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4/15/2021

Abalone Cove Landslide Abatement District
P.O. Box 3675
Palos Verdes Peninsula, CA 90274.
Attention: Tim Kelly and Michael Barth

Second Site Meeting and Review Re: Ground Deformation/Local Damage
Near Intersection of Cinnamon Lane and Clove Tree Place
Abalone Cove Residential Area, Rancho Palos Verdes, California

1.0 Introduction

As requested, a second site meeting and review of ground deformation features in the subject area was conducted on March 19, 2021 by Wood Environment & Infrastructure Solutions, Inc (Wood) with ACLAD Board members Tim Kelly, Dennis Gardner, and later in the afternoon, Jim Knight. These observations follow a previous site meeting/review of the subject area conducted on December 15, 2020, as summarized in Wood's previous report dated January 21, 2021. In the interim between these site observations, the water main along Cinnamon Drive broke on January 17, 2021 along the trend of ground deformation features that were mapped crossing the adjoining section of the Cinnamon Drive roadway (refer to annotated site plan attached to the 1-21-2021 report).

The second site meeting/review was conducted in response to a water main break and gas leak beneath the nearby section of Clovetree Place, along the westerly extension of the previously mapped pavement distress features. The water line break was initially observed on the morning of March 19, 2021, and ground deformation in the vicinity of the break reportedly continued through the day. At the time of the site review in the late afternoon, significant recent ground deformation/cracking was evident in the pavement, lawn areas, and flatwork easterly and westerly of the leak location. An updated version of the previous site plan, including plots of the more recent ground deformation/damage features was prepared and is attached following the text. A brief summary of the compiled observations, homeowner comments, etc. is provided below, including comparisons of the recent distress features to the previous observations and photographs. Selected photographs of the of the recent distress/damage conditions are also attached following the text.

Reference is made to Sheets P-18, P-19 and P-21 of the City of Rancho Palos Verdes Redevelopment Agency (RPVRA) sewer design plans prepared by CTE Engineers and dated May 16, 2000 that were provided by ACLAD. In addition to the planned sewer design details, the approximate locations of buried utilities are also shown on the plan view design plots. An excerpt of Sheet P-18 was used as a base map for the site plan distress plot that is attached following the text., showing both the planned sewer locations and the other underground utilities in the subject area.

Reference is also made to Wood's recently completed report (3-22-2021) summarizing limited review of available GPS survey monitoring results for selected stations in the Abalone Cove landslide area, including two survey monuments in the general vicinity of the subject ground deformation features. Observations/conclusions regarding the origin of the distress features plotted on the attached site plan, and

appropriate recommendations, including review of the existing sewer lines beneath the deformation area, are also addressed.

2.0 Compiled Observations, Homeowner Comments, Pertinent Reference Information, etc.

The observations, comments, etc. for each of the areas discussed below include reiteration of the 12-15-2020 site review information from Wood's January 21, 2021 report to facilitate comparison to changes in the conditions observed on 3-19-2021.

2.1 Cinnamon Lane and Clove Tree Place Roadway Pavement

2.1.1 December 15, 2020 Site Review of Roadway/Subsurface Utility Conditions

Tension cracking of the pavement was observed crossing the Cinnamon Lane and Clove Tree Place roadway surfaces in an approximately east-west direction about 30 to 40 feet southerly of the intersection of the two streets (refer to annotations on attached site plan). Subtle elevation differentials with the southerly side down are associated with each set of tension cracks. Cinnamon Lane was reportedly slurry-coated about a year ago, and Clove Tree Lane was reportedly slurry-coated within the last several years. The presence of open fractures in the slurry coat suggests relatively recent activity, but the observed elevation differences across the fracture zones suggest the tension cracking is redevelopment of longer-term ground deformation.

Temporary asphalt patches were observed in the Cinnamon Lane road pavement about 40 feet northerly and 90 feet southerly of the tension cracking zone. The homeowner at 9 Cinnamon Lane indicated that these patches are the result of gas line leak repairs that were performed in the last year or two (refer to attached site plan).

As mentioned in the Introduction, a water main break occurred adjacent to the Cinnamon Lane roadway on January 17, 2021, along the projected trend of the subject ground deformation area. The broken waterline/repair is located beneath a landscape area a few feet northerly of the driveway for 16 Cinnamon Lane (refer to annotations on attached plan excerpt). Nearby homeowner and ACLAD Board member, Jim Knight, spoke to the California Water Service (Cal Water) supervisor at the repair site and he indicated that the pipe had "snapped", but the pipe itself was in good condition (presumed to mean it was broken, but not corroded). Apparently one of the first indications there was a problem occurred when one of the local residents noticed that she had no water supply. The referenced sewer design plans indicate the water main is a 4-inch diameter pipe, and on the basis of Jim Knight's discussion with the Cal Water representative, it consists of galvanized steel pipe. Other details regarding the actual break in the line, such as whether it occurred at a joint or coupling, are not known.

2.1.2 March 19, 2021 Site Review Conditions of Roadway/Subsurface Utility Conditions

The water main break beneath Clovetree Place was reportedly noticed on the morning of March 19, 2021 and the water to this section of the main was turned off by the fire department. Flow from the break emanated from the edge of the pavement, and although a small local depression was observed in the adjoining pavement at that location, the outflow was reportedly clear, and there was no residual evidence of significant piping erosion of the soil associated with the leak (refer to attached site plan and Photo 1). One of the local residents reported that flow from the broken water main did not appear at the ground surface until about three hours after he lost the water supply at his house. There was no specific information available regarding the timing/occurrence of the various additional distress features in the vicinity, but pavement cracking and ground deformation apparently continued for some time after the water main break was reported. No noticeable increase in the extent or width of the pavement/ground cracks was observed during the site review in the late afternoon and early evening on the day of the water main break (3-19-2021).

