FOR CONTRACT NO.: 02-3C3004
PROJECT ID: 0200000317

INFORMATION HANDOUT

AGREEMENTS

CALIFORNIA DEPARTMENT OF FISH AND GAME
NOTIFICATION NO.1600-2011-0064-R2

MATERIALS INFORMATION

FOUNDATION REPORT FOR WALL LOCATION 15 (BR NO. 09E0002), DATED MARCH 4, 2011 - (WALL LOCATION 15 CHANGED TO WALL LOCATION 11 AFTER REPORT WAS SUBMITTED).

FOUNDATION REPORT FOR WALL LOCATIONS 32, 33 & 34 (BR NOS. 09E0003, 09E0004, & 09E0005),DATED MARCH 4, 2011 - (WALL LOCATIONS 32, 33 & 34 CHANGED TO WALL LOCATIONS 26, 27 & 28 AFTER REPORT WAS SUBMITTED).
INCLUDES:
APPENDIX C - GGB SEISMIC SURVEY REPORT, ROUTE 70 WALLS PREPARED BY CALTRANS GEOPHYSICS AND GEOLOGY BRANCH, DATED SEPTEMBER 15, 2010.

FOUNDATION REVIEW FOR WALL LOCATIONS 11, 26, 27,28 DATED AUGUST 23, 2011

AERIALLY DEPOSITED LEAD AND NATURALLY OCCURRING ASBESTOS SITE INVESTIGATION REPORT - STATE ROUTE

ROUTE: 02-Plu-70-0.6/35.2

State of California -The Natural Resources Agency
DEPARTMENT OF FISH AND GAME
North Central Region
1701 Nimbus Road, Suite A
Rancho Cordova, CA 95670-4599
916-358-2900
http://www.dfg.ca.gov

EDMUND G. BROWN, Jr, Governor
JOHN McCAMMON, Director

May 20, 2011

Eric Orr
California Department of Transportation
1657 Riverside Drive
Redding, CA 96001

Subject: Final Lake or Streambed Alteration Agreement
Notification No. 1600-2011-0064-R2
Plumas SR 70 – Metal Beam Guardrail Repair

Dear Mr. Orr:

Enclosed is the final Streambed Alteration Agreement ("Agreement") for the Plumas SR 70 – Metal Beam Guardrail Repair Project. Before the Department of Fish and Game ("Department") may issue an Agreement, it must comply with the California Environmental Quality Act ("CEQA"). In this case, the Department, acting as a lead agency, determined your project is exempt from CEQA and filed a notice of exemption ("NOE") on May 20, 2011.

Under CEQA, filing a NOE starts a 35-day period within which a party may challenge the filing agency's approval of the project. You may begin your project before the 35-day period expires if you have obtained all necessary local, state, and federal permits or other authorizations. However, if you elect to do so, it will be at your own risk.

If you have any questions regarding this matter, please contact Tim Nosal, Environmental Scientist at (916) 358-2853 or tnosal@dfg.ca.gov.

Sincerely,

Jeff Drongesen for

Kent Smith
~~Acting~~ Regional Manager

ec: Tim Nosal

tnosal@dfg.ca.gov

Conserving California's Wildlife Since 1870

CALIFORNIA DEPARTMENT OF FISH AND GAME
NORTH CENTRAL REGION
1701 NIMBUS ROAD, SUITE A
RANCHO CORDOVA, CA 95670

STREAMBED ALTERATION AGREEMENT
NOTIFICATION NO. 1600-2011-0064-R2
North Fork Feather River and East Branch North Fork Feather River

CALIFORNIA DEPARTMENT OF TRANSPORTATION (CALTRANS)
PLUMAS SR 70 METAL BEAM GUARDRAIL REPAIR PROJECT

This Streambed Alteration Agreement (Agreement) is entered into between the California Department of Fish and Game (DFG) and Caltrans (Permittee): as represented by Eric Orr.

RECITALS

WHEREAS, pursuant to Fish and Game Code (FGC) section 1602, Permittee notified DFG on April 6, 2011 that Permittee intends to complete the project described herein.

WHEREAS, pursuant to FGC section 1603, DFG has determined that the project could substantially adversely affect existing fish or wildlife resources and has included measures in the Agreement necessary to protect those resources.

WHEREAS, Permittee has reviewed the Agreement and accepts its terms and conditions, including the measures to protect fish and wildlife resources.

NOW THEREFORE, Permittee agrees to complete the project in accordance with the Agreement.

PROJECT LOCATION

The project is located in Plumas County, along SR 70, from approximately 0.1 mile east of the Butte County line to approximately 2.05 miles east of the junction with State Route 89 (approximately 35 miles). This section of SR 70 follows the North Fork Feather River and East Branch North Fork Feather River, in the County of Plumas, State of California; the center of the project is found approximately at Latitude 40.007055° N, Longitude -121.250069° W or Section 24, Township 25N, Range 06E, U.S. Geological Survey (USGS) map Belden, Mount Diablo baseline and meridian. Additional USGS maps that this project occurs on are Pulga, Soapstone Hill, Storrie, Caribou, Twain, and Crescent Mills.

PROJECT DESCRIPTION

The California Department of Transportation (Caltrans) proposes to reconstruct and upgrade metal beam guardrail (MBGR) on State Route 70 in Plumas County at various locations between post miles 0.1 and 35.1. The project is needed due to failing earth retaining structures (ERSs), erosion at MBGR posts, non-standard MBGR height, non-standard MBGR components, and lack of MBGR at some locations.

Various types of ERSs are utilized along the highway throughout the Feather River Canyon due to the steep terrain. Existing ERSs will be repaired and reconstructed and new ERSs will be constructed where needed. The types of ERSs to be used for this project include can walls and micro-pile walls with barrier slabs. Can walls consist of a series of corrugated steel pipe (CSP) culverts installed vertically, side-by-side, and filled with dirt. This project will utilize 36-inch diameter CSPs. Many existing can walls within the project limits require underpinning (installation of a new concrete base) and refilling with dirt. Micro-pile walls with barrier slabs are horizontal concrete slabs supported by small diameter vertical steel piles and small diameter tie-back piles. The vertical piles are eight inches in diameter, spaced approximately six feet apart, inserted in drilled holes to the depth of competent rock, which is estimated at approximately 40 feet. Horizontal lagging will be installed between the vertical piles.

A total of approximately 41,681 linear feet of MBGR will be reconstructed. Existing MBGR will be upgraded to current standards. Horizontal beams will be reused when possible. Existing wooden MBGR posts will be replaced with galvanized metal posts. Metal posts are easier to replace and repair and they are fire resistant. New MBGR end components and anchoring devices will be installed as necessary. Where appropriate, new metal finishes of can walls, downdrains, and MBGR will be treated to soften the bright finish and concrete will be stained or textured to blend into the surrounding landscape.

Asphalt concrete (AC) dike and CSP down drains with energy dissipation pads, constructed of ¼-ton rock slope protection (RSP), will be constructed as necessary to accommodate highway storm water drainage. Several existing unpaved wide areas adjacent to the traveled way will be paved with asphalt concrete to provide opportunities for motorists to safely pull off of the traveled way in the event of an emergency. The pull-outs will be approximately 12 feet in width and vary in length. Shoulder backing will be placed as necessary.

The majority of the construction operations will be performed by equipment operating from the roadway or road shoulder. Contractor staging and storage areas will be located adjacent to the highway in existing cleared areas. Appropriate erosion control measures, including seeding, will be included in the project. To prevent debris and earthen material from entering the water during construction, temporary catchment barriers will be installed on slopes between the work area and the water surface. Any excess materials and debris will be disposed of at an appropriate upland disposal area approved by the Caltrans Resident Engineer.

No listed threatened or endangered species will be affected by the project. The Installation and repair of earth retaining structures and downdrains will require trimming or removal of riparian vegetation at some locations. Vegetation removal will be limited to the extent necessary to accomplish the work. Trees and shrubs will be trimmed in lieu of removal when possible. Trees will be removed during the period of September 1 through February 15 to avoid impacting nesting birds. No work is planned below the ordinary high water mark of the NFFR or its tributaries. The project will not affect wetlands.

Environmentally sensitive area (ESA) fencing will be installed temporarily on the boundary of some work locations to prevent unnecessary encroachment into adjacent riparian areas during construction.

A detailed project description is provided in the notification materials submitted to DFG. The notification, together with all supporting documents submitted with the notification, *Categorical Exemption/Categorical Exclusion Determination Form* (EA 3C3000), *Natural Environment Study – Located in Plumas County on Highway 70 – 02-PLU-PM00-35.1 (February 2011),* and *Project Plans for Construction on State Highway near Rock Creek from the Butte County Line to 0.2 mile west of Spanish Creek Bridge #09-0015 ; install Metal Beam Guardrail (revised 2-11-11)* are hereby incorporated into this agreement to describe the location, features, avoidance measures and mitigation measures of the proposed project.

PROJECT IMPACTS

Existing fish or wildlife resources the project could substantially adversely affect include: Cantelow's lewisia (*Lewisia cantelovii*), Mildred's clarkia (*Clarkia mildrediae var. mildrediae*), white-stemmed clarkia (*Clarkia gracilis var. albicaulis*), Flat-leaved bladderwort (*Utricularia intermedia*), Feather River stonecrop (*Sedum albomarginatum),* Webber's milkvetch (*Astragalus webberi*), Stebbins' monardella (*Monardella stebbinsii*), Lewis Rose's ragwort (*Packera eurycephala var. lewisrosei*) Clifton's eremogone (*Eremogone cliftonii*), bald eagle (*Haliaeetus leucocephalus*), osprey (*Pandion haliaetus*), and northern goshawk (*Accipiter gentilis*), hardhead (*Mylopharodon conocephalus*), cold water fish species, amphibians, and other aquatic and terrestrial plant and wildlife species.

The adverse effects the project could have on the fish or wildlife resources identified above include: disturbance from project activity; direct take of terrestrial species; loss of riparian habitat and loss of upland habitat.

MEASURES TO PROTECT FISH AND WILDLIFE RESOURCES

1. Administrative Measures

Permittee shall meet each administrative requirement described below.

1.1 Documentation at Project Site. Permittee shall make the Agreement, any extensions and amendments to the Agreement, and all related notification materials and California Environmental Quality Act (CEQA) documents, readily available at the project site at all times and shall be presented to DFG personnel, or personnel from another state, federal, or local agency upon request.

1.2 Providing Agreement to Persons at Project Site. Permittee shall provide copies of the Agreement and any extensions and amendments to the Agreement to all persons who will be working on the project at the project site on behalf of Permittee, including but not limited to contractors, subcontractors, inspectors, and monitors.

1.3 Notification of Conflicting Provisions. Permittee shall notify DFG if Permittee determines or learns that a provision in the Agreement might conflict with a provision imposed on the project by another local, state, or federal agency. In that event, DFG shall contact Permittee to resolve any conflict.

1.4 Project Site Entry. Permittee agrees that DFG personnel may enter the project site to verify compliance with the Agreement. DFG personnel may only enter the project site when it is safe to do so. When appropriate, DFG personnel shall contact the Permittee prior to entering the construction area.

1.5 Authorized Work. The notification, together with all supporting documents submitted with the notification, is hereby incorporated into this agreement to describe the location and features of the proposed project. The Permittee agrees that all work shall be done as described in the notification and supporting documents, incorporating all project modifications, wildlife resource protection features, mitigation measures, and provisions as described in this agreement. Where apparent conflicts exist between the notification and the provisions listed in this agreement, the Permittee shall comply with the provisions listed in this agreement. The Permittee further agrees to notify DFG of any modifications made to the project plans submitted to DFG. At the discretion of DFG, this agreement will be amended to accommodate modifications to the project plans submitted to DFG and/or new project activities.

2. Avoidance and Minimization Measures

To avoid or minimize adverse impacts to fish and wildlife resources identified above, Permittee shall implement each measure listed below.

2.1 Establish Environmentally Sensitive Areas

- Sensitive natural resource features (where present) occurring outside of the expected construction impact area will be avoided or minimized by designating these features as "environmentally sensitive areas" (ESAs).

- ESA provisions may include, but are not limited to, the use of temporary orange fencing to delineate the proposed limit of work in areas adjacent to sensitive resources, or to delineate and exclude sensitive resources from potential construction impacts.
- Contractor encroachment into ESAs will be restricted (including the staging/operation of heavy equipment or casting of excavation materials).
- ESA provisions shall be implemented as a first order of work, and remain in place until all construction activities are complete.

2.2: Special Status Plants

- Should a special status plant species [as per CEQA sections 15380 and 15125 (c)] be discovered before or during the life of the project, a 25-foot no-operations buffer shall be flagged around the area and the CDFG shall be immediately notified. Consultation with the CDFG and/or USFWS shall ensure that potential impacts are avoided or minimized, and that project activities do not inhibit long-term conservation efforts for the survival of special status plant species.

2.3: Comply with Migratory Bird Treaty Act (MBTA)

- Implementation of the proposed maintenance project would result in the temporary disturbance and permanent loss of vegetation that provides potential breeding and foraging habitat for a number of bird species protected under the MBTA, or classified as California species of special concern, California fully protected species, or breeding raptors. The following measures are recommended to reduce project impacts on bird species:

- Minimize removal of native vegetation by locating staging areas and access routes in previously disturbed areas and establishing Environmentally Sensitive Areas;

2.3a: Restrict Timing of Vegetation Removal

- If feasible, removal of vegetation shall be conducted in the fall and winter (between September 1st and February 14th) after fledging and before the initiation of breeding activities.

2.3b: Pre-Construction Nesting Bird Surveys

- If vegetation removal during migratory bird non-nesting season is determined unfeasible, then pre-construction bird nest surveys shall be performed in spring to determine the location of nest sites within the proposed project areas.
- If active bird nests are found, Caltrans shall consult with USFWS regarding appropriate action to comply with the Migratory Bird Treaty Act of 1918, and with CDFG to comply with provisions of the Fish and Game Code of California.
- If a lapse in project related work of fifteen (15) days or longer occurs, another survey and, if required, consultation with USFWS and CDFG will be required

before the work can be reinitiated.

2.4: Minimize Disturbance to Jurisdictional Waters

- Disruption of the streambeds and adjacent riparian corridors will be minimized and vegetation removal shall be limited to the absolute minimum amount required for construction.

2.5: Containment Measures / Best Management Practices

- Caltrans Standard Specifications require the contractor to submit a Storm Water Pollution Prevention Plan (SWPPP). This plan must meet the standards and objectives to minimize water pollution impacts set forth in section 7-1.01G of Caltrans Standard Specifications. These standards/objectives are at times referred to as Best Management Practices (BMPs).
- Measures will be employed to prevent any construction material, debris, or petroleum products associated with equipment from entering surface waters. BMPs for erosion control will be implemented and in place prior to, during, and after construction in order to prevent silt, sediment, backfill, or petroleum products from entering surface waters.
- The SWPPP must also be in compliance with the goals and restrictions identified in the State Water Quality Control Board's Basin Plan for the project area.

2.6: Noxious Weed Prevention

- Remove mud, dirt, and plant parts from project equipment before moving equipment into a project area. Revegetate disturbed soil in a manner that optimizes plant establishment for that specific site.
- Revegetation may include topsoil replacement, planting, seeding, fertilization, liming, and weed-free mulching as necessary.
- Only native seed material shall be used; seed, hay and straw used in erosion control applications shall be certified weed-free or weed-seed free.

3. Compensatory Measures

To compensate for adverse impacts to fish and wildlife resources identified above that cannot be avoided or minimized, Permittee shall implement each measure listed below.

3.1 Site Restoration. All exposed/disturbed areas and access points within the stream zone left barren of vegetation as a result of the construction activities shall be restored using locally native grass seeds, locally native grass plugs and/or a mix of quick growing sterile non-native grass with locally native grass seeds. Seeded areas shall be covered with broadcast straw and/or jute netted (monofilament erosion blankets are not authorized).

4. Reporting Measures

Permittee shall meet each reporting requirement described below.

4.1 The Permittee shall notify DFG within two working days of beginning work within the stream zone of the North Fork Feather River and the East Branch of the North Fork Feather River. Notification shall be submitted as instructed in Contact Information section below. Email notification is preferred.

4.2 Upon completion of the project activities described in this agreement, any work area within the ordinary high water mark or riparian vegetation of the stream zone shall be digitally photographed. Photographs shall be submitted to DFG within two days of completion. Photographs and project commencement notification shall be submitted as instructed in Contact Information section below. Email submittal is preferred.

CONTACT INFORMATION

Any communication that Permittee or DFG submits to the other shall be in writing and any communication or documentation shall be delivered to the address below by U.S. mail, fax, or email, or to such other address as Permittee or DFG specifies by written notice to the other.

To Permittee:

Eric Orr
California Department of Transportation
1657 Riverside Drive,
Redding, Ca 96001
(530) 225-3439
eric.orr@dot.ca.gov

cc:
Chris Quiney
California Department of Transportation
1657 Riverside Drive,
Redding, Ca 96001
(530) 225-3174
chris.quiney@dot.ca.gov

To DFG:

Department of Fish and Game
North Central Region
1701 Nimbus Road, Suite A
Rancho Cordova, CA 95670

Attn: Lake and Streambed Alteration Program – Tim Nosal
Notification #1600-2011-0064-R2
Fax: 916-358-2912
Email: tnosal@dfg.ca.gov

LIABILITY

Permittee shall be solely liable for any violations of the Agreement, whether committed by Permittee or any person acting on behalf of Permittee, including its officers, employees, representatives, agents or contractors and subcontractors, to complete the project or any activity related to it that the Agreement authorizes.

This Agreement does not constitute DFG's endorsement of, or require Permittee to proceed with the project. The decision to proceed with the project is Permittee's alone.

SUSPENSION AND REVOCATION

DFG may suspend or revoke in its entirety the Agreement if it determines that Permittee or any person acting on behalf of Permittee, including its officers, employees, representatives, agents, or contractors and subcontractors, is not in compliance with the Agreement.

Before DFG suspends or revokes the Agreement, it shall provide Permittee written notice by certified or registered mail that it intends to suspend or revoke. The notice shall state the reason(s) for the proposed suspension or revocation, provide Permittee an opportunity to correct any deficiency before DFG suspends or revokes the Agreement, and include instructions to Permittee, if necessary, including but not limited to a directive to immediately cease the specific activity or activities that caused DFG to issue the notice.

ENFORCEMENT

Nothing in the Agreement precludes DFG from pursuing an enforcement action against Permittee instead of, or in addition to, suspending or revoking the Agreement.

Nothing in the Agreement limits or otherwise affects DFG's enforcement authority or that of its enforcement personnel.

OTHER LEGAL OBLIGATIONS

This Agreement does not relieve Permittee or any person acting on behalf of Permittee, including its officers, employees, representatives, agents, or contractors and

subcontractors, from obtaining any other permits or authorizations that might be required under other federal, state, or local laws or regulations before beginning the project or an activity related to it.

This Agreement does not relieve Permittee or any person acting on behalf of Permittee, including its officers, employees, representatives, agents, or contractors and subcontractors, from complying with other applicable statutes in the FGC including, but not limited to, FGC sections 2050 et seq. (threatened and endangered species), 3503 (bird nests and eggs), 3503.5 (birds of prey), 5650 (water pollution), 5652 (refuse disposal into water), 5901 (fish passage), 5937 (sufficient water for fish), and 5948 (obstruction of stream).

Nothing in the Agreement authorizes Permittee or any person acting on behalf of Permittee, including its officers, employees, representatives, agents, or contractors and subcontractors, to trespass.

AMENDMENT

DFG may amend the Agreement at any time during its term if DFG determines the amendment is necessary to protect an existing fish or wildlife resource.

Permittee may amend the Agreement at any time during its term, provided the amendment is mutually agreed to in writing by DFG and Permittee. To request an amendment, Permittee shall submit to DFG a completed DFG "Request to Amend Lake or Streambed Alteration" form and include with the completed form payment of the corresponding amendment fee identified in DFG's current fee schedule (see Cal. Code Regs., tit. 14, § 699.5).

TRANSFER AND ASSIGNMENT

This Agreement may not be transferred or assigned to another entity, and any purported transfer or assignment of the Agreement to another entity shall not be valid or effective, unless the transfer or assignment is requested by Permittee in writing, as specified below, and thereafter DFG approves the transfer or assignment in writing.

The transfer or assignment of the Agreement to another entity shall constitute a minor amendment, and therefore to request a transfer or assignment, Permittee shall submit to DFG a completed DFG "Request to Amend Lake or Streambed Alteration" form and include with the completed form payment of the minor amendment fee identified in DFG's current fee schedule (see Cal. Code Regs., tit. 14, § 699.5).

EXTENSIONS

In accordance with FGC section 1605(b), Permittee may request one extension of the Agreement, provided the request is made prior to the expiration of the Agreement's

term. To request an extension, Permittee shall submit to DFG a completed DFG "Request to Extend Lake or Streambed Alteration" form and include with the completed form payment of the extension fee identified in DFG's current fee schedule (see Cal. Code Regs., tit. 14, § 699.5). DFG shall process the extension request in accordance with FGC 1605(b) through (e).

If Permittee fails to submit a request to extend the Agreement prior to its expiration, Permittee must submit a new notification and notification fee before beginning or continuing the project the Agreement covers (Fish & G. Code, § 1605, subd. (f)). .

EFFECTIVE DATE

The Agreement becomes effective on the date of DFG's signature, which shall be: 1) after Permittee's signature; 2) after DFG complies with all applicable requirements under the California Environmental Quality Act (CEQA); and 3) after payment of the applicable FGC section 711.4 filing fee listed at http://www.dfg.ca.gov/habcon/ceqa/ceqa_changes.html.

TERM

This Agreement shall expire on December 31, 2015 unless it is terminated or extended before then. All provisions in the Agreement shall remain in force throughout its term. Permittee shall remain responsible for implementing any provisions specified herein to protect fish and wildlife resources after the Agreement expires or is terminated, as FGC section 1605(a)(2) requires.

AUTHORITY

If the person signing the Agreement (signatory) is doing so as a representative of Permittee, the signatory hereby acknowledges that he or she is doing so on Permittee's behalf and represents and warrants that he or she has the authority to legally bind Permittee to the provisions herein.

AUTHORIZATION

This Agreement authorizes only the project described herein. If Permittee begins or completes a project different from the project the Agreement authorizes, Permittee may be subject to civil or criminal prosecution for failing to notify DFG in accordance with FGC section 1602.

CONCURRENCE

The undersigned accepts and agrees to comply with all provisions contained herein.

FOR CALIFORNIA DEPARTMENT OF TRANSPORATION

Eric Orr
Project Manager

5/13/11
Date

FOR DEPARTMENT OF FISH AND GAME

Kent Smith
Regional Manager

5/23/11
Date

Prepared by: Tim Nosal
Environmental Scientist

State of California
Department of Transportation

M e m o r a n d u m

Business, Transportation and Housing Agency

Flex your power!
Be energy efficient!

To: MR. GARY BLAKESLEY
Senior Bridge Engineer
Division of Engineering Services
Structure Design
Office of Bridge Design North
Bridge Design Branch 5

Date: March 4, 2011

File: 02-PLU-70-PM 1.67/1.68
02-3C3001
0200000317
Bridge No. 09E0002
PLU 70 MBGR
Reconstruction
Wall Location 15

From: **DEPARTMENT OF TRANSPORTATION**
Division of Engineering Services
Geotechnical Services

Subject: **Foundation Report for Wall Location 15**

INTRODUCTION

As requested, the Office of Geotechnical Design - North (GDN) of Geotechnical Services is providing a Foundation Report (FR) for the retaining wall proposed for the subject project. The subject project proposes to reconstruct and upgrade Metal Beam Guard Railing (MBGR) at various locations on State Route (SR) 70, between PM 0.0 and 33.0, in Plumas County. According to the Project Study Report (PSR, Reference No. 12), deterioration of embankment slopes due to erosion is requiring construction of a new Earth Retaining Structures (ERS) to support the MBGR posts at Location 15.

Proposed Structures

The proposed retaining wall is to be composed of an anchored wall system utilizing "pinpile" (or micropile) vertical wall elements and one row of rock anchors located approximately 5 to 7 feet below the top of wall. Shotcrete lagging is also proposed. The wall is to be constructed left of the highway on SR 70, between approximately PM 1.67 and 1.68 (see Plate No. 1 for a vicinity map). According to the Caltrans Digital Photolog Viewer, Roadview Explorer 2.0 (http://onramp.dot.ca.gov/photolog/roadview_index.htm), the subject site is located at latitude and longitude coordinates of 39.8823903^{o} North and -121.3700574^{o} West (these coordinates are the basis for obtaining data in this report available through GIS related information sources). Based on Microstation files provided by Structure Design, Design Branch 5 (wall_layouts_10_19_10.dgn, last updated 10-19-10), the proposed wall will be located as shown on Table No. 1.

Table No. 1. Layout Line of Proposed Walls

WALL LOCATION	STA, OFFSET ("A1" LINE)	~ PM	TOTAL LENGTH (ft)
15	Begin: 87+55.5 18.66' LT	1.67	90
	End: 88+45.7 18.66' LT	1.68	

Scope of work

The scope of our work included performing a literature and historical review in an effort to obtain geological and geotechnical data pertaining to the subject site that could provide insight into the design and construction of the proposed wall facilities. A site investigation was implemented, which included a subsurface exploration program (see below) composed of the drilling of exploratory borings to characterize the subsurface conditions and collect samples. Laboratory testing of selected samples obtained from the site investigation program was performed, followed by engineering analysis and preparation of this report summarizing our findings, conclusions and recommendations.

