SOUTHERN CALIFORNIA EDISON

Preliminary Geology and Geotechnical Evaluation
Riverside Transmission Reliability Project (RTRP)
Double Circuit 230kV T/L
Eastern, Western and Van Buren Suggested Routes
Mira Loma - Vista #1 230kV to Wildlife Substation
Riverside County, California

June 10, 2010
Project # 10-037
Revision 1

SOUTHERN CALIFORNIA EDISON
An EDISON INTERNATIONAL℠ Company

TDBU Civil/Structural & Geotechnical Engineering Group

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OVERVIEW SUMMARY

In order to meet the increased electrical demand associated with the growth within the Riverside Public Utilities (RPU) service area, the construction of double-circuit 230 kV transmission line is needed from the existing Mira Loma-Vista #1 230 kV line to a proposed City of Riverside substation called Wildlife. Three alignment alternatives are currently under consideration. These include Western, Eastern and Van Buren Alignments. This evaluation provides preliminary assessment of geologic and geotechnical constraints likely to be encountered during design, construction, and on going maintenance.

Placing the structure locations and access in or near the river is problematic from a structure and transmission line integrity point of view. Structure access during rains/floods would not be possible. Any road established in the floodplains of the river could be washed away at various times during the year and any road maintenance would be problematic.

Overall the Eastern route places 40 structures in flood zone location conditions that could jeopardize the foundation and structure integrity of the double circuit 230 kV transmission line. Also, there are 43 structures with erosion and 6 structures with slope stability potential. Maintenance access could be non existent for up to 40 structures during flood conditions. Elevated roads in the flood zone are not considered feasible. Road maintenance in the flood zone would be a constant and costly effort which could be restricted by permitting requirements. The Eastern route may not be able to perform the function intended, to serve the public with reliable transmission service.

Overall the Western route places 5 structures in flood zone location conditions that could jeopardize the foundation and structure integrity of the double circuit 230 kV transmission line. Also, there are 13 structures with erosion and 13 structures with slope stability potential. Maintenance access could be non existent for up to 5 structures during flood conditions. Elevated roads in the flood zone are not considered feasible. Road maintenance in the flood zone would be a constant and costly effort which could be restricted by permitting requirements.

Overall the Van Buren route places 9 structures in flood zone location conditions that could jeopardize the foundation and structure integrity of the double circuit 230 kV transmission line. Also, there are 3 structures with erosion and 3 structures with slope stability potential. Maintenance access could be non existent for up to 9 structures during flood conditions. Elevated roads in the flood zone are not considered feasible. Road maintenance in the flood zone would be a constant and costly effort which could be restricted by permitting requirements.

Based on this preliminary evaluation and the literature reviewed, it appears that from the perspective of foundation, and structure integrity, access, and long term maintenance, the Western and Van Buren Alignment alternatives both are clearly more favorable than the Eastern Alignment Alternative.

For clarification purposes, Revision 1 of this report includes an addendum dated May 17, 2010 which itemizes the number of structures for each route that are subject to liquefaction, erosion, slope instability or are within the 100 year flood zone.

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1.0 INTRODUCTION

In order to meet the increased electrical demand associated with the growth within the Riverside Public Utilities (RPU) service area, the construction of double-circuit 230 kV transmission line is needed from the existing Mira Loma – Vista #1 230 kV Line to a proposed City of Riverside substation called Wildlife. Several alignment alternatives are currently under consideration. These include a “Western Alignment”, an “Eastern Alignment” and a “Van Buren Alignment or Van Buren”.

Based on reviews conducted for this assessment, the proposed alignment alternatives include towers at dead end and angle points with Tubular Steel Poles (TSP) constructed between the towers spaced at approximate distances of about 750 feet. Within the River corridor, the Eastern Alignment includes 4 towers and 64 monopoles based on the available staking table. The Western Alignment includes 57 structures (approximately 15 towers and 42 monopoles), and the Van Buren Alignment includes 15 structures (approximately 4 towers and 11 monopoles).

The data and recommendations included in this report are based on desktop study, helicopter tour was conducted on March 18, 2010 and the review of available literature & maps pertinent to the project. No subsurface exploration has been conducted. Structure locations were not staked and structure locations were not firm. The report does not contain sufficient information for the design of foundations for towers or the Tubular Steel Poles.

2.0 ROUTE DESCRIPTIONS

2.1 Eastern Route

The Eastern Route will tap into Mira Loma–Vista#1 230 kV just west of the Colton landfill, and extend westerly in the immediate river corridor approximately eight miles to the proposed Wildlife Substation. Much of this alignment is located in the river corridor within the floodplain of the Santa Ana River. The route is shown on Figure (1a & 1b), *Eastern Route Layout Map.*

2.2 Western Route

The Western Route will tap into Mira Loma–Vista#1 230 kV northwest of the intersection of Galena Street with Wineville Avenue, extend south along Wineville Avenue and Interstate 15 to 68th Street where it will turn east into the river corridor. The line will cross to the south bank of the Santa Ana River at the Mira Loma Golf course, and then continue easterly largely across vacant land on a low bluff above the south bank of the river. At Tyler Street the line will pass along the top of a granitic bluff north of a residential development, cross Van Buren Boulevard, extend along the south side of a sewage treatment plant and then through industrial/commercial properties to the proposed Wildlife Substation. The total length of this alignment is approximately 10 miles with approximately 6.5 miles within the immediate river corridor. The route is shown on Figure (2a & 2b), *Western Route Layout Map.*

2.3 Van Buren Route

The Van Buren Route will tap into Mira Loma–Vista#1 near the railroad easement east of Etiwanda Street and just north of the Pomona Freeway (CA 60), extend southerly generally along the railroad alignment and Van Buren Boulevard to Pedley Road and then westerly on the granitic ridges above the north bank of the Santa Ana River to a point just opposite the proposed Wildlife Substation. The line will cross the river to the proposed Wildlife Substation a few hundred feet east of the alignment of the existing gas line crossing. The total length of this alignment is approximately 7.25 miles with a little more than 1.5 miles within the immediate river corridor. The route is shown on Figure (3a & 3b), *Van Buren Route Layout Map.*

3.0 VICINITY GEOLOGIC SETTING

The project site is located in the northeast portion of the Peninsular Ranges Geomorphic Province of California. The Peninsular Ranges Geomorphic Province consists of a series of northwest-trending mountain ranges and valleys and similarly-oriented earthquake faults, and extends southward from the San Gabriel Mountain in the Transverse Ranges to several hundred miles into Baja California. The alignments are located within the northern portion of a large structural block of land known as the Perris Block which is part of the Peninsular Ranges Geomorphic Province of California. This block is bounded by the San Jacinto Fault on the northeast and Chino and Whittier-Elsinore Faults on the southwest. See Figure (4), *Regional Geologic Map With Proposed Eastern, Western and Van Buren Routes*.

4.0 PROJECT GEOLOGIC SETTING

The majority of the alignments are underlain by alluvium and older alluvium overlying granitic bedrock. Sediments are likely to be mixtures of clay, silt, sand and gravel. Alluvium in the active stream channel is likely to be poorly consolidated. Older alluvium typically occurs as elevated terraces along the banks of the river, and is likely to be better consolidated than the younger materials. Granitic bedrock is medium to coarse-grained and generally slightly foliated. Although weathered near the surface, granitic bedrock should be expected to be quite hard at shallow depth. Groundwater could be encountered in order of 15 to 35 feet below ground surface within the Santa Ana River corridor.

5.0 FAULTING & LOCAL SEISMICITY

There are no active faults that cross the three 230 kV routes. However, the routes are located in the seismically active southern California region, as shown on Figure (5) *Faulting & Local Seismicity Map*. An active fault is defined as a fault that has had surface displacement within Holocene time (about the last 11,000 years). According to California Geological Survey CGS, and United States Geological Survey (USGS) Open File Report 2008-1128, At the east end, the alignments extend to within about 4 miles of the San Jacinto fault - San Bernardino segment. At the west end, the alignments extend to within about 6.5 miles of the Chino-Elsinore fault and within about 9 miles of the Whittier-Elsinore fault. The San Andreas fault trends along a roughly northwest/southeast alignment and is located approximately 16.2 miles northeast of the northeastern-most 230 kV study area. The San Andreas fault zone delineates the boundary between two global tectonic plates known as the North American Plate and Pacific Plate.

6.0 LIQUEFACTION

Liquefaction is defined as the phenomenon of sudden decrease and loss of soil shear strength in a soil mass due to the development of excess pore pressures during an earthquake. Soil liquefaction may occur in submerged loose to medium-dense granular soils at the upper 50 feet during or after strong ground shaking. Ground motion must be intense with duration of shaking sufficient for the soils to lose shear resistance. The generation of excess pore pressure under un-drained loading conditions is a distinguishing characteristic of all liquefaction phenomena. The tendency for dry cohesionless soils to densify under both static and cyclic loading is well known. The tendency for densification occurs when saturated cohesionless soils under un-drained conditions are subjected to cyclic shaking typically caused by an earthquake. The densification in turn causes the soil mass to deform, and transfer the stress from the sand grains to the pore water thus causing excess pore pressure. The excess pore pressure will reduce the effective stress, which is the key to trigger liquefaction. The soil will liquefy when the effective stress is reduced to zero.

When the soil becomes liquefied and looses its shear strength, ground failures such as lateral spreading, flow failure and loss of bearing capacity occurs. The change of the soils volume will be seen at the ground level as surface settlement. The soils may be non-homogeneous which will cause the settlement to be non-uniform resulting in large differential settlement.

The potential for liquefaction at structure locations was evaluated on a preliminary basis. The various potentials for liquefaction were assigned primarily on the basis of the susceptibility of the general underlying material type. Risk Categories where defined as follows:

NA *Not Applicable*: Materials underlying the proposed structure location are not susceptible to liquefaction. No analysis is required.

L *Low*: Materials underlying the proposed structure location are expected to be moderately consolidated and to have a relatively low potential for liquefaction. Analyses of representative areas should be considered.

E *Evaluate*: Materials underlying the proposed structure location are expected to include fine-grained granular material that is poorly consolidated. A potential for liquefaction during seismic loading under high groundwater conditions is considered likely. Specific analyses of each proposed tower location should be considered.

G *Graded*: The structure is proposed within or near an area that has been graded or otherwise improved. Evaluation/mitigation of liquefaction may not be necessary or feasible.

Based on this classification, structures along the various alignments were assigned liquefaction risk potentials as follows:

Liquefaction Rating	**Number of Structures & [Structure Numbers]**		
	Eastern Route	**Western Route**	**Van Buren Route**
NA	20	73	57
L	11	9	0
E	24 [68,18-29, 56-59, 62-66, & 69-70]	0	3 [BX11- BX13]
G	15 [38-39, 67,40-49, & 60-61]	0	0

Mitigation of shallow liquefaction hazards can be achieved by using deeper foundations that extend below the liquefiable zone as shown on Figure (8), *Liquefaction Sites*. Liquefaction can occur at depths of 50 feet or greater.

7.0 FLOODING

Based on the review of FEMA Maps on Figures (11-14), *FEMA Map Eastern and Western Routes*, the flood potential for each structure has been assessed. The two floodplain conditions for 100 and 500 years floodplain are considered during the study. The 100 years or the 500 years refers to the recurrence interval. Structures along the alignments occur in defined flood hazard zones as follows:

Flood Zone	**Number of Structures & [Structure Numbers]**		
	Eastern Route	**Western Route**	**Van Buren Route**
100 Year Flood	40 [15-29, 32, 35, 41-42, 49-53, 55-70]	5 [AX15, & JB1-JB4]	9 [BX1, BX3-5, BX7-10, & BX13]
500 Year Flood	7	0	2
Outside 500 Year Flood	23	77	49

Along both the Western and Van Buren Alignments most of the structures are proposed well above the main river channel and are not likely to be subject to flooding hazards. Exceptions occur on the Van Buren Alignment where 9 structures are located in the 100-year floodplain along Pedley Road west of Van Buren Boulevard, and 5 structures on the Western Alignment.

Although precise survey of the tower locations is not currently available, comparison of flood elevations indicated on FEMA maps with rough tower elevations determined using publicly available references suggest that flooding along the Eastern Alignment could occur to depths exceeding ten feet at some of the tower locations and that flood depths of five to six feet are likely to be quite common. An elevated access road design above the 100 year flood level may not be feasible due to potential instability during flood conditions. In addition, mitigation of these flood levels in a manner that would assure 24/7 access to tower locations during flood periods would require extensive modification of the floodplain to construct appropriate access roads and tower pads. Allowing vehicles and individuals on the road during flood conditions may be restricted due to safety concerns. Such extensive construction in a major floodplain would likely require permitting through numerous local state and federal agencies.

The foundations and the towers have to be protected from the flood debris impact. Risk of such impact can be reduced by building a rip-rap or concrete protection system around the foundation. Failure to protect the foundation may jeopardize the stability of the structure. Soil washout plays a major role in the stability of structures that are placed in flood or river areas. Based on experience, the repair of such damage is very costly and is usually completed in a very tight window and most probably requires outage. These situations must be considered during the design phase.

8.0 EROSION

In addition to inundation, other hazards associated with flooding include scour and debris impact. Some examples are shown on Figure (15-17), *Erosion*. These hazards are included along with surface erosion not directly related to river flood stages to assign a relative risk of erosion-related hazard at the structure locations. Risk categories were loosely defined as follows:

NA Structure locations are not susceptible to erosion.

L Materials underlying the proposed structure location are expected to be generally non-erodible, given proper drainage control or the site is elevated with limited upslope catchment area.

M Materials underlying the proposed structure location are expected to include materials readily susceptible to erosion; drainage in the surrounding area is poor, the site is located within either the 100-year or 500-year flood plain, but near the margins of the drainage channel.

H The structure is proposed within or near the main floodway; site observations noted evidence of periodic flooding (existing damage that appears to be flood related, past repairs, piles of flood debris in the vicinity.

Based on this classification, structures along the various routes were assigned erosion risks as follows:

Erosion Rating	Number of Structures & [Structure Numbers]		
	Eastern Route	**Western Route**	**Van Buren Route**
NA	0	27	48
L	27	42	9
M	25 [6-7, 10, 14-16, 26-30, 32, 52, 54, 55, & 61-70]	13 [AX14- AX21, D6-D10]	0
H	18 [17-25, 49-51, 53, & 56-60]	0	3 [BX11 - BX13]

Access roads will also be under a high potential of erosion. An erosion control plan for construction sites may be required. The surface water from all sources must be conveyed off the roadway at frequent locations to control roadbed soil erosion. These roads will require routine erosion monitoring. The foundation of the structures located within the 100 year flood zone should be designed with additional scour that could be in range of 10 feet in addition to the design depth as shown in Figure (7), *Rip-Rap Erosion Protection System*. In general, risks associated with erosion might be mitigated using drainage control on building pads and along access routes. These mitigation measures can include berms and concrete swales to control normal surface runoff. Where structures will be located in areas subject to severe flooding, access routes and pads may require some combination of extensive rip-rap, shotcrete, hydro-seed and other measures to help protect the structures against serious undermining along with other damages, and to maintain appropriate access to the structures during flooding as shown in Figure (18), *Erosion Repair*.