Repair of the water main break and also of the leak in the nearby gas line continued into the evening. The water line pulled apart at a pipe coupling on the south side of the zone of tension cracking, beneath the low point of the pavement deformation (Photos 1 and 2). The water line is shown on the referenced RPVRA sewer design plans as 4-inch diameter, and comparisons using that nominal diameter indicate a local horizontal pipe offset of about 1 to 2 inches, and a vertical offset of about 4 to 5 inches (southerly side down) occurred in the immediate vicinity of the repair excavation (Photo 3). Additional pipe deformation/bending may have occurred immediately north of the excavation, beneath the area of largest vertical pavement deformation (i.e., beneath the landslide scarp). At the time the water line photo was taken (~7:00PM), an ~5 to 6-foot length of the nearby 2-inch diameter gas line had been exposed, but the source of the leak/break had not been located, and no additional observations of the repair process were made.

Previously observed subtle elevation differentials across the east-west trending zones of tension cracking in the Cinnamon Lane and Clovetree Place pavement were noticeably larger, to the extent that reduced speed would be advisable for car travel across the ground deformation areas in the two roadways. The down-dropped areas on the southerly sides of the tension cracking zones are spread across several feet with an estimated total elevation difference of about 3 to 6 inches along Cinnamon Lane and about 6 to 12 inches along Clovetree Place. In the immediate vicinity of the recent water main break beneath Clovetree Place, the down-dropped area forms a local trough near the edge of the pavement that appears to be about 12 to 16 inches below the adjacent roadway surface on the northerly side of the tension cracking zone. The actual tension cracks crossing Clovetree Place were obscured by equipment, vehicles, and excavated soils associated with repairs that were in progress at the time of the site review. Although the tension cracking zone across Cinnamon Lane was also locally obscured by repair vehicles, the exposed easterly portion of the zone showed relatively minor changes from the previous site visit that were essentially limited to a few additional fractures, minor local dilation of the previously observed fractures and a small local elevation difference across some fractures that appeared to be less than about ¼-inch (south side down, refer to site plan distress plot and Photo 4).

An additional set of parallel tension cracking was observed crossing the Clovetree Place roadway about 15 to 20 feet south of the previously observed zone, forming the southerly edge of a very shallow down-dropped trough in the pavement (i.e., a small, local landslide graben). These cracks in the pavement apparently formed and continued to dilate for several hours after the water main break was noticed and the water was turned off. At the time of the site visit in the late afternoon/early evening, the crack widths ranged from hairline up to about ¾-inch, with a local north-side down elevation difference up to about ¼-inch (Photo 5). These tension cracks did not extend to the east into the adjoining concrete driveway on Lot 9 (Photo 6). However, separations that appeared to be very recent (i.e., no leaf/soil debris infill) of up to about ½-inch were observed along the easterly side of the brick ribbon bordering the end of the concrete driveway, and up to about ¾-inch on the westerly side, adjoining the street pavement (Photo 7).

The parallel sets of tension cracks crossing Clovetree Place were also observed extending to the west about 15 to 20 feet across the front lawn on Lot 11 (Photos 8 and 9). Although vertical offsets across these ground cracks were generally not distinct, the overall ground surface, and deformation of the perimeter fence and concrete walkway in this portion of the lot suggest the presence of a subtle trough between the fracture zones (Photo 10).

The observed zones of tension cracking and adjoining elevation differentials/displacement appear to coincide with a pre-existing scarp/landslide boundary that was interpreted from the historic aerial photos of the subject area (refer to Section 2.6 of Wood's 1-21-2021 report).

2.2 9 Cinnamon Lane

2.2.1 December 15, 2020 Site Review of Lot 9 Conditions

Tension cracking crossing the Cinnamon Lane roadway extends across the northerly corner of the adjoining concrete driveway at 9 Cinnamon Lane. The homeowner reported that several irrigation leak repairs have been required over the last year or two in the northerly portion of the lot (i.e., in the vicinity of the tension cracking). During that same time frame, the water service line for the residence reportedly required repair for a leak near the water meter, which is located about 100 feet southerly of the observed tension cracking zone along Cinnamon Lane (refer to attached site plan distress plot).

2.2.2 March 19, 2021 Site Review of Lot 9 Conditions

With the exception of pavement separations at the end of the westerly driveway described under Section 2.1.2 (Photo 7), there appeared to be no significant changes to the previously observed cracking present near the easterly end of the driveway (Photo 11), and no other distress features were recognized on Lot 9 along the trend of the tension cracking zones. It should be noted that improvements in the northerly corner of Lot 9 consist of the relatively rigid concrete driveway and local well-developed tree roots that would tend to bridge the ground movement, and also relatively flexible landscaping features that would tend to obscure ground cracking/displacements and other evidence of movement. The plots of previous irrigation line breaks/leaks shown in this landscaping area on the site plan are generalized, and do not represent specific leak locations.

2.3 11 Cinnamon Lane

2.3.1 December 15, 2020 Site Review of Lot 11 Conditions

Westerly projection of the zone of tension cracking in the Clove Tree Place roadway crosses the essentially undeveloped bare ground/lawn yard space on the southeasterly side of the lot, apparently intersecting with the southerly corner of the residence. Open fractures are present crossing through the exterior stucco that forms the southerly corner of the structure at a height of about 3 to 4 feet above the ground surface. Relative displacement of the stucco wall surface across the fracture on the southeasterly side of house shows the lower corner of wall has been displaced up to about 1-inch to the south relative to the upper portion of the wall. The displaced stucco surface protruding from the southwesterly wall face has been painted, indicating it is not a recent feature. However, open tension cracks on the adjoining southwesterly facing wall that connect at the wall corner with the protruding stucco surface are dilated up to about ¼-inch, and the fracture surfaces do not appear to have not been covered with paint, indicating more recent movement has occurred.

The homeowner also reported a recent irrigation line leak repair in the yard area about 15 feet southerly of the building corner, as evidenced by poorly replaced turf in the repair excavation at that location.

