DEPARTMENT OF CONSERVATION

CALIFORNIA GEOLOGICAL SURVEY

801 K STREET • MS 13-40 • SACRAMENTO, CALIFORNIA 95814

PHONE 916 / 327-0791 • **FAX** 916 / 323-9264 • **TDD** 916 / 324-2555 • **WEB SITE** conservation.ca.gov

Memorandum

To: Jeanette Pedersen
California Department of Forestry
and Fire Protection
17501 N. Highway 101
Willits, CA 95490

Date: August 11, 2011

From: David Longstreth
Department of Conservation
California Geological Survey
17501 N. Highway 101
Willits, CA 95490

Subject: Engineering Geologic Assessment of Grading Operations at 29880 and 30010 Highway 101, Willits, CA; Cal Fire LE Case # 11CAMEU004127-46

References:

California Forest Practice Rules (CFPR), 2011. Incl. the Z'Berg-Nejedly Forest Practice Act of 1973. California Department of Forestry & Fire Protection, Resource Management, Forest Practice Program, PO Box 944246, Sacramento, CA 94244-2460.

California Building Code (CBC), 2010 (IBC 2009), Appendix J. GRADING.

Kelsey, H.M.,1998, *Formation of Inner Gorges*: Catena, Vol 15, p.433-458.

Kilbourne, R.T., 1984 A, Geology and Geomorphic Features Related to Landsliding, Longvale 7.5' Quadrangle, Mendocino County, California: California Division of Mines and Geology Open File Report 84-18, scale 1:24,000.

Kilbourne, R.T., 1984 B, Geology and Geomorphic Features Related to Landsliding, Willits NW (Burbeck) 7.5' Quadrangle, Mendocino County, California: California Division of Mines and Geology Open File Report 84-19, scale 1:24,000.

Pampeyan, E.H., and others, 1981, *Preliminary Map Showing Recently Active Breaks Along the Maacama Fault Zone Between Laytonville and Hopland, Mendocino County, California*, USGS, Map MF-1217.

Reid, M.E., et al, 2003, *Debris-flow initiation from large, slow-moving landslides*: Debris-Flow Hazards Mitigation: Mechanics, Prediction, and Assessment, Rickenmann& Chen (eds).

Scullin, C.M., 1990, *Excavation and Grading Code Administration, Inspection, and Enforcement, Prentice-Hall*, Englewood Cliffs, New Jersey.

Swanson, F.J., and Swanston, D.N., 1977, *Complex mass-movement terrains in the western Cascade Range, Oregon*: Geological Society of America, Reviews in Engineering Geology, Volume III.

Aerial Photographs Inspected:

CDFI, 1947, Black and white aerial photographs, Roll 6, Frames 2, 3, nominal scale 1:20,000.

CVN, 1952, Black and white aerial photographs, Roll 9K, Frames 124, 125, nominal scale 1:20,000.

Cartwright,1963, Black and white aerial photographs, Mendocino County Flight, Roll 3, Frames 156, 157; 158; nominal scale 1:20,000

CDF ALL-UK, 1981, Black and white photographs, Flight CDF ALL-UK, Roll 26, Frames 2, 3, nominal scale 1:24,000.

WAC Inc., 1984, Black and white photographs, Flight WAC-84C, Roll 15, Frames 167, 168, nominal scale 1:12,000.

WAC Inc., 1988, Black and white photographs, flight WAC CA 88, Roll 15, Frames 94, 95; nominal scale 1:31680.

WAC Inc., 2000, Black and white photographs, Flight WAC-00-CA, Roll 2, Frames 99, 100; nominal scale 1:31,680.

Introduction:

The California Geological Survey (CGS) was requested by CALFIRE to evaluate reported grading operations conducted at 29880 and 30010 Highway 101, Willits, CA., on slopes inclined up to 80 percent and more. A July 8, 2011 site visit was attended by Rusty Boccaleoni (CDFG), Stormer Feiler (NCRWQCB), Bob Scaglione (AQMD), Jim McCleary (County of Mendocino Code Enforcement), Ray Madrigal (County of Mendocino Code Enforcement), Jeanette Pedersen (CAL FIRE), Craig Pedersen (CAL FIRE), Lou Sciocchetti (CAL FIRE), Tim Meyers (CAL FIRE), Andy Whitlock (CAL FIRE) and Dave Longstreth (CGS).

Geologic Conditions:

The subject properties consist of two adjacent parcels (29880 and 30010 Highway 101, Willits, California) both of which are on steep slopes that drain to tributaries of Outlet Creek, a 303d listed tributary to the Eel River. The slopes are underlain by Upper Cretaceous to Tertiary age Coastal Belt of the Franciscan Complex (Kilbourne, 1984 A and B, Figure 1) that is described as gray-green consolidated sandstone containing scattered interbeds of siltstone, shale, and conglomerate. Where observed bedrock generally consisted of gray brown to orange brown sandstone that appeared pervasively jointed.