Subsurface Exploration Program

Our subsurface exploration program was performed on August 4, 5, and 6 of 2009 utilizing Christensen CS 500 and Acker MP-8 truck-mounted drilling rigs. Two borings were performed at the locations shown on Plate No. 2. The borings were accomplished utilizing mud rotary drilling advanced with a self-casing wire-line drill system. Samples of materials were collected at various depths by advancing a "Standard Penetration Test" ("SPT", 2.0 inch O.D.) sampler under a standard striking force weight (140 lb) dropped 30 inches. The respective drill rigs Hammer Energy Ratio (ERi) for SPT sampling were obtained from the Caltrans Office of Geotechnical Support, Foundation Testing Branch (Reference No. 15). Samples were also obtained by core drilling with carbide and diamond impregnated bits (2.4 inch I.D.). Core samples were stored in core boxes and returned to the Transportation Laboratory for reference and testing.

Laboratory Testing

Laboratory testing was performed to assist in determining the general engineering characteristics of site materials for facility design and construction. Unconfined compression testing (ASTM D 7012-07) of selected rock core samples was performed. Core samples obtained from site subsurface exploration primarily consisted of rock-like materials as soil materials generally washed out during drilling; Hence, the minimum

required sample size for corrosion testing (as specified on the "Geotechnical Laboratory Testing Information" form (available at http://www.dot.ca.gov/hq/esc/geotech/gl/glquickreference.pdf) could not be fulfilled. Therefore, corrosion testing was not performed.

FINDINGS

Site Description and History

At the project site, SR 70 stretches along the easterly base of the Feather River Canyon, with the water body of the North Fork of the Feather River adjacent to the west (see Site Plan, Plate No. 2). The adjacent water body is composed of a reservoir associated with the PG&E Cresta Dam, a gravity dam built in 1949 with a crest elevation of 1,680 feet (per DWR, Reference No. 17). The SR 70 roadway grade at the project site is around elevation 1,709 feet, and roughly 30 feet above the observed reservoir water level. According to asbuilt plans (Reference No. 1), the SR 70 facility at the project site was originally constructed in the 1930's with 0.25H:1V cut slopes and 1.4H:1V fill slopes. The observed slope gradients on the site generally coincided with the asbuilt values, with the exception of the embankment slopes which appeared as steep as 1.1H:1V within the proposed wall layout. Cut slopes at the site are as high as 40 to 50 feet, and are composed of "blocky" near vertical slopes of igneous rock (Photo No. 2).

At the proposed Location 15 wall site, 3 feet high, roughly 65 foot long "can-wall" retaining system extends along the westerly edge of the roadway and supports MBGR (Photo No. 3). As built plans (Reference No. 3) indicate that in the 1980's, 3 to 5 feet high "can-walls" (36 inch diameter CSP vertically aligned and battered at 6V:1H, placed on timber footings atop a shallow bench) were intermittently placed approximately 16 feet left of the SR 70 centerline. The can-walls appear to have been utilized to accommodate new MBGR. According to the PSR, many of the can-walls on SR 70 in the Feather River Canyon have lost their foundational support as the bench supporting the cans has eroded. This has resulted in numerous individual cans losing their batter, becoming emptied of the material within the can, and in some cases the interconnected cans and the inserted MBGR posts have completely lost their support and are dangling. At the proposed Location 15 wall site, the can-wall was observed to have lost foundational support and the underlying timber footing was notably deteriorated (see Photo No. 4). Rocky materials were noted on the slope below the can-wall (Photo No. 5). The MBGR within the can-wall limits was noted to be bent with the supporting posts tilting.

Site description comments in this section were based on site visits made on an intermitted basis between May 19, 2009 and September 9, 2010.

Geology/Faulting/Seismicity

The project area is in the northerly part of the Sierra Nevada Geomorphic Province. According to published geologic mapping (Reference Nos. 2 and 4), the immediate site of the proposed wall is located atop the Mesozoic igneous rocks of the Grizzly Pluton, which is part of the Sierran Batholith. The plutonic rock is described as quartz diorite, tonalie, trondhjemite and quartz monzonite.

The Caltrans ARS Online web tool (http://10.160.173.178/shake2/shake_index2.php) indicates that the closest "active" fault (ruptured within past 700,000 years and meeting Caltrans criteria for inclusion per Reference No. 14) to the site is the Butt Creek fault zone. The web tool indicates the closest surface projection of the top of rupture plane of this fault to be a distance of approximately 20 miles northeasterly of the project site, and that this fault is a "right-lateral strike-slip" fault type capable of generating a Maximum Movement Magnitude (Mmax) of 6.8. According to the Alquist-Priolo Earthquake Fault Zone Maps available through the California Geologic Survey (Reference No. 18), Plumas County is not an "affected county"; hence, the site is not within an Alquist-Priolo Earthquake Fault Zone. No faults are known to extend close to or on the project site.

According to the 2007 Caltrans Deterministic PGA Map (Reference No. 11), a peak ground acceleration (PGA) of 0.20g would be applicable to the site for a Vs_{30}=2,500 ft/sec (760 m/sec, for soft bedrock) condition and depicts the Butt Creek fault zone as the controlling fault. Vs_{30} is defined as the average small strain shear wave velocity for the upper 100 feet (30 meters) of materials. The map notes "PGA contours do not incorporate any site correction factors (e.g. soil amplification, near fault factor, etc) and is not to be used for final seismic analysis or design." However, Bridge Design Specifications (BDS, Reference No. 7) Section 5.2.2.3 indicates that seismic forces applied shall be based on a horizontal seismic acceleration coefficient, k_h, equal to one-third of the expected peak acceleration at the site as defined in the Caltrans Seismic Hazard Map.

Based on medium dense soil over rock conditions encountered at the site, a Vs_{30} of = 1,200 ft/sec is applicable to the site. The Caltrans ARS Online web tool indicates the Deterministic Spectral Acceleration near a period of T= 0 seconds to be around 0.17g (per the "upper envelope values"). Table No. 1 below presents the peak ground acceleration (PGA) for the site for various probabilities (based on the 2008 USGS National Seismic Hazard Maps) for a time interval of 50 years. According to AASHTO

LRFD Bridge Design Specifications (Section C3.10.2) "It can also be shown that if the time interval is lengthened to, say, 75 years, the probability of exceeding an earthquake with a return period of 475 years increases to about 15 percent."

Table 1. Probabilistic Peak Ground Acceleration (P-PGA)

P-PGA (%g) for Vs_{30} = 2,500 feet/sec	**P-PGA (%g) for Vs_{30} = 1,200 feet/sec (based on soil amplification factor [3])**	**Probability of Exceedance in 50 years**	**Return Period**
20.2 [1]	23.9	5 %	975 years
14.7 [2]	17.4[4]	10 %	475 years

Notes:
[1] P-PGA obtained from the Caltrans ARS Online Probabilistic Response Spectrum Spread Sheet.
[2] P-PGA obtained from the 2008 USGS National Seismic Hazard Maps (at http://gldims.cr.usgs.gov/nshmp2008/viewer.htm).
[3] Soil amplification factor of 1.182 (at a period, T=0 seconds) obtained from the Caltrans ARS Online Probabilistic Response Spectrum Spread Sheet.
[4] P-PGA for 10% Probability of Exceedance in 50 years provided as appropriate PGA for "evaluation of seismic hazards other than surface fault-rupture" per SCEC (1999), Reference No. 5.

Based on the materials encountered in our subsurface exploration, the potential for liquefaction related ground failure at the site as a result of earthquake induced ground motions is considered very low.

Subsurface Soil and Rock Conditions

Borings were performed within the westerly (left) lane of SR 70. The near-surface materials encountered underlying the asphalt concrete surface course generally consisted of silty sand with gravel. In Boring RC-09-001A, the silty sand contained dioritic cobbles from 3 to 7 inches in intersected length. It should be noted that significant loss of sample recovery often occurred in these soil materials and was due to the washing out of finer materials (silt, sand, fine gravel) and "blocking-off" at the core bit by gravel and coble-sized rock fragments as indicated on the Boring Records. The soil materials extended to underlying "rock-like" materials at depths of approximately 35 and 10 feet below the ground surface (BGS), for Borings RC-09-001A and RC-09-001B, respectively.

Rock like materials encountered underlying the near-surface soil materials consisted of from moderately weathered to fresh, dioritic igneous rock.. Rock hardness ranged from moderately hard to hard. Fracturing was noted to range from intensely fractured to

slightly fractured. Unconfined compression testing (ASTM D 7012-07) of selected rock core specimens yielded compressive strengths of 2,031 and 2,371 PSI.

Boring locations are presented on Plate No. 2. A more detailed description of the subsurface conditions encountered during our field exploration, along with laboratory testing results, is presented graphically on the Boring Records of Appendix A, attached. The results of laboratory testing are also presented in Appendix B. Boring logs will also be presented on the project plans in Log-Of-Test-Boring (LOTB) format.

Groundwater

At the completion of drilling of each boring, the level of the ground water surface was measured in the open hole of the borings. The ground water surface was measured at depths of 28.5 and 27.2 feet BGS. The level of the ground water surface appears to roughly coincide with the level of the water in the adjacent reservoir (approximate elevation of 1680 feet).

Characterization & Analysis

Based on the relative steepness of natural bedrock slopes above the adjacent roadway cut excavations, it is anticipated that the elevation of the top of the formational dioritic bedrock will be significantly lower at the wall layout line (WLOL) than that encountered in exploratory borings. Due to the sloping nature of the stratigraphy, a limit equilibrium method (LEM) of analysis (utilizing SlopeW, Reference No. 13) was implemented to provide more appropriate modeling for determining the available passive earth pressure in front of the proposed walls. Based on the anticipated geometry of the wall facilities and subsurface characterization, the design model of Figure 1B was developed for LEM analysis. A back analysis to a Factor of Safety (FS) of 1.1 was utilized to derive geotechnical parameters for the soil, cobble and boulder materials overlying formational rock. The idealized passive pressure distribution presented on Figure 1A was derived from the LEM analysis based on a FS=1.

CONCLUSIONS & RECOMMENDATIONS

Based on data collected from exploratory borings, geophysical exploration, topographical mapping, and field review of rock exposures, the following table was derived estimating the elevation of the top of formation on the proposed WLOLs.

Table No. 2. Estimated Elevation of Top of Formation Rock on WLOLs

WALL LOCATION	STA ("A1" LINE)	ELEVATION OF TOP OF FORMATIONAL ROCK (ft)
15	87+55.5 to 87+70	1663
	87+70 to 87+80	1676
	87+80 to 88+45.7	1688

Lateral Earth Pressures

Active

The active lateral earth pressure acting on the wall may be determined base on the following parameters:

Angle of Internal Friction, $\phi = 34^o$
Cohesion, c = 0 psf
Total Unit Weight, $\gamma = 135$ pcf

Below the top of rock elevations provided in Table No. 2, the active earth pressure acting on the wall may be taken as zero, as diagramed in Bridge Design Specifications (BDS, Reference No. 7) Figure 5.5.5.6-2.

Passive

Passive earth pressure resistance may be applied below an elevation of 1 foot below the proposed bench elevation. The proposed shotcrete lagging should extend down to at least this elevation. The passive lateral earth pressure available in front of the wall may be determined based on the following parameters (see also Figure 1A):

Above the top of rock elevation of Table No. 2:

Passive Earth Pressure coefficient, Kp = 1.613
Total Unit Weight, γ_T = 95 pcf
Buoyant Unit Weight, γ_{BUOY} = 32.6 pcf (use buoyant below elevation 1688 feet elevation)

Below the top of rock elevation of Table No. 2:

Passive Earth Pressure coefficient, Kp = 5.752
Total Unit Weight, γ_T = 165 pcf
Buoyant Unit Weight, γ_{BUOY} = 102.6 pcf (use buoyant below elevation 1688 feet elevation)

The passive pressure formula in Figure 5.5.5.6-2 of the BDS is considered inappropriate for the wall design on this project as discontinuities potentially exist in the near surface rock that would affect the implied failure geometry.

Pile Axial Loading

According to BDN, the anticipated axial compression loading on each pile will be 59 kips, with a drilled hole diameter of at least 8 inches. Based on the estimated top of rock elevations presented on Table No. 2, the following table was developed providing recommended tip elevations for piles. Micropiles not achieving the minimum rock socket should be of Type B Construction Type Classification (Reference No. 9) with neat cement grout placed under pressure (75 to 145 psi).

Table No. 3. Recommended Pile Tip Elevations Based on Axial Compression Loading

WALL LOCATION	STA ("A1" LINE)	PILE TIP ELEVATION (ft)
	87+55.5 to 87+70	1668
15	87+70 to 87+80	1672
	87+80 to 88+45.7	1680*

*Piles tip elevation based on a minimum rock socket of 8 feet

.

Anchors

According to BDN, rock anchors are proposed to be installed in drilled holes of at least 4 inches in diameter, at an angle of 20^{o} from level, and located on the wall face at 4 feet below the top of wall; tension loads of 42 kips are proposed on each anchor. Accordingly, anchors should be socketed (drilled) at least 7 feet into the formational rock. Table No. 4 below provides estimated rock anchor embedment lengths to achieve the minimum 7 feet rock socket requirement for anchors. The bond length for test anchors will be comprised of the rock socket. Soil materials should not be expected to contribute significantly to anchor capacity.

Table No. 4. Recommended Rock Anchor Embedment Lengths

WALL LOCATION	STA ("A1" LINE)	ANCHOR EMBEDMENT LENGTH (ft)*
15	87+55.5 to 87+70	45
	87+70 to 87+80	35
	87+80 to 88+45.7	25

*Anchors should extend at least 7 feet into formational rock.

Water Drainage

The provided wall loads do not account for groundwater derived hydrostatic pressures. The placement of geocomposite drain strips between the wall and native materials and weep holes should facilitate an acceptable drainage system for the relief of hydrostatic pressures.

Corrosion

Although corrosion testing could not be performed, based on the site materials encountered and the corrosion potential rating provided by the USDA (Reference No. 18), the site materials can be assumed to be non-corrosive.

Construction

The contractor may encounter difficulties during drilling for anchors and piles due to the presence of zones of fresh, hard rock encountered in subsurface exploration. The zones of hard rock will likely necessitate the use of specialty equipment (down-hole hammers, core barrels, etc.) to drill to the required pile depths and anchor lengths.

Caving conditions are likely to occur in the materials overlying bedrock materials at the site that contain gravel, cobbles and boulders. In addition, the blocky nature of the fractured bedrock is conducive to rock wedge failures into unsupported boreholes; hence, casing would likely be needed to keep the holes open prior to placing grout and concrete.

Although groundwater measurements in the open boreholes roughly coincided with the elevation of water in the adjacent reservoir (see "Groundwater" section), it can be expected that significant groundwater at the site could be encountered either perched atop rock materials, or flowing through rock fractures. In some cases, confined (under pressure) groundwater aquifers could be encountered while drilling even during the driest periods of the year. Hence, the pile and anchor installations may require dewatering or the placement of concrete and grout in wet conditions. If the contractor opts to place the concrete and grout in wet conditions, the specifications should require the displacement of water via a closed system using a concrete pump or a tremie tube to place concrete and grout at the bottom of the hole. In cases where drilling encounters confined aquifers, the contractor should expect water seepage out of the hole at the surface for a significant period of time.

Due to the fractured nature of the underlying rock materials, the potential for excess loss of concrete and grout in voids and fractures should be expected. Controlling measures, such as the use of a "grout sock", could potentially reduce grout loss.

<u>Project Information</u>

Standard Special Provisions S5-280, "Project Information," discloses to bidders and contractors a list of pertinent information available for their inspection prior to bid opening. The following is an excerpt from SSP S5-280 disclosing information originating from Geotechnical Services. Items listed to be included in the information Handout will be provided in Acrobat (.pdf) format to the addressee(s) of this report via electronic mail.

Data and information attached with the project plans are:

A. Log of Test Borings for the 2009 subsurface exploration.

Data and Information included in the Information Handout provided to the bidders and Contractors are:

A."Foundation Report for Wall Location 15" (Bridge No. 09E0002), dated March 4, 2011.

Data and Information available for inspection at the District Office:

A. None

Data and information available for inspection at the Transportation Laboratory:

A. Core samples collected from the 2009 subsurface exploration.

If any conceptual changes are made during final project design, the Office of Geotechnical Design North should review those changes to determine if these foundation recommendations are still applicable. If you have any questions or comments, please call Mark Hagy at (916) 227-1077 or Douglas Brittsan at (916) 227-1079.

MARK HAGY, P.E., G.E.
Transportation Engineer
Office of Geotechnical Design North, Branch C

c: Doug Brittsan
Eric Orr - D02 – Proj. Mgmt.
Struct. Const. RE Pending File
DES OE, Office of PS&E
DME
GS Corporate
GDN File

Attachments: References
Figure No. 1. Passive Earth Pressure Application
Plate No. 1: Vicinity Map
Plate No. 2: Site Plan
Plate No. 3: Photographs
Appendix A: Boring Records
Hole I.D. RC-09-001A (2 sheets); Hole I.D. RC-09-001B (2 sheets);
Boring Record Legend (3 Sheets)
Appendix B: Laboratory Test Results
Plate No. B-1: Summary of Unconfined Compression Test Results
Plate No. B-2: Unconfined Compression Test Results, Specimen R09-001A-11
Plate No. B-3: Unconfined Compression Test Results, Specimen R09-001B-5

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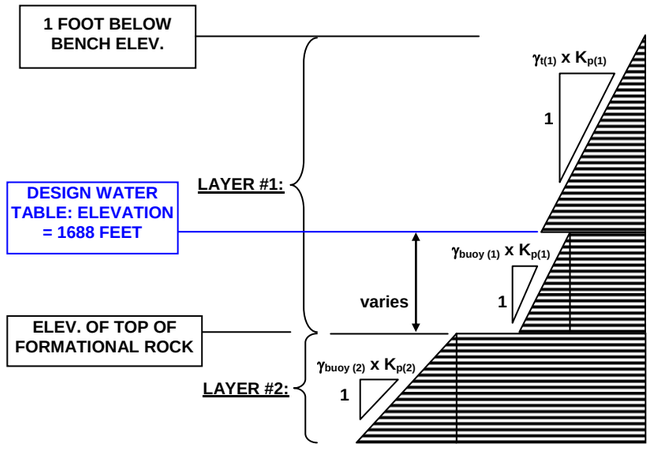
FIGURE NO. 1. PASSIVE EARTH PRESSURE APPLICATION (PLU 70 LOCATION 15, 02-3C3001)

APPOXIMATE SCALE : 1" = 10 feet
(vertical = horizontal)

0 10 20 feet

FIGURE 1A. IDEALIZED PASSIVE PRESSURE DISTRIBUTION



IDEALIZED DESIGN PARAMETERS AT WLOL:

LAYER #1 (SOIL, COBBLES AND BOULDERS):

$\gamma_{t(1)}$ = 95 pcf

$\gamma_{buoyant(1)}$ = 32.6 pcf

LOG SPIRAL PARAMETERS:

$\phi_{(1)} = 44^o$

$\beta_{(1)} = -40^o$

$\beta/\phi = -0.909$

$\delta/\phi \simeq 1$

$K_{p(1)} = 1.613$

LAYER #2 (FORMATIONAL ROCK):

$\gamma_{t(2)}$ = 165 pcf

$\gamma_{buoyant(2)}$ = 102.6 pcf

LOG SPIRAL PARAMETERS:

$\phi_{(2)} = 38^o$

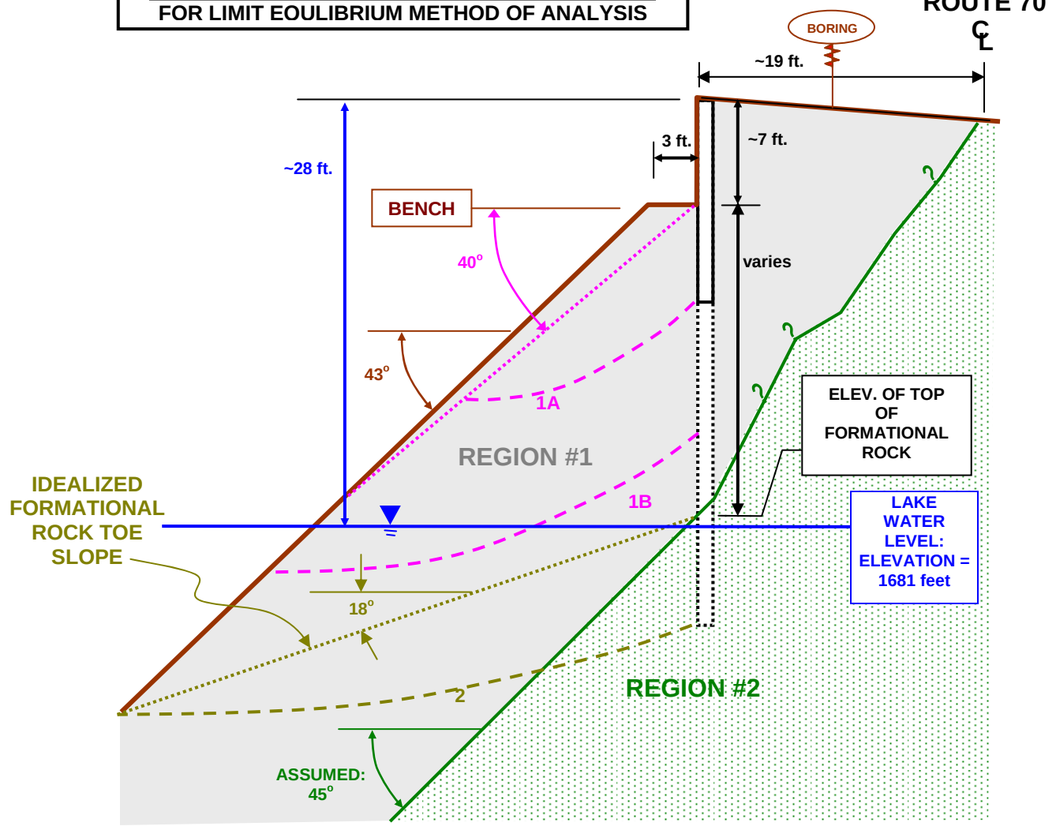
$\beta_{effective(2)} = -18^o$

$\beta/\phi = -0.474$

$\delta/\phi \simeq 1$

$K_{p(2)} = 5.752$

FIGURE 1B. APPROXIMATED DESIGN GEOMETRY FOR LIMIT EOULIBRIUM METHOD OF ANALYSIS



LIMIT EQUILIBRIUM ANALYSIS PARAMETERS

FS of slope = 1.1 (with 240 psf traffic surcharge)

REGION #1: (SOIL, COBBLES & BOULDERS)

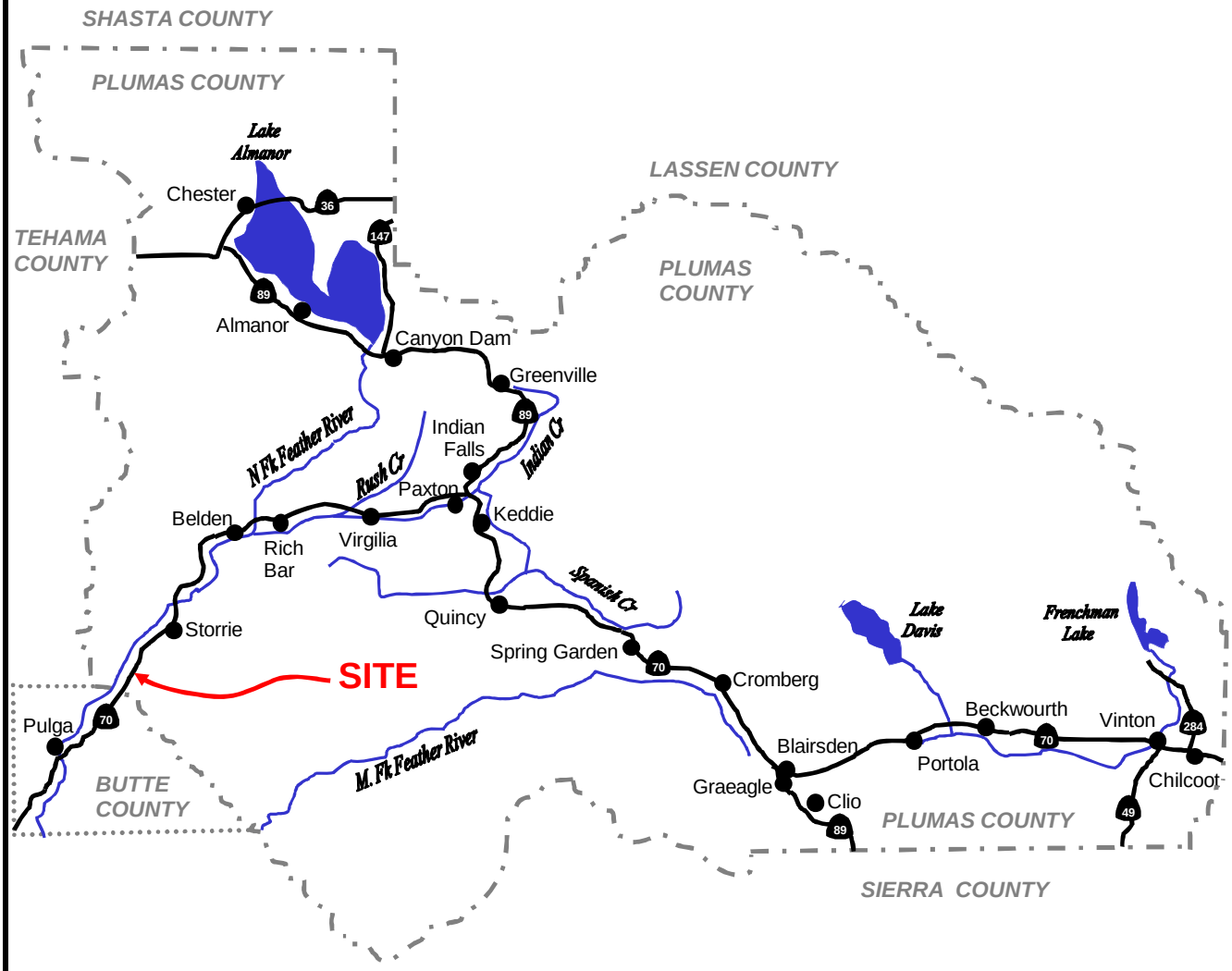
$\phi = 44^o$, c = 25 psf

γ_t = 125 pcf γ_{sat} = 130 pcf

REGION #2 (FORMATIONAL ROCK):

