INFORMATION HANDOUT

For Contract No. 01-262014
At 01-Men-101-52.1/52.6

Identified by
Project ID 0112000205

PERMITS

United States Army Corps of Engineers

WATER QUALITY

California Regional Water Quality Control Board

North Coast Region

AGREEMENTS

California Department of Fish and Wildlife

Notification No. 1600-2015-006-R1

MATERIALS INFORMATION

Tunnel Safety Orders/Mining & Tunneling Unit Classification

Ryan Creek Culvert Replacement Project Report

Geotechnical Design Report

DEPARTMENT OF THE ARMY
SAN FRANCISCO DISTRICT, U.S. ARMY CORPS OF ENGINEERS
1455 MARKET STREET
SAN FRANCISCO, CALIFORNIA 94103-1398

AUG 14 2015

Regulatory Division

SIXTH LETTER OF MODIFICATION 1991-194740N
Willits Bypass – Ryan Creek Fish Passage

Ms. Kendall Schinke
Caltrans Environmental Management
District 3
2379 Gateway Oaks Drive (MS-19)
Sacramento, California 95833

Dear Ms. Schinke:

This letter is in response to a request from Caltrans Environmental Management Chief, Kendall Schinke, dated January 5, 2015, for a modification of Permit No. 1991-19470N. Your Project was authorized under Individual Permit 1991-194740N – Willits Bypass Project pursuant to section 404 of the Clean Water Act (33 U.S.C. § 1344), to construct a new segment of U.S. Highway 101 (U.S. 101) that will bypass the City of Willits in Mendocino County, California (Willits Bypass Project), beginning at Post Mile 43.1 and terminating at Post Mile 45.6, City of Willits, Mendocino County, California. This project was previously modified on September 20, 2013, July 8, 2014, July 10, 2014, July 15, 2014, and January 2015.

The original project description of your permit is for a four-lane freeway segment of U.S. 101. Each lane shall be 12 feet wide with a 22-foot median separating the northbound and southbound lanes. The proposed freeway shall bypass the City of Willits with several bridges spanning creeks and local roads, a viaduct spanning the floodway, and interchanges on either end of the bypass. The interchange ramps shall be single-lane. The project shall be constructed in two phases: Phase I of the project shall be the two southbound lanes. However, Phase I shall function as an interim facility upon which northbound and southbound traffic shall travel until construction of Phase II. Upon completion of both phases, traffic shall be separated via a median and two viaducts.

The Ryan Creek Fish Passage Project is located on Highway 101 from Post Mile (PM) 52.1 to PM 52.5 and is required mitigation for the Willits Bypass Project. The project would replace 1) the two existing 60 inch corrugated metal pipe (CMP) culverts on the South Fork of Ryan Creek along SR 101 (PM 52.25) with double 120 inch rammed steel pipe (SP) culverts, and 2) the existing 60 inch CMP culvert on the North Fork of Ryan Creek along SR 101 (PM 52.36) with a 12 foot by 10 foot reinforced concrete box (RCB) culvert. Rock weirs, rock sills, and native materials would be placed in the creek at both locations to provide an engineered streambed that provides fish passage for all life stages of salmonids. The project would also include widening an existing driveway off of SR 101 and relocating several utility power lines and poles. The driveway widening, included in the South Fork work, is necessary to allow access for equipment required to construct the project.

The utility relocation is required for both North and South Fork work. Work would require permanent placement of 223.65 cubic yards of fill within 0.3 acre (798.4 linear feet) of Ryan Creek. Work would require temporary placement of 10.08 cubic yards of fill within 0.002 acre (7.0 linear feet) of Ryan Creek. All work shall be completed in accordance with the plans and drawings titled "USACE File #1991-194740N, Willits Bypass - Impact Map - North and South Fork Ryan Creeks Fish Passage Improvement Project, August 7, 2015, Pages 1 and 2" provided as enclosure 1.

At the South Fork Ryan Creek (PM 52.25) crossing, the existing 60-inch metal culvert would be replaced with two 10 foot diameter steel pipes counter sunk to a depth of 42 inches. New wingwalls would be constructed for the project. The new double culverts would be installed alongside the existing culvert using a large ramming head that advances the pipe in place without first having to excavate the fill in the road prism. Once the culverts are in place and have been cleared of bore debris, the stream flow would be redirected into the new inlets. The old culvert would be filled and abandoned. The material placed at the bottom of the culverts would be native bed material or clean sand and gravel for spawning habitat. There would be four rock "bands" and one rock weir in the outfall section and two rock weirs in the inlet section constructed in this location. These bands/weirs would be constructed to provide a 6 inch rise between each structure. The proposed work would also excavate material where necessary to achieve a minimum pool depth of two feet within the rock weirs.

At the North Fork of Ryan Creek (PM 52.36), the existing 60-inch culvert would be removed and replaced with a 12 foot wide by 10 foot deep reinforced concrete box (RCB) countersunk two feet below the streambed. The RCB would maintain the existing culvert alignment; however the new culvert would result in an extension of the existing facility by approximately 5 feet on the east (inlet) side. The existing headwalls and endwalls would be removed and replaced with wing-walls. The material placed at the bottom of the culvert would be native bed material or clean sand and gravel for spawning habitat. In addition, there would be 5 rock weirs and 4 rock "bands" in the outfall section and two rock weirs in the inlet section constructed in this location. The weirs/bands would be constructed to provide a 6-inch rise between each structure. The proposed work would also excavate material where necessary to achieve a minimum pool depth of two feet with spawning material between the rock weirs. If there is not enough native material to place as spawning material the contractor will place "Clean Sand and Gravel." At the resident engineer's discretion where the streambed is widened or realigned, or existing scour holes are excessively deep, a layer of rock slope protection (RSP) would first be placed below the clean sand and gravel layer to insure stream grade stability. Thus RSP would have voids backfilled and rodded (rodding is tamping the back fill material into the voids of the RSP with a steel rod to ensure its compacted sufficiently to prevent piping) with a suitable material to prevent piping (piping occurs if the voids in the RSP are not filled properly; the water goes below the surface into the voids and then surfaces later).

Permit No. 1991-19470N is hereby modified under the provisions of 33 C.F.R. § 325.7(b) to include replacement culverts, and rock weirs, rock sills, and native materials in Ryan Creek located at Highway 101 from PM 52.1 to PM 52.5 in the City of Willits, Mendocino County. In order to ensure compliance with this permit modification, the following special conditions shall be implemented:

1. A copy of this permit authorization, and the Section 401 Water Quality Certification, shall be onsite during all work activities and will be available to USACE representatives upon request.

2. The permittee must allow representatives from the San Francisco USACE office or any other person(s) designated by USACE, to inspect the authorized activity at any time deemed necessary to ensure the project is being or has been accomplished in accordance with the terms and conditions of the permit modification.

3. Riparian restoration shall be completed as described in the document titled, "Riparian Restoration Plan South Fork Ryan Creek and North Fork Ryan Creek Fish Passage Improvement Project On U.S. Highway 101 In Mendocino County, CA", dated July 2015. All work shall be completed in accordance with the plans and drawings titled "USACE File #1991-194740N, Willits Bypass, Ryan Creeks Fish Passage Improvement Project, Riparian Restoration Plan, August 7, 2015, Pages 1 and 2" provided as enclosure 2.

4. Restoration performance standards shall be adhered to as per pages 18 and 19 (Enclosure 3) of the Riparian Restoration Plan, dated July 2015, and an annual monitoring report shall be submitted to the Corps by December 31 for five years following the completion of construction. This report shall include dated photographs that cover the entire project reach within Corps' jurisdiction. If performance standards are not being met, a brief explanation of the difficulties and potential remedial actions shall be provided.

Except for the above modification and previous modifications dated September 20, 2013, July 8, 2014, July 10, 2014, and July 15, 2015 all terms and conditions of the original permit authorization remain in effect.

Should you have any questions regarding this matter, please contact Sahrye Cohen of our Regulatory Division at (415) 307-2205 or by email: Sahrye.E.Cohen@ usace.army.mil. Please address all correspondence to the Regulatory Division and refer to the File Number at the head of this letter.

Sincerely,

Jane M. Hicks
Chief, Regulatory Division

Enclosures

Copies furnished without enclosures:

California Department of Fish and Wildlife, Eureka, CA
North Coast Regional Water Quality Control Board, Santa Rosa, CA
National Marine Fisheries Service, Santa Rosa, CA
Charlie Fielder, Caltrans District 1, Eureka, CA

January 27, 2016

U.S. Army Corps of Engineers
San Francisco District, Regulatory Branch
Attn: Sahrye Cohen
1455 Market Street, 16th Floor
San Francisco, CA 94103-1398

Dear Ms. Cohen:

Subject: Willits Bypass Project Clean Water Act Section 404 Permit Modification Request
File: Highway 101 – Willits Bypass Project

The North Coast Regional Water Quality Control Board (Regional Water Board) has reviewed the permit modification request and supplemental materials submitted by the California Department of Transportation (Caltrans) to the U.S. Army Corps of Engineers (Corps) to provide fish passage improvements within U.S. waters on the North and South Fork of Ryan Creek, as mitigation for the State Route 101 Willits Bypass Project (Project). The Regional Water Board issued section 401 water quality certification to Caltrans for the Project on August 6, 2010.

Based upon our review of the application materials, we find that a section 401 water quality certification of the 404 modification is not needed because the proposed activities are covered under the existing certification.

We request the Corps notifies the Regional Water Board if Caltrans deviates from the submitted application and revegetation plan. Should deviations from the submitted application result in actual or potential negative impacts to water quality, then Regional Water Board actions may include halting Project activities, modifying the Project 401 water quality certification, issuing a new 401 water quality certification, or requiring Caltrans to submit a Report of Waste Discharge and issuing Waste Discharge Requirements.

Thank you for bringing this application to our attention. If you have any questions, please contact Brandon Stevens of my staff, at Brandon.Stevens@waterboards.ca.gov or (707) 576-2377.

Sincerely,

Fred Blatt
Fred Blatt 2016.01.27 14:17:14 -08'00'
Water Boards

Fred Blatt
Division Chief, Non-Point Source and Surface Water Protection Division

160127_BDS_dp_RyanCreek404_ModRequest

cc: Mr. Stephen Bargsten, Regional Water Board Stephen.Bargsten@waterboards.ca.gov
Mr. Mike Bartlett, Caltrans Mike.Bartlett@dot.ca.gov
Mr. John Webb, Caltrans John.Webb@dot.ca.gov
Mr. Chris Collison, Caltrans Chris.Collison@dot.ca.gov

California Regional Water Quality Control Board
North Coast Region
Geoffrey M. Hales, Chairman

www.waterboards.ca.gov/northcoast
5550 Skylane Boulevard, Suite A, Santa Rosa, California 95403
Phone: (877) 721-9203 (toll free) • Office: (707) 576-2220 • FAX: (707) 523-0135

Linda S. Adams
Secretary for Environmental Protection

Arnold Schwarzenegger
Governor

August 6, 2010

In the Matter of

Water Quality Certification

for the

California Department of Transportation
Highway 101 – Willits Bypass Project:
WDID No. 1B10019WNME

APPLICANT:	California Department of Transportation
RECEIVING WATER:	Wetlands and Haehl Creek, Baechtel Creek, Broaddus Creek, Mill Creek, Outlet Creek, Upp Creek, and Ryan Creek
HYDROLOGIC AREA:	Eel River Hydrologic Unit (HU) No.111.00 Outlet Creek Hydrologic Sub-Area (HSA) No. 111.61
COUNTY:	Mendocino
FILE NAME:	CDOT - Hwy 101, Willits Bypass Project

BY THE EXECUTIVE OFFICER:

1. On March 1, 2010, the North Coast Regional Water Quality Control Board (Regional Water Board) received an application and $40,000.00 fee from the California Department of Transportation (Caltrans), requesting federal Clean Water Act (CWA), section 401, Water Quality Certification for activities related to the proposed first phase of the Highway 101, Willits Bypass project (project). The proposed project will cause disturbances to waters of the United States (U.S.) and waters of the State, including wetlands and intermittent, ephemeral and perennial tributaries to Outlet Creek, which is located within the Eel River Hydrologic Unit No.111.00, the Outlet Creek Hydrologic Sub-Area (HSA) No. 111.61, and the Little Lake Valley Ground Water Basin. The Regional Water Board is proposing to

regulate this project pursuant to Section 401 of the CWA (33 USC 1341) and/or Porter-Cologne Water Quality Control Act authority.

2. The Regional Water Board provided public notice of the application pursuant to title 23, California Code of Regulations, section 3858 on April 29, 2010, and posted information describing the project on the Regional Water Board's website. Regional Water Board staff received letters from 75 individuals or groups in response to the subject notice of Water Quality Certification and Waste Discharge Requirements. Of those 75, 27 were in favor of the proposed project, while 48 raised various objections. Because many of the same comments were described in different letters, Regional Water Board staff grouped comments together where appropriate, and provided one response. The Regional Water Board has issued a response to comments concurrently with this Order, and is included as Attachment 1.

3. The proposed project is located on Highway 101, in Mendocino County, and will begin approximately 0.8 mile south of the Haehl Overhead and end approximately 1.9 miles south of the Reynolds Highway. The overall length of the bypass is approximately 5.9 miles from post mile realignment (PMR) 43.1 and ending near PMR 49.0. The purpose of the project is to upgrade the level of service to the traveling public along Highway 101 by reducing travel times and reducing the traffic congestion along Highway 101 and within the City of Willits. Beginning at the southern end of the project, the new alignment of Highway 101 would swing to the northeast and then travel back to the northwest, adjacent to the Willits Wastewater Treatment Plant (WWTP). Because of funding constraints, the decision was made to construct the bypass in two phases such that a functional interim two-lane facility would be constructed initially; when adequate funding becomes available in the future, the remaining lanes will be constructed to complete the four-lane bypass. This Water Quality Certification is for Phase I only.

Project Description

4. The proposed project will be constructed largely on fill material imported to the site. The bypass requires imported borrow material from outside the project area in addition to material excavated on-site. The area from which Caltrans proposes that the contractor will take fill material for the project is at Oil Well Hill, which is located on the east side of Highway 101, approximately 0.85 mile north of the intersection of Reynolds Highway and Highway 101. The State Geology and Mining Board granted an exception to the Surface Mining and Reclamation Act (SMARA) permitting requirement on March 13, 2008 for obtaining the fill material from Oil Well Hill. The construction contractor will have the option to determine whether the source of fill material for the project will be from the Caltrans-designated borrow site at Oil Well Hill, a commercial borrow site, or another site. If

the contractor chooses to use available commercial borrow sites in the vicinity of the project to obtain the required fill, it will likely not need to obtain any additional environmental permitting when soil is exported, because commercial borrow sites typically hold preapproved operating permits. Should the contractor select an alternative, noncommercial borrow site for this project, the contractor will be responsible for obtaining proper approvals.

5. The following structures will be constructed during the project:
   - Two interchanges will be constructed for the project. The Haehl Creek interchange will be located at the south end of the project near Haehl Creek and connect the existing highway into Willits with the new highway facility. The Quail Meadows interchange will be located near the north end of Little Lake Valley and connect the new highway facility to the existing highway north of Willits.
   - The bypass will cross multiple creeks, riparian corridors, streets, and railroad rights-of-way using 22 bridges, three retaining walls, and a one mile long viaduct that will span the regulated floodway.
   - Six bridges will be constructed in the Haehl Creek interchange area, one for each of the following:
     1. Northbound freeway lanes separation over State Route (SR) 20
     2. Southbound freeway lanes separation over SR 20
     3. Southbound off-ramp over Haehl Creek
     4. Northbound on-ramp over Haehl Creek
     5. Northbound freeway lanes over Haehl Creek
     6. Southbound freeway lanes over Haehl Creek

   - A culvert will be replaced during improvement of the proposed new Schmidbauer Ranch access road.

   - Two retaining walls will be constructed in the Haehl Creek interchange area adjacent to Haehl Creek:
     1. East side of northbound lanes
     2. West side of northbound on-ramp

   - One retaining wall will be constructed on the west side of the southbound roadway lanes, just south of Center Valley Road.

   - Two bridges will be constructed to cross East Hill Road:
     1. One bridge for the southbound roadway lanes (Phase 1)
     2. One bridge for the northbound roadway lanes (Phase 2)

- Two bridges will be constructed to cross the middle reach of Haehl Creek south of Shell Lane:
  1. One bridge for the southbound roadway lanes (Phase 1)
  2. One bridge for the northbound roadway lanes (Phase 2)

- Two viaduct structures will be constructed to span the floodway:
  1. Southbound (Phase 1)
  2. Northbound (Phase 2)

- Two bridges will be constructed to cross over the North Western Pacific Rail Road tracks in the Quail Meadows interchange area, one for each of the following:
  1. U.S. Highway 101 Willits Bypass
  2. Southbound roadway lanes (Phase 1)
  3. Northbound roadway lanes (Phase 2)

- Two bridges will be constructed to cross the new connector road to existing U.S. Highway 101 in Quail Meadows Interchange area:
  1. One for the southbound roadway lanes (Phase 1)
  2. One for the northbound roadway lanes (Phase 2)

- Six bridges will be constructed to cross Upp Creek directly north of the Quail Meadows interchange, one for each of the following:
  1. Southbound roadway lanes (Phase 1)
  2. Northbound roadway lanes (Phase 2)
  3. Northbound on-ramp (Phase 1)
  4. Northbound on-ramp (Phase 2)
  5. Southbound off-ramp
  6. Roundabout local intersection

- The proposed alignment encroaches upon the 100 year floodplain. The design includes two elevated structures, which make up the floodway viaducts. The purpose of this design feature is to span the floodway. The Willits Bypass Floodplain Evaluation Report, dated September 2006, concludes that the project will not increase the base flood elevation of the floodway, and does not constitute a significant floodplain encroachment as defined in 23 CFR 650.105(q). The viaduct will be located in the central part of the project area and will span Center Valley Road, the lower reach of Haehl Creek just upstream of the confluence with Baechtel Creek, Hearst Willits Road, Baechtel and Broaddus Creeks at their confluence (beginning of the Outlet Creek designation), the WWTP, and Mill Creek. The approximately 6,000-foot long structures will consist of separate northbound and southbound elevated viaduct

superstructures. The total area of both viaducts would be 11.6 acres. Each of the viaducts will be approximately 42.6 feet wide. The edge to edge distance between the structures will be approximately 31.2 feet, and each will have a 16.5 foot minimum clearance underneath. The viaducts will require supporting columns, ranging in size from 4.5 to 7 feet in diameter.

Proposed Impacts to Wetlands and Surface Waters within the Regional Water Board's Jurisdiction

6. The project will result in impacts to wetlands and surface waters within the Outlet Creek HSA, including Haehl Creek, Baechtel Creek, Broaddus Creek, Mill Creek, Outlet Creek, Upp Creek, Ryan Creek and two ponds (Rutledge and Niesen). Caltrans has determined that the project would directly impact a total of 89.27 acres of waters of the U.S[1]., including 83.77 acres of impacts to wetlands and 5.5 acres (12,416 linear feet) to streams and ponds also identified as waters of the U.S. The project would temporarily impact 29.88 acres of wetlands and 3.16 acres (9,255 linear feet) of streams and ponds identified as waters of the U.S[2]. In addition, the project would result in permanent impacts to 53.89 acres of wetlands and up to 2.34 acres (3,161 linear feet) of streams and ponds that are waters of the U.S.[3]

7. Caltrans has also determined that the project would result in 10.12 acres of temporary impacts (6,693 linear feet) and 10.88 acres of permanent impacts (8,535 linear feet) to waters of the state, including riparian areas.[4] "Waters of the

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[1] Waters of the U.S. is defined in section 232.2 of title 40 of the Code of Federal Regulations and includes "all waters which are currently used, were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters which are subject to the ebb and flow of the tide. All interstate waters, including interstate wetlands. All other waters including intrastate lakes, rivers, streams (including intermittent streams), mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds, the use, degradation, or destruction of which would or could affect interstate or foreign commerce… and wetlands adjacent to waters (other than waters that are themselves wetlands) …"

[2] A temporary impact is the short term impact that occurs during the placement of fill within wetlands for access roads, or the removal of trees and vegetation along streams to construct false work and structures.

[3] A permanent impact is the placement of fill within areas for the purpose of a permanent structure such as the roadway embankments for the new highway, bridge footings, or culverts within streams.

[4] Riparian areas are transitional between terrestrial and aquatic ecosystems, through which surface and subsurface hydrology connects waterbodies with their adjacent uplands. Protection of riparian areas adjacent to streams, lakes, and estuarine-marine shorelines is essential to the protection of the beneficial uses of the waterbodies. As collectively agreed to by the resource agencies with jurisdiction over this project, riparian areas are: 1) Category I Riparian Corridors, which include areas of salmonid streams and adjacent riparian areas extending 100 feet from each bank laterally from the Ordinary High Water Mark; 2) Category II Riparian Corridors, which include tributaries of Category I Riparian Corridors that are within 1,000 feet of the confluence with a Category I Stream,

State" is defined very broadly within the Water Code as "any surface water or groundwater, including saline waters, within the boundaries of the state." (Cal. Water Code, § 13050(e)). It has been interpreted to include all Waters of the U.S., in addition to areas outside of Waters of the U.S., such as isolated wetlands, headwaters, and riparian areas above the ordinary high water mark.

8. Protecting riparian areas is essential to ensuring the protection of beneficial uses identified in the Regional Water Board's Water Quality Control Plan (Basin Plan). Riparian areas support and protect surface water quality by accumulating and filtering sediment before it reaches surface waters and providing shade for the enhancement and protection of cold freshwater habitat. In addition, riparian areas have their own beneficial uses that are recognized in the Basin Plan, such as providing terrestrial habitats, vegetation, and wildlife (WILD), providing flood peak attenuation/ flood water storage (FLD), providing water quality enhancement, including filtration, purification and erosion control (WQE), and the preservation and enhancement of wetland habitat (WET).

Proposed Mitigation

9. As part of its application for the Water Quality Certification, Caltrans submitted the *Final Mitigation and Monitoring Proposal* (Final MMP), dated June 8, 2010. To mitigate impacts to wetlands, Caltrans has proposed creating 24.33 acres of wetlands. During the project planning process Caltrans assessed over 6,000 acres of land within Little Lake Valley to identify potential mitigation for the impacts of the bypass project and contacted the property owners, requesting that they consider selling land to Caltrans for mitigation. Caltrans received responses from willing sellers of 3,157 acres, of which there was little opportunity for wetland creation. At the request of the Regional Water Board, Caltrans expanded their search to approximately 11,000 acres outside Little Lake Valley. Caltrans received responses from land owners willing to sell 2,700 acres, with little opportunity for wetland creation.

10. Prior to the beginning of ground-disturbing project construction activities, known populations of wetlands plant species to be affected by construction will either be salvaged for transportation to adjacent on-site locations, or salvaged for relocation to off-site mitigation parcels, where the harvested material will be used to topdress created wetlands. Off-site mitigation actions for wetlands creation will require site preparation, including grading uplands and modifying local hydrology; seeding

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and extending 50 feet from the OHWM on each bank; and 3) Category III Riparian Corridors, which include tributaries of Category I Riparian Corridors that are more than 1,000 feet upstream of the confluence with the Category I Stream, extending 25 feet from the OHWM on each bank.

graded areas; planting wetlands species; and monitoring for successful wetland establishment.

11. After the creation of approximately 24 acres of wetlands, the project would still result in a permanent net loss of approximately 29 acres of wetlands. State of California Executive Order W-59-93 directs all state agencies to *"ensure no overall net loss and long term net gain in the quantity, quality and permanence of wetlands acreage and values in California…"* Executive Order W-59-93 also directs all state agencies "to encourage partnerships to make restoration, landowner incentive programs, and cooperative planning efforts the primary focus of wetland conservation." To compensate for the loss of the approximately 29 acres of wetlands, the United States Environmental Protection Agency (U.S. EPA), United States Fish and Wildlife Service (U.S. FWS), United States Army Corps of Engineers (U.S. ACE), National Marine Fisheries Service (NMFS), California Department of Fish and Game (CDFG), Mendocino County Resource Conservation District (MCRCD), Willits Environmental Center (WEC) and Regional Water Board collectively agreed to and developed an ecologically based watershed approach designed to ensure no net loss of ecological functions and values. The watershed approach would provide significant improvements to the ecological functions and values of wetlands off-site of the project, but still within the Little Lake Valley[5]. (The project is planned in the west-central portion of the Little Lake Valley.) The resource agencies agreed that the mitigation should be focused within Little Lake Valley because it hosts a variety of unique ecological features, including the presence of several rare, threatened, and endangered species (e.g. anadromous fish and Baker's Meadowfoam).

12. In addition, the watershed approach option was developed in collaboration with U.S. EPA and U.S. ACE to be consistent with federal Compensatory Mitigation Rule released on April 10, 2008. (40 CFR § 230, Subpart J; 33 CFR 332.). Caltrans proposed that 1,011.13 acres of existing wetlands would be enhanced and in combination with the 24.33 acres created and 53.44 acres preserved, for a total of 1,088.90 acres of wetlands secured in perpetuity. Wetland enhancement actions include: filling in man-made drainage ditches to increase the residence time of surface waters within the wetland area; implementing a grazing management plan to reduce the impacts from cattle; and removing invasive species to promote the health and natural recruitment of native wetland species. The enhancement of wetlands will be verified through a robust monitoring and reporting program (per Condition 10) that requires Caltrans to use the California

[5] During the Willits Bypass Mitigation Development Team meetings, it was collectively agreed between the U.S. EPA, U.S. ACE, U.S. FWS, CDFG, NMFS, WEC, Caltrans, and the Regional Water Board that the most appropriate use of the mitigation funds would be a watershed approach within Little Lake Valley. The resource agencies believe, that in this case, a watershed based approach will be superior to an approach relying on wetland creation/establishment ratios..