9.0 SLOPE STABILITY

Potential risks associated with slope stability at proposed structure locations were assessed in terms of the height, gradient and proximity of nearby slopes taking into consideration the nature of the underlying materials. Slope stability issues in granitic terrain may be related to adversely oriented foliation or joins, excessive slope gradient of or height, rockfall from upslope areas, or surficial slumping in overlying soil and highly weathered rock. Some examples are shown in Figures (19 & 20), *Slope Instability*. Most of the hazards in granitic terrain are considered largely nuisance-level, limited in extent and/or readily mitigated.

Slope stability issues in sedimentary terrain (alluvium and older alluvium) are primarily related to the potential for erosion, slumping and bluff collapse either above or below the proposed structures. These hazards can be mitigated to a large degree by providing some combination of proper drainage control, judicious relocation, and the use of deepened foundations. Where structures are proposed near the base of steep slopes in alluvium, consideration should be given to increasing the distance between the structure and the slope or relocating the structure above deepened foundations at the top of the slope. The stability of access route must be considered as well.

Slope stability hazard categories were defined as follows:

NA Structure locations are not susceptible to slope instability.

L Little or no slope stability risk anticipated. Primarily identified for structures proposed on flat sites, at significant distances from slopes, or where underlying conditions are such that no significant risk is expected associated with nearby slopes. Specific slope stability analyses are not considered warranted.

M Some element of slope stability risk is anticipated; however, the risk is considered either primarily nuisance level, easily mitigated, or not of immediate concern. The potential for some slope stability risk should be considered in the design and planning process, possibly supported by specific slope stability analysis. The need for mitigation measures is considered low.

H Conditions at the structure locations require careful analysis of slope stability issues. Some degree of mitigation is anticipated.

Based on this classification, structures along the various routes were assigned slope stability risks as follows:

Slope Stability Rating	Number of Structures & [Structure Numbers]		
	Eastern Route	**Western Route**	**Van Buren Route**
NA	0	27	51
L	64	42	6
M	2 [9-10]	13 [AX14- AX21, & D6-D10]	3 [BX8 - BX10]
H	4 [52-55]	0	0

Most of the identified slope stability issues concern structures located close to either the top or toe of a steep slope. Most commonly these issues can be mitigated using deepened foundations (for structures located too close to the tops of slopes) or by moving the structure a greater distance from the slope, see Figures (9 & 10), *Slope Stability Repair*. Where concerns involve slopes in granitic terrain, in most cases, the mitigation will require assurance that foundations extend into firm lightly weathered bedrock. This typically might involve deepening foundations three to five feet beyond typical design depths. Where concerns involve slopes in sedimentary terrain, or on higher, steeper granitic slopes greater embedment depths – perhaps as much as fifteen to twenty feet beyond typical design depths might be required. In cases where greater depths might be indicated, it might prove more practical to relocate the structure.

10.0 BLUFF RETREAT

A series of structures (seven structures) included in the Western Alignment (D5 through D11) are proposed on a bluff elevated about 60 to 80 feet above the south bank of the Santa Ana River. Along the length of most of the bluff the main floodway defined for the 100-year flood extends essentially to the base of the bluff. This bluff can be expected to retreat from the shoreline similar to sea cliff retreat. Erosion likely continues almost barely on a yearly basis with periods of more accelerated erosion and bluff collapse. These periods of accelerated erosion are likely to occur primarily during major floods. East of roughly structure D5, the bluff is underlain by granite at the river flow level. The granite slope is inclined at nearly vertical in places and at some locations appears to have been degraded by past grading. Although some consideration should be given to retreat of these granite bluffs, the potential for significant retreat in these areas over the anticipated lifetime of the structure is considered low.

West of Structure D5, the bluff is underlain by older alluvium. Structures in this location are proposed at distances ranging from about 120 feet to 400 feet from the edge of the bluff. The older alluvium is far less resistant to weathering than the nearby granite. Careful consideration should be given to structures propose along this section of bluff. A systematic assessment of bluff top retreat based on a more detailed assessment of site geology and analysis of historic stereoscopic aerial photographs as these structures move through the planning and design phase.

11.0 CONSTRUCTION

Proposed structure locations were assessed in terms of difficulty of construction and maintaining access routes and level pads appropriate to accommodate vehicles/trucks normally anticipated to be needed during construction. Access was assessed in terms of the proximity of the proposed structure to existing through street and the level of grading judged necessary to establish access from existing through street to the proposed structure location. Along most of the Western and Van Buren routes, acceptable access appears to be available in the river corridor segments at relatively short distances from existing roads. Improvements including light paving and drainage control may be required in some areas.

12.0 ACCESS ROADS BEING AVAILABLE 24/7

Access roads are required for maintenance purposes and emergency situations over the lifetime of the structures. It is always desired to facilitate access to any site location because access for maintenance or repair can be needed at any time. The Engineering standards do not address the 24/7 requirement due to this being an operational need and not a technical need.

Much of the eastern Alignment is located within or near the 100-year flood plain segment of the Santa Ana River. Establishing appropriate access along this corridor will require extensive grading and modification of the river channel to construct an appropriately wide access road (approximately 16 feet) for SCE 40 tons maintenance truck. Engineering made an assumption that to maintain 24/7 access during a 100-year flood event, a road being two feet above the flood plane would be required. A severe flood impacting part or all of the access road may result in washing the access road away. In order to meet the above requirements there could be a great need for berms and retaining wall protection. The road would require importing earth fill probably exceeding 50,000 cubic yards per each linear mile of the proposed access road. The road embankments would require rip-rap or concrete (shotcrete) as protection from flood erosion. Placement of this system will have an effect on the river flow. Construction of such a project in the river channel would be expected to alter flood heights and would require careful hydrologic evaluation to ensure that properties adjacent to the floodplain are not compromised. Permitting such a structure would be a complicated process involving numerous agencies including the City and County of Riverside, the California Department of Fish and Game, the Department of Transportation, the Army Corp of Engineers, the Federal Emergency Management Agency, and probably several others. There would be many levels of technical reviews by official agencies. The project may also be challenged by independent consultants hired by nearby property owners and environmental groups to oppose the project as well as utility structures in existing easements such as the Gas Company and the Union Pacific Railroad. Therefore, the elevated road may not be feasible.

13.0 FOUNDATION TOP ELEVATION WITHIN THE 100 YEAR FLOOD ZONE

When locating structures, every attempt should be made to keep structures located out of river beds and other known flood hazard areas, in the Eastern route, several structures will either be located in the riverbed or adjacent to riverbeds with unprotected banks and within the 100 year flood zone. Foundations to be located in the flood zone or river beds shall be designed to accommodate an appropriate scour depth. The top of the foundation being two feet above the flood plane may reduce the trash impact on the foundation and eliminate the steel structure members from being underwater during the flood period as shown in Figures (6 & 16), *Concrete Impact and Erosion System Within Santa Ana River R/W* and *Erosion*. The foundations in such areas shall be designed based on the submerged condition and add a “trash” load at the maximum flood level which will be two feet below the top of the foundation. The “trash” load shall account for debris and tree sections or branches. The pressure of the water velocity of the river plays a major role in the dynamic impact.

14.0 CONCLUSION

This preliminary study has been prepared to aid in the evaluation of three alternative proposed Riverside Transmission Reliability Project alignments with particular emphasis on those sections of the alignments in the immediate vicinity of the Santa Ana River Corridor. The conclusions and recommendations of this report were prepared in accordance with the generally accepted professional engineering and engineering geologic principles and practice within our profession in effect at this time in Southern California for studies of this magnitude.

Placing the structure locations and access in or near the river is problematic from a structure and transmission line integrity point of view. Structure access during rains/floods would not be possible. Any road established would be washed away at various times during the year and any road maintenance would be problematic.

A summary of the preliminary evaluation relating to the river flood zone is provided below.

Eastern Route

There are 24 structures (3.5 miles) with liquefaction potential which could jeopardize foundation and structure integrity.

There are 40 structures (5.5 miles) within a 100 year flood hazard zones which could jeopardize foundation and structure integrity. Special foundation and structure base elevations will be required to minimize, but not eliminate, integrity of the structures.

There are 25 structures in erosion potential areas at the edge of the flood zone and 18 structures in erosion potential areas in the flood zone. This situation could jeopardize foundation and structure integrity.

There are 6 structures in medium or high slope stability issues which could jeopardize foundation and structure integrity.

The access for the 40 structures in the 100 year flood zone could be limited or non-existent during flood conditions. If access was required for foundation or structure integrity stabilization access would need to be delayed until flood conditions subsided. The concept of elevated roads above a 100 year flood condition is considered infeasible due to the following:

A. Stability of an elevated berm road would be problematic during and after a flood condition,
B. Road berms in the flood zone may divert water in an undesirable way,
C. Permitting for elevated road berms would be very complex,
D. Maintenance personnel and equipment would not be able to use the roads during flood conditions due to personal safety concerns.

Overall the Eastern route places 40 structures in flood zone location conditions that could jeopardize the foundation and structure integrity of the double circuit 230 kV transmission line. Also, there are 43 structures with erosion and 6 structures with slope stability potential.

Maintenance access could be non existent for up to 40 structures during flood conditions. Elevated roads in the flood zone are not considered feasible. Road maintenance in the flood zone would be a constant and costly effort which could be restricted by permitting requirements. The Eastern Route may not be able to perform the function intended, to serve the public with reliable transmission service.

Western Route

There are 0 structures with liquefaction potential which could jeopardize foundation and structure integrity.

There are 5 structures within a 100 year flood hazard zones which could jeopardize foundation and structure integrity. Special foundation and structure base elevations will be required to minimize, but not eliminate, integrity of the structures.

There are 13 structures in erosion potential areas at the edge of the flood zone and 0 structures in erosion potential areas in the flood zone. This situation could jeopardize foundation and structure integrity.

There are 13 structures in medium or high slope stability issues which could jeopardize foundation and structure integrity.

The access for the 5 structures in the 100 year flood zone could be limited or non-existent during flood conditions. If access was required for foundation or structure integrity, stabilization access would need to be delayed until flood conditions subsided. The concept of elevated roads above a 100 year flood condition is considered infeasible due to the following:

A. Stability of an elevated berm road would be problematic during and after a flood condition,
B. Road berms in the flood zone may divert water in an undesirable way,
C. Permitting for elevated road berms would be very complex,
D. Maintenance personnel and equipment would not be able to use the roads during flood conditions due to personal safety concerns.

Overall the Western route places 5 structures in flood zone location conditions that could jeopardize the foundation and structure integrity of the double circuit 230 kV transmission line. Also, there are 13 structures with erosion and 13 structures with slope stability potential. Maintenance access could be non existent for up to 13 structures during flood conditions. Elevated roads in the flood zone are not considered feasible. Road maintenance in the flood zone would be a constant and costly effort which could be restricted by permitting requirements.

Van Buren Route

There are 3 structures with liquefaction potential which could jeopardize foundation and structure integrity.

There are 9 structures (approximately one mile) within a 100 year flood hazard zones which could jeopardize foundation and structure integrity. Special foundation and structure base elevations will be required to minimize, but not eliminate, integrity of the structures.

There are 0 structures in erosion potential areas at the edge of the flood zone and 3 structures in erosion potential areas in the flood zone. This situation could jeopardize foundation and structure integrity.

There are 3 structures in medium or high slope stability issues which could jeopardize foundation and structure integrity.

The access for the 9 structures in the 100 year flood zone could be limited or non-existent during flood conditions. If access was required for foundation or structure integrity, stabilization access would need to be delayed until flood conditions subsided. The concept of elevated roads above a 100 year flood condition is considered infeasible due to the following:

A. Stability of an elevated berm road would be problematic during and after a flood condition,
B. Road berms in the flood zone may divert water in an undesirable way,
C. Permitting for elevated road berms would be very complex,
D. Maintenance personnel and equipment would not be able to use the roads during flood conditions due to personal safety concerns.

Overall the Van Buren route places 9 structures in flood zone location conditions that could jeopardize the foundation and structure integrity of the double circuit 230 kV transmission line. Also, there are 3 structures with erosion and 3 structures with slope stability potential. Maintenance access could be non existent for up to 9 structures during flood conditions. Elevated roads in the flood zone are not considered feasible. Road maintenance in the flood zone would be a constant and costly effort which could be restricted by permitting requirements.

Route Summary

Based on this preliminary evaluation and the literature reviewed, it appears that from the perspective of foundation, and structure integrity, access, and long term maintenance, the Western and Van Buren Alignment alternatives both are clearly more favorable than the Eastern Alignment Alternative.

15.0 REFERENCES

1 Dibblee, T. W.; 2004; Geologic Map of the San Bernardino North/North ½ of San Bernardino South Quadrangles, San Bernardino and Riverside Counties, California; Dibblee Foundation Map DF-127.

2 Dibblee, T. W.; 2004; Geologic Map of the Riverside West/South ½ of Fontana Quadrangles, San Bernardino and Riverside Counties, California; Dibblee Foundation Map DF-128.

3 Federal Emergency Management Agency; 2008; Flood Insurance Rate Map, Riverside County, California and Incorporated Areas, Panel 682 of 3805; Map Number 06065C0682G; Effective date August 28, 2008.

4 Federal Emergency Management Agency; 2008; Flood Insurance Rate Map, Riverside County, California and Incorporated Areas, Panel 684 of 3805; Map Number 06065C0684G; Effective date August 28, 2008.

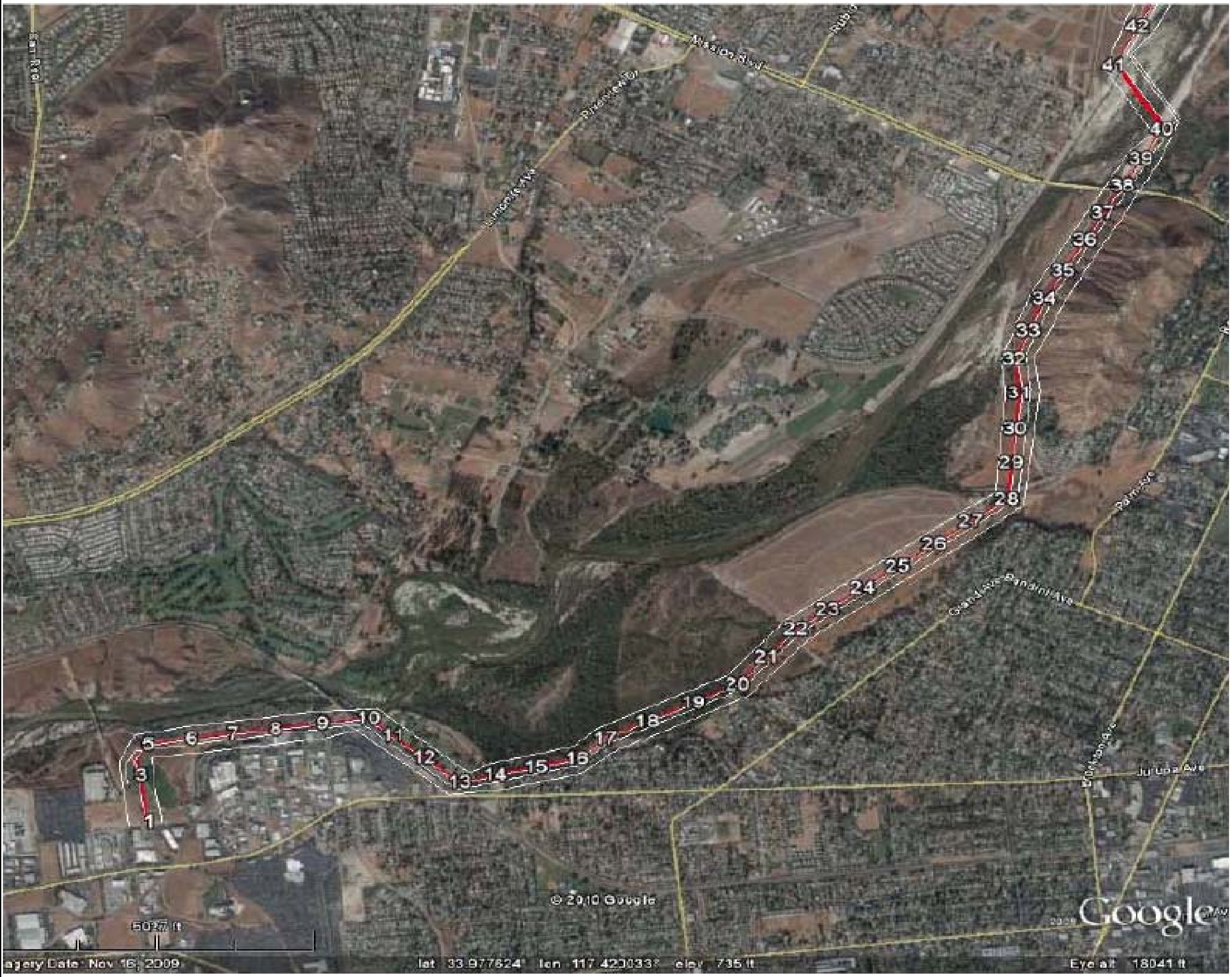
5 Federal Emergency Management Agency; 2008; Flood Insurance Rate Map, Riverside County, California and Incorporated Areas, Panel 702 of 3805; Map Number 06065C0702G; Effective date August 28, 2008.