2.3.2 March 19, 2021 Site Review of Lot 11 Conditions

Parallel sets of tension cracks extend westerly from the edge of the Clovetree Place roadway about 15 to 20 feet into the yard/lawn area on the southeasterly side of Lot 11 (refer to discussion under Section 2.1.2 above). The fine details of these open tension cracks were observed the in the soil/lawn during the site review, indicating they are very recent features. The northerly set of fractures follows the top of a shallow slope that crosses the lawn and a stamped concrete walkway, along a projection that intersects the southerly corner of the residence (Photos 9, 10, and 12). In the interim since the previous site review, a separation has developed in the paving stones at the westerly end of the front porch along the trend of the northerly set of tension cracks, and projecting through the corner of the house (refer to attached site plan distress plot and Photo 13). The previously observed cracks offsets and separations in the stucco and along the bottom of the windowsill at the southerly corner of the residence appear to have increased slightly in width, but are generally about the same as observed/photographed on December 15, 2020 (Photos 14, 15 and 16).

However, a noticeable separation is now present between the westerly end of the front porch and the adjoining stucco wall of the residence (Photo 15).

The gas meter for the Lot 11 residence is located adjacent to the damaged wall corner, along the projected trend of the observed ground deformation zone. Apparent tilting of the meter and associated plumbing suggests it may have been displaced to some extent by the ground movement (Photos 14 and 15). In response to inquiries after the site visit, the homeowner reported that the Southern California Gas Company has been onsite and checked the conditions.

A westerly projection of the southerly set of tension cracks across the yard from Clovetree Place coincides with the previously identified irrigation line repair (refer to attached site plan distress plot and Photo 17).

2.4 3 Cinnamon Lane

No attempt was made to access Lot 3 on the southwesterly side of Lot 11 during the December 15, 2020 site review. However, during the course of the March 19, 2021 site review, discussions with the Lot 3 homeowner, Mr. Gutierrez, indicated that there are some fractures and slight buckling of a small, concrete block, garden wall on the easterly side of his yard, along the trend of the nearby distress features on Lot 11 (refer to site plan distress plot). Although a quick glimpse of these cracks was made, the sudden appearance of the family dog in that part of the yard did not allow any close-up photographs to be taken. Mr. Gutierrez indicated that there did not appear to have been any recent changes in the wall cracks. A photograph along the east-west trend of the garden wall and stucco house wall cracking on Lots 3 and 11 was taken from the westerly side of the yard (Photo 18).

2.5 16 Cinnamon Lane

2.5.1 December 15, 2020 Site Review of Lot 16 Conditions

The homeowner at 9 Cinnamon Lane indicated that tension cracking across the Cinnamon Lane pavement appeared to extend up the lower portion of the asphalt driveway at 16 Cinnamon Lane. Observations and photos taken during the site visit from the foot of the driveway indicated the presence tension cracks in the pavement that are consistent with those in the nearby roadway. However, the tension cracking at this location appeared to decrease and die-out to the east near the top of the driveway, and no contact was made with the homeowner at 16 Cinnamon Lane.

As discussed above under Section 2.1.1, a water main break occurred on January 17, 2021 adjacent to the driveway at the westerly corner of this property.

2.5.2 March 19, 2021 Site Review of Lot 16 Conditions

Similar to the previous site review, observations on Lot 16 were limited to views/photographs of the tension cracks in the asphalt driveway from the street right-of-way. No significant changes in the length or width of these cracks appeared to have occurred (refer to site plan distress plot and Photo 19).

2.6 Existing Buried Utilities that Cross the Observed Zone of Tension Cracking

As summarized in Wood's previous report regarding the ground deformation conditions, existing water, gas, and sewer lines/mains are present beneath both the Cinnamon Lane, and Clovetree Place right-of ways, extending through the subject ground deformation zone (refer to Section 2.5 of Wood's 1-21-2021 report). The approximate locations of these underground utilities are shown on the referenced sewer construction plan excerpt that was used as a base map to plot the distress features (attached). The water mains and one of the gas mains beneath both of these roadways have broken within the last three months along the ground

deformation zone. The gas main beneath Cinnamon Lane has also reportedly broken at two locations in the vicinity of this ground movement area with the last two years.

The referenced sewer construction plans indicate the sewer lines crossing the deformation zone consist of a 2-inch diameter PVC force main and a 1.5-inch diameter HDPE low pressure force main beneath Cinnamon Lane and Clovetree Place, respectively. There have apparently been no leaks or pipeline breaks reported for the local sewer system, but the greater depth of the sewer lines may tend to limit surface manifestation of any pipeline breaks/leakage that may be present. The sewer system was reportedly constructed by the City of Rancho Palos Verdes Redevelopment Agency, and Wood previously recommended that the City of RPV be given formal notice of the ground deformation observations, and of the apparently associated recent line breaks/leaks of buried pipelines (refer to Section 4.1 of Wood's 1-21-2021 report). Wood also recommended that RPV conduct a review/inspection of the sewer system in the vicinity of the ground movement area. The City of RPV has apparently been notified about the ground deformation problems in the subject area, but there have been no reports that recommended review/inspection of the sewer system have been performed.

3.0 Probable Primary Cause of Observed Ground Deformation

The observed zone of tension cracking, ground deformation and associated local damage and utility breaks extend in an approximately east-west direction over a distance of about 400 feet (i.e., from the easterly side of Lot 3 to the westerly corner of Lot 16; refer to attached site plan distress plot). Wall and pavement cracking at the west and east ends of this zone (Lots 3 and 16) are relatively minor and appear to represent the end points of noticeable distress that is likely associated with the observed ground deformation. However, indistinct westerly and easterly extensions of the ground deformation from these apparent end points may also be present, or could occur in the future. The most significant ground movement/distress features are concentrated in the vicinity of the recent (3-19-2021) water main break beneath the northwesterly edge of the Clovetree Place pavement, and extending about 20 feet to the east and west from that location. Parallel sets of tension cracks in this area form a small landslide scarp on the north, and the edge of a shallow trough (landslide graben) on the south (refer to site plan distress plot). Comparison of the 12-15-2020 site review photographs to the 3-19-2021 photographs indicate that previously observed distress and ground deformation features to the east and west of this approximately 40-foot-long graben zone have not changed substantially from the previous site review.

