approximately 42,000 residents of Rancho Palos Verdes and the approximately 67,000 residents of the Palos Verdes Peninsula, the Rancho Palos Verdes City Council is requesting Governor Newsom invoke his emergency powers pursuant to the Emergency Services Act, Gov't Code § 8550 et seq., and proclaim a State of Emergency for the Palos Verdes Peninsula region to assist the City to stabilize land movement in the greater Portuguese Bend Landslide Complex (Landslide). For reference, see attached map to show the boundaries of the Landslide.

As a result of the 2023 and 2024 winter storms, the City of Rancho Palos Verdes has been impacted by substantial precipitation that has caused an unprecedented acceleration of land movement equating to an annualized rate of 10 feet per year. This significant and sudden increase in land movement is causing severe damage to Palos Verdes Drive South – a major arterial roadway and evacuation route for the Palos Verdes Peninsula; damage and disruption to utility infrastructure including water, sewer, gas line and utility pole breaks; closures of approximately 8 miles of public trails due to slope instability; fissures and sink holes throughout the Palos Verdes Nature Preserve; the closure of residential intersections due to sink holes and ground separation; the temporary closure of the Wayfarers Chapel - a federal and state designated historic landmark; and the red-tagging of homes with many more homes on a watch list due to foundation and structural damage.

On October 3, 2023, the Rancho Palos Verdes City Council adopted a Local Declaration

of Emergency pursuant to Section 8630 of the Government Code, which has been renewed several times as required by that law; the Local Emergency is still in effect.[1] This action was intended to provide immediate access to resources and to assist in expediting remediation measures to stabilize and manage land movement that poses an imminent threat to the public's health, safety, and property. The City's Geologist and Geotechnical Engineering team and the two state-recognized Geologic Hazard Abatement Districts' geologists (Abalone Cove Landslide Abatement District and Klondike Canyon Landslide Abatement District) propose to stabilize land movement by immediately implementing the following:

- Filling fissures to prevent surface water from directly recharging the water table and further lubricating the slip plane.
- Constructing drainage swales, lining certain canyons with non-penetrable membrane, and/or installing flexible drainage pipes to properly convey surface water to the ocean and/or sanitary lines to prevent recharging the water table.
- Installing dewatering wells in the form of horizontal hydraugers and/or vertical dewatering wells to extract groundwater from the slip plane and reducing the local water table.

As the City continues its response and recovery operations, we have determined that these remediation measures must be implemented immediately to minimize the threat to the public's health, safety, and property. Therefore, the City Council requests, pursuant to the authority provided by the Act, and specifically by Sections 8571 and 8625 of the Government Code, that the Governor declare a State of Emergency for the City of Rancho Palos Verdes, waive and/or suspend certain state laws and permits required by local and state agencies that include, but are not limited to, the California Coastal Commission, the California Department of Fish and Wildlife, the Regional Water Quality Control Board, the State Water Resources Control Board, the South Coast Air Quality Management District, and other State agency permits or review processes. Finally, the City Council requests the Governor waive any requirements under the California Environmental Quality Act and its implementing regulations related to the approval and implementation of the remediation measures set forth above. Additionally, the City is requesting that the Governor submit a request to the President of the United States for a Federal Emergency Declaration pursuant to the Stafford Act, 42 U.S.C. §§ 5121-5207.

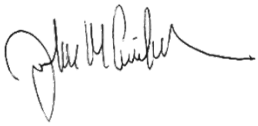
The City has identified that permits would be required by the aforementioned state agencies prior to proceeding any landslide stabilization work. Suspension of these requirements will allow the City and the Geologic Hazard Abatement Districts to immediately proceed with construction and installation of the enumerated measures to stabilize the Landslide without the costs and time delays typically experienced with obtaining permits. It is imperative that the City and two Geologic Hazard Abatement Districts are able to expedite the installation of dewatering wells and surface drains knowing that we are in an El Niño winter pattern with repeated atmospheric rivers

[1] The City also adopted an Interim Urgency Ordinance pursuant to Section 65958 of the Government Code, which effected a moratorium on all construction in the Landslide, with some limited exceptions.

forecasted to extend into spring, and every rain event is exacerbating the rate of land movement.

Please contact City Manager Ara Mihranian at aram@rpvca.gov or by telephone at 310-544-5202.

Sincerely,



John Cruikshank
Mayor

Attachments:

- Portuguese Bend Landslide Complex Map
- Information on the Portuguese Bend Landslide including resolutions adopting and extending the City's Proclaimed Local Emergency can be found on the City's website at: www.rpvca.gov/landslide

cc:

Laphonza Butler, U.S. Senator, California
Alex Padilla, U.S. Senator, California
Ted Lieu, U.S. Representative, 36th Congressional District
Ben Allen, Senator, 24th State Senate District
Al Muratsuchi, Assemblymember, 66th Assembly District
Janice Hahn, L.A. County Supervisor, 4th District
Kevin McGowan, Director, L.A. County Office of Emergency Management
Brandy Villaneuva, Disaster Manager Area Coordinator, L.A. County Area G
Rancho Palos Verdes City Council

CREST ROAD

BURMA ROAD

PONY TRAIL

ANCIENT PORTUGUESE BEND LANDSLIDE COMPLEX

NARCISSA DRIVE

FLYING TRIANGLE LANDSLIDE

PALOS VERDES DRIVE SOUTH

SWEETBAY ROAD

ABALONE COVE LANDSLIDE

PORTUGUESE BEND LANDSLIDE

KLONDIKE CANYON LANDSLIDE

ABALONE COVE

SACRED COVE

PORTUGUESE POINT

INSPIRATION POINT

SEAVIEW TRACT

North

0 250 500 1000

(feet)

EXPLANATION

- Limits of the Ancient Portuguese Bend Landslide Complex
- Limits of Historically Mapped Landslides
- 2023 Landslide Mapping
- Current Limits of Major Landslide Movement (February 2024)

Hillshade basemap produced from publicly available LiDAR: "2015 - 2016 LARIAC Lidar DEM: Los Angeles Region, CA"

COTTON, SHIRES AND ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS

LANDSLIDE MAPPING UPDATE 2/20/24
Abalone Cove, Portuguese Bend, Klondike Canyon
RANCHO PALOS VERDES, CALIFORNIA

GEO/ENG BY	SCALE	PROJECT NO.
MP	1"=500'	SC6163
APPROVED BY	DATE	FIGURE NO.
POS	February 2024	1

CITY OF RANCHO PALOS VERDES
ADMINISTRATION DEPARTMENT
CITY MANAGER'S OFFICE

March 17, 2025

Via email and Grants Portal

Mr. Robert Fenton
FEMA District No. 9 Administrator

Robert Larsen, Public Assistance Officer
California Office of Emergency Services

Subject: Appeal of FEMA's Eligibility Determination, Project Number 754842
FEMA-4769-DR-CA, California's Severe Winter Storms, Tornadoes, Flooding, Landslides, and Mudslides (Damage Inventory No. 1385922, 1385923, 1389524, 1385925)

Dear Messrs. Robert Fenton and Robert Larsen,

On April 13, 2024, the President declared a major disaster (**FEMA-DR-4769-CA**) in the State of California due to damages from severe winter storms, tornadoes, flooding, landslide and mudslides with an incident period of **January 31 through February 9, 2024**. The declared disaster by the President is similar to a federal disaster declared on April 3, 2023 for California Severe Winter Storms, Straight-Line Winds, Flooding, Landslides and Mudslides that occurred between **February 21, 2023 and July 10, 2023 (DR-4699-CA)**.

On May 9, 2024, the City of Rancho Palos Verdes (City) filed for disaster aid cost recovery for the City's response to the 2024 winter storms. In total, the City filed applications totaling $38.4 million.

On January 17, 2025, the City received FEMA's Eligibility Determination Memorandum **denying** in full the City's request for $3,231,000 to conduct repairs to public trails and the open space areas known as the Portuguese Bend and Filiorum Reserves that have been indefinitely closed to the public due to damage sustained by the winter storms that occurred between January 31 and February 9, 2024. The denial cites the following reasons:

- Pre-disaster ground instability and on-going non-disaster related causes.
- Disaster damage was not a result of the declared disaster event.
- Pre-existing conditions of landslide.

According to Section 102.1 and 102.2 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, an "Emergency" means *any occasion or instance for which, in the determination of the President, Federal assistance is needed to supplement State and local efforts and capabilities to save lives and to protect property and public health*

*and safety, or **to lessen or avert the threat of a catastrophe (emphasis added)** in any part of the United States*. Moreover, a "Major Disaster" *means any natural catastrophe (including any hurricane, tornado, storm, high water, winddriven water, tidal wave, tsunami, earthquake, volcanic eruption, **landslide (emphasis added)**, mudslide, snowstorm, or drought), or, regardless of cause, any fire, flood, or explosion, in any part of the United States, which in the determination of the President causes damage of sufficient severity and magnitude to warrant major disaster assistance under this Act to **supplement the efforts and available resources of States, local governments, and disaster relief organizations in alleviating the damage, loss, hardship, or suffering caused thereby (emphasis added)**.*

The City's disaster recovery request was submitted to FEMA based on the aforementioned definitions found in the Stafford Act and the declared major disaster resulting from winter storms of 2024 that **contributed to a significant and documented acceleration of land movement caused by the activation of a <u>new</u> historic and previously dormant landslide known as the Altamira Landslide** within the Greater Portuguese Bend Landslide Complex (Landslide Complex).

According to the City Geologist's reports to the City Council in 2024, the **Altamira Landslide is a deeper slip plane that the Landslide Complex "rafted" on top of as a direct result of the unprecedented and record rainfall during the 2024 winter storm event resulting in the shallower slip plane of the Landslide Complex to move more than it ever did before in its documented history**. Contrary to FEMA's Eligibility Determination Memorandum, what is **not pre-existing** are the areal dimensions, depth of movement, velocity of movement, artesian and near-artesian groundwater pressures beneath it, and even direction of movement. The land movement experienced as a result of the 2024 winter storms is not just a simple **expansion** of the Landslide Complex, but is an **entirely different, larger and deeper landslide with much broader boundaries** (including the new coastline offshore at the Portuguese Bend Beach Club), nearly twice as deep in some areas, and unprecedented rates of movement. None of this was seen during the history of the City, nor during the approximately 70-year history of landslide studies, monitoring, and observations conducted in the area, contrary to what is noted in the Eligibility Determination Memorandum. It is the opinion of the City and its subject matter experts, that will be discussed in this appeal letter, that this is largely caused by "weather whiplash" (induced by climate change) starting in 2011.

The City respectfully requests that you, as FEMA's District No. 9 Administrator, reverse the eligibility denial and uphold the City's appeal based on facts, data and other pertinent information found in this appeal letter that will clearly demonstrate that a new landslide was activated causing an acceleration of land movement as a direct result of the 2024 winter storms resulting in costly and significant damage to the City's infrastructure. The City firmly believes that this **appeal letter** will demonstrate that the requested cost recovery work complies with Title 44 of C.F.R. Section 206.223(a)(1) in that the financial assistance requested is directly related to the winter storms of 2024. As such, the City is requesting **$3,231,000** to conduct repairs to public trails and the open space areas known

as the Portuguese Bend and Filiorum Reserves that have been indefinitely closed to the public due to damage sustained by the winter storms that occurred between January 31 and February 9, 2024.

Historic Background

As noted in the January 17, 2025 Eligibility Determination Memorandum and throughout various City records, the Landslide Complex is a known ancient landslide that was activated in 1956 when, prior to the City's 1973 incorporation, Los Angeles County was expanding Crenshaw Boulevard to Palos Verdes Drive South and its grading efforts combined with ground water, activated the Portuguese Bend Landslide. Land movement has not stopped since 1956 but has been managed at a slow creep to no movement for years through remediation efforts implemented by the City and its two geologic hazard abatement districts, Abalone Cove Landslide Abatement District (ACLAD) and Klondike Canyon Landslide Abatement District (KCLAD).

The Landslide Complex, historically existing for thousands of years, encompasses the following four sub-landslide areas in the City: the Portuguese Bend Landslide (PBL), the Abalone Cove Landslide (ACL), the Klondike Canyon Landslide (KCL), and the Beach Club Landslide (BCL). As noted above, in 1956, the PBL began moving, then in 1979, ACL and KCL began moving with the BCL, which is nested within the KCL and, while dormant itself, moves with the KCL. The Landslide Complex also includes areas outside of those known landslides, predominantly uphill from the PBL and ACL, within the ancient Landslide Complex as mapped by various agencies (i.e., U.S. Geological Survey and California Geological Survey) and other researchers. This fifth landslide is in the City of Rolling Hills and is known as the Flying Triangle Landslide.

According to a November 8, 2024 report prepared by the City Geologist, Mike Phipps of Cotton Shires and Associates (CSA) (Attached), the PBL has been continuously active since reactivation in 1956 with many areas of the landslide having moved hundreds of feet seaward over the ensuing seven decades. The ACL was active from 1979 **until the late 1990's**, involving only several feet of movement, when dewatering and other mitigation efforts largely halted movement. An **imperceptible creep movement** of the ACL has occurred over the past 25 years **following rainy seasons that were significantly above average rainfall amounts.** The KCL has been episodically active in 1979-1983 and 2005-2006, experiencing only several inches of movement, typically in response to significantly above average rainfall. Landslide movements throughout the Landslide Complex **outside of the historical boundaries of** the ACL and PBL previously exhibited low rates of creep movement, or movement at or near the instrument precision range, in the 11-year monitoring period of 2007-2018.

Impacts of Rainwater

These landslides are deep translational-type failures within seaward-dipping strata of the Monterey Formation, with the landslide slip surfaces occurring within very weak bentonitic

clay beds. Historically, the movement behavior of these landslides routinely exhibited high sensitivity to increased groundwater pore pressure, and increased rates of land movement which have been **correlative with 6-to-12-months of antecedent rainfall that was well above average**. Similarly, land movement decreased during below average rainy seasons or multi-year periods of drought.

Simply stated, numerous studies conducted over approximately seven decades all point to water as being the primary contributor to land movement, particularly rainwater. Rainwater runoff is known to penetrate the ground through fissures during a rain event and recharge the ground water table. During particular significant rain events or seasons, runoff that enters the ground may take months to show signs of land movement. Depending on where rain runoff enters the ground, it can settle below the slip plane thereby resulting in artesian pressure or settle above the slip plane, which is made up of volcanic ash known as bentonite and lubricates the slip plane resulting in horizontal movement.

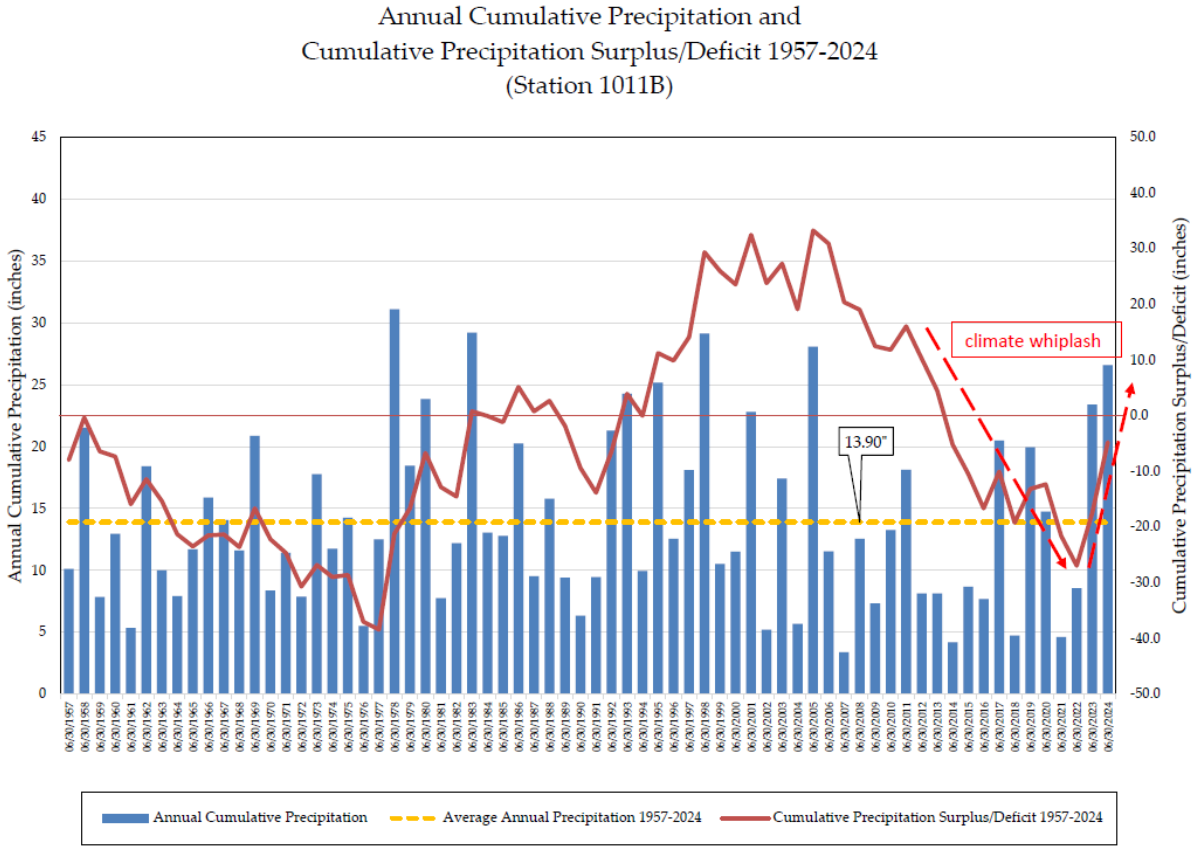
Changes in climate over the years, now commonly referred to as “weather whiplash” has resulted in extreme weather in Southern California including extended periods of dry weather followed by severe wet weather in the form of atmospheric rivers as experienced in 2023 and 2024. This extraordinary wet weather resulted in the President declaring a major federal disaster in both 2023 and 2024. Underscoring how extreme weather has become over the years, in August 2023, California, particularly Southern California, experienced days of record rain in August 2023 as a result of Tropical Storm Hillary.

Extreme wet weather patterns have proven to contribute towards the change in behavior of the Landslide Complex. Beginning in 2021, the City Geologist began reviewing Global Positioning Satellite (GPS) monitoring data for survey monuments within the entire Landslide Complex. Review of GPS monitoring data from 2007 through 2024 indicated that land movement acceleration initially began between 2018 and 2019. This acceleration was correlative with significantly above-normal rainfall in two out of three prior rainfall seasons (2016-17 and 2018-19) which followed five consecutive drier than normal rainfall seasons (2011-12 through 2015-16).

Another way to look at this is to analyze annual rainfall deviations from the mean, and tally up those cumulative deviations over time, as a measure of *precipitation* surplus/deficit that is impacting the area. According to the graphic on the following page, in which the dark red line shows the precipitation surplus/deficit over time, note the precipitous drop particularly from 2011-2022, which whipsaws back to a steep climb from 2022-2024. Weather whiplash is illustrated by the red arrows, showing the impact of the dry years (rapidly declining surplus/deficit curve) quickly reversing to a steep inclining surplus/deficit curve. It doesn't matter that this all happened in *deficit* territory on the graph, because it followed a two-decade long period of precipitation surplus. It is reasonable to say that two decades of precipitation surplus between 1991 and 2011 might have contributed to **strain-softening** of the Altamira failure surface clays, as the landslide imperceptibly crept and stretched out. It follows that this generally prolonged period of

drying commencing in 2011, followed by a short, huge pulse of wetting between 2022-2024, is what **triggered** the massive previously inactive Altamira Landslide to move in 2024.

It is also worth noting that 8.29 inches of rain fell at the Rolling Hills Fire Station rain gauge during the 10-day FEMA disaster window. Keep in mind, the mean (average) for the 57-year rainfall data set is currently 13.88 inches/year and the standard deviation of the entire 57-year dataset is a whopping 7 inches/year, indicating very high variability in annual rainfall. In other words, more rain fell in the 10-day FEMA disaster window than the standard deviation for the entire 57-year rainfall data set. Underscoring that this wet weather behavior was an extraordinary event.



Significant accelerations in movement velocity were documented in May 2023 following major storm sequences in January, February and March of 2023, which added to cumulative seasonal rainfall totals exceeding 193% of average rainfall. Approximately 87% of this rain fell prior to June 18, 2023. Most of this rainfall occurred from three significant atmospheric river-type storm sequences occurring on January 9-16 (3.59 inches), February 23-March 1 (3.79 inches) and March 10-15 (4.12 inches). Land movement velocities further increased as of the July 15, 2023 monitoring. An anomalous tropical storm (Tropical Storm Hillary) dropped an additional 3.05 inches of rain on August 19 through August 20, 2023, resulting in further land movement acceleration as of the

October 10, 2023 monitoring.

Furthermore, accelerated ground movement occurred throughout the Landslide Complex during and following the 2022-23 rainy season which was more than 220% of the historical average rainfall. Based upon the GPS monitoring survey on January 13, 2024, average land movement velocities within the Landslide Complex since October 10, 2023 have accelerated by a factor of three to four times compared to the previous 12 month (Oct 2022-Oct 2023) monitoring period. Expressed another way, the total movement over the 3 month period of October 2023 through January 2024 is nearly equal to, and in some cases exceeds, the total movement over the previous entire year's monitoring period (i.e., October 2022 through October 2023). Movement of this magnitude has not been previously observed or documented in the ancient landslide complex north of the historical boundaries of the ACL, PBL and KCL.

An example of this is highlighted by six GPS monitoring points in the upper ancient landslide area, in the vicinity of upper Narcissa Drive and uphill from it. These survey monuments have experienced average displacements of 4.07 feet over the past 15 months (3.26 feet on an annualized basis). Average displacements for these six points over the prior annual monitoring period (Sept 28, 2021-Oct 10, 2022) were 0.36 feet. This represents approximately a 9-fold increase in total land movement on an annualized basis. **Two GPS monitoring points near the toe of the Abalone Cove Landslide moved an average of 0.76 feet (Sept 2021-Oct 2022) to 7.30 feet (Oct 2022-Jan 2024) over the same periods, a 9.6-fold increase in displacement**.

Activation of the New Altamira Landslide

According to the City Geologist's Memorandum dated November 8, 2024 and March 16, 2025 (Attached), total landslide movements in the upper ancient landslide area are significant and greatly exceed what has been observed over the past seven decades. The Altamira Landslide is a **newly** active landslide that has occurred within a previously mapped ancient Landslide Complex (most recently labeled the "Ancient Altamira Landslide Complex" which was a name modification of the "Ancient Portuguese Bend Landslide" identified on the California Geological Survey's Landslide Inventory Map (CGS, 2007) which is referred to as the Landslide Complex in this appeal letter). See map on the following page.

It is important to make this distinction for consistency and to avoid confusion, because the Altamira Landslide is, in fact, a new member of the historically active Landslide Complex but largely **underlies it** and occupies an area of active land movement >700 acres and extends to more than 500 feet off of the coastline, whereas the shallower historically active Landslide Complex only occupied about 380 acres.

The Altamira Landslide in Rancho Palos Verdes is therefore a recently identified large landslide that largely underlies (and therefore largely encompasses but exceeds the area of) the previously understood active Landslide Complex containing the four historically

active landslides. The Altamira Landslide includes large areas outside of the historically mapped boundaries of these known landslides, predominantly upslope and downslope from the historically mapped PBL and ACL, within, but smaller than, the Landslide Complex as shown on the map on the following page.

To provide an example of the change in size, the dimensions from head to toe of the previously historical ACL is 2,250 feet and the width up to 1,450 feet wide. The dimensions from head to toe of the Altamira Landslide, underlying and extending up and down slope from both the PBL and the ACL, is 5,800 feet (more than double that of the ACL) with a width of up to 7,400 feet wide (more than five times as wide as the ACL).

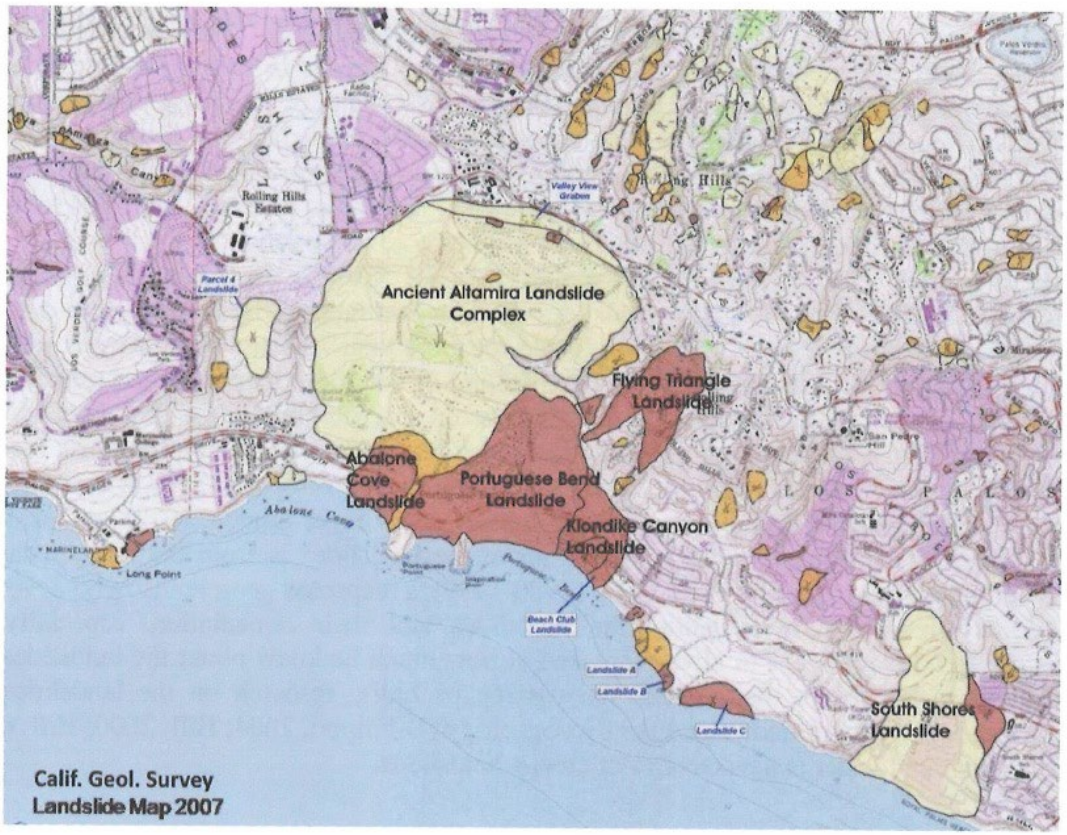


Figure 1. Landslide map of a portion of the south flank of the Palos Verdes Peninsula prepared by the California Geological Survey (2007). The major and some minor landslides are identified. Light yellow indicates that the landslide is inactive, red is active and orange is dormant.

While previous geotechnical investigators identified inactive deep failure surfaces in both the historically active and ancient landslide areas, none of them mapped or identified as active the entire depth or breadth of movement that has recently impacted the area, nor did they opine that such an event would occur in historic times. The areal dimensions, depth of movement, velocity of movement, artesian and near-artesian groundwater pressures beneath it, and even the direction of movement, are different than the ACL, PBL, and KCL landslides, collectively referred to as the Landslide Complex. The

distinction to be made then, is that the Altamira Landslide is not just simple *expansion* of an existing group of landslides, **it is an entirely different, larger and deeper landslide with much broader boundaries (including the new coastline offshore), nearly twice as deep as the depth of historic landslide movement in some areas, and with unprecedented rates of movement (which were not seen in the early LA County Engineer surveys, the Charles Abbott Associates surveys beginning in 1994, nor the McGee surveys since 2007)**. None of this was experienced during the history of the City, and the Altamira Landslide is a unique landslide not characterized in its current dimensions during the over 70-year history of landslide investigations, exploratory borings, monitoring and observations being conducted in the area.

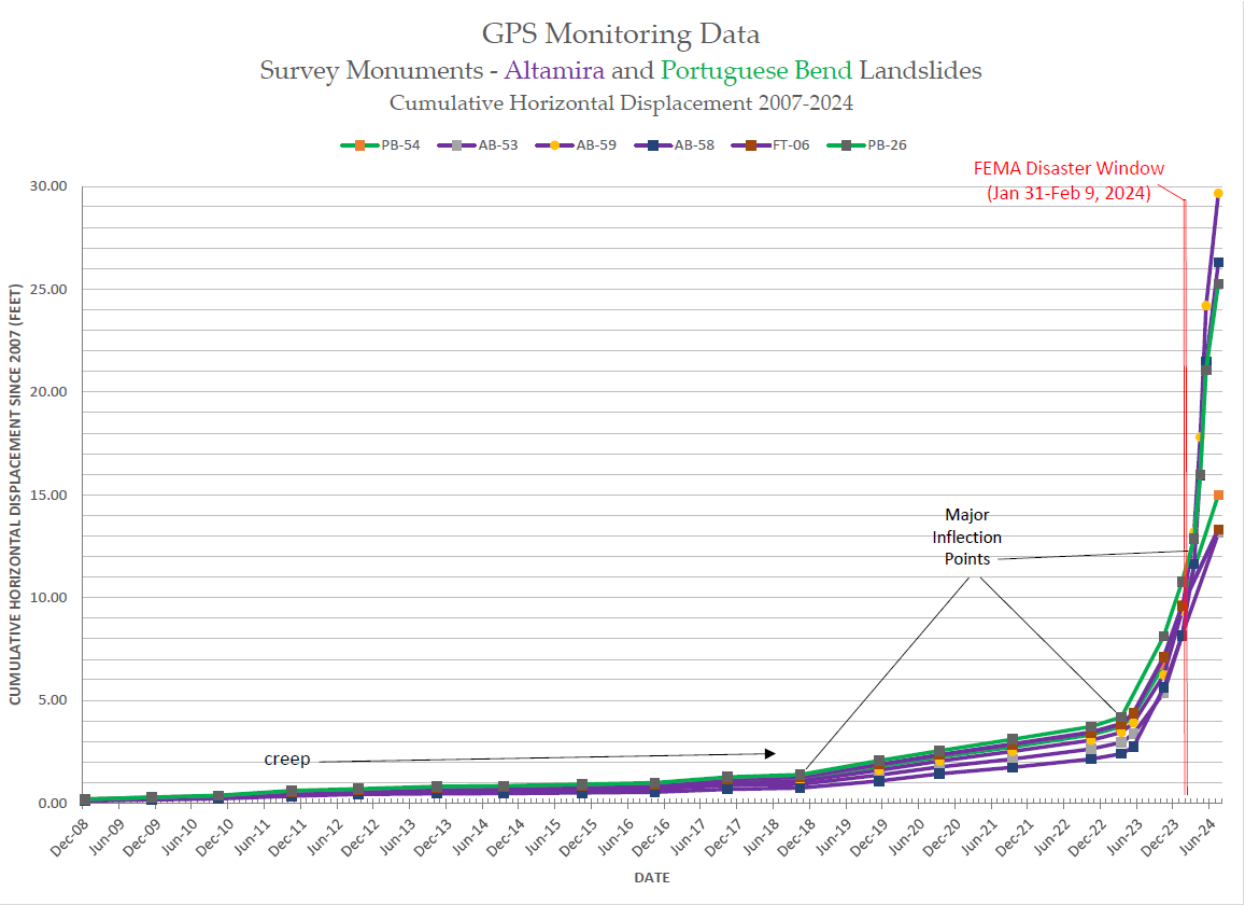
Land movement correlated to the Altamira Landslide continues to manifest at the ground surface in the form of landslide scarps, fissures, grabens/sinkholes, tensional cracking, and shear zones. Field mapping corroborates the GPS monitoring data, indicating that a large portion of the ancient Altamira Landslide above the historically mapped Landslide Complex (PBL, ACL and KCL boundaries) is now involved in significant active landslide movement that is impacting trails, roads, drainage facilities, and private property and continues to have the potential to impact above and below ground utility infrastructure (i.e., utility lines, gas lines, water lines, communication lines, etc.).

Causation

The activation of the Altamira Landslide was largely caused by "climate whiplash" (also more technically described as hydroclimate volatility) induced by climate change, particularly starting in 2011, with five years of drought, and eight out of eleven years significantly below normal rainfall from 2011-2022, followed by two consecutive extraordinarily heavy rain seasons that dropped approximately 4 feet of rainfall on the landslide and surrounding areas draining into the landslide on the south flank of the Palos Verdes Hills.

The graphic on the following page depicts *cumulative horizontal displacement* of select GPS survey monitoring points, including some of the fastest moving points in the Altamira Landslide and a couple of representative points in the PBL (which overlies the Altamira Landslide). There are three significant inflection points indicated in the graph. Prior to the first inflection point, the cumulative displacement lines indicate that the GPS monitoring points within the Altamira Landslide were creeping quite slowly (imperceptibly, near the range of instrument precision) for a number of years extending back before 2011. There was no observed or documented surface manifestation of this minor creep movement at the ground surface; however, this movement is believed to have caused deformation (elongation or stretching out of the earth materials comprising the subsurface which in turn causes additional fracturing of those earth materials) of the Altamira Landslide body, which increased secondary permeability within the rock mass allowing rainfall at the ground surface to percolate more readily into the deep subsurface, raising groundwater levels to a point where they result in high pore pressures that contribute to landslide movement. Between October 2018 and October 2019 GPS readings (first inflection point),

an acceleration of creep movement is evident. Then following the multiple atmospheric river rains of January and February 2023 (second inflection point), a further acceleration of creep movement is evident, which would have resulted in further stretching out and opening up of the landslide mass. The final inflection point around March, 2024 (immediately following the FEMA declared disaster of January 31-February 9 wherein 8.29 inches of rain fell) shows a dramatic acceleration and **represents the triggering of major movement of the Altamira Landslide**, as reflected by some of the graphed points going very steep and nearly vertical on the graph. The graph includes GPS monitoring point AB-59, which has been the fastest moving point and is not surprisingly located in the center of the entire Altamira Landslide mass.

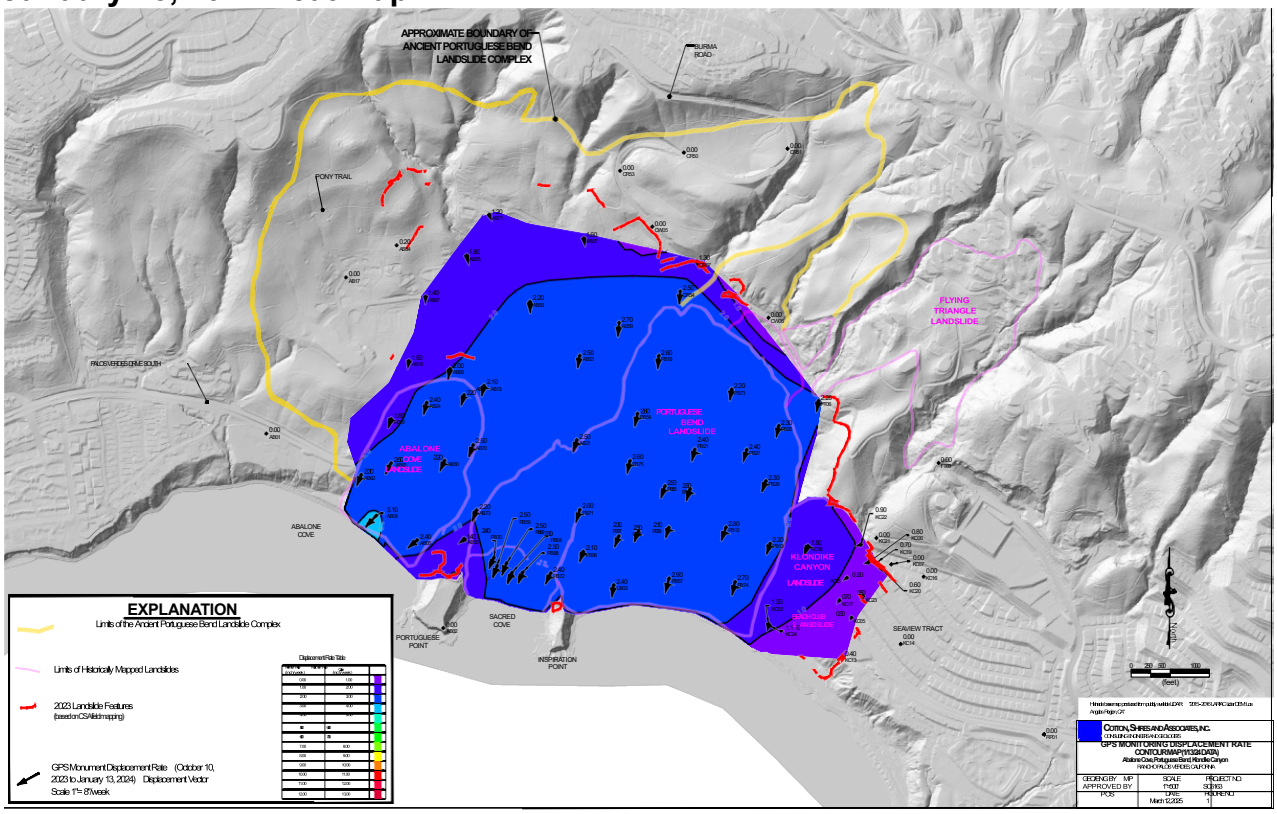


The change in ground movement rates before January 31 and after February 9, 2024 is significant. Based on a comprehensive review of the McGee GPS survey monitoring, the rates of Altamira Landslide ground movement in the Abalone Cove area (for points north of the previously active ACL) as of January 13, 2024 ranged from 1.2 inches per week (at the periphery) up to 2.7 inches per week (in the body of the landslide). After that intense period of rainfall, plus additional rainfall resulting in a total of over 11 inches in February, as of the GPS survey completed on March 8, 2024, the rates increased to 1.5 (at the periphery) to 5.9 (main body) inches per week, more than doubling in the body of the landslide, and then increased dramatically to as much as 13.5 inches per week in the

body of the landslide by July 1, 2024, probably as a slightly delayed reaction to the rainfall as it took time for the water to convert from rainfall absorption to higher groundwater pore pressures where it could have the greatest driving force impact on landslide movement.

The following graphics are “heat maps” that illustrate in color contours the rates at which the ground was moving based on the GPS survey monuments for January 13, 2024, March 8, 2024 and July 1, 2024, respectively. The heat maps include the City’s on-ground geologic mapping of visible land movement features, which started as tension cracks or narrow fissures that were discontinuous (as of December 2023 mapping and are shown on the January 13, 2024 heat map), but these features further developed into more continuous/connected tension cracks and fissures, which have now developed into large scarps, grabens and well-developed boundary features. It wasn’t until March 2024 that the City Geologist’s first drew a boundary (dashed green line) around the “Area of Major Land Movement”, because prior to that time, the surface manifestation of movement was poorly developed and inconsistent and there was not sufficient development of the landslide to develop a boundary.

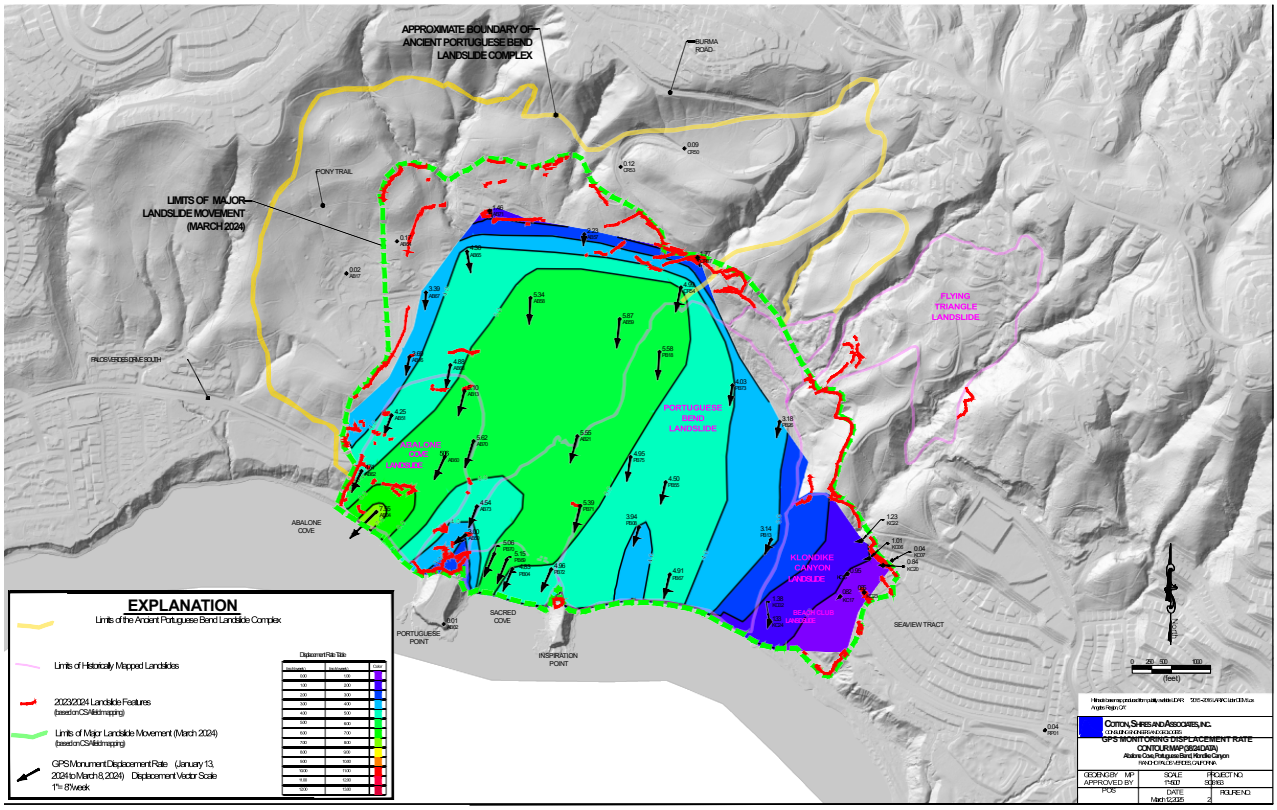
January 13, 2024 Heat Map



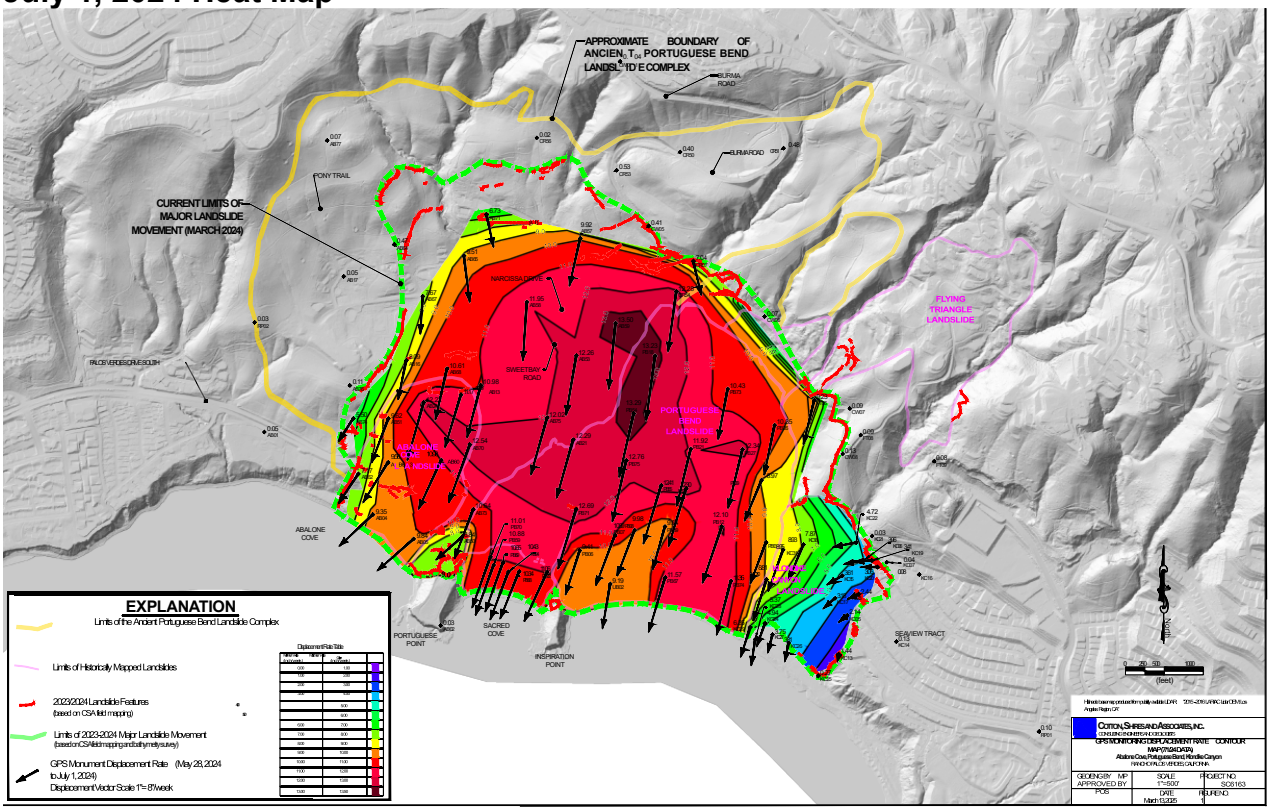
By March 2024, with further mapping and the extraordinary acceleration of numerous GPS monitoring points, a boundary defining the “Area of Major Land Movement” was delineated. Today, following many tens of feet of movement since early 2024, the boundary of the Altamira Landslide is well-defined. North of Palos Verdes Drive South,

the Altamira boundary extends significantly farther west of the historical ACL boundary (resulting in the destruction of the landmark Wayfarer's Chapel), upslope through the York property (6001 PV Drive South), and north of the historical ACL boundary through the Portuguese Bend Riding Club Area, crossing upper Narcissa Drive, through and north of residences on upper Cinnamon Lane, and eventually turning east across Altamira Canyon, extending through the Vanderlip Estate (100 Vanderlip Drive), destroying Vanderlip Drive and adjacent properties, and ultimately continuing northeast to the lower stretch of Burma Road Trail in the Portuguese Bend Reserve. The Altamira Landslide also created never before seen deformation where it underlies and now extends south of the KCL, including formation of a more seaward toe accompanied by uplifting ground that trended southwest through the beach area of the Portuguese Bend Beach Club and extending up to 500 feet or more offshore where it emerged through the sea floor and formed a new rocky coastline above sea level, generally east of Inspiration Point. The emergence of the new land offshore from the previous coastline was first reported to, and was subsequently observed by, the City Geologist in late February of 2024, consistent with the triggering of major movement of the Altamira Landslide described above.

March 8, 2024 Heat Map



July 1, 2024 Heat Map



<u>Impacts of Movement of The Altamira Landslide</u>

As of this date, the major land movement of the Altamira Landslide has resulted in the red-tagging (Unsafe to Enter/Occupy) and yellow-tagging (Limited Entry) of dozens of residential and commercial structures. It has also caused major destructive impacts to public and private roads, damages to drainage facilities and utility infrastructure (water, sewer, gas, electricity and cable), causing certain utilities to be shut-off, and closure of certain Preserve land that is otherwise heavily accessed by the public for hiking, biking, equestrian, and other purposes.

To reiterate, the damage the City sustained as a result of the winter storms of 2024 is attributed to the activation of the deeper slip plane, known as the Altamira Landslide, that has historically been inactive until the 2024 winter storms. The activation of this new landslide that carried the shallower landslide, referred to as the Landslide Complex herein, is **not** pre-existing and therefore invalidates the reason for denying the City's disaster cost recovery request.

The only practical mitigation measure available to address a landslide with such a colossal scale is relieving groundwater pore pressures through pumping of groundwater, but it has to be done on a large enough scale to be effective at reducing the movement to an acceptable level. This technique has proven effective for the east side of the Altamira Landslide where deep dewatering wells have been installed, maintained and the rate of ground movement monitored such that a correlation between increased pumping of groundwater and reduction in the rate of ground movement has been confirmed.

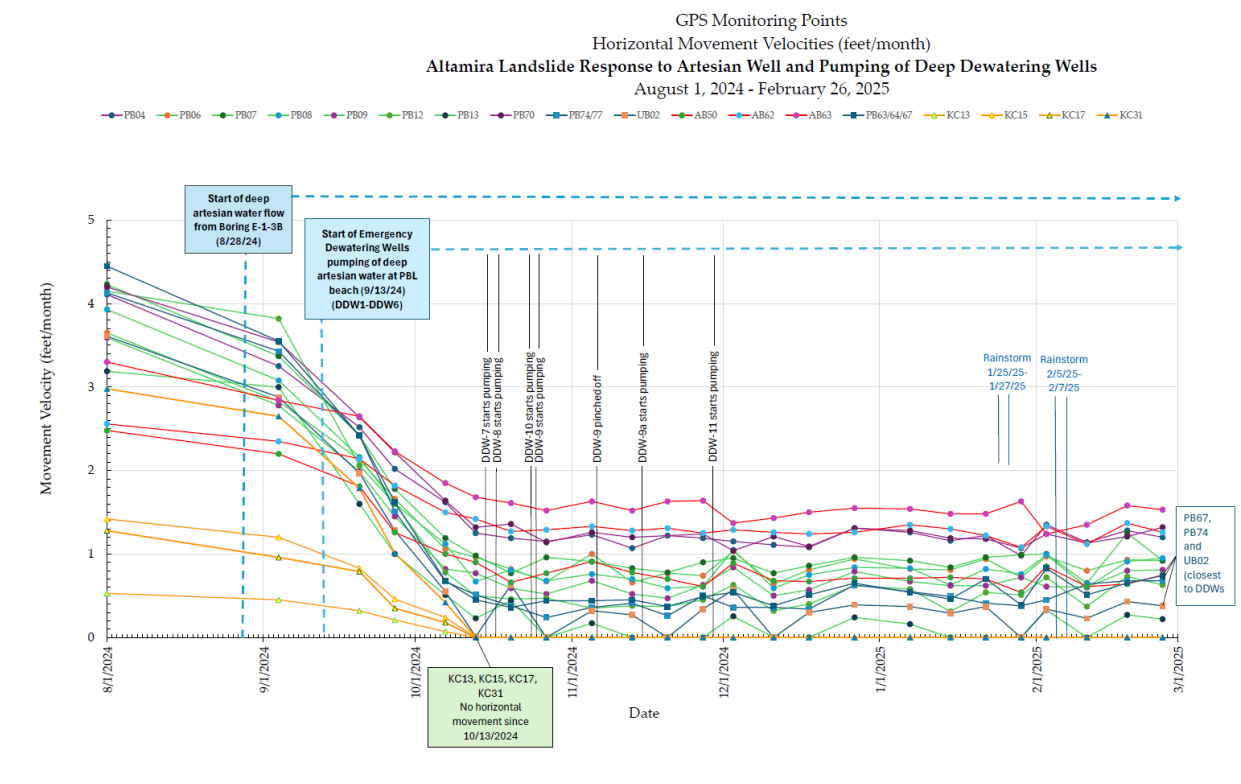
Emergency Measures

Emergency measures taken by the City and abatement districts (ACLAD and KCLAD) to date have included drilling, pumping and monitoring deep dewatering wells, winterization measures including lining channels and installing culverts to reduce the amount of surface water percolating into the groundwater regime from upslope drainages/canyons, and filling of and establishing drainage for fissures and grabens that, if left unmitigated, facilitate surface water intrusion into the groundwater regime. This strategy has proven to be effective in reducing the rate of movement of the Altamira Landslide and even stopping movement of the eastern portion of the landslide in the area of the KCL. Because piezometers installed in deep borings that penetrated the base of the Altamira Landslide indicated high groundwater pore pressures beneath the landslide (some areas were found to have near-artesian or artesian groundwater pressures – pressures higher than the ground surface), a pilot program strategy was pursued by the City that involved drilling a series of deep dewatering wells at the toe of coast below the base of movement of the Altamira Landslide slip plan and pumping to dewater the high groundwater pressures beneath the landslide. This strategy turned out to be more successful than originally contemplated because the movement of the landslide slowed quickly in response to the initial dewatering efforts and the deep wells continued to function for weeks or months before re-drilling was necessary.

The chart on the following page illustrates the timing of artesian water being encountered in one of the test borings (Boring E-1-3B, which was retrofitted to function as an artesian well), the installation of the deep dewatering wells, and the deceleration of the Altamira Landslide in response to the dewatering efforts.

Additional deep dewatering wells are also needed in order to reduce the movement of the middle and eastern portions of the Altamira Landslide to the level experienced prior to the impact of climate whiplash. However, the cost of drilling, pumping, maintaining and re-drilling requires significant funding which the City is unable to fund underscoring the significance of the requested disaster cost recovery – to return land movement to pre-2024 winter storm disaster rates.

Continued on the next page



Natural Disaster Cost Recovery

The cost to respond to this natural disaster has been immeasurable to City and its limited resources. To date, the City's estimated expenditures responding to land movement between October 2022 and June 2025 is approximately $47.5 million with approximately $36.3 million being spent this fiscal year (2024-25). Overall, the $36.3 million reflects a 290% increase from the prior year. These costs include emergency response efforts such as test boreholes, deep dewatering wells, maintenance of the deep dewatering wells until June 30, 2025, winterization, fissure filling, road repairs, sewer repairs, and drainage repairs to name a few.

Similar to the entire state of California, and in fact, the entire United States, there are known pre-existing conditions that lend themselves to natural disasters, such as wildfires, earthquakes, floods, hurricanes, tornadoes, etc. When one of these pre-existing conditions result in a natural disaster such as the recent devastating Palisades and Eaton wildfires, FEMA does not turn their back on those communities in need citing this area is mapped and known to be a Very High Fire Severity Zones. Similarly, FEMA and the federal government do not reject financial aid in known areas of earthquakes, floods, and hurricanes. That same principle should be applied to Rancho Palos Verdes and the recent acceleration of land movement resulting from the atmospheric river storms of 2023 and 2024, and the activation of the new landslide, Altamira Landslide. Moreover, **nowhere in the Stafford Act does it state that pre-existing conditions are ineligible for disaster**

recovery. In fact, the Stafford Act clearly cites the **intent** of Congress, by this Act, is to provide an orderly and continuing means of **assistance** by the Federal Government to State and **local governments** in carrying out their responsibilities to alleviate the suffering and damage which result from such disasters by (1) revising and broadening the scope of existing disaster relief programs; (2) encouraging the development of comprehensive disaster preparedness and assistance plans, programs, capabilities, and organizations by the States and by local governments; (3) achieving greater coordination and responsiveness of disaster preparedness and relief programs; (4) encouraging individuals, States, and local governments to protect themselves by obtaining insurance coverage to supplement or replace governmental assistance; (5) encouraging hazard mitigation measures to reduce losses from disasters, including development of land use and construction regulations; (6) **providing Federal assistance programs for both public and private losses sustained in disasters**; and (7) identifying and improving the climate and natural hazard resilience of vulnerable communities.

Clarification to FEMA's Document Descriptions

In addition to the above, the City provides the following responses for context purposes to the some of the documents citied in the Eligibility Determination Memorandum. As you will see, the extracted statements used to deny the City's request do not accurately support nor justify the denial because they are taken out of context of the overall document and do not provide an accurate analysis of the reason for the land movement and the basis for denial as stated earlier in this appeal letter. The City's position remains that the 2024 winter storms triggered the activation of the **new Altamira Landslide** which carried, at an accelerated rate of movement, the greater Landslide Complex which up until recently has been managed.

1. June 7, 2023 City Letter to Los Angeles County Fourth District Supervisor Hahn

   FEMA's determination letter references the City's June 7, 2023 letter to Los Angeles County Fourth District Supervisor Hahn (Sup. Hahn) as the basis for emphasizing its position that the requested damage recovery for water control features traverses a pre-existing landslide and that the City "continuously repairs and maintains these drainage pipes." The determination letter also states that "the damages claimed are a result of decades of pre-disaster ground instability and ongoing non-disaster related causes" which the City does not believe is accurate based on the information provided in this appeal letter.

   The City's letter to Sup. Hahn quotes a few words that when taken out of context gives a very different meaning to the reader. The letter was sent to Sup. Hahn requesting $6 million to help the City fund its matching portion of FEMA's Building Resiliency Infrastructure Communities (BRIC) Grant for the Portuguese Bend Landslide Remediation Project. The letter to Sup. Hahn includes data on the average rate of movement for context purposes to garner her advocacy and financial support needed

to develop and implement a remediation plan as a **preventive measure** to a potential imminent threat to public health and safety.

The Portuguese Bend Landslide Remediation project, concentrated within the PBL, was developed by the City to **prevent** the acceleration of land movement by addressing rainwater runoff from entering the ground and recharging the water table, which occurred during the rain events of 2023 and 2024.

The Stafford Act states that pre-existing conditions are not eligible for disaster recovery but rather that to be eligible it has to be directly related to an incident per Title 44 of C.F.R. 206.223(a)(1). However, as noted earlier, the behavior of this slow moving landslide noticeably changed in response to the Winter Storms of 2023 and 2024, and that the extreme wet weather activated a **new** landslide, Altamira Landslide, and should therefore not be considered pre-existing, the point to this appeal.

2. Cotton Shires and Associates (CSA) Geologic Report dated September 9, 2023

   According to your determination letter, the City's Geotechnical Engineer's September 9, 2023 memo is cited as one of the basis for denying the City's recovery request because "*the work claimed is not required as a result of the declared disaster and the applicant cannot demonstrate the damage was directly caused by FEMA-DR-4769-CA. Rather these damages are a result of long-term creep displacement and recent years acceleration of earth movement from non-disaster causes as documented in the multiple reports.*"

   As previously noted, the City respectfully disagrees with these statements and in fact, can demonstrate that the winter storms of 2023 and 2024 correlated to climate change and seasonal changes in weather patterns are the reasons the City experienced a noticeable behavioral **change** in the landslide rate of movement with the activation of the dormant and inactive Altamira Landslide. Moreover, the Eligibility Determination Memorandum neglects to cite relevant and pertinent information in the CSA's September 9, 2023 memo emphasizing the following significant and noticeable change in the behavior of the landslide:

   GPS Survey Monitoring Data Review: GPS monitoring of survey monuments throughout the Landslide Complex area has been performed tri-annually since 2007 by McGee Surveying Consulting. In their June 6, 2023 Survey Report, McGee stated:

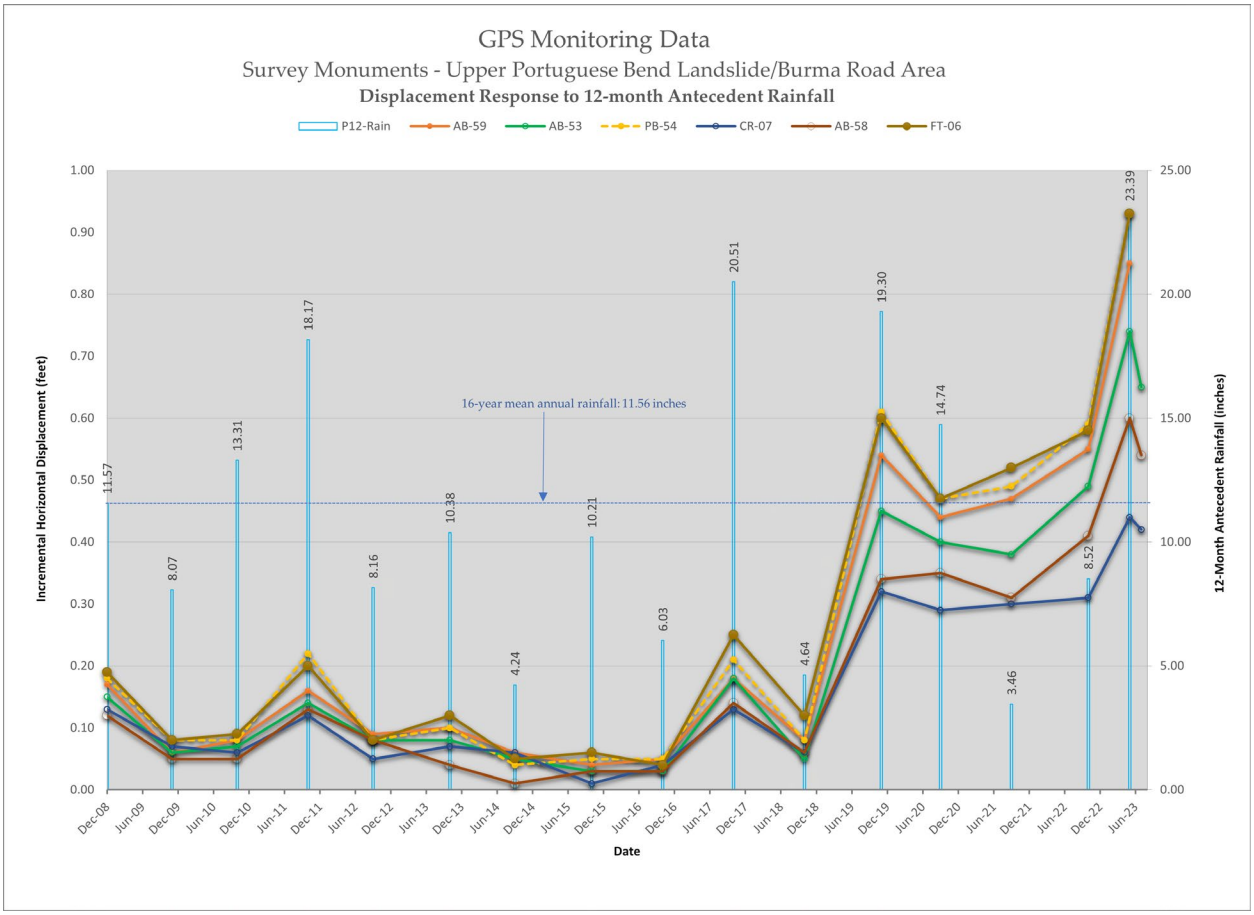
   "*In the last seven months the movement velocities have accelerated over the average velocity for the previous four years which saw an acceleration over the previous 15-20 years……**Velocities were stable** prior to 2018. After the Fall of 2018 they increased about 3 to 6 fold at most points and remained stable to the Fall of 2022. In the last seven months since the **Fall of 2022** the velocities generally have **doubled more or less***." (emphasis added)

This is a significant and important observation from the surveyor, and comports with the past several years of field observations by CSA staff of roadway distress and trail distress within the PBR, as well as reports of street distress, building distress and utility line breaks throughout the various known landslide areas.

Several graphics based upon CSA's own analysis of the GPS survey monitoring data further illustrate what is happening with the landslide ground movement. According to Figure 2 in CSA's September 9, 2023 memo, depict horizontal displacements (in feet) and ground displacement vectors for 12 selected GPS survey monuments mostly located in the mid and upper Landslide Complex. These figures are based upon McGee's GPS monitoring of the survey monuments from October 2018 to May 2023 (with the exception of two monuments which were last read in October 2022, PB18 and AB71). Four of these monuments were also read in mid-July, 2023 and those movement data are also presented. Two of the monuments, CR07 and FT06 are located on Burma Road outside of the PBL and indicate 1.67 feet and 3.09 feet of horizontal displacement over the ~4.5-year period. The CR07 point moved an additional 0.42 feet in two months (through July 15, 2023), which translates to ground movement velocity of about 2.5 feet per year. Most of the other points on this figure are in the Landslide Complex (and mostly in LMA Zone 2) and are indicating total displacements of approximately 1 to 3 feet (or average velocities of about 0.22 to 0.67 feet/year across the ~4.5-year period). Several of these points in LMA Zone 2 that were also monitored in July, 2023 showed continued acceleration from May to July 2023, with calculated velocities of ~1.25 feet/year at AB67 to ~3.9 feet/year at AB53. These are extraordinary rates of landslide movement that, to the City Geologist's knowledge, have not been previously documented in the LMA Zone 2 area.

Incremental displacement has been analyzed of these points versus 12-month antecedent rainfall, as a measure of the landslide response to rainfall. A graph of cumulative displacement of these points since 2007 is presented on the following page. This graphed movement data indicates a clear acceleration of movement beginning in late 2018 (as noted in the area labeled inflection point).

Accelerated landslide movements since late 2018 appear to be correlative with significantly above normal rainfall in three out of four rainfall seasons (2016-17, 2018-19 and 2019-20) which followed five consecutive drier than normal rainfall seasons (2011-12 through 2015-16). **The extraordinary rainy season of 2022-23, where rainfall totals were more than 200% of average, has resulted in further acceleration**.



It is imperative to bring to your attention that the City Geologist recently provided an updated memorandums dated November 8, 2024 and March 16, 2025 (attached) that further underscores the impacts and damage caused by FEMA-DR-4769-CA also known as the winter storms of January 31 through February 9, 2024, as documented earlier in this appeal letter.

3. Rancho Palos Verdes Geo-Logic Associates (GLA) Report Dated December 2019

   According to the Eligibility Determination Letter, a December 2019 report prepared by GLA, a geotechnical engineering firm, hired by the City to prepare its Portuguese Bend Landslide Remediation project is cited. This report cites, as one of the basis to determine that the requested disaster damage recovery occurred in a pre-existing landslide area and not related to the storms citing the following:

   "the landslide complex includes approximately 239 acres with ground movement varying across the site ranging up to approximately 11 feet per year."

   This very citation supports the City's request and claim that the damage sustained occurred as a result of the winter storms in 2023 and 2024 based on the following:

As noted earlier, the Landslide Complex is generally comprised of 5 subslides. The 239 acres noted above is limited to the PBL. This is because the study area for the Landslide Complex was specific to the PBL. In fact, the City Geologist's November 8, 2024 memo states since 2024, this significantly greater depth of movement has resulted in a broader footprint of active land movement at the ground surface and offshore, and expansion of the historical land movement area from approximately 380 acres to **over 700 acres**.

Furthermore, as previously stated, according to the City Geologist's March 16, 2025 memo (attached), the Altamira Landslide is a newly active landslide that has occurred within a previously mapped ancient landslide complex. It is important to make this distinction for consistency and to avoid confusion, because the Altamira Landslide is, in fact, a new member of the historically active PBL/ACL/KCL Landslide Complex but largely **underlies it** and occupies an area of active land movement >700 acres and extends to more than 500 feet off of the coastline, whereas the shallower historically active PBL/ACL/KCL Landslide Complex only occupied about 380 acres. While previous geotechnical investigators identified inactive deep failure surfaces in both the historically active and ancient landslide areas, none of them mapped or identified as active the entire depth or breadth of movement that has recently impacted the area, nor did they opine that such an event would occur in historic times. The active Altamira Landslide currently involves major land movement comprising an area of over 700 acres landward of the coast and extends to approximately 500 feet or more off the coastline. The areal dimensions, depth of movement, velocity of movement, artesian and near-artesian groundwater pressures beneath it, and even the direction of movement, are different than the Landslide Complex. The distinction to be made then, is that the Altamira Landslide is not just simple *expansion* of an existing group of landslides, it is an entirely different, larger and deeper landslide with much broader boundaries (including the new coastline offshore), nearly twice as deep as the depth of historic landslide movement in some areas, and with unprecedented rates of movement (which were not seen in the early LA County Engineer surveys, the Charles Abbott Associates surveys beginning in 1994, nor the McGee surveys since 2007).

None of this was experienced during the history of the City, and the Altamira Landslide is a unique landslide not characterized in its current dimensions during the over 70-year history of landslide investigations, exploratory borings, monitoring and observations being conducted in the area.

4. Landslide Working Group November 1, 2023 Meeting Notes

   The FEMA Eligibility Determination Memorandum cites that the City has a pre-disaster active task force called the RPV Landslide Complex Working Group which meets to continue to address ongoing landslide problems, and that is **not** correct.

As previously noted, on October 3, 2023, the City Council declared a local state of emergency in response to the rapid and significant acceleration in land movement. As a result, the Council directed staff to working with community stakeholders including utilities, geologists, HOA representatives and residents to collaborate the City's and community's response to the declared local state of emergency. It was four months later when the then-mayor sent a letter to the Governor requesting he declare a state of emergency and request the President declare a federal disaster in response to the land movement resulting from the winter storms of 2023 and 2024 (attached)

5. Michael McGee's 2007 GPS Technical Report

   In 2007, the City began using GPS technology to track on-ground movement of the Landslide Complex. No one is denying that the shallower Landslide Complex has been moving since 1956, what is evident in the data FEMA's analysts overlooked is that there is a significant and noticeable change in the behavior of the landslide and the rate of movement in response to rain events as clearly demonstrated in the charts earlier in this letter. Moreover, a new, previously dormant landslide was activated in response to the 2024 Winter Storm event.

   To reiterate, the City Geologist has clearly documented that the rain events of 2023, and particularly 2024, have contributed to the accelerated rate of movement and the damage sustained by the City and its infrastructure. The point that warrants a reconsideration of reversing the denial is that there is a clear change in the rate of movement based on the GPS monitoring points cited in your memo between 2023 and present.

<u>Additional Information - Land Movement and the Monks Lawsuit</u>

In 1978, the City enacted an ordinance imposing a moratorium on the construction of new homes in the vicinity where accelerated landslides had recently occurred. The so-called "Monks" plaintiffs owned 16 vacant lots impacted by the moratorium. Some of these property owners claimed to have been waiting over 30 years to build homes on their properties on land that has not showed signs of movement. The lots in question were otherwise zoned for single-family dwellings.

Eventually, these property owners filed suit against the City seeking to invalidate the moratorium criteria and alleging a claim for inverse condemnation based on the state takings clause because, as the plaintiffs asserted, the land was not moving and suitable for development. The trial court denied their request and ultimately found in the City's favor. The property owners appealed.

The Court of Appels ruled in favor of the plaintiffs citing that the City's ordinance requiring owners of land in specific zones within the Landslide Complex to present data demonstrating to satisfaction of city geologist that the gross geotechnical factor of safety

where their lots were located was at least 1.5 in order to build on their lots deprived the land of all economically beneficial use, and resulted in a permanent categorical taking. **The Courts ruled that the plaintiffs could build on their lots.** (*Monks v. City of Rancho Palos Verdes*, 167 Cal.App.4th 263 (2008)

Conclusion

The basis for denying the City's disaster recovery on a pre-existing condition is not a valid reason when, as demonstrated in this appeal letter and supporting attachments, it is clear that a **new, inactive** for hundreds of years, landslide was activated in response to the 2024 Winter Storm event that led to the federal disaster declaration (FEMA-DR-4769-CA). The activation of the Altamira Landslide resulted in significant damage to the City's infrastructure including, but not limited to, public trails and the open space areas known as the Portuguese Bend and Filiorum Reserves that have been indefinitely closed to the public due to damage sustained by the winter storms that occurred between January 31 and February 9, 2024. It is now known that the activation of the Altamira Landslide carried the subslides of ACL, PBL, and KCL which is clearly demonstrated in this appeal letter that the rate of movement significantly increased along with the behavior of the land movement as a result of the 2023 and 2024 Winter Storm Events.

It is for the reasons cited throughout this appeal letter that disaster recovery financial assistance be provided for the destruction resulting from the activation of the Altamira Landslide caused by the extraordinary rain events of 2024. The weather whiplash over the years has adversely impacted the City, its residents and businesses, and its economics. Overturning the denial and providing the disaster recovery assistance requested will enable the City to properly respond to the activation of the new Altamira Landslide by stabilizing land movement and repairing damaged and critical infrastructure.

On behalf of the Rancho Palos Verdes City Council and residents, we thank you for your consideration of this appeal letter.

Sincerely,

Ara Michael Mihranian, AICP
City Manager

Attachments:

- September 9, 2023 CSA Memo
- November 8, 2024 CSA Memo
- March 16, 2025 CSA Memo
- February 20, 2024 Letter to Governor Newsom

c. Rep. Ted Lieu

Senator Adam Schiff
Senator Alex Padilla
State Senator Ben Allen
Asm. Al Muratsuchi
Rancho Palos Verdes Mayor Bradley and City Council
William Wynder, Rancho Palos Verdes City Attorney
Catherine Jun, Rancho Palos Verdes Deputy City Manager
Ramzi Awwad, Rancho Palos Verdes Director of Public Works
Vina Ramos, Rancho Palos Verdes Director of Finance

COTTON, SHIRES AND ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS

CITY OF RANCHO PALOS VERDES

CSA Project No. SC6022

MEMORANDUM

TO: Katie Lozano, Open Space Manager
CC: Ara Mihranian, City Manager
William Wynder, Elena Gerli, and John Fox, City Attorneys
Cory Linder, Director of Recreation and Parks
Ramzi Awwad, Public Works Director
Taylor Fox, Senior Park Ranger
FROM: Michael Phipps, CEG 1832, Contract City Geologist
Christopher Dean, CEG 1751, Contract City Geologist
Matthew Janousek, GE 3005, Contract City Geotechnical Engineer
RE: **Preliminary Geotechnical Assessment of Recent Land Movement in the Portuguese Bend Reserve and Impacts to Burma Road Trail, Rancho Palos Verdes**
DATE: September 29, 2023

INTRODUCTION

In accordance with your request, this memorandum has been prepared to provide a preliminary geotechnical assessment of recent land movement within the Portuguese Bend Reserve (PBR) with a specific focus on the impacts of land movement to the Burma Road Trail. We understand that the PBR is one of the City's most popular land reserves, it is heavily used by the public for recreation and is also used by public utilities including Southern California Edison and California Water Service Company. A portion of the PBR is underlain by the historically active Portuguese Bend Landslide (active since 1955-56) as well as the Ancient Portuguese Bend Landslide Complex. Some areas of the Reserve are now experiencing significant land movement and ground surface manifestation that is beyond the limits of the historically active and previously mapped Portuguese Bend Landslide, resulting in damage to trails and fire roads which provide access for public safety, utilities, maintenance, conservation, and public recreation. Cotton, Shires and Associates, Inc. (CSA) geologists have been requested by the City to observe various landslide-related issues in the Reserve involving damage to trails since 2021 and the SCE transmission lines along Burma Road since the summer of 2022. In 2021 we also began a detailed review of Global Positioning Satellite (GPS) monitoring data for survey monuments both within and outside the PBR, including points within the Abalone Cove Landslide, Klondike Canyon Landslide, and elsewhere within the Ancient Portuguese Bend Landslide Complex.

