INFORMATION HANDOUT

For Contract No. 05-0Q6004
At 05-SCr-17-1.0/1.4

Identified by
Project ID 0500020290

MATERIALS INFORMATION

Documents: Revised District Preliminary Geotechnical Report, dated, 10/17/2013

Drainage Memorandum, dated 5/1/2015

Rocks placed in a natural form, referee sample

Representative Site Photos

a. Existing concrete ditch

b. Acacia on slope

Temporary Alternative Crash Cushion System

Water Source Information: Scotts Valley Water District

M e m o r a n d u m

Flex your power!
Be energy efficient!

To: PETE RIEGELHUTH
NPDES/Stormwater Coordinator
District 5 Central Region NPDES

Date: October 17, 2013

File: SCr-017-0.74-1.38
05-0Q600K
Project: **0500020290**

From: DEPARTMENT OF TRANSPORTATION
DIVISION OF ENGINEERING SERVICES
GEOTECHNICAL SERVICES

Subject: Revised District Preliminary Geotechnical Report

Executive Summary

A revised District Preliminary Geotechnical Report (DPGR) replaces the first report submitted on August 9, 2011. This revised report incorporates all previous recommendations and also recommends the use of an anchored mesh system with rock slop protection (RSP) along the steeper cut slopes bordering Highway 17. All conditions and mitigation recommended address sediment reduction along Highway 17 between the Pasatiempo Rd. O.C. and Beulah Park U.C (PM 0.74-1.38) in Santa Cruz County. This preliminary report provides mitigation alternatives for reduction of sediment loads into the adjacent Carbonera Creek, which is a tributary to the San Lorenzo watershed. Permissible drainage sediment loads, are regulated by the Central Coast Regional Water Quality Control Board (CCRWQCB) under the Total Maximum Daily Load (TMDL). This project is supported by the 335 SHOPP program which assists the districts in complying with these regulations under the (NPDES) permit. The proposed area for mitigation is considered the most critical of several locations along Highway 17 because of significant volumes of sediment shed annually. The proposed area for sediment reduction occurs along moderate to steeply (1.5:1 to vertical) inclined slopes covered by dense, mature trees rooted in shallow, loose sandy loam, underlain by the poorly endurated Santa Margarita sandstone. We recommend drainage, biotechnical erosion control, anchored mesh, RSP, and tree maintenance as a primary mitigation for reduction of sediment loads. The above mitigation may be supported by earthwork (flattening over-steepened slopes), or use of rockeries to support over-steepened slope faces. A resource estimate table is provided for estimated time anticipated to complete the design phase geotechnical investigation for sediment reduction.

Introduction

A District Preliminary Geotechnical Report (DPGR) is provided for the above referenced project per request of the Central Coast NPDES storm water unit on May 25, 2011. This preliminary report assesses mitigation alternatives for the reduction of sedimentation during storm events in Santa Cruz county, along southbound Highway 17 , between PM 0.74-1.38 (Attachment 1). This location, which lies between the Pasatiempo Rd. O.C and Beulah Park U.C., is considered the most critical for sediment control of several locations along the length of Highway 17, because of significant amounts of erosion on and above the existing cut slopes. A portion of this sediment flows into Carbonera Creek (near the Pasatiempo O.C.), a tributary of the San Lorenzo watershed. The CCRWQCB regulates permissible volumes of sediment load in the San Lorenzo River and its tributaries by establishment of a TMDL. The 335 SHOPP supports districts in complying with the above regulation under the NPDES permit. The erosion in this vicinity occurs because of highly permeable soils and underlying formation which readily conduct water during storm events. This report provides sediment reduction alternatives for meeting the TMDL requirement.

Pertinent Reports and Investigations

Site conditions were assessed by use of topographic and geologic maps, aerial photographs and nearby geotechnical investigations pertinent to the project. A preliminary field investigation of the proposed project location was conducted on July 8, 2011. Actual conditions may vary from those assumed in this report. The following maps and reports were used to assess geologic and geotechnical site conditions along westbound Highway 17 between PM 0.74 and 1.38:

1. *Biotechnical Soil Stabilization,* Caltrans, Camp, Dresser, and McKee, 1999.

2. *California Seismic Hazard Map,* Caltrans, Mualchin, L., 2007.

3. California Department of Water Resources (DWR). 2006. Central Coast Hydrologic Region; Scotts Valley Groundwater Basin, Bulletin No. 118. 180p.

4. Highway 17 at El Rancho Road: Retaining Wall Tiebacks: Comments on Contractor's Claim and Geotechnical Engineer's Claim, Exponent, 2005.

5. *Lockheed Fire; Post Fire Risk Assessment,* San Mateo-Santa Cruz Unit, California Department of Forestry and Fire Protection, Cal Fire, 2009.

6. *Zayante Area Sediment Source Study,* Swanson Hydrology and Geomorphology, January, 2001.

Description of Project Alternatives and Existing Facilities

The project is located in Santa Cruz County on southbound Route 17 between Post Miles 0.74 and 1.38, which roughly coincides with the Pasatiempo O.C. and Beulah Park U.C. respectively. Route 17 joins Santa Cruz and Route 1 with Highway 101, 280, 85, and 880 corridors in the Santa Clara Valley. North and south bound lanes at this location are separated by an approximate twenty two-foot wide median with concrete barrier. The southbound shoulder varies between one to eight feet with an AC-dike at the base of the existing cut slope (Attachment 2).

The southbound shoulder is flanked by 0.75:1 to vertical slopes at highway elevation and flatter (1:1 to 1.5:1) slopes extending to the ridge line. The steeper slopes at the highway are devoid of vegetation where erosion has occurred. Ephemeral springs are reported to occur along the faces of these slopes following the rainy season. The slope is currently drained by a concrete valley gutter which follows a 10 to 15 foot wide terrace, incised by erosion gullies and slump failure scarps. This gutter, has been broken by slope movement and/or erosion, and mended by re-directing surface water directly down-slope of the break with two 18-inch diameter HDPE corrugated drain pipes on both ends (Attachment 7). The corrugated pipes are fitted with energy attenuators and terminate on the inside edge of the AC dike along the shoulder near PM 1.29 and 1.35. The uninterrupted portions of the gutter on either end, terminate in natural drainages at the north and south end of the project boundaries.

Directly above the project area, the Pasatiempo Golf Course spans across the ridge-line beyond the northern and southern limits of the proposed area for sediment reduction. The eastern boundaries of the this course (side closest to Highway 17) are between 1000 and 2,500 feet up slope of Highway 17. Below the golf course are several residential communities and private roads. With exception to the golf course and a few properties, the slopes between the golf course and Highway 17 are densely populated with groves of eucalyptus, redwood, tanbark oak, douglas fir, and acacia trees. Acacia dominates much of the slope, many which have fallen, exposing loose soils beneath the humus layer (Attachment 8).

Several remediation alternatives exist for sediment reduction, all which include drainage improvement, tree maintenance, and erosion control. Alternatives include exclusive use of biotechnical erosion control, double twisted wire-anchored mesh with rock slope protection (RSP) along cut slopes, earthwork, horizontal drains, retaining walls, or no improvements. The no-improvements-alternative is not a viable alternative because Caltrans is a stakeholder in the TMDL regulation, and is required to reduce sedimentation on the highways adjacent to protected drainages during storm events.

The biotechnical-erosion-control-alternative is commonly defined as a practice that uses both vegetation and structural components, including use of geotextiles for soils reinforcement. Biotechnical erosion control may utilize strategic planting of native species including grasses, shrubs, and trees, through seeding, planting, and/or staking of live cuttings, with reinforcement by use of geotextiles, mulch, live-gabions and rockeries. Both the use of plants and other materials such as rock and geotextiles may be used to construct drainage systems to intercept both surface and subsurface water flow. Details of this erosion control and slope stabilization practice may be found in the biotechnical manual prepared for Caltrans (Camp, Dresser, and McKee, 1999). This alternative would include extensive tree maintenance, namely lowering or removal of leaning trees particularly at the top of the cut slope and adjacent to drainage systems. Because of anticipated high volumes of surface and subsurface water flow, biotechnical drainage design should be augmented with slope-interceptor drains, installed in natural or constructed topographic depressions (swales) for capture of surface full. A drainage design would be developed after further field investigation.

The anchored wire mesh system with RSP, would be applied along the steeper cut-slope faces bordering Highway 17. The existing slopes described above, currently support isolated small groves of non-native and native species of trees, with exposed 0.3:1 to 0.75:1 faces of exposed, poorly endurated Santa Margarita sandstone. A ten-foot spaced-grid of 1-inch diameter reinforced bar anchors would be set 12-feet into the cut-slope with grout slurry. Double-twisted wire mesh would be secured to the anchor system with nuts and bearing plates. A geo-textile or organic type filter material such as coconut-fiber would be used behind the wire mesh to retain finer sediment.

The earthwork alternative may take two approaches: 1) use of displaced soils for buttressing locally over-steepened and recessed-slope faces at highway elevation, or 2) flattening current slope faces over the length of the project, to a uniform slope aspect, with development of lateral drainage terraces upslope, for intercepting ground and surface water. Both approaches would utilize extensive erosion control and drainage design. The later approach would allow for development of a catchment area at the toe of the slope, but also expose significantly greater surface area requiring greater efforts in erosion control.

The horizontal drain (H-drain) alternative would serve as an additional drainage alternative for augmenting removal of subsurface water flow. Reduction of subsurface flow through the local formation material would both diminish saturation potential of the loose overlying soils, and reduce spring flow along the steep faces at highway elevation. The H-drains would be placed strategically, in areas where existing spring activity occurs, and/or erosion is most problematic. The alternative, as stated above would be combined with extensive erosion control and surface drainage design.

A retaining wall alternative may be used both as a barrier to the influx of sediment migration from erosion upslope and/or support for slopes which have failed or are susceptible to failure. The selection of a retaining wall type and the design, should consider drainage and access for maintenance, for removal of sediment accumulation behind the wall. The length, height, and location of the wall would be determined from site specific characteristics, including ground and surface water conditions, anticipated sediment volumes, and topography. Wall types are discussed in the Preliminary Recommendations section of this report.

Physical Setting

Climate

The climate in Santa Cruz, CA is characterized as Mediterranean, with cool, wet winters and mostly dry, warm summers. Temperatures are moderated by the local fog and low overcast developed in Monterey Bay. Average annual maximum and minimum temperatures are 68°F and 45°F respectively. There is commonly little or no precipitation during the summer months and moderate precipitation in the winter (November though March). Average annual rainfall in the project area is approximately 30 inches.

Topography and Drainage

The project is located in the Santa Cruz Mountains in the Coast Ranges geomorphic province. The terrain consists of steep sided mountains and steep drainages covered densely with mature trees and understory vegetation. Embankments typically contain loose surface soils and thick humus layers. Locally, the slopes above Highway 17 and Carbonera Creek, are covered by the loose soils of the Zayante Series, a weathering product of the Santa Margarita sandstone. These soils contain 90 percent sand, which contribute to rapid drainage from high permeability.

Geology

Regional

The Santa Cruz Mountains are part of the Coast Range geomorphic province characterized by a landscape controlled by a regional trending northwest structure of faults and folds. The Santa Cruz Mountains are composed mostly of Cenozoic marine rocks which unconformably overly crystalline basement composed of meta-sedimentary and granitic rock characteristic of the Salinian block. Paleo-marine terraces preserved in Ben Lomond Mountain have been generated from transpression (compression and lateral movement) along a constraining bend in the San Andreas Fault a few miles east of the proposed project sites. The Santa Cruz Mountains continue to rise (0.5 mm/yr) as a result of these forces along the San Andreas Fault.

Site

Locally, the slopes adjacent to southbound Highway 17 between PM 0.74 and 1.38 expose the Upper Miocene-aged Santa Margarita sandstone, which forms steep (0.75:1 to vertical) faces along the shoulder. The Santa Margarita sandstone is a massive, fine to coarse grain arkose (>50% feldspar). Locally, it is medium-grained with trace well rounded out-sized (fine GRAVEL) clasts. This formation is overlain by undifferentiated Pleistocene age terrace deposits along the ridge line and shallow (3-4 feet deep) soils and debris flow deposits on the slopes immediately above the highway. The Santa Margarita Formation is a water bearing unit for Scott's Valley groundwater basin and the source rock for Crystal Springs spring water.

The project location is within a seismically active area, with the NW-SE trending San Andreas Fault Zone and Zayante-Vergales fault to the north. Active faults potentially affecting the project area are summarized under the seismicity section of Geologic Considerations.

Evidence of seeps or springs were not present during field mapping of the site. Maintenance however, has reported spring activity along the flanks of the Santa Margarita Formation following the winter storms. Establishment of spring locations and other hydraulic characteristics including water table elevation, will be determined in the design phase geotechnical investigation.

Geologic Considerations

Petrology

The semi-lithified Santa Margarita sandstone is characteristically friable and rapidly erodes from accelerated surface water flow and subsurface flow. This formation appears to be relatively stable under dry conditions at 0.75:1 slopes. Local diversion of surface flow on the slopes above the highway, and extraction of groundwater flow intercepting the face (springs) should be reduced to reduce erosion potential. This formation weathers into loose sandy soils (Zayante Series) which generally are poor in organic nutrients for supporting a variety of plants.

Aggregate/Construction Material Resources

If retaining walls are used, the geologic materials within the project limits may be used as structural back fill material behind retaining walls and/or embankments. Surficial debris flow deposits contain mudstone GRAVELS and organic debris which may be sieved for use for earth berms or backfill behind walls.

Excavation Characteristics

Excavation difficulty within the Santa Margarita sandstone is anticipated to be classified as easily ripped (< 3,400 ft/s seismic velocity). The Santa Margarita sandstone behaves as a massive, very dense sand, with no local evidence for cementation. The overlying soils are very loose.

Erosion

High erosion potential is expected where soils and/or formation material is exposed. All work on the upper slopes should be conducted with a minimum impact approach, minimizing access for equipment to a single path when possible. Construction should be avoided within the months of anticipated rain (November–April). Where vegetation and/or the protective humus layer of the soil is removed during equipment operation, temporary erosion protection should be implemented.

Ground Water

Sources

Ground water (namely springs), were not observed during the site visit, however, were reported by Santa Cruz maintenance following the rainy season. The Santa Margarita sandstone is a major water bearing unit for the Scott's Valley Ground Water Basin. Locally, groundwater may be charged where vegetation, including mature trees do not exist, particularly along the ridge line occupied by the Pasatiempo Golf Club (Attachment 5) and private residences down slope. Subsurface flow may also likely occur at the boundary between the loose overlying soils and the significantly denser formation.

Effect on Groundwater Regime

Proposed drainage improvements would intentionally reduce spring activity and surface flow on the slopes above Highway 17. Surface drainage is not expected to change the local groundwater regime. Further investigation will be required to determine the regional effects that the H-drain alternative may have on water table, including local spring activity.

Seismicity

The San Andreas Fault (right lateral strike-slip) and the Monterey Bay-Tularcitos Fault (right lateral strike slip) are northeast and southwest of the project site. According to the Caltrans *California Seismic Hazard Map* (2007), the controlling fault for this site is the San Andreas Fault with a maximum credible earthquake Moment Magnitude (M_w) of 7.9. According to the Caltrans-adopted peak acceleration curves, the peak bedrock acceleration in the project area due to an earthquake along the San Andreas Fault is estimated to be about 0.4g (Attachment 4). The fault attributes are summarized in the table below

Liquefaction generally occurs from seismic shaking of saturated, uniformly graded, SAND or SILT. Liquefaction is generally not a concern for locations where the water table is 50 feet below the surface. Although groundwater elevation is unknown, the occurrence of liquefaction at highway elevation is likely low, where foundations for retaining walls would be constructed.

Faults- SCr 17, PM 0.74-1.38			
Fault Name	*Maximum Credible Moment Magnitude*	*Approximate Distance(mi)*	*Acceleration (gravity)*
San Andreas Fault Zone (Santa Cruz Mountains)	7.9	9.4	0.39g
Monterey Bay-Tularcitos Fault (Monterey Bay Section)	7.3	7.3	0.37g

Rockfall

Rockfall may occur along the existing vertical slopes spanning the site boundaries during storm events but is considered negligible. The source of rock would come from debris flow deposits up slope. The average maximum size of rock observed in debris flow deposits is about six inches. Although the Santa Margarita formation does not produce rock, debris flow deposits have transported mudstone GRAVELS along with plant debris down slope and up to the edge of the steep slope faces along the highway shoulder. Any rock that could fall, will likely be incorporated in debris flows during storm events.

Geotechnical Engineering Considerations

Erosion

Maintenance along PM 0.74-1.38, according to the Santa Cruz Area Maintenance Superintendant Tom Barnett, has required significant efforts. Sediment, including uprooted trees have obstructed the existing drainage inlets and southbound highway lanes. The reduction of sediment deposition on the highway by use of conventional or non-conventional erosion control practices is the main focus of this project. Protection of loose soils up slope as well as prevention of over-steepening slope faces below will require attention to maintenance of existing vegetation (namely removal or reduction in height of leaning trees) and strategic planting of new vegetation in highly exposed areas. The Landscape Architecture Branch should be consulted for details on both temporary and permanent erosion control.

Groundwater – Control of Subsurface Water

Shallow ground water occurs in the form of springs, which intersect the existing cut slopes along the exposed slopes of the Santa Margarita sandstone. Controlling the flow of shallow groundwater will reduce the erosion of this sandstone. Control of shallow groundwater may be controlled with subsurface French or slope groundwater-interceptor drains and/or horizontal drains constructed into the slope from highway elevation. Future field work will be required to characterize both shallow and deeper ground water flow regimes, before specific drainage types and plans are recommended.

Seismicity

The two most significant, historical earth quakes which impacted the Santa Cruz Mountains are the San Francisco (M=7.8, 1906), and Loma Prieta (M=6.9, 1989) earth quakes. Liquefaction would occur in the loose SANDY soils of the Zayante Series, triggering significantly larger scaled debris flows and shallow translational type failures.

Slope Stability

The Santa Cruz Mountains have a long history of landslides, which have been triggered commonly by large storm events and earth quakes. Slope stability in these mountains, is mostly controlled by lithology and water. Catastrophic events, under the right conditions, may trigger large scale landslides. Maintenance records show that the 1989 Loma Prieta earthquake triggered numerous significant debris flows along the Highway 17 corridor, particularly near the summit. The Zayante Series soils at this project site, are developed on relatively steep (1:1) slopes and absorb water rapidly during high intensity storm events. Shallow debris flow failures and slumps along the steeper faces of the Santa Margarita sandstone appear to be the main mode of failure. The Santa Margarita formation is relatively stable at 0.75:1 to vertical under dry conditions.

Preliminary Recommendations

Exploration and Investigations

A geotechnical investigation will be required at the site to determine engineering properties of local soil and rock, including depth of soil profile, hydraulic conductivity, and relative density. Seismic refraction would be used to generate depth of soil layer across the site. Hand auger borings may be used for verification of soil depth and collection of samples at depth. Hydraulic conductivity may be estimated in the field (infiltration testing) and/or laboratory testing of samples collected in the field. Field mapping would include observed spring activity, slide scarps, debris flows, changes in lithology, and other geologic attributes related to erosion. Characterization of groundwater flow may be monitored through a series of shallow monitoring wells.

Geotechnical

Areas and Alternative Measures for Stabilization

Several alternatives exist for soils stabilization and were summarized under the project alternatives section of this report. The recommended soils stabilization method is an application of Biotechnical erosion control and anchored mesh with RSP with a redundant drainage design. Biotechnical erosion control, as described earlier, uses plants, geosythetic filters, and structures to retain soils on steep, loose slopes.

The use of retaining walls or other non-standard structures may be used to prevent sediment from reaching the highway corridor. Several retaining wall designs are suitable for retention of shallow slope failures and retention of eroded soils. In addition, anchored mesh and soil nail walls are summarized as non-standard structures.

Gravity Walls

Crib walls are constructed of timber, concrete, or steel and may be battered (1:6) or vertical. Concrete crib wall Types vary in base width depending on design height. Based on the embankment dimensions at the proposed location of shoulder widening on Highway 1, a Standard Plan (C7A/C7C) battered or vertical Type A or B wall would be constructed in native soils at the toe of the embankment. Design height would be selected to allow for a 2:1 back-slope up to shoulder elevation. If the wall base is constructed in the embankment, a minimum of 5.0 feet of embankment at 95% relative compaction is required below the base of the wall according to Standard Plans Sheet C7F.

Gabion Walls

Gabion walls use stacked or interconnected structural elements, which utilize rock fill, to resist earth pressures by acting as gravity retaining walls. Rock filled wire gabion baskets are used to construct a gabion wall. Prefabricated modular walls may be used where conventional reinforced concrete walls are considered. Steel crib walls shall not be used where aggressive industrial pollutants or other environmental conditions are present at a given site. Traffic barriers shall not be placed at the face of this type wall but shall be placed in fill above the top of the wall. The aesthetic appearance of some of these type walls is governed by the nature of the structural elements used. This type wall is most economical for low to medium height walls.

Semi-Gravity Retaining Walls

The Caltrans Standard Plan Retaining Walls (Type 1 through 7) are a typical semi-gravity retaining wall type. These walls have relatively narrow base widths. They can be supported by both shallow and deep foundations. The position of the wall stem relative to the footing can be varied to accommodate right-of-way constraints. This wall would also be placed near the toe of the embankment completed with a 2:1 or flatter back-slope. These walls can support overlying structures, including concrete barrier walls. They are most economical at low to medium wall heights. Due to the rigidity of gravity walls and semi-gravity walls they should only be used where their foundations can be designed to limit total and differential settlements to acceptable values.

Soil-Nail-Walls

Soil-Nail-Walls use a top-down construction, which would not require excavation of back slopes or footings. Anchors may be drilled from a platform suspended by a crane. Anchor spacing and depths would be determined in the design phase of the project and require geotechnical borings to determine engineering strength properties of the formation material.

Anchored-wire-mesh

Similar to the construction of soil-nail-walls, a grid of anchors are installed. The anchored-mesh system, however, would not require anchor design like the soil-nail-wall, utilizing a predetermined approximate 1-inch diameter epoxy coated reinforcement bar with end threads, embedded 12-feet into the slope face. A double-twisted wire mesh is attached to the anchor system using nuts and bearing plates anchor. A seeded-compost mat or other geotextile may be applied beneath the wire-mesh for additional reinforcement of loose granular material.

Rock Slope Protection (RSP)

Rock slope protection serves as a slope reinforcement alternative at locations where vertical retrograding erosion scarps have developed. Imported 3/4-ton angular rock, preapproved by the engineer, would be constructed at an approximate 1:1 slope from a 2-foot deep keyway, excavated across the base of the eroded notch. Filter fabric is installed between the exposed erosion surface and RSP, with coarse gravel backfill between the back coarse of rock and the filter fabric.