Review of aerial photographs (sets 1947, 1952, 1963, 1981, 1984, 1988, 2000) suggest that the steep stream side slopes (70 to 90 percent) that flank drainages within the site area appear as debris slide slopes, a geomorphic feature characterized by an aggregate of debris slide scars left by the movement of predominantly unconsolidated rock, colluvium, and soil along relatively shallow failure planes. Additionally two deep-seated landslides interpreted by review of the historical set of aerial photographs (sets 1947 through 2000) and by hummocky topography are observed at the site. The landslides, which appear to be translational/rotational rock slides, are likely characterized by very slow progressive ground deformation on a subsurface slip plane or basal shear zone. Deep-seated landslides often toe into watercourses forming steep slopes that may be susceptible to shallow landsliding (Reid et al, 2003).

Site slopes were observed to be steep ranging from 70 to 90± percent where they toe into an unnamed watercourse that flow to Reeves Canyon. Inner gorge geomorphology was observed on the slopes that flank site drainages. Kelsey (1988) describes the formation of inner gorge geomorphology as a process where a stream down cuts through rock, resulting in an abrupt change in slope angle, with steep channel banks and upper, less steep valley slopes. In the California Coast Ranges, Kelsey (1988) describes a mechanism of inner gorge formation

controlled by tectonic uplift, climate, and underlying rock characteristics. This process occurs over a geologic time scale of thousands to hundreds of thousands of years and can be temporally and physically intermittent depending on controlling factors.

A lineament of the active Maacama fault zone is mapped as trending through the site area (Pampeyan and others, 1981, Figure 2) that parallels the northwest trending ridge system along the western margin of the site area. This suggests the bedrock in the area may be sheared and broken from fault movements. The steep slopes observed in the subject site area appear to be underlain by pervasively jointed and sheared bedrock that is inherently prone to deep-seated and shallow seated landslide processes. Human activities such as road construction and grading may adversely impact slope stability (Swanson and Swanston, 1977) on slopes such as these. Such adverse impacts can result in accelerated land movement, additional landsliding, sediment delivery, and adverse impacts to habitat and public safety.

Observations. (keyed to Figures 3, 4, 5, 6, 7).

Pad Area #1. The southern approximately 1.8 acre pad was constructed on a northeast trending spur ridge (Figures 4 and 5). Materials cut from the ridge nose were side cast on the ridge flanks. The fill is estimated to be a maximum of about 20 to 25 feet thick and it is estimated to be on the order of about 15,000 cubic yards of materials. Organic debris (for example tree stumps, brush, and logs) were observed protruding out of the fill. In many places the organic debris was observed to be in positions that appeared to be supporting the fill materials. The fills do not appear to have been founded, keyed into, or placed on firm soils or bedrock. The fills appear very loose and uncompacted. Fills are perched on 80 percent slopes that descend to watercourses that flow to Highway 101. Review of aerial photographs (sets 1947 through 2000) indicate that while roads or skid trails were constructed in the area of the pad in the 1980s, no pad area was present prior to the 2000 aerial photographs.

A house pad with what appears to be a manufactured home is located immediately below and northeast of Pad Area #1 (Figure 3). This is immediately below what is estimated to be the thickest fill slopes at the northeast end of Pad #1.

Pad Area 2. The northern 0.6± acres pad was constructed on a northeast facing slope (Figure 6). Fills estimated to range from from about 10 to 20 feet thick appear to have been side cast on the slope. It is estimated that roughly 2500 cubic yards of fill materials were generated. Organic debris (for example tree stumps, brush, and logs) was observed protruding out of the fill. In many places the organic debris was observed to be in positions that appeared to be supporting the fill materials. The fills do not appear to have been founded, keyed into, or placed on firm soils or bedrock. The fills appear very loose and uncompacted. The fills are perched on 80 percent slopes that descend to Highway 101. Review of aerial photographs (sets 1947 through 2000) indicates that a smaller pad area was constructed in this area in the 1980s and was enlarged sometime after the 2000 photographs were taken.

Road Reconstruction. An approximately 1300-foot long driveway constructed at a 30 percent gradient leads from the pad areas to Highway 101 (Figure 7). The driveway appears to have been pre-existing and recently reconstructed. The driveway contains an outside berm and appears undrained for approximately 1300 feet before reaching Highway 101.

Cutting and filling appears to have recently occurred at the top of the driveway. What appears to be approximately 300 to 400 cubic yards of side cast materials were placed onto 90 percent slopes that descend to a watercourse channel. The side cast fills extend from the driveway all the way to the channel (approximately 100 feet) and have resulted in sediment in the watercourse. The watercourse flows to an on-site domestic water supply and eventually to an approximately 42-inch diameter culvert that flows under Highway 101 (Figure 7). The culvert was observed to be about half filled with sediment at the time of the inspection.

Environmental and Public Safety Concerns.

1). Grading. It appears that the grading techniques used to construct the pad fills were conducted in a manner that is considered unstable and not safe from failure (CFPR, 2011; CBC, 2010; Scullin, 1990). As such, there appears to be a significant potential that if the fills used in the pad constructions become saturated the fill slopes will fail. This would likely impact downslope watercourses, the downslope house pad, site driveway and Highway 101. This could impact the health and well fare of inhabitants of the house immediately below Pad #1 and could result damage to utilities on the site, such as fuels or other toxic materials potentially stored on site that could potentially contaminate ground water. Saturation of the uncompacted fills could occur from irrigation of vegetation of plants on the pad and/or from winter rains.