A comprehensive reconnaissance of the PBR was conducted by vehicle with City staff on June 28, 2023. Following this field visit, the City's Open Space Manager requested a report addressing the following items:

DRAFT

- Information and a map presenting our observations of where new landslide scarps are forming;
- An evaluation of whether Burma Road is currently able to accommodate vehicles, ranging from smaller Park Ranger trucks to heavy equipment used by utility companies and fire department, and if it is currently able to accommodate vehicles, an estimate of how long the road will remain stable;
- Recommendations for re-routing Burma Road (if necessary) to areas less prone to land movement as the fire road is needed for the City, fire department, and utility companies;
- Consideration of recommendations for additional warning signage due to the increased land movement to warn recreational users (hikers, bikers, horseback riders) and authorized outside agency personnel who drive the Reserve fire roads;
- Recommendations for a maintenance plan to fill fissures and keep Burma Road passable to pedestrians and vehicles, as the fissures have become too significant for park rangers to fill in with shovels.

This memorandum will address these requested items, based upon our field observations and geologic mapping, analysis of GPS monitoring data, background knowledge of the area, and professional experience.

PREVIOUS WORK

Previous City-requested reconnaissance and observation of trail conditions in the PBR performed by CSA geologists have included the following:

- 8/27/21: Burma Road trail reconnaissance (fissures/ground movement)
- 9/29/21: Burma Road and Garden Trail reconnaissance (fissures/ground movement)
- 1/5/22: Burma Road trail reconnaissance (fissures/ground movement)
- 8/31/22: Burma Road trail reconnaissance, meeting with SCE contractor and City staff, (regarding power pole relocation due to fissures, ground movement)
- 3/8/22: Upper Burma Road trail reconnaissance (rockfall hazards)
- 4/5/23: Burma Road Trail, Garden Trail, and Rim Trail reconnaissance (fissures/ground movement)

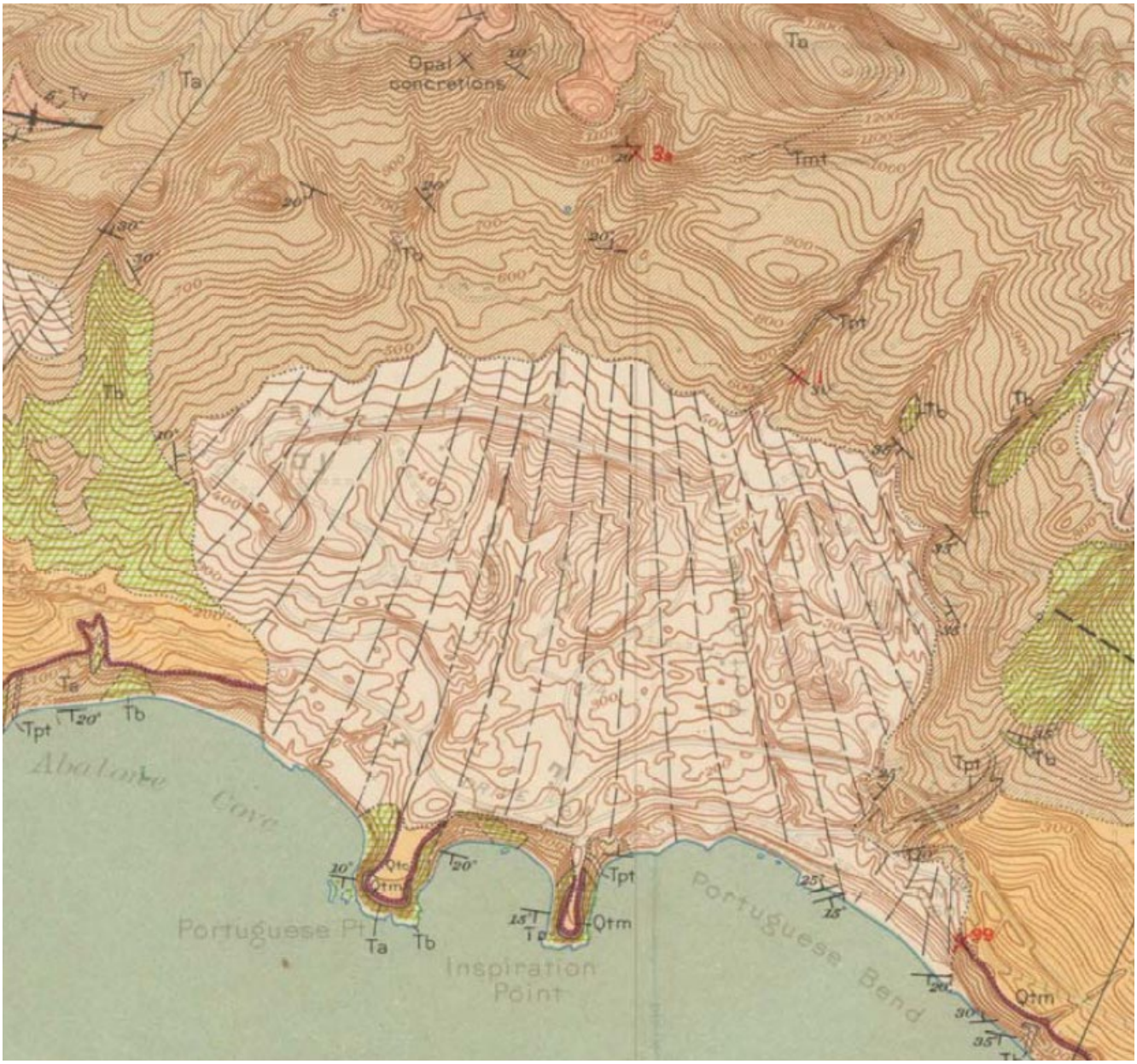
Findings and recommendations from these field visits have been routinely documented by either memoranda or email addressed to City staff. Recent published documents include memoranda dated February 9, 2022 (Burma Road/Rim Trail Junction) and May 19, 2023 (SCE Power Pole Relocation, Burma Road).

Preliminary geologic mapping of the upper limits of active landsliding along the Burma Road trail and vicinity was performed on June 28, 2023 and supplemented on September 22, 2023; however, this work is incomplete and requires additional field effort. Because of the steep terrain, large mapping area, and thick (inaccessible) vegetation in some areas, we have supplemented our field mapping with photo-geologic mapping utilizing high-resolution Nearmap (vertical aerial) imagery captured on January 17, 2023 and June 17, 2023.

DRAFT

FINDINGS

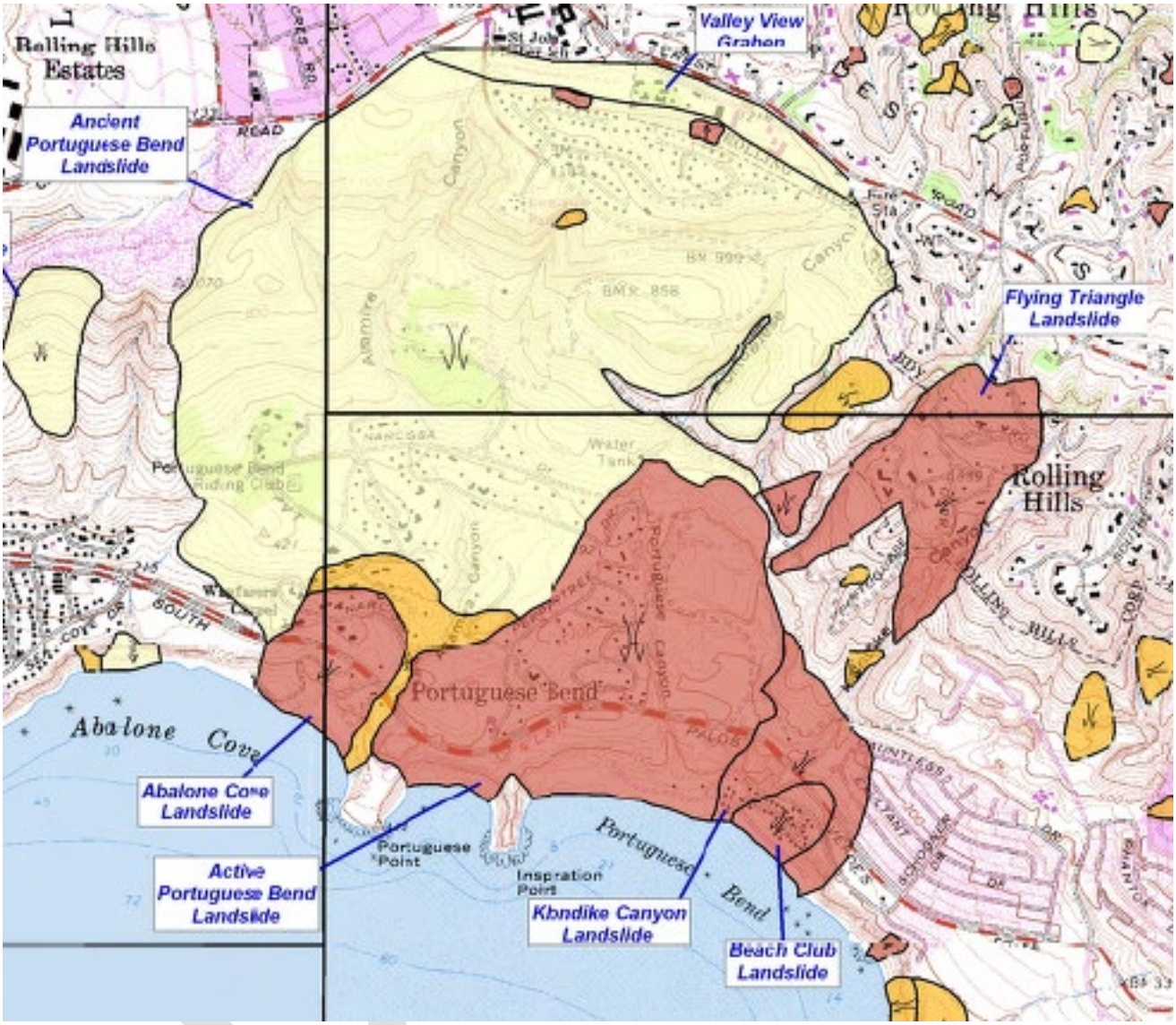
Geologic Mapping: The Ancient Portuguese Bend Landslide Complex (APBLC) was first mapped by the U.S. Department of the Interior Geological Survey (aka, USGS) in 1946 (shown as white area with black dashed lines in the image below) and occupies a broad area on the south side of the Palos Verdes Peninsula from the crest of peninsula to the Pacific Ocean.



U.S. Department of the Interior, 1946, Portion of Geologic Map of the Palos Verdes Hills, Los Angeles County, California

Within the APBLC, several large landslide masses have reactivated since the 1950s, including the Portuguese Bend Landslide, Abalone Cove Landslide, Klondike Canyon Landslide, and Beach Club Landslide. The Flying Triangle Landslide is in similar but higher terrain northeast of the Portuguese

Bend Landslide but is not considered part of the APBLC on regional geologic maps. These landslides are depicted on the California Geological Survey's Landslide Inventory Map of the Palos Verdes Peninsula (2007, image below).



California Geological Survey, 2007, portion of Landslide Inventory Map of the Palos Verdes Peninsula

Burma Road (and Trail) is located along what was previously proposed to be the Crenshaw Boulevard Extension, until the Portuguese Bend Landslide reactivated in 1956. The lower reach of Burma Road trends southeast immediately uphill from the headscarp of the Portuguese Bend Landslide. Previous site visits by our staff to the Burma Road area within the PBR beginning in 2021 were primarily in response to reported "fissures" forming in multiple locations across trails. We understand that City ranger staff have been routinely filling in the fissures with soil using hand tools. At other times heavier grading equipment has been reportedly used by Cal Water to fill fissures and maintain the Burma Road access to their facilities. Recent field mapping and GPS data suggest that these fissures are in fact the incipient manifestations of headward enlargement of the Portuguese Bend Landslide as well as an upslope manifestation of accelerated movement of a portion of the Ancient Portuguese Bend Landslide

Complex west of the active Portuguese Bend Landslide boundary. Four significant landslide scarps, which initially manifested as ground cracking and small fissures in Burma Road, have now formed across Burma Road, generally between the Eagle's Nest Trail intersection on the west and the Rim Trail intersection on the east.

Figure 1 (attached) was prepared on a Nearmap vertical color image taken January 17, 2023. The approximate limits of the active Portuguese Bend Landslide are depicted in red. The upper area of recent headward enlargement of the Portuguese Bend Landslide is depicted with yellow lines delineating landslide scarps which can be seen crossing Burma Road in at least seven locations. While the Burma Road trail has been repeatedly maintained by minor grading-leveling across these features, the scarps have grown in height and width adjacent to the road over time, and in some locations, grabens (wide pull-apart fissures) have formed in response to significant landslide movement. If not maintained in this manner over the past several years, landslide scarps ranging from 1 to 8 feet in height would extend across the road making it impassable to vehicles, cyclists, and even pedestrians. The most severe location is the western (and uppermost, elevation-wise) scarp located between the Water Tank trail and Eagle's Nest Trail intersection with Burma Road. The landslide displacement at this location has produced a scarp 6 to 8 feet in height and significantly displaced an SCE power pole that is now leaning approximately 35-40 degrees out of plumb. Other scarps across Burma Road southeast of this location are smaller, generally ranging from 1 to 4 feet in height adjacent to the road. Of note is that these scarps have grown substantially in size since our June 28, 2023 reconnaissance.

The downslope limits of the new landslide scarps (yellow contacts on Figure 1) appear to be directly connected to the Portuguese Bend Landslide at the eastern end; however, at the western end they are not well-defined at the ground surface and additional field mapping is necessary to further delineate the western margin. The western margin was observed crossing Kubota Trail and trending toward the Vanderlip Trail, where it was lost in heavy vegetation. It is important to note that the western extent of this new landslide movement is somewhat west of the head of the Portuguese Bend Landslide. It is our interpretation that the western extent of this new landslide movement is occurring in response to long-term creep displacement and recent acceleration of movement of the Ancient Portuguese Bend Landslide Complex (APBLC) since October 2018.

GPS Survey Monitoring Data Review: GPS monitoring of survey monuments throughout the APBLC area has been performed tri-annually since 2007 by McGee Surveying Consulting. In their June 6, 2023 Survey Report, McGee stated:

"*In the last seven months the movement velocities have accelerated over the average velocity for the previous four years which saw an acceleration over the previous 15-20 years……Velocities were stable prior to 2018. After the Fall of 2018 they increased about 3 to 6 fold at most points and remained stable to the Fall of 2022. In the last seven months since the Fall of 2022 the velocities generally have doubled more or less*."

This is a significant and important observation from the surveyor and comports with the past several years of field observations by CSA staff of roadway distress and trail distress within the PBR, as well as reports of street distress, building distress and utility line breaks throughout the various known landslide areas. We have prepared several graphics based upon our own analysis of the GPS survey

DRAFT

monitoring data to further illustrate what is happening with the landslide ground movement. Figure 2 (attached) depicts horizontal displacements (in feet) and ground displacement vectors, for 12 selected GPS survey monuments mostly located in the mid and upper Ancient Portuguese Bend Landslide Complex. These figures are based upon McGee's GPS monitoring of the survey monuments from October 2018 to May 2023 (with the exception of two monuments which were last read in October 2022, PB18 and AB71). Four of these monuments were also read in mid-July, 2023 and those movement data are also presented. Two of the monuments, CR07 and FT06 are located on Burma Road outside of the Portuguese Bend Landslide and indicate 1.67 feet and 3.09 feet of horizontal displacement over the ~4.5-year period. The CR07 point moved an additional 0.42 feet in two months (through July 15, 2023), which translates to ground movement velocity of about 2.5 feet per year. Most of the other points on this figure are in the Ancient Portuguese Bend Landslide Complex (and mostly in LMA Zone 2) and are indicating total displacements of approximately 1 to 3 feet (or average velocities of about 0.22 to 0.67 feet/year across the ~4.5-year period). Several of these points in LMA Zone 2 that were also monitored in July, 2023 showed continued acceleration from May to July 2023, with calculated velocities of ~1.25 feet/year at AB67 to ~3.9 feet/year at AB53. These are extraordinary rates of landslide movement that, to our knowledge, have not been previously documented in the LMA Zone 2 area.

We have also reviewed and analyzed cumulative and incremental displacements from 2007-2023 for six select survey monitoring points that are generally in the upper Portuguese Bend Landslide/Burma Road area, including three points that are in the Ancient Portuguese Bend Landslide Complex west of the historically active Portuguese Bend Landslide (i.e., in Landslide Moratorium Area Zone 2). These six points are identified as:

- CR07 adjacent to Burma Road Trail;
- PB54 located within the "Landward Subslide" of the Portuguese Bend Landslide Complex;
- AB53, AB58 and AB59 located within the Ancient Portuguese Bend Landslide Complex (Landslide Moratorium Zone 2); and
- FT06 adjacent to Burma Road Trail southeast of the Rim Trail intersection.

We have analyzed incremental displacement of these points versus 12-month antecedent rainfall, as a measure of the landslide response to rainfall (Figure 3). A graph of cumulative displacement of these points since 2007 is also presented in Figure 4. This graphed movement data indicates a clear acceleration of movement beginning in late 2018 (as noted in the area labeled inflection point).

Accelerated landslide movements since late 2018 appear to be correlative with significantly above-normal rainfall in three out of four rainfall seasons (2016-17, 2018-19 and 2019-20) which followed five consecutive drier than normal rainfall seasons (2011-12 through 2015-16). The extraordinary rainy season of 2022-23, where rainfall totals were more than 200% of average, has resulted in further acceleration based upon limited monitoring data. A significant concern is that the movement velocities have not declined back to the pre-2018 levels despite two significantly below-normal rainy seasons (2020-21, one of the driest on record, and 2021-22). Also of note is that our rainfall data do not include the impacts from Tropical Storm Hilary which dropped several inches of rain across most of southern California in August, 2023.

DRAFT

CONCLUSIONS AND RECOMMENDATIONS

Landslide movements throughout the Ancient Portuguese Bend Landslide Complex *outside of the historical boundary of the Portuguese Bend Landslide* previously exhibited relatively low rates of creep movement in the 11-year monitoring period of 2007-2018 for which we have readily available data. Beginning in late 2018, and through the present, the survey data indicate a significant acceleration of landslide movement. The movement of the Portuguese Bend Landslide also accelerated in this timeframe. The cumulative displacements over this time have now manifested as headward enlargement of the Portuguese Bend Landslide as well as new active landslide masses forming northwest of the Portuguese Bend Landslide crown in Landslide Moratorium Area Zone 1, upslope from LMA Zone 2. These new actively moving landslide masses are directly impacting Burma Road and threaten future accessibility.

We understand this issue is also exceeding current resources (i.e., ranger staff) to monitor and maintain the safety of the trails; primarily the heavily used Burma Road Trail. At this time, we consider this to be a critical and evolving situation that poses risks to the general public who are accessing the PBR for recreation, to utility infrastructure that traverses the landslide area, and to accessibility for other stakeholders including conservation groups and the fire department. It is evolving because we are days from entering the rainy season and most meteorologists and climatologists that we follow are citing development of El Nino conditions in the Eastern Pacific Ocean and these are frequently associated with wetter-than-normal rainfall conditions in southern California. We are also awaiting receipt of the fall GPS survey data which are typically gathered in early October.

To address the City's specific items, we offer the following:

Landslide Maps: For the purposes of this memorandum, a landslide overview map (Figure 1, attached) was prepared to illustrate the entire affected area and impacts to Burma Road. We conducted field mapping on much larger scale maps which allow for presentation of detailed observations; however, these were not formally drafted and produced due to time constraints. We recommend that additional field mapping be performed in an effort to further define the limits of active landsliding. Drafted larger scale maps will be provided if necessary and/or upon request, to provide details in specific areas.

Burma Road Conditions and Maintenance Considerations: Given the current landslide movement velocities, the newly identified landslides impacting Burma Road are active and considered unstable. Burma Road only remains passable because of the reported efforts of other stakeholders to level the ground surface across the landslide areas with larger equipment, in response to the creeping landslide movement. We anticipate that the landslide movement will continue and is likely to be exacerbated by the 2023-24 rainy season regardless of whether it is wetter or drier than historical averages. The filling of fissures crossing the road with manual labor (by park rangers) has become untenable and such measures are reportedly proving to be short-lived. The fissures, which are developing landslide scarps, have widened and deepened in some areas due to significant ground movement. Smaller vehicles (ranger trucks) are typically 2-3 tons and present lower risks when crossing the landslide areas;

DRAFT

however, larger, heavier vehicles including fire trucks which typically weigh 10 to 20 tons present a much larger transient load across the landslides, thus presenting a relatively greater risk.

Currently it is our opinion that Burma Road Trail should be closed to the public across the landslide area *unless it can be monitored on a daily basis by the park rangers*. This is due to active landslide movement directly impacting the road and posing significant risks to pedestrians, cyclists and horseback riders. Ground leveling efforts to keep the road passable for vehicles may continue; however, crews should avoid placing earth fill directly on the landslides because it adds weight and is a driving force of landslide movement. Continued notching (lowering) of the trail approaches to the landslide scarps may be the only effective solution in the short-term to maintain passage of vehicles. Care should also be given to avoid ground-alterations that would direct more Burma Road drainage directly into the landslide areas.

Burma Road Re-routing Considerations: Burma Road and trail occupy a portion of wider, leveled ground graded during the proposed Crenshaw Boulevard extension (circa 1955-56). Several of the new landslide scarps extend to near the north edge of the previously leveled area, thus, there does not appear to be a feasible location to re-route the road through these areas. Furthermore, we do not see an opportunity to completely re-route Burma Road outside of the former graded area without consideration of massive grading and drainage improvements in steeply sloping areas, some of which may also be in sensitive habitat area. There are also slope stability concerns north of Burma Road for any considered re-route, and we are currently lacking information due to a lack of GPS monitoring points north of Burma Road. The depth of movement of the new landslides is also unknown and at best could only be estimated based on previous studies of the Portuguese Bend Landslide.

Consideration could be given to stabilizing the affected portions of Burma Road in its current location; however, this would require an extensive geotechnical investigation, including geologic mapping, installation of instrumented borings (e.g., slope inclinometer casings and piezometers), laboratory soil testing, extensive slope stability analyses, and design of possible stabilization alternatives. Stabilization, if technically feasible, might require a combination of extensive in-ground structural measures (i.e., steel-reinforced concrete shear pins with tiebacks) and grading. Based upon our experience, such mitigation would likely have a cost in the millions of dollars.

Additional Warning Signage: Additional warning signage due to the increased land movement, to warn recreational users (hikers, bikers, horseback riders) and authorized outside agencies who drive the Reserve fire roads, is reasonable and appropriate from a geotechnical perspective, particularly if the City is going to keep Burma Road Trail and other potentially affected trails open to the public. As mentioned above, the new landslide areas impacting Burma Road and Trail are currently unstable. The landslide areas are currently moving (creeping) at velocities that are generally imperceptible to humans and may seem innocuous from that perspective; however, over short periods of time the movement creates significant hazards to trail users due to differential ground movement with associated ground cracking and fissuring within the landslide masses as well as scarp formation at the movement boundaries.

DRAFT

Additional Recommendations: In addition to the specific items requested to be addressed by the City, we have the following comments and recommendations:

- CSA previously issued a memorandum regarding the proposed SCE power pole relocation (May 19, 2023). At that time, we noted that the upslope extent of active landsliding had not been geologically mapped (to our knowledge), the depth of landslide movement is unknown, and there is a lack of GPS survey monitoring points north of Burma Road between Portuguese and Paintbrush Canyons. We subsequently stated that due to this lack of information, it was difficult to assess the impacts of future land movements on the proposed power pole relocation areas. It is our understanding that SCE may be considering a larger scale relocation of their transmission line(s) that are currently within the active landslide area, in lieu of the relocation project that we previously reviewed. The existing transmission line along Burma Road is partially supported by power poles located in actively moving landslides and at least two of the power poles have now been severely compromised. This transmission line poses a significant risk if not de-energized.

- The above-ground water main which trends along Burma Road traverses portions of the new landslide areas and is lacking ground support (i.e., the pipe is in the air) in some isolated areas. Our concern is that the pipe *may* not have been designed for such conditions. This should be further evaluated by the utility company responsible for the water main.

- Additional geologic mapping (on ground, possibly supplemented with drone photogrammetry) should be performed in an effort to further define the areal extent of new active landsliding. This information will be beneficial to the City for future evaluation of the safety of Burma Road and other trails within the Portuguese Bend Reserve, and also useful to other stakeholders.

- Additional GPS monitoring points should be established north of Burma Road, between Portuguese Canyon and Paintbrush Canyon. CSA will assist with recommended locations for these points if requested by the City. We also recommend that the tri-annual GPS monitoring be performed on <u>all</u> monuments in each monitoring session, in lieu of the partial monitoring that has been historically performed in two of the three sessions per year.

- Periodic closures of the trail system within the PBR during and immediately after significant rainfall events, as has been the policy of the City, should continue to allow for safety assessment of the trails by ranger staff.

- Where feasible, park ranger staff should continue to do routine monitoring and filling of ground fissures on other trails to keep the trails relatively safe; otherwise, the trails should be closed.

We hope this memorandum provides the City of Rancho Palos Verdes with the requested information and recommendations regarding Burma Road within the Portuguese Bend Reserve at this time. Please contact us if you have further questions or concerns.

-o-

DRAFT

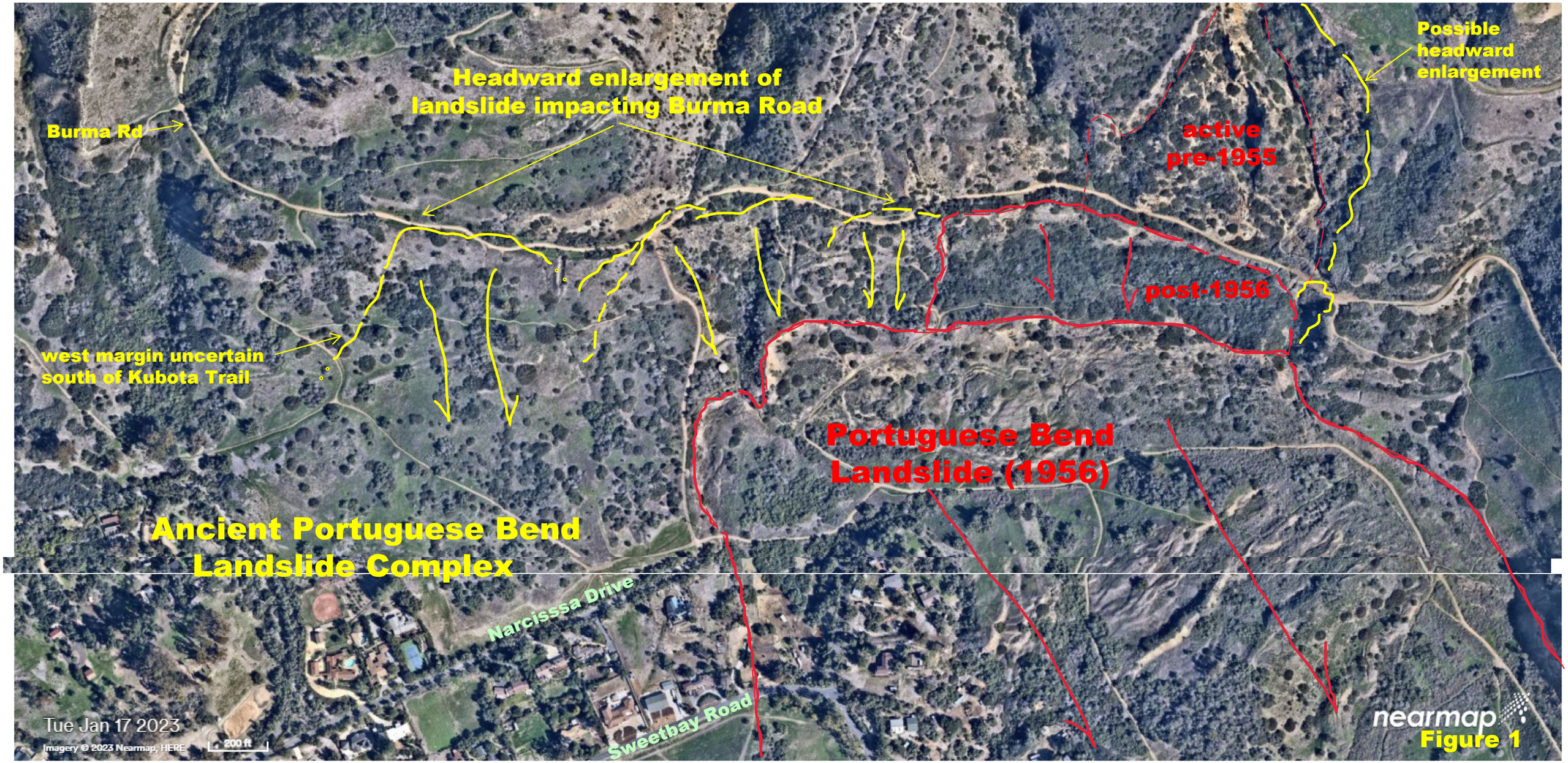
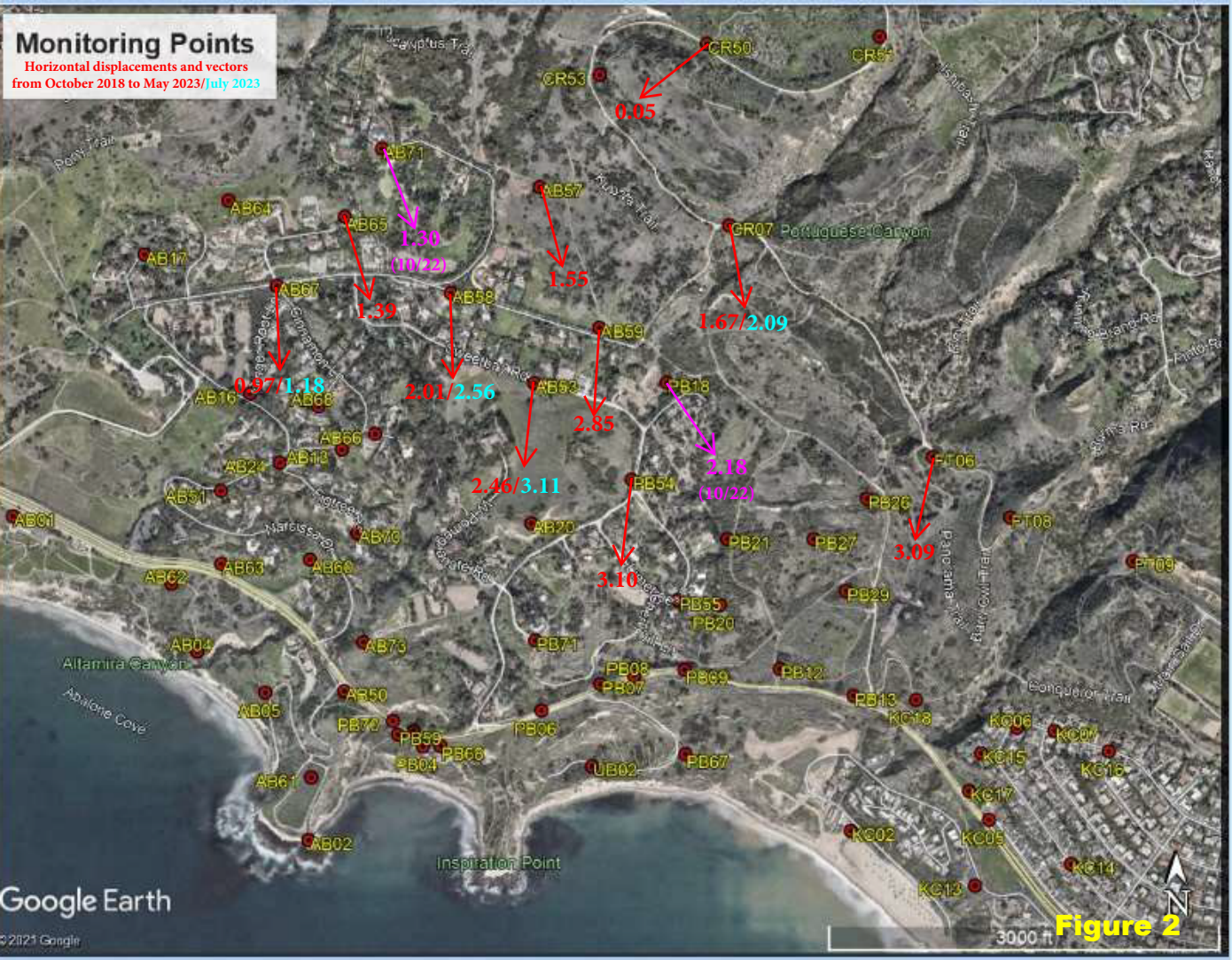

Headward enlargement of
landslide impacting Burma Road
Burma Rd
Possible
headward
enlargement
active
pre-1955
post-1956
west margin uncertain
south of Kubota Trail
Portuguese Bend
Landslide (1956)
Ancient Portuguese Bend
Landslide Complex
Narcisssa Drive
Sweetbay Road
Tue Jan 17 2023
Imagery © 2023 Nearmap, HERE
200 ft
nearmap

Figure 1


Monitoring Points
Horizontal displacements and vectors
from October 2018 to May 2023/July 2023
CR50
CR53
CR54
0.05
AB71
AB64
AB65
1.30
(10/22)
AB57
1.55
CR07
Portuguese Canyon
AB17
AB67
1.39
AB58
1.67/2.09
AB59
0.97/1.18
AB16
AB68
2.01/2.56
AB53
2.85
PB18
AB66
AB13
AB24
2.18
(10/22)
PT06
2.46/3.11
PB54
AB51
PB26
AB01
AB70
AB20
PB21
PB27
3.09
PT08
AB02
AB63
AB69
3.10
PT09
PB29
PB55
PB20
AB04
AB73
PB71
Altamira Canyon
PB08
PB07
PB69
PB12
Conqueror Trail
Abalone Cove
AB05
AB50
PB13
KC18
KC06
KC07
PB70
PB59
PB06
PB66
PB04
KC15
KC16
PB67
UB02
AB61
KC17
KC02
KC05
AB02
KC14
Inspiration Point
KC13
Google Earth
©2021 Google
3000 ft
N
Figure 2

GPS Monitoring Data

Survey Monuments - Upper Portuguese Bend Landslide/Burma Road Area

Displacement Response to 12-month Antecedent Rainfall

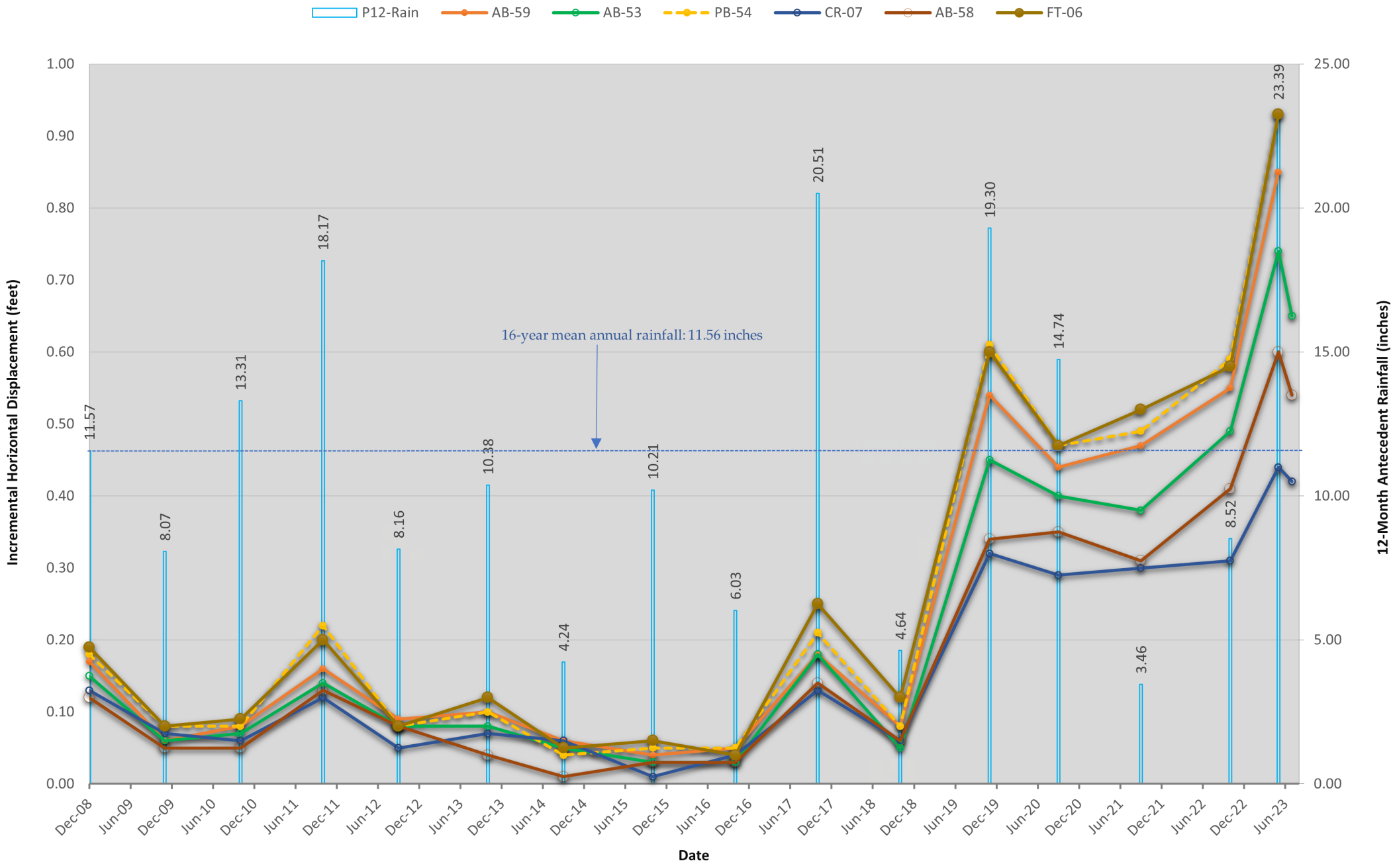


Figure 3

GPS Monitoring Data

Survey Monuments - Upper Portuguese Bend Landslide/Burma Road Area

Cumulative Horizontal Displacement 2007-2023

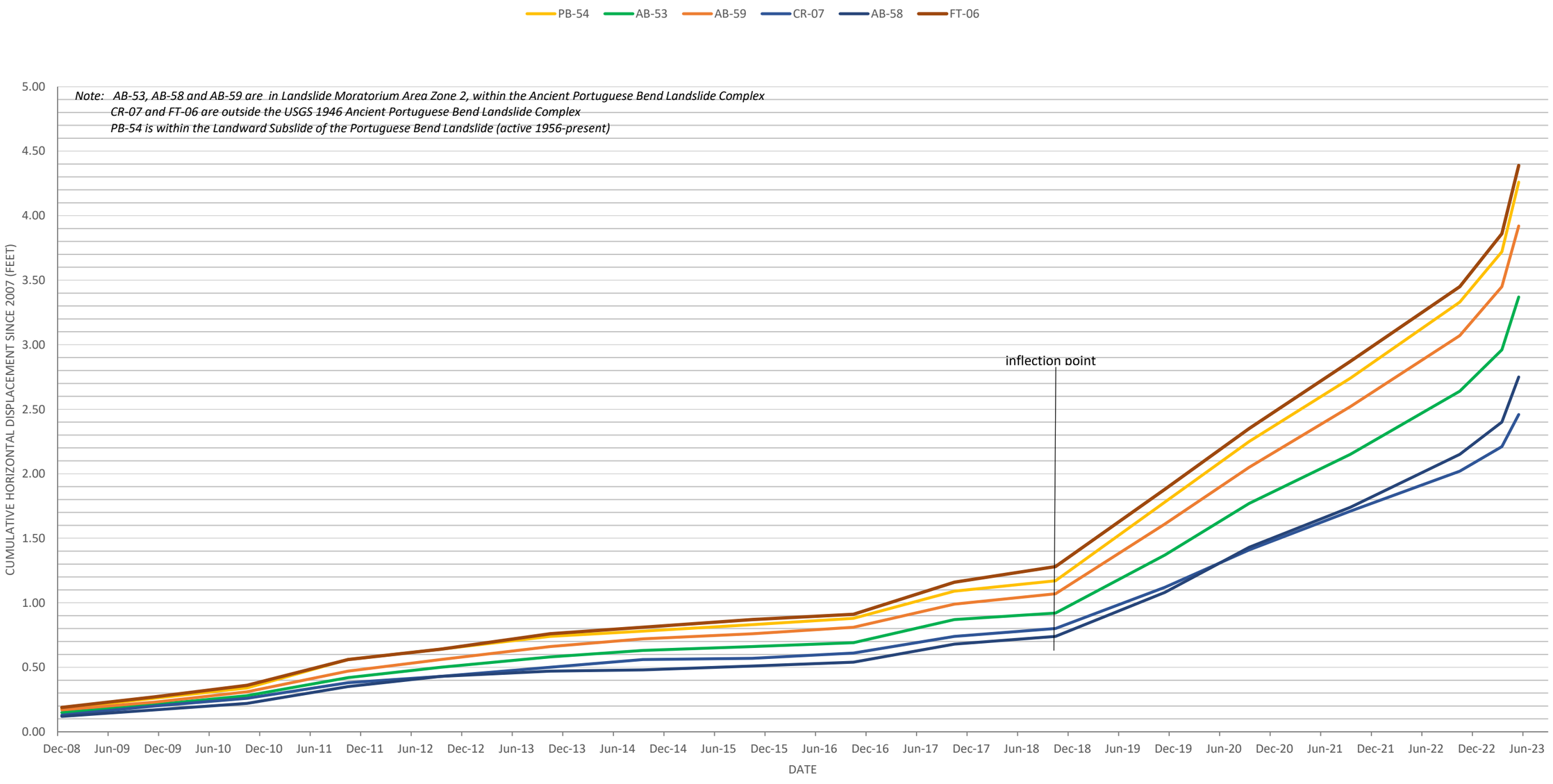


Figure 4

COTTON, SHIRES AND ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS

CITY OF RANCHO PALOS VERDES

CSA Project No: SC6163

MEMORANDUM

TO: Brandy Forbes, Community Development Director
CC: Ara Mihranian, City Manager
Ramzi Awwad, Public Works Director
FROM: Michael Phipps, CEG 1832, Contract City Geologist
Patrick Shires, GE 770, Contract City Geotechnical Engineer
RE: **Movement of the Altamira (Greater Portuguese Bend) Landslide Complex and Related Impacts, Rancho Palos Verdes, California**
DATE: November 8, 2024

INTRODUCTION

In this memorandum Cotton, Shires and Associates, Inc. (CSA) summarizes our evaluation of land movement of the Altamira Landslide Complex (previously referred to as the Greater Portuguese Bend Landslide Complex or Ancient Portuguese Bend Landslide Complex in past correspondence) from 2022-2024, with specific focus on the impacts of the land movement to private property, residential structures, and infrastructure. The active Altamira Landslide Complex currently involves major land movement comprising an area of over 700 acres landward of the coast. As of this date, the major land movement has resulted in the red-tagging (Unsafe to Enter/Occupy) of 18 residential structures and 2 commercial structures (at Wayfarer's Chapel), and the yellow-tagging (Limited Entry) of 38 other residential structures. It has also caused major impacts to public and private roads (some requiring closure), damages to utility infrastructure (water, sewer, gas, electricity and cable) causing certain utilities to be shut-off, and closure of certain Preserve land that is heavily accessed by the public for hiking, biking, equestrian, and other purposes.

BACKGROUND

The Altamira Landslide Complex in Rancho Palos Verdes includes four historically active, previously identified landslide areas: the Portuguese Bend Landslide (PBL) which began moving in 1956, the Abalone Cove Landslide (ACL) which began moving in 1979, the Klondike Canyon Landslide (KCL) which also began moving in 1979, and the Beach Club Landslide (BCL) which is nested within the KCL and, while dormant itself, moves with the KCL. It also now includes areas outside of the historically mapped boundaries of these known landslides, predominantly upslope from the historically mapped Portuguese Bend and Abalone Cove Landslides, within the Ancient Portuguese Bend Landslide Complex as mapped by various agencies (i.e., U.S. Geological Survey, California Geological Survey and other researchers (see attached Figure 1 - Landslide Area Map).

Based upon historically mapped boundaries, the ACL, PBL and KCL previously comprised an area of approximately 380 acres and affected portions of neighborhoods known as the Portuguese Bend Community, the Seaview Community and the Portuguese Bend Beach Club, as well as City-owned land within the Portuguese Bend Reserve (a sub-area of the greater Palos Verdes Nature Preserve). The

PBL has been continuously active since reactivation in 1956 with many areas of the landslide having moved hundreds of feet seaward over the ensuing six-plus decades. The ACL was active from 1979 until the late 1990's, involving only several feet of movement, when dewatering and other mitigation efforts largely halted movement. Creep movement of the ACL has occurred over the past 25 years following rainy seasons that were significantly above average rainfall amounts. The KCL has been episodically active in 1979-1983 and 2005-2006, experiencing only several inches of movement, typically in response to significantly above average rainfall. Landslide movements throughout the Ancient Portuguese Bend Landslide Complex *outside of the historical boundaries of* the ACL and PBL previously exhibited low rates of creep movement, or movement at or near the instrument precision range, in the 11-year monitoring period of 2007-2018 for which we have readily available data. These landslides are deep translational-type failures within seaward-dipping strata of the Monterey Formation, with the landslide slip surfaces occurring within very weak bentonitic clay beds. Historically, the movement behavior of these landslides routinely exhibited high sensitivity to increased groundwater pore pressure, and increased rates of land movement were correlative with 6-to-12-month antecedent rainfall that was well above average. Similarly, land movement decreased during below average rainy seasons or multi-year periods of drought.

Beginning in 2021, CSA geologists were requested by the City of Rancho Palos Verdes to observe reported distress (ground cracking and fissures) to trails in the Portuguese Bend Reserve. At that time, we also began reviewing Global Positioning Satellite (GPS) monitoring data for survey monuments within the entire Ancient Portuguese Bend Landslide Complex or Altamira Landslide Complex. In the summer of 2022, CSA was also asked to evaluate distress to an SCE transmission line along Burma Road within the Portuguese Bend Reserve. Subsequent geologic mapping of the Reserve area revealed that headward and lateral enlargement of the Portuguese Bend Landslide was occurring. We were also receiving reports of underground water line breaks occurring within the Portuguese Bend Community Association area and the Seaview Community. Review of GPS monitoring data from 2007 through 2023 indicated that land movement acceleration initially began between 2018 and 2019. We postulated that this acceleration was correlative with significantly above-normal rainfall in two out of three prior rainfall seasons (2016-17 and 2018-19) which followed five consecutive drier than normal rainfall seasons (2011-12 through 2015-16) (see attached Figure 2 – GPS Monitoring Data, Ancient Portuguese Bend Landslide: Displacement Response to 12-Month Antecedent Rainfall, December 2008-January 2024). One notable item, however, is that the land movement velocities did not decline back to the pre-2018 levels despite two significantly below-normal rainy seasons (2020-21, one of the driest on record, and 2021-22).

RAINFALL IMPACTS – 2022 THROUGH 2024

Further acceleration of land movement occurred throughout the Altamira Landslide Complex during and following the 2022-23 rain season, and the rainfall impacts from mid- to late-winter storms significantly contributed to the increased ground movements. Significant accelerations in movement velocity were documented in May 2023 following major storm sequences in January, February and March of 2023, which added to cumulative seasonal rainfall totals exceeding 193% of average rainfall. Approximately 87% of this rain fell prior to June 18, 2023. Most of this rainfall occurred from three significant atmospheric river-type storm sequences occurring on January 9-16 (3.59 inches), February 23-March 1 (3.79 inches) and March 10-15 (4.12 inches). Land movement velocities further increased as of the July 15, 2023 monitoring. An anomalous tropical storm dropped an additional 3.05 inches of

rain on August 19-20, 2023, resulting in further land movement acceleration as of the October 10, 2023 monitoring. The multiple increases in landslide velocities (i.e., accelerations) resulted in additional mappable ground surface expressions of the uphill limits of active landsliding, including the formation of landslide scarps, fissures, grabens, tensional cracking and shear zones, including areas north, west and east of the historically known landslide boundaries. Field geologic mapping and photo-geologic mapping performed in mid to late 2023 corroborated the GPS monitoring data findings that a large portion of the Ancient Portuguese Bend Landslide Complex (Altamira Landslide Complex) above the historically mapped PBL, ACL and KCL boundaries was involved in significant active landslide movement. The boundary of that major land movement has been updated through November 2024 and is depicted by the green dashed line on the attached Figure 1 – Landslide Area Map.

The 2023-2024 rainfall season total of more than 23 inches was 170% of the long-term average and had a compounding effect on the previous season's extraordinary rainfall. This rainfall season was characterized by additional atmospheric river type storms, including a sequence of storms that resulted in a Federally declared disaster from January 30 - February 9, 2024. The February 2024 rainfall total of 11.22 was the second wettest February in the 67-year history of recorded data for the Palos Verdes Peninsula. The landslide response to these rains was almost immediate and we observed continued accelerating land movement in the GPS monitoring data through August 1, 2024. A peak land movement velocity of >13 inches/week occurred in the center of the landslide as of the May 28, 2024 monitoring period. Movement velocities appeared to peak across the breadth of the landslide in the July 1 - August 1, 2024 monitoring period with the majority of stations moving >10 inches/week and peak movements >12 inches per week. Attached Figures 3, 4, 5 and 6 – GPS Monitoring Displacement Rate Contour Maps, are landslide movement velocity contour maps produced from GPS monitoring data through August 1, 2024, September 4, 2024, October 8, 2024 and October 29, 2024, respectively.

For reference, rainfall data utilized for this evaluation are from the Los Angeles County Department of Public Works - Hydrology Division Station 1011B, located at the Rolling Hills Fire Station No. 56. This rainfall station serves as a reasonable proxy for rainfall impacts to the southern face of the Palos Verdes Peninsula due to its elevation, which should reflect some orographic effect for storms approaching the Palos Verdes Peninsula from the west, southwest, and south, compared to coastal stations such as Point Vicente which may underestimate rain totals in the higher reaches of the landslide complex and watershed.

TOTAL LAND MOVEMENT – OCTOBER 2022 THROUGH OCTOBER 2024

Since October 10, 2022, total horizontal land movement throughout the Altamira Landslide Complex has ranged from approximately 27 to 39 feet in most areas, with the exception being approximately 6 to 21 feet of horizontal land movement in the Klondike Canyon Landslide area. Vertical displacements have ranged from 1 - 10 feet in most areas over this same period. This land movement has had a destructive and devastating effect on numerous residential and commercial properties and structures, private and public roadways, and utility infrastructure. In addition to the 18 red-tagged and 38 yellow-tagged structures, dozens of homes are experiencing varying amounts of distress and inaccessibility due to differential land movements, and electricity and gas service has been cut off from the majority of these properties. The most significant damage is to structures on or adjacent to the landslide boundaries, or those located on boundaries between subslides (blocks) within the Altamira Landslide Complex that are moving at different rates.

Since June 2024, the City has undertaken emergency mitigation measures including 18 deep geotechnical test borings with sophisticated instrumentation to detect the depth(s) of land movement and groundwater pore pressures within and beneath the active landslide mass(es). The instrumented geotechnical test borings revealed that the basal slip surface of the Altamira Landslide Complex beneath the Portuguese Bend Landslide portion of the Altamira complex is up to twice as deep as previously/historically modeled, and moving at a much faster rate than the shallower PBL slip surface. This significantly greater depth of movement has resulted in a broader footprint of active land movement at the ground surface and offshore, and expansion of the historical land movement area from approximately 380 acres to over 700 acres. The test borings also indicated that artesian or near-artesian groundwater pressure is present beneath the Altamira slip surface, and confined groundwater under significant pressure is present between the Altamira and PBL slip surfaces. High unconfined groundwater levels were also determined within the historically modeled Portuguese Bend and Abalone Cove landslide bodies. Beginning September 13, 2024, the first of 10 deep dewatering wells came online. The ten wells, all located near the toe, or lower 1/3 of the landslide complex, are currently extracting approximately 1 million gallons per day of groundwater within and beneath the landslide.

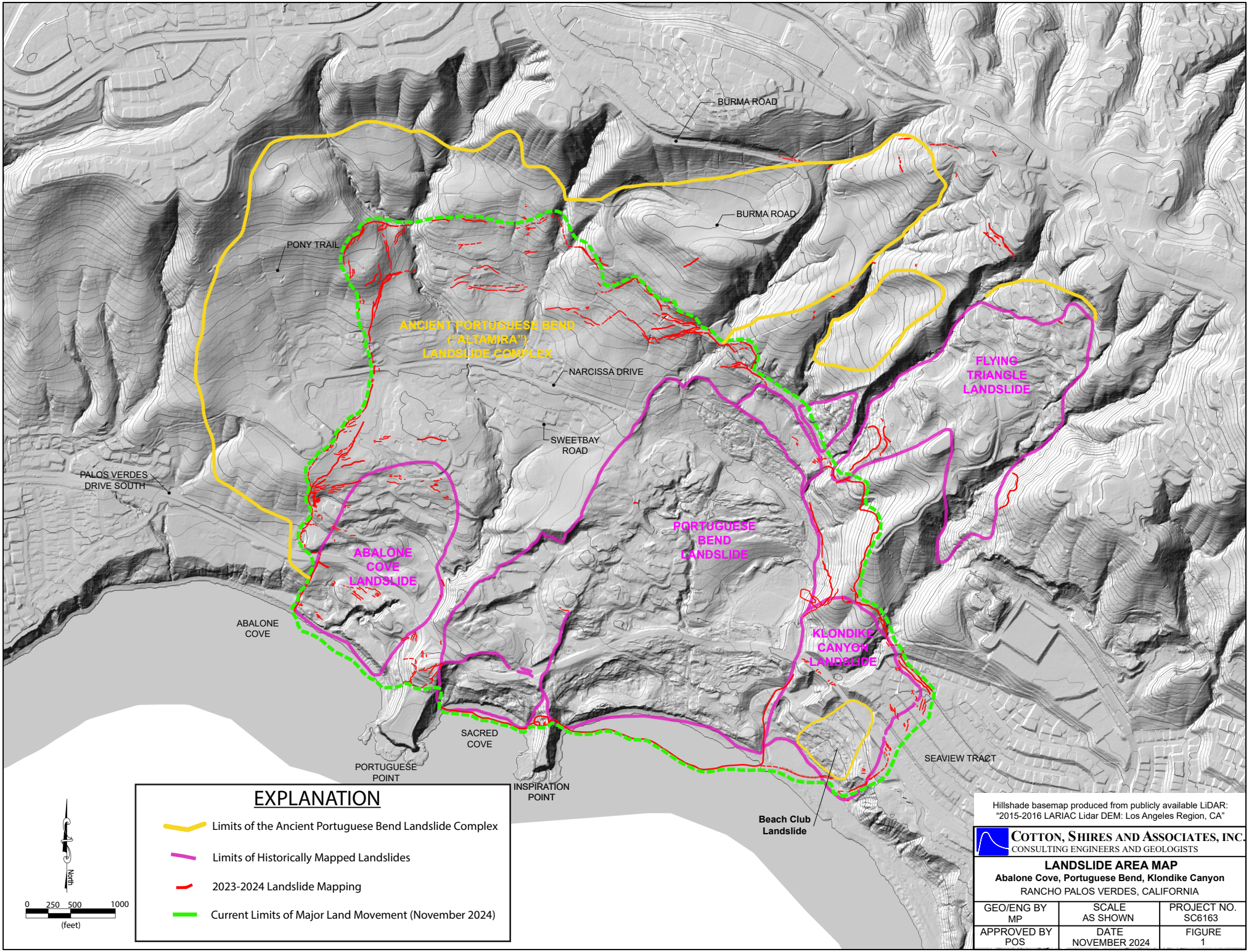
FUTURE LAND MOVEMENT POTENTIAL

As described above, major movement of the Altamira Landslide Complex ranging from 6 to 39 feet horizontally and 1 to 10 feet vertically has occurred since October 2022, with the majority of that movement occurring during and following the 2023-24 rainy season. The highest observed movement rates have exceeded 12 inches per week. While emergency dewatering mitigation efforts and 6 months without any rainfall recharge have reduced movements in most areas to a current level of 0.5 to 6 inches per week, there are many uncertainties regarding the longevity and long-term effectiveness of the deep dewatering wells that have been installed, including the availability of additional funding needed to maintain them and keep them operational. There is also uncertainty regarding the quantity of dewatering wells needed to maintain landslide movements at low (creep) movement levels, and whether funding for additional wells can be obtained. Given the emergency measures that are in place, the future response of the landslide to seasonal rains, including the severity of those rains is unknown; however, historical land movement data demonstrates increases in land movement with above-average rainy seasons despite the operation of past dewatering facilities operated by private geologic hazard abatement districts such as ACLAD and KCLAD.

-o-

Attachments:

Figure 1 – Landslide Area Map
Figure 2 – GPS Monitoring Data, Displacement Response to 12-Month Antecedent Rainfall, December 2008-January 2024
Figure 3 – GPS Monitoring Displacement Rate Contour Map (8/1/2024 Data)
Figure 4 – GPS Monitoring Displacement Rate Contour Map (9/4/2024 Data)
Figure 5 – GPS Monitoring Displacement Rate Contour Map (10/8/2024 Data)
Figure 6 – GPS Monitoring Displacement Rate Contour Map (10/29/2024 Data)

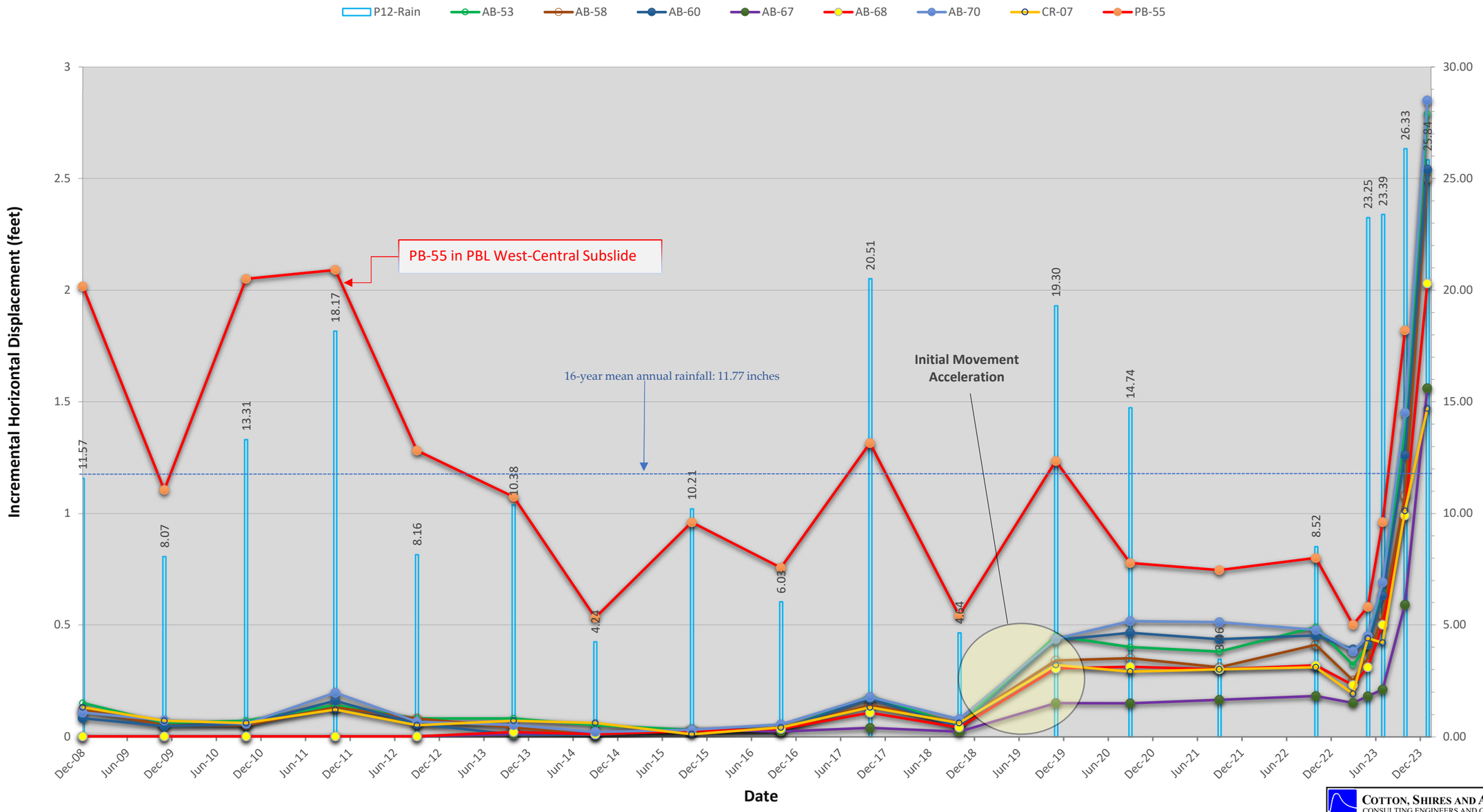

BURMA ROAD
BURMA ROAD
PONY TRAIL
ANCIENT PORTUGUESE BEND ("ALTAMIRA") LANDSLIDE COMPLEX
NARCISSA DRIVE
SWEETBAY ROAD
PALOS VERDES DRIVE SOUTH
FLYING TRIANGLE LANDSLIDE
PORTUGUESE BEND LANDSLIDE
ABALONE COVE LANDSLIDE
KLONDIKE CANYON LANDSLIDE
ABALONE COVE
SACRED COVE
PORTUGUESE POINT
INSPIRATION POINT
SEAVIEW TRACT
Beach Club Landslide
EXPLANATION
Limits of the Ancient Portuguese Bend Landslide Complex
Limits of Historically Mapped Landslides
2023-2024 Landslide Mapping
Current Limits of Major Land Movement (November 2024)
North
0 250 500 1000
(feet)
Hillshade basemap produced from publicly available LiDAR: "2015-2016 LARIAC Lidar DEM: Los Angeles Region, CA"
COTTON, SHIRES AND ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS
LANDSLIDE AREA MAP
Abalone Cove, Portuguese Bend, Klondike Canyon
RANCHO PALOS VERDES, CALIFORNIA
GEO/ENG BY MP
SCALE AS SHOWN
PROJECT NO. SC6163
APPROVED BY POS
DATE NOVEMBER 2024
FIGURE 1

GPS Monitoring Data

Survey Monuments - ACL, PBL and Upper Ancient Landslide Complex

Displacement Response to 12-month Antecedent Rainfall

December 2008-January 2024



COTTON, SHIRES AND ASSOCIATES, INC. CONSULTING ENGINEERS AND GEOLOGISTS	
GPS Monitoring Data Survey Monuments- ACL, PBL, and Upper Ancient Landslide Complex Displacement Response to 12-month Antecedent Rainfall Rancho Palos Verdes, California	
GEO/ENG BY MP	SCALE
APPROVED BY POS	DATE NOVEMBER 2024

PROJECT NO. SC6163

FIGURE 2

APPROXIMATE BOUNDARY OF ANCIENT PORTUGUESE BEND LANDSLIDE COMPLEX

"Creeping Area" Approximately 0.5 inch/week

CURRENT LIMITS OF MAJOR LANDSLIDE MOVEMENT (AUGUST 2024)

PONY TRAIL

BURMA ROAD

PALOS VERDES DRIVE SOUTH

ABALONE COVE

PORTUGUESE POINT

SACRED COVE

INSPIRATION POINT

SEAVIEW TRACT

PORTUGUESE BEND LANDSLIDE

ABALONE COVE LANDSLIDE

FLYING TRIANGLE LANDSLIDE

KLONDIKE CANYON LANDSLIDE

0.06 CW01
0.08 AB77
0.07 CR56
0.33 CR50
0.47 CR51
0.49 CR53
0.52 CW05
0.00 AB71 no data
0.00 CR57 no data
0.48 AB64
0.01 AB17
0.03 RP02
0.05 CW06
0.24 AB76
0.06 AB01
0.04 CW07
0.02 FT08
0.05 CW08
0.01 FT09
0.02 FT00
0.06 AB02
0.08 KC14
0.02 RP01
0.23 KC25
0.46 KC13
4.09 KC22
0.04 KC21
3.84 KC33
3.89 KC06
3.40 KC19
0.03 KC07
0.03 KC16
3.45 KC20
3.91 KC15
2.72 KC23
3.53 KC17
2.41 KC05
5.68 KC28
5.16 KC24
3.88 KC27
4.09 KC26
6.48 KC29
9.21 KC30
8.82 PB13
8.23 KC31
7.84 KC18
11.39 PB74
11.45 PB12
9.87 PB26
9.36 PB29
10.91 PB27
9.39 PB73
11.89 PB54
10.41 PB21
11.54 PB75
11.13 PB55
10.83 PB20
10.84 PB08
9.92 PB09
11.68 PB07
12.96 PB71
12.29 PB67
9.98 UB02
11.36 PB59
11.13 PB69
11.58 PB70
11.34 PB04
11.15 PB68
11.81 PB72
10.07 PB06
10.75 AB73
11.99 AB75
12.43 AB21
11.69 AB70
10.19 AB60
9.11 AB63
7.08 AB62
9.20 AB04
8.55 AB05
6.86 AB50
5.16 AB74
8.95 AB51
11.23 AB24
10.64 AB13
10.10 AB66
9.79 AB68
7.49 AB16
7.48 AB67
8.88 AB65
9.39 AB57
11.00 AB58
12.65 AB59
11.80 CR54
11.29 AB53
11.89 PB18
0.00 AB71 no data
7.0
8.0
9.0
10.0
11.0
12.0

EXPLANATION

- Limits of the Ancient Portuguese Bend Landslide Complex
- Limits of Historically Mapped Landslides
- 2023/2024 Landslide Mapping
- Current Limits of Major Landslide Movement (August 2024)
- GPS Monument Displacement!Rate (July 1, 2024 to August 1, 2024) Displacement Vector! Scale 1"= 8"/week

Displacement Rate Table

Minimum Rate (inch/week)	Maximum Rate (inch/week)	Color
0.00	1.00	
1.00	2.00	
2.00	3.00	
3.00	4.00	
4.00	5.00	
5.00	6.00	
6.00	7.00	
7.00	8.00	
8.00	9.00	
9.00	10.00	
10.00	11.00	
11.00	12.00	
12.00	13.00	

North

0 250 500 1000 (feet)

Hillshade basemap produced from publicly available LiDAR: "2015 - 2016 LARIAC Lidar DEM: Los Angeles Region, CA"

COTTON, SHIRES AND ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS

GPS MONITORING DISPLACEMENT RATE CONTOUR MAP (8/1/24 DATA)
Abalone Cove, Portuguese Bend, Klondike Canyon
RANCHO PALOS VERDES, CALIFORNIA

GEO/ENG BY	SCALE	PROJECT NO.
MP	1"=500'	SC6163
APPROVED BY	DATE	FIGURE NO.
POS	November 8, 2024	3

APPROXIMATE BOUNDARY OF ANCIENT PORTUGUESE BEND LANDSLIDE COMPLEX

CURRENT LIMITS OF MAJOR LANDSLIDE MOVEMENT (SEPTEMBER 2024)

"Creeping Area" Approximately 0.5 inch/week

BURMA ROAD

PONY TRAIL

PALOS VERDES DRIVE SOUTH

PORTUGUESE BEND LANDSLIDE

ABALONE COVE LANDSLIDE

KLONDIKE CANYON LANDSLIDE

FLYING TRIANGLE LANDSLIDE

ABALONE COVE

SACRED COVE

PORTUGUESE POINT

INSPIRATION POINT

SEAVIEW TRACT

EXPLANATION

- Limits of the Ancient Portuguese Bend Landslide Complex
- Limits of Historically Mapped Landslides
- 2023/2024 Landslide Mapping
- Current Limits of Major Landslide Movement (September 2024)
- GPS Monument Displacement Rate (August 1, 2024 to September 4, 2024) Displacement Vector Scale 1"= 8"/week

Displacement Rate Table

Minimum Rate (inch/week)	Maximum Rate (inch/week)	Color
0.00	1.00	
1.00	2.00	
2.00	3.00	
3.00	4.00	
4.00	5.00	
5.00	6.00	
6.00	7.00	
7.00	8.00	
8.00	9.00	
9.00	10.00	
10.00	11.00	
11.00	12.00	
12.00	13.00	

North

0 250 500 1000 (feet)

Hillshade basemap produced from publicly available LiDAR: "2015 - 2016 LARIAC Lidar DEM: Los Angeles Region, CA"

COTTON, SHIRES AND ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS

GPS MONITORING DISPLACEMENT RATE CONTOUR MAP (9/4/24 DATA)
Abalone Cove, Portuguese Bend, Klondike Canyon
RANCHO PALOS VERDES, CALIFORNIA

GEO/ENG BY	SCALE	PROJECT NO.
MP	1"=500'	SC6163
APPROVED BY	DATE	FIGURE NO.
POS	November 8, 2024	4

APPROXIMATE BOUNDARY OF ANCIENT PORTUGUESE BEND LANDSLIDE COMPLEX

CURRENT LIMITS OF MAJOR LANDSLIDE MOVEMENT (OCTOBER 2024)

"Creeping Area" Approximately 0.5 inch/week

BURMA ROAD

PONY TRAIL

PALOS VERDES DRIVE SOUTH

ABALONE COVE

SACRED COVE

PORTUGUESE POINT

INSPIRATION POINT

SEAVIEW TRACT

ABALONE COVE LANDSLIDE

PORTUGUESE BEND LANDSLIDE

KLONDIKE CANYON LANDSLIDE

FLYING TRIANGLE LANDSLIDE

0.04 AB80
0.04 AB79
0.03 CW01
0.06 AB77
0.07 CR56
0.35 CR50
0.44 CR51
0.00 CR60
0.43 CR53
0.36 CR58
1.78 AB78
6.17 AB57
0.47 CW05
0.03 CR59
0.12 AB64
6.14 AB65
0.11 CR57
0.04 AB17
5.09 AB67
6.86 CR54
7.44 AB58
0.00 RP03
0.07 CW06
7.90 AB59
0.03 FT10
5.42 AB16
6.82 AB68
7.37 AB53
6.95 PB18
0.11 AB76
6.91 AB66
7.23 AB13
3.84 PB76
7.88 AB24
7.18 AB75
6.99 PB54
4.01 PB26
0.05 AB01
3.66 AB74
6.18 AB51
7.85 AB70
7.29 AB21
0.03 FT08
4.96 PB21
5.05 PB27
0.02 CW08
6.23 AB69
6.74 AB69
6.28 PB75
0.04 FT09
5.03 AB62
5.26 PB55
3.42 PB29
4.99 PB20
0.04 KC21
6.09 AB04
7.08 PB71
6.04 AB73
6.03 PB70
5.88 PB59
1.57 KC06
3.88 AB50
5.64 PB69
4.62 PB08
4.08 PB09
4.21 PB12
3.04 PB13
1.80 KC22
1.35 KC19
5.11 PB07
5.74 PB04
3.23 KC31
2.49 KC18
0.04 KC07
4.58 PB06
1.67 KC33
1.29 KC20
0.02 KC16
5.71 PB68
5.77 PB72
4.63 PB67
4.54 PB74
3.38 KC30
1.53 KC15
3.74 UB02
1.34 KC17
1.05 KC23
1.05 KC05
2.27 KC29
1.75 KC24
2.47 KC38
1.98 KC28
1.34 KC26
0.55 KC13
0.05 KC35
0.05 KC14
0.05 KC34
0.03 KC36
0.08 KC25
0.04 KC37
0.04 RP01

5.0
6.0
7.0
4.0
3.0
2.0
1.0

EXPLANATION

- Limits of the Ancient Portuguese Bend Landslide Complex
- Limits of Historically Mapped Landslides
- 2023/2024 Landslide Mapping
- Current Limits of Major Landslide Movement (October 2024)
- GPS Monument Displacement Rate (September 4, 2024 to October 8, 2024) Displacement Vector Scale 1"= 8"/week

Displacement Rate Table

Minimum Rate (inch/week)	Maximum Rate (inch/week)	Color
0.00	1.00	
1.00	2.00	
2.00	3.00	
3.00	4.00	
4.00	5.00	
5.00	6.00	
6.00	7.00	
7.00	8.00	
8.00	9.00	
9.00	10.00	
10.00	11.00	
11.00	12.00	
12.00	13.00	

North

0 250 500 1000
(feet)

Hillshade basemap produced from publicly available LiDAR: "2015 - 2016 LARIAC Lidar DEM: Los Angeles Region, CA"

COTTON, SHIRES AND ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS

GPS MONITORING DISPLACEMENT RATE CONTOUR MAP (10/8/24 DATA)
Abalone Cove, Portuguese Bend, Klondike Canyon
RANCHO PALOS VERDES, CALIFORNIA

GEO/ENG BY	SCALE	PROJECT NO.
MP	1"=500'	SC6163
APPROVED BY	DATE	FIGURE NO.
POS	November 8, 2024	5

APPROXIMATE BOUNDARY OF ANCIENT PORTUGUESE BEND LANDSLIDE COMPLEX

CURRENT LIMITS OF MAJOR LANDSLIDE MOVEMENT (NOVEMBER 2024)

BURMA ROAD

PONY TRAIL

PALOS VERDES DRIVE SOUTH

ABALONE COVE

PORTUGUESE POINT

SACRED COVE

INSPIRATION POINT

ABALONE COVE LANDSLIDE

PORTUGUESE BEND LANDSLIDE

KLONDIKE CANYON LANDSLIDE

FLYING TRIANGLE LANDSLIDE

SEAVIEW TRACT

0.07 AB80 · 0.12 AB79 · 0.02 CW01 · 0.06 AB77 · 0.04 CR56 · 0.08 CR50 · 0.10 CR51 · 0.03 CR60 · 0.01 CR53 · 0.07 CR58 · 0.13 AB78 · 0.08 CW05 · 0.08 CR59 · 0.62 AB64 · 4.83 AB57 · 4.21 AB65 · 0.09 CR57 · 0.09 AB17 · 3.61 AB67 · 4.0 · 5.10 AB58 · 4.68 CR54 · 5.0 · 5.04 AB59 · 0.01 RP03 · 0.08 CW06 · 3.91 AB16 · 4.51 AB53 · 4.01 PB18 · 0.07 FT10 · 4.72 AB68 · 4.74 AB66 · 0.11 AB76 · 3.32 AB76 · 1.55 PB76 · 5.64 AB24 · 0.13 AB01 · 3.06 AB74 · 4.17 AB51 · 4.70 AB75 · 4.23 PB54 · 0.56 PB26 · 0.04 FT08 · 4.63 AB21 · 2.48 PB21 · 2.08 PB27 · 0.16 GW08 · 0.06 FT09 · 5.46 AB70 · 4.37 AB69 · 5.29 AB60 · 3.49 PB75 · 3.64 AB62 · 2.88 PB55 · 0.36 PB29 · 4.0 · 4.36 PB71 · 2.03 PB20 · 4.32 AB04 · 3.53 AB73 · 1.97 PB08 · 2.0 · 0.04 KC21 · 0.22 KC06 · 3.47 PB70 · 3.38 PB59 · 1.67 PB09 · 1.23 PB12 · 0.38 PB13 · 3.0 · 2.46 PB07 · 3.63 PB69 · 0.22 KC31 · 0.14 KC18 · 0.19 KC22 · 0.28 KC19 · 2.07 AB50 · 2.21 PB06 · 3.25 PB04 · 0.24 KC33 · 0.11 KC07 · 3.25 PB68 · 3.22 PB72 · 1.0 · 0.68 UB02 · 1.14 PB67 · 0.97 PB74 · 0.16 KC20 · 0.13 KC16 · 0.16 KC30 · 0.19 KC15 · 0.11 KC17 · 0.20 KC23 · 0.19 KC05 · 0.12 KC29 · 0.11 KC24 · 0.22 KC38 · 0.17 KC28 · 0.08 KC26 · 0.12 KC13 · 0.09 KC25 · 0.11 KC14 · 0.12 KC35 · 0.14 KC34 · 0.10 KC36 · 0.16 KC37 · 0.11 RP01

EXPLANATION

- Limits of the Ancient Portuguese Bend Landslide Complex
- Limits of Historically Mapped Landslides
- 2023/2024 Landslide Mapping
- Current Limits of Major Landslide Movement (November 2024)
- GPS Monument Displacement Rate (October 8, 2024 to October 29, 2024) Displacement Vector Scale 1"= 8"/week

Displacement Rate Table

Minimum Rate (inch/week)	Maximum Rate (inch/week)	Color
0.00	1.00	
1.00	2.00	
2.00	3.00	
3.00	4.00	
4.00	5.00	
5.00	6.00	
6.00	7.00	
7.00	8.00	
8.00	9.00	
9.00	10.00	
10.00	11.00	
11.00	12.00	
12.00	13.00	

North

0 250 500 1000 (feet)

Hillshade basemap produced from publicly available LiDAR: "2015 - 2016 LARIAC Lidar DEM: Los Angeles Region, CA"

COTTON, SHIRES AND ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS

GPS MONITORING DISPLACEMENT RATE CONTOUR MAP (10/29/24 DATA)
Abalone Cove, Portuguese Bend, Klondike Canyon
RANCHO PALOS VERDES, CALIFORNIA

GEO/ENG BY	SCALE	PROJECT NO.
MP	1"=500'	SC6163
APPROVED BY	DATE	FIGURE NO.
POS	November 8, 2024	6

COTTON, SHIRES AND ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS

CITY OF RANCHO PALOS VERDES

CSA Project No: SC6163

MEMORANDUM

TO: Ara Mihranian, City Manager
CC: Ramzi Awwad, Public Works Director

FROM: Michael Phipps, CEG 1832, Contract City Geologist
Patrick Shires, GE 770, Contract City Geotechnical Engineer
RE: **Movement of the Altamira Landslide: Characterization, Related Impacts, Causation, and Emergency Measures, Rancho Palos Verdes, California**
DATE: March 16, 2025

INTRODUCTION

In this memorandum Cotton, Shires and Associates, Inc. (CSA) summarizes our evaluation of movement of the Altamira Landslide, with specific focus on the characteristics, differences, and causation of movement of this new landslide, distinguishing it from the known historically active Landslide Complex that is comprised of the Portuguese Bend Landslide (PBL), Abalone Cove Landslide (ACL), Klondike Canyon Landslide (KCL) and Beach Club Landslide (BCL). We include the BCL as part of the KCL, because it is, in itself, dormant and nested within (or rafts upon) the KCL. Also discussed are impacts of the Altamira Landslide movement to private property, residential structures, and infrastructure in the landslide area.