Erosion Considerations

Erosion is anticipated to be greatest along the flatter slopes composed of loose, sandy Zayante Series soils, up slope of the steeper faces of Santa Margarita sandstone at highway elevation. Erosion control efforts should be focused on stabilization of these soils, including interception and diversion of surface and subsurface waters with drainage. Redundancy in drainage design and erosion control efforts is recommended to minimize potential for debris flows from saturation of the overlying soils. Trees should be pruned rather than removed to preserve mature root systems and avoid unnecessary disturbance of soils. Pruning efforts should be prioritized by reduction of tree height or removal of trees located along the break in slope above the highway first, followed by maintenance of trees next to drainage, and finally pruning of all leaning trees along the slope. If tree removal is required, native plantings with aggressive root systems should be planted in its place. Temporary erosion control may be considered (such as jute net or mulch) around new plantings until the roots are well developed.

Corrosion

If retaining walls are used, corrosion testing of soils will be required near the surface and at depth from samples collected during advancement of geotechnical borings.

Estimated Geotechnical Services Time Required

The following resource estimate is provided based upon the following assumptions:

Design will provide the information required to complete the geotechnical investigation or will provide additional information if requested.

The Department will provide the appropriate resources (funding, staff, and equipment) for the project.

The District will provide the necessary permits and clearances for drilling and performing geophysics at the site.

Geotechnical borings would be required if the retaining wall alternative is used. The approximate depth of borings would be 40 feet. Resource hours include 3 borings per wall and 4 walls over the length of the project area. Additional geotechnical investigation may include hand auger borings, hydrogeologic investigation, and seismic refraction survey. Resource hours for the above surveys are estimated for Geotechnical Design North (GDN).

Table 5 below summarizes the estimated resource hours for design phase geotechnical investigation. The table includes Geotechnical Services (GS), cost centers for Geotechnical Drafting Services, Geotechnical Support, Geotechnical Drilling Services, and Geotechnical Design North. The estimate is based on the current scope of the project assuming the preferred alternative of the through cut. Please note that if scope changes occur, revisions to the resource estimate will be required.

Table 1. Preliminary Resource Estimate for Highway 17 Shoulder Widening

	Unit	100	150	160	185	230	240	250	255	270	275	285	290	Totals
Drafting	3643 (296)	0	0	0	0	100	0	0	0	0	0	0	0	**100**
GS	3650 (316)	0	0	0	0	280	0	0	0	0	0	0	0	**280**
Drilling	3656 (322)	0	0	0	0	880	0	0	0	0	0	0	0	**880**
GDN	3657 (323)	0	0	40	0	600	0	0	0	80	0	0	0	**720**
Totals (hours)		**0**	**0**	**40**	**0**	**1860**	**0**	**0**	**0**	**80**	**0**	**0**	**0**	**1,980**

Notes:

1. *Includes nine (12) mud rotary or auger borings necessary for the subsurface investigation.*
2. *The request for the FR should be forwarded to Geotechnical Services a minimum of twelve (12) weeks before the requested due date.*
3. *This estimate is preliminary and is subject to revision.*

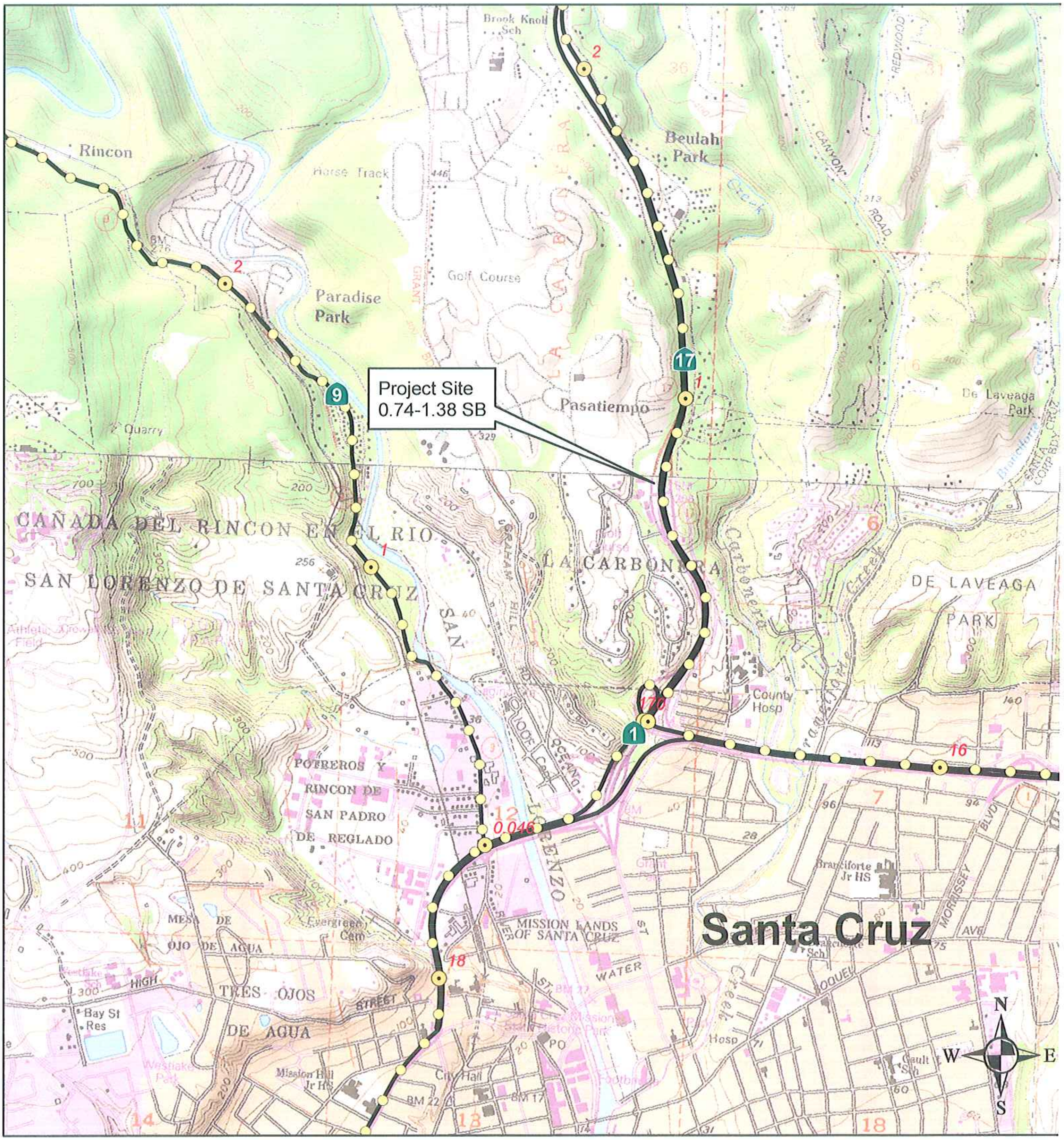
If you have any questions or comments, please contact Mike Jurasius at (805) 549-3729 or Michael Finegan at (805) 549-3194.

MIKE JURASIUS, P.G.
Engineering Geologist
Geotechnical Design – North
Branch D

MICHAEL S. FINEGAN, P.E.
Branch Chief
Geotechnical Design – North
Branch D

c: District Project Manager –Steve Degrazia
Project Coordination Engineer – Marissa Nishikawa
GS Corporate – Mark Willian
District Environmental Planning- Matt Fowler
District Materials Engineer-Glen Johnson

LIST OF ATTACHMENTS



Location Map
SCr-017-0.74-1.39
Sediment Reduction

0 1,250 2,500 5,000 Feet

Attachment 1

INDEX OF SHEETS

Sheet No.	Description
1	Title Sheet
2	Typical Cross Sections

DIST	COUNTY	ROUTE	POST MILE TOTAL PROJECT	SHEET No	TOTAL SHEETS
05	SCr	17	0.74 / 1.38	1	--

STATE OF CALIFORNIA

DEPARTMENT OF TRANSPORTATION

PROJECT PLANS FOR CONSTRUCTION ON

STATE HIGHWAY

IN SANTA CRUZ COUNTY IN AND NEAR SANTA CRUZ FROM PASATIEMPO OC (PM 0.74) TO BEULAH PARK UC (PM 1.38)

To be supplemented by Standard Plans dated May, 2006

The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.

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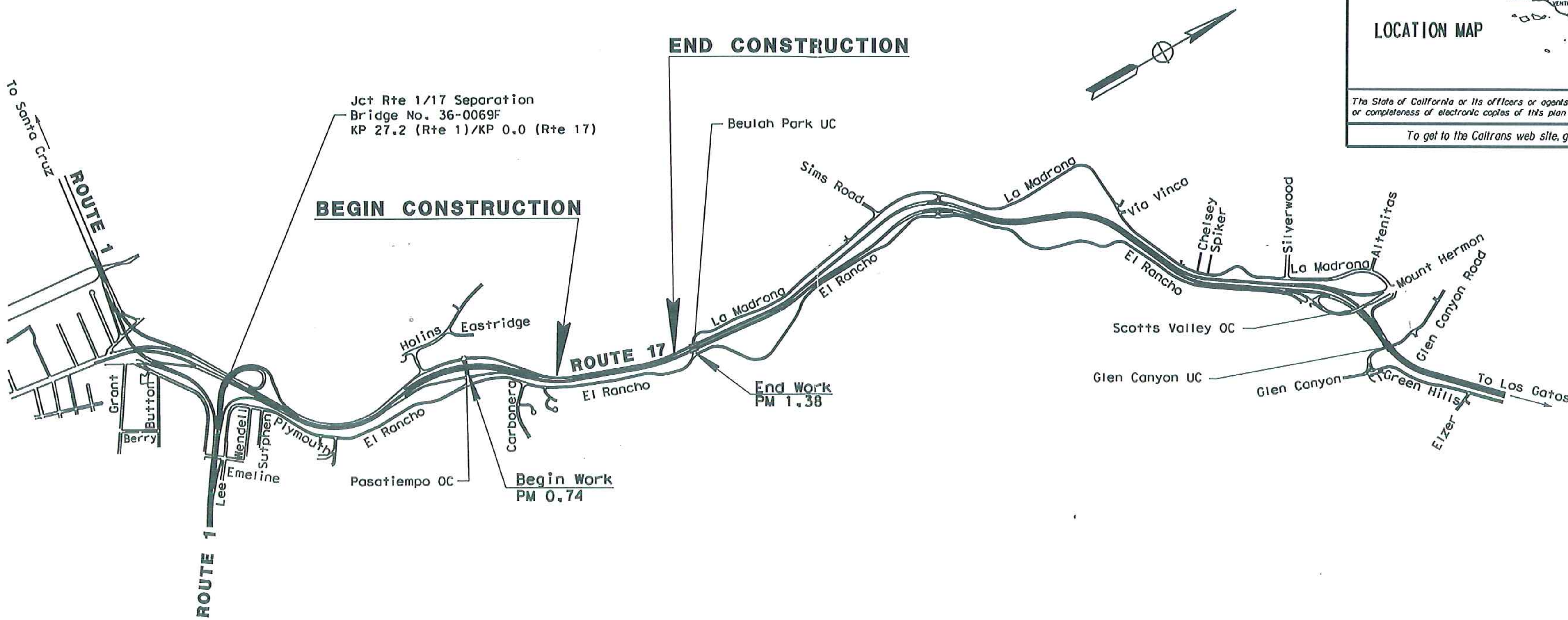

Project Engineer Date
Registered Civil Engineer

Plans Approval Date

REGISTERED PROFESSIONAL ENGINEER
No.
Exp.
CIVIL
STATE OF CALIFORNIA

PROJECT ENGINEER	DATE	PROJECT MANAGER	DATE
P.Petrakis	07/11	D. Hessing	07/11

The Contractor shall possess the class (or classes) of license as specified in the "Notice to Contractors."

NO SCALE

Attachment 2

Contract No. 05-0Q600K

LAST REVISION 07-16-11

DATE PLOTTED => $DATE
$TIME

FORM DC-OE-93-PF (REV. 3/88)

RELATIVE BORDER SCALE IS IN MILLIMETERS 0 20 40 60 80

USERNAME => $USER
DGN FILE => $REQUEST

$REQUEST

CU 05602

EA 00600K

DIST	COUNTY	ROUTE	POST MILE TOTAL PROJECT	SHEET No	TOTAL SHEETS
05	SCr	17	0.74 / 1.38	2	--

REGISTERED CIVIL ENGINEER

PLANS APPROVAL DATE

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REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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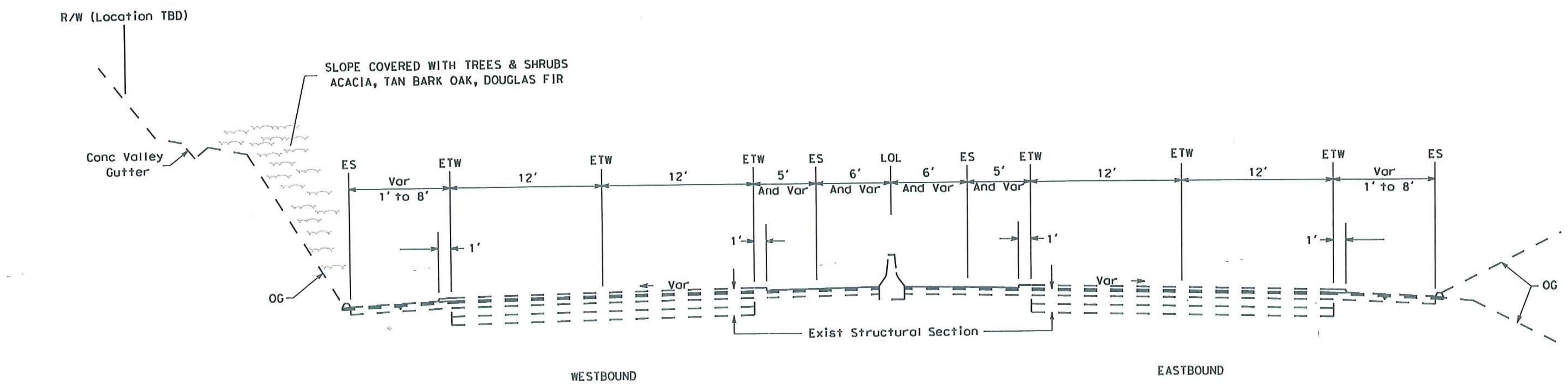
NOTES:

1. DIMENSIONS OF THE STRUCTURAL SECTIONS ARE SUBJECT TO TOLERANCES SPECIFIED IN THE STANDARD SPECIFICATIONS.



ROUTE 17

PM 0.74 to 1.38

Attachment 2

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

TYPICAL CROSS SECTIONS

NO SCALE

X-1

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans MAINTENANCE DESIGN

PROJECT ENGINEER: PETE PETRAKIS

CALCULATED/DESIGNED BY: MANNY T. MARCOS

CHECKED BY

DATE | REVISED BY | DATE REVISED

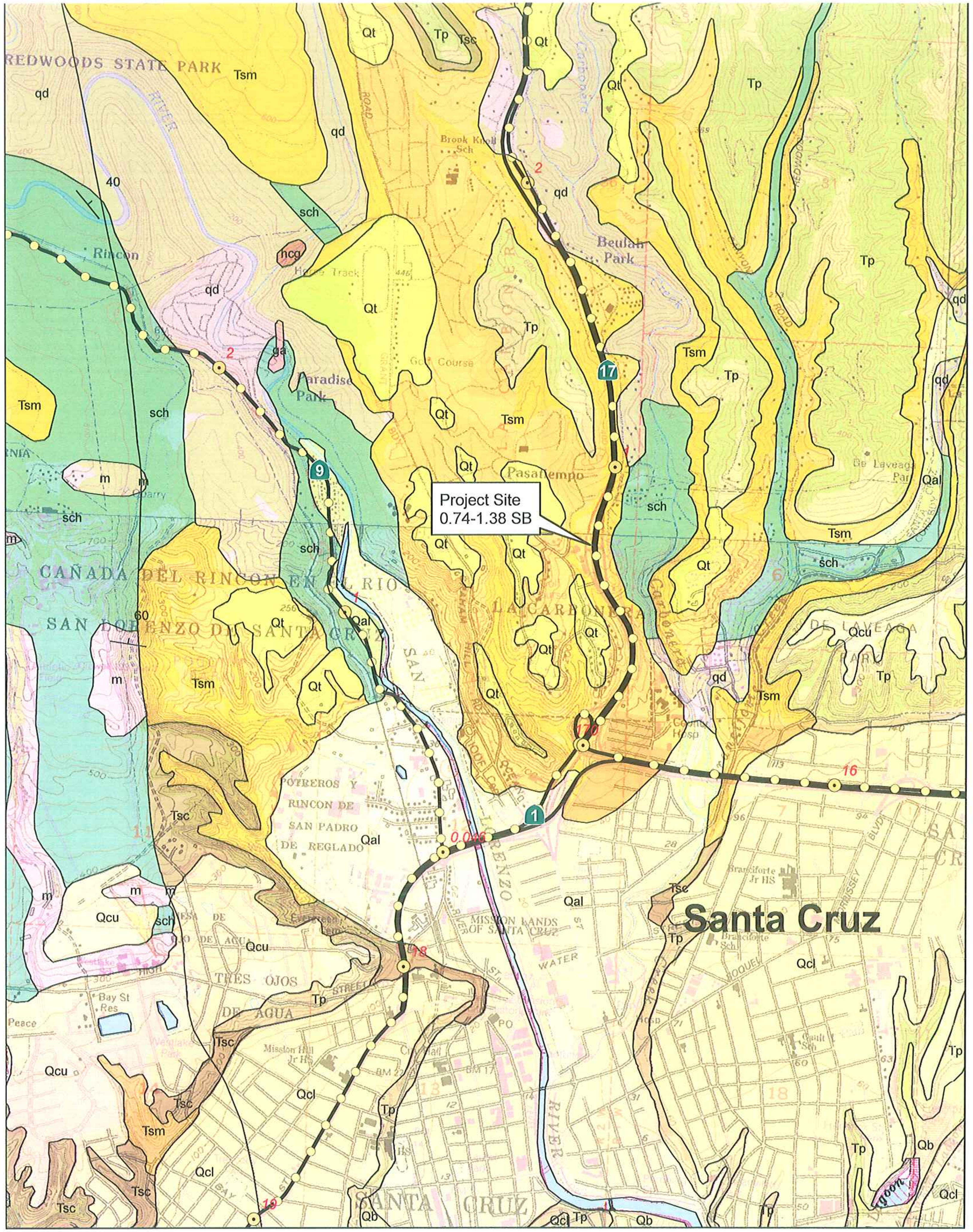
LAST REVISION 07-18-11 | DATE PLOTTED => $DATE | TIME PLOTTED => $TIME

RELATIVE BORDER SCALE IS IN MILLIMETERS 0 20 40 60 80

USERNAME => $USER DGN FILE => $REQUEST

CU 06231 | EA 00600K

$REQUEST



Geologic Map
SCr-017-0.74-1.38
Sediment Reduction

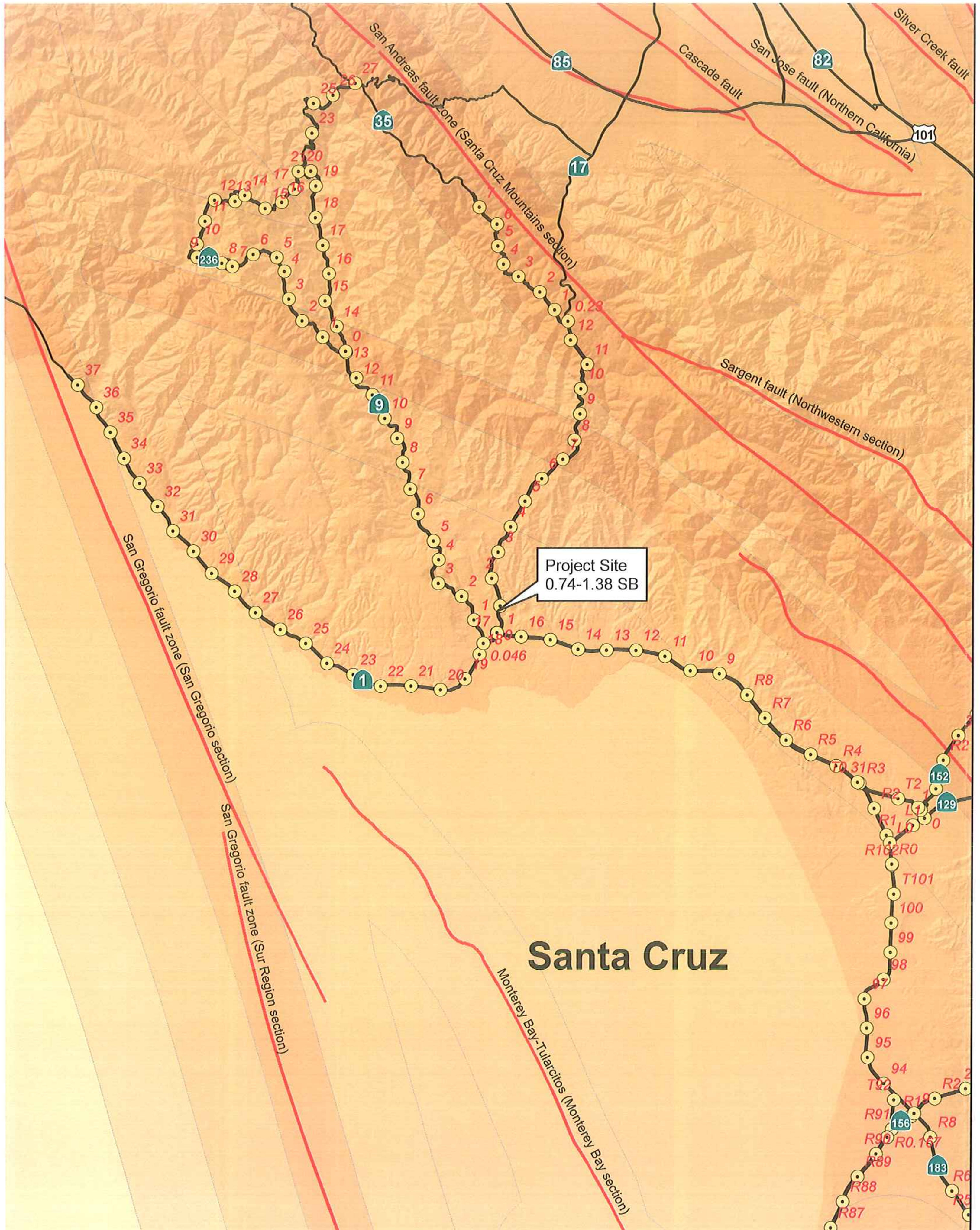
Legend

- Qal- Alluvial deposits, undifferentiated (Holocene)
- Qb- Basin deposits (Holocene)
- Qcl-Lowest emergent coastal terrace deposits (Pleistoce
- Qcu- Coastal deposits (Pleistocene)
- Qt- Terrace deposits, undifferentiated (Pleistocence)
- Tp- Purisma Fm. (Pliocenc- U. Miocence)
- Tsc- Santa Cruz mudstone (U. Miocene)
- Tsm- Santa Margarita sandstone (U. Miocence)
- ga- Granite and adamellite (Cretaceous)
- hcg-Hornblende-cummingtonite gabbro (Cretaceous)
- m- Marble (Mezozoic)
- qd- Quartz diorite (Cretaceous)
- sch-Metasedimentary rocks (Mesozoic)
- Bedding Attitude

1,300 650 0 1,300 2,600 3,900 5,200 Feet

N W E S

Attachment 3



Fault Map
SCr-017-0.74-1.38
Sediment Reduction

Legend

2007_Active-Faults

Caltrans -Faults Buffered

Peak Ground Acceleration (g)

- 0.1
- 0.2
- 0.3
- 0.4
- 0.5
- 0.6
- 0.7

N
W E
S

0 1.252.5 5 7.5 10 12.5 Miles

Attachment 4

N

0 550 1,100 2,200 3,300 4,400
Feet

SCr-017-0.74-1.38
Sediment Control
Attachment 5

Attachment 6

Attachment 7

Attachment 8

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Drainage Memorandum

Date: **5/1/2015**

To: **Kevin Bewsey/Keith Rhodes - TY Lin International**

From: **Eman Bidokhti/Jennifer Abrams/Grant Wilcox - WRECO**

Project: **San Lorenzo River Watershed Sediment TMDL Source Control Project**

Subject: **65% PS&E Ditch Design**

Introduction

The San Lorenzo River Watershed Sediment Total Maximum Daily Load (TMDL) Source Control Project (Project) is located in Santa Cruz County on State Route 17 from 0.7 mile north of the Route 1/17 separation to the Beulah Park Undercrossing (Figure 1 and Figure 2). The purpose of this Project is to minimize the amount of sediment eroding from slopes adjacent and above the southbound lanes per the California Department of Transportation (Caltrans) District 5 Work Plan's Region Specific Activities Plan to comply with the Central Coast Regional Water Quality Control Board (CCRWQCB) TMDL for sediment which has been set for the San Lorenzo River watershed (including Carbonera Creek, Lompico Creek, and Shingle Mill Creek).