6 Federal Emergency Management Agency; 2008; Flood Insurance Rate Map, Riverside County, California and Incorporated Areas, Panel 705 of 3805; Map Number 06065C0705G; Effective date August 28, 2008.

7 Federal Emergency Management Agency; 2008; Flood Insurance Rate Map, Riverside County, California and Incorporated Areas, Panel 706 of 3805; Map Number 06065C0706G; Effective date August 28, 2008.

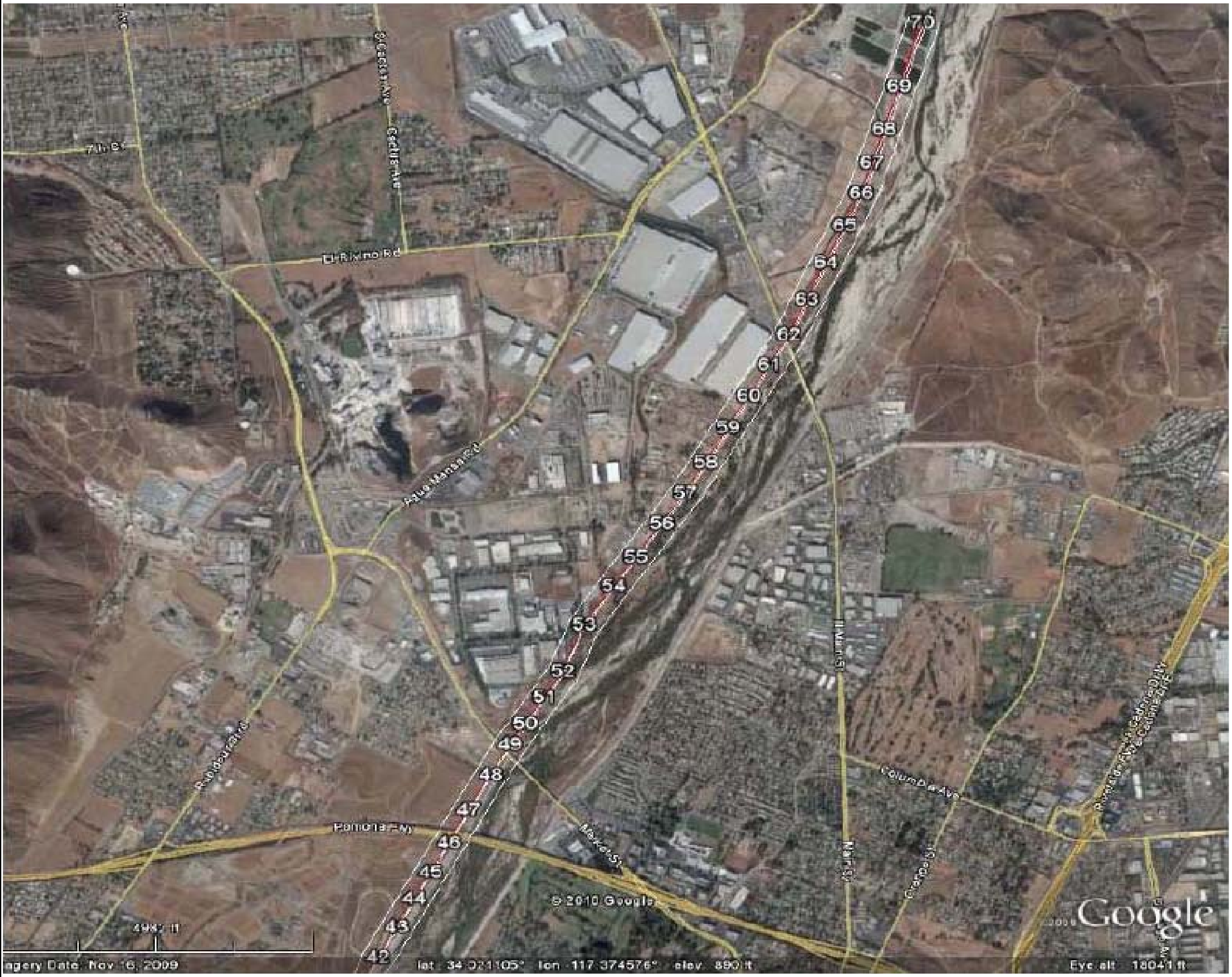
8 USGS Open File Report 2008 - 1128.

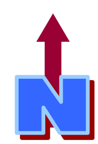
9 Riverside Geologic Atlas Map



Eastern Route Layout Map

Project Name: Riverside Transmission Reliability Project 230kV (RTRP), Eastern Route Location: Riverside County, CA	Source: Google Earth
TDBU Civil/Structural & Geotechnical Engineering Group	Figure No. **1a**



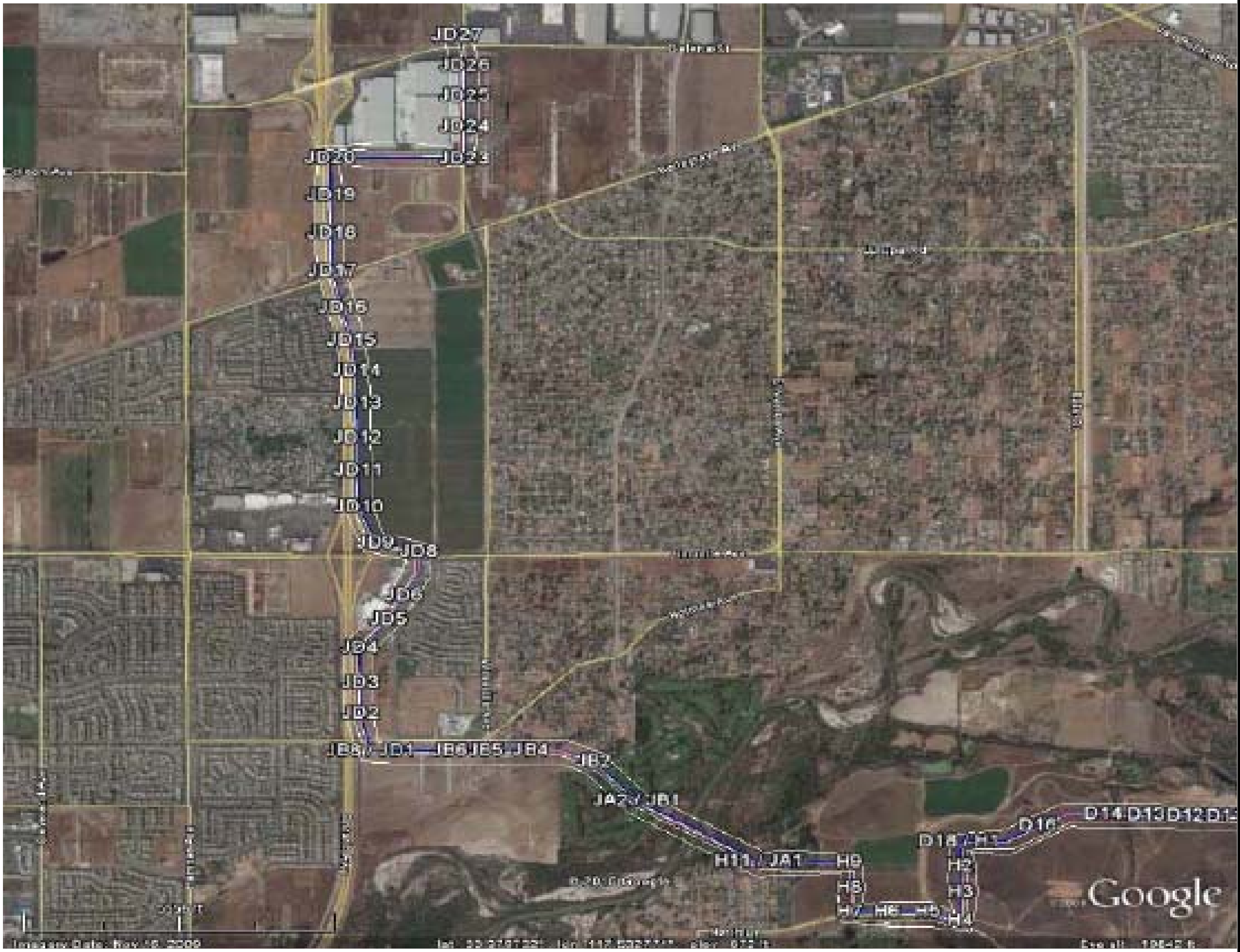


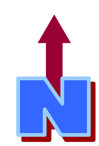
Eastern Route Layout Map

Project Name: Riverside Transmission Reliability Project 230kV (RTRP), Eastern Route Location: Riverside County, CA	Source: Google Earth
TDBU Civil/Structural & Geotechnical Engineering Group	Figure No. **1b**

Western Route Layout Map

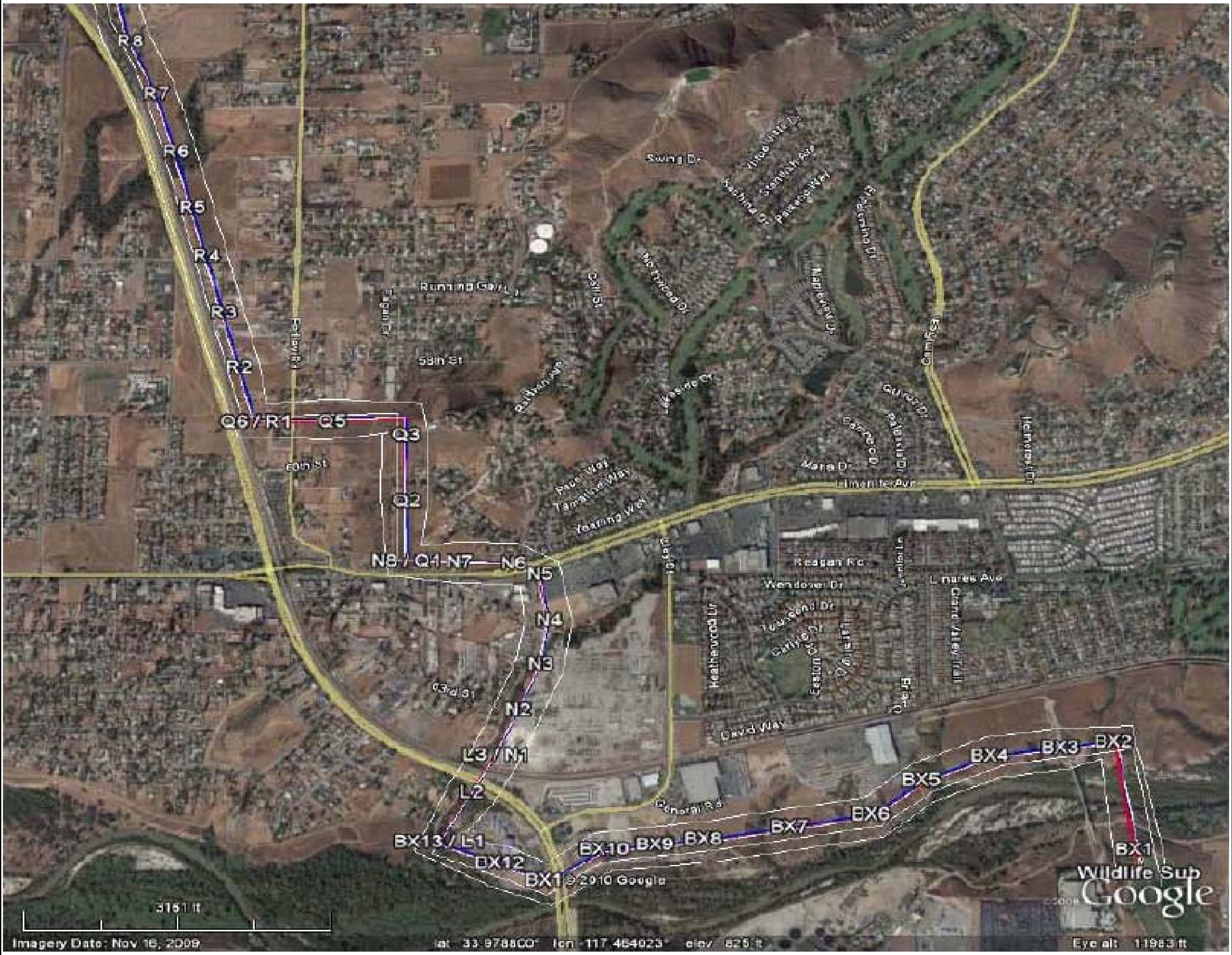
Project Name: Riverside Transmission Reliability Project 230kV (RTRP), Western Route Location: Riverside County, CA	Source: Google Earth
TDBU Civil/Structural & Geotechnical Engineering Group	Figure No. **2a**





Western Route Layout Map

Project Name: Riverside Transmission Reliability Project 230kV (RTRP), Western Route Location: Riverside County, CA	Source: Google Earth
TDBU Civil/Structural & Geotechnical Engineering Group	Figure No. **2b**