DISTINGUISHING THE ALTAMIRA LANDSLIDE

For definition purposes, the Altamira Landslide is a newly active landslide that has occurred within a previously mapped ancient landslide complex, most recently labeled the "Ancient Altamira Landslide Complex" (Douglas, 2013) which was a name modification of the "Ancient Portuguese Bend Landslide" identified on the California Geological Survey's Landslide Inventory Map (CGS, 2007). See the excerpted Figure 1 from Douglas (2013) on the following page for this clarification. It is important to make this distinction for consistency and to avoid confusion, because the Altamira Landslide is, in fact, a new member of the historically active PBL/ACL/KCL Landslide Complex but largely **underlies it** and occupies an area of active land movement >700 acres and extends to more than 500 feet off of the coastline, whereas the shallower historically active PBL/ACL/KCL complex only occupied about 380 acres.

The Altamira Landslide in Rancho Palos Verdes is therefore a recently identified large landslide that largely underlies (and therefore largely encompasses, but exceeds the area of) the previously understood active Landslide Complex containing the four historically active landslides: the PBL which historically began moving in 1956, the ACL which began moving in 1979, the KCL which also began moving in 1979, and the BCL which is nested within the KCL and, while dormant itself, moves along with the KCL. The Altamira Landslide includes large areas outside of the historically mapped boundaries of these known landslides, predominantly upslope and downslope from the historically

mapped PBL and ACL, within, but smaller than, the Ancient Altamira Landslide Complex as defined above. To provide an example of the change in size, the dimensions from head to toe of the previously historical ACL is 2,250 feet and the width up to 1,450 feet wide. The dimensions from head to toe of the Altamira Landslide, underlying and extending up and down slope from both the PBL and the ACL, is 5,800 feet (more than double that of the ACL) with a width of up to 7,400 feet wide (more than five times as wide as the ACL).

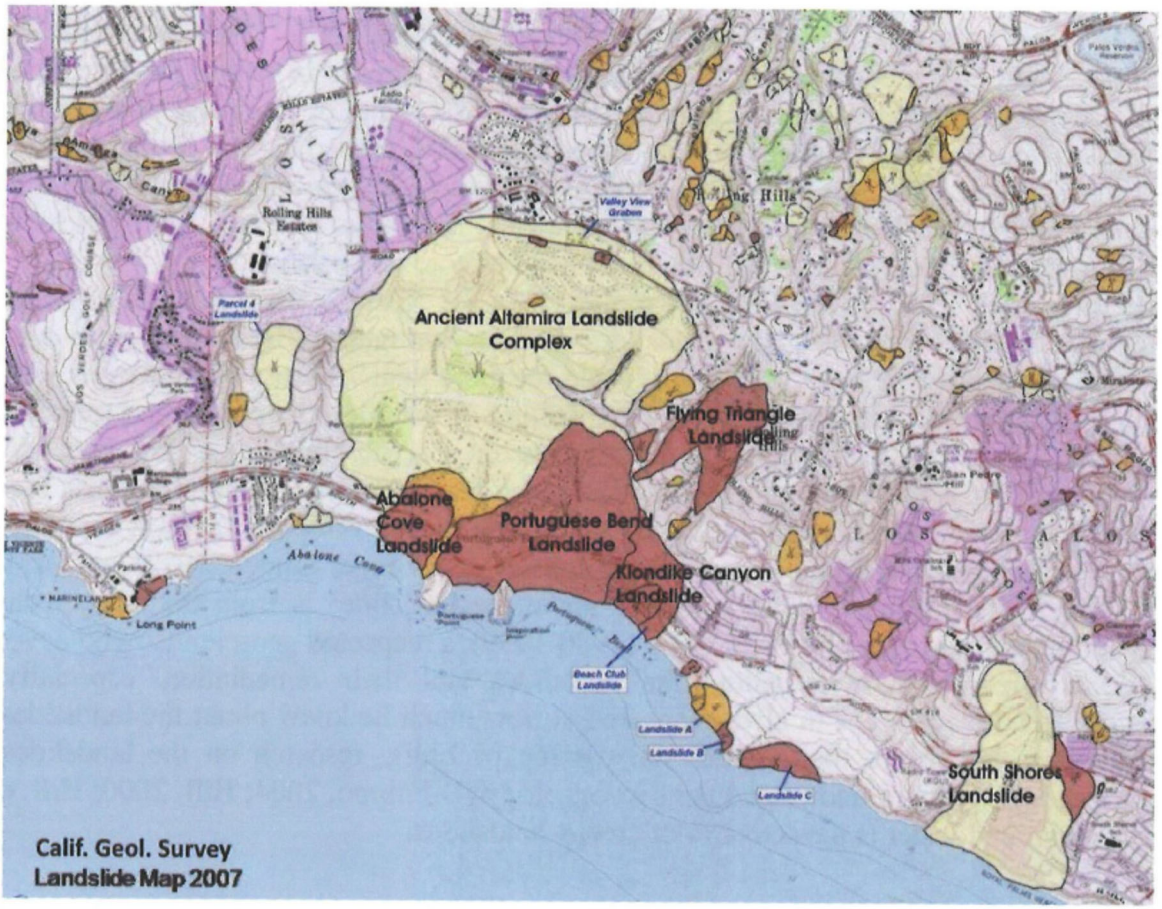


Figure 1. Landslide map of a portion of the south flank of the Palos Verdes Peninsula prepared by the California Geological Survey (2007). The major and some minor landslides are identified. Light yellow indicates that the landslide is inactive, red is active and orange is dormant.

While previous geotechnical investigators identified inactive deep failure surfaces in both the historically active and ancient landslide areas, none of them mapped or identified as active the entire depth or breadth of movement that has recently impacted the area, nor did they opine that such an event would occur in historic times. The active Altamira Landslide currently involves major land movement comprising an area of over 700 acres landward of the coast and extends to approximately 500 feet or more off the coastline. The areal dimensions, depth of movement, velocity of movement, artesian and near-artesian groundwater pressures beneath it, and even the direction of movement, are different than the Abalone Cove, Portuguese Bend, and Klondike Canyon landslides. The distinction to be made then, is that the Altamira Landslide is not just simple *expansion* of an existing group of landslides, it is an entirely different, larger and deeper landslide with much broader boundaries (including the new coastline offshore), nearly twice as deep as the depth of historic landslide movement in some areas, and with unprecedented rates of movement (which were not seen in the early LA County

Engineer surveys, the Charles Abbott Associates surveys beginning in 1994, nor the McGee surveys since 2007). None of this was experienced during the history of the City, and the Altamira Landslide is a unique landslide not characterized in its current dimensions during the over 70-year history of landslide investigations, exploratory borings, monitoring and observations being conducted in the area.

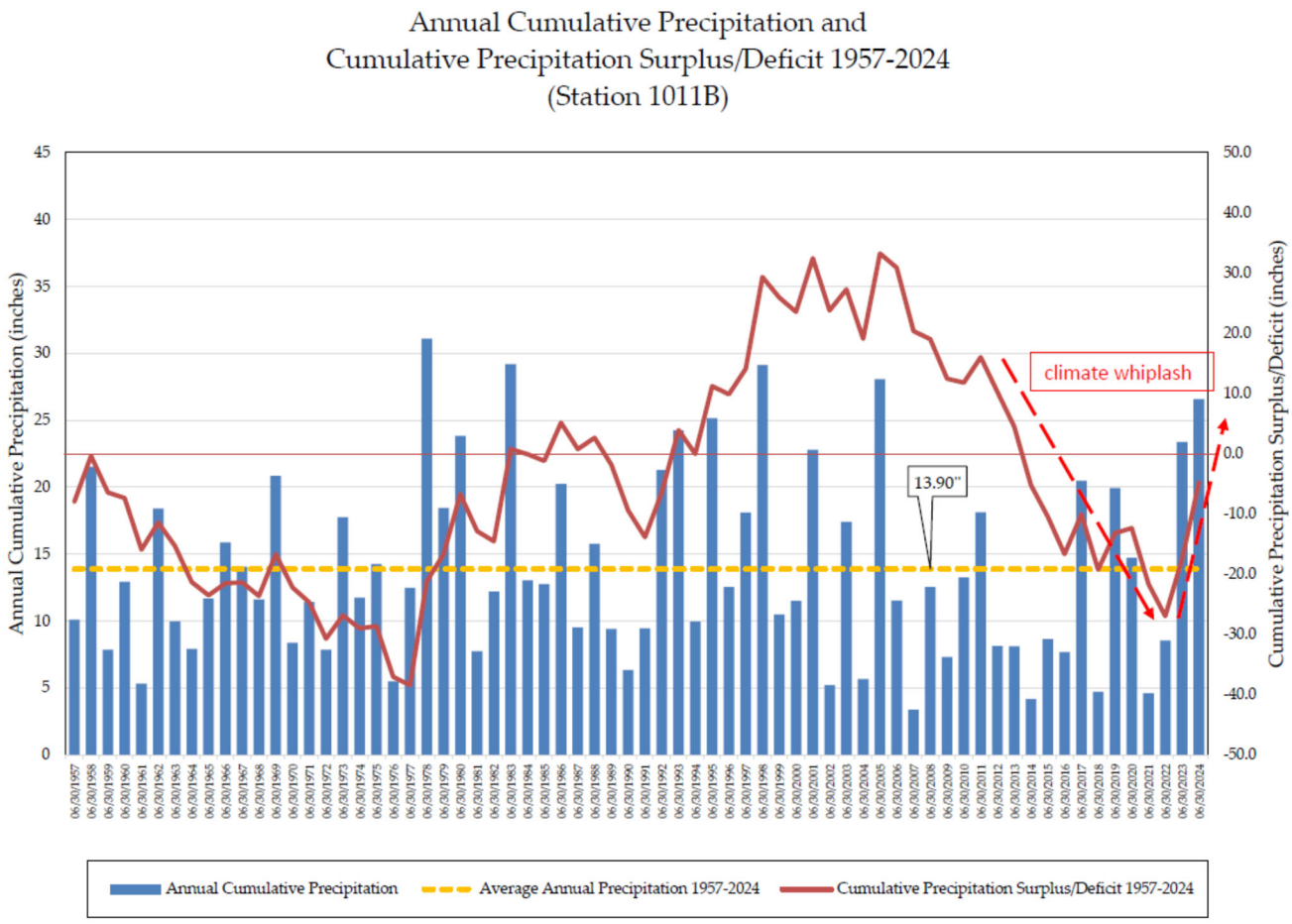
IMPACTS OF MOVEMENT OF THE ALTAMIRA LANDSLIDE

As of this date, the major land movement of the Altamira Landslide has resulted in the red-tagging (Unsafe to Enter/Occupy) and yellow tagging (Limited Entry) of several residential and commercial structures. It has also caused major destructive impacts to public and private roads, damages to utility infrastructure (water, sewer, gas, electricity and cable), causing certain utilities to be shut-off, and closure of certain Preserve land that is otherwise heavily accessed by the public for hiking, biking, equestrian, and other purposes. The only practical mitigation measure available to address a landslide with such a colossal scale is relieving groundwater pore pressures through pumping of groundwater, but it has to be done on a large enough scale to be effective at reducing the movement to an acceptable level. This technique has proven effective for the east side of the Altamira Landslide where deep dewatering wells have been installed, maintained and the rate of ground movement monitored such that a correlation between increased pumping of groundwater and reduction in the rate of ground movement has been confirmed.

CAUSATION

It is our opinion that the activation of the Altamira Landslide was largely caused by "climate whiplash" (also more technically described as hydroclimate volatility) induced by climate change, particularly starting in 2011, with five years of drought, and eight out of eleven years significantly below normal rainfall from 2011-2022, followed by two consecutive extraordinarily heavy rain seasons that dropped approximately 4 feet of rainfall on the landslide and surrounding areas draining into the landslide on the south flank of the Palos Verdes Hills.

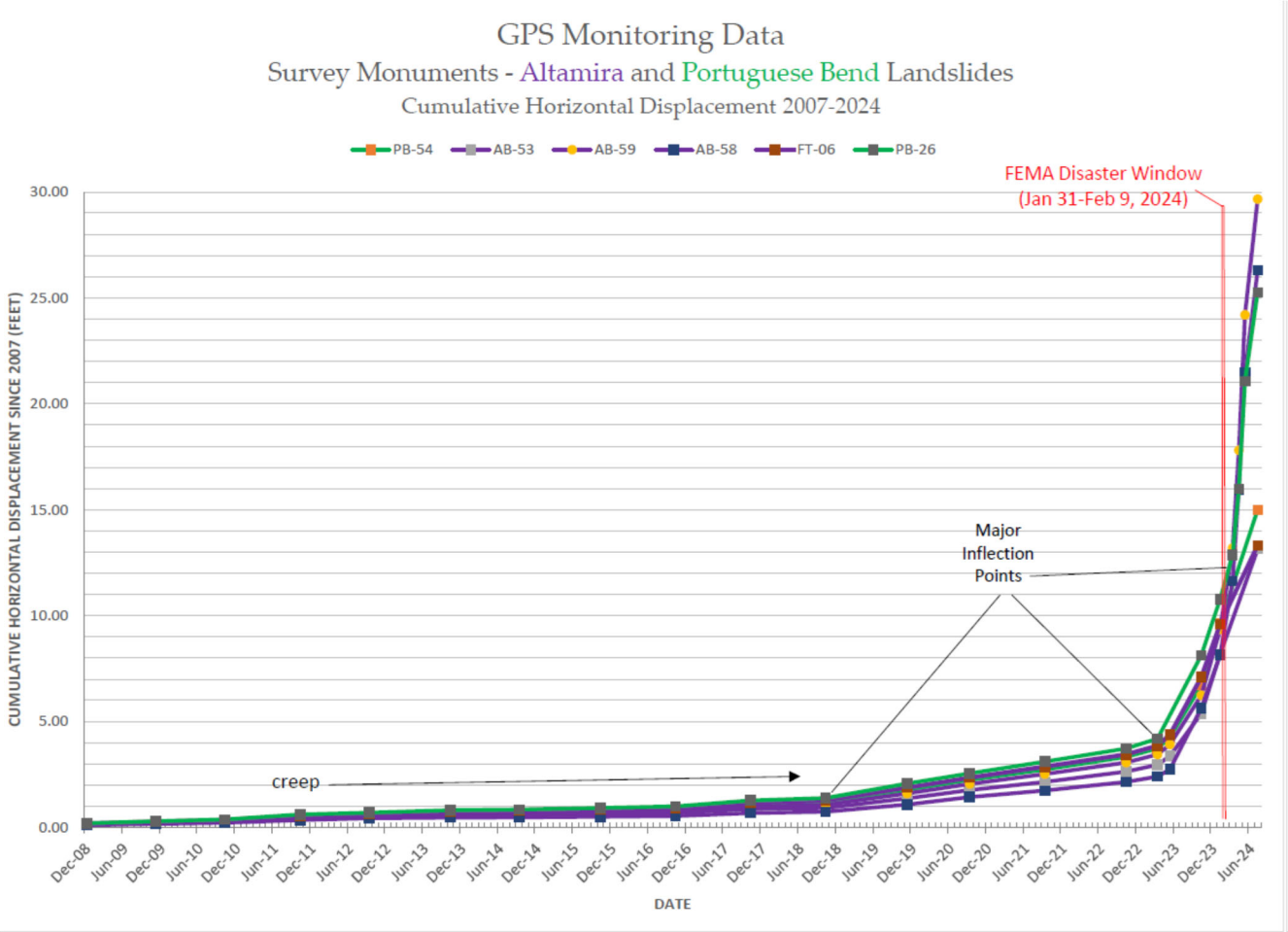
As illustrated in the following graphic, using data gathered by Los Angeles County Department of Public Works Stormwater Engineering Division, we analyzed annual rainfall deviations from the mean, and tallied up those cumulative deviations over time, as a measure of *precipitation surplus/deficit* that has impacted the area. The dark red line on the graphic shows the precipitation surplus/deficit over time. A precipitous drop is noted in the surplus/deficit line, particularly from 2011-2022, which whipsaws back to a steep climb from 2022 through 2024. Climate whiplash is illustrated by the red dashed arrows, showing the impact of the dry years (on a rapidly declining surplus/deficit curve) quickly reversing to a steeply inclining surplus/deficit curve. It is not important that this whiplash or volatility occurred in *deficit* territory on the graph, because it followed a two-decade long period of significant precipitation surplus. Two decades of precipitation surplus between 1991 and 2011 likely contributed to *strain-softening* of the Altamira Landslide failure surface clays, as the landslide began imperceptibly creeping and elongating/stretching out over a prolonged period. It follows that this generally prolonged period of drying commencing in 2011, followed by a large pulse of wetting from 2022 through the winter of 2024, and culminating in an intense barrage of rainfall from January 31st through February 9th 2024, triggered the massive Altamira movement and accelerated the landslide to unprecedented rates of movement.



Of note is that 8.29 inches of rain fell at the Rolling Hills Fire Station rain gauge from January 31st through February 9th 2024. The mean (average) rainfall for the Rolling Hills Fire Station's 57-year rainfall data set is currently 13.88 inches/year and the standard deviation of the entire 57-year dataset is 7 inches/year, indicating very high variability in annual rainfall. More rain fell between January 31st and February 9th 2024 than the standard deviation for the entire 57-year rainfall data set, indicating that this storm sequence was a statistically rare, outlier event.

The following graphic depicts *cumulative horizontal displacement* of select GPS survey monitoring points, including some of the fastest moving points in the Altamira Landslide and a couple of representative points in the PBL (which overlies the Altamira Landslide). There are three significant inflection points indicated in the graph. Prior to the first inflection point, the cumulative displacement lines indicate that the GPS monitoring points within the Altamira Landslide were creeping quite slowly (imperceptibly, near the range of instrument precision) for a number of years extending back before 2011. There was no observed or documented surface manifestation of this minor creep movement at the ground surface; however, this movement is believed to have caused deformation (elongation or stretching out of the earth materials comprising the subsurface which in turn causes additional

fracturing of those earth materials) of the Altamira Landslide body, which increased secondary permeability within the rock mass allowing rainfall at the ground surface to percolate more readily into the deep subsurface, raising groundwater levels to a point where they result in high pore pressures that contribute to landslide movement. Between the October 2018 and October 2019 GPS readings (first inflection point), an acceleration of creep movement is evident. Then following the multiple atmospheric river rains of January and February 2023 (second inflection point), a further acceleration of creep movement is evident, which would have resulted in further stretching out and opening up of the landslide mass. The final inflection point around March, 2024 (immediately following the FEMA-declared disaster of January 31-February 9 wherein 8.29 inches of rain fell) shows a dramatic acceleration and **represents the triggering of major movement of the Altamira Landslide**, as reflected by some of the graphed points going very steep and nearly vertical on the graph. The graph includes GPS monitoring point AB-59, which has been the fastest moving point and is not surprisingly located in the center of the entire Altamira Landslide mass.



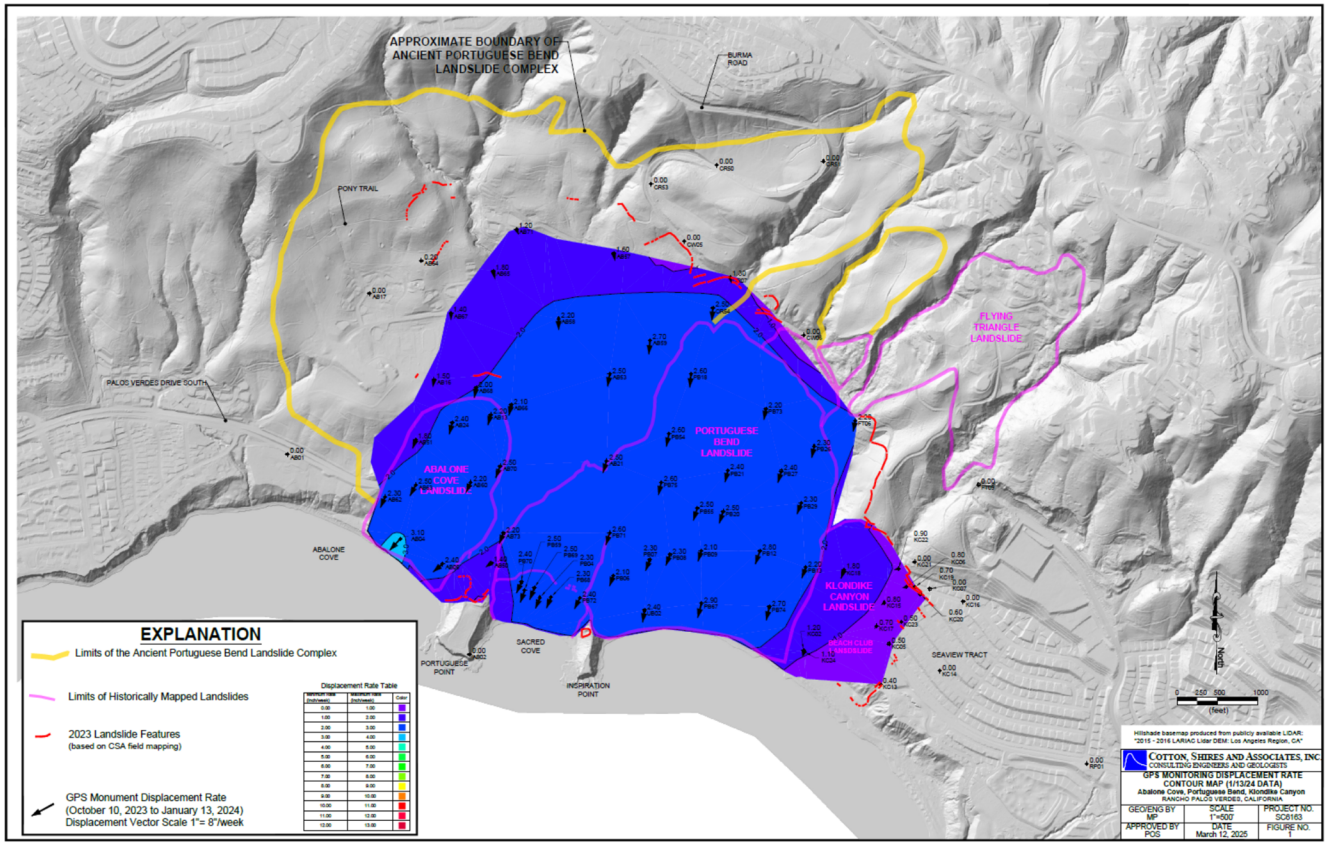
The change in ground movement rates before January 31st and after February 9th 2024 is significant. Based on our comprehensive review of the McGee GPS survey monitoring, the rates of

Altamira Landslide ground movement in the Abalone Cove area (for points north of the previously active ACL) as of January 13, 2024 ranged from 1.2 inches per week (at the periphery) up to 2.7 inches per week (in the body of the landslide). After that intense period of rainfall, plus additional rainfall resulting in a total of over 11 inches in February, as of the GPS survey completed on March 8, 2024, the rates increased to 1.5 (at the periphery) to 5.9 (main body) inches per week, more than doubling in the body of the landslide, and then increased dramatically to as much as 13.5 inches per week in the body of the landslide by July 1, 2024, probably as a slightly delayed reaction to the rainfall as it took time for the water to convert from rainfall absorption to higher groundwater pore pressures where it could have the greatest driving force impact on landslide movement.

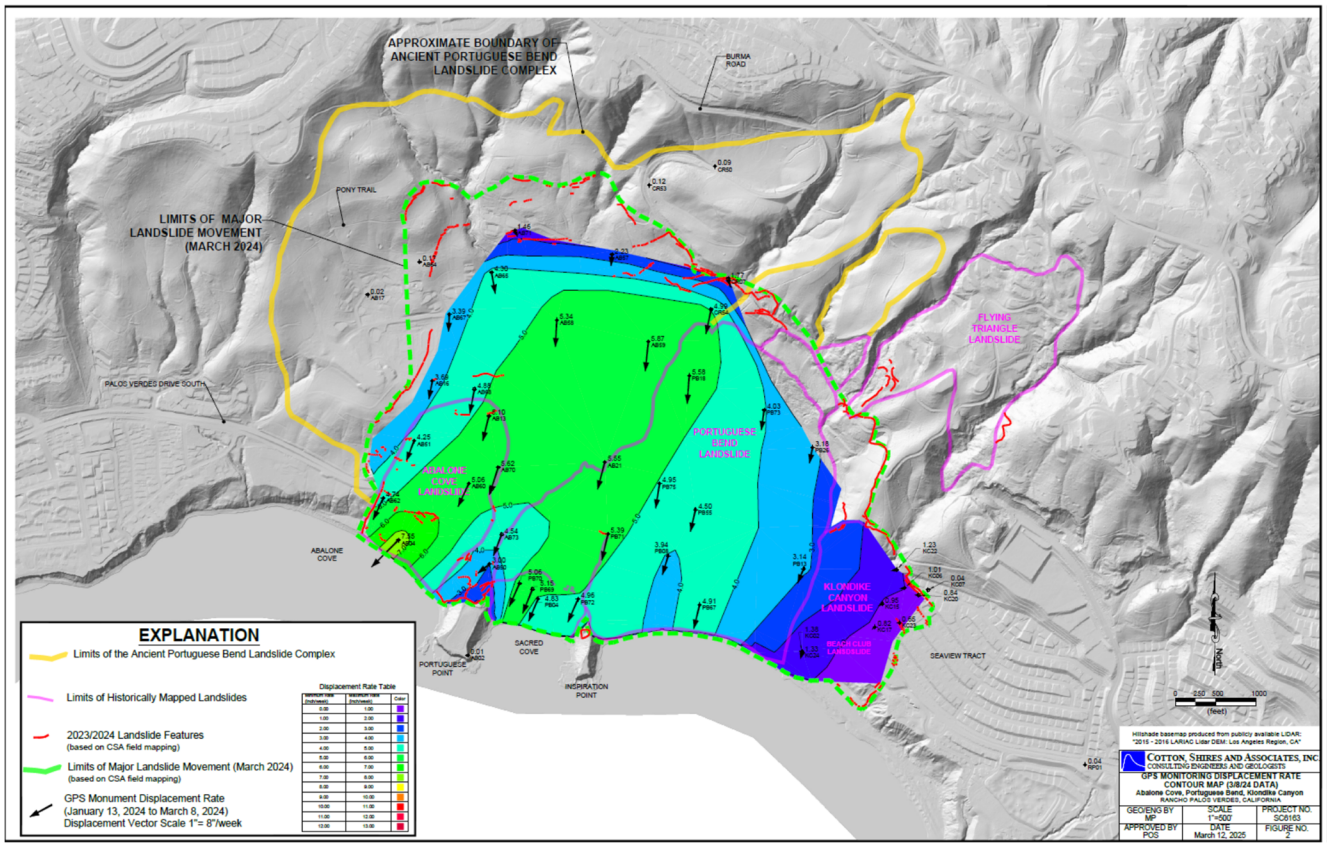
The graphics on the following two pages are "heat maps" that illustrate in color contours the rates at which the ground was moving based on the GPS survey monuments for January 13, 2024, March 8, 2024 and July 1, 2024, respectively. The heat maps include our on-ground geologic mapping of visible land movement features, which started as tension cracks or narrow fissures that were discontinuous (as of December 2023 mapping and are shown on the January 13, 2024 heat map), but these features further developed into more continuous/connected tension cracks and fissures, which have now developed into large scarps, grabens and well-developed boundary features. It wasn't until March 2024 that we first drew a boundary (dashed green line) around the "Area of Major Land Movement", because prior to that time, the surface manifestation of movement was poorly developed and inconsistent and there was not sufficient development of the landslide to develop a boundary. By March 2024, with further mapping and the extraordinary acceleration of numerous GPS monitoring points, a boundary defining the "Area of Major Land Movement" was delineated. Today, following many tens of feet of movement since early 2024, the boundary of the Altamira Landslide is well-defined. North of PV Drive South, the Altamira boundary extends significantly further west of the historical ACL boundary (resulting in the destruction of the landmark Wayfarer's Chapel), upslope through the York property (6001 PV Drive South), and north of the historical ACL boundary through the Portuguese Bend Riding Club Area, crossing upper Narcissa Drive, through and north of residences on upper Cinnamon Lane, and eventually turning east across Altamira Canyon, extending through the Vanderlip Estate (100 Vanderlip Drive), destroying Vanderlip Drive and adjacent properties, and ultimately continuing northeast to the lower stretch of Burma Road Trail in the Portuguese Bend Reserve.

The Altamira Landslide movement also created never-before-seen deformation where it underlies and now extends south of the KCL, including formation of a more seaward toe accompanied by uplifting ground that trended southwest through the beach area of the Portuguese Bend Beach Club and extending up to 500 feet or more offshore where it emerged through the sea floor and formed a new rocky coastline above sea level, generally east of Inspiration Point. The emergence of the new land offshore from the previous coastline was first reported to, and was subsequently observed by the City Geologist in late February of 2024, consistent with the triggering of major movement of the Altamira Landslide described above.

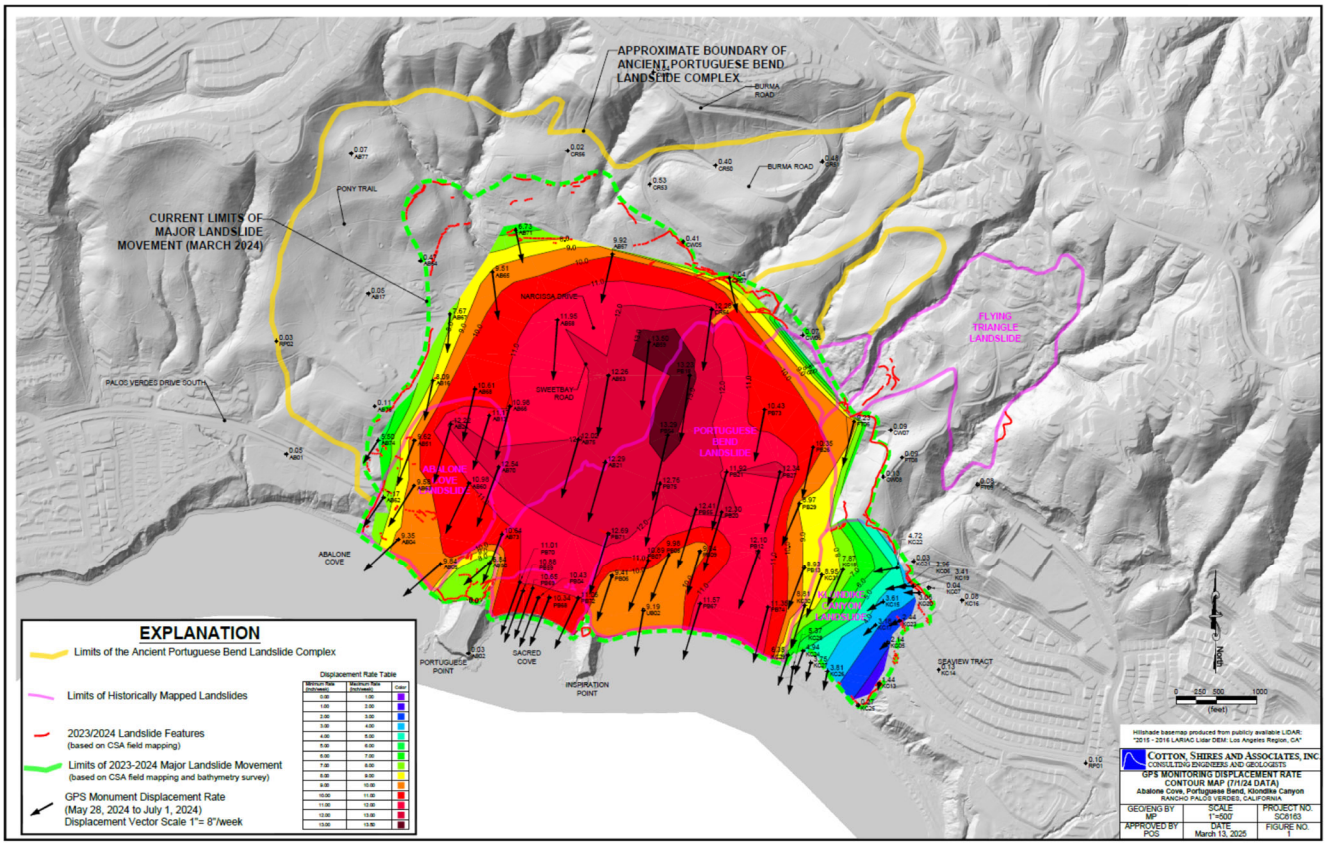
1/13/2024 Heat Map



3/8/2024 Heat Map



7/1/2024 Heat Map

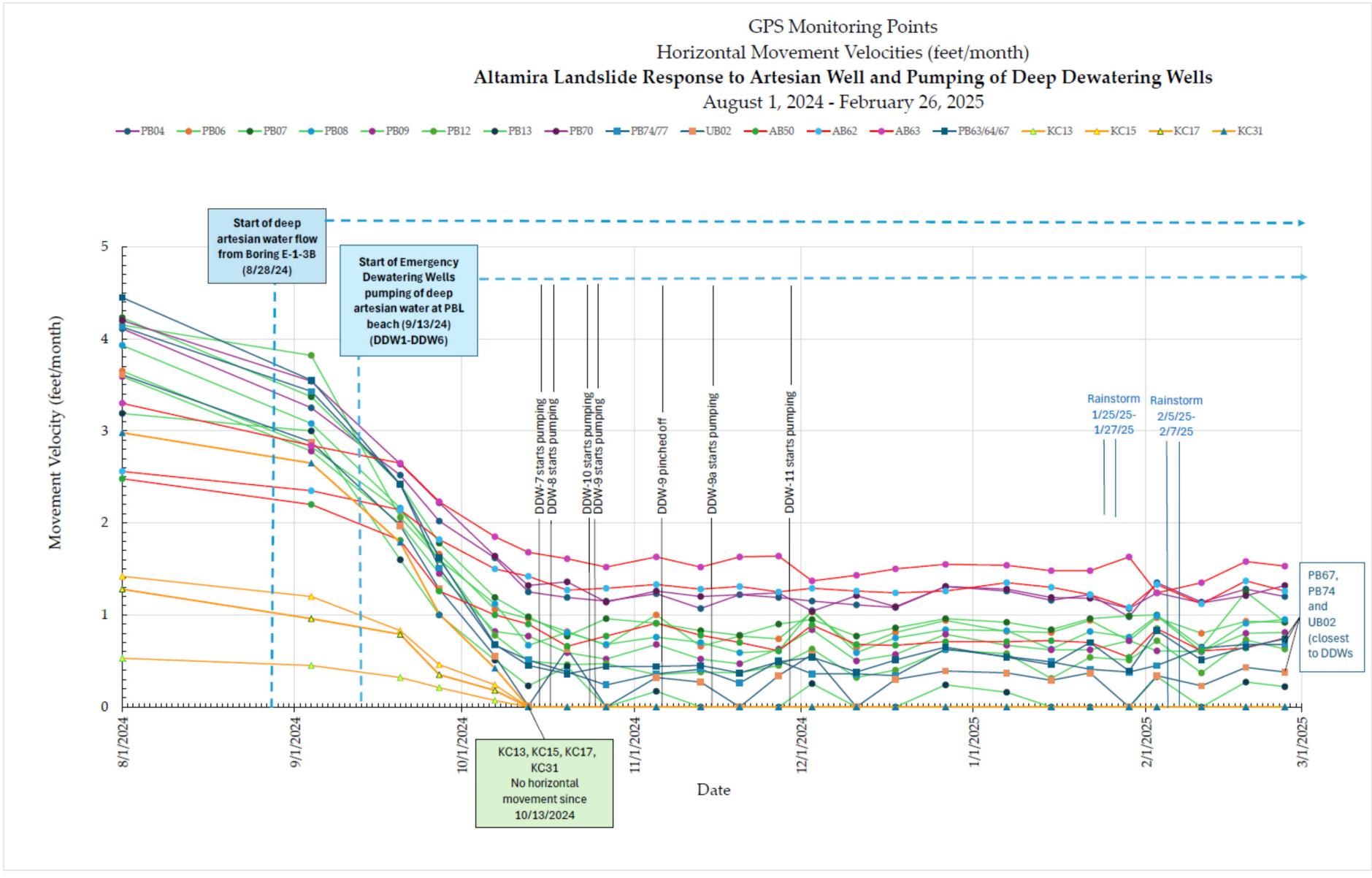


EMERGENCY MEASURES

Emergency measures taken by the City and abatement districts (ACLAD and KCLAD) to date have included drilling, pumping and monitoring deep dewatering wells, winterization measures including lining channels and installing culverts to reduce the amount of surface water percolating into the groundwater regime from upslope drainages/canyons, and filling of and establishing drainage for fissures and grabens that, if left unmitigated, facilitate surface water intrusion into the groundwater regime. This strategy has proven to be effective in reducing the rate of movement of the Altamira Landslide and even stopping movement of the eastern portion of the landslide in the area of the KCL. Because piezometers installed in deep borings that penetrated the base of the Altamira Landslide indicated high groundwater pore pressures beneath the landslide (some areas were found to have near-artesian or artesian groundwater pressures – pressures higher than the ground surface), a pilot program strategy was pursued that involved drilling a series of five deep dewatering wells near the coast to approximately 50 feet below the base of movement and pumping the wells until the landslide movement sheared off the well casings at depth and then re-drilling them to approximately 50 feet beneath the landslide to re-establish the wells so that they could continue to be pumped to dewater the high groundwater pressures beneath the landslide. This strategy turned out to be more successful than originally contemplated because the movement of the landslide slowed quickly in response to the initial dewatering efforts and the deep wells continued to function for weeks or months before re-drilling was necessary.

The chart on the following page illustrates the timing of artesian water being encountered in one of the test borings (Boring E-1-3B, which was retrofitted to function as an artesian well), the installation of the deep dewatering wells, and the deceleration of the Altamira Landslide in response to the dewatering efforts.

Based on the success of the deep dewatering program, we now know that this strategy works. Consequently, the City agreed to loan the landslide abatement districts funding so that they could re-establish wells that were no longer functioning and to establish deep dewatering wells at additional locations as well as to establish additional measures to reduce infiltration of surface water. Additional wells are also needed in the areas that the City controls. Unfortunately the cost of drilling, pumping, maintaining and re-drilling requires significant funding which the City was able to keep up with to a point, but now needs additional funding assistance to keep the wells that have already been established functioning and to establish additional deep dewatering wells in order to reduce the movement of the middle and eastern portions of the Altamira Landslide to the level experienced prior to the impact of climate whiplash.


GPS Monitoring Points
Horizontal Movement Velocities (feet/month)
Altamira Landslide Response to Artesian Well and Pumping of Deep Dewatering Wells
August 1, 2024 - February 26, 2025
PB04 PB06 PB07 PB08 PB09 PB12 PB13 PB70 PB74/77 UB02 AB50 AB62 AB63 PB63/64/67 KC13 KC15 KC17 KC31
Start of deep artesian water flow from Boring E-1-3B (8/28/24)
Start of Emergency Dewatering Wells pumping of deep artesian water at PBL beach (9/13/24) (DDW1-DDW6)
DDW-7 starts pumping
DDW-8 starts pumping
DDW-10 starts pumping
DDW-9 starts pumping
DDW-9 pinched off
DDW-9a starts pumping
DDW-11 starts pumping
Rainstorm 1/25/25-1/27/25
Rainstorm 2/5/25-2/7/25
PB67, PB74 and UB02 (closest to DDWs
KC13, KC15, KC17, KC31 No horizontal movement since 10/13/2024
Movement Velocity (feet/month)
Date
0
1
2
3
4
5
8/1/2024
9/1/2024
10/1/2024
11/1/2024
12/1/2024
1/1/2025
2/1/2025
3/1/2025

City of Rancho Palos Verdes

John Cruikshank, Mayor
Eric Alegria, Mayor Pro Tem
David L. Bradley, Councilmember
Barbara Ferraro, Councilmember
Paul Seo, Councilmember

February 20, 2024

California Office of Emergency Services Disaster Analysis Unit
3650 Schriever Avenue
Mather, CA 95655

SUBJECT: REQUEST FOR A STATE OF EMERGENCY FOR THE GREATER PORTUGUESE BEND LANDSLIDE COMPLEX

To whom it may concern:

On behalf of the approximately 42,000 residents of Rancho Palos Verdes and the approximately 67,000 residents of the Palos Verdes Peninsula, the Rancho Palos Verdes City Council is requesting Governor Newsom invoke his emergency powers pursuant to the Emergency Services Act, Gov't Code § 8550 et seq., and proclaim a State of Emergency for the Palos Verdes Peninsula region to assist the City to stabilize land movement in the greater Portuguese Bend Landslide Complex (Landslide). For reference, see attached map to show the boundaries of the Landslide.

As a result of the 2023 and 2024 winter storms, the City of Rancho Palos Verdes has been impacted by substantial precipitation that has caused an unprecedented acceleration of land movement equating to an annualized rate of 10 feet per year. This significant and sudden increase in land movement is causing severe damage to Palos Verdes Drive South – a major arterial roadway and evacuation route for the Palos Verdes Peninsula; damage and disruption to utility infrastructure including water, sewer, gas line and utility pole breaks; closures of approximately 8 miles of public trails due to slope instability; fissures and sink holes throughout the Palos Verdes Nature Preserve; the closure of residential intersections due to sink holes and ground separation; the temporary closure of the Wayfarers Chapel - a federal and state designated historic landmark; and the red-tagging of homes with many more homes on a watch list due to foundation and structural damage.

On October 3, 2023, the Rancho Palos Verdes City Council adopted a Local Declaration

of Emergency pursuant to Section 8630 of the Government Code, which has been renewed several times as required by that law; the Local Emergency is still in effect.[1] This action was intended to provide immediate access to resources and to assist in expediting remediation measures to stabilize and manage land movement that poses an imminent threat to the public's health, safety, and property. The City's Geologist and Geotechnical Engineering team and the two state-recognized Geologic Hazard Abatement Districts' geologists (Abalone Cove Landslide Abatement District and Klondike Canyon Landslide Abatement District) propose to stabilize land movement by immediately implementing the following:

- Filling fissures to prevent surface water from directly recharging the water table and further lubricating the slip plane.
- Constructing drainage swales, lining certain canyons with non-penetrable membrane, and/or installing flexible drainage pipes to properly convey surface water to the ocean and/or sanitary lines to prevent recharging the water table.
- Installing dewatering wells in the form of horizontal hydraugers and/or vertical dewatering wells to extract groundwater from the slip plane and reducing the local water table.

As the City continues its response and recovery operations, we have determined that these remediation measures must be implemented immediately to minimize the threat to the public's health, safety, and property. Therefore, the City Council requests, pursuant to the authority provided by the Act, and specifically by Sections 8571 and 8625 of the Government Code, that the Governor declare a State of Emergency for the City of Rancho Palos Verdes, waive and/or suspend certain state laws and permits required by local and state agencies that include, but are not limited to, the California Coastal Commission, the California Department of Fish and Wildlife, the Regional Water Quality Control Board, the State Water Resources Control Board, the South Coast Air Quality Management District, and other State agency permits or review processes. Finally, the City Council requests the Governor waive any requirements under the California Environmental Quality Act and its implementing regulations related to the approval and implementation of the remediation measures set forth above. Additionally, the City is requesting that the Governor submit a request to the President of the United States for a Federal Emergency Declaration pursuant to the Stafford Act, 42 U.S.C. §§ 5121-5207.

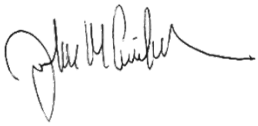
The City has identified that permits would be required by the aforementioned state agencies prior to proceeding any landslide stabilization work. Suspension of these requirements will allow the City and the Geologic Hazard Abatement Districts to immediately proceed with construction and installation of the enumerated measures to stabilize the Landslide without the costs and time delays typically experienced with obtaining permits. It is imperative that the City and two Geologic Hazard Abatement Districts are able to expedite the installation of dewatering wells and surface drains knowing that we are in an El Niño winter pattern with repeated atmospheric rivers

[1] The City also adopted an Interim Urgency Ordinance pursuant to Section 65958 of the Government Code, which effected a moratorium on all construction in the Landslide, with some limited exceptions.

forecasted to extend into spring, and every rain event is exacerbating the rate of land movement.

Please contact City Manager Ara Mihranian at aram@rpvca.gov or by telephone at 310-544-5202.

Sincerely,



John Cruikshank
Mayor

Attachments:

- Portuguese Bend Landslide Complex Map
- Information on the Portuguese Bend Landslide including resolutions adopting and extending the City's Proclaimed Local Emergency can be found on the City's website at: www.rpvca.gov/landslide

cc:

Laphonza Butler, U.S. Senator, California
Alex Padilla, U.S. Senator, California
Ted Lieu, U.S. Representative, 36th Congressional District
Ben Allen, Senator, 24th State Senate District
Al Muratsuchi, Assemblymember, 66th Assembly District
Janice Hahn, L.A. County Supervisor, 4th District
Kevin McGowan, Director, L.A. County Office of Emergency Management
Brandy Villaneuva, Disaster Manager Area Coordinator, L.A. County Area G
Rancho Palos Verdes City Council

CREST ROAD

BURMA ROAD

PONY TRAIL

ANCIENT PORTUGUESE BEND LANDSLIDE COMPLEX

NARCISSA DRIVE

FLYING TRIANGLE LANDSLIDE

PALOS VERDES DRIVE SOUTH

SWEETBAY ROAD

ABALONE COVE LANDSLIDE

PORTUGUESE BEND LANDSLIDE

KLONDIKE CANYON LANDSLIDE

ABALONE COVE

SACRED COVE

PORTUGUESE POINT

INSPIRATION POINT

SEAVIEW TRACT

North

0 250 500 1000

(feet)

EXPLANATION

- Limits of the Ancient Portuguese Bend Landslide Complex
- Limits of Historically Mapped Landslides
- 2023 Landslide Mapping
- Current Limits of Major Landslide Movement (February 2024)

Hillshade basemap produced from publicly available LiDAR: "2015 - 2016 LARIAC Lidar DEM: Los Angeles Region, CA"

COTTON, SHIRES AND ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS

LANDSLIDE MAPPING UPDATE 2/20/24
Abalone Cove, Portuguese Bend, Klondike Canyon
RANCHO PALOS VERDES, CALIFORNIA

GEO/ENG BY	SCALE	PROJECT NO.
MP	1"=500'	SC6163
APPROVED BY	DATE	FIGURE NO.
POS	February 2024	1

CITY OF RANCHO PALOS VERDES
ADMINISTRATION DEPARTMENT
CITY MANAGER'S OFFICE

March 17, 2025

Via email and Grants Portal

Mr. Robert Fenton
FEMA District No. 9 Administrator

Robert Larsen, Public Assistance Officer
California Office of Emergency Services

Subject: Appeal of FEMA's Eligibility Determination, Project Number 754846
FEMA-4769-DR-CA, California's Severe Winter Storms, Tornadoes, Flooding, Landslides, and Mudslides (Damage Inventory No. 1385921)

Dear Messrs. Robert Fenton and Robert Larsen,

On April 13, 2024, the President declared a major disaster (**FEMA-DR-4769-CA**) in the State of California due to damages from severe winter storms, tornadoes, flooding, landslide and mudslides with an incident period of **January 31 through February 9, 2024**. The declared disaster by the President is similar to a federal disaster declared on April 3, 2023 for California Severe Winter Storms, Straight-Line Winds, Flooding, Landslides and Mudslides that occurred between **February 21, 2023 and July 10, 2023 (DR-4699-CA)**.

On May 9, 2024, the City of Rancho Palos Verdes (City) filed for disaster aid cost recovery for the City's response to the 2024 winter storms. In total, the City filed applications totaling $38.4 million.

On January 17, 2025, the City received FEMA's Eligibility Determination Memorandum **denying** in full the City's request for $3,000,000 to conduct permanent repairs to the City's Abalone Cove Sanitary (sewer) System damaged by the winter storms that occurred between January 31 and February 9, 2024. The denial cites the following reasons:

- Pre-disaster ground instability and on-going non-disaster related causes.
- Disaster damage was not a result of the declared disaster event.
- Pre-existing conditions of landslide.

According to Section 102.1 and 102.2 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, an "Emergency" means *any occasion or instance for which, in the determination of the President, Federal assistance is needed to supplement State and local efforts and capabilities to save lives and to protect property and public health and safety, or* ***to lessen or avert the threat of a catastrophe (emphasis added)*** *in any part of the United States*. Moreover, a "Major Disaster" *means any natural catastrophe (including any hurricane, tornado, storm, high water, winddriven water, tidal wave,*

tsunami, earthquake, volcanic eruption, ***landslide (emphasis added)****, mudslide, snowstorm, or drought), or, regardless of cause, any fire, flood, or explosion, in any part of the United States, which in the determination of the President causes damage of sufficient severity and magnitude to warrant major disaster assistance under this Act to* ***supplement the efforts and available resources of States, local governments, and disaster relief organizations in alleviating the damage, loss, hardship, or suffering caused thereby (emphasis added)****.*

The City's disaster recovery request was submitted to FEMA based on the aforementioned definitions found in the Stafford Act and the declared major disaster resulting from winter storms of 2024 that **contributed to a significant and documented acceleration of land movement caused by the activation of a <u>new</u> historic and previously dormant landslide known as the Altamira Landslide** within the Greater Portuguese Bend Landslide Complex (Landslide Complex).

According to the City Geologist's reports to the City Council in 2024, the **Altamira Landslide is a deeper slip plane that the Landslide Complex "rafted" on top of as a direct result of the unprecedented and record rainfall during the 2024 winter storm event resulting in the shallower slip plane of the Landslide Complex to move more than it ever did before in its documented history**. Contrary to FEMA's Eligibility Determination Memorandum, what is **not pre-existing** are the areal dimensions, depth of movement, velocity of movement, artesian and near-artesian groundwater pressures beneath it, and even direction of movement. The land movement experienced as a result of the 2024 winter storms is not just a simple **expansion** of the Landslide Complex, but is an **entirely different, larger and deeper landslide with much broader boundaries** (including the new coastline offshore at the Portuguese Bend Beach Club), nearly twice as deep in some areas, and unprecedented rates of movement. None of this was seen during the history of the City, nor during the approximately 70-year history of landslide studies, monitoring, and observations conducted in the area, contrary to what is noted in the Eligibility Determination Memorandum. It is the opinion of the City and its subject matter experts, that will be discussed in this appeal letter, that this is largely caused by "weather whiplash" (induced by climate change) starting in 2011.

The City respectfully requests that you, as FEMA's District No. 9 Administrator, reverse the eligibility denial and uphold the City's appeal based on facts, data and other pertinent information found in this appeal letter that will clearly demonstrate that a new landslide was activated causing an acceleration of land movement as a direct result of the 2024 winter storms resulting in costly and significant damage to the City's infrastructure. The City firmly believes that this **appeal letter** will demonstrate that the requested cost recovery work complies with Title 44 of C.F.R. Section 206.223(a)(1) in that the financial assistance requested is directly related to the winter storms of 2024. As such, the City is requesting **$3,000,000** to conduct permanent repairs to the City's Abalone Cove Sanitary (sewer) System damaged by the winter storms that occurred between January 31 and February 9, 2024.

Historic Background

As noted in the January 17, 2025 Eligibility Determination Memorandum and throughout various City records, the Landslide Complex is a known ancient landslide that was activated in 1956 when, prior to the City's 1973 incorporation, Los Angeles County was expanding Crenshaw Boulevard to Palos Verdes Drive South and its grading efforts combined with ground water, activated the Portuguese Bend Landslide. Land movement has not stopped since 1956 but has been managed at a slow creep to no movement for years through remediation efforts implemented by the City and its two geologic hazard abatement districts, Abalone Cove Landslide Abatement District (ACLAD) and Klondike Canyon Landslide Abatement District (KCLAD).

The Landslide Complex, historically existing for thousands of years, encompasses the following four sub-landslide areas in the City: the Portuguese Bend Landslide (PBL), the Abalone Cove Landslide (ACL), the Klondike Canyon Landslide (KCL), and the Beach Club Landslide (BCL). As noted above, in 1956, the PBL began moving, then in 1979, ACL and KCL began moving with the BCL, which is nested within the KCL and, while dormant itself, moves with the KCL. The Landslide Complex also includes areas outside of those known landslides, predominantly uphill from the PBL and ACL, within the ancient Landslide Complex as mapped by various agencies (i.e., U.S. Geological Survey and California Geological Survey) and other researchers. This fifth landslide is in the City of Rolling Hills and is known as the Flying Triangle Landslide.

According to a November 8, 2024 report prepared by the City Geologist, Mike Phipps of Cotton Shires and Associates (CSA) (Attached), the PBL has been continuously active since reactivation in 1956 with many areas of the landslide having moved hundreds of feet seaward over the ensuing seven decades. The ACL was active from 1979 **until the late 1990's**, involving only several feet of movement, when dewatering and other mitigation efforts largely halted movement. An **imperceptible creep movement** of the ACL has occurred over the past 25 years **following rainy seasons that were significantly above average rainfall amounts.** The KCL has been episodically active in 1979-1983 and 2005-2006, experiencing only several inches of movement, typically in response to significantly above average rainfall. Landslide movements throughout the Landslide Complex **outside of the historical boundaries of** the ACL and PBL previously exhibited low rates of creep movement, or movement at or near the instrument precision range, in the 11-year monitoring period of 2007-2018.

Impacts of Rainwater

These landslides are deep translational-type failures within seaward-dipping strata of the Monterey Formation, with the landslide slip surfaces occurring within very weak bentonitic clay beds. Historically, the movement behavior of these landslides routinely exhibited high sensitivity to increased groundwater pore pressure, and increased rates of land movement which have been **correlative with 6-to-12-months of antecedent rainfall that was well above average**. Similarly, land movement decreased during below

average rainy seasons or multi-year periods of drought.

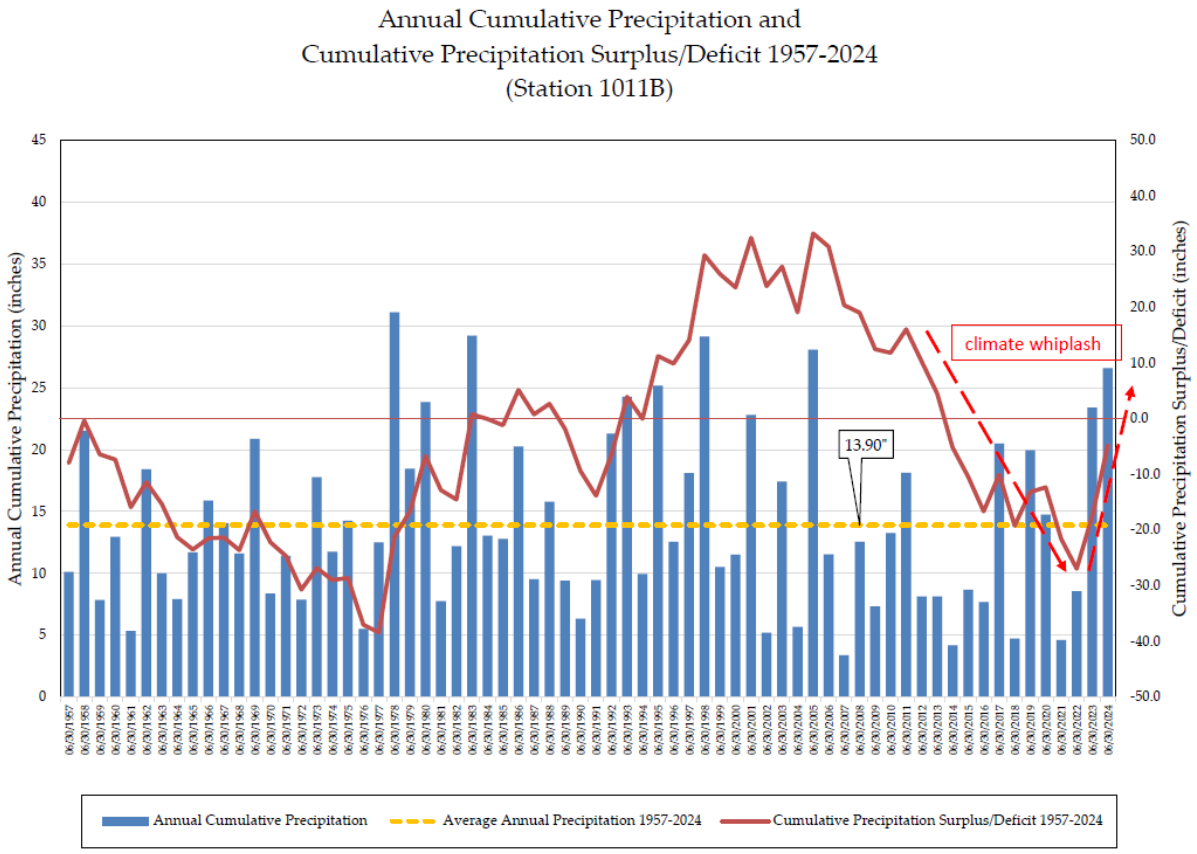
Simply stated, numerous studies conducted over approximately seven decades all point to water as being the primary contributor to land movement, particularly rainwater. Rainwater runoff is known to penetrate the ground through fissures during a rain event and recharge the ground water table. During particular significant rain events or seasons, runoff that enters the ground may take months to show signs of land movement. Depending on where rain runoff enters the ground, it can settle below the slip plane thereby resulting in artesian pressure or settle above the slip plane, which is made up of volcanic ash known as bentonite and lubricates the slip plane resulting in horizontal movement.

Changes in climate over the years, now commonly referred to as “weather whiplash” has resulted in extreme weather in Southern California including extended periods of dry weather followed by severe wet weather in the form of atmospheric rivers as experienced in 2023 and 2024. This extraordinary wet weather resulted in the President declaring a major federal disaster in both 2023 and 2024. Underscoring how extreme weather has become over the years, in August 2023, California, particularly Southern California, experienced days of record rain in August 2023 as a result of Tropical Storm Hillary.

Extreme wet weather patterns have proven to contribute towards the change in behavior of the Landslide Complex. Beginning in 2021, the City Geologist began reviewing Global Positioning Satellite (GPS) monitoring data for survey monuments within the entire Landslide Complex. Review of GPS monitoring data from 2007 through 2024 indicated that land movement acceleration initially began between 2018 and 2019. This acceleration was correlative with significantly above-normal rainfall in two out of three prior rainfall seasons (2016-17 and 2018-19) which followed five consecutive drier than normal rainfall seasons (2011-12 through 2015-16).

Another way to look at this is to analyze annual rainfall deviations from the mean, and tally up those cumulative deviations over time, as a measure of *precipitation* surplus/deficit that is impacting the area. According to the graphic on the following page, in which the dark red line shows the precipitation surplus/deficit over time, note the precipitous drop particularly from 2011-2022, which whipsaws back to a steep climb from 2022-2024. Weather whiplash is illustrated by the red arrows, showing the impact of the dry years (rapidly declining surplus/deficit curve) quickly reversing to a steep inclining surplus/deficit curve. It doesn't matter that this all happened in *deficit* territory on the graph, because it followed a two-decade long period of precipitation surplus. It is reasonable to say that two decades of precipitation surplus between 1991 and 2011 might have contributed to **strain-softening** of the Altamira failure surface clays, as the landslide imperceptibly crept and stretched out. It follows that this generally prolonged period of drying commencing in 2011, followed by a short, huge pulse of wetting between 2022-2024, is what **triggered** the massive previously inactive Altamira Landslide to move in 2024.

It is also worth noting that 8.29 inches of rain fell at the Rolling Hills Fire Station rain gauge during the 10-day FEMA disaster window. Keep in mind, the mean (average) for the 57-year rainfall data set is currently 13.88 inches/year and the standard deviation of the entire 57-year dataset is a whopping 7 inches/year, indicating very high variability in annual rainfall. In other words, more rain fell in the 10-day FEMA disaster window than the standard deviation for the entire 57-year rainfall data set. Underscoring that this wet weather behavior was an extraordinary event.



Significant accelerations in movement velocity were documented in May 2023 following major storm sequences in January, February and March of 2023, which added to cumulative seasonal rainfall totals exceeding 193% of average rainfall. Approximately 87% of this rain fell prior to June 18, 2023. Most of this rainfall occurred from three significant atmospheric river-type storm sequences occurring on January 9-16 (3.59 inches), February 23-March 1 (3.79 inches) and March 10-15 (4.12 inches). Land movement velocities further increased as of the July 15, 2023 monitoring. An anomalous tropical storm (Tropical Storm Hillary) dropped an additional 3.05 inches of rain on August 19 through August 20, 2023, resulting in further land movement acceleration as of the October 10, 2023 monitoring.

Furthermore, accelerated ground movement occurred throughout the Landslide Complex during and following the 2022-23 rainy season which was more than 220% of the historical

average rainfall. Based upon the GPS monitoring survey on January 13, 2024, average land movement velocities within the Landslide Complex since October 10, 2023 have accelerated by a factor of three to four times compared to the previous 12 month (Oct 2022-Oct 2023) monitoring period. Expressed another way, the total movement over the 3 month period of October 2023 through January 2024 is nearly equal to, and in some cases exceeds, the total movement over the previous entire year's monitoring period (i.e., October 2022 through October 2023). Movement of this magnitude has not been previously observed or documented in the ancient landslide complex north of the historical boundaries of the ACL, PBL and KCL.

An example of this is highlighted by six GPS monitoring points in the upper ancient landslide area, in the vicinity of upper Narcissa Drive and uphill from it. These survey monuments have experienced average displacements of 4.07 feet over the past 15 months (3.26 feet on an annualized basis). Average displacements for these six points over the prior annual monitoring period (Sept 28, 2021-Oct 10, 2022) were 0.36 feet. This represents approximately a 9-fold increase in total land movement on an annualized basis. **Two GPS monitoring points near the toe of the Abalone Cove Landslide moved an average of 0.76 feet (Sept 2021-Oct 2022) to 7.30 feet (Oct 2022-Jan 2024) over the same periods, a 9.6-fold increase in displacement**.

Activation of the New Altamira Landslide

According to the City Geologist's Memorandum dated November 8, 2024 and March 16, 2025 (Attached), total landslide movements in the upper ancient landslide area are significant and greatly exceed what has been observed over the past seven decades. The Altamira Landslide is a **newly** active landslide that has occurred within a previously mapped ancient Landslide Complex (most recently labeled the "Ancient Altamira Landslide Complex" which was a name modification of the "Ancient Portuguese Bend Landslide" identified on the California Geological Survey's Landslide Inventory Map (CGS, 2007) which is referred to as the Landslide Complex in this appeal letter). See map on the following page.

It is important to make this distinction for consistency and to avoid confusion, because the Altamira Landslide is, in fact, a new member of the historically active Landslide Complex but largely **underlies it** and occupies an area of active land movement >700 acres and extends to more than 500 feet off of the coastline, whereas the shallower historically active Landslide Complex only occupied about 380 acres.

The Altamira Landslide in Rancho Palos Verdes is therefore a recently identified large landslide that largely underlies (and therefore largely encompasses but exceeds the area of) the previously understood active Landslide Complex containing the four historically active landslides. The Altamira Landslide includes large areas outside of the historically mapped boundaries of these known landslides, predominantly upslope and downslope from the historically mapped PBL and ACL, within, but smaller than, the Landslide Complex as shown on the map on the following page.

To provide an example of the change in size, the dimensions from head to toe of the previously historical ACL is 2,250 feet and the width up to 1,450 feet wide. The dimensions from head to toe of the Altamira Landslide, underlying and extending up and down slope from both the PBL and the ACL, is 5,800 feet (more than double that of the ACL) with a width of up to 7,400 feet wide (more than five times as wide as the ACL).

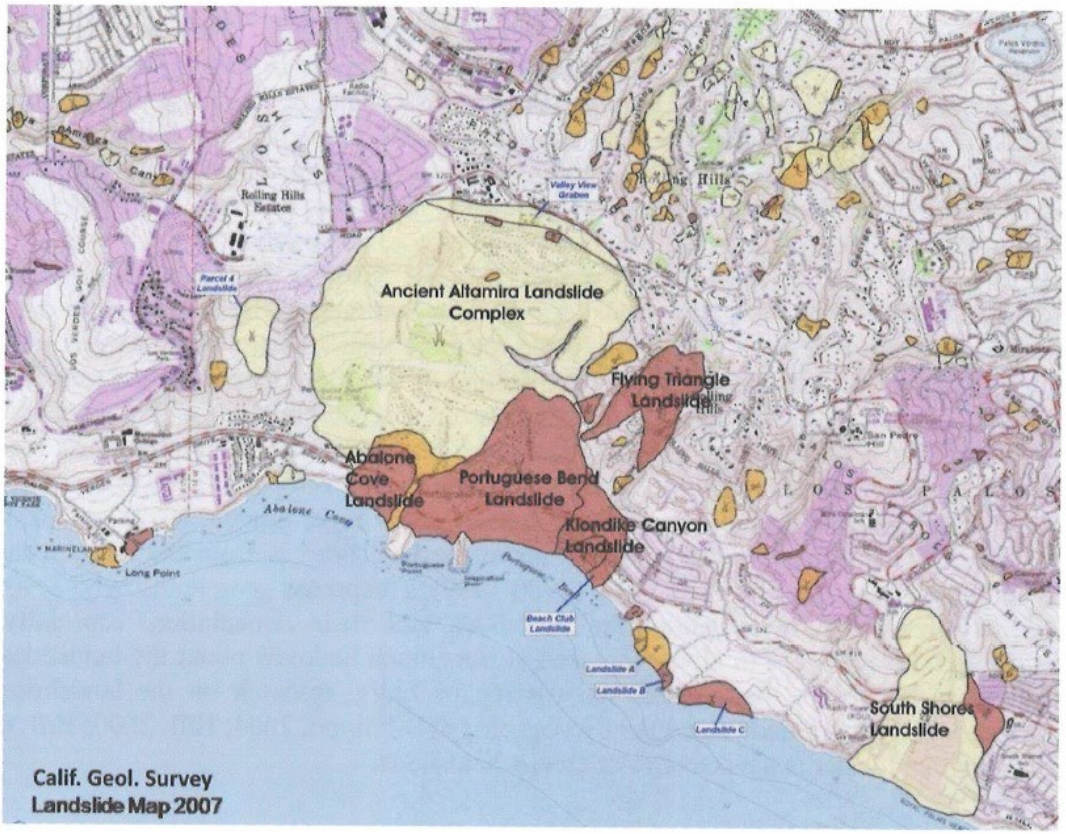


Figure 1. Landslide map of a portion of the south flank of the Palos Verdes Peninsula prepared by the California Geological Survey (2007). The major and some minor landslides are identified. Light yellow indicates that the landslide is inactive, red is active and orange is dormant.