$\phi = 38^o$, c = 3,500 psf

$\gamma_t = \gamma_{sat}$ = 165 pcf



N

NO SCALE

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Geotechnical Services
Office of Geotechnical Design - North

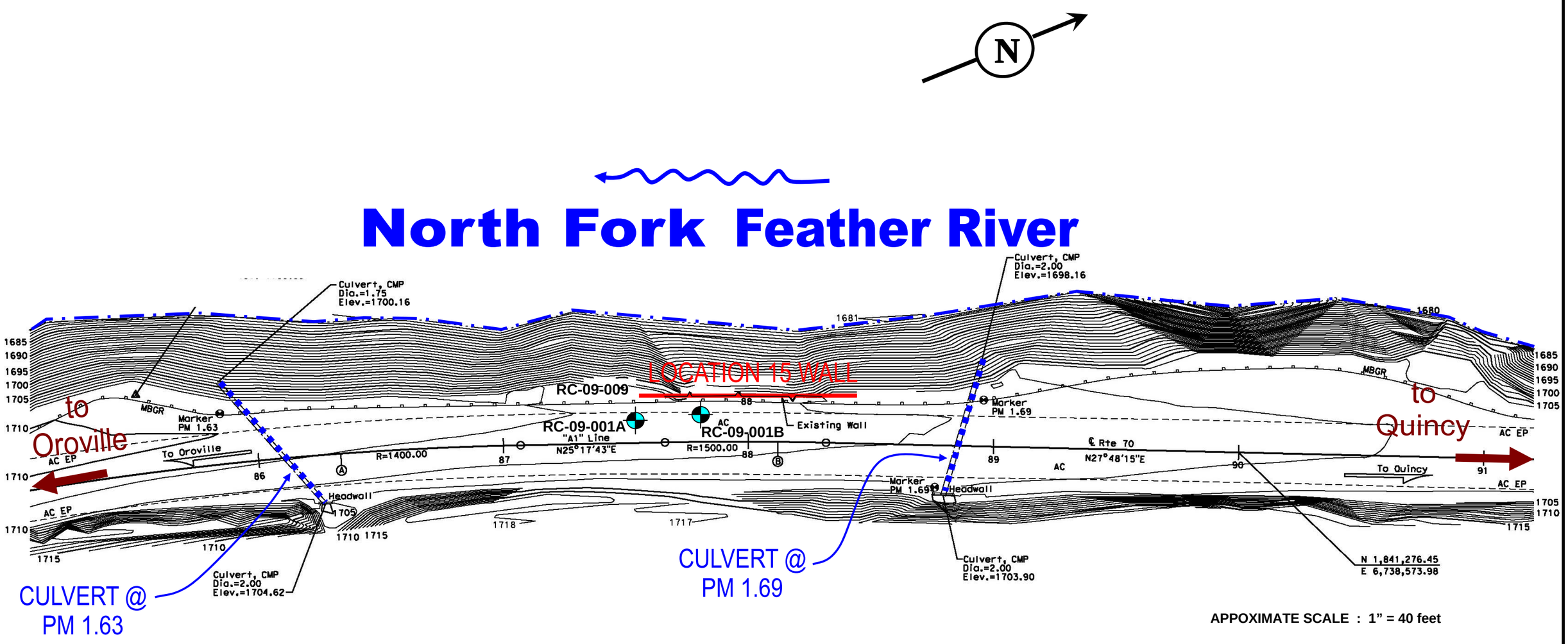
EA:	02-3C3001
Date:	March-11

VICINITY MAP

02-PLU-70 PM 1.67/1.68 (LOCATION 15)

Foundation Report

PLATE NO. **1**



APPOXIMATE SCALE : 1" = 40 feet

0 40 80 feet

LEGEND

RC-09-001A **Denotes location of Exploratory Boring No. 1A performed in 2009.**

Base Map Reference: "Soldier Pile Wall 1 (Location 15) – Foundation Plan", by Caltrans Structure Design – Design Branch 5, Preliminary Investigation Section, revision date 7-14-09, from Microstation file "09-wall1-e-fpl01.dgn". elevations shown are in feet; 1 foot contour intervals.

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EA: 02-3C3001

Date: March 2011

SITE PLAN

02-PLU-70 PM 1.67/1.68
LOCATION 15
FOUNDATION REPORT

Plate No. 2

Photo No. 1. Route 70 at Location 15; looking northerly; photo date 9-9-10.

Photo No. 2. Rock cut slope, opposite of proposed Location 15 wall; right of approx. STA "A1" 88+80; photo date 5-19-09.

Photo No. 3. Can-wall at Location 15; viewing northerly; photo dated 5-19-09.

Photo No. 4. Can-wall at Location 15; viewing northerly; note deteriorating timber footings and undermining; photo dated 9-9-10.

Photo No. 5. Rock exposure on toe slope below can-wall at Location 15; looking southerly; photo date 9-9-10.

Photo No. 6. Bent MBGR and tilting posts atop can-wall at Location 15; viewing northerly; photo date 5-19-09.

APPENDIX A

Boring Records

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
M. Kiesse	8-4-09	8-5-09	NAD83	RC-09-001A
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line) 8.50' Rt Sta 87+55A1	SURFACE ELEVATION 1708.8 ft NAVD88
DRILLING METHOD Rotary Wire-Line			DRILL RIG CS-500	BOREHOLE DIAMETER 3.7 in
SAMPLER TYPE(S) AND SIZE(S) (ID) SPT (1.4")			SPT HAMMER TYPE safety (manual)	HAMMER EFFICIENCY, ERi 62%
BOREHOLE BACKFILL AND COMPLETION bentonite			GROUNDWATER READINGS DURING DRILLING AFTER DRILLING (DATE) 28.5 ft on 8-5-09	TOTAL DEPTH OF BORING 40.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method / Casing Depth	Remarks
	0		ASPHALT CONCRETE (6").											
	1		AGGREGATE BASE (18").											
1706.80	2		SILTY SAND with GRAVEL (SM); and COBBLES; very dense, brown and grey, moist, 55% from coarse to fine subrounded SAND; 25% coarse and fine subrounded GRAVEL; 20% fines; from 10% to 30% DIORITE COBBLES, 3-7 inches, hard..		1	50/5"	REF							2 to 35 feet depth: fine gravel, sand and fines materials washing out at return
	3				2			39						
1704.80	4													
	5				3			10						"blocking off" at bit with rock fragments during runs; driller indicates hard drilling effort intervals between relatively soft intervals
1702.80	6													
	7													
1700.80	8													
	9													
1698.80	10				4			7						
	11													
1696.80	12													
	13													
1694.80	14													
	15				5			0						
1692.80	16													
	17													
1690.80	18													
	19													
	20													

(continued)

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Office of Geotechnical Design - North

REPORT TITLE				HOLE ID
BORING RECORD				RC-09-001A
DIST. 02	COUNTY PLU	ROUTE 70	POSTMILE D0.0/D34.3	EA 02-3C3001
PROJECT OR BRIDGE NAME PLU 70 WALLS				
BRIDGE NUMBER L15 (PM 1.68)	PREPARED BY Hagy		DATE 2-18-11	SHEET 1 of 2

5 BR - STANDARD PLU70WALLSL15.GPJ CALTRANS_LIBRARY_DEC09.GLB 3/11/11

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	20		SILTY SAND with GRAVEL (SM) *(continued)*.		6			0							
	21														
1686.80	22														
	23														
1684.80	24														
	25				7	50/5"	REF								
					8			11							
1682.80	26														
	27														
1680.80	28														
	29														
1678.80	30				9			20							
	31														
1676.80	32														
	33														
1674.80	34														
	35		IGNEOUS ROCK (DIORITE), black and white, slightly weathered, moderately soft, very slightly fractured.		10			100	100						
1672.80	36														
	37		Fresh, moderately hard.												
1670.80	38				11			100	100						
	39														UC (ASTM D 7012-07) = 2,371 PSI
1668.80	40		Bottom of borehole at 40.0 ft bgs												
	41														
1666.80	42														
	43														
	44														

5 BR - STANDARD PLU70WALLSL15.GPJ CALTRANS_LIBRARY_DEC09.GLB 3/11/11

Department of Transportation
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Geotechnical Services
Office of Geotechnical Design - North

REPORT TITLE				HOLE ID
BORING RECORD				RC-09-001A
DIST.	COUNTY	ROUTE	POSTMILE	EA
02	PLU	70	D0.0/D34.3	02-3C3001
PROJECT OR BRIDGE NAME				
PLU 70 WALLS				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
L15 (PM 1.68)	Hagy		2-18-11	2 of 2

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
H. AkbarZadegan	8-6-09	8-6-09	NAD83	RC-09-001B
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line) 10.00' Rt Sta 87+83A1	SURFACE ELEVATION 1708.6 ft NAVD88
DRILLING METHOD Rotary Wire-Line			DRILL RIG Acker MP 8	BOREHOLE DIAMETER 3.7 in
SAMPLER TYPE(S) AND SIZE(S) (ID) HQ Core			SPT HAMMER TYPE automatic	HAMMER EFFICIENCY, ERi 74%
BOREHOLE BACKFILL AND COMPLETION bentonite			GROUNDWATER READINGS DURING DRILLING	AFTER DRILLING (DATE) 27.2 ft on 8-6-09	TOTAL DEPTH OF BORING 40.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		ASPHALT CONCRETE (6").		1			17							
	1		SILTY SAND with GRAVEL (SM); gray; moist; 60% from coarse to fine sand subangular SAND; 20% fine subangular GRAVEL; 20% fines.												0.5 to 10 feet depth: sand and fines materials washing out at return
1706.60	2														
	3														
1704.60	4														
	5				2			0							no core recovery
1702.60	6														
	7														
1700.60	8														
	9														
1698.60	10		IGNEOUS ROCK (DIORITE), black and white, slightly weathered, hard, intensely and moderately fractured.		3			84	42						
	11														
1696.60	12		Dark gray, moderately weathered.												
	13														
1694.60	14														
	15		Black and white, moderately hard.		4			100	38						
1692.60	16														
	17														
1690.60	18														
	19														
	20														

(continued)

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

REPORT TITLE				HOLE ID
BORING RECORD				RC-09-001B
DIST. 02	COUNTY PLU	ROUTE 70	POSTMILE D0.0/D34.3	EA 02-3C3001
PROJECT OR BRIDGE NAME PLU 70 WALLS				
BRIDGE NUMBER L15 (PM 1.68)	PREPARED BY Hagy		DATE 2-18-11	SHEET 1 of 2

5 BR - STANDARD PLU70WALLSL15.GPJ CALTRANS_LIBRARY_DEC09.GLB 3/11/11

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	20		IGNEOUS ROCK (Diorite) *(continued)*.		5			100	74						UC (ASTM D 7012-07) = 2,031 PSI
	21		Moderately and slightly weathered, hard, slightly fractured.												
1686.60	22		Intensely fractured.												
	23														
1684.60	24		Intensely and moderately fractured.												
	25				6			100	78						
1682.60	26														
	27														
1680.60	28		Slightly fractured.												
	29														
1678.60	30		Intensely and moderately fractured.		7			67	52						
	31														
1676.60	32														
	33														
1674.60	34														
	35		Moderately soft, intensely fractured.		8			60	20						
1672.60	36														
	37														
1670.60	38														
	39														
1668.60	40														
			Bottom of borehole at 40.0 ft bgs												
	41														
1666.60	42														
	43														
	44														

5 BR - STANDARD PLU70WALLSL15.GPJ CALTRANS_LIBRARY_DEC09.GLB 3/11/11

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

REPORT TITLE				HOLE ID
BORING RECORD				RC-09-001B
DIST. 02	COUNTY PLU	ROUTE 70	POSTMILE D0.0/D34.3	EA 02-3C3001
PROJECT OR BRIDGE NAME PLU 70 WALLS				
BRIDGE NUMBER L15 (PM 1.68)	PREPARED BY Hagy		DATE 2-18-11	SHEET 2 of 2

GROUP SYMBOLS AND NAMES

Graphic / Symbol	Group Names
GW	Well-graded GRAVEL Well-graded GRAVEL with SAND
GP	Poorly graded GRAVEL Poorly graded GRAVEL with SAND
GW-GM	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND
GW-GC	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
GP-GM	Poorly graded GRAVEL with SILT Poorly graded GRAVEL with SILT and SAND
GP-GC	Poorly graded GRAVEL with CLAY (or SILTY CLAY) Poorly graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
GM	SILTY GRAVEL SILTY GRAVEL with SAND
GC	CLAYEY GRAVEL CLAYEY GRAVEL with SAND
GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND
SW	Well-graded SAND Well-graded SAND with GRAVEL
SP	Poorly graded SAND Poorly graded SAND with GRAVEL
SW-SM	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL
SW-SC	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
SP-SM	Poorly graded SAND with SILT Poorly graded SAND with SILT and GRAVEL
SP-SC	Poorly graded SAND with CLAY (or SILTY CLAY) Poorly graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
SM	SILTY SAND SILTY SAND with GRAVEL
SC	CLAYEY SAND CLAYEY SAND with GRAVEL
SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL
PT	PEAT
	COBBLES COBBLES and BOULDERS BOULDERS

Graphic / Symbol	Group Names
CL	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
CL-ML	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY elastic ELASTIC SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND

FIELD AND LABORATORY TESTS

C	Consolidation (ASTM D 2435-04)
CL	Collapse Potential (ASTM D 5333-03)
CP	Compaction Curve (CTM 216 - 06)
CR	Corrosion, Sulfates, Chlorides (CTM 643 - 99; CTM 417 - 06; CTM 422 - 06)
CU	Consolidated Undrained Triaxial (ASTM D 4767-02)
DS	Direct Shear (ASTM D 3080-04)
EI	Expansion Index (ASTM D 4829-03)
M	Moisture Content (ASTM D 2216-05)
OC	Organic Content (ASTM D 2974-07)
P	Permeability (CTM 220 - 05)
PA	Particle Size Analysis (ASTM D 422-63 [2002])
PI	Liquid Limit, Plastic Limit, Plasticity Index (AASHTO T 89-02, AASHTO T 90-00)
PL	Point Load Index (ASTM D 5731-05)
PM	Pressure Meter
PP	Pocket Penetrometer
R	R-Value (CTM 301 - 00)
SE	Sand Equivalent (CTM 217 - 99)
SG	Specific Gravity (AASHTO T 100-06)
SL	Shrinkage Limit (ASTM D 427-04)
SW	Swell Potential (ASTM D 4546-03)
TV	Pocket Torvane
UC	Unconfined Compression - Soil (ASTM D 2166-06) Unconfined Compression - Rock (ASTM D 2938-95)
UU	Unconsolidated Undrained Triaxial (ASTM D 2850-03)
UW	Unit Weight (ASTM D 4767-04)
VS	Vane Shear (AASHTO T 223-96 [2004])

SAMPLER GRAPHIC SYMBOLS

- Standard Penetration Test (SPT)
- Standard California Sampler
- Modified California Sampler
- Shelby Tube
- Piston Sampler
- NX Rock Core
- HQ Rock Core
- Bulk Sample
- Other (see remarks)

DRILLING METHOD SYMBOLS

- Auger Drilling
- Rotary Drilling
- Dynamic Cone or Hand Driven
- Diamond Core

WATER LEVEL SYMBOLS

- First Water Level Reading (during drilling)
- Static Water Level Reading (short-term)
- Static Water Level Reading (long-term)

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

REPORT TITLE: **BORING RECORD LEGEND**

DIST.	COUNTY	ROUTE	POSTMILE	EA
02	Plumas	70	D0.0/D34.3	02-3C3001

PROJECT OR BRIDGE NAME: **PLU 70 WALLS**

BRIDGE NUMBER	PREPARED BY	DATE	SHEET
L15 (PM 1.68)			1 of 3

CONSISTENCY OF COHESIVE SOILS				
Descriptor	Unconfined Compressive Strength (tsf)	Pocket Penetrometer (tsf)	Torvane (tsf)	Field Approximation
Very Soft	< 0.25	< 0.25	< 0.12	Easily penetrated several inches by fist
Soft	0.25 - 0.50	0.25 - 0.50	0.12 - 0.25	Easily penetrated several inches by thumb
Medium Stiff	0.50 - 1.0	0.50 - 1.0	0.25 - 0.50	Can be penetrated several inches by thumb with moderate effort
Stiff	1.0 - 2.0	1.0 - 2.0	0.50 - 1.0	Readily indented by thumb but penetrated only with great effort
Very Stiff	2.0 - 4.0	2.0 - 4.0	1.0 - 2.0	Readily indented by thumbnail
Hard	> 4.0	> 4.0	> 2.0	Indented by thumbnail with difficulty

APPARENT DENSITY OF COHESIONLESS SOILS	
Descriptor	SPT N_{60} - Value (blows / foot)
Very Loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	> 50

MOISTURE	
Descriptor	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

PERCENT OR PROPORTION OF SOILS	
Descriptor	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

SOIL PARTICLE SIZE		
Descriptor		Size
Boulder		> 12 inches
Cobble		3 to 12 inches
Gravel	Coarse	3/4 inch to 3 inches
	Fine	No. 4 Sieve to 3/4 inch
Sand	Coarse	No. 10 Sieve to No. 4 Sieve
	Medium	No. 40 Sieve to No. 10 Sieve
	Fine	No. 200 Sieve to No. 40 Sieve
Silt and Clay		Passing No. 200 Sieve

PLASTICITY OF FINE-GRAINED SOILS	
Descriptor	Criteria
Nonplastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled, and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll, and not much time is required to reach the plastic limit; it cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.

CEMENTATION	
Descriptor	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

NOTE: This legend sheet provides descriptors and associated criteria for required soil description components only. Refer to Caltrans Soil and Rock Logging, Classification, and Presentation Manual (July 2007), Section 2, for tables of additional soil description components and discussion of soil description and identification.

ROCK GRAPHIC SYMBOLS


IGNEOUS ROCK


SEDIMENTARY ROCK


METAMORPHIC ROCK

BEDDING SPACING

Descriptor	Thickness or Spacing
Massive	> 10 ft
Very thickly bedded	3 to 10 ft
Thickly bedded	1 to 3 ft
Moderately bedded	3-5/8 inches to 1 ft
Thinly bedded	1-1/4 to 3-5/8 inches
Very thinly bedded	3/8 inch to 1-1/4 inches
Laminated	< 3/8 inch

WEATHERING DESCRIPTORS FOR INTACT ROCK

	Diagnostic Features					
	Chemical Weathering-Discoloration-Oxidation		Mechanical Weathering and Grain Boundary Conditions	Texture and Solutioning		
Descriptor	Body of Rock	Fracture Surfaces		Texture	Solutioning	General Characteristics
Fresh	No discoloration, not oxidized	No discoloration or oxidation	No separation, intact (tight)	No change	No solutioning	Hammer rings when crystalline rocks are struck.
Slightly Weathered	Discoloration or oxidation is limited to surface of, or short distance from, fractures; some feldspar crystals are dull	Minor to complete discoloration or oxidation of most surfaces	No visible separation, intact (tight)	Preserved	Minor leaching of some soluble minerals may be noted	Hammer rings when crystalline rocks are struck. Body of rock not weakened.
Moderately Weathered	Discoloration or oxidation extends from fractures usually throughout; Fe-Mg minerals are "rusty"; feldspar crystals are "cloudy"	All fracture surfaces are discolored or oxidized	Partial separation of boundaries visible	Generally preserved	Soluble minerals may be mostly leached	Hammer does not ring when rock is struck. Body of rock is slightly weakened.
Intensely Weathered	Discoloration or oxidation throughout; all feldspars and Fe-Mg minerals are altered to clay to some extent; or chemical alteration produces in situ disaggregation (refer to grain boundary conditions)	All fracture surfaces are discolored or oxidized; surfaces are friable	Partial separation, rock is friable; in semi-arid conditions, granitics are disaggregated	Altered by chemical disintegration such as via hydration or argillation	Leaching of soluble minerals may be complete	Dull sound when struck with hammer; usually can be broken with moderate to heavy manual pressure or by light hammer blow without reference to planes of weakness such as incipient or hairline fractures or veinlets. Rock is significantly weakened.
Decomposed	Discolored of oxidized throughout, but resistant minerals such as quartz may be unaltered; all feldspars and Fe-Mg minerals are completely altered to clay		Complete separation of grain boundaries (disaggregated)	Resembles a soil; partial or complete remnant rock structure may be preserved; leaching of soluble minerals usually complete		Can be granulated by hand. Resistant minerals such as quartz may be present as "stringers" or "dikes".

Note: Combination descriptors (such as "slightly weathered to fresh") are used where equal distribution of both weathering characteristics is present over significant intervals or where characteristics present are "in between" the diagnostic feature. However, combination descriptors should not be used where significant identifiable zones can be delineated. Only two adjacent descriptors shall be combined. "Very intensely weathered" is the combination descriptor for "decomposed to intensely weathered".

RELATIVE STRENGTH OF INTACT ROCK

Descriptor	Uniaxial Compressive Strength (psi)
Extremely Strong	> 30,000
Very Strong	14,500 - 30,000
Strong	7,000 - 14,500
Medium Strong	3,500 - 7,000
Weak	700 - 3,500
Very Weak	150 - 700
Extremely Weak	< 150

ROCK HARDNESS

Descriptor	Criteria
Extremely Hard	Specimen cannot be scratched with pocket knife or sharp pick; can only be chipped with repeated heavy hammer blows
Very hard	Specimen cannot be scratched with pocket knife or sharp pick; breaks with repeated heavy hammer blows
Hard	Specimen can be scratched with pocket knife or sharp pick with heavy pressure; heavy hammer blows required to break specimen
Moderately Hard	Specimen can be scratched with pocket knife or sharp pick with light or moderate pressure; breaks with moderate hammer blows
Moderately Soft	Specimen can be grooved 1/6 in. with pocket knife or sharp pick with moderate or heavy pressure; breaks with light hammer blow or heavy hand pressure
Soft	Specimen can be grooved or gouged with pocket knife or sharp pick with light pressure, breaks with light to moderate hand pressure
Very Soft	Specimen can be readily indented, grooved, or gouged with fingernail, or carved with pocket knife; breaks with light hand pressure

CORE RECOVERY CALCULATION (%)

$$\frac{\Sigma \text{ Length of the recovered core pieces (in.)}}{\text{Total length of core run (in.)}} \times 100$$

RQD CALCULATION (%)

$$\frac{\Sigma \text{ Length of intact core pieces} > 4 \text{ in.}}{\text{Total length of core run (in.)}} \times 100$$

FRACTURE DENSITY

Descriptor	Criteria
Unfractured	No fractures
Very Slightly Fractured	Lengths greater 3 ft
Slightly Fractured	Lengths from 1 to 3 ft, few lengths outside that range
Moderately Fractured	Lengths mostly in range of 4 in. to 1 ft, with most lengths about 8 in.
Intensely Fractured	Lengths average from 1 in. to 4 in. with scattered fragmented intervals with lengths less than 4 in.
Very Intensely Fractured	Mostly chips and fragments with few scattered short core lengths

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

REPORT TITLE
BORING RECORD LEGEND

DIST.	COUNTY	ROUTE	POSTMILE	EA
02	Plumas	70	D0.0/D34.3	02-3C3001

PROJECT OR BRIDGE NAME
PLU 70 WALLS

BRIDGE NUMBER	PREPARED BY	DATE	SHEET
L15 (PM 1.68)			3 of 3

APPENDIX B

Laboratory Test Results

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION
OFFICE OF GEOTECHNICAL SUPPORT
GEOTECHNICAL LABORATORY

UNCONFINED COMPRESSION TEST RESULTS (ASTM D7012-07 Method C)

JOB LOCATION **02-Plu-70** **PM 1.68-2.73** GL No. **09-068** DATE **2/22/2010**

TEST BY **AZM**

JOB NUMBER **02-3C3001** **PLU 70 Walls** Bridge No. _____ CHECKED BY **LP 2/26/10**

SAMPLE NO.	DEPTH FT.	DIA. IN.	LENGTH IN.	L/D RATIO	WEIGHT LBS.	LOAD LBS.	DENSITY PCF	STRENGTH PSI	REMARKS
R09-001A-11	38.5-39	2.38	5.13	2.16	2.2	10548	163	2371	
R09-001B-5	20-20.5	2.40	5.45	2.27	2.2	9186	155	2031	