The location, orientation, extent, and sense of movement along the small and/or subtle scarps crossing the roadways in the subject area, extending into the Lot 11 yard, and ultimately through the westerly corner of the Lot 11 residence, are believed to be associated with longterm upslope progression, or northerly extension of the active Abalone Cove landslide movement. This conclusion is consistent with recently reviewed GPS survey measurements that indicate slow creeping landslide movement of the subject area appears to have been occurring for the duration of the approximately 25-year period of the available GPS survey records (i.e., 1994 to 2019; refer to Sections 4.2 and 6.0 of Wood's 3-22-2021 report). The location of the observed deformation/distress features also approximately coincide with a pre-existing scarp/landslide boundary interpreted from historic (1945) aerial photos, and from an accompanying topographic base map that was produced from the photos (refer to Section 2.6 of Wood's 1-21-2021 report).

Previous evaluations of available survey results by Dr. Ehlig and Dr. Douglas observed that the Abalone Cove landslide moves faster in the portion of the slide nearest the beach and the rate/amount of movement decreases incrementally upslope (refer to Section 2.0 of Wood's 3-22-2021 report). From a macro/overall perspective, Dr. Ehlig observed that landslide movement was "*causing the average thickness of the landslide to decrease and the length of the landslide to increase*." In effect, the landslide displacement is "stretching" the landslide mass in a downslope direction. Referenced "thinning" of the landslide is documented in the longterm GPS survey results that consistently show decreases in the elevations of the referenced monitoring points through time (Wood, 3-22-2021).

Recently completed review of the available GPS survey monitoring results indicate that this downslope "stretching" of the landslide mass has apparently continued for at least 25 years at an overall average rate on the order of about of about 0.5 to 1-inch/year (Wood, 3-22-2021). Longterm extension or downslope spreading of the deep foundation soils comprising the slide would have the effect of producing tension cracking and minor subsidence in/across the slide mass. These effects are generally not noticeable at the ground surface because are spread over wide areas. Potential distress/damage of structures and other improvements from the landslide movement would generally be indistinguishable from the effects expansive and/or compressible foundation soils (i.e., heave and/or settlement), and/or from longterm ageing and deterioration of the improvements. However, at those locations where the movement is concentrated along a pre-existing slide boundary, damaging differential ground deformation can occur, as has been observed in the subject area.

The localized extent (~40 feet long) and relatively sudden occurrence of additional ground deformation coincident with the water main break makes it very unlikely that this recent additional ground cracking/deformation across Clovetree Place and the nearby portion of Lot 11 was the result of some type of abrupt acceleration of deep ground movement. The timing and location of the recent additional ground movement are believed to be directly associated with local flooding and abrupt deep wetting of a zone of tension cracking (i.e., the small graben). The observed small scarp and graben are believed to have formed along a pre-existing landslide boundary as a result of longterm, creeping landslide movement that has been locally concentrated along that boundary.

Wetting of the dilated ("stretched") soils comprising the tension cracking zone (small graben) caused them to settle (hydrocompression), and may also have induced some lateral compression of deeper soils in the vicinity of the graben that have been similarly affected by longterm creeping slide movement. Under these conditions, cracking and subsidence of the ground surface would be expected to continue at a decreasing rate until wetting, and possibly local excess pore pressure slowly works its way down through the dilated soil profile. Logs from previous exploratory borings about 150 to 200 feet south of the deformation zone suggest this zone of dilated soils may extend to depths of more that 100 feet, although the width of the zone would tend to decrease significantly with depth. No noticeable increase in the extent or width of the pavement/ground cracks was observed during the site review in the late afternoon and early evening on the day of the water main break (3-19-2021).

It is possible that the previous water main break beneath the Cinnamon Lane right-of-way on 1-17-2021 induced a small amount of hydrocompression and local subsidence along the tension cracking zone/scarp in that area. Although the height of the shallow scarp crossing the road at that location appeared to have increased in the interim since the previous site review on 12-15-2020, the associated tension cracking zones crossing the roadway and extending into the adjacent driveway areas did not appear to have changed significantly.

4.0 Recommendations

4.1 Local Sewer System

The pressurized water/sewer lines are of most concern to the local stability conditions because even relatively minor long-term leaks have the potential to infiltrate directly into the deep subsurface along tension cracks in the ground deformation area. Relatively clean sand is commonly used to backfill the pipe zone in utility construction trenches, so discharge from buried water/sewer line leaks has the potential to travel a considerable distance in sloping hillside terrain before infiltrating into subsurface ground cracks. However, as recently observed with the recent water main breaks along the Cinnamon Lane and Clovetree Place right-of-ways, large leaks and/or catastrophic failure of pressurized pipelines tend to manifest at the ground surface

relatively quickly. This, however, may not be the case for the deeper, apparently lower pressure sewer mains. As previously recommended, review/inspection of the sewer system in the vicinity of the ground deformation area, particularly the pressurized sections of the sewer lines, should be performed by the City of RPV.

4.2 Gas Meter and Associated Plumbing at 11 Cinnamon Lane

The gas meter for the Lot 11 residence is located along the projected trend of observed ground deformation zone, immediately adjacent to the damaged/displaced southerly corner of the house. Apparent tilting of the meter and associated plumbing suggests it may have been displaced to some extent by the ground movement. Although representatives of the Southern California Gas Company have reportedly been onsite and checked the conditions, some consideration should be given to replacing all the pipe fittings in the immediate vicinity of the meter to remove any stress that may have accumulated from the ground deformation. The portion of the plumbing that extends through the wall into the crawl space below the house is of greatest concern because of the potentially catastrophic consequence of a leak and accumulation of gas in the crawl space area.

