INFORMATION HANDOUT

For Contract No. 02-4G4904
At Sha-44- PM 44.9/45.5

Identified by
Project ID 0214000004

MATERIALS INFORMATION

GEOTECHNICAL DESIGN REPORT

OPTIONAL DISPOSAL/MATERIAL SITES

WATER CONSERVATION CATEGORY

POTENTIAL WATER SOURCE

CALTRANS CONTRACT N0.: 02-4G4904

02-SHA-44-PM 44.9/45.5

INFORMATIONAL HANDOUT

FOR A CONSTRUCTION CONTRACT

ON STATE ROUTE 44 IN SHATSA COUNTY

(On Route 44 near Viola from 1.7 miles to 1.1 mile west

Of North Battle Creek Reservoir Road)

LOWER MANZANITA CURVE IMPROVEMENT PROJECT

SHA-44-PM 44.9/45.5

FOR

GEOTECHNICAL REPORT

M e m o r a n d u m

Flex your power!
Be energy efficient!

To: MR. ERIC ORR
Safety Design Senior
District 2/Redding

Attention: Zidan Zheng
Project Engineer

Date: July 22, 2015

File: 02-SHA 44
PM 44.9/45.5
EA# 4G490
EFIS 0214000004
Lower Manzanita
Safety Project

From: **DEPARTMENT OF TRANSPORTATION**
DIVISION OF ENGINEERING SERVICES
GEOTECHNICAL SERVICES – MS 5

Subject: Cutslope, Rockfall, Catchment, Rippability, and Fill Slope Recommendations

Introduction

This report, prepared by the Office of Geotechnical Design North (OGDN), provides geotechnical recommendations for the proposed widening and straightening improvements of State Highway 44 from PM 45.1 to 45.5 in Shasta County, California. Plate 1 provides a vicinity map showing the location of the site. Plate 2 provides an aerial photograph of the site.

Project Description/Scope of Work

The purpose of this project is to increase safety for the travelling public by straightening the curve at the center of the project and widening the roadway to include 8-foot paved shoulders for increased recovery room and greater sight distance. The major cuts for the proposed improvements are all located on the north side of the existing highway. Some minor cuts are proposed on the south side of the highway at the western end of the project. Only minor fills are proposed for this project, which are all located at the western end of the project. The majority of the excavated material is to be disposed of offsite.

This report includes a geological description of the material to be excavated and disposed, cut slope and catchment recommendations, information on rippability and excavation characteristics, earthwork factors, fill slope recommendations, and construction advisories and recommendations. This information and these recommendations are based on a review of published geologic literature and mapping, aerial photographs, geologic mapping by OGDN, and 4 seismic refraction survey lines.

Regional and Site Geology

The project lies within the southwestern part of the Cascade Range physiographic/geomorphic province (Macdonald, 1966). Basement rocks in this area are believed to be those of the Pre-Cretaceous (before 145 million years ago) Sierra Nevada-Klamath Mountains Complex, which are exposed to the south-southeast (Sierra Nevada Range) and to the north-northwest (Klamath Mountains). These rocks consist primarily of intrusive granitics. Late Cretaceous (100 to 65 million years ago) rocks consisting of sandstones, shales, and conglomerates rest unconformably atop these basement rocks. Late Eocene (about 43 to 35 million years ago) sandstones of the Montgomery Creek Formation rest unconformably on top of the late Cretaceous rocks. These rocks are overlain unconformably by Miocene (24 to 5 million years ago) and Pliocene (5 to 2 million years ago) volcanic rocks. Pleistocene (between 2 million years and 10,000 years ago) volcanics consisting primarily of andesite, basalt, basaltic andesite, rhyolite, and rhyodacite unconformably overlie these earlier volcanics in the area within and around the project. A geologic map of the project area is presented in Plate 3.

The exposed bedrock within the project limits consists entirely of mid-Pleistocene andesite of the Viola flow (*av* on the geological map of Plate 3). Joints and fractures in the andesite are predominantly vertical and appear to be solely a result of cooling, or stresses imparted to the rock during cooling. A majority of these discontinuities are oriented roughly north-south, varying azimuthally between about 345 ° and 20°. The remainder of the discontinuities appear to be fairly scattered and diverse, with a possible slight clustering oriented roughly perpendicular to the northward trend, giving some of the existing outcrops a blocky appearance. The frequency and width of separation of all discontinuities, and the presence and amount of soil infilling and weathering within them, vary considerably along the project alignment.

The rocks observed at the site and shown on the map are not typically known to contain naturally occurring asbestos.

A normal fault (downdropped to the west-southwest) trending a little over 2 miles at an approximate azimuth of 340° exists at the western edge of the project area. Cross-cutting relationships with other dated volcanic units outside of the project area indicate that the last apparent movement on this fault occurred sometime during the mid-Pleistocene (about 1 to 2 million years ago).

Rockfall

Rockfall is a moderate problem in the middle of the project where the driver's sight distance is limited due to the tight curve and the high near-vertical rock cut faces. Rocks occasionally become dislodged from the rock faces and have nowhere to go but onto the roadway, due to the lack of catchment. These rocks pose s moderate to significant threat here due to the very limited driver sight distance.

Water

Manzanita Creek parallels the roadway along its southern side, remaining fairly close to the road in the eastern half of the project before drifting a bit to the south in the western half of the project. This creek is ephemeral due to the fractured nature of the bedrock, typically carrying water above ground less than half of an average year. The absence of any seeps or artesian conditions within or nearby the project limits, together with the ephemeral nature of the creek and the fact that its bed lies below the elevation of both the existing and proposed grade, indicates that the groundwater table is situated below the toe of both the existing and proposed cut slopes.