Rapid Assessment Method (CRAM) for wetlands, as well as additional hydrology, vegetation, and surface water sampling and analysis methods to verify the enhancement of wetland functions and values. The mitigation site preservation and site protection instruments would be a combination of fee title purchase, conservation easement, or other deed restriction.

13. The Eel River watershed is listed on the Clean Water Act section 303(d) list as impaired for sediment and temperature. In 2004, the U.S. EPA established sediment and temperature total maximum daily loads (TMDLs) for the Upper Main Eel River and tributaries (including Tomki Creek, Outlet Creek and Lake Pillsbury). Therefore, to fully develop a watershed approach the mitigation must include a nexus to address the temperature and sediments impairments. The nexus relates how the proposed mitigation will implement additional measures to reduce stream temperatures and excessive sediment inputs into the watershed. For sediment, Caltrans has prepared an assessment of all the erosion sites located within the off-site mitigation lands, which includes the inventory, prescription, and prioritization of restoration actions that will reduce erosion and sediment delivery within the watershed. In addition, the bypass structure has been designed to reduce erosion and sediment delivery to the maximum extent practicable (MEP). For temperature impairment, the most practical way to reduce stream temperatures is to provide riparian vegetation in all areas feasible within the project limits, including bypass alignment and off-site mitigation lands (maximum site potential shade). In addition, baseline surveys will be conducted to find all areas that benefit from riparian plantings to achieve maximum site potential shade, and percent effective shade (shade on water). Additionally, the current land management practices of stream alteration and cattle grazing have potentially negative side effects on water. Therefore, the proposed grazing management plan, which is geared towards the enhancement and protection of natural resources, will be implemented to improve the overall health of the watershed.

14. Caltrans proposes to mitigate impacts to riparian areas by planting with native riparian species along approximately 48 acres (approximately 35,000 linear feet) adjacent to waters of the U.S. and State, and monitoring to ensure successful establishment. In addition, 49 acres of riparian areas would be enhanced by the following actions: expanding riparian habitat through planting native species; increasing habitat complexity; improving hydrology; controlling invasive species; and implementing a grazing management plan. A total of 104 acres of riparian areas would be secured in perpetuity. The mitigation site protection would be a combination of fee title purchase, conservation easement, or other deed restriction.

15. To mitigate for temporary and permanent impacts to waters of the U.S. and State, Caltrans proposes to enhance approximately 17 acres of streams by improving hydrology and increasing habitat complexity. The Rutledge pond will be realigned

adjacent to the bypass, and therefore its disturbance will only be a temporary impact. Additionally, Caltrans proposes to grade and modify the Neisen pond as part its plan to create wetlands. Approximately 24 acres of streams identified as waters of the U.S. and State will be protected in perpetuity. Overall, the mitigation plan would result in the purchase and/or preservation of approximately 2,100 acres of land within Little Lake Valley.

16. Caltrans proposes to remove fish passage barriers along Upp Creek, Haehl Creek and Ryan Creek. The removal and/or upgrade of these facilities would likely reduce sediment input into the creeks as well as improve the beneficial use of the creeks for migration by anadromous fish. One existing culvert in the upper Haehl Creek channel, located under the proposed highway bridge, will be permanently removed and the stream channel will be restored as a natural drainage feature. A second existing culvert in upper Haehl Creek will be replaced and the area restored during improvement of the proposed new Schmidbauer Ranch access road. An existing box culvert in the vicinity of the proposed Quail Meadows interchange and passing under US 101 will be permanently removed and the creek contoured, re-graded, stabilized, and replanted; local traffic will cross Upp Creek on the new bridge that will be on the north leg of the roundabout. Stabilization of both creek channels that pass through the interchange areas (Haehl and Upp Creeks) will consist of grade control structures located downstream of the culvert, at appropriate heights and intervals, for the distance necessary to stabilize the natural stream gradient. Fish passage design elements will comply with guidelines established by NMFS and CDFG.

17. The project will result in an increase of approximately 38 new acres of impervious surface in the Little Lake Valley. The total area of impervious surface that will exist within the project limits will be 49 acres (including new and existing impervious surface) when the first phase of the project is completed. Caltrans will provide permanent post-construction storm water treatment for approximately 43 acres of impervious surface. Storm water runoff and modifications to the local hydrograph will be controlled primarily through the use of low impact development (LID) best management practices (BMPs) such as bio-strips, bio-swales, and shallow vegetated detention basins that rely on infiltration and dispersion. In addition, where feasible, Caltrans will install and maintain traction sand traps within drain inlets along the roadway to reduce sediment delivery to Outlet Creek HSA.

18. If Caltrans uses Oil Well Hill as a borrow site for fill material, the modifications to the roadside area will allow room for additional post-construction treatment BMPs. Therefore, additional storm water treatment would be provided by treating existing Highway 101 storm water runoff.

Project Schedule

19. The proposed activities associated with the bypass project are scheduled to begin in the fall of 2010 with the projected completion of the first phase of the project near the end of 2015. The proposed project will be conducted year round; however, work within jurisdictional streams will only occur within summer months during low flow conditions from the period of June15th to October 15th. The entire project is expected to take four to five years to complete.

Federal and State Regulatory Compliance

20. Caltrans has applied for authorization from the U.S. ACE to conduct the project under an individual Department of the Army permit pursuant to the CWA, section 404. Caltrans has applied to the CDFG for a 1602 Lake and Streambed Alteration Agreement. Additionally, Caltrans has sought formal consultation and obtained Biological Opinions from the U.S. FWS and the NMFS. On October 25, 2006, Caltrans certified a Final Environmental Impacts Statement / Environmental Impact Report (FEIS/EIR - State Clearing House No. 1990030006) for the project in order to comply with the National Environmental Policy Act (NEPA) and California Environmental Quality Act (CEQA). On December 15, 2006, Caltrans filed a Notice of Determination (NOD) for the proposed project. On December 18, 2006, Caltrans filed a Record of Decision (ROD) for the proposed project. A Supplemental Environmental Impact Report (EIR) was prepared pursuant to CEQA. The draft report was signed on November 15, 2009. Comments were received during the circulation period, which ended January 19, 2010. The Final Supplemental EIR was completed in May 2010, with potential impacts to NCSG determined to be less than significant after mitigation.

Total Maximum Daily Loads and Compliance with Water Quality Standards

21. The Eel River watershed is listed on the Clean Water Act section 303(d) list as impaired for sediment and temperature. In 2004, the U.S. EPA established sediment TMDLs for the Upper Main Eel River and tributaries (including Tomki Creek, Outlet Creek and Lake Pillsbury). Roads are a significant source of sediment in the watershed (directly, from surface erosion, and, indirectly, by triggering landslides). In addition, activities that impact the riparian zone and reduce riparian vegetation are identified as sources contributing to increased stream temperatures. A focus on measures to reduce sediment discharges to surface waters from roads in the watershed, and measures to avoid, minimize, and mitigate impacts on riparian zones is essential for achieving TMDL compliance.

22. Pursuant to Regional Water Board Resolution R1-2004-0087, *Total Maximum Daily Load Implementation Policy Statement for Sediment-Impaired Receiving Waters within the North Coast Region* (Sediment TMDL Implementation Policy), the Executive Officer is directed to "rely on the use of all available authorities, including existing regulatory standards, and permitting and enforcement tools to more effectively and efficaciously pursue compliance with sediment-related standards by all dischargers of sediment waste."

23. To ensure compliance with sediment, temperature and other related Water Quality Objectives within the Basin Plan, and consistent with the U.S. EPA-established TMDLs, adequate wetland and riparian protection and stringent requirements to avoid, minimize, and mitigate the sediment and temperature impacts associated with the proposed project will be incorporated as enforceable conditions this Water Quality Certification. In addition, Caltrans will be required to conduct surface water monitoring, sampling, and analysis in accordance with the conditions of the Water Quality Certification. Additionally, storm water runoff monitoring, sampling, and analysis will be conducted as required by the State Water Resources Control Board (SWRCB) National Pollutant Discharge Elimination System (NPDES) Permit for Storm Water Discharges from the State of California, Department of Transportation (Caltrans) Properties, Facilities and Activities Order No. 99 – 06 - DWQ. The surface water data collected will be utilized to assess the adequacy of BMPs during construction as well as site specific mitigation measures proposed to minimize impacts to the environment, including sediment and temperature impacts.

24. The federal antidegradation policy requires that state water quality standards include an antidegradation policy consistent with the federal policy. The State Water Board established California's antidegradation policy in State Water Board Resolution No. 68-16. Resolution No. 68-16 incorporates the federal antidegradation policy where the federal policy applies under federal law. Resolution No. 68-16 requires that existing quality of waters be maintained unless degradation is justified based on specific findings. The Regional Water Board's Basin Plan implements, and incorporates by reference, both the State and federal antidegradation policies. This Order is consistent with applicable federal and State antidegradation policies, as it does not authorize the discharge of increased concentrations of pollutants or increased volumes of treated wastewater, and does not otherwise authorize degradation of the waters affected by this project.

California Environmental Quality Act

25. On October 25, 2006, Caltrans certified the FEIS/EIR (State Clearing House No. 1990030006) for the project in order to comply with the NEPA and CEQA. On December 15, 2006, Caltrans filed a NOD for the proposed project. On December 18, 2006, Caltrans filed a ROD for the proposed project. The Final Supplemental

EIR for NCSG was completed in May 2010. As a Responsible Agency, the Regional Water Board complies with CEQA by considering the FEIS/FEIR prepared by the Lead Agency (Caltrans) and by reaching its own conclusions on whether and how to approve the project involved. (Cal. Code Regs, tit. 14, § 15096.) The Regional Water Board has considered the FEIS/FEIR and any proposed changes incorporated into the project or required as a condition of approval to avoid significant effects to the environment. The Regional Water Board's conclusions on the FEIS/FEIR and findings for impacts to resources within the jurisdiction of the Regional Water Board are included in Attachment 2 to this Water Quality Certification and incorporated herein.

Receiving Waters:	Wetlands, Haehl Creek, Baechtel Creek, Broaddus Creek, Mill Creek, Outlet Creek, Upp Creek, and Ryan Creek Eel River Hydrologic Unit No.111.00 Outlet Creek Hydrologic Sub-Area No. 111.61
Filled or Excavated Areas:	Permanent - wetlands: 53.89 acres Permanent - streams and ponds: 2.34 acres Permanent - riparian areas: 10.88 acres Temporary - wetlands: 29.88 acres Temporary - streams and ponds: 3.16 acres Temporary - riparian areas: 10.12 acres
Total Linear Impacts:	Permanent - wetlands: 20,222 linear ft (2.83 miles) Permanent - streams and ponds: 3,161 linear ft (0.6 miles) Permanent - riparian areas: 8,535 linear ft (1.62 miles) Temporary - wetlands: 21,463 linear ft (4.07 miles) Temporary - streams and ponds: 9,255 linear ft (1.75 miles) Temporary - riparian areas: 6,693 linear ft (1.27 miles)
Dredge Volume :	None
Fill Volume :	Permanent - wetlands: 358,083 cubic yards Permanent - streams and ponds: 15,099 cubic yards Permanent - riparian areas: 72,846 cubic yards Temporary - wetlands: 167,682 cubic yards Temporary - streams and ponds: 20,581 cubic yards Temporary - riparian areas: 67,764 cubic yards

Latitude/Longitude:	39.3752 N/123.3249 W (Southern Interchange) 39.4392 N/123.2563 W (Northern Interchange)
Expiration:	This Water Quality Certification authorizes dredge and fill activities for ten years following the date of issuance or until the U.S. ACE CWA Section 404 permit expires. If this Water Quality Certification Expires and the project does not comply with the proposed application, findings, and conditions of this Order, the Regional Water Board may enroll the project in the appropriate regulatory tool as determined by the Executive Officer. Conditions and monitoring requirements outlined in this Order are not subject to the expiration date outlined above, and remain in full effect and are enforceable.

ACCORDINGLY, BASED ON ITS INDEPENDENT REVIEW OF THE RECORD, THE REGIONAL WATER BOARD CERTIFIES THAT THE Caltrans – Highway 101 – Willits Bypass Project, WDID No. 1B10019WNME, as described in the application will comply with sections 301, 302, 303, 306 and 307 of the Clean Water Act, and with applicable provisions of state law, provided that Caltrans complies with the requirements and conditions specified in this certification and the activity being limited and all proposed mitigation being completed in compliance with the applicant's project description, as set forth in the application and applicable documents received by the Regional Water Board from Caltrans. Discharges from these projects are also regulated under the State Water Resources Control Board Order No. 2003-0017-DWQ, "Statewide General Waste Discharge Requirements for Dredge or Fill Discharges That Have Received State Water Quality Certification," which requires compliance with all conditions of this Order.

STANDARD CONDITIONS

1. This certification action is subject to modification or revocation upon administrative or judicial review; including review and amendment pursuant to Water Code section 13330 and title 23, California Code of Regulations, section 3867.

2. This certification action is not intended and shall not be construed to apply to any discharge from any activity involving a hydroelectric facility requiring a Federal Energy Regulatory Commission (FERC) license or an amendment to a FERC license unless the pertinent certification application was filed pursuant to title 23, California Code of Regulations, section 3855, subdivision (b) and the application specifically identified that a FERC license or amendment to a FERC license for a hydroelectric facility was being sought.

3. The validity this certification is conditioned upon total payment of any fee required under title 23, California Code of Regulations, section 3833, and owed by the application.

4. Except as may be modified by any preceding conditions, all certification actions are contingent on: a) the discharge being limited, and all proposed revegetation and mitigation being completed, in strict compliance with the applicant's project description, as approved herein, and b) compliance with all applicable water quality requirements and water quality control plans including the requirements of the Basin Plan, and amendments thereto.

COMPENSATORY MITIGATION CONDITIONS

5. Caltrans shall submit plans and reports to the satisfaction of the Executive Officer of the Regional Water Board by all dates and time frames detailed in this Order, unless an exception is granted by the Executive Officer, or all bypass construction activities shall cease and desist, until the Regional Water Board authorizes operations.

6. Caltrans is ultimately responsible for the success of all mitigation performance standards, success criteria, and long term management actions.

7. Caltrans shall mitigate the project impacts by implementing the Caltrans-prepared *Final Mitigation and Monitoring Proposal (Final MMP)*, adopted June 8, 2010. At a minimum, the mitigation shall result the enhancement of approximately 1,011 acres of existing wetlands, the creation of 24 acres, the preservation of 53 acres for a total of approximately 1,088 of wetlands to be secured in perpetuity. In addition, Caltrans must mitigate impacts to riparian areas (waters of the State) by creating 47.57 acres, enhancing 48.51 acres, and securing in perpetuity 104 acres. Additionally the mitigation must enhance 27.58 acres and preserve 24.5 acres of waters of the U.S. and State.

8. At least 90 days prior to conducting any channel- ground- or vegetation-disturbing activities associated with bypass construction and no later than December 31, 2010; Caltrans shall acquire by fee title, easement, or deed restriction and permanently preserve all the mitigation lands identified in the Final MMP, dated June 8, 2010. Caltrans must maintain the properties to prohibit any owner/occupier of property to be used for mitigation from using that land, or allowing activities on the land that would interfere with the use of the property as mitigation including dredging, filling, modifying drainage patterns, or removing any vegetation within waters of the State, including riparian areas.

9. Caltrans shall submit a restoration work plan for the erosion sites identified in Appendix J of the final MMP, to the Executive Officer of the Regional Water Board for review, consideration, and concurrence by April 30, 2012. The restoration plan shall include the following locations and shall have work completed by October 15, 2012:
   - Outlet Creek (108-010-06);
   - Outlet Tributary (108-030-04;
   - Berry Creek tributaries (108-070-04); and
   - Davis Creek tributaries (108-070-13).

   The erosion site restoration work plan shall be submitted to the, U.S. ACE, CDFG, and the Executive Officer of the Regional Water Board for prior review, consideration, and concurrence. The restoration plans shall include:
   - Existing functions and conditions (wetted channel width, pool/riffle ratio, mean/maximum depths, complexity, shade/cover);
   - List and plot of native species to be planted, density of plantings;
   - Detailed design plans and cross-sections;
   - Restoration methods and materials; and
   - Water diversion plans (if necessary).

10. Caltrans must implement the monitoring and reporting program (MRP) set forth in Attachment 3. The MRP is designed to collect data and provide reports that assess the biological, chemical, physical conditions of resources within the jurisdiction of the Regional Water Board for both the bypass footprint alignment and the associated mitigation lands. The required technical reports outlined in the MRP are necessary for the Regional Water Board to appropriately determine whether or not the project will adequately comply with the Basin Plan and all applicable Water Quality Standards and provide the mitigation necessary to compensate for the impacts to jurisdictional resources. The results of the monitoring requirements outlined in the MRP shall be used to develop performance standards and success criteria for the on-site repair areas (bypass alignment) and the off-site mitigation lands. Additionally, the data will be used to demonstrate the enhancement and protection of beneficial uses and long term TMDL implementation for the receiving waters with the Outlet Creek HSA. The baseline reports are due to the Regional Water Board by January 31, 2012. In addition, the revised MMP including revised management plans shall submitted to the Executive Officer of the Regional Water Board by April 30, 2012, for review, consideration, and concurrence. Caltrans may request revisions to the MRP by submitting a plan to the Executive Officer of the Regional Water Board for review, consideration, and concurrence.

11. Subsequent to obtaining baseline information on the mitigation parcels, and no later than April 30, 2012, Caltrans shall submit a revised grazing management plan to the Executive Officer of the Regional Water Board for review, consideration, and concurrence. If it is determined by Regional Water Board staff that the grazing practices are not implemented in accordance with the approved management plan and pose a potential threat to water quality the Regional Water Board will adopt Individual Waste Discharge Requirements (WDRs) for the short term and long term grazing practices under Porter-Cologne Water Quality Control Act authority.

12. Herbicides and pesticides shall not be used on the bypass or mitigation parcels. If Caltrans or the long term manager has a compelling case as to why herbicides and pesticides should be used, they may submit a plan to the Regional Water Board for Executive Officer review, consideration, and concurrence.

13. Caltrans shall provide detailed designs and implementation schedule for the Ryan Creek Fish Passage projects. Final plans will be prepared and submitted to the Executive Officer of the Regional Water Board for review and concurrence no later than June 30, 2012. Caltrans shall complete construction of the South Fork Ryan Creek culvert project no later than October 15, 2013.

14. At least 90-days prior to initiating channel- ground- or vegetation-disturbing activities on Oil Well Hill, Caltrans shall submit the following information to the Executive Officer of the Regional Water Board for review, consideration, and concurrence:

    a) A geotechnical report on the site specific hydrology and geology of the Oil Well Hill borrow area. The report shall identify potential hazards and corrective actions in regards to slope stability, ground water interception, and the potential for mass wasting;
    b) A site specific land restoration/reclamation plan;
    c) A surface water monitoring plan to address storm water runoff discharges to and from waters of the State, and any potentially new waters of the State (springs or seeps) that may develop as a result of excavation or any activities on Oil Well Hill.
    d) A revised risk level assessment for the entire project (Oil Well Hill, bypass alignment, and mitigation sites).

    If it is determined by Regional Water Board staff that the reclamation/restoration activities are not implemented in accordance with the approved plan and pose a potential threat to water quality, the Regional Water Board will adopt individual WDRs under Porter-Cologne Water Quality Control Act authority.

15. At least 90 days prior to conducting any channel- ground- or vegetation-disturbing activities Caltrans shall:

    a) Appoint an appropriate land manager that is approved by the Executive Officer of the Regional Water Board.
    b) Obtain the land manager's concurrence with the final MMP and associated management plans.
    c) Recalculate the Property Analysis Record (PAR) and long term endowment to include all the conditions of this Order, projected changes to the short term and long term management plans for long term manager approval.

16. The land manager shall comply with all conditions within this Order and shall submit confirmation to the Regional Water Board that they approve the final MMP and any future modifications thereto, including but not limited to: associated plans; PAR; long term endowment; and acceptance of all conditions of this Order. Any revisions or modifications to the final MMP (e.g. work plan, grazing plan, long term management plan, adaptive management actions or plans, stream alteration plans or actions, and flood control plans or actions) shall cause an open review period of the PAR and endowment and shall be approved by the land manager. The open review period allows the land manager and Caltrans to revisit the PAR and endowment to ensure the revised mitigation actions are appropriately funded. In addition, any change in the PAR, endowment or final MMP shall be submitted to the U.S. ACE, CDFG, and the Executive Officer of the Regional Water Board for review, consideration, and concurrence.

17. Mitigation and monitoring requirements outlined in this Order are not subject to an expiration date, and remain in full effect and are enforceable.

GENERAL CONDITIONS

All conditions of this order apply to Caltrans (and all its employees) and all contractors (and their employees), sub-contractors (and their employees), the land manager, and any other entity or agency that performs activities or work on the project (including the off-site mitigation lands) as related to this Water Quality Certification.

18. This Water Quality Certification covers the construction of Phase I only.

19. All conditions required by this Order shall be included in the Plans and Specifications prepared by Caltrans for the Contractor. In addition, Caltrans shall require compliance with all conditions included in this Order in the bid contract for this project and the worker training program requirement per Condition 27 below.

20. Caltrans shall construct the project in accordance with the project described in the application and the findings above, and shall comply with all applicable water quality requirements and Water Quality Standards as detailed in the Basin Plan.

21. Any change in the design or implementation of the project that would have a significant or material effect on the findings, conclusions, or conditions of this Order must be submitted to the Executive Officer of the Regional Water Board for prior review, consideration, and concurrence.

22. At least 90 days before initiating channel- ground- or vegetation-disturbing activities associated with construction, Caltrans shall submit to the Regional Water Board a technical analysis of the proposed haul road(s) and demonstrate that the contractor's proposal will not impact the 100-year floodplain. All temporary bridges, culverts, haul roads, or other structures that will remain in place after October 15 shall be designed to pass the 100-year flood event. Structures and materials not designed to withstand high flows or 100-year flood shall be removed from the floodplain prior to October 1st and the associated areas shall be appropriately stabilized to prevent erosion and sediment discharges to "Waters of the State".

23. Caltrans shall provide a copy of this Order, associated attachments, and State Water Resources Control Board (SWRCB) Order No. 2003-0017-DWQ to the contractor, all subcontractors, and all utility companies conducting the work, and require that copies remain in their possession at the work site. Caltrans shall be responsible for work conducted by its employees, contractors, subcontractors, utility companies, and land manager.

24. The Regional Water Board shall be notified in writing each year at least five working days (working days are Monday – Friday) prior to the commencement of ground disturbing activities, major concrete pours, dewatering activities, or water diversion activities with details regarding the construction schedule, in order to allow Regional Water Board staff to be present on-site during installation and removal activities, and to answer any public inquiries that may arise regarding the project. Caltrans shall provide Regional Water Board staff access to the project site to document compliance with this order.

25. Caltrans shall provide monthly updates and coordinate with the City of Willits on their construction schedule of work to avoid conflicts with the WWTP during construction and to avoid potential cumulative impacts.

26. The Resident Engineer (or appropriately authorized agent) shall hold on-site water quality permit compliance meetings (similar to tailgate safety meetings) to discuss permit compliance, including instructions on how to avoid violations and

procedures for reporting violations. The meetings shall be held at least every other week, before forecasted storm events, and when a new contractor or subcontractor arrives to begin work at the site. The contractors, subcontractors and their employees, as well as any inspectors or monitors assigned to the project, shall be present at the meetings. Caltrans shall maintain dated sign-in sheets for attendees at these meetings, and shall make them available to the Regional Water Board on request.

27. Caltrans shall conduct an environmental awareness and compliance training program for all contractors, sub-contractors and Caltrans staff working on the project and shall be approved by the Executive Officer of the Regional Water Board. The training program shall present the environmental regulations and various permit conditions that Caltrans, the contractors, and land manager shall comply with and the applicable measures established for the project to minimize impacts to water quality and avoid sensitive resources, habitats, and species. The training program shall be conducted at least once annually during the construction of the bypass, and is required for all employees, contractors, sub-contractors, and other entities prior to performing any work or monitoring activities on the project. The training program must emphasize that Caltrans and the contractors are legally liable for compliance with all environmental regulations and permit conditions. In addition, the training program must emphasize a clear understanding of all applicable permits and conditions thereof. Caltrans shall prepare and distribute wallet-sized cards or a fact sheet handout containing this information for workers to carry on-site. Upon completion of the program, employees shall sign a form stating they attended the program and understand all protection measures. These forms shall be filed at the worksite offices and be available to Regional Water Board staff upon request.

28. Pursuant to its authority under Section D(2) of the Caltrans Storm Water MS4 permit, the Regional Water Board hereby requires Caltrans to conduct a risk determination in accordance with the State Water Resources Control Board (SWRCB) Construction General Permit (CGP) Order No. 2009-0009-DWQ for the entire area of the bypass and the mitigation sites. In addition, Caltrans shall submit the Storm Water Pollution Prevent Plan (SWPPP) in an electronic format using the Storm Water Multi-Application Reporting and Tracking System (SMARTS). http://smarts.waterboards.ca.gov/. Risk determination shall include the time frame (i.e. number of years) that will be required to completely construct the bypass. Caltrans shall submit the SWPPP, including the risk level determination(s) 30 days prior to initiating channel- ground- or vegetation-disturbing activities.

29. If the contractor elects to use Oil Well Hill as a borrow site, Caltrans shall recalculate the risk determination to fully include the borrow site and the entire area of the bypass, and the mitigation sites in the risk analysis. In addition, the risk

determination shall include the time frame, in years that will be required to completely construct the bypass and fully (to the satisfaction of the Regional Water Board) complete reclamation on Oil Well Hill. Additionally, if the Oil Well Hill site is used then Caltrans shall develop and install the appropriate post-construction storm water treatment measures along existing Highway 101 to the maximum extent practicable (MEP).