WRECO performed analysis of existing ditches and sizing of proposed ditches that included calculations of off-site flows and capacity of the ditches. The hydrology and hydraulic analysis was calculated following the procedures in the Caltrans *Highway Design Manual* (HDM) (updated March 2014). TY Lin International (TYLI) provided site layouts, as-builts, and a topographic surface.

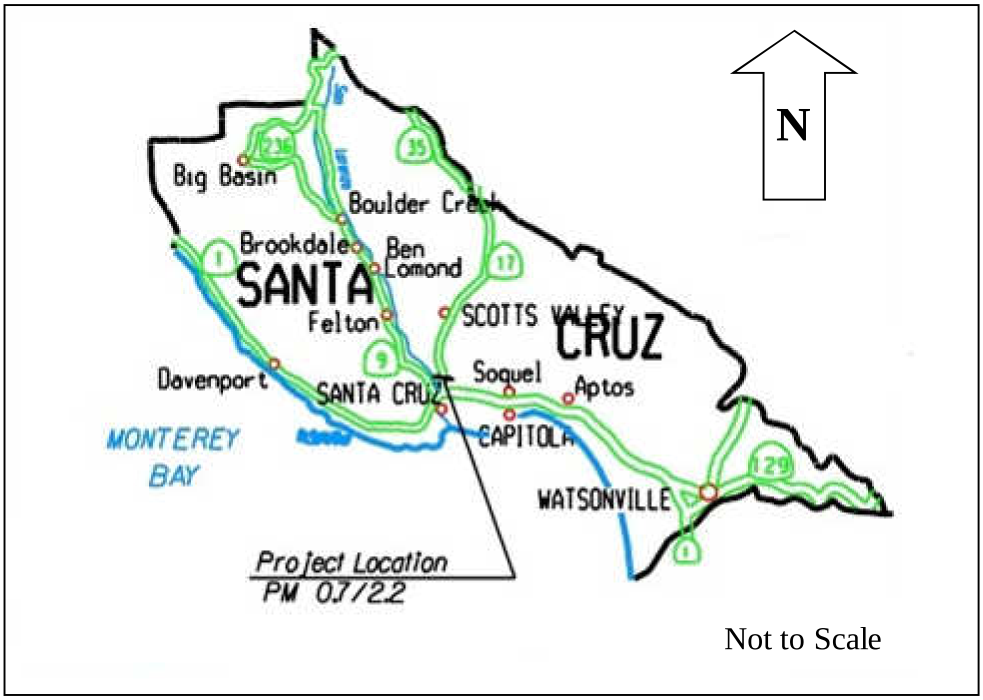

Figure 1. Location Map

Source: TYLI

Figure 2. Vicinity Map

Source: Google

Design Criteria

WRECO estimated times of concentration following the procedures presented in section 816.6 of the HDM. The HDM recommends a minimum time of concentration of 5 minutes for paved areas and steep unpaved areas, and 10 minutes for rural or undeveloped areas. Per Table 831.3 and Section 834.3 of the HDM, the ditches were sized to convey the 25-year flow plus freeboard and have a longitudinal slope greater than 0.0025 ft/ft. The proposed combination access road/ditch is unlined, which requires the velocity of the flow inside the ditch to remain under 4 ft/s to prevent erosion, according to Table 862.2 of the HDM. The side slopes of the access/road ditch have a maximum slope of 10:1 (horizontal: vertical) for ease of maintenance. Manning's equation was used for the analysis of the existing and proposed ditches, per section 816.6 of the HDM.

Precipitation Data

Precipitation data was obtained from the National Oceanic and Atmospheric Administration's (NOAA's) Atlas 14. NOAA Atlas 14 provides point precipitation frequency estimates at specified locations. The 25-year intensities are shown in Table 1. The full NOAA Atlas 14 output is included in the Attachments.

Table 1. 25-year Precipitation Intensities at the Project Site

Duration (min)	Intensity (in./hr)
5	5.05
10	3.62
15	2.92
30	2.02
60	1.43

Source: NOAA Atlas 14

Watershed Delineation

The topographic surface provided by TYLI and United States Geological Survey (USGS) topographic mapping were used to delineate the off-site watersheds of all existing and proposed ditches. All watersheds are unpaved. The existing and proposed watershed maps and maps showing the ditch labeling convention are in the Attachments.

Hydrologic Calculations

Using the procedures presented in the HDM, the time of concentration was determined by finding the sum of the sheet flow, shallow concentrated flow, and channel flow travel times. The Rational Method was used to calculate peak flow rates.

Sheet Flow

Per HDM specification, sheet flow represents up to the first 100 ft of the watershed. The following equation was used to find the sheet flow travel time:

$$T_t = \frac{0.42L^{4/5}n^{4/5}}{P_2^{1/2}s^{2/5}}$$

Where:

T_t = Travel time, minutes
L = Length of flow path, ft
s = Slope of flow path, ft/ft
n = Manning's roughness coefficient
P_2 = 2-year, 24-hour rainfall depth, in.

The 2-year, 24-hour rainfall depth was obtained NOAA Atlas 14. The Manning's n value was selected from Table 816.6A of the HDM. A value of 0.6 was assigned, which was the average between light and dense underbrush. The elevation at the upstream and downstream ends of the sheet flow path were estimated using USGS topography because the topographic surface provided by TYLI did not cover the entire off-site watershed. The sheet flow travel time results are in Table 2.

Table 2. Sheet Flow Travel Time

Existing/Proposed Watershed	L (ft)	n	P_2 (in.)	s (ft/ft)	T_t (min)
Ex. Ditch 1/Ditch 1	100	0.6	4.19	0.32	8.6
Ditch 2	100	0.6	4.19	0.34	8.4
Ditch 3	100	0.6	4.19	0.35	8.3
Ditch 4	100	0.6	4.19	0.34	8.4
Ditch 5	100	0.6	4.19	0.39	7.9
Ex. Ditch 2/Ditch 6	100	0.6	4.19	0.41	7.8
Ditch 7	100	0.6	4.19	0.43	7.6
Ex. Ditch 3/Ditch 8	100	0.6	4.19	0.42	7.7
Ex. Ditch 4/Ditch 9	100	0.6	4.19	0.44	7.5

Shallow Concentrated Flow

The velocity in the shallow concentrated flow segment was determined by using the following equation:

$$V = (3.28)kS^{1/2}$$

Where:

V = Velocity, ft/s
k = Intercept coefficient
S = Slope, %

The intercept coefficient was found in Table 816.6B of the HDM. It was determined that the off-site area was best described as "forest with heavy ground liter", and an intercept coefficient of 0.076 was assigned accordingly. The slope was measured using the topographic surface provided by TYLI where possible and USGS topography elsewhere. The travel time for the shallow concentrated flow was determined by the following equation:

$$T_t = \frac{L}{60V}$$

Where:

L = Length of flow, ft
V = Velocity, ft/s

The results of the shallow concentration flow travel time are summarized in Table 3.

Table 3. Shallow Concentrated Flow Travel Time

Existing/Proposed Watershed	k	S (%)	L (ft)	V (ft/s)	T_t (min)
Ex. Ditch 1/Ditch 1	0.076	50	145	1.76	1.4
Ditch 2	0.076	51	157	1.78	1.5
Ditch 3	0.076	49	196	1.74	1.9
Ditch 4	0.076	50	225	1.76	2.1
Ditch 5	0.076	51	197	1.78	1.8
Ex. Ditch 2/Ditch 6	0.076	48	200	1.73	1.9
Ditch 7	0.076	51	200	1.78	1.9
Ex. Ditch 3/Ditch 8	0.076	52	200	1.80	1.9
Ex. Ditch 4/Ditch 9	0.076	53	200	1.81	1.8

Channel Flow Travel Time and Flow Rate Calculation

The channel flow travel time, which is the travel time inside the existing concrete or proposed vegetated channel, was determined per HDM specifications by using Manning's equation:

$$V = \frac{K}{n} R^{2/3} S^{1/2}$$

Where:

K = Conversion factor, 1.49 for English units
n = Manning's roughness coefficient
R = Hydraulic Radius, ft
S = Slope, ft/ft

The hydraulic radius (R) is found using the following equation:

$$R = \frac{A}{P}$$

Where:

A = Wetted area, ft^2
P = Wetted perimeter, ft

The channel flow calculation was iterated with the flow rate calculation, because they are interdependent, until the travel time for the channel yielded a value that corresponded to the resulting precipitation intensity for the time of concentration. The flow rate was calculated using the Rational Method equation:

$$Q = CiA$$

Where:

Q = Peak discharge, cfs
C = Rational runoff coefficient
i = Rainfall intensity, in./hr
A = Drainage area, acre

The results of the channel flow travel time calculations are included in Table 4. Additional details regarding these hydraulic calculations are included in the Hydraulic Calculations summary. The channel flow travel time and Manning's n calculations are included in the Attachments.

Time of Concentration

The times of concentration, which are the sum of the three travel times, are shown in Table 4. All of the times of concentration exceeded the minimum value of 5 minutes. The existing times of concentration range from 9.7 minutes to 10.3 minutes. The proposed times of concentration range from 12.1 minutes to 17.6 minutes. The proposed times are longer because the ditches are vegetated instead of concrete lined.

Table 4. Time of Concentration Summary

Existing/Proposed Watershed	Sheet flow	Shallow Concentrated Flow	Channel Flow	Time of Concentration
	T_t (min)	T_t (min)	T_t (min)	T_c (min)
Ex. Ditch 1	8.6	1.4	0.3	10.3
Ex. Ditch 2	7.8	1.9	0.6	10.3
Ex. Ditch 3	7.7	1.9	0.3	9.9
Ex. Ditch 4	7.5	1.8	0.4	9.7
Ditch 1	8.6	1.4	2.9	12.9
Ditch 2	8.4	1.5	2.7	12.5
Ditch 3	8.3	1.9	2.9	13.0
Ditch 4	8.4	2.1	7.1	17.6
Ditch 5	7.9	1.8	2.4	12.1
Ditch 6	7.8	1.9	2.7	12.4
Ditch 7	7.6	1.9	3.0	12.4
Ditch 8	7.7	1.9	4.3	13.8
Ditch 9	7.5	1.8	4.8	14.1

Peak Flow Rate

The Rational Method calculation results are summarized in Table 5. The existing ditch peak flows range from 1.22 cfs to 5.32 cfs. The proposed ditch peak flows range from 0.59 cfs to 4.85 cfs. The proposed ditch peak flows are generally less than the existing ditch peak flows because the proposed times of concentration are generally larger.

Table 5. 25-year Flow Rate Calculation Summary

Existing/Proposed Watershed	T_c (min)	C	i_{25} (in./hr)	A (ac)	Q_{25} (cfs)
Ex. Ditch 1	10.3	0.53	3.30	0.65	1.22
Ex. Ditch 2	10.3	0.53	2.99	2.84	5.32
Ex. Ditch 3	9.9	0.53	2.94	2.66	5.07
Ex. Ditch 4	9.7	0.53	3.20	1.43	2.77
Ditch 1	12.9	0.53	3.17	0.65	1.09
Ditch 2	12.5	0.53	3.21	0.74	1.26
Ditch 3	13.0	0.53	3.15	0.36	0.59
Ditch 4	17.6	0.53	2.71	0.67	0.96
Ditch 5	12.1	0.53	3.26	0.61	1.05
Ditch 6	12.4	0.53	3.22	2.84	4.85
Ditch 7	12.4	0.53	3.22	0.75	1.28
Ditch 8	13.8	0.53	3.05	1.52	2.46
Ditch 9	14.1	0.53	3.02	1.43	2.29

Hydraulic Calculations

Existing Ditches

The existing ditches were analyzed to better understand the current conditions at the Project site. The dimensions of the ditches were measured in the field by WRECO. Existing Ditch 1 had a top width of 3 ft, a base of 0.6 ft, and side slopes of 0.8:1 (H:V). Existing ditches 2, 3, and 4 had a top width of 4.7 ft, a base of 1.7 ft, and side slopes of 1:1 (H:V). All of the existing ditches are concrete lined, which increases the velocity within the channel significantly. Using Manning's equation, it was found that all four of the existing ditches were found to convey the flow with freeboard. An n value of 0.015 was used for these ditches. Table 6 summarizes the results.

Table 6. Existing Ditch Manning's Equation Results

Ditch	Velocity (ft/s)	Normal Depth (ft)	Required Freeboard (ft)	Required Depth (ft)	Available Depth (ft)
Ex. Ditch 1	8.4	0.19	0.26	0.45	1.5
Ex. Ditch 2	9.2	0.55	0.38	0.93	1.5
Ex. Ditch 3	10.7	0.48	0.45	0.93	1.5
Ex. Ditch 4	9.3	0.34	0.34	0.68	1.5

Proposed Ditches

All of the proposed ditches were first designed as unlined V-ditches, with a top width of 10 feet. The longitudinal slopes of all ditches were measured using the topographic surface provided by TYLI, as no significant grading is expected to occur. If this configuration was not sufficient to convey the 25-

year flow with freeboard, a low-flow V-ditch was added down the center of the alignment, forming a compound ditch.

In the existing alignment of Ditch 7, the ditch receives a watershed area too large for Ditch 7's capacity. Ditch 8 is downhill from Ditch 7, so a portion of the Ditch 7 alignment will be removed and regarded so that an increased amount of off-site flow will reach Ditch 8 instead of Ditch 7.

Proposed Ditches 1, 2, and 5 are classified as combination access road/Type 1 ditch. Type 1 ditches will have a depth of 0.5 feet and side slopes of 10:1 (H:V). Ditches 3, 4, 6, 7, 8 and 9 will be classified as combination access road/Type 2 ditches. Type 2 ditches have a side slope on either side of 10:1 (H:V), for maintenance vehicles, similar to Type 1 ditches. However, a low flow ditch, with a side slope of 2:1 on either side, is placed within the center of the wider ditch, to increase capacity. The secondary ditch has a top width of 3 ft and depth of 0.75 ft. Illustrations of both combination access road/ditch Types are in the drainage details in the Attachments.

Using Manning's equation, it was determined that the Type 1 ditches are expected to fully contain all flow during the 25-yr event while satisfying all other Caltrans requirements. A summary of the results can be found in Table 7, and the full calculations can be found in the Attachments.

Table 7. Type 1 Ditch Manning's Equation Calculations

Proposed Ditch	Depth (ft)	Velocity (ft/s)	Normal Depth (ft)	Required Freeboard (ft)	Required Depth (ft)	Available Depth (ft)
Ditch 1	0.5	0.81	0.39	0.08	0.47	0.50
Ditch 2	0.5	0.81	0.41	0.08	0.49	0.50
Ditch 5	0.5	0.70	0.40	0.08	0.48	0.50

Two separate Manning's equation calculations were performed for each of the Type 2 ditches. One calculation was performed for the main (10:1 side slope) ditch and one for the low flow (2:1 side slope) ditch in the center. Using the separate calculations and combining the capacities of both components.

A Manning's n value of 0.2 was selected for the ditch calculations to conservatively account for debris accumulation in the channel. Most of the ditches should convey the 25-year peak flow with freeboard assuming this n value. Two ditches, Ditch 6 and Ditch 8, do not have sufficient freeboard using this n value. Ditch 6 would have enough freeboard using a Manning's n of 0.1 and Ditch 8 would have enough freeboard using an n value of 0.15. These n values are still high for a typical ditch. During the next phase of design, modifications and alternatives will be evaluated to increase the capacity of the ditches or redistribute the flows. A summary of the results can be found in Table 8 and the full calculations can be found in the Attachments.

Table 8. Ditch Type 2 Hydraulic Calculation Summary

Proposed Ditch	Peak Flow Rate	Slope	Low-flow Capacity	Remaining Flow	Required Depth	Available Depth
	(cfs)	(ft/ft)	(cfs)	(cfs)	(ft)	(ft)
Ditch 3	0.59	0.01	0.40	0.19	0.36	0.50
Ditch 4	0.96	0.03	0.70	0.26	0.34	0.50
Ditch 6* *(n=0.1)*	4.85	0.15	1.56	3.29	0.50	0.50
Ditch 7	1.28	0.03	0.70	0.58	0.45	0.50
Ditch 8* *(n=0.15)*	2.46	0.05	0.90	1.56	0.50	0.50
Ditch 9	2.29	0.07	1.07	1.22	0.50	0.50

* Ditches 6 and 8 do not have sufficient freeboard using n values of 0.2. The n values shown are what result in a sufficient freeboard calculation.

Recommendations

Ditches 1, 2, and 5 will be classified as combination access road/ditch Type 1; while ditches 3, 4, 6, 7, 8, and 9 will be classified as combination access road/ditch Type 2. Based on the best available data, it has been determined that all nine proposed ditches will be able to successfully convey all off-site flow.

References

Caltrans (2014). *Highway Design Manual.* <http://www.dot.ca.gov/hq/oppd/hdm/pdf/english> (Last accessed: April 2015)

Google (2015). *Google Earth Pro.*

National Oceanic and Atmospheric Administration. *NOAA Atlas 14 Point Precipitation Frequency Estimates.* http://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html?bkmrk=ca (Last accessed: April, 2015).

United States Geological Survey. (2001). *California: Seamless USGS Topographic Maps.*

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Attachments:

- NOAA Atlas 14 precipitation depths and intensities
- Layout sheets showing ditch labeling convention
- Existing and proposed watershed maps
- Drainage details
- Ditch calculations

NOAA Atlas 14, Volume 6, Version 2
Location name: Santa Cruz, California, US*
Latitude: 37.0095°, Longitude: -122.0238°
Elevation: 588 ft*
* source: Google Maps