Note: No moistures recorded

* Sample fell apart while preparing for testing -- Not suitable for testing

** The test specimen length/diameter ratio was not in compliance with the test method

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

EA: 02-3C3001

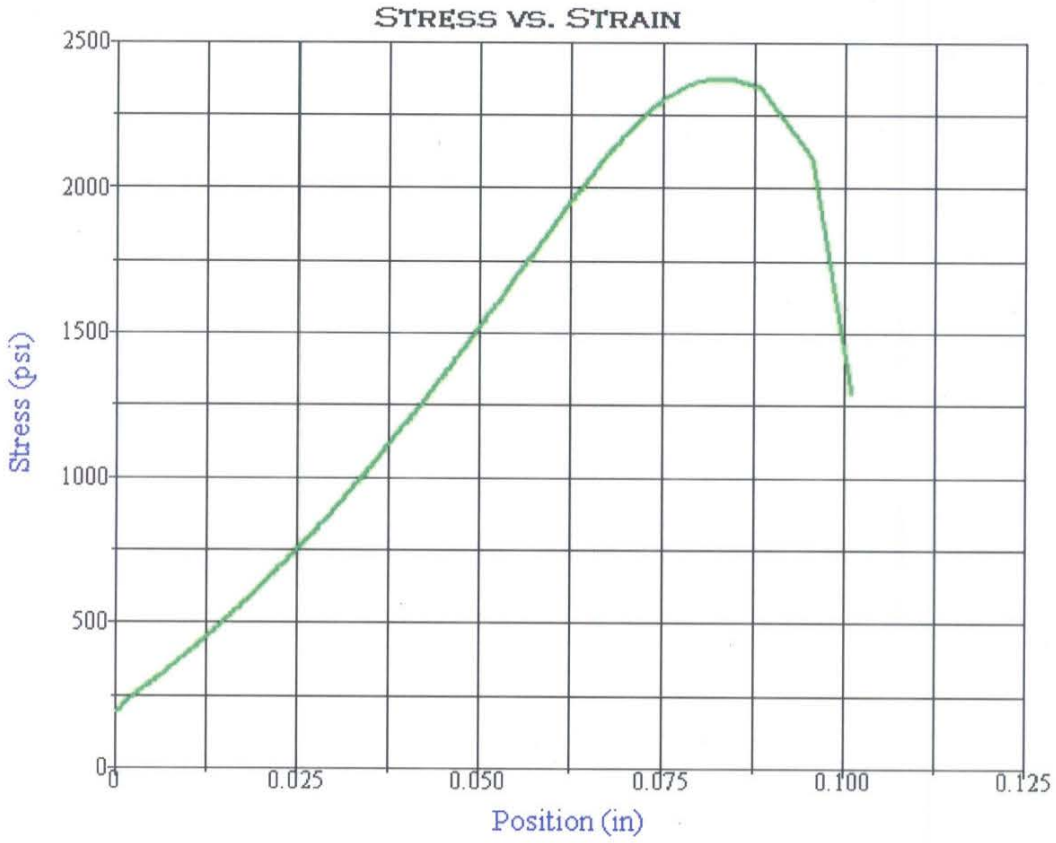
Date: March 2011

SUMMARY OF UNCONFINED COMPRESSION TEST RESULTS

02-PLU-70; PM 1.67-1.68
FOUNDATION REPORT

Plate No. B-1

D1K00YB1338 3:34:09 PM 2/22/2010



Test Summary

Counter:	338
Elapsed Time:	00:01:03
Sample NO.	R09-001A-11
TEST NO.	Q10-030
E.A. NUMBER:	02-3C3001
Procedure Name:	Cores test
Start Date:	2/22/2010
Start Time:	3:30:46 PM
End Date:	2/22/2010
End Time:	3:31:49 PM
Workstation:	D1K00YB1
Tested By:	AZM
GL NO.	09-068

Test Results

Specimen Gage Length:	5.1300 in
Diameter:	2.3800 in
Area:	4.4488 in²
Maximum Load:	10548 lbf
Compressive Strength:	2371 psi

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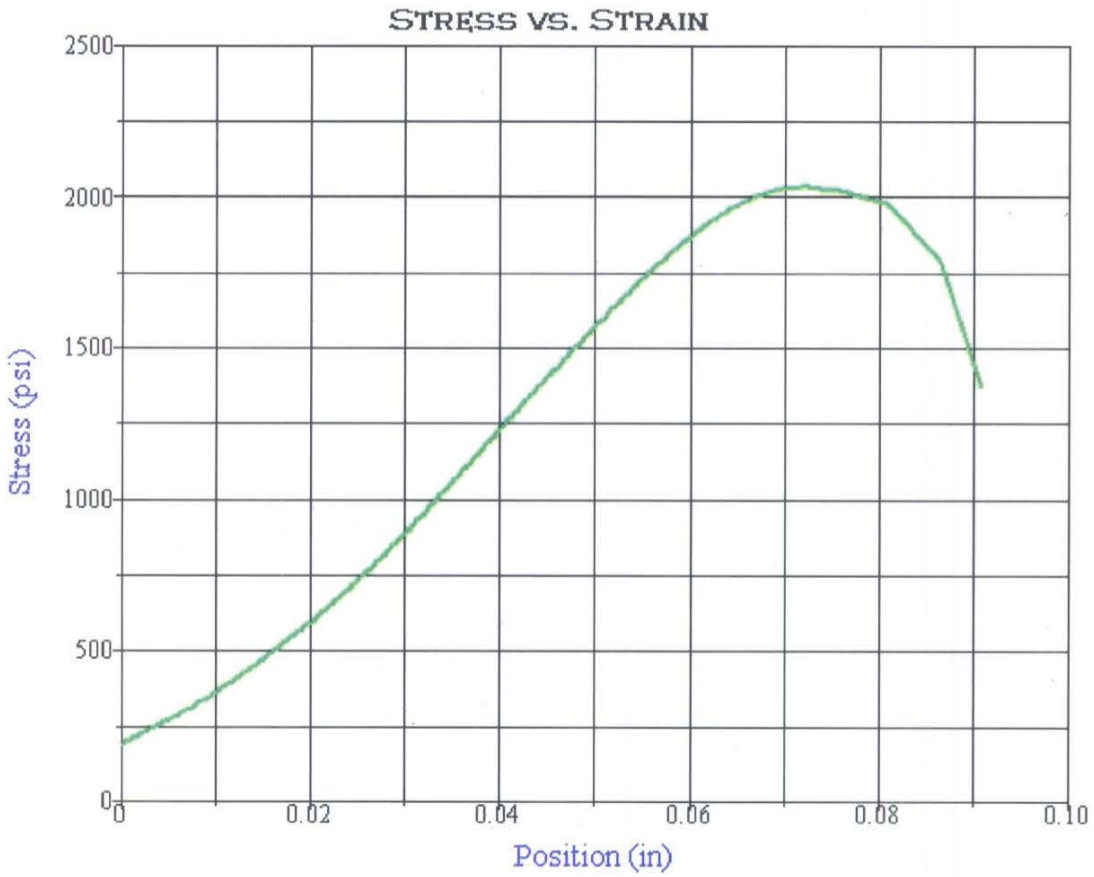
Office of Geotechnical Design - North

EA: 02-3C3001	**UNCONFINED COMPRESSION TEST RESULTS SPECIMEN R09-001A-11**
Date: March 2011	
02-PLU-70; PM 1.67-1.68 FOUNDATION REPORT	Plate No. B-2



Test Summary

Counter:	339
Elapsed Time:	00:00:53
Sample:	R09-001B-5
TEST NO:	Q10- 031
E.A. NUMBER:	02-3C3001
Procedure Name:	Cores test
Start Date:	2/22/2010
Start Time:	3:41:19 PM
End Date:	2/22/2010
End Time:	3:42:12 PM
Workstation:	D1K00YB1
Tested By:	AZM
GL NO.	09-068

Test Results

Specimen Gage Length:	5.4500 in
Diameter:	2.4000 in
Area:	4.5239 in^2
Maximum Load:	9186 lbf
Compressive Strength:	2031 psi

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EA: 02-3C3001	**UNCONFINED COMPRESSION TEST RESULTS SPECIMEN R09-001B-5**
Date: March 2011	
02-PLU-70; PM 1.67-1.68 FOUNDATION REPORT	Plate No. B-3

M e m o r a n d u m

Flex your power!
Be energy efficient!

To: MR. GARY BLAKESLEY
Senior Bridge Engineer
Division of Engineering Services
Structure Design
Office of Bridge Design North
Bridge Design Branch 5

Date: March 4, 2011

File: 02-PLU-70-PM 2.66/2.74
02-3C3001
0200000317
Bridge Nos. 09E0003
09E0004
09E0005
PLU 70 MBGR Reconstruction
Wall Locations 32, 33 and 34

From: **DEPARTMENT OF TRANSPORTATION**
Division of Engineering Services
Geotechnical Services

Subject: **Foundation Report for Wall Locations 32, 33 & 34**

INTRODUCTION

As requested, the Office of Geotechnical Design - North (GDN) of Geotechnical Services is providing a Foundation Report (FR) for three retaining walls proposed for the subject project. The subject project proposes to reconstruct and upgrade Metal Beam Guard Railing (MBGR) at various locations on State Route (SR) 70, between PM 0.0 and 33.0, in Plumas County. According to the Project Study Report (PSR, Reference No. 12), deterioration of embankment slopes due to erosion and rockfall related damage is requiring construction of two new Earth Retaining Structures (ERS) to support the MBGR posts at Locations 32 (Bridge No. 09E003) and 33 (Bridge No. 09E004). The Location 34 (Bridge No. 09E005) wall was later added (in September 2010) as significant erosion and undermining of MBGR posts was subsequently noted around PM 2.73.

Proposed Structures

The three proposed retaining walls are to be composed of an anchored wall system utilizing "pinpile" (or micropile) vertical wall elements and one row of rock anchors located approximately 5 to 7 feet below the top of wall. Shotcrete lagging is also proposed. The three walls are to be constructed left of the highway on SR 70, between approximately PM 2.66 and 2.74 (see Plate No. 1 for a vicinity map). According to the Caltrans Digital Photolog Viewer, Roadview Explorer 2.0 (http://onramp.dot.ca.gov/photolog/roadview_index.htm), the subject site is located at latitude and longitude coordinates of 39.8940288^{o} North and -121.3595779^{o} West (these coordinates are the basis for obtaining data in this report available through GIS related

information sources). Based on Microstation files (wall_layouts_10_19_10.dgn, last updated 10-19-10) provided by Structure Design, Office of Bridge Design - North (BDN) the proposed walls will be located as shown on Table No. 1.

Table No. 1. Layout Line of Proposed Walls

WALL LOCATION	STA, OFFSET ("A2" LINE)	~ PM	TOTAL LENGTH (ft)
32	Begin: 140+25, 18.66' LT	2.66	223
	End: 142+48, 18.66' LT	2.70	
33	Begin: 142+73, 18.66' LT	2.70	77
	End: 143+50, 18.66' LT	2.72	
34	Begin: 144+01, 18.66' LT	2.73	84
	End: 144+85, 18.66' LT	2.74	

Scope of work

The scope of our work included performing a literature and historical review in an effort to obtain geological and geotechnical data pertaining to the subject site that could provide insight into the design and construction of the proposed wall facilities. A site investigation was implemented, which included a subsurface exploration program (see below) composed of the drilling of exploratory borings to characterize the subsurface conditions and collect samples. The subsurface exploration program also included a seismic survey of subsurface conditions performed by the Geophysics and Geology Branch (GGB) of the Office of Geotechnical Support, Geotechnical Services. The subsurface exploration program was limited to the proposed wall Locations 32 and 33; The Location 34 wall facility was proposed subsequent to the subsurface exploration program. Laboratory testing of selected samples obtained from the site investigation program was performed, followed by engineering analysis and preparation of this report summarizing our findings, conclusions and recommendations.

Subsurface Exploration Program

Our subsurface exploration program was performed on an intermittent basis between August 11, 2009 and April 15, 2010 utilizing Christensen CS 2000, and Acker MP-8 and MPCA truck-mounted drilling rigs. Five borings were performed at the locations shown on Plate No. 2. The borings were accomplished utilizing mud rotary drilling advanced with a self-casing wire-line drill system. Samples of materials were collected at various depths by advancing a "Standard Penetration Test" ("SPT", 2.0 inch O.D.) sampler under

a standard striking force weight (140 lb) dropped 30 inches. The respective drill rig Hammer Energy Ratio (ER_i) for SPT sampling were obtained from the Caltrans Office of Geotechnical Support, Foundation Testing Branch (Reference No. 15). Samples were also obtained by core drilling with carbide and diamond impregnated bits (2.4 inch I.D.). Core samples were stored in core boxes and returned to the Transportation Laboratory for reference and testing.

The subsurface exploration program also included a seismic survey of subsurface conditions performed by the GGB; the results of the seismic survey were provided in a report attached as Appendix C. The seismic survey included a 246 feet long seismic refraction line from borehole RC-09-009 to RC-09-011. The survey also included employment of downhole-to-surface seismic tomographic imaging at each of the five boreholes.

Laboratory Testing

Laboratory testing was performed to assist in determining the general engineering characteristics of site materials for facility design and construction. Unconfined compression testing (ASTM D 7012-07) of selected rock core samples was performed. Core samples obtained from site subsurface exploration primarily consisted of rock-like materials as soil materials generally washed out during drilling; Hence, the minimum required sample size for corrosion testing (as specified on the "Geotechnical Laboratory Testing Information" form (available at http://www.dot.ca.gov/hq/esc/geotech/gl/glquickreference.pdf) could not be fulfilled. Therefore, corrosion testing was not performed.

FINDINGS

Site Description and History

At the project site, SR 70 stretches along the easterly base of the Feather River Canyon, with the water body of the North Fork of the Feather River adjacent to the west (see Site Plan, Plate No. 2). The adjacent water body is composed of a reservoir associated with the PG&E Cresta Dam, a gravity dam built in 1949 with a crest elevation of 1,680 feet (per DWR, Reference No. 17). The SR 70 roadway grade at the project site is around elevation 1,700 feet, and just over 20 feet above the observed reservoir water level. According to asbuilt plans (Reference No. 1), the SR 70 facility at the project site was originally constructed in the 1930's with 0.25H:1V cut slopes and 1.4H:1V fill slopes. The observed slope gradients on the site generally coincided with the asbuilt values, with the exception of some variations. Between approximately "A2" Line STA 142+10 and

143+00, igneous formational rock exposes at the toe slope and slopes near vertical (see Photo Nos. 7 and 8). RSP Boulders (some exotic) were noted throughout the embankment slope. Cut slopes at the site are as high as 40 to 50 feet, and are composed of "blocky" near vertical slopes in igneous rock (Photo No. 10). A cross-drainage culvert at PM 2.67 extends into the location of Wall 32.

Through a majority of the project site, roughly 3 feet high can-wall retaining systems stretch along the westerly edge of the roadway and support MBGR. As built plans (Reference No. 3) indicate that in the 1980's, 3 to 5 feet high "can-walls" (36 inch diameter CSP vertically aligned and battered at 6V:1H, placed on timber footings atop a shallow bench) were intermittently placed approximately 16 feet left of the SR 70 centerline. The can-walls appear to have been utilized to accommodate new MBGR. According to the PSR, many of the can-walls on SR 70 in the Feather River Canyon have lost their foundational support as the bench supporting the cans has eroded. This has resulted in numerous individual cans losing their batter, becoming emptied of the material within the can, and in some cases the interconnected cans and the inserted MBGR posts have completely lost their support and are dangling. Numerous can wall at the site were noted to have lost foundational support (see Photo No. 7).

A highly damaged can-wall system was noted around STA 143+00 (Photo Nos. 3 and 9). Approximately 60 feet of asphalt concrete patched roadway and K-rail was observed adjacent to the failed can-wall. Reportedly, on December 7, 2004, at PM 2.73 an 80-ton granitic rock "flake" parted and fell from the adjacent rock slope to the east (see Photo Nos. 1 and 2, Plate No. 3). Facility damage resulting from impact of the flake included cratering of the westerly lane, in addition to extreme damage to the adjacent can-wall. Following removal of the flake, the crater was backfilled, paved, and the K-rail was placed (see Photo Nos. 4 through 6).

No significant seeps were noted emanating from the cut slopes within the project site. However, roughly, 200 feet north of the site, a horizontal drain was noted extending from the toe of the uphill slope and exhibited a significant amount of water flowing from it; the drain was encompassed by perennial vegetation.

Site description comments in this section were based on site visits made on an intermitted basis between May 19, 2009 and April 6, 2010.

Geology/Faulting/Seismicity

The project area is in the northerly part of the Sierra Nevada Geomorphic Province. According to published geologic mapping (Reference Nos. 2 and 4), the immediate site of the proposed wall is located atop the Mesozoic igneous rocks of the Grizzly Pluton, which is part of the Sierran Batholith. The plutonic rock is described as quartz diorite, tonalie, trondhjemite and quartz monzonite.

The Caltrans ARS Online web tool (http://10.160.173.178/shake2/shake_index2.php) indicates that the closest "active" fault (ruptured within past 700,000 years and meeting Caltrans criteria for inclusion per Reference No. 14) to the site is the Butt Creek fault zone. The web tool indicates the closest surface projection of the top of rupture plane of this fault to be a distance of approximately 20 miles northeasterly of the project site, and that this fault is a "right-lateral strike-slip" fault type capable of generating a Maximum Movement Magnitude (Mmax) of 6.8. According to the Alquist-Priolo Earthquake Fault Zone Maps available through the California Geologic Survey (Reference No. 18), Plumas County is not an "affected county"; hence, the site is not within an Alquist-Priolo Earthquake Fault Zone. No faults are known to extend close to or on the project site.

According to the 2007 Caltrans Deterministic PGA Map (Reference No. 11), a peak ground acceleration (PGA) of 0.20g would be applicable to the site for a Vs_{30}=2,500 ft/sec (760 m/sec, for soft bedrock) condition and depicts the Butt Creek fault zone as the controlling fault. Vs_{30} is defined as the average small strain shear wave velocity for the upper 100 feet (30 meters) of materials. The map notes "PGA contours do not incorporate any site correction factors (e.g. soil amplification, near fault factor, etc) and is not to be used for final seismic analysis or design." However, Bridge Design Specifications (BDS, Reference No. 7) Section 5.2.2.3 indicates that seismic forces applied shall be based on a horizontal seismic acceleration coefficient, k_h, equal to one-third of the expected peak acceleration at the site as defined in the Caltrans Seismic Hazard Map.

Based on shallow rock conditions encountered at the site, a Vs_{30} of = 5,000 ft./sec is applicable to the site. The Caltrans ARS Online web tool indicates the Deterministic Spectral Acceleration near a period of T= 0 seconds to be around 0.17g (per the "upper envelope values"). Table No. 1 below presents the peak ground acceleration (PGA) for the site for various probabilities (based on the 2008 USGS National Seismic Hazard Maps) for a time interval of 50 years. According to AASHTO LRFD Bridge Design Specifications (Section C3.10.2) "It can also be shown that if the time interval is lengthened to, say, 75 years, the probability of exceeding an earthquake with a return period of 475 years increases to about 15 percent."

Table 1. Probabilistic Peak Ground Acceleration (P-PGA)

P-PGA (%g) for Vs_{30} = 2,500 feet/sec	**P-PGA (%g) for Vs_{30} = 5,000 feet/sec (based on soil amplification factor [3])**	**Probability of Exceedance in 50 years**	**Return Period**
20.5 [1]	16.7	5 %	975 years
14.9 [2]	12.1 [4]	10 %	475 years

Notes:

[1] P-PGA obtained from the Caltrans ARS Online Probabilistic Response Spectrum Spread Sheet.

[2] P-PGA obtained from the 2008 USGS National Seismic Hazard Maps (at http://gldims.cr.usgs.gov/nshmp2008/viewer.htm).

[3] Soil amplification factor of 0.815 (at a period, T=0 seconds) obtained from the Caltrans ARS Online Probabilistic Response Spectrum Spread Sheet.

[4] P-PGA for 10% Probability of Exceedance in 50 years provided as appropriate PGA for "evaluation of seismic hazards other than surface fault-rupture" per SCEC (1999), Reference No. 5.

Based on the materials encountered in our subsurface exploration, the potential for liquefaction related ground failure at the site as a result of earthquake induced ground motions is considered very low.

Subsurface Soil and Rock Conditions

Borings were performed within the westerly (left) lane of SR 70. The near-surface materials encountered underlying the asphalt concrete surface course generally consisted of medium dense silty sand, well-graded sand with silt and gravel, and clayey sand. These soil materials generally contained dioritic gravel and cobbles from 2.5 to 5 inches in intersected length. It should be noted that significant loss of sample recovery often occurred in these soil materials and was due to the washing out of finer materials (silt, sand, and fine gravel) and "blocking-off" at the core bit by gravel and coble-sized rock fragments as indicated on the Boring Records. The soil materials extended to underlying "rock-like" materials at depths between approximately 3.5 and 6.5 feet below the ground surface (BGS), with the exception of Boring RC-09-010, which encountered a 4 feet deep void above the top of rock-like materials at 9 feet BGS. The 4 feet deep void is possibly fissure in the rock materials related to the reported flake impact (see "Site Description and History" section). Rock like materials encountered underlying the near-surface soil materials generally consisted of moderately weathered to fresh, dioritic igneous rock, with the exception of some relatively small decomposed rock intervals in Boring RC-09-011. Rock hardness ranged from soft to very hard. Fracturing was noted to range from intensely fractured to unfractured. Unconfined compression testing (ASTM D 7012-07)

of selected rock core specimens yielded compressive strengths ranging between 3,125 and 9,651 PSI.

Boring locations are presented on Plate No. 2. A more detailed description of the subsurface conditions encountered during our field exploration, along with laboratory testing results, is presented graphically on the Boring Records of Appendix A, attached. The results of laboratory testing are also presented in Appendix B. Boring logs will also be presented on the project plans in Log-Of-Test-Boring (LOTB) format.

Groundwater

At the completion of drilling of each boring, the level of the ground water surface was measured in the open hole of the borings. The ground water surface was measured at a depth of between 19 and 20 feet BGS (approximate elevation of 1680 feet) in each of the five borings performed. The level of the ground water surface appears to roughly coincide with the level of the water in the adjacent reservoir.

Characterization & Analysis

Based on the relative steepness of natural bedrock slopes above the adjacent roadway cut excavations, it is anticipated that the elevation of the top of the formational dioritic bedrock will be significantly lower at the wall layout line (WLOL) than that encountered in exploratory borings. Seismic velocity models provided in the GGB report (Reference No. 16) were utilized to approximate depth to rock on the WLOL and dipping of the top of rock surface. Due to the sloping nature of the stratigraphy, a limit equilibrium method (LEM) of analysis (utilizing SlopeW, Reference No. 13) was implemented to provide more appropriate modeling for determining the available passive earth pressure in front of the proposed walls. Based on the anticipated geometry of the wall facilities and subsurface characterization, the design model of Figure 1B was developed for LEM analysis. A back analysis to a Factor of Safety (FS) of 1.1 was utilized to derive geotechnical parameters for the soil, cobble and boulder materials overlying formational rock. The idealized passive pressure distribution presented on Figure 1A was derived from the LEM analysis based on a FS=1.

CONCLUSIONS & RECOMMENDATIONS

Based on data collected from exploratory borings, geophysical exploration, topographical mapping, and field review of rock exposures, the following table was derived estimating the elevation of the top of formation on the proposed WLOLs.

Table No. 2. Estimated Elevation of Top of Formation Rock on WLOLs

WALL LOCATION	STA ("A2" LINE)	ELEVATION OF TOP OF FORMATIONAL ROCK (ft)
32	140+25 to 140+80	1684
	140+80 to 141+90	1680
	141+90 to 142+15	1686
	142+15 to 142+48	1694
33	142+73 to 142+80	1694
	142+80 to 142+90	1686
	142+90 to 143+30	1680
	143+30 to 143+50	1683
34	144+01 to 144+85	1680

Lateral Earth Pressures

Active

The active lateral earth pressure acting on the wall may be determined base on the following parameters:

Angle of Internal Friction, $\phi = 34^o$
Cohesion, c = 0 psf
Total Unit Weight, γ = 135 pcf

Below the top of rock elevations provided in Table No. 2, the active earth pressure acting on the wall may be taken as zero, as diagramed in BDS (Reference No. 7) Figure 5.5.5.6-2.

Passive

Passive earth pressure resistance may be applied below an elevation of 1 foot below the proposed bench elevation. The proposed shotcrete lagging should extend down to at least this elevation. The passive lateral earth pressure available in front of the wall may be determined based on the following parameters (see also Figure 1A):

Above the top of rock elevation of Table No. 2:

Passive Earth Pressure coefficient, Kp = 1.613
Total Unit Weight, γ_T = 95 pcf
Buoyant Unit Weight, γ_{BUOY} = 32.6 pcf (use buoyant below elevation 1688 feet elevation)

Below the top of rock elevation of Table No. 2:

Passive Earth Pressure coefficient, Kp = 5.752
Total Unit Weight, γ_T = 165 pcf
Buoyant Unit Weight, γ_{BUOY} = 102.6 pcf (use buoyant below elevation 1688 feet elevation)

The passive pressure formula in Figure 5.5.5.6-2 of the BDS is considered inappropriate for the wall design on this project as discontinuities potentially exist in the near surface rock that would affect the implied failure geometry.

Pile Axial Loading

According to BDN, the anticipated axial compression loading on each pile will be 59 kips, with a drilled hole diameter of at least 8 inches. Accordingly, piles should be socketed (drilled) at least 8 feet into formational rock. Based on the estimated top of rock elevations presented on Table No. 2, the following table was developed providing recommended tip elevations for piles.

Table No. 3. Recommended Pile Tip Elevations Based on Axial Compression Loading

WALL LOCATION	STA ("A2" LINE)	PILE TIP ELEVATION (ft)*
32	140+25 to 140+80	1676.00
	140+80 to 141+90	1672.00
	141+90 to 142+15	1678.00
	142+15 to 142+48	1686.00
33	142+73 to 142+80	1686.00
	142+80 to 142+90	1678.00
	142+90 to 143+30	1672.00
	143+30 to 143+50	1675.00
34	144+01 to 144+85	1672.00

*The piles extend to the recommended tip elevations or at least 8 feet into rock, whichever is deeper.

Anchors

According to BDN, rock anchors are proposed to be installed in drilled holes of at least 4 inches in diameter, at an angle of 20^{o} from level, and located on the wall face at 4 feet below the top of wall; tension loads of 42 kips are proposed on each anchor. Accordingly, anchors should be socketed (drilled) at least 7 feet into the formational rock. Table No. 4 below provides estimated rock anchor embedment lengths to achieve the minimum 7 feet rock socket requirement for anchors. The bond length for test anchors will be comprised of the rock socket. Soil materials should not be expected to contribute significantly to anchor capacity.