2). Driveway Drainage. The existing reconstructed driveway appears undrained and if left in its current condition, runoff from it appears to be in a position to flow onto Highway 101. This could result in sediment deposition onto Highway 101 and could adversely impact the safety of the motorists that use the highway.

3). Highway 101 Culvert. The approximately 42-inch diameter culvert that flows under Highway 101 could become plugged if fills that have been side cast into the watercourse channel at the top of the driveway are not removed from the channel. If the culvert plugs, water will likely pond along fills used to construct Highway 101 and eventually flow across the highway. This could adversely impact stability of Highway 101 and the safety of the motorists that use it.

4). Irrigation. Irrigation of plants on the pad areas could lead to percolation of water into loose fill and bedrock exposed on the pad surface and could result in adverse impacts to slope stability of the slopes on the site.

Recommendations:

A mitigation plan shall be developed by a California Certified Engineering Geologist (CEG) and a licensed Geotechnical Engineer. The mitigation plan shall include but not be limited to:

- A CEG and Geotechnical Engineering shall evaluate the adequacy of grading techniques and the stability of on-site cuts and fill, including an evaluation of potential impacts resulting from failure of slopes to the house pad immediately below Pad #1. The evaluation shall also address potential impacts related to the reconstructed driveway, and potential impacts to downslope drainages, watercourse, and Highway 101. The mitigation plan shall include a map that identifies the locations of unstable fills and slopes and shall include a finding by the project CEG regarding the stability of existing fill slopes.
- The geotechnical engineer shall provide mitigations and designs that include remediation of unstable fills that includes but is not limited to a grading plan that outlines

corrective grading designs. The corrective grading plan and designs will likely require the removal and possible re-compaction of unstable fills and shall be designed by the geotechnical engineer in such a way to minimize potential adverse impacts to slope stability identified by the CEG.

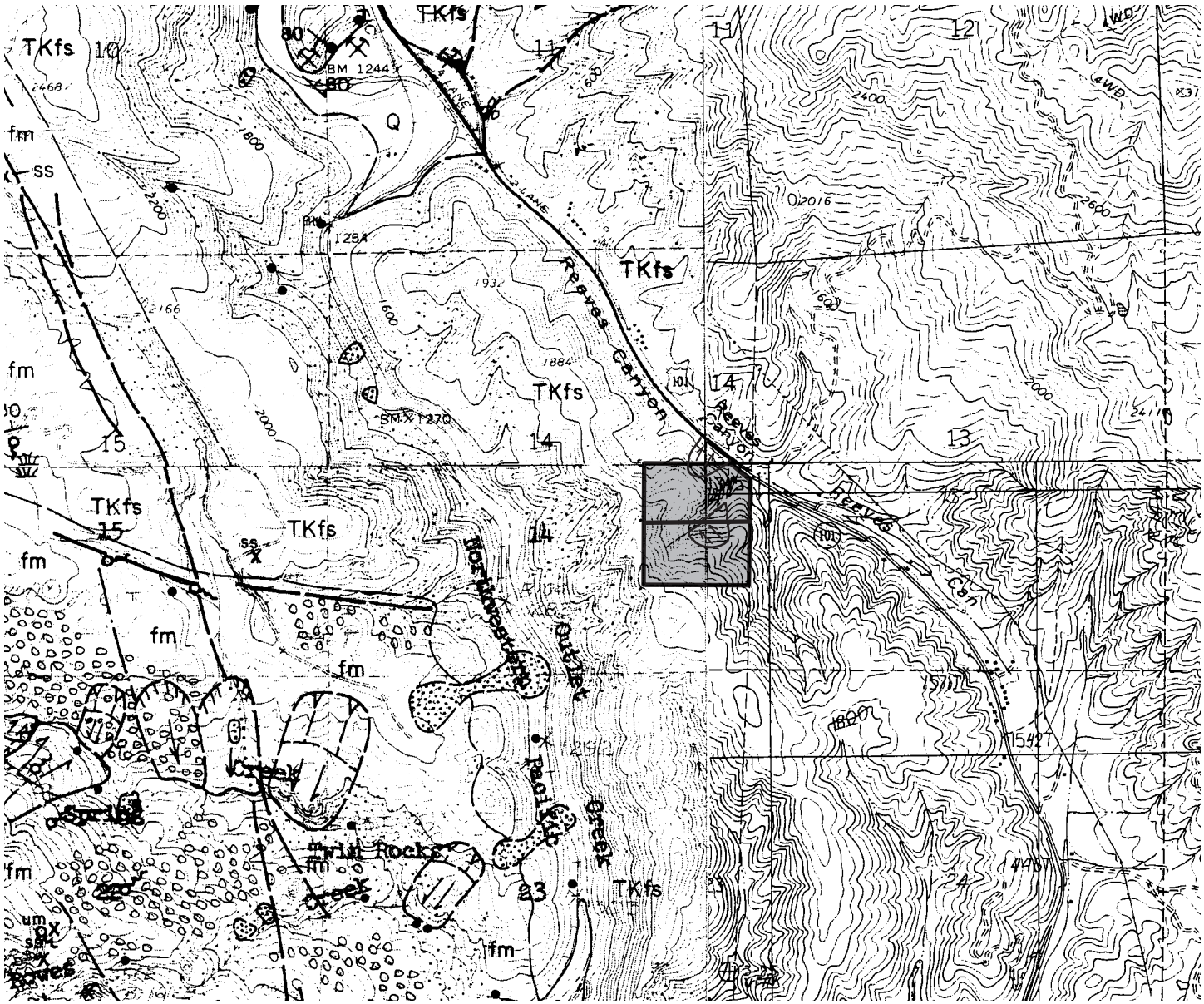
- Cal Trans shall be notified of potential impacts to Highway 101 and the 42-inch diameter culvert that runs under the highway and have the opportunity to comment or participate in any mitigations to Highway 101.
- A geotechnical engineering or CEG shall provide mitigation and design that de-waters and drains the site driveway. This can be included on the corrective grading plan that is developed for site remediation.
- A CEG shall evaluate potential impacts to slope stability resulting from irrigation of plants placed on the pad areas and the potential for percolation of water into bedrock, unstable fills, and along the bedrock/fill contact.
- The mitigation plan shall include a time frame that outlines completion of mitigations prior to commencement of the 2011 fall/winter rains and shall include a schedule of post-remediation inspections.
- CGS shall review and provide recommendations to Cal Fire regarding the approval of the mitigation plan prior to implementation.