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.206 (0.180-0.237)	0.248 (0.217-0.287)	0.306 (0.266-0.354)	0.354 (0.305-0.415)	0.421 (0.348-0.516)	0.475 (0.381-0.598)	0.531 (0.413-0.690)	0.592 (0.444-0.796)	0.677 (0.482-0.961)	0.747 (0.510-1.11)
10-min	0.295 (0.258-0.340)	0.356 (0.311-0.411)	0.438 (0.382-0.508)	0.507 (0.437-0.595)	0.604 (0.498-0.739)	0.681 (0.547-0.857)	0.762 (0.593-0.989)	0.848 (0.637-1.14)	0.971 (0.691-1.38)	1.07 (0.731-1.59)
15-min	0.356 (0.312-0.411)	0.430 (0.376-0.497)	0.530 (0.461-0.614)	0.613 (0.529-0.719)	0.730 (0.602-0.894)	0.823 (0.661-1.04)	0.921 (0.717-1.20)	1.03 (0.770-1.38)	1.17 (0.836-1.67)	1.29 (0.884-1.92)
30-min	0.493 (0.432-0.569)	0.595 (0.520-0.688)	0.733 (0.639-0.850)	0.849 (0.731-0.995)	1.01 (0.834-1.24)	1.14 (0.915-1.43)	1.27 (0.992-1.66)	1.42 (1.06-1.91)	1.63 (1.16-2.31)	1.79 (1.22-2.65)
60-min	0.696 (0.609-0.803)	0.841 (0.735-0.971)	1.03 (0.901-1.20)	1.20 (1.03-1.41)	1.43 (1.18-1.75)	1.61 (1.29-2.02)	1.80 (1.40-2.34)	2.00 (1.50-2.70)	2.29 (1.63-3.25)	2.53 (1.73-3.75)
2-hr	1.05 (0.921-1.21)	1.25 (1.09-1.45)	1.52 (1.33-1.77)	1.76 (1.51-2.06)	2.09 (1.73-2.56)	2.36 (1.90-2.97)	2.65 (2.06-3.44)	2.97 (2.23-3.99)	3.42 (2.44-4.86)	3.80 (2.59-5.63)
3-hr	1.34 (1.17-1.54)	1.58 (1.38-1.83)	1.93 (1.68-2.23)	2.22 (1.91-2.60)	2.65 (2.18-3.24)	2.99 (2.40-3.76)	3.37 (2.62-4.37)	3.77 (2.83-5.08)	4.36 (3.11-6.19)	4.86 (3.31-7.20)
6-hr	1.91 (1.68-2.21)	2.28 (1.99-2.63)	2.78 (2.42-3.22)	3.21 (2.77-3.77)	3.84 (3.17-4.70)	4.36 (3.50-5.48)	4.91 (3.82-6.38)	5.51 (4.14-7.42)	6.39 (4.55-9.06)	7.12 (4.85-10.5)
12-hr	2.54 (2.22-2.93)	3.11 (2.71-3.59)	3.88 (3.38-4.50)	4.54 (3.91-5.32)	5.47 (4.51-6.70)	6.22 (4.99-7.82)	7.01 (5.45-9.10)	7.86 (5.90-10.6)	9.07 (6.46-12.9)	10.1 (6.86-14.9)
24-hr	3.30 (3.05-3.65)	4.19 (3.86-4.64)	5.37 (4.94-5.96)	6.35 (5.80-7.09)	7.71 (6.85-8.85)	8.77 (7.65-10.2)	9.87 (8.44-11.8)	11.0 (9.20-13.5)	12.6 (10.2-16.0)	13.9 (10.9-18.1)
2-day	4.21 (3.89-4.65)	5.41 (4.99-5.98)	6.98 (6.42-7.74)	8.26 (7.55-9.23)	10.0 (8.90-11.5)	11.4 (9.92-13.3)	12.7 (10.9-15.2)	14.2 (11.8-17.3)	16.1 (13.0-20.4)	17.7 (13.8-23.0)
3-day	4.86 (4.49-5.37)	6.26 (5.78-6.93)	8.08 (7.44-8.96)	9.56 (8.74-10.7)	11.6 (10.3-13.3)	13.1 (11.4-15.3)	14.7 (12.6-17.5)	16.3 (13.6-19.9)	18.5 (14.9-23.4)	20.2 (15.8-26.3)
4-day	5.42 (5.01-6.00)	6.99 (6.45-7.73)	9.01 (8.29-9.99)	10.6 (9.73-11.9)	12.9 (11.4-14.8)	14.6 (12.7-17.0)	16.3 (13.9-19.4)	18.0 (15.1-22.0)	20.4 (16.4-25.8)	22.3 (17.4-29.0)
7-day	6.77 (6.25-7.48)	8.64 (7.97-9.56)	11.1 (10.2-12.3)	13.0 (11.9-14.5)	15.6 (13.9-17.9)	17.6 (15.4-20.6)	19.6 (16.8-23.4)	21.7 (18.1-26.5)	24.5 (19.7-31.0)	26.7 (20.9-34.8)
10-day	7.62 (7.04-8.42)	9.69 (8.93-10.7)	12.3 (11.3-13.7)	14.5 (13.2-16.1)	17.3 (15.4-19.9)	19.5 (17.0-22.7)	21.6 (18.5-25.8)	23.9 (19.9-29.2)	26.9 (21.6-34.0)	29.2 (22.8-38.0)
20-day	9.90 (9.14-10.9)	12.6 (11.6-14.0)	16.0 (14.7-17.8)	18.7 (17.1-20.9)	22.2 (19.8-25.5)	24.8 (21.7-29.0)	27.4 (23.5-32.7)	30.0 (25.1-36.7)	33.5 (27.0-42.4)	36.1 (28.3-47.1)
30-day	12.1 (11.1-13.3)	15.4 (14.2-17.1)	19.6 (18.0-21.7)	22.8 (20.8-25.4)	26.9 (23.9-30.9)	30.0 (26.2-35.1)	33.0 (28.2-39.3)	35.9 (30.0-43.9)	39.8 (32.1-50.4)	42.7 (33.4-55.7)
45-day	14.8 (13.7-16.4)	19.0 (17.5-21.0)	24.0 (22.1-26.6)	27.9 (25.5-31.1)	32.7 (29.1-37.6)	36.2 (31.6-42.3)	39.6 (33.9-47.3)	42.9 (35.8-52.5)	47.2 (38.0-59.7)	50.3 (39.4-65.7)
60-day	17.6 (16.2-19.4)	22.4 (20.7-24.8)	28.3 (26.0-31.4)	32.7 (29.9-36.5)	38.3 (34.0-43.9)	42.2 (36.8-49.3)	45.9 (39.2-54.8)	49.5 (41.4-60.5)	54.1 (43.6-68.6)	57.5 (45.0-75.0)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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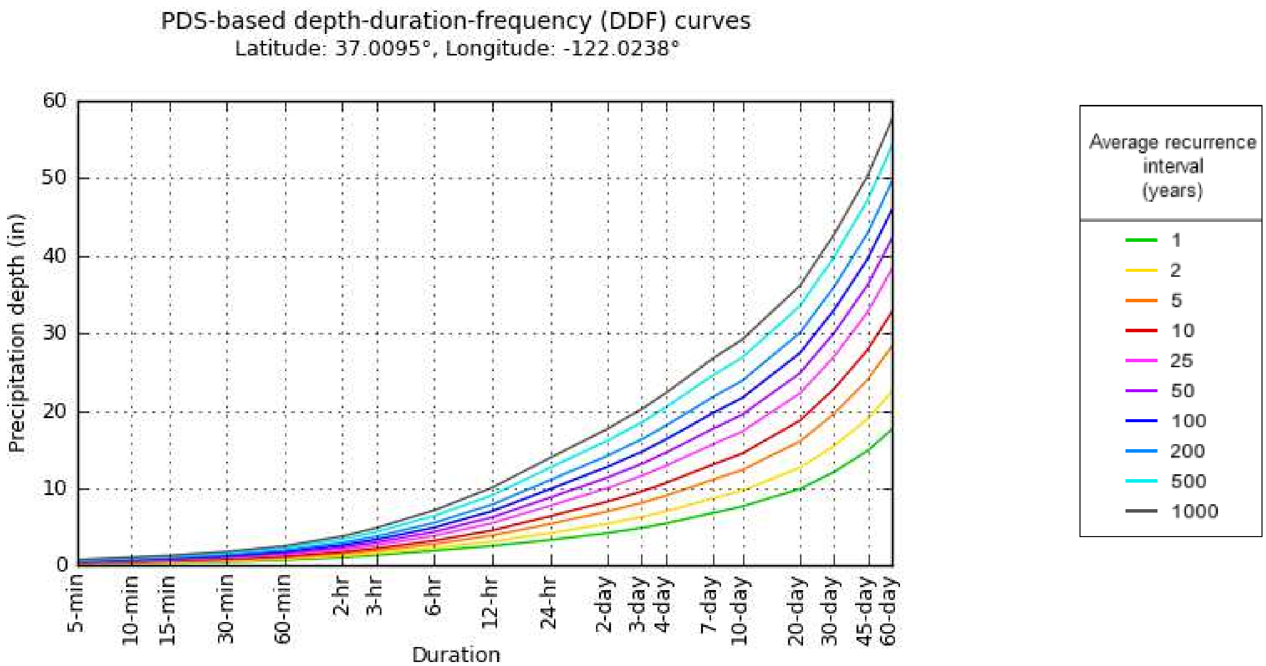
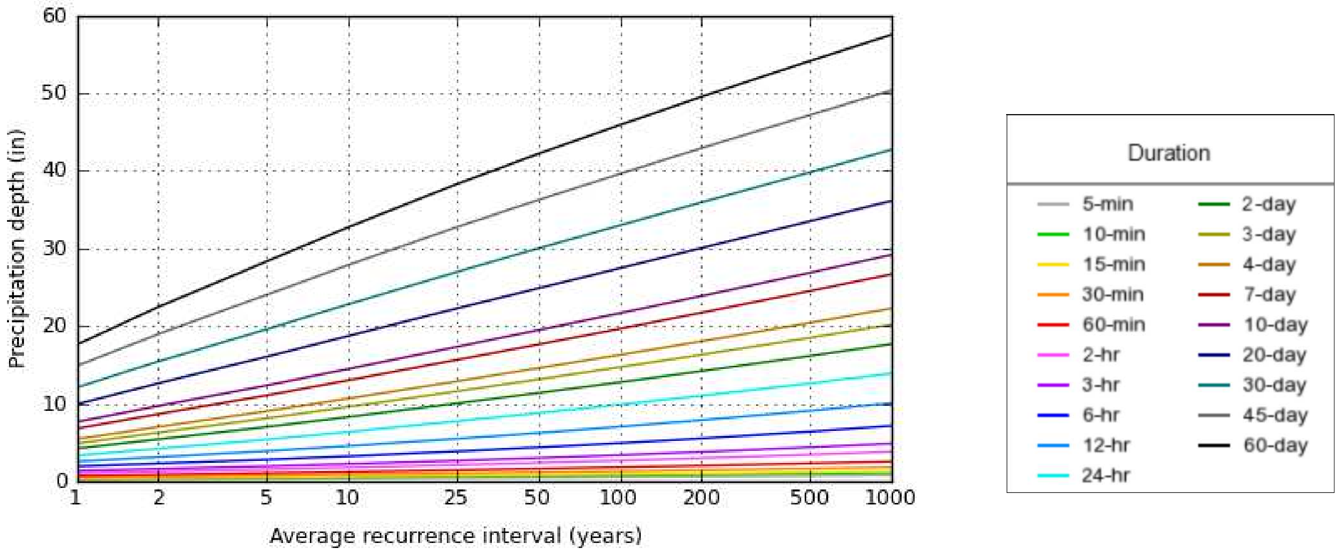
PF graphical





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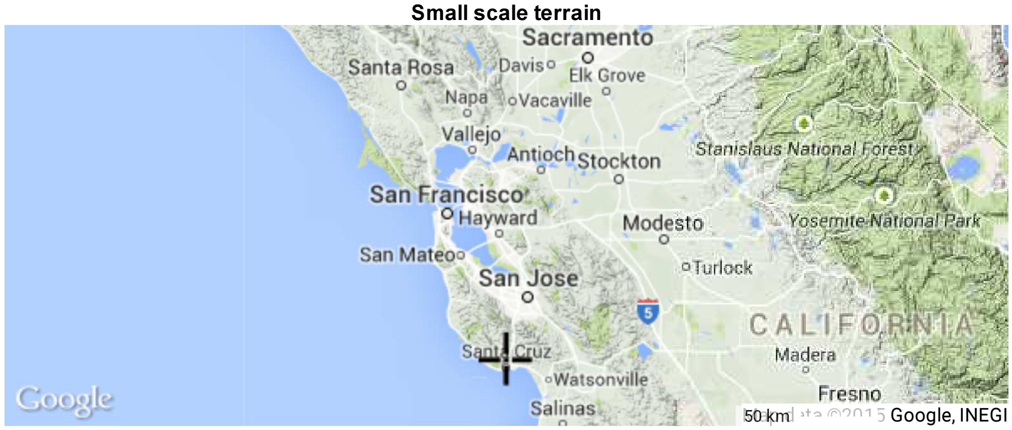
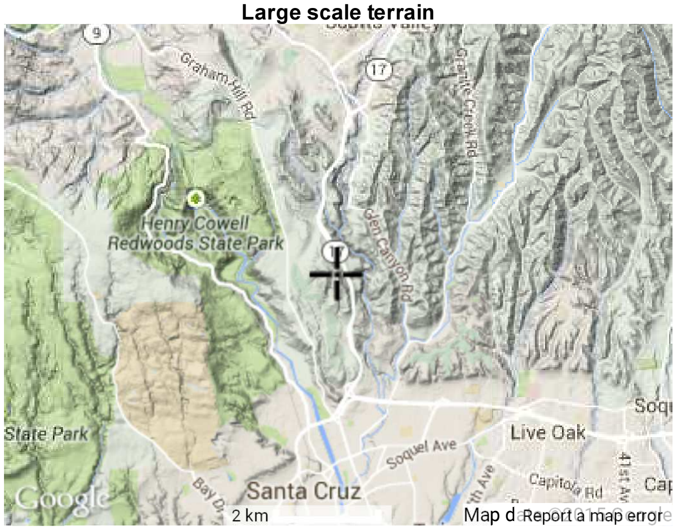
Maps & aerials

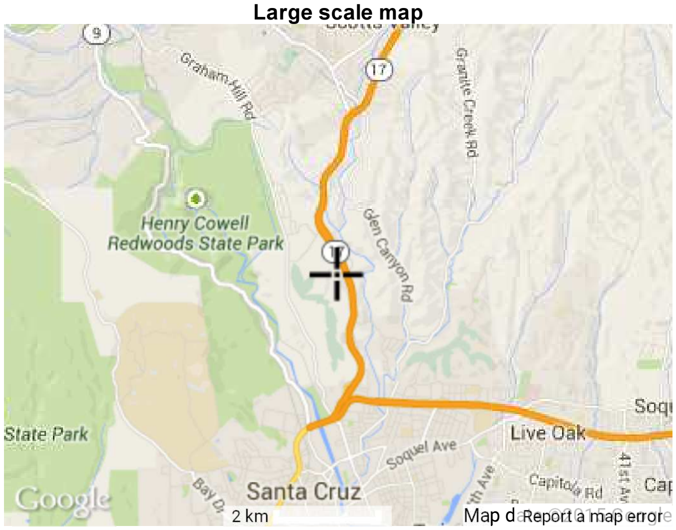
Small scale terrain



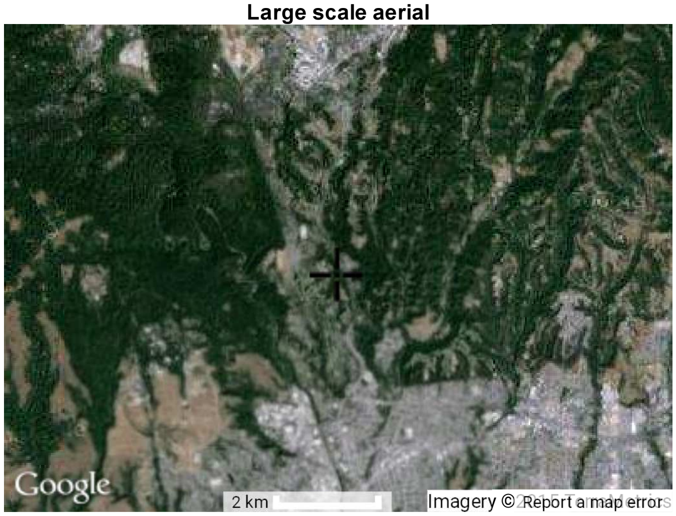
Large scale terrain



Large scale map



Large scale aerial



NOAA Atlas 14, Volume 6, Version 2
Location name: Santa Cruz, California, US*
Latitude: 37.0095°, Longitude: -122.0238°
Elevation: 588 ft*
* source: Google Maps

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	2.47 (2.16-2.84)	2.98 (2.60-3.44)	3.67 (3.19-4.25)	4.25 (3.66-4.98)	5.05 (4.18-6.19)	5.70 (4.57-7.18)	6.37 (4.96-8.28)	7.10 (5.33-9.55)	8.12 (5.78-11.5)	8.96 (6.12-13.3)
10-min	1.77 (1.55-2.04)	2.14 (1.87-2.47)	2.63 (2.29-3.05)	3.04 (2.62-3.57)	3.62 (2.99-4.43)	4.09 (3.28-5.14)	4.57 (3.56-5.93)	5.09 (3.82-6.85)	5.83 (4.15-8.26)	6.43 (4.39-9.52)
15-min	1.42 (1.25-1.64)	1.72 (1.50-1.99)	2.12 (1.84-2.46)	2.45 (2.12-2.88)	2.92 (2.41-3.58)	3.29 (2.64-4.14)	3.68 (2.87-4.78)	4.10 (3.08-5.52)	4.70 (3.34-6.66)	5.18 (3.54-7.68)
30-min	0.986 (0.864-1.14)	1.19 (1.04-1.38)	1.47 (1.28-1.70)	1.70 (1.46-1.99)	2.02 (1.67-2.48)	2.28 (1.83-2.87)	2.55 (1.98-3.31)	2.84 (2.13-3.82)	3.25 (2.31-4.61)	3.59 (2.45-5.31)
60-min	0.696 (0.609-0.803)	0.841 (0.735-0.971)	1.03 (0.901-1.20)	1.20 (1.03-1.41)	1.43 (1.18-1.75)	1.61 (1.29-2.02)	1.80 (1.40-2.34)	2.00 (1.50-2.70)	2.29 (1.63-3.25)	2.53 (1.73-3.75)
2-hr	0.526 (0.460-0.607)	0.626 (0.546-0.722)	0.762 (0.664-0.883)	0.878 (0.756-1.03)	1.05 (0.862-1.28)	1.18 (0.948-1.49)	1.33 (1.03-1.72)	1.48 (1.11-2.00)	1.71 (1.22-2.43)	1.90 (1.30-2.81)
3-hr	0.446 (0.390-0.514)	0.527 (0.461-0.609)	0.641 (0.558-0.744)	0.739 (0.637-0.866)	0.881 (0.727-1.08)	0.996 (0.800-1.25)	1.12 (0.872-1.46)	1.26 (0.943-1.69)	1.45 (1.03-2.06)	1.62 (1.10-2.40)
6-hr	0.320 (0.280-0.369)	0.380 (0.332-0.439)	0.464 (0.404-0.538)	0.537 (0.462-0.629)	0.642 (0.529-0.786)	0.728 (0.584-0.915)	0.820 (0.638-1.06)	0.921 (0.691-1.24)	1.07 (0.760-1.51)	1.19 (0.811-1.76)
12-hr	0.211 (0.185-0.243)	0.258 (0.225-0.298)	0.322 (0.280-0.373)	0.377 (0.324-0.441)	0.454 (0.374-0.556)	0.516 (0.414-0.649)	0.582 (0.453-0.755)	0.652 (0.490-0.878)	0.752 (0.536-1.07)	0.834 (0.569-1.24)
24-hr	0.138 (0.127-0.152)	0.175 (0.161-0.193)	0.224 (0.206-0.248)	0.265 (0.242-0.295)	0.321 (0.285-0.369)	0.365 (0.319-0.427)	0.411 (0.352-0.491)	0.459 (0.383-0.561)	0.526 (0.423-0.666)	0.578 (0.452-0.754)
2-day	0.088 (0.081-0.097)	0.113 (0.104-0.125)	0.145 (0.134-0.161)	0.172 (0.157-0.192)	0.209 (0.185-0.240)	0.237 (0.207-0.277)	0.266 (0.227-0.317)	0.295 (0.247-0.361)	0.336 (0.271-0.426)	0.368 (0.288-0.480)
3-day	0.068 (0.062-0.075)	0.087 (0.080-0.096)	0.112 (0.103-0.125)	0.133 (0.121-0.148)	0.161 (0.143-0.185)	0.182 (0.159-0.213)	0.204 (0.174-0.243)	0.226 (0.189-0.277)	0.257 (0.207-0.325)	0.280 (0.219-0.366)
4-day	0.057 (0.052-0.062)	0.073 (0.067-0.081)	0.094 (0.086-0.104)	0.111 (0.101-0.124)	0.134 (0.119-0.154)	0.152 (0.132-0.177)	0.169 (0.145-0.202)	0.188 (0.157-0.229)	0.213 (0.171-0.269)	0.232 (0.181-0.302)
7-day	0.040 (0.037-0.045)	0.051 (0.047-0.057)	0.066 (0.061-0.073)	0.077 (0.071-0.086)	0.093 (0.083-0.107)	0.105 (0.092-0.123)	0.117 (0.100-0.139)	0.129 (0.108-0.158)	0.146 (0.118-0.185)	0.159 (0.124-0.207)
10-day	0.032 (0.029-0.035)	0.040 (0.037-0.045)	0.051 (0.047-0.057)	0.060 (0.055-0.067)	0.072 (0.064-0.083)	0.081 (0.071-0.095)	0.090 (0.077-0.108)	0.099 (0.083-0.122)	0.112 (0.090-0.142)	0.122 (0.095-0.159)
20-day	0.021 (0.019-0.023)	0.026 (0.024-0.029)	0.033 (0.031-0.037)	0.039 (0.036-0.044)	0.046 (0.041-0.053)	0.052 (0.045-0.061)	0.057 (0.049-0.068)	0.063 (0.052-0.076)	0.070 (0.056-0.088)	0.075 (0.059-0.098)
30-day	0.017 (0.015-0.019)	0.021 (0.020-0.024)	0.027 (0.025-0.030)	0.032 (0.029-0.035)	0.037 (0.033-0.043)	0.042 (0.036-0.049)	0.046 (0.039-0.055)	0.050 (0.042-0.061)	0.055 (0.045-0.070)	0.059 (0.046-0.077)
45-day	0.014 (0.013-0.015)	0.018 (0.016-0.019)	0.022 (0.020-0.025)	0.026 (0.024-0.029)	0.030 (0.027-0.035)	0.034 (0.029-0.039)	0.037 (0.031-0.044)	0.040 (0.033-0.049)	0.044 (0.035-0.055)	0.047 (0.036-0.061)
60-day	0.012 (0.011-0.013)	0.016 (0.014-0.017)	0.020 (0.018-0.022)	0.023 (0.021-0.025)	0.027 (0.024-0.031)	0.029 (0.026-0.034)	0.032 (0.027-0.038)	0.034 (0.029-0.042)	0.038 (0.030-0.048)	0.040 (0.031-0.052)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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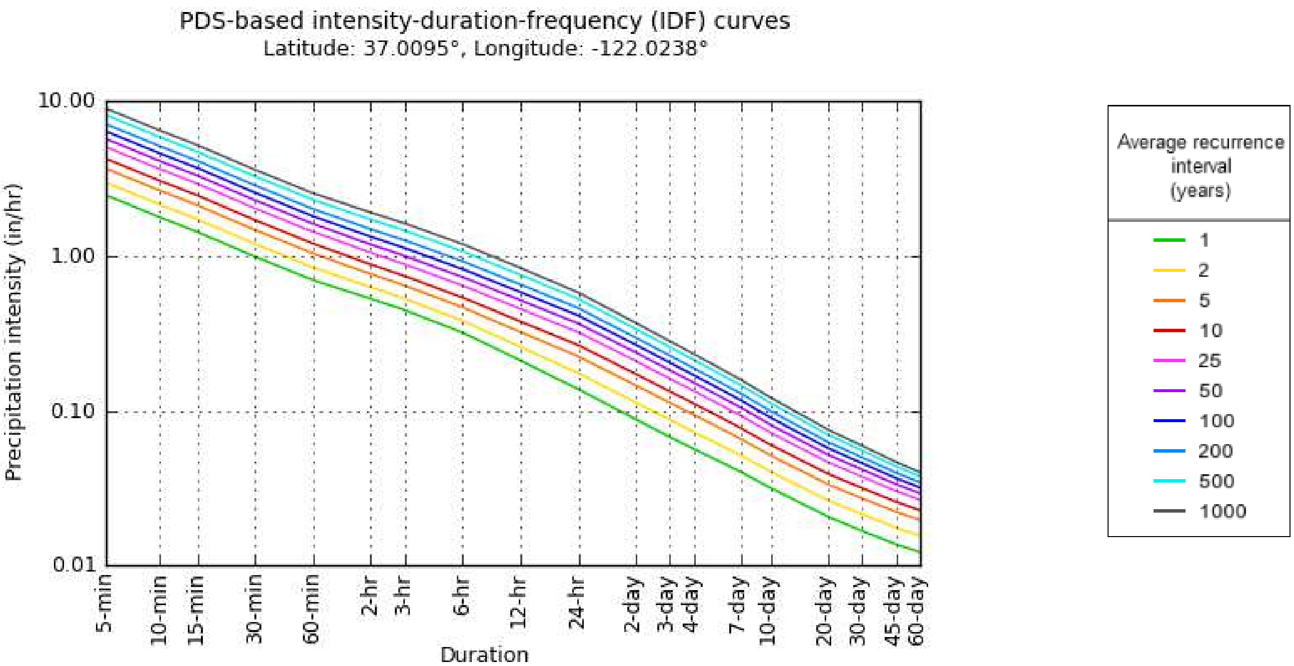
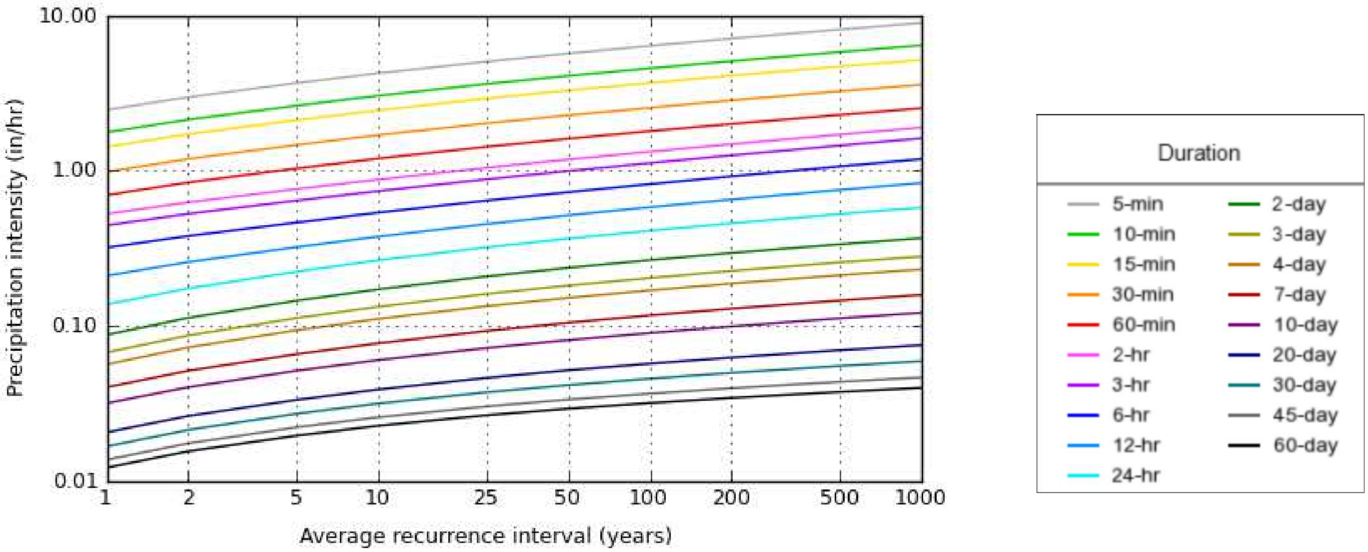
PF graphical