30. All activities and best management practices (BMPs) shall be implemented according to the submitted application and the conditions in this Order. BMPs for erosion, sediment, turbidity and pollutant control shall be implemented and in place at commencement of, during, and after any ground clearing activities, construction activities, or any other project activities that could result in erosion, sediment, or other pollutant discharges to waters of the State. The BMPs shall be implemented in accordance with the Caltrans Construction Site Best Management Practice Manual (CCSBMPM) and all contractors and subcontractors shall comply with the CCSBMPM. In addition, BMPs for erosion and sediment control shall be utilized year round, regardless of season or time of year. Caltrans shall stage erosion and sediment control materials at the work site. All BMPs shall be installed properly and in accordance with the manufacturer's specifications. If the project Resident Engineer elects to install alternative BMPs for use on the project, Caltrans shall submit a proposal to Regional Water Board staff for review and concurrence.

31. Caltrans shall prioritize the use of wildlife-friendly biodegradable (not photo-degradable) erosion control products wherever feasible. Caltrans shall not use or allow the use of erosion control products that contain synthetic netting for permanent erosion control (i.e. erosion control materials to be left in place for two years or after the completion date of the project). If Caltrans finds that erosion control netting or products have entrapped or harmed wildlife, personnel shall remove the netting or product and replace it with wildlife-friendly biodegradable products. Caltrans shall not use or allow the use of erosion control products that contain synthetic materials within waters of the United States or waters of the State at any time. Caltrans shall request approval from the Regional Water Board if an exception from this requirement is needed for a specific location.

32. Work in flowing or standing surface waters, unless otherwise proposed in the project description and approved by the Regional Water Board, is prohibited. If construction dewatering of groundwater is found to be necessary, Caltrans shall use a method of water disposal other than disposal to surface waters (such as land disposal) or Caltrans shall apply for coverage under the Low Threat Discharge Permit or an individual National Pollutant Discharge Elimination System (NPDES) Permit and receive notification of coverage to discharge to surface waters, prior to the discharge.

33. Caltrans is prohibited from discharging waste to waters of the State, unless explicitly authorized by this Order. For example, no debris, soil, silt, sand, bark, slash, sawdust, rubbish, cement or concrete or concrete washings, welding slag, oil or petroleum products, or other organic or earthen material from any construction or associated activity of whatever nature, other than that authorized by this Order, shall be allowed to enter into waters of the State. In addition, none of the materials listed above shall be placed within 150 linear feet of waters of the State or where the materials may be washed by rainfall into waters of the State.

34. Herbicides and pesticides shall not be used on the bypass. If Caltrans has a compelling case as to why herbicides and pesticides should be used, they may submit a request along with a BMP plan to the Executive Officer of the Regional Water Board for review, consideration, and concurrence.

35. Caltrans shall submit, subject to approval by the Regional Water Board staff, a dewatering and/or diversion plan that appropriately describe the dewatered or diverted areas and how those areas will be handled during construction. The diversion/dewatering plans shall be submitted no later than 30 days prior to conducting the proposed activity. Information submitted shall include the area or work to be diverted or dewatered and method of the proposed activity. All diversion or dewatering activities shall be designed to minimize the impact to waters of the State and maintain natural flows upstream and downstream. All dewatering or diversion structures shall be installed in a manner that does not cause sedimentation, siltation or erosion upstream or downstream. All dewatering or diversion structures shall be removed immediately upon completion of project activities. The in-channel work within fish-bearing streams will only be conducted between June 15th and October 15th. This Water Quality Certification does not authorize Caltrans to draft surface waters.

36. Fueling, lubrication, maintenance, storage and staging of vehicles and equipment shall be at least 150 linear feet beyond of waters of U.S. and the State with the exception of cranes and stationary equipment which shall only be refueled using a company certified by the CDFG. Proper certification and documentation of fueling (field logs) shall be provided to the Regional Water Board upon request. The Regional Water Board shall provide concurrence with each fueling location prior to fueling equipment within waters of the State. Fueling, lubrication, maintenance, storage and staging of vehicles and equipment shall not result in a discharge or a threatened discharge to any waters of the State or the U.S. At no time shall Caltrans or its contractors allow use of any vehicle or equipment, which leaks any substance that may impact water quality.

37. If, at any time, an unauthorized discharge to surface water (including wetlands, rivers or streams) occurs, or any water quality problem arises, the associated

project activities shall cease immediately until adequate BMPs are implemented. The Regional Water Board shall be notified promptly and in no case more than 24 hours after the unauthorized discharge or water quality problem arises.

38. Caltrans shall implement appropriate BMPs to prevent the discharge of equipment fluids to the stream channel. The minimum requirements will include: storing hazardous materials at least 150 linear feet outside of the stream banks; checking equipment for leaks and preventing the use of equipment with leaks; pressure washing or steam cleaning equipment to remove fluid residue on any of its surfaces prior to its entering any stream channel in a manner that does not result in a discharge to Waters of the State.

39. Spill kits are required at each fueling location and at each location that work will be conducted with streams. If the event of an unauthorized release of fuel (spill or leak) to waters of the State, Caltrans shall immediately stop work and conduct the following measures:

    a) Notify the appropriate agencies including the Regional Water Board, CDFG, and the Office of Emergency Services (OES) at 1(800) 852-7550;
    b) Utilized the appropriate spill kits for containment and clean up of the release;
    c) Collect samples within the release, 50 feet downstream, and downstream to the full extent of the release; and
    d) Analyze samples for total petroleum hydrocarbons as diesel (TPH-D), total petroleum hydrocarbons as gasoline (TPH-G), and benzene, toluene, ethlybenzene, total xylenes (BTEX).

40. The project shall have no more than 17 acres of disturbed soil area (DSA) at any time. Caltrans shall request approval from the Regional Water Board if an exception from this requirement is needed. Request for exceptions must include the locations, size of area, anticipated duration of exposure (e.g. DSA without BMPs), and a location specific rain event action plan (REAP). All disturbed soil areas and exceptions to the 17 acre limit shall be adequately documented in the site specific SWPPP.

41. Caltrans shall establish and clearly define stream setbacks that limit construction activities and prohibit ground disturbing activities within 50 linear feet of streams during the rainy season (October 15th to May 15th). If an exception from this requirement is needed for a specific location, Caltrans shall request approval from the Regional Water Board at least 5 working days in advance. At no time shall in-stream activities be conducted outside the work window of June 15th to October 15th. Exceptions may be granted by the Executive Officer of the Regional Water Board on a case by case review, only if the streams are dry or have minimal flow, and CDFG and NMFS have concurred.

42. If work is allowed within the stream channel or on the banks outside of the above referenced work window, Caltrans shall monitor the seventy-two (72) hour forecast from the National Weather Service. When forecast indicates a probability of precipitation of 50 percent or greater within the 72-hour period, or at the onset of any precipitation, ground disturbing activities shall cease and erosion and sediment control measures shall be implemented to stabilize exposed soils and prevent the mobilization of sediment into the stream channel or adjacent wetland or riparian areas. Caltrans bears full liability should the BMPs employed fail to prevent any discharge to waters of the State that exceeds applicable water quality standards or is beyond the certified area of impact. All earthwork and ground disturbing activities halted due to precipitation may resume when precipitation ceases and a 50 percent or less chance of precipitation is forecast throughout the duration of the subsequent 72-hour weather forecast.

43. Caltrans and their contractor are not authorized to discharge wastewater (e.g., water that has contacted uncured concrete or cement, or asphalt) to surface waters, ground waters, or land. Wastewater may only be disposed of to a sanitary waste water collection system/facility (with authorization from the facility's owner or operator) or a properly-licensed disposal or reuse facility. If Caltrans or their contractor proposes an alternate disposal method, Caltrans or their contractor shall apply for a permit from the Regional Water Board. Plans to reuse or recycle wastewater require written approval from Regional Water Board staff.

44. Any potentially hazardous waste(s) (solids, liquids, or slurries) derived or encountered in this project shall undergo the appropriate characterization to demonstrate compliance will all applicable waste disposal laws and regulations. If unanticipated or anticipated waste are encountered or created during the project, Caltrans shall notify the Regional Water Board immediately and at least within 24 hours. Caltrans or their contractor shall prepare applicable work plans for handling, treating, transporting, and disposing of waste. The work plans shall be prepared and signed by an engineer or geologist with the appropriate and valid California licenses.

45. Caltrans shall provide analysis and verification that placing non-hazardous waste or inert materials (which may include discarded product or recycled materials) will not result in degradation of water quality, human health, or the environment. All project-generated waste shall be handled, transported, and disposed in strict compliance with all applicable State and Federal laws and regulations. When operations are complete, any excess material or debris shall be removed from the work area and disposed of properly and in accordance with the Special Provisions for the project and/or Standard Specification 7-1.13, Disposal of Material Outside the Highway Right of Way. Caltrans shall submit to the Regional Water Board the

satisfactory evidence provided to the Caltrans Engineer by the Contractor referenced in Standard Specification 7-1.13. In accordance with State and Federal laws and regulations, Caltrans is liable and responsible for the proper disposal of waste generated by their project.

46. Wastewater from invasive species control and equipment washing must be disposed of at an appropriately permitted facility or comply with the proper NPDES requirements for discharges. Wastewater from vehicle cleaning will not be allowed for on-site use for any purposes (e.g. dust control) unless Caltrans can demonstrate to the satisfaction of the Regional Water Board that the wastewater has been adequately treated for potential pollutants and invasive species.

47. All imported fill material shall be clean and free of pollutants. All fill material shall be imported from a source that has the appropriate environmental clearances and permits. The reuse of low-level contaminated solids as fill on-site shall be performed in accordance with all State and Federal policies and established guidelines and must be submitted to the Regional Water Board for review and concurrence.

48. Only clean washed spawning gravel (0.5” – 4”) with a cleanliness value of at least 85, using the Cleanness Value Test Method for California Test No. 227 will be placed in the streams. Gravel bag fabric shall be nonwoven polypropylene geotextile (or comparable polymer) and shall conform to the following requirements:
    - Mass per unit area, grams per square meter, min ASTM Designation: D 5261 – 270
    - Grab tensile strength (25-mm grip), kilonewtons, min. ASTM Designation: D4632* 0.89
    - Ultraviolet stability, percent tensile strength retained after 500 hours, ASTM Designation: D4355, xenon arc lamp method 70 or appropriate test method for specific polymer
    - Gravel bags shall be between 600 mm and 800 mm in length, and between 400 mm and 500 mm in width.
    - Yarn used in construction of the gravel bags shall be as recommended by the manufacturer or bag supplier and shall be of a contrasting color. Gravel shall be between 0.5” – 4” in diameter, and shall be clean and free from clay balls, organic matter, and other deleterious materials. The opening of gravel-filled bags shall be secured to prevent gravel from escaping. Gravel-filled bags shall be between 13 kg and 22 kg in mass.

If an exception from this requirement is needed for a specific location, Caltrans may request that the Executive Officer of the Regional Water Board consider and approve the exception.

49. Caltrans shall retain a dedicated Water Quality Monitor to be on-site daily and document compliance with all applicable water quality requirements. At least 30 days before initiating channel- ground- or vegetation-disturbing activities, Caltrans shall submit to the Regional Water Board in writing the name, qualifications, and contact information for the designated water quality monitor(s). The water quality monitor(s) shall be knowledgeable of and have experience with the Basin Plan, and surface water monitoring procedures, protocols, quality assurance, and quality control protocols. The water quality monitor(s) shall be responsible for monitoring Project activities and/or channel- ground- or vegetation disturbing activities that result in or have the potential to result in a discharge to waters of the State.

50. The water quality monitor shall be on-site daily while project activities including all pile installation, dewatering, channel- vegetation- or ground-disturbing activities that may affect water quality to: (1) document compliance with water quality standards and conditions of this Order; (2) record the results of all required surface water monitoring; (3) evaluate the effectiveness of BMPs, mitigation measures, and avoidance measures; (4) alert key construction staff of precipitation forecasts; and (5) make stop work recommendations for activities that results in or may result in violations of this Order. The water quality monitor(s) shall prepare daily written observation and inspection records summarizing: oversight activities and compliance inspections; recommendations; monitoring and sampling results; and discharges.

51. Surface water monitoring shall be conducted whenever a project activity is conducted within waters of the State (e.g. demolition, pier construction, stream diversions). Surface water monitoring shall be conducted when any project activity has, or has the potential to, mobilize sediment and/or alter background conditions within waters of the State. In order to demonstrate compliance with receiving water limitations and applicable Water Quality Standards, field measurements shall be collected whenever a project activity may alter background conditions.

52. Caltrans in conjunction with the water quality monitor shall establish effluent, upstream (background) and downstream monitoring locations to demonstrate compliance with all applicable water quality requirements, and Water Quality Objectives as detailed in the Basin Plan. The downstream location shall be no more than 50 feet from the effluent location. Field measurements shall be taken from each location four times daily for flow, pH, temperature, dissolved oxygen, total dissolved solids, turbidity and specific conductance. In addition, visual observations shall be made four times daily and include the appearance of the

discharge including color, turbidity, floating or suspended matter or debris, appearance of the receiving water at the point of discharge (occurrence of erosion and scouring, turbidity, solids deposition, unusual aquatic growth, etc), and observations about the receiving water, such as the presence of aquatic life. Measurements shall be collected from each sampling location four times daily while work is being conducted within waters of the State. Prior to conducting any and all monitoring and sampling activities required by this Water Quality Certification, Caltrans shall develop the proper Quality Assurance Project Plan (QAPP) to ensure the data gathered is valid and will be reliable for statistical evaluation.

53. Whenever, as a result of project activities, downstream measurements exceed the following Water Quality Objectives, appropriate measurements shall be collected from all monitoring locations every hour during the period of increase, and shall continue until measurements demonstrate compliance with receiving water limitations and the water quality parameters are no longer increasing as a result of project activities.

pH	<6.5 or >8.5 (any changes >0.5 units)
temperature	>0.5^{o}F above background
dissolved oxygen	<7 milligrams per liter (mg/L)
total dissolved solids	>125 mg/L
turbidity	20% above natural background
specific conductance	>200 micromhos @ 77°F

If any measurements are beyond the water quality objectives 50 feet downstream of the source(s), all necessary steps shall be taken to install, repair, and/or modify BMPs to control the source(s). In addition, the overall distance from the source(s) to the downstream extent of the exceedance shall be measured.

Monitoring results shall be reported to appropriate Regional Water Board staff person by telephone within one hour of taking any measurements that exceed the limits detailed above (turbidity only if it is higher than 20 NTU as well). Upstream and downstream pictures within the working and/or disturbed area shall be taken and submitted to the appropriate Regional Water Board staff via e-mail or fax within 24 hours of the incident. All other monitoring data shall be reported on a monthly basis and is due to the Regional Water Board by the 15th of the following month.

54. Monthly Monitoring Reports: shall be submitted to the Executive Officer of the Regional Water Board. The monthly monitoring reports shall include at a minimum a summary of discharges, a summary of corrective actions taken (if necessary), photographs, all field sampling measurements and/or results, project status (i.e.

upcoming construction schedule and disturbed soil area updates), water quality monitor reports and field logs, water quality monitor reports and field logs, and all field monitoring equipment calibration logs. Caltrans shall develop, and Regional Water Board shall approve, a data management and reporting system to efficiently and effectively report sampling and monitoring data. Monthly monitoring reports are due to the Regional Water Board by the 15th of each month once work on the project has been initiated.

55. Rainy Day Reports: Caltrans shall take photos of all areas disturbed by project activities, including all excess materials disposal areas, after rainfall events that generate visible runoff from these areas in order to demonstrate that erosion control and revegetation measures are present and have been installed appropriately and successfully. A brief report containing these photos shall be submitted within 30 days of the rainfall event that generated runoff from the disturbed areas.

56. Slope Stability Reports: Caltrans shall provide yearly slope evaluation and erosion control monitoring reports for up to 10 years subsequent to the completion of the bypass project. Caltrans shall provide at least 80 percent coverage of established erosion control of all exposed areas along the bypass. To ensure the reduction of sediment transport into the Outlet Creek HSA, Caltrans shall conduct inspections prior to and subsequent to each rainy season up to 10 years after completion of the bypass. Reports shall include, at a minimum, the following information: name and title of personnel conducting monitoring and/or maintenance; observation dates; site photographs; maps including percent coverage of established erosion control and revegetation efforts; and an erosion evaluation. If the new bypass project has slope failures, excessive erosion, or causes other water quality degradation corrective actions will be required to mitigate the impacts. Established erosion control is vegetation growth, not applied erosion control product.

57. Annual Status Reports: Caltrans shall provide the Regional Water Board with an Annual Status Report no later than January 31 of every year beginning with issuance of this Order and continuing until the Regional Water Board accepts the Final Mitigation Report. Each annual report shall include, at a minimum: 1) a summary of all monitoring reports identified in this Order; 2) a general description of the status of the project site and project activities, including actual or projected completion dates, if known; 3) a summary of the annual mitigation monitoring reports and the current implementation status of each mitigation measure; 4) an assessment of the effectiveness of each completed or partially completed mitigation measure in minimizing and mitigating project impacts; 5) results and an evaluation of the data collected from the SWMRP; 6) Monthly Monitoring and Rainy Day Reports; and 7) A compliance table (spreadsheet) that presents each

condition of this certification, time frame (yearly calendar), project milestones and achievements, all reported discharges, and all violations of this Order.

58. Final Mitigation Report: No later than 90 days after completion of the project, including completion of all mitigation measures, Caltrans shall provide the Regional Water Board with a Final Mitigation Report. The Final Mitigation Report shall include, at a minimum: 1) a summary of all monthly monitoring reports and annual status reports; 2) copies of all mitigation monitoring reports documenting when success criteria for each of the mitigation measures were achieved; 3) all available information about mitigation measures, data collection for the SWMRP, and projects taken to implement the sediment and temperature TMDL; 4) each yearly compliance calendar; 5) an assessment of the effectiveness of the required measures in minimizing and mitigating project impacts; 6) any recommendations on how mitigation measures might be changed to more effectively minimize impacts to water quality and mitigate the impacts of future projects; 7) a final long term management plan; 8) revised PAR and endowment calculation approved by the long term manager; and 9) any other pertinent information.

59. In the event of any violation or threatened violation of the conditions of this Order, the violation or threatened violation shall be subject to any remedies, penalties, process or sanctions as provided for under applicable state or federal law. For the purposes of section 401(d) of the Clean Water Act, the applicability of any state law authorizing remedies, penalties, process or sanctions for the violation or threatened violation constitutes a limitation necessary to assure compliance with the water quality standards and other pertinent requirements incorporated into this Order. In response to a suspected violation of any condition of this certification, the State Water Board may require the holder of any federal permit or license subject to this Order to furnish, under penalty of perjury, any technical or monitoring reports the State Water Board deems appropriate, provided that the burden, including costs, of the reports shall bear a reasonable relationship to the need for the reports and the benefits to be obtained from the reports. In response to any violation of the conditions of this Order, the Regional Water Board may add to or modify the conditions of this Order as appropriate to ensure compliance.

60. The Regional Water Board may add to or modify the conditions of this Order, as appropriate, and to implement any new or revised Water Quality Standards and implementation plans adopted or approved pursuant to the Porter-Cologne Water Quality Control Act or section 303 of the Clean Water Act.

61. This Order is not transferable. In the event of any change in control of ownership of land presently owned or controlled by Caltrans, Caltrans shall notify the successor-in-interest of the existence of this Order by letter and shall forward a copy of the letter to the Regional Water Board. The successor-in-interest must

send to the Regional Water Board Executive Officer a written request for transfer of this Order to discharge dredged or fill material under this Order. The request must contain the following:

a. requesting entity's full legal name
b. the state of incorporation, if a corporation
c. address and phone number of contact person
d. description of any changes to the project or confirmation that the successor-in-interest intends to implement the project as described in this Order.

62. This Water Quality Certification authorizes dredge and fill activities for ten years following the date of issuance or until the U.S. ACE CWA Section 404 permit expires. If this Water Quality Certification Expires and the project does not comply with the proposed application, findings, and conditions of this Order, the Regional Water Board may enroll the project in the appropriate regulatory tool as determined by the Executive Officer. Conditions and monitoring requirements outlined in this Order are not subject to the expiration date outlined above, and remain in full effect and are enforceable.

63. Please contact our staff Environmental Specialist / Caltrans Liaison Jeremiah Puget of at (707) 576-2835 or jpuget@waterboards.ca.gov if you have any questions.

_____

Catherine Kuhlman
Executive Officer

100806_JJP_CDOT_Hwy101_WillitsBypass_401cert

Attachments:

1. Response to Public Comments
2. CEQA Findings
3. Monitoring and Reporting Program
4. State Water Resources Control Board Order No. 2003-0017 -DWQ, General Waste Discharge Requirements for Dredge and Fill Discharges That Have Received State Water Quality Certification

Original sent to: Mr. Jeremy Ketchum, Caltrans, 2800 Gateway Oaks Drive, Sacramento, CA 95833

Copies sent to:

Ms. Jane Hicks, U.S. Army Corps of Engineers, Regulatory Functions,1455 Market Street, San Francisco, CA 94103-1398

Ms. Laurie Monarres, U. S. Army Corps of Engineers, 1455 Market Street, San Francisco, CA 941003

Mr. David Wickens, U. S. Army Corps of Engineers, 1455 Market Street, San Francisco, CA 941003

Mr. Jason Brush, U.S. Environmental Protection Agency, Region 9, 75 Hawthorne Street, San Francisco, CA 94105

Ms. Melissa Scianni, U.S. Environmental Protection Agency, Region 9, 75 Hawthorne Street, San Francisco, CA 94105

Mr. Tom Daugherty, NMFS, 777 Sonoma Avenue, Room 325, Santa Rosa, CA 95404

Mr. Ray Bosch, U.S. Fish & Wildlife Service, 1655 Heindon Road, Arcata, CA 95521

Mr. Craig Martz, California Department of Fish and Game, 601 Locust Street, Redding, CA 96001

Mr. Dave Kelly, Caltrans, P.O. Box 911, Marysville, CA 95901

Mr. Jason Meigs, Caltrans, 2800 Gateway Oaks Drive, Sacramento, CA 95833

CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE
REGION 1 - NORTHERN
619 SECOND STREET
EUREKA, CALIFORNIA, 95501

RECEIVED
SEP 28 2015
CDFW - EUREKA

STREAMBED ALTERATION AGREEMENT
NOTIFICATION NO. 1600-2015-0006-R1
NORTH AND SOUTH FORKS OF RYAN CREEK

CALIFORNIA DEPARTMENT OF TRANSPORTATION
MEN101 NORTH AND SOUTH RYAN CREEK FISH PASSAGE
EA 01-262010; S.R. 101 PMS 52.1 AND 52.5, MENDOCINO COUNTY

This Streambed Alteration Agreement (Agreement) is entered into between the California Department of Fish and Wildlife (CDFW) and the California Department of Transportation (Caltrans) (Permittee) as represented by Mr. Mauricio Serrano.

RECITALS

WHEREAS, pursuant to Fish and Game Code (FGC) Section 1602, Permittee notified CDFW on January 9, 2015, that Permittee intends to complete the Project described herein.

WHEREAS, pursuant to FGC Section 1603, CDFW 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 situated on the North and South Forks of Ryan Creek, tributary to Outlet Creek, tributary to South Fork Eel River, tributary to Eel River, tributary to Pacific Ocean. The Project is located along State Route (SR) 101 between Post Mile (PM) 52.1 and PM 52.5 near Willits in the County of Mendocino; State of California; Section 24 and 25, Township 19 North, Range 14 West, Mt. Diablo Base and Meridian; Willits U.S. Geological Survey 7.5-minute quadrangle.

PROJECT DESCRIPTION

Implementing a Fish Passage Project on Ryan Creek is mandated as a condition of both the CDFW June 2010 Streambed Alteration Agreement (1600-2010-0044-R1), as

amended in March 2014, and the July 2010 Incidental Take Permit (No. 2081-2010-007-01), as amended in March 2014, issued for the Willits Bypass Project. The Agreement and Permit require Caltrans to improve fish passage on two forks of Ryan Creek by remediating barriers to fish passage at SR 101 between PMs 52.1 and 52.5.

The Project will replace two existing 60-inch-diameter corrugated metal pipe (CMP) culverts on the South Fork of Ryan Creek along SR 101 at PM 52.25 with double 120-inch-diameter rammed steel pipe (SP) culverts, and will replace a 60-inch-diameter CMP culvert on the North Fork of Ryan Creek along SR 101 at PM 52.36 with a 12-foot by 10-foot reinforced concrete box (RCB) culvert.

At both the South Fork and North Fork locations, rock weirs are proposed for fish passage and stream grade stability. Materials, including rip rap, native bed material, and clean sand and gravel will be placed in the creeks to provide an engineered streambed that provides fish passage for salmonids and other aquatic species.

To permit access and staging and storing of equipment and supplies, the Project proposes to widen an existing driveway on the west side of SR 101 and relocate several utility power lines and poles. The utility power lines and poles must be moved and the driveway widened to allow access for equipment and storage of materials required to construct the Project (e.g., crane, ramming hammer and adapter, compressor for ramming head, steel pipe segments, welding equipment, pipe, and rock).

Clear water diversion and fish relocation are proposed if needed, as are noxious weed minimization measures and biotechnical erosion control.

South Fork Ryan Creek

At the South Fork Ryan Creek crossing (PM 52.25), the existing 60-inch metal culvert will be replaced with two 10-foot-diameter steel pipes counter sunk to a depth of 42 inches. The new culverts will be aligned side by side to the south of the existing culvert, and installed using a large ramming head that advances the pipe in place without first excavating the road fill prism. Starting at the downstream end (outlet side), the ramming operations will use pneumatic percussive blows (at an estimated 180-580 blows per minute) to drive the 10-foot-diameter steel pipe in 20-foot segments through the fill prism. After a 20-foot segment has been driven, the next 20-foot segment will be welded to the end of the previous segment and then driven through the fill by the ramming head. An Insertion Pit will need to be excavated in the location where the new pipe will outlet to accommodate pipe ramming equipment for 20-foot pipe segments. The area of excavation and vegetation removal needed for the Insertion Pit is estimated at approximately 50 feet long, 29 feet wide and four feet deep (based on notification information and the 2001 U.S. Army Corps of Engineers Technical Report #2001.04 "Guidelines for Pipe Ramming"). Once the culverts have been rammed in place, or between ramming of sections of pipe, bore debris is cleared from the culverts.