Disclosure: This memo should in no way be considered an Engineering Geologic Report and should not be substituted in any way for such evaluations and reports recommended and requested in this memo.

original signed by
David Longstreth, CEG # 2068
Certified Engineering Geologist

Concur
08-11-11 *original signed by*
Date, Thomas E. Spittler, CEG 1078
Senior Engineering Geologist

Attachments: Figures 1, 2, 3, 4, 5, 6, and 7.



Explanation

Q	Alluvium
TKfs	Franciscan Formation, coastal belt

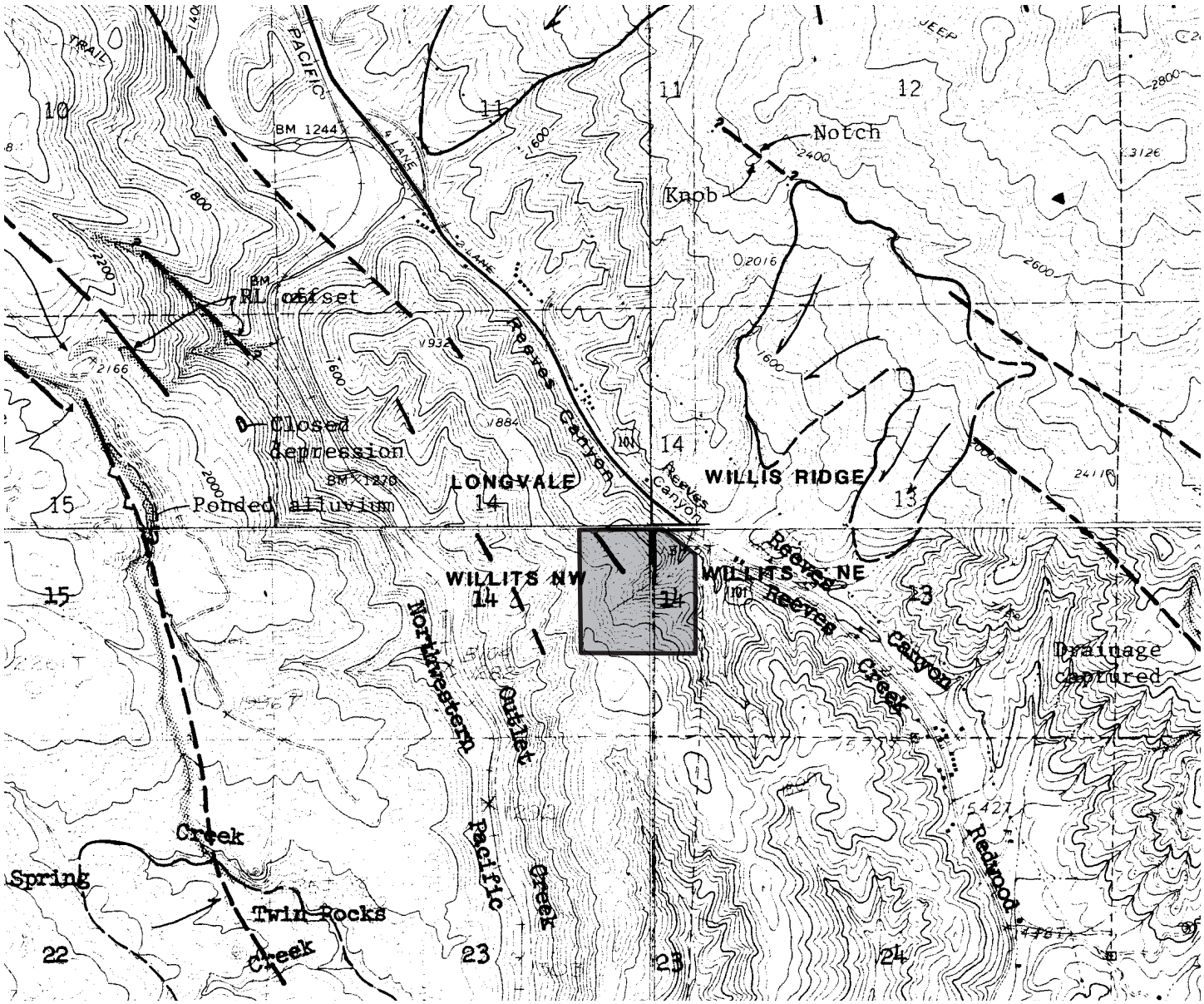
N

0 1000' 2000'