4.3 Acquisition and Review of 2019-2020 GPS Monitoring Results

The largest annual displacements measured in the subject area were recorded during the 2018-2019 monitoring period, which was the last set of measurements available for the GPS monitoring program (refer to Section 6.0 of Wood's 3-22-2021 report). The reports for previous GPS monitoring suggest that the City of RPV has likely received a new set of monitoring measurements for the 2019-2020 monitoring period. Considering the recent flurry of subsurface utility breaks, observed ground surface deformation, and local damages to residential improvements in the subject area, it would seem prudent for the City to review and evaluate the most current survey results at their earliest convenience. However, in the interim, acquisition and review of the results for the six monitoring stations previously reviewed and evaluated by Wood, as summarized in the 3-22-2021 report, is recommended.

ACLAD Board members have indicated they were not aware of any formal review and evaluation of the GPS survey monitoring results being performed by the City of RPV. Some type of formal review, data reduction and evaluation of the compiled GPS survey results by RPV is recommended for the benefit of residents and other stakeholders in the Portuguese Bend monitoring area. Annual comparisons of the monitoring measurements presented in the summary reports provide a quick snapshot of the landslide displacements that are likely valuable for evaluations of the faster moving Portuguese Bend landslide, but are not particularly useful for assessing the longterm consistency and trends of slow creeping movement associated with the Abalone Cove and Klondike Canyon landslides. Annual displacement measurements in these areas during the drier rainfall seasons are often near the range of anticipated error in the measurements. This resolution problem can be mitigated by comparing the current measurements to the original baseline survey station locations, similar to the way data reductions are performed for inclinometer survey measurements.

Longer-term results for survey points selected for Wood's review showed consistent azimuth directions of displacement for each monitoring station when the comparisons were made to the original baseline survey location. Previous experience with inclinometer measurements of the Klondike Canyon landslide in the early 1980s showed that scaled vector plots of cumulative displacement relative to the baseline measurements-locations were invaluable in delineating the location and direction of landsliding. Time-displacement plots of the total displacement relative to the original location also provide a valuable presentation of the survey results, particularly for assessing longterm changes/acceleration in the rates of landslide movement. Preparation of scaled vector plots of displacement relative to the baseline location are recommended for the available annual records for each of the GPS survey stations in the greater Abalone Cove landslide complex area and in the vicinity of the Klondike Canyon landslide. Similarly, this information should, in turn, be used to prepare time-displacement plots of the total displacement relative to the original station locations for the available GPS results at each monitoring station. This information will provide an invaluable source of information for use in evaluating the longterm location, magnitude, distribution, and rate of landslide

movement in these slowly creeping landslide areas. These data presentations will also support assessment of longterm changes in the landside displacement conditions, and also of the effectiveness of ongoing mitigation measures being maintained by the Geologic Hazard Abatement Districts in both of these landslide area

Wood's 3-22-2021 GPS survey review report should be referenced for more specific discussion and recommendations.

4.4 Review Groundwater Monitoring Data

Available longterm records of groundwater level measurements in monitoring wells in the vicinity of the subject area should be compiled and evaluated for evidence of significant recent changes. Similarly, any available longterm groundwater level measurements in the dewatering wells that are considered representative of the static/equilibrium groundwater level (i.e., relatively unaffected by recent pumping of the well) should also be compiled and evaluated.

5.0 CLOSURE AND GENERAL CONDITIONS

This report is based on the project as described and the data obtained from Wood's site observations, reported conditions and from the referenced documents. The conclusions and interpretations do not reflect possible undetected variations that may occur between the reported observations, data points, or findings. Wood should be notified of any pertinent difference or change in the reported site conditions, or if site conditions are found, or are known to exist, that differ from those described in this report.

This report has not been prepared for use by parties other than the Abalone Cove Landslide Abatement District, or their designated representatives, or for projects or locations other than that described herein. This document may not contain sufficient information for other parties or other purposes. This report has been prepared in accordance with generally accepted engineering geologic practices and makes no other warranties, either express or implied, as to the professional advice or data included.

Wood Environment & Infrastructure Solutions, Inc.

Scott T. Kerwin
Senior Associate Engineering Geologist CEG 1267

Attachments: Site Plan Distress Plot (1 page)
Annotated Photos of Site Conditions (19 pages)

STK/STK

Attachments

CINNAMON LANE AND CLOVETREE PLACE GROUND DEFORMATION / DAMAGES
12/15/2020 AND 3/19/2021 OBSERVATIONS

NORTH
1" = 50'

APPROX. LOCATION OF TENSION CRACKING/SEPARATIONS (PARALLEL SETS = SMALL GRABEN/SHALLOW TROUGH
APPROX. LOCATION OF WALL CRACK/SEPARATIONS
APPROX. LOCATION OF WATER MAIN, WATER SERVICELINE, OR IRRIGATION LINE LEAKS
APPROX. LOCATION OF GAS LINE BREAKS OR LEAKS