Table No. 4. Recommended Rock Anchor Embedment Lengths

WALL LOCATION	STA ("A2" LINE)	ANCHOR EMBEDMENT LENGTH (ft)*
32	140+25 to 140+80	22
	140+80 to 141+90	28
	141+90 to 142+15	22
	142+15 to 142+48	14
33	142+73 to 142+80	14
	142+80 to 142+90	22
	142+90 to 143+30	28
	143+30 to 143+50	24
34	144+01 to 144+85	28

*Anchors should extend at least 7 feet into formational rock.

Water Drainage

The provided wall loads do not account for groundwater derived hydrostatic pressures. The placement of geocomposite drain strips between the wall and native materials and weep holes should facilitate an acceptable drainage system for the relief of hydrostatic pressures.

Corrosion

Although corrosion testing could not be performed, based on the site materials encountered and the corrosion potential rating provided by the USDA (Reference No. 19), the site materials can be assumed to be non-corrosive.

Construction

The contractor may encounter difficulties during drilling for anchors and piles due to the presence of zones of fresh, very hard rock encountered in subsurface exploration. The zones of hard rock will likely necessitate the use of specialty equipment (down-hole hammers, core barrels, etc.) to drill to the required pile depths and anchor lengths.

Caving conditions are likely to occur in the materials overlying bedrock materials at the site that contain gravel, cobbles and boulders. In addition, the blocky nature of the fractured bedrock is conducive to rock wedge failures into unsupported boreholes; hence, casing would likely be needed to keep the holes open prior to placing grout and concrete.

Although groundwater measurements in the open boreholes roughly coincided with the elevation of water in the adjacent reservoir (see “Groundwater” section), it can be expected that significant groundwater at the site could be encountered either perched atop rock materials, or flowing through rock fractures. In some cases, confined (under pressure) groundwater aquifers could be encountered while drilling even during the driest periods of the year as exemplified by the horizontal drain seep noted approximately 200 feet north of the site (see “Site Description and History” section). Hence, the pile and anchor installations may require dewatering or the placement of concrete and grout in wet conditions. If the contractor opts to place the concrete and grout in wet conditions, the specifications should require the displacement of water via a closed system using a concrete pump or a tremie tube to place concrete and grout at the bottom of the hole. In cases where drilling encounters confined aquifers, the contractor should expect water seepage out of the hole at the surface for a significant period of time.

Due to the fractured nature of the underlying rock materials, the potential for excess loss of concrete and grout in voids and fractures should be expected. Controlling measures, such as the use of a "grout sock", could potentially reduce grout loss.

Project Information

Standard Special Provisions S5-280, "Project Information," discloses to bidders and contractors a list of pertinent information available for their inspection prior to bid opening. The following is an excerpt from SSP S5-280 disclosing information originating from Geotechnical Services. Items listed to be included in the information Handout will be provided in Acrobat (.pdf) format to the addressee(s) of this report via electronic mail.

Data and information attached with the project plans are:

A. Log of Test Borings for the 2009/2010 subsurface exploration.

Data and Information included in the Information Handout provided to the bidders and Contractors are

A. "Foundation Report for Wall Locations 32, 33 & 34" (Bridge Nos. 09E0003, 09E0004 & 09E0005), dated March 4, 2011.

B. "Route 70 Walls" prepared by Caltrans Geophysics and Geology Branch, dated September 15, 2010.

Data and Information available for inspection at the District Office:

A. None

Data and information available for inspection at the Transportation Laboratory:

A. Core samples collected from the 2009/2010 subsurface exploration.

If any conceptual changes are made during final project design, the Office of Geotechnical Design North should review those changes to determine if these foundation recommendations are still applicable.

If you have any questions or comments, please call Mark Hagy at (916) 227-1077 or Douglas Brittsan at (916) 227-1079.

MARK HAGY, P.E., G.E.
Transportation Engineer
Office of Geotechnical Design North, Branch C

c: Doug Brittsan
Eric Orr - D02 – Proj. Mgmt.
Struct. Const. RE Pending File
DES OE, Office of PS&E
DME
GS Corporate
GDN File

Attachments: References
Figure No. 1. Passive Earth Pressure Application
Plate No. 1: Vicinity Map
Plate No. 2: Site Plan
Plate No. 3: Photographs
Plate No. 4: Photographs
Appendix A: Boring Records
Hole I.D. RC-09-007 (2 sheets)
Hole I.D. RC-10-008 (2 sheets)
Hole I.D. RC-09-009 (2 sheets)
Hole I.D. RC-09-010 (2 sheets)
Hole I.D. RC-09-011 (2 sheets)
Boring Record Legend (3 Sheets)
Appendix B: Laboratory Test Results;
Plate No. B-1: Summary of Unconfined Compression Test Results
Plate No. B-2: Unconfined Compression Test Results, Specimen R09-007-3
Plate No. B-3: Unconfined Compression Test Results, Specimen R09-009-3
Plate No. B-4: Unconfined Compression Test Results, Specimen R09-010-3
Plate No. B-5: Unconfined Compression Test Results, Specimen R09-011-5
Appendix C: GGB Seismic Survey Report (Reference 16)

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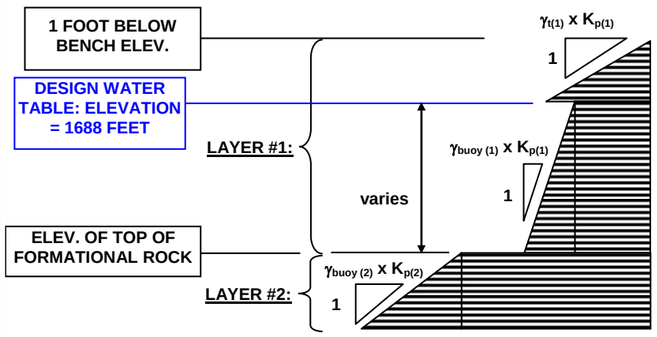
FIGURE NO. 1. PASSIVE EARTH PRESSURE APPLICATION (PLU 70 LOCATIONS 32, 33 AND 34, 02-3C3001)
MARCH 2011

APPOXIMATE SCALE : 1" = 10 feet
(vertical = horizontal)

0 10 20 feet

FIGURE 1A. IDEALIZED PASSIVE PRESSURE DISTRIBUTION



IDEALIZED DESIGN PARAMETERS AT WLOL:

LAYER #1 (SOIL, COBBLES AND BOULDERS):

$\gamma_{t(1)}$ = 95 pcf

$\gamma_{buoyant(1)}$ = 32.6 pcf

LOG SPIRAL PARAMETERS:

$\phi_{(1)} = 44^o$

$\beta_{(1)} = -40^o$

$\beta/\phi = -0.909$

$\delta/\phi \simeq 1$

$K_{p(1)} = 1.613$

LAYER #2 (FORMATIONAL ROCK):

$\gamma_{t(2)}$ = 165 pcf

$\gamma_{buoyant(2)}$ = 102.6 pcf

LOG SPIRAL PARAMETERS:

$\phi_{(2)} = 38^o$

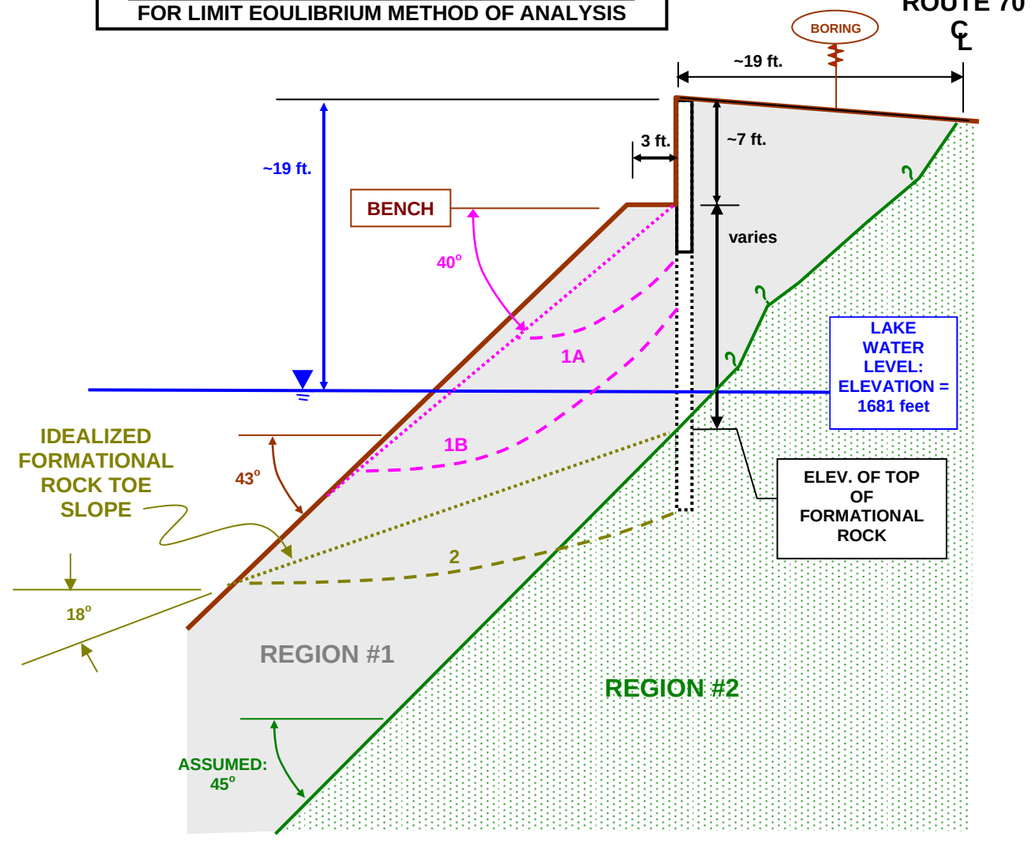
$\beta_{effective(2)} = -18^o$

$\beta/\phi = -0.474$

$\delta/\phi \simeq 1$

$K_{p(2)} = 5.752$

FIGURE 1B. APPROXIMATED DESIGN GEOMETRY FOR LIMIT EOULIBRIUM METHOD OF ANALYSIS



LIMIT EQUILIBRIUM ANALYSIS PARAMETERS
FS of slope = 1.1 (with 240 psf traffic surcharge)

REGION #1: (SOIL, COBBLES & BOULDERS)

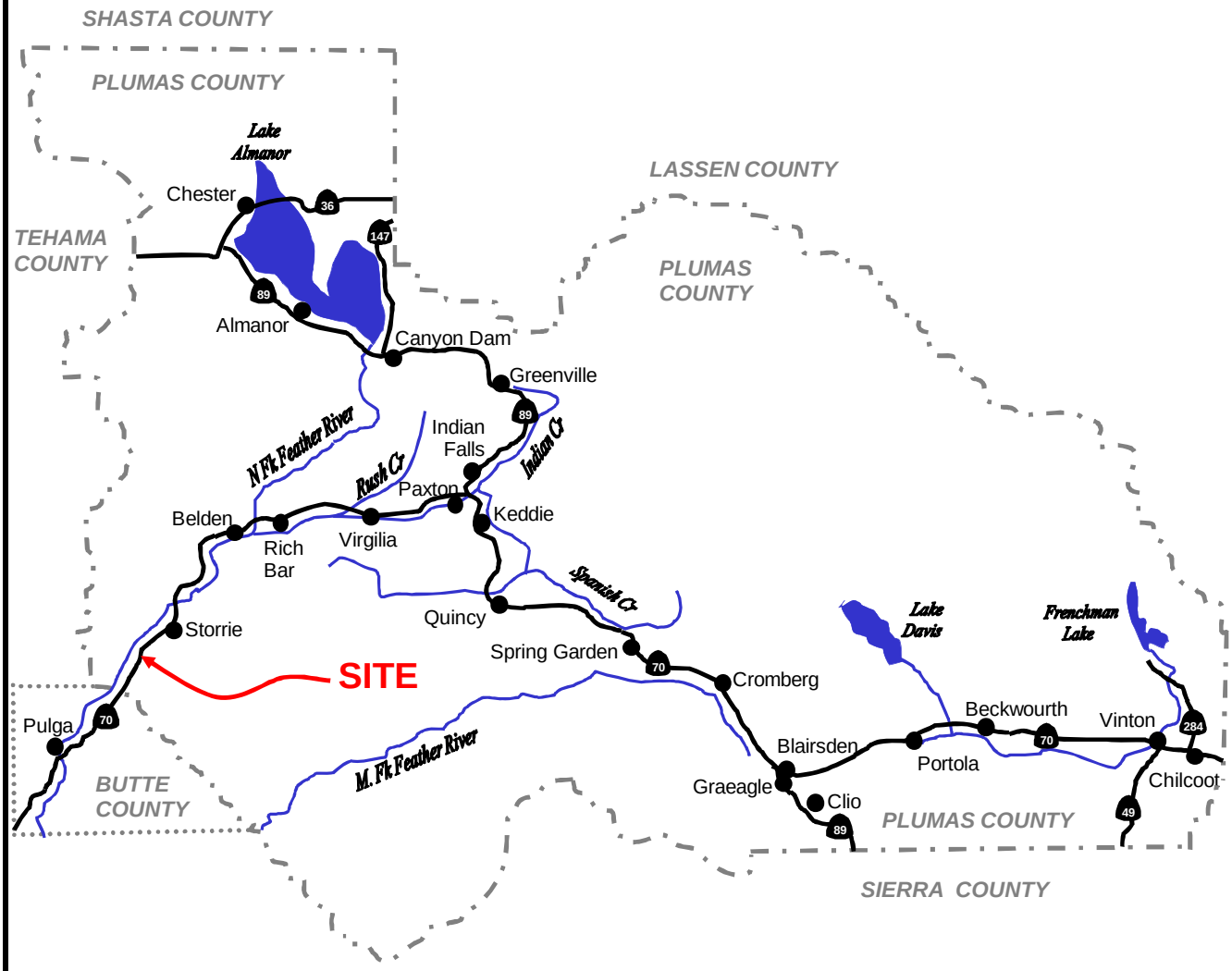
$\phi = 44^o$, c = 25 psf

γ_t = 125 pcf γ_{sat} = 130 pcf

REGION #2 (FORMATIONAL ROCK):

$\phi = 38^o$, c = 3,500 psf

$\gamma_t = \gamma_{sat}$ = 165 pcf



N

NO SCALE

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

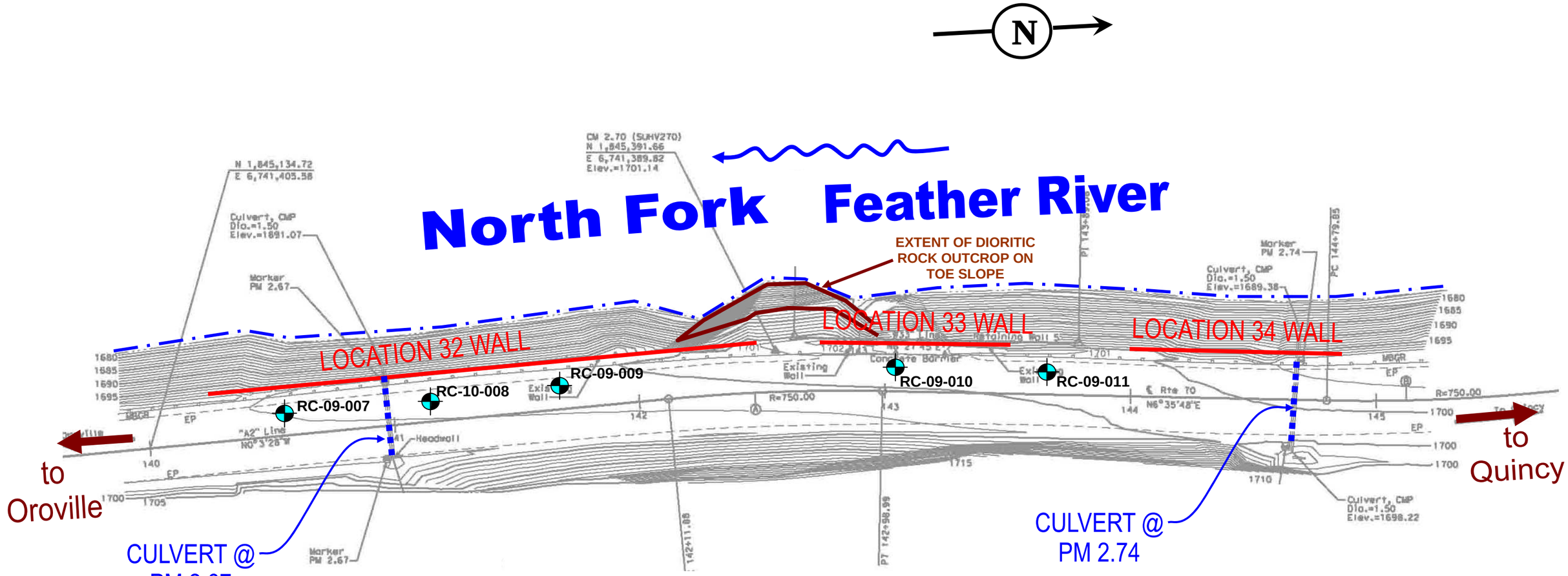
EA:	02-3C3001
Date:	March-11

VICINITY MAP

02-PLU-70 PM 2.66/2.74 (LOCATIONS 32, 33, & 34)

Foundation Report

PLATE NO. **1**



APPOXIMATE SCALE : 1" = 40 feet

0 40 80 feet

LEGEND

RC-09-007 **Denotes location of Exploratory Boring No. 7 performed in 2009.**

Base Map Reference: "Soldier Pile Wall 5 (Location 33) – Foundation Plan", by Caltrans Structure Design – Design Branch 5, Preliminary Investigation Section, revision date 7-16-09, from Microstation file "09-wall4-e-fpl01a.dgn". elevations shown are in feet; 1 foot contour intervals.

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

EA: 02-3C3001

Date: March 2011

SITE PLAN

02-PLU-70 PM 2.66/2.74
LOCATIONS 32, 33 and 34
FOUNDATION REPORT

Plate No. 2

Photo No. 1. Rockfall rock flake at PM 2.73; looking south; photo date 12-7-04.

Photo No. 2. Rock flake source on rock slope above roadway (PM 2.73); photo date 12-7-04.

Photo No. 3. Damaged can-wall at PM 2.73 (Location 33); photo dated 12-9-04.

Photo No. 4. Roadway repair of crater from rock flake impact; looking north; photo date 12-9-04.

Photo No. 5. Repaired roadway and K-rail at rock flake impact location (PM 2.73); looking north; photo date 12-9-04.

Photo No. 6. Repaired roadway and K-rail at rock flake impact location (PM 2.73); looking southwesterly; photo date 12-14-04.

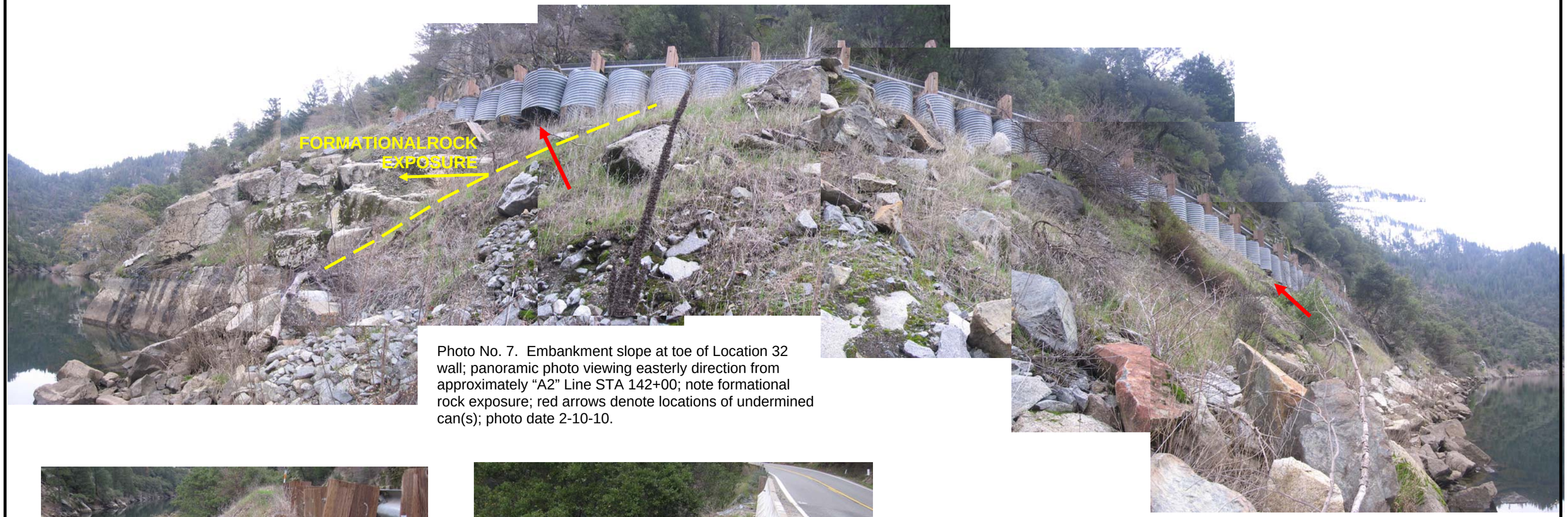


Photo No. 7. Embankment slope at toe of Location 32 wall; panoramic photo viewing easterly direction from approximately "A2" Line STA 142+00; note formational rock exposure; red arrows denote locations of undermined can(s); photo date 2-10-10.

Photo No. 8. Toe Slope "A2" Line approximately STA 142+00; photo viewing northerly direction; note formational rock exposure; Photo date 2-10-10.

Photo No. 9. Toe slope "A2" Line approximately STA 143+00; photo viewing northerly direction; note damaged can-wall; Photo date 5-19-09.

Photo No. 10. Cut slope right of "A2" Line approximately STA 143+00; photo viewing easterly direction; Photo date 5-19-09.

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EA: 02-3C3001

Date: March 2011

PHOTOGRAPHS

02-PLU-70; PM 2.66-2.74
FOUNDATION REPORT

Plate No. 4

APPENDIX A

Boring Records

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
H. AkbarZadegan	8-11-09	8-11-09	NAD83	RC-09-007
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
			8.00' Lt Sta 140+54A2	1699.0 ft NAVD88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Rotary Wire-Line			Acker MP 8	3.7 in
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
SPT (1.4")			automatic	74%
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
bentonite			19.0 ft on8-12-09	40.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		ASPHALT CONCRETE (6").		1										
	1		Well-graded SAND with SILT and GRAVEL (SW-SM); and COBBLES, medium dense, brown and gray, wet, little coarse and fine GRAVEL; 10% DIORITIC COBBLES, 3-5", hard.												0 to 5 feet depth: "blocking off" at bit with cobble-sized rock fragments; sand, silt and pulvarized gravel materials washing out at return
1697.00	2														
	3														
1695.00	4				2	4 4 11	15								
	5				3			77	60						
1693.00	6		IGNEOUS ROCK (DIORITE), white and black, fresh, hard, intensely fractured.												
	7		Moderately and slightly fractured.							0	166				UC (ASTM D 7012-07) = 7,668 PSI
1691.00	8														
	9														
1689.00	10		Very hard.		4			100	92						
	11														
1687.00	12														
	13														
1685.00	14														
	15		Extremely hard, unfractured.		5			100	100						
1683.00	16														
	17														
1681.00	18														
	19														
	20														

(continued)

5 BR - STANDARD PLU70WALLSL32 33.GPJ CALTRANS_LIBRARY_DEC09.GLB 3/11/11

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Office of Geotechnical Design - North

REPORT TITLE				HOLE ID
BORING RECORD				RC-09-007
DIST.	COUNTY	ROUTE	POSTMILE	EA
02	PLU	70	D0.0/D34.3	02-3C3001
PROJECT OR BRIDGE NAME				
PLU 70 WALLS				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
L32 (PM 2.68)	Hagy		3-4-11	1 of 2

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	20		Hard, intensely and moderately fractured. IGNEOUS ROCK (Diorite) *(continued)*.		6			80	58						
	21														
1677.00	22														
	23														
1675.00	24														
	25		Very hard, unfractured.		7			100	100						
1673.00	26														
	27														
1671.00	28														
	29														
1669.00	30		Hard, moderate and slightly weathered.		8			100	68						
	31														
			Intensely fractured.												
1667.00	32														
	33														
			Moderately fractured.												
1665.00	34														
	35		Fresh, very hard, intensely fractured.		9			100	90						
1663.00	36		Slightly fractured.												
	37														
1661.00	38														
	39		Moderately fractured.												
1659.00	40														
			Bottom of borehole at 40.0 ft bgs												
1657.00	42														
	43														
	44														

5 BR - STANDARD PLU70WALLSL32 33.GPJ CALTRANS_LIBRARY_DEC09.GLB 3/11/11

Department of Transportation
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Office of Geotechnical Design - North

REPORT TITLE: **BORING RECORD**				HOLE ID: **RC-09-007**
DIST.: **02**	COUNTY: **PLU**	ROUTE: **70**	POSTMILE: **D0.0/D34.3**	EA: **02-3C3001**
PROJECT OR BRIDGE NAME: **PLU 70 WALLS**				
BRIDGE NUMBER: **L32 (PM 2.68)**	PREPARED BY: **Hagy**		DATE: **3-4-11**	SHEET: **2 of 2**