Any surface water that might arise during times of high precipitation does not create sheet flow as it quickly percolates through the porous colluvial overburden and into the bedrock fractures.

Seismic Refraction Survey

Seismic refraction survey lines were located roughly parallel to the proposed alignment and directly above areas likely to be cut. Their approximate locations are shown in Plate 2. The primary purpose of these surveys was to delineate the depth to the overburden-bedrock contact in order to more accurately design compound slope ratio cut slopes. A secondary purpose of the refraction data was to assist in assessing the relative density of fracturing/jointing and discontinuity weathering of buried bedrock in order to better evaluate its excavation characteristics and determine viable bedrock cut slope ratios.

Depth sections for all four refraction lines are presented in Plate 4. The upper layers, which have velocities (labelled as V1) varying from 1200 to 1600 feet (ft) per second (ft/s), are composed of cobble and boulder colluvium. From west to east across the project the colluvium velocities decrease from 1600 ft/s (line1) to 1500 ft/s (line 2) to 1200 ft/s (lines 3 & 4), which is indicative of a decreasing percentage of cobbles and boulders and an increase in the percentage of gravel, sands, and minor silts.

Bedrock velocities (labelled as V2), which vary from 2700 ft/s to 4900 ft/s, do not follow a similar west to east trend. Bedrock velocities (V2) are inversely related to the density of fracture/jointing discontinuities and the general amount of separation within them. The relatively low bedrock velocities (V2) of 2700 ft/s and 2800 ft/s, which are seen in lines 1 and 2, respectively, are indicative of average fracture densities somewhere on the order of every 2 to 6 ft. The highest bedrock velocity (V2) of 4900 ft/s, which is seen in line 3, is indicative of lower fracture densities where block widths greater than 12 ft are common. Line 3 is located where the existing rock outcrops and proposed cut slopes are at their highest. This is also where the rock north and south of the road was breached in recent geologic time by the creek. The creek once passed through the location where the existing road is presently situated, but the creek now passes through a culvert that was installed directly through the rock immediately south of the roadway.

Rippability and Excavation Characteristics

All of the overburden colluvium is considered easily ripped, although there are occasional intact (no discontinuities) boulders within the colluvium up to 10 ft in diameter that cannot be reduced by a ripper. Such boulders will require a large hoe-ram, blasting, or other method beside dozer ripping to reduce their size.

The direct correlation of seismic velocity to rippability does not apply for the bedrock at this site due to the presence and considerable variation in fracture and jointing discontinuities within the rock. Seismic velocities have been greatly reduced within the bedrock due to these openings. The 12^{th} edition of the Caterpillar Rippability Manual (2012) states that basalt rock (equivalent to the andesite in the project area with respect to rippability) demonstrating seismic velocities below 8000 ft/s is considered rippable. No seismic velocities were observed in the bedrock greater than 4900 ft/s, and most velocities were well below that. Yet the existing cut faces reveal numerous blocks of bedrock in many areas that are clearly unrippable. These blocks are made of hard unweathered andesite and would likely have seismic velocities over 10,000 ft/s if the refraction surveys could have sampled them individually. Massive blocks, some potentially as large as 35 ft in diameter, will be unmovable by the largest of dozers. The reduction of blocks too large to move or transport by the excavating dozer will only be achieved by alternate methods such as hoe-rams, blasting, chemical expanders in drilled holes, etc.

The concept of excavatability is here defined as whether a D9 dozer can excavate (move from the existing slope) and reduce material to blocks less than or equal to 3 ft in diameter, a size that can reasonably be lifted and hauled off-site with standard construction equipment. In this case, determining the excavatability of subsurface material requires the field mapping of discontinuities and block sizes, correlating them to observed velocities, and extrapolating the results to unexposed bedrock. Table 1 below presents the approximate excavatability of the proposed cuts by station interval, based on the above criterion of reduction to boulders 3 ft or less in diameter.

Table 1. Excavatability by station interval of proposed cuts. Material considered excavatable can be removed from the slope and reduced to boulders less than or equal to 3 ft in diameter by a D9 dozer or smaller.

STATION INTERVAL	% EASILY EXCAVATABLE	% DIFFICULT TO EXCAVATE	% NON-EXCAVATABLE
18+50 TO 25+00	99	1	0
25+01 TO 29+50	98	1	1
29+51 TO 31+00	80	10	10
31+01 TO 33+50	50	15	35
33+51 TO 36+50	40	20	40
36+51 TO 38+50	40	40	20
38+51 TO 46+00	80	20	0

Earthwork Factor

OGDN recommends an earthwork grading factor of 1.15, based on mapped percentages of cobbles and boulders, seismic refraction results, and previous work in similar terrain. This factor indicates a swell of 15% when going from the in-situ location to the disposal or fill location. This factor is predicated on the assumption that the excavated material is compacted at the disposal site. Due to the significant proportion of large rock, standard compaction methodology and testing may not be performed on most of the material from the site, but several passes with heavy equipment should be performed to attain some type of effective compaction and volume reduction. If material is simply dumped uncompacted at the disposal site the grading factor may be as high as 1.3, indicating a 30% increase in disposal volume over excavation volume.

Recommendations

Cut Slopes

To best reduce excavation quantities and maximize widening and sight distance improvement, OGDN recommends compound slope ratio cut slopes for this project, with the upper reaches of many slopes being cut at 1:1 in the overburden colluvium and the lower portion of the slope being cut in the bedrock at 0.25:1. In some locations where overburden is relatively minimal, single cut slope ratios of 0.25:1 are recommended. In other locations where bedrock is not likely to be reached based on the estimated design height of the cut slope, a single cut slope ratio of 1:1 is recommended. Table 2 lists recommended cut slope ratios by stationing for the project. Transitions between station intervals with different cut slope ratios shall be smoothed as much as possible. Where compound cut slope ratios are recommended the last column of the table provides the depth to the break between the two cut slope ratios, with the depth being measured perpendicular to the general orientation of original ground. Based on the preliminary design and slope ratios recommended herein, proposed cut slopes have a maximum height of 40 ft.