The old South Fork Ryan Creek culvert will be filled in place and abandoned, and a new end wall and headwall are proposed at South Fork Ryan Creek. Additionally, five rock weirs are proposed in the outfall section and two rock weirs in the inlet section. These weirs will be constructed to provide no more than an eight-inch rise between each structure. Bank stabilization using willow and root wad revetments is also proposed for South Fork Ryan Creek.

North Fork Ryan Creek

Culvert replacement on the North Fork Ryan Creek (PM 52.36) entails replacing the existing five-foot diameter CMP with a 12-foot span x 10-foot rise reinforced concrete box (RCB) countersunk 24 inches below the streambed. The existing 60-inch culvert will be replaced via cut and cover, where pavement is removed and the existing culvert excavated and replaced in the same alignment. Although the RCB will maintain the existing culvert alignment, the new culvert will extend the facility by approximately 5 feet on the inlet side. The existing headwalls and end-walls will be removed and replaced with wing-walls. At the North Fork crossing there are nine rock weirs proposed in the outfall section, and two rock weirs in the inlet section. These weirs will be constructed to provide no more than an eight-inch rise between structures. The proposal also includes excavation as needed to achieve a minimum pool depth of two feet between rock weirs. Rock slope protection (RSP) may be placed below gravel fill in stream to insure stream grade stability.

PROJECT IMPACTS

Existing fish or wildlife resources the Project could substantially adversely affect include: **California coastal Chinook salmon (*Oncorhynchus tshawytscha*), Southern Oregon-Northern California Coast (SONCC) coho salmon (*O. kisutch*), northern California steelhead (*O. mykis irideuss*),** nesting or migrating riparian-dependent bird species; amphibians, reptiles, aquatic invertebrates, mammals, and other aquatic and riparian species.

The adverse effects the Project could have on the fish or wildlife resources identified above include:

- direct and/or indirect mortality of fish, amphibians and other aquatic species;
- injury to downstream fish and benthic invertebrates and spawning and/or rearing habitats through sediment transport and deposition and/or spills of deleterious materials;
- changes in channel form and contour of bed, bank, or channel;
- temporary increase of sediment and turbidity;
- temporary loss of riparian habitat;
- potential mortality of nesting birds, eggs or young through vegetation removal and construction disturbance; and
- colonization by non-native and/or invasive plants.

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, readily available at the Project site at all times and shall be presented to CDFW 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 in responsible positions 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 CDFW 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, CDFW shall contact Permittee to resolve any conflict.

1.4 Project Site Entry. Permittee agrees that CDFW personnel may enter the Project site at any time to verify compliance with the Agreement.

2. Avoidance and Minimization Measures

To avoid or minimize adverse impacts to fish and other aquatic species, Permittee shall implement each measure listed below.

2.1 Except where otherwise stipulated in this Agreement, all work shall be in accordance with Permittee's notification, including all maps, plans, photographs, drawings, and all other supporting documents submitted as part of the notification and received as of July 20, 2015.

2.2 The Permittee shall instruct all persons who will be completing any ground disturbing activity at the work site to comply with the conditions set forth in this Agreement, and shall inspect each work site before, during, and after completion of any ground-disturbing activity.

2.3 If sightings of ring-tailed cat (*Bassariscus astutus*), Pacific fisher (*Martes pennanti*), or marten (*Martes americana*) are encountered in the course of activities at Project sites, the Permittee shall immediately notify and consult with CDFW to

identify any measures that may be needed to avoid take or minimize adverse impacts to these species.

2.4 Permittee shall perform pre-construction amphibian surveys immediately prior to initiating construction activities. Native amphibian species found within the work area shall be relocated to a suitable habitat area outside of the construction limits. Suitable exclusion measures shall be in place prior to construction to minimize injury or mortality to wildlife.

TIMING

2.5 All work within the bed, bank or channel shall be confined to the period June 15 to October 15 of any year in which this Agreement is valid and the stream is dry or at minimum flow, in accordance with other provisions in this Agreement. Pneumatic ramming blows shall be limited to the period July 15 through October 15, in compliance with all other Agreement measures.

2.6 If weather conditions permit and the stream is dry or at minimum flow, the Permittee may perform work outside of the above referenced work window, provided a written request is made to CDFW at least five (5) days before the proposed work period variance. Written approval from CDFW for the proposed work period variance must be received by the Permittee prior to starting or continuing work outside of the above referenced work window.

2.7 If work is performed within the stream channel or on the banks outside of the above referenced work window, the Permittee shall do all of the following:

a. Stage erosion and sediment control materials at the work site.

b. Monitor the seventy-two (72) hour forecast from the National Weather Service.

c. When the 72-hour forecast indicates a probability of precipitation of 60% or greater, or prior to the onset of any precipitation, ground disturbing activities shall cease and erosion control measures shall be implemented to stabilize exposed soils and prevent the mobilization of sediment into the stream channel or adjacent riparian areas.

2.8 Heavy equipment work shall not occur within 0.25 miles of any suitable habitat for northern spotted between February 1 and July 31. The work window may be advanced prior to July 31 if protocol surveys determine that suitable habitat is unoccupied.

RIPARIAN HABITAT PROTECTION

2.9 Vehicles and equipment shall not be driven or operated in water or where riparian vegetation or aquatic organisms may be destroyed, except as otherwise provided for in this Agreement to complete authorized work.

2.10 Project-related personnel and equipment shall access the Project site using existing designated routes and shall not cross undisturbed ground outside of the Project site. Project-related vehicle traffic shall be restricted to established roads, staging, and parking areas.

2.11 Except where provided for within this Agreement, the removal of riparian vegetation from the streambed or banks is prohibited without prior written approval from CDFW. The work area shall be identified to all workers, as represented in plans.

2.12 Where feasible, hand tools (chain saws, etc.) shall be used to cut or trim woody riparian vegetation. Whenever possible, root systems shall be left intact to facilitate more rapid recovery following temporary construction impacts. No ground disturbance shall occur during any felling or removal of vegetation from October 15 to June 15.

2.13 Removal of existing trees and shrubs shall not exceed the minimum necessary to complete operations, and shall occur after August 31 and before March 1 to the greatest extent feasible to avoid impacts to nesting birds.

2.14 If vegetation must be removed during the nesting season (March 1 to September 1), nest surveys shall be conducted just prior to vegetation clearing, and nesting buffers placed as appropriate prior to, and while, conducting work. Once vegetation is trimmed or removed, repeated hand-cutting of re-growth during the nesting season is permitted as needed to avoid re-growth that may attract nesting birds.

2.15 Permittee shall clearly delineate right-of-way and/or property boundaries of the Project site with fencing, stakes or flags and shall similarly delineate the limits of Project activities. Permittee shall restrict all Project activities to within the fenced, staked or flagged Project boundaries. Permittee shall maintain all fencing, stakes and flags until the completion of Project activities, at which time, Permittee shall remove all flagging and fencing from the site and dispose of it properly.

2.16 Environmentally Sensitive Area (ESA) fencing shall be clearly shown on the Project plans and drawings, and shall be installed prior to any ground or vegetation disturbance. ESA fencing shall consist of temporary orange construction fence or other highly visible material that clearly delineates the limits of the work area. The Permittee shall ensure that the contractor, their

subcontractors, and all personnel working on the Project are instructed on the purpose of the ESA fencing and understand the limits of the work area.

DEWATERING and ISOLATING WORK SITE

2.17 All construction work within the stream channel, bed or bank shall be performed in isolation from surface or subsurface flow.

2.18 Where water is present in the work area, a temporary stream diversion shall be constructed to isolate the work area from water. Temporary diversions may be constructed using small excavated in-channel sumps, gravel berms, clean washed spawning gravels, sand bags, K-rail, plastic sheeting, or a combination of these.

2.19 Temporary diversion techniques shall effectively isolate the work site and prevent or minimize water entering the construction site. Diverted stream flows shall be cleanly bypassed around the work site via pumping or gravity flow using temporary culverts, pipes, or conduits, and cleanly released downstream of the work area.

2.20 Dewatering shall be done in a manner that prevents the discharge of material that could be deleterious to fish, plants or other aquatic life and maintains adequate flows to downstream reaches during all times natural flow would have supported aquatic life

2.21 Pumps and pipes or conduits used to dewater stream reaches shall be screened as follows:

a. Perforated plate: screen openings shall not exceed 3/32 inches (2.38 mm) in diameter.

b. Woven wire: screen openings shall not exceed 3/32 inches (2.38 mm) measured diagonally.

c. Screen material shall provide a minimum of 27% open area.

d. Approach velocity shall not exceed 0.33 feet per second.

2.22 If clean washed spawning gravel (0.5" – 4") is used for diversion berms, it may be left in the channel following construction provided it is spread to a depth less than 6 inches and does not impede the movement of fish or redirect stream flows. All other temporary diversion materials shall be removed from the stream channel upon completion of work.

2.23 The Permittee shall remove any turbid water and sediment present in the work area prior to restoring water flow through the Project Site. Turbid water and

sediment removed from the isolated work area may be used for construction purposes (compaction, dust abatement, etc.) or shall be properly disposed of in an upland area where it will not drain to surface waters.

2.24 Drafting of water from the North or South Fork of Ryan Creek is not authorized by this Agreement. Water for construction purposes shall be obtained from legal commercial municipal, industrial or groundwater sources.

INSTREAM STRUCTURES

2.25 No fill material shall be placed within a stream except as specified in this Agreement. Fill excavated from Project work shall be placed in stable areas where it cannot enter or erode into a stream.

2.26 Temporary structures that will remain in the channel after October 15 shall be designed to pass the 100-year flood event. Structures and materials not designed to withstand high flows shall be removed from the floodplain prior to October 15.

2.27 Installation of permanent culverts, weirs, and other instream channel modifications shall not impede the passage of fish up or down stream.

2.28 Pneumatic pipe ramming activities, i.e., repeated percussive blows, shall be confined to the period July 15 through October 15. To minimize noise and reduce sound exposure levels, blankets or other approved attenuation measures shall be used during ramming activities.

2.29 If South Fork Ryan Creek has not dried up, prior to excavating insertion and/or receiving pits for the ramming operation, Permittee shall submit a Fish Relocation Plan to CDFW for review and approval at least 10 days prior to proposed work.

2.30 At least 14 days prior to beginning construction activities, Permittee shall provide to CDFW for review and concurrence information on the location of concrete washouts, the lubrication methods and materials proposed for the ramming operations (to include Material Safety Data Sheets for any lubricants proposed), the proposed methods of spoil removal from inside the pipe, and how lubricant-contaminated soils will be handled.

EROSION, SEDIMENT CONTROL and REVEGETATION

2.31 Following commencement of Project activities, adequate erosion and sediment control devices to prevent sediment or turbid or silt-laden water from entering the North or South Fork of Ryan Creek shall be in place, operative, and effective at all times.

2.32 Where needed, the Permittee shall use native vegetation or other treatments to protect and stabilize soils. All bare mineral soil exposed in conjunction with construction, deconstruction, maintenance or repair shall be treated for effective erosion control prior to the onset of precipitation capable of generating run-off or the end of the yearly work period, whichever comes first.

2.33 Erosion control measures shall include the proper installation and maintenance of approved Best Management Practices (BMPs), and may include applications of *lopped native slash, native duff (leaves, needles, fine twigs, etc.), jute netting*, straw wattles, coir, wood chip mat, or straw mats, geotextiles, regionally-native seed, weed-free straw, compost and mulch, or combinations thereof. Geotextiles, fiber rolls, and other erosion control treatments shall not contain plastic mesh netting that can entrap or harm wildlife. Photodegradable synthetic products are not considered biodegradable.

2.34 No known invasive grass seed such as annual or perennial ryegrass (*Lolium multiflorum or L. perenne*, which are now referred to as *Festuca perennis*), shall be used in erosion control or revegetation seed mixes.

2.35 Encroachments and associated structures, fills, and other exposed soils shall be armored as needed to protect fill, end walls, head walls, and wing walls, and the stream channel and banks from erosion. The Permittee shall provide site maintenance during the life of the structure, including, but not limited to, re-applying erosion control to minimize surface erosion and ensuring stream banks remain sufficiently functional, armored and/or stable, and crossings remain fish-passable

2.36 Erosion control measures shall be monitored and maintained during and after storm events. Modifications, repairs, and improvements to erosion control measures shall be made following storm events to halt any erosion and prevent sediment from entering surface waters.

2.37 Immediately following construction, all disturbed upland areas shall be stabilized and reseeded with a native, regionally appropriate grass and forb seed mix, and willow slips (cuttings) and container tree and shrub species shall be planted and maintained as described in the September 2015 Revegetation Plan. Plant material for revegetation shall be from the same source(s) of plant material approved for the Willits Bypass mitigation lands. Weed removal on replanted areas shall be undertaken yearly during the life of this Agreement.

PETROLEUM, CHEMICAL AND OTHER POLLUTANTS

2.38 Where flowing water may be present during operations that include concrete pouring, Permittee shall:

a) Install a cofferdam above the concrete pour site to catch and divert stream flow and isolate and dewater the work site, and below the concrete pour site to catch and remove any water that may have contacted wet concrete and prevent transport downstream. Cofferdams shall be constructed of non-polluting materials including sand bags, rock, and/or plastic tarps. Mineral soil shall not be used in the construction of cofferdams.

b) Allow poured concrete to dry/cure for a minimum of 30 days in isolation from surface and subsurface stream flow to prevent the release of materials that may be toxic to fish and other aquatic species.

c) As an alternative to b) above, the Permittee may allow the concrete to dry/cure for 72 hours, continually pumping out to a lined off-channel basin any water that may come into contact with the poured concrete during this 72 hour period. Permittee shall then monitor the pH of any water that comes into contact with the poured concrete. If this water has a pH of 9.0 or greater, the water shall continue to be pumped to a lined off-channel basin and allowed to evaporate or be transported to an appropriate facility for disposal. All water that has come in contact with poured concrete shall be removed and not allowed to flow downstream or otherwise come in contact with fish and other aquatic resources until the pH values are below 9.0. The water shall be retested until pH values become less than 9.0. Once this has been determined, the area no longer needs to be isolated and water may be allowed to flow downstream. Results of pH monitoring shall be made available to CDFW upon request.

2.39 The Permittee shall install the necessary containment structures to control the placement of wet concrete and to prevent it from entering into the channel outside of the structures. The Permittee shall install a secondary containment structure between the primary containment structure and the stream channel as necessary to prevent wet concrete from entering water upon failure or leak of the primary structure. When Permittee is pouring or working with wet concrete, there shall be a designated monitor to inspect the containment structures and ensure that no concrete or other debris enters into the channel outside of the structures.

2.40 Any equipment or vehicles driven and/or operated within or adjacent to the stream channel shall be checked and maintained daily to prevent leaks of materials that, if introduced to water, could be deleterious to aquatic life, wildlife, or riparian habitat.

2.41 All equipment used during construction of this Project shall be cleaned (i.e. free of dirt and debris that may harbor noxious weed seeds and plant parts) prior to its arrival on site.

2.42 Stationary equipment including but not limited to motors, pumps, generators, compressors, and welders that contain deleterious materials, located within or

adjacent to a stream shall be positioned over drip pans, be bermed to contain spilled materials, or have other suitable containment systems installed to handle a catastrophic spill/leak and prevent contaminants from entering water.

2.43 All activities performed in or near a stream shall have absorbent materials designated for spill containment and clean-up activities on-site for use in an accidental spill. Clean up of all spills shall begin immediately. The Permittee shall immediately notify the State Office of Emergency Services at 1-800-852-7550 for all types of hazardous materials spills and incidents. CDFW shall be notified by the Permittee and consulted regarding clean-up procedures.

2.44 Refueling of machinery or heavy equipment, or adding or draining oil, lubricants, coolants, or hydraulic fluids shall not take place within or adjacent to any stream. All such fluids and containers shall be disposed of properly off-site. Heavy equipment used or stored within stream bed, channel, and bank shall use drip pans or other devices (i.e., absorbent blankets, sheet barriers or other materials) as needed to prevent soil and water contamination.

2.45 No debris, soil, silt, sand, bark, slash, sawdust, rubbish, cement or concrete or washings thereof, asphalt, paint or other coating material, oil or petroleum products or other organic or earthen material from any construction, or associated activity of whatever nature shall be allowed to enter into, or placed where it may be washed by rainfall or runoff into, waters of the State. When operations are completed, any excess materials or debris shall be removed from the work area. No rubbish shall be deposited within 150 feet of the high water mark of any stream or lake.

3. Reporting Measures

3.1 Permittee shall notify CDFW within the seven-day period preceding the beginning of work permitted by this Agreement. Information to be disclosed shall include Agreement number, and the anticipated start date. Subsequently, the Permittee shall notify CDFW no later than seven days after the Project is fully completed. Notification may be faxed to CDFW at (707) 441-2021, Attn: JoAnn Dunn, Senior Environmental Scientist (Specialist), or via email: joann.dunn@wildlife.ca.gov .

3.2 If South Fork Ryan Creek has not dried up prior to excavating insertion and/or receiving pits for the ramming operation, Permittee shall submit a Fish Relocation Plan to CDFW for review and approval at least 10 days prior to proposed work.

3.3 At least 14 days prior to beginning construction activities, Permittee shall provide to CDFW for review and concurrence detailed information as required by 2.30 above.

3.4 If sightings of ring-tailed cat, Pacific fisher, or marten are encountered in the course of activities at Project sites, the Permittee shall immediately notify and consult with CDFW as described in 2.3 above.

CONTACT INFORMATION

Written communication that Permittee or CDFW submits to the other shall be delivered to the address below unless Permittee or CDFW specifies otherwise:

To Permittee:

Mr. Mauricio Serrano
Caltrans
2379 Gateway Oaks Road, Suite 150
Sacramento, CA 95901
Email: Mauricio.serrano@dot.ca.gov

To CDFW:

California Department of Fish and Wildlife
Northern Region
619 Second Street
Eureka, California 95501
Attn: Lake or Streambed Alteration Program
Notification #1600-2015-0006-R1
Fax: (707) 441-2021

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 CDFW'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

CDFW 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 CDFW 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 CDFW 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 CDFW to issue the notice.

ENFORCEMENT

Nothing in the Agreement precludes CDFW 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 CDFW'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

CDFW may amend the Agreement at any time during its term if CDFW 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 CDFW and Permittee. To request an amendment, Permittee shall submit to CDFW a completed CDFW "Request to Amend Lake or Streambed Alteration" form and include with the completed form payment of the

corresponding amendment fee identified in CDFW's current fee schedule (see Calif. Code Regs., Title 14, Section 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 CDFW 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 CDFW a completed CDFW "Request to Amend Lake or Streambed Alteration" form and include with the completed form payment of the minor amendment fee identified in CDFW's current fee schedule (see Calif. Code Regs., Title 14, Section 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 CDFW a completed CDFW "Request to Extend Lake or Streambed Alteration" form and include with the completed form payment of the extension fee identified in CDFW's current fee schedule (see Calif. Code Regs., Title 14, Section 699.5). CDFW shall process the extension request in accordance with FGC Section 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 (FGC Section 1605(f)).

EFFECTIVE DATE

The Agreement becomes effective on the date of CDFW's signature, which shall be: 1) after Permittee's signature; 2) after CDFW 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.CDFW.ca.gov/habcon/ceqa/ceqa_changes.html.

TERM

This Agreement shall expire **5 years** from the effective date, 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 CDFW in accordance with FGC Section 1602.

CONCURRENCE

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

FOR CALIFORNIA DEPT. OF TRANSPORTATION

Mauricio R. Serrano — 9/24/15

Mauricio Serrano — Date

Project Manager

FOR CALIFORNIA DEPT. OF FISH AND WILDLIFE

9/28/15

Gordon Leppig — Date

Senior Environmental Scientist (Supervisor)

Prepared by: JoAnn Dunn, Senior Environmental Scientist (Specialist), August 17, 2015; Rev 9/23/2015

STATE OF CALIFORNIA EDMUND G. BROWN, JR., Governor

DEPARTMENT OF INDUSTRIAL RELATIONS
DIVISION OF OCCUPATIONAL SAFETY AND HEALTH
MINING AND TUNNELING UNIT
2424 Arden Way, Suite 125
Sacramento, California 95825
doshM&Tsac@dir.ca.gov

Telephone (916) 574-2540
FAX (916) 574-2542

November 25, 2015

Calif. Dept. of Transportation
703 B Street
Marysville, CA 95901

Attention: Kara Brimhall

Subject: Project: 16022 – Ryan Creek Coho Mitigation, Mendocino County
Classification: Potentially Gassy With Special Conditions
Number Attached: 1(A)

The information provided to this office relative to the above project has been reviewed. On the basis of this analysis, an Underground Classification of "Potentially Gassy With Special Conditions" has been assigned to the tunnel identified on your submittal. Please retain the original Classification for your records and deliver a true and correct copy of the Classification to the tunnel contractor for posting at the job site.

When the contractor who will be performing the work is selected, please advise them to notify this office to schedule the mandated Pre-Job Conference with the Division prior to commencing any activity associated with boring of the tunnel. A Pre-Job Request Form is enclosed.

Should you have another bore under construction that is not required to have an Underground Classification (i.e.: less than 30 inches in diameter), please contact the Mining and Tunneling Unit prior to any employee entry of such a space.

If you have any questions on this subject, please contact this office at your earliest convenience.

Sincerely,

Douglas Patterson
Senior Engineer

enc: Classification
Pre-Job Request Form

State of California

Department of Industrial Relations

DIVISION OF OCCUPATIONAL SAFETY AND HEALTH
MINING AND TUNNELING UNIT

Underground Classification

16022A045CT

STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

of 703 B STREET; MARYSVILLE, CA 95901

at RYAN CREEK COHO MITIGATION

has been classified as *** POTENTIALLY GASSY WITH SPECIAL CONDITIONS ***

as required by the California Labor Code § 7955.

The Division shall be notified if sufficient quantities of flammable gas or vapors have been encountered underground. Classifications are based on the California Labor Code Part 9, Tunnel Safety Orders and Mine Safety Orders.

SPECIAL CONDITIONS

1. A Certified Gas Tester shall perform pre-entry and continuous monitoring of the underground environment to measure Oxygen and detect explosive, flammable, and toxic gasses whenever an employee is working in the underground environment.
2. Mechanical ventilation shall provide for continuous exhaust of fumes and air at any time an employee is working in the underground environment. The primary ventilation fans must be located outside of the underground environment and shall be reversible by a single switch near the fan location.
3. The Division shall be notified immediately if any **Flammable Gas** or **Petroleum Vapor** exceeds 5% of the Lower Explosive Limit.
4. All utilities that may be in conflict with the project shall be identified and physically located (potholed) prior to the start of project operations.

The twin parallel 120-inch-diameter 113-foot-long tunnel bores beneath State Highway 101 located approximately 4 miles north of Willits, Mendocino County

This classification shall be conspicuously posted at the place of employment.

Douglas Patterson, Senior Engineer

November 25, 2015

State of California
Department of Industrial Relations
Division of Occupational Safety & Health

REQUEST FOR PRE-JOB (TUNNEL)

ATTACH COPY OF CLASSIFICATION AND DIESEL PERMIT

Company Name:_____

Phone_____FAX:_____

DATE FAXED: _____

PLEASE NOTE: THE BORING CONTRACTOR SHOULD SCHEDULE THE PREJOB AS FAR IN ADVANCE AS POSSIBLE – AT LEAST 3-4 DAYS IN ADVANCE. THE DIVISION REQUIRES THE JOB TO BE SET UP WHEN THE FIELD ENGINEER ARRIVES FOR THE PREJOB. THIS MEANS THAT THE BORE PIT HAS BEEN DUG AND PROPERLY GUARDED, THE CRANE IS IN PLACE AND READY TO LIFT, THE BORING MACHINE IS IN THE PIT AND READY TO GO, AND THE CREW IS READY TO BEGIN BORING THE TUNNEL. IF THERE IS A DELAY IN SETTING UP THE JOB, THE BORING CONTRACTOR SHOULD CONTACT THE DIVISION IMMEDIATELY.

PRE-JOB REQUEST DATE & TIME: _____

ON-SITE SUPERVISOR & CELL NO.: _____

CLASSIFICATION #: _____ **DIESEL PERMIT #:** _____

BORE DIAMETER AND LENGTH: _____ _____
(Diameter) (Length)

IS BORE ENTRY ANTICIPATED? YES NO
(Circle One)

You MUST contact the Division if entry is planned, REGARDLESS of the bore diameter.