While previous geotechnical investigators identified inactive deep failure surfaces in both the historically active and ancient landslide areas, none of them mapped or identified as active the entire depth or breadth of movement that has recently impacted the area, nor did they opine that such an event would occur in historic times. The areal dimensions, depth of movement, velocity of movement, artesian and near-artesian groundwater pressures beneath it, and even the direction of movement, are different than the ACL, PBL, and KCL landslides, collectively referred to as the Landslide Complex. The distinction to be made then, is that the Altamira Landslide is not just simple *expansion* of an existing group of landslides, **it is an entirely different, larger and deeper landslide with much broader boundaries (including the new coastline offshore), nearly twice as deep as the depth of historic landslide movement in some areas, and with**

unprecedented rates of movement (which were not seen in the early LA County Engineer surveys, the Charles Abbott Associates surveys beginning in 1994, nor the McGee surveys since 2007). None of this was experienced during the history of the City, and the Altamira Landslide is a unique landslide not characterized in its current dimensions during the over 70-year history of landslide investigations, exploratory borings, monitoring and observations being conducted in the area.

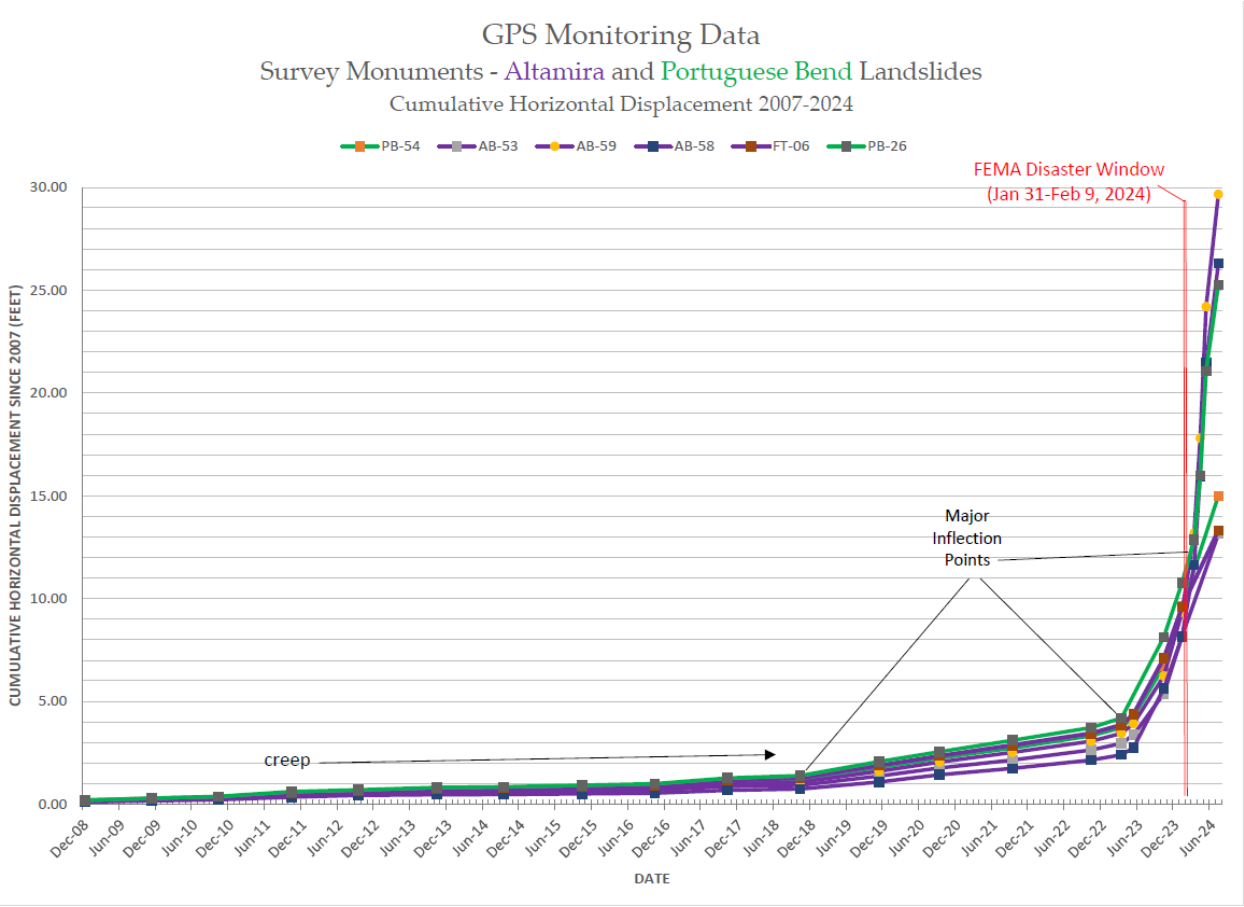
Land movement correlated to the Altamira Landslide continues to manifest at the ground surface in the form of landslide scarps, fissures, grabens/sinkholes, tensional cracking, and shear zones. Field mapping corroborates the GPS monitoring data, indicating that a large portion of the ancient Altamira Landslide above the historically mapped Landslide Complex (PBL, ACL and KCL boundaries) is now involved in significant active landslide movement that is impacting trails, roads, drainage facilities, and private property and continues to have the potential to impact above and below ground utility infrastructure (i.e., utility lines, gas lines, water lines, communication lines, etc.).

Causation

The activation of the Altamira Landslide was largely caused by "climate whiplash" (also more technically described as hydroclimate volatility) induced by climate change, particularly starting in 2011, with five years of drought, and eight out of eleven years significantly below normal rainfall from 2011-2022, followed by two consecutive extraordinarily heavy rain seasons that dropped approximately 4 feet of rainfall on the landslide and surrounding areas draining into the landslide on the south flank of the Palos Verdes Hills.

The graphic on the following page depicts *cumulative horizontal displacement* of select GPS survey monitoring points, including some of the fastest moving points in the Altamira Landslide and a couple of representative points in the PBL (which overlies the Altamira Landslide). There are three significant inflection points indicated in the graph. Prior to the first inflection point, the cumulative displacement lines indicate that the GPS monitoring points within the Altamira Landslide were creeping quite slowly (imperceptibly, near the range of instrument precision) for a number of years extending back before 2011. There was no observed or documented surface manifestation of this minor creep movement at the ground surface; however, this movement is believed to have caused deformation (elongation or stretching out of the earth materials comprising the subsurface which in turn causes additional fracturing of those earth materials) of the Altamira Landslide body, which increased secondary permeability within the rock mass allowing rainfall at the ground surface to percolate more readily into the deep subsurface, raising groundwater levels to a point where they result in high pore pressures that contribute to landslide movement. Between October 2018 and October 2019 GPS readings (first inflection point), an acceleration of creep movement is evident. Then following the multiple atmospheric river rains of January and February 2023 (second inflection point), a further acceleration of creep movement is evident, which would have resulted in further stretching out and opening up of the landslide mass. The final inflection point around March, 2024

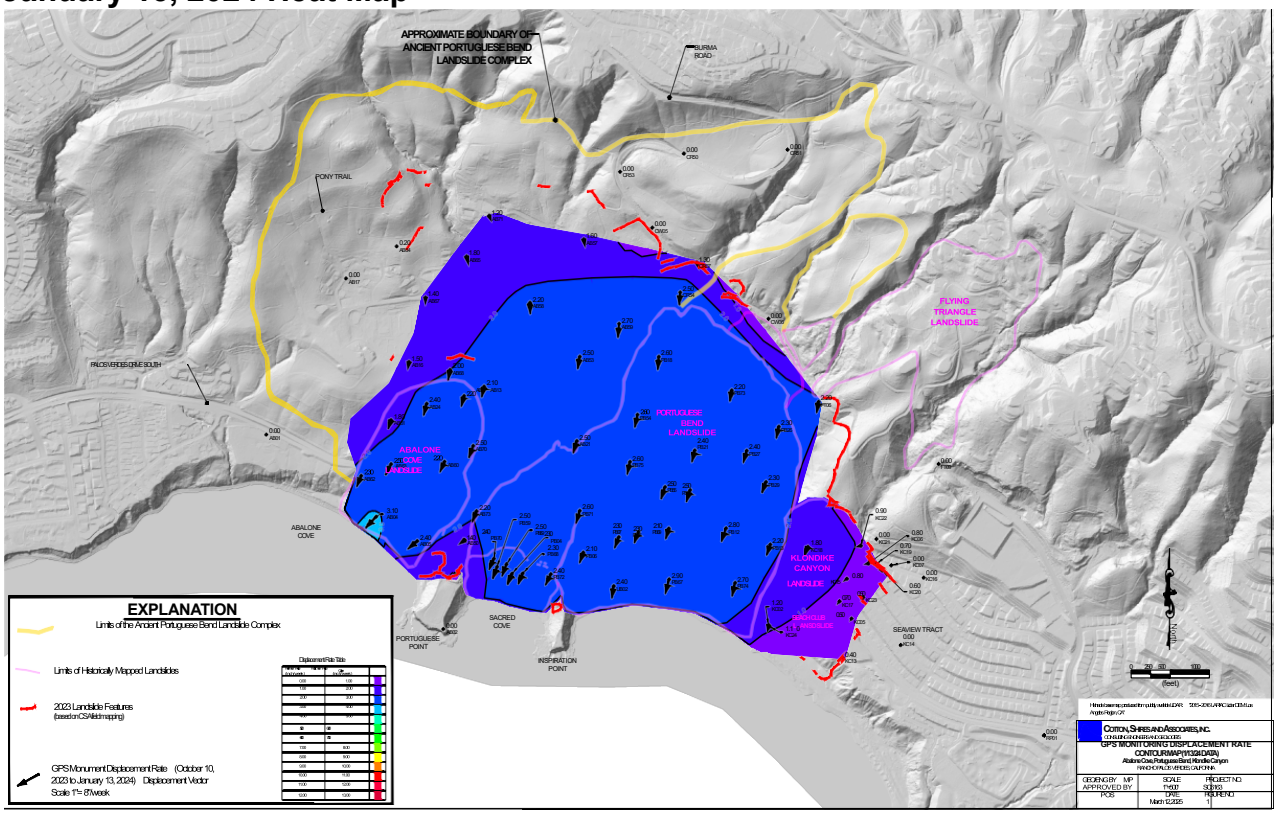
(immediately following the FEMA declared disaster of January 31-February 9 wherein 8.29 inches of rain fell) shows a dramatic acceleration and **represents the triggering of major movement of the Altamira Landslide**, as reflected by some of the graphed points going very steep and nearly vertical on the graph. The graph includes GPS monitoring point AB-59, which has been the fastest moving point and is not surprisingly located in the center of the entire Altamira Landslide mass.



The change in ground movement rates before January 31 and after February 9, 2024 is significant. Based on a comprehensive review of the McGee GPS survey monitoring, the rates of Altamira Landslide ground movement in the Abalone Cove area (for points north of the previously active ACL) as of January 13, 2024 ranged from 1.2 inches per week (at the periphery) up to 2.7 inches per week (in the body of the landslide). After that intense period of rainfall, plus additional rainfall resulting in a total of over 11 inches in February, as of the GPS survey completed on March 8, 2024, the rates increased to 1.5 (at the periphery) to 5.9 (main body) inches per week, more than doubling in the body of the landslide, and then increased dramatically to as much as 13.5 inches per week in the body of the landslide by July 1, 2024, probably as a slightly delayed reaction to the rainfall as it took time for the water to convert from rainfall absorption to higher groundwater pore pressures where it could have the greatest driving force impact on landslide movement.

The following graphics are “heat maps” that illustrate in color contours the rates at which the ground was moving based on the GPS survey monuments for January 13, 2024, March 8, 2024 and July 1, 2024, respectively. The heat maps include the City’s on-ground geologic mapping of visible land movement features, which started as tension cracks or narrow fissures that were discontinuous (as of December 2023 mapping and are shown on the January 13, 2024 heat map), but these features further developed into more continuous/connected tension cracks and fissures, which have now developed into large scarps, grabens and well-developed boundary features. It wasn’t until March 2024 that the City Geologist’s first drew a boundary (dashed green line) around the “Area of Major Land Movement”, because prior to that time, the surface manifestation of movement was poorly developed and inconsistent and there was not sufficient development of the landslide to develop a boundary.

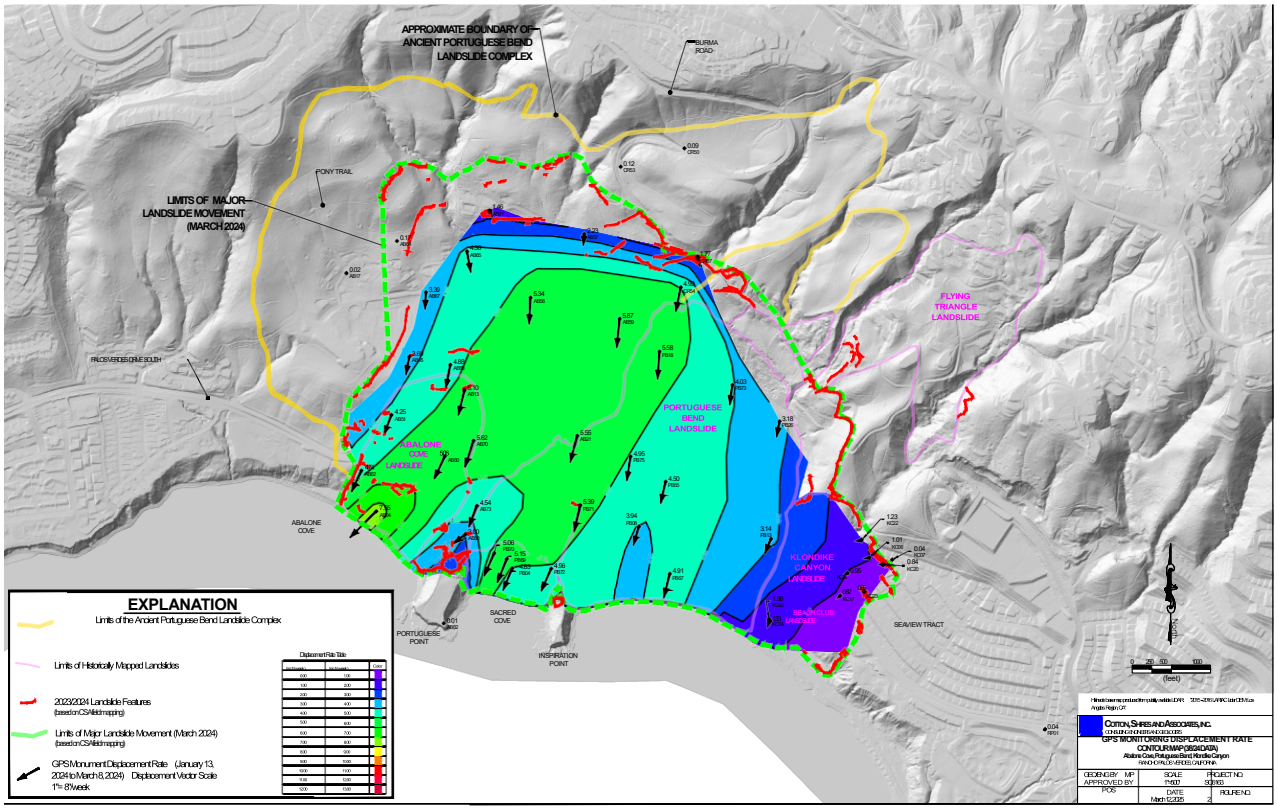
January 13, 2024 Heat Map



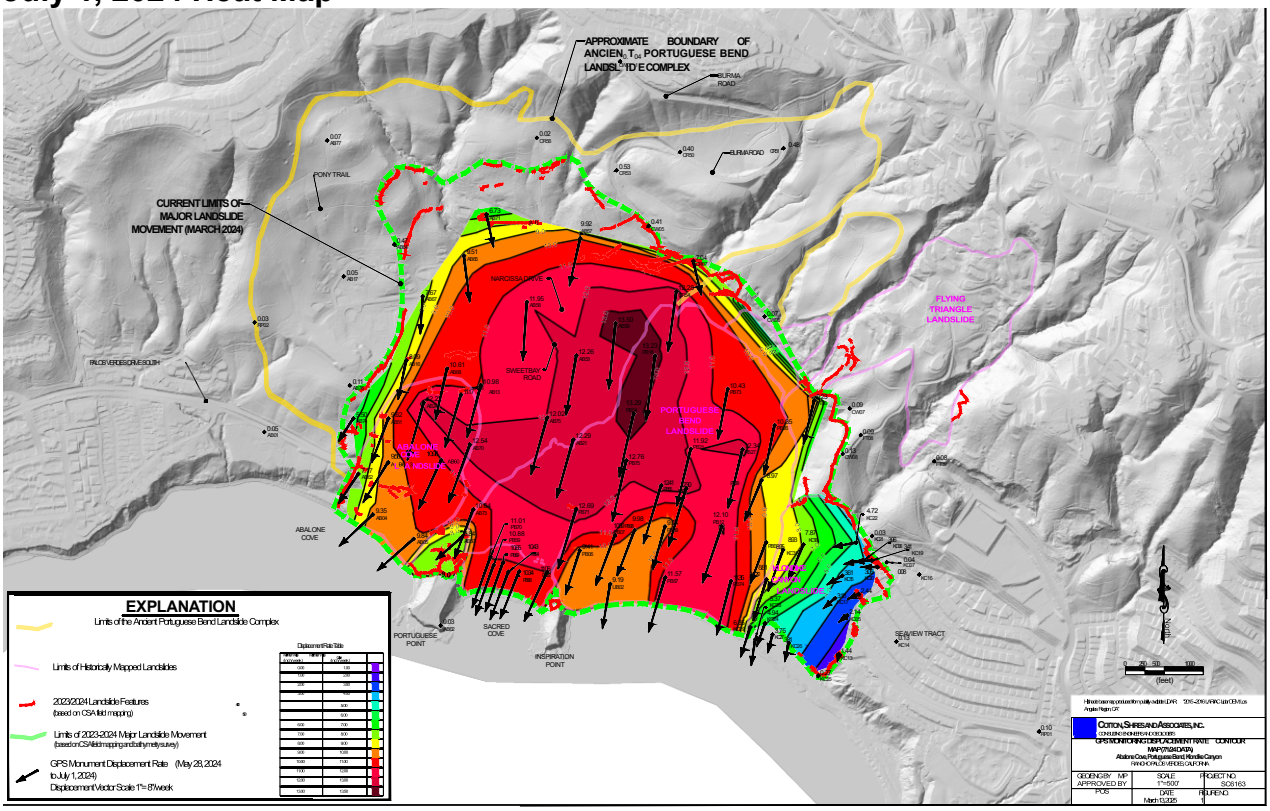
By March 2024, with further mapping and the extraordinary acceleration of numerous GPS monitoring points, a boundary defining the “Area of Major Land Movement” was delineated. Today, following many tens of feet of movement since early 2024, the boundary of the Altamira Landslide is well-defined. North of Palos Verdes Drive South, the Altamira boundary extends significantly farther west of the historical ACL boundary (resulting in the destruction of the landmark Wayfarer’s Chapel), upslope through the York property (6001 PV Drive South), and north of the historical ACL boundary through the Portuguese Bend Riding Club Area, crossing upper Narcissa Drive, through and north of

residences on upper Cinnamon Lane, and eventually turning east across Altamira Canyon, extending through the Vanderlip Estate (100 Vanderlip Drive), destroying Vanderlip Drive and adjacent properties, and ultimately continuing northeast to the lower stretch of Burma Road Trail in the Portuguese Bend Reserve. The Altamira Landslide also created never before seen deformation where it underlies and now extends south of the KCL, including formation of a more seaward toe accompanied by uplifting ground that trended southwest through the beach area of the Portuguese Bend Beach Club and extending up to 500 feet or more offshore where it emerged through the sea floor and formed a new rocky coastline above sea level, generally east of Inspiration Point. The emergence of the new land offshore from the previous coastline was first reported to, and was subsequently observed by, the City Geologist in late February of 2024, consistent with the triggering of major movement of the Altamira Landslide described above.

March 8, 2024 Heat Map



July 1, 2024 Heat Map



<u>Impacts of Movement of The Altamira Landslide</u>

As of this date, the major land movement of the Altamira Landslide has resulted in the red-tagging (Unsafe to Enter/Occupy) and yellow-tagging (Limited Entry) of dozens of residential and commercial structures. It has also caused major destructive impacts to public and private roads, damages to drainage facilities and utility infrastructure (water, sewer, gas, electricity and cable), causing certain utilities to be shut-off, and closure of certain Preserve land that is otherwise heavily accessed by the public for hiking, biking, equestrian, and other purposes.

To reiterate, the damage the City sustained as a result of the winter storms of 2024 is attributed to the activation of the deeper slip plane, known as the Altamira Landslide, that has historically been inactive until the 2024 winter storms. The activation of this new landslide that carried the shallower landslide, referred to as the Landslide Complex herein, is **not** pre-existing and therefore invalidates the reason for denying the City's disaster cost recovery request.

The only practical mitigation measure available to address a landslide with such a colossal scale is relieving groundwater pore pressures through pumping of groundwater, but it has to be done on a large enough scale to be effective at reducing the movement to an acceptable level. This technique has proven effective for the east side of the

Altamira Landslide where deep dewatering wells have been installed, maintained and the rate of ground movement monitored such that a correlation between increased pumping of groundwater and reduction in the rate of ground movement has been confirmed.

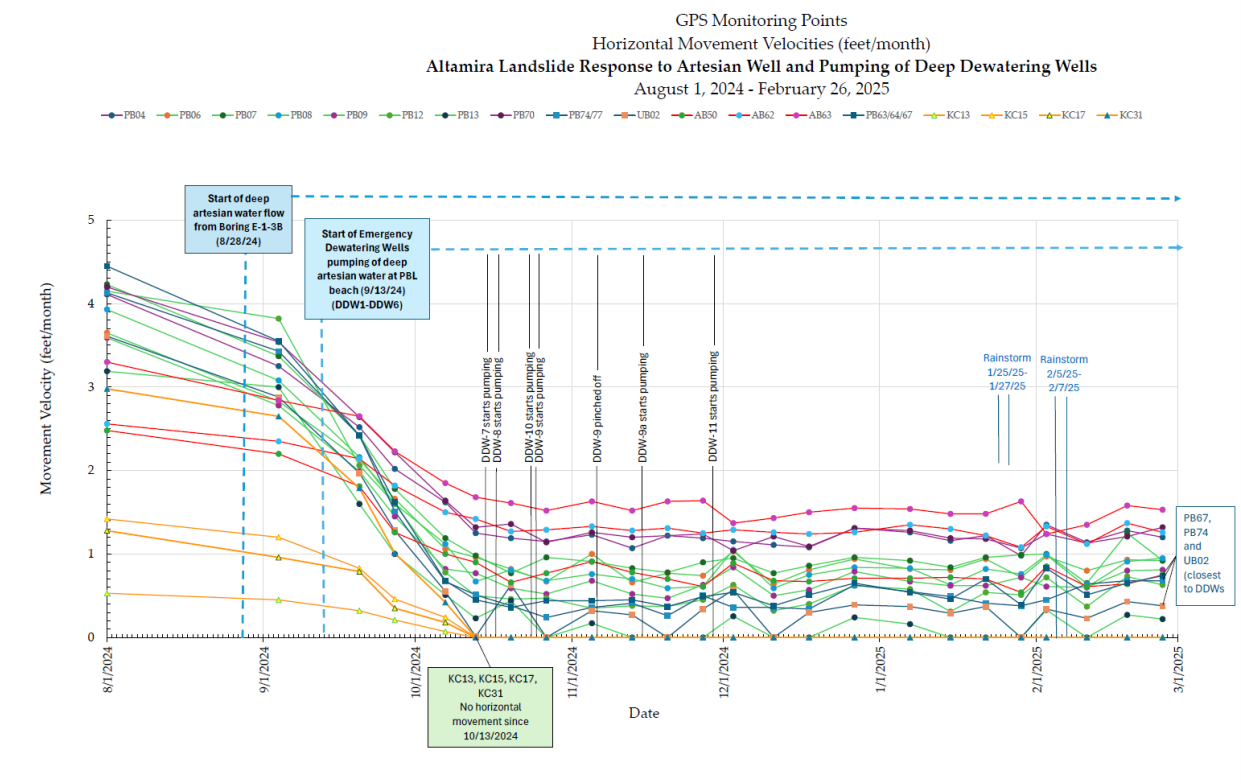
Emergency Measures

Emergency measures taken by the City and abatement districts (ACLAD and KCLAD) to date have included drilling, pumping and monitoring deep dewatering wells, winterization measures including lining channels and installing culverts to reduce the amount of surface water percolating into the groundwater regime from upslope drainages/canyons, and filling of and establishing drainage for fissures and grabens that, if left unmitigated, facilitate surface water intrusion into the groundwater regime. This strategy has proven to be effective in reducing the rate of movement of the Altamira Landslide and even stopping movement of the eastern portion of the landslide in the area of the KCL. Because piezometers installed in deep borings that penetrated the base of the Altamira Landslide indicated high groundwater pore pressures beneath the landslide (some areas were found to have near-artesian or artesian groundwater pressures – pressures higher than the ground surface), a pilot program strategy was pursued by the City that involved drilling a series of deep dewatering wells at the toe of coast below the base of movement of the Altamira Landslide slip plan and pumping to dewater the high groundwater pressures beneath the landslide. This strategy turned out to be more successful than originally contemplated because the movement of the landslide slowed quickly in response to the initial dewatering efforts and the deep wells continued to function for weeks or months before re-drilling was necessary.

The chart on the following page illustrates the timing of artesian water being encountered in one of the test borings (Boring E-1-3B, which was retrofitted to function as an artesian well), the installation of the deep dewatering wells, and the deceleration of the Altamira Landslide in response to the dewatering efforts.

Additional deep dewatering wells are also needed in order to reduce the movement of the middle and eastern portions of the Altamira Landslide to the level experienced prior to the impact of climate whiplash. However, the cost of drilling, pumping, maintaining and re-drilling requires significant funding which the City is unable to fund underscoring the significance of the requested disaster cost recovery – to return land movement to pre-2024 winter storm disaster rates.

Continued on the next page



Natural Disaster Cost Recovery

The cost to respond to this natural disaster has been immeasurable to City and its limited resources. To date, the City's estimated expenditures responding to land movement between October 2022 and June 2025 is approximately $47.5 million with approximately $36.3 million being spent this fiscal year (2024-25). Overall, the $36.3 million reflects a 290% increase from the prior year. These costs include emergency response efforts such as test boreholes, deep dewatering wells, maintenance of the deep dewatering wells until June 30, 2025, winterization, fissure filling, road repairs, sewer repairs, and drainage repairs to name a few.

Similar to the entire state of California, and in fact, the entire United States, there are known pre-existing conditions that lend themselves to natural disasters, such as wildfires, earthquakes, floods, hurricanes, tornadoes, etc. When one of these pre-existing conditions result in a natural disaster such as the recent devastating Palisades and Eaton wildfires, FEMA does not turn their back on those communities in need citing this area is mapped and known to be a Very High Fire Severity Zones. Similarly, FEMA and the federal government do not reject financial aid in known areas of earthquakes, floods, and hurricanes. That same principle should be applied to Rancho Palos Verdes and the recent acceleration of land movement resulting from the atmospheric river storms of 2023 and 2024, and the activation of the new landslide, Altamira Landslide. Moreover, **nowhere in the Stafford Act does it state that pre-existing conditions are ineligible for disaster**

recovery. In fact, the Stafford Act clearly cites the **intent** of Congress, by this Act, is to provide an orderly and continuing means of **assistance** by the Federal Government to State and **local governments** in carrying out their responsibilities to alleviate the suffering and damage which result from such disasters by (1) revising and broadening the scope of existing disaster relief programs; (2) encouraging the development of comprehensive disaster preparedness and assistance plans, programs, capabilities, and organizations by the States and by local governments; (3) achieving greater coordination and responsiveness of disaster preparedness and relief programs; (4) encouraging individuals, States, and local governments to protect themselves by obtaining insurance coverage to supplement or replace governmental assistance; (5) encouraging hazard mitigation measures to reduce losses from disasters, including development of land use and construction regulations; (6) **providing Federal assistance programs for both public and private losses sustained in disasters**; and (7) identifying and improving the climate and natural hazard resilience of vulnerable communities.

Clarification to FEMA's Document Descriptions

In addition to the above, the City provides the following responses for context purposes to the some of the documents citied in the Eligibility Determination Memorandum. As you will see, the extracted statements used to deny the City's request do not accurately support nor justify the denial because they are taken out of context of the overall document and do not provide an accurate analysis of the reason for the land movement and the basis for denial as stated earlier in this appeal letter. The City's position remains that the 2024 winter storms triggered the activation of the **new Altamira Landslide** which carried, at an accelerated rate of movement, the greater Landslide Complex which up until recently has been managed.

1. June 7, 2023 City Letter to Los Angeles County Fourth District Supervisor Hahn

   FEMA's determination letter references the City's June 7, 2023 letter to Los Angeles County Fourth District Supervisor Hahn (Sup. Hahn) as the basis for emphasizing its position that the requested damage recovery for water control features traverses a pre-existing landslide and that the City "continuously repairs and maintains these drainage pipes." The determination letter also states that "the damages claimed are a result of decades of pre-disaster ground instability and ongoing non-disaster related causes" which the City does not believe is accurate based on the information provided in this appeal letter.

   The City's letter to Sup. Hahn quotes a few words that when taken out of context gives a very different meaning to the reader. The letter was sent to Sup. Hahn requesting $6 million to help the City fund its matching portion of FEMA's Building Resiliency Infrastructure Communities (BRIC) Grant for the Portuguese Bend Landslide Remediation Project. The letter to Sup. Hahn includes data on the average rate of movement for context purposes to garner her advocacy and financial support needed

to develop and implement a remediation plan as a **preventive measure** to a potential imminent threat to public health and safety.

The Portuguese Bend Landslide Remediation project, concentrated within the PBL, was developed by the City to **prevent** the acceleration of land movement by addressing rainwater runoff from entering the ground and recharging the water table, which occurred during the rain events of 2023 and 2024.

The Stafford Act states that pre-existing conditions are not eligible for disaster recovery but rather that to be eligible it has to be directly related to an incident per Title 44 of C.F.R. 206.223(a)(1). However, as noted earlier, the behavior of this slow moving landslide noticeably changed in response to the Winter Storms of 2023 and 2024, and that the extreme wet weather activated a **new** landslide, Altamira Landslide, and should therefore not be considered pre-existing, the point to this appeal.

2. Cotton Shires and Associates (CSA) Geologic Report dated September 9, 2023

   According to your determination letter, the City's Geotechnical Engineer's September 9, 2023 memo is cited as one of the basis for denying the City's recovery request because "*the work claimed is not required as a result of the declared disaster and the applicant cannot demonstrate the damage was directly caused by FEMA-DR-4769-CA. Rather these damages are a result of long-term creep displacement and recent years acceleration of earth movement from non-disaster causes as documented in the multiple reports.*"

   As previously noted, the City respectfully disagrees with these statements and in fact, can demonstrate that the winter storms of 2023 and 2024 correlated to climate change and seasonal changes in weather patterns are the reasons the City experienced a noticeable behavioral **change** in the landslide rate of movement with the activation of the dormant and inactive Altamira Landslide. Moreover, the Eligibility Determination Memorandum neglects to cite relevant and pertinent information in the CSA's September 9, 2023 memo emphasizing the following significant and noticeable change in the behavior of the landslide:

   GPS Survey Monitoring Data Review: GPS monitoring of survey monuments throughout the Landslide Complex area has been performed tri-annually since 2007 by McGee Surveying Consulting. In their June 6, 2023 Survey Report, McGee stated:

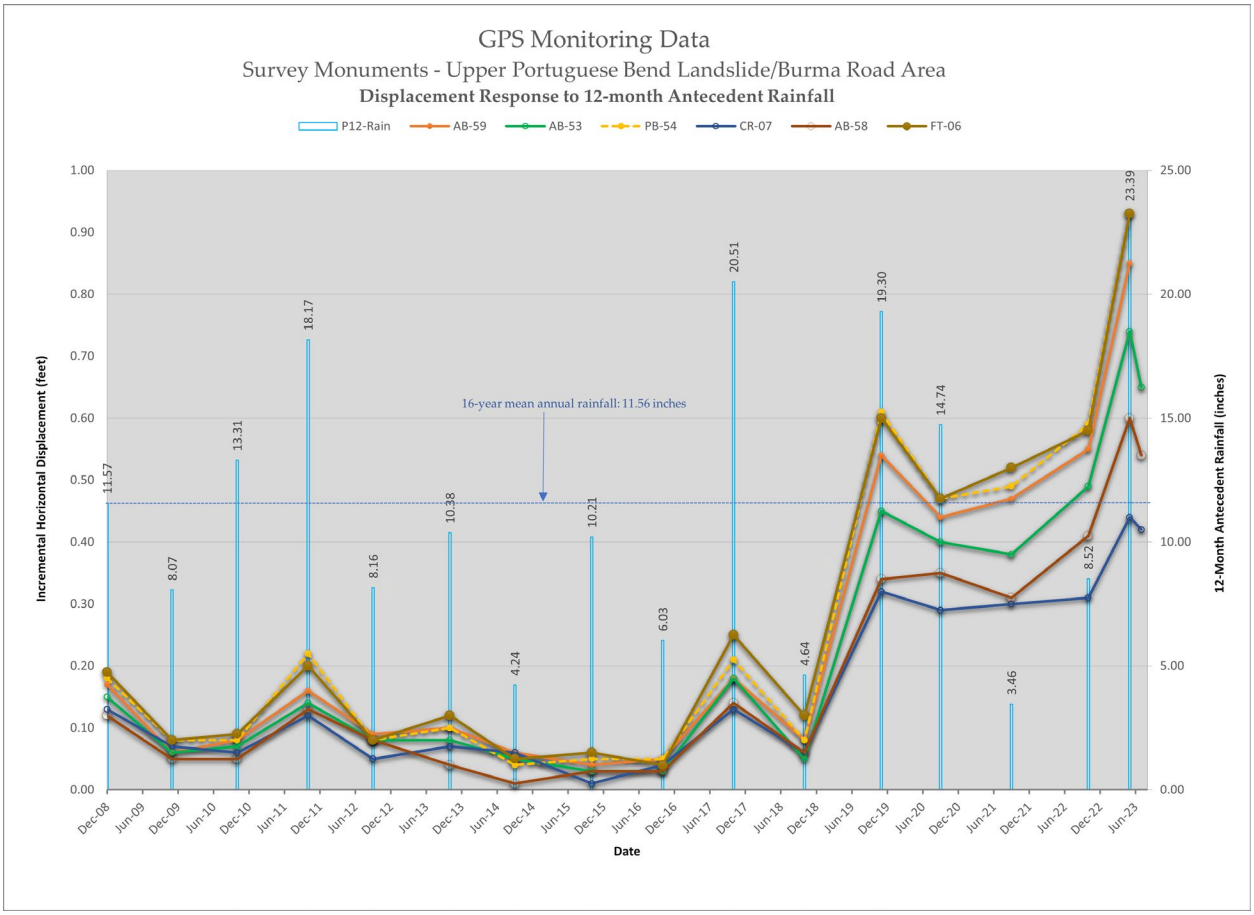
   "*In the last seven months the movement velocities have accelerated over the average velocity for the previous four years which saw an acceleration over the previous 15-20 years……**Velocities were stable** prior to 2018. After the Fall of 2018 they increased about 3 to 6 fold at most points and remained stable to the Fall of 2022. In the last seven months since the **Fall of 2022** the velocities generally have **doubled more or less***." (emphasis added)

This is a significant and important observation from the surveyor, and comports with the past several years of field observations by CSA staff of roadway distress and trail distress within the PBR, as well as reports of street distress, building distress and utility line breaks throughout the various known landslide areas.

Several graphics based upon CSA's own analysis of the GPS survey monitoring data further illustrate what is happening with the landslide ground movement. According to Figure 2 in CSA's September 9, 2023 memo, depict horizontal displacements (in feet) and ground displacement vectors for 12 selected GPS survey monuments mostly located in the mid and upper Landslide Complex. These figures are based upon McGee's GPS monitoring of the survey monuments from October 2018 to May 2023 (with the exception of two monuments which were last read in October 2022, PB18 and AB71). Four of these monuments were also read in mid-July, 2023 and those movement data are also presented. Two of the monuments, CR07 and FT06 are located on Burma Road outside of the PBL and indicate 1.67 feet and 3.09 feet of horizontal displacement over the ~4.5-year period. The CR07 point moved an additional 0.42 feet in two months (through July 15, 2023), which translates to ground movement velocity of about 2.5 feet per year. Most of the other points on this figure are in the Landslide Complex (and mostly in LMA Zone 2) and are indicating total displacements of approximately 1 to 3 feet (or average velocities of about 0.22 to 0.67 feet/year across the ~4.5-year period). Several of these points in LMA Zone 2 that were also monitored in July, 2023 showed continued acceleration from May to July 2023, with calculated velocities of ~1.25 feet/year at AB67 to ~3.9 feet/year at AB53. These are extraordinary rates of landslide movement that, to the City Geologist's knowledge, have not been previously documented in the LMA Zone 2 area.

Incremental displacement has been analyzed of these points versus 12-month antecedent rainfall, as a measure of the landslide response to rainfall. A graph of cumulative displacement of these points since 2007 is presented on the following page. This graphed movement data indicates a clear acceleration of movement beginning in late 2018 (as noted in the area labeled inflection point).

Accelerated landslide movements since late 2018 appear to be correlative with significantly above normal rainfall in three out of four rainfall seasons (2016-17, 2018-19 and 2019-20) which followed five consecutive drier than normal rainfall seasons (2011-12 through 2015-16). **The extraordinary rainy season of 2022-23, where rainfall totals were more than 200% of average, has resulted in further acceleration**.



It is imperative to bring to your attention that the City Geologist recently provided an updated memorandums dated November 8, 2024 and March 16, 2025 (attached) that further underscores the impacts and damage caused by FEMA-DR-4769-CA also known as the winter storms of January 31 through February 9, 2024, as documented earlier in this appeal letter.

3. Rancho Palos Verdes Geo-Logic Associates (GLA) Report Dated December 2019

   According to the Eligibility Determination Letter, a December 2019 report prepared by GLA, a geotechnical engineering firm, hired by the City to prepare its Portuguese Bend Landslide Remediation project is cited. This report cites, as one of the basis to determine that the requested disaster damage recovery occurred in a pre-existing landslide area and not related to the storms citing the following:

   "the landslide complex includes approximately 239 acres with ground movement varying across the site ranging up to approximately 11 feet per year."

   This very citation supports the City's request and claim that the damage sustained occurred as a result of the winter storms in 2023 and 2024 based on the following:

As noted earlier, the Landslide Complex is generally comprised of 5 subslides. The 239 acres noted above is limited to the PBL. This is because the study area for the Landslide Complex was specific to the PBL. In fact, the City Geologist's November 8, 2024 memo states since 2024, this significantly greater depth of movement has resulted in a broader footprint of active land movement at the ground surface and offshore, and expansion of the historical land movement area from approximately 380 acres to **over 700 acres**.

Furthermore, as previously stated, according to the City Geologist's March 16, 2025 memo (attached), the Altamira Landslide is a newly active landslide that has occurred within a previously mapped ancient landslide complex. It is important to make this distinction for consistency and to avoid confusion, because the Altamira Landslide is, in fact, a new member of the historically active PBL/ACL/KCL Landslide Complex but largely **underlies it** and occupies an area of active land movement >700 acres and extends to more than 500 feet off of the coastline, whereas the shallower historically active PBL/ACL/KCL Landslide Complex only occupied about 380 acres. While previous geotechnical investigators identified inactive deep failure surfaces in both the historically active and ancient landslide areas, none of them mapped or identified as active the entire depth or breadth of movement that has recently impacted the area, nor did they opine that such an event would occur in historic times. The active Altamira Landslide currently involves major land movement comprising an area of over 700 acres landward of the coast and extends to approximately 500 feet or more off the coastline. The areal dimensions, depth of movement, velocity of movement, artesian and near-artesian groundwater pressures beneath it, and even the direction of movement, are different than the Landslide Complex. The distinction to be made then, is that the Altamira Landslide is not just simple *expansion* of an existing group of landslides, it is an entirely different, larger and deeper landslide with much broader boundaries (including the new coastline offshore), nearly twice as deep as the depth of historic landslide movement in some areas, and with unprecedented rates of movement (which were not seen in the early LA County Engineer surveys, the Charles Abbott Associates surveys beginning in 1994, nor the McGee surveys since 2007).

None of this was experienced during the history of the City, and the Altamira Landslide is a unique landslide not characterized in its current dimensions during the over 70-year history of landslide investigations, exploratory borings, monitoring and observations being conducted in the area.

4. Landslide Working Group November 1, 2023 Meeting Notes

The FEMA Eligibility Determination Memorandum cites that the City has a pre-disaster active task force called the RPV Landslide Complex Working Group which meets to continue to address ongoing landslide problems, and that is **not** correct.

As previously noted, on October 3, 2023, the City Council declared a local state of emergency in response to the rapid and significant acceleration in land movement. As a result, the Council directed staff to working with community stakeholders including utilities, geologists, HOA representatives and residents to collaborate the City's and community's response to the declared local state of emergency. It was four months later when the then-mayor sent a letter to the Governor requesting he declare a state of emergency and request the President declare a federal disaster in response to the land movement resulting from the winter storms of 2023 and 2024 (attached)

5. Michael McGee's 2007 GPS Technical Report

   In 2007, the City began using GPS technology to track on-ground movement of the Landslide Complex. No one is denying that the shallower Landslide Complex has been moving since 1956, what is evident in the data FEMA's analysts overlooked is that there is a significant and noticeable change in the behavior of the landslide and the rate of movement in response to rain events as clearly demonstrated in the charts earlier in this letter. Moreover, a new, previously dormant landslide was activated in response to the 2024 Winter Storm event.

   To reiterate, the City Geologist has clearly documented that the rain events of 2023, and particularly 2024, have contributed to the accelerated rate of movement and the damage sustained by the City and its infrastructure. The point that warrants a reconsideration of reversing the denial is that there is a clear change in the rate of movement based on the GPS monitoring points cited in your memo between 2023 and present.

<u>Additional Information - Land Movement and the Monks Lawsuit</u>

In 1978, the City enacted an ordinance imposing a moratorium on the construction of new homes in the vicinity where accelerated landslides had recently occurred. The so-called "Monks" plaintiffs owned 16 vacant lots impacted by the moratorium. Some of these property owners claimed to have been waiting over 30 years to build homes on their properties on land that has not showed signs of movement. The lots in question were otherwise zoned for single-family dwellings.

Eventually, these property owners filed suit against the City seeking to invalidate the moratorium criteria and alleging a claim for inverse condemnation based on the state takings clause because, as the plaintiffs asserted, the land was not moving and suitable for development. The trial court denied their request and ultimately found in the City's favor. The property owners appealed.

The Court of Appels ruled in favor of the plaintiffs citing that the City's ordinance requiring owners of land in specific zones within the Landslide Complex to present data demonstrating to satisfaction of city geologist that the gross geotechnical factor of safety

where their lots were located was at least 1.5 in order to build on their lots deprived the land of all economically beneficial use, and resulted in a permanent categorical taking. **The Courts ruled that the plaintiffs could build on their lots.** (*Monks v. City of Rancho Palos Verdes*, 167 Cal.App.4th 263 (2008)

Conclusion

The basis for denying the City's disaster recovery on a pre-existing condition is not a valid reason when, as demonstrated in this appeal letter and supporting attachments, it is clear that a **new, inactive** for hundreds of years, landslide was activated in response to the 2024 Winter Storm event that led to the federal disaster declaration (FEMA-DR-4769-CA). The activation of the Altamira Landslide resulted in significant damage to the City's infrastructure including, but not limited to, the City's Abalone Cove Sanitary (sewer) System damaged by the winter storms that occurred between January 31 and February 9, 2024. It is now known that the activation of the Altamira Landslide carried the subslides of ACL, PBL, and KCL which is clearly demonstrated in this appeal letter that the rate of movement significantly increased along with the behavior of the land movement as a result of the 2023 and 2024 Winter Storm Events.

It is for the reasons cited throughout this appeal letter that disaster recovery financial assistance be provided for the destruction resulting from the activation of the Altamira Landslide caused by the extraordinary rain events of 2024. The weather whiplash over the years has adversely impacted the City, its residents and businesses, and its economics. Overturning the denial and providing the disaster recovery assistance requested will enable the City to properly respond to the activation of the new Altamira Landslide by stabilizing land movement and repairing damaged and critical infrastructure.

On behalf of the Rancho Palos Verdes City Council and residents, we thank you for your consideration of this appeal letter.

Sincerely,

Ara Michael Mihranian, AICP
City Manager

Attachments:

- September 9, 2023 CSA Memo
- November 8, 2024 CSA Memo
- March 16, 2025 CSA Memo
- February 20, 2024 Letter to Governor Newsom

c. Rep. Ted Lieu
Senator Adam Schiff

Senator Alex Padilla
State Senator Ben Allen
Asm. Al Muratsuchi
Rancho Palos Verdes Mayor Bradley and City Council
William Wynder, Rancho Palos Verdes City Attorney
Catherine Jun, Rancho Palos Verdes Deputy City Manager
Ramzi Awwad, Rancho Palos Verdes Director of Public Works
Vina Ramos, Rancho Palos Verdes Director of Finance

COTTON, SHIRES AND ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS

CITY OF RANCHO PALOS VERDES

CSA Project No. SC6022

MEMORANDUM

TO: Katie Lozano, Open Space Manager
CC: Ara Mihranian, City Manager
William Wynder, Elena Gerli, and John Fox, City Attorneys
Cory Linder, Director of Recreation and Parks
Ramzi Awwad, Public Works Director
Taylor Fox, Senior Park Ranger
FROM: Michael Phipps, CEG 1832, Contract City Geologist
Christopher Dean, CEG 1751, Contract City Geologist
Matthew Janousek, GE 3005, Contract City Geotechnical Engineer
RE: **Preliminary Geotechnical Assessment of Recent Land Movement in the Portuguese Bend Reserve and Impacts to Burma Road Trail, Rancho Palos Verdes**
DATE: September 29, 2023

INTRODUCTION

In accordance with your request, this memorandum has been prepared to provide a preliminary geotechnical assessment of recent land movement within the Portuguese Bend Reserve (PBR) with a specific focus on the impacts of land movement to the Burma Road Trail. We understand that the PBR is one of the City's most popular land reserves, it is heavily used by the public for recreation and is also used by public utilities including Southern California Edison and California Water Service Company. A portion of the PBR is underlain by the historically active Portuguese Bend Landslide (active since 1955-56) as well as the Ancient Portuguese Bend Landslide Complex. Some areas of the Reserve are now experiencing significant land movement and ground surface manifestation that is beyond the limits of the historically active and previously mapped Portuguese Bend Landslide, resulting in damage to trails and fire roads which provide access for public safety, utilities, maintenance, conservation, and public recreation. Cotton, Shires and Associates, Inc. (CSA) geologists have been requested by the City to observe various landslide-related issues in the Reserve involving damage to trails since 2021 and the SCE transmission lines along Burma Road since the summer of 2022. In 2021 we also began a detailed review of Global Positioning Satellite (GPS) monitoring data for survey monuments both within and outside the PBR, including points within the Abalone Cove Landslide, Klondike Canyon Landslide, and elsewhere within the Ancient Portuguese Bend Landslide Complex.

A comprehensive reconnaissance of the PBR was conducted by vehicle with City staff on June 28, 2023. Following this field visit, the City's Open Space Manager requested a report addressing the following items:

DRAFT

- Information and a map presenting our observations of where new landslide scarps are forming;
- An evaluation of whether Burma Road is currently able to accommodate vehicles, ranging from smaller Park Ranger trucks to heavy equipment used by utility companies and fire department, and if it is currently able to accommodate vehicles, an estimate of how long the road will remain stable;
- Recommendations for re-routing Burma Road (if necessary) to areas less prone to land movement as the fire road is needed for the City, fire department, and utility companies;
- Consideration of recommendations for additional warning signage due to the increased land movement to warn recreational users (hikers, bikers, horseback riders) and authorized outside agency personnel who drive the Reserve fire roads;
- Recommendations for a maintenance plan to fill fissures and keep Burma Road passable to pedestrians and vehicles, as the fissures have become too significant for park rangers to fill in with shovels.

This memorandum will address these requested items, based upon our field observations and geologic mapping, analysis of GPS monitoring data, background knowledge of the area, and professional experience.

PREVIOUS WORK

Previous City-requested reconnaissance and observation of trail conditions in the PBR performed by CSA geologists have included the following:

- 8/27/21: Burma Road trail reconnaissance (fissures/ground movement)
- 9/29/21: Burma Road and Garden Trail reconnaissance (fissures/ground movement)
- 1/5/22: Burma Road trail reconnaissance (fissures/ground movement)
- 8/31/22: Burma Road trail reconnaissance, meeting with SCE contractor and City staff, (regarding power pole relocation due to fissures, ground movement)
- 3/8/22: Upper Burma Road trail reconnaissance (rockfall hazards)
- 4/5/23: Burma Road Trail, Garden Trail, and Rim Trail reconnaissance (fissures/ground movement)

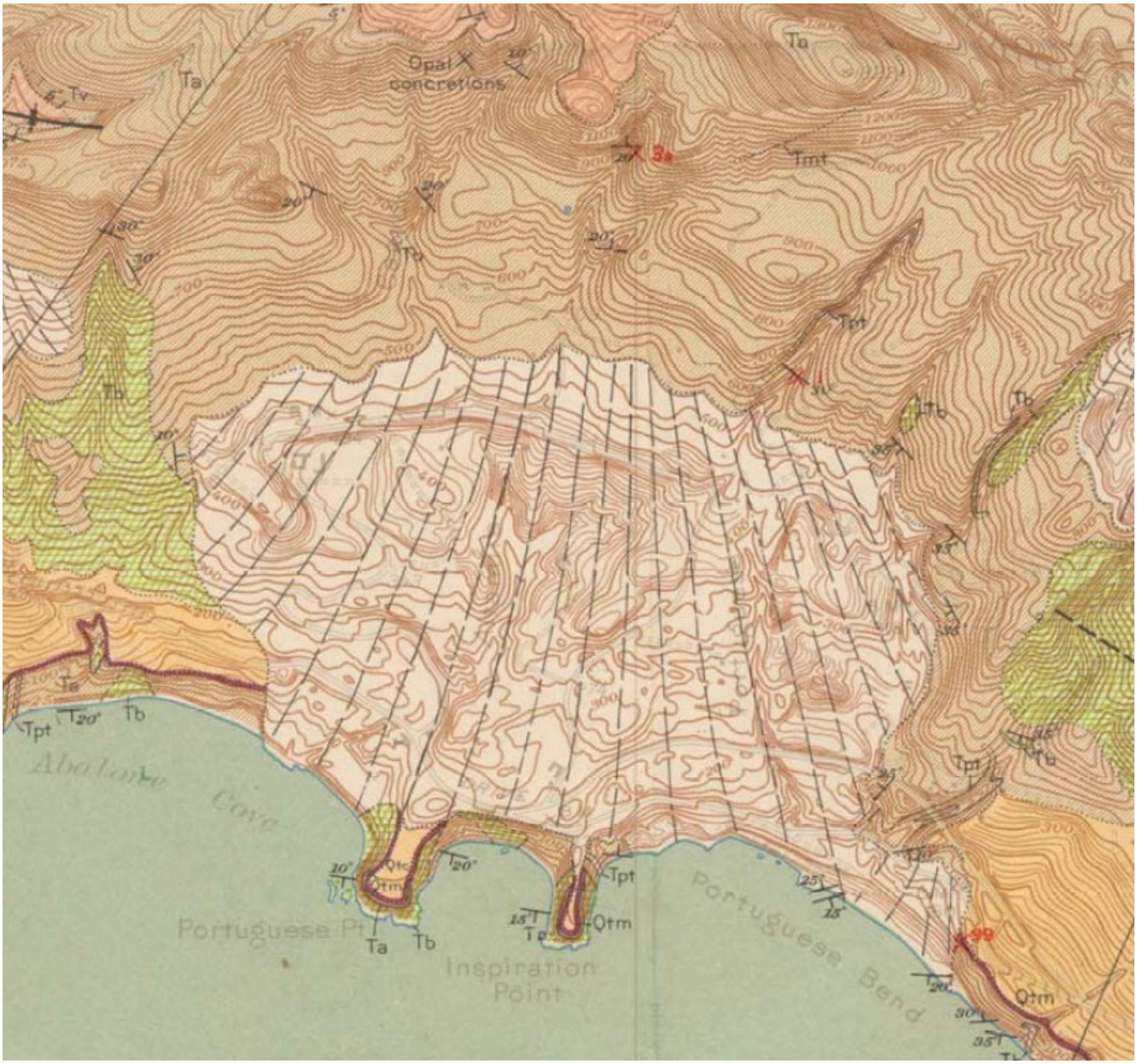
Findings and recommendations from these field visits have been routinely documented by either memoranda or email addressed to City staff. Recent published documents include memoranda dated February 9, 2022 (Burma Road/Rim Trail Junction) and May 19, 2023 (SCE Power Pole Relocation, Burma Road).

Preliminary geologic mapping of the upper limits of active landsliding along the Burma Road trail and vicinity was performed on June 28, 2023 and supplemented on September 22, 2023; however, this work is incomplete and requires additional field effort. Because of the steep terrain, large mapping area, and thick (inaccessible) vegetation in some areas, we have supplemented our field mapping with photo-geologic mapping utilizing high-resolution Nearmap (vertical aerial) imagery captured on January 17, 2023 and June 17, 2023.

DRAFT

FINDINGS

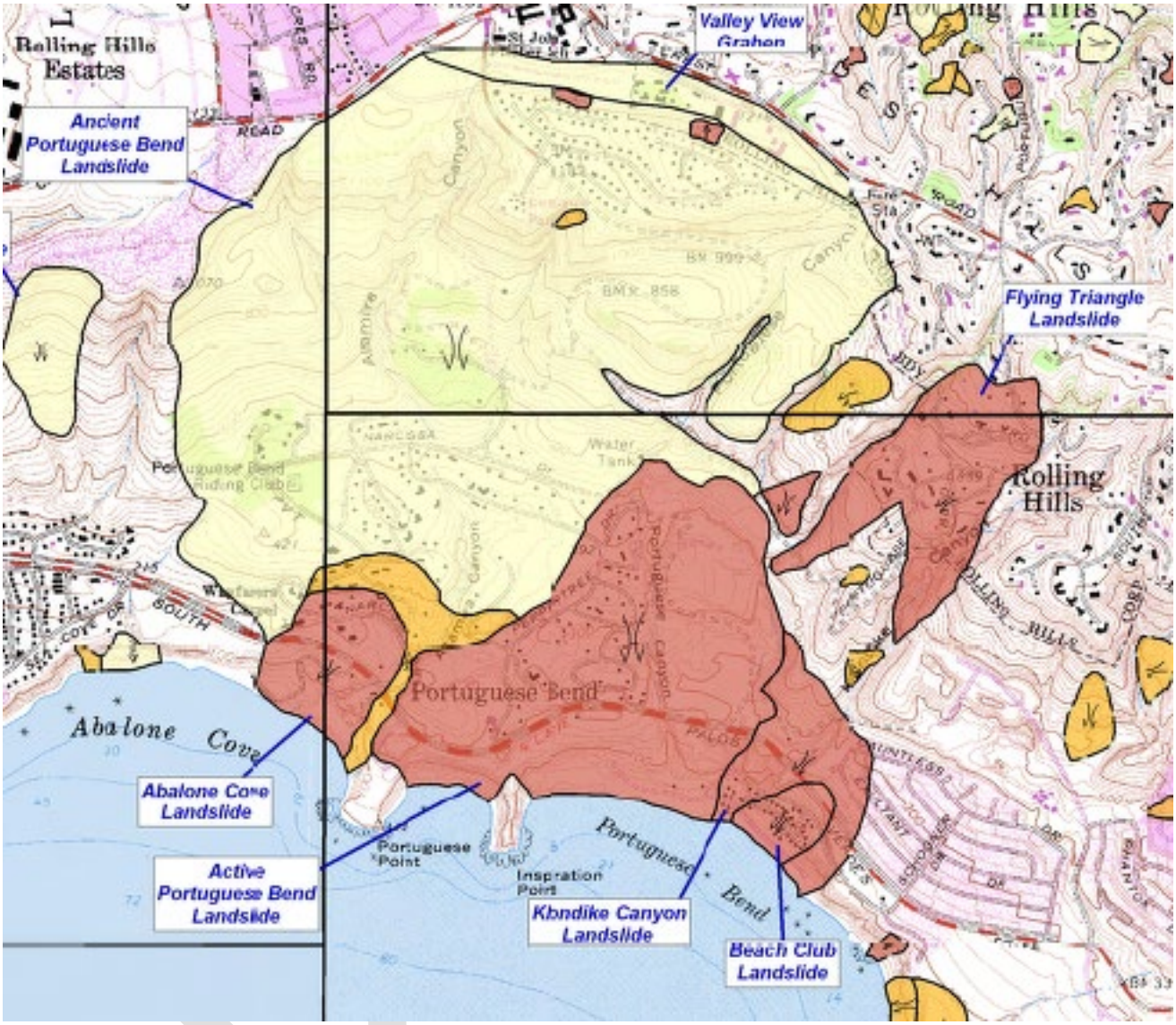
Geologic Mapping: The Ancient Portuguese Bend Landslide Complex (APBLC) was first mapped by the U.S. Department of the Interior Geological Survey (aka, USGS) in 1946 (shown as white area with black dashed lines in the image below) and occupies a broad area on the south side of the Palos Verdes Peninsula from the crest of peninsula to the Pacific Ocean.



U.S. Department of the Interior, 1946, Portion of Geologic Map of the Palos Verdes Hills, Los Angeles County, California

Within the APBLC, several large landslide masses have reactivated since the 1950s, including the Portuguese Bend Landslide, Abalone Cove Landslide, Klondike Canyon Landslide, and Beach Club Landslide. The Flying Triangle Landslide is in similar but higher terrain northeast of the Portuguese

Bend Landslide but is not considered part of the APBLC on regional geologic maps. These landslides are depicted on the California Geological Survey's Landslide Inventory Map of the Palos Verdes Peninsula (2007, image below).



California Geological Survey, 2007, portion of Landslide Inventory Map of the Palos Verdes Peninsula

Burma Road (and Trail) is located along what was previously proposed to be the Crenshaw Boulevard Extension, until the Portuguese Bend Landslide reactivated in 1956. The lower reach of Burma Road trends southeast immediately uphill from the headscarp of the Portuguese Bend Landslide. Previous site visits by our staff to the Burma Road area within the PBR beginning in 2021 were primarily in response to reported "fissures" forming in multiple locations across trails. We understand that City ranger staff have been routinely filling in the fissures with soil using hand tools. At other times heavier grading equipment has been reportedly used by Cal Water to fill fissures and maintain the Burma Road access to their facilities. Recent field mapping and GPS data suggest that these fissures are in fact the incipient manifestations of headward enlargement of the Portuguese Bend Landslide as well as an upslope manifestation of accelerated movement of a portion of the Ancient Portuguese Bend Landslide

Complex west of the active Portuguese Bend Landslide boundary. Four significant landslide scarps, which initially manifested as ground cracking and small fissures in Burma Road, have now formed across Burma Road, generally between the Eagle's Nest Trail intersection on the west and the Rim Trail intersection on the east.

Figure 1 (attached) was prepared on a Nearmap vertical color image taken January 17, 2023. The approximate limits of the active Portuguese Bend Landslide are depicted in red. The upper area of recent headward enlargement of the Portuguese Bend Landslide is depicted with yellow lines delineating landslide scarps which can be seen crossing Burma Road in at least seven locations. While the Burma Road trail has been repeatedly maintained by minor grading-leveling across these features, the scarps have grown in height and width adjacent to the road over time, and in some locations, grabens (wide pull-apart fissures) have formed in response to significant landslide movement. If not maintained in this manner over the past several years, landslide scarps ranging from 1 to 8 feet in height would extend across the road making it impassable to vehicles, cyclists, and even pedestrians. The most severe location is the western (and uppermost, elevation-wise) scarp located between the Water Tank trail and Eagle's Nest Trail intersection with Burma Road. The landslide displacement at this location has produced a scarp 6 to 8 feet in height and significantly displaced an SCE power pole that is now leaning approximately 35-40 degrees out of plumb. Other scarps across Burma Road southeast of this location are smaller, generally ranging from 1 to 4 feet in height adjacent to the road. Of note is that these scarps have grown substantially in size since our June 28, 2023 reconnaissance.

The downslope limits of the new landslide scarps (yellow contacts on Figure 1) appear to be directly connected to the Portuguese Bend Landslide at the eastern end; however, at the western end they are not well-defined at the ground surface and additional field mapping is necessary to further delineate the western margin. The western margin was observed crossing Kubota Trail and trending toward the Vanderlip Trail, where it was lost in heavy vegetation. It is important to note that the western extent of this new landslide movement is somewhat west of the head of the Portuguese Bend Landslide. It is our interpretation that the western extent of this new landslide movement is occurring in response to long-term creep displacement and recent acceleration of movement of the Ancient Portuguese Bend Landslide Complex (APBLC) since October 2018.

GPS Survey Monitoring Data Review: GPS monitoring of survey monuments throughout the APBLC area has been performed tri-annually since 2007 by McGee Surveying Consulting. In their June 6, 2023 Survey Report, McGee stated:

"*In the last seven months the movement velocities have accelerated over the average velocity for the previous four years which saw an acceleration over the previous 15-20 years……Velocities were stable prior to 2018. After the Fall of 2018 they increased about 3 to 6 fold at most points and remained stable to the Fall of 2022. In the last seven months since the Fall of 2022 the velocities generally have doubled more or less*."

This is a significant and important observation from the surveyor and comports with the past several years of field observations by CSA staff of roadway distress and trail distress within the PBR, as well as reports of street distress, building distress and utility line breaks throughout the various known landslide areas. We have prepared several graphics based upon our own analysis of the GPS survey

DRAFT

monitoring data to further illustrate what is happening with the landslide ground movement. Figure 2 (attached) depicts horizontal displacements (in feet) and ground displacement vectors, for 12 selected GPS survey monuments mostly located in the mid and upper Ancient Portuguese Bend Landslide Complex. These figures are based upon McGee's GPS monitoring of the survey monuments from October 2018 to May 2023 (with the exception of two monuments which were last read in October 2022, PB18 and AB71). Four of these monuments were also read in mid-July, 2023 and those movement data are also presented. Two of the monuments, CR07 and FT06 are located on Burma Road outside of the Portuguese Bend Landslide and indicate 1.67 feet and 3.09 feet of horizontal displacement over the ~4.5-year period. The CR07 point moved an additional 0.42 feet in two months (through July 15, 2023), which translates to ground movement velocity of about 2.5 feet per year. Most of the other points on this figure are in the Ancient Portuguese Bend Landslide Complex (and mostly in LMA Zone 2) and are indicating total displacements of approximately 1 to 3 feet (or average velocities of about 0.22 to 0.67 feet/year across the ~4.5-year period). Several of these points in LMA Zone 2 that were also monitored in July, 2023 showed continued acceleration from May to July 2023, with calculated velocities of ~1.25 feet/year at AB67 to ~3.9 feet/year at AB53. These are extraordinary rates of landslide movement that, to our knowledge, have not been previously documented in the LMA Zone 2 area.

We have also reviewed and analyzed cumulative and incremental displacements from 2007-2023 for six select survey monitoring points that are generally in the upper Portuguese Bend Landslide/Burma Road area, including three points that are in the Ancient Portuguese Bend Landslide Complex west of the historically active Portuguese Bend Landslide (i.e., in Landslide Moratorium Area Zone 2). These six points are identified as:

- CR07 adjacent to Burma Road Trail;
- PB54 located within the "Landward Subslide" of the Portuguese Bend Landslide Complex;
- AB53, AB58 and AB59 located within the Ancient Portuguese Bend Landslide Complex (Landslide Moratorium Zone 2); and
- FT06 adjacent to Burma Road Trail southeast of the Rim Trail intersection.

We have analyzed incremental displacement of these points versus 12-month antecedent rainfall, as a measure of the landslide response to rainfall (Figure 3). A graph of cumulative displacement of these points since 2007 is also presented in Figure 4. This graphed movement data indicates a clear acceleration of movement beginning in late 2018 (as noted in the area labeled inflection point).

Accelerated landslide movements since late 2018 appear to be correlative with significantly above-normal rainfall in three out of four rainfall seasons (2016-17, 2018-19 and 2019-20) which followed five consecutive drier than normal rainfall seasons (2011-12 through 2015-16). The extraordinary rainy season of 2022-23, where rainfall totals were more than 200% of average, has resulted in further acceleration based upon limited monitoring data. A significant concern is that the movement velocities have not declined back to the pre-2018 levels despite two significantly below-normal rainy seasons (2020-21, one of the driest on record, and 2021-22). Also of note is that our rainfall data do not include the impacts from Tropical Storm Hilary which dropped several inches of rain across most of southern California in August, 2023.

DRAFT

CONCLUSIONS AND RECOMMENDATIONS

Landslide movements throughout the Ancient Portuguese Bend Landslide Complex *outside of the historical boundary of the Portuguese Bend Landslide* previously exhibited relatively low rates of creep movement in the 11-year monitoring period of 2007-2018 for which we have readily available data. Beginning in late 2018, and through the present, the survey data indicate a significant acceleration of landslide movement. The movement of the Portuguese Bend Landslide also accelerated in this timeframe. The cumulative displacements over this time have now manifested as headward enlargement of the Portuguese Bend Landslide as well as new active landslide masses forming northwest of the Portuguese Bend Landslide crown in Landslide Moratorium Area Zone 1, upslope from LMA Zone 2. These new actively moving landslide masses are directly impacting Burma Road and threaten future accessibility.

We understand this issue is also exceeding current resources (i.e., ranger staff) to monitor and maintain the safety of the trails; primarily the heavily used Burma Road Trail. At this time, we consider this to be a critical and evolving situation that poses risks to the general public who are accessing the PBR for recreation, to utility infrastructure that traverses the landslide area, and to accessibility for other stakeholders including conservation groups and the fire department. It is evolving because we are days from entering the rainy season and most meteorologists and climatologists that we follow are citing development of El Nino conditions in the Eastern Pacific Ocean and these are frequently associated with wetter-than-normal rainfall conditions in southern California. We are also awaiting receipt of the fall GPS survey data which are typically gathered in early October.

To address the City's specific items, we offer the following:

Landslide Maps: For the purposes of this memorandum, a landslide overview map (Figure 1, attached) was prepared to illustrate the entire affected area and impacts to Burma Road. We conducted field mapping on much larger scale maps which allow for presentation of detailed observations; however, these were not formally drafted and produced due to time constraints. We recommend that additional field mapping be performed in an effort to further define the limits of active landsliding. Drafted larger scale maps will be provided if necessary and/or upon request, to provide details in specific areas.

Burma Road Conditions and Maintenance Considerations: Given the current landslide movement velocities, the newly identified landslides impacting Burma Road are active and considered unstable. Burma Road only remains passable because of the reported efforts of other stakeholders to level the ground surface across the landslide areas with larger equipment, in response to the creeping landslide movement. We anticipate that the landslide movement will continue and is likely to be exacerbated by the 2023-24 rainy season regardless of whether it is wetter or drier than historical averages. The filling of fissures crossing the road with manual labor (by park rangers) has become untenable and such measures are reportedly proving to be short-lived. The fissures, which are developing landslide scarps, have widened and deepened in some areas due to significant ground movement. Smaller vehicles (ranger trucks) are typically 2-3 tons and present lower risks when crossing the landslide areas;

DRAFT

however, larger, heavier vehicles including fire trucks which typically weigh 10 to 20 tons present a much larger transient load across the landslides, thus presenting a relatively greater risk.

Currently it is our opinion that Burma Road Trail should be closed to the public across the landslide area *unless it can be monitored on a daily basis by the park rangers*. This is due to active landslide movement directly impacting the road and posing significant risks to pedestrians, cyclists and horseback riders. Ground leveling efforts to keep the road passable for vehicles may continue; however, crews should avoid placing earth fill directly on the landslides because it adds weight and is a driving force of landslide movement. Continued notching (lowering) of the trail approaches to the landslide scarps may be the only effective solution in the short-term to maintain passage of vehicles. Care should also be given to avoid ground-alterations that would direct more Burma Road drainage directly into the landslide areas.

Burma Road Re-routing Considerations: Burma Road and trail occupy a portion of wider, leveled ground graded during the proposed Crenshaw Boulevard extension (circa 1955-56). Several of the new landslide scarps extend to near the north edge of the previously leveled area, thus, there does not appear to be a feasible location to re-route the road through these areas. Furthermore, we do not see an opportunity to completely re-route Burma Road outside of the former graded area without consideration of massive grading and drainage improvements in steeply sloping areas, some of which may also be in sensitive habitat area. There are also slope stability concerns north of Burma Road for any considered re-route, and we are currently lacking information due to a lack of GPS monitoring points north of Burma Road. The depth of movement of the new landslides is also unknown and at best could only be estimated based on previous studies of the Portuguese Bend Landslide.

Consideration could be given to stabilizing the affected portions of Burma Road in its current location; however, this would require an extensive geotechnical investigation, including geologic mapping, installation of instrumented borings (e.g., slope inclinometer casings and piezometers), laboratory soil testing, extensive slope stability analyses, and design of possible stabilization alternatives. Stabilization, if technically feasible, might require a combination of extensive in-ground structural measures (i.e., steel-reinforced concrete shear pins with tiebacks) and grading. Based upon our experience, such mitigation would likely have a cost in the millions of dollars.

Additional Warning Signage: Additional warning signage due to the increased land movement, to warn recreational users (hikers, bikers, horseback riders) and authorized outside agencies who drive the Reserve fire roads, is reasonable and appropriate from a geotechnical perspective, particularly if the City is going to keep Burma Road Trail and other potentially affected trails open to the public. As mentioned above, the new landslide areas impacting Burma Road and Trail are currently unstable. The landslide areas are currently moving (creeping) at velocities that are generally imperceptible to humans and may seem innocuous from that perspective; however, over short periods of time the movement creates significant hazards to trail users due to differential ground movement with associated ground cracking and fissuring within the landslide masses as well as scarp formation at the movement boundaries.

DRAFT

Additional Recommendations: In addition to the specific items requested to be addressed by the City, we have the following comments and recommendations:

- CSA previously issued a memorandum regarding the proposed SCE power pole relocation (May 19, 2023). At that time, we noted that the upslope extent of active landsliding had not been geologically mapped (to our knowledge), the depth of landslide movement is unknown, and there is a lack of GPS survey monitoring points north of Burma Road between Portuguese and Paintbrush Canyons. We subsequently stated that due to this lack of information, it was difficult to assess the impacts of future land movements on the proposed power pole relocation areas. It is our understanding that SCE may be considering a larger scale relocation of their transmission line(s) that are currently within the active landslide area, in lieu of the relocation project that we previously reviewed. The existing transmission line along Burma Road is partially supported by power poles located in actively moving landslides and at least two of the power poles have now been severely compromised. This transmission line poses a significant risk if not de-energized.

- The above-ground water main which trends along Burma Road traverses portions of the new landslide areas and is lacking ground support (i.e., the pipe is in the air) in some isolated areas. Our concern is that the pipe *may* not have been designed for such conditions. This should be further evaluated by the utility company responsible for the water main.

- Additional geologic mapping (on ground, possibly supplemented with drone photogrammetry) should be performed in an effort to further define the areal extent of new active landsliding. This information will be beneficial to the City for future evaluation of the safety of Burma Road and other trails within the Portuguese Bend Reserve, and also useful to other stakeholders.

- Additional GPS monitoring points should be established north of Burma Road, between Portuguese Canyon and Paintbrush Canyon. CSA will assist with recommended locations for these points if requested by the City. We also recommend that the tri-annual GPS monitoring be performed on <u>all</u> monuments in each monitoring session, in lieu of the partial monitoring that has been historically performed in two of the three sessions per year.

- Periodic closures of the trail system within the PBR during and immediately after significant rainfall events, as has been the policy of the City, should continue to allow for safety assessment of the trails by ranger staff.

- Where feasible, park ranger staff should continue to do routine monitoring and filling of ground fissures on other trails to keep the trails relatively safe; otherwise, the trails should be closed.

We hope this memorandum provides the City of Rancho Palos Verdes with the requested information and recommendations regarding Burma Road within the Portuguese Bend Reserve at this time. Please contact us if you have further questions or concerns.