Table 2. Recommended Cut Slope Ratios by Station or Station Interval. All slopes are on the north side of the roadway unless otherwise noted by an "S" indicating south side.

STATION INTERVAL	SLOPE RATIO 1	SLOPE RATIO 2	Depth to Slope Break (ft)
	(S1)	(S2)	(S1/S2)
23+50 to 26+75 (S)	1:1	NA	NA
23+50 to 30+50	1:1	NA	NA
30+75 to 32+25	0.25:1	NA	NA
32+50 to 32+75	1:1	NA	NA
33+00 to 34+75	0.25:1	NA	NA
35+00 to 35+50	1:1	0.25:1	10
35+75 to 36+00	1:1	0.25:1	5
36+25 to 37+00	0.25:1	NA	NA
37+25	1:1	0.25:1	10
37+50	1:1	0.25:1	8
37+75 to 39+00	0.25:1	NA	NA
39+25	1:1	0.25:1	5
39+50	1:1	0.25:1	10
39+75 to 45+50	1:1	NA	NA

Rockfall

Recommended rockfall catchment for all cut slopes is a minimum of 8-foot wide unpaved shoulder sloping towards the toe of the cut slope at 6:1. This width is designed to intercept over 95% of all possible rock impacts from the proposed cut slopes (40 ft high or lower). This catchment width/slope is designed to retain at least 85% of rockfall runout from over 80% of the proposed cut slopes, and 75% of rockfall runout from the remaining 20%. Because the highest slopes are located in areas where the rock is generally more massive (less fractures) and thereby less prone to produce frequent rockfall, this reduced retaining capacity is considered acceptable, in lieu of the costs (right-of-way, increased excavation, permitting,…) of increasing catchment width and the moderate frequency of rockfall events. These retaining percentages represent a significant improvement over the existing situation at this site. Greater runout containment results in exponentially increased costs, due to the significant increase in catchment width necessary, together with the excavation and disposal costs associated with such an increase.

The Rockfall Hazard Rating System (RHRS) (NHI; Pierson & Van Vickle, 1993) score for the project area will decrease significantly for this stretch of roadway following the proposed improvements. A lower RHRS score means rockfall hazard is less.

Fill Slopes

Minor fill slopes proposed for the west end of the project have a maximum height of 12 ft. OGDN recommends fill slope ratios of 1.5:1 or flatter.

Construction Considerations

The proposed cuts are not anticipated to encounter or impact the groundwater regime, nor are surface or sheet flows expected to occur during construction.

Some proposed cuts may present unstable rocks during the excavation process, which could potentially cause rockfall while construction crews operate below. Construction crews shall be made aware of this, and the presence of construction personnel on foot beneath these cuts should be minimized during excavation. As stated above in the section on *Rippability and Excavation Characteristics*, excavation will sometimes require alternate methods such as hoe-rams, blasting, chemical expanders in drilled holes, or other non-dozer methods.

If you have any questions or require further assistance, please call Scott Lewis at (530) 225-3516.

Report by:

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Office of Geotechnical Design North

Attachments

1. Plate 1. Project Location
2. Plate 2. Aerial Photograph of Lower Manzanita Project Area w/ Alignment & Seismic Line Locations
3. Plate 3. Geologic Map
4. Plate 4. Refraction Survey Depth Sections 1 thru 4

ec: OGDN Project Folder
GS File Room (GeoDogg Archiving system)
Construction RE Pending File-(through Zidan Zheng, Project Engineer)
Project Manager- Chris Harvey
Materials Lab Senior Engineer- Byron Berger