MANNER OF EXCAVATION: _____

_____

JOB-SITE LOCATION AND DIRECTIONS: _____

_____

_____

GENERAL CONTRACTOR: _____

SUBMITTED BY: _____

REVIEWED BY: _____ **DATE:** _____

☐ *Mining & Tunneling Unit, District 1*
2424 Arden Way, Suite 125
Sacramento, California 95825-2400
(916) 574-2540; ***FAX: (916) 574-2542***

☐ *Mining & Tunneling Unit, District 2*
6150 Van Nuys Blvd., Suite 310
Van Nuys, California 91401-3333
(818) 901-5420; ***FAX: (818) 901-5579***

☐ *Mining & Tunneling Unit, District 3*
464 West Fourth Street, Suite 354
San Bernardino, California 92401-1442
(909) 383-6782; ***FAX: (909) 388-7132***

Final

Ryan Creek Culvert Replacement Project

Prepared for:

California Department of Transportation

AECOM

May 2014

Final

Ryan Creek Culvert Replacement Project

Prepared for:

California Department of Transportation
Design Branch – M5
703 B Street
Marysville, CA 95901

Contact:

Scott Foster
Transportation – Civil Engineer
530/741-4015

Douglas Jones
Design Branch Chief – Design M5
530/741-4027

Prepared by:

AECOM
2020 L Street, Suite 400
Sacramento, CA 95811

Contact:

Steve Pagliughi
Fisheries Biologist
916/715-5929

AECOM

60298786
05.12.14

May 2014

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ACRONYMS AND OTHER ABBREVIATIONS

AECOM	AECOM Technical Services
BO	Biological Opinion
Caltrans	California Department of Transportation
CDFW	California Department of Fish and Wildlife
CESA	California Endangered Species Act
cfs	cubic feet per second
CMP	corrugated metal pipe
DPS	Distinct Population Segment
EJL	engineered log jams
ESU	Evolutionarily Significant Unit
FESA	federal endangered species act
ft/s	feet per second
Hwy 101	United States Highway 101
LWD	large woody debris
NRCS	National Resources Conservation Services
NMFS	National Marine Fisheries Service
Project	Ryan Creek Fish Passage Project
RCB	reinforced concrete box
SONCC	Southern Oregon-Northern California Coasts
WBP	Willits Bypass Project

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1 INTRODUCTION

The Willits Bypass Project (WBP) is located near Willits, CA in Little Lake Valley, Mendocino County. The project involves construction of a new freeway alignment for United States Highway 101 (Hwy 101) to the east of and around Willits. WBP activities have the potential to affect fish species protected under the federal (FESA) and state (CESA) endangered species act. The Ryan Creek Fish Passage Project (Project) satisfies mitigation requirements under several WBP permits. The project's Streambed Alteration Agreement permit (No. 1600-2010-0044-R) requires mitigation for adverse impacts to fish resources that cannot be avoided or minimized. Compensatory measures 3.6, 3.7, and 3.8 require the California Department of Transportation (Caltrans) to improve fish passage on Ryan Creek. The WBP CESA Incidental Take Permit (No. 2081-2010-007-01) requires mitigation for incidental take of CESA threatened Southern Oregon-Northern California Coasts (SONCC) Evolutionarily Significant Unit (ESU) coho salmon (*Oncorhynchus kisutch*). Condition of Approval Measure 8 requires Caltrans to implement a fish passage improvement project to restore access to spawning and rearing habitat on Ryan Creek. The National Marine Fisheries Service (NMFS) permitted the WBP for incidental take, through issuance of a Biological Opinion (BO), that included three federally threatened fish species: California Coastal ESU Chinook salmon (*Oncorhynchus tshawytscha*), SONCC ESU coho salmon, and Northern California Distinct Population Segment (DPS) steelhead (*Oncorhynchus mykiss*). Reasonable and Prudent Measure 5 and associated non-discretionary terms and conditions require Caltrans to implement the Project. The NMFS BO also requires the Project to be consistent with NMFS guidelines for passage of salmonids at stream crossings.

The objectives of this report are to:

- Present an overview of the proposed Project including historic and current site assessments;
- Discuss stream reach fluvial, geomorphic, and fisheries issues;
- Present the Ryan Creek Fish Passage Design Proposal prepared by Caltrans;
- Provide comments and recommendations on the proposed fish passage design; and
- Assess future compliance of the proposed Project with regulatory guidance documents.

The intent of this report is to provide a consensus building document among Caltrans, NMFS, California Department of Fish and Wildlife (CDFW), and stakeholders facilitating 1) a team approach to development of an appropriate and successful fish passage design on Ryan Creek, 2) pre-permitting approval of the fish passage design among vested parties, and 3) permit acquisition.

AECOM Technical Services (AECOM) and Caltrans personnel attended a site visit to Ryan Creek on May 29, 2013. The site visit offered AECOM and Caltrans the opportunity to view Project features and adjacent influential features, and discuss passage designs and solutions. The attendees are listed in Table 1.

Table 1 Attendance list for the first site visit to Ryan Creek, Mendocino Co., CA			
Name	**Affiliation**	**Phone Number**	**Email**
Steve Pagliughi	AECOM	916-715-5929	Steve.pagliughi@aecom.com
Stephen Blanton	AECOM	503-227-1042	Stephen.blanton@aecom.com
Roy Leidy	AECOM	916-414-5855	Roy.leidy@aecom.com
Matthew Silva	AECOM	916-204-0217	Matthew.silva@aecom.com
Scott Foster	Caltrans	530-741-4015	Scott.foster@dot.ca.gov
Erik Schwab	Caltrans	916-274-0585	Erik_schwab@dot.ca.gov
Chris Collison	Caltrans	916-274-0560	Chris_collison@dot.ca.gov
Mark Hagy	Caltrans	916-227-1077	Mark_hagy@dot.ca.gov
Douglas Jones	Caltrans	530-741-4027	Douglas_jones@dot.ca.gov
Mitch Andros	Caltrans	530-741-5545	Mitch_andros@dot.ca.gov
Jiftay Lee	Caltrans	916-227-8469	Jiftay.lee@dot.ca.gov
Henry Fang	Caltrans	916-227-8471	Henry.fang@dot.ca.gov
Kara Brimhall	Caltrans	530-741-4054	Kara_brimhall@dot.ca.gov

2 SITE BACKGROUND

Ryan Creek is a tributary to Outlet Creek which discharges into the Eel River. The Project area is approximately 4,880 feet upstream of the confluence of Outlet and Ryan creeks (RTA 2013). Ryan Creek hosts four anadromous fish species: coho salmon, Chinook salmon, steelhead, and Pacific lamprey (*Lampetra tridentata*). SONCC ESU coho salmon are state and federally listed as threatened, and California Coastal ESU Chinook salmon and Northern California DPS steelhead are federally listed as threatened. Pacific lamprey has no federal or state listing status.

The Project involves replacement of two Hwy 101 culverts; one culvert is on the South Fork Ryan Creek (PM 52.25) and one culvert is on the North Fork Ryan Creek (PM 52.36). Culvert replacement on the South Fork entails replacing the existing 5-foot diameter corrugated metal pipe (CMP) with two 10-foot diameter steel pipes counter sunk to a depth of 42 inches. The new culverts will be aligned slightly to the south of the current culverts alignment. Culvert replacement on the North Fork entails replacing the existing 5-foot diameter CMP with a 12-foot span x 10-foot rise reinforced concrete box (RCB) countersunk 24 inches. Under existing conditions, adult upstream passage of the South Fork Hwy 101 culvert is minimal (Caltrans 2005). A perched outlet on the North Fork Hwy 101 culvert prevents fish passage of all life stages (Caltrans 2005). Both Hwy 101 culverts rank high on Caltrans and Mendocino County's remediation priority list (Appendix A, Ryan Creek Fish Passage Design Proposal).

At the stream reach scale, culverts upstream and downstream of the two Hwy 101 culverts potentially impact fish passage and natural stream functions (Figure 1). The Ryan Creek Road culvert is approximately 580 feet downstream of the South Fork Hwy 101 culvert, 810 feet downstream of the North Fork Hwy 101 culvert, and 80 feet downstream of the confluence of the South and North Forks of Ryan Creek. The approximately 82 feet long culvert was remediated in the summer of 2011 with an open bottom concrete arch culvert having a 20-foot span and 10-foot rise. The arch culvert was set on concrete footings. Stream restoration in association with this project included placement of eight large wood structures within the approximate 580-fett stream reach of South Fork Ryan Creek between Ryan Creek Road and Hwy 101 (RTA 2013).

Two 5-foot diameter culverts running underneath a privately maintained road are located approximately 300 feet upstream of the South Fork Hwy 101 culvert. The passage potential of various fish life stages, in either direction, is unknown. The Five Counties Salmonid Conservation Program is working with private landowners to remediate these culverts and improve fish passage (RTA 2013). A private culvert is also present on the North Fork approximately 1,100 feet upstream of the North Fork Hwy 101 culvert. This culvert has not been evaluated and the fish passage potential is unknown.

2.1 HISTORIC AND CURRENT SITE CONDITIONS

2.1.1 FLUVIAL AND GEOMORPHIC

During the May 29 site visit, participants investigated the North Fork and South Fork of Ryan Creek from the Ryan Creek Road culvert to points upstream of each of the Highway 101 culverts. The creek sections from the Ryan Creek Road culvert upstream to the Hwy 101 culverts in both the South and North forks are experiencing active fluvial and geomorphic processes that will influence the proposed remediation of the Hwy 101 culverts. Caltrans is committed to the success and long-term structural stability and integrity of the Hwy 101 culvert

remediations and is taking a stream reach approach. Therefore, the Project area is defined as the Hwy 101 culverts downstream to the inlet of the Ryan Creek Road culvert. Accordingly, the proposed designs will include features to remediate current and active fluvial and geomorphic issues from the Hwy 101 culverts downstream to the inlet of the Ryan Creek Road culvert. Following are brief summaries of each creek section providing descriptions and photos of the current site conditions.

RYAN CREEK ROAD CULVERT UPSTREAM TO THE CONFLUENCE OF THE NORTH AND SOUTH FORKS

The downstream extent of the Project reach is defined as the Ryan Creek Road culvert. Prior to remediation during the summer of 2011, the Ryan Creek Road culvert was an approximate 10-foot span x 6-foot rise x 82-foot long box culvert with a 2.7 percent slope. Figure 2 shows the outlet (downstream) prior to remediation. The box culvert created shallow flow depth across the concrete bottom. A failed concrete apron and scour pool created jump height issues leading to the fish passage barrier classification. The concrete bottom of this culvert was likely the controlling point of Ryan Creek upstream, creating a hard point that maintained the channel invert.

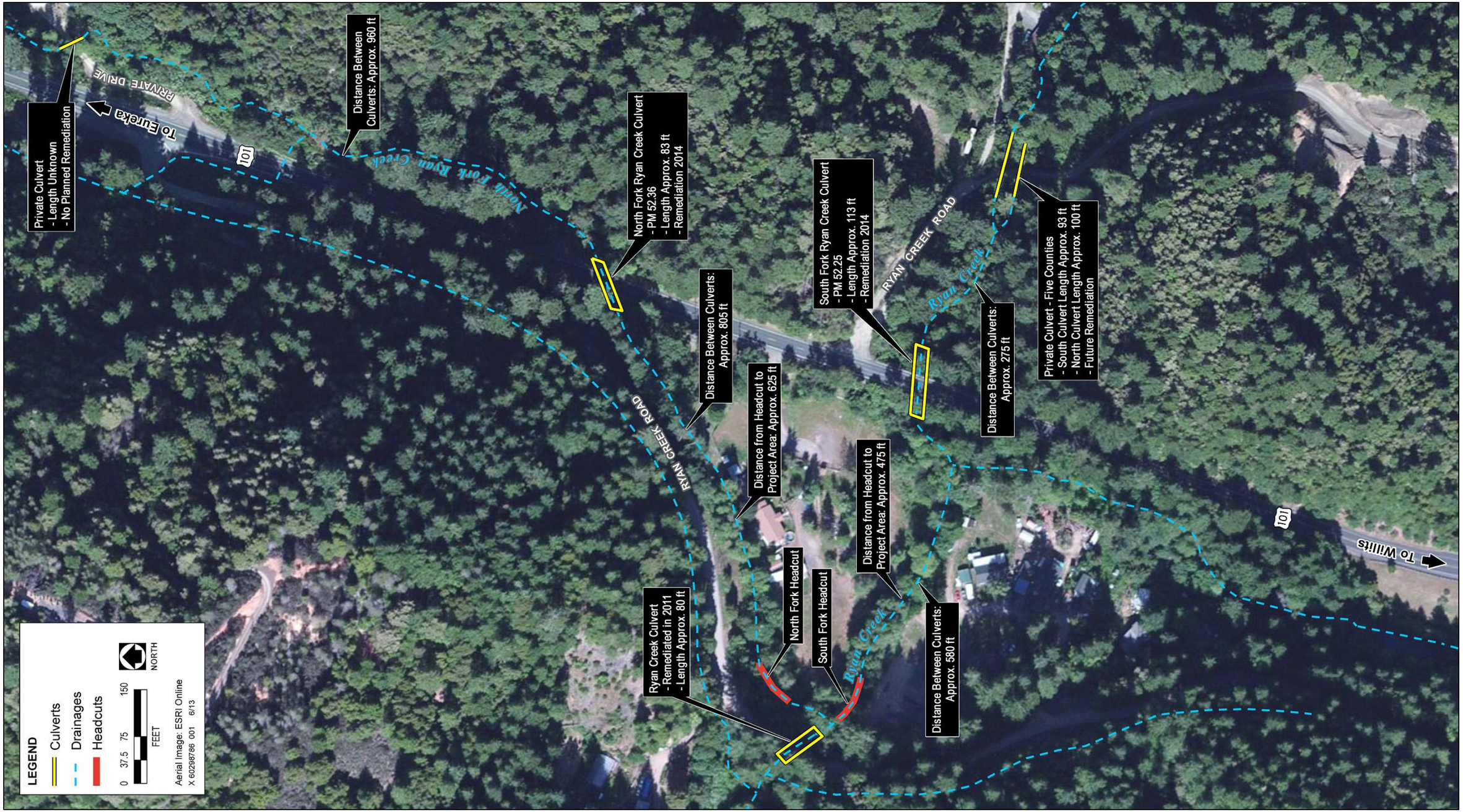
This creek section includes the remediated Ryan Creek Road culvert and upstream approximately 30 feet. Figure 3 shows the Ryan Creek Road culvert inlet post remediation. The bank material on the left side of the channel inside the culvert has been washed away since the completion of the culvert replacement project in 2011. The general shape of the channel within the culvert immediately after construction completion is shown in Figure 4.

Ryan Creek extends approximately 30 feet upstream from the Ryan Creek Road culvert to the confluence of the North and South forks. A small deposition area (Figure 5) has formed at the confluence. The small gravel bar has a different material gradation (larger) than the rest of the channel which consists primarily of a sand and gravel mix. Bank failure has occurred and appears to be active within the confluence area along the South Fork left bank (Figure 6). The bank failure is approximately 20 to 30 feet long and includes several pieces of large woody debris (LWD) that are cabled together. The LWD likely was placed along the base of the stream bank and the slumping material pushed the structure away from the bank and into the stream channel.

NORTH FORK RYAN CREEK - CONFLUENCE UPSTREAM TO THE HWY 101 CULVERT

Incision and downcutting are occurring in the lower portion of this creek section. Immediately upstream of the confluence the North Fork channel contains near vertical banks with little vegetation. Both banks are up to 10 feet in height with bare banks hidden by blackberry vines and other vegetation (Figure 7).

Within the lower 100 feet of the North Fork Ryan Creek, the channel has incised up to 3 feet (Figure 8). The vegetation line shown in Figure 7 provides evidence of the downcutting in the lower portion of the North Fork channel. The headcut migration creating the incision is currently restricted from further upstream movement by a bedrock sill spanning the current channel. The rock sill is angled toward the right bank which is causing bank erosion. If the angle of the sill remains constant, the creek will continue to erode the right bank creating a section of channel that is wider than those found both upstream and downstream. The rock sill is currently acting as a hard point that is maintaining the North Fork channel upstream of the sill. Channel migration and incision currently are not occurring on the North Fork upstream of the sill. Between the sill and the Hwy 101 culvert, the channel has maintained its natural functions and appears to be stable (Figure 9). The Hwy 101 culvert consists of a 5-foot diameter CMP. The outlet of this culvert is perched resulting in scoured channel banks and the accumulation of larger bed material (Figure 10).



Source: AECOM 2013

Figure 1. Features associated with and adjacent to the Ryan Creek Fish Passage Design Proposal project area.

Source: Five Counties Salmonid Conservation Program Northwest California Council

Figure 2. The Ryan Creek Road culvert outlet prior to remediation.

Figure 3. The Ryan Creek Road culvert inlet post remediation.

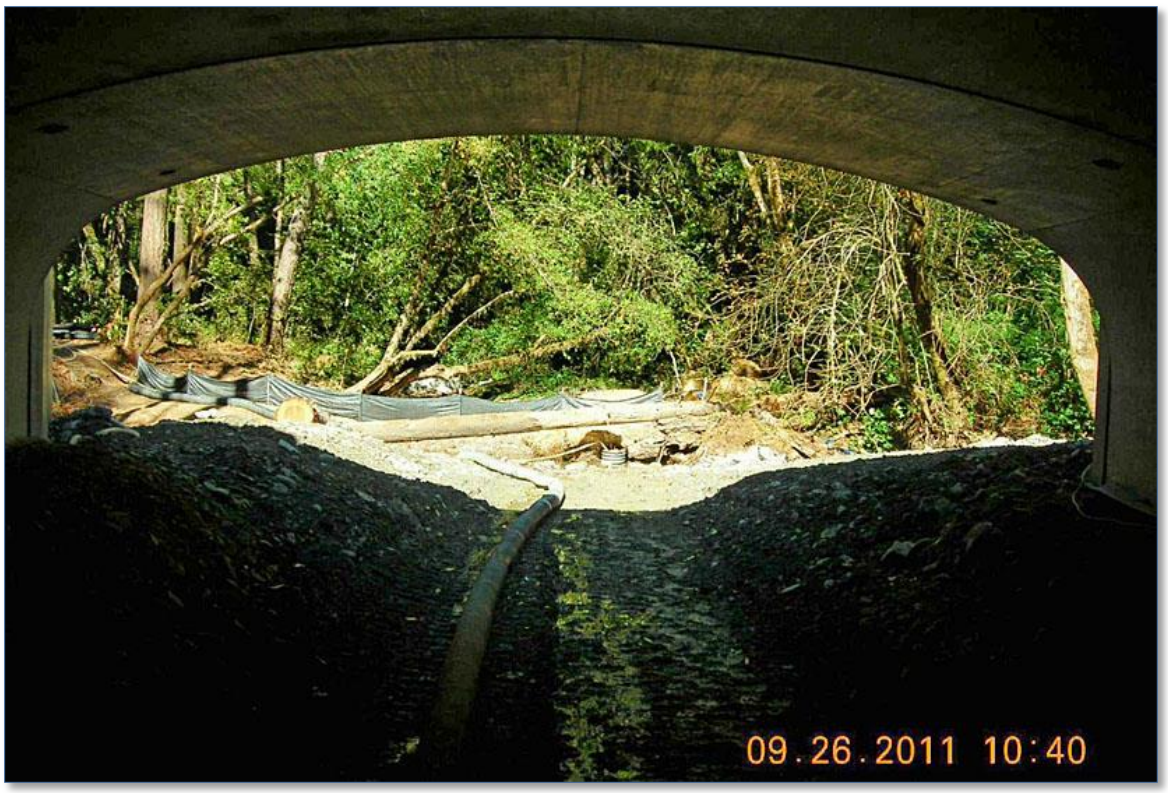


Figure 4. Channel morphology within the Ryan Creek Road culvert immediately following construction completion in 2011.

Figure 5. A small gravel bar has formed at the confluence of the North and South forks of Ryan Creek.

Figure 6. Bank failure on the left bank of the South Fork Ryan Creek just upstream of the confluence of the North and South forks.

Figure 7. Eroded banks on the North Fork Ryan Creek just upstream of the confluence with South Fork Ryan Creek.

Figure 8. Channel incision near the headcut on the North Fork Ryan Creek between the Ryan Creek Road culvert and the Hwy 101 culvert.

Figure 9. North Fork Ryan Creek just above the headcut showing lack of incision and bank erosion.

Figure 10. The perched outlet of the Hwy 101 culvert on the North Fork Ryan Creek showing scoured channel banks and the accumulation of larger diameter clasts.

NORTH FORK RYAN CREEK - UPSTREAM OF THE HWY 101 CULVERT

The inlet and channel upstream of the Highway 101 North Fork culvert currently is in good, stable condition. The stream channel consists of gravels with adjacent vegetated banks and a low vegetated floodplain (Figure 11). The existing culvert is likely responsible for maintaining the channel conditions upstream of Hwy 101. Site participants walked approximately 300 feet upstream of the Hwy 101 culvert and this entire length of creek is in equilibrium with high quality spawning gravels, low grade banks, and ample riparian vegetation (Figure 12). A privately owned culvert, not observed during the May 29 site visit, is approximately 960 feet upstream of Hwy 101. The fish passage potential of this culvert is unknown and the quality of habitat above this culvert is unknown. There are no known plans to remediate this culvert.

SOUTH FORK RYAN CREEK - CONFLUENCE UPSTREAM TO THE HWY 101 CULVERT

The lower portion of the South Fork is showing signs of geomorphic changes through channel incision and downcutting. Engineered log jams (ELJ) appear to have been incorporated into the Ryan Creek Road culvert remediation project to mitigate channel incision or add fish habitat. The ELJ structure shown in Figure 13 currently is well above the water surface of the creek. The bare, lower banks are evidence of channel incision and the left bank (foreground) is near vertical and is currently eroding.

Figure 14 shows another ELJ showing the logs well above the water surface of the creek and the bed and banks providing evidence of incision. All of the ELJs on the South Fork appear to have used bolts and cable to hold the

Figure 11. The inlet of the North Fork Ryan Creek Hwy 101 culvert showing gravels, vegetated banks, and a low vegetated floodplain.

Figure 12. High quality salmonid habitat is present upstream of the Hwy 101 culvert on the North Fork Ryan Creek.

Figure 13. Image of an engineered log jam on the South Fork Ryan Creek showing channel incision and bank erosion.

Figure 14. Image shows the extent of incision that has occurred during the 2 years since the placement of engineered log jams in the South Fork Ryan Creek.

logs in place. In Figure 13, a bolt is shown at the lower portion of the tree along the bank. In addition, it appears rebar was driven through the logs and into the channel bed to provide additional support and stability (Figure 14).

ELJs typically are designed to be flexible structures that can reposition themselves as the river geomorphology changes. The ELJs on the South Fork are mechanically held in place with bolts and cables and are rigid resulting in the current conditions where they are not in contact with the creek. Approximately nine ELJs have been constructed and placed within the South Fork between the confluence with the North Fork and the Hwy 101 culvert. Evidence of channel incision decreases with upstream distance from the confluence. The upstream migration of the headcut likely has not reached the upper areas yet as opposed to the possibility that the headcutting has stopped. Figure 15 shows the South Fork channel just downstream of the Hwy 101 culvert. The vegetation line along the banks suggests only minor geomorphic adjustments (approximately 0.5 feet) have occurred. The South Fork Hwy 101 culvert is a 5-foot diameter CMP that is partially buried at the outlet (Figure 16).

SOUTH FORK RYAN CREEK - UPSTREAM OF THE HWY 101 CULVERT

The culvert inlet is protected by a concrete headwall (Figure 17). The stream channel upstream of Hwy 101 appears to be stable and in equilibrium. The channel substrate consists predominantly of gravel, with adjacent vegetated banks and a low vegetated floodplain (Figure 18). The existing culvert is likely responsible for maintaining the channel conditions upstream of Hwy 101. A privately owned culvert, consisting of two CMP's, is approximately 275 feet upstream of Hwy 101. The Five Counties Salmonid Conservation Program is working with private landowners to remediate these culverts and improve fish passage (RTA 2013). The fish passage potential of these private culverts is unknown. High quality salmonid habitat is present above these culverts including vegetated banks and low vegetated floodplain (Figure 19).

Figure 15. South Fork Ryan creek just downstream of the Hwy 101 showing lack of channel incision.

Figure 16. The outlet of the South Fork Ryan Creek Hwy 101 culvert is partially buried.

Figure 17. The inlet of the South Fork Ryan Creek Hwy 101 inlet is protected by a concrete headwall.

Figure 18. South Fork Ryan Creek just upstream of Hwy 101 is stable and consists of high quality salmonid habitat.

Figure 19. High quality salmonid habitat exists upstream of the South Fork Ryan Creek private culverts (scheduled for remediation by Five Counties Salmonid Conservation Program).

2.1.2 FISHERIES

Willits, CA is located in Little Lake Valley. The valley is within the Outlet Creek sub-basin within the Eel River watershed. The small drainages within Little Lake Valley, including Ryan Creek which is located just north of the valley floor, discharge into Outlet Creek which is a tributary to the Eel River. Chinook salmon, coho salmon, and steelhead historically utilized the low gradient reaches of the drainages as migration corridors during adult spawning and smolt migrations (LeDoux-Bloom 2006). Spawning and rearing generally occurred in the higher reaches of these water courses. LeDoux-Bloom (2006) reported that in 1920 the U.S. Department of Agriculture Soil Survey stated that all streams in the Little Lake Valley area were intermittent. Historically, low flows during certain years may have prevented salmon and steelhead from reaching and spawning within the Outlet Creek sub-basin.

Changing land use patterns and development has affected the drainages within Little Lake Valley and the surrounding area. Dam construction, road construction, grazing, and other activities have led to decreases in annual flows, gravel recruitment, habitat complexity, and water depth while contributing to increased sedimentation of fine substrates and increased water temperatures (http://coastalwatersheds.ca.gov/Watersheds/NorthCoast/OutletCreek/OutletCreekBasin/tabid/435/Default.aspx). Man-made barriers also prevent salmon and steelhead from accessing much of the available historic upper reach spawning habitat. In general, salmonid habitat suitability and availability has decreased through time. According to NMFS (2012), habitat within Ryan Creek is generally more suitable for salmonids than other area drainages. As a result, Ryan Creek is of particularly high value to salmonids within the Outlet Creek sub-basin and therefore is the subject of restoration and conservation efforts by state and federal agencies and non-governmental organizations.