-o-

DRAFT

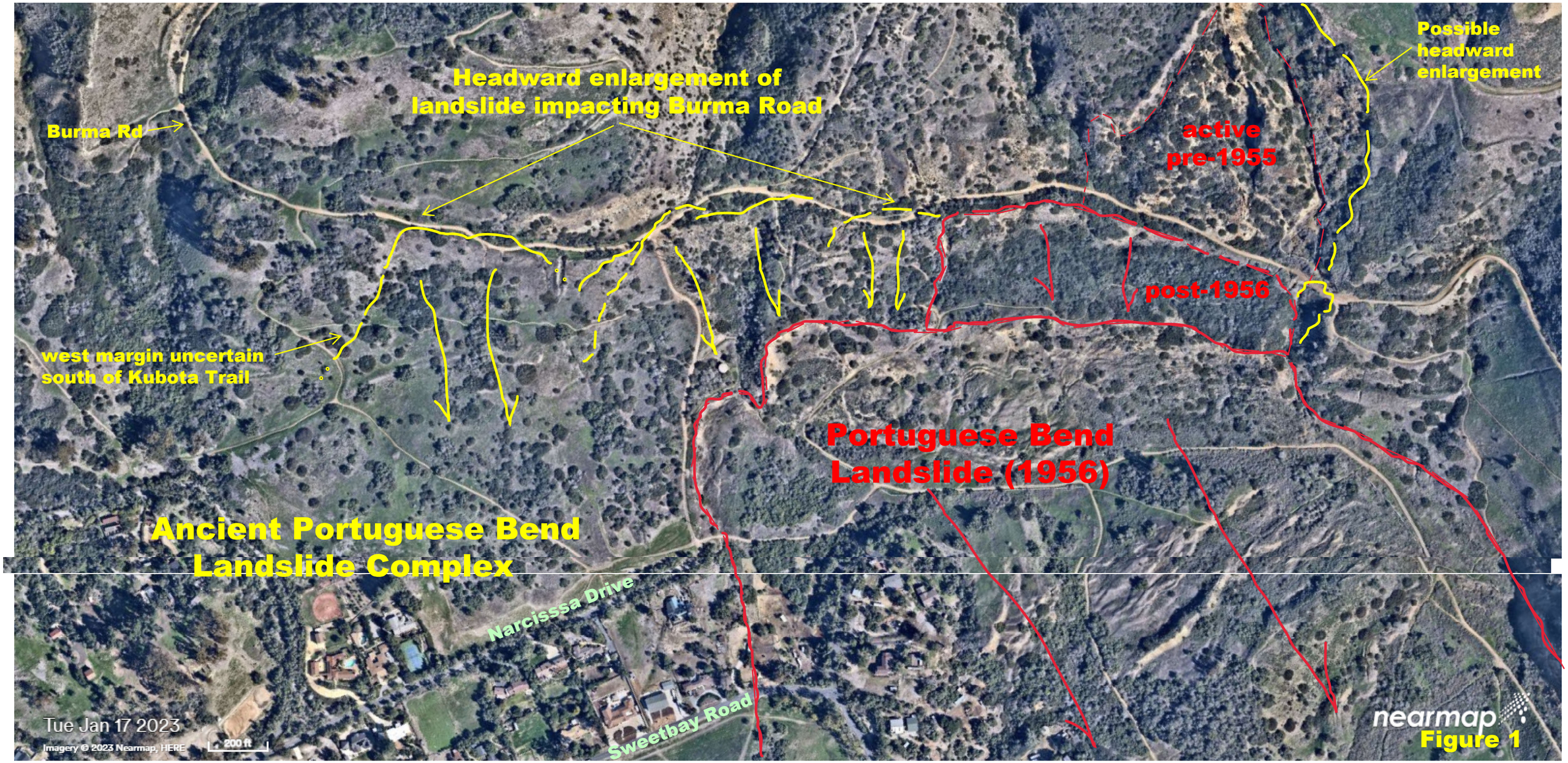
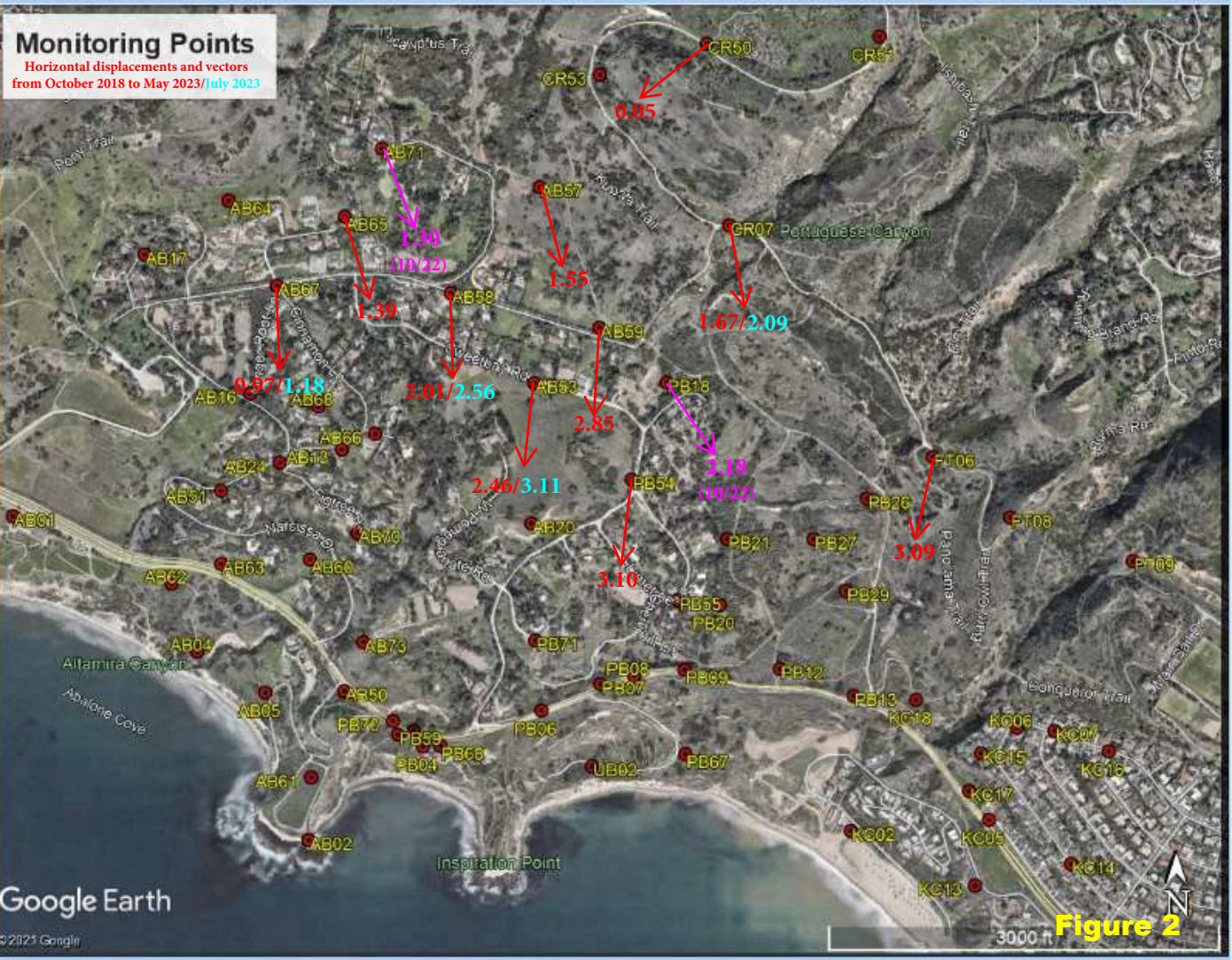

Headward enlargement of
landslide impacting Burma Road
Burma Rd
Possible
headward
enlargement
active
pre-1955
post-1956
west margin uncertain
south of Kubota Trail
Portuguese Bend
Landslide (1956)
Ancient Portuguese Bend
Landslide Complex
Narcisssa Drive
Sweetbay Road
Tue Jan 17 2023
Imagery © 2023 Nearmap, HERE
200 ft
nearmap

Figure 1


Monitoring Points
Horizontal displacements and vectors
from October 2018 to May 2023/July 2023
CR50
CR53
CR54
0.05
AB71
AB64
AB65
1.30
(10/22)
AB57
1.55
CR07
Portuguese Canyon
AB17
AB67
1.39
AB58
1.67/2.09
AB59
0.97/1.18
AB16
AB68
2.01/2.56
AB53
2.85
PB18
AB66
AB13
AB24
2.18
(10/22)
PT06
2.46/3.11
PB54
AB51
PB26
AB01
AB70
AB20
PB21
PB27
3.09
PT08
AB02
AB63
AB69
3.10
PT09
PB29
PB55
PB20
AB04
AB73
PB71
Altamira Canyon
PB08
PB07
PB69
PB12
Conqueror Trail
Abalone Cove
AB05
AB50
PB13
KC18
KC06
KC07
PB70
PB59
PB06
PB66
PB04
KC15
KC16
PB67
UB02
AB61
KC17
KC02
KC05
AB02
KC14
Inspiration Point
KC13
Google Earth
©2021 Google
3000 ft
N
Figure 2

GPS Monitoring Data

Survey Monuments - Upper Portuguese Bend Landslide/Burma Road Area

Displacement Response to 12-month Antecedent Rainfall

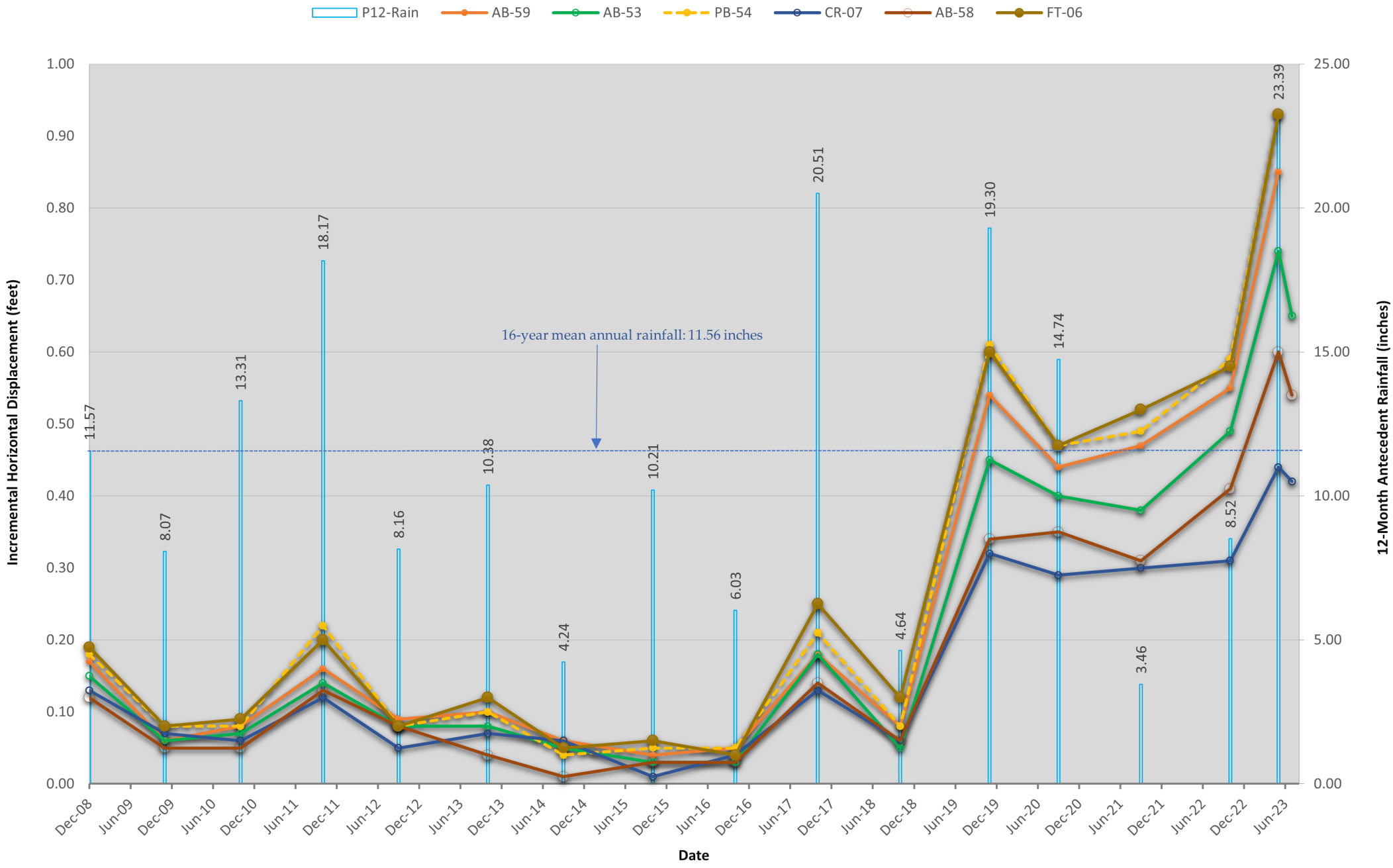


Figure 3

GPS Monitoring Data

Survey Monuments - Upper Portuguese Bend Landslide/Burma Road Area

Cumulative Horizontal Displacement 2007-2023

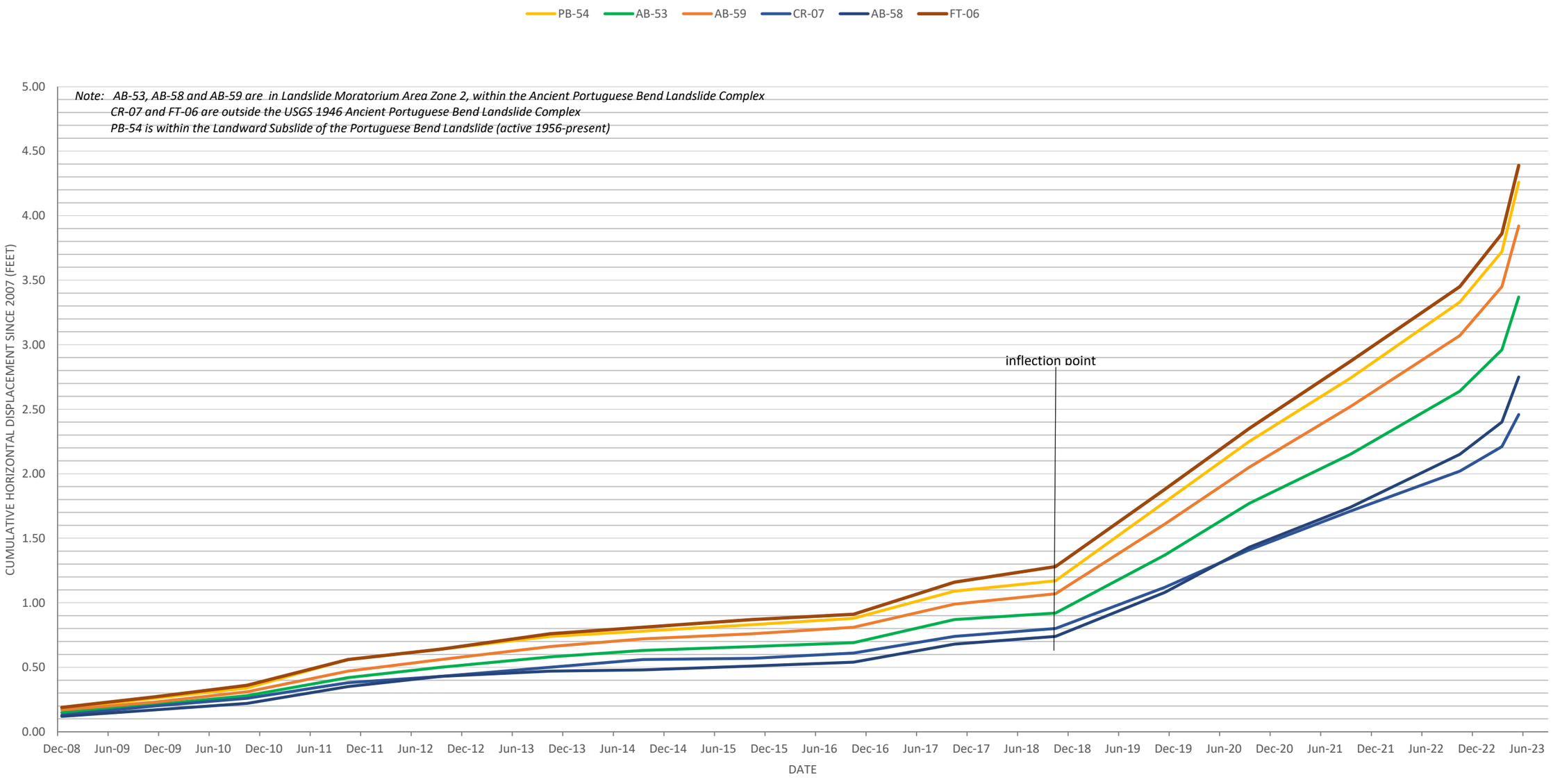


Figure 4

COTTON, SHIRES AND ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS

CITY OF RANCHO PALOS VERDES

CSA Project No: SC6163

MEMORANDUM

TO: Brandy Forbes, Community Development Director
CC: Ara Mihranian, City Manager
Ramzi Awwad, Public Works Director
FROM: Michael Phipps, CEG 1832, Contract City Geologist
Patrick Shires, GE 770, Contract City Geotechnical Engineer
RE: **Movement of the Altamira (Greater Portuguese Bend) Landslide Complex and Related Impacts, Rancho Palos Verdes, California**
DATE: November 8, 2024

INTRODUCTION

In this memorandum Cotton, Shires and Associates, Inc. (CSA) summarizes our evaluation of land movement of the Altamira Landslide Complex (previously referred to as the Greater Portuguese Bend Landslide Complex or Ancient Portuguese Bend Landslide Complex in past correspondence) from 2022-2024, with specific focus on the impacts of the land movement to private property, residential structures, and infrastructure. The active Altamira Landslide Complex currently involves major land movement comprising an area of over 700 acres landward of the coast. As of this date, the major land movement has resulted in the red-tagging (Unsafe to Enter/Occupy) of 18 residential structures and 2 commercial structures (at Wayfarer's Chapel), and the yellow-tagging (Limited Entry) of 38 other residential structures. It has also caused major impacts to public and private roads (some requiring closure), damages to utility infrastructure (water, sewer, gas, electricity and cable) causing certain utilities to be shut-off, and closure of certain Preserve land that is heavily accessed by the public for hiking, biking, equestrian, and other purposes.

BACKGROUND

The Altamira Landslide Complex in Rancho Palos Verdes includes four historically active, previously identified landslide areas: the Portuguese Bend Landslide (PBL) which began moving in 1956, the Abalone Cove Landslide (ACL) which began moving in 1979, the Klondike Canyon Landslide (KCL) which also began moving in 1979, and the Beach Club Landslide (BCL) which is nested within the KCL and, while dormant itself, moves with the KCL. It also now includes areas outside of the historically mapped boundaries of these known landslides, predominantly upslope from the historically mapped Portuguese Bend and Abalone Cove Landslides, within the Ancient Portuguese Bend Landslide Complex as mapped by various agencies (i.e., U.S. Geological Survey, California Geological Survey and other researchers (see attached Figure 1 - Landslide Area Map).

Based upon historically mapped boundaries, the ACL, PBL and KCL previously comprised an area of approximately 380 acres and affected portions of neighborhoods known as the Portuguese Bend Community, the Seaview Community and the Portuguese Bend Beach Club, as well as City-owned land within the Portuguese Bend Reserve (a sub-area of the greater Palos Verdes Nature Preserve). The

PBL has been continuously active since reactivation in 1956 with many areas of the landslide having moved hundreds of feet seaward over the ensuing six-plus decades. The ACL was active from 1979 until the late 1990's, involving only several feet of movement, when dewatering and other mitigation efforts largely halted movement. Creep movement of the ACL has occurred over the past 25 years following rainy seasons that were significantly above average rainfall amounts. The KCL has been episodically active in 1979-1983 and 2005-2006, experiencing only several inches of movement, typically in response to significantly above average rainfall. Landslide movements throughout the Ancient Portuguese Bend Landslide Complex *outside of the historical boundaries of* the ACL and PBL previously exhibited low rates of creep movement, or movement at or near the instrument precision range, in the 11-year monitoring period of 2007-2018 for which we have readily available data. These landslides are deep translational-type failures within seaward-dipping strata of the Monterey Formation, with the landslide slip surfaces occurring within very weak bentonitic clay beds. Historically, the movement behavior of these landslides routinely exhibited high sensitivity to increased groundwater pore pressure, and increased rates of land movement were correlative with 6-to-12-month antecedent rainfall that was well above average. Similarly, land movement decreased during below average rainy seasons or multi-year periods of drought.

Beginning in 2021, CSA geologists were requested by the City of Rancho Palos Verdes to observe reported distress (ground cracking and fissures) to trails in the Portuguese Bend Reserve. At that time, we also began reviewing Global Positioning Satellite (GPS) monitoring data for survey monuments within the entire Ancient Portuguese Bend Landslide Complex or Altamira Landslide Complex. In the summer of 2022, CSA was also asked to evaluate distress to an SCE transmission line along Burma Road within the Portuguese Bend Reserve. Subsequent geologic mapping of the Reserve area revealed that headward and lateral enlargement of the Portuguese Bend Landslide was occurring. We were also receiving reports of underground water line breaks occurring within the Portuguese Bend Community Association area and the Seaview Community. Review of GPS monitoring data from 2007 through 2023 indicated that land movement acceleration initially began between 2018 and 2019. We postulated that this acceleration was correlative with significantly above-normal rainfall in two out of three prior rainfall seasons (2016-17 and 2018-19) which followed five consecutive drier than normal rainfall seasons (2011-12 through 2015-16) (see attached Figure 2 – GPS Monitoring Data, Ancient Portuguese Bend Landslide: Displacement Response to 12-Month Antecedent Rainfall, December 2008-January 2024). One notable item, however, is that the land movement velocities did not decline back to the pre-2018 levels despite two significantly below-normal rainy seasons (2020-21, one of the driest on record, and 2021-22).

RAINFALL IMPACTS – 2022 THROUGH 2024

Further acceleration of land movement occurred throughout the Altamira Landslide Complex during and following the 2022-23 rain season, and the rainfall impacts from mid- to late-winter storms significantly contributed to the increased ground movements. Significant accelerations in movement velocity were documented in May 2023 following major storm sequences in January, February and March of 2023, which added to cumulative seasonal rainfall totals exceeding 193% of average rainfall. Approximately 87% of this rain fell prior to June 18, 2023. Most of this rainfall occurred from three significant atmospheric river-type storm sequences occurring on January 9-16 (3.59 inches), February 23-March 1 (3.79 inches) and March 10-15 (4.12 inches). Land movement velocities further increased as of the July 15, 2023 monitoring. An anomalous tropical storm dropped an additional 3.05 inches of

rain on August 19-20, 2023, resulting in further land movement acceleration as of the October 10, 2023 monitoring. The multiple increases in landslide velocities (i.e., accelerations) resulted in additional mappable ground surface expressions of the uphill limits of active landsliding, including the formation of landslide scarps, fissures, grabens, tensional cracking and shear zones, including areas north, west and east of the historically known landslide boundaries. Field geologic mapping and photo-geologic mapping performed in mid to late 2023 corroborated the GPS monitoring data findings that a large portion of the Ancient Portuguese Bend Landslide Complex (Altamira Landslide Complex) above the historically mapped PBL, ACL and KCL boundaries was involved in significant active landslide movement. The boundary of that major land movement has been updated through November 2024 and is depicted by the green dashed line on the attached Figure 1 – Landslide Area Map.

The 2023-2024 rainfall season total of more than 23 inches was 170% of the long-term average and had a compounding effect on the previous season's extraordinary rainfall. This rainfall season was characterized by additional atmospheric river type storms, including a sequence of storms that resulted in a Federally declared disaster from January 30 - February 9, 2024. The February 2024 rainfall total of 11.22 was the second wettest February in the 67-year history of recorded data for the Palos Verdes Peninsula. The landslide response to these rains was almost immediate and we observed continued accelerating land movement in the GPS monitoring data through August 1, 2024. A peak land movement velocity of >13 inches/week occurred in the center of the landslide as of the May 28, 2024 monitoring period. Movement velocities appeared to peak across the breadth of the landslide in the July 1 - August 1, 2024 monitoring period with the majority of stations moving >10 inches/week and peak movements >12 inches per week. Attached Figures 3, 4, 5 and 6 – GPS Monitoring Displacement Rate Contour Maps, are landslide movement velocity contour maps produced from GPS monitoring data through August 1, 2024, September 4, 2024, October 8, 2024 and October 29, 2024, respectively.

For reference, rainfall data utilized for this evaluation are from the Los Angeles County Department of Public Works - Hydrology Division Station 1011B, located at the Rolling Hills Fire Station No. 56. This rainfall station serves as a reasonable proxy for rainfall impacts to the southern face of the Palos Verdes Peninsula due to its elevation, which should reflect some orographic effect for storms approaching the Palos Verdes Peninsula from the west, southwest, and south, compared to coastal stations such as Point Vicente which may underestimate rain totals in the higher reaches of the landslide complex and watershed.

TOTAL LAND MOVEMENT – OCTOBER 2022 THROUGH OCTOBER 2024

Since October 10, 2022, total horizontal land movement throughout the Altamira Landslide Complex has ranged from approximately 27 to 39 feet in most areas, with the exception being approximately 6 to 21 feet of horizontal land movement in the Klondike Canyon Landslide area. Vertical displacements have ranged from 1 - 10 feet in most areas over this same period. This land movement has had a destructive and devastating effect on numerous residential and commercial properties and structures, private and public roadways, and utility infrastructure. In addition to the 18 red-tagged and 38 yellow-tagged structures, dozens of homes are experiencing varying amounts of distress and inaccessibility due to differential land movements, and electricity and gas service has been cut off from the majority of these properties. The most significant damage is to structures on or adjacent to the landslide boundaries, or those located on boundaries between subslides (blocks) within the Altamira Landslide Complex that are moving at different rates.

Since June 2024, the City has undertaken emergency mitigation measures including 18 deep geotechnical test borings with sophisticated instrumentation to detect the depth(s) of land movement and groundwater pore pressures within and beneath the active landslide mass(es). The instrumented geotechnical test borings revealed that the basal slip surface of the Altamira Landslide Complex beneath the Portuguese Bend Landslide portion of the Altamira complex is up to twice as deep as previously/historically modeled, and moving at a much faster rate than the shallower PBL slip surface. This significantly greater depth of movement has resulted in a broader footprint of active land movement at the ground surface and offshore, and expansion of the historical land movement area from approximately 380 acres to over 700 acres. The test borings also indicated that artesian or near-artesian groundwater pressure is present beneath the Altamira slip surface, and confined groundwater under significant pressure is present between the Altamira and PBL slip surfaces. High unconfined groundwater levels were also determined within the historically modeled Portuguese Bend and Abalone Cove landslide bodies. Beginning September 13, 2024, the first of 10 deep dewatering wells came online. The ten wells, all located near the toe, or lower 1/3 of the landslide complex, are currently extracting approximately 1 million gallons per day of groundwater within and beneath the landslide.

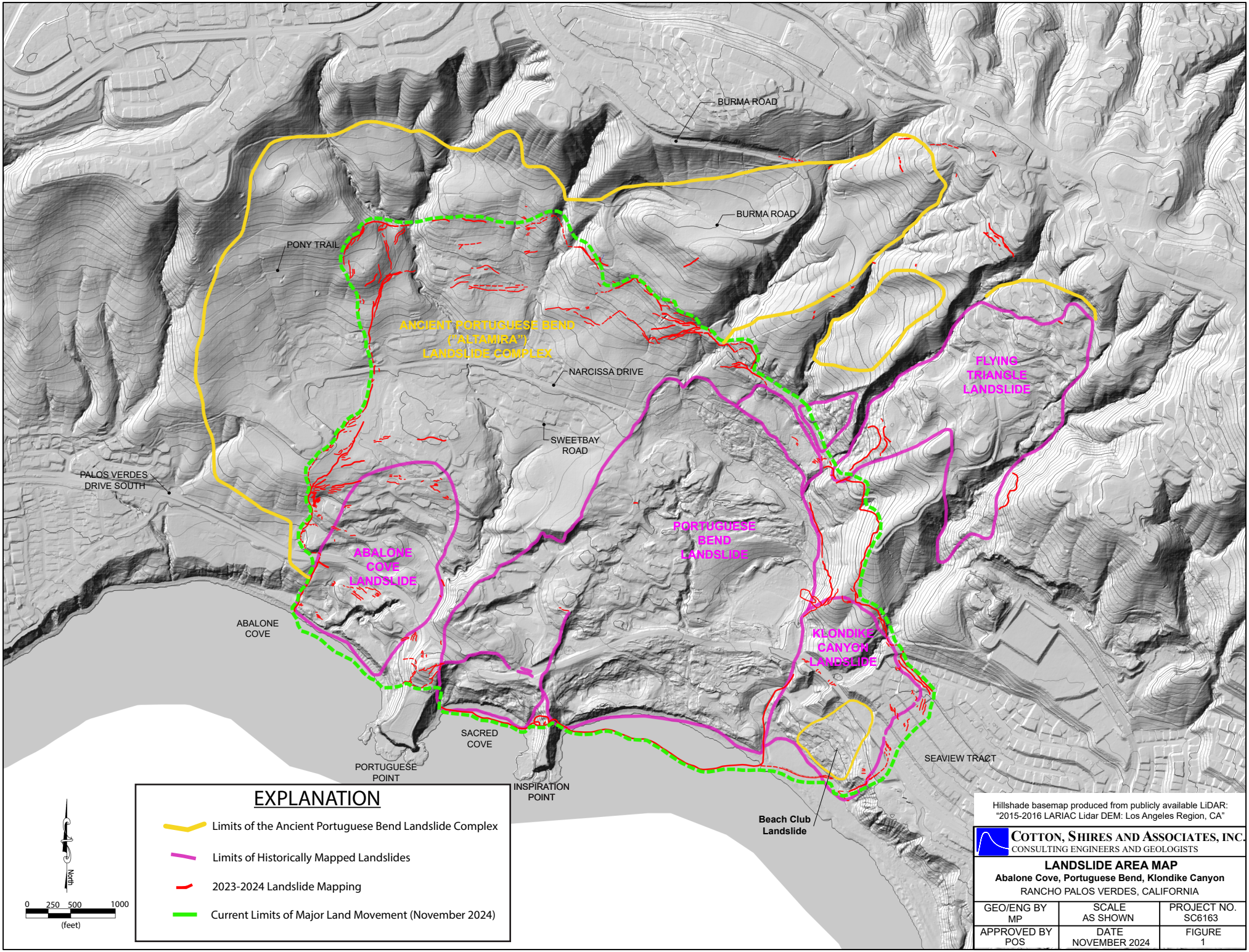
FUTURE LAND MOVEMENT POTENTIAL

As described above, major movement of the Altamira Landslide Complex ranging from 6 to 39 feet horizontally and 1 to 10 feet vertically has occurred since October 2022, with the majority of that movement occurring during and following the 2023-24 rainy season. The highest observed movement rates have exceeded 12 inches per week. While emergency dewatering mitigation efforts and 6 months without any rainfall recharge have reduced movements in most areas to a current level of 0.5 to 6 inches per week, there are many uncertainties regarding the longevity and long-term effectiveness of the deep dewatering wells that have been installed, including the availability of additional funding needed to maintain them and keep them operational. There is also uncertainty regarding the quantity of dewatering wells needed to maintain landslide movements at low (creep) movement levels, and whether funding for additional wells can be obtained. Given the emergency measures that are in place, the future response of the landslide to seasonal rains, including the severity of those rains is unknown; however, historical land movement data demonstrates increases in land movement with above-average rainy seasons despite the operation of past dewatering facilities operated by private geologic hazard abatement districts such as ACLAD and KCLAD.

-o-

Attachments:

Figure 1 – Landslide Area Map
Figure 2 – GPS Monitoring Data, Displacement Response to 12-Month Antecedent Rainfall, December 2008-January 2024
Figure 3 – GPS Monitoring Displacement Rate Contour Map (8/1/2024 Data)
Figure 4 – GPS Monitoring Displacement Rate Contour Map (9/4/2024 Data)
Figure 5 – GPS Monitoring Displacement Rate Contour Map (10/8/2024 Data)
Figure 6 – GPS Monitoring Displacement Rate Contour Map (10/29/2024 Data)

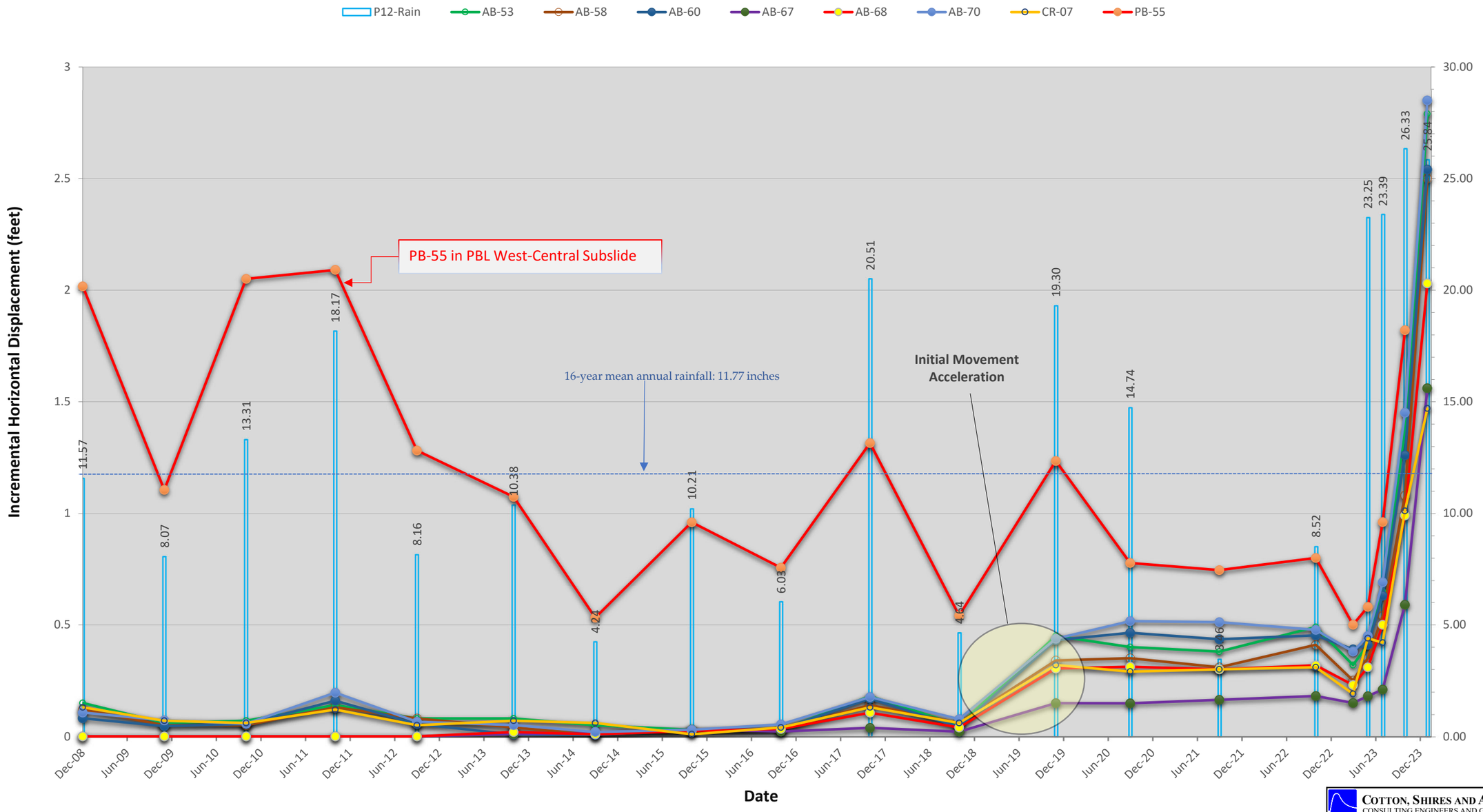

BURMA ROAD
BURMA ROAD
PONY TRAIL
ANCIENT PORTUGUESE BEND ("ALTAMIRA") LANDSLIDE COMPLEX
NARCISSA DRIVE
SWEETBAY ROAD
PALOS VERDES DRIVE SOUTH
FLYING TRIANGLE LANDSLIDE
PORTUGUESE BEND LANDSLIDE
ABALONE COVE LANDSLIDE
KLONDIKE CANYON LANDSLIDE
ABALONE COVE
SACRED COVE
PORTUGUESE POINT
INSPIRATION POINT
SEAVIEW TRACT
Beach Club Landslide
EXPLANATION
Limits of the Ancient Portuguese Bend Landslide Complex
Limits of Historically Mapped Landslides
2023-2024 Landslide Mapping
Current Limits of Major Land Movement (November 2024)
North
0 250 500 1000
(feet)
Hillshade basemap produced from publicly available LiDAR: "2015-2016 LARIAC Lidar DEM: Los Angeles Region, CA"
COTTON, SHIRES AND ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS
LANDSLIDE AREA MAP
Abalone Cove, Portuguese Bend, Klondike Canyon
RANCHO PALOS VERDES, CALIFORNIA
GEO/ENG BY MP
SCALE AS SHOWN
PROJECT NO. SC6163
APPROVED BY POS
DATE NOVEMBER 2024
FIGURE 1

GPS Monitoring Data

Survey Monuments - ACL, PBL and Upper Ancient Landslide Complex

Displacement Response to 12-month Antecedent Rainfall

December 2008-January 2024



COTTON, SHIRES AND ASSOCIATES, INC. CONSULTING ENGINEERS AND GEOLOGISTS	
GPS Monitoring Data Survey Monuments- ACL, PBL, and Upper Ancient Landslide Complex Displacement Response to 12-month Antecedent Rainfall Rancho Palos Verdes, California	
GEO/ENG BY MP	SCALE
APPROVED BY POS	DATE NOVEMBER 2024

PROJECT NO. SC6163

FIGURE 2

APPROXIMATE BOUNDARY OF ANCIENT PORTUGUESE BEND LANDSLIDE COMPLEX

"Creeping Area" Approximately 0.5 inch/week

CURRENT LIMITS OF MAJOR LANDSLIDE MOVEMENT (AUGUST 2024)

PONY TRAIL

BURMA ROAD

PALOS VERDES DRIVE SOUTH

ABALONE COVE

PORTUGUESE POINT

SACRED COVE

INSPIRATION POINT

SEAVIEW TRACT

PORTUGUESE BEND LANDSLIDE

ABALONE COVE LANDSLIDE

FLYING TRIANGLE LANDSLIDE

KLONDIKE CANYON LANDSLIDE

0.06 CW01
0.08 AB77
0.07 CR56
0.33 CR50
0.47 CR51
0.49 CR53
0.52 CW05
0.00 AB71 no data
0.00 CR57 no data
0.48 AB64
0.01 AB17
0.03 RP02
0.05 CW06
0.24 AB76
0.06 AB01
0.04 CW07
0.02 FT08
0.05 CW08
0.01 FT09
0.02 FT00
0.06 AB02
0.08 KC14
0.02 RP01
0.23 KC25
0.46 KC13
4.09 KC22
0.04 KC21
3.84 KC33
3.89 KC06
3.40 KC19
0.03 KC07
0.03 KC16
3.45 KC20
3.91 KC15
2.72 KC23
3.53 KC17
2.41 KC05
5.68 KC28
5.16 KC24
3.88 KC27
4.09 KC26
6.48 KC29
9.21 KC30
8.82 PB13
8.23 KC31
7.84 KC18
11.39 PB74
11.45 PB12
9.87 PB26
9.36 PB29
10.91 PB27
9.39 PB73
11.89 PB54
10.41 PB21
11.54 PB75
11.13 PB55
10.83 PB20
10.84 PB08
9.92 PB09
11.68 PB07
12.96 PB71
12.29 PB67
9.98 UB02
11.36 PB59
11.13 PB69
11.58 PB70
11.34 PB04
11.15 PB68
11.81 PB72
10.07 PB06
10.75 AB73
11.99 AB75
12.43 AB21
11.69 AB70
10.19 AB60
9.11 AB63
7.08 AB62
9.20 AB04
8.55 AB05
6.86 AB50
5.16 AB74
8.95 AB51
11.23 AB24
10.64 AB13
10.10 AB66
9.79 AB68
7.49 AB16
7.48 AB67
8.88 AB65
9.39 AB57
11.00 AB58
12.65 AB59
11.80 CR54
11.29 AB53
11.89 PB18
0.00 AB71 no data
7.0
8.0
9.0
10.0
11.0
12.0

EXPLANATION

- Limits of the Ancient Portuguese Bend Landslide Complex
- Limits of Historically Mapped Landslides
- 2023/2024 Landslide Mapping
- Current Limits of Major Landslide Movement (August 2024)
- GPS Monument Displacement!Rate (July 1, 2024 to August 1, 2024) Displacement Vector! Scale 1"= 8"/week

Displacement Rate Table

Minimum Rate (inch/week)	Maximum Rate (inch/week)	Color
0.00	1.00	
1.00	2.00	
2.00	3.00	
3.00	4.00	
4.00	5.00	
5.00	6.00	
6.00	7.00	
7.00	8.00	
8.00	9.00	
9.00	10.00	
10.00	11.00	
11.00	12.00	
12.00	13.00	

North

0 250 500 1000 (feet)

Hillshade basemap produced from publicly available LiDAR: "2015 - 2016 LARIAC Lidar DEM: Los Angeles Region, CA"

COTTON, SHIRES AND ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS

GPS MONITORING DISPLACEMENT RATE CONTOUR MAP (8/1/24 DATA)
Abalone Cove, Portuguese Bend, Klondike Canyon
RANCHO PALOS VERDES, CALIFORNIA

GEO/ENG BY	SCALE	PROJECT NO.
MP	1"=500'	SC6163
APPROVED BY	DATE	FIGURE NO.
POS	November 8, 2024	3

APPROXIMATE BOUNDARY OF ANCIENT PORTUGUESE BEND LANDSLIDE COMPLEX

CURRENT LIMITS OF MAJOR LANDSLIDE MOVEMENT (SEPTEMBER 2024)

"Creeping Area" Approximately 0.5 inch/week

BURMA ROAD

PONY TRAIL

PALOS VERDES DRIVE SOUTH

PORTUGUESE BEND LANDSLIDE

ABALONE COVE LANDSLIDE

KLONDIKE CANYON LANDSLIDE

FLYING TRIANGLE LANDSLIDE

ABALONE COVE

SACRED COVE

PORTUGUESE POINT

INSPIRATION POINT

SEAVIEW TRACT

EXPLANATION

- Limits of the Ancient Portuguese Bend Landslide Complex
- Limits of Historically Mapped Landslides
- 2023/2024 Landslide Mapping
- Current Limits of Major Landslide Movement (September 2024)
- GPS Monument Displacement Rate (August 1, 2024 to September 4, 2024) Displacement Vector Scale 1"= 8"/week

Displacement Rate Table

Minimum Rate (inch/week)	Maximum Rate (inch/week)	Color
0.00	1.00	
1.00	2.00	
2.00	3.00	
3.00	4.00	
4.00	5.00	
5.00	6.00	
6.00	7.00	
7.00	8.00	
8.00	9.00	
9.00	10.00	
10.00	11.00	
11.00	12.00	
12.00	13.00	

North

0 250 500 1000 (feet)

Hillshade basemap produced from publicly available LiDAR: "2015 - 2016 LARIAC Lidar DEM: Los Angeles Region, CA"

COTTON, SHIRES AND ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS

GPS MONITORING DISPLACEMENT RATE CONTOUR MAP (9/4/24 DATA)
Abalone Cove, Portuguese Bend, Klondike Canyon
RANCHO PALOS VERDES, CALIFORNIA

GEO/ENG BY	SCALE	PROJECT NO.
MP	1"=500'	SC6163
APPROVED BY	DATE	FIGURE NO.
POS	November 8, 2024	4

APPROXIMATE BOUNDARY OF ANCIENT PORTUGUESE BEND LANDSLIDE COMPLEX

CURRENT LIMITS OF MAJOR LANDSLIDE MOVEMENT (OCTOBER 2024)

"Creeping Area" Approximately 0.5 inch/week

BURMA ROAD

PONY TRAIL

PALOS VERDES DRIVE SOUTH

ABALONE COVE

SACRED COVE

PORTUGUESE POINT

INSPIRATION POINT

SEAVIEW TRACT

ABALONE COVE LANDSLIDE

PORTUGUESE BEND LANDSLIDE

KLONDIKE CANYON LANDSLIDE

FLYING TRIANGLE LANDSLIDE

0.04 AB80
0.04 AB79
0.03 CW01
0.06 AB77
0.07 CR56
0.35 CR50
0.44 CR51
0.00 CR60
0.43 CR53
0.36 CR58
1.78 AB78
6.17 AB57
0.47 CW05
0.03 CR59
0.12 AB64
6.14 AB65
0.11 CR57
0.04 AB17
5.09 AB67
6.86 CR54
7.44 AB58
0.00 RP03
0.07 CW06
7.90 AB59
0.03 FT10
5.42 AB16
6.82 AB68
7.37 AB53
6.95 PB18
0.11 AB76
6.91 AB66
7.23 AB13
3.84 PB76
7.88 AB24
7.18 AB75
6.99 PB54
4.01 PB26
0.05 AB01
3.66 AB74
6.18 AB51
7.85 AB70
7.29 AB21
0.03 FT08
4.96 PB21
5.05 PB27
0.02 CW08
6.23 AB69
6.74 AB69
6.28 PB75
0.04 FT09
5.03 AB62
5.26 PB55
3.42 PB29
4.99 PB20
0.04 KC21
6.09 AB04
7.08 PB71
6.04 AB73
6.03 PB70
5.88 PB59
1.57 KC06
3.88 AB50
5.64 PB69
4.62 PB08
4.08 PB09
4.21 PB12
3.04 PB13
1.80 KC22
1.35 KC19
5.11 PB07
5.74 PB04
3.23 KC31
2.49 KC18
0.04 KC07
4.58 PB06
1.67 KC33
1.29 KC20
0.02 KC16
5.71 PB68
5.77 PB72
4.63 PB67
4.54 PB74
3.38 KC30
1.53 KC15
3.74 UB02
1.34 KC17
1.05 KC23
1.05 KC05
2.27 KC29
1.75 KC24
2.47 KC38
1.98 KC28
1.34 KC26
0.55 KC13
0.05 KC35
0.05 KC14
0.05 KC34
0.03 KC36
0.08 KC25
0.04 KC37
0.04 RP01

5.0
6.0
7.0
4.0
3.0
2.0
1.0

EXPLANATION

- Limits of the Ancient Portuguese Bend Landslide Complex
- Limits of Historically Mapped Landslides
- 2023/2024 Landslide Mapping
- Current Limits of Major Landslide Movement (October 2024)
- GPS Monument Displacement Rate (September 4, 2024 to October 8, 2024) Displacement Vector Scale 1"= 8"/week

Displacement Rate Table

Minimum Rate (inch/week)	Maximum Rate (inch/week)	Color
0.00	1.00	
1.00	2.00	
2.00	3.00	
3.00	4.00	
4.00	5.00	
5.00	6.00	
6.00	7.00	
7.00	8.00	
8.00	9.00	
9.00	10.00	
10.00	11.00	
11.00	12.00	
12.00	13.00	

North

0 250 500 1000
(feet)

Hillshade basemap produced from publicly available LiDAR: "2015 - 2016 LARIAC Lidar DEM: Los Angeles Region, CA"

COTTON, SHIRES AND ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS

GPS MONITORING DISPLACEMENT RATE CONTOUR MAP (10/8/24 DATA)
Abalone Cove, Portuguese Bend, Klondike Canyon
RANCHO PALOS VERDES, CALIFORNIA

GEO/ENG BY	SCALE	PROJECT NO.
MP	1"=500'	SC6163
APPROVED BY	DATE	FIGURE NO.
POS	November 8, 2024	5

APPROXIMATE BOUNDARY OF ANCIENT PORTUGUESE BEND LANDSLIDE COMPLEX

CURRENT LIMITS OF MAJOR LANDSLIDE MOVEMENT (NOVEMBER 2024)

BURMA ROAD

PONY TRAIL

PALOS VERDES DRIVE SOUTH

ABALONE COVE

PORTUGUESE POINT

SACRED COVE

INSPIRATION POINT

ABALONE COVE LANDSLIDE

PORTUGUESE BEND LANDSLIDE

KLONDIKE CANYON LANDSLIDE

FLYING TRIANGLE LANDSLIDE

SEAVIEW TRACT

0.07 AB80 · 0.12 AB79 · 0.02 CW01 · 0.06 AB77 · 0.04 CR56 · 0.08 CR50 · 0.10 CR51 · 0.03 CR60 · 0.01 CR53 · 0.07 CR58 · 0.13 AB78 · 0.08 CW05 · 0.08 CR59 · 0.62 AB64 · 4.83 AB57 · 4.21 AB65 · 0.09 CR57 · 0.09 AB17 · 3.61 AB67 · 4.0 · 5.10 AB58 · 4.68 CR54 · 5.0 · 5.04 AB59 · 0.01 RP03 · 0.08 CW06 · 3.91 AB16 · 4.51 AB53 · 4.01 PB18 · 0.07 FT10 · 4.72 AB68 · 4.74 AB66 · 0.11 AB76 · 3.32 AB76 · 1.55 PB76 · 5.64 AB24 · 0.13 AB01 · 3.06 AB74 · 4.17 AB51 · 4.70 AB75 · 4.23 PB54 · 0.56 PB26 · 0.04 FT08 · 4.63 AB21 · 2.48 PB21 · 2.08 PB27 · 0.16 GW08 · 0.06 FT09 · 5.46 AB70 · 4.37 AB69 · 5.29 AB60 · 3.49 PB75 · 3.64 AB62 · 2.88 PB55 · 0.36 PB29 · 4.0 · 4.36 PB71 · 2.03 PB20 · 4.32 AB04 · 3.53 AB73 · 1.97 PB08 · 2.0 · 0.04 KC21 · 0.22 KC06 · 3.47 PB70 · 3.38 PB59 · 1.67 PB09 · 1.23 PB12 · 0.38 PB13 · 3.0 · 2.46 PB07 · 3.63 PB69 · 0.22 KC31 · 0.14 KC18 · 0.19 KC22 · 0.28 KC19 · 2.07 AB50 · 2.21 PB06 · 3.25 PB04 · 0.24 KC33 · 0.11 KC07 · 3.25 PB68 · 3.22 PB72 · 1.0 · 0.68 UB02 · 1.14 PB67 · 0.97 PB74 · 0.16 KC20 · 0.13 KC16 · 0.16 KC30 · 0.19 KC15 · 0.11 KC17 · 0.20 KC23 · 0.19 KC05 · 0.12 KC29 · 0.11 KC24 · 0.22 KC38 · 0.17 KC28 · 0.08 KC26 · 0.12 KC13 · 0.09 KC25 · 0.11 KC14 · 0.12 KC35 · 0.14 KC34 · 0.10 KC36 · 0.16 KC37 · 0.11 RP01

EXPLANATION

- Limits of the Ancient Portuguese Bend Landslide Complex
- Limits of Historically Mapped Landslides
- 2023/2024 Landslide Mapping
- Current Limits of Major Landslide Movement (November 2024)
- GPS Monument Displacement Rate (October 8, 2024 to October 29, 2024) Displacement Vector Scale 1"= 8"/week

Displacement Rate Table

Minimum Rate (inch/week)	Maximum Rate (inch/week)	Color
0.00	1.00	
1.00	2.00	
2.00	3.00	
3.00	4.00	
4.00	5.00	
5.00	6.00	
6.00	7.00	
7.00	8.00	
8.00	9.00	
9.00	10.00	
10.00	11.00	
11.00	12.00	
12.00	13.00	

North

0 250 500 1000 (feet)

Hillshade basemap produced from publicly available LiDAR: "2015 - 2016 LARIAC Lidar DEM: Los Angeles Region, CA"

COTTON, SHIRES AND ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS

GPS MONITORING DISPLACEMENT RATE CONTOUR MAP (10/29/24 DATA)
Abalone Cove, Portuguese Bend, Klondike Canyon
RANCHO PALOS VERDES, CALIFORNIA

GEO/ENG BY	SCALE	PROJECT NO.
MP	1"=500'	SC6163
APPROVED BY	DATE	FIGURE NO.
POS	November 8, 2024	6

COTTON, SHIRES AND ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS

CITY OF RANCHO PALOS VERDES

CSA Project No: SC6163

MEMORANDUM

TO: Ara Mihranian, City Manager
CC: Ramzi Awwad, Public Works Director

FROM: Michael Phipps, CEG 1832, Contract City Geologist
Patrick Shires, GE 770, Contract City Geotechnical Engineer
RE: **Movement of the Altamira Landslide: Characterization, Related Impacts, Causation, and Emergency Measures, Rancho Palos Verdes, California**
DATE: March 16, 2025

INTRODUCTION

In this memorandum Cotton, Shires and Associates, Inc. (CSA) summarizes our evaluation of movement of the Altamira Landslide, with specific focus on the characteristics, differences, and causation of movement of this new landslide, distinguishing it from the known historically active Landslide Complex that is comprised of the Portuguese Bend Landslide (PBL), Abalone Cove Landslide (ACL), Klondike Canyon Landslide (KCL) and Beach Club Landslide (BCL). We include the BCL as part of the KCL, because it is, in itself, dormant and nested within (or rafts upon) the KCL. Also discussed are impacts of the Altamira Landslide movement to private property, residential structures, and infrastructure in the landslide area.

DISTINGUISHING THE ALTAMIRA LANDSLIDE

For definition purposes, the Altamira Landslide is a newly active landslide that has occurred within a previously mapped ancient landslide complex, most recently labeled the "Ancient Altamira Landslide Complex" (Douglas, 2013) which was a name modification of the "Ancient Portuguese Bend Landslide" identified on the California Geological Survey's Landslide Inventory Map (CGS, 2007). See the excerpted Figure 1 from Douglas (2013) on the following page for this clarification. It is important to make this distinction for consistency and to avoid confusion, because the Altamira Landslide is, in fact, a new member of the historically active PBL/ACL/KCL Landslide Complex but largely **underlies it** and occupies an area of active land movement >700 acres and extends to more than 500 feet off of the coastline, whereas the shallower historically active PBL/ACL/KCL complex only occupied about 380 acres.

The Altamira Landslide in Rancho Palos Verdes is therefore a recently identified large landslide that largely underlies (and therefore largely encompasses, but exceeds the area of) the previously understood active Landslide Complex containing the four historically active landslides: the PBL which historically began moving in 1956, the ACL which began moving in 1979, the KCL which also began moving in 1979, and the BCL which is nested within the KCL and, while dormant itself, moves along with the KCL. The Altamira Landslide includes large areas outside of the historically mapped boundaries of these known landslides, predominantly upslope and downslope from the historically

mapped PBL and ACL, within, but smaller than, the Ancient Altamira Landslide Complex as defined above. To provide an example of the change in size, the dimensions from head to toe of the previously historical ACL is 2,250 feet and the width up to 1,450 feet wide. The dimensions from head to toe of the Altamira Landslide, underlying and extending up and down slope from both the PBL and the ACL, is 5,800 feet (more than double that of the ACL) with a width of up to 7,400 feet wide (more than five times as wide as the ACL).

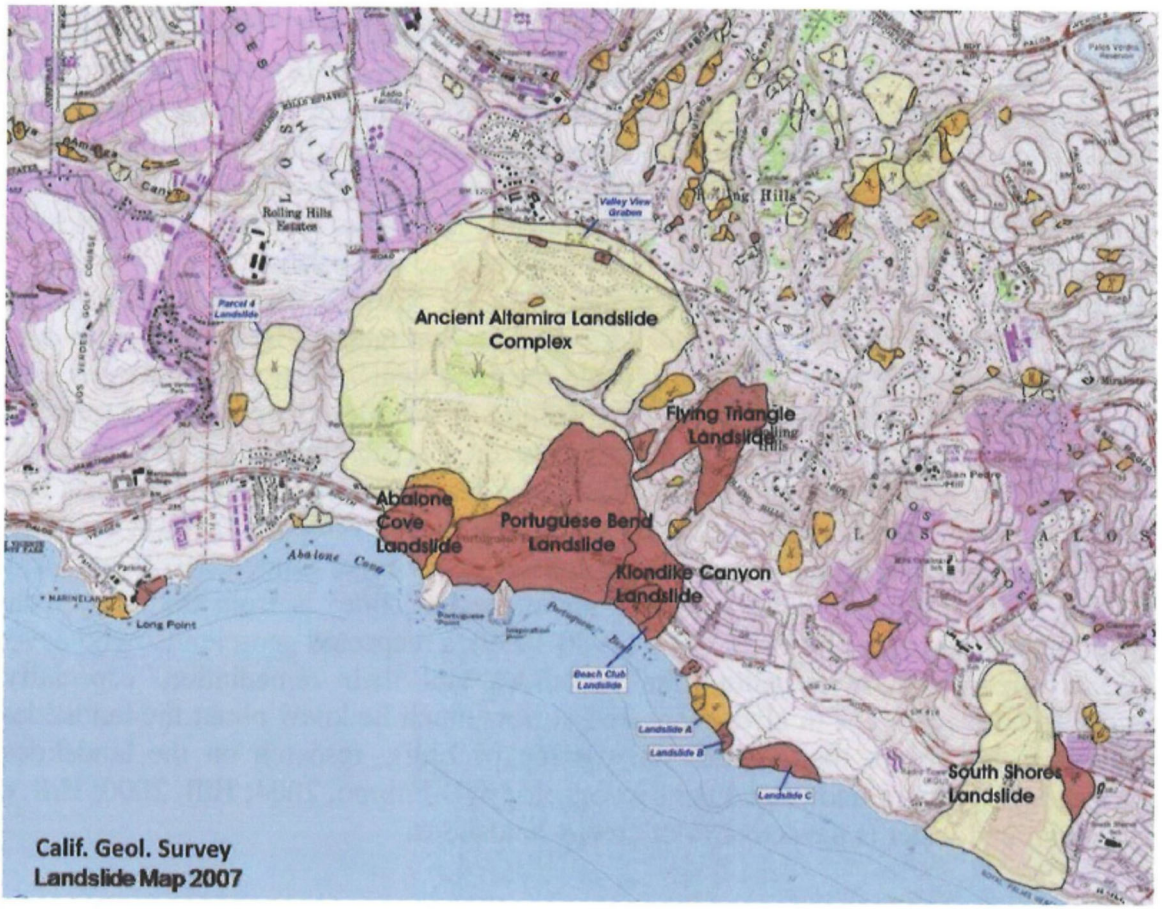


Figure 1. Landslide map of a portion of the south flank of the Palos Verdes Peninsula prepared by the California Geological Survey (2007). The major and some minor landslides are identified. Light yellow indicates that the landslide is inactive, red is active and orange is dormant.

While previous geotechnical investigators identified inactive deep failure surfaces in both the historically active and ancient landslide areas, none of them mapped or identified as active the entire depth or breadth of movement that has recently impacted the area, nor did they opine that such an event would occur in historic times. The active Altamira Landslide currently involves major land movement comprising an area of over 700 acres landward of the coast and extends to approximately 500 feet or more off the coastline. The areal dimensions, depth of movement, velocity of movement, artesian and near-artesian groundwater pressures beneath it, and even the direction of movement, are different than the Abalone Cove, Portuguese Bend, and Klondike Canyon landslides. The distinction to be made then, is that the Altamira Landslide is not just simple *expansion* of an existing group of landslides, it is an entirely different, larger and deeper landslide with much broader boundaries (including the new coastline offshore), nearly twice as deep as the depth of historic landslide movement in some areas, and with unprecedented rates of movement (which were not seen in the early LA County

Engineer surveys, the Charles Abbott Associates surveys beginning in 1994, nor the McGee surveys since 2007). None of this was experienced during the history of the City, and the Altamira Landslide is a unique landslide not characterized in its current dimensions during the over 70-year history of landslide investigations, exploratory borings, monitoring and observations being conducted in the area.

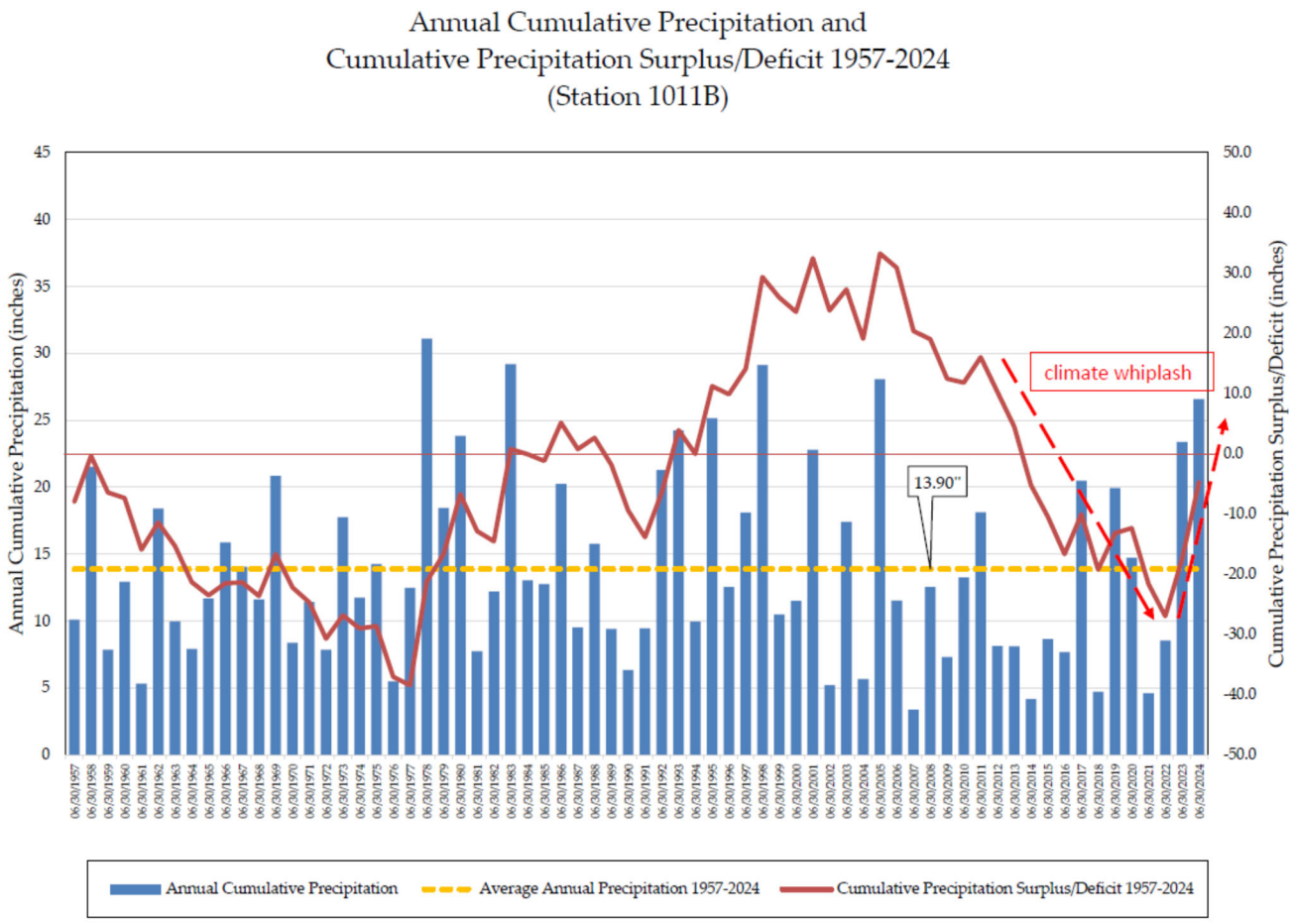
IMPACTS OF MOVEMENT OF THE ALTAMIRA LANDSLIDE

As of this date, the major land movement of the Altamira Landslide has resulted in the red-tagging (Unsafe to Enter/Occupy) and yellow tagging (Limited Entry) of several residential and commercial structures. It has also caused major destructive impacts to public and private roads, damages to utility infrastructure (water, sewer, gas, electricity and cable), causing certain utilities to be shut-off, and closure of certain Preserve land that is otherwise heavily accessed by the public for hiking, biking, equestrian, and other purposes. The only practical mitigation measure available to address a landslide with such a colossal scale is relieving groundwater pore pressures through pumping of groundwater, but it has to be done on a large enough scale to be effective at reducing the movement to an acceptable level. This technique has proven effective for the east side of the Altamira Landslide where deep dewatering wells have been installed, maintained and the rate of ground movement monitored such that a correlation between increased pumping of groundwater and reduction in the rate of ground movement has been confirmed.

CAUSATION

It is our opinion that the activation of the Altamira Landslide was largely caused by "climate whiplash" (also more technically described as hydroclimate volatility) induced by climate change, particularly starting in 2011, with five years of drought, and eight out of eleven years significantly below normal rainfall from 2011-2022, followed by two consecutive extraordinarily heavy rain seasons that dropped approximately 4 feet of rainfall on the landslide and surrounding areas draining into the landslide on the south flank of the Palos Verdes Hills.

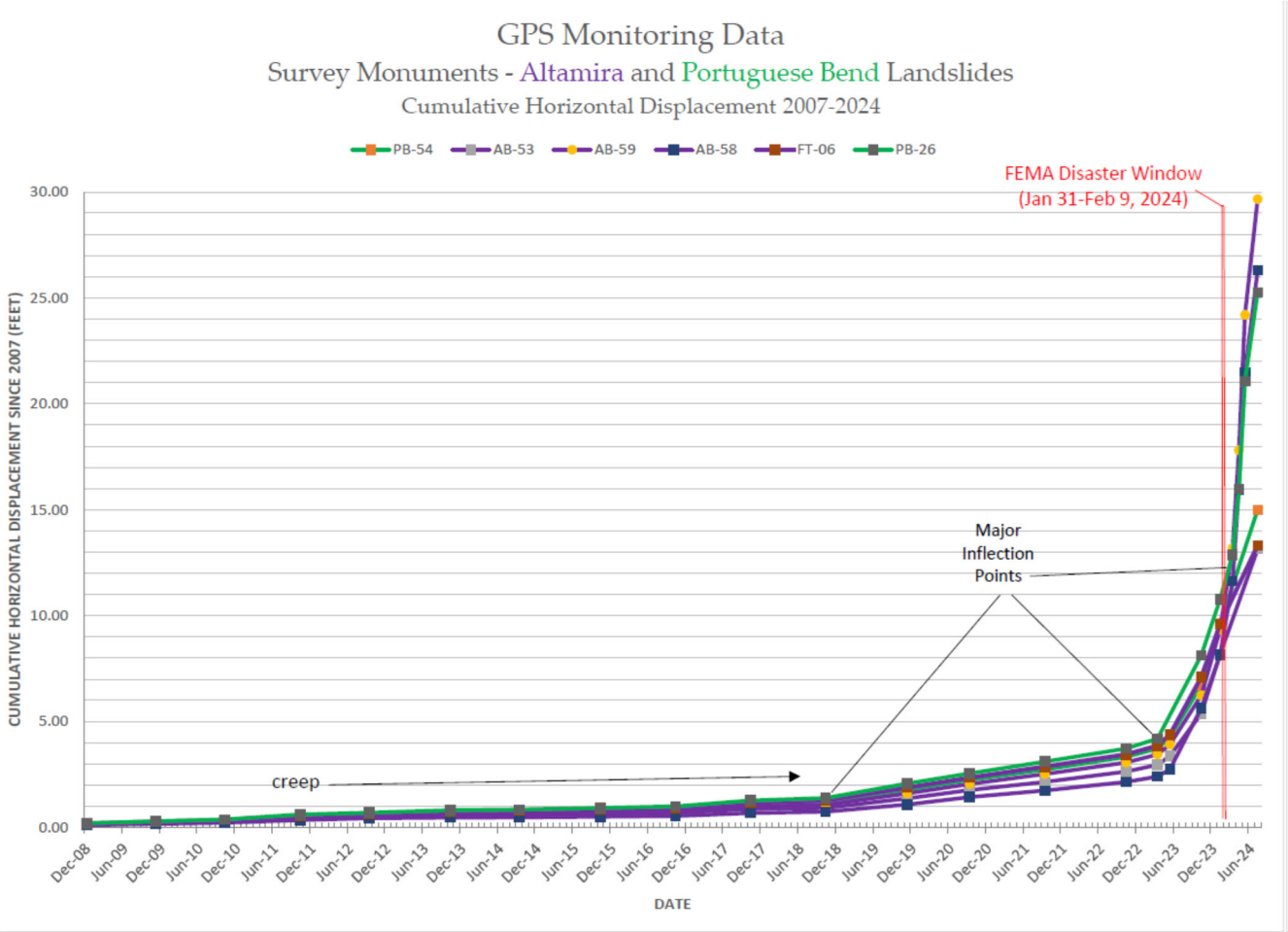
As illustrated in the following graphic, using data gathered by Los Angeles County Department of Public Works Stormwater Engineering Division, we analyzed annual rainfall deviations from the mean, and tallied up those cumulative deviations over time, as a measure of *precipitation surplus/deficit* that has impacted the area. The dark red line on the graphic shows the precipitation surplus/deficit over time. A precipitous drop is noted in the surplus/deficit line, particularly from 2011-2022, which whipsaws back to a steep climb from 2022 through 2024. Climate whiplash is illustrated by the red dashed arrows, showing the impact of the dry years (on a rapidly declining surplus/deficit curve) quickly reversing to a steeply inclining surplus/deficit curve. It is not important that this whiplash or volatility occurred in *deficit* territory on the graph, because it followed a two-decade long period of significant precipitation surplus. Two decades of precipitation surplus between 1991 and 2011 likely contributed to *strain-softening* of the Altamira Landslide failure surface clays, as the landslide began imperceptibly creeping and elongating/stretching out over a prolonged period. It follows that this generally prolonged period of drying commencing in 2011, followed by a large pulse of wetting from 2022 through the winter of 2024, and culminating in an intense barrage of rainfall from January 31st through February 9th 2024, triggered the massive Altamira movement and accelerated the landslide to unprecedented rates of movement.



Of note is that 8.29 inches of rain fell at the Rolling Hills Fire Station rain gauge from January 31st through February 9th 2024. The mean (average) rainfall for the Rolling Hills Fire Station's 57-year rainfall data set is currently 13.88 inches/year and the standard deviation of the entire 57-year dataset is 7 inches/year, indicating very high variability in annual rainfall. More rain fell between January 31st and February 9th 2024 than the standard deviation for the entire 57-year rainfall data set, indicating that this storm sequence was a statistically rare, outlier event.

The following graphic depicts *cumulative horizontal displacement* of select GPS survey monitoring points, including some of the fastest moving points in the Altamira Landslide and a couple of representative points in the PBL (which overlies the Altamira Landslide). There are three significant inflection points indicated in the graph. Prior to the first inflection point, the cumulative displacement lines indicate that the GPS monitoring points within the Altamira Landslide were creeping quite slowly (imperceptibly, near the range of instrument precision) for a number of years extending back before 2011. There was no observed or documented surface manifestation of this minor creep movement at the ground surface; however, this movement is believed to have caused deformation (elongation or stretching out of the earth materials comprising the subsurface which in turn causes additional

fracturing of those earth materials) of the Altamira Landslide body, which increased secondary permeability within the rock mass allowing rainfall at the ground surface to percolate more readily into the deep subsurface, raising groundwater levels to a point where they result in high pore pressures that contribute to landslide movement. Between the October 2018 and October 2019 GPS readings (first inflection point), an acceleration of creep movement is evident. Then following the multiple atmospheric river rains of January and February 2023 (second inflection point), a further acceleration of creep movement is evident, which would have resulted in further stretching out and opening up of the landslide mass. The final inflection point around March, 2024 (immediately following the FEMA-declared disaster of January 31-February 9 wherein 8.29 inches of rain fell) shows a dramatic acceleration and **represents the triggering of major movement of the Altamira Landslide**, as reflected by some of the graphed points going very steep and nearly vertical on the graph. The graph includes GPS monitoring point AB-59, which has been the fastest moving point and is not surprisingly located in the center of the entire Altamira Landslide mass.