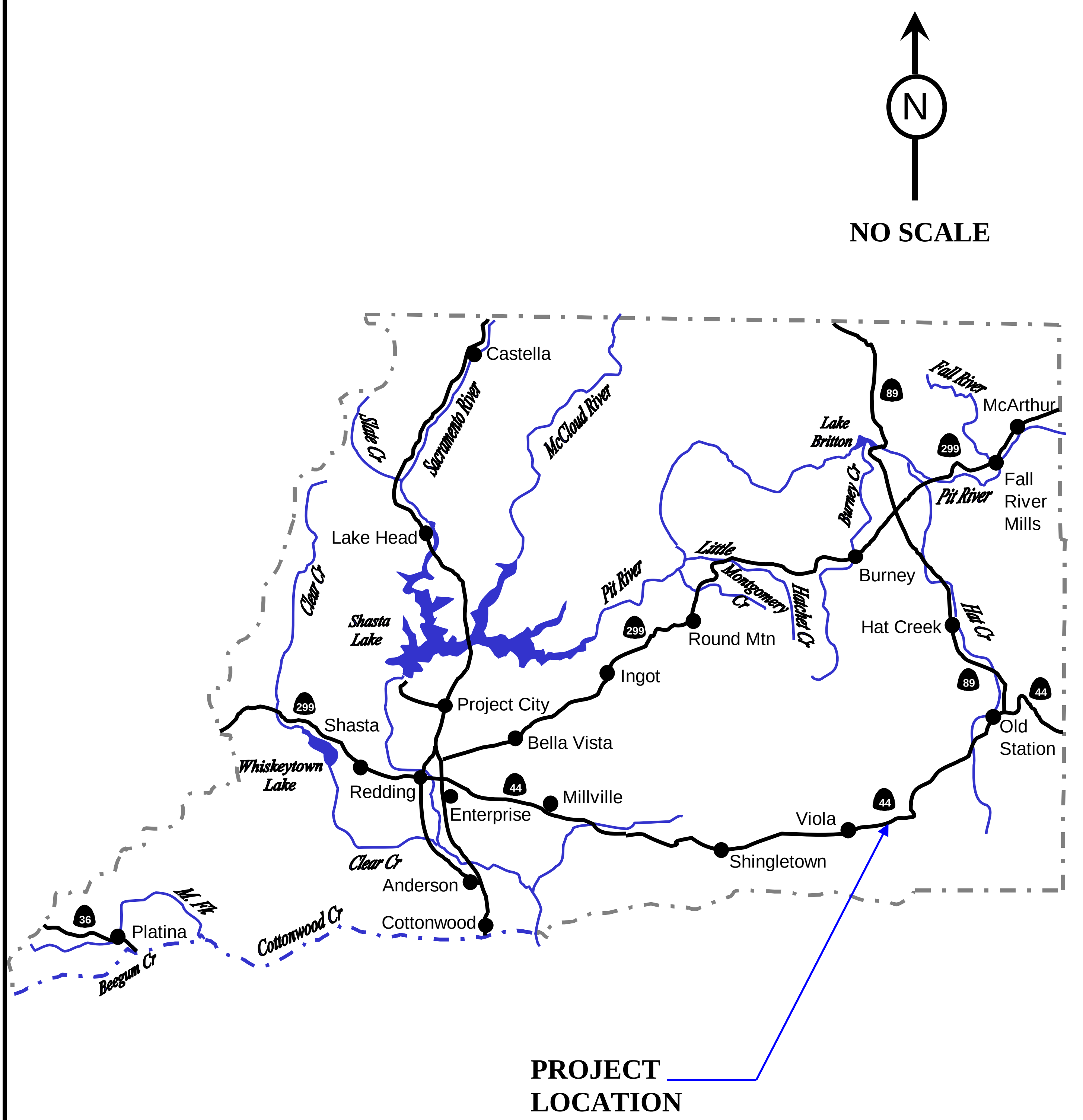
REFERENCES

California Department of Conservation, Division of Mines and Geology, 1962, Geologic Map of California, Redding Sheet.

Clynne, M. A. and Muffler, L. J. P., 2010, Geologic Map of Lassen Volcanic National Park and Vicinity, California: U. S. Geological Survey Scientific Investigations Map 2899, Sheet 1 of 3

MacDonald, G.A., 1966, Geology of the Cascade Range and Modoc Plateau in Geology of Northern California. Edgar Bailey, editor. Published by California Department of Conservation, Division of Mines and Geology.

Pierson, L. A., Van Vickle, R., 1993, Rockfall Hazard Rating System, National Highway Institute, Federal Highway Administration SA-93-057.



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Division of Engineering Services
Geotechnical Services
Office of Geotechnical Design-North

EA: 02-4G490	**PROJECT LOCATION**	
Date: July 2015		
02-SHA-44 PM 44.9/45.5 **GEOTECHNICAL RECOMMENDATIONS**		Plate No. 1

N

Aerial Photo of the Lower Manzanita Project Area. Proposed new alignment is shown in white. Approximate location of seismic lines 1 thru 4 are shown as orange lines.

CALTRANS Division of Engineering Services Geotechnical Services Office of Geotechnical Design-North	EA: 02-4G490 Date: July 2015	AERIAL PHOTO OF LOWER MANZANITA PROJECT AREA w/ ALIGNMENT & SEISMIC LINE LOCATIONS	
	02-SHA-44 PM 44.9/45.5 GEOTECHNICAL RECOMMENDATIONS		Plate No. 2

EXPLANATION

amz (Mid-Pleistocene)
Andesite of Manzanita Creek

av (mid-Pleistocene)
Andesite of Viola

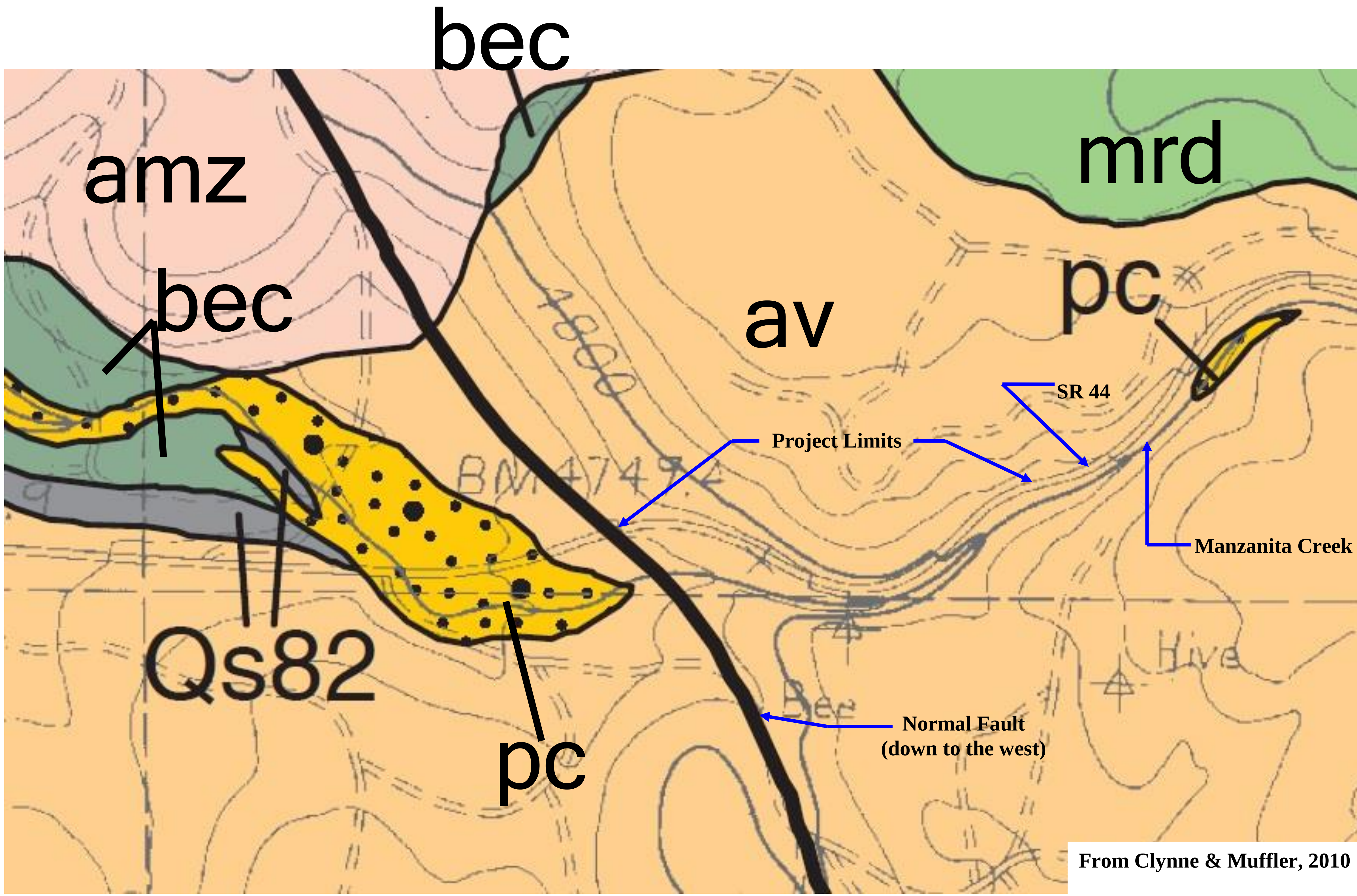
bec (mid-Pleistocene)
Tholeitic basalt of Eagle Canyon