- Geologic contact, dashed where approximately located
- Fault
- Rotational/Translational Landslide
- Active Landslide (too small to show at map scale)
- Earthflow
- Disrupted ground
- Debris Slide
- Slopes >70 percent
- 75 Strike and dip of bedding
- Debris Flow/Torrent Track
- Shaded area represents estimated limits of investigation area.
- Debris Slide Amphitheater/ Slope

Base Map: Modified from Kilbourne, R.T., 1984 A, Geology and Geomorphic Features Related to Landsliding, Longvale 7.5' Quadrangle, Mendocino County, California: California Division of Mines and Geology Open File Report 84-18, scale 1:24,000 and Kilbourne, R.T., 1984 B, Geology and Geomorphic Features Related to Landsliding, Willits NW (Burbeck) 7.5' Quadrangle, Mendocino County, California: California Division of Mines and Geology Open File Report 84-19, scale 1:24,000.

Date: Aug 2011 Scale: 1" =2000'	Regional Geologic Map To Accompany Engineering Geologic Review of LE Case # 11CAMUE004127-46	Figure: 1



Explanation

Obvious photogeologic or field evidence of recent movement.

Less obvious photogeologic or field evidence of recent movement, but very probably a fault break.

Lineament inferred to be a recent fault break based on alinement of topographic features, but evidence of recent movement is inconclusive.

Shaded area represents estimated limits of site area.