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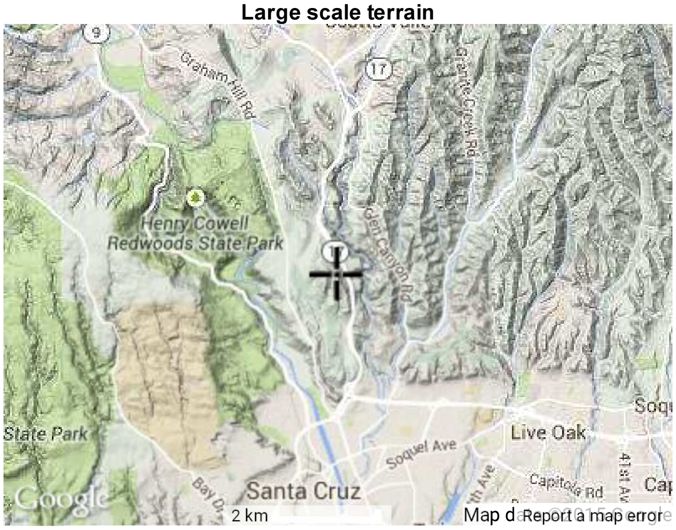
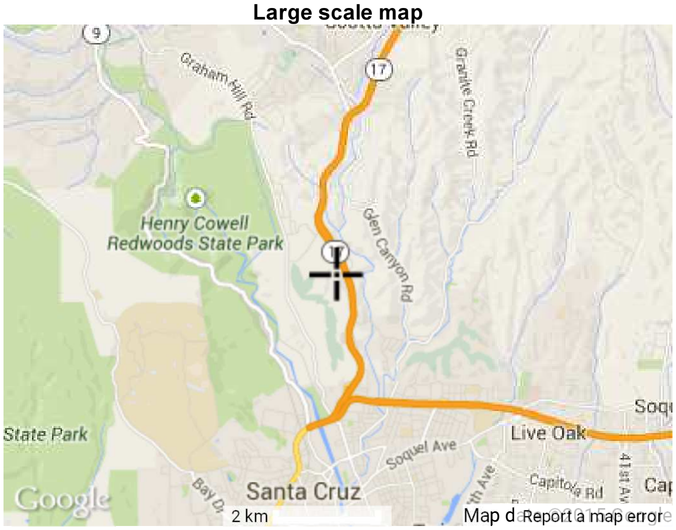
Maps & aerials

Small scale terrain

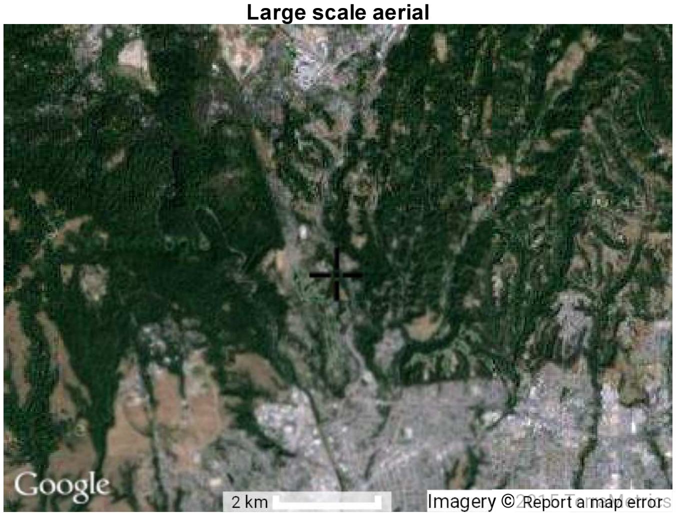
Large scale terrain



Large scale map



Large scale aerial



Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
05	SCr	17	0.7/1.38		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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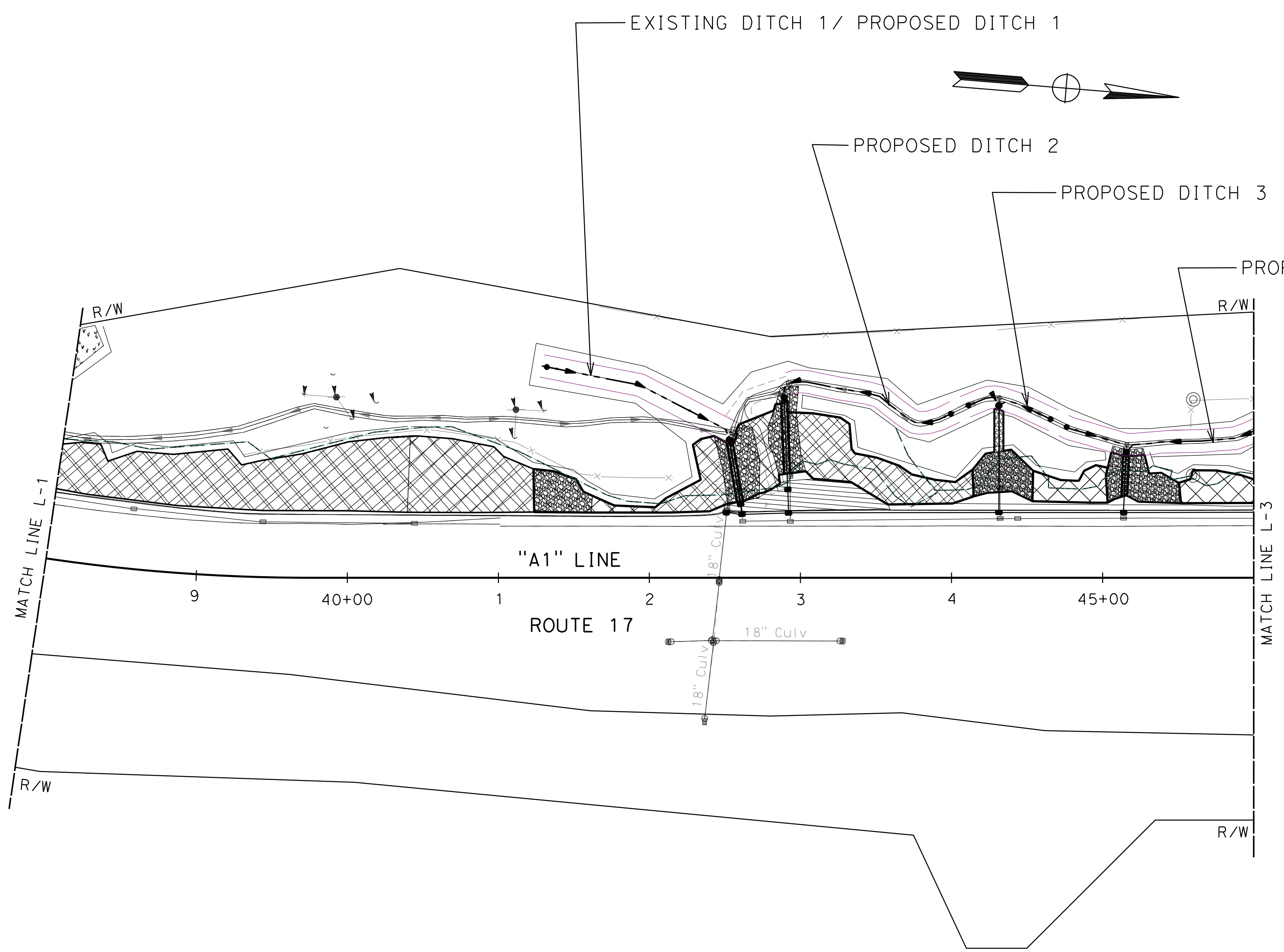
SUITE 108
WALNUT CREEK, CA 94596

NOTE:

FOR ACCURATE RIGHT OF WAY DATA, CONTACT RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.



LAYOUT

SCALE: 1'' = 50'

PRELIMINARY DESIGN-NOT FOR CONSTRUCTION

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET L-1

L-2

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

CALCULATED-DESIGNED BY: FLANNERY BANKS

CHECKED BY: GRANT WILCOX

REVISED BY: FB

DATE REVISED: 5/1/15

LAST REVISION: 04-03-15

DATE PLOTTED => 4/29/2015
TIME PLOTTED => 9:29:33 AM

BORDER LAST REVISED 7/2/2010

USERNAME => Eman_bidokhti
DGN FILE => ...\500600ea002.dgn

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

UNIT 0000

PROJECT NUMBER & PHASE 0500020290

NOTE:

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
05	SCr	17	0.7/1.38		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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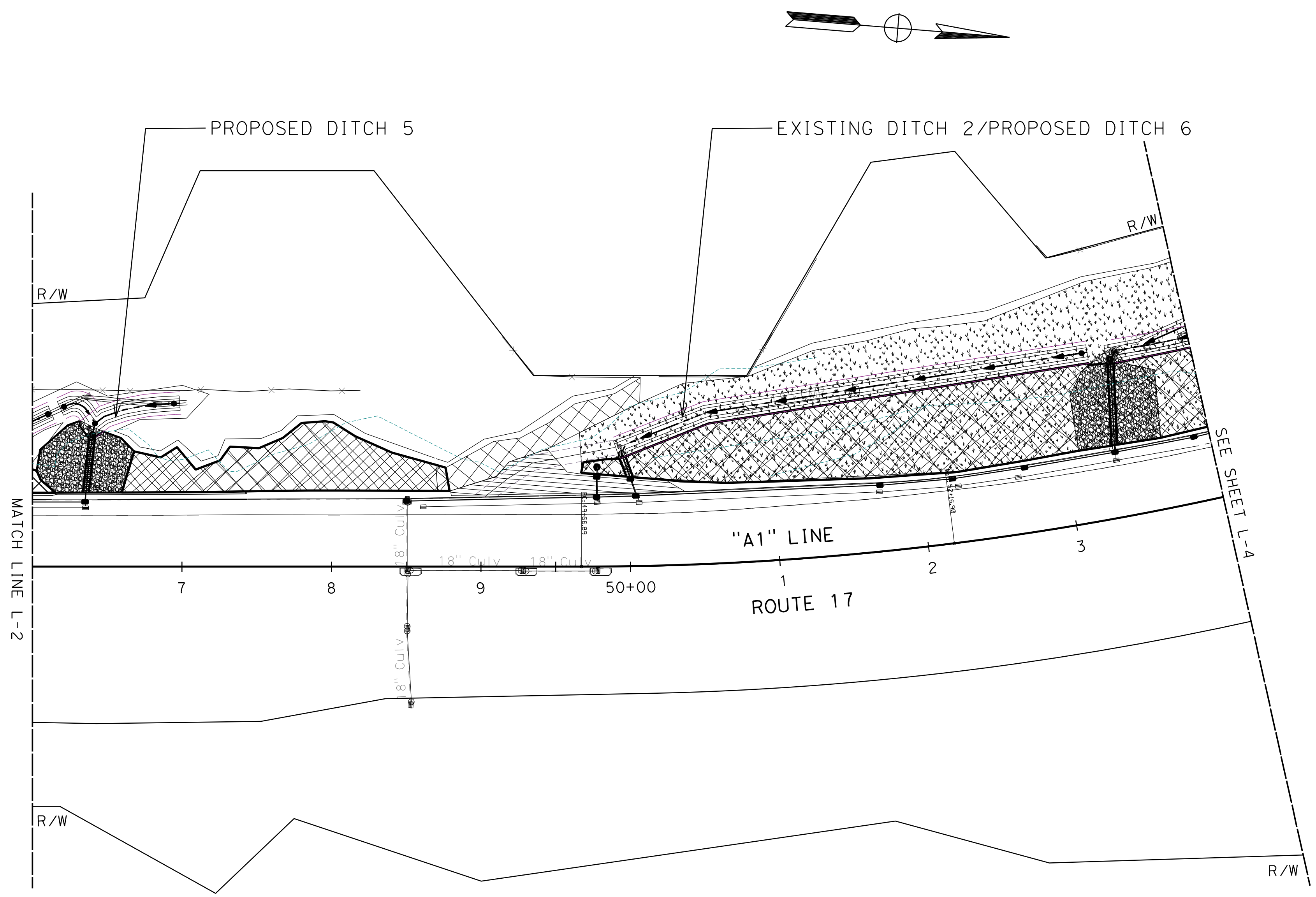

LAYOUT

SCALE: 1'' = 50'

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FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET L-1

L-3

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR	HAN-BIN LIANG	
CALCULATED-DESIGNED BY	FLANNERY BANKS	
CHECKED BY	GRANT WILCOX	
REVISED BY	FB	
DATE REVISED	5/1/15	

LAST REVISION 04-03-15 DATE PLOTTED => 4/29/2015 TIME PLOTTED => 9:38:23 AM

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
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SUITE 108
WALNUT CREEK, CA 94596

NOTE:

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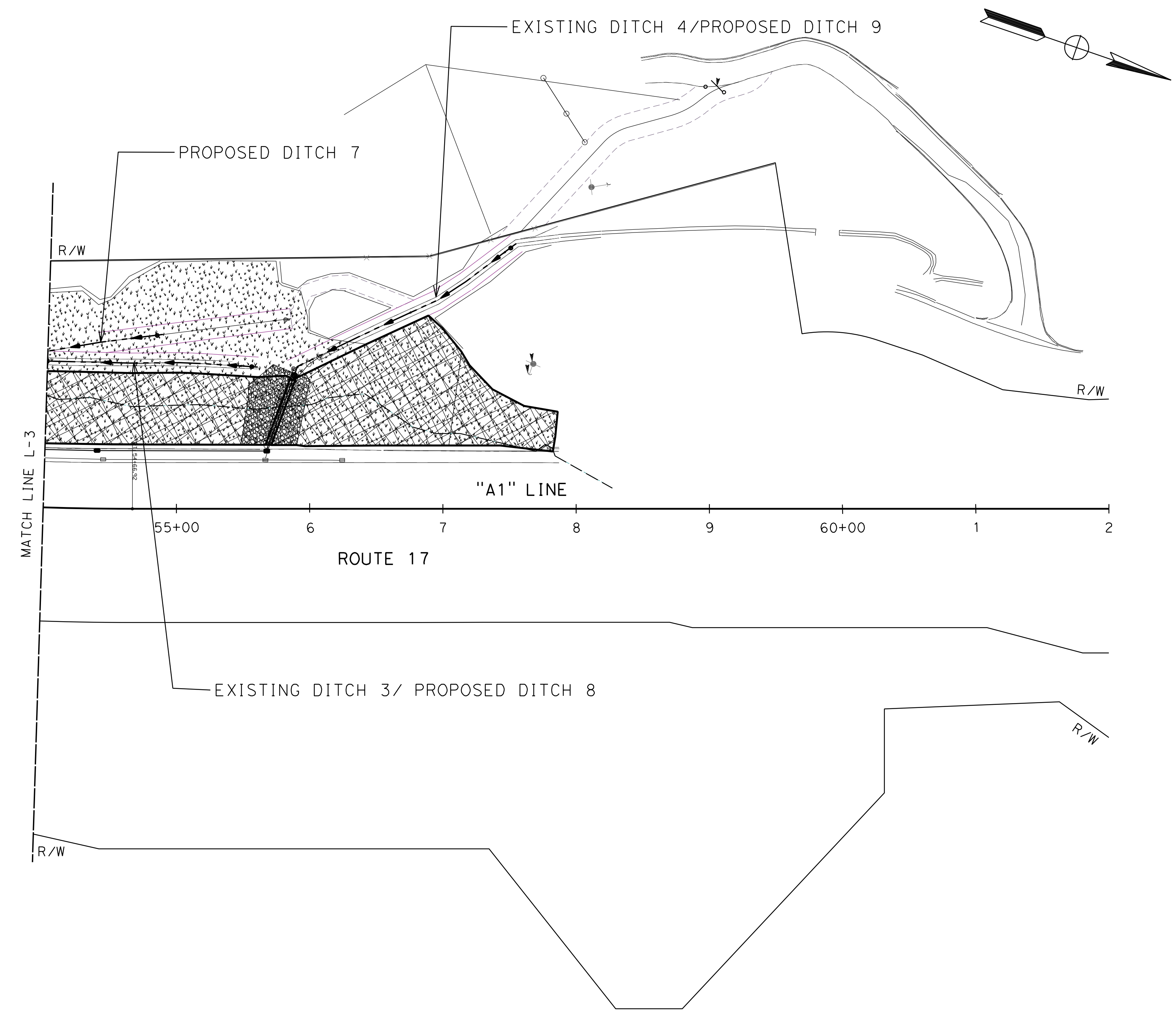

LAYOUT

SCALE: 1'' = 50'

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans®

CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	CHECKED BY	REVISED BY	DATE REVISED
HAN-BIN LIANG	FLANNERY BANKS	GRANT WILCOX	FB	5/1/15

PRELIMINARY DESIGN-NOT FOR CONSTRUCTION

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET L-1

L-4

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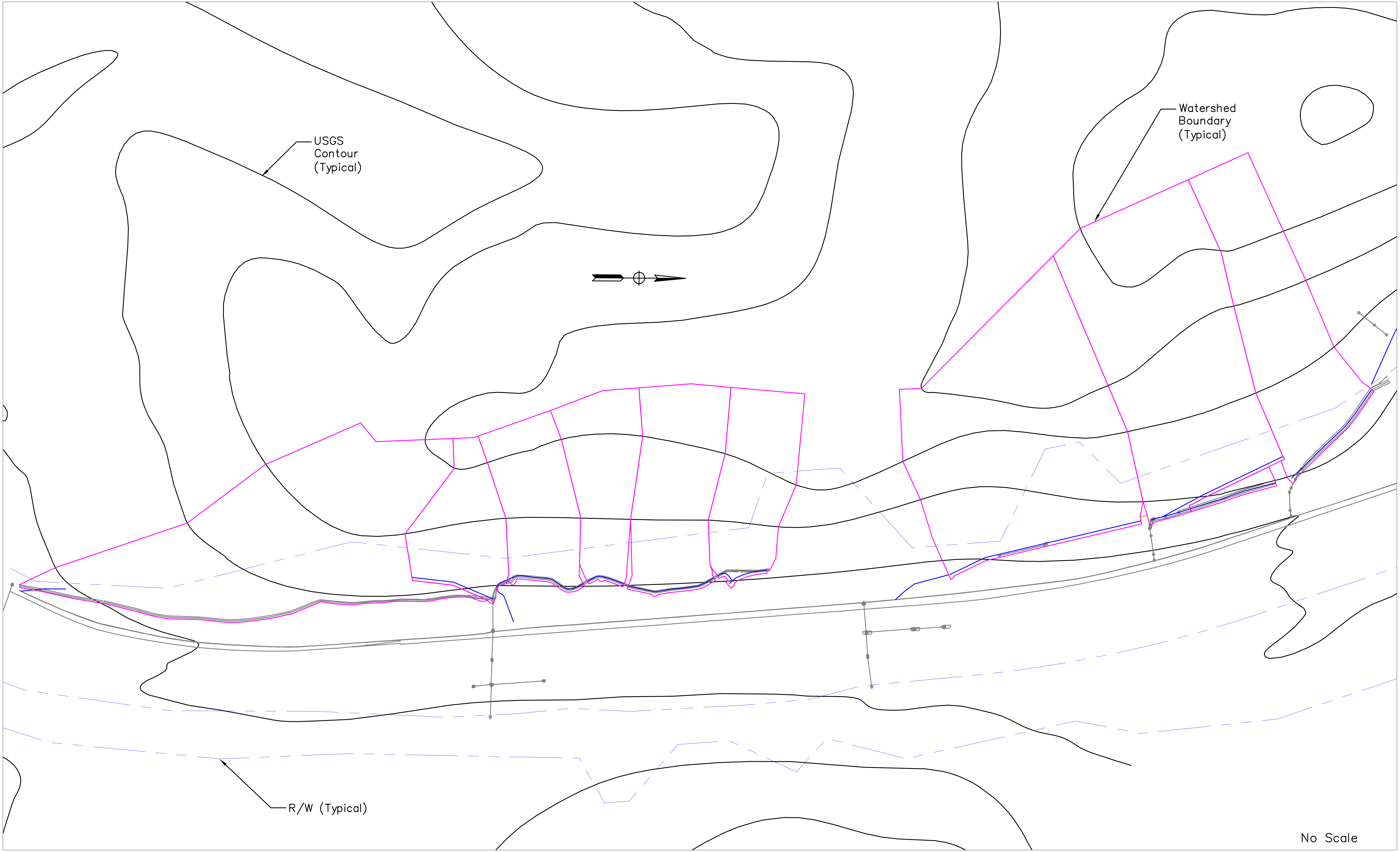

Off-site Watershed Map

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
05	SCr	17	0.7/1.38		

REGISTERED CIVIL ENGINEER 5-1-15 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER GRANT WILCOX No. 49875 Exp. 09-30-16 CIVIL STATE OF CALIFORNIA

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1243 ALPINE ROAD
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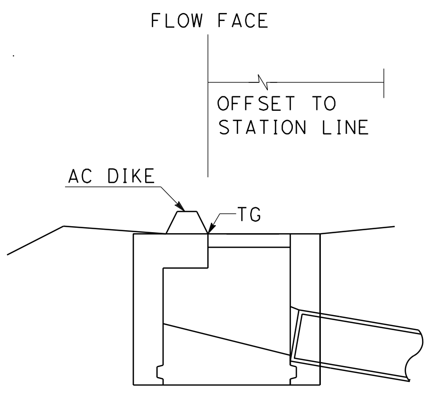

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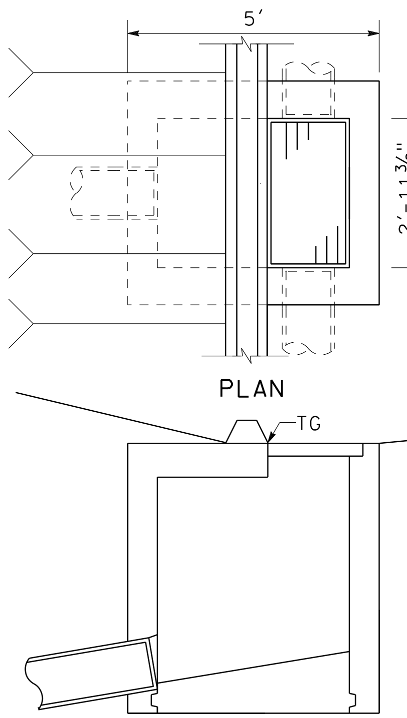

ELEVATION

G2 Mod DI

NOTE: FOR DETAILS NOT SHOWN, REFER TO CALTRANS STANDARD PLAN D73.