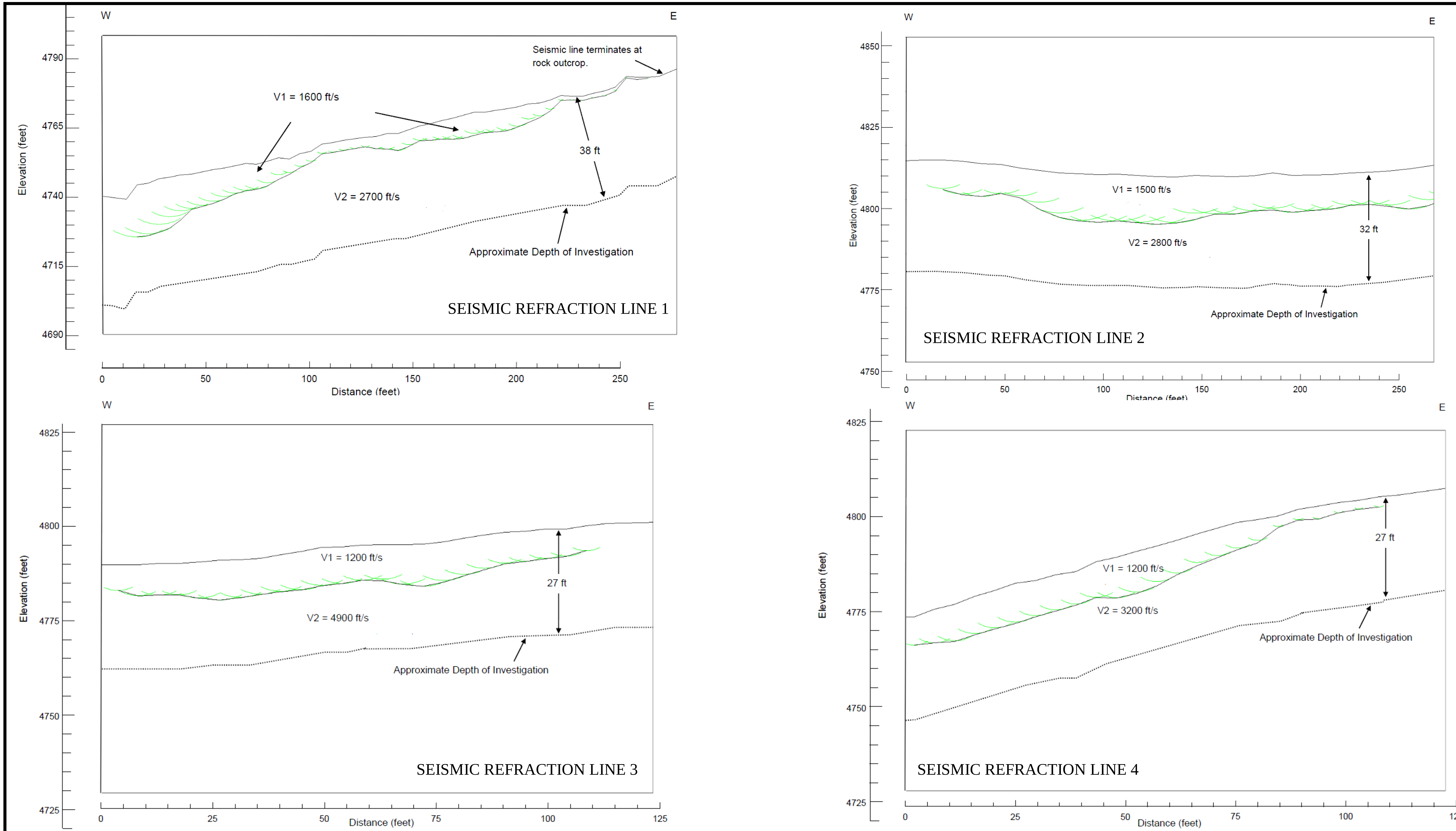
mrd (late Pleistocene)
Basaltic andesite & andesite of Red Lake Mtn

pc (late Pleistocene)
Rhyodacite Pumiceous pyroclastic flow & fall deposits

Qs82 (mid-Pleistocene)
Avalanche deposit from Dacite of hill 8283

N





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Geotechnical Services
Office of Geotechnical Design-
North