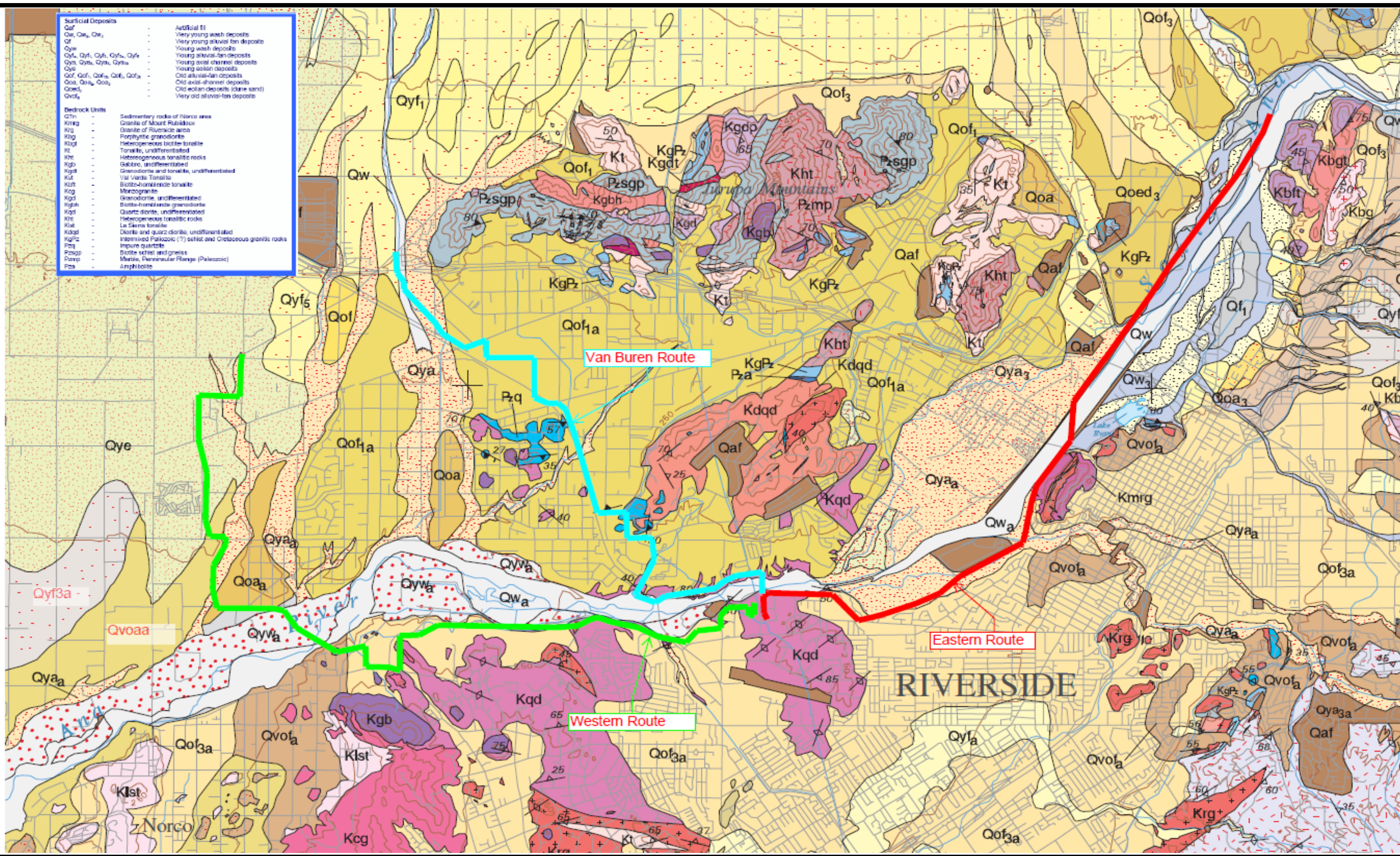


Van Buren Route Layout Map

Project Name: Riverside Transmission Reliability Project 230kV (RTRP), Van Buren Route Location: Riverside County, CA	Source: Google Earth
TDBU Civil/Structural & Geotechnical Engineering Group	Figure No. **3a**

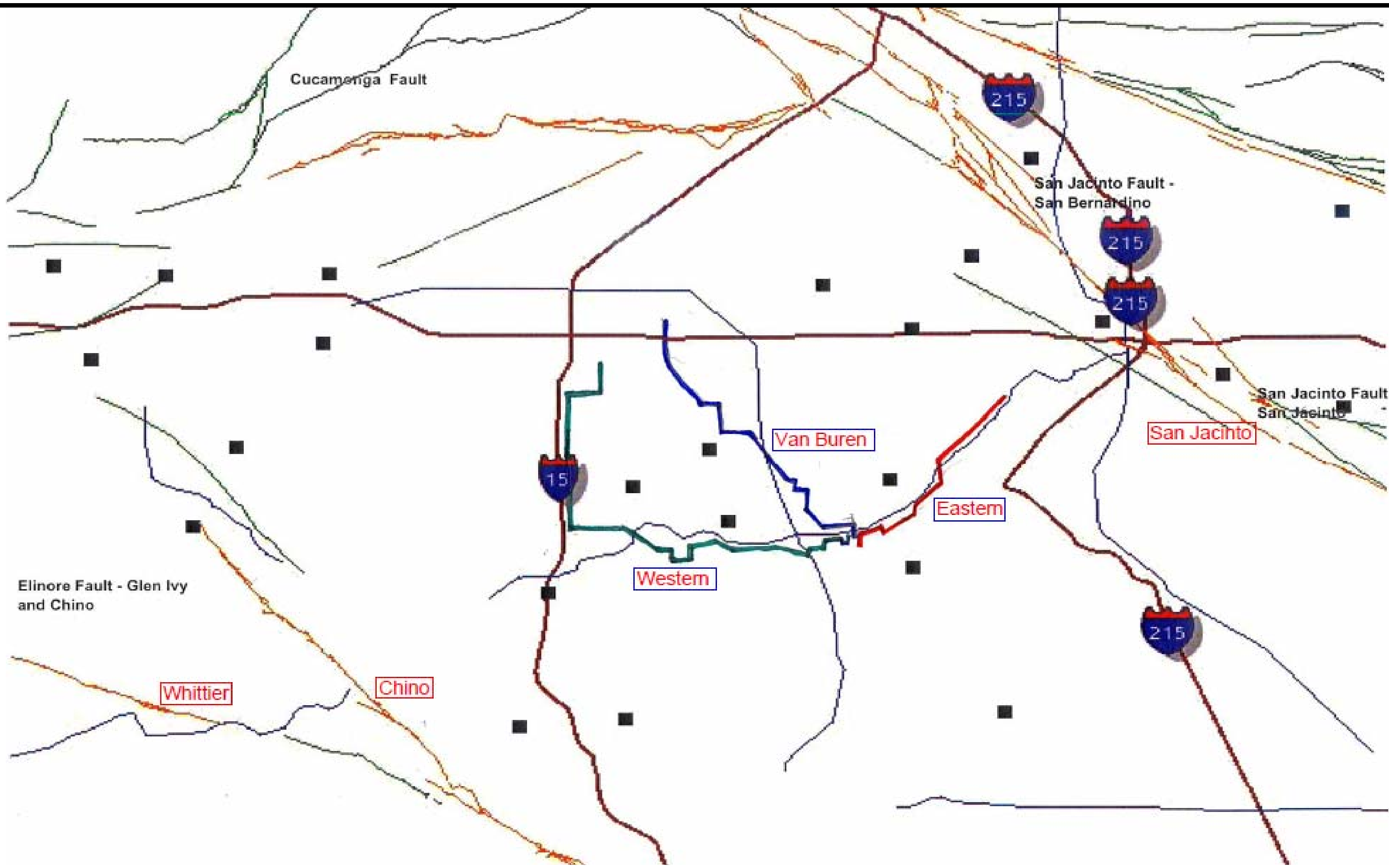
Van Buren Route Layout Map

Project Name: Riverside Transmission Reliability Project 230kV (RTRP), Van Buren Route Location: Riverside County, CA	Source: Google Earth
TDBU Civil/Structural & Geotechnical Engineering Group	Figure No. **3b**



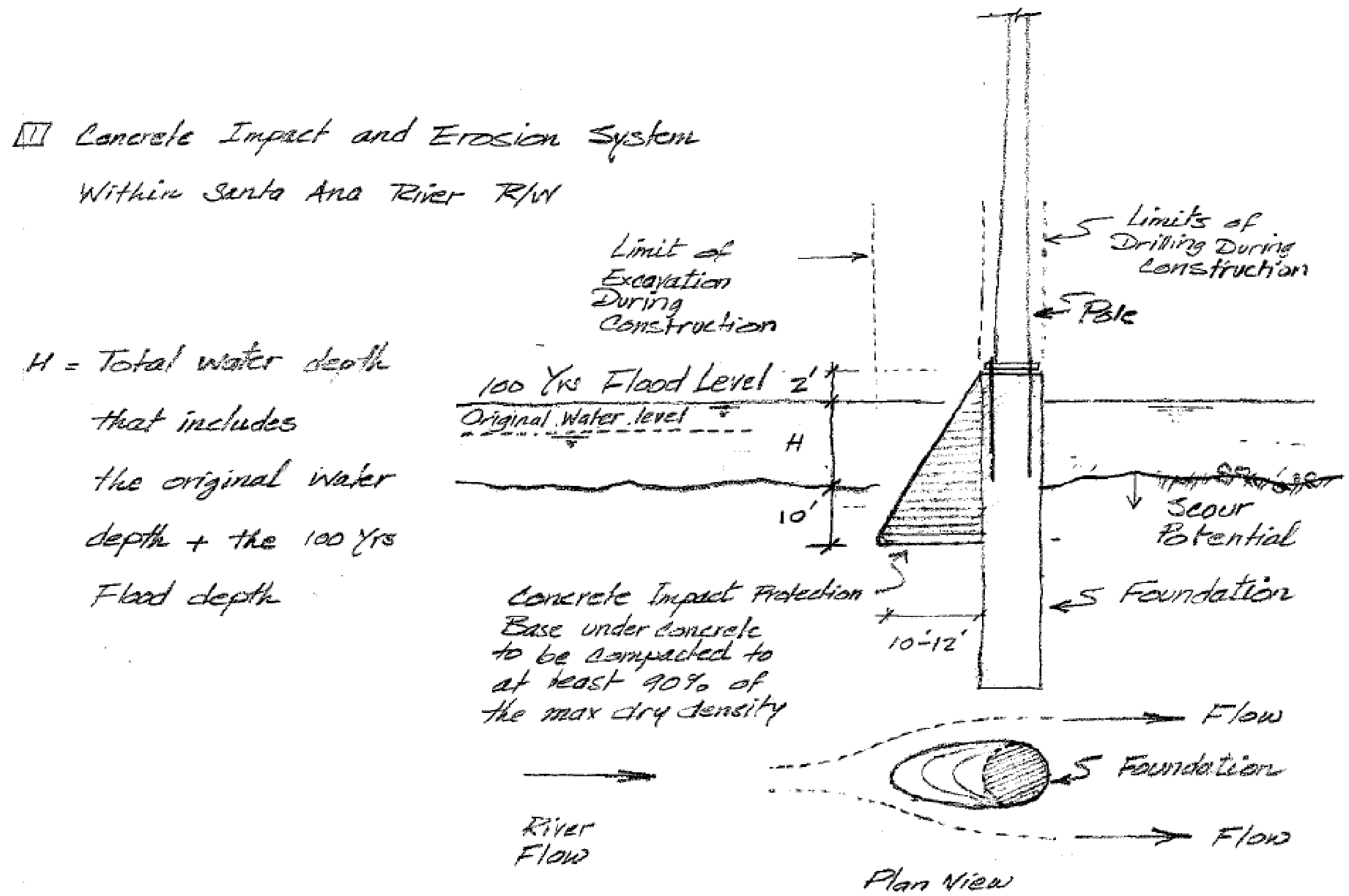
Regional Geologic Map With Proposed Eastern, Western and Van Buren Routes

Project Name: Riverside Transmission Reliability Project (RTRP) Location: Riverside County, CA	Source:
TDBU Civil/Structural & Geotechnical Engineering Group	Figure No. **4**



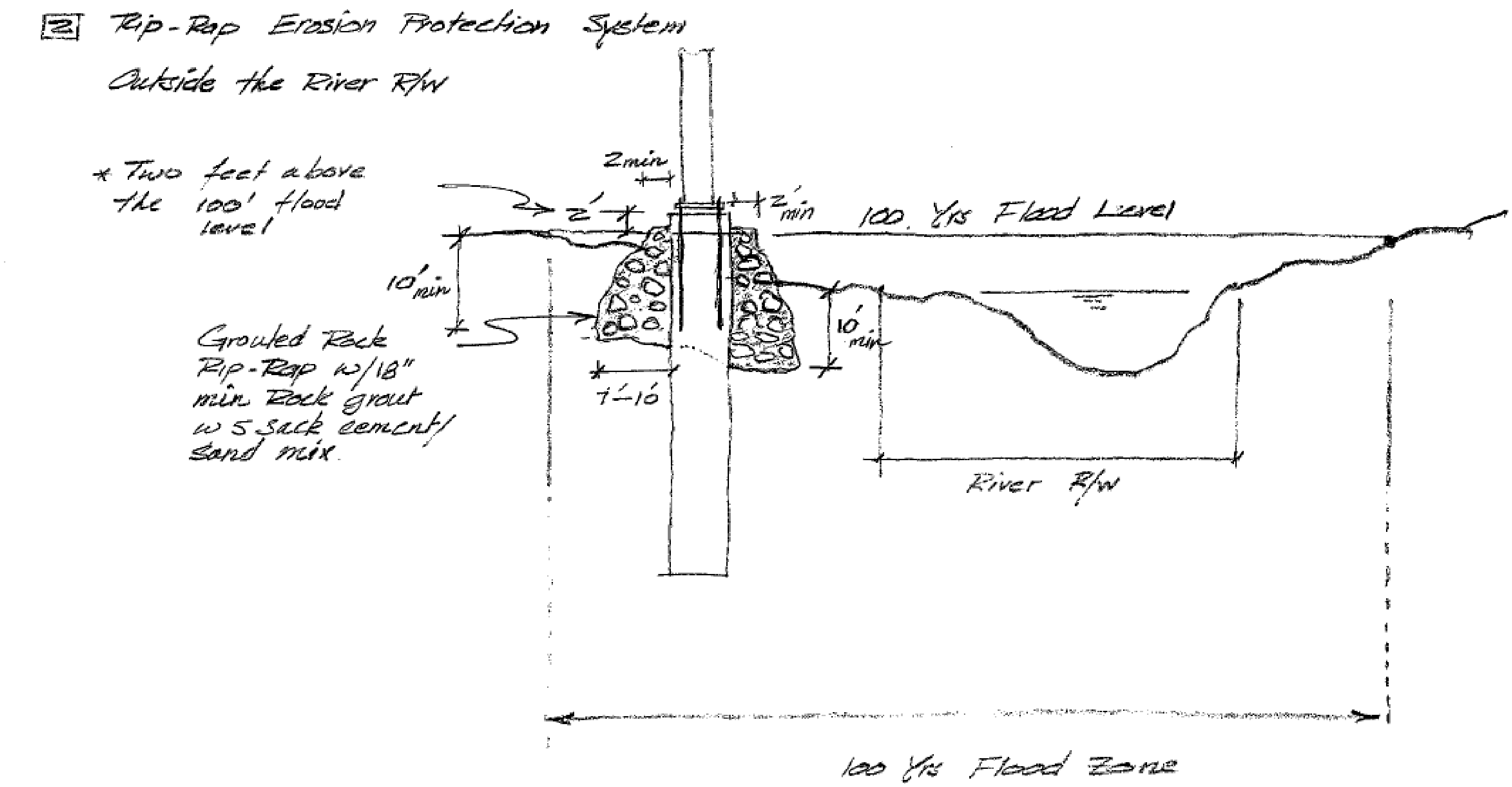
Faulting & Local Seismicity Map

Project Name: Riverside Transmission Reliability Project (RTRP) Location: Riverside County, CA	Source: SCE
TDBU Civil/Structural & Geotechnical Engineering Group	Figure No. **5**