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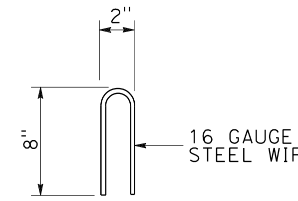

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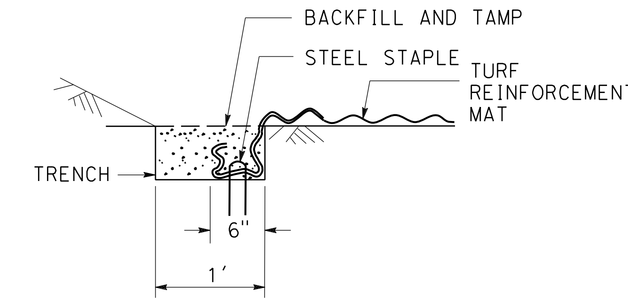

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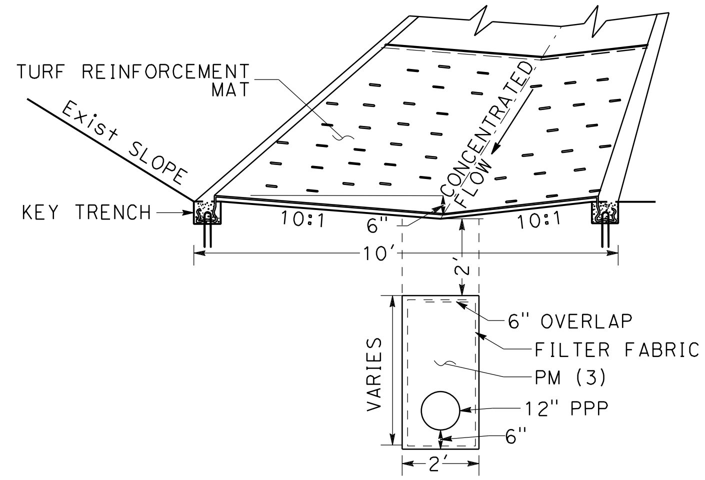
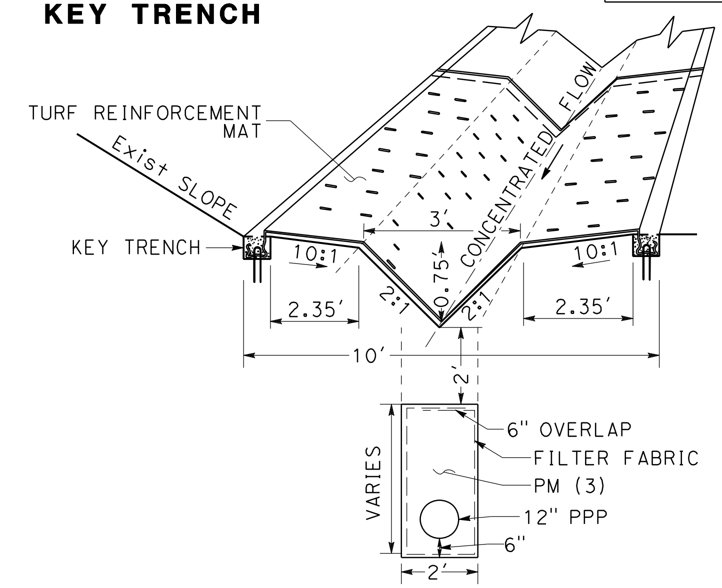


COMBINATION ACCESS ROAD/ DITCH TYPE 1

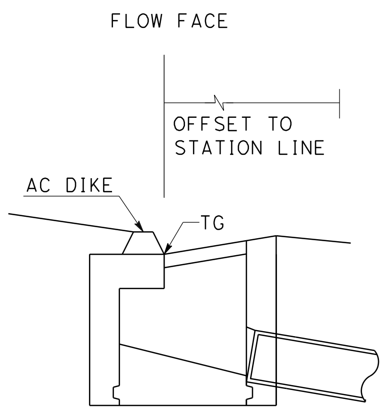


COMBINATION ACCESS ROAD/ DITCH TYPE 2

NOTE: DEPTH OF UNDERDRAIN TRENCHS TO BE DETERMINED IN THE FIELD. UNDERDRAIN WILL EXTEND ONE FOOT BELOW BEDROCK CONTACT OR 5′ Max DEPTH.

1 a 2 a 6 b

3 b 4 b 9 c 10 d 10 g 11 d



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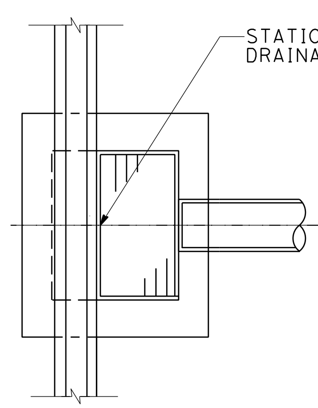
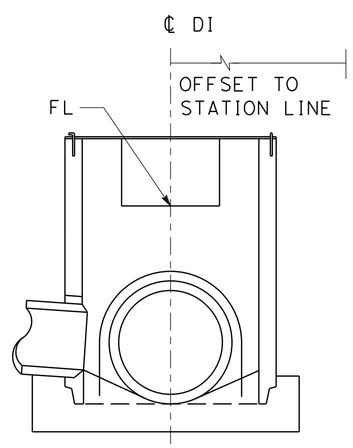
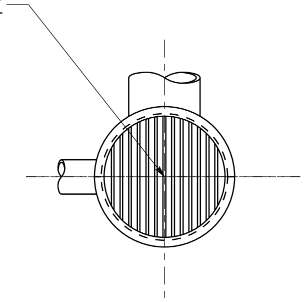


PLAN

INLET ADJACENT TO AC DIKE



ELEVATION



PLAN

OCPI DI

DRAINAGE UNIT	APPROXIMATE ℄ LOCATION	BEGIN FLOWLINE (Ft)	END FLOWLINE (Ft)	WIDTH (W)(Ft)	DEPTH (D)(Ft)	LENGTH (Ft)
1 a	140.21′ Lt "A1" 41+29 TO 93.10 Lt "A1" 42+52	356.91	335.97	10.0	0.5	135
2 a	121.28′ Lt "A1" 42+89 TO 109.76′ Lt "A1" 44+02	341.48	355.76	10.0	0.5	127
3 b	113.18′ Lt "A1" 44+09 TO 104.11′ Lt "A1" 44+68	355.97	356.50	10.0	0.5	63
4 b	100.86′ Lt "A1" 44+74 TO 103.13′ Lt "A1" 46+13	356.54	360.30	10.0	0.5	143
6 b	106.00′ Lt "A1" 46+19 TO 109.46′ Lt "A1" 46+99	360.35	368.28	10.0	0.5	95
9 c	77.18′ Lt "A1" 49+96 TO 112.92′ Lt "A1" 53+28	340.05	390.38	10.0	0.75	321
10 d	106.68′ Lt "A1" 53+44 TO 106.41′ Lt "A1" 55+61	386.45	398.26	10.0	0.75	212
10 g	110.13′ Lt "A1" 53+65 TO 130.83′ Lt "A1" 54+90	391.19	400.78	10.0	0.5	121
11 d	102.01′ Lt "A1" 55+89 TO 199.10′ Lt "A1" 57+55	399.34	415.17	10.0	0.75	194

DRAINAGE DETAIL

NO SCALE

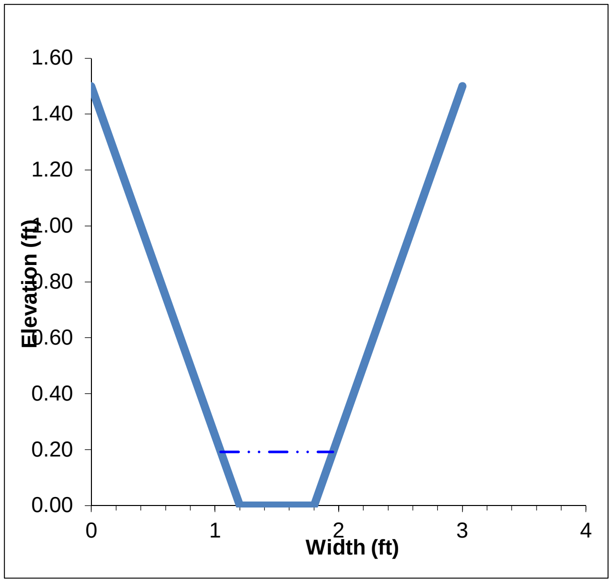
DD-1

PRELIMINARY DESIGN-NOT FOR CONSTRUCTION

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans
CONSULTANT FUNCTIONAL SUPERVISOR HAN-BIN LIANG
CALCULATED-DESIGNED BY FLANNERY BANKS
CHECKED BY GRANT WILCOX
REVISED BY FB
DATE REVISED 5/1/15
LAST REVISION 04-03-15
DATE PLOTTED => 4/29/2015
TIME PLOTTED => 8:49:56 AM

Normal Depth Calculations for Channels using Manning's Equation
Existing Ditch 1

Input Values		
Height	1.5	ft
Bottom Width	0.6	ft
LT Side Slope	0.8	:1 (h:v)
Rt Side Slope	0.8	:1 (h:v)
Mannings	0.015	
Slope	0.11	ft/ft
Design Flow	1.22	cfs



Normal Depth for Channel		
Depth	0.192	ft
Area	0.14	ft^2
Perimeter	1.09	ft
Rh	0.13	ft
V	8.43	ft/s
Q	1.22	cfs
Goal Seek	0.00	

Ditch Check		
Energy head (He)=	**1.29**	ft
Freeboard (0.2He)=	**0.26**	ft
Required Height (ft)	**0.45**	ft
Passing?	yes	

Ditch Information		
Ditch Length	140	ft
Travel Time	0.28	min
Time of Concentration	10.3	min

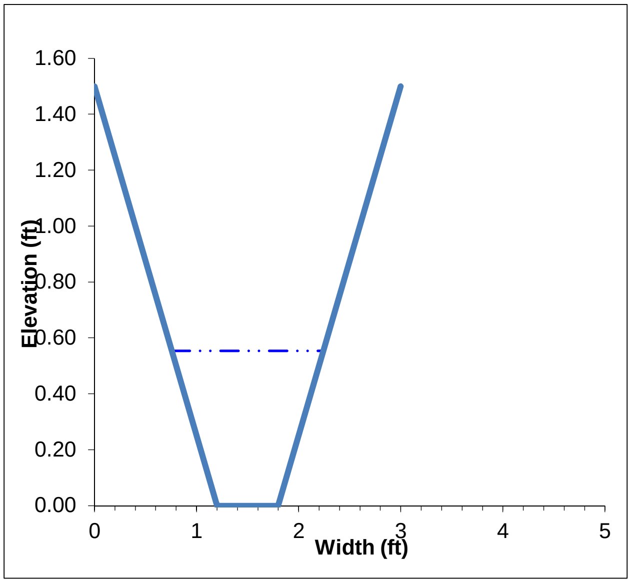
f

Watershed Information

	Upstream T_t (min)	**C**	**A (ac)**	**i (in./hr)**	**Q (cfs)**
Unpaved Area	10.0	0.53	0.65		
Total	10.3	0.53	0.65	3.54	1.22

Normal Depth Calculations for Channels using Manning's Equation
Existing Ditch 2

Input Values		
Height	1.5	ft
Bottom Width	0.6	ft
LT Side Slope	0.8	:1 (h:v)
Rt Side Slope	0.8	:1 (h:v)
Mannings	0.015	
Slope	0.05	ft/ft
Design Flow	5.32	cfs



Normal Depth for Channel		
Depth	0.553	ft
Area	0.58	ft^2
Perimeter	2.02	ft
Rh	0.29	ft
V	9.24	ft/s
Q	5.32	cfs
Goal Seek	0.00	

Ditch Check		
Energy head (He)=	**1.88**	ft
Freeboard (0.2He)=	**0.38**	ft
Required Height (ft)	**0.93**	ft
Passing?	yes	

Ditch Information		
Ditch Length	325	ft
Travel Time	0.59	min
Time of Concentration	10.3	min

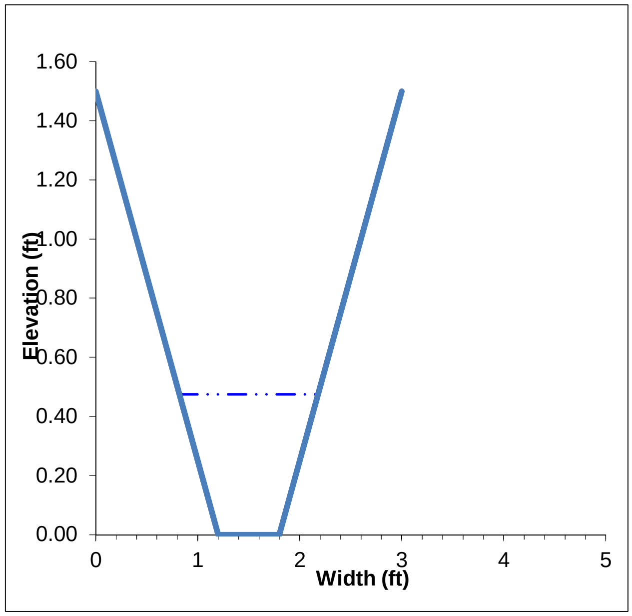
Watershed Information

	Upstream T_t (min)	**C**	**A (ac)**	**i (in./hr)**	**Q (cfs)**
Unpaved Area	9.7	0.53	2.84		
Total	10.3	0.53	2.84	3.54	5.32

Normal Depth Calculations for Channels using Manning's Equation
Existing Ditch 3

Input Values		
Height	1.5	ft
Bottom Width	0.6	ft
LT Side Slope	0.8	:1 (h:v)
Rt Side Slope	0.8	:1 (h:v)
Mannings	0.015	
Slope	0.07	ft/ft
Design Flow	5.07	cfs

Normal Depth for Channel		
Depth	0.482	ft
Area	0.48	ft^2
Perimeter	1.83	ft
Rh	0.26	ft
V	10.68	ft/s
Q	5.07	cfs
Goal Seek	0.00	



Ditch Check		
Energy head (He)=	**2.25**	ft
Freeboard (0.2He)=	**0.45**	ft
Required Height (ft)	**0.93**	ft
Passing?	yes	

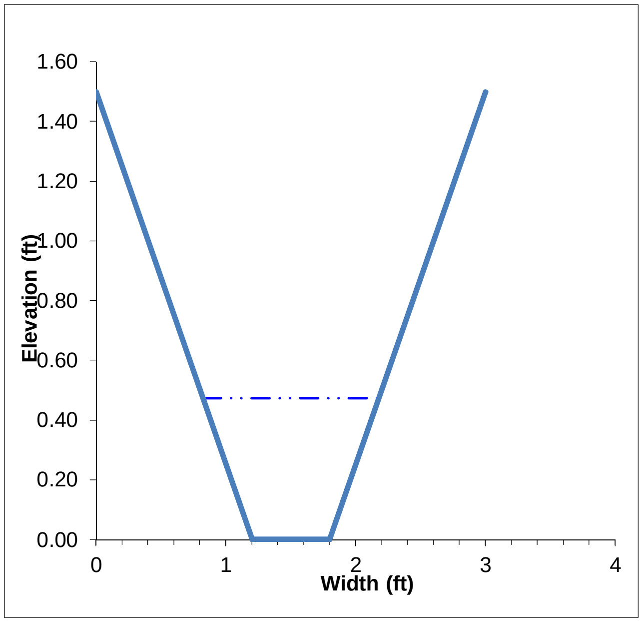
Ditch Information		
Ditch Length	213	ft
Travel Time	0.33	min
Time of Concentration	9.9	min

Watershed Information

	Upstream T_t (min)	**C**	**A (ac)**	**i (in./hr)**	**Q (cfs)**
Unpaved Area	9.6	0.53	2.66		
Total	9.9	0.53	2.66	3.60	5.07

Normal Depth Calculations for Channels using Manning's Equation
Existing Ditch 4

Input Values		
Height	1.5	ft
Bottom Width	0.6	ft
LT Side Slope	0.8	:1 (h:v)
Rt Side Slope	0.8	:1 (h:v)
Mannings	0.015	
Slope	0.08	ft/ft
Design Flow	2.77	cfs



Normal Depth for Channel		
Depth	0.340	ft
Area	0.30	ft^2
Perimeter	1.47	ft
Rh	0.20	ft
V	9.33	ft/s
Q	2.77	cfs
Goal Seek	0.00	

Ditch Check		
Energy head (He)=	**1.69**	ft
Freeboard (0.2He)=	**0.34**	ft
Required Height (ft)	**0.68**	ft
Passing?	yes	

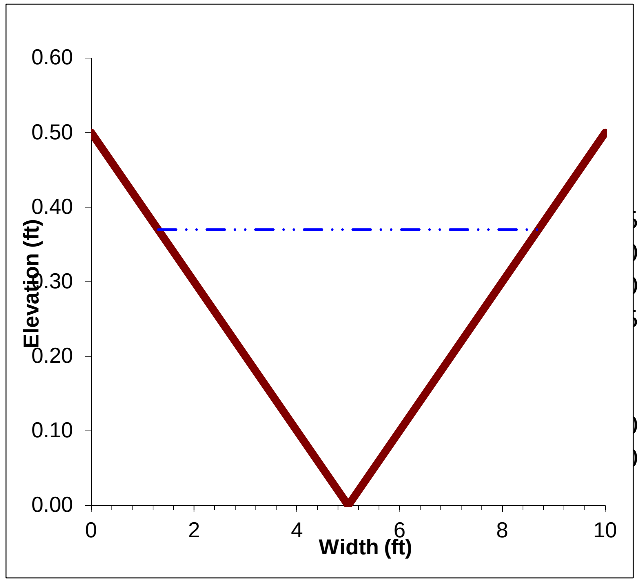
Ditch Information		
Ditch Length	200	ft
Travel Time	0.36	min
Time of Concentration	9.7	min

Watershed Information

	Upstream T_t (min)	C	A (ac)	i (in./hr)	Q (cfs)
Unpaved Area	9.3	0.53	1.43		
Total	9.7	0.53	1.43	3.65	2.77

Normal Depth Calculations for Channels using Manning's Equation
Proposed Ditch 1

Input Values		
Height	0.5	ft
Bottom Width	0	ft
LT Side Slope	10	:1 (h:v)
Rt Side Slope	10	:1 (h:v)
Mannings	0.2	
Slope	0.11	ft/ft
Design Flow	1.09	cfs



Normal Depth for Channel		
Depth	0.370	ft
Area	1.37	ft^2
Perimeter	7.43	ft
Rh	0.18	ft
V	0.80	ft/s
Q	1.09	cfs
Goal Seek	0.00	

Ditch Check		
Energy head (He)=	**0.38**	ft
Freeboard (0.2He)=	**0.08**	ft
Required Height (ft)	**0.45**	ft
Passing?	yes	

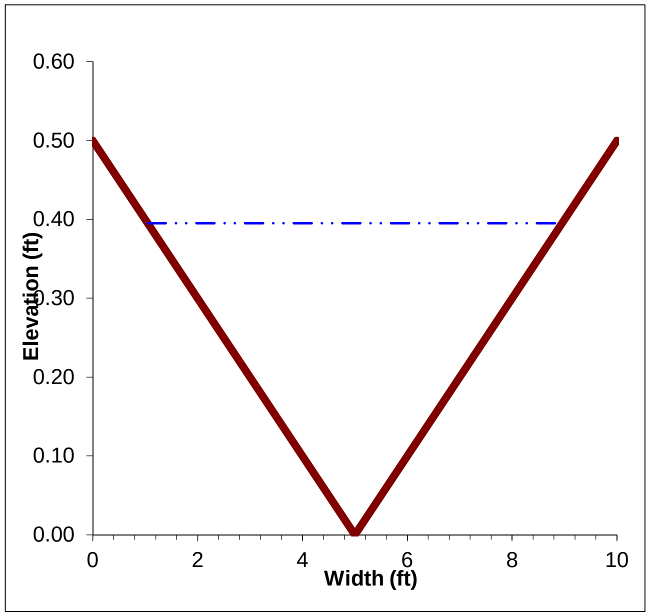
Ditch Information		
Ditch Length	140	ft
Travel Time	2.93	min
Time of Concentration	12.9	min

Watershed Information

	Upstream T_t (min)	**C**	**A (ac)**	**I (in/hr)**	**Q (cfs)**
Unpaved Area	9.9	0.53	0.65		
Total	12.9	0.53	0.65	3.17	1.09
			Low-flow ditch capacity		N/A
		Remainder for main ditch			N/A

Normal Depth Calculations for Channels using Manning's Equation
Proposed Ditch 2

Input Values		
Height	0.5	ft
Bottom Width	0	ft
LT Side Slope	10	:1 (h:v)
Rt Side Slope	10	:1 (h:v)
Mannings	0.2	
Slope	0.10	ft/ft
Design Flow	1.26	cfs