EA: 02-4G490

Date: July 2015

REFRACTION SURVEY DEPTH SECTIONS 1 THRU 4

02-SHA-44 PM 44.9/45.5
GEOTECHNICAL RECOMMENDATIONS

Plate
No. 4

INFORMATIONAL HANDOUT

FOR A CONSTRUCTION CONTRACT
ON STATE ROUTE 44 IN SHASTA COUNTY

(On Route 44 near Viola from 1.7 miles to 1.1 miles west of North Battle Creek Reservoir Road)

LOWER MANZANITA CURVE IMPROVEMENT PROJECT

SHA-44-PM 44.9/45.5

For

Optional locations for permanent disposal of: Asphalt-concrete grindings, aggregate base, concrete, and earthen material:

1) **D Mine** - Hat Creek Construction
2) **Wildcat Pit** - Jake Myers Excavating
3) **Hat Creek Maintenance Station** - Caltrans

Note: The records from this compilation may be inspected in the Caltrans District 2 Office at 1657 Riverside Drive Redding, CA 96001 or Contact the Disposal Site Coordinator, Russ Irvin (530) 225-2084, e-mail: Russell_Irvin@dot.ca.gov

Facts stated herein are as known to the State of California, Caltrans, and are to be verified by the Contractor as per Section 6-2 of the Standard Specifications.

Table of Contents

General Information

These sites are provided for use by Caltrans, at the option of the contractor, for the permanent disposal of material generated during the Lower Manzanita Curve Improvement Project on State Route 44. It is anticipated the following approximate amounts of excess material will be generated:

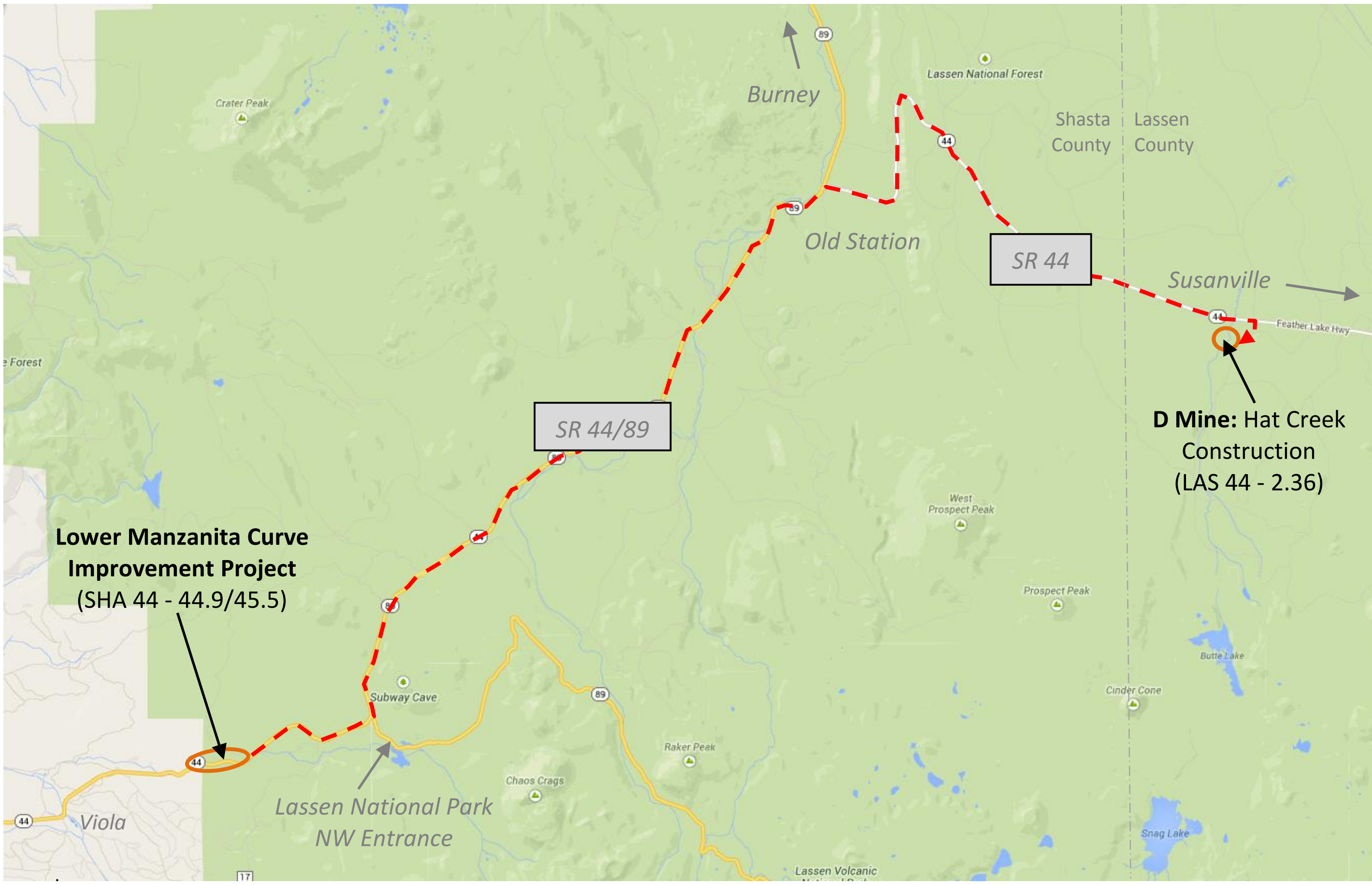
Asphalt-Concrete Grindings - 2,430 cubic yards