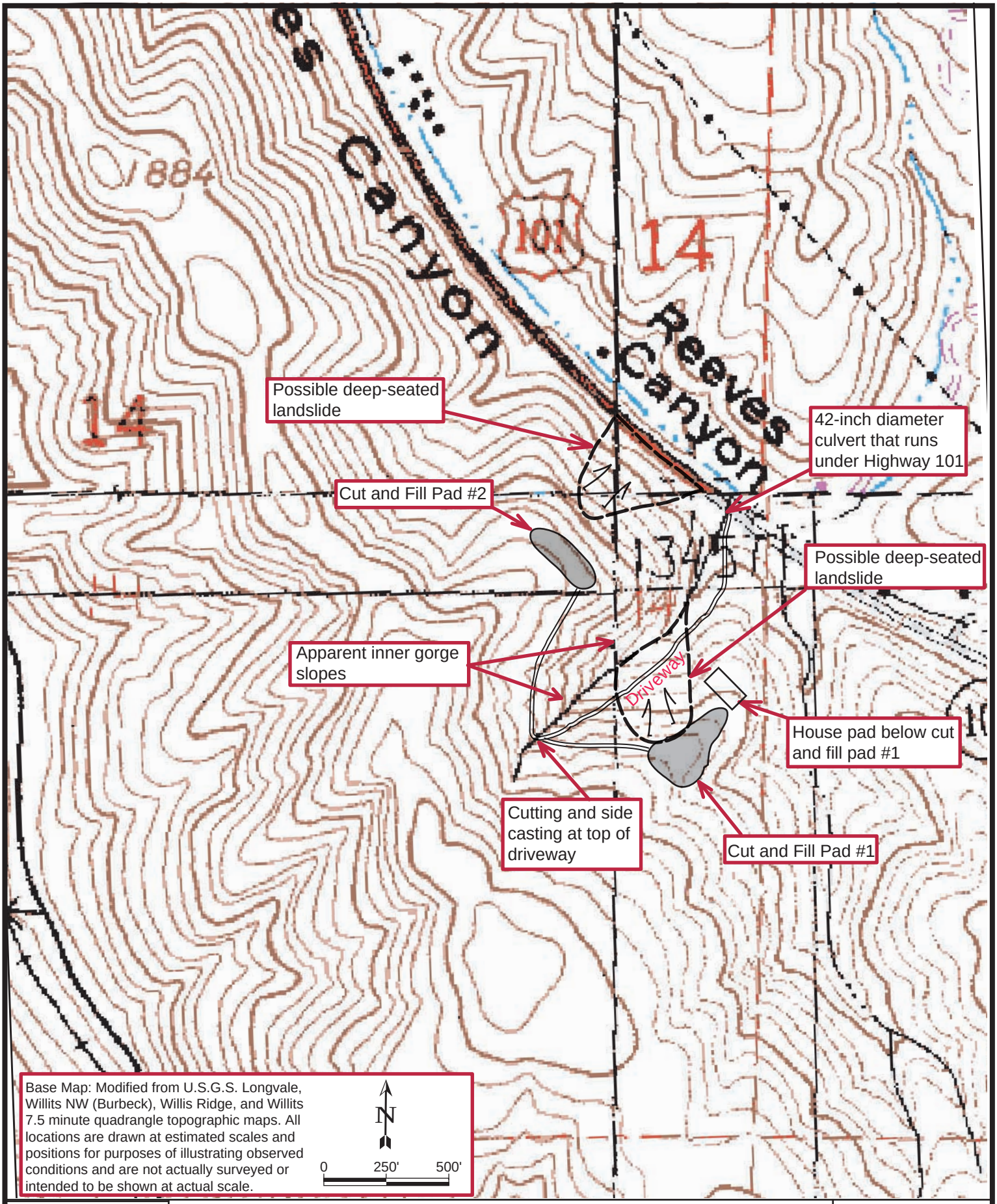
N

0 1000' 2000'