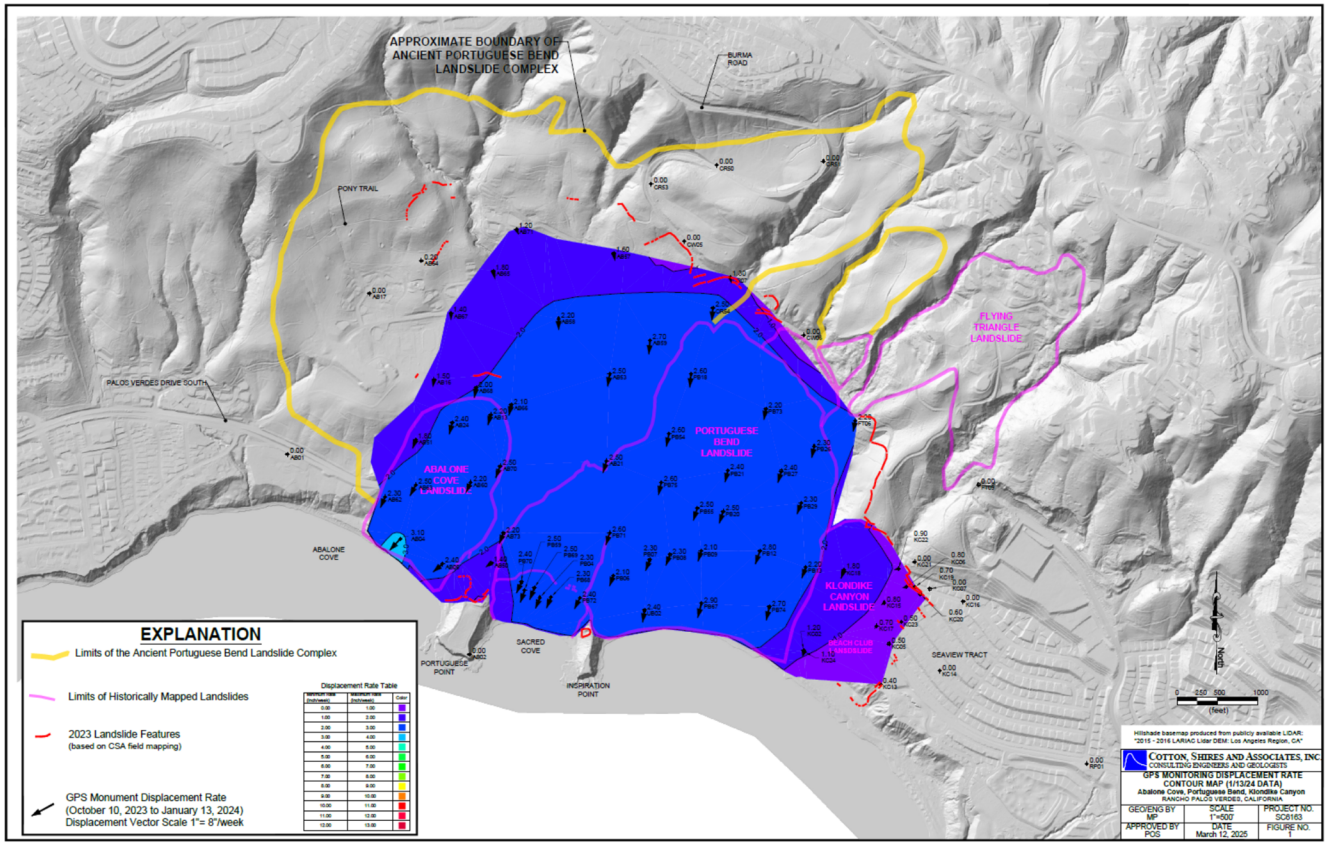
The change in ground movement rates before January 31st and after February 9th 2024 is significant. Based on our comprehensive review of the McGee GPS survey monitoring, the rates of

Altamira Landslide ground movement in the Abalone Cove area (for points north of the previously active ACL) as of January 13, 2024 ranged from 1.2 inches per week (at the periphery) up to 2.7 inches per week (in the body of the landslide). After that intense period of rainfall, plus additional rainfall resulting in a total of over 11 inches in February, as of the GPS survey completed on March 8, 2024, the rates increased to 1.5 (at the periphery) to 5.9 (main body) inches per week, more than doubling in the body of the landslide, and then increased dramatically to as much as 13.5 inches per week in the body of the landslide by July 1, 2024, probably as a slightly delayed reaction to the rainfall as it took time for the water to convert from rainfall absorption to higher groundwater pore pressures where it could have the greatest driving force impact on landslide movement.

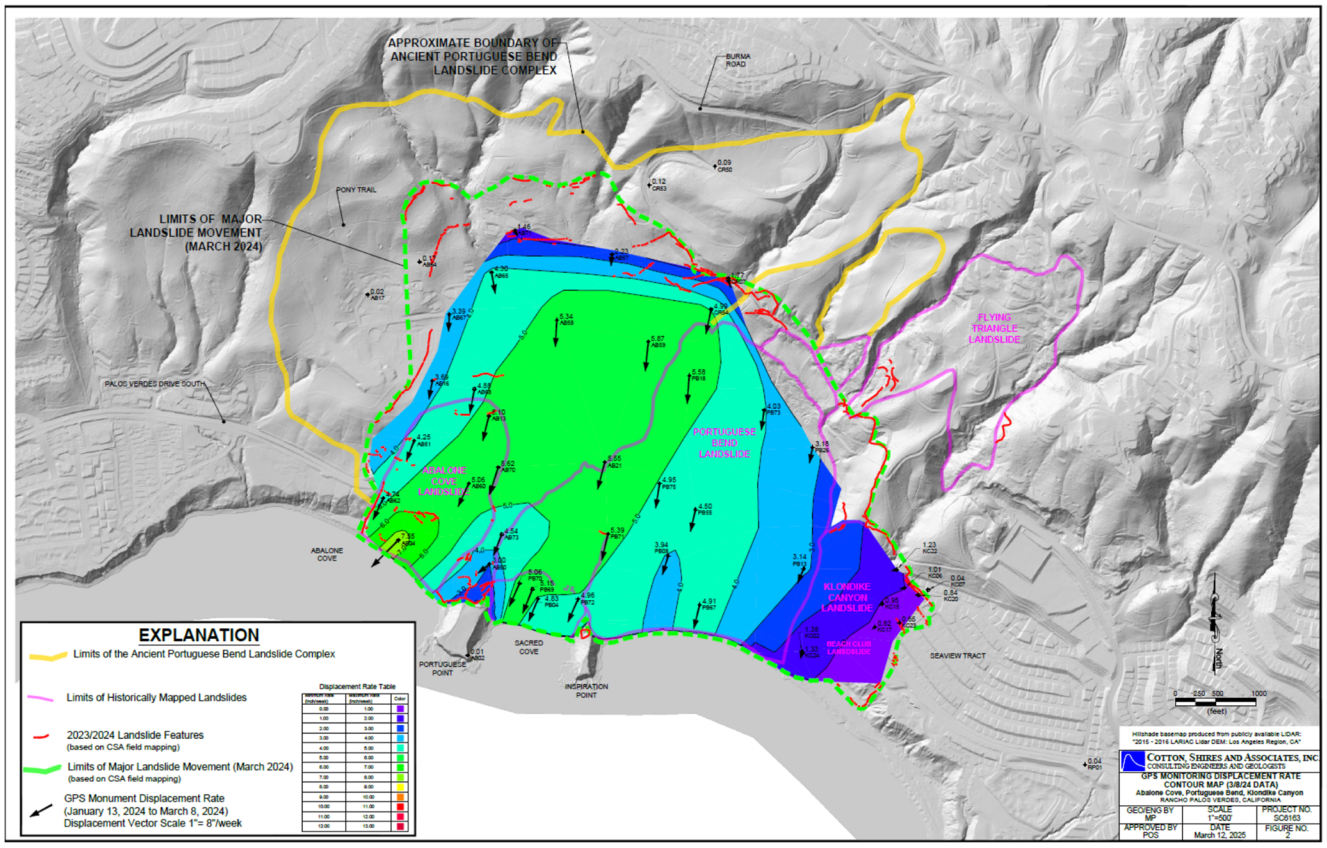
The graphics on the following two pages are "heat maps" that illustrate in color contours the rates at which the ground was moving based on the GPS survey monuments for January 13, 2024, March 8, 2024 and July 1, 2024, respectively. The heat maps include our on-ground geologic mapping of visible land movement features, which started as tension cracks or narrow fissures that were discontinuous (as of December 2023 mapping and are shown on the January 13, 2024 heat map), but these features further developed into more continuous/connected tension cracks and fissures, which have now developed into large scarps, grabens and well-developed boundary features. It wasn't until March 2024 that we first drew a boundary (dashed green line) around the "Area of Major Land Movement", because prior to that time, the surface manifestation of movement was poorly developed and inconsistent and there was not sufficient development of the landslide to develop a boundary. By March 2024, with further mapping and the extraordinary acceleration of numerous GPS monitoring points, a boundary defining the "Area of Major Land Movement" was delineated. Today, following many tens of feet of movement since early 2024, the boundary of the Altamira Landslide is well-defined. North of PV Drive South, the Altamira boundary extends significantly further west of the historical ACL boundary (resulting in the destruction of the landmark Wayfarer's Chapel), upslope through the York property (6001 PV Drive South), and north of the historical ACL boundary through the Portuguese Bend Riding Club Area, crossing upper Narcissa Drive, through and north of residences on upper Cinnamon Lane, and eventually turning east across Altamira Canyon, extending through the Vanderlip Estate (100 Vanderlip Drive), destroying Vanderlip Drive and adjacent properties, and ultimately continuing northeast to the lower stretch of Burma Road Trail in the Portuguese Bend Reserve.

The Altamira Landslide movement also created never-before-seen deformation where it underlies and now extends south of the KCL, including formation of a more seaward toe accompanied by uplifting ground that trended southwest through the beach area of the Portuguese Bend Beach Club and extending up to 500 feet or more offshore where it emerged through the sea floor and formed a new rocky coastline above sea level, generally east of Inspiration Point. The emergence of the new land offshore from the previous coastline was first reported to, and was subsequently observed by the City Geologist in late February of 2024, consistent with the triggering of major movement of the Altamira Landslide described above.

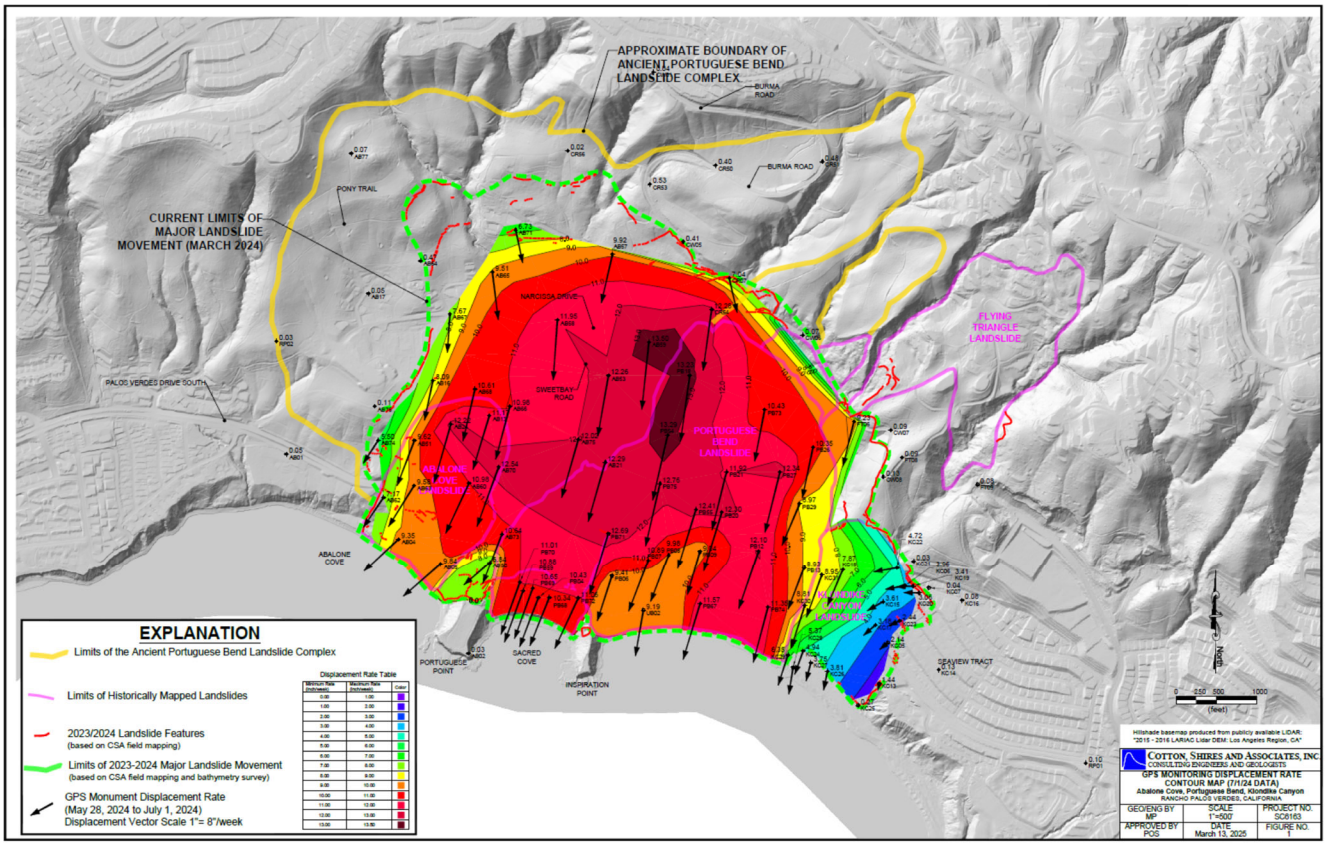
1/13/2024 Heat Map



3/8/2024 Heat Map



7/1/2024 Heat Map

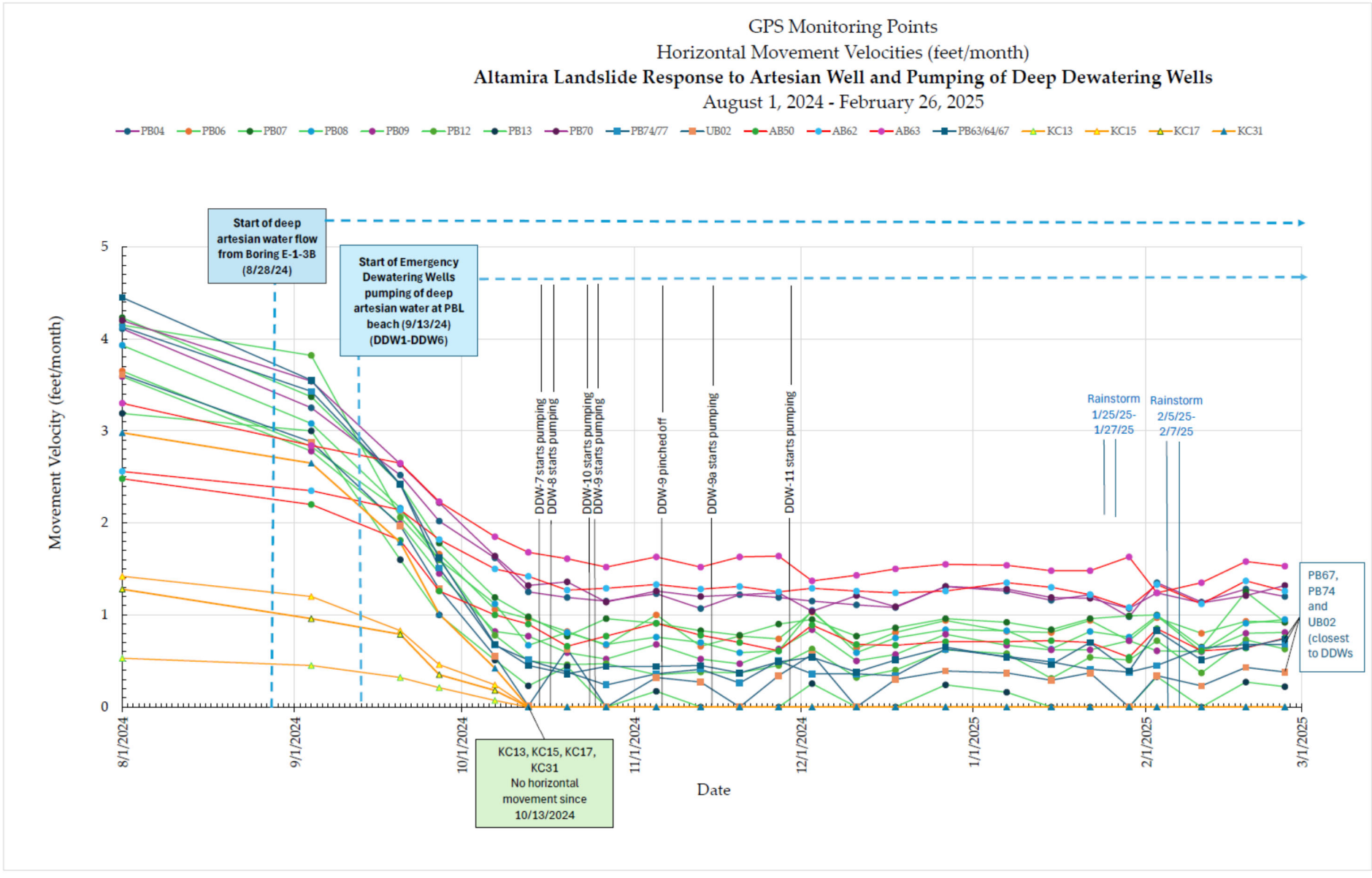


EMERGENCY MEASURES

Emergency measures taken by the City and abatement districts (ACLAD and KCLAD) to date have included drilling, pumping and monitoring deep dewatering wells, winterization measures including lining channels and installing culverts to reduce the amount of surface water percolating into the groundwater regime from upslope drainages/canyons, and filling of and establishing drainage for fissures and grabens that, if left unmitigated, facilitate surface water intrusion into the groundwater regime. This strategy has proven to be effective in reducing the rate of movement of the Altamira Landslide and even stopping movement of the eastern portion of the landslide in the area of the KCL. Because piezometers installed in deep borings that penetrated the base of the Altamira Landslide indicated high groundwater pore pressures beneath the landslide (some areas were found to have near-artesian or artesian groundwater pressures – pressures higher than the ground surface), a pilot program strategy was pursued that involved drilling a series of five deep dewatering wells near the coast to approximately 50 feet below the base of movement and pumping the wells until the landslide movement sheared off the well casings at depth and then re-drilling them to approximately 50 feet beneath the landslide to re-establish the wells so that they could continue to be pumped to dewater the high groundwater pressures beneath the landslide. This strategy turned out to be more successful than originally contemplated because the movement of the landslide slowed quickly in response to the initial dewatering efforts and the deep wells continued to function for weeks or months before re-drilling was necessary.

The chart on the following page illustrates the timing of artesian water being encountered in one of the test borings (Boring E-1-3B, which was retrofitted to function as an artesian well), the installation of the deep dewatering wells, and the deceleration of the Altamira Landslide in response to the dewatering efforts.

Based on the success of the deep dewatering program, we now know that this strategy works. Consequently, the City agreed to loan the landslide abatement districts funding so that they could re-establish wells that were no longer functioning and to establish deep dewatering wells at additional locations as well as to establish additional measures to reduce infiltration of surface water. Additional wells are also needed in the areas that the City controls. Unfortunately the cost of drilling, pumping, maintaining and re-drilling requires significant funding which the City was able to keep up with to a point, but now needs additional funding assistance to keep the wells that have already been established functioning and to establish additional deep dewatering wells in order to reduce the movement of the middle and eastern portions of the Altamira Landslide to the level experienced prior to the impact of climate whiplash.


GPS Monitoring Points
Horizontal Movement Velocities (feet/month)
Altamira Landslide Response to Artesian Well and Pumping of Deep Dewatering Wells
August 1, 2024 - February 26, 2025
PB04 PB06 PB07 PB08 PB09 PB12 PB13 PB70 PB74/77 UB02 AB50 AB62 AB63 PB63/64/67 KC13 KC15 KC17 KC31
Start of deep artesian water flow from Boring E-1-3B (8/28/24)
Start of Emergency Dewatering Wells pumping of deep artesian water at PBL beach (9/13/24) (DDW1-DDW6)
DDW-7 starts pumping
DDW-8 starts pumping
DDW-10 starts pumping
DDW-9 starts pumping
DDW-9 pinched off
DDW-9a starts pumping
DDW-11 starts pumping
Rainstorm 1/25/25-1/27/25
Rainstorm 2/5/25-2/7/25
PB67, PB74 and UB02 (closest to DDWs
KC13, KC15, KC17, KC31 No horizontal movement since 10/13/2024
Movement Velocity (feet/month)
Date
0
1
2
3
4
5
8/1/2024
9/1/2024
10/1/2024
11/1/2024
12/1/2024
1/1/2025
2/1/2025
3/1/2025

City of Rancho Palos Verdes

John Cruikshank, Mayor
Eric Alegria, Mayor Pro Tem
David L. Bradley, Councilmember
Barbara Ferraro, Councilmember
Paul Seo, Councilmember

February 20, 2024

California Office of Emergency Services Disaster Analysis Unit
3650 Schriever Avenue
Mather, CA 95655

SUBJECT: REQUEST FOR A STATE OF EMERGENCY FOR THE GREATER PORTUGUESE BEND LANDSLIDE COMPLEX

To whom it may concern:

On behalf of the approximately 42,000 residents of Rancho Palos Verdes and the approximately 67,000 residents of the Palos Verdes Peninsula, the Rancho Palos Verdes City Council is requesting Governor Newsom invoke his emergency powers pursuant to the Emergency Services Act, Gov't Code § 8550 et seq., and proclaim a State of Emergency for the Palos Verdes Peninsula region to assist the City to stabilize land movement in the greater Portuguese Bend Landslide Complex (Landslide). For reference, see attached map to show the boundaries of the Landslide.

As a result of the 2023 and 2024 winter storms, the City of Rancho Palos Verdes has been impacted by substantial precipitation that has caused an unprecedented acceleration of land movement equating to an annualized rate of 10 feet per year. This significant and sudden increase in land movement is causing severe damage to Palos Verdes Drive South – a major arterial roadway and evacuation route for the Palos Verdes Peninsula; damage and disruption to utility infrastructure including water, sewer, gas line and utility pole breaks; closures of approximately 8 miles of public trails due to slope instability; fissures and sink holes throughout the Palos Verdes Nature Preserve; the closure of residential intersections due to sink holes and ground separation; the temporary closure of the Wayfarers Chapel - a federal and state designated historic landmark; and the red-tagging of homes with many more homes on a watch list due to foundation and structural damage.

On October 3, 2023, the Rancho Palos Verdes City Council adopted a Local Declaration

of Emergency pursuant to Section 8630 of the Government Code, which has been renewed several times as required by that law; the Local Emergency is still in effect.[1] This action was intended to provide immediate access to resources and to assist in expediting remediation measures to stabilize and manage land movement that poses an imminent threat to the public's health, safety, and property. The City's Geologist and Geotechnical Engineering team and the two state-recognized Geologic Hazard Abatement Districts' geologists (Abalone Cove Landslide Abatement District and Klondike Canyon Landslide Abatement District) propose to stabilize land movement by immediately implementing the following:

- Filling fissures to prevent surface water from directly recharging the water table and further lubricating the slip plane.
- Constructing drainage swales, lining certain canyons with non-penetrable membrane, and/or installing flexible drainage pipes to properly convey surface water to the ocean and/or sanitary lines to prevent recharging the water table.
- Installing dewatering wells in the form of horizontal hydraugers and/or vertical dewatering wells to extract groundwater from the slip plane and reducing the local water table.

As the City continues its response and recovery operations, we have determined that these remediation measures must be implemented immediately to minimize the threat to the public's health, safety, and property. Therefore, the City Council requests, pursuant to the authority provided by the Act, and specifically by Sections 8571 and 8625 of the Government Code, that the Governor declare a State of Emergency for the City of Rancho Palos Verdes, waive and/or suspend certain state laws and permits required by local and state agencies that include, but are not limited to, the California Coastal Commission, the California Department of Fish and Wildlife, the Regional Water Quality Control Board, the State Water Resources Control Board, the South Coast Air Quality Management District, and other State agency permits or review processes. Finally, the City Council requests the Governor waive any requirements under the California Environmental Quality Act and its implementing regulations related to the approval and implementation of the remediation measures set forth above. Additionally, the City is requesting that the Governor submit a request to the President of the United States for a Federal Emergency Declaration pursuant to the Stafford Act, 42 U.S.C. §§ 5121-5207.

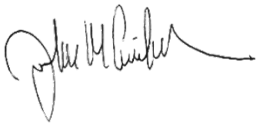
The City has identified that permits would be required by the aforementioned state agencies prior to proceeding any landslide stabilization work. Suspension of these requirements will allow the City and the Geologic Hazard Abatement Districts to immediately proceed with construction and installation of the enumerated measures to stabilize the Landslide without the costs and time delays typically experienced with obtaining permits. It is imperative that the City and two Geologic Hazard Abatement Districts are able to expedite the installation of dewatering wells and surface drains knowing that we are in an El Niño winter pattern with repeated atmospheric rivers

[1] The City also adopted an Interim Urgency Ordinance pursuant to Section 65958 of the Government Code, which effected a moratorium on all construction in the Landslide, with some limited exceptions.

forecasted to extend into spring, and every rain event is exacerbating the rate of land movement.

Please contact City Manager Ara Mihranian at aram@rpvca.gov or by telephone at 310-544-5202.

Sincerely,



John Cruikshank
Mayor

Attachments:

- Portuguese Bend Landslide Complex Map
- Information on the Portuguese Bend Landslide including resolutions adopting and extending the City's Proclaimed Local Emergency can be found on the City's website at: www.rpvca.gov/landslide

cc:

Laphonza Butler, U.S. Senator, California
Alex Padilla, U.S. Senator, California
Ted Lieu, U.S. Representative, 36th Congressional District
Ben Allen, Senator, 24th State Senate District
Al Muratsuchi, Assemblymember, 66th Assembly District
Janice Hahn, L.A. County Supervisor, 4th District
Kevin McGowan, Director, L.A. County Office of Emergency Management
Brandy Villaneuva, Disaster Manager Area Coordinator, L.A. County Area G
Rancho Palos Verdes City Council

CREST ROAD

BURMA ROAD

PONY TRAIL

ANCIENT PORTUGUESE BEND LANDSLIDE COMPLEX

NARCISSA DRIVE

FLYING TRIANGLE LANDSLIDE

PALOS VERDES DRIVE SOUTH

SWEETBAY ROAD

ABALONE COVE LANDSLIDE

PORTUGUESE BEND LANDSLIDE

KLONDIKE CANYON LANDSLIDE

ABALONE COVE

SACRED COVE

PORTUGUESE POINT

INSPIRATION POINT

SEAVIEW TRACT

North

0 250 500 1000

(feet)

EXPLANATION

- Limits of the Ancient Portuguese Bend Landslide Complex
- Limits of Historically Mapped Landslides
- 2023 Landslide Mapping
- Current Limits of Major Landslide Movement (February 2024)

Hillshade basemap produced from publicly available LiDAR: "2015 - 2016 LARIAC Lidar DEM: Los Angeles Region, CA"

COTTON, SHIRES AND ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS

LANDSLIDE MAPPING UPDATE 2/20/24
Abalone Cove, Portuguese Bend, Klondike Canyon
RANCHO PALOS VERDES, CALIFORNIA

GEO/ENG BY	SCALE	PROJECT NO.
MP	1"=500'	SC6163
APPROVED BY	DATE	FIGURE NO.
POS	February 2024	1

CITY OF RANCHO PALOS VERDES
ADMINISTRATION DEPARTMENT
CITY MANAGER'S OFFICE

March 17, 2025

Via email and Grants Portal

Mr. Robert Fenton
FEMA District No. 9 Administrator

Robert Larsen, Public Assistance Officer
California Office of Emergency Services

Subject: Appeal of FEMA's Eligibility Determination, Project Number 754843
FEMA-4769-DR-CA, California's Severe Winter Storms, Tornadoes, Flooding, Landslides, and Mudslides (Damage Inventory No. 1385928, 1385929)

Dear Messrs. Robert Fenton and Robert Larsen,

On April 13, 2024, the President declared a major disaster (**FEMA-DR-4769-CA**) in the State of California due to damages from severe winter storms, tornadoes, flooding, landslide and mudslides with an incident period of **January 31 through February 9, 2024**. The declared disaster by the President is similar to a federal disaster declared on April 3, 2023 for California Severe Winter Storms, Straight-Line Winds, Flooding, Landslides and Mudslides that occurred between **February 21, 2023 and July 10, 2023 (DR-4699-CA)**.

On May 9, 2024, the City of Rancho Palos Verdes (City) filed for disaster aid cost recovery for the City's response to the 2024 winter storms. In total, the City filed applications totaling $38.4 million.

On January 17, 2025, the City received FEMA's Eligibility Determination Memorandum **denying** in full the City's request for $11,635,000 to conduct permanent repairs to collector and residential streets damaged by the winter storms that occurred between January 31 and February 9, 2024. The denial cites the following reasons:

- Pre-disaster ground instability and on-going non-disaster related causes.
- Disaster damage was not a result of the declared disaster event.
- Pre-existing conditions of landslide.

According to Section 102.1 and 102.2 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, an "Emergency" means *any occasion or instance for which, in the determination of the President, Federal assistance is needed to supplement State and local efforts and capabilities to save lives and to protect property and public health and safety, or* ***to lessen or avert the threat of a catastrophe (emphasis added)*** *in any part of the United States*. Moreover, a "Major Disaster" *means any natural catastrophe*

(including any hurricane, tornado, storm, high water, winddriven water, tidal wave, tsunami, earthquake, volcanic eruption, ***landslide (emphasis added)****, mudslide, snowstorm, or drought), or, regardless of cause, any fire, flood, or explosion, in any part of the United States, which in the determination of the President causes damage of sufficient severity and magnitude to warrant major disaster assistance under this Act to* ***supplement the efforts and available resources of States, local governments, and disaster relief organizations in alleviating the damage, loss, hardship, or suffering caused thereby (emphasis added)****.*

The City's disaster recovery request was submitted to FEMA based on the aforementioned definitions found in the Stafford Act and the declared major disaster resulting from winter storms of 2024 that **contributed to a significant and documented acceleration of land movement caused by the activation of a <u>new</u> historic and previously dormant landslide known as the Altamira Landslide** within the Greater Portuguese Bend Landslide Complex (Landslide Complex).

According to the City Geologist's reports to the City Council in 2024, the **Altamira Landslide is a deeper slip plane that the Landslide Complex "rafted" on top of as a direct result of the unprecedented and record rainfall during the 2024 winter storm event resulting in the shallower slip plane of the Landslide Complex to move more than it ever did before in its documented history**. Contrary to FEMA's Eligibility Determination Memorandum, what is **not pre-existing** are the areal dimensions, depth of movement, velocity of movement, artesian and near-artesian groundwater pressures beneath it, and even direction of movement. The land movement experienced as a result of the 2024 winter storms is not just a simple **expansion** of the Landslide Complex, but is an **entirely different, larger and deeper landslide with much broader boundaries** (including the new coastline offshore at the Portuguese Bend Beach Club), nearly twice as deep in some areas, and unprecedented rates of movement. None of this was seen during the history of the City, nor during the approximately 70-year history of landslide studies, monitoring, and observations conducted in the area, contrary to what is noted in the Eligibility Determination Memorandum. It is the opinion of the City and its subject matter experts, that will be discussed in this appeal letter, that this is largely caused by "weather whiplash" (induced by climate change) starting in 2011.

The City respectfully requests that you, as FEMA's District No. 9 Administrator, reverse the eligibility denial and uphold the City's appeal based on facts, data and other pertinent information found in this appeal letter that will clearly demonstrate that a new landslide was activated causing an acceleration of land movement as a direct result of the 2024 winter storms resulting in costly and significant damage to the City's infrastructure. The City firmly believes that this **appeal letter** will demonstrate that the requested cost recovery work complies with Title 44 of C.F.R. Section 206.223(a)(1) in that the financial assistance requested is directly related to the winter storms of 2024. As such, the City is requesting $11,635,000 to conduct permanent repairs to collector and residential streets damaged by the winter storms that occurred between January 31 and February 9, 2024.

Historic Background

As noted in the January 17, 2025 Eligibility Determination Memorandum and throughout various City records, the Landslide Complex is a known ancient landslide that was activated in 1956 when, prior to the City's 1973 incorporation, Los Angeles County was expanding Crenshaw Boulevard to Palos Verdes Drive South and its grading efforts combined with ground water, activated the Portuguese Bend Landslide. Land movement has not stopped since 1956 but has been managed at a slow creep to no movement for years through remediation efforts implemented by the City and its two geologic hazard abatement districts, Abalone Cove Landslide Abatement District (ACLAD) and Klondike Canyon Landslide Abatement District (KCLAD).

The Landslide Complex, historically existing for thousands of years, encompasses the following four sub-landslide areas in the City: the Portuguese Bend Landslide (PBL), the Abalone Cove Landslide (ACL), the Klondike Canyon Landslide (KCL), and the Beach Club Landslide (BCL). As noted above, in 1956, the PBL began moving, then in 1979, ACL and KCL began moving with the BCL, which is nested within the KCL and, while dormant itself, moves with the KCL. The Landslide Complex also includes areas outside of those known landslides, predominantly uphill from the PBL and ACL, within the ancient Landslide Complex as mapped by various agencies (i.e., U.S. Geological Survey and California Geological Survey) and other researchers. This fifth landslide is in the City of Rolling Hills and is known as the Flying Triangle Landslide.

According to a November 8, 2024 report prepared by the City Geologist, Mike Phipps of Cotton Shires and Associates (CSA) (Attached), the PBL has been continuously active since reactivation in 1956 with many areas of the landslide having moved hundreds of feet seaward over the ensuing seven decades. The ACL was active from 1979 **until the late 1990's**, involving only several feet of movement, when dewatering and other mitigation efforts largely halted movement. An **imperceptible creep movement** of the ACL has occurred over the past 25 years **following rainy seasons that were significantly above average rainfall amounts.** The KCL has been episodically active in 1979-1983 and 2005-2006, experiencing only several inches of movement, typically in response to significantly above average rainfall. Landslide movements throughout the Landslide Complex **outside of the historical boundaries of** the ACL and PBL previously exhibited low rates of creep movement, or movement at or near the instrument precision range, in the 11-year monitoring period of 2007-2018.

Impacts of Rainwater

These landslides are deep translational-type failures within seaward-dipping strata of the Monterey Formation, with the landslide slip surfaces occurring within very weak bentonitic clay beds. Historically, the movement behavior of these landslides routinely exhibited high sensitivity to increased groundwater pore pressure, and increased rates of land movement which have been **correlative with 6-to-12-months of antecedent rainfall that was well above average**. Similarly, land movement decreased during below

average rainy seasons or multi-year periods of drought.

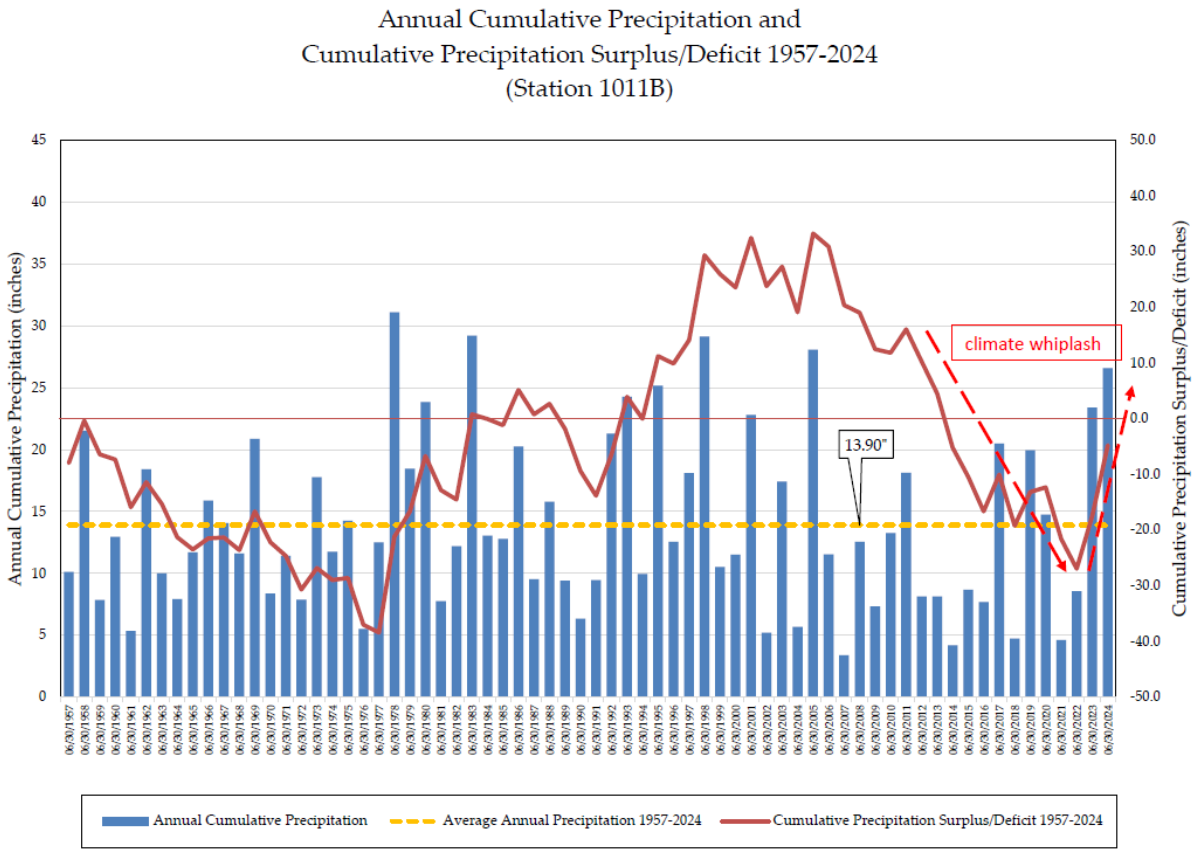
Simply stated, numerous studies conducted over approximately seven decades all point to water as being the primary contributor to land movement, particularly rainwater. Rainwater runoff is known to penetrate the ground through fissures during a rain event and recharge the ground water table. During particular significant rain events or seasons, runoff that enters the ground may take months to show signs of land movement. Depending on where rain runoff enters the ground, it can settle below the slip plane thereby resulting in artesian pressure or settle above the slip plane, which is made up of volcanic ash known as bentonite and lubricates the slip plane resulting in horizontal movement.

Changes in climate over the years, now commonly referred to as “weather whiplash” has resulted in extreme weather in Southern California including extended periods of dry weather followed by severe wet weather in the form of atmospheric rivers as experienced in 2023 and 2024. This extraordinary wet weather resulted in the President declaring a major federal disaster in both 2023 and 2024. Underscoring how extreme weather has become over the years, in August 2023, California, particularly Southern California, experienced days of record rain in August 2023 as a result of Tropical Storm Hillary.

Extreme wet weather patterns have proven to contribute towards the change in behavior of the Landslide Complex. Beginning in 2021, the City Geologist began reviewing Global Positioning Satellite (GPS) monitoring data for survey monuments within the entire Landslide Complex. Review of GPS monitoring data from 2007 through 2024 indicated that land movement acceleration initially began between 2018 and 2019. This acceleration was correlative with significantly above-normal rainfall in two out of three prior rainfall seasons (2016-17 and 2018-19) which followed five consecutive drier than normal rainfall seasons (2011-12 through 2015-16).

Another way to look at this is to analyze annual rainfall deviations from the mean, and tally up those cumulative deviations over time, as a measure of *precipitation* surplus/deficit that is impacting the area. According to the graphic on the following page, in which the dark red line shows the precipitation surplus/deficit over time, note the precipitous drop particularly from 2011-2022, which whipsaws back to a steep climb from 2022-2024. Weather whiplash is illustrated by the red arrows, showing the impact of the dry years (rapidly declining surplus/deficit curve) quickly reversing to a steep inclining surplus/deficit curve. It doesn't matter that this all happened in *deficit* territory on the graph, because it followed a two-decade long period of precipitation surplus. It is reasonable to say that two decades of precipitation surplus between 1991 and 2011 might have contributed to **strain-softening** of the Altamira failure surface clays, as the landslide imperceptibly crept and stretched out. It follows that this generally prolonged period of drying commencing in 2011, followed by a short, huge pulse of wetting between 2022-2024, is what **triggered** the massive previously inactive Altamira Landslide to move in 2024.

It is also worth noting that 8.29 inches of rain fell at the Rolling Hills Fire Station rain gauge during the 10-day FEMA disaster window. Keep in mind, the mean (average) for the 57-year rainfall data set is currently 13.88 inches/year and the standard deviation of the entire 57-year dataset is a whopping 7 inches/year, indicating very high variability in annual rainfall. In other words, more rain fell in the 10-day FEMA disaster window than the standard deviation for the entire 57-year rainfall data set. Underscoring that this wet weather behavior was an extraordinary event.



Significant accelerations in movement velocity were documented in May 2023 following major storm sequences in January, February and March of 2023, which added to cumulative seasonal rainfall totals exceeding 193% of average rainfall. Approximately 87% of this rain fell prior to June 18, 2023. Most of this rainfall occurred from three significant atmospheric river-type storm sequences occurring on January 9-16 (3.59 inches), February 23-March 1 (3.79 inches) and March 10-15 (4.12 inches). Land movement velocities further increased as of the July 15, 2023 monitoring. An anomalous tropical storm (Tropical Storm Hillary) dropped an additional 3.05 inches of rain on August 19 through August 20, 2023, resulting in further land movement acceleration as of the October 10, 2023 monitoring.

Furthermore, accelerated ground movement occurred throughout the Landslide Complex during and following the 2022-23 rainy season which was more than 220% of the historical

average rainfall. Based upon the GPS monitoring survey on January 13, 2024, average land movement velocities within the Landslide Complex since October 10, 2023 have accelerated by a factor of three to four times compared to the previous 12 month (Oct 2022-Oct 2023) monitoring period. Expressed another way, the total movement over the 3 month period of October 2023 through January 2024 is nearly equal to, and in some cases exceeds, the total movement over the previous entire year's monitoring period (i.e., October 2022 through October 2023). Movement of this magnitude has not been previously observed or documented in the ancient landslide complex north of the historical boundaries of the ACL, PBL and KCL.

An example of this is highlighted by six GPS monitoring points in the upper ancient landslide area, in the vicinity of upper Narcissa Drive and uphill from it. These survey monuments have experienced average displacements of 4.07 feet over the past 15 months (3.26 feet on an annualized basis). Average displacements for these six points over the prior annual monitoring period (Sept 28, 2021-Oct 10, 2022) were 0.36 feet. This represents approximately a 9-fold increase in total land movement on an annualized basis. **Two GPS monitoring points near the toe of the Abalone Cove Landslide moved an average of 0.76 feet (Sept 2021-Oct 2022) to 7.30 feet (Oct 2022-Jan 2024) over the same periods, a 9.6-fold increase in displacement**.

Activation of the New Altamira Landslide

According to the City Geologist's Memorandum dated November 8, 2024 and March 16, 2025 (Attached), total landslide movements in the upper ancient landslide area are significant and greatly exceed what has been observed over the past seven decades. The Altamira Landslide is a **newly** active landslide that has occurred within a previously mapped ancient Landslide Complex (most recently labeled the "Ancient Altamira Landslide Complex" which was a name modification of the "Ancient Portuguese Bend Landslide" identified on the California Geological Survey's Landslide Inventory Map (CGS, 2007) which is referred to as the Landslide Complex in this appeal letter). See map on the following page.

It is important to make this distinction for consistency and to avoid confusion, because the Altamira Landslide is, in fact, a new member of the historically active Landslide Complex but largely **underlies it** and occupies an area of active land movement >700 acres and extends to more than 500 feet off of the coastline, whereas the shallower historically active Landslide Complex only occupied about 380 acres.

The Altamira Landslide in Rancho Palos Verdes is therefore a recently identified large landslide that largely underlies (and therefore largely encompasses but exceeds the area of) the previously understood active Landslide Complex containing the four historically active landslides. The Altamira Landslide includes large areas outside of the historically mapped boundaries of these known landslides, predominantly upslope and downslope from the historically mapped PBL and ACL, within, but smaller than, the Landslide Complex as shown on the map on the following page.

To provide an example of the change in size, the dimensions from head to toe of the previously historical ACL is 2,250 feet and the width up to 1,450 feet wide. The dimensions from head to toe of the Altamira Landslide, underlying and extending up and down slope from both the PBL and the ACL, is 5,800 feet (more than double that of the ACL) with a width of up to 7,400 feet wide (more than five times as wide as the ACL).

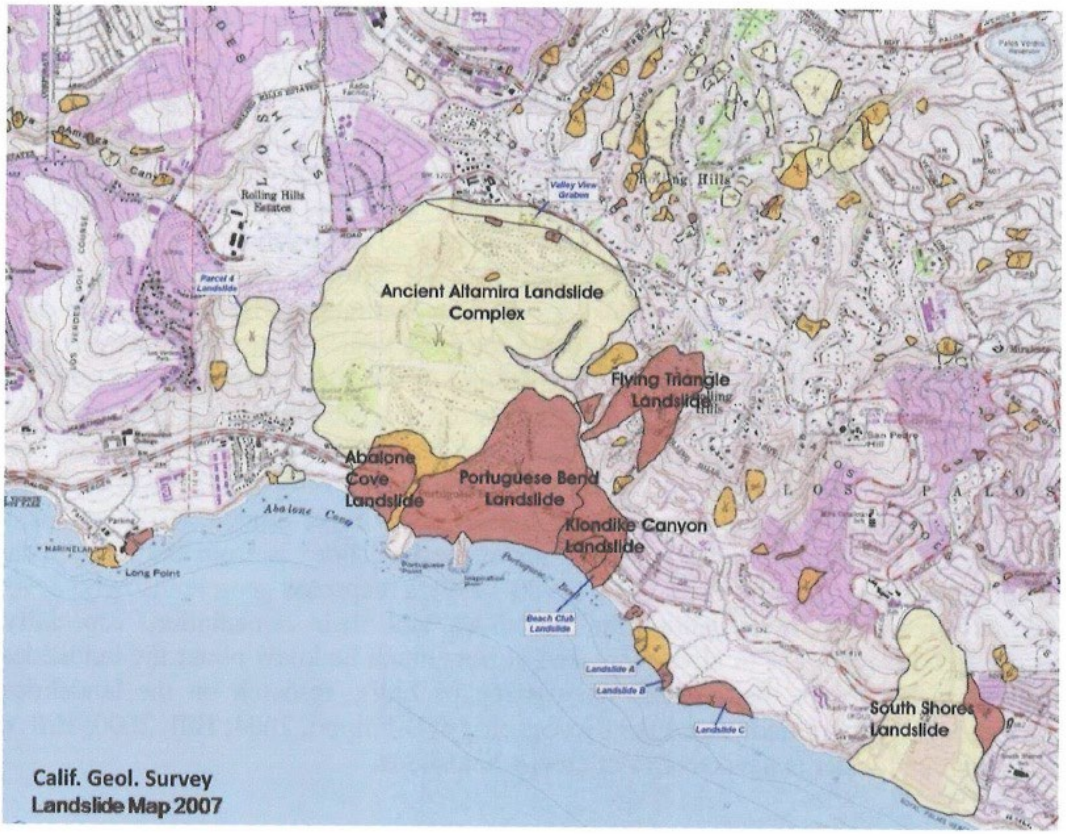


Figure 1. Landslide map of a portion of the south flank of the Palos Verdes Peninsula prepared by the California Geological Survey (2007). The major and some minor landslides are identified. Light yellow indicates that the landslide is inactive, red is active and orange is dormant.

While previous geotechnical investigators identified inactive deep failure surfaces in both the historically active and ancient landslide areas, none of them mapped or identified as active the entire depth or breadth of movement that has recently impacted the area, nor did they opine that such an event would occur in historic times. The areal dimensions, depth of movement, velocity of movement, artesian and near-artesian groundwater pressures beneath it, and even the direction of movement, are different than the ACL, PBL, and KCL landslides, collectively referred to as the Landslide Complex. The distinction to be made then, is that the Altamira Landslide is not just simple *expansion* of an existing group of landslides, **it is an entirely different, larger and deeper landslide with much broader boundaries (including the new coastline offshore), nearly twice as deep as the depth of historic landslide movement in some areas, and with**

unprecedented rates of movement (which were not seen in the early LA County Engineer surveys, the Charles Abbott Associates surveys beginning in 1994, nor the McGee surveys since 2007). None of this was experienced during the history of the City, and the Altamira Landslide is a unique landslide not characterized in its current dimensions during the over 70-year history of landslide investigations, exploratory borings, monitoring and observations being conducted in the area.

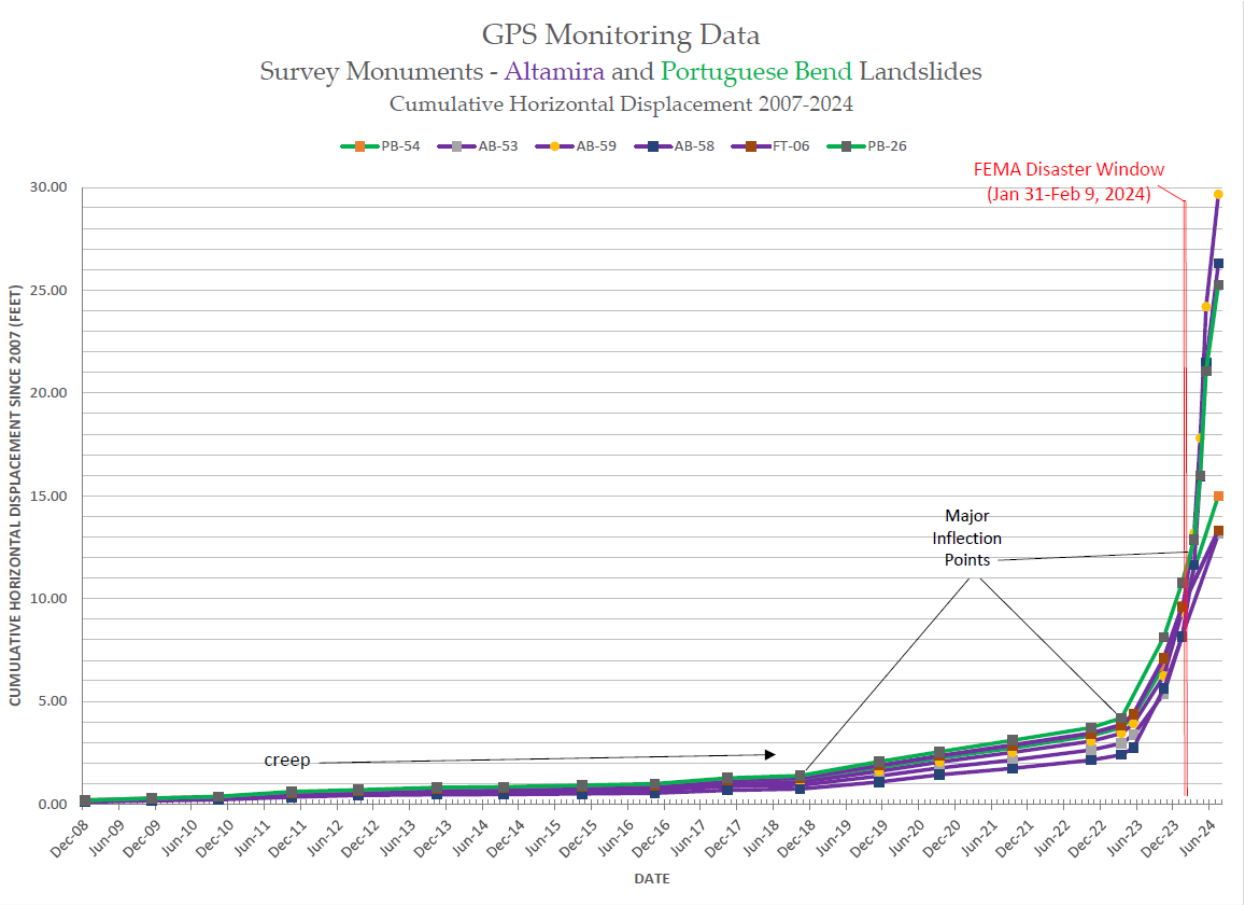
Land movement correlated to the Altamira Landslide continues to manifest at the ground surface in the form of landslide scarps, fissures, grabens/sinkholes, tensional cracking, and shear zones. Field mapping corroborates the GPS monitoring data, indicating that a large portion of the ancient Altamira Landslide above the historically mapped Landslide Complex (PBL, ACL and KCL boundaries) is now involved in significant active landslide movement that is impacting trails, roads, drainage facilities, and private property and continues to have the potential to impact above and below ground utility infrastructure (i.e., utility lines, gas lines, water lines, communication lines, etc.).

Causation

The activation of the Altamira Landslide was largely caused by "climate whiplash" (also more technically described as hydroclimate volatility) induced by climate change, particularly starting in 2011, with five years of drought, and eight out of eleven years significantly below normal rainfall from 2011-2022, followed by two consecutive extraordinarily heavy rain seasons that dropped approximately 4 feet of rainfall on the landslide and surrounding areas draining into the landslide on the south flank of the Palos Verdes Hills.

The graphic on the following page depicts *cumulative horizontal displacement* of select GPS survey monitoring points, including some of the fastest moving points in the Altamira Landslide and a couple of representative points in the PBL (which overlies the Altamira Landslide). There are three significant inflection points indicated in the graph. Prior to the first inflection point, the cumulative displacement lines indicate that the GPS monitoring points within the Altamira Landslide were creeping quite slowly (imperceptibly, near the range of instrument precision) for a number of years extending back before 2011. There was no observed or documented surface manifestation of this minor creep movement at the ground surface; however, this movement is believed to have caused deformation (elongation or stretching out of the earth materials comprising the subsurface which in turn causes additional fracturing of those earth materials) of the Altamira Landslide body, which increased secondary permeability within the rock mass allowing rainfall at the ground surface to percolate more readily into the deep subsurface, raising groundwater levels to a point where they result in high pore pressures that contribute to landslide movement. Between October 2018 and October 2019 GPS readings (first inflection point), an acceleration of creep movement is evident. Then following the multiple atmospheric river rains of January and February 2023 (second inflection point), a further acceleration of creep movement is evident, which would have resulted in further stretching out and opening up of the landslide mass. The final inflection point around March, 2024

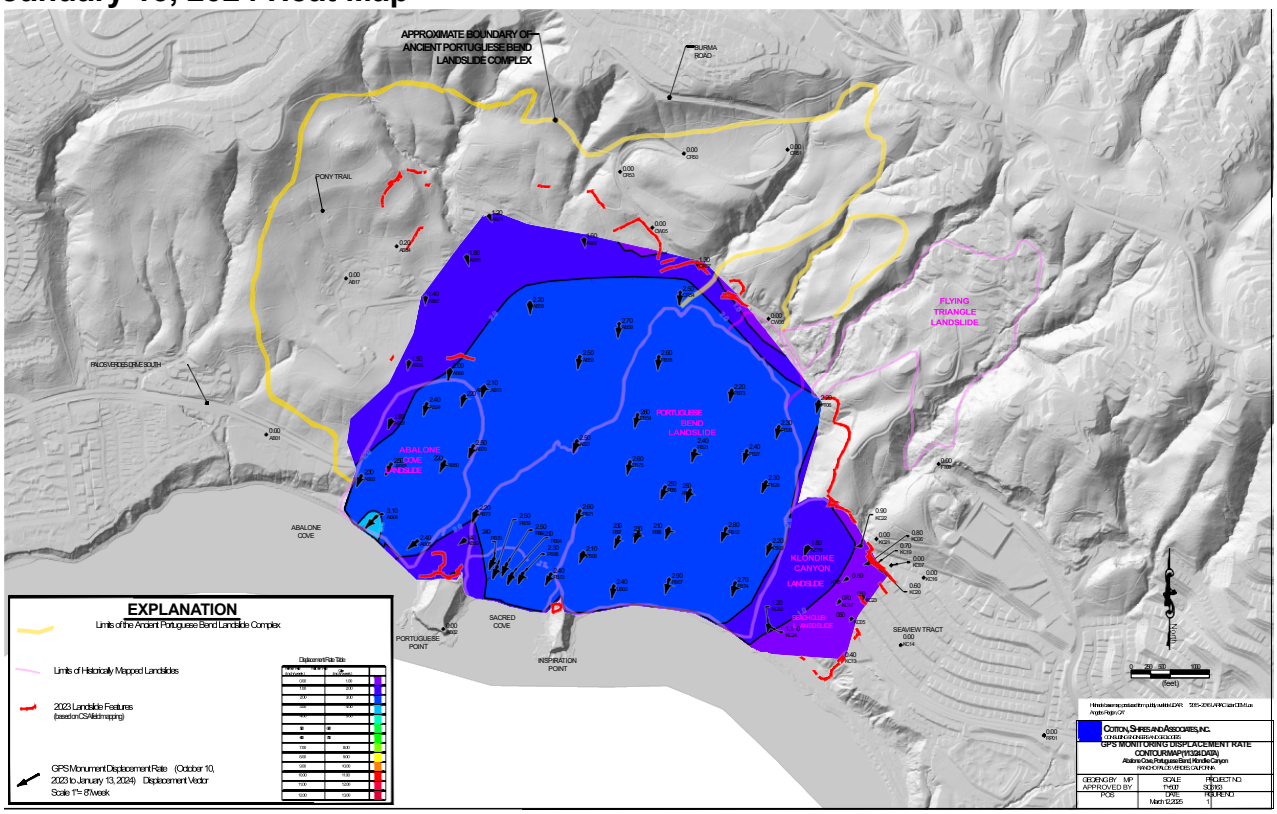
(immediately following the FEMA declared disaster of January 31-February 9 wherein 8.29 inches of rain fell) shows a dramatic acceleration and **represents the triggering of major movement of the Altamira Landslide**, as reflected by some of the graphed points going very steep and nearly vertical on the graph. The graph includes GPS monitoring point AB-59, which has been the fastest moving point and is not surprisingly located in the center of the entire Altamira Landslide mass.



The change in ground movement rates before January 31 and after February 9, 2024 is significant. Based on a comprehensive review of the McGee GPS survey monitoring, the rates of Altamira Landslide ground movement in the Abalone Cove area (for points north of the previously active ACL) as of January 13, 2024 ranged from 1.2 inches per week (at the periphery) up to 2.7 inches per week (in the body of the landslide). After that intense period of rainfall, plus additional rainfall resulting in a total of over 11 inches in February, as of the GPS survey completed on March 8, 2024, the rates increased to 1.5 (at the periphery) to 5.9 (main body) inches per week, more than doubling in the body of the landslide, and then increased dramatically to as much as 13.5 inches per week in the body of the landslide by July 1, 2024, probably as a slightly delayed reaction to the rainfall as it took time for the water to convert from rainfall absorption to higher groundwater pore pressures where it could have the greatest driving force impact on landslide movement.

The following graphics are “heat maps” that illustrate in color contours the rates at which the ground was moving based on the GPS survey monuments for January 13, 2024, March 8, 2024 and July 1, 2024, respectively. The heat maps include the City’s on-ground geologic mapping of visible land movement features, which started as tension cracks or narrow fissures that were discontinuous (as of December 2023 mapping and are shown on the January 13, 2024 heat map), but these features further developed into more continuous/connected tension cracks and fissures, which have now developed into large scarps, grabens and well-developed boundary features. It wasn’t until March 2024 that the City Geologist’s first drew a boundary (dashed green line) around the “Area of Major Land Movement”, because prior to that time, the surface manifestation of movement was poorly developed and inconsistent and there was not sufficient development of the landslide to develop a boundary.

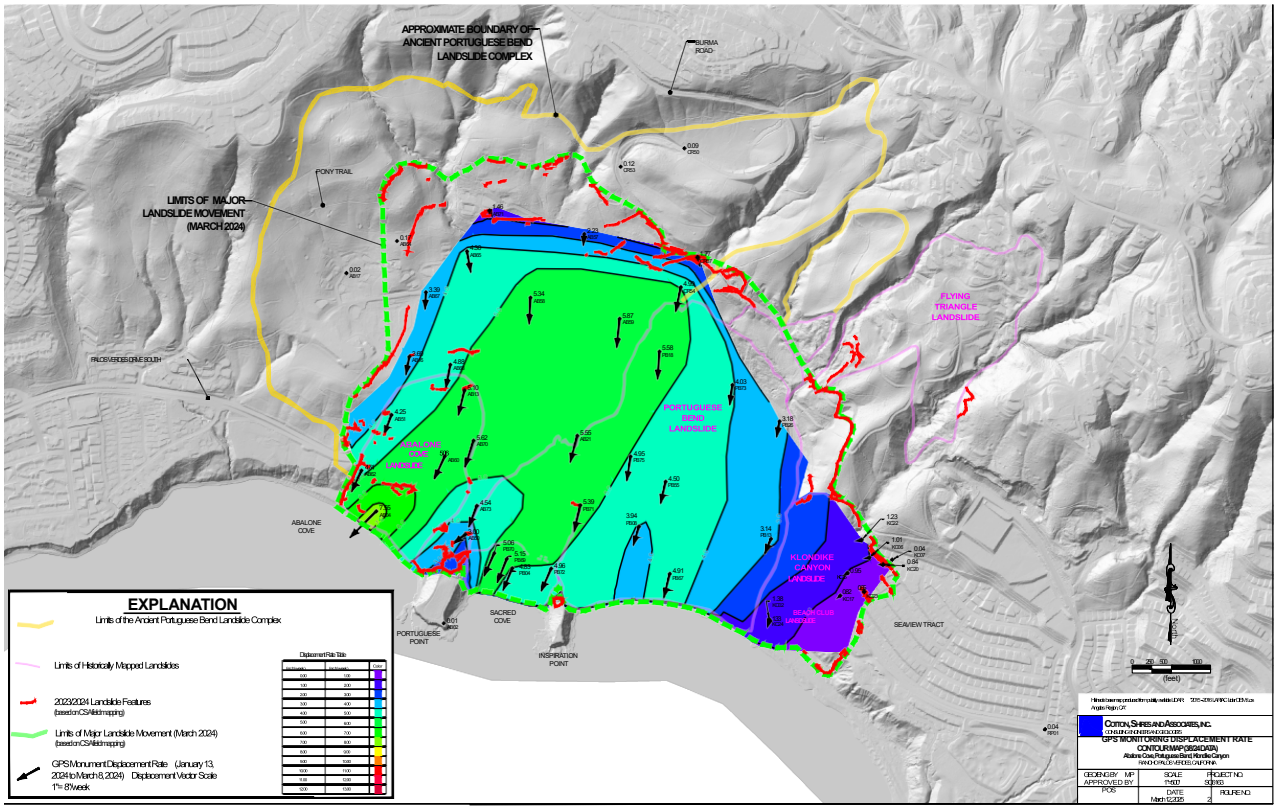
January 13, 2024 Heat Map



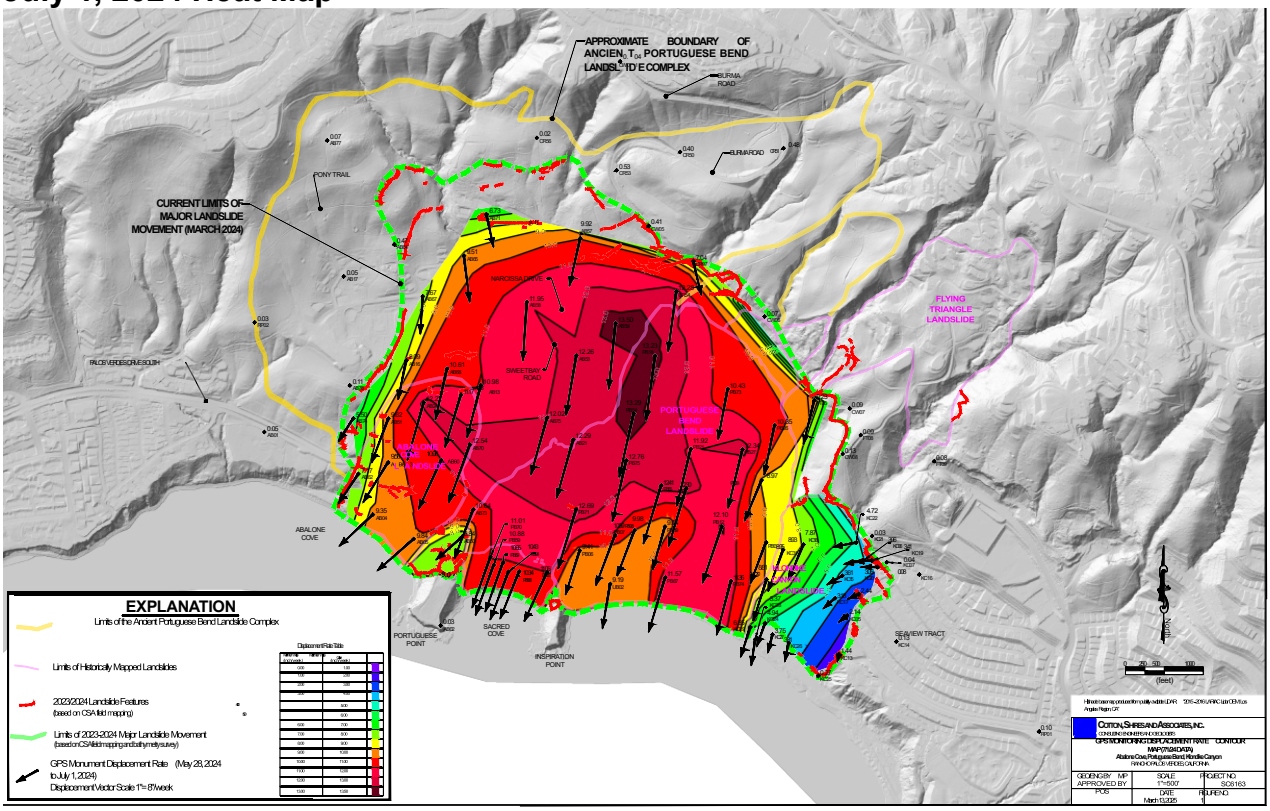
By March 2024, with further mapping and the extraordinary acceleration of numerous GPS monitoring points, a boundary defining the “Area of Major Land Movement” was delineated. Today, following many tens of feet of movement since early 2024, the boundary of the Altamira Landslide is well-defined. North of Palos Verdes Drive South, the Altamira boundary extends significantly farther west of the historical ACL boundary (resulting in the destruction of the landmark Wayfarer’s Chapel), upslope through the York property (6001 PV Drive South), and north of the historical ACL boundary through the Portuguese Bend Riding Club Area, crossing upper Narcissa Drive, through and north of

residences on upper Cinnamon Lane, and eventually turning east across Altamira Canyon, extending through the Vanderlip Estate (100 Vanderlip Drive), destroying Vanderlip Drive and adjacent properties, and ultimately continuing northeast to the lower stretch of Burma Road Trail in the Portuguese Bend Reserve. The Altamira Landslide also created never before seen deformation where it underlies and now extends south of the KCL, including formation of a more seaward toe accompanied by uplifting ground that trended southwest through the beach area of the Portuguese Bend Beach Club and extending up to 500 feet or more offshore where it emerged through the sea floor and formed a new rocky coastline above sea level, generally east of Inspiration Point. The emergence of the new land offshore from the previous coastline was first reported to, and was subsequently observed by, the City Geologist in late February of 2024, consistent with the triggering of major movement of the Altamira Landslide described above.

March 8, 2024 Heat Map



July 1, 2024 Heat Map



<u>Impacts of Movement of The Altamira Landslide</u>

As of this date, the major land movement of the Altamira Landslide has resulted in the red-tagging (Unsafe to Enter/Occupy) and yellow-tagging (Limited Entry) of dozens of residential and commercial structures. It has also caused major destructive impacts to public and private roads, damages to drainage facilities and utility infrastructure (water, sewer, gas, electricity and cable), causing certain utilities to be shut-off, and closure of certain Preserve land that is otherwise heavily accessed by the public for hiking, biking, equestrian, and other purposes.

To reiterate, the damage the City sustained as a result of the winter storms of 2024 is attributed to the activation of the deeper slip plane, known as the Altamira Landslide, that has historically been inactive until the 2024 winter storms. The activation of this new landslide that carried the shallower landslide, referred to as the Landslide Complex herein, is **not** pre-existing and therefore invalidates the reason for denying the City's disaster cost recovery request.

The only practical mitigation measure available to address a landslide with such a colossal scale is relieving groundwater pore pressures through pumping of groundwater, but it has to be done on a large enough scale to be effective at reducing the movement to an acceptable level. This technique has proven effective for the east side of the

Altamira Landslide where deep dewatering wells have been installed, maintained and the rate of ground movement monitored such that a correlation between increased pumping of groundwater and reduction in the rate of ground movement has been confirmed.

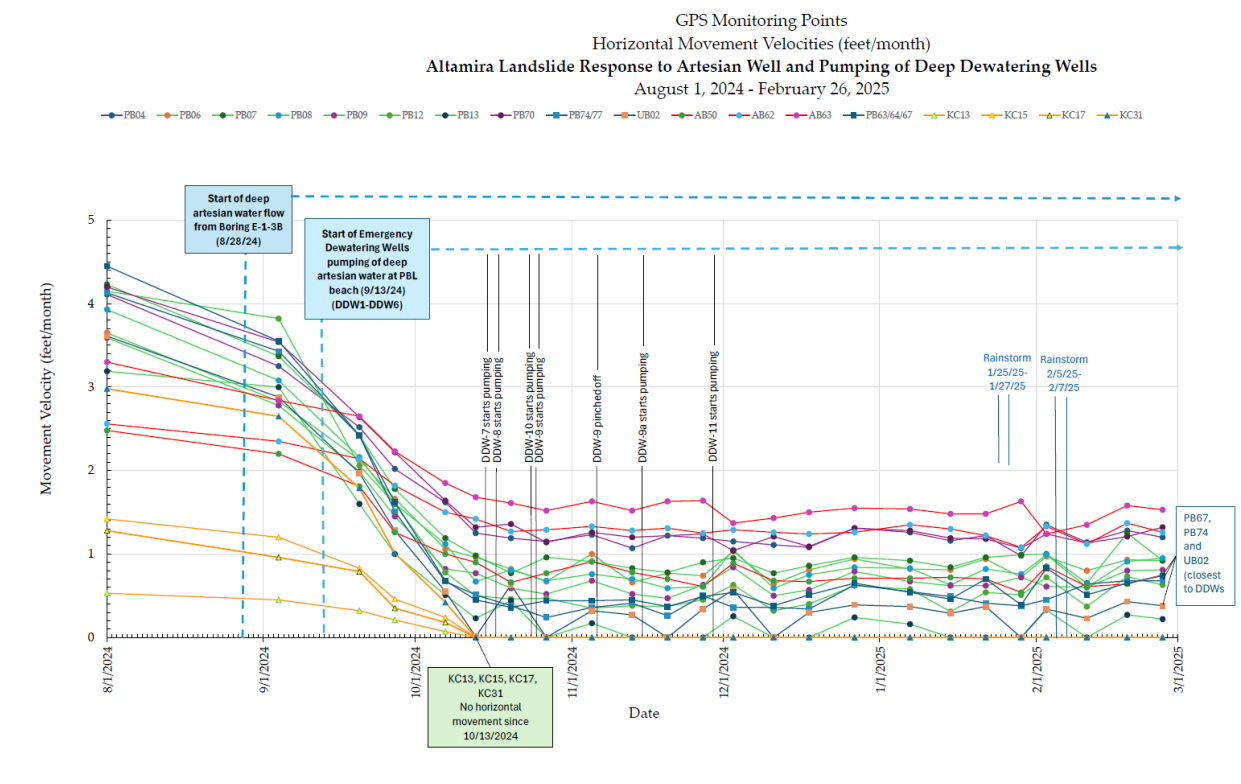
Emergency Measures

Emergency measures taken by the City and abatement districts (ACLAD and KCLAD) to date have included drilling, pumping and monitoring deep dewatering wells, winterization measures including lining channels and installing culverts to reduce the amount of surface water percolating into the groundwater regime from upslope drainages/canyons, and filling of and establishing drainage for fissures and grabens that, if left unmitigated, facilitate surface water intrusion into the groundwater regime. This strategy has proven to be effective in reducing the rate of movement of the Altamira Landslide and even stopping movement of the eastern portion of the landslide in the area of the KCL. Because piezometers installed in deep borings that penetrated the base of the Altamira Landslide indicated high groundwater pore pressures beneath the landslide (some areas were found to have near-artesian or artesian groundwater pressures – pressures higher than the ground surface), a pilot program strategy was pursued by the City that involved drilling a series of deep dewatering wells at the toe of coast below the base of movement of the Altamira Landslide slip plan and pumping to dewater the high groundwater pressures beneath the landslide. This strategy turned out to be more successful than originally contemplated because the movement of the landslide slowed quickly in response to the initial dewatering efforts and the deep wells continued to function for weeks or months before re-drilling was necessary.

The chart on the following page illustrates the timing of artesian water being encountered in one of the test borings (Boring E-1-3B, which was retrofitted to function as an artesian well), the installation of the deep dewatering wells, and the deceleration of the Altamira Landslide in response to the dewatering efforts.

Additional deep dewatering wells are also needed in order to reduce the movement of the middle and eastern portions of the Altamira Landslide to the level experienced prior to the impact of climate whiplash. However, the cost of drilling, pumping, maintaining and re-drilling requires significant funding which the City is unable to fund underscoring the significance of the requested disaster cost recovery – to return land movement to pre-2024 winter storm disaster rates.

Continued on the next page



Natural Disaster Cost Recovery

The cost to respond to this natural disaster has been immeasurable to City and its limited resources. To date, the City's estimated expenditures responding to land movement between October 2022 and June 2025 is approximately $47.5 million with approximately $36.3 million being spent this fiscal year (2024-25). Overall, the $36.3 million reflects a 290% increase from the prior year. These costs include emergency response efforts such as test boreholes, deep dewatering wells, maintenance of the deep dewatering wells until June 30, 2025, winterization, fissure filling, road repairs, sewer repairs, and drainage repairs to name a few.