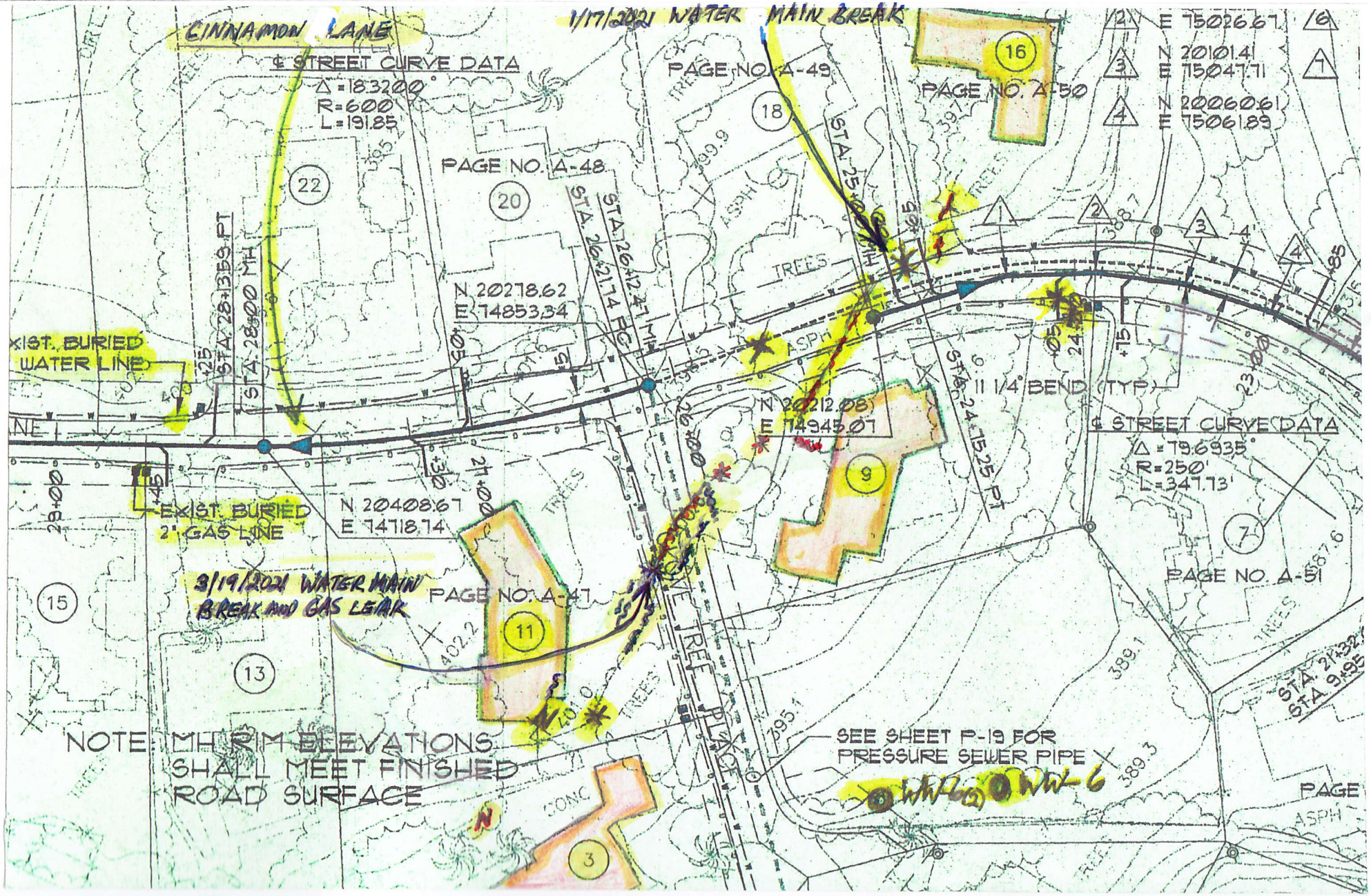

Photo 1 - View west from Lot 9 along the trend of the previously observed ground deformation showing the location of the water main break near the westerly edge of the Clovetree Place roadway.

Photo 2 - View southeasterly at watermain break beneath edge of Clovetree Place; the break is located beneath the low spot in the sunken roadway pavement.

Photo 3 - Close-up view of water main break/pull-apart at pipe joint; local horizontal pipe offset of about 1 to 2 inches, and a vertical offset of about 4 to 5 inches.

Photo 4 - View northeast at tension crack zone and subtle landslide scarp crossing Cinnamon Lane between Lots 9 and 16, with slight vertical offset on some cracks.

Photo 5 - View southeast across the shallow trough (small landslide graben) in Clovetree Place pavement; the tension crack zone forms the south side of the shallow trough/graben in pavement (north side down offset); the west driveway on Lot 9 is in the background.

Photo 6 - View east along the southerly tension crack zone, extending towards the Lot 9 driveway.

Photo 7 - View southwesterly along edge of Lot 9 west driveway entrance; the southerly tension crack zone crossing Clovetree Place is visible in the right background.

Photo 8 - View to the east along the southerly tension crack zone that extends into the Lot 11 yard/lawn area.

Photo 9 - View westerly along the northerly tension crack zone that crosses beneath the stamped concrete walkway and forms the top of a small/gentle south-facing slope (landslide scarp) extending to the west in this portion of the Lot 11 front yard.