Ryan Creek currently hosts, and is designated critical habitat for, SONCC ESU coho salmon (FESA and CESA threatened), California Coastal ESU Chinook salmon (FESA threatened), and Northern California DPS steelhead (FESA threatened). The three species were known to occupy the Ryan Creek Road culvert outlet pool prior to the culverts remediation (RTA 2001; RTA 2013). However, only steelhead had been observed upstream of this barrier prior to remediation. Based on the presence of coho and Chinook salmon downstream of the Ryan Creek Road culvert, it was assumed that upstream habitat would be re-colonized by these species fairly quickly following the culverts remediation in the summer of 2011 (RTA 2013). Low rainfall during the 2011-12 winter precluded salmon from accessing Ryan Creek (RTA 2013). Precipitation was favorable the following year and in December of 2012 Chinook salmon were observed in the South Fork Ryan Creek upstream of the private double culvert (RTA 2013; Figure 1). Coho salmon only return to the Outlet Creek sub-basin once every three years because two of the three cohorts have been extirpated (RTA 2013). The winter of 2013-14 will be the first time since the Ryan Creek Road culvert was remediated that coho salmon will have an opportunity to return to Ryan Creek. During a site visit to Ryan Creek on May 29, 2013, AECOM personnel observed age 0 salmonids throughout the South Fork Ryan Creek as far upstream as above the private double culvert and on the North Fork Ryan Creek between the Ryan Creek Road culvert and the Hwy 101 culvert. Salmonids were not observed upstream of the Hwy 101 culvert on the North Fork Ryan Creek. All observed salmonids appeared to be steelhead.

Following remediation of the Ryan Creek Road culvert, the two Hwy 101 culverts now represent the most downstream barrier to fish passage in the South and North forks of Ryan Creek. Based on recent observations coho salmon, Chinook salmon, and steelhead can migrate past the Ryan Creek culvert and in some years, likely

during the highest flows, migrate past the private double culvert on the South Fork. As of the winter of 2012-13 salmon and steelhead have not been observed upstream of the North Fork Hwy 101 culvert; the culvert appears to completely block fish passage.

LIFE HISTORIES AND PROJECT AREA PRESENCE DATES

Chinook salmon, coho salmon, and steelhead are anadromous and spend various amounts of time in both freshwater and saltwater. The timing of adult and juvenile migrations and the length of freshwater rearing prior to saltwater entry varies among species. The project area presence dates for each life stage is important because the Project's passage designs must provide conditions conducive to fish passage during those time periods when the various salmonid life stages are present within the project area. A brief life history of coho salmon, Chinook salmon, and steelhead follows including time periods when adults and juveniles are most likely to be present within the project area.

Coho Salmon

Coho salmon are most common in relatively small, coastal streams characterized by heavily forested watersheds with intact riparian habitat, perennial flows, high water quality with cool water temperatures, large amounts of instream cover and undercut banks, and gravel and cobble substrates (Sandercock 1991). In California, a simple three-year life cycle is most common (NMFS 2012). Two of the three cohorts have been extirpated in the Outlet Creek sub-basin (RTA 2013). Therefore, adult coho salmon would be expected to return to Ryan Creek once every three years. Adult immigration in the Eel River watershed occurs from October through February and peaks November through December (Fukushima and Lesh 1998). Spawning occurs shortly after arrival on spawning grounds. Juveniles typically rear in freshwater for one year before migrating to saltwater (NMFS 2012). Deep pool habitat with low turbidity is important during the rearing life stage (NMFS 2012). Smolt emigration in the Eel River watershed occurs from May through July and peaks April through June (Fukushima and Lesh 1998).

Chinook Salmon

Chinook salmon in the Eel River watershed and the Outlet Creek sub-basin are ocean-type fish; adults migrate in fall/winter and juveniles emigrate shortly after emergence (NMFS 2012). California Coastal ESU Chinook salmon exhibit a two to five year life cycle (Myers et al. 1998). Adult immigration in the Eel River watershed occurs from October through January (Fukushima and Lesh 1998). Spawning occurs shortly after arriving on spawning grounds in swift, relatively shallow riffles or along the edges of fast runs at depths greater than 24 centimeters (NMFS 2012). Fry emergence begins in December and continues into mid-April (Leidy and Leidy 1984). Smolt emigration typically occurs from April through July (Myers et al. 1998).

Steelhead

In California coastal streams, steelhead usually exhibit a three to four year life cycle rearing in freshwater for two years and spending one or two years in saltwater before returning to natal streams to spawn (NMFS 2012). Unlike salmon, steelhead can return to freshwater to spawn multiple times before dying but the percentage of a given population that spawns multiple times is unknown. Winter-run steelhead are most likely to be found within the Outlet Creek sub-basin (NMFS 2012) with adults immigrating between November and April and spawning shortly after arrival on spawning grounds (NMFS 2012). Instream cover is an important habitat component during the typical two year juvenile rearing period (Shirvell 1990; Meehan and Bjornn 1991). Smolt emigration can

occur during any month of the year but occurs most frequently in the Eel River watershed from April through May (Fukushima and Lesh 1998).

2.2 PROPOSED SITE CONDITIONS

The following two sections describe the intended results of the Ryan Creek Fish Passage Design Proposal. A more detailed description of the proposed conditions can be found in Appendix A, Ryan Creek Fish Passage Design Proposal.

2.2.1 FLUVIAL AND GEOMORPHIC

The proposed Project is intended to provide for unimpeded upstream fish passage for all salmonid life stages throughout the project reach. The existing Hwy 101 culvert on the South Fork is considered a fish passage barrier based on flow velocities and water depth. Current conditions provide for minimal upstream adult fish passage. The existing Hwy 101 culvert on the North Fork is also considered a fish passage barrier due to flow velocities, water depth, and a perched outlet. The perched outlet presumably completely blocks upstream fish passage. The proposed culvert remediation will replace the existing culverts with counter-sunk culverts that provide natural stream beds through the length of each culvert.

The proposed culvert designs utilize the Active Channel Design option and the Hydraulic Design option. The Active Channel Design option addresses fish passage conditions and features associated with and within the replacement culverts. The Hydraulic Design option addresses those design features that will be constructed within the stream channel upstream and downstream of the culverts. Under the Active Channel Design option, the culvert is oversized for the channel hydraulics, and bed material is designed to match upstream and downstream channel conditions; the proposed designs mimic the existing natural channel conditions. Therefore, hydraulic analysis is not required because favorable fish passage conditions are assumed with the Active Channel Design option. The proposed culvert designs incorporate the Hydraulic Design option because rock weirs and sills are proposed design features intended to maintain stream bed integrity and elevations.

The proposed culvert designs are consistent with hydraulic conveyance requirements related to high and low flows and are intended to allow the culverts to convey flood flows while also providing adequate flow velocities and water depths during low flow periods. The proposed designs include construction of rock weir dams and sills upstream and downstream of the Hwy 101 culverts because stream incision is currently occurring within the project reach. The intention of these design features is to stabilize and maintain the channel invert (thalweg).

2.2.2 FISHERIES

The intended results of the proposed Project are to remediate two culverts to provide fish passage for all life stages of salmonids that are present in Ryan Creek. Designs and design features were chosen to provide a creek section with stable geomorphic and fluvial processes that provides appropriate flow velocities, water depths, and elevational drops within the suitability range of adult and juvenile salmon and steelhead that are consistent with criteria set forth in CDFW (2002) and NMFS (2001) culvert replacement guidance documents. Designs and design features also provide for structural and creek bed integrity through time and through the full range of flows anticipated. Remediation of the North Fork Hwy 101 culvert is anticipated to provide fish additional access to a minimum of approximately 960 feet (Figure 1) of Ryan Creek that contains suitable spawning and rearing habitat. The remediation may provide access to much more habitat but the fish passage potential at the upstream private

culvert is unknown at this time. Remediation of the South Fork Hwy 101 culvert is anticipated to provide fish additional access to a minimum of approximately of 275 feet (Figure 1) of creek that contains suitable spawning and rearing habitat. The Five Counties Salmonid Conservation Program is working with private landowners to remediate the private culverts upstream of Hwy 101. Therefore, completion of the proposed Project is the first step in a larger to plan to provide fish access to more of the upstream habitat available on the South Fork.

3 REVIEW OF THE RYAN CREEK FISH PASSAGE DESIGN PROPOSAL

3.1 HEC-RAS MODELING

Caltrans engineers developed a HEC-RAS[1] model of Ryan Creek to assist in the assessment and design of the proposed Project. The downstream model boundary is approximately 850 feet downstream of the Ryan Creek Road culvert. The upstream model boundary on the North Fork is approximately 1,100 feet upstream of the Hwy 101 culvert. The upstream model boundary on the South Fork extends more than 1,500 feet upstream of the Hwy 101 culvert.

The channel geometry is based on surveyed cross sections. The model incorporates 47 cross sections downstream of the confluence of the North and South forks. Upstream of the confluence, the model incorporates 114 cross sections on the South Fork and 121 cross sections on the North Fork. The model is designed to assess the hydraulic characteristics of the creeks under 10 flow conditions. The flow conditions represent various return frequency flood events and flows associated with fish passage ranging from 1 cubic feet per second (cfs) for low flow juveniles to over 1,000 cfs for the 100-year flow event. Although modeled, the HEC-RAS model was not used for the assessment of fish passage criteria within the culverts; it was only used for jump height at the rock weirs. The hydraulics within the culvert associated with fish passage are not required to develop appropriate designs under the Active Channel Design option.

3.2 CONVEYANCE

The hydraulics conveyance capacity of the proposed culverts was assessed based on the 10-year and 100-year flow events. For the 10-year flow, the water surface at the inlet of the culvert must be below the crown of the culvert. The requirement under the 100-year flow conditions is that flows cannot overtop the roadway or cause upstream backwaters that adversely impact property and structures.

Figure 20 and 21 show the HEC-RAS water surface elevations for the proposed culverts on the South and North forks, respectively. The water surface elevations at the culvert inlets are below the crown of the culverts for the 10-year event. For the 100-year event, it is assumed that the water surface elevations upstream of the culvert inlets will be less than the existing culverts because the capacity of the proposed culverts are greater than the existing culverts.

3.3 STREAM POWER – MATERIAL SIZING

The HEC-RAS model was used to assess flow velocities and water depth associated with the channel geometry design and rock protection sizing. The 2-year flow rate was assumed to be equal to bank-full conditions and therefore was used to set the channel width and top bank elevations relative to the channel invert. The rock protection and boulder sizes were developed based on the hydraulic conditions under the 100-year high flow event. Flow depths guided the level of bank protection and flow velocities were used to determine appropriate diameters for the rock protection material. Selection of appropriate sized protection material ensures the material is not transported downstream during high flow events.

[1] Hydrologic Engineering Centers River Analysis System (HEC-RAS) http://www.hec.usace.army.mil/software/hec-ras/

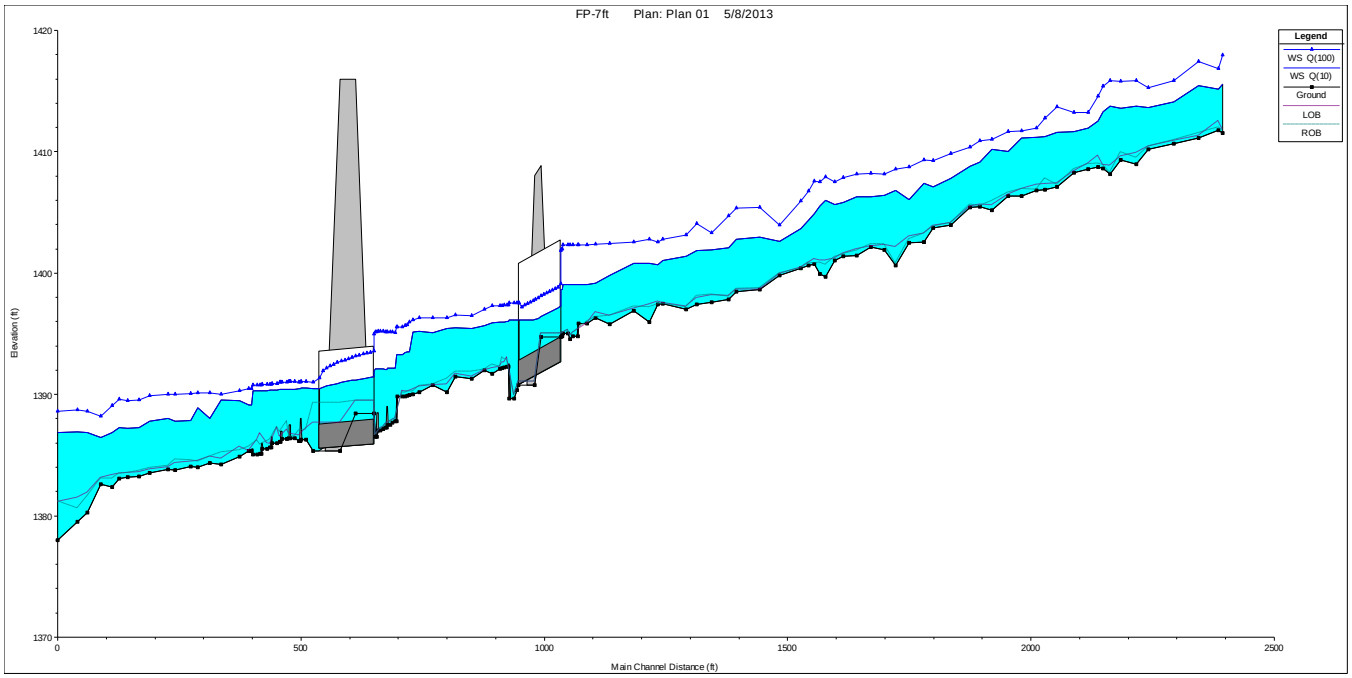


Figure 20. HEC-RAS water surface profile for South Fork Ryan Creek.

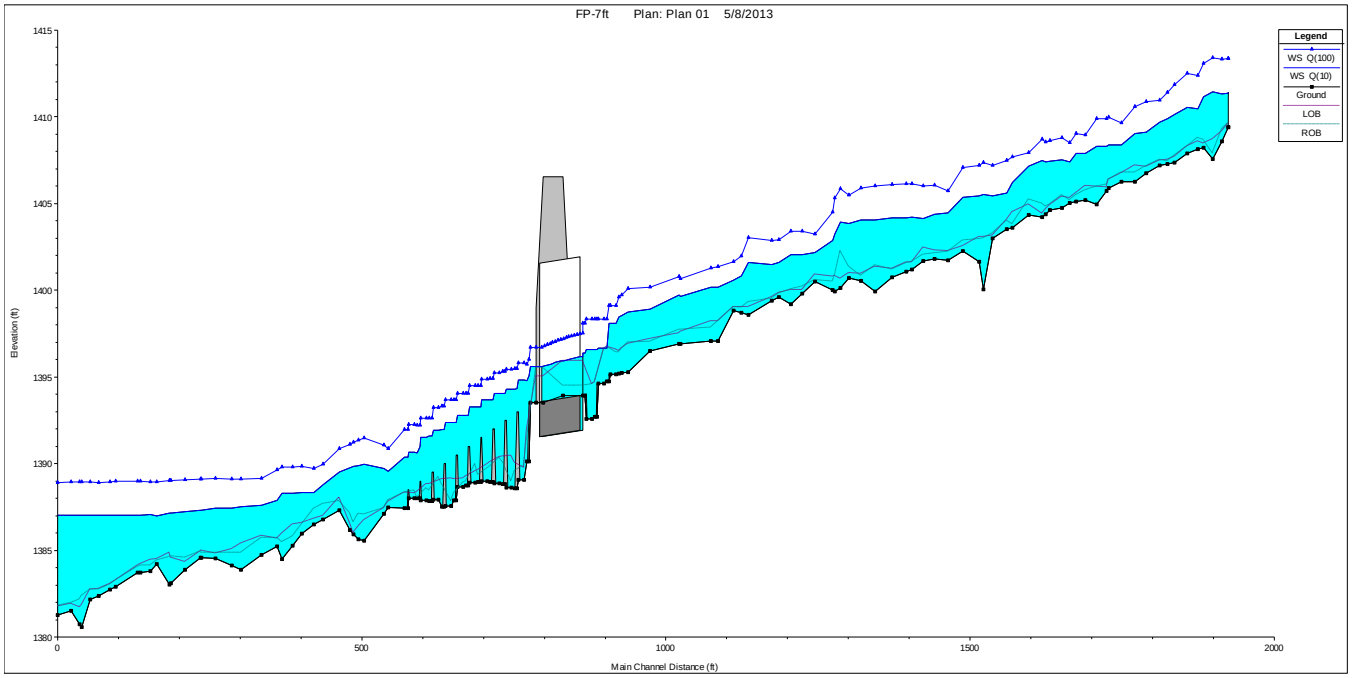


Figure 21. HEC-RAS water surface profile for North Fork Ryan Creek.

The momentum equation in the HEC-RAS model was used to estimate the 100-year flow event velocities near the proposed rock weirs. The estimated velocity ranges were 3.2 feet per second (fps) to 6.3 fps for the South Fork and 1.5 fps to 6.9 fps for the North Fork. The calculations used to determine the appropriate size rock for the proposed rock weirs (i.e., sized to ensure stability and structural integrity through the estimated velocity ranges) are included in the Ryan Creek Fish Passage Design Proposal (Appendix A).

3.4 CULVERT AND STRUCTURE DESIGNS

CDFW (2002) and NMFS (2001) fish passage criteria are identical and reiterated in the California Salmonid Stream Habitat Restoration Manual (CDFW 2009). The Active Channel Design option methodology allows selection of an appropriate sized culvert large enough and buried deep enough into the channel bed to allow natural movement of bedload through the culvert and formation of a stable bed inside the culvert. The determination of high and low flow fish passage criteria for velocity and depth is not used in this simplified approach because this design approach mimics the upstream and downstream natural channel conditions within the culvert. The approach is suitable for:

- New and replacement culverts;
- Simple installations with channel slopes less the 3 percent;
- Short culverts (less than 100-feet); and
- Passage required for all fish.

The minimum culvert width should be equal to or greater than 1.5 times the active channel width. The culvert should be placed level (zero percent slope) and buried into the streambed not less than 20 percent of the culvert height at the outlet and not more than 40 percent of the culvert height at the inlet.

The active channel near Hwy 101 on the South Fork is 105 inches wide; the proposed culverts have a 120-inch diameter and are approximately 113 feet long. Each end of the culvert will be buried 42 inches which is 35 percent of the culvert height. The slope of the remediated culverts will be approximately 0.35 percent. Culvert diameter and burial depth meet CDFW and NMFS design criteria. However, the length of the culverts is slightly outside of recommended ranges, but the velocity through the culvert is lower than the recommended range. The active channel near Hwy 101 on the North Fork is 84 inches wide; the proposed RCB has a 144-inch span and is approximately 83 feet long. Each end of the culvert will be buried 24 inches into the streambed which is 40 percent of the culvert height. The slope of the remediated culvert will be approximately 0.45 percent. Culvert length, diameter, and burial depth meet CDFW and NMFS design criteria. The slope has to be less than 3 percent.

Drop structures, also called rock weirs or sills, are individually constructed drops in the channel bed that span the entire channel. Construction of drop structures can improve fish passage, stabilize streambed channels, or raise the streambed channel. The proposed designs include construction of rock weirs and sills to improve fish passage, and stabilize and raise the streambed channels. The proposed designs are consistent with recommendations in the California Salmonid Stream Habitat Restoration Manual (CDFW 2009). Placement of drop structures around culverts should be done with caution. However, in cases where a culvert replacement is designed using stream simulation or low-slope approaches, such as the proposed Project, scour pools associated are not expected to form and drop structures can be placed closer to the culvert. The closest weirs are located 15 feet above and 13 feet below the South Fork culvert and 16 feet above and 9 feet below the North Fork culvert.

Keying drop structures sufficiently into the streambed and stream bank is essential for preventing undermining and flanking (CDFW 2009). Where weirs intersect a steep stream bank, the structures will be extended into the bank a distance equaling the bank height or 8 feet, whichever is less. All weirs will be keyed into the streambed a minimum of 3 feet to prevent undermining. Cutoff walls, if required, will be oriented perpendicular to overbank flows and extended to prevent flanking.

Arch shaped rock weirs with the apex pointing upstream are proposed for construction. This design directs flows towards the center of the channel and away from the stream bank to reduce bank erosion. A depositional area along the channel margins may be created, further reducing the risk of bank erosion (CDFW 2009). A W-shaped rock weir is proposed for construction just upstream and downstream of the culverts on the South Fork. Because there are two culverts proposed, the W-Shaped weirs allow for pool formation at each end of the culvert. This design feature will allow the stream to establish and adjust between the culverts instead of forcing the stream to one side.

The proposed culvert designs incorporate the Hydraulic Design option because rock weirs and sills are proposed design features. This options methodologies address flow depth, velocities, and jump heights associated with the rock weirs. The fish passage design flows used for the hydraulic analyses required under the Hydraulic Design option (Table 2; Appendix A, Table 2) are based on estimated peak flows using the National Resources Conservation Services (NRCS) methodology and were validated and consistent with recommendations in Caltrans 2007. The high flows are based on 50 percent of the 2-year period flow for adults and 10 percent of the 2-year period flow for juveniles. The minimum alternative flows of 3 cfs for adults and 1 cfs for juveniles were used because the contributing watershed area above the culverts is relatively small. All of the flow criteria meet CDFW and NMFS criteria.

Table 2
NRCS peak flows for fish passage

Location	Salmonid Life Stage	Low Flow (cfs)	High Flow (cfs)
SF Ryan Creek	Adult	3	46
	Juvenile	1	9
NF Ryan Creek	Adult	3	16
	Juvenile	1	3

CDFW (2002), NMFS (2001), and Caltrans (2007) fish passage guidance documents provide criteria for minimum water depths, maximum average water velocities, and maximum water surface drop for passage of salmonids at stream crossings. The fish passage criteria shown in Tables 3 through 6 were agreed upon by CDFW, NMFS, and Caltrans during a site visit to Ryan Creek. To provide unimpeded passage these criteria should be satisfied at both low and high fish passage design flows. Minimum water depth and maximum average water velocity ranges were predicted using HEC-RAS modeling for conditions that would occur under the proposed Project. Criteria for maximum water surface drop are standardized and design features were developed to ensure this criteria is met. The proposed conditions are shown in Tables 3 through 6. In all instances but two, the proposed range of conditions are consistent with fish passage criteria. The minimum range value for the predicted minimum water depth (feet) for adult salmonids during low flow on the South Fork is 3 inches shallower than the criterion. The minimum range value for the predicted maximum average water velocity (feet/second [ft/s]) for juvenile salmonids during high

flow on the South Fork is 0.59 ft/s greater the criterion. The proposed design minimizes impacts to the existing channel; therefore weirs are only placed in certain areas leaving the channel between weirs unmodified. The existing channel has water depths and/or flow velocities that fall outside of design criteria ranges and this sometimes causes predicted values to be outside of established suitability ranges.

Table 3
Low flow fish passage design on the South Fork Ryan Creek showing CDFW, NMFS, and Caltrans criteria and proposed conditions predicted using HEC-RAS modeling

Low Flow Passage Design – South Fork Ryan Creek[1]						
Salmonid Life Stage	Minimum Water Depth (ft)		Maximum Average Water Velocity (ft/s)		Maximum Water Surface Drop (ft)	
	Criteria	Proposed	Criteria	Proposed	Criteria	Proposed
Juvenile Salmonids	0.50	0.62 – 2.86	1.00	0.03 - 0.37	0.50	0.50
Adult Salmonids	1.00	0.75 – 2.99[2]	5.00	0.08 -0.78	1.00	0.50

Notes: f = feet; ft/s = feet per second
[1] creek section 23+75 to 26+75
[2] the stream bed is being rebuilt from 24+63 to 26+75. The Minimum Water Depth is not achieved in some places where the streambed is not altered between rock weirs.

Table 4
High Flow Fish Passage Design on the South Fork Ryan Creek Showing CDFW, NMFS, and Caltrans Criteria and Proposed Conditions Predicted Using HEC-RAS Modeling

High Flow Passage Design – South Fork Ryan Creek[1]						
Salmonid Life Stage	Minimum Water Depth (ft)		Maximum Average Water Velocity (ft/s)		Maximum Water Surface Drop (ft)	
	Criteria	Proposed	Criteria	Proposed	Criteria	Proposed
Juvenile Salmonids	0.50	1.00 – 3.18	1.00	0.21 – 1.59[2]	0.50	0.50
Adult Salmonids	1.00	1.50 – 3.23	5.00	0.73 – 3.65	1.00	0.50

Notes: f = feet; ft/s = feet per second
[1] creek section 23+75 to 26+75
[2] the stream bed is being rebuilt from 24+63 to 26+75; the Maximum Average Water Velocity is not achieved in some places where the streambed is not altered between rock weirs.

Table 5
Low Flow Fish Passage Design on the North Fork Ryan Creek Showing CDFW, NMFS, And Caltrans Criteria And Proposed Conditions Predicted Using HEC-RAS Modeling

Low Flow Passage Design – North Fork Ryan Creek[1]						
Salmonid Life Stage	Minimum Water Depth (ft)		Maximum Average Water Velocity (ft/s)		Maximum Water Surface Drop (ft)	
	Criteria	Proposed	Criteria	Proposed	Criteria	Proposed
Juvenile Salmonids	0.50	0.77 – 4.19	1.00	0.01 – 0.15	0.50	0.50
Adult Salmonids	1.00	1.00-4.34	5.00	0.03 – 0.39	1.00	0.50

Note: f = feet; ft/s = feet per second
[1] creek section 15+75 to 19+40

Table 6
High flow fish passage design on the North Fork Ryan Creek showing CDFW, NMFS, and Caltrans criteria and proposed conditions predicted using HEC-RAS modeling

High Flow Passage Design – North Fork Ryan Creek[1]						
Salmonid Life Stage	Minimum Water Depth (ft)		Maximum Average Water Velocity (ft/s)		Maximum Water Surface Drop (ft)	
	Criteria	Proposed	Criteria	Proposed	Criteria	Proposed
Juvenile Salmonids	0.50	0.95 – 4.35	1.00	0.03 – 0.42	0.50	0.50
Adult Salmonids	1.00	1.38 – 4.70	5.00	0.13 – 2.91	1.00	0.50

Note: f = feet; ft/s = feet per second
[1] creek section 15+75 to 19+40

4 ASSESSMENT AND RECOMMENDATIONS

4.1 HEADCUTTING – CHANNEL INCISION

Visual inspection of Ryan Creek associated with the Ryan Creek Road culvert and Hwy 101 culvert remediation efforts found evidence of channel incision. The headcutting of the channel invert appears to begin near the Ryan Creek Road culvert. The headcutting/incision is impacting both the North and South forks in the lower reaches (Figure 1). The surveyed channel thalweg profile for Ryan Creek from downstream of the Ryan Creek Road culvert to the South Fork Highway 101 culvert outlet is shown in Figure 22. The surveyed channel thalweg profile for the North Fork from the confluence to upstream of the rock sill that is restricting additional headcut migration is shown in Figure 23.