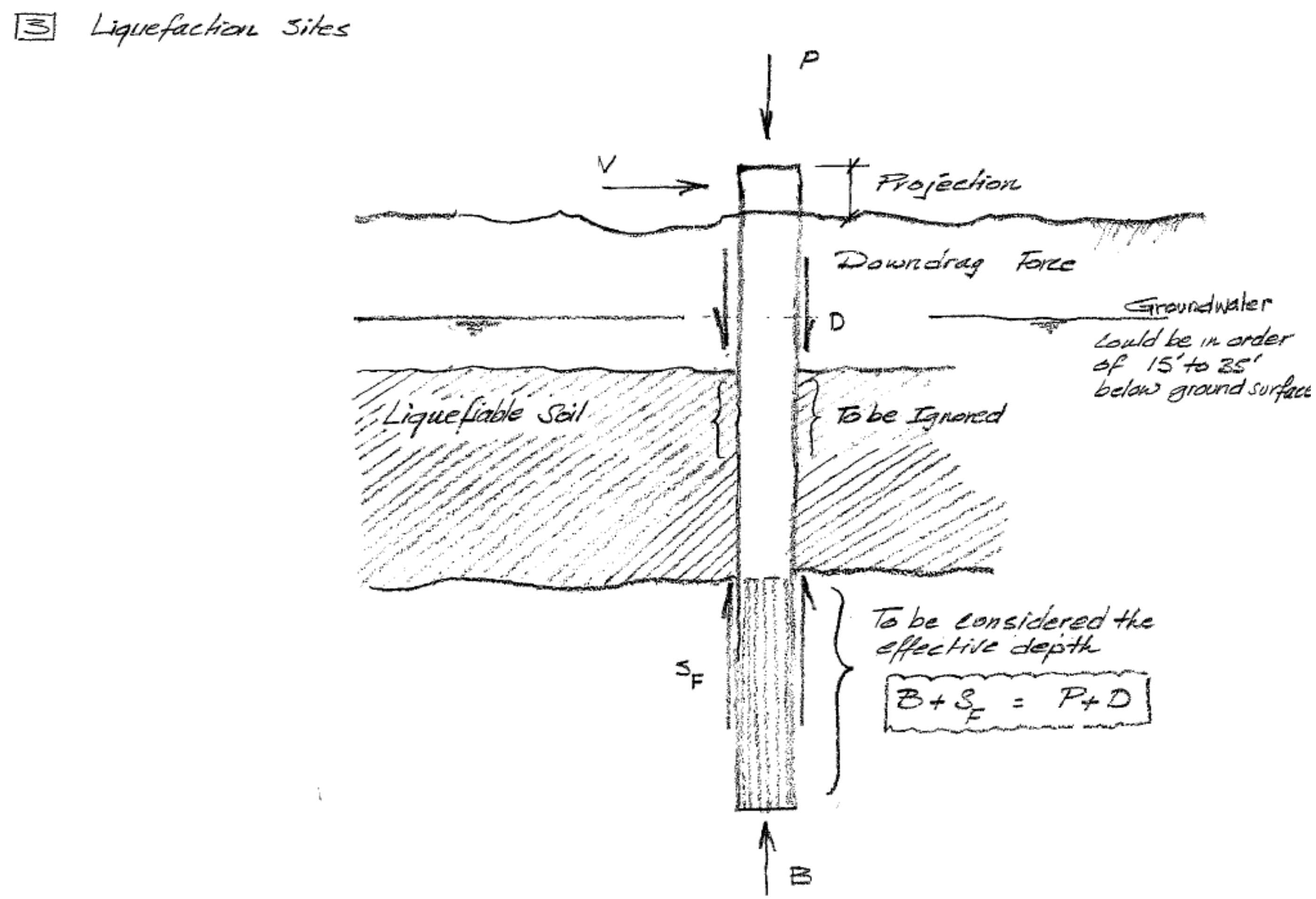
Concrete Impact and Erosion System Within Santa Ana River R/W

Project Name: Riverside Transmission Reliability Project (RTRP) Location: Riverside County, CA	Source: SCE drawing
TDBU Civil/Structural & Geotechnical Engineering Group	Figure No. **6**



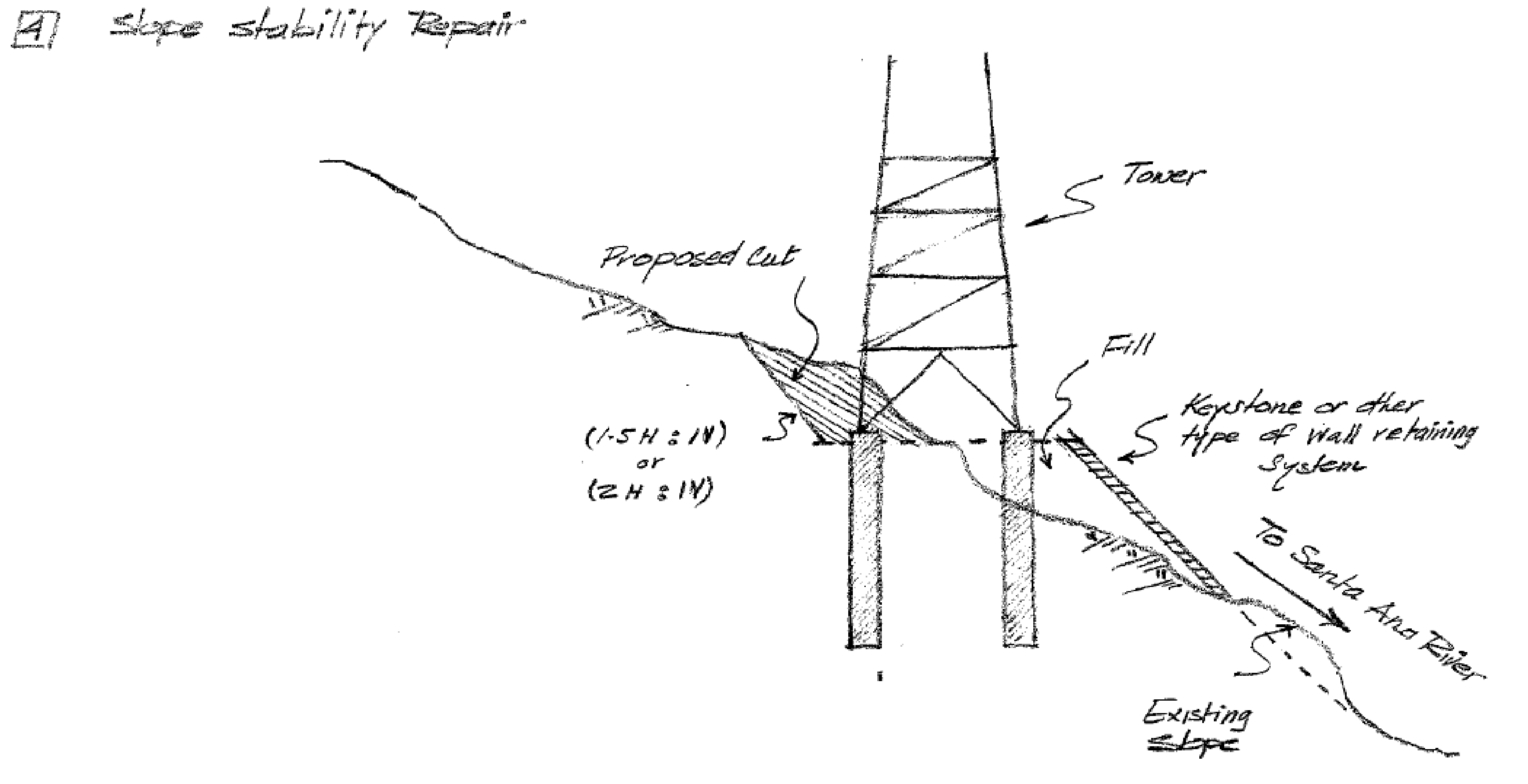
Rip-Rap Erosion Potection System

Project Name: Riverside Transmission Reliability Project (RTRP) Location: Riverside County, CA	Source: SCE drawing
TDBU Civil/Structural & Geotechnical Engineering Group	Figure No. **7**



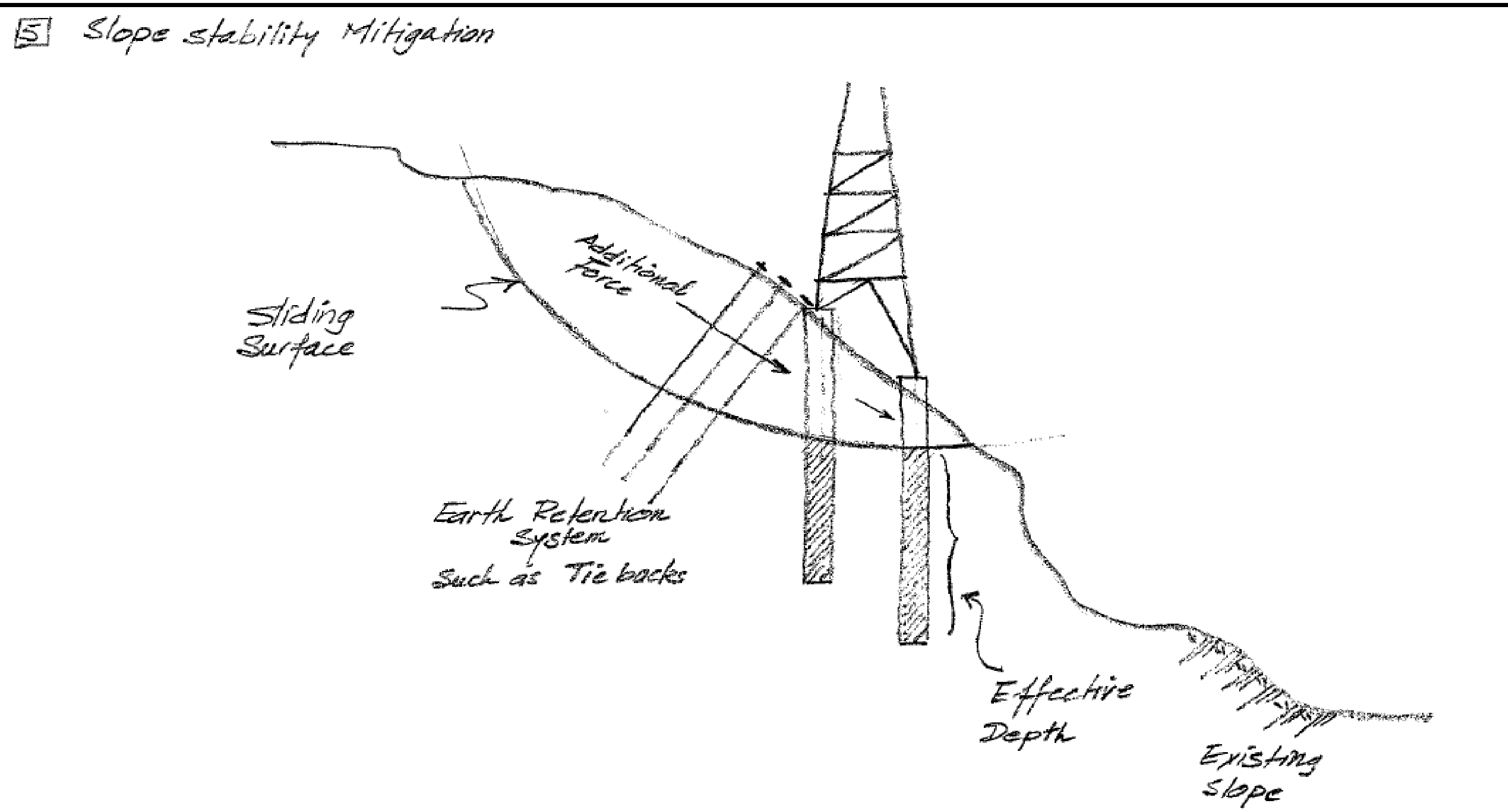
Liquefaction Sites

Project Name: Riverside Transmission Reliability Project (RTRP) Location: Riverside County, CA	Source: SCE drawing
TDBU Civil/Structural & Geotechnical Engineering Group	Figure No. **8**



Slope Stability Repair

Project Name: Riverside Transmission Reliability Project (RTRP) Location: Riverside County, CA	Source: SCE drawing
TDBU Civil/Structural & Geotechnical Engineering Group	Figure No. **9**

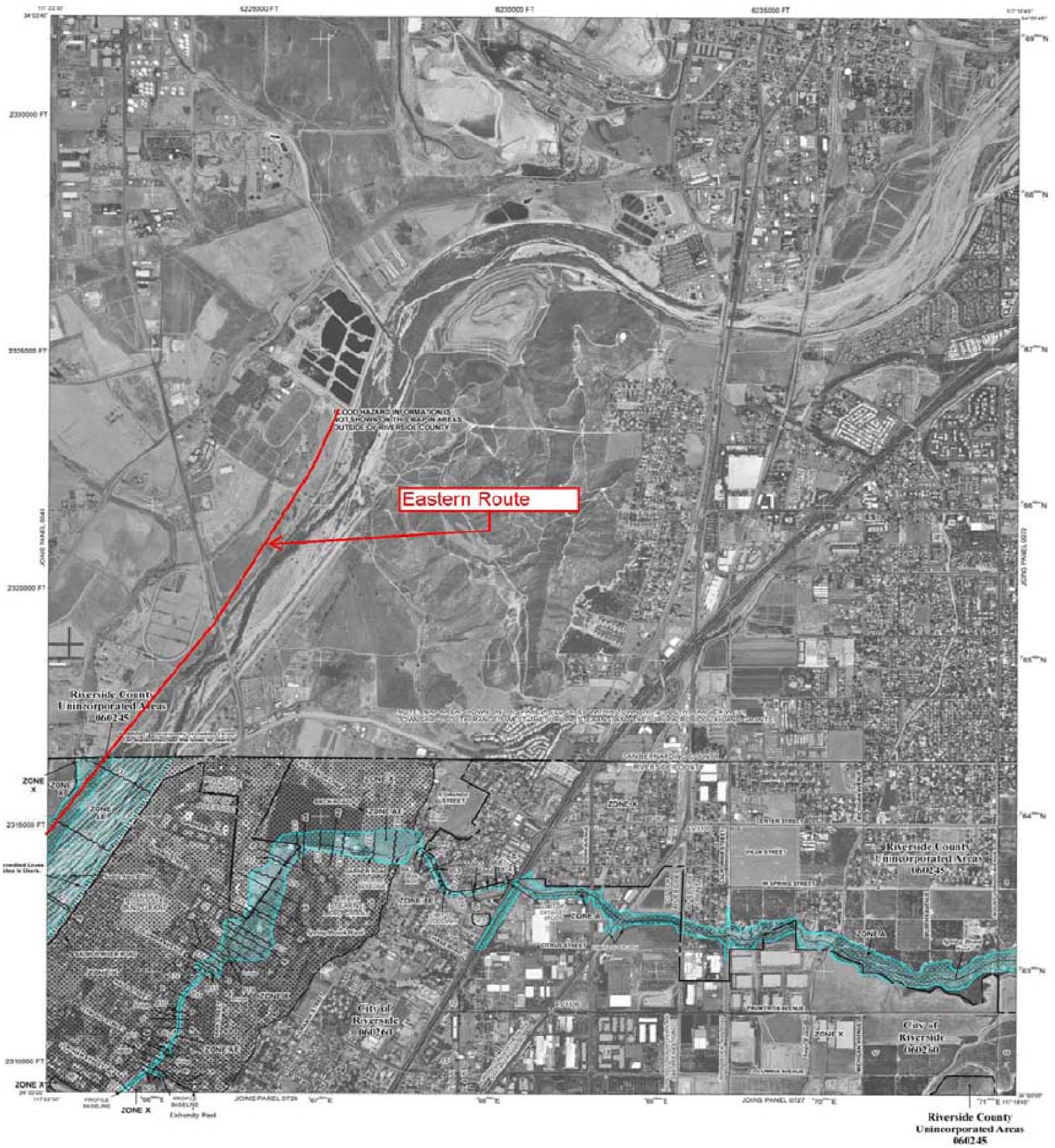


Slope Stability Mitigation

Project Name: Riverside Transmission Reliability Project (RTRP) Location: Riverside County, CA	Source: SCE drawing
TDBU Civil/Structural & Geotechnical Engineering Group	Figure No. **10**