Earthen - 22,000 cubic yards

The following provisions apply to all sites:

- Delivery and placement of material will need to be coordinated with the contacts responsible for each site. See the individual maps for contact information.
- Sites anticipated to be used must be included in the contractor's Storm Water Pollution Control Plan and all Construction Storm Water Best Management Practices shall apply to those sites. No additional compensation shall be made for placement of the erosion control measures at disposal sites.
- Existing facilities at these disposal sites shall be protected from damage by the contractor in accordance with Section 5-1.36 "Property and Facility Preservation" of the Standard Specifications.
- The contractor bears all liability for damage to haul vehicles and any facility or equipment damaged by the contractor's use of the site. The State assumes no liability for damage to contractor's equipment.
- Materials are to be placed within the site limits in an organized and safe manner with no risk of instability to embankments or drainage facilities.
- All asphalt grindings generated by this project, not placed in a disposal site identified by Caltrans, will remain property of the contractor.
- If the contractor uses a disposal location other than those shown in this Materials Information Handout attention is directed to Section 5-1.20B(4) of the Standard Specifications.
- Disposal or reuse of savaged materials will be in accordance with Section 14 and Section 15 of the 2010 Standard Specifications.
- These sites have been environmentally approved for this project, however, they may not be completely satisfactory to the contractor's needs.

Location Map: Site 1 - D Mine (LAS 44 - 2.36)



Contact information:

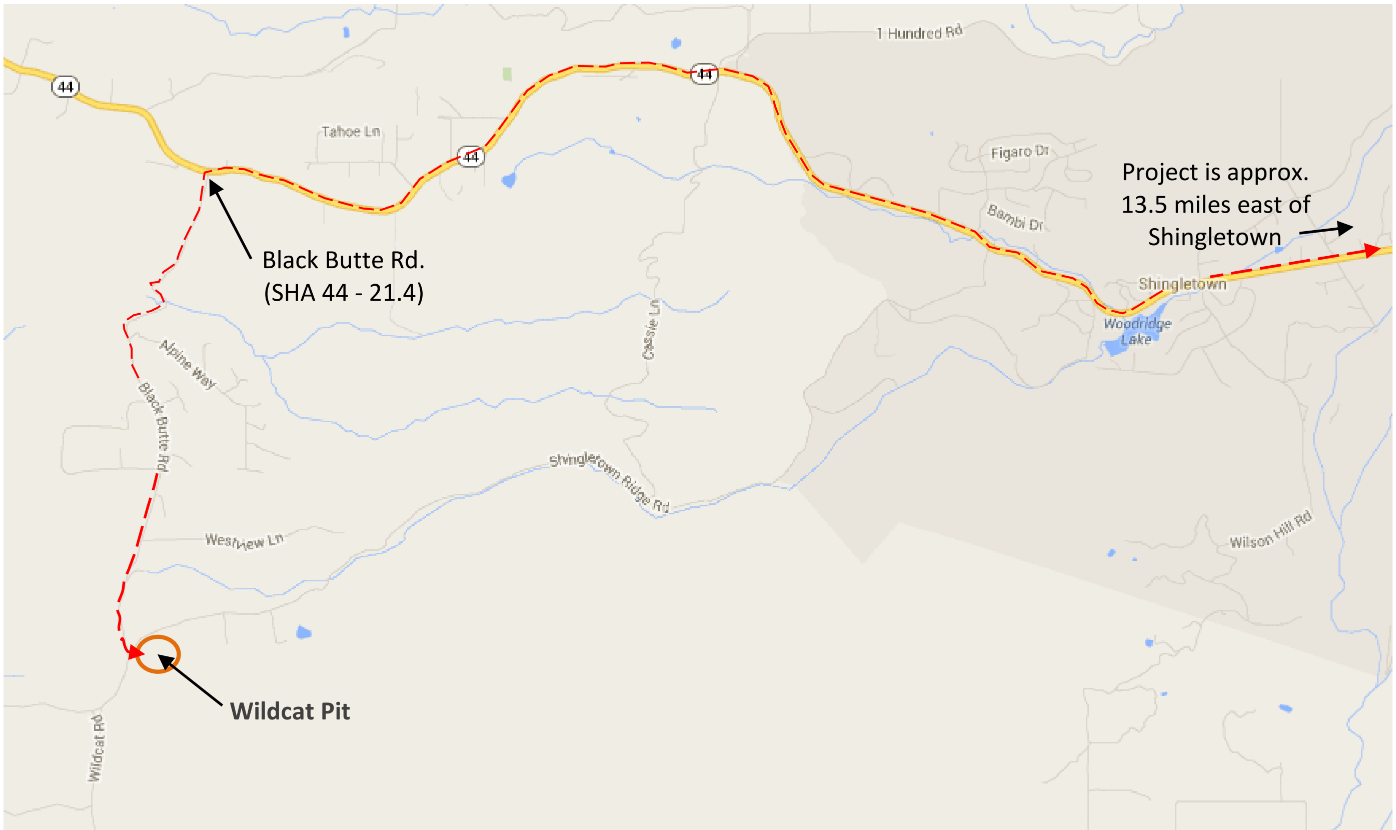
Facility location: The D Mine is located on the Hat Creek Rim off LAS 44, approximately 28 miles east of the project on USFS Road 32N21. This is the access road to Butte Lake in Lassen National Park.