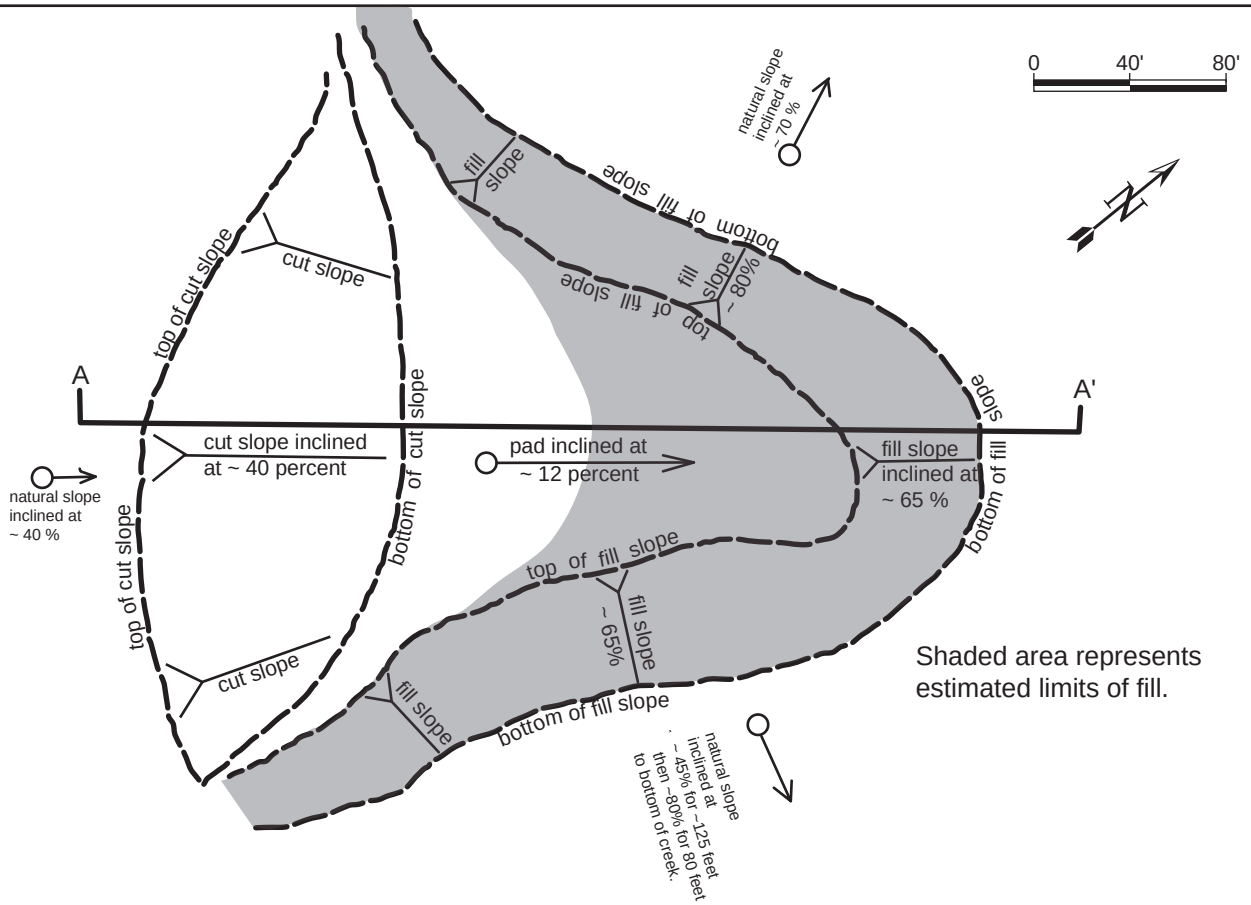
feet

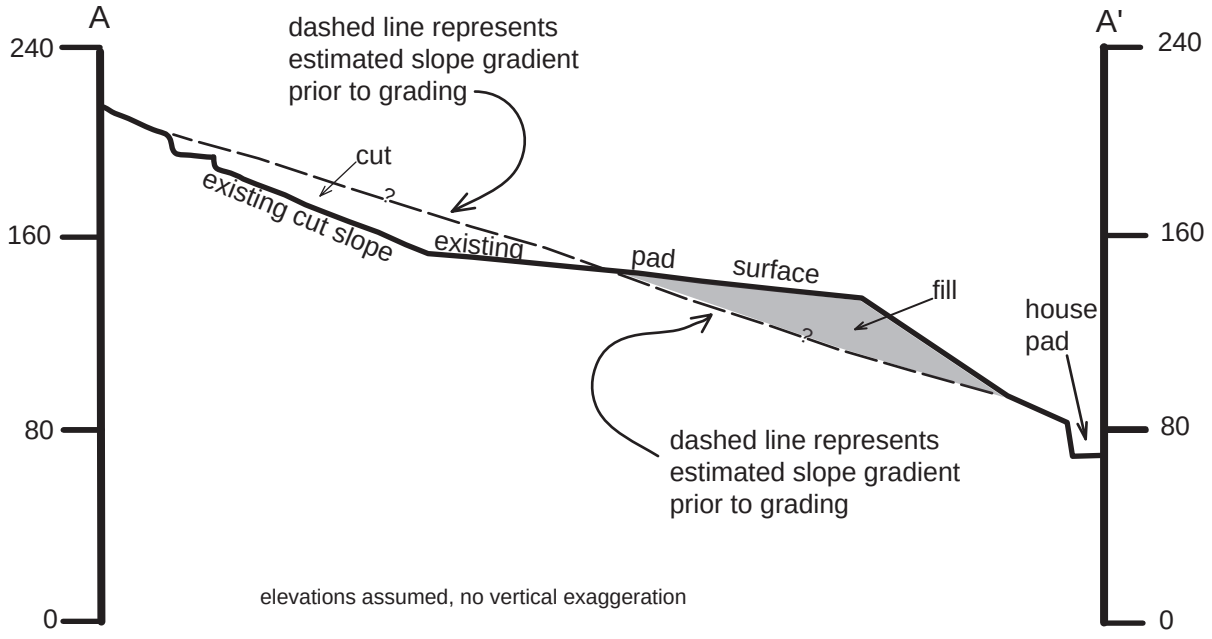
Base Map: Modified from Pampeyan and others, 1981, Preliminary Map Showing Recently Active Breaks Along the Maacama Fault Zone Between Laytonville and Hopland, Mendocino County, California, USGS, Map MF-1217.

Date: Aug 2011 Scale: 1" =2000'	Regional Geologic Map To Accompany Engineering Geologic Review of LE Case # 11CAMUE004127-46	Figure: 2



Scale: 1" = 500'	Site Map To Accompany Preliminary Engineering Geologic Review of LE Case # 11CAMUE004127-46	Figure: 3





Locations and positions shown on sketch map and sketch cross section are drawn at estimated scales, positions, and thicknesses for purposes of illustrating observed conditions and are not actually surveyed or intended to be shown at actual scale.

Scale: 1" ~ 80'	Sketch map and cross section of cut and fill pad # 1 LE Case # 11CAMUE004127-46	Figure: 4

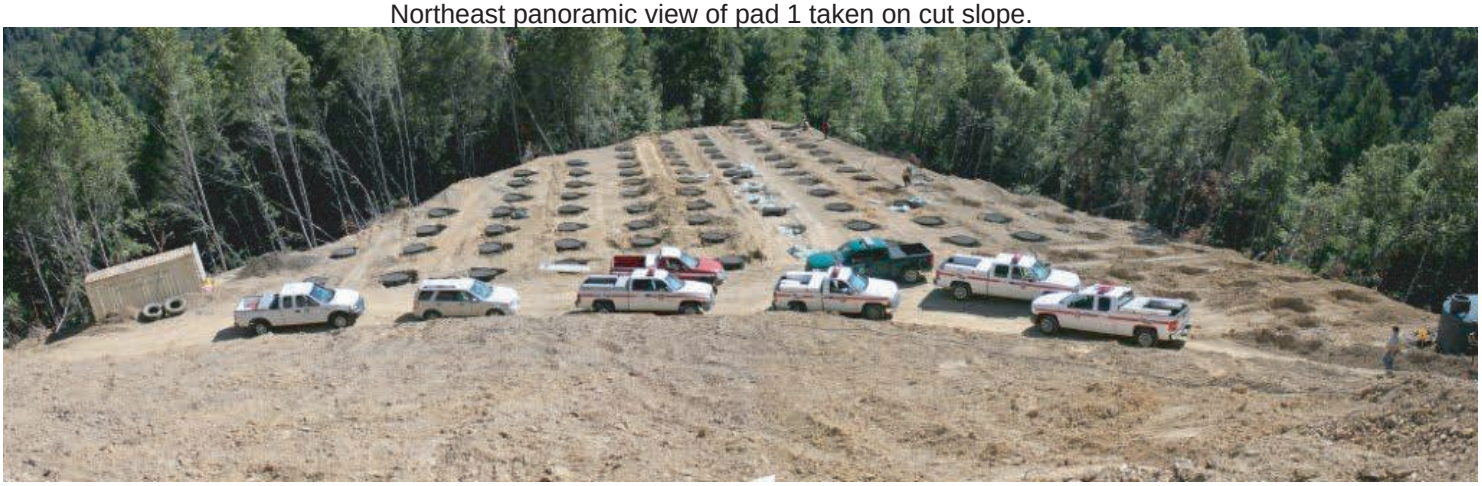
Bottom of fill slope along pad 1.