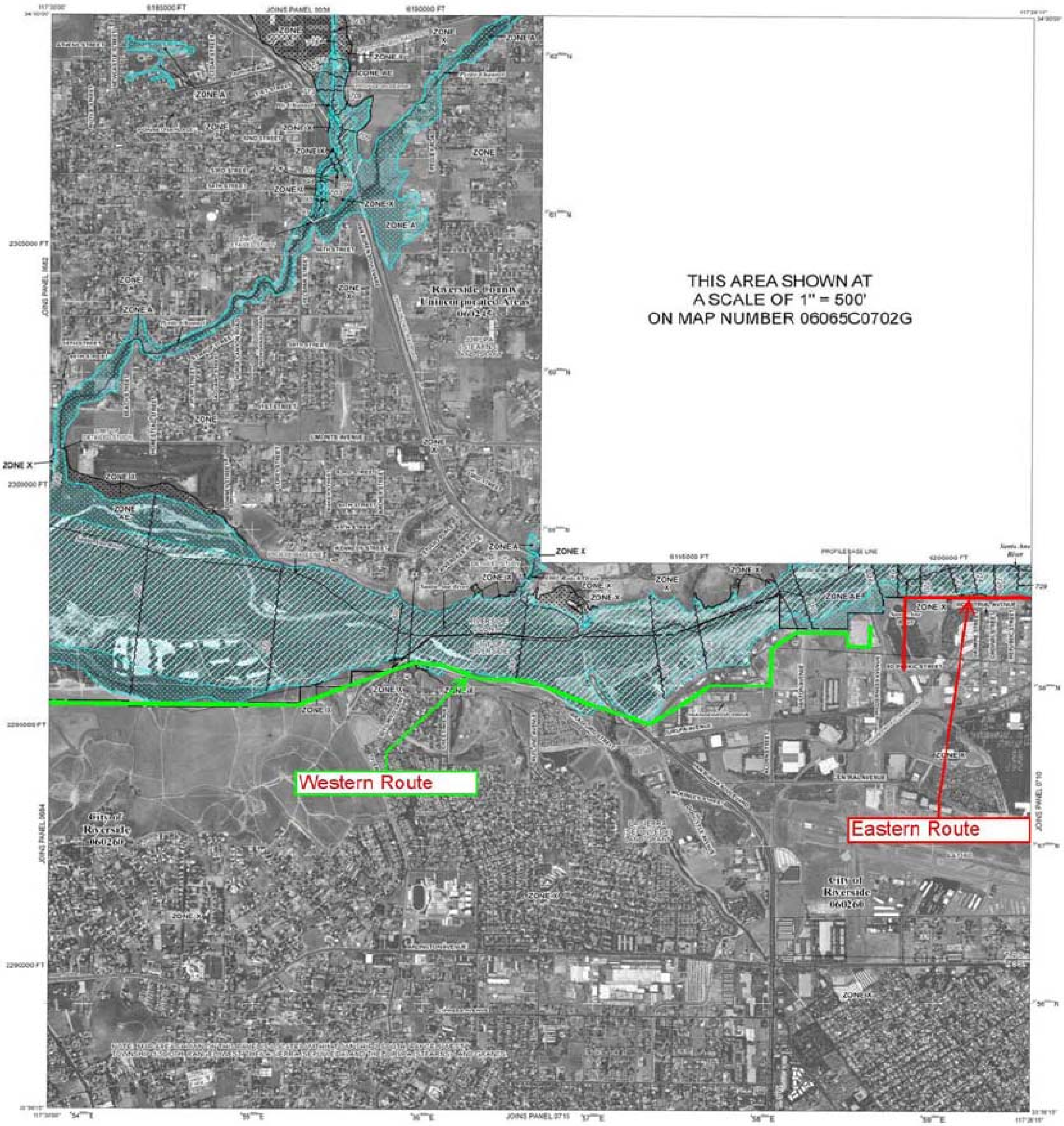
FEMA Map Eastern Route

Project Name: Riverside Transmission Reliability Project 230kV (RTRP) Location: Riverside County, CA	Source: FEMA
TDBU Civil/Structural & Geotechnical Engineering Group	Figure No. **11**



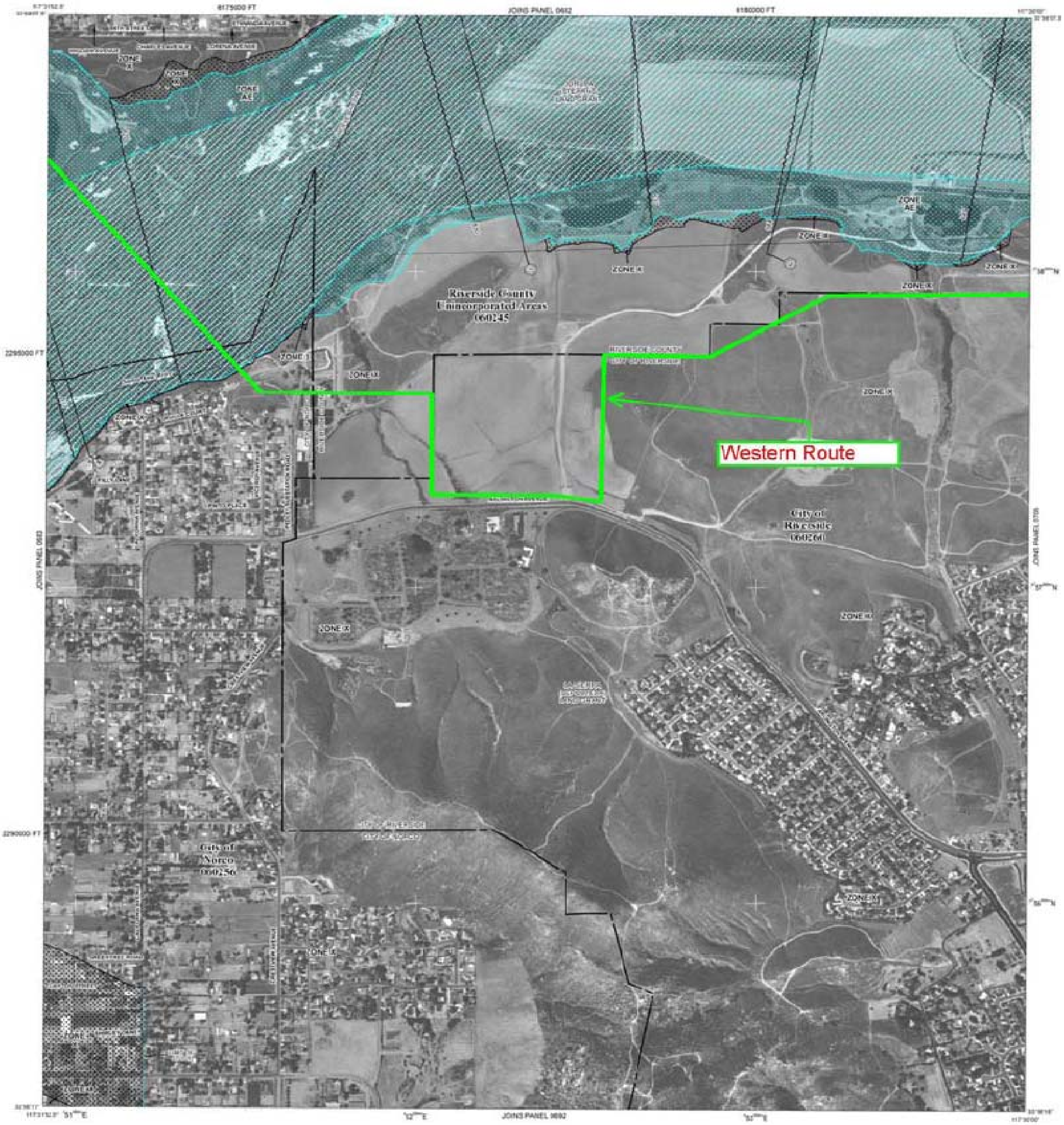
FEMA Map Eastern Route

Project Name: Riverside Transmission Reliability Project 230kV (RTRP) Location: Riverside County, CA	Source: FEMA
TDBU Civil/Structural & Geotechnical Engineering Group	Figure No. **12**



FEMA Map Eastern and Western Route

Project Name: Riverside Transmission Reliability Project 230kV (RTRP) Location: Riverside County, CA	Source: FEMA
TDBU Civil/Structural & Geotechnical Engineering Group	Figure No. **13**



FEMA Map Western Route

Project Name: Riverside Transmission Reliability Project 230kV (RTRP) Location: Riverside County, CA	Source: FEMA
TDBU Civil/Structural & Geotechnical Engineering Group	Figure No. **14**

Banning

Banning

Erosion

Project Name: Riverside Transmission Reliability Project 230kV (RTRP) Location: Riverside County, CA	Source: SCE
TDBU Civil/Structural & Geotechnical Engineering Group	Figure No. **15**

TSP M9-P5
Borrego-Chiquita 66kV T/L

TSP M9-P5
Borrego-Chiquita 66kV T/L

Erosion

Project Name: Riverside Transmission Reliability Project 230kV (RTRP) Location: Riverside County, CA	Source: SCE
TDBU Civil/Structural & Geotechnical Engineering Group	Figure No. **16**

M8-P6 Borrego-Chiquita T/L

M8-P6 Borrego-Chiquita T/L

Erosion

Project Name: Riverside Transmission Reliability Project 230kV (RTRP) Location: Riverside County, CA	Source: SCE
TDBU Civil/Structural & Geotechnical Engineering Group	Figure No. **17**

Erosion Repair

Project Name: Riverside Transmission Reliability Project 230kV (RTRP) Location: Riverside County, CA	Source: SCE
TDBU Civil/Structural & Geotechnical Engineering Group	Figure No. **18**

Midway-Vincent 500KV T/L M76-T1
Rotational Slide

Pardee-Pastoria M196-T4

Slope Instability	
Project Name: Riverside Transmission Reliability Project 230kV (RTRP) Location: Riverside County, CA	Source: SCE
TDBU Civil/Structural & Geotechnical Engineering Group	Figure No. **19**

Moorpark-Pardee 220 kV

Moorpark-Pardee 220 kV

Slope Instability

Project Name: Riverside Transmission Reliability Project 230kV (RTRP) Location: Riverside County, CA	Source: SCE
TDBU Civil/Structural & Geotechnical Engineering Group	Figure No. **20**

Photo 1

Photo 2

Photo 3

Photo 4

Photo 5

Photo 6

Photo 7

Photo 8

Photo 9

Photo 10

Photo 11

Photo 12

Photo 13

Photo 14

Photo 15

Photo 16

Photo 17

Photo 18

Photo 19

Photo 20

Photo 21

Photo 22

Photo 23

Photo 24

Photo 25

Photo 26

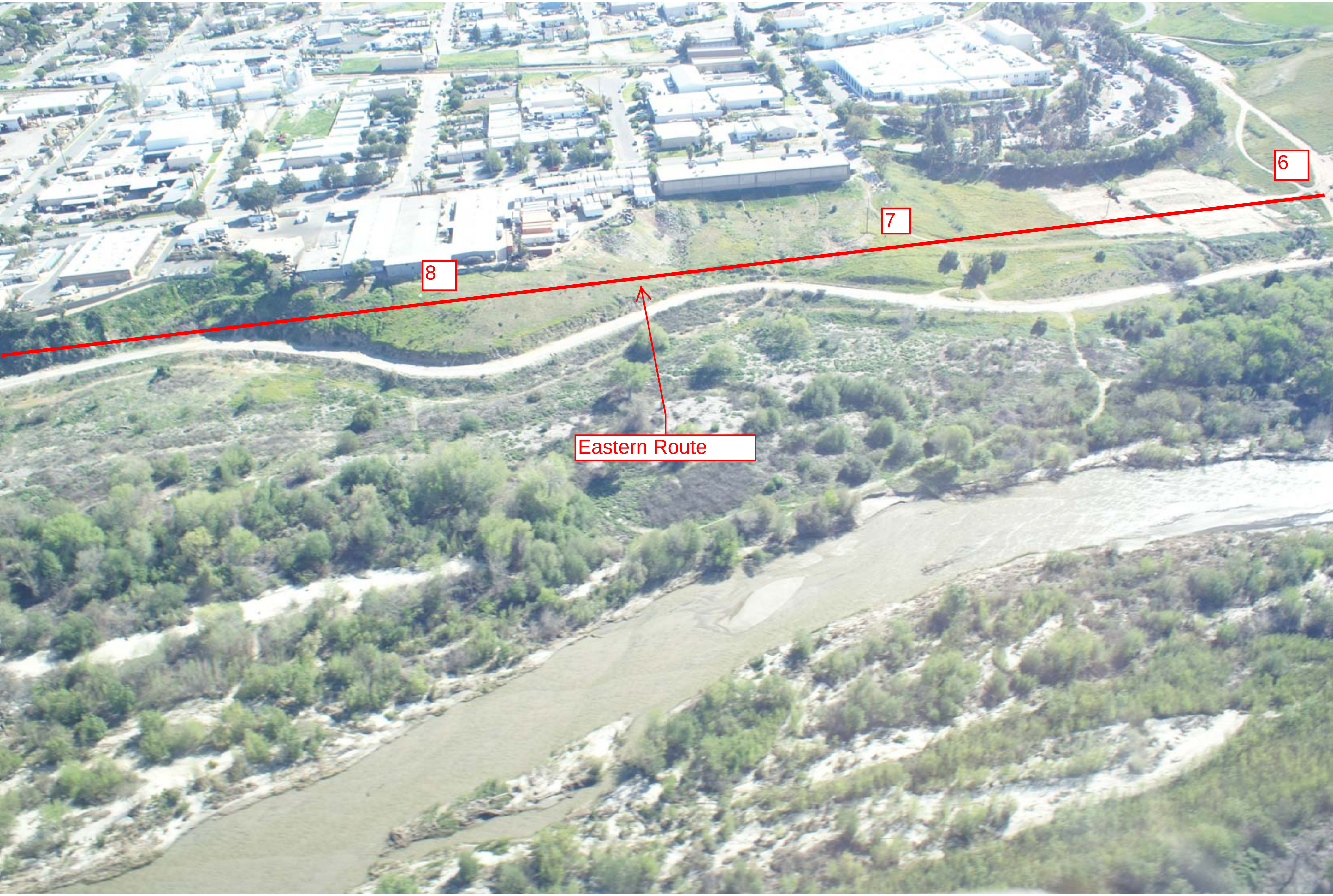


Photo 27

Photo 28

Photo 29

Photo 30


1
2
3
4
5
AX1
AX2
AX3
AX4
AX5
BX1
Wildlife Sub
Western Route
Eastern Route
Van Buren Route
Photo 31