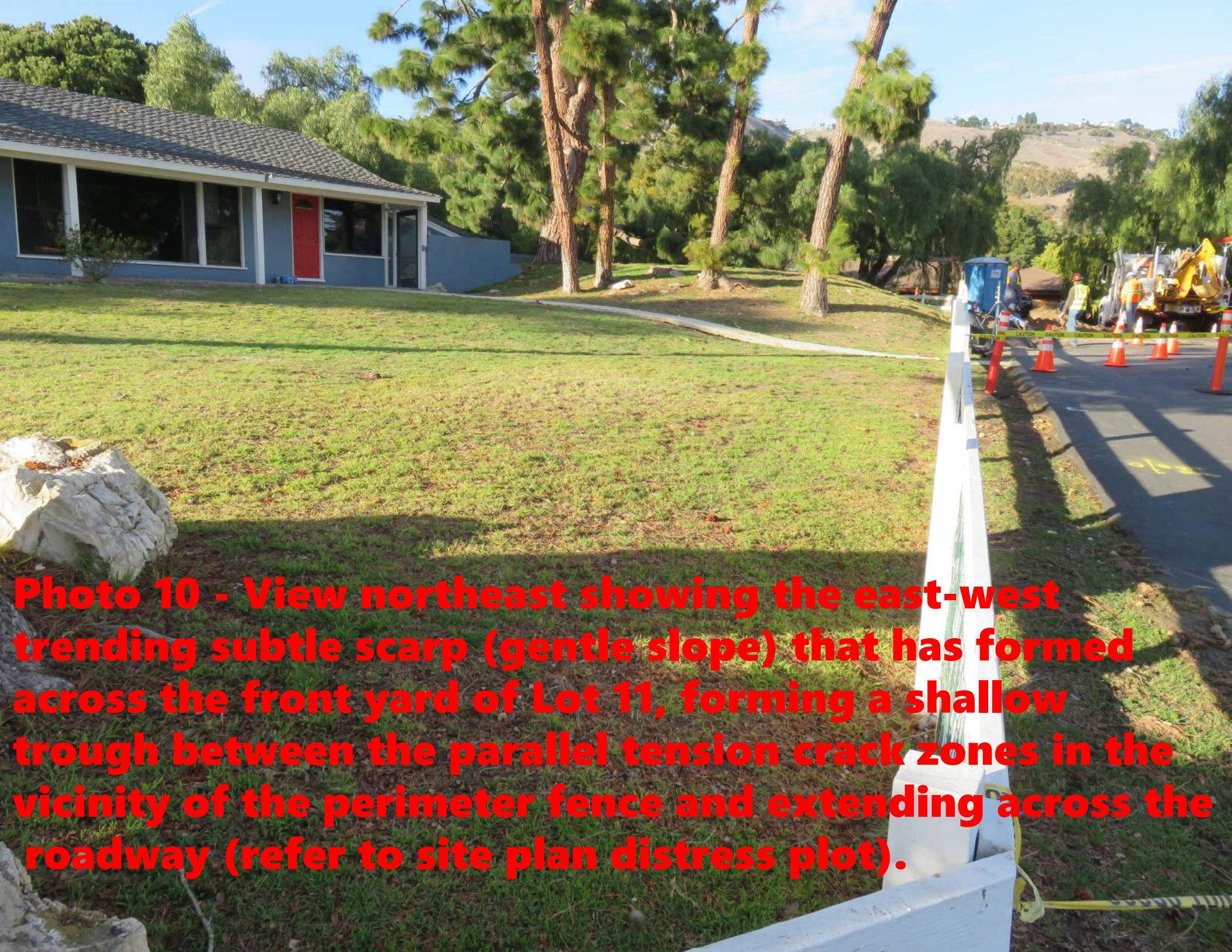

Photo 10 - View northeast showing the east-west trending subtle scarp (gentle slope) that has formed across the front yard of Lot 11, forming a shallow trough between the parallel tension crack zones in the vicinity of the perimeter fence and extending across the roadway (refer to site plan distress plot).

Photo 11 - View to the west along the northerly tension crack zone crossing through the corner of the Lot 9 east driveway entrance; comparisons with the 12/15/2020 photos show no significant changes in the fractures.

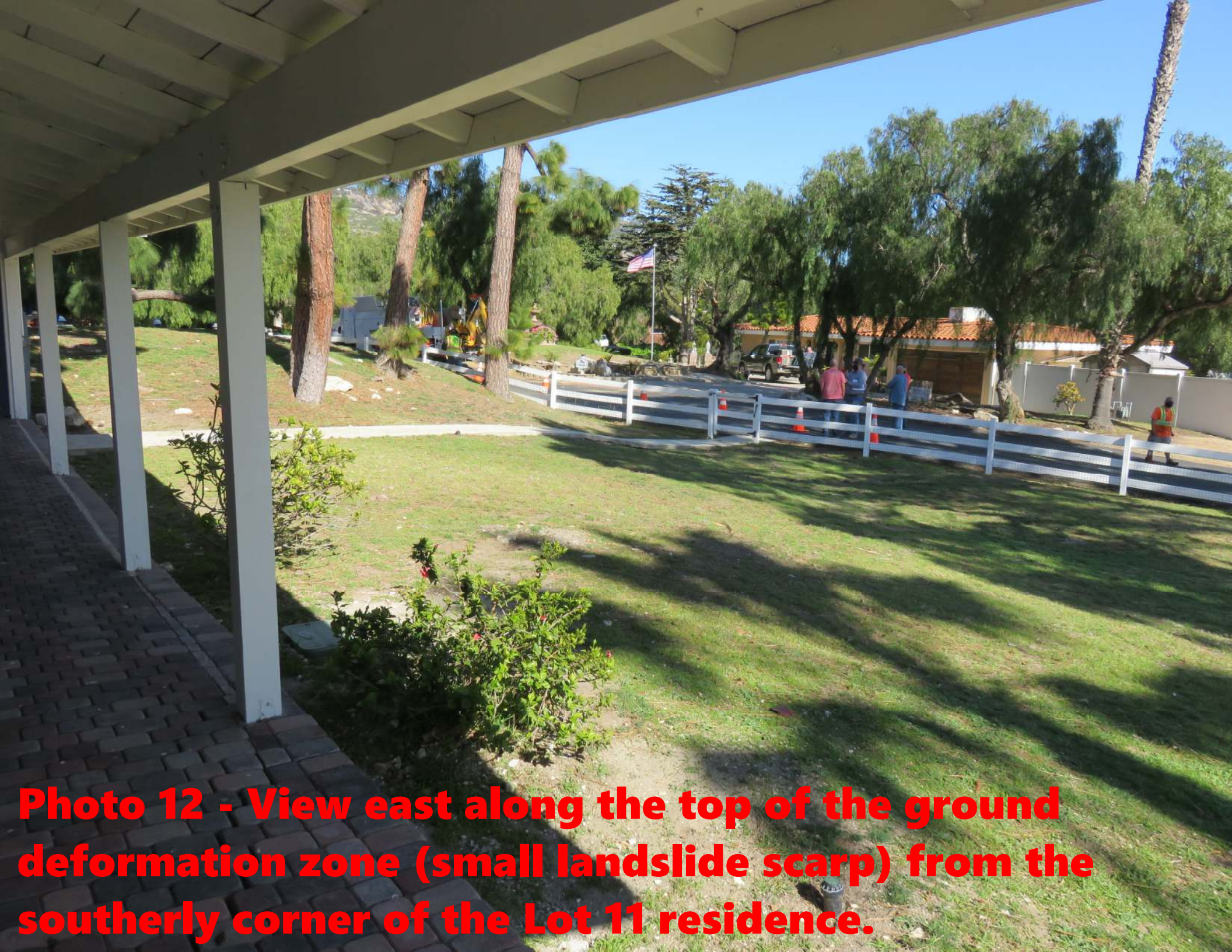

Photo 12 - View east along the top of the ground deformation zone (small landslide scarp) from the southerly corner of the Lot 11 residence.