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C. Hoadley	4-14-10	4-14-10	NAD83	RC-10-008
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line) 9.00' Lt Sta 141+16A2	SURFACE ELEVATION 1699.4 ft NAVD88
DRILLING METHOD Rotary Wire-Line			DRILL RIG CS 2000 (truck)	BOREHOLE DIAMETER 3.7 in
SAMPLER TYPE(S) AND SIZE(S) (ID) HQ Core			SPT HAMMER TYPE automatic	HAMMER EFFICIENCY, ERi 93%
BOREHOLE BACKFILL AND COMPLETION bentonite			GROUNDWATER READINGS DURING DRILLING AFTER DRILLING (DATE) 20.0 ft on4-15-10	TOTAL DEPTH OF BORING 39.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method / Casing Depth	Remarks
	0		ASPHALT CONCRETE (3").		1				0					
	1		AGGREGATE BASE (9").											
			Well-graded SAND with SILT and GRAVEL (SW-SM); brown; and COBBLES, medium dense, brown and gray, wet, little coarse and fine GRAVEL; 10% DIORITIC COBBLES, 3-4", hard.											0 to 5 feet depth: "blocking off" at bit with cobble-sized rock fragments; sand, silt and pulvarized gravel materials washing out at return
1697.40	2													
	3													
1695.40	4													
	5		IGNEOUS ROCK (DIORITE), white and black, slightly weathered, moderately hard, intensely fractured. Fracture filled with decomposed dioritic rock (clayey SAND).		2			90	57					
1693.40	6													
	7		Slightly fractured.											
1691.40	8													
	9													
1689.40	10		No soil filled fractures.		3			75	75					
	11													
1687.40	12													
	13													
1685.40	14													
	15		Hard, 15 to 15.5 feet depth: very intensely fractured. Pinkish gray, mottled black, slightly fractured.		4			100	90					
1683.40	16													
	17													
1681.40	18													
	19													
	20													

(continued)

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REPORT TITLE				HOLE ID
BORING RECORD				RC-10-008
DIST. 02	COUNTY PLU	ROUTE 70	POSTMILE D0.0/D34.3	EA 02-3C3001
PROJECT OR BRIDGE NAME PLU 70 WALLS				
BRIDGE NUMBER L32 (PM 2.68)	PREPARED BY Hagy		DATE 3-4-11	SHEET 1 of 2

5 BR - STANDARD PLU70WALLSL32 33.GPJ CALTRANS_LIBRARY_DEC09.GLB 3/11/11

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	20		White and black. IGNEOUS ROCK (Diorite) *(continued)*.		5			97	95						
	21														
1677.40	22														
	23														
1675.40	24														
	25		Fresh.		6			97	97						
1673.40	26														
	27														
1671.40	28		28 to 28.5 feet depth: very intensely fracture.												
			Slightly fractured.												
	29														
1669.40	30		Moderately weathered, moderately hard, intensely fractured.		7			80	62						
	31		Fresh.												
1667.40	32		Very hard, unfractured.												
	33														
1665.40	34														
	35				8			100	100						
1663.40	36														
	37														
1661.40	38														
	39		Bottom of borehole at 39.0 ft bgs												
1659.40	40														
	41														
1657.40	42														
	43														
	44														

5 BR - STANDARD PLU70WALLSL32 33.GPJ CALTRANS_LIBRARY_DEC09.GLB 3/11/11

Department of Transportation
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Office of Geotechnical Design - North

REPORT TITLE				HOLE ID
BORING RECORD				**RC-10-008**
DIST. **02**	COUNTY **PLU**	ROUTE **70**	POSTMILE **D0.0/D34.3**	EA **02-3C3001**
PROJECT OR BRIDGE NAME **PLU 70 WALLS**				
BRIDGE NUMBER **L32 (PM 2.68)**	PREPARED BY **Hagy**		DATE **3-4-11**	SHEET **2 of 2**

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
M. Kiesse	8-11-09	8-11-09	NAD83	RC-09-009
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
			8.00' Lt Sta 141+71A2	1699.7 ft NAVD88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Rotary Wire-Line			Acker MPCA	3.7 in
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
HQ Core			automatic	68%
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
bentonite			20.0 ft on8-12-10	40.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method / Casing Depth	Remarks
	0		ASPHALT CONCRETE (6").		1			55	22					
	1		AGGREGATE BASE (12").											
1697.70	2		Well-graded SAND with SILT and GRAVEL (SW-SM); brown and gray, some coarse and fine GRAVEL.											0 to 3.5 feet depth: "blocking off" at bit with rock fragments; sand, silt and pulvarized gravel materials washing out at return
	3													
1695.70	4		IGNEOUS ROCK (DIORITE), white and black, slightly weathered, moderately hard and hard, moderately fractured.											
	5				2			92	63					
1693.70	6		Intensely fractured.											
	7		Moderately and slightly fractured.											
1691.70	8													
	9		Moderately weathered.											
1689.70	10				3			100	93					
	11		Fresh. Hard, unfractured.											
1687.70	12													UC (ASTM D 7012-07) = 3,125 PSI
	13													
1685.70	14													
	15		Moderately and slightly fractured.		4			93	87					
1683.70	16													
	17													
1681.70	18													
	19													
	20													

(continued)

Department of Transportation
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REPORT TITLE				HOLE ID
BORING RECORD				RC-09-009
DIST.	COUNTY	ROUTE	POSTMILE	EA
02	PLU	70	D0.0/D34.3	02-3C3001
PROJECT OR BRIDGE NAME				
PLU 70 WALLS				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
L32 (PM 2.68)	Hagy		3-4-11	1 of 2

5 BR - STANDARD PLU70WALLSL32 33.GPJ CALTRANS_LIBRARY_DEC09.GLB 3/11/11

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	20		Slightly weathered, moderately hard, slightly fractured. IGNEOUS ROCK (Diorite) *(continued)*.		5			100	92						
	21														
1677.70	22		Moderately weathered, soft and moderately soft, intensely fractured.												
	23		Slightly weathered, moderately hard, slightly fractured.												
1675.70	24														
	25		Intensely and moderately fractured.		6			75	67						
1673.70	26		Moderately weathered, moderately soft and moderately hard.												
	27														
1671.70	28		Slightly fractured.												
	29														
1669.70	30		Slightly weathered, hard and very hard, very slightly fractured.		7			100	98						
	31														
1667.70	32														
	33														
1665.70	34														
	35		Fresh.		8			100	100						
1663.70	36														
	37														
1661.70	38														
	39														
1659.70	40		Bottom of borehole at 40.0 ft bgs												
	41														
1657.70	42														
	43														
	44														

5 BR - STANDARD PLU70WALLSL32 33.GPJ CALTRANS_LIBRARY_DEC09.GLB 3/11/11

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

REPORT TITLE				HOLE ID
BORING RECORD				**RC-09-009**
DIST. **02**	COUNTY **PLU**	ROUTE **70**	POSTMILE **D0.0/D34.3**	EA **02-3C3001**
PROJECT OR BRIDGE NAME **PLU 70 WALLS**				
BRIDGE NUMBER **L32 (PM 2.68)**	PREPARED BY **Hagy**		DATE **3-4-11**	SHEET **2 of 2**

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
H. AkbarZadegan	8-12-09	8-12-09	NAD83	RC-09-010
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
			8.00' Lt Sta 143+07A2	1700.4 ft NAVD88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Rotary Wire-Line			Acker MP 8	3.7 in
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
HQ Core			automatic	74%
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
bentonite			20.0 ft on8-12-10	40.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method / Casing Depth	Remarks
	0		ASPHALT CONCRETE (6").		1									
	1		Well-graded SAND with SILT and GRAVEL (SW-SM); moist; and COBBLES, brown and gray, little coarse and fine GRAVEL; 10% DIORITIC COBBLES, 3-5", hard.											0 to 5 feet depth: "blocking off" at bit with rock fragments; sand, silt and pulvarized gravel materials washing out at return
1698.40	2													
	3													
1696.40	4													
	5		VOID.		2			18	0					4 feet of "free fall" of core barrel from 5 feet depth
1694.40	6													
	7													
1692.40	8													
	9		IGNEOUS ROCK (DIORITE), white and black, moderately weathered, moderately hard, intensely fractured.											
1690.40	10		Fresh, very hard, moderately and slightly fractured.		3			100	94					
	11													
1688.40	12													
	13													
1686.40	14													
	15		Slightly fractured.		4			100	94					UC (ASTM D 7012-07) = 9,651 PSI
1684.40	16													
	17													
1682.40	18													
	19													
	20													

(continued)

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REPORT TITLE				HOLE ID
BORING RECORD				RC-09-010
DIST.	COUNTY	ROUTE	POSTMILE	EA
02	PLU	70	D0.0/D34.3	02-3C3001
PROJECT OR BRIDGE NAME				
PLU 70 WALLS				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
L33 (PM 2.73)	Hagy		3-4-11	1 of 2

5 BR - STANDARD PLU70WALLSL32 33.GPJ CALTRANS_LIBRARY_DEC09.GLB 3/11/11

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	20		IGNEOUS ROCK (Diorite) *(continued)*.		5			100	90						hard drilling below 20 feet
	21														
1678.40	22														
	23														
1676.40	24														
	25		Moderately and slightly fractured.		6			100	100						
1674.40	26														
	27														
1672.40	28														
	29														
1670.40	30				7			86	78						
	31														
1668.40	32														
	33														
1666.40	34														
	35				8			88	80						
1664.40	36														
	37														
1662.40	38														
	39														
1660.40	40		Bottom of borehole at 40.0 ft bgs												
	41														
1658.40	42														
	43														
	44														

5 BR - STANDARD PLU70WALLSL32 33.GPJ CALTRANS_LIBRARY_DEC09.GLB 3/11/11

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

REPORT TITLE				HOLE ID
BORING RECORD				RC-09-010
DIST. 02	COUNTY PLU	ROUTE 70	POSTMILE D0.0/D34.3	EA 02-3C3001
PROJECT OR BRIDGE NAME PLU 70 WALLS				
BRIDGE NUMBER L33 (PM 2.73)	PREPARED BY Hagy		DATE 3-4-11	SHEET 2 of 2

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
M. Kiesse	8-12-09	8-12-09	NAD83	RC-09-011
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
			8.00' Lt Sta 143+66A2	1700.6 ft NAVD88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Rotary Wire-Line			Acker MPCA	3.7 in
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
HQ Core			automatic	68%
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
bentonite			20.0 ft on8-12-10	40.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method / Casing Depth	Remarks
	0		ASPHALT CONCRETE (6").		1			55						
	1		AGGREGATE BASE (12").											
1698.60	2		CLAYEY SAND (SC); dark brown; moist; fine and medium SAND; some fines.											
	3		IGNEOUS ROCK (DIORITE), brownish gray, decomposed, very soft, (SILTY SAND (SM), medium dense, moist, fine and medium SAND; little fines).											
1696.60	4													
	5		IGNEOUS ROCK (DIORITE), white and black, intensely weathered, soft and moderately soft, unfractured.		2			100	75					
1694.60	6		Scattered 2-4" decomposed zones (SILTY SAND (SM), moist, fine and medium SAND; little fines).											
	7													
1692.60	8													
	9													
1690.60	10				3			100	60					
	11													
1688.60	12		IGNEOUS ROCK (DIORITE), light brownish gray, decomposed, very soft, unfractured, (SILTY SAND (SM), moist, fine and medium SAND; little fines).											
	13													
1686.60	14		IGNEOUS ROCK (DIORITE), white and black; intensely and moderately weathered, moderately soft and moderately hard, unfractured.											
	15		Fresh, hard.		4			100	100					
1684.60	16													
	17													
1682.60	18													
	19													
	20													

(continued)

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

REPORT TITLE				HOLE ID
BORING RECORD				RC-09-011
DIST.	COUNTY	ROUTE	POSTMILE	EA
02	PLU	70	D0.0/D34.3	02-3C3001
PROJECT OR BRIDGE NAME				
PLU 70 WALLS				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
L33 (PM 2.73)	Hagy		3-4-11	1 of 2

5 BR - STANDARD PLU70WALLSL32 33.GPJ CALTRANS_LIBRARY_DEC09.GLB 3/11/11

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	20		IGNEOUS ROCK (Diorite) *(continued)*.		5			100	95						
	21														
1678.60	22														
	23														
1676.60	24														
	25				6			100	85						UC (ASTM D 7012-07) = 9,506 PSI
1674.60	26														
	27														
1672.60	28														
	29														
1670.60	30				7			100	85						
	31														
1668.60	32														
	33														
1666.60	34		Intensely and moderately fractured.												
	35		Very slightly fractured.		8			100	100						
1664.60	36														
	37														
1662.60	38														
	39														
1660.60	40														
			Bottom of borehole at 40.0 ft bgs												
1658.60	42														
	43														
	44														

5 BR - STANDARD PLU70WALLSL32 33.GPJ CALTRANS_LIBRARY_DEC09.GLB 3/11/11

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

REPORT TITLE: BORING RECORD				HOLE ID: RC-09-011
DIST.: 02	COUNTY: PLU	ROUTE: 70	POSTMILE: D0.0/D34.3	EA: 02-3C3001
PROJECT OR BRIDGE NAME: PLU 70 WALLS				
BRIDGE NUMBER: L33 (PM 2.73)	PREPARED BY: Hagy		DATE: 3-4-11	SHEET: 2 of 2

GROUP SYMBOLS AND NAMES

Graphic / Symbol	Group Names
GW	Well-graded GRAVEL Well-graded GRAVEL with SAND
GP	Poorly graded GRAVEL Poorly graded GRAVEL with SAND
GW-GM	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND
GW-GC	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
GP-GM	Poorly graded GRAVEL with SILT Poorly graded GRAVEL with SILT and SAND
GP-GC	Poorly graded GRAVEL with CLAY (or SILTY CLAY) Poorly graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
GM	SILTY GRAVEL SILTY GRAVEL with SAND
GC	CLAYEY GRAVEL CLAYEY GRAVEL with SAND
GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND
SW	Well-graded SAND Well-graded SAND with GRAVEL
SP	Poorly graded SAND Poorly graded SAND with GRAVEL
SW-SM	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL
SW-SC	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
SP-SM	Poorly graded SAND with SILT Poorly graded SAND with SILT and GRAVEL
SP-SC	Poorly graded SAND with CLAY (or SILTY CLAY) Poorly graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
SM	SILTY SAND SILTY SAND with GRAVEL
SC	CLAYEY SAND CLAYEY SAND with GRAVEL
SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL
PT	PEAT
	COBBLES COBBLES and BOULDERS BOULDERS

Graphic / Symbol	Group Names
CL	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
CL-ML	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY elastic ELASTIC SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND

FIELD AND LABORATORY TESTS

C	Consolidation (ASTM D 2435-04)
CL	Collapse Potential (ASTM D 5333-03)
CP	Compaction Curve (CTM 216 - 06)
CR	Corrosion, Sulfates, Chlorides (CTM 643 - 99; CTM 417 - 06; CTM 422 - 06)
CU	Consolidated Undrained Triaxial (ASTM D 4767-02)
DS	Direct Shear (ASTM D 3080-04)
EI	Expansion Index (ASTM D 4829-03)
M	Moisture Content (ASTM D 2216-05)
OC	Organic Content (ASTM D 2974-07)
P	Permeability (CTM 220 - 05)
PA	Particle Size Analysis (ASTM D 422-63 [2002])
PI	Liquid Limit, Plastic Limit, Plasticity Index (AASHTO T 89-02, AASHTO T 90-00)
PL	Point Load Index (ASTM D 5731-05)
PM	Pressure Meter
PP	Pocket Penetrometer
R	R-Value (CTM 301 - 00)
SE	Sand Equivalent (CTM 217 - 99)
SG	Specific Gravity (AASHTO T 100-06)
SL	Shrinkage Limit (ASTM D 427-04)
SW	Swell Potential (ASTM D 4546-03)
TV	Pocket Torvane
UC	Unconfined Compression - Soil (ASTM D 2166-06) Unconfined Compression - Rock (ASTM D 2938-95)
UU	Unconsolidated Undrained Triaxial (ASTM D 2850-03)
UW	Unit Weight (ASTM D 4767-04)
VS	Vane Shear (AASHTO T 223-96 [2004])

SAMPLER GRAPHIC SYMBOLS

- Standard Penetration Test (SPT)
- Standard California Sampler
- Modified California Sampler
- Shelby Tube
- Piston Sampler
- NX Rock Core
- HQ Rock Core
- Bulk Sample
- Other (see remarks)

DRILLING METHOD SYMBOLS

- Auger Drilling
- Rotary Drilling
- Dynamic Cone or Hand Driven
- Diamond Core

WATER LEVEL SYMBOLS

- First Water Level Reading (during drilling)
- Static Water Level Reading (short-term)
- Static Water Level Reading (long-term)

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

REPORT TITLE: **BORING RECORD LEGEND**

DIST.	COUNTY	ROUTE	POSTMILE	EA
02	Plumas	70	D0.0/D34.3	02-3C3001

PROJECT OR BRIDGE NAME: **PLU 70 WALLS**

BRIDGE NUMBER	PREPARED BY	DATE	SHEET
L32 (PM 2.68)			1 of 3

CONSISTENCY OF COHESIVE SOILS				
Descriptor	Unconfined Compressive Strength (tsf)	Pocket Penetrometer (tsf)	Torvane (tsf)	Field Approximation
Very Soft	< 0.25	< 0.25	< 0.12	Easily penetrated several inches by fist
Soft	0.25 - 0.50	0.25 - 0.50	0.12 - 0.25	Easily penetrated several inches by thumb
Medium Stiff	0.50 - 1.0	0.50 - 1.0	0.25 - 0.50	Can be penetrated several inches by thumb with moderate effort
Stiff	1.0 - 2.0	1.0 - 2.0	0.50 - 1.0	Readily indented by thumb but penetrated only with great effort
Very Stiff	2.0 - 4.0	2.0 - 4.0	1.0 - 2.0	Readily indented by thumbnail
Hard	> 4.0	> 4.0	> 2.0	Indented by thumbnail with difficulty

APPARENT DENSITY OF COHESIONLESS SOILS	
Descriptor	SPT N_{60} - Value (blows / foot)
Very Loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	> 50

MOISTURE	
Descriptor	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

PERCENT OR PROPORTION OF SOILS	
Descriptor	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

SOIL PARTICLE SIZE		
Descriptor		Size
Boulder		> 12 inches
Cobble		3 to 12 inches
Gravel	Coarse	3/4 inch to 3 inches
	Fine	No. 4 Sieve to 3/4 inch
Sand	Coarse	No. 10 Sieve to No. 4 Sieve
	Medium	No. 40 Sieve to No. 10 Sieve
	Fine	No. 200 Sieve to No. 40 Sieve
Silt and Clay		Passing No. 200 Sieve

PLASTICITY OF FINE-GRAINED SOILS	
Descriptor	Criteria
Nonplastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled, and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll, and not much time is required to reach the plastic limit; it cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.

CEMENTATION	
Descriptor	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

NOTE: This legend sheet provides descriptors and associated criteria for required soil description components only. Refer to Caltrans Soil and Rock Logging, Classification, and Presentation Manual (July 2007), Section 2, for tables of additional soil description components and discussion of soil description and identification.

ROCK GRAPHIC SYMBOLS


IGNEOUS ROCK


SEDIMENTARY ROCK


METAMORPHIC ROCK

BEDDING SPACING

Descriptor	Thickness or Spacing
Massive	> 10 ft
Very thickly bedded	3 to 10 ft
Thickly bedded	1 to 3 ft
Moderately bedded	3-5/8 inches to 1 ft
Thinly bedded	1-1/4 to 3-5/8 inches
Very thinly bedded	3/8 inch to 1-1/4 inches
Laminated	< 3/8 inch

WEATHERING DESCRIPTORS FOR INTACT ROCK

	Diagnostic Features					
	Chemical Weathering-Discoloration-Oxidation		Mechanical Weathering and Grain Boundary Conditions	Texture and Solutioning		
Descriptor	Body of Rock	Fracture Surfaces		Texture	Solutioning	General Characteristics
Fresh	No discoloration, not oxidized	No discoloration or oxidation	No separation, intact (tight)	No change	No solutioning	Hammer rings when crystalline rocks are struck.
Slightly Weathered	Discoloration or oxidation is limited to surface of, or short distance from, fractures; some feldspar crystals are dull	Minor to complete discoloration or oxidation of most surfaces	No visible separation, intact (tight)	Preserved	Minor leaching of some soluble minerals may be noted	Hammer rings when crystalline rocks are struck. Body of rock not weakened.
Moderately Weathered	Discoloration or oxidation extends from fractures usually throughout; Fe-Mg minerals are "rusty"; feldspar crystals are "cloudy"	All fracture surfaces are discolored or oxidized	Partial separation of boundaries visible	Generally preserved	Soluble minerals may be mostly leached	Hammer does not ring when rock is struck. Body of rock is slightly weakened.
Intensely Weathered	Discoloration or oxidation throughout; all feldspars and Fe-Mg minerals are altered to clay to some extent; or chemical alteration produces in situ disaggregation (refer to grain boundary conditions)	All fracture surfaces are discolored or oxidized; surfaces are friable	Partial separation, rock is friable; in semi-arid conditions, granitics are disaggregated	Altered by chemical disintegration such as via hydration or argillation	Leaching of soluble minerals may be complete	Dull sound when struck with hammer; usually can be broken with moderate to heavy manual pressure or by light hammer blow without reference to planes of weakness such as incipient or hairline fractures or veinlets. Rock is significantly weakened.
Decomposed	Discolored of oxidized throughout, but resistant minerals such as quartz may be unaltered; all feldspars and Fe-Mg minerals are completely altered to clay		Complete separation of grain boundaries (disaggregated)	Resembles a soil; partial or complete remnant rock structure may be preserved; leaching of soluble minerals usually complete		Can be granulated by hand. Resistant minerals such as quartz may be present as "stringers" or "dikes".

Note: Combination descriptors (such as "slightly weathered to fresh") are used where equal distribution of both weathering characteristics is present over significant intervals or where characteristics present are "in between" the diagnostic feature. However, combination descriptors should not be used where significant identifiable zones can be delineated. Only two adjacent descriptors shall be combined. "Very intensely weathered" is the combination descriptor for "decomposed to intensely weathered".

RELATIVE STRENGTH OF INTACT ROCK

Descriptor	Uniaxial Compressive Strength (psi)
Extremely Strong	> 30,000
Very Strong	14,500 - 30,000
Strong	7,000 - 14,500
Medium Strong	3,500 - 7,000
Weak	700 - 3,500
Very Weak	150 - 700
Extremely Weak	< 150

ROCK HARDNESS

Descriptor	Criteria
Extremely Hard	Specimen cannot be scratched with pocket knife or sharp pick; can only be chipped with repeated heavy hammer blows
Very hard	Specimen cannot be scratched with pocket knife or sharp pick; breaks with repeated heavy hammer blows
Hard	Specimen can be scratched with pocket knife or sharp pick with heavy pressure; heavy hammer blows required to break specimen
Moderately Hard	Specimen can be scratched with pocket knife or sharp pick with light or moderate pressure; breaks with moderate hammer blows
Moderately Soft	Specimen can be grooved 1/6 in. with pocket knife or sharp pick with moderate or heavy pressure; breaks with light hammer blow or heavy hand pressure
Soft	Specimen can be grooved or gouged with pocket knife or sharp pick with light pressure, breaks with light to moderate hand pressure
Very Soft	Specimen can be readily indented, grooved, or gouged with fingernail, or carved with pocket knife; breaks with light hand pressure

CORE RECOVERY CALCULATION (%)

$$\frac{\Sigma \text{ Length of the recovered core pieces (in.)}}{\text{Total length of core run (in.)}} \times 100$$

RQD CALCULATION (%)

$$\frac{\Sigma \text{ Length of intact core pieces} > 4 \text{ in.}}{\text{Total length of core run (in.)}} \times 100$$

FRACTURE DENSITY

Descriptor	Criteria
Unfractured	No fractures
Very Slightly Fractured	Lengths greater 3 ft
Slightly Fractured	Lengths from 1 to 3 ft, few lengths outside that range
Moderately Fractured	Lengths mostly in range of 4 in. to 1 ft, with most lengths about 8 in.
Intensely Fractured	Lengths average from 1 in. to 4 in. with scattered fragmented intervals with lengths less than 4 in.
Very Intensely Fractured	Mostly chips and fragments with few scattered short core lengths

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

REPORT TITLE: **BORING RECORD LEGEND**

DIST.	COUNTY	ROUTE	POSTMILE	EA
02	Plumas	70	D0.0/D34.3	02-3C3001

PROJECT OR BRIDGE NAME: **PLU 70 WALLS**

BRIDGE NUMBER	PREPARED BY	DATE	SHEET
L32 (PM 2.68)			3 of 3

APPENDIX B

Laboratory Test Results

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION
OFFICE OF GEOTECHNICAL SUPPORT
GEOTECHNICAL LABORATORY

UNCONFINED COMPRESSION TEST RESULTS (ASTM D7012-07 Method C)