Contact person: Perry Thompson (Quarry Manager)
Phone: (530) 335-5501 or 949-6145

Provisions that apply to this site:

- The contractor shall contact the quarry at least 1 week prior to disposal at this location.
- There may be a charge for material taken to this location.
- This is a SMARA regulated location, however, it was not listed on the AB 3098 List dated July 3, 2015: D Mine- #91-45-0050

Location Map: Site 2 - Wildcat Pit (SHA 44-21.4)



Contact information:

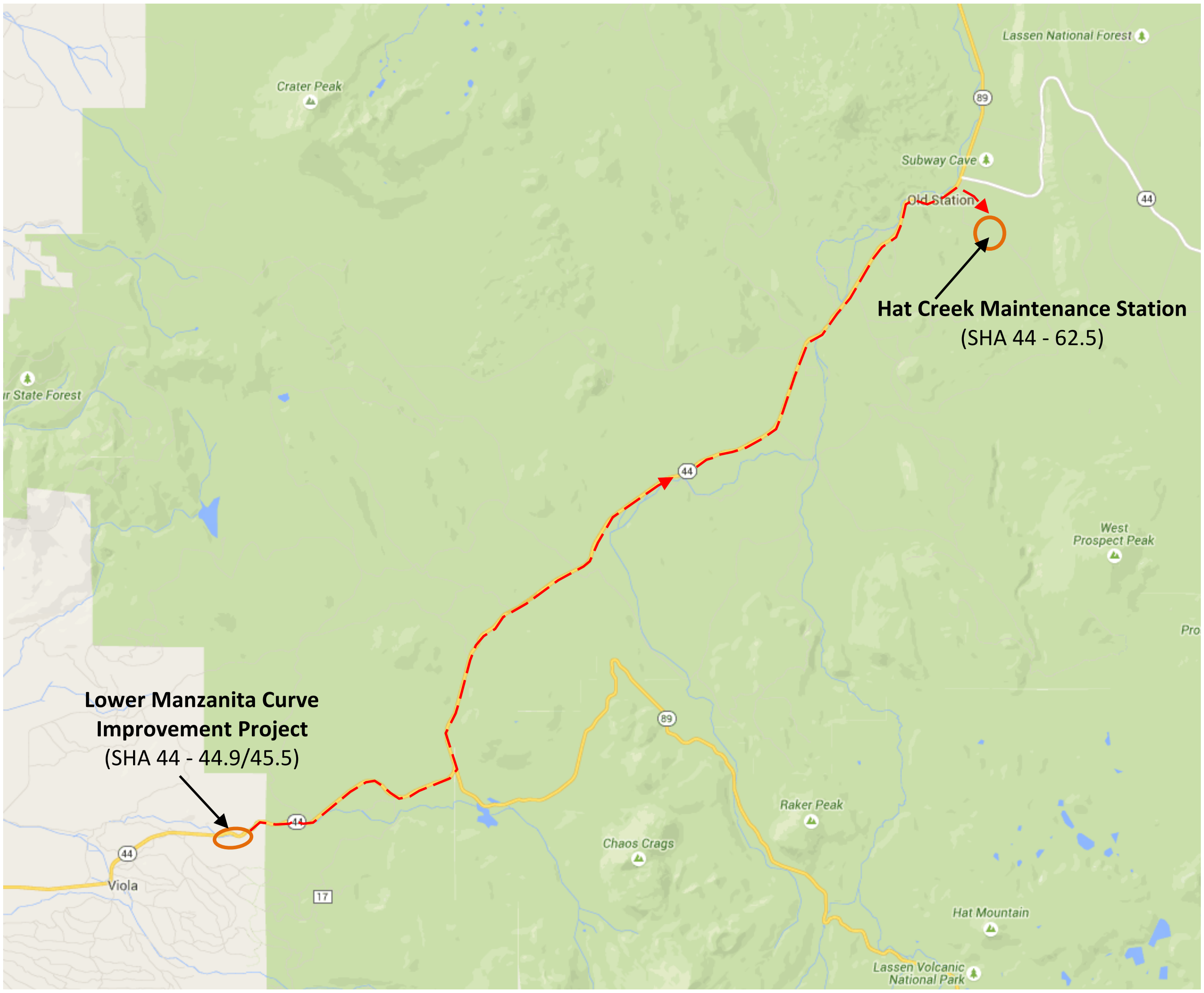
<u>Facility location:</u> The Wildcat Pit off Black Butte Rd/Wildcat Rd west of Shingletown, approximately 24.6 miles from the project location. Turn south off SR 44 at postmile 21.4. It is 3.2 miles off State Route 44 on Black Butte Rd.

<u>Contact person:</u> Jake Meyers (Owner)
Phone: (530) 365-8858

<u>Provisions that apply to this site:</u>

- The contractor shall contact the quarry at least 1 week prior to disposal at this location.
- There may be no charge for material taken to this location.
- This is a SMARA regulated location, however, it was not listed on the AB 3098 List dated July 3, 2015: Wildcat Pit - #91-45-0036

Location Map: Site 3 - Hat Creek Maintenance Station
(SHA 44 - 62.5)



Contact information:

Facility location: At the end of Brian's Way in Old Station. Approximately 17 miles from the project. 13191 Brian's Way, Old Station

Contact Person: Richard Arendt (Maintenance Supervisor)
Phone: (530) 335-7101

Provisions that apply to this site:

- The contractor shall contact Caltrans at least 1 week prior to disposal at this location.
- Only AC grindings will be accepted at this location: no more than 500 cubic yards.

Potential Water Sources

It is the responsibility of the contractor to acquire an adequate and reliable source of water for construction activities for this project. Potential sources of water near the project location are included in, but not limited to, the following list.

PG & E
North Battle Creek Reservoir
(530)246-6439