Photo 13 - Separation that has developed in the paving stones at the westerly end of the Lot 11 front porch that has developed since 12/15/2020 site review

Photo 14 - Wall cracks and separations at the southerly corner of the residence on Lot 11, which is located along the projected west trend of the tension crack/deformation zone.

Photo 15 - Wall fractures/offsets at the southerly corner of the Lot 11 residence showing southerly diplacement and down-dropping of the lower wall corner/foundation relative to the upper wall corner and adjoining northerly portion of the structure; separation between the porch and house wall (X) has developed since the 12/15/2020 site review.

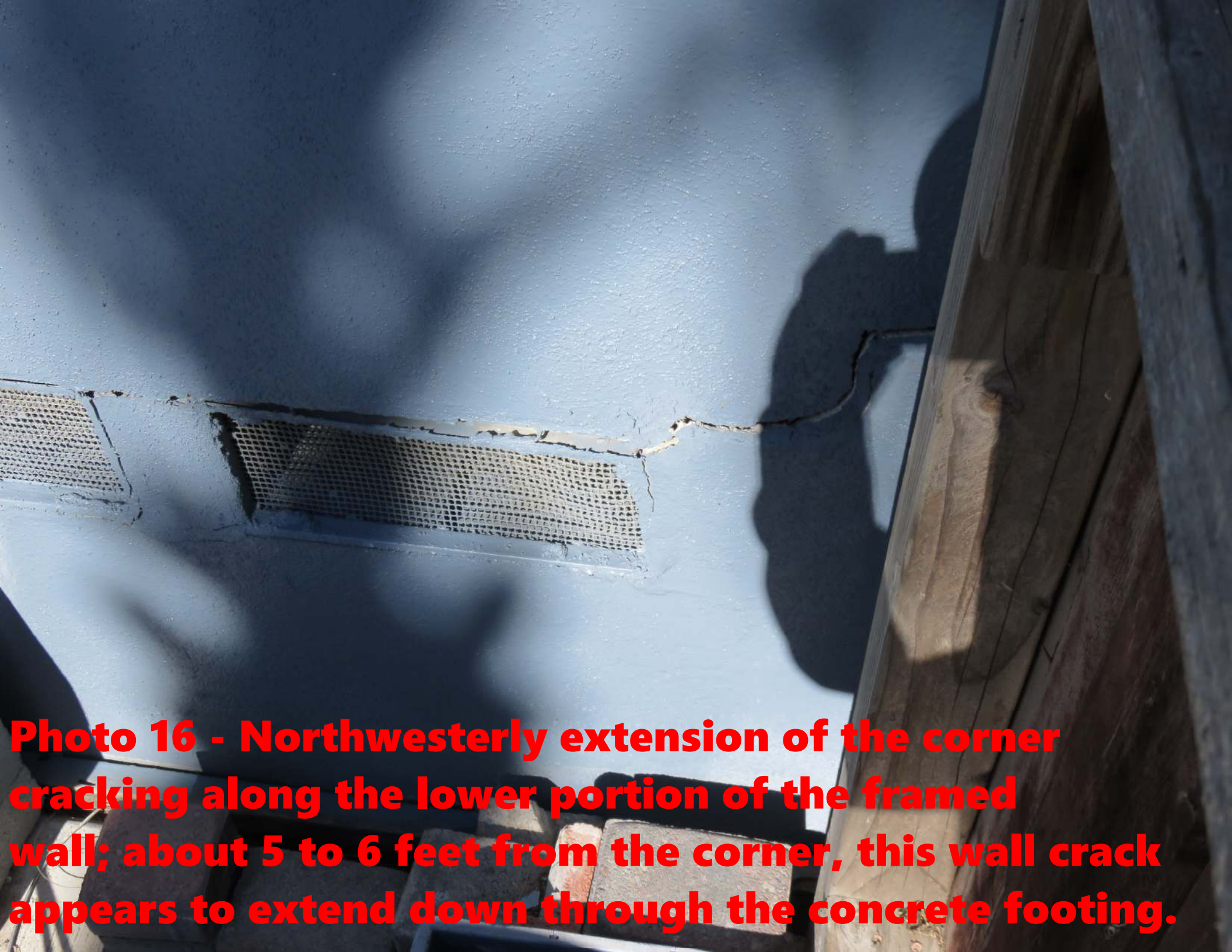

Photo 16 - Northwesterly extension of the corner cracking along the lower portion of the framed wall; about 5 to 6 feet from the corner, this wall crack appears to extend down through the concrete footing.

Photo 17 - Irrigation line break/leak repair on Lot 11, located about 15 feet southerly of the damaged wall corner, along the projected west trend of the southerly tension cracking zone (refer to site plan).

Photo 18 - View east across Lot 3 along the projected trend of the northerly zone of cracking/deformation; the "X" marks the approx. location of cracking/minor buckling in the small block wall; the damaged corner of the residence on lot 11 is visible in the background.

Photo 19 - Tension cracking in Lot 16 driveway that appears to be essentially the same as observed and photographed on 12/15/2020.