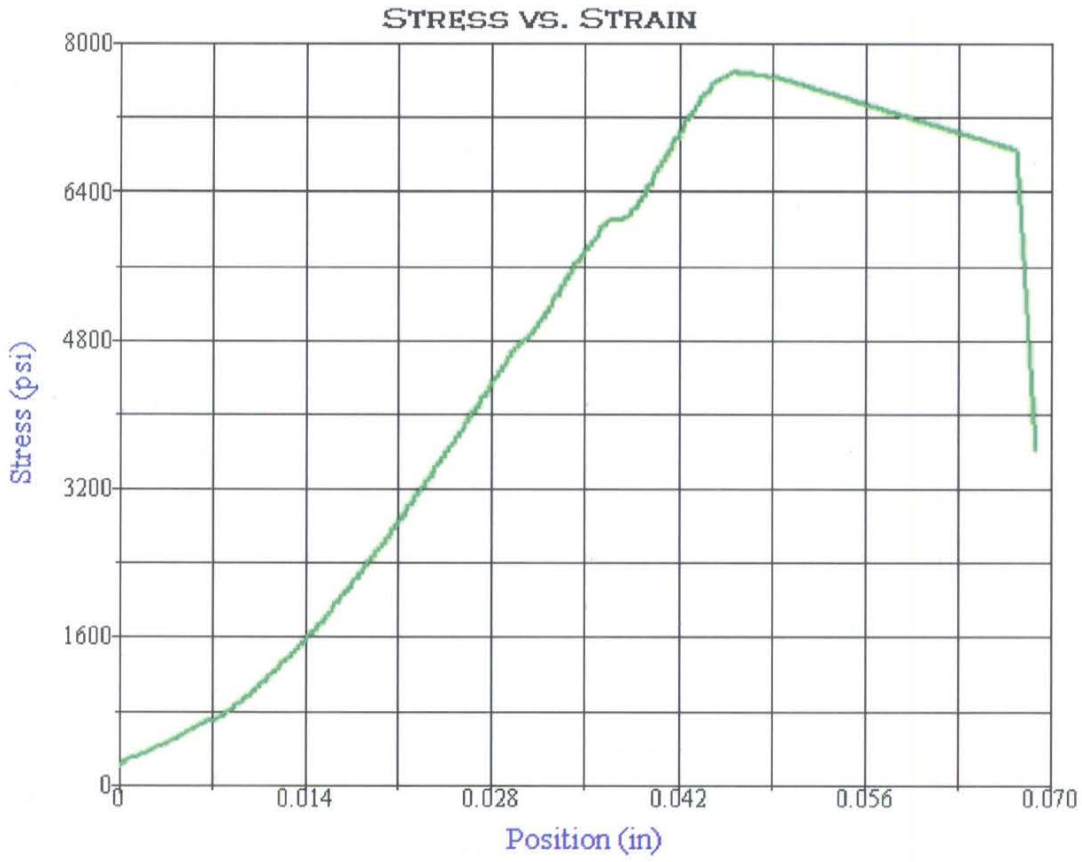
JOB LOCATION 02-Plu-70 PM 1.68-2.73 GL No. 09-068 DATE 2/22/2010
TEST BY AZM
JOB NUMBER 02-3C3001 PLU 70 Walls Bridge No. CHECKED BY LP 2/26/10

SAMPLE NO.	DEPTH FT.	DIA. IN.	LENGTH IN.	L/D RATIO	WEIGHT LBS.	LOAD LBS.	DENSITY PCF	STRENGTH PSI	REMARKS
R09-007-3	7-7.5	2.40	5.72	2.38	2.5	34691	166	7668	
R09-009-3	12-12.5	2.39	5.79	2.42	2.5	14018	164	3125	
R09-010-3	14.5-15	2.39	5.79	2.42	2.5	43297	168	9651	
R09-011-5	24.5-25	2.39	5.50	2.30	2.4	42648	168	9506	

Note: No moistures recorded

* Sample fell apart while preparing for testing -- Not suitable for testing

** The test specimen length/diameter ratio was not in compliance with the test method



Test Summary

Counter:	345
Elapsed Time:	00:03:32
Operator:	AZM
Sample NO.	R09-007-3
TEST NO.	Q10- 037
E.A. NUMBER:	02-3C3001
Procedure Name:	Cores test
Start Date:	2/22/2010
Start Time:	4:53:44 PM
End Date:	2/22/2010
End Time:	4:57:16 PM
Workstation:	D1K00YB1
Tested By:	AZM
Lab GL #	09-068

Test Results

Specimen Gage Length:	5.7200 in
Diameter:	2.4000 in
Area:	4.5239 in^2
Maximum Load:	34691 lbf
Compressive Strength:	7668 psi

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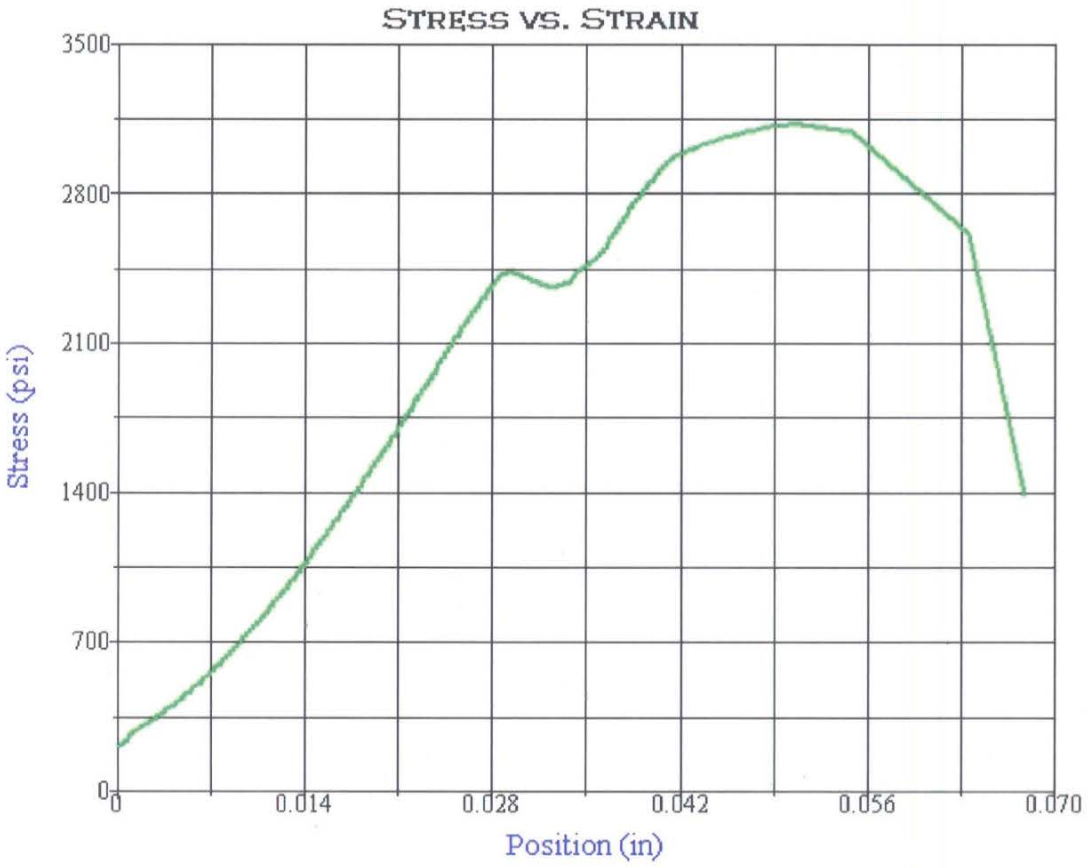
Geotechnical Services
Office of Geotechnical Design - North

EA: 02-3C3001	**UNCONFINED COMPRESSION TEST RESULTS SPECIMEN R09-007-3**
Date: March 2011	
02-PLU-70; PM 2.68-2.73 FOUNDATION REPORT	Plate No. B-2



Test Summary

Counter:	346
Elapsed Time:	00:01:23
Sample NO.	R09-009- 3
Test NO.	Q10-038
E.A. NUMBER:	02-3C3001
Procedure Name:	Cores test
Start Date:	2/23/2010
Start Time:	1:23:31 PM
End Date:	2/23/2010
End Time:	1:24:54 PM
Workstation:	D1K00YB1
Tested By:	AZM
Lab GL #	09-068

Test Results

Specimen Gage Length:	5.7900 in
Diameter:	2.3900 in
Area:	4.4863 in²
Maximum Load:	14018 lbf
Compressive Strength:	3125 psi

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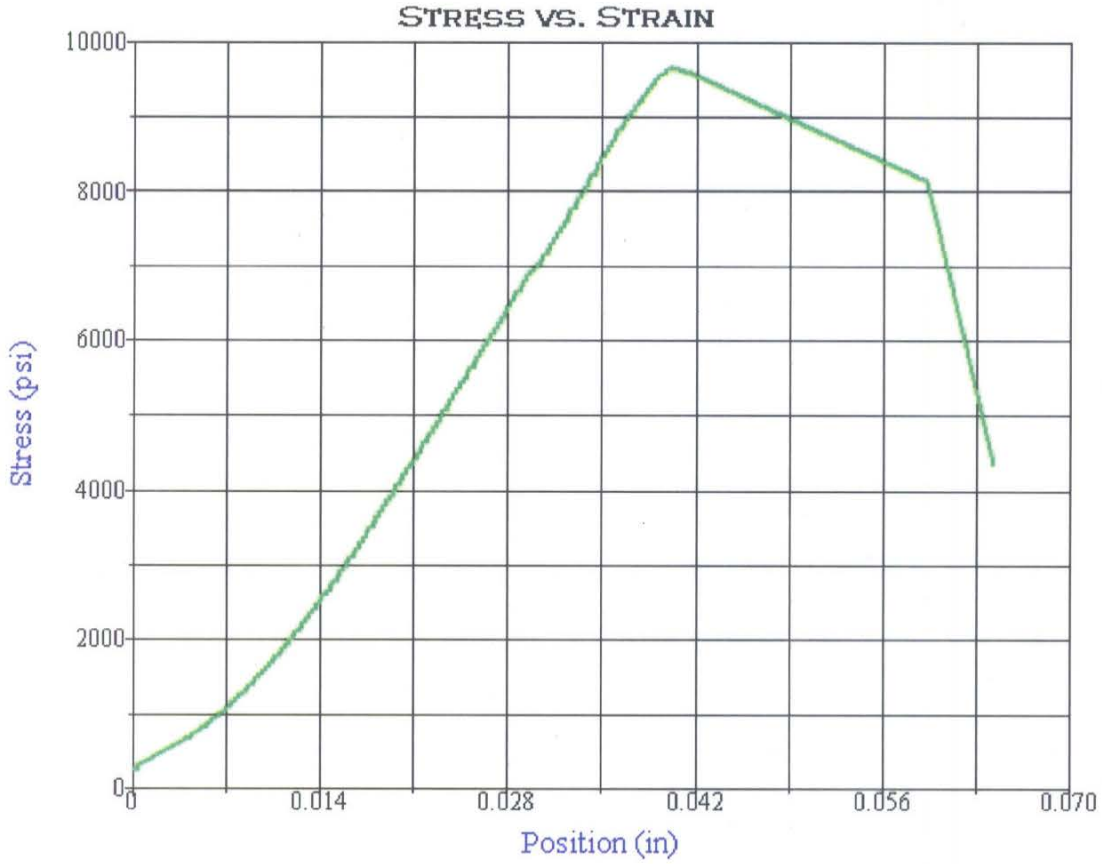
EA: 02-3C3001	**UNCONFINED COMPRESSION TEST RESULTS SPECIMEN R09-009-3**
Date: March 2011	
02-PLU-70; PM 2.68-2.73 FOUNDATION REPORT	Plate No. B-3



Test Summary

Counter:	347
Elapsed Time:	00:04:28
Sample:	NO. R09-010-3
TEST NO.	Q10- 039
E.A. NUMBER:	02-3C3001
Procedure Name:	Cores test
Start Date:	2/23/2010
Start Time:	1:31:30 PM
End Date:	2/23/2010
End Time:	1:35:58 PM
Workstation:	D1K00YB1
Tested By:	AZM
Lab GL#	09-068

Test Results

Specimen Gage Length:	5.7900 in
Diameter:	2.3900 in
Area:	4.4863 in²
Maximum Load:	43297 lbf
Compressive Strength:	9651 psi

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Office of Geotechnical Design - North

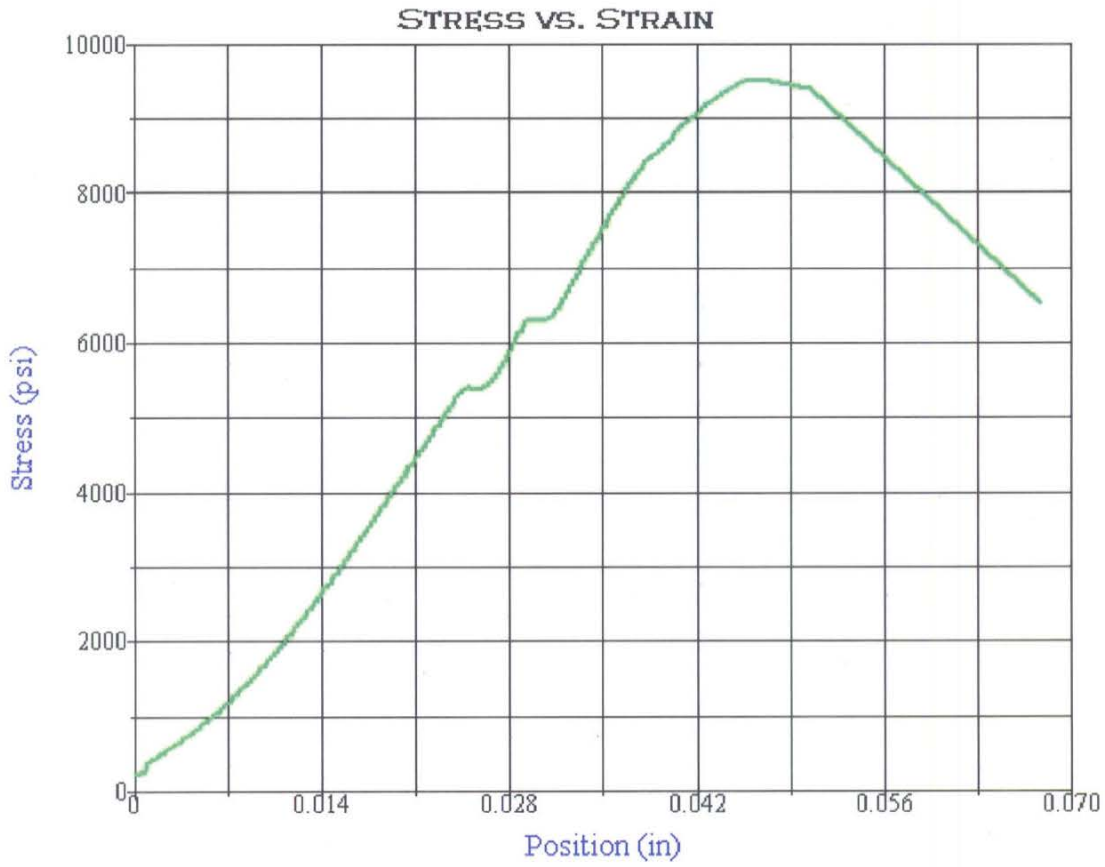
EA: 02-3C3001

Date: March 2011

UNCONFINED COMPRESSION TEST RESULTS
SPECIMEN R09-010-3

02-PLU-70; PM 2.68-2.73
FOUNDATION REPORT

Plate No. B-4



Test Summary

Counter:	348
Elapsed Time:	00:04:21
Sample NO.	R09-011-5
TEST NO.	Q10- 040
E.A. NUMBER:	02-3C3001
Procedure Name:	Cores test
Start Date:	2/23/2010
Start Time:	1:43:08 PM
End Date:	2/23/2010
End Time:	1:47:29 PM
Workstation:	D1K00YB1
Tested By:	AZM
Lab GL#	09-068

Test Results

Specimen Gage Length:	5.5000 in
Diameter:	2.3900 in
Area:	4.4863 in^2
Maximum Load:	42648 lbf
Compressive Strength:	9506 psi

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Geotechnical Services
Office of Geotechnical Design - North

EA: 02-3C3001

Date: March 2011

UNCONFINED COMPRESSION TEST RESULTS
SPECIMEN R09-011-5

02-PLU-70; PM 2.68-2.73
FOUNDATION REPORT

Plate No. B-5

APPENDIX C

GGB Seismic Survey Report

State of California
DEPARTMENT OF TRANSPORTATION

Business, Transportation and Housing Agency

M e m o r a n d u m

Flex your power!
Be energy efficient!

To: **Douglas Brittsan**
Senior Transportation Engineer
Geotechnical Design North
Division of Engineering Services

Date September 15, 2010

File: 02-PLU-70-PM 2.68
EA: 02-3C3001

Attention: Mark Hagy

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

Subject: Route 70 Walls

Introduction

This memo documents the results of a seismic survey using borehole-to-surface tomographic imaging and seismic refraction to identify the limits of granitic bedrock below fill sections of State Route 70 in the Feather River Canyon. At this location, the roadway is confined to the edge of the Feather River where a narrow exposure of diorite exists. The task was to investigate if the diorite there exists as undisturbed bedrock, or as emplaced boulder fill. Log of Test Boring (LOTB) information was used for correlation with the seismic data.

A 75-meter (246 ft) long seismic refraction line was acquired on the road surface from borehole R-09-009 to R-09-011 to measure seismic velocities of the materials at the site (Figure 1). Downhole-to-surface seismic tomographic imaging was employed at five boreholes along the alignment (locations also shown in Figure 1). Surface geophones were placed from each borehole to the water's edge along the embankment. Small charges were placed in the boreholes at various depths and the arrival times at the surface phones were recorded for office processing. Figures 2 through 7 show the processed models.

Results and Discussion

The results of two different seismic methods are presented. The first discussion summarizes the results of a single seismic refraction profile collected on the alignment and analyzed using the Generalized Reciprocal Method (GRM; see *Data Acquisition and Processing* and Palmer [1980] for explanations of the technique). The second provides the results of seismic tomographic imaging from five profiles acquired perpendicular to the alignment. The reader is referred to Owen (2006) for additional discussion of that method.

GRM Results

The seismic refraction line indicated three measured velocities (labeled V1 through V3). V1 corresponds to asphalt and base material and has a measured velocity of about 340 meters/second (1115 feet/second). V2 correlates with fractured diorite identified in the logs of test borings (LOTB's). Its measured velocity is 630 meters/second (2067 feet/second) and supports the LOTB descriptions of moderately to intensively fractured diorite as detached blocks with low RQD and high void ratio (possibly boulder fill). V3 correlates with LOTB descriptions of high-RQD, diorite bedrock and has a seismic velocity of 3990 meters/second, or about 13,000 feet/second. The refractor presents as an undulating surface with elevation of roughly 512 meters (1680 feet), about 23 feet below the existing road surface.

It should be noted that due to the orientation of the GRM profile the resulting model would be expected to provide reasonable estimates of average seismic velocities along the alignment, but may not yield reliable estimates of bedrock depth. Because of the possibility of significant dip oriented perpendicular to the refraction profile, the orientation of the profile parallel to the road cut does not assure that the identified refractor surface is actually located directly beneath the profile. The possibility exists that the refractor may originate off-axis, which could yield incorrect depth estimates to bedrock beneath the profile. Since site geometry eliminated the possibility of collecting GRM profiles normal to the alignment (and parallel to dip), we use the GRM profile for average material velocities only, and present the tomographic sections (acquired parallel to dip) for estimation of depth to bedrock.

Tomography Results

Downhole to surface seismic tomographic imaging provided additional information on the extents of the boulder fill and bedrock. Figure 3 is the processed velocity model at Boring R-09-007. The model indicates bedrock exists below the proposed retaining wall location at approximate elevation 511 m (1676 ft). (At this location the seismic refraction profile indicates rock with a velocity of 13,000 ft/s at elevation 1679 feet, or 512 m).

Figure 4 is the velocity model for boring R-09-008. This model indicates bedrock at slightly higher elevation (512.5 m or 1681 ft) compared to Figure 3.

Figure 5 is the velocity model for boring R-09-009. The modeled velocities correlate with the LOTB description of unfractured, hard to very hard diorite at elevation 1671ft. (509 m).

Borings 10 and 11 (Figures 6 and 7) also indicate a trend of better rock with depth. At boring R-09-010, rock appears to be substantially deeper at the wall location (elevation 509.5 m or 1672 feet) than at the other locations surveyed. At R-09-011, rock is modeled at elevation 513.50 meters (1685 feet).

Caution must be observed regarding the velocities presented in the tomographic models. Generally, V2 velocity from the GRM profile is much lower than indicated on the tomographic models. Experience with the tomographic technique is such that, though it provides reasonable

correlation to geologic contacts described from borehole data, the velocities derived from the inversion do not always agree with observations. Therefore, where seismic velocities are required for estimates of soil and rock properties, values directly measured from boreholes or calculated from seismic refraction methods such as the GRM are preferred over those derived from inversion techniques (such as tomography). Additional limitations of the tomographic method are provided in the next section.

Data Acquisition and Processing

Seismic refraction data were recorded using an EG&G Smartseis 24-channel seismograph with 14-Hz geophones. The profiles varied in length, but all used 2.0 meter (6.56 feet) geophone spacing. The energy sources employed were a hammer and striker plate, a downhole shotgun, or explosives where necessary. Arrival-time data from each shot were stored in the seismograph's memory. Both profile geometry and refraction data were backed-up to paper and floppy disk upon completion of the survey.

Interpretation of the seismic refraction profile used the Generalized Reciprocal Method (GRM; Palmer, 1980). This method can accommodate variation in refractor velocity and depth along the seismic line, is relatively insensitive to refractor dip (up to 20 degrees) and can accommodate hidden layer conditions (where supporting borehole data exist). Processing of the refraction data used the Viewseis computer application, developed through Earthfx Inc. The tomographic sections were processed using the program SeisOpt Pro (Optim, Inc.)

Additional limitations must be noted regarding application of the tomographic models presented in this report. The tomographic inversion method relies on the evaluation of a large number of possible solutions to derive a model that best fits the observed field data. Multiple models are evaluated and those that corroborate actual and assumed site conditions are presented. Therefore, these models provide estimates of actual subsurface conditions and are best suited for development of initial earthwork cross-sections. Use of these models for detailed project design and calculation of final quantities is not recommended without additional validation.

Profiles in this report are presented in terms of velocity units. A velocity unit is a three-dimensional unit which, due to its elastic properties and density, propagates seismic waves at a characteristic velocity or within a characteristic velocity range. Velocities denoted in this report and in the seismic refraction sections are expressed in meters per second. At least one velocity is present within a geological rock unit. In addition, each zone of weathering or fracturing within that geological unit can constitute its own velocity unit. Conversely, when two rock units (such as water saturated gravel and moderately weathered rock) propagate seismic waves at the same velocity and are adjacent to each other, both units would be part of the same velocity unit. Lastly, discontinuous velocities might result from variation in the degree of alteration in the form of physical and chemical weathering and should be considered in the interpretation of the data.

Thank you for the opportunity to work on this project. If you have any questions or need additional assistance, please contact me at (916) 227-1307 or Mr. Bill Owen at (916) 227-0227.

Report by:

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Reviewed By:

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DL/WO
Project File:
02_PLU_70_2.68_2011_SEI.pdf

References

Owen, W.P., 2006, Examples of subsurface velocity imaging via combined downhole and surface source and receiver arrays, *2006 Highway Geophysics—NDE Conference Proceedings*, St. Louis, Missouri, p. 253-268

Palmer, D., 1980, The generalized reciprocal method of seismic refraction interpretation, Society of Exploration Geophysicists, Tulsa, Oklahoma, 104 p.

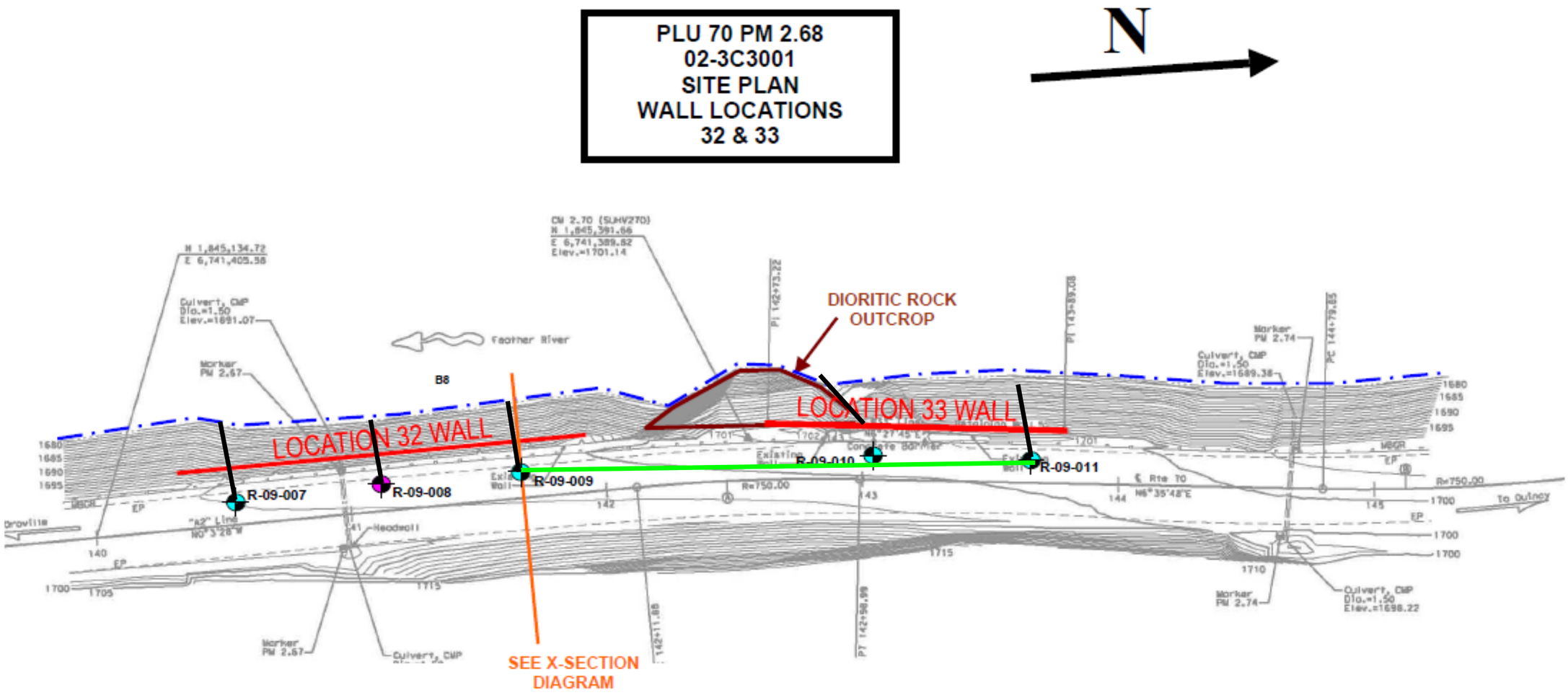

Figure 1. Site map showing the locations of the seismic investigation. Green line is location of the refraction profile acquired for velocity data, black lines are the borehole to surface tomographic sections. Stationing line provides scale.