Normal Depth for Channel		
Depth	0.395	ft
Area	1.56	ft^2
Perimeter	7.94	ft
Rh	0.20	ft
V	0.81	ft/s
Q	1.26	cfs
Goal Seek	0.00	

Ditch Check		
Energy head (He)=	**0.41**	ft
Freeboard (0.2He)=	**0.08**	ft
Required Height (ft)	**0.48**	ft
Passing?	yes	

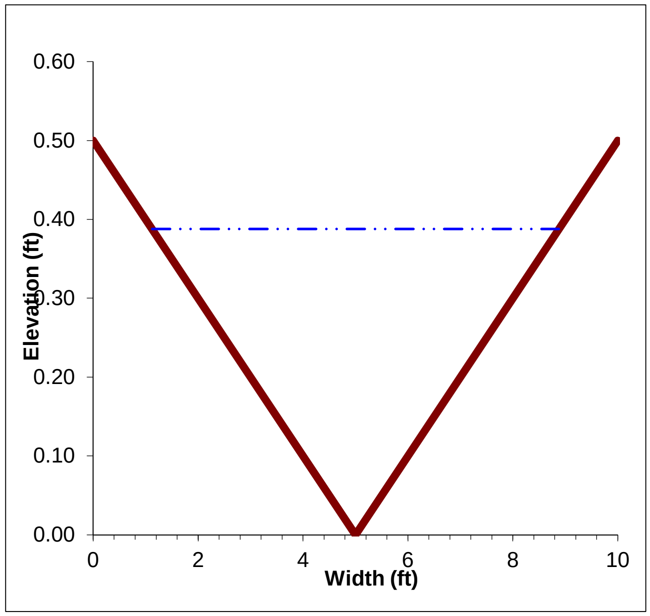
Ditch Information		
Ditch Length	130	ft
Travel Time	2.69	min
Time of Concentration	12.5	min

Watershed Information

	Upstream T_t (min)	**C**	**A (ac)**	**I (in/hr)**	**Q (cfs)**
Unpaved Area	9.8	0.53	0.74		
Total	12.5	0.53	0.74	3.21	1.26
			Low-flow ditch capacity		N/A
			Remainder for main ditch		N/A

Normal Depth Calculations for Channels using Manning's Equation
Proposed Ditch 5

Input Values		
Height	0.5	ft
Bottom Width	0	ft
LT Side Slope	10	:1 (h:v)
Rt Side Slope	10	:1 (h:v)
Mannings	0.2	
Slope	0.08	ft/ft
Design Flow	1.05	cfs



Normal Depth for Channel		
Depth	0.388	ft
Area	1.50	ft^2
Perimeter	7.80	ft
Rh	0.19	ft
V	0.70	ft/s
Q	1.05	cfs
Goal Seek	0.00	

Ditch Check		
Energy head (He)=	**0.40**	ft
Freeboard (0.2He)=	**0.08**	ft
Required Height (ft)	**0.47**	ft
Passing?	yes	

Ditch Information		
Ditch Length	100	ft
Travel Time	2.39	min
Time of Concentration	12.1	min

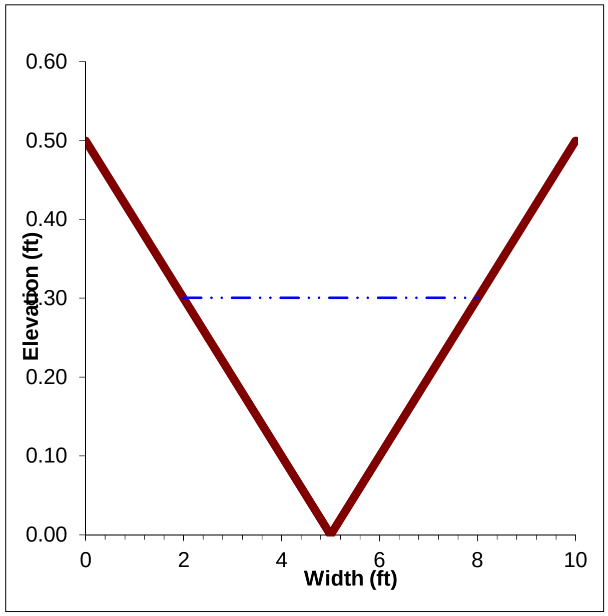
Watershed Information

	Upstream T_t (min)	**C**	**A (ac)**	**I (in/hr)**	**Q (cfs)**
Unpaved Area	9.8	0.53	0.61		
Total	12.1	0.53	0.61	3.26	1.05
			Low-flow ditch capacity		N/A
			Remainder for main ditch		N/A

Normal Depth Calculations for Channels using Manning's Equation
Proposed Ditch 3

Input Values		
Height	0.5	ft
Bottom Width	0	ft
LT Side Slope	10	:1 (h:v)
Rt Side Slope	10	:1 (h:v)
Mannings	0.2	
Slope	0.01	ft/ft
Design Flow	0.19	cfs

Normal Depth for Channel		
Depth	0.301	ft
Area	0.90	ft^2
Perimeter	6.04	ft
Rh	0.15	ft
V	0.21	ft/s
Q	0.19	cfs
Goal Seek	0.00	



Ditch Check		
Energy head (He)=	**0.30**	ft
Freeboard (0.2He)=	**0.06**	ft
Required Height (ft)	**0.36**	ft
Passing?	yes	

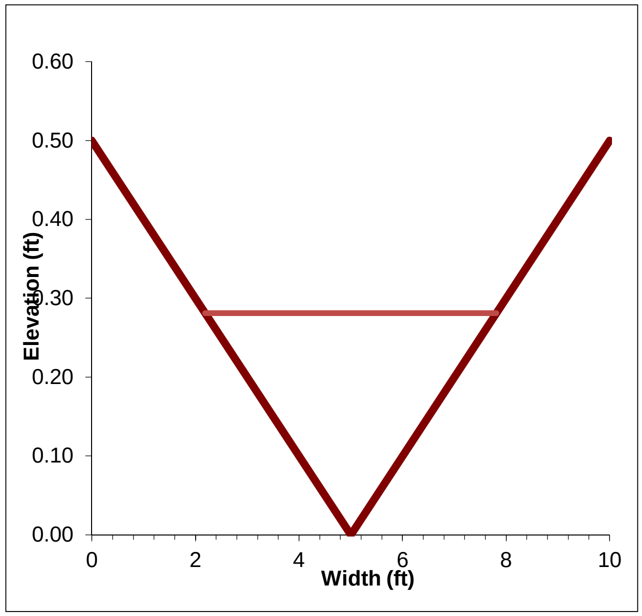
Ditch Information		
Ditch Length	36	ft
Travel Time	2.87	min
Time of Concentration	13.0	min

Watershed Information

	Upstream T_t (min)	**C**	**A (ac)**	**I (in/hr)**	**Q (cfs)**
Unpaved Area	10.1	0.53	0.36		
Total	13.0	0.53	0.36	3.15	0.59
		Low-flow ditch capacity			0.40
		Remainder for main ditch			0.19

Normal Depth Calculations for Channels using Manning's Equation
Proposed Ditch 4

Input Values		
Height	0.5	ft
Bottom Width	0	ft
LT Side Slope	10	:1 (h:v)
Rt Side Slope	10	:1 (h:v)
Mannings	0.2	
Slope	0.03	ft/ft
Design Flow	0.26	cfs



Normal Depth for Channel		
Depth	0.281	ft
Area	0.79	ft^2
Perimeter	5.65	ft
Rh	0.14	ft
V	0.33	ft/s
Q	0.26	cfs
Goal Seek	0.00	

Ditch Check		
Energy head (He)=	**0.28**	ft
Freeboard (0.2He)=	**0.06**	ft
Required Height (ft)	**0.34**	ft
Passing?	yes	

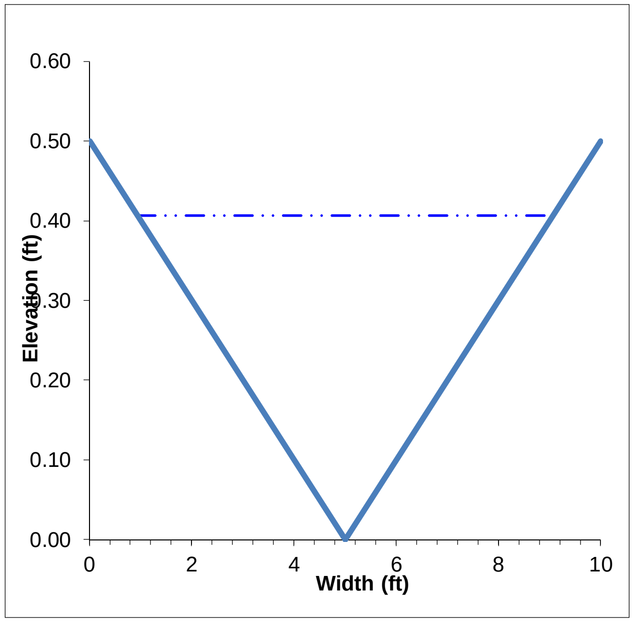
Ditch Information		
Ditch Length	140	ft
Travel Time	7.10	min
Time of Concentratio	17.6	min

Watershed Information

	Upstream T_t (min)	**C**	**A (ac)**	**I (in/hr)**	**Q (cfs)**
Unpaved Area	10.5	0.53	0.67		
Total	17.6	0.53	0.67	2.71	0.96
			Low-flow ditch capacity		0.70
		Remainder for main ditch			0.26

Normal Depth Calculations for Channels using Manning's Equation
Proposed Ditch 6

Input Values		
Height	0.5	ft
Bottom Width	0	ft
LT Side Slope	10	:1 (h:v)
Rt Side Slope	10	:1 (h:v)
Mannings	0.1	
Slope	0.15	ft/ft
Design Flow	3.29	cfs



Normal Depth for Channel		
Depth	0.407	ft
Area	1.66	ft^2
Perimeter	8.18	ft
Rh	0.20	ft
V	1.98	ft/s
Q	3.29	cfs
Goal Seek	0.00	

Ditch Check		
Energy head (He)=	**0.47**	ft
Freeboard (0.2He)=	**0.09**	ft
Required Height (ft)	**0.50**	ft
Passing?	no	

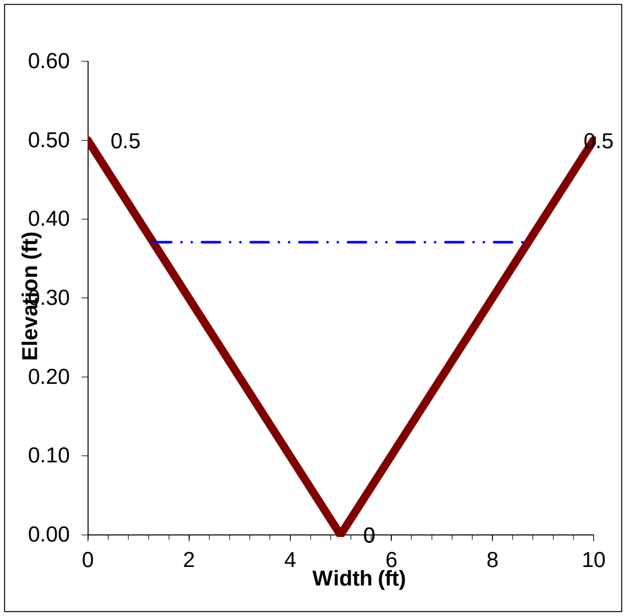
Ditch Information		
Ditch Length	325	ft
Travel Time	2.73	min
Time of Concentration	12.4	min

Watershed Information

	Upstream T_t (min)	C	A (ac)	I (in/hr)	Q (cfs)
Unpaved Area	9.7	0.53	2.84		
Total	12.4	0.53	2.84	3.22	4.85
			Low-flow ditch capacity		1.56
			Remainder for main ditch		3.29

Normal Depth Calculations for Channels using Manning's Equation
Proposed Ditch 7

Input Values		
Height	0.5	ft
Bottom Width	0	ft
LT Side Slope	10	:1 (h:v)
Rt Side Slope	10	:1 (h:v)
Mannings	0.2	
Slope	0.03	ft/ft
Design Flow	0.58	cfs



Normal Depth for Channel		
Depth	0.371	ft
Area	1.38	ft^2
Perimeter	7.45	ft
Rh	0.18	ft
V	0.42	ft/s
Q	0.58	cfs
Goal Seek	0.00	

Ditch Check		
Energy head (He)=	**0.37**	ft
Freeboard (0.2He)=	**0.07**	ft
Required Height (ft)	**0.45**	ft
Passing?	yes	

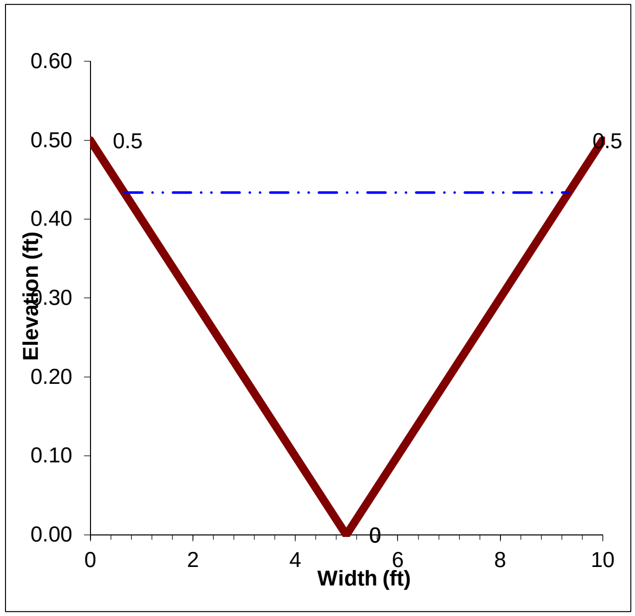
Ditch Information		
Ditch Length	75	ft
Travel Time	2.96	min
Time of Concentration	12.4	min

Watershed Information

	Upstream T_t (min)	C	A (ac)	I (in/hr)	Q (cfs)
Unpaved Area	9.5	0.53	0.75		
Total	12.4	0.53	0.75	3.22	1.28
			Low-flow ditch capacity		0.70
			Remainder for main ditch		0.58

Normal Depth Calculations for Channels using Manning's Equation
Proposed Ditch 8

Input Values		
Height	0.5	ft
Bottom Width	0	ft
LT Side Slope	10	:1 (h:v)
Rt Side Slope	10	:1 (h:v)
Mannings	0.15	
Slope	0.05	ft/ft
Design Flow	1.56	cfs



Normal Depth for Channel		
Depth	0.434	ft
Area	1.88	ft^2
Perimeter	8.72	ft
Rh	0.22	ft
V	0.83	ft/s
Q	1.56	cfs
Goal Seek	0.00	

Ditch Check		
Energy head (He)=	**0.44**	ft
Freeboard (0.2He)=	**0.09**	ft
Required Height (ft)	**0.52**	ft
Passing?	no	

Ditch Information		
Ditch Length	213	ft
Travel Time	4.29	min
Time of Concentrati	13.8	min

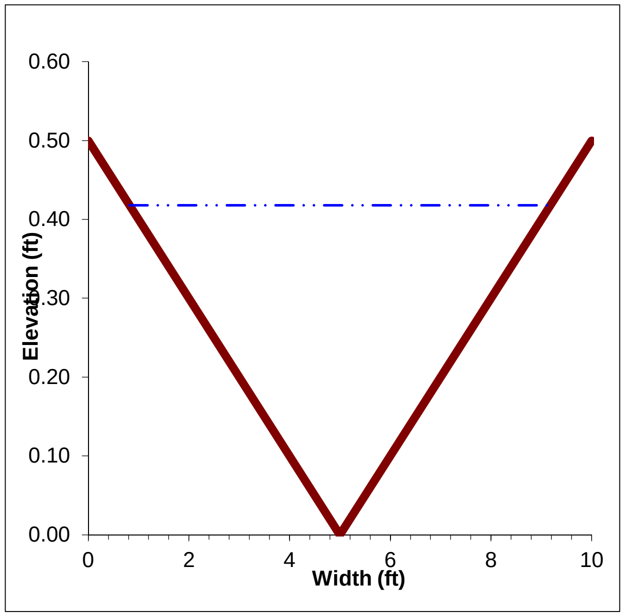
Watershed Information

	Upstream T_t (min)	**C**	**A (ac)**	**I (in/hr)**	**Q (cfs)**
Unpaved Area	9.5	0.53	1.52		
Total	13.8	0.53	1.52	3.05	2.46
			Low-flow ditch capacity		0.90
			Remainder for main ditch		1.56

Normal Depth Calculations for Channels using Manning's Equation
Proposed Ditch 9

Input Values		
Height	0.5	ft
Bottom Width	0	ft
LT Side Slope	10	:1 (h:v)
Rt Side Slope	10	:1 (h:v)
Mannings	0.2	
Slope	0.07	ft/ft
Design Flow	1.22	cfs

Normal Depth for Channel		
Depth	0.418	ft
Area	1.75	ft^2
Perimeter	8.40	ft
Rh	0.21	ft
V	0.70	ft/s
Q	1.22	cfs
Goal Seek	0.00	

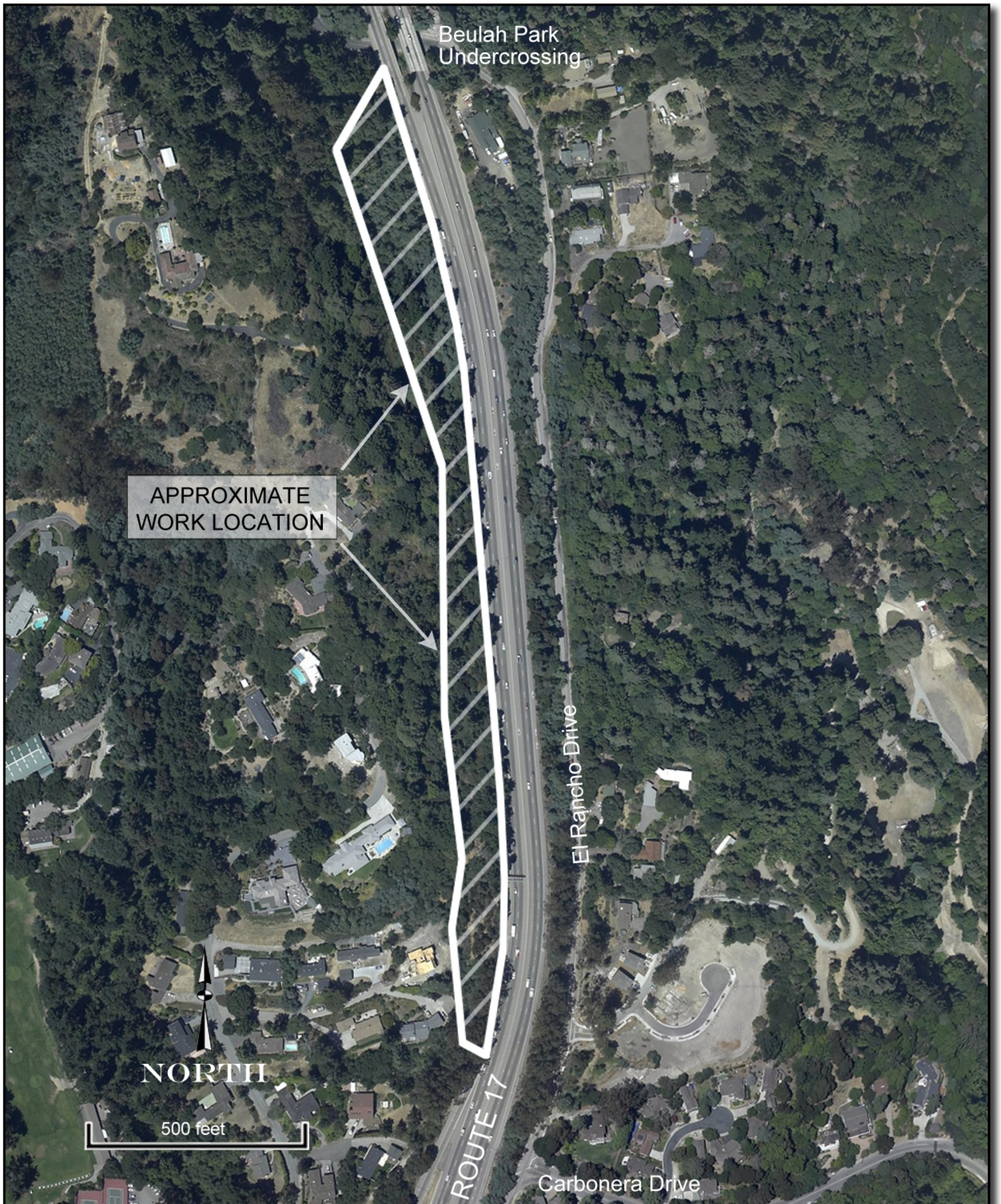


Ditch Check		
Energy head (He)=	**0.43**	ft
Freeboard (0.2He)=	**0.09**	ft
Required Height (ft)	**0.50**	ft
Passing?	no	

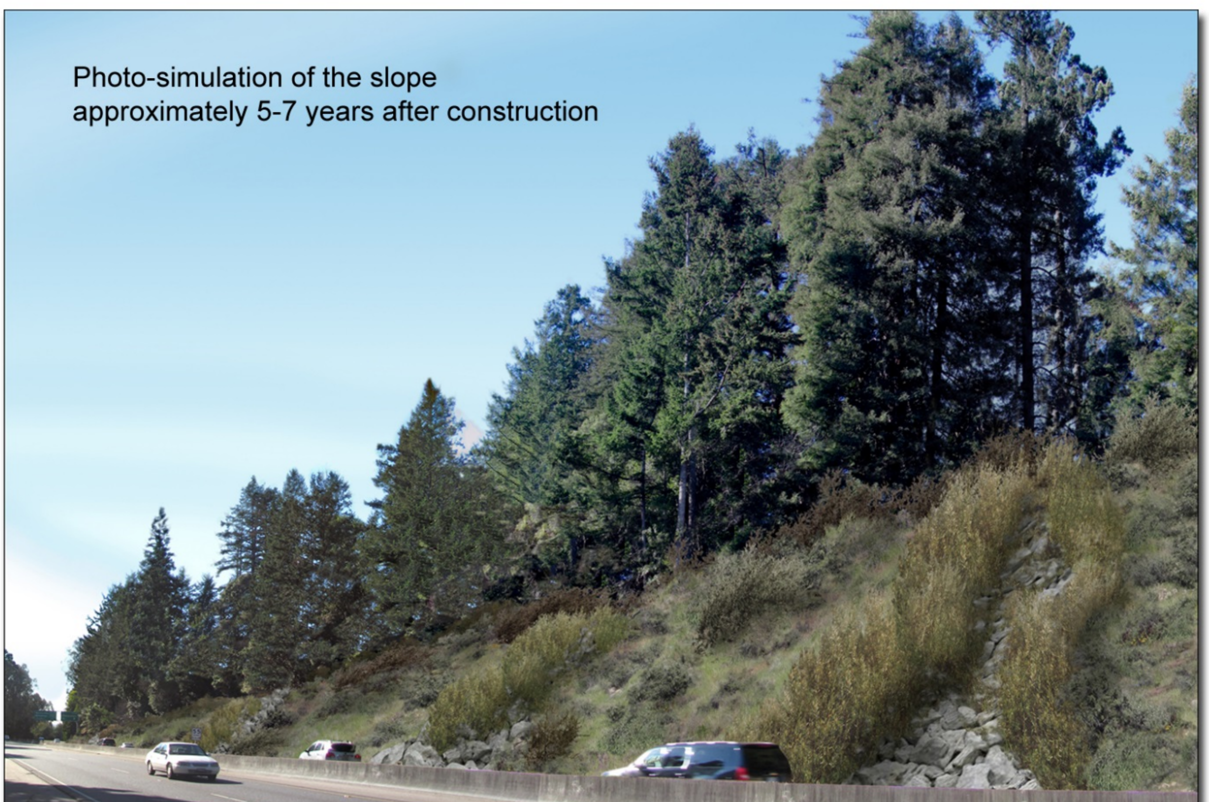
Ditch Information		
Ditch Length	200	ft
Travel Time	4.76	min
Time of Concentrati	14.1	min

Watershed Information

	Upstream T_t (min)	**C**	**A (ac)**	**I (in/hr)**	**Q (cfs)**
Unpaved Area	9.4	0.53	1.43		
Total	14.1	0.53	1.43	3.02	2.29
			Low-flow ditch capacity		1.07
		Remainder for main ditch			1.22



Rocks placed in a natural form, referee sample



Route 17 Sediment Control Project

View of the southern portion of the project slope

Rocks placed in a natural form, referee sample

Route 17 Sediment Control Project

View of the northern portion of the project slope.