1
2
AX2
AX3
3
AX4
AX5
AX1
4
BX1
Western Route
5
Wildlife Sub
Eastern Route
Van Buren Route

Photo 32

Photo 33

Photo 34

Photo 35

Photo 36

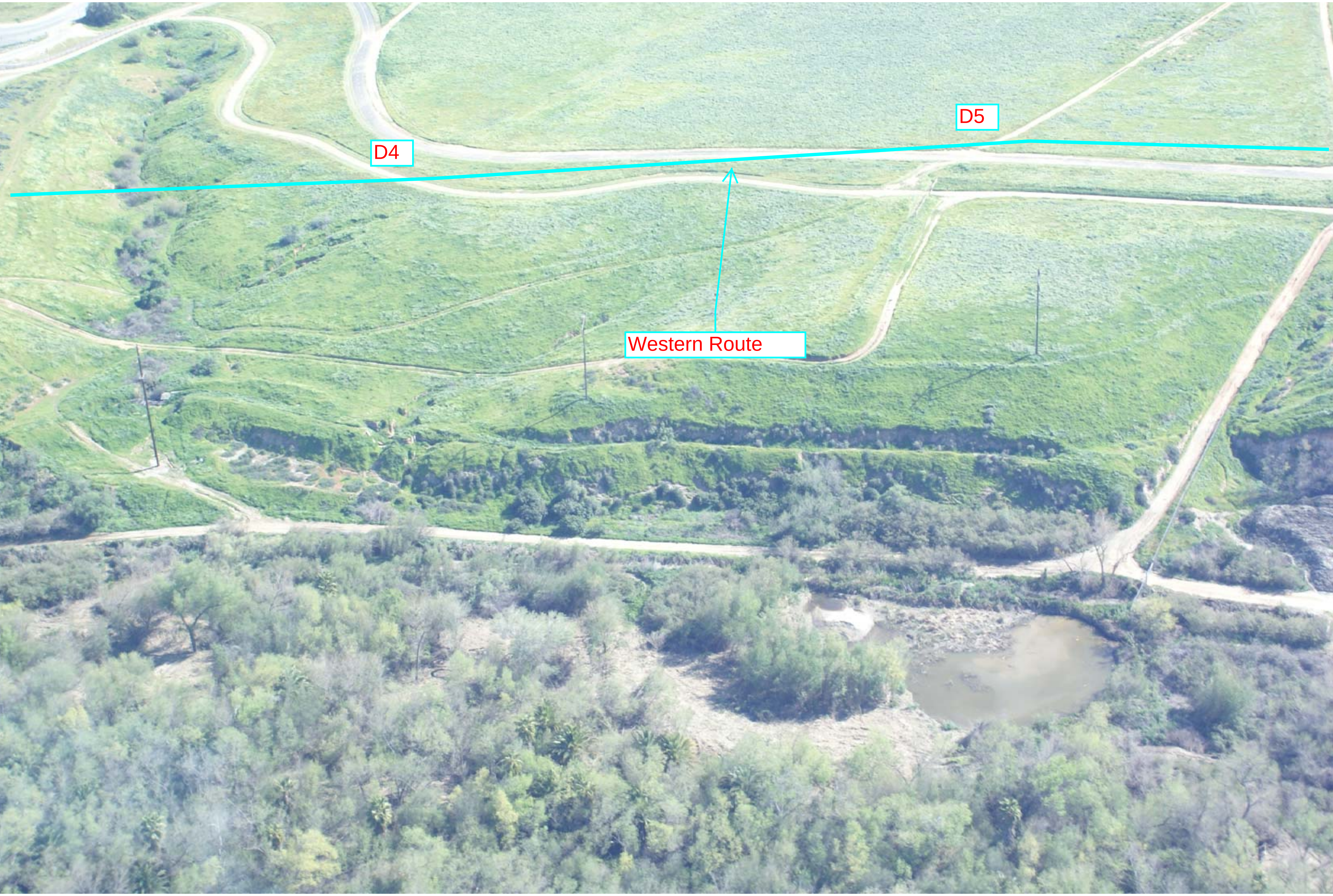


Photo 37

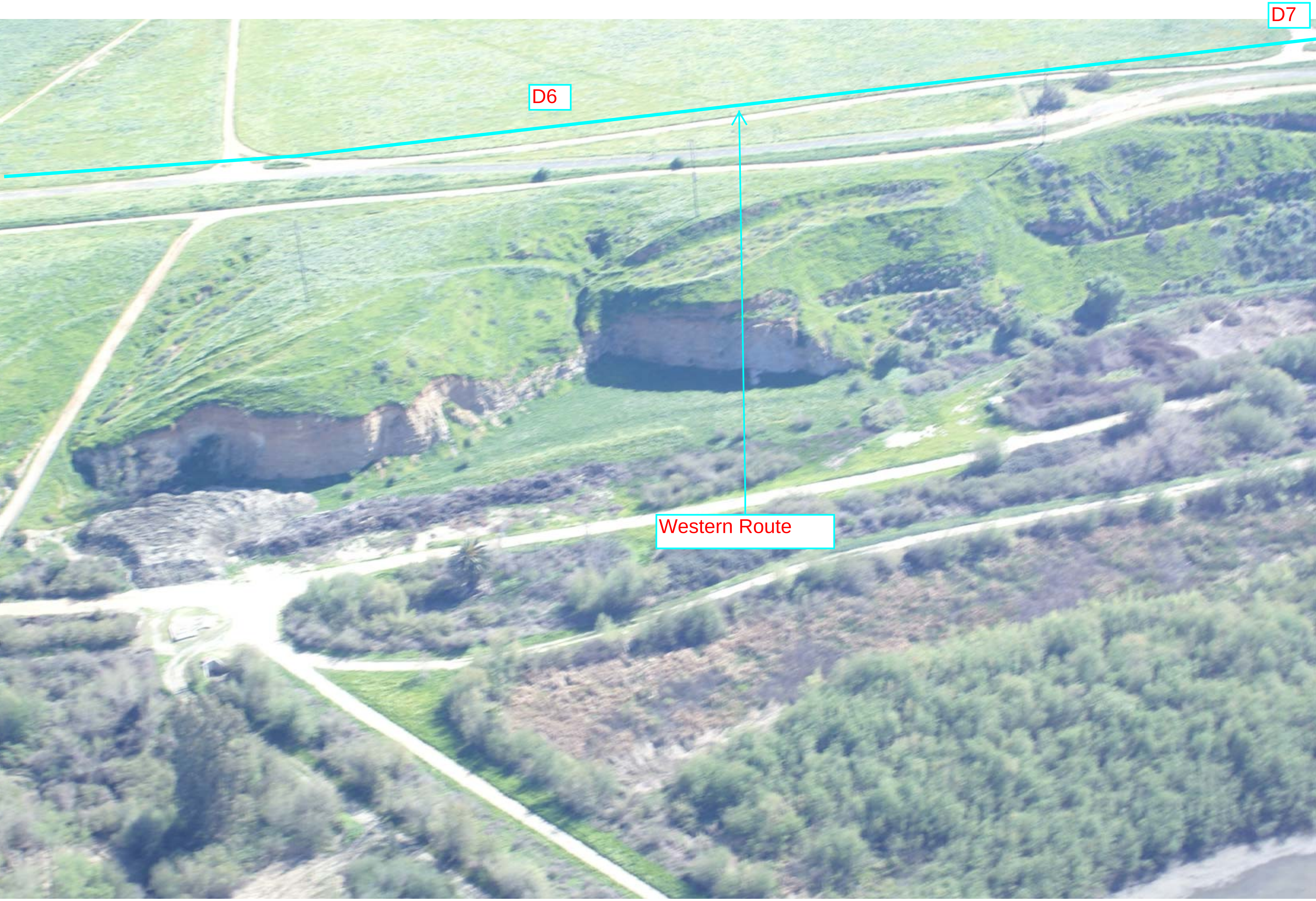


Photo 38

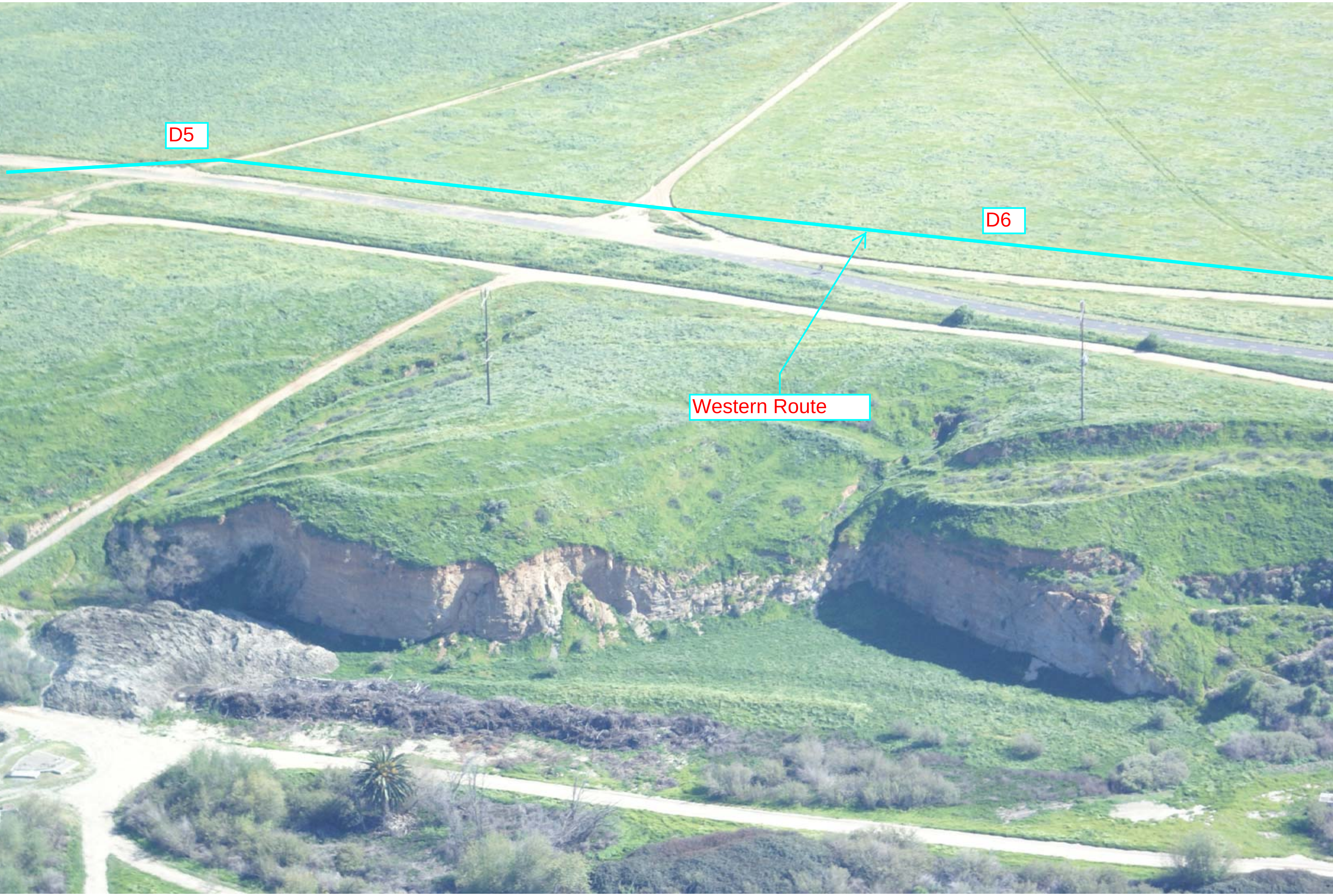


Photo 39

Photo 40

Photo 41

Photo 42

Photo 43

Photo 44

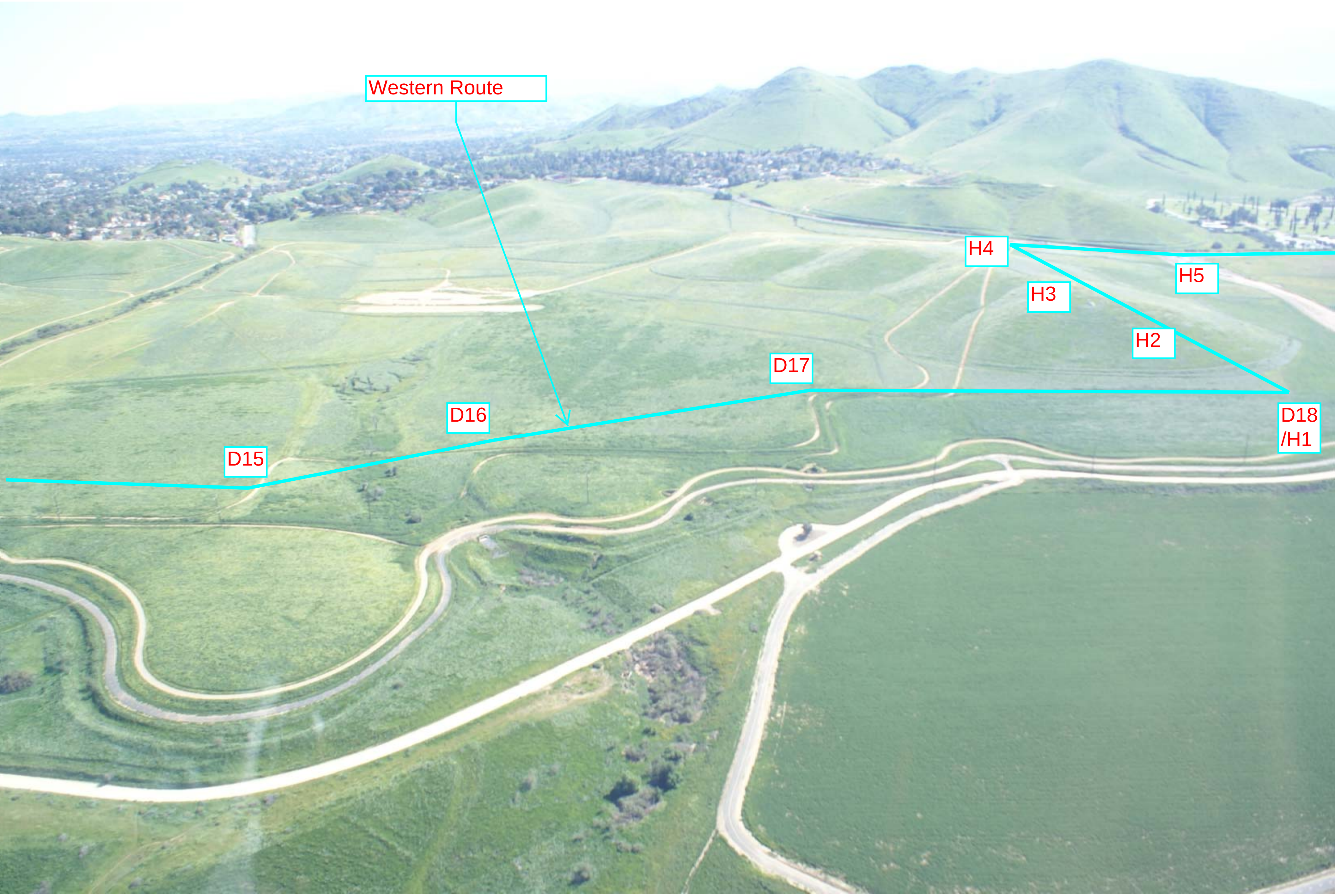


Photo 45

Photo 46

Photo 47

Photo 48

Photo 49

Photo 50

Photo 51

Photo 52

Photo 53

Photo 54


JB6
JB7
JB8/
JD1
JD2
JD3
JD4
JD5
JD6
JD7
JD8
JD9
JD10
Western Route

Photo 55

Photo 56

May 17, 2010

Subject: **Addendum to the Preliminary Geology and Geotechnical Evaluation Report**
Riverside Transmission Reliability Project (RTRP)

Reference: **Preliminary Geology and Geotechnical Evaluation Report**
Riverside Transmission Reliability Project (RTRP)
Double Circuit 230kV T/L
Eastern, Western and Van Buren Suggested Routes
Mira Loma - Vista #1 230kV to Wildlife Substation
Riverside County, California.
Dated April 2, 2010

Project No. 10-037

This addendum was prepared to summarize the findings provided in the reference report. A master table that includes the outcome of the evaluation is included in this addendum. The referenced report only included towers that are located in and or within Santa Ana River and its premises. The attached table includes all the towers included in each route to provide a more comprehensive comparison.