South North

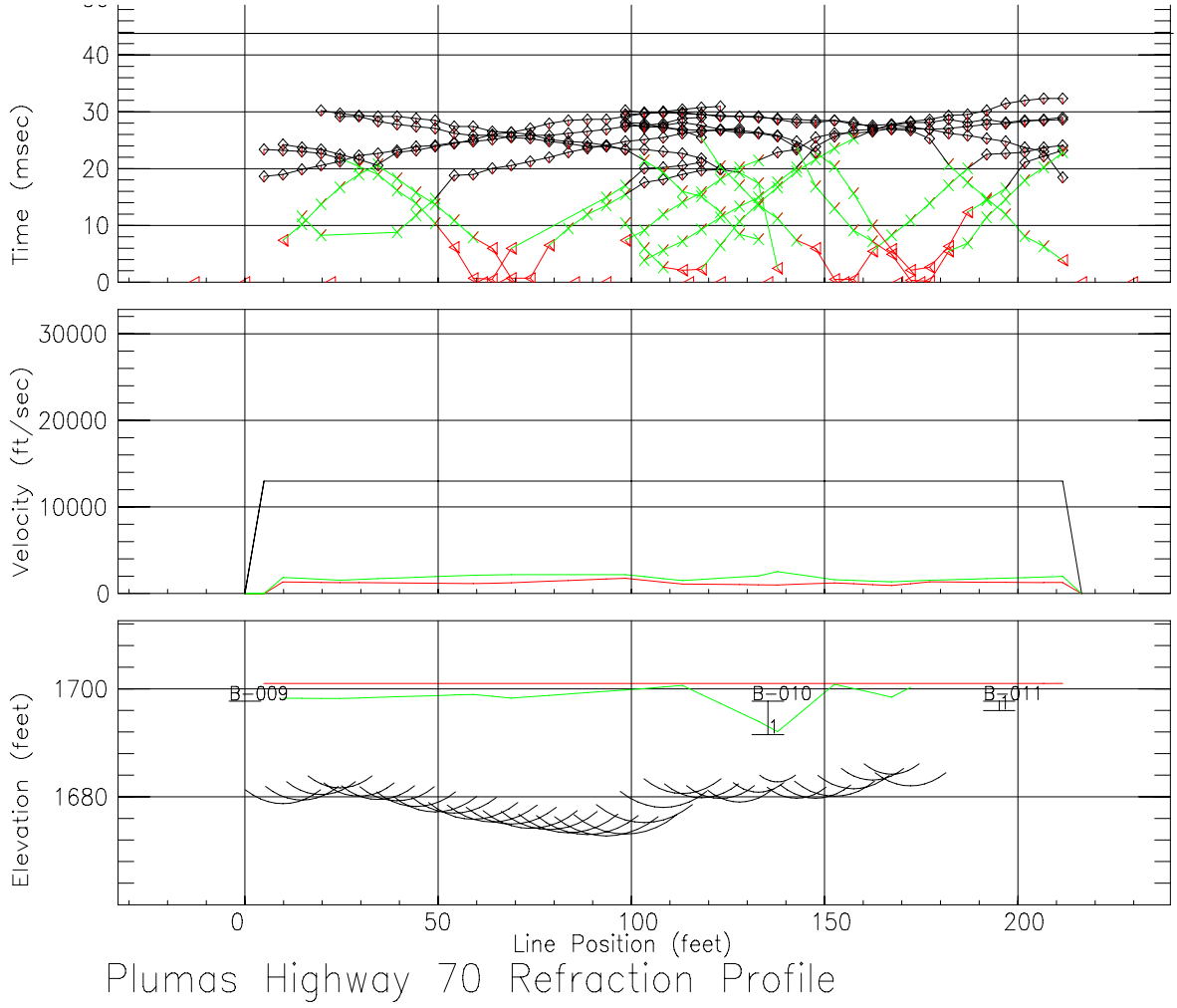

Figure 2. Travel time curve, velocity model and depth section for the seismic refraction line performed on the existing pavement from Borehole 009 through 011. Model indicates approximately 20 feet of very slow material (Vp=200 ft/s) above rock (Vp=13,000 ft/s).

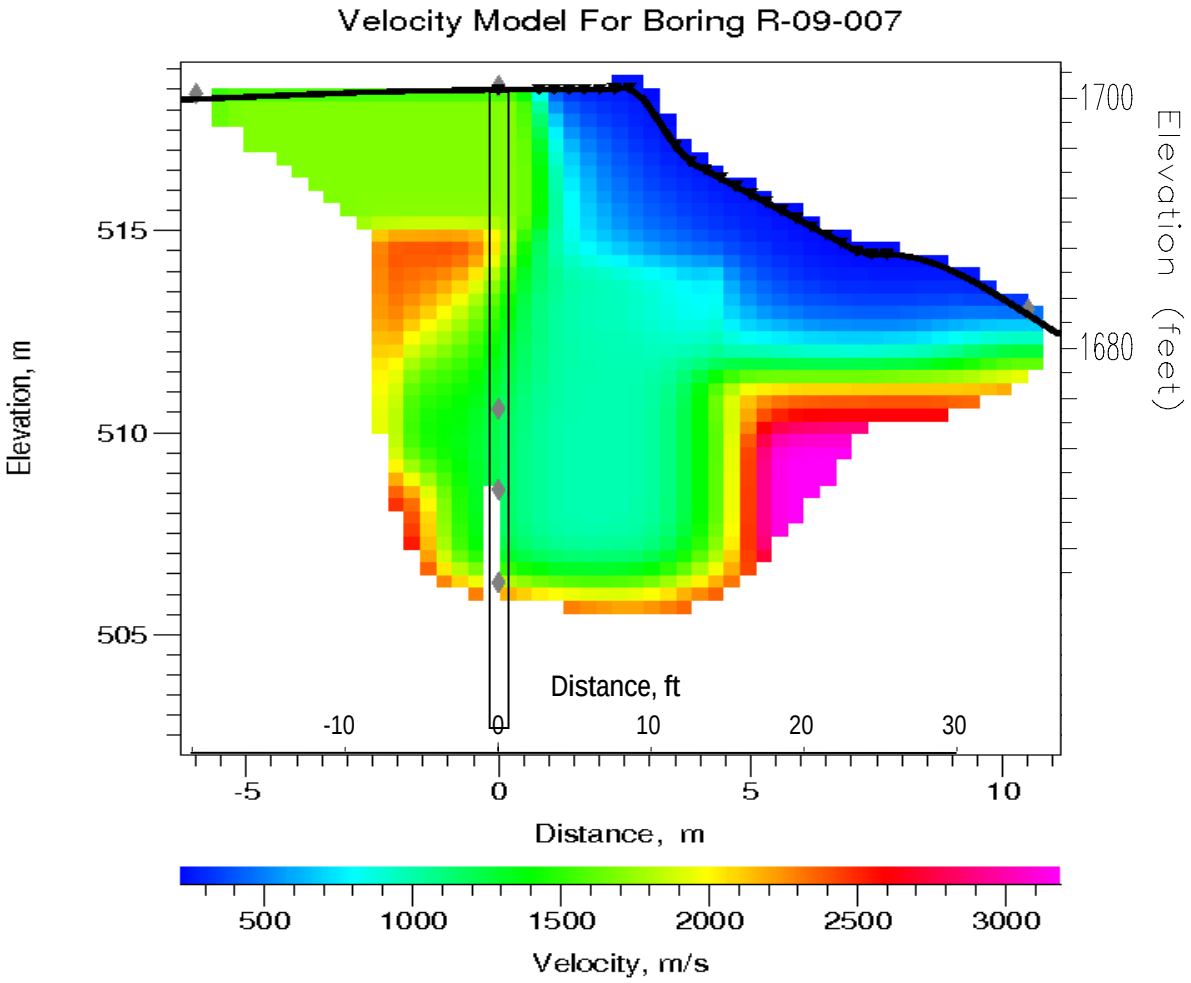

Figure 3. Velocity model for Boring R-09-007. Boring is at 0 meters as shown. Model indicates competent rock through entire borehole, and below fill, (blue color) at elevation 513.5 meters (1685 feet) at the wall location, about 3.50 m (11.5 ft) on the X axis. Shot points are shown as diamonds and the geophones are shown as small black triangles along the slope. Ground surface is the dark black line. LOTB describes hard diorite below elevation 516 m (1692.5 ft).

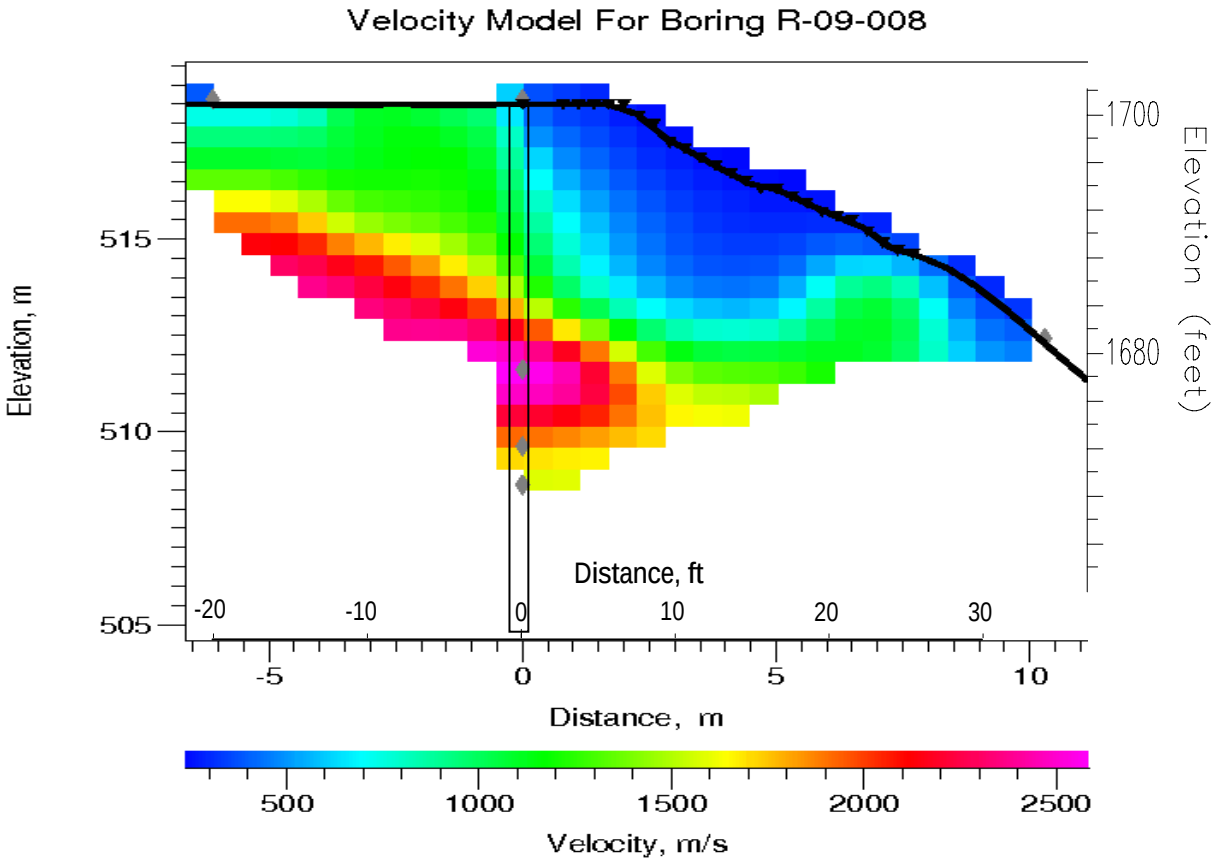

Figure 4. Velocity model of boring R09-008. Blue color is interpreted as slow boulder fill and fractured diorite. Green color interpreted as fractured diorite and red color is higher-velocity bedrock. Wall location is approximately 2.35 m (7.7 ft.) on the X axis. Shot points are shown as diamonds and geophones are shown as small black triangles. Model indicates fractured diorite at elevation 512.5 m (1681 ft) at proposed wall location. Ground surface is the black line. LOTB describes very hard, unfractured diorite below elevation 1667 ft. (508 m).

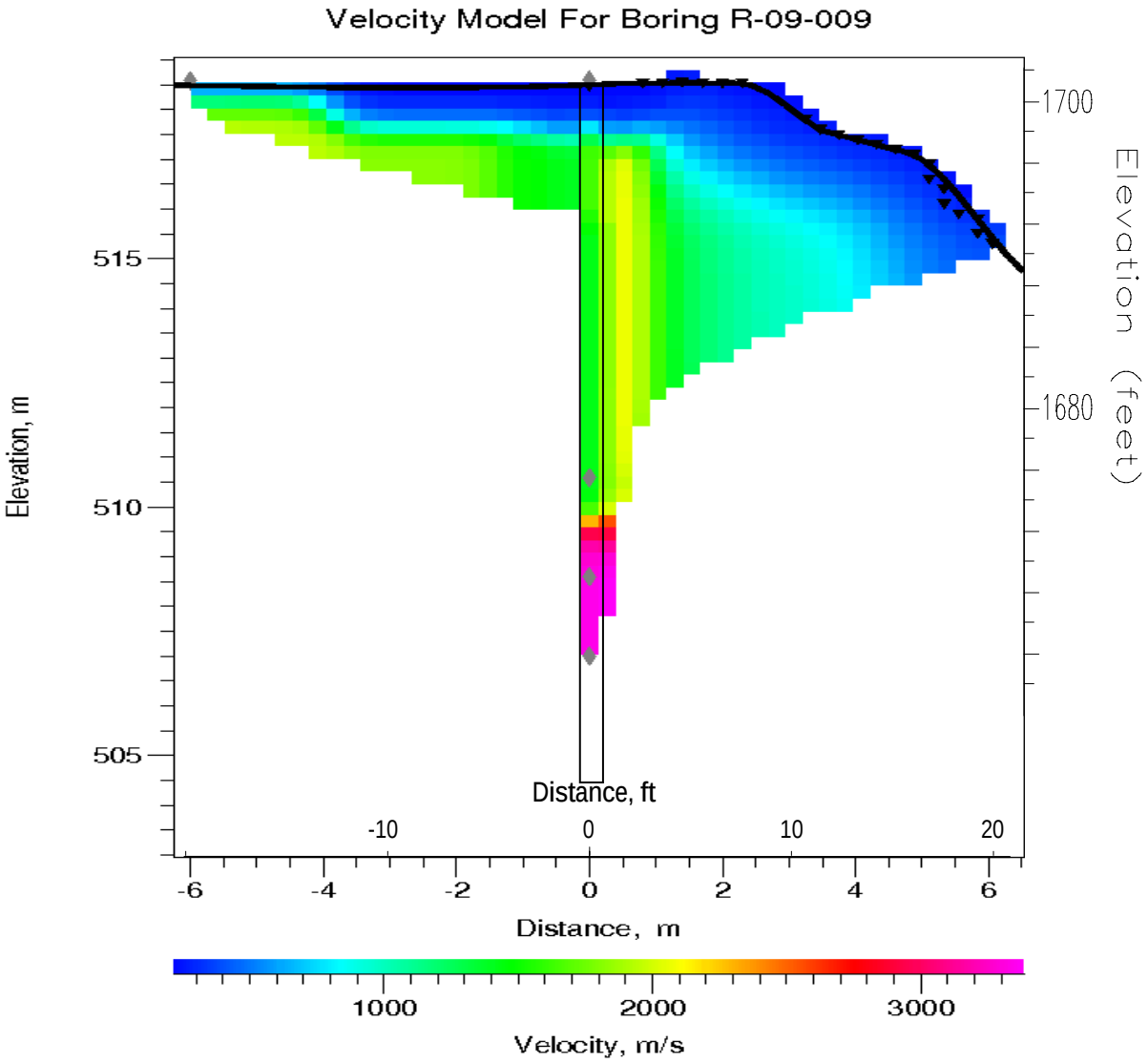

Figure 5. Velocity model for boring R-09-009. Blue color represents slow boulder fill and road base, green is interpreted as fractured diorite. Bedrock may not extend as far west (towards the river) as at other borings, but still appears to extend under the proposed wall location at about 2.81 m (9.2 ft) on the X axis. Red color indicates better-quality bedrock that correlates with LOTB descriptions of unfractured hard to very hard diorite at elevation 509 m (1671 ft). Ground surface is the black line. Shot points are shown as diamonds and geophones are shown as small black triangles.

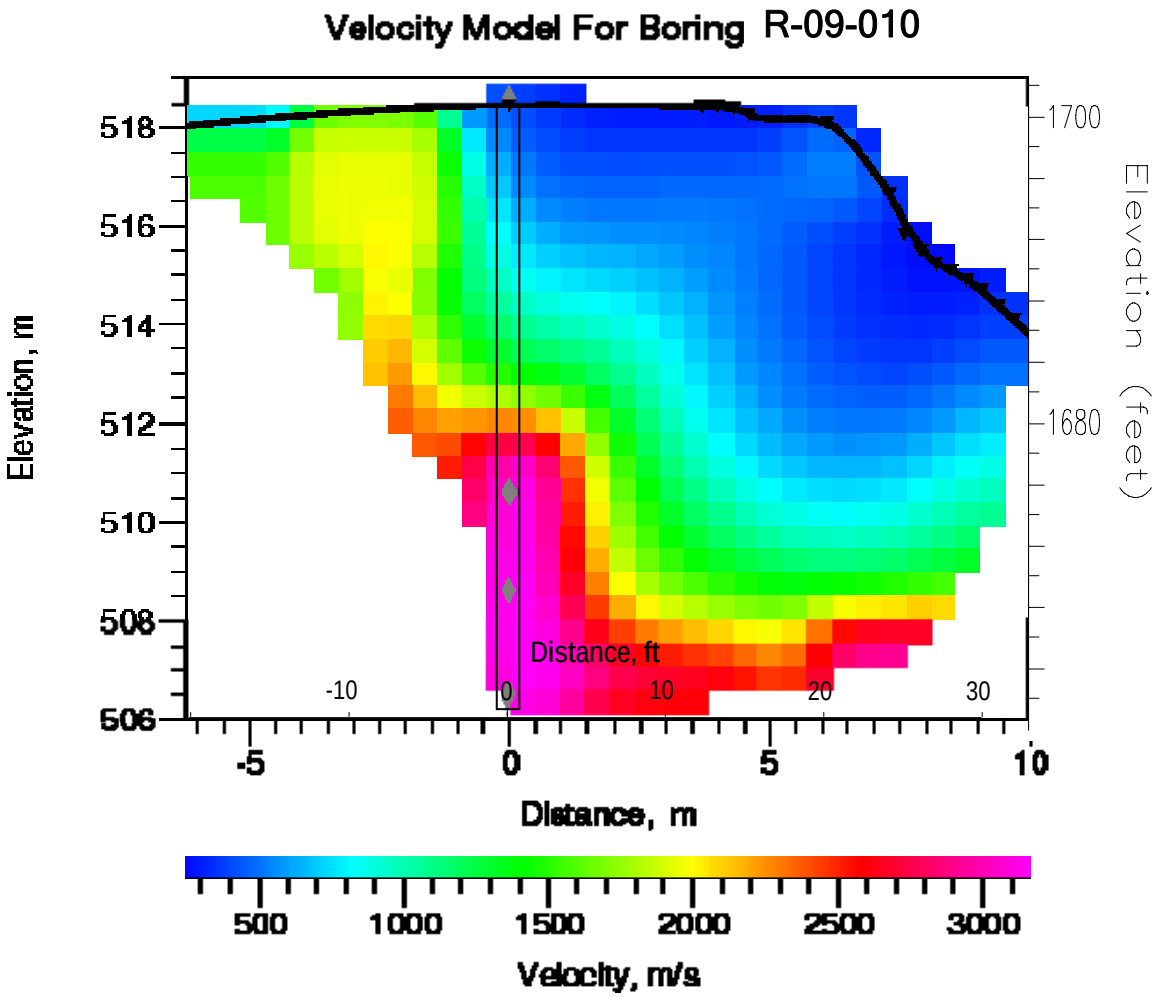

Figure 6. Velocity model for boring R-09-010. LOTB indicates a 4-foot void from 5.0 feet to 9.0 feet. Model indicates very slow material (blue color) in upper section of boring but competent rock (lime green and red) under boulder fill at the wall location and approximate elevation 509.5 meters (1672 feet).

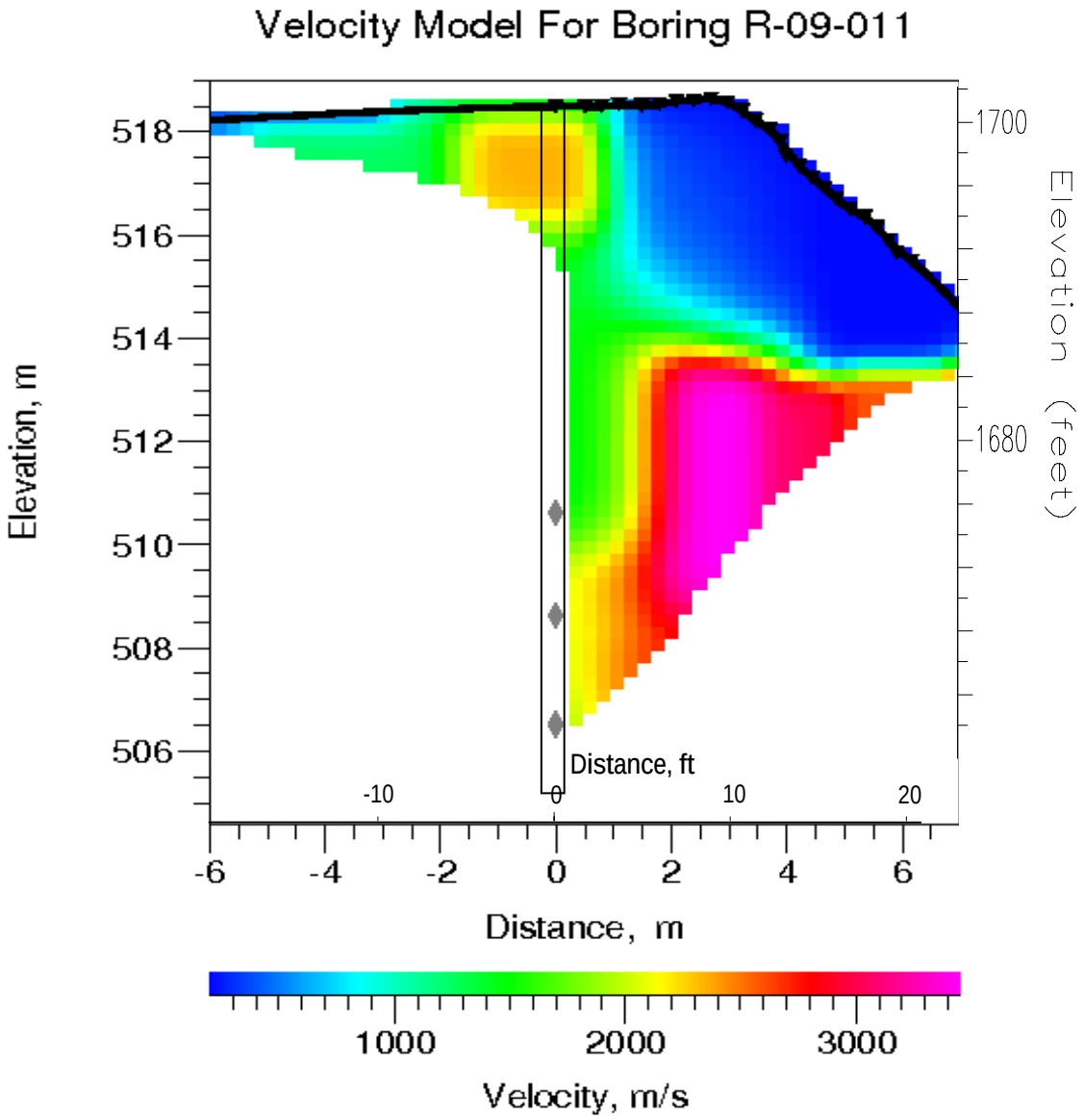

Figure 7. Velocity model for boring R-09-011. Competent rock is at elevation 513.50 meters (1685 feet) at the wall location (about 3.0 m (9.8 ft) on the X axis. Shot points are shown as diamonds and geophones are small triangles along the ground surface (black line).

FOUNDATION REVIEW

DIVISION OF ENGINEERING SERVICES
GEOTECHNICAL SERVICES

To: **Structure Design**
1. Design
2. R.E. Pending File
3. Specifications & Estimates
4. File

Geotechnical Services
1. GD - North ; South ; West
2 GS File Room

Date: 8/23/11

Wells 11, 2C, 27 & 28
Structure Name

04 - Plu - 070 - Var
District County Route ~~km~~ Post

District Project Development
District Project Engineer

04-3C3001 09E 0002, 3, 4, 5
E.A. Number Structure Number

Foundation Report By: M Hogy Dated: 3/4/11

Reviewed By: M Cullen (SD) R. Pin (GS)

General Plan Dated: 8/12/11 Foundation Plan Dated:

☒ No changes. ☐ The following changes are necessary.

FOUNDATION CHECKLIST

/ Pile Types and Design Loads		Effect of Fills on Abutments and Bents
_ Pile Lengths	_ Footing Elevations, Design Loads, and Locations	_ Fill Surcharge
_ Predrilling	_ Seismic Data	_ Approach Paving Slabs
_ Pile Load Test	_ Location of Adjacent Structures and Utilities	_ Scour
_ Substitution of H Piles For Concrete Piles ☐ Yes ☒ No	_ Stability of Cuts or Fills	_ Ground Water
	_ Fill Time Delay	_ Tremie Seals/Type D Excavation
		_

M J Cullen
Structure Design Bridge Design Branch No.

Geotechnical Services

Rev. 06/02