The 2010 survey was completed prior to the Ryan Creek Road culvert replacement project. The location of the Ryan Creek Road culvert is located in Figure 22 between 250 feet and 325 feet. The 2010 profile shows that the inlet of the old Ryan Creek Road culvert was approximately 3 feet higher than the current Ryan Creek Road culvert. The 2011 thalweg profile presumably represents the post-construction channel.

The North Fork thalweg survey shows headcutting similar to that found on the South Fork. As the profile indicates, the headcut has stopped migrating at 475 feet which corresponds to the rock ledge found during the site visit. Additional headcut migration on the North Fork will likely not continue as long as the rock ledge can maintain the channel invert.

The lowering of a streambed elevation, or channel incision, is a common geomorphic process. It is important to develop an understanding of the causes of channel incision and the channel evolution that the process is an element of. There are many potential causes for channel incision, but for the Ryan Creek issue it appears the headcutting is associated with the Ryan Creek Road culvert replacement project. The new culvert may have decreased the erosional resistance of the stream reach resulting in a steeper channel slope.

Streams generally exist in a state of dynamic equilibrium where minor hydraulic/hydrologic characteristic changes are naturally corrected in order to bring the stream back to a stable condition. Lane's diagram (Figure 24) illustrates the relationship between flow (Q) and channel slope (S) with bed material volumes (Qs) and the size of the bed material. As the scale representation suggests, changes to any of the variables represented will cause the balance to tip toward degradation or aggradation. The channel response will be to adjust one of the other variables in order to restore system equilibrium. Channel incision is considered degradation.

Based on the variables presented, one or more of the following changes has occurred on Ryan Creek to cause degradation:

- A change in bed material volume or size;
- Stream flows peaks and/or volume have increased; or
- Channel slope has increased.

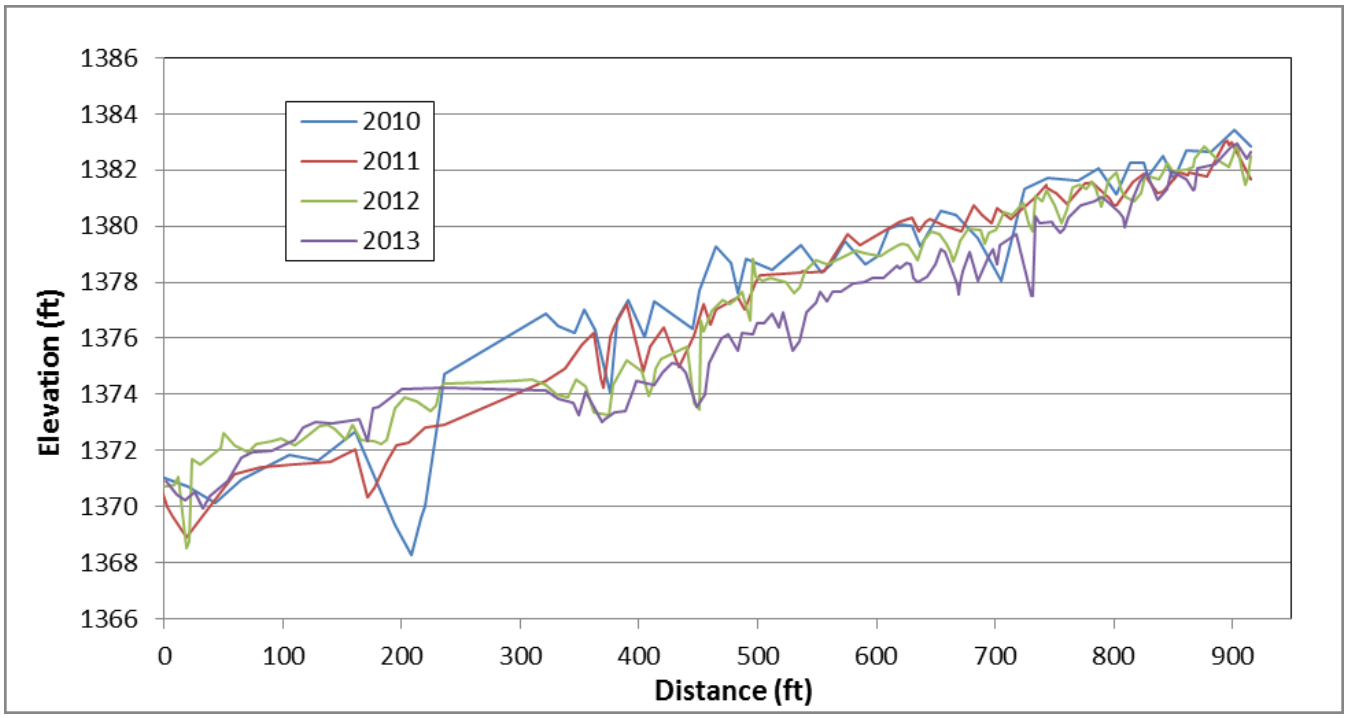


Figure 22. The surveyed channel thalweg profile for Ryan Creek from downstream of the Ryan Creek Road culvert to the South Fork Hwy 101 culvert.

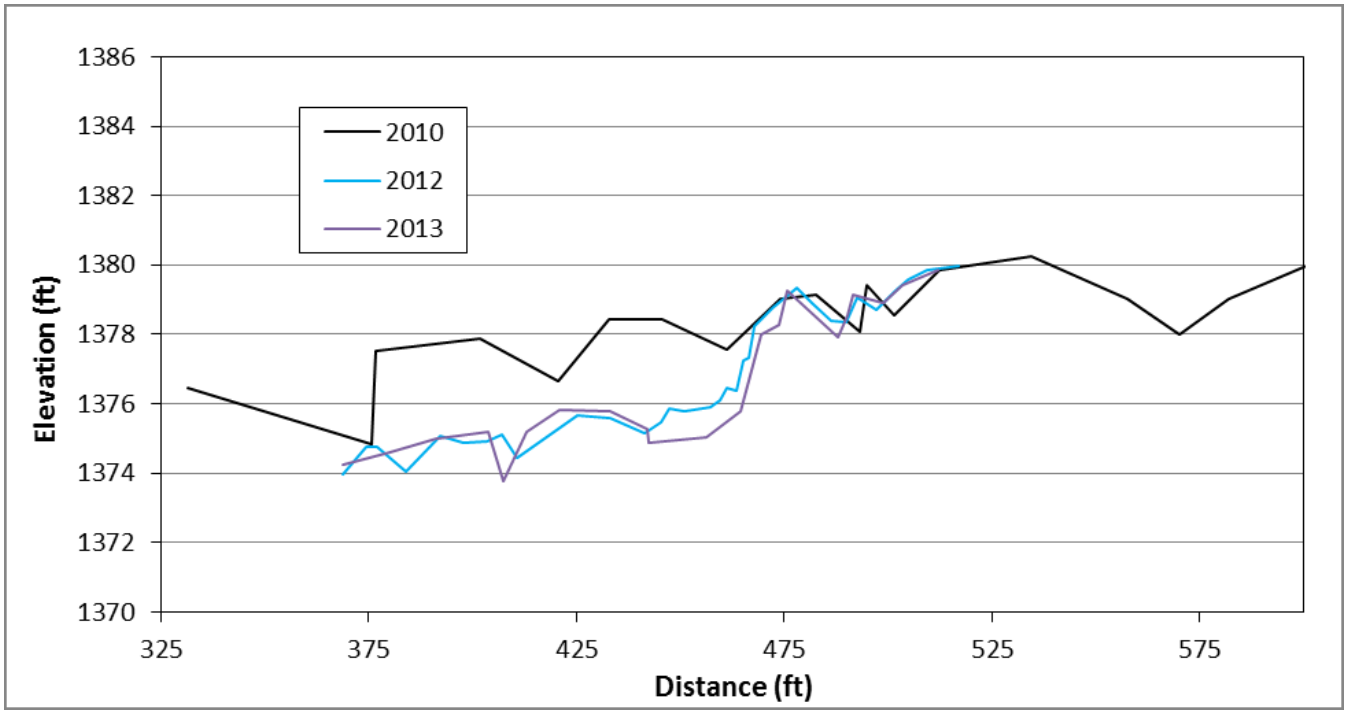


Figure 23. The surveyed channel thalweg profile for the North Fork from the confluence with the South Fork to upstream of the rock sill that is restricting additional headcut migration.

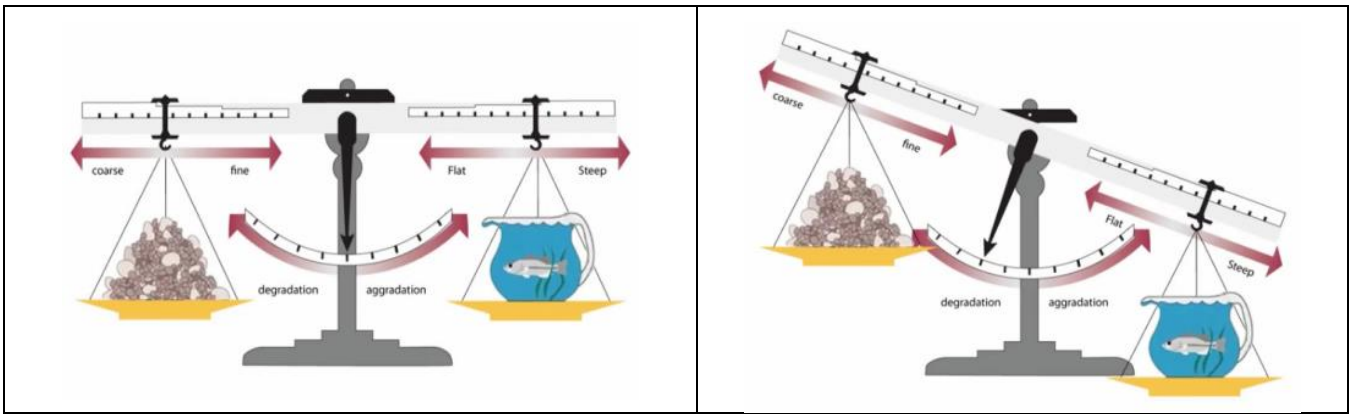


Figure 24. Lane's diagram illustrates the relationship between flow (Q) and channel slope (S) with bed material volumes (Qs) and the size of the bed material.

Based on the channel profiles shown in Figures 22 and 23, the removal of the old culvert likely removed a hard point in the bed channel, allowing the channel slope to correct to an elevation that balanced the scale at the Ryan Creek Road culvert location. Once this occurred, the channel slope steepened resulting in the current degradation. Ryan Creek is in an adjustment phase where it is attempting to recreate its historic channel slope at an elevation approximately 3.5 feet lower.

4.2 CHANNEL EVOLUTION

Headcutting/channel incision is the first step in a channel evolution process (Figure 25). There are five stages to channel evolution that starts and ends with a stable channel, a rebalancing of the Lane's diagram. Following is a brief discussion of each stage.

Stage 1. A stream has achieved dynamic equilibrium where flows and slopes are balanced with the sediment transport needs of the system. Stage 1 in Figure 25 references the 2-year flow (Q2). This return interval flow rate typically is considered the bank-full, effective flow or channel forming flow. For streams in northern California, this is the highest flow rate prior to the stream flows spreading out across a functioning floodplain.

Stage 2. The capacity of the channel increases as headcutting occurs. Instead of flows spreading across the floodplain with 2-year flows, the deeper channel allows larger flows to stay within the channel resulting in high flow velocities within the stream and increased erosion potential.

Stage 3. Increased channel erosion creates unstable channel banks that eventually fail and slump into the channel where it is washed away.

Stage 4. The widened stream channel typically is not hydraulically efficient resulting in channelization during lower flow rates. This initiates the creation a new defined channel capable of conveying the bankfull flows (Q2).

Stage 5. Over time the channel geometry develops similar to for Stage 1 geometry. However, if the cause of the headcutting was increased flows, the Stage 5 channel will be sized to effectively convey the new Q2 with access to the newly developed floodplain.

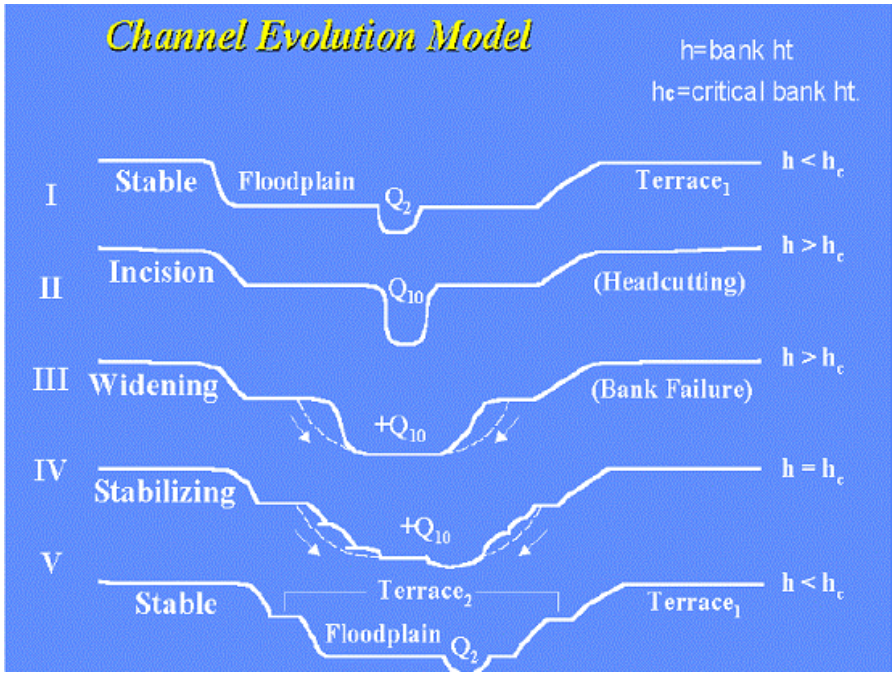


Figure 25. Stream channel evolution process and the channel evolution model.

The reaches of Ryan Creek currently experiencing headcutting will progress through all five stages of the channel evolution. Bank failure is already occurring near the confluence of the North and South forks leading to channel widening. As the channel widening continues, adjacent infrastructure and residences may become at risk.

4.3 DESIGN ELEMENTS

The proposed Caltrans Hwy 101 culvert remediation designs appear to account for potential channel incision at the culverts. The designs include rock weirs and sills to provide hard points that will maintain the channel invert elevation in the project reach. It will be important to ensure the gradation of rock material proposed for the construction of the weirs and sills is sufficiently large enough to remain stable during anticipated flow conditions.

As the current channel headcutting occurring downstream proves, culvert replacement can lead to adverse consequences. Caltrans has developed preliminary plans that address the potential for channel incision caused by culvert replacement. Additionally, Caltrans acknowledges the downstream headcutting issues and understand these issues have the potential to migrate into and affect the design elements of the proposed Project. The proposed Project can address the downstream issues and incorporate solutions into the proposed Project by 1) keying in the most downstream rock weir structure deeper so that when the headcut reaches the downstream face the structure does not get undermined and fail, and/or 2) correct the current headcutting by placing rock weirs or embedded ELJs throughout Ryan Creek starting at the Ryan Creek Road culvert. The second option is the preferred approach because should the headcut migrate upstream to the most downstream proposed rock weir a significant elevation drop may develop leading to additional fish passage issues. Also, continued channel evolution may put adjacent structures at risk.

4.4 CONCLUSIONS

The Hwy 101 culvert replacement project reach along Ryan Creek is currently experiencing headcutting on the North and South Forks. The headcutting appears to be the result of a geomorphic response to the replacement of the Ryan Creek Road culvert in 2011. The headcut on the North fork currently is being maintained in place by a bedrock sill. Downstream of the sill the creek has incised approximately 3 feet. The headcut on the South Fork is migrating upstream and does not appear to have reached a similar bedrock sill as the North Fork. The headcut will likely reach Hwy 101 if left unremediated.

The proposed Project accounts for the potential for headcutting associated with culvert replacement by incorporating rock weirs and sills into design features. The downstream headcutting issue if left unremediated may adversely impacted the proposed Project. It is recommended that additional rock weirs or ELJs be installed downstream to the Ryan Creek Road culvert to restore the historic channel elevation or to hold in-place the current channel.

The proposed design for the replacement culverts and conditions within the culverts for the North and South forks are based on the Active Channel Design option. Hydraulic assessment associated with fish passage is not required under this option because the proposed remediation designs mimic the upstream and downstream stream channel geometry and bed material. This design approach assumes that natural stream flow will develop flows paths through the culverts that area adequate for all life stages of salmonids.

A HEC-RAS hydraulic model of Ryan Creek was developed to assist in the assessment of culvert hydraulics and conveyance capacity for large flow events. Based on criteria in the Caltrans Highway Design Manual, the culverts were assessed for the estimated 10- and 100-year flow events to determine if the proposed culverts met the criteria. Model results suggest the proposed culvert designs meet criteria for the 10- and 100-year flow events. The proposed culverts provide at least twice the flow area of the existing culverts; therefore, it is expected that the flow conveyance for the proposed culverts is adequate.

Under the Hydraulic Design option, the HEC-RAS model was used to assess the flow characteristics associated with the rock weir structures. The predicted jump height and flow velocities across the proposed structures were assessed. The model results indicate jump heights (less than 0.5 feet) and flow velocities under the proposed designs result in conditions that, in most instances, meet CDFW and NMFS criteria. Because the weirs are made of rock, multiple flow paths over the structures are likely to develop which will offer multiple options for upstream and downstream fish migration.

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5 REFERENCES

California Department of Transportation. 2005. District 1 pilot fish passage assessment volume 1. Prepared by Environmental Resources Engineering, Humboldt State University.

———. 2007. Fish passage design for road crossings: an engineering document providing fish passage design guidance for Caltrans projects.

Caltrans. *See* California Department of Transportation.

California Department of Fish and Wildlife. 2002. Culvert criteria for fish passage. Department of Fish and Wildlife, Sacramento, CA.

———. 2009. California Salmonid Stream Habitat Restoration Manual. PART XII Fish Passage Design and Implementation.

CDFW. *See* California Department of Fish and Wildlife.

Fukushima, L. and E. W. Lesh. 1998. Adult and juvenile anadromous salmonid migration timing in California streams. California Department of Fish and Game 84(3):133-145.

LeDoux-Bloom, C. M. 2006. Outlet Creek basin assessment report (draft) Coastal Watershed Planning and Assessment Program. California Department of Fish and Game. Fort Bragg, California.

Leidy, R. A. and G. R. Leidy. 1984. Life stage periodicities of anadromous salmonids in the Klamath River Basin, northwestern California. United States Fish and Wildlife Service, Sacramento, California.

Meehan, W. R. and T. C. Bjornn. 1991. Salmonid distribution and life histories. Pages 47-82 *in* Influences of Forest and Rangeland Management on Salmonid Fishes and Their Habitats. W. R. Meehan, editor. American Fisheries Society Special Publication 19. American Fisheries Society. Bethesda, Maryland.

Myers, J. M., R. G. Kope, G. J. Bryant, D. Teel, L. J. Lierheimer, T. C. Wainwright, W. S. Grand, F. W. Waknitz, K. Neely, S. T. Lindley, and R. S. Waples. 1998. Status review of Chinook salmon from Washington, Idaho, Oregon, and California. United States Department of Commerce, National Oceanic and Atmospheric Administration Technical Memorandum NMFS-NWFSC-35.

National Marine Fisheries Service (NMFS). 2001. Guidelines for salmonid passage at stream crossings. National Marine Fisheries Service, Southwest Region, Long Beach, California.

———. 2012. National Marine Fisheries Service's Biological Opinion for the California Department of Transportation's Willits Bypass Project. National Marine Fisheries Service, Southwest Region, Long Beach, California.

NMFS. *See* National Marine Fisheries Service.

Ross Taylor and Associates (RTA). 2001. Coastal Mendocino County culvert inventory and fish passage evaluation.

———. 2013. Findings report for channel profile surveys – Ryan Creek/ Ryan Creek Road barrier removal project.

RTA. *See* Ross Taylor and Associates.

Sandercock, F. K. 1991. Life history of coho salmon (*Oncorhynchus kisutch*). Pages 396-445 *in* C. Groot and L. Margolis, editors. Pacific Salmon Life Histories. University of British Columbia Press, Vancouver.

Shirvell, C. S. 1990. Role of instream rootwads as juvenile coho salmon (*Oncorhynchus kisutch*) and steelhead trout (*O. mykiss*) cover habitat under varying stream flows. Canadian Journal of Fisheries and Aquatic Sciences 47:852-860.

APPENDIX A

Ryan Creek Fish Passage Design Proposal

Fish Passage Design Proposal
Ryan Creek

South Fork Ryan Creek

North Fork Ryan Creek

Prepared by:

Caltrans

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PROJECT DESCRIPTION

The Ryan Creek fish passage mitigation project was initiated to fulfill permit conditions for the Willits bypass project. Permit conditions for the Willits bypass project are provided in detail in the Ryan Creek Culvert Replacement Project final report.

After meeting in the field with the California Department of Fish and Wildlife (CDFW), National Marine Fisheries Service (NMFS), Five Counties Salmonid Conversation Program, and Caltrans staff, the following recommendations were proposed for Ryan Creek. The existing Ryan Creek culvert at (PM 52.25), hereafter referred to as the South Fork Ryan Creek, is a 5-foot diameter corrugated metal pipe (CMP) proposed to be replaced with two 10-foot diameter culverts counter sunk to a depth of 42 inches. Route 101 is a major transportation artery and cannot be closed for any extended amount of time. The height of the fill at this location is over 45 feet. A detour around the proposed work in the South Fork would create significant environmental impacts. This led to the decision to propose installing the culverts via jacking/ramming. The unnamed tributary culvert (PM 52.36), hereafter referred to as the North Fork Ryan Creek, is proposed to be replaced with a 12-foot x 10-foot reinforced concrete box (RCB) counter sunk to a depth of 24 inches. See Attachment A-1.

This document follows the procedures established in the California Department of Transportation Fish Passage Manual and the California Department of Fish and Wildlife California Salmonid Stream Habitat Restoration Manual. This report is an attachment to the Ryan Creek Culvert Replacement Project final report and describes the proposed design and documents the design process.

EXISTING FISH PASSAGE CONDITIONS

Ryan Creek supports runs of Coho and Chinook salmon and steelhead. Implementation of the project would result in long term improvement to fish passage on Ryan Creek and allow access to additional of spawning habitat. For more information on the existing fish passage conditions see the Ryan Creek Culvert Replacement Project final report dated November 2013.

SOUTH FORK RYAN CREEK

The existing culvert is 5-foot diameter CMP with a concrete lined invert and a 2.67 percent slope. The inlet is protected with a concrete headwall. The outlet invert is below channel grade and sediment has accumulated in the lower 40 percent of the culverts length. The metal above the concrete lining is perforated in some locations.

NORTH FORK RYAN CREEK

The existing culvert is 5-foot diameter CMP with a concrete lined invert and a 1.67 percent slope. The inlet is protected by a concrete headwall. The outlet is perched approximately 4.5 feet with outfall onto large rocks. The culvert itself does not provide spawning gravels and is rated as a barrier to all life stages of fish.

SITE CONDITIONS AND CONSIDERATIONS

Between April and July 2011, initial base mapping was developed through conventional survey methods for the Ryan Creek project. In May 2012 additional hand surveys were requested to incorporate the counties new Ryan Creek Road culvert, changes in the thalweg caused by the replacement of the Ryan Creek Road culvert, and

additional information within the project limits. There have been numerous site visits to Ryan Creek to gather photos, site information, and meet with agency staff and stakeholders concerning the proposed work.

SOUTH FORK RYAN CREEK

A portion of the existing culvert has accumulated sediments lacking suitable spawning gravels. The stream section immediately below the culvert shows sign of aggradation. The stream is bounded by developed parcels between MEN 101 and Ryan Creek Road. The stream is confined to a corridor approximately 40 feet wide with side slopes of 1.5:1 or steeper, channel depths ranging from 3.5 to 8 feet, and streambed bottom widths ranging from 2 to 6 feet.

Upstream of the MEN 101 culvert the creek seems to be in equilibrium with signs of native bed material and areas where the stream overtops the existing channel banks into a small floodplain supporting mature riparian vegetation.

NORTH FORK RYAN CREEK

Suitable spawning habitat is not present within the culver. The stream section immediately below the culvert is deeply incised with little aggradation or spawning habitat. A narrow detached riparian corridor bounded by near vertical banks characterizes the stream section from the culvert downstream approximately 120 feet. Stream width at the plunge pool is approximately 20 feet but this quickly narrows to 4 to 5 feet. Further downstream, the stream is bounded by a developed parcel on one side and Ryan Creek Road on the other. The stream is confined to a corridor approximately 40 to 80 feet wide with channel depths ranging from 4 to 10 feet, and streambed bottom widths ranging from 2 to 6 feet. Structures are built along the top of the easterly bank.