Similar to the entire state of California, and in fact, the entire United States, there are known pre-existing conditions that lend themselves to natural disasters, such as wildfires, earthquakes, floods, hurricanes, tornadoes, etc. When one of these pre-existing conditions result in a natural disaster such as the recent devastating Palisades and Eaton wildfires, FEMA does not turn their back on those communities in need citing this area is mapped and known to be a Very High Fire Severity Zones. Similarly, FEMA and the federal government do not reject financial aid in known areas of earthquakes, floods, and hurricanes. That same principle should be applied to Rancho Palos Verdes and the recent acceleration of land movement resulting from the atmospheric river storms of 2023 and 2024, and the activation of the new landslide, Altamira Landslide. Moreover, **nowhere in the Stafford Act does it state that pre-existing conditions are ineligible for disaster**

recovery. In fact, the Stafford Act clearly cites the **intent** of Congress, by this Act, is to provide an orderly and continuing means of **assistance** by the Federal Government to State and **local governments** in carrying out their responsibilities to alleviate the suffering and damage which result from such disasters by (1) revising and broadening the scope of existing disaster relief programs; (2) encouraging the development of comprehensive disaster preparedness and assistance plans, programs, capabilities, and organizations by the States and by local governments; (3) achieving greater coordination and responsiveness of disaster preparedness and relief programs; (4) encouraging individuals, States, and local governments to protect themselves by obtaining insurance coverage to supplement or replace governmental assistance; (5) encouraging hazard mitigation measures to reduce losses from disasters, including development of land use and construction regulations; (6) **providing Federal assistance programs for both public and private losses sustained in disasters**; and (7) identifying and improving the climate and natural hazard resilience of vulnerable communities.

Clarification to FEMA's Document Descriptions

In addition to the above, the City provides the following responses for context purposes to the some of the documents citied in the Eligibility Determination Memorandum. As you will see, the extracted statements used to deny the City's request do not accurately support nor justify the denial because they are taken out of context of the overall document and do not provide an accurate analysis of the reason for the land movement and the basis for denial as stated earlier in this appeal letter. The City's position remains that the 2024 winter storms triggered the activation of the **new Altamira Landslide** which carried, at an accelerated rate of movement, the greater Landslide Complex which up until recently has been managed.

1. June 7, 2023 City Letter to Los Angeles County Fourth District Supervisor Hahn

   FEMA's determination letter references the City's June 7, 2023 letter to Los Angeles County Fourth District Supervisor Hahn (Sup. Hahn) as the basis for emphasizing its position that the requested damage recovery for water control features traverses a pre-existing landslide and that the City "continuously repairs and maintains these drainage pipes." The determination letter also states that "the damages claimed are a result of decades of pre-disaster ground instability and ongoing non-disaster related causes" which the City does not believe is accurate based on the information provided in this appeal letter.

   The City's letter to Sup. Hahn quotes a few words that when taken out of context gives a very different meaning to the reader. The letter was sent to Sup. Hahn requesting $6 million to help the City fund its matching portion of FEMA's Building Resiliency Infrastructure Communities (BRIC) Grant for the Portuguese Bend Landslide Remediation Project. The letter to Sup. Hahn includes data on the average rate of movement for context purposes to garner her advocacy and financial support needed

to develop and implement a remediation plan as a **preventive measure** to a potential imminent threat to public health and safety.

The Portuguese Bend Landslide Remediation project, concentrated within the PBL, was developed by the City to **prevent** the acceleration of land movement by addressing rainwater runoff from entering the ground and recharging the water table, which occurred during the rain events of 2023 and 2024.

The Stafford Act states that pre-existing conditions are not eligible for disaster recovery but rather that to be eligible it has to be directly related to an incident per Title 44 of C.F.R. 206.223(a)(1). However, as noted earlier, the behavior of this slow moving landslide noticeably changed in response to the Winter Storms of 2023 and 2024, and that the extreme wet weather activated a **new** landslide, Altamira Landslide, and should therefore not be considered pre-existing, the point to this appeal.

2. Cotton Shires and Associates (CSA) Geologic Report dated September 9, 2023

   According to your determination letter, the City's Geotechnical Engineer's September 9, 2023 memo is cited as one of the basis for denying the City's recovery request because "*the work claimed is not required as a result of the declared disaster and the applicant cannot demonstrate the damage was directly caused by FEMA-DR-4769-CA. Rather these damages are a result of long-term creep displacement and recent years acceleration of earth movement from non-disaster causes as documented in the multiple reports."*

   As previously noted, the City respectfully disagrees with these statements and in fact, can demonstrate that the winter storms of 2023 and 2024 correlated to climate change and seasonal changes in weather patterns are the reasons the City experienced a noticeable behavioral **change** in the landslide rate of movement with the activation of the dormant and inactive Altamira Landslide. Moreover, the Eligibility Determination Memorandum neglects to cite relevant and pertinent information in the CSA's September 9, 2023 memo emphasizing the following significant and noticeable change in the behavior of the landslide:

   GPS Survey Monitoring Data Review: GPS monitoring of survey monuments throughout the Landslide Complex area has been performed tri-annually since 2007 by McGee Surveying Consulting. In their June 6, 2023 Survey Report, McGee stated:

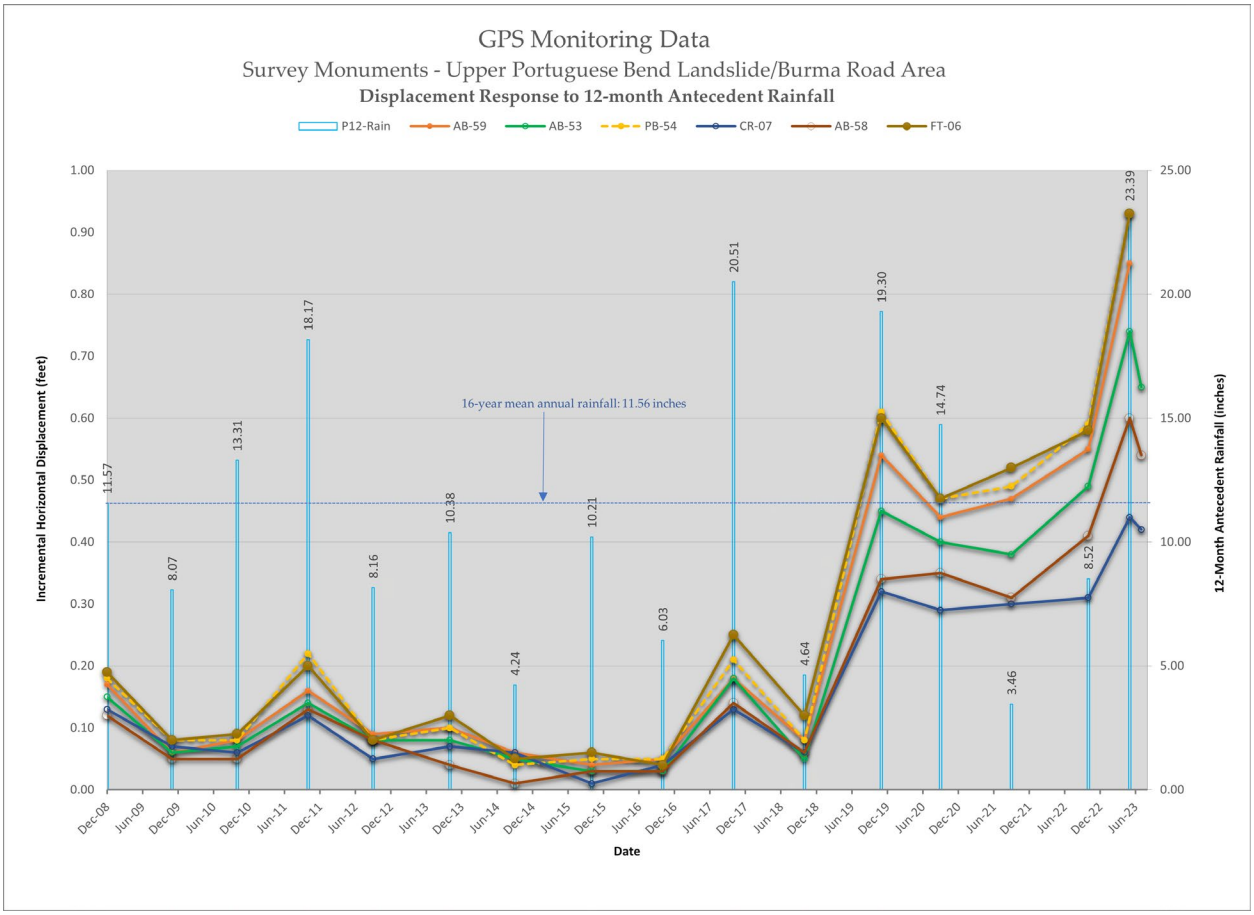
   "*In the last seven months the movement velocities have accelerated over the average velocity for the previous four years which saw an acceleration over the previous 15-20 years……**Velocities were stable** prior to 2018. After the Fall of 2018 they increased about 3 to 6 fold at most points and remained stable to the Fall of 2022. In the last seven months since the **Fall of 2022** the velocities generally have **doubled more or less***." (emphasis added)

This is a significant and important observation from the surveyor, and comports with the past several years of field observations by CSA staff of roadway distress and trail distress within the PBR, as well as reports of street distress, building distress and utility line breaks throughout the various known landslide areas.

Several graphics based upon CSA's own analysis of the GPS survey monitoring data further illustrate what is happening with the landslide ground movement. According to Figure 2 in CSA's September 9, 2023 memo, depict horizontal displacements (in feet) and ground displacement vectors for 12 selected GPS survey monuments mostly located in the mid and upper Landslide Complex. These figures are based upon McGee's GPS monitoring of the survey monuments from October 2018 to May 2023 (with the exception of two monuments which were last read in October 2022, PB18 and AB71). Four of these monuments were also read in mid-July, 2023 and those movement data are also presented. Two of the monuments, CR07 and FT06 are located on Burma Road outside of the PBL and indicate 1.67 feet and 3.09 feet of horizontal displacement over the ~4.5-year period. The CR07 point moved an additional 0.42 feet in two months (through July 15, 2023), which translates to ground movement velocity of about 2.5 feet per year. Most of the other points on this figure are in the Landslide Complex (and mostly in LMA Zone 2) and are indicating total displacements of approximately 1 to 3 feet (or average velocities of about 0.22 to 0.67 feet/year across the ~4.5-year period). Several of these points in LMA Zone 2 that were also monitored in July, 2023 showed continued acceleration from May to July 2023, with calculated velocities of ~1.25 feet/year at AB67 to ~3.9 feet/year at AB53. These are extraordinary rates of landslide movement that, to the City Geologist's knowledge, have not been previously documented in the LMA Zone 2 area.

Incremental displacement has been analyzed of these points versus 12-month antecedent rainfall, as a measure of the landslide response to rainfall. A graph of cumulative displacement of these points since 2007 is presented on the following page. This graphed movement data indicates a clear acceleration of movement beginning in late 2018 (as noted in the area labeled inflection point).

Accelerated landslide movements since late 2018 appear to be correlative with significantly above normal rainfall in three out of four rainfall seasons (2016-17, 2018-19 and 2019-20) which followed five consecutive drier than normal rainfall seasons (2011-12 through 2015-16). **The extraordinary rainy season of 2022-23, where rainfall totals were more than 200% of average, has resulted in further acceleration**.



It is imperative to bring to your attention that the City Geologist recently provided an updated memorandums dated November 8, 2024 and March 16, 2025 (attached) that further underscores the impacts and damage caused by FEMA-DR-4769-CA also known as the winter storms of January 31 through February 9, 2024, as documented earlier in this appeal letter.

3. Rancho Palos Verdes Geo-Logic Associates (GLA) Report Dated December 2019

   According to the Eligibility Determination Letter, a December 2019 report prepared by GLA, a geotechnical engineering firm, hired by the City to prepare its Portuguese Bend Landslide Remediation project is cited. This report cites, as one of the basis to determine that the requested disaster damage recovery occurred in a pre-existing landslide area and not related to the storms citing the following:

   "the landslide complex includes approximately 239 acres with ground movement varying across the site ranging up to approximately 11 feet per year."

   This very citation supports the City's request and claim that the damage sustained occurred as a result of the winter storms in 2023 and 2024 based on the following:

As noted earlier, the Landslide Complex is generally comprised of 5 subslides. The 239 acres noted above is limited to the PBL. This is because the study area for the Landslide Complex was specific to the PBL. In fact, the City Geologist's November 8, 2024 memo states since 2024, this significantly greater depth of movement has resulted in a broader footprint of active land movement at the ground surface and offshore, and expansion of the historical land movement area from approximately 380 acres to **over 700 acres**.

Furthermore, as previously stated, according to the City Geologist's March 16, 2025 memo (attached), the Altamira Landslide is a newly active landslide that has occurred within a previously mapped ancient landslide complex. It is important to make this distinction for consistency and to avoid confusion, because the Altamira Landslide is, in fact, a new member of the historically active PBL/ACL/KCL Landslide Complex but largely **underlies it** and occupies an area of active land movement >700 acres and extends to more than 500 feet off of the coastline, whereas the shallower historically active PBL/ACL/KCL Landslide Complex only occupied about 380 acres. While previous geotechnical investigators identified inactive deep failure surfaces in both the historically active and ancient landslide areas, none of them mapped or identified as active the entire depth or breadth of movement that has recently impacted the area, nor did they opine that such an event would occur in historic times. The active Altamira Landslide currently involves major land movement comprising an area of over 700 acres landward of the coast and extends to approximately 500 feet or more off the coastline. The areal dimensions, depth of movement, velocity of movement, artesian and near-artesian groundwater pressures beneath it, and even the direction of movement, are different than the Landslide Complex. The distinction to be made then, is that the Altamira Landslide is not just simple *expansion* of an existing group of landslides, it is an entirely different, larger and deeper landslide with much broader boundaries (including the new coastline offshore), nearly twice as deep as the depth of historic landslide movement in some areas, and with unprecedented rates of movement (which were not seen in the early LA County Engineer surveys, the Charles Abbott Associates surveys beginning in 1994, nor the McGee surveys since 2007).

None of this was experienced during the history of the City, and the Altamira Landslide is a unique landslide not characterized in its current dimensions during the over 70-year history of landslide investigations, exploratory borings, monitoring and observations being conducted in the area.

4. Landslide Working Group November 1, 2023 Meeting Notes

The FEMA Eligibility Determination Memorandum cites that the City has a pre-disaster active task force called the RPV Landslide Complex Working Group which meets to continue to address ongoing landslide problems, and that is **not** correct.

As previously noted, on October 3, 2023, the City Council declared a local state of emergency in response to the rapid and significant acceleration in land movement. As a result, the Council directed staff to working with community stakeholders including utilities, geologists, HOA representatives and residents to collaborate the City's and community's response to the declared local state of emergency. It was four months later when the then-mayor sent a letter to the Governor requesting he declare a state of emergency and request the President declare a federal disaster in response to the land movement resulting from the winter storms of 2023 and 2024 (attached)

5. Michael McGee's 2007 GPS Technical Report

   In 2007, the City began using GPS technology to track on-ground movement of the Landslide Complex. No one is denying that the shallower Landslide Complex has been moving since 1956, what is evident in the data FEMA's analysts overlooked is that there is a significant and noticeable change in the behavior of the landslide and the rate of movement in response to rain events as clearly demonstrated in the charts earlier in this letter. Moreover, a new, previously dormant landslide was activated in response to the 2024 Winter Storm event.

   To reiterate, the City Geologist has clearly documented that the rain events of 2023, and particularly 2024, have contributed to the accelerated rate of movement and the damage sustained by the City and its infrastructure. The point that warrants a reconsideration of reversing the denial is that there is a clear change in the rate of movement based on the GPS monitoring points cited in your memo between 2023 and present.

<u>Additional Information - Land Movement and the Monks Lawsuit</u>

In 1978, the City enacted an ordinance imposing a moratorium on the construction of new homes in the vicinity where accelerated landslides had recently occurred. The so-called "Monks" plaintiffs owned 16 vacant lots impacted by the moratorium. Some of these property owners claimed to have been waiting over 30 years to build homes on their properties on land that has not showed signs of movement. The lots in question were otherwise zoned for single-family dwellings.

Eventually, these property owners filed suit against the City seeking to invalidate the moratorium criteria and alleging a claim for inverse condemnation based on the state takings clause because, as the plaintiffs asserted, the land was not moving and suitable for development. The trial court denied their request and ultimately found in the City's favor. The property owners appealed.

The Court of Appels ruled in favor of the plaintiffs citing that the City's ordinance requiring owners of land in specific zones within the Landslide Complex to present data demonstrating to satisfaction of city geologist that the gross geotechnical factor of safety

where their lots were located was at least 1.5 in order to build on their lots deprived the land of all economically beneficial use, and resulted in a permanent categorical taking. **The Courts ruled that the plaintiffs could build on their lots.** (*Monks v. City of Rancho Palos Verdes*, 167 Cal.App.4th 263 (2008)

Conclusion

The basis for denying the City's disaster recovery on a pre-existing condition is not a valid reason when, as demonstrated in this appeal letter and supporting attachments, it is clear that a **new, inactive** for hundreds of years, landslide was activated in response to the 2024 Winter Storm event that led to the federal disaster declaration (FEMA-DR-4769-CA). The activation of the Altamira Landslide resulted in significant damage to the City's infrastructure including, but not limited to, collector and residential streets damaged by the winter storms that occurred between January 31 and February 9, 2024. It is now known that the activation of the Altamira Landslide carried the subslides of ACL, PBL, and KCL which is clearly demonstrated in this appeal letter that the rate of movement significantly increased along with the behavior of the land movement as a result of the 2023 and 2024 Winter Storm Events.

It is for the reasons cited throughout this appeal letter that disaster recovery financial assistance be provided for the destruction resulting from the activation of the Altamira Landslide caused by the extraordinary rain events of 2024. The weather whiplash over the years has adversely impacted the City, its residents and businesses, and its economics. Overturning the denial and providing the disaster recovery assistance requested will enable the City to properly respond to the activation of the new Altamira Landslide by stabilizing land movement and repairing damaged and critical infrastructure.

On behalf of the Rancho Palos Verdes City Council and residents, we thank you for your consideration of this appeal letter.

Sincerely,

Ara Michael Mihranian, AICP
City Manager

Attachments:

- September 9, 2023 CSA Memo
- November 8, 2024 CSA Memo
- March 16, 2025 CSA Memo
- February 20, 2024 Letter to Governor Newsom

c. Rep. Ted Lieu
Senator Adam Schiff

Senator Alex Padilla
State Senator Ben Allen
Asm. Al Muratsuchi
Rancho Palos Verdes Mayor Bradley and City Council
William Wynder, Rancho Palos Verdes City Attorney
Catherine Jun, Rancho Palos Verdes Deputy City Manager
Ramzi Awwad, Rancho Palos Verdes Director of Public Works
Vina Ramos, Rancho Palos Verdes Director of Finance

COTTON, SHIRES AND ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS

CITY OF RANCHO PALOS VERDES

CSA Project No. SC6022

MEMORANDUM

TO: Katie Lozano, Open Space Manager
CC: Ara Mihranian, City Manager
William Wynder, Elena Gerli, and John Fox, City Attorneys
Cory Linder, Director of Recreation and Parks
Ramzi Awwad, Public Works Director
Taylor Fox, Senior Park Ranger
FROM: Michael Phipps, CEG 1832, Contract City Geologist
Christopher Dean, CEG 1751, Contract City Geologist
Matthew Janousek, GE 3005, Contract City Geotechnical Engineer
RE: **Preliminary Geotechnical Assessment of Recent Land Movement in the Portuguese Bend Reserve and Impacts to Burma Road Trail, Rancho Palos Verdes**
DATE: September 29, 2023

INTRODUCTION

In accordance with your request, this memorandum has been prepared to provide a preliminary geotechnical assessment of recent land movement within the Portuguese Bend Reserve (PBR) with a specific focus on the impacts of land movement to the Burma Road Trail. We understand that the PBR is one of the City's most popular land reserves, it is heavily used by the public for recreation and is also used by public utilities including Southern California Edison and California Water Service Company. A portion of the PBR is underlain by the historically active Portuguese Bend Landslide (active since 1955-56) as well as the Ancient Portuguese Bend Landslide Complex. Some areas of the Reserve are now experiencing significant land movement and ground surface manifestation that is beyond the limits of the historically active and previously mapped Portuguese Bend Landslide, resulting in damage to trails and fire roads which provide access for public safety, utilities, maintenance, conservation, and public recreation. Cotton, Shires and Associates, Inc. (CSA) geologists have been requested by the City to observe various landslide-related issues in the Reserve involving damage to trails since 2021 and the SCE transmission lines along Burma Road since the summer of 2022. In 2021 we also began a detailed review of Global Positioning Satellite (GPS) monitoring data for survey monuments both within and outside the PBR, including points within the Abalone Cove Landslide, Klondike Canyon Landslide, and elsewhere within the Ancient Portuguese Bend Landslide Complex.

A comprehensive reconnaissance of the PBR was conducted by vehicle with City staff on June 28, 2023. Following this field visit, the City's Open Space Manager requested a report addressing the following items:

DRAFT

- Information and a map presenting our observations of where new landslide scarps are forming;
- An evaluation of whether Burma Road is currently able to accommodate vehicles, ranging from smaller Park Ranger trucks to heavy equipment used by utility companies and fire department, and if it is currently able to accommodate vehicles, an estimate of how long the road will remain stable;
- Recommendations for re-routing Burma Road (if necessary) to areas less prone to land movement as the fire road is needed for the City, fire department, and utility companies;
- Consideration of recommendations for additional warning signage due to the increased land movement to warn recreational users (hikers, bikers, horseback riders) and authorized outside agency personnel who drive the Reserve fire roads;
- Recommendations for a maintenance plan to fill fissures and keep Burma Road passable to pedestrians and vehicles, as the fissures have become too significant for park rangers to fill in with shovels.

This memorandum will address these requested items, based upon our field observations and geologic mapping, analysis of GPS monitoring data, background knowledge of the area, and professional experience.

PREVIOUS WORK

Previous City-requested reconnaissance and observation of trail conditions in the PBR performed by CSA geologists have included the following:

- 8/27/21: Burma Road trail reconnaissance (fissures/ground movement)
- 9/29/21: Burma Road and Garden Trail reconnaissance (fissures/ground movement)
- 1/5/22: Burma Road trail reconnaissance (fissures/ground movement)
- 8/31/22: Burma Road trail reconnaissance, meeting with SCE contractor and City staff, (regarding power pole relocation due to fissures, ground movement)
- 3/8/22: Upper Burma Road trail reconnaissance (rockfall hazards)
- 4/5/23: Burma Road Trail, Garden Trail, and Rim Trail reconnaissance (fissures/ground movement)

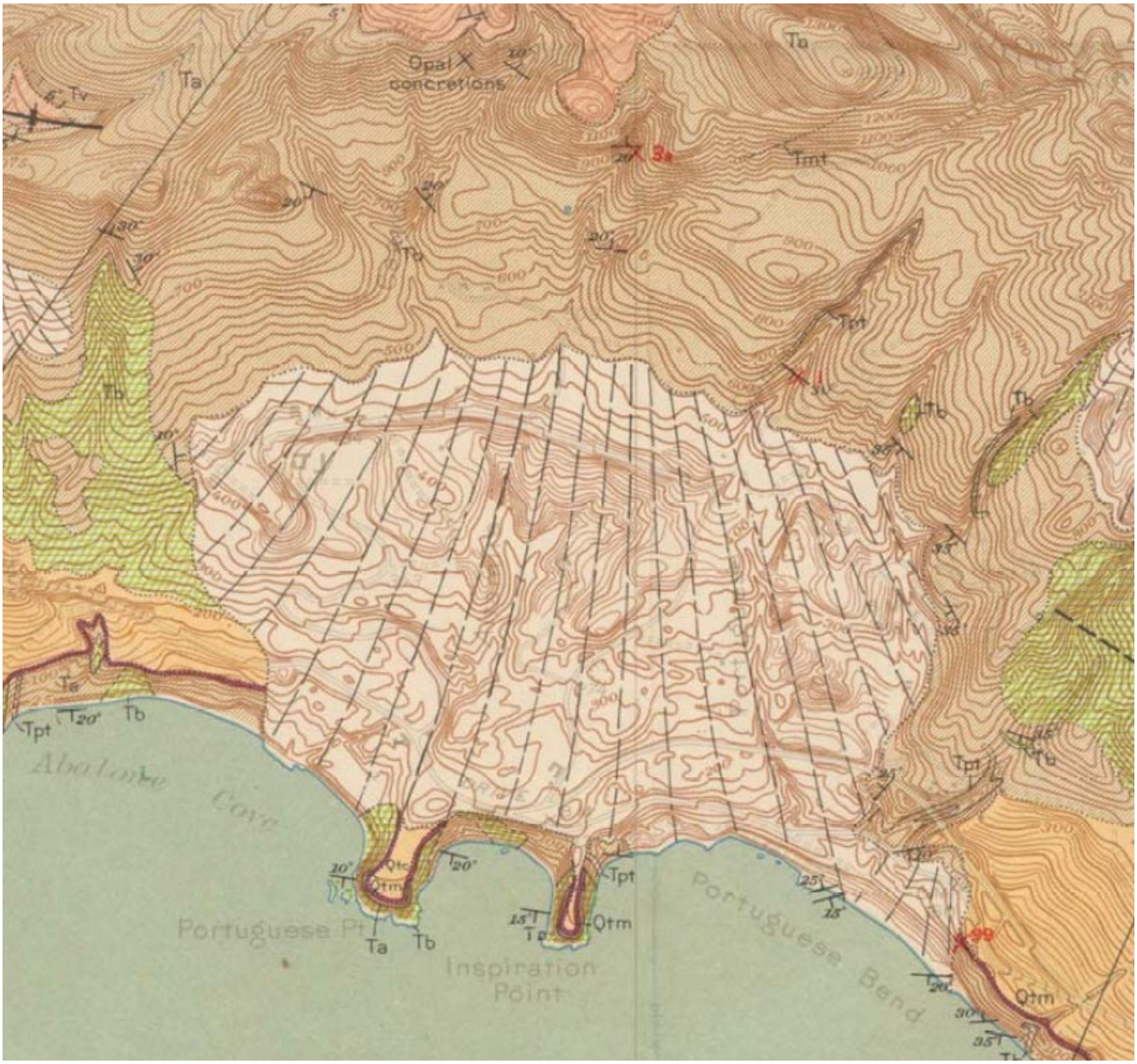
Findings and recommendations from these field visits have been routinely documented by either memoranda or email addressed to City staff. Recent published documents include memoranda dated February 9, 2022 (Burma Road/Rim Trail Junction) and May 19, 2023 (SCE Power Pole Relocation, Burma Road).

Preliminary geologic mapping of the upper limits of active landsliding along the Burma Road trail and vicinity was performed on June 28, 2023 and supplemented on September 22, 2023; however, this work is incomplete and requires additional field effort. Because of the steep terrain, large mapping area, and thick (inaccessible) vegetation in some areas, we have supplemented our field mapping with photo-geologic mapping utilizing high-resolution Nearmap (vertical aerial) imagery captured on January 17, 2023 and June 17, 2023.

DRAFT

FINDINGS

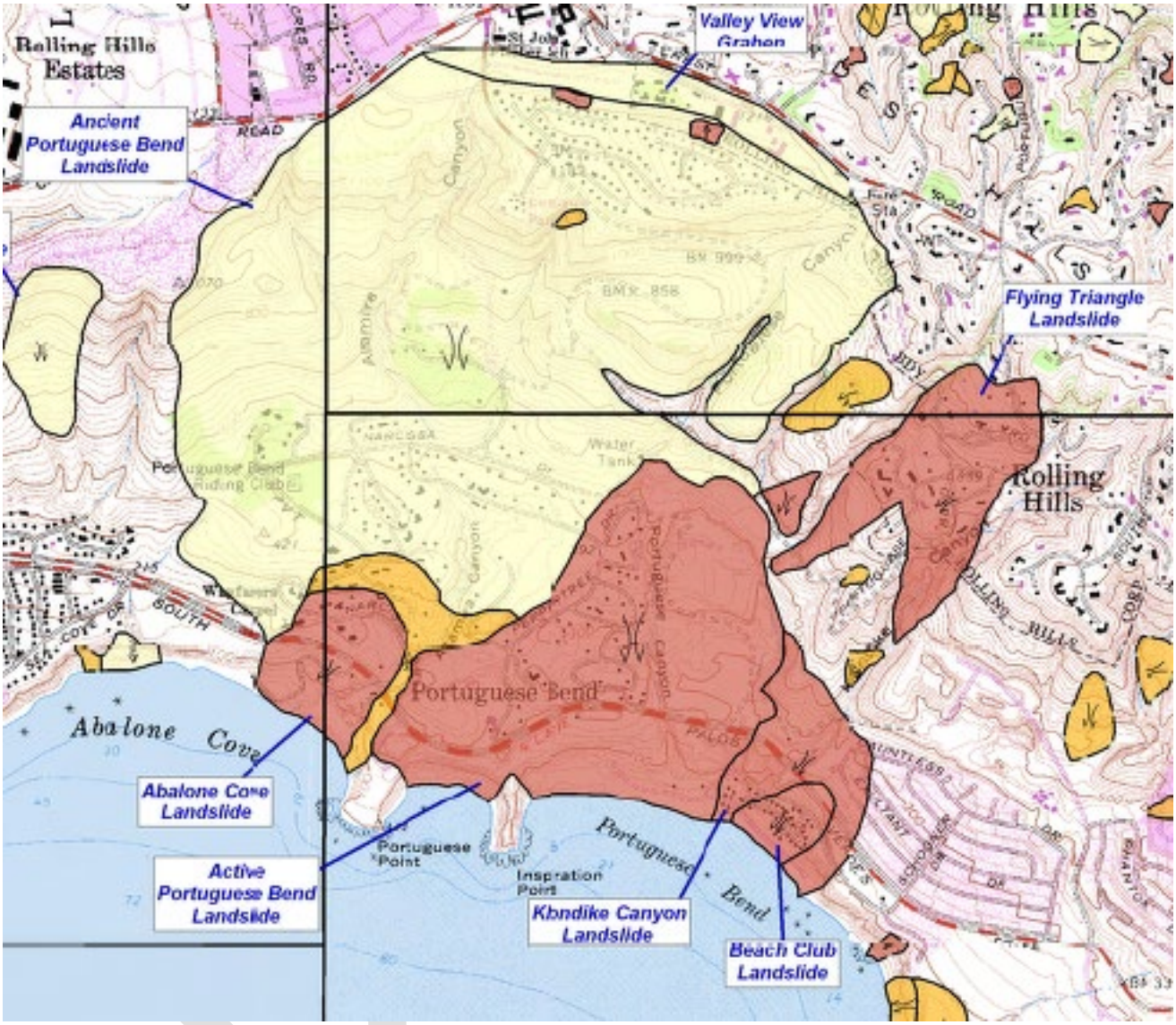
Geologic Mapping: The Ancient Portuguese Bend Landslide Complex (APBLC) was first mapped by the U.S. Department of the Interior Geological Survey (aka, USGS) in 1946 (shown as white area with black dashed lines in the image below) and occupies a broad area on the south side of the Palos Verdes Peninsula from the crest of peninsula to the Pacific Ocean.



U.S. Department of the Interior, 1946, Portion of Geologic Map of the Palos Verdes Hills, Los Angeles County, California

Within the APBLC, several large landslide masses have reactivated since the 1950s, including the Portuguese Bend Landslide, Abalone Cove Landslide, Klondike Canyon Landslide, and Beach Club Landslide. The Flying Triangle Landslide is in similar but higher terrain northeast of the Portuguese

Bend Landslide but is not considered part of the APBLC on regional geologic maps. These landslides are depicted on the California Geological Survey's Landslide Inventory Map of the Palos Verdes Peninsula (2007, image below).



California Geological Survey, 2007, portion of Landslide Inventory Map of the Palos Verdes Peninsula

Burma Road (and Trail) is located along what was previously proposed to be the Crenshaw Boulevard Extension, until the Portuguese Bend Landslide reactivated in 1956. The lower reach of Burma Road trends southeast immediately uphill from the headscarp of the Portuguese Bend Landslide. Previous site visits by our staff to the Burma Road area within the PBR beginning in 2021 were primarily in response to reported "fissures" forming in multiple locations across trails. We understand that City ranger staff have been routinely filling in the fissures with soil using hand tools. At other times heavier grading equipment has been reportedly used by Cal Water to fill fissures and maintain the Burma Road access to their facilities. Recent field mapping and GPS data suggest that these fissures are in fact the incipient manifestations of headward enlargement of the Portuguese Bend Landslide as well as an upslope manifestation of accelerated movement of a portion of the Ancient Portuguese Bend Landslide

Complex west of the active Portuguese Bend Landslide boundary. Four significant landslide scarps, which initially manifested as ground cracking and small fissures in Burma Road, have now formed across Burma Road, generally between the Eagle's Nest Trail intersection on the west and the Rim Trail intersection on the east.

Figure 1 (attached) was prepared on a Nearmap vertical color image taken January 17, 2023. The approximate limits of the active Portuguese Bend Landslide are depicted in red. The upper area of recent headward enlargement of the Portuguese Bend Landslide is depicted with yellow lines delineating landslide scarps which can be seen crossing Burma Road in at least seven locations. While the Burma Road trail has been repeatedly maintained by minor grading-leveling across these features, the scarps have grown in height and width adjacent to the road over time, and in some locations, grabens (wide pull-apart fissures) have formed in response to significant landslide movement. If not maintained in this manner over the past several years, landslide scarps ranging from 1 to 8 feet in height would extend across the road making it impassable to vehicles, cyclists, and even pedestrians. The most severe location is the western (and uppermost, elevation-wise) scarp located between the Water Tank trail and Eagle's Nest Trail intersection with Burma Road. The landslide displacement at this location has produced a scarp 6 to 8 feet in height and significantly displaced an SCE power pole that is now leaning approximately 35-40 degrees out of plumb. Other scarps across Burma Road southeast of this location are smaller, generally ranging from 1 to 4 feet in height adjacent to the road. Of note is that these scarps have grown substantially in size since our June 28, 2023 reconnaissance.

The downslope limits of the new landslide scarps (yellow contacts on Figure 1) appear to be directly connected to the Portuguese Bend Landslide at the eastern end; however, at the western end they are not well-defined at the ground surface and additional field mapping is necessary to further delineate the western margin. The western margin was observed crossing Kubota Trail and trending toward the Vanderlip Trail, where it was lost in heavy vegetation. It is important to note that the western extent of this new landslide movement is somewhat west of the head of the Portuguese Bend Landslide. It is our interpretation that the western extent of this new landslide movement is occurring in response to long-term creep displacement and recent acceleration of movement of the Ancient Portuguese Bend Landslide Complex (APBLC) since October 2018.

GPS Survey Monitoring Data Review: GPS monitoring of survey monuments throughout the APBLC area has been performed tri-annually since 2007 by McGee Surveying Consulting. In their June 6, 2023 Survey Report, McGee stated:

"*In the last seven months the movement velocities have accelerated over the average velocity for the previous four years which saw an acceleration over the previous 15-20 years……Velocities were stable prior to 2018. After the Fall of 2018 they increased about 3 to 6 fold at most points and remained stable to the Fall of 2022. In the last seven months since the Fall of 2022 the velocities generally have doubled more or less*."

This is a significant and important observation from the surveyor and comports with the past several years of field observations by CSA staff of roadway distress and trail distress within the PBR, as well as reports of street distress, building distress and utility line breaks throughout the various known landslide areas. We have prepared several graphics based upon our own analysis of the GPS survey

DRAFT

monitoring data to further illustrate what is happening with the landslide ground movement. Figure 2 (attached) depicts horizontal displacements (in feet) and ground displacement vectors, for 12 selected GPS survey monuments mostly located in the mid and upper Ancient Portuguese Bend Landslide Complex. These figures are based upon McGee's GPS monitoring of the survey monuments from October 2018 to May 2023 (with the exception of two monuments which were last read in October 2022, PB18 and AB71). Four of these monuments were also read in mid-July, 2023 and those movement data are also presented. Two of the monuments, CR07 and FT06 are located on Burma Road outside of the Portuguese Bend Landslide and indicate 1.67 feet and 3.09 feet of horizontal displacement over the ~4.5-year period. The CR07 point moved an additional 0.42 feet in two months (through July 15, 2023), which translates to ground movement velocity of about 2.5 feet per year. Most of the other points on this figure are in the Ancient Portuguese Bend Landslide Complex (and mostly in LMA Zone 2) and are indicating total displacements of approximately 1 to 3 feet (or average velocities of about 0.22 to 0.67 feet/year across the ~4.5-year period). Several of these points in LMA Zone 2 that were also monitored in July, 2023 showed continued acceleration from May to July 2023, with calculated velocities of ~1.25 feet/year at AB67 to ~3.9 feet/year at AB53. These are extraordinary rates of landslide movement that, to our knowledge, have not been previously documented in the LMA Zone 2 area.

We have also reviewed and analyzed cumulative and incremental displacements from 2007-2023 for six select survey monitoring points that are generally in the upper Portuguese Bend Landslide/Burma Road area, including three points that are in the Ancient Portuguese Bend Landslide Complex west of the historically active Portuguese Bend Landslide (i.e., in Landslide Moratorium Area Zone 2). These six points are identified as:

- CR07 adjacent to Burma Road Trail;
- PB54 located within the "Landward Subslide" of the Portuguese Bend Landslide Complex;
- AB53, AB58 and AB59 located within the Ancient Portuguese Bend Landslide Complex (Landslide Moratorium Zone 2); and
- FT06 adjacent to Burma Road Trail southeast of the Rim Trail intersection.

We have analyzed incremental displacement of these points versus 12-month antecedent rainfall, as a measure of the landslide response to rainfall (Figure 3). A graph of cumulative displacement of these points since 2007 is also presented in Figure 4. This graphed movement data indicates a clear acceleration of movement beginning in late 2018 (as noted in the area labeled inflection point).

Accelerated landslide movements since late 2018 appear to be correlative with significantly above-normal rainfall in three out of four rainfall seasons (2016-17, 2018-19 and 2019-20) which followed five consecutive drier than normal rainfall seasons (2011-12 through 2015-16). The extraordinary rainy season of 2022-23, where rainfall totals were more than 200% of average, has resulted in further acceleration based upon limited monitoring data. A significant concern is that the movement velocities have not declined back to the pre-2018 levels despite two significantly below-normal rainy seasons (2020-21, one of the driest on record, and 2021-22). Also of note is that our rainfall data do not include the impacts from Tropical Storm Hilary which dropped several inches of rain across most of southern California in August, 2023.

DRAFT

CONCLUSIONS AND RECOMMENDATIONS

Landslide movements throughout the Ancient Portuguese Bend Landslide Complex *outside of the historical boundary of the Portuguese Bend Landslide* previously exhibited relatively low rates of creep movement in the 11-year monitoring period of 2007-2018 for which we have readily available data. Beginning in late 2018, and through the present, the survey data indicate a significant acceleration of landslide movement. The movement of the Portuguese Bend Landslide also accelerated in this timeframe. The cumulative displacements over this time have now manifested as headward enlargement of the Portuguese Bend Landslide as well as new active landslide masses forming northwest of the Portuguese Bend Landslide crown in Landslide Moratorium Area Zone 1, upslope from LMA Zone 2. These new actively moving landslide masses are directly impacting Burma Road and threaten future accessibility.

We understand this issue is also exceeding current resources (i.e., ranger staff) to monitor and maintain the safety of the trails; primarily the heavily used Burma Road Trail. At this time, we consider this to be a critical and evolving situation that poses risks to the general public who are accessing the PBR for recreation, to utility infrastructure that traverses the landslide area, and to accessibility for other stakeholders including conservation groups and the fire department. It is evolving because we are days from entering the rainy season and most meteorologists and climatologists that we follow are citing development of El Nino conditions in the Eastern Pacific Ocean and these are frequently associated with wetter-than-normal rainfall conditions in southern California. We are also awaiting receipt of the fall GPS survey data which are typically gathered in early October.

To address the City's specific items, we offer the following:

Landslide Maps: For the purposes of this memorandum, a landslide overview map (Figure 1, attached) was prepared to illustrate the entire affected area and impacts to Burma Road. We conducted field mapping on much larger scale maps which allow for presentation of detailed observations; however, these were not formally drafted and produced due to time constraints. We recommend that additional field mapping be performed in an effort to further define the limits of active landsliding. Drafted larger scale maps will be provided if necessary and/or upon request, to provide details in specific areas.

Burma Road Conditions and Maintenance Considerations: Given the current landslide movement velocities, the newly identified landslides impacting Burma Road are active and considered unstable. Burma Road only remains passable because of the reported efforts of other stakeholders to level the ground surface across the landslide areas with larger equipment, in response to the creeping landslide movement. We anticipate that the landslide movement will continue and is likely to be exacerbated by the 2023-24 rainy season regardless of whether it is wetter or drier than historical averages. The filling of fissures crossing the road with manual labor (by park rangers) has become untenable and such measures are reportedly proving to be short-lived. The fissures, which are developing landslide scarps, have widened and deepened in some areas due to significant ground movement. Smaller vehicles (ranger trucks) are typically 2-3 tons and present lower risks when crossing the landslide areas;

DRAFT

however, larger, heavier vehicles including fire trucks which typically weigh 10 to 20 tons present a much larger transient load across the landslides, thus presenting a relatively greater risk.

Currently it is our opinion that Burma Road Trail should be closed to the public across the landslide area *unless it can be monitored on a daily basis by the park rangers*. This is due to active landslide movement directly impacting the road and posing significant risks to pedestrians, cyclists and horseback riders. Ground leveling efforts to keep the road passable for vehicles may continue; however, crews should avoid placing earth fill directly on the landslides because it adds weight and is a driving force of landslide movement. Continued notching (lowering) of the trail approaches to the landslide scarps may be the only effective solution in the short-term to maintain passage of vehicles. Care should also be given to avoid ground-alterations that would direct more Burma Road drainage directly into the landslide areas.

Burma Road Re-routing Considerations: Burma Road and trail occupy a portion of wider, leveled ground graded during the proposed Crenshaw Boulevard extension (circa 1955-56). Several of the new landslide scarps extend to near the north edge of the previously leveled area, thus, there does not appear to be a feasible location to re-route the road through these areas. Furthermore, we do not see an opportunity to completely re-route Burma Road outside of the former graded area without consideration of massive grading and drainage improvements in steeply sloping areas, some of which may also be in sensitive habitat area. There are also slope stability concerns north of Burma Road for any considered re-route, and we are currently lacking information due to a lack of GPS monitoring points north of Burma Road. The depth of movement of the new landslides is also unknown and at best could only be estimated based on previous studies of the Portuguese Bend Landslide.

Consideration could be given to stabilizing the affected portions of Burma Road in its current location; however, this would require an extensive geotechnical investigation, including geologic mapping, installation of instrumented borings (e.g., slope inclinometer casings and piezometers), laboratory soil testing, extensive slope stability analyses, and design of possible stabilization alternatives. Stabilization, if technically feasible, might require a combination of extensive in-ground structural measures (i.e., steel-reinforced concrete shear pins with tiebacks) and grading. Based upon our experience, such mitigation would likely have a cost in the millions of dollars.

Additional Warning Signage: Additional warning signage due to the increased land movement, to warn recreational users (hikers, bikers, horseback riders) and authorized outside agencies who drive the Reserve fire roads, is reasonable and appropriate from a geotechnical perspective, particularly if the City is going to keep Burma Road Trail and other potentially affected trails open to the public. As mentioned above, the new landslide areas impacting Burma Road and Trail are currently unstable. The landslide areas are currently moving (creeping) at velocities that are generally imperceptible to humans and may seem innocuous from that perspective; however, over short periods of time the movement creates significant hazards to trail users due to differential ground movement with associated ground cracking and fissuring within the landslide masses as well as scarp formation at the movement boundaries.

DRAFT

Additional Recommendations: In addition to the specific items requested to be addressed by the City, we have the following comments and recommendations:

- CSA previously issued a memorandum regarding the proposed SCE power pole relocation (May 19, 2023). At that time, we noted that the upslope extent of active landsliding had not been geologically mapped (to our knowledge), the depth of landslide movement is unknown, and there is a lack of GPS survey monitoring points north of Burma Road between Portuguese and Paintbrush Canyons. We subsequently stated that due to this lack of information, it was difficult to assess the impacts of future land movements on the proposed power pole relocation areas. It is our understanding that SCE may be considering a larger scale relocation of their transmission line(s) that are currently within the active landslide area, in lieu of the relocation project that we previously reviewed. The existing transmission line along Burma Road is partially supported by power poles located in actively moving landslides and at least two of the power poles have now been severely compromised. This transmission line poses a significant risk if not de-energized.

- The above-ground water main which trends along Burma Road traverses portions of the new landslide areas and is lacking ground support (i.e., the pipe is in the air) in some isolated areas. Our concern is that the pipe *may* not have been designed for such conditions. This should be further evaluated by the utility company responsible for the water main.

- Additional geologic mapping (on ground, possibly supplemented with drone photogrammetry) should be performed in an effort to further define the areal extent of new active landsliding. This information will be beneficial to the City for future evaluation of the safety of Burma Road and other trails within the Portuguese Bend Reserve, and also useful to other stakeholders.

- Additional GPS monitoring points should be established north of Burma Road, between Portuguese Canyon and Paintbrush Canyon. CSA will assist with recommended locations for these points if requested by the City. We also recommend that the tri-annual GPS monitoring be performed on <u>all</u> monuments in each monitoring session, in lieu of the partial monitoring that has been historically performed in two of the three sessions per year.

- Periodic closures of the trail system within the PBR during and immediately after significant rainfall events, as has been the policy of the City, should continue to allow for safety assessment of the trails by ranger staff.

- Where feasible, park ranger staff should continue to do routine monitoring and filling of ground fissures on other trails to keep the trails relatively safe; otherwise, the trails should be closed.

We hope this memorandum provides the City of Rancho Palos Verdes with the requested information and recommendations regarding Burma Road within the Portuguese Bend Reserve at this time. Please contact us if you have further questions or concerns.

-o-

DRAFT

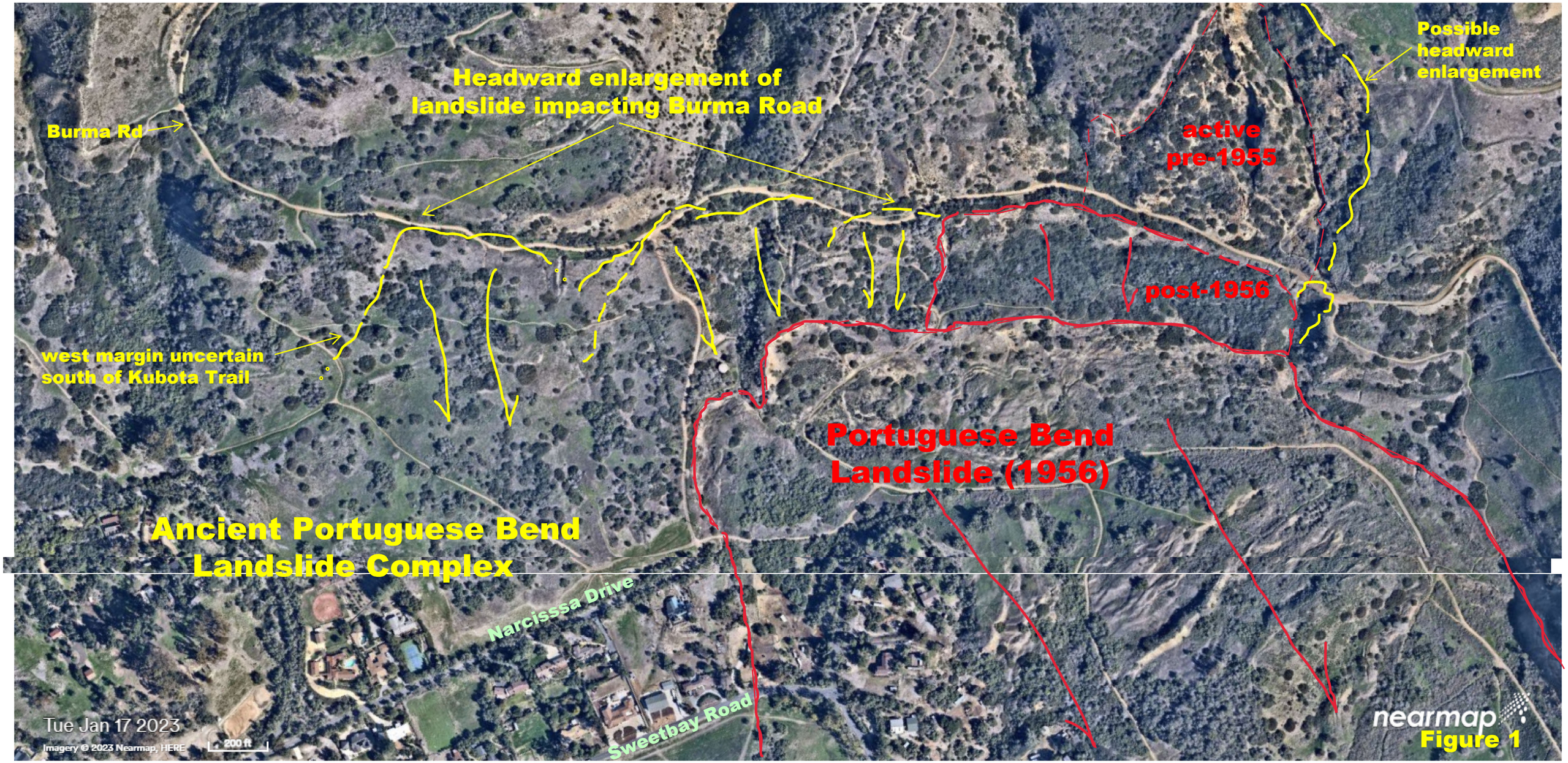
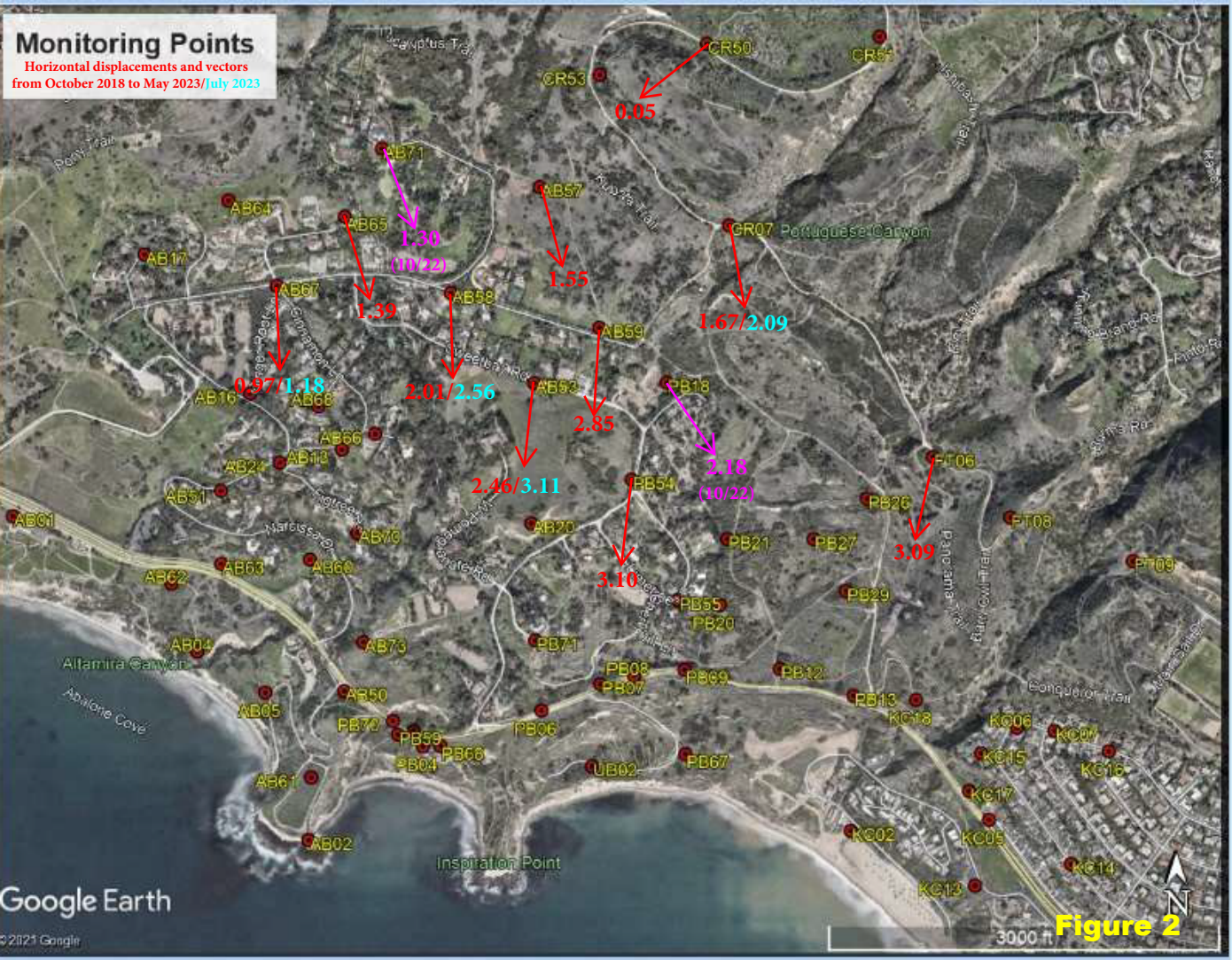

Headward enlargement of
landslide impacting Burma Road
Burma Rd
Possible
headward
enlargement
active
pre-1955
post-1956
west margin uncertain
south of Kubota Trail
Portuguese Bend
Landslide (1956)
Ancient Portuguese Bend
Landslide Complex
Narcisssa Drive
Sweetbay Road
Tue Jan 17 2023
Imagery © 2023 Nearmap, HERE
200 ft
nearmap

Figure 1


Monitoring Points
Horizontal displacements and vectors
from October 2018 to May 2023/July 2023
CR50
CR53
CR54
0.05
AB71
AB64
AB65
1.30
(10/22)
AB57
1.55
CR07
Portuguese Canyon
AB17
AB67
1.39
AB58
1.67/2.09
AB59
0.97/1.18
AB16
AB68
2.01/2.56
AB53
2.85
PB18
AB66
AB13
AB24
2.18
(10/22)
PT06
2.46/3.11
PB54
AB51
PB26
AB01
AB70
AB20
PB21
PB27
3.09
PT08
AB02
AB63
AB69
3.10
PT09
PB29
PB55
PB20
AB04
AB73
PB71
Altamira Canyon
PB08
PB07
PB69
PB12
Conqueror Trail
Abalone Cove
AB05
AB50
PB13
KC18
KC06
KC07
PB70
PB59
PB06
PB66
PB04
KC15
KC16
PB67
UB02
AB61
KC17
KC02
KC05
AB02
KC14
Inspiration Point
KC13
Google Earth
©2021 Google
3000 ft
N
Figure 2

GPS Monitoring Data

Survey Monuments - Upper Portuguese Bend Landslide/Burma Road Area

Displacement Response to 12-month Antecedent Rainfall

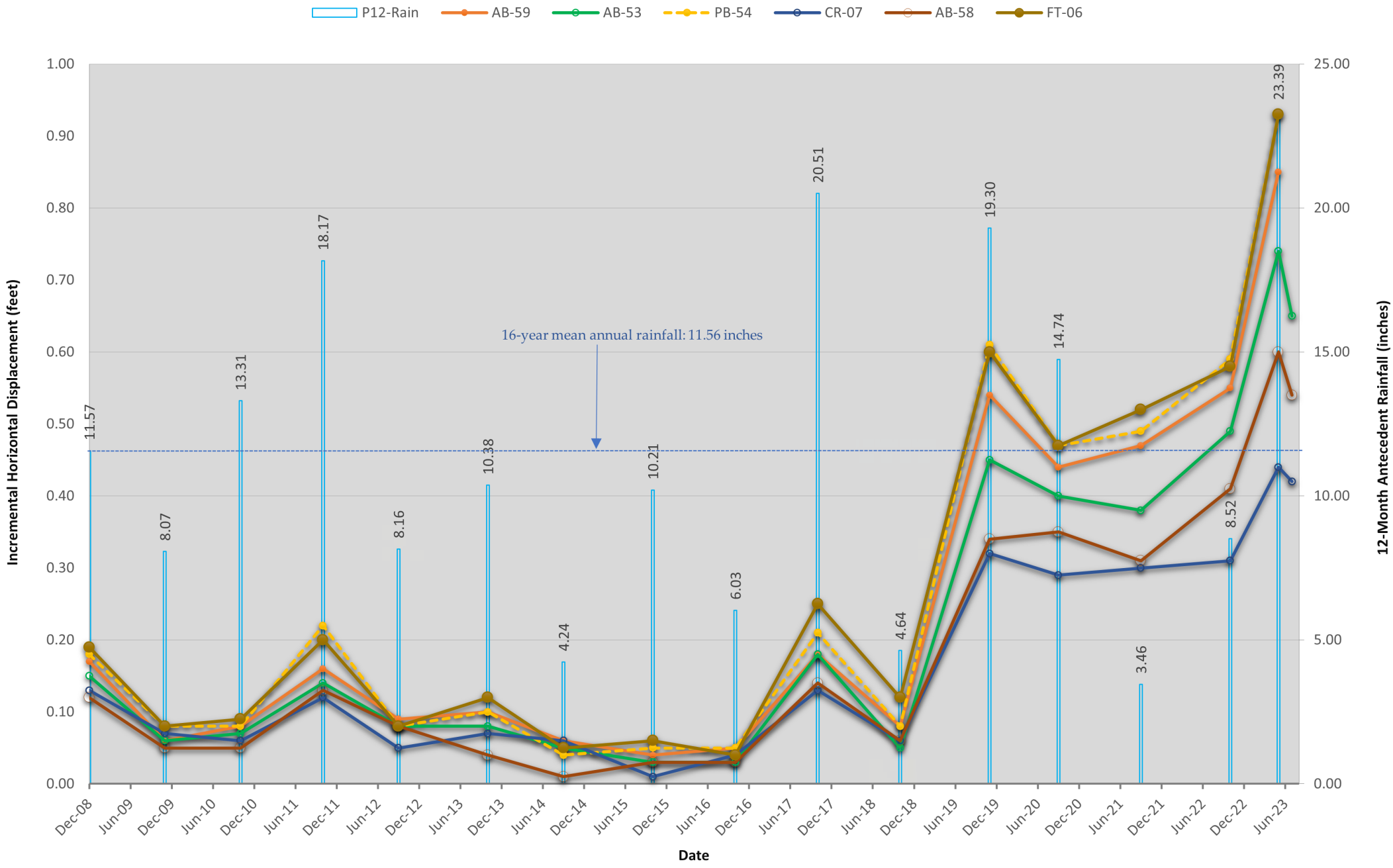


Figure 3

GPS Monitoring Data

Survey Monuments - Upper Portuguese Bend Landslide/Burma Road Area

Cumulative Horizontal Displacement 2007-2023

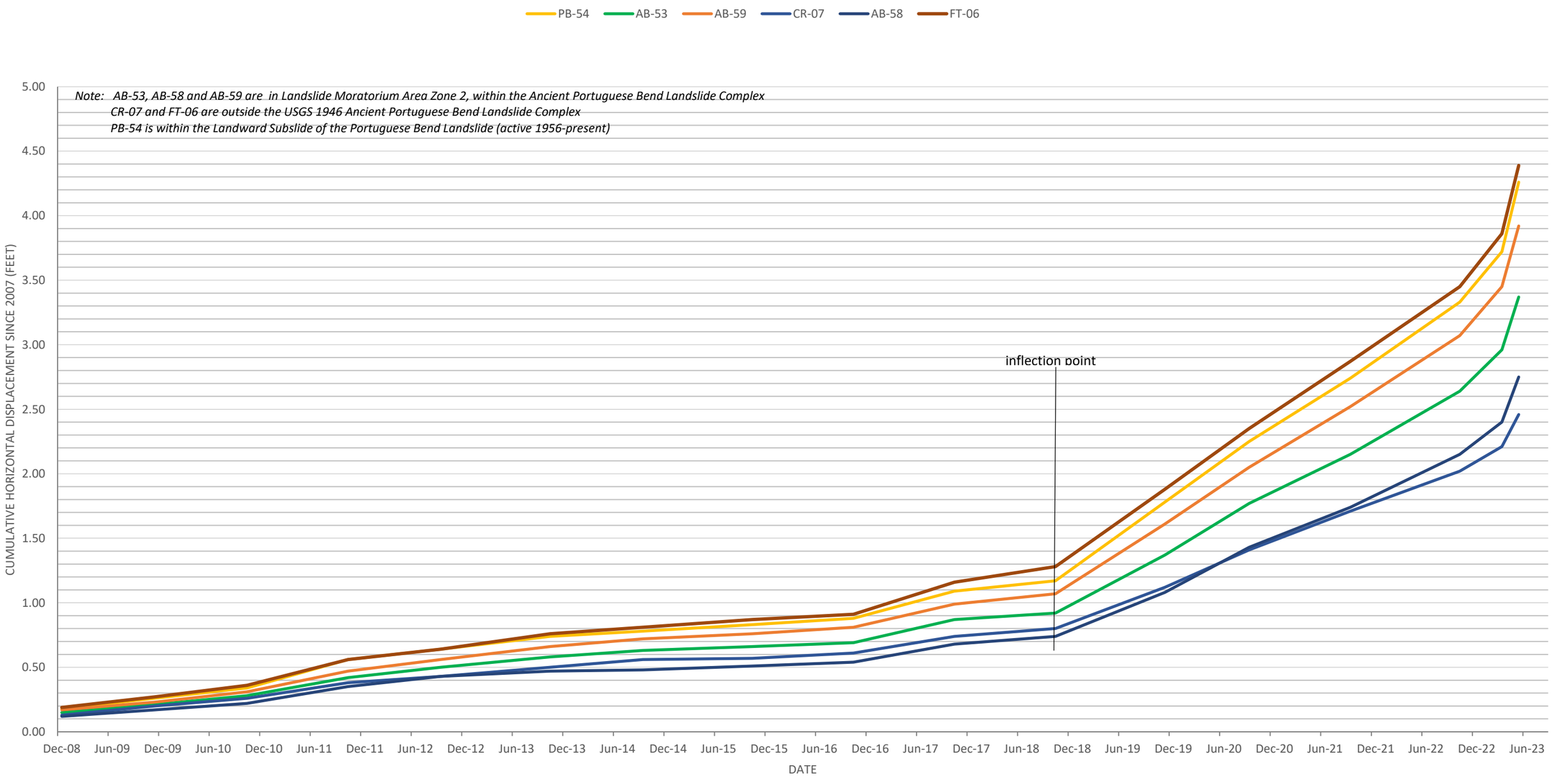


Figure 4

COTTON, SHIRES AND ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS

CITY OF RANCHO PALOS VERDES

CSA Project No: SC6163

MEMORANDUM

TO: Brandy Forbes, Community Development Director
CC: Ara Mihranian, City Manager
Ramzi Awwad, Public Works Director
FROM: Michael Phipps, CEG 1832, Contract City Geologist
Patrick Shires, GE 770, Contract City Geotechnical Engineer
RE: **Movement of the Altamira (Greater Portuguese Bend) Landslide Complex and Related Impacts, Rancho Palos Verdes, California**
DATE: November 8, 2024

INTRODUCTION

In this memorandum Cotton, Shires and Associates, Inc. (CSA) summarizes our evaluation of land movement of the Altamira Landslide Complex (previously referred to as the Greater Portuguese Bend Landslide Complex or Ancient Portuguese Bend Landslide Complex in past correspondence) from 2022-2024, with specific focus on the impacts of the land movement to private property, residential structures, and infrastructure. The active Altamira Landslide Complex currently involves major land movement comprising an area of over 700 acres landward of the coast. As of this date, the major land movement has resulted in the red-tagging (Unsafe to Enter/Occupy) of 18 residential structures and 2 commercial structures (at Wayfarer's Chapel), and the yellow-tagging (Limited Entry) of 38 other residential structures. It has also caused major impacts to public and private roads (some requiring closure), damages to utility infrastructure (water, sewer, gas, electricity and cable) causing certain utilities to be shut-off, and closure of certain Preserve land that is heavily accessed by the public for hiking, biking, equestrian, and other purposes.

BACKGROUND

The Altamira Landslide Complex in Rancho Palos Verdes includes four historically active, previously identified landslide areas: the Portuguese Bend Landslide (PBL) which began moving in 1956, the Abalone Cove Landslide (ACL) which began moving in 1979, the Klondike Canyon Landslide (KCL) which also began moving in 1979, and the Beach Club Landslide (BCL) which is nested within the KCL and, while dormant itself, moves with the KCL. It also now includes areas outside of the historically mapped boundaries of these known landslides, predominantly upslope from the historically mapped Portuguese Bend and Abalone Cove Landslides, within the Ancient Portuguese Bend Landslide Complex as mapped by various agencies (i.e., U.S. Geological Survey, California Geological Survey and other researchers (see attached Figure 1 - Landslide Area Map).

Based upon historically mapped boundaries, the ACL, PBL and KCL previously comprised an area of approximately 380 acres and affected portions of neighborhoods known as the Portuguese Bend Community, the Seaview Community and the Portuguese Bend Beach Club, as well as City-owned land within the Portuguese Bend Reserve (a sub-area of the greater Palos Verdes Nature Preserve). The

PBL has been continuously active since reactivation in 1956 with many areas of the landslide having moved hundreds of feet seaward over the ensuing six-plus decades. The ACL was active from 1979 until the late 1990's, involving only several feet of movement, when dewatering and other mitigation efforts largely halted movement. Creep movement of the ACL has occurred over the past 25 years following rainy seasons that were significantly above average rainfall amounts. The KCL has been episodically active in 1979-1983 and 2005-2006, experiencing only several inches of movement, typically in response to significantly above average rainfall. Landslide movements throughout the Ancient Portuguese Bend Landslide Complex *outside of the historical boundaries of* the ACL and PBL previously exhibited low rates of creep movement, or movement at or near the instrument precision range, in the 11-year monitoring period of 2007-2018 for which we have readily available data. These landslides are deep translational-type failures within seaward-dipping strata of the Monterey Formation, with the landslide slip surfaces occurring within very weak bentonitic clay beds. Historically, the movement behavior of these landslides routinely exhibited high sensitivity to increased groundwater pore pressure, and increased rates of land movement were correlative with 6-to-12-month antecedent rainfall that was well above average. Similarly, land movement decreased during below average rainy seasons or multi-year periods of drought.

Beginning in 2021, CSA geologists were requested by the City of Rancho Palos Verdes to observe reported distress (ground cracking and fissures) to trails in the Portuguese Bend Reserve. At that time, we also began reviewing Global Positioning Satellite (GPS) monitoring data for survey monuments within the entire Ancient Portuguese Bend Landslide Complex or Altamira Landslide Complex. In the summer of 2022, CSA was also asked to evaluate distress to an SCE transmission line along Burma Road within the Portuguese Bend Reserve. Subsequent geologic mapping of the Reserve area revealed that headward and lateral enlargement of the Portuguese Bend Landslide was occurring. We were also receiving reports of underground water line breaks occurring within the Portuguese Bend Community Association area and the Seaview Community. Review of GPS monitoring data from 2007 through 2023 indicated that land movement acceleration initially began between 2018 and 2019. We postulated that this acceleration was correlative with significantly above-normal rainfall in two out of three prior rainfall seasons (2016-17 and 2018-19) which followed five consecutive drier than normal rainfall seasons (2011-12 through 2015-16) (see attached Figure 2 – GPS Monitoring Data, Ancient Portuguese Bend Landslide: Displacement Response to 12-Month Antecedent Rainfall, December 2008-January 2024). One notable item, however, is that the land movement velocities did not decline back to the pre-2018 levels despite two significantly below-normal rainy seasons (2020-21, one of the driest on record, and 2021-22).

RAINFALL IMPACTS – 2022 THROUGH 2024

Further acceleration of land movement occurred throughout the Altamira Landslide Complex during and following the 2022-23 rain season, and the rainfall impacts from mid- to late-winter storms significantly contributed to the increased ground movements. Significant accelerations in movement velocity were documented in May 2023 following major storm sequences in January, February and March of 2023, which added to cumulative seasonal rainfall totals exceeding 193% of average rainfall. Approximately 87% of this rain fell prior to June 18, 2023. Most of this rainfall occurred from three significant atmospheric river-type storm sequences occurring on January 9-16 (3.59 inches), February 23-March 1 (3.79 inches) and March 10-15 (4.12 inches). Land movement velocities further increased as of the July 15, 2023 monitoring. An anomalous tropical storm dropped an additional 3.05 inches of

rain on August 19-20, 2023, resulting in further land movement acceleration as of the October 10, 2023 monitoring. The multiple increases in landslide velocities (i.e., accelerations) resulted in additional mappable ground surface expressions of the uphill limits of active landsliding, including the formation of landslide scarps, fissures, grabens, tensional cracking and shear zones, including areas north, west and east of the historically known landslide boundaries. Field geologic mapping and photo-geologic mapping performed in mid to late 2023 corroborated the GPS monitoring data findings that a large portion of the Ancient Portuguese Bend Landslide Complex (Altamira Landslide Complex) above the historically mapped PBL, ACL and KCL boundaries was involved in significant active landslide movement. The boundary of that major land movement has been updated through November 2024 and is depicted by the green dashed line on the attached Figure 1 – Landslide Area Map.

The 2023-2024 rainfall season total of more than 23 inches was 170% of the long-term average and had a compounding effect on the previous season's extraordinary rainfall. This rainfall season was characterized by additional atmospheric river type storms, including a sequence of storms that resulted in a Federally declared disaster from January 30 - February 9, 2024. The February 2024 rainfall total of 11.22 was the second wettest February in the 67-year history of recorded data for the Palos Verdes Peninsula. The landslide response to these rains was almost immediate and we observed continued accelerating land movement in the GPS monitoring data through August 1, 2024. A peak land movement velocity of >13 inches/week occurred in the center of the landslide as of the May 28, 2024 monitoring period. Movement velocities appeared to peak across the breadth of the landslide in the July 1 - August 1, 2024 monitoring period with the majority of stations moving >10 inches/week and peak movements >12 inches per week. Attached Figures 3, 4, 5 and 6 – GPS Monitoring Displacement Rate Contour Maps, are landslide movement velocity contour maps produced from GPS monitoring data through August 1, 2024, September 4, 2024, October 8, 2024 and October 29, 2024, respectively.

For reference, rainfall data utilized for this evaluation are from the Los Angeles County Department of Public Works - Hydrology Division Station 1011B, located at the Rolling Hills Fire Station No. 56. This rainfall station serves as a reasonable proxy for rainfall impacts to the southern face of the Palos Verdes Peninsula due to its elevation, which should reflect some orographic effect for storms approaching the Palos Verdes Peninsula from the west, southwest, and south, compared to coastal stations such as Point Vicente which may underestimate rain totals in the higher reaches of the landslide complex and watershed.

TOTAL LAND MOVEMENT – OCTOBER 2022 THROUGH OCTOBER 2024

Since October 10, 2022, total horizontal land movement throughout the Altamira Landslide Complex has ranged from approximately 27 to 39 feet in most areas, with the exception being approximately 6 to 21 feet of horizontal land movement in the Klondike Canyon Landslide area. Vertical displacements have ranged from 1 - 10 feet in most areas over this same period. This land movement has had a destructive and devastating effect on numerous residential and commercial properties and structures, private and public roadways, and utility infrastructure. In addition to the 18 red-tagged and 38 yellow-tagged structures, dozens of homes are experiencing varying amounts of distress and inaccessibility due to differential land movements, and electricity and gas service has been cut off from the majority of these properties. The most significant damage is to structures on or adjacent to the landslide boundaries, or those located on boundaries between subslides (blocks) within the Altamira Landslide Complex that are moving at different rates.

Since June 2024, the City has undertaken emergency mitigation measures including 18 deep geotechnical test borings with sophisticated instrumentation to detect the depth(s) of land movement and groundwater pore pressures within and beneath the active landslide mass(es). The instrumented geotechnical test borings revealed that the basal slip surface of the Altamira Landslide Complex beneath the Portuguese Bend Landslide portion of the Altamira complex is up to twice as deep as previously/historically modeled, and moving at a much faster rate than the shallower PBL slip surface. This significantly greater depth of movement has resulted in a broader footprint of active land movement at the ground surface and offshore, and expansion of the historical land movement area from approximately 380 acres to over 700 acres. The test borings also indicated that artesian or near-artesian groundwater pressure is present beneath the Altamira slip surface, and confined groundwater under significant pressure is present between the Altamira and PBL slip surfaces. High unconfined groundwater levels were also determined within the historically modeled Portuguese Bend and Abalone Cove landslide bodies. Beginning September 13, 2024, the first of 10 deep dewatering wells came online. The ten wells, all located near the toe, or lower 1/3 of the landslide complex, are currently extracting approximately 1 million gallons per day of groundwater within and beneath the landslide.