Rocks placed in a natural form, referee sample

Photo 1. Representative Photo of Existing Concrete Ditch.

Photo 2. Representative Photo of Acacia on slope.

SCOTTS VALLEY
WATER DISTRICT

January 15, 2016

T.Y. Lin International
Kevin M Bewsey P.E.
1601 Response Rd, Suite 260
Sacramento, CA 95815

Dear Mr. Bewsey,

We received your request for the Scotts Valley Water District to supply recycled bulk water to the Caltrans project to improve slope stability along southbound Highway 17 between La Madrona Drive Undercrossing and the Pasatiempo Overcrossing.

Currently, Scotts Valley Water District can produce up to 1 MGD of Title 22 unrestricted use quality water that is approved by the Regional Water Quality Control Board Division of Drinking Water for use for construction purposes. We are able to supply the 520,000 gallons of water that are required for construction activities along Highway 17.

There are currently five recycled water 4" wharf hydrants at different locations in Scotts Valley. Recycled bulk water to be used outside of the city limits is billed at a flat rate of $8.84 per 1,000 gallons, which is in effect until 12/14/16 and subject to annual renewal. In addition to the charge for water use, the District requires the following:

- A deposit of $1,000 for a recycled bulk meter
- A recycled bulk water permit (application attached)
- Contractor attendance at a training for distribution of recycled water
- Purple recycled water stickers (provided by the District) to be affixed to all bulk water tanks and containers, visible at water supply outlets

Please let me know if you have any additional questions.

Sincerely,

David McNair
dmcnair@svwd.org
831-600-1905

Scotts Valley Water District
2 Civic Center Drive · Scotts Valley, CA 95066-1459
Phone: (831) 438-2363 · *Fax:* (831) 438-6235
contact@svwd.org

METER #____________________________ BRAND ___________________________________

START READ _______________________

POTABLE AND RECYCLED BULK WATER PERMIT

NAME ____

MAILING ADDRESS ____

____

DATE______________________________ PHONE ____________________________

IS AUTHORIZED TO USE **POTABLE______ RECYCLED______** BULK WATER FOR THE PROJECT

LOCATED AT ____

ESTIMATED DATES FROM_______________________TO _________________________________

TANKER SIZE_____________________________LICENSE _________________________________

DEPOSIT OF $1,000 FOR A POTABLE or RECYCLED METER, RECEIVED ON:__________AND

DEPOSIT OF $1,000 FOR POTABLE WATER USAGE, RECEIVED ON _______________________

IS HEREBY ACKNOWLEDGED BY ____
Scott Valley Water District Representative

<u>PENALTY</u> It is understood and agreed that failure to report usage on the 28th of each month, or use if bulk water at any other than the above designated project, and to display this permit in the truck or on site at all times while drawing water, will result in forfeiture of all deposits and loss of the permit. Failure to comply will result in criminal prosecution, to the maximum extent allowable under law.

CUSTOMER AUTHORIZED SIGNATURE ____

TITLE ____

The District is granting permits for the use of potable and recycled bulk water. Recycled water is to be used solely for construction and landscaping purposes. The following rules and regulations for the extraction and use of bulk water must be strictly adhered to. Failure to do so may result in the loss of deposits and privileges to acquire bulk water from the district.

Potable bulk water may be used only within the boundaries of the Scotts Valley Water District; recycled bulk water may be used inside and outside the boundaries of the District.

Bulk water must be drawn through the meter from the hydrant that it is assigned. It shall be unlawful to operate the valve of any hydrant other than by use of a spanner wrench designed for that purpose. Water must be drawn from the meter at a flow rate no greater than 400 gallons per minute, and may be drawn only during daylight hours. Tampering with any hydrant or unauthorized use of water therefrom, shall constitute a misdemeanor, punishable by law.

The customer shall use reasonable care to prevent damage to the meter and all facilities belonging to the District. If the meter or other facilities are damaged, the cost of repairs shall be borne by the customer, unless the damage occurs after the customer had provided the District with 48 hours written notice to remove the temporary facilities.

A deposit of $1000.00 for water usage for potable water and a deposit of $1,000.00 for a potable or recycled meter is required at the time the permit is issued. Deposits are non-negotiable. The deposit may be refunded only at such time as the meter has been returned to the District in good working order, or less the cost to repair the meter. Furthermore, the deposit may be refunded less any outstanding balance for water consumption or past due payments on the account.

Potable bulk water is billed in accordance with the current rate structure as follows:
Monthly basic service fee = $207.49
Water Consumption Rates per thousand gallons:

0 – 3,000 gallons	= $3.70/1000 gallons
3,001 – 7,000	= $6.21
7,001 – 15,000	= $8.01
15,001 – 25,000	= $9.66
25,001 – 50,000	= $12.36
OVER 50,000	= $13.97

Recycled bulk water is billed at a flat rate which is in effect until 12/14/2016 and subject to annual renewal:
Customers inside the City: $7.07/1000 gallons
Customers outside the City: $8.84/1000 gallons

Bulk water meter customers are required to call in the meter reads on the 28th day of each month. Payment in full must be made within 30 days of the billing.

I have read, understand, and agree to adhere to, the above rules and regulations regarding my responsibility as a bulk water customer of Scotts Valley Water District.

Signature____ Date___________________________

Printed Name____

Company ____

ACZ-350™

PORTABLE TL-2 & TL-3 END TREATMENT

EASY CLEAN-UP
NARROW PROFILE
MINIMUM INTRUSION
LOW COST/ AFFORDABLE
QUICK/EASY TO MOVE

OVERVIEW

The ACZ-350 System combines ease of use and NCHRP 350, gating, non-redirective TL-2 and TL-3 crash cushion performance for work zone protection. This partially reuseable crash cushion can be easily transported, and installed with No Roadway Anchors.

SUPERIOR IMPACT PERFORMANCE

The unique design of the ACZ-350 systems protects errant drivers from impacting concrete barrier ends, and also contains the errant vehicle from vaulting into the workzone.

FEATURES AND BENEFITS

- ➜ No Vaulting
- ➜ Safely contains errant vehicle
- ➜ Accommodates impacts up to 2,000 kg, (4,500 lbs) traveling at speeds up to 100 km/h (62 mph)
- ➜ Simple and Fast Installation
- ➜ Protects Permanent or Temporary, Steel or Concrete Barrier
- ➜ Ideal for Work Zones
- ➜ No Foundation or Anchoring

NON-REDIRECTIVE, GATING CRASH CUSHION SYSTEM

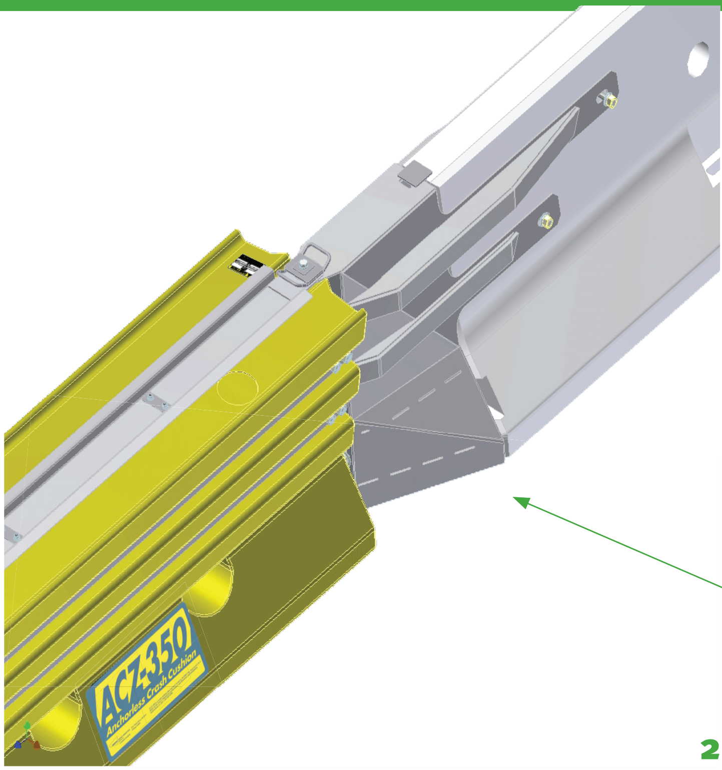
All Crash Cushions defined as Non-redirective and Gating require a clear zone. Clear Zones are areas behind the crash cushion that NO workers, machinery, obstructions or other debris could interfere with an errant vehicle. This area should also remain relatively flat. If there are any questions or concerns, please contact your local Energy Absorption Systems, Inc. representative.

ENERGY ABSORPTION SYSTEMS, INC.

SAVING LIVES BY DESIGN®

www.energyabsorption.com

ACZ-350™

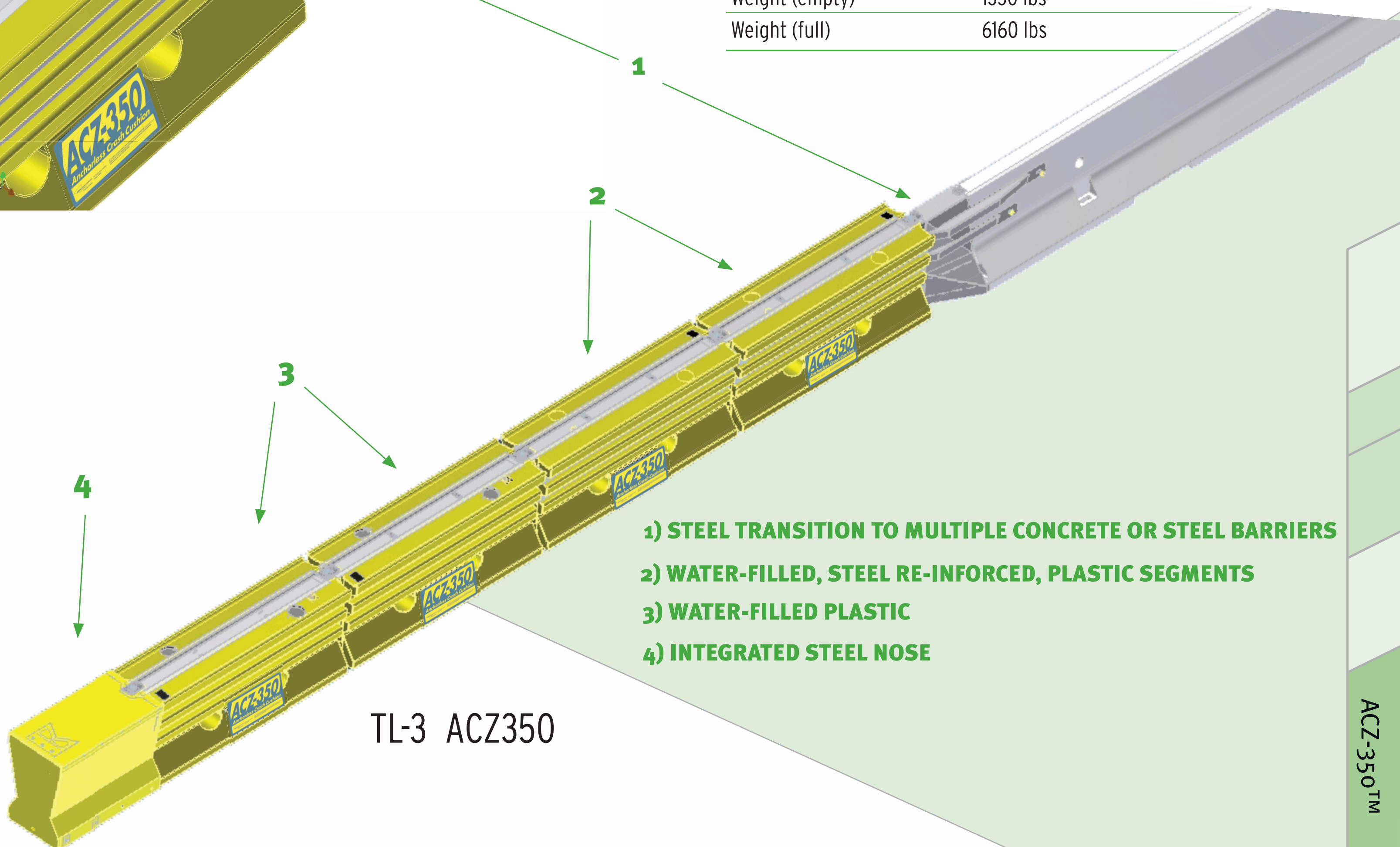


EASY DEPLOYMENT AND REMOVAL

The ACZ-350 System can be easily unloaded and positioned without cranes or heavy equipment. Deployment involves three simple steps:

1. Unload
2. Position and pin barrier sections.
3. Fill Segments with water

SPECIFICATIONS	TL-3
Length	31'-7" (9.6 m)
Width	1'-10" (.6m)
Height	2' 9" (.8m)
Weight (empty)	1350 lbs
Weight (full)	6160 lbs



1) STEEL TRANSITION TO MULTIPLE CONCRETE OR STEEL BARRIERS

2) WATER-FILLED, STEEL RE-INFORCED, PLASTIC SEGMENTS

3) WATER-FILLED PLASTIC

4) INTEGRATED STEEL NOSE

ACZ-350™

DISTRIBUTED BY:

Quixote Transportation Safety

www.quixtrans.com

35 East Wacker Drive • Chicago, IL 60601
Tel: (312) 467-6750 • Fax: (312) 467-9625
www.energyabsorption.com

ENERGY ABSORPTION SYSTEMS, INC.

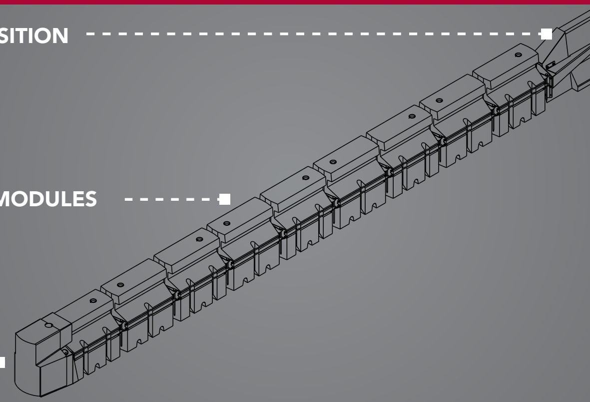
ABSORB 350® | NON-REDIRECTIVE CRASH CUSHION - SACRIFICIAL

- ANCHORLESS INSTALLATION - NO FOUNDATION REQUIRED
- COST EFFECTIVE PROTECTION FROM CONCRETE BARRIER ENDS
- WORLDWIDE PROVEN PERFORMANCE
- NCHRP 350 ACCEPTED

BARRIER SYSTEMS®
BY LINDSAY

PHYSICAL SPECIFICATIONS

Classification	NR-S	
TL-3 Length	32′	9.7 m
Width	24″	610 mm
Height	32″	813 mm
Module Weight Empty	110 lb.	50 kg
Test Level	NCHRP 350	TL 1/2/3



NARROW ANCHORLESS WATER FILLED CRASH CUSHION

No ground anchoring, the largest selection of transitions and modular technology allow the ABSORB 350 System to be used in multiple speed conditions. The ABSORB 350 System is ideal for contractors due to the ease of maintenance after an impact and quick deployment. At 24″ (610 mm) wide, it is ideally suited for narrow areas where road and workspace is limited. The ABSORB 350 System is easy to restore after an impact because the System uses uniform modular components. The use of standardized modular components also helps to reduce inventory costs.

FREQUENTLY ASKED QUESTIONS

Can the nose be angled off the barrier to better face traffic?
Yes, as long as all of the ABSORB 350 modules remain pinned and connected. For larger angles, it is recommended that the last barrier section be moved to face traffic.

Can the ABSORB 350 System be moved while filled with water?
Yes, the System is rigid enough to be repositioned filled with water by sliding the optional wheel / jack assembly under each element.

What transitions are available?
Dozens of transition options are available, including attachments to; Standard NJ / J / K / F, Wide / X-Wide NJ, I-Lock, Smooth Face, JJ Hook, QMB, ArmorGuard®, Orion®, BarrierGuard® and ZoneGuard®.

Can the ABSORB 350 System be used during cold weather?
Since ABSORB 350 modules have no internal steel parts, the use of any approved anti icing chemical is acceptable.

FEATURES

- Rapid deployment and retrieval
- No ground anchoring required
- Low initial price
- Narrow footprint
- Can be deployed on almost any road surface
- Meets NCHRP 350 TL-1, TL-2, TL-3 test criteria
- Easily transitioned to multiple widths and shapes of barriers
- Nose and transition are reusable after most design impacts
- Approved for use in permanent and work zone locations

DISTRIBUTED BY:

Lindsay Transportation Solutions Sales and Services, Inc.
180 River Road • Rio Vista, CA 94571 • +1 707.374.6800 U.S. Toll Free: 888.800.3691 • www.barrriersystemsinc.com

PT # ABS04-03252013

TrafFix Devices Inc.

SLED™

Sentry Longitudinal Energy Dissipater

PRODUCT BULLETIN

SLED™ TL-3 in use on a Missouri Highway

SLED™ TL-2 in Illinois

SLED™ TL-3 in Downtown Cincinnati, Ohio

- FHWA Accepted for Shielding the Blunt End of Concrete, Steel and Water Filled Barriers
- Quick and Easy Set-Up, No Foundation Anchoring, Minimized Installation Exposure Time
- Cost Effective End Treatment for Concrete, Steel or Water Filled Barriers
- Universal Transition Quickly and Easily Attaches to a Variety of Barrier Shapes and Sizes
- *SLED's* Stout Design Virtually Eliminates Vaulting
- Narrow Footprint is Ideal for Work Zones or Roads with Minimal Shoulder Spacing
- Shortest Length TL-3 Water Filled Crash Cushion, Fewer Incidental Impacts
- Containment Impact *SLED* Minimizes Debris Field
- Visual "Drive By" Fill Indicators Quickly Verify Water Module's are Properly Filled
- FHWA Accepted for Use in Uni- and Bi- Directional Applications
- Internal Steel Cables Help Envelop Vehicle After an Impact, Creating a Truly "Limited Gating" System

Scan for Instant QR Video

www.traffixdevices.com

SLED™

Sentry Longitudinal Energy Dissipater

Inline TL-3 Truck Test Pre Impact

Inline TL-3 Truck Test Post Impact

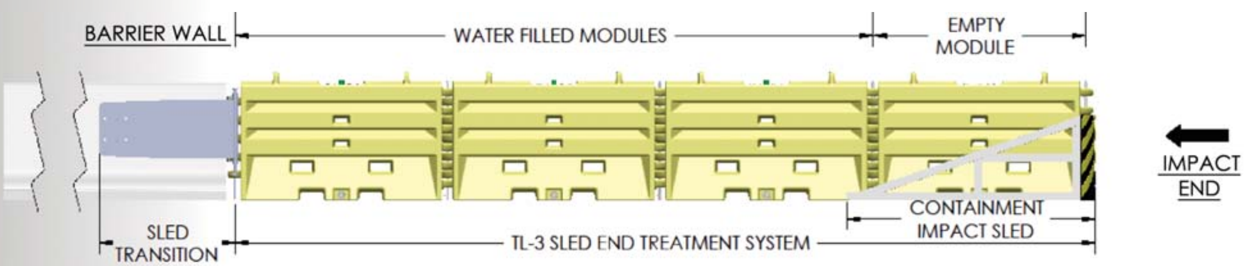
SLED™ Sentry Longitudinal Energy Dissipater

The Sentry Longitudinal Energy Dissipater (SLED) is a narrow, non-redirective gating crash cushion. SLED is designed to shield the end of all permanent and temporary portable barrier shapes including concrete, steel and plastic. SLED's unique design incorporates four internal steel cables which help envelop the impacting vehicle, reducing the possibility of secondary accidents. The SLED End Treatment does not require foundation anchor bolts to be attached to the road or bridge deck. The complete crash cushion can be installed quickly, with as little as one pick up truck and two workers on compacted dirt, gravel, decomposed granite, asphalt or concrete.

Each SLED module is manufactured from a high visibility yellow polyethylene that is UV stabilized to minimize degradation. It is designed to deform and rupture on impact, absorbing the energy of the errant vehicle. SLED has the most versatile transition for shielding all permanent and temporary portable barriers. The combination of hinging and contouring, allows the transition panels of the SLED End Treatment to be attached to narrow, wide or other profile shapes with either converging, or diverging angles, up to 10 degrees.

SLED™ TL-3 4500 lb. Pick-Up Truck Impact Attached to Concrete Median Barrier Wall

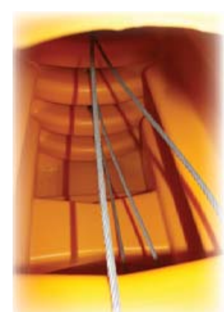
TL-3 SPECIFICATIONS	
Length:	25' 3"
Width:	22'-1/2"
Height:	42"
Weight (Empty):	995 lb.
Weight (Full):	6505 lb.



Steel Barrier Attachment

SLED™ TL-3 Transports in a Pick-Up Truck

Concrete Barrier Attachment



SLED™ Internal Cables

Distributed by:

TrafFix Devices Inc.®

160 Avenida La Pata, San Clemente, CA 92673
(949) 361-5663 FAX (949) 361-9205
www.traffixdevices.com

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