Buried debris exposed in fill slope along pad 1

House pad immediately below pad 1.

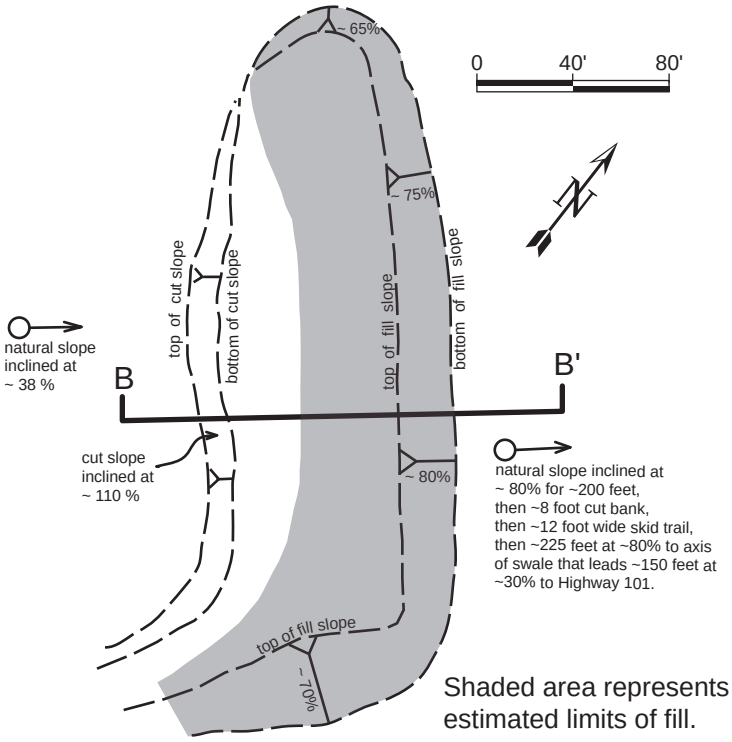
Debris exposed in fill slope along pad 1.

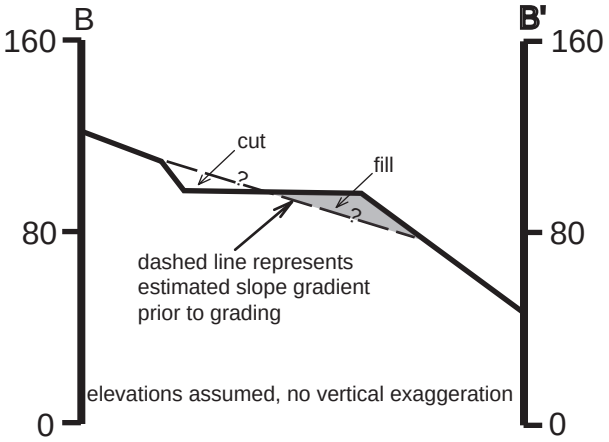
Northeast panoramic view of pad 1 taken on cut slope.



Southwest panoramic view taken from northeast margin of pad 1 looking towards cut slope.

No Scale	Photographs taken of cut and fill pad # 1 LE Case # 11CAMUE004127-46	Figure: 5





Northwest view of pad 2, cut bank excavation

Southeast view of pad 2

View southeast along pad 2 fill slope.

Facing east taken from above cut slope at pad 2.

Locations and positions shown on sketch map and sketch cross section are drawn at estimated scales, positions, and thicknesses for purposes of illustrating observed conditions and are not actually surveyed or intended to be shown at actual scale.

Scale: 1" = 80'	Sketch map and cross section of cut and fill pad # 2 LE Case # 11CAMUE004127-46	Figure: 6

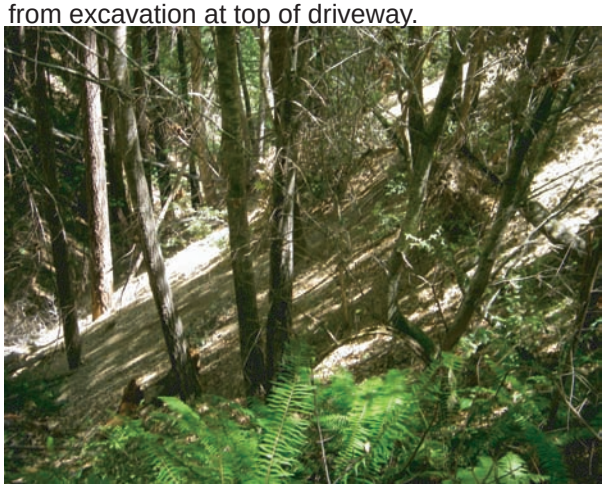
Half plugged ~ 42" culvert under Highway 101

Driveway that descends to Highway 101 (in distance).

Excavation at top of driveway from which sidecast fill appear to have been generated.

View of driveway ascending from Highway 101.

Loose sidecast on ~90% slopes into creek generated from excavation at top of driveway.



Midslope portion of undrained driveway that contains an outside berm.

No Scale	Photographs taken of driveway and culvert under Highway 101, LE Case # 11CAMUE004127-46	Figure: 7