The route evaluation is only based on a desktop study as no subsurface exploration has been conducted. The route description is provided in section 2 of the reference report. The number of impacted towers is approximate and is used as a guidance to provide data to select the appropriate route from the licensing, construction and maintenance standpoint. The assessment only considers four critical geotechnical and geology concerns that are common to occur within this geological formation as addressed in sections 3, 4 and 5 of the referenced report. These four concerns are Liquefaction, Flood potential, Erosion and Slope instability impact (refer to sections 6, 7, 8 and 9 for more details.)

The attached master table indicates that approximately 23 out of 70 towers are unaffected in the Eastern route (33%). The Western and Van Buren include 65 out of 82 (79%) and 49 out of 60 (82%) respectively. Some of the impacted towers have single impact others have dual or triple impact. For instance, the 57 impacted towers in the eastern include 8 single, 12 dual and 27 triple impacts. On the other hand, there are 24 towers impacted by liquefaction. Also there are 40, 43 and 6 towers impacted by flood, erosion and slope instability respectively. The master table includes details regarding the impacted towers in the Western and Van Buren routes.

The liquefaction impact is categorized into four categories - Not Applicable, Low, Evaluate and Graded. We only considered the category Evaluate as the impacted towers for liquefaction potential. The other geology/geotechnical impact considered only the 100 year flood zone category and medium & high ratings in case of erosion and slope instability.

The construction, Access Roads and Foundation Top Elevation within the 100 year flood zone concerns are discussed in sections 11, 12, and 13. Proposed structure locations were assessed in terms of difficulty of construction, maintaining access routes and level pads appropriate to accommodate vehicles/trucks normally anticipated to be needed during construction. Access roads are required for maintenance purposes and emergency situations over the lifetime of the structures. The available options were addressed. Several structures will either be located in the riverbed or adjacent to the riverbed with unprotected banks and within the 100 year flood zone. The master table provides the same tables that were included in the referenced report but updated to address all the towers in the entire alignment not just the riverbed.

A “100 year flood event” measure was used as one of the basis of the data impacts. Some if not all of these impacts could be of concern at lower flood return periods.

Eastern		Geotechnical Conditions				Impact per Tower			
	Str. #/Str. Name	*Liquefaction*	*100 Year Flood Zone*	*Erosion*	*Slope Instability*	Single	Dual	Triple	Unaffected
Total Structures		70				8	12	27	23
	Total	24	40	43	6				
	Percentage	34%	57%	61%	9%				
Total unaffected									33%
	1								1
	2								1
	3								1
	4								1
	5								1
	6			Y		1			
	7			Y		1			
	8								1
	9				Y	1			
	10			Y	Y		1		
	11								1
	12								1
	13								1
	14			Y		1			
	15		Y	Y			1		
	16		Y	Y			1		
	17		Y	Y			1		
	18	Y	Y	Y				1	
	19	Y	Y	Y				1	
	20	Y	Y	Y				1	
	21	Y	Y	Y				1	
	22	Y	Y	Y				1	
	23	Y	Y	Y				1	
	24	Y	Y	Y				1	
	25	Y	Y	Y				1	
	26	Y	Y	Y				1	
	27	Y	Y	Y				1	
	28	Y	Y	Y				1	
	29	Y	Y	Y				1	
	30			Y		1			
	31								1
	32		Y	Y			1		
	33								1
	34								1
	35		Y			1			
	36								1
	37								1
	38								1
	39								1
	40								1
	41		Y			1			
	42		Y			1			
	43								1
	44								1
	45								1
	46								1
	47								1
	48								1
	49		Y	Y			1		
	50		Y	Y			1		

Western		Geotechnical Conditions				Impact per Tower			
Str. #	Str. Name	*Liquefaction*	*100 Year Flood Zone*	*Erosion*	*Slope Instability*	Single	Dual	Triple	Unaffected
Total Structures		82				4	12	1	65
	Total	0	5	13	13				
	Percentage	0%	6%	16%	16%				
Total unaffected									79%
1	AX1								1
2	AX2								1
3	AX3								1
4	AX4								1
5	AX5								1
6	AX6								1
7	AX7								1
8	AX8								1
9	AX9								1
10	AX10								1
11	AX11								1
12	AX12								1
13	AX13								1
14	AX14			Y	Y		1		
15	AX15		Y	Y	Y			1	
16	AX16			Y	Y		1		
17	AX17			Y	Y		1		
18	AX18			Y	Y		1		
19	AX19			Y	Y		1		
20	AX20			Y	Y		1		
21	AX21/D1			Y	Y		1		
22	D2								1
23	D3								1
24	D4								1
25	D5								1
26	D6			Y	Y		1		
27	D7			Y	Y		1		
28	D8			Y	Y		1		
29	D9			Y	Y		1		
30	D10			Y	Y		1		
31	D11								1
32	D12								1
33	D13								1
34	D14								1
35	D15								1
36	D16								1
37	D17								1
38	D18/H1								1
39	H2								1
40	H3								1
41	H4								1
42	H5								1
43	H6								1
44	H7								1
45	H8								1
46	H9								1
47	H10								1
48	H11/JA1								1
49	JA2/JB1		Y			1			
50	JB2		Y			1			

Van Buren		Geotechnical Conditions				Impact per Tower			
Str #	Str. Name	*Liquefaction*	*100 Year Flood Zone*	*Erosion*	*Slope Instability*	Single	Dual	Triple	Unaffected
Total Structures		60				5	5	1	49
	Total	3	9	3	3				
	Percentage	5%	15%	5%	5%				
Total unaffected									82%
1	BX1		Y			1			
2	BX2								1
3	BX3		Y			1			
4	BX4		Y			1			
5	BX5		Y			1			
6	BX6								1
7	BX7		Y			1			
8	BX8		Y		Y		1		
9	BX9		Y		Y		1		
10	BX10		Y		Y		1		
11	BX11	Y		Y			1		
12	BX12	Y		Y			1		
13	BX13/L1	Y	Y	Y				1	
14	L2								1
15	L3/N1								1
16	N2								1
17	N3								1
18	N4								1
19	N5								1
20	N6								1
21	N7								1
22	N8/Q1								1
23	Q2								1
24	Q3								1
25	Q4								1
26	Q5								1
27	Q6/R1								1
28	R2								1
29	R3								1
30	R4								1
31	R5								1
32	R6								1
33	R7								1
34	R8								1
35	R9								1
36	R10								1
37	R11								1
38	R12								1
39	R13								1
40	R14								1
41	R15								1
42	R16								1
43	R17								1
44	R18								1
45	R19								1
46	R20								1
47	R21								1
48	R22								1
49	R23								1
50	R24								1

Updated Tables from "Preliminary Geology and Geotechnical Evaluation" April 2, 2010

Liquefaction Rating	Number of Structures & [Structure Numbers]		
	Eastern Route	Western Route	Van Buren Route
NA	20	73	57
L	11	9	0
E	24 [68,18-29, 56-59, 62-66, & 69-70]	0	3 [BX11- BX13]
G	15 [38-39, 67,40-49, & 60-61]	0	0

NA: *Not Applicable*: Materials Underlying the proposed structure locations are not susceptible to liquefaction. No analysis required.
L: *Low:* Materials underlying the proposed structure are expected to be moderately consolidated and to have a relatively low potential for liquefaction. Analyses of representative areas should be considered.
E: *Evaluate:* Materials underlying the proposed structure location are expected to include fine-grained granular material that is poorly consolidated. A potential for liquefaction during seismic loading under high groundwater conditions Is considered likely. Specific analyses of each proposed tower location should considered.
G: *Graded:* The structure is proposed within or near an area that has been graded or otherwise improved. Evaluation/mitigation may not be necessary or feasible.

Flood Zone	Number of Structures & [Structure Numbers]		
	Eastern Route	Western Route	Van Buren Route
100 Year Flood	40 [15-29, 32, 35, 41-42, 49-53, 55-70]	5 [AX15, & JB1-JB4]	9 [BX1, BX3-5, BX7-10, & BX13]
500 Year Flood	7	0	2
Outside 500 Year Flood	23	77	49

Erosion Rating	Number of Structures & [Structure Numbers]		
	Eastern Route	Western Route	Van Buren Route
NA	0	27	48
L	27	42	9
M	25 [6-7, 10, 14-16, 26-30, 32, 52, 54, 55, & 61-70]	13 [AX14- AX21, D6-D10]	0
H	18 [17-25, 49-51, 53, & 56-60]	0	3 [BX11 - BX13]

NA: *Not applicable:* Structure locations are not susceptible to erosion
L: *Low:* Materials underlying the proposed structure location are expected to be generally non-erodible, given proper drainage control or the site is elevated with limited upslope catchment area.
M: *Medium:* Materials underlying the proposed structure location are expected to include materials readily susceptible to erosion; drainage in the surrounding area is poor, the site is located within either the 100-year or 500-year flood plain, but near the margins of the drainage channel.
H: *High:* The structure is proposed within or near the main floodway; site observations noted evidence of periodic flooding (existing damage that appears to be flood related, past repairs, piles of flood debris in the vicinity.

Slope Instability Rating	Number of Structures & [Structure Numbers]		
	Eastern Route	Western Route	Van Buren Route
NA	0	27	51
L	64	42	6
M	2 [9-10]	13 [AX14- AX21, & D6-D10]	3 [BX8 - BX10]
H	4 [52-55]	0	0

NA: *Not applicable:* Structure locations are not susceptible to slope instability
L: *Little:* Little or no slope stability risk anticipated. Primarily identified for structure proposed on flat sites, at significant distances from slopes, or where underlying conditions are such that no significant risk is expected associated with nearby slopes. Specific slope stability analyses are not considered warranted.
M: *Medium:* Some elements of slope stability risk is anticipated; however, the risk is considered wither primarily nuisance level, easily mitigated, or not of immediate concern. The potential for some slope stability risk should be considered in the design and planning process, possibly supported by specific slope stability analysis. The need for mitigation measures is considered low.
H: *High:* Conditions at the structure locations require careful analysis of slope stability issues. Some degree of mitigation is anticipated.

Preliminary Geological Condition Impact Evaluation
MASTER TABLE

Project Name: Riverside Transmission Reliability Project
230 kV (RTRP) - 2010-037
Location: Riverside County, CA

EDISON

TDBU **Geotechnical Engineering Group**

Eastern		Geotechnical Conditions				Impact per Tower			
	Str. #/Str. Name	*Liquefaction*	*100 Year Flood Zone*	*Erosion*	*Slope Instability*	Single	Dual	Triple	Unaffected
	51		Y	Y			1		
	52		Y	Y	Y			1	
	53		Y	Y	Y			1	
	54			Y	Y		1		
	55		Y	Y	Y			1	
	56	Y	Y	Y				1	
	57	Y	Y	Y				1	
	58	Y	Y	Y				1	
	59	Y	Y	Y				1	
	60		Y	Y			1		
	61		Y	Y			1		
	62	Y	Y	Y				1	
	63	Y	Y	Y				1	
	64	Y	Y	Y				1	
	65	Y	Y	Y				1	
	66	Y	Y	Y				1	
	67		Y	Y			1		
	68	Y	Y	Y				1	
	69	Y	Y	Y				1	
	70	Y	Y	Y				1	
Total Structures		70				8	12	27	23
	Total	24	40	43	6				
	Percentage	34%	57%	61%	9%				
Total unaffected									**33%**

Western		Geotechnical Conditions				Impact per Tower			
Str. #	Str. Name	*Liquefaction*	*100 Year Flood Zone*	*Erosion*	*Slope Instability*	Single	Dual	Triple	Unaffected
51	JB3		Y			1			
52	JB4		Y			1			
53	JB5								1
54	JB6								1
55	JB7								1
56	JB8/JD1								1
57	JD2								1
58	JD3								1
59	JD4								1
60	JD5								1
61	JD6								1
62	JD7								1
63	JD8								1
64	JD9								1
65	JD10								1
66	JD11								1
67	JD12								1
68	JD13								1
69	JD14								1
70	JD15								1
71	JD16								1
72	JD17								1
73	JD18								1
74	JD19								1
75	JD20								1
76	JD21								1
77	JD22								1
78	JD23								1
79	JD24								1
80	JD25								1
81	JD26								1
82	JD27								1
Total Structures		82				4	12	1	65
	Total	0	5	13	13				
	Percentage	0%	6%	16%	16%				
Total unaffected									**79%**

Van Buren		Geotechnical Conditions				Impact per Tower			
Str #	Str. Name	*Liquefaction*	*100 Year Flood Zone*	*Erosion*	*Slope Instability*	Single	Dual	Triple	Unaffected
51	R25								1
52	R26								1
53	R27/S1								1
54	S2								1
55	S3								1
56	S4								1
57	S5								1
58	S6								1
59	S7								1
60	S8								1
Total Structures		60				5	5	1	49
	Total	3	9	3	3				
	Percentage	5%	15%	5%	5%				
Total unaffected									**82%**

Str. #/Str. Name | Liquefaction | 100 Year Flood Zone | Erosion | Slope Instability | Single | Dual | Triple | Unaffected
Eastern | Geotechnical Conditions | Impact per Tower
Str. # | Str. Name | Liquefaction | 100 Year Flood Zone | Erosion | Slope Instability | Single | Dual | Triple | Unaffected
Western | Geotechnical Conditions | Impact per Tower
Str # | Str. Name | Liquefaction | 100 Year Flood Zone | Erosion | Slope Instability | Single | Dual | Triple | Unaffected
Van Buren | Geotechnical Conditions | Impact per Tower

Preliminary Geological Condition Impact Evaluation
MASTER TABLE

Project Name: Riverside Transmission Reliability Project
230 kV (RTRP) - 2010-037
Location: Riverside County, CA

TDBU **Geotechnical Engineering Group**