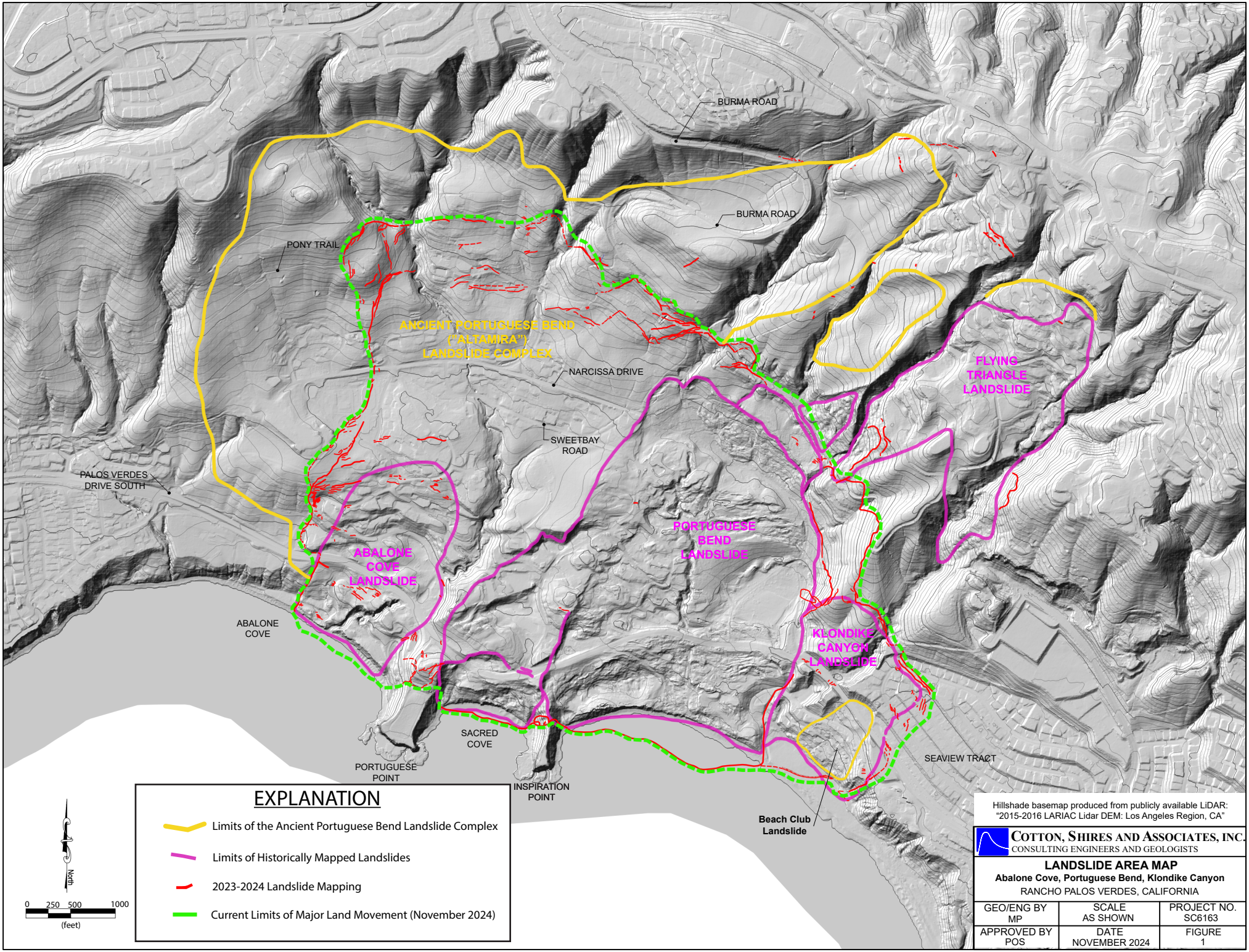
FUTURE LAND MOVEMENT POTENTIAL

As described above, major movement of the Altamira Landslide Complex ranging from 6 to 39 feet horizontally and 1 to 10 feet vertically has occurred since October 2022, with the majority of that movement occurring during and following the 2023-24 rainy season. The highest observed movement rates have exceeded 12 inches per week. While emergency dewatering mitigation efforts and 6 months without any rainfall recharge have reduced movements in most areas to a current level of 0.5 to 6 inches per week, there are many uncertainties regarding the longevity and long-term effectiveness of the deep dewatering wells that have been installed, including the availability of additional funding needed to maintain them and keep them operational. There is also uncertainty regarding the quantity of dewatering wells needed to maintain landslide movements at low (creep) movement levels, and whether funding for additional wells can be obtained. Given the emergency measures that are in place, the future response of the landslide to seasonal rains, including the severity of those rains is unknown; however, historical land movement data demonstrates increases in land movement with above-average rainy seasons despite the operation of past dewatering facilities operated by private geologic hazard abatement districts such as ACLAD and KCLAD.

-o-

Attachments:

Figure 1 – Landslide Area Map
Figure 2 – GPS Monitoring Data, Displacement Response to 12-Month Antecedent Rainfall, December 2008-January 2024
Figure 3 – GPS Monitoring Displacement Rate Contour Map (8/1/2024 Data)
Figure 4 – GPS Monitoring Displacement Rate Contour Map (9/4/2024 Data)
Figure 5 – GPS Monitoring Displacement Rate Contour Map (10/8/2024 Data)
Figure 6 – GPS Monitoring Displacement Rate Contour Map (10/29/2024 Data)

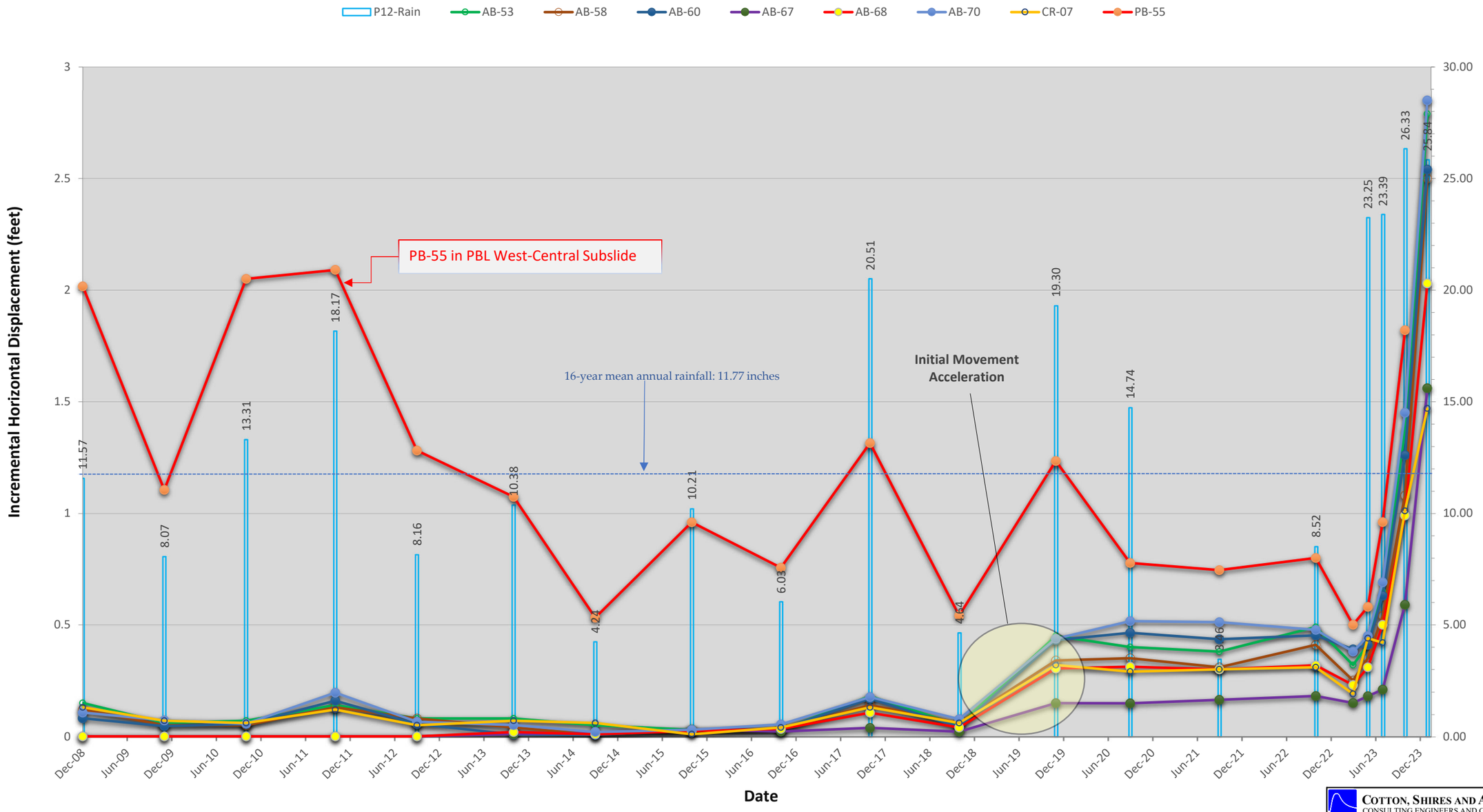

BURMA ROAD
BURMA ROAD
PONY TRAIL
ANCIENT PORTUGUESE BEND ("ALTAMIRA") LANDSLIDE COMPLEX
NARCISSA DRIVE
SWEETBAY ROAD
PALOS VERDES DRIVE SOUTH
FLYING TRIANGLE LANDSLIDE
PORTUGUESE BEND LANDSLIDE
ABALONE COVE LANDSLIDE
KLONDIKE CANYON LANDSLIDE
ABALONE COVE
SACRED COVE
PORTUGUESE POINT
INSPIRATION POINT
SEAVIEW TRACT
Beach Club Landslide
EXPLANATION
Limits of the Ancient Portuguese Bend Landslide Complex
Limits of Historically Mapped Landslides
2023-2024 Landslide Mapping
Current Limits of Major Land Movement (November 2024)
North
0 250 500 1000
(feet)
Hillshade basemap produced from publicly available LiDAR: "2015-2016 LARIAC Lidar DEM: Los Angeles Region, CA"
COTTON, SHIRES AND ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS
LANDSLIDE AREA MAP
Abalone Cove, Portuguese Bend, Klondike Canyon
RANCHO PALOS VERDES, CALIFORNIA
GEO/ENG BY MP
SCALE AS SHOWN
PROJECT NO. SC6163
APPROVED BY POS
DATE NOVEMBER 2024
FIGURE 1

GPS Monitoring Data

Survey Monuments - ACL, PBL and Upper Ancient Landslide Complex

Displacement Response to 12-month Antecedent Rainfall

December 2008-January 2024



COTTON, SHIRES AND ASSOCIATES, INC. CONSULTING ENGINEERS AND GEOLOGISTS	
GPS Monitoring Data Survey Monuments- ACL, PBL, and Upper Ancient Landslide Complex Displacement Response to 12-month Antecedent Rainfall Rancho Palos Verdes, California	
GEO/ENG BY MP	SCALE
APPROVED BY POS	DATE NOVEMBER 2024

PROJECT NO. SC6163

FIGURE 2

APPROXIMATE BOUNDARY OF ANCIENT PORTUGUESE BEND LANDSLIDE COMPLEX

"Creeping Area" Approximately 0.5 inch/week

CURRENT LIMITS OF MAJOR LANDSLIDE MOVEMENT (AUGUST 2024)

PONY TRAIL

BURMA ROAD

PALOS VERDES DRIVE SOUTH

ABALONE COVE

PORTUGUESE POINT

SACRED COVE

INSPIRATION POINT

SEAVIEW TRACT

PORTUGUESE BEND LANDSLIDE

ABALONE COVE LANDSLIDE

FLYING TRIANGLE LANDSLIDE

KLONDIKE CANYON LANDSLIDE

0.06 CW01
0.08 AB77
0.07 CR56
0.33 CR50
0.47 CR51
0.49 CR53
0.52 CW05
0.00 AB71 no data
0.00 CR57 no data
0.48 AB64
0.01 AB17
0.03 RP02
0.05 CW06
0.24 AB76
0.06 AB01
0.04 CW07
0.02 FT08
0.05 CW08
0.01 FT09
0.02 FT00
0.06 AB02
0.08 KC14
0.02 RP01
0.23 KC25
0.46 KC13
4.09 KC22
0.04 KC21
3.84 KC33
3.89 KC06
3.40 KC19
0.03 KC07
0.03 KC16
3.45 KC20
3.91 KC15
2.72 KC23
3.53 KC17
2.41 KC05
5.68 KC28
5.16 KC24
3.88 KC27
4.09 KC26
6.48 KC29
9.21 KC30
8.82 PB13
8.23 KC31
7.84 KC18
11.39 PB74
11.45 PB12
9.87 PB26
9.36 PB29
10.91 PB27
9.39 PB73
11.89 PB54
10.41 PB21
11.54 PB75
11.13 PB55
10.83 PB20
10.84 PB08
9.92 PB09
11.68 PB07
12.96 PB71
12.29 PB67
9.98 UB02
11.36 PB59
11.13 PB69
11.58 PB70
11.34 PB04
11.15 PB68
11.81 PB72
10.07 PB06
10.75 AB73
11.99 AB75
12.43 AB21
11.69 AB70
10.19 AB60
9.11 AB63
7.08 AB62
9.20 AB04
8.55 AB05
6.86 AB50
5.16 AB74
8.95 AB51
11.23 AB24
10.64 AB13
10.10 AB66
9.79 AB68
7.49 AB16
7.48 AB67
8.88 AB65
9.39 AB57
11.00 AB58
12.65 AB59
11.80 CR54
11.29 AB53
11.89 PB18
0.00 AB71 no data
7.0
8.0
9.0
10.0
11.0
12.0

EXPLANATION

- Limits of the Ancient Portuguese Bend Landslide Complex
- Limits of Historically Mapped Landslides
- 2023/2024 Landslide Mapping
- Current Limits of Major Landslide Movement (August 2024)
- GPS Monument Displacement!Rate (July 1, 2024 to August 1, 2024) Displacement Vector! Scale 1"= 8"/week

Displacement Rate Table

Minimum Rate (inch/week)	Maximum Rate (inch/week)	Color
0.00	1.00	
1.00	2.00	
2.00	3.00	
3.00	4.00	
4.00	5.00	
5.00	6.00	
6.00	7.00	
7.00	8.00	
8.00	9.00	
9.00	10.00	
10.00	11.00	
11.00	12.00	
12.00	13.00	

North

0 250 500 1000 (feet)

Hillshade basemap produced from publicly available LiDAR: "2015 - 2016 LARIAC Lidar DEM: Los Angeles Region, CA"

COTTON, SHIRES AND ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS

GPS MONITORING DISPLACEMENT RATE CONTOUR MAP (8/1/24 DATA)
Abalone Cove, Portuguese Bend, Klondike Canyon
RANCHO PALOS VERDES, CALIFORNIA

GEO/ENG BY	SCALE	PROJECT NO.
MP	1"=500'	SC6163
APPROVED BY	DATE	FIGURE NO.
POS	November 8, 2024	3

APPROXIMATE BOUNDARY OF ANCIENT PORTUGUESE BEND LANDSLIDE COMPLEX

CURRENT LIMITS OF MAJOR LANDSLIDE MOVEMENT (SEPTEMBER 2024)

"Creeping Area" Approximately 0.5 inch/week

BURMA ROAD

PONY TRAIL

PALOS VERDES DRIVE SOUTH

PORTUGUESE BEND LANDSLIDE

ABALONE COVE LANDSLIDE

KLONDIKE CANYON LANDSLIDE

FLYING TRIANGLE LANDSLIDE

ABALONE COVE

SACRED COVE

PORTUGUESE POINT

INSPIRATION POINT

SEAVIEW TRACT

EXPLANATION

- Limits of the Ancient Portuguese Bend Landslide Complex
- Limits of Historically Mapped Landslides
- 2023/2024 Landslide Mapping
- Current Limits of Major Landslide Movement (September 2024)
- GPS Monument Displacement Rate (August 1, 2024 to September 4, 2024) Displacement Vector Scale 1"= 8"/week

Displacement Rate Table

Minimum Rate (inch/week)	Maximum Rate (inch/week)	Color
0.00	1.00	
1.00	2.00	
2.00	3.00	
3.00	4.00	
4.00	5.00	
5.00	6.00	
6.00	7.00	
7.00	8.00	
8.00	9.00	
9.00	10.00	
10.00	11.00	
11.00	12.00	
12.00	13.00	

North

0 250 500 1000 (feet)

Hillshade basemap produced from publicly available LiDAR: "2015 - 2016 LARIAC Lidar DEM: Los Angeles Region, CA"

COTTON, SHIRES AND ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS

GPS MONITORING DISPLACEMENT RATE CONTOUR MAP (9/4/24 DATA)
Abalone Cove, Portuguese Bend, Klondike Canyon
RANCHO PALOS VERDES, CALIFORNIA

GEO/ENG BY	SCALE	PROJECT NO.
MP	1"=500'	SC6163
APPROVED BY	DATE	FIGURE NO.
POS	November 8, 2024	4

APPROXIMATE BOUNDARY OF ANCIENT PORTUGUESE BEND LANDSLIDE COMPLEX

CURRENT LIMITS OF MAJOR LANDSLIDE MOVEMENT (OCTOBER 2024)

"Creeping Area" Approximately 0.5 inch/week

BURMA ROAD

PONY TRAIL

PALOS VERDES DRIVE SOUTH

ABALONE COVE

SACRED COVE

PORTUGUESE POINT

INSPIRATION POINT

SEAVIEW TRACT

ABALONE COVE LANDSLIDE

PORTUGUESE BEND LANDSLIDE

KLONDIKE CANYON LANDSLIDE

FLYING TRIANGLE LANDSLIDE

0.04 AB80
0.04 AB79
0.03 CW01
0.06 AB77
0.07 CR56
0.35 CR50
0.44 CR51
0.00 CR60
0.43 CR53
0.36 CR58
1.78 AB78
6.17 AB57
0.47 CW05
0.03 CR59
0.12 AB64
6.14 AB65
0.11 CR57
0.04 AB17
5.09 AB67
6.86 CR54
7.44 AB58
0.00 RP03
0.07 CW06
7.90 AB59
0.03 FT10
5.42 AB16
6.82 AB68
7.37 AB53
6.95 PB18
0.11 AB76
6.91 AB66
7.23 AB13
3.84 PB76
7.88 AB24
7.18 AB75
6.99 PB54
4.01 PB26
0.05 AB01
3.66 AB74
6.18 AB51
7.85 AB70
7.29 AB21
0.03 FT08
4.96 PB21
5.05 PB27
0.02 CW08
6.23 AB69
6.74 AB69
6.28 PB75
0.04 FT09
5.03 AB62
5.26 PB55
3.42 PB29
4.99 PB20
0.04 KC21
6.09 AB04
7.08 PB71
6.04 AB73
6.03 PB70
5.88 PB59
1.57 KC06
3.88 AB50
5.64 PB69
4.62 PB08
4.08 PB09
4.21 PB12
3.04 PB13
1.80 KC22
1.35 KC19
5.11 PB07
5.74 PB04
3.23 KC31
2.49 KC18
0.04 KC07
4.58 PB06
1.67 KC33
1.29 KC20
0.02 KC16
5.71 PB68
5.77 PB72
4.63 PB67
4.54 PB74
3.38 KC30
1.53 KC15
3.74 UB02
1.34 KC17
1.05 KC23
1.05 KC05
2.27 KC29
1.75 KC24
2.47 KC38
1.98 KC28
1.34 KC26
0.55 KC13
0.05 KC35
0.05 KC14
0.05 KC34
0.03 KC36
0.08 KC25
0.04 KC37
0.04 RP01

5.0
6.0
7.0
4.0
3.0
2.0
1.0

EXPLANATION

- Limits of the Ancient Portuguese Bend Landslide Complex
- Limits of Historically Mapped Landslides
- 2023/2024 Landslide Mapping
- Current Limits of Major Landslide Movement (October 2024)
- GPS Monument Displacement Rate (September 4, 2024 to October 8, 2024) Displacement Vector Scale 1"= 8"/week

Displacement Rate Table

Minimum Rate (inch/week)	Maximum Rate (inch/week)	Color
0.00	1.00	
1.00	2.00	
2.00	3.00	
3.00	4.00	
4.00	5.00	
5.00	6.00	
6.00	7.00	
7.00	8.00	
8.00	9.00	
9.00	10.00	
10.00	11.00	
11.00	12.00	
12.00	13.00	

North

0 250 500 1000
(feet)

Hillshade basemap produced from publicly available LiDAR: "2015 - 2016 LARIAC Lidar DEM: Los Angeles Region, CA"

COTTON, SHIRES AND ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS

GPS MONITORING DISPLACEMENT RATE CONTOUR MAP (10/8/24 DATA)
Abalone Cove, Portuguese Bend, Klondike Canyon
RANCHO PALOS VERDES, CALIFORNIA

GEO/ENG BY	SCALE	PROJECT NO.
MP	1"=500'	SC6163
APPROVED BY	DATE	FIGURE NO.
POS	November 8, 2024	5

APPROXIMATE BOUNDARY OF ANCIENT PORTUGUESE BEND LANDSLIDE COMPLEX

CURRENT LIMITS OF MAJOR LANDSLIDE MOVEMENT (NOVEMBER 2024)

BURMA ROAD

PONY TRAIL

PALOS VERDES DRIVE SOUTH

ABALONE COVE

PORTUGUESE POINT

SACRED COVE

INSPIRATION POINT

ABALONE COVE LANDSLIDE

PORTUGUESE BEND LANDSLIDE

KLONDIKE CANYON LANDSLIDE

FLYING TRIANGLE LANDSLIDE

SEAVIEW TRACT

0.07 AB80 · 0.12 AB79 · 0.02 CW01 · 0.06 AB77 · 0.04 CR56 · 0.08 CR50 · 0.10 CR51 · 0.03 CR60 · 0.01 CR53 · 0.07 CR58 · 0.13 AB78 · 0.08 CW05 · 0.08 CR59 · 0.62 AB64 · 4.83 AB57 · 4.21 AB65 · 0.09 CR57 · 0.09 AB17 · 3.61 AB67 · 4.0 · 5.10 AB58 · 4.68 CR54 · 5.0 · 5.04 AB59 · 0.01 RP03 · 0.08 CW06 · 3.91 AB16 · 4.51 AB53 · 4.01 PB18 · 0.07 FT10 · 4.72 AB68 · 4.74 AB66 · 0.11 AB76 · 3.32 AB76 · 1.55 PB76 · 5.64 AB24 · 0.13 AB01 · 3.06 AB74 · 4.17 AB51 · 4.70 AB75 · 4.23 PB54 · 0.56 PB26 · 0.04 FT08 · 4.63 AB21 · 2.48 PB21 · 2.08 PB27 · 0.16 GW08 · 0.06 FT09 · 5.46 AB70 · 4.37 AB69 · 5.29 AB60 · 3.49 PB75 · 3.64 AB62 · 2.88 PB55 · 0.36 PB29 · 4.0 · 4.36 PB71 · 2.03 PB20 · 4.32 AB04 · 3.53 AB73 · 1.97 PB08 · 2.0 · 0.04 KC21 · 0.22 KC06 · 3.47 PB70 · 3.38 PB59 · 1.67 PB09 · 1.23 PB12 · 0.38 PB13 · 3.0 · 2.46 PB07 · 3.63 PB69 · 0.22 KC31 · 0.14 KC18 · 0.19 KC22 · 0.28 KC19 · 2.07 AB50 · 2.21 PB06 · 3.25 PB04 · 0.24 KC33 · 0.11 KC07 · 3.25 PB68 · 3.22 PB72 · 1.0 · 0.68 UB02 · 1.14 PB67 · 0.97 PB74 · 0.16 KC20 · 0.13 KC16 · 0.16 KC30 · 0.19 KC15 · 0.11 KC17 · 0.20 KC23 · 0.19 KC05 · 0.12 KC29 · 0.11 KC24 · 0.22 KC38 · 0.17 KC28 · 0.08 KC26 · 0.12 KC13 · 0.09 KC25 · 0.11 KC14 · 0.12 KC35 · 0.14 KC34 · 0.10 KC36 · 0.16 KC37 · 0.11 RP01

EXPLANATION

- Limits of the Ancient Portuguese Bend Landslide Complex
- Limits of Historically Mapped Landslides
- 2023/2024 Landslide Mapping
- Current Limits of Major Landslide Movement (November 2024)
- GPS Monument Displacement Rate (October 8, 2024 to October 29, 2024) Displacement Vector Scale 1"= 8"/week

Displacement Rate Table

Minimum Rate (inch/week)	Maximum Rate (inch/week)	Color
0.00	1.00	
1.00	2.00	
2.00	3.00	
3.00	4.00	
4.00	5.00	
5.00	6.00	
6.00	7.00	
7.00	8.00	
8.00	9.00	
9.00	10.00	
10.00	11.00	
11.00	12.00	
12.00	13.00	

North

0 250 500 1000 (feet)

Hillshade basemap produced from publicly available LiDAR: "2015 - 2016 LARIAC Lidar DEM: Los Angeles Region, CA"

COTTON, SHIRES AND ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS

GPS MONITORING DISPLACEMENT RATE CONTOUR MAP (10/29/24 DATA)
Abalone Cove, Portuguese Bend, Klondike Canyon
RANCHO PALOS VERDES, CALIFORNIA

GEO/ENG BY	SCALE	PROJECT NO.
MP	1"=500'	SC6163
APPROVED BY	DATE	FIGURE NO.
POS	November 8, 2024	6

COTTON, SHIRES AND ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS

CITY OF RANCHO PALOS VERDES

CSA Project No: SC6163

MEMORANDUM

TO: Ara Mihranian, City Manager
CC: Ramzi Awwad, Public Works Director

FROM: Michael Phipps, CEG 1832, Contract City Geologist
Patrick Shires, GE 770, Contract City Geotechnical Engineer
RE: **Movement of the Altamira Landslide: Characterization, Related Impacts, Causation, and Emergency Measures, Rancho Palos Verdes, California**
DATE: March 16, 2025

INTRODUCTION

In this memorandum Cotton, Shires and Associates, Inc. (CSA) summarizes our evaluation of movement of the Altamira Landslide, with specific focus on the characteristics, differences, and causation of movement of this new landslide, distinguishing it from the known historically active Landslide Complex that is comprised of the Portuguese Bend Landslide (PBL), Abalone Cove Landslide (ACL), Klondike Canyon Landslide (KCL) and Beach Club Landslide (BCL). We include the BCL as part of the KCL, because it is, in itself, dormant and nested within (or rafts upon) the KCL. Also discussed are impacts of the Altamira Landslide movement to private property, residential structures, and infrastructure in the landslide area.

DISTINGUISHING THE ALTAMIRA LANDSLIDE

For definition purposes, the Altamira Landslide is a newly active landslide that has occurred within a previously mapped ancient landslide complex, most recently labeled the "Ancient Altamira Landslide Complex" (Douglas, 2013) which was a name modification of the "Ancient Portuguese Bend Landslide" identified on the California Geological Survey's Landslide Inventory Map (CGS, 2007). See the excerpted Figure 1 from Douglas (2013) on the following page for this clarification. It is important to make this distinction for consistency and to avoid confusion, because the Altamira Landslide is, in fact, a new member of the historically active PBL/ACL/KCL Landslide Complex but largely **underlies it** and occupies an area of active land movement >700 acres and extends to more than 500 feet off of the coastline, whereas the shallower historically active PBL/ACL/KCL complex only occupied about 380 acres.

The Altamira Landslide in Rancho Palos Verdes is therefore a recently identified large landslide that largely underlies (and therefore largely encompasses, but exceeds the area of) the previously understood active Landslide Complex containing the four historically active landslides: the PBL which historically began moving in 1956, the ACL which began moving in 1979, the KCL which also began moving in 1979, and the BCL which is nested within the KCL and, while dormant itself, moves along with the KCL. The Altamira Landslide includes large areas outside of the historically mapped boundaries of these known landslides, predominantly upslope and downslope from the historically

mapped PBL and ACL, within, but smaller than, the Ancient Altamira Landslide Complex as defined above. To provide an example of the change in size, the dimensions from head to toe of the previously historical ACL is 2,250 feet and the width up to 1,450 feet wide. The dimensions from head to toe of the Altamira Landslide, underlying and extending up and down slope from both the PBL and the ACL, is 5,800 feet (more than double that of the ACL) with a width of up to 7,400 feet wide (more than five times as wide as the ACL).

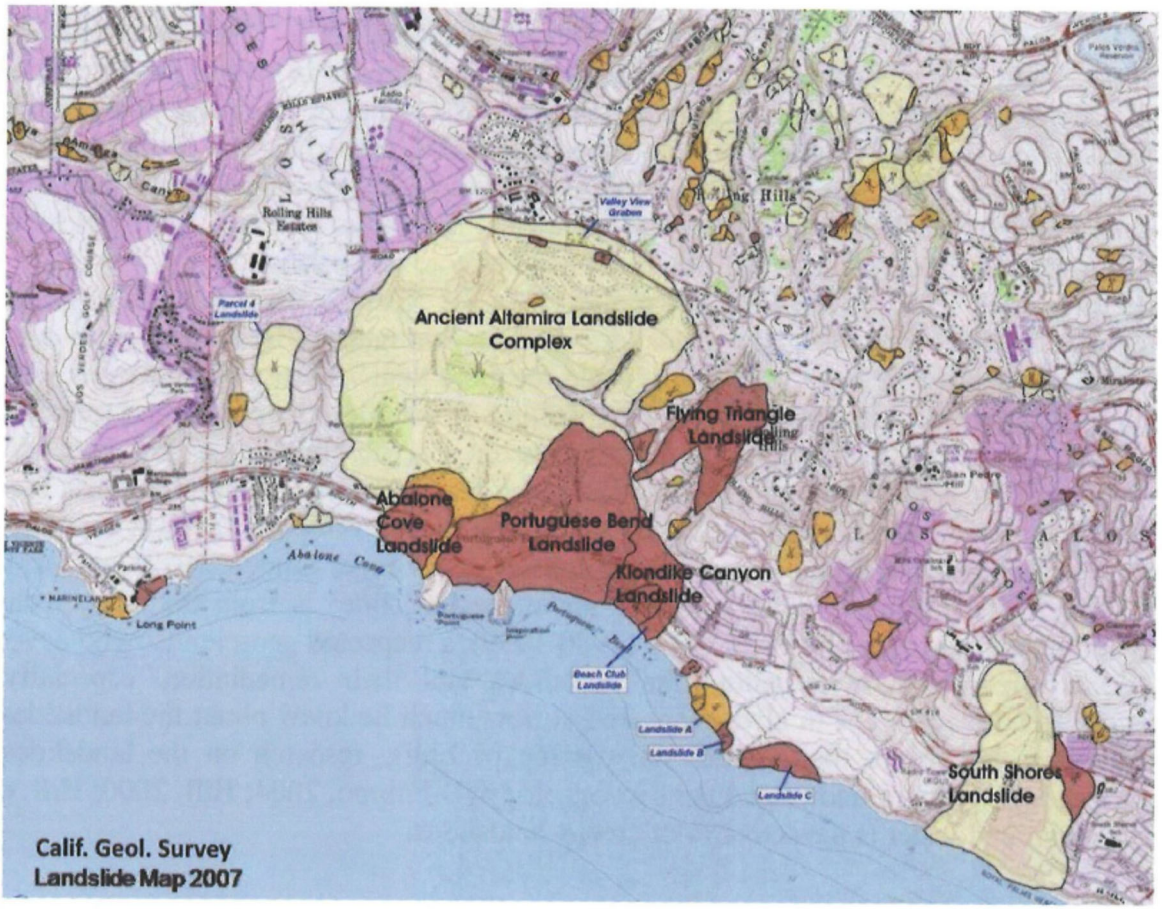


Figure 1. Landslide map of a portion of the south flank of the Palos Verdes Peninsula prepared by the California Geological Survey (2007). The major and some minor landslides are identified. Light yellow indicates that the landslide is inactive, red is active and orange is dormant.

While previous geotechnical investigators identified inactive deep failure surfaces in both the historically active and ancient landslide areas, none of them mapped or identified as active the entire depth or breadth of movement that has recently impacted the area, nor did they opine that such an event would occur in historic times. The active Altamira Landslide currently involves major land movement comprising an area of over 700 acres landward of the coast and extends to approximately 500 feet or more off the coastline. The areal dimensions, depth of movement, velocity of movement, artesian and near-artesian groundwater pressures beneath it, and even the direction of movement, are different than the Abalone Cove, Portuguese Bend, and Klondike Canyon landslides. The distinction to be made then, is that the Altamira Landslide is not just simple *expansion* of an existing group of landslides, it is an entirely different, larger and deeper landslide with much broader boundaries (including the new coastline offshore), nearly twice as deep as the depth of historic landslide movement in some areas, and with unprecedented rates of movement (which were not seen in the early LA County

Engineer surveys, the Charles Abbott Associates surveys beginning in 1994, nor the McGee surveys since 2007). None of this was experienced during the history of the City, and the Altamira Landslide is a unique landslide not characterized in its current dimensions during the over 70-year history of landslide investigations, exploratory borings, monitoring and observations being conducted in the area.

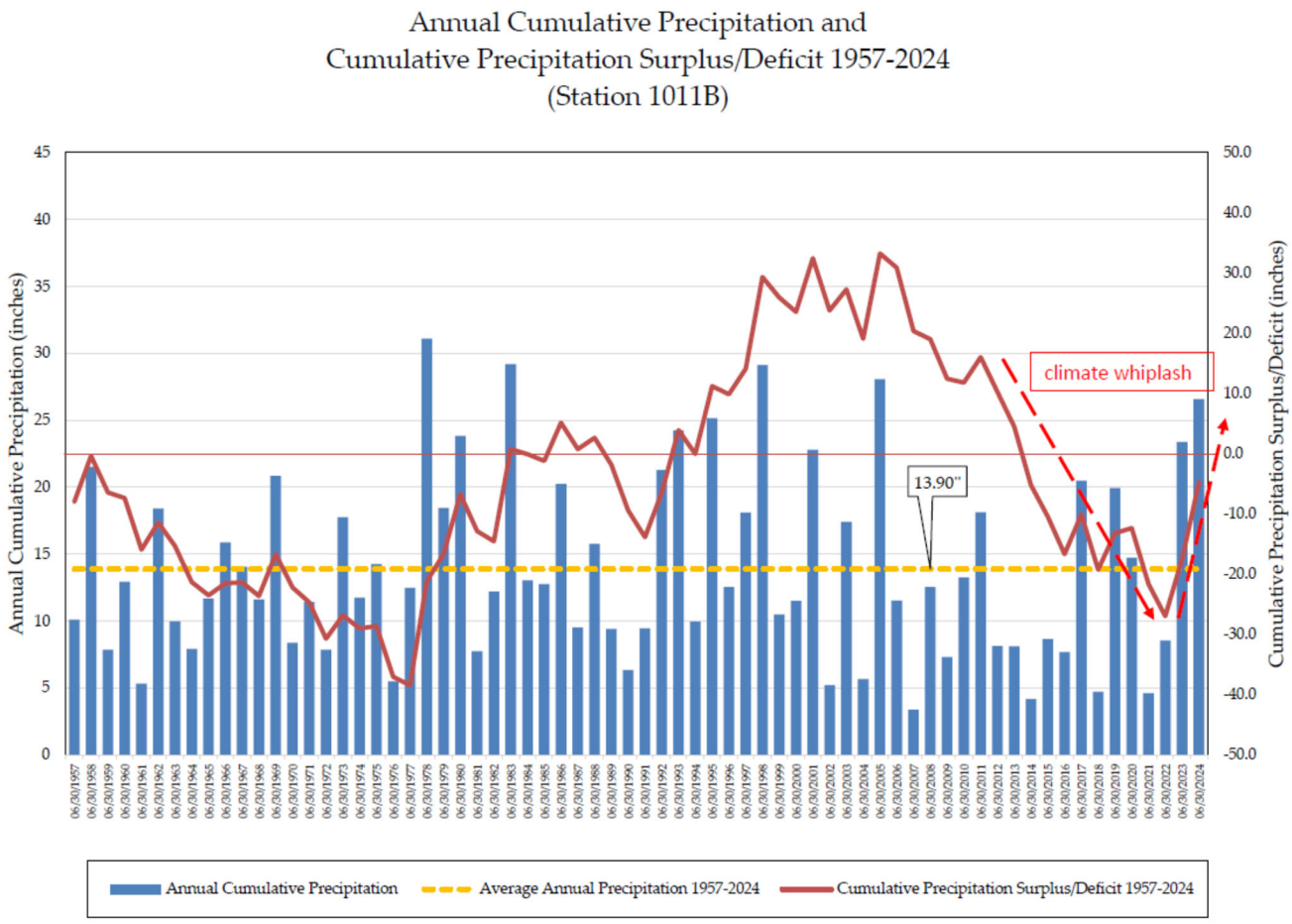
IMPACTS OF MOVEMENT OF THE ALTAMIRA LANDSLIDE

As of this date, the major land movement of the Altamira Landslide has resulted in the red-tagging (Unsafe to Enter/Occupy) and yellow tagging (Limited Entry) of several residential and commercial structures. It has also caused major destructive impacts to public and private roads, damages to utility infrastructure (water, sewer, gas, electricity and cable), causing certain utilities to be shut-off, and closure of certain Preserve land that is otherwise heavily accessed by the public for hiking, biking, equestrian, and other purposes. The only practical mitigation measure available to address a landslide with such a colossal scale is relieving groundwater pore pressures through pumping of groundwater, but it has to be done on a large enough scale to be effective at reducing the movement to an acceptable level. This technique has proven effective for the east side of the Altamira Landslide where deep dewatering wells have been installed, maintained and the rate of ground movement monitored such that a correlation between increased pumping of groundwater and reduction in the rate of ground movement has been confirmed.

CAUSATION

It is our opinion that the activation of the Altamira Landslide was largely caused by "climate whiplash" (also more technically described as hydroclimate volatility) induced by climate change, particularly starting in 2011, with five years of drought, and eight out of eleven years significantly below normal rainfall from 2011-2022, followed by two consecutive extraordinarily heavy rain seasons that dropped approximately 4 feet of rainfall on the landslide and surrounding areas draining into the landslide on the south flank of the Palos Verdes Hills.

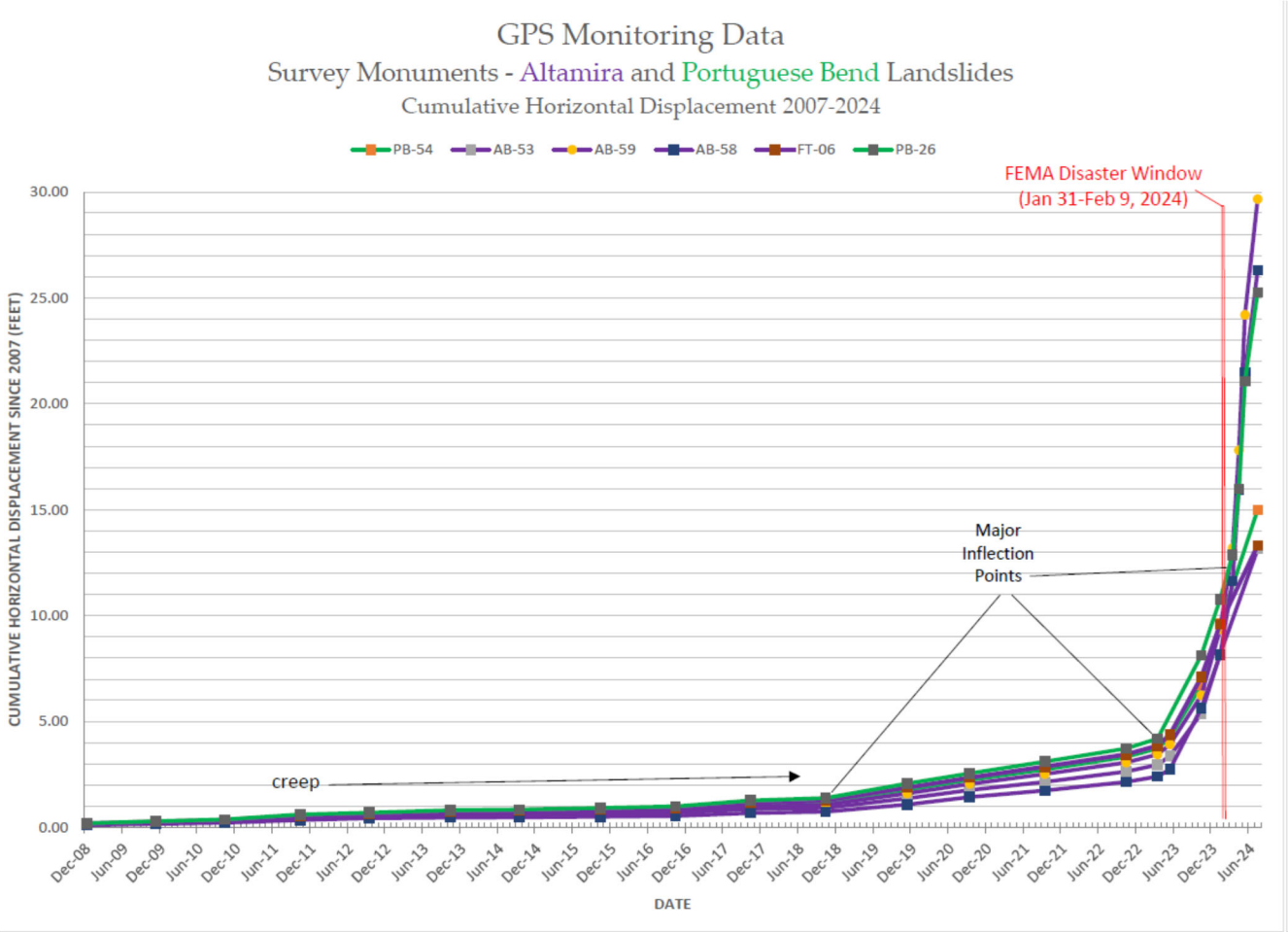
As illustrated in the following graphic, using data gathered by Los Angeles County Department of Public Works Stormwater Engineering Division, we analyzed annual rainfall deviations from the mean, and tallied up those cumulative deviations over time, as a measure of *precipitation surplus/deficit* that has impacted the area. The dark red line on the graphic shows the precipitation surplus/deficit over time. A precipitous drop is noted in the surplus/deficit line, particularly from 2011-2022, which whipsaws back to a steep climb from 2022 through 2024. Climate whiplash is illustrated by the red dashed arrows, showing the impact of the dry years (on a rapidly declining surplus/deficit curve) quickly reversing to a steeply inclining surplus/deficit curve. It is not important that this whiplash or volatility occurred in *deficit* territory on the graph, because it followed a two-decade long period of significant precipitation surplus. Two decades of precipitation surplus between 1991 and 2011 likely contributed to *strain-softening* of the Altamira Landslide failure surface clays, as the landslide began imperceptibly creeping and elongating/stretching out over a prolonged period. It follows that this generally prolonged period of drying commencing in 2011, followed by a large pulse of wetting from 2022 through the winter of 2024, and culminating in an intense barrage of rainfall from January 31st through February 9th 2024, triggered the massive Altamira movement and accelerated the landslide to unprecedented rates of movement.



Of note is that 8.29 inches of rain fell at the Rolling Hills Fire Station rain gauge from January 31st through February 9th 2024. The mean (average) rainfall for the Rolling Hills Fire Station's 57-year rainfall data set is currently 13.88 inches/year and the standard deviation of the entire 57-year dataset is 7 inches/year, indicating very high variability in annual rainfall. More rain fell between January 31st and February 9th 2024 than the standard deviation for the entire 57-year rainfall data set, indicating that this storm sequence was a statistically rare, outlier event.

The following graphic depicts *cumulative horizontal displacement* of select GPS survey monitoring points, including some of the fastest moving points in the Altamira Landslide and a couple of representative points in the PBL (which overlies the Altamira Landslide). There are three significant inflection points indicated in the graph. Prior to the first inflection point, the cumulative displacement lines indicate that the GPS monitoring points within the Altamira Landslide were creeping quite slowly (imperceptibly, near the range of instrument precision) for a number of years extending back before 2011. There was no observed or documented surface manifestation of this minor creep movement at the ground surface; however, this movement is believed to have caused deformation (elongation or stretching out of the earth materials comprising the subsurface which in turn causes additional

fracturing of those earth materials) of the Altamira Landslide body, which increased secondary permeability within the rock mass allowing rainfall at the ground surface to percolate more readily into the deep subsurface, raising groundwater levels to a point where they result in high pore pressures that contribute to landslide movement. Between the October 2018 and October 2019 GPS readings (first inflection point), an acceleration of creep movement is evident. Then following the multiple atmospheric river rains of January and February 2023 (second inflection point), a further acceleration of creep movement is evident, which would have resulted in further stretching out and opening up of the landslide mass. The final inflection point around March, 2024 (immediately following the FEMA-declared disaster of January 31-February 9 wherein 8.29 inches of rain fell) shows a dramatic acceleration and **represents the triggering of major movement of the Altamira Landslide**, as reflected by some of the graphed points going very steep and nearly vertical on the graph. The graph includes GPS monitoring point AB-59, which has been the fastest moving point and is not surprisingly located in the center of the entire Altamira Landslide mass.



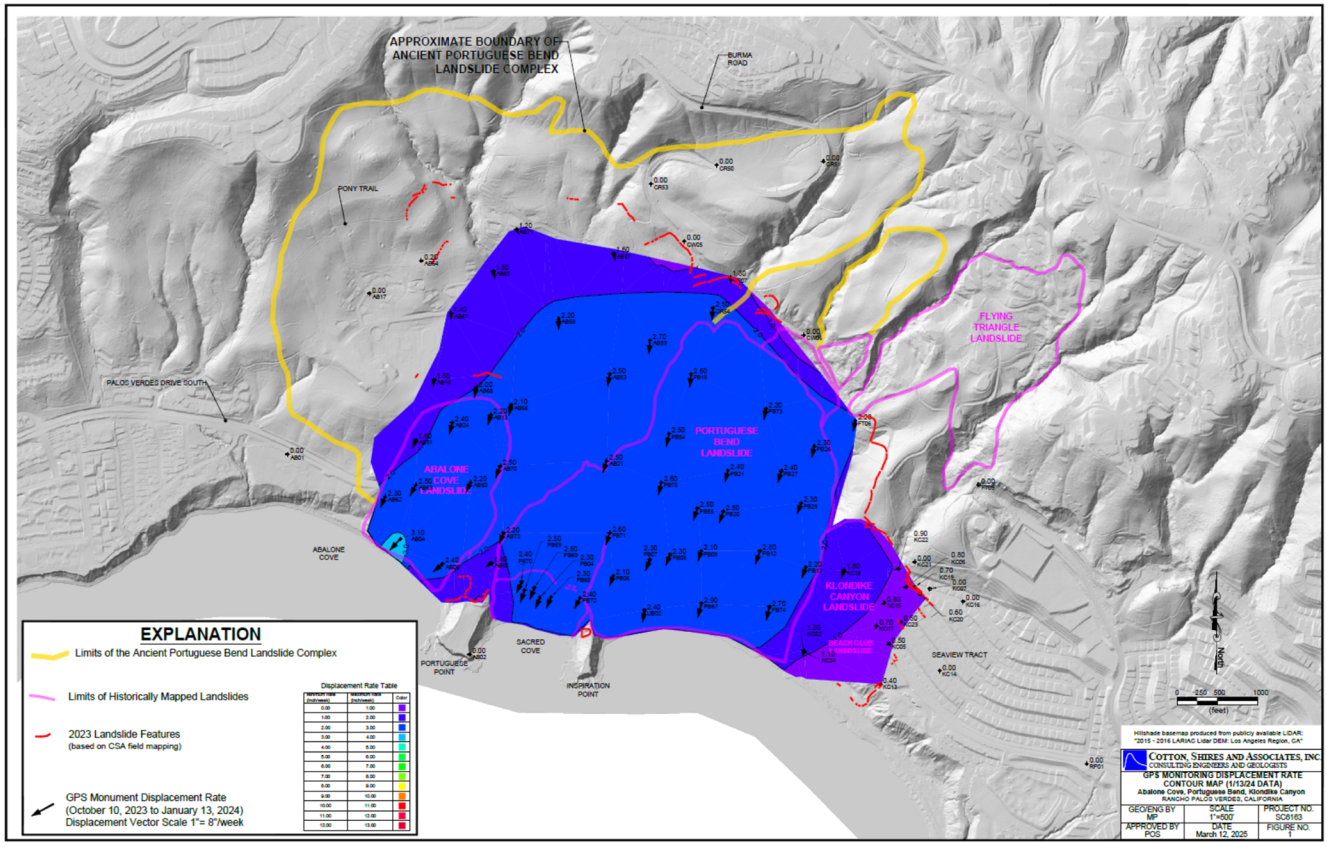
The change in ground movement rates before January 31st and after February 9th 2024 is significant. Based on our comprehensive review of the McGee GPS survey monitoring, the rates of

Altamira Landslide ground movement in the Abalone Cove area (for points north of the previously active ACL) as of January 13, 2024 ranged from 1.2 inches per week (at the periphery) up to 2.7 inches per week (in the body of the landslide). After that intense period of rainfall, plus additional rainfall resulting in a total of over 11 inches in February, as of the GPS survey completed on March 8, 2024, the rates increased to 1.5 (at the periphery) to 5.9 (main body) inches per week, more than doubling in the body of the landslide, and then increased dramatically to as much as 13.5 inches per week in the body of the landslide by July 1, 2024, probably as a slightly delayed reaction to the rainfall as it took time for the water to convert from rainfall absorption to higher groundwater pore pressures where it could have the greatest driving force impact on landslide movement.

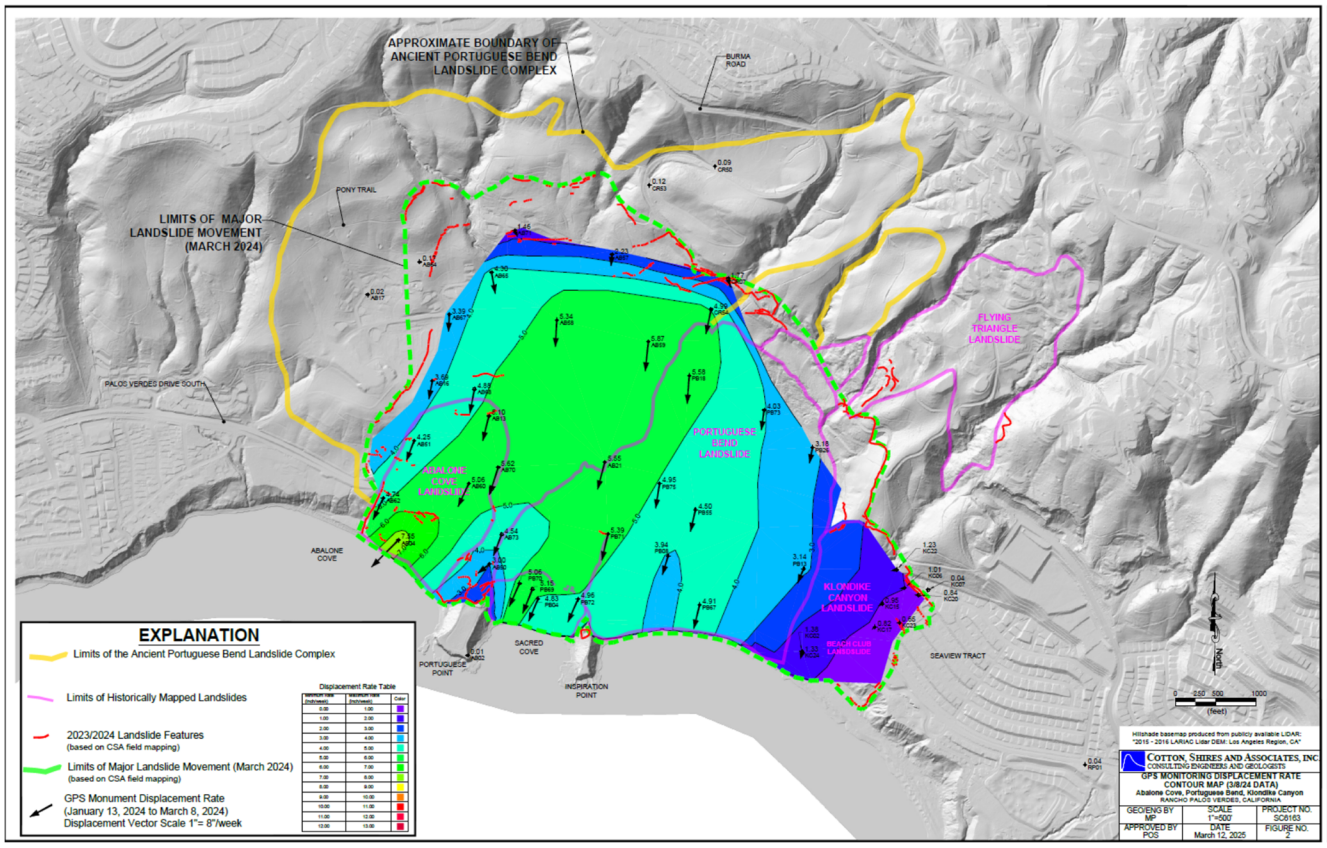
The graphics on the following two pages are "heat maps" that illustrate in color contours the rates at which the ground was moving based on the GPS survey monuments for January 13, 2024, March 8, 2024 and July 1, 2024, respectively. The heat maps include our on-ground geologic mapping of visible land movement features, which started as tension cracks or narrow fissures that were discontinuous (as of December 2023 mapping and are shown on the January 13, 2024 heat map), but these features further developed into more continuous/connected tension cracks and fissures, which have now developed into large scarps, grabens and well-developed boundary features. It wasn't until March 2024 that we first drew a boundary (dashed green line) around the "Area of Major Land Movement", because prior to that time, the surface manifestation of movement was poorly developed and inconsistent and there was not sufficient development of the landslide to develop a boundary. By March 2024, with further mapping and the extraordinary acceleration of numerous GPS monitoring points, a boundary defining the "Area of Major Land Movement" was delineated. Today, following many tens of feet of movement since early 2024, the boundary of the Altamira Landslide is well-defined. North of PV Drive South, the Altamira boundary extends significantly further west of the historical ACL boundary (resulting in the destruction of the landmark Wayfarer's Chapel), upslope through the York property (6001 PV Drive South), and north of the historical ACL boundary through the Portuguese Bend Riding Club Area, crossing upper Narcissa Drive, through and north of residences on upper Cinnamon Lane, and eventually turning east across Altamira Canyon, extending through the Vanderlip Estate (100 Vanderlip Drive), destroying Vanderlip Drive and adjacent properties, and ultimately continuing northeast to the lower stretch of Burma Road Trail in the Portuguese Bend Reserve.

The Altamira Landslide movement also created never-before-seen deformation where it underlies and now extends south of the KCL, including formation of a more seaward toe accompanied by uplifting ground that trended southwest through the beach area of the Portuguese Bend Beach Club and extending up to 500 feet or more offshore where it emerged through the sea floor and formed a new rocky coastline above sea level, generally east of Inspiration Point. The emergence of the new land offshore from the previous coastline was first reported to, and was subsequently observed by the City Geologist in late February of 2024, consistent with the triggering of major movement of the Altamira Landslide described above.

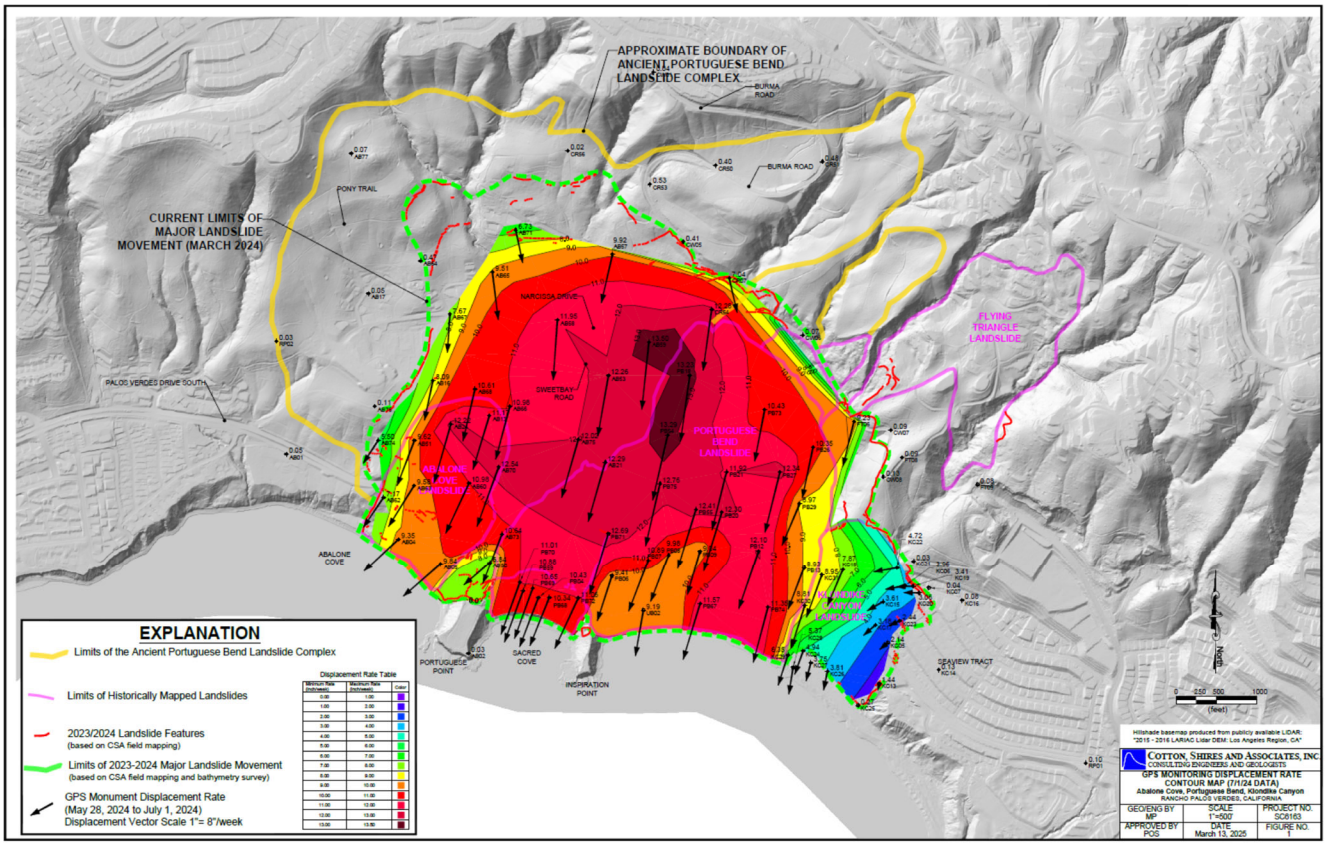
1/13/2024 Heat Map



3/8/2024 Heat Map



7/1/2024 Heat Map

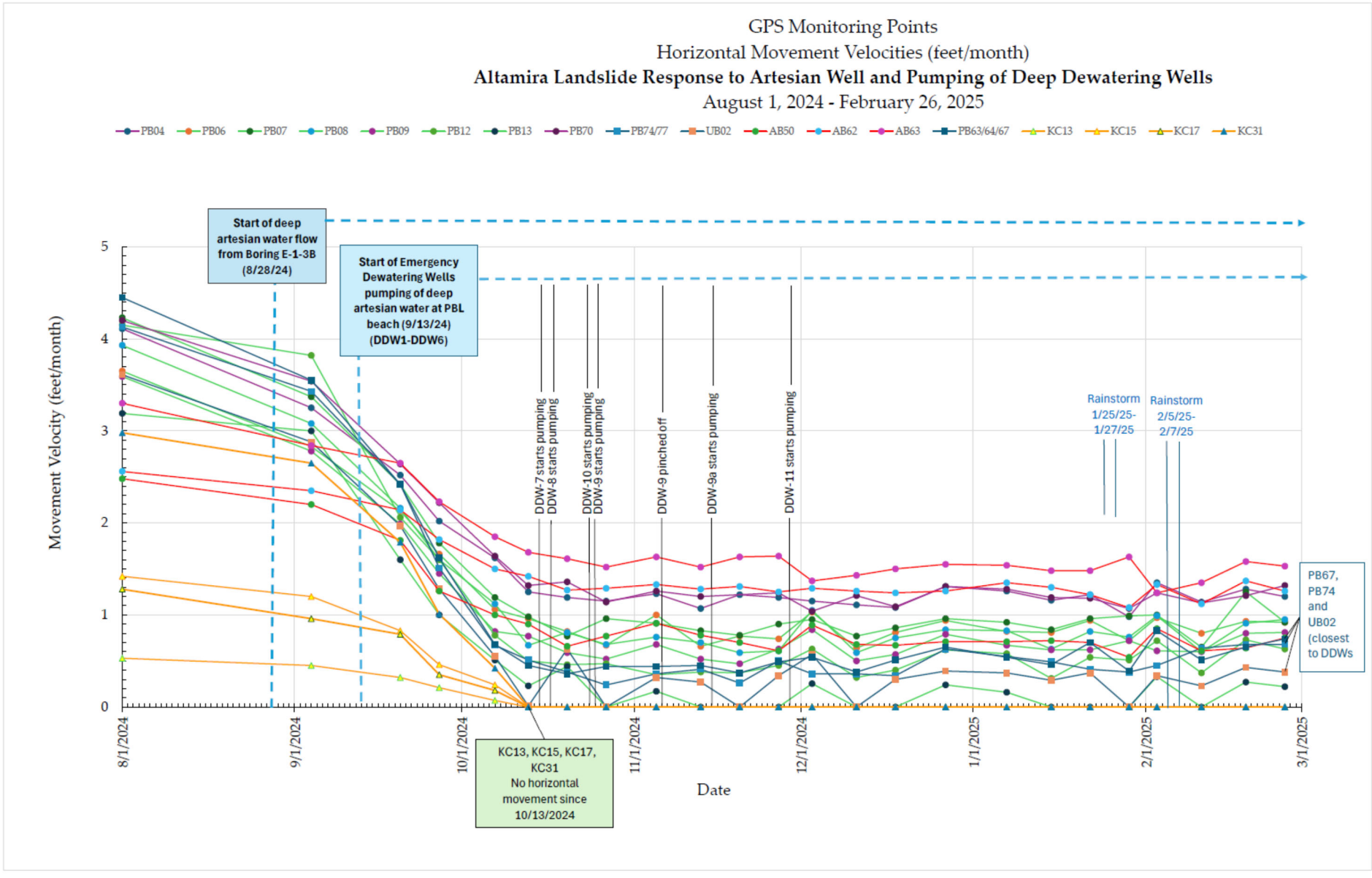


EMERGENCY MEASURES

Emergency measures taken by the City and abatement districts (ACLAD and KCLAD) to date have included drilling, pumping and monitoring deep dewatering wells, winterization measures including lining channels and installing culverts to reduce the amount of surface water percolating into the groundwater regime from upslope drainages/canyons, and filling of and establishing drainage for fissures and grabens that, if left unmitigated, facilitate surface water intrusion into the groundwater regime. This strategy has proven to be effective in reducing the rate of movement of the Altamira Landslide and even stopping movement of the eastern portion of the landslide in the area of the KCL. Because piezometers installed in deep borings that penetrated the base of the Altamira Landslide indicated high groundwater pore pressures beneath the landslide (some areas were found to have near-artesian or artesian groundwater pressures – pressures higher than the ground surface), a pilot program strategy was pursued that involved drilling a series of five deep dewatering wells near the coast to approximately 50 feet below the base of movement and pumping the wells until the landslide movement sheared off the well casings at depth and then re-drilling them to approximately 50 feet beneath the landslide to re-establish the wells so that they could continue to be pumped to dewater the high groundwater pressures beneath the landslide. This strategy turned out to be more successful than originally contemplated because the movement of the landslide slowed quickly in response to the initial dewatering efforts and the deep wells continued to function for weeks or months before re-drilling was necessary.

The chart on the following page illustrates the timing of artesian water being encountered in one of the test borings (Boring E-1-3B, which was retrofitted to function as an artesian well), the installation of the deep dewatering wells, and the deceleration of the Altamira Landslide in response to the dewatering efforts.

Based on the success of the deep dewatering program, we now know that this strategy works. Consequently, the City agreed to loan the landslide abatement districts funding so that they could re-establish wells that were no longer functioning and to establish deep dewatering wells at additional locations as well as to establish additional measures to reduce infiltration of surface water. Additional wells are also needed in the areas that the City controls. Unfortunately the cost of drilling, pumping, maintaining and re-drilling requires significant funding which the City was able to keep up with to a point, but now needs additional funding assistance to keep the wells that have already been established functioning and to establish additional deep dewatering wells in order to reduce the movement of the middle and eastern portions of the Altamira Landslide to the level experienced prior to the impact of climate whiplash.


GPS Monitoring Points
Horizontal Movement Velocities (feet/month)
Altamira Landslide Response to Artesian Well and Pumping of Deep Dewatering Wells
August 1, 2024 - February 26, 2025
PB04 PB06 PB07 PB08 PB09 PB12 PB13 PB70 PB74/77 UB02 AB50 AB62 AB63 PB63/64/67 KC13 KC15 KC17 KC31
Start of deep artesian water flow from Boring E-1-3B (8/28/24)
Start of Emergency Dewatering Wells pumping of deep artesian water at PBL beach (9/13/24) (DDW1-DDW6)
DDW-7 starts pumping
DDW-8 starts pumping
DDW-10 starts pumping
DDW-9 starts pumping
DDW-9 pinched off
DDW-9a starts pumping
DDW-11 starts pumping
Rainstorm 1/25/25-1/27/25
Rainstorm 2/5/25-2/7/25
PB67, PB74 and UB02 (closest to DDWs
KC13, KC15, KC17, KC31 No horizontal movement since 10/13/2024
Movement Velocity (feet/month)
Date
0
1
2
3
4
5
8/1/2024
9/1/2024
10/1/2024
11/1/2024
12/1/2024
1/1/2025
2/1/2025
3/1/2025

City of Rancho Palos Verdes

John Cruikshank, Mayor
Eric Alegria, Mayor Pro Tem
David L. Bradley, Councilmember
Barbara Ferraro, Councilmember
Paul Seo, Councilmember

February 20, 2024

California Office of Emergency Services Disaster Analysis Unit
3650 Schriever Avenue
Mather, CA 95655

SUBJECT: REQUEST FOR A STATE OF EMERGENCY FOR THE GREATER PORTUGUESE BEND LANDSLIDE COMPLEX

To whom it may concern:

On behalf of the approximately 42,000 residents of Rancho Palos Verdes and the approximately 67,000 residents of the Palos Verdes Peninsula, the Rancho Palos Verdes City Council is requesting Governor Newsom invoke his emergency powers pursuant to the Emergency Services Act, Gov't Code § 8550 et seq., and proclaim a State of Emergency for the Palos Verdes Peninsula region to assist the City to stabilize land movement in the greater Portuguese Bend Landslide Complex (Landslide). For reference, see attached map to show the boundaries of the Landslide.

As a result of the 2023 and 2024 winter storms, the City of Rancho Palos Verdes has been impacted by substantial precipitation that has caused an unprecedented acceleration of land movement equating to an annualized rate of 10 feet per year. This significant and sudden increase in land movement is causing severe damage to Palos Verdes Drive South – a major arterial roadway and evacuation route for the Palos Verdes Peninsula; damage and disruption to utility infrastructure including water, sewer, gas line and utility pole breaks; closures of approximately 8 miles of public trails due to slope instability; fissures and sink holes throughout the Palos Verdes Nature Preserve; the closure of residential intersections due to sink holes and ground separation; the temporary closure of the Wayfarers Chapel - a federal and state designated historic landmark; and the red-tagging of homes with many more homes on a watch list due to foundation and structural damage.

On October 3, 2023, the Rancho Palos Verdes City Council adopted a Local Declaration

of Emergency pursuant to Section 8630 of the Government Code, which has been renewed several times as required by that law; the Local Emergency is still in effect.[1] This action was intended to provide immediate access to resources and to assist in expediting remediation measures to stabilize and manage land movement that poses an imminent threat to the public's health, safety, and property. The City's Geologist and Geotechnical Engineering team and the two state-recognized Geologic Hazard Abatement Districts' geologists (Abalone Cove Landslide Abatement District and Klondike Canyon Landslide Abatement District) propose to stabilize land movement by immediately implementing the following:

- Filling fissures to prevent surface water from directly recharging the water table and further lubricating the slip plane.
- Constructing drainage swales, lining certain canyons with non-penetrable membrane, and/or installing flexible drainage pipes to properly convey surface water to the ocean and/or sanitary lines to prevent recharging the water table.
- Installing dewatering wells in the form of horizontal hydraugers and/or vertical dewatering wells to extract groundwater from the slip plane and reducing the local water table.

As the City continues its response and recovery operations, we have determined that these remediation measures must be implemented immediately to minimize the threat to the public's health, safety, and property. Therefore, the City Council requests, pursuant to the authority provided by the Act, and specifically by Sections 8571 and 8625 of the Government Code, that the Governor declare a State of Emergency for the City of Rancho Palos Verdes, waive and/or suspend certain state laws and permits required by local and state agencies that include, but are not limited to, the California Coastal Commission, the California Department of Fish and Wildlife, the Regional Water Quality Control Board, the State Water Resources Control Board, the South Coast Air Quality Management District, and other State agency permits or review processes. Finally, the City Council requests the Governor waive any requirements under the California Environmental Quality Act and its implementing regulations related to the approval and implementation of the remediation measures set forth above. Additionally, the City is requesting that the Governor submit a request to the President of the United States for a Federal Emergency Declaration pursuant to the Stafford Act, 42 U.S.C. §§ 5121-5207.

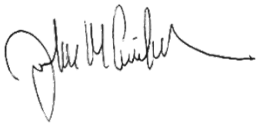
The City has identified that permits would be required by the aforementioned state agencies prior to proceeding any landslide stabilization work. Suspension of these requirements will allow the City and the Geologic Hazard Abatement Districts to immediately proceed with construction and installation of the enumerated measures to stabilize the Landslide without the costs and time delays typically experienced with obtaining permits. It is imperative that the City and two Geologic Hazard Abatement Districts are able to expedite the installation of dewatering wells and surface drains knowing that we are in an El Niño winter pattern with repeated atmospheric rivers

[1] The City also adopted an Interim Urgency Ordinance pursuant to Section 65958 of the Government Code, which effected a moratorium on all construction in the Landslide, with some limited exceptions.

forecasted to extend into spring, and every rain event is exacerbating the rate of land movement.

Please contact City Manager Ara Mihranian at aram@rpvca.gov or by telephone at 310-544-5202.

Sincerely,



John Cruikshank
Mayor

Attachments:

- Portuguese Bend Landslide Complex Map
- Information on the Portuguese Bend Landslide including resolutions adopting and extending the City's Proclaimed Local Emergency can be found on the City's website at: www.rpvca.gov/landslide

cc:

Laphonza Butler, U.S. Senator, California
Alex Padilla, U.S. Senator, California
Ted Lieu, U.S. Representative, 36th Congressional District
Ben Allen, Senator, 24th State Senate District
Al Muratsuchi, Assemblymember, 66th Assembly District
Janice Hahn, L.A. County Supervisor, 4th District
Kevin McGowan, Director, L.A. County Office of Emergency Management
Brandy Villaneuva, Disaster Manager Area Coordinator, L.A. County Area G
Rancho Palos Verdes City Council

CREST ROAD

BURMA ROAD

PONY TRAIL

ANCIENT PORTUGUESE BEND LANDSLIDE COMPLEX

NARCISSA DRIVE

FLYING TRIANGLE LANDSLIDE

PALOS VERDES DRIVE SOUTH

SWEETBAY ROAD

ABALONE COVE LANDSLIDE

PORTUGUESE BEND LANDSLIDE

KLONDIKE CANYON LANDSLIDE

ABALONE COVE

SACRED COVE

PORTUGUESE POINT

INSPIRATION POINT

SEAVIEW TRACT

North

0 250 500 1000

(feet)

EXPLANATION

- Limits of the Ancient Portuguese Bend Landslide Complex
- Limits of Historically Mapped Landslides
- 2023 Landslide Mapping
- Current Limits of Major Landslide Movement (February 2024)

Hillshade basemap produced from publicly available LiDAR: "2015 - 2016 LARIAC Lidar DEM: Los Angeles Region, CA"

COTTON, SHIRES AND ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS

LANDSLIDE MAPPING UPDATE 2/20/24
Abalone Cove, Portuguese Bend, Klondike Canyon
RANCHO PALOS VERDES, CALIFORNIA

GEO/ENG BY	SCALE	PROJECT NO.
MP	1"=500'	SC6163
APPROVED BY	DATE	FIGURE NO.
POS	February 2024	1