Upstream of the MEN 101 culvert, the creek appears to be in equilibrium with signs of native bed material and areas where the stream overtops the existing channel banks into a small floodplain supporting mature riparian vegetation. There is a private culvert 1100’ upstream of the MEN 101 culvert that has not been evaluated as it relates to fish passage.

DESIGN SPECIES AND LIFE STAGES

Objectives of state and federal guidelines for new crossing installations include provision of unimpeded passage for both adult and juvenile salmonids. After meeting onsite at Ryan Creek with representatives from CDFW and NMFS, the following criterion was agreed to by all parties:

SOUTH FORK RYAN CREEK

The proposed fish passage design will allow upstream passage for all salmonid life stages.

NORTH FORK RYAN CREEK

The proposed fish passage design will allow upstream passage for all salmonid life stages.

DESIGN APPROACH

The Ryan Creek project proposes to remove the existing culverts on MEN 101 at the South and North Forks of Ryan Creek with minimal channel realignment at each location. Route 101 is the interregional transportation corridor for the western part of the state; this means that the route must stay open to traffic at all times. Both existing culverts are undersized. When the culverts were constructed over 50 years ago fish passage and stream connectivity were not factors in sizing culverts. The culvert size needs to be greatly increased to include fish passage and stream connectivity considerations. The guidelines in the Caltrans manual *Fish Passage Design for Road Crossings* and the CDFW manual *Fish Passage and Implementation Part XII* do not emphasize hydraulic capacity. The manuals help design culverts having internal flows that behave much like those within a natural streambed; thus culverts designed to specifications provided by the two manuals have more than adequate hydraulic capacity. When flows within the barrel of a culvert are similar to those within a natural stream, flow velocities allow fish passage and contribute to stream connectivity.

SOUTH FORK RYAN CREEK

The limiting factors for fish passage in the existing culvert are length, hydraulic capacity, and grade. These factors affect the speed and depth of flow through the culvert which currently allows only minimal adult passage. With CDFW and NMFS concurrence, and factoring in the work Five Counties has completed upstream and downstream of the existing facility, Caltrans proposes the following work for this culvert.

The existing culvert within the state right of way is to be removed and replaced with two 10-foot diameter steel pipes counter sunk to a depth of 42 inches (Attachment A-2, PV-1). There were several factors which led to this decision. First, the project is to provide fish passage and the existing culvert is not sized to provide for fish passage or stream connectivity so lining, baffles, etc. are not suitable options. Second, MEN 101 is an interregional transportation corridor and the depth of fill over the existing culvert is in excess of 35 feet which eliminates most conventional methods of culvert replacement. A cut and cover operation, which means cutting the pavement, digging the existing culvert up and then placing new culverts in the same alignment, is not practical because of the depth of fill. The cut and layback slopes for a cut and cover operation would be significant and the highway would have to be detoured leading to significant and serious environmental impacts. Jacking or ramming pipes was selected in order to minimize environmental impacts including damages to the surrounding riparian corridor. Pipes cannot be rammed or jacked on an existing pipe alignment and therefore would be offset to the south of the existing alignment. The proposed alignment takes advantage of a bend in the existing creek thalweg. There is a minor loss of sinuosity but the stream is in a better relationship with the downstream thalweg which would enhance outlet stability.

The CDFW and Caltrans manuals suggest sizing culvert pipes at least 1.25 times the width of the stream. The reference stream reach width is 96 inches. The Caltrans manual also discusses acceptable headwater which, if using a 10-foot diameter pipe, is less than 5 feet; the computed head of 3 feet is within standard guidelines. A 10-foot diameter culvert pipe was selected for this project based on these estimates. A HEC-RAS analysis, based on using one 10-foot diameter culvert pipe, predicted velocities would mobilize gravels and other potential habitat within the culvert in relatively small storms (less than 5-year.). This level of mobilization is not acceptable and after several iterations, a HEC-RAS run using two 10-foot diameter culverts predicted lower velocities and a more realistic streambed environment within the culverts. A two culvert design would also improve stream movement and connectivity. For these reasons a two culvert system was chosen over the preferred single culvert.

The material placed within the culverts would be a native bed material or clean sand and gravel for spawning habitat (Attachment A-3, FPP-1). Nine rock weirs are proposed with the uppermost weir constructed at existing grade to maintain the stream profile upstream of the proposed project area. Each weir would be constructed to provide a 0.5-foot drop between each structure. W-shaped weirs are proposed for construction at the inlet and outlet. This feature would allow pools to form at each culvert and would allow the stream to adjust between the culverts. At the discretion of the engineer, the proposed work would excavate material where necessary to achieve a minimum water depth of 2.5 feet between rock weirs to provide for spawning habitat (Attachment A-4, DD-2).

Following an onsite field visit, CDFW, NMFS, Five Counties Salmonid Conservation Program, and Caltrans agreed to the preliminary design presented in this report. Under an adaptive strategy, modifications to designs would be applied as needed.

NORTH FORK RYAN CREEK

The limiting factors for fish passage in the existing culvert are the length and grade. The outlet is perched 4.5 feet above large rocks which prohibits fish passage through this culvert. With CDFW and NMFS concurrence, and factoring in the work Five Counties has completed upstream and downstream of the existing facility, Caltrans proposes the following work for this culvert.

The existing culvert within the state right of way is to be removed and replaced with a 12-foot by 10-foot reinforced concrete box (RCB) countersunk to a depth of 2 feet (Attachment A-2, PV-2). There were several factors which led to this decision. The depth of fill allows for a standard cut and cover operation which would maintain the existing stream alignment. The existing streambed in the reference reach is 84 inches wide which means the minimum culvert size of 9-foot diameter could be used. The HEC-RAS predicted flow velocities within a 9-foot diameter culvert were too high. Material within the culvert would be mobilized and washed downstream in relatively small storms (less than 2 years). A 12-foot by 10-foot RCB was selected after multiple HEC-RAS iterations. The predicted velocities for this size RCB would ensure a stable streambed within the box. The material placed within the culverts would be a native bed material or clean sand and gravel for spawning habitat (Attachment A-3, FPP-2). Fourteen rock weirs are proposed with the uppermost weir constructed at existing grade to maintain the stream profile upstream of the proposed project area. Each weir would be constructed to provide a 0.5-foot drop between each structure. The design approach for most of the spaces between rock weirs would be to place a thin layer of native material and allow deep pools to form. At the discretion of the engineer, the proposed work would excavate material where necessary to achieve a minimum water depth of 2 feet between rock weirs to provide for spawning habitat. Scouring at the outlet is severe. Therefore, at the engineer's discretion, where the streambed has widened, realigned, or existing scour holes are excessively deep, a layer of rock slope protection (RSP) backfill would be placed below the clean sand and gravel layer to insure stream grade stability (Attachment A-4, DD-2).

Following an onsite field visit, CDFW, NMFS, Five Counties Salmonid Conservation Program, and Caltrans agreed to the preliminary design presented in this report. Under and adaptive strategy, modifications to designs would be applied as needed.

ENGINEERED STEAM BED MATERIAL

There are multiple components to engineered streambed material. The uppermost component is native bed or clean sand and gravel. The second component is RSP backfill that is placed in areas where there is a need for stream grade stability and to prevent piping (Attachment A-3, FPP-1 and FPP-2; Attachment A-4).

If enough native material is harvested during excavation activities, and is deemed suitable for spawning habitat, the material would be placed in the bottom of the culverts and between rock weirs as shown on the proposed plans or as directed by the site engineer. Clean sand and gravel would be used if not enough native material could be harvested from onsite construction activities. Clean sand and gravel is an item description Caltrans uses for contract purposes. The gradation breakdown of the item was agreed upon by Caltrans materials and construction divisions, with concurrence from CDFW and NMFS to develop a suitable make-up of material for streambed stability and spawning gravel. CDFW and Caltrans manuals give guidance on developing a proper depth of this material, and both methods were used to check the design depth. This material is also developed to mimic a natural streambed which means it is supposed to mobilize and migrate. During most flows, little mobilization is expected other than small grains and fine material. During larger flow events, increased streambed mobilization would be expected. However, mobilization and recruitment rate would be expected to be similar, thus there would be no net loss of material.

The second component of engineered streambed material is RSP backfill. This material is placed below the native bed material or clean sand and gravel where there is a concern about stream grade stability. Between weirs and culvert inlets and outlets where there are Hydraulic forces can destabilize stream grade lines. This can occur between weirs, culvert inlets and outlets, or deep holes or areas where the stream has unnaturally been widened or realigned by hydraulic forces. These places tend to seal improperly leading to discontinuity in stream flows. This discontinuity is sometimes caused as surface water disappears and flows sub-surface only to reappear downstream; this is called piping. This prevents stream connectivity and inhibits passage of juvenile fish. RSP material is a mixture of rock sized to withstand hydraulic forces and void filler having a plasticity index which seals interstitial spaces. The void filler material is jetted, rodded, and tamped into the rock voids to seal the streambed and prevent piping.

BANKLINE ROCK

Reconstructed streambed banks are designed to be resistant to erosion, much like natural streambeds. A common failure of reconstructed banks is flanking which occurs when the stream flow finds a weak spot and realigns around the edge of the weir instead of going over the rock weir. This component of the stream cross section is referred to as bankline rock (Attachments A-3, FPP-1 and FPP-2; Attachment A-4, DD-2).

CDFW and Caltrans manuals provide guidance on developing properly sized material to line channels. One of the benefits of modeling the stream in HEC-RAS is that the velocity along the bank is predicted from which a minimum rock size can be determined. The standard is to go one size larger than the HEC-RAS results predict; this is because bankline rock is not a standard RSP gradation. The gradation should include the large rocks determined through HEC-RAS and include smaller material to fill voids and prevent piping. If enough native material is harvested during excavation activities that meet plasticity index and gradation criteria, the material can be incorporated with the bankline rock to fill voids and seal stream banks. Otherwise, the void filler used with the RSP backfill can be used to insure that stream banks perform as desired.

Bankline rock is a form of RSP which includes a material to stabilize it with native material. The interaction of the rock with the slope in a stream can be unstable over time. This is caused by the manner in which water flows around large rocks and native material while mobilizing finer clasts. Through time this causes bank destabilization and failure. A common practice to prevent this is to place RSP geotextile fabric between the bank protection component and native soils. This practice is frowned upon in fish bearing streams and footing rock is the preferred approach. Footing rock protects stream banks from losing the supporting soils and reduces the need for geotextiles in the stream environment. Samples of native material are taken and analyzed to develop an appropriate footing rock size to place between the bankline rock and native soil to prevent the loss of soil through erosion.

ROCK WEIR AND CUT-OFF SILL

Step pool height for this project was developed through consultation with NMFS and CDFW. The CDFW and Caltrans manuals provide clear guidance on how to size the large rock for the construction of the rock weirs and cut-off sills. One of the pieces of information a HEC-RAS analysis provides is flow velocities in the main channel. Given this information an appropriate rock size can be determined for weir and sill construction. It is common practice to use slightly larger rock size for weir and sill construction than the size rock suggested by HEC-RAS analysis. Both manuals provide guidance on weir placement and distance between drop structures; however, the geomorphology of the stream and other factors also need to be accounted for. Both Ryan Creek reaches are in a state of equilibrium on the inlet side of the existing culverts. A decision was made to maintain the integrity of the upstream conditions and focus pool construction on the outlet side of the new culverts where the stream environment is not conducive to fish passage (Attachment A-2, PV-1 and PV-2; Attachment A-4, DD-1).

Construction of the drop structures was divided into two parts. The rock weir is the part of the structure located between the bankline rocks. The cut-off sills are the part of the structure positioned out from the bankline rock. The rock weir is the area where fish would be jumping between pools and this necessitates the need for vertically stacked rocks and shaped in a manner facilitating downstream pool maintenance. There is a certain amount of disability introduced into the weir but it is the only way to get the vertical leap path and pool depth needed by adult fish to successfully jump from one pool to another. Cut-off sill configuration is perpendicular to the mainstem flow; the sides of each sill are 1:1 and the top of the sill is at ground level in the overbank region of the stream. Each sill is keyed into the side slope of the overbank area. Proposed designs are consistent with guidance provided in CDFW and Caltrans manuals concerning depth of embedment for each sill. Keying in each sill to the proper depth prevents flanking and ensures drop structure stability through time. With this guidance in mind, an alignment was developed along the centerline of each structure, and this alignment would be staked in the field to ensure each drop structure is placed according to designs.

The weirs and sills would be constructed on footing rock to help with main rock placement and structure stabilization. Each weir and sill would be placed with a minimum three point contact and voids would be filled with a rock weir backfill to ensure the structures do not leak and function as expected. The void filler would be jetted into the voids and tamped to ensure proper sealing.

DESIGN FLOWS

For the proposed designs, fish passage and flood flows were developed for both locations. The following hydrologic information was used:

SOUTH FORK RYAN CREEK

- Drainage Area: 1.15 miles^2
- Mean Annual Precipitation: 51 inches
- Mean Basin Elevation: 1600 feet

NORTH FORK RYAN CREEK

- Drainage Area: 0.67 miles^2
- Mean Annual Precipitation: 51 inches
- Mean Basin Elevation: 1600 feet

PEAK FLOWS

The various flows for the areas were derived using the National Resources Conservation Services (NRCS) method; they were checked with the regional regression equations shown in the Caltrans Highway Design Manual (sixth edition). See the Ryan Creek Drainage Report for details. The flows in Table 1 were used in the HEC-RAS model to predict the effect from different flows on fish passage structures.

Table 1 NRCS Peak Discharge for Fish Passage

Location	Q_2		Q_5		Q_{10}		Q_{25}		Q_{50}		Q_{100}	
	m^3/s	ft^3/s	m^3/s	ft^3/s	m^3/s	ft^3/s	m^3/s	ft^3/s	m^3/s	ft^3/s	m^3/s	ft^3/s
South Fork	2.61	92	5.68	201	8.43	298	12.46	440	15.44	545	19.17	678
North Fork	0.93	33	2.06	73	3.24	115	4.82	170	6.14	217	7.44	263

Caltrans policy is to design culverts to accommodate the 10-year flow without causing the headwater elevation to rise above the top of the inlet culvert. On a 100-year flow, the headwater cannot rise above an elevation that would cause objectionable backwater depths or outlet velocities (Caltrans HDM 820-2). Additionally, the 100-year flows were used for the design of the bank lined rock and rock weir boulder sizes. The 2-year flows were used in the design of the channel geometry for each location.

FISH PASSAGE DESIGN FLOWS

The proposed step pools are hydraulic designs consistent with designs described in the section Fish Passage Design and Implementation within CDFW's California Salmonid Stream Habitat Restoration Manual and the section Rock Weir Design within Caltrans' Fish Passage Design for Road Crossings Manual. Hydraulic design should provide suitable fish passage conditions (depth, velocity, and turbulence) for each species and life stage of interest at migration flows. NMFS and CDFW guidelines define these flows in terms of annual exceedance obtained from flow duration curves or 2-year return period flows.

For this project, flows allowing passage of all salmonid life stages were considered for both forks of Ryan Creek. High flows for each site were developed from 2-year return period flows derived from the NRCS method. Low flows for each site were developed from exceedance curves built with gauge data from two different stations within the Outlet Creek watershed. These flows were less than the minimum alternative flows given in both the CDFW and Caltrans manuals so the minimum alternative flows were used.

Table 2 Fish Passage Design Flows					
Location	Species and Life Stage	Low Flow		High Flow	
		m^3/s	ft^3/s	m^3/s	ft^3/s
South Fork Ryan Creek	Adult Salmon	0.08	3	1.31	46
				(50% 2-yr Return Period Flow)	
	Juvenile Salmonids	0.03	1	0.26	9
				(10% 2-yr Return Period Flow)	
North Fork Ryan Creek	Adult Salmon	0.08	3	0.46	16
				(50% 2-yr Return Period Flow)	
	Juvenile Salmonids	0.03	1	0.09	3
				(10% 2-yr Return Period Flow)	

FISH PASSAGE CRITERIA

CDFW, NOAA, and Caltrans fish passage guidelines recommend minimum water depths, maximum average water velocities, and maximum water surface drop for passage of salmonids at stream crossings. After meeting in the field with representatives from the various agencies, the following fish passage criteria were agreed upon (Table 3). These criteria should be satisfied at both low and high fish passage design flows to provide unimpeded fish passage. These requirements should be met because existing culverts would be removed and grade control structures would be placed in the creeks.

Table 3 Fish Passage Depth, Velocity, and Drop Criteria						
Species and Life Stage	Minimum Water Depth		Maximum Ave. Water Velocity		Maximum Water Surface Drop	
	mm	ft	m/s	ft/s	mm	ft
Juvenile Salmonids	152	0.50	0.30	1.00	152	0.50
Adult Salmonids	305	1.00	1.52	4.00	305	1.00

HYDRAULIC MODELING APPROACH

Two models were developed to find the hydraulic conditions at each location; one with existing conditions and the other with the proposed designs.

EXISTING CONDITIONS

Existing conditions included culvert grade, stream grade, and alignment and were modeled using HEC-RAS. The model was checked using the Culvert Master model and field observations.

LOW FISH PASSAGE FLOW

At the low fish passage flow, the existing HEC-RAS model was modified to reflect weir placements, and stream channel profile and alignment modifications. The culverts were not placed in this model because the flows are negligible in regard to culvert geometry. The channels were modeled as open channel through the structures.

HIGH FISH PASSAGE FLOW

At the high fish passage flow, the existing HEC-RAS model was modified to reflect weir placements, and stream channel profile and alignment modifications. The culverts were not placed in this model because the flows are negligible in regard to culvert geometry. The channels were modeled as open channel through the structures.

PEAK FLOW CAPACITY

At peak flow, the existing HEC-RAS model was modified to reflect weir placements, and stream channel profile and alignment modifications. The culverts were placed in this model and the stream bed material profile was used for the bottom chord in the structure.

FISH PASSAGE CONDITIONS IN SOUTH FORK RYAN CREEK

Details of the various models at specific weirs and cross-sections are available in South Fork Ryan Creek HEC-RAS Results (provided upon request). The range of results for the weirs and cross sections are summarized in Tables 4 and 5.

Table 4 Low Flow Passage Design

23+75 to 26+75 (South Fork Ryan Creek)

Low Flow Passage Conditions	Flow		Existing Conditions				Proposed Conditions			
			Depth		Velocity		Depth		Velocity	
	m^3/s	ft^3/s	m	ft	m/s	ft/s	m	ft	m/s	ft/s
Juvenile Salmonids	0.03	1	0.05 - 0.57	0.17 - 1.86	0.08 - 0.71	0.25 - 2.32	0.19 - 0.87	0.62 - 2.86	0.01 - 0.11	0.03 - 0.37
Adult Salmonids	0.08	3	0.08 - 0.63	0.26 - 2.06	0.19 - 0.78	0.61 - 2.55	0.23 - 0.91	0.75 - 2.99	0.02 - 0.24	0.08 - 0.78

Table 5 High Flow Passage Design

23+75 to 26+75 (South Fork Ryan Creek)

High Flow Passage Conditions	Flow		Existing Conditions				Proposed Conditions			
			Depth		Velocity		Depth		Velocity	
	m^3/s	ft^3/s	m	ft	m/s	ft/s	m	ft	m/s	ft/s
Juvenile Salmonids	0.26	9.21	0.15 - 0.72	0.48 - 2.35	0.45 - 1.08	1.47 - 3.53	0.30 - 0.97	1.00 - 3.18	0.06 - 0.48	0.21 - 1.59
Adult Salmonids	1.30	46.03	0.33 - 0.93	1.08 - 3.06	0.61 - 1.78	1.99 - 5.85	0.46 - 0.98	1.50 - 3.23	0.22 - 1.11	0.73 - 3.65

WATER DEPTHS

From station 23+75 to 26+75 through the step pool complex the rock weirs were modeled as broad crest weirs and would provide a water depth of 0.75 feet during low flows, which is outside the design criteria, and meets fish passage criteria during high flows across the crests themselves. HEC-RAS does not model rock weirs accurately because water flowing over the rock reflects broad crest weir flow characteristics and water flowing between the rock reflects v-shaped weir flow characteristics. The most conservative answer for water depth is to model the

weirs as a broad crest weir with the understanding that the true water depth in the gaps between weirs is greater than the model results.

The stream bed is being rebuilt from 24+63 to 26+75. The Minimum Water Depth is not achieved in some places for adults during low flows where the streambed is not altered between rock weirs.

WATER VELOCITIES

The stream bed would be rebuilt from 24+63 to 26+75; the Maximum Average Water Velocity is not achieved for juveniles in some places where the streambed is not altered between rock weirs.

WATER DROPS

The recommended maximum drop for juvenile salmonids is 0.5 feet. With the proposed rock weir configuration a drop of 0.5 feet is achieved for the design flows. The proposed rock weirs at the upper end are at existing grades and have no drop associated with them.

FISH PASSAGE CONDITIONS IN NORTH FORK RYAN CREEK

Details of the various models at specific weirs and cross-sections are available in North Fork Ryan Creek HEC-RAS Results (provided upon request). The range of results for the weirs and cross sections are summarized in Tables 6 and 7.

Table 6 Low Flow Passage Design

15+75 to 19+40 (North Fork Ryan Creek)

Low Flow Passage Conditions	Flow		Existing Conditions				Proposed Conditions			
			Depth		Velocity		Depth		Velocity	
	m^3/s	ft^3/s	m	ft	m/s	ft/s	m	ft	m/s	ft/s
Juvenile Salmonids	0.03	1	0.005 - 0.04	0.16 - 1.36	0.002 - 0.06	0.07 - 2.13	0.23 - 1.28	0.77 - 4.19	0.003 - 0.06	0.01 - 0.15
Adult Salmonids	0.08	3	0.008 - 0.04	0.28 - 1.58	0.004 - 0.08	0.15 - 2.69	0.30 - 1.32	1.00 - 4.34	0.01 - 0.12	0.03 - 0.39

Table 7 High Flow Passage Design

15+75 to 19+40 (North Fork Ryan Creek)

High Flow Passage Conditions	Flow		Existing Conditions				Proposed Conditions			
			Depth		Velocity		Depth		Velocity	
	m^3/s	ft^3/s	m	ft	m/s	ft/s	m	ft	m/s	ft/s
Juvenile Salmonids	0.26	9.21	0.008 - 0.05	0.29 - 1.60	0.005 - 0.08	0.16 - 2.70	0.29 - 1.33	0.95 - 4.35	0.01 - 0.13	0.03 - 0.42
Adult Salmonids	1.30	46.03	0.02 - 0.06	0.68 - 2.17	0.01 - 0.12	0.47 - 4.26	0.42 - 1.43	1.38 - 4.70	0.04 - 0.89	0.13 - 2.91

WATER DEPTHS

From station 15+75 to 19+40 through the step pool complex the rock weirs were modeled as broad crest weirs and provide a water depth of 1.0 feet during low flows, which is within the design criteria. HEC-RAS does not model rock weirs accurately because water flowing over the rock reflects broad crest weir flow characteristics and water flowing between the rock reflects v-shaped weir flow characteristics. The most conservative answer for water depth is to model the weirs as a broad crest weir with the understanding that the true water depth in the gaps between weirs is greater than the model results.

WATER VELOCITIES

From station 15+75 to 19+40 through the step pool complex the flow velocity meets fish passage criteria.

WATER DROPS

The recommended maximum drop for juvenile salmonids is 0.5 feet. With the proposed rock weir configuration a drop of less than 0.5 feet is achieved for the design flows. The uppermost proposed rock weir is at existing grade and has no drop associated with it.

HYDRAULIC CAPACITY

SOUTH FORK RYAN CREEK

Culvert capacity was calculated using HEC-RAS. Under existing conditions, the existing culvert is below grade at the outlet and 25 feet of headwater at the inlet. The headwater would be removed and the stream gradient re-established with the removal of the existing culvert and construction of a double 10-foot diameter steel pipe culvert and rock weirs. The California Highway Design Manual has an established clearance from water surface elevations for hydraulic evaluation. The structures in the South Fork have more than adequate freeboard during peak flow events.

NORTH FORK RYAN CREEK

Culvert capacity was calculated using HEC-RAS. Under existing conditions, the existing culvert had over a 4.25-foot drop at the outlet and 5 feet of headwater at the inlet. The headwaters would be removed and the stream gradient would be re-established with the removal of the existing culvert and the construction of a 12-foot by 10-foot RCB and rock weirs. The California Highway Design Manual has an established clearance from water surface elevations for hydraulic evaluation. The structure in the North Fork has more than adequate freeboard during peak flow events.

CONCLUSIONS

SOUTH FORK RYAN CREEK

One objective of the proposed project is to re-establish fish passage for all salmonid life stages in the project reach in South Fork Ryan Creek. With agency input, the project reach was characterized as potential adult spawning

habitat and potential juvenile rearing habitat. The proposed designs are based on passage criteria for all salmonid life stages.

The existing culvert is believed to block fish passage under most flow conditions. The step pools would be constructed around and below the new culverts and would provide sufficient water depths and acceptable velocities throughout the project stream reach for all salmonid life stages. Although passage barriers exist upstream of the project reach, the proposed project would provide a significant improvement in adult upstream passage conditions and juvenile rearing habitat for all salmonids within the project reach. The proposed project is the first step towards providing upstream access to significant amounts of high quality spawning and rearing habitat.

NORTH FORK RYAN CREEK

One objective of the proposed project is to re-establish fish passage for all salmonid life stages in the project reach in North Fork Ryan Creek. With agency input, the project reach was characterized as potential adult spawning habitat and potential juvenile rearing habitat. The proposed designs are based on passage criteria for all salmonid life stages.

The existing culvert is believed to completely block fish passage under a full range of flow conditions. The step pools would be constructed around and below the new RCB and would provide sufficient water depths and acceptable velocities throughout the project stream reach for all salmonid life stages.

It is uncertain if passage barriers exist upstream of the proposed project reach. However, the proposed project is the first step towards providing upstream access to significant amounts of high quality salmonid spawning and rearing habitat.

REFERENCES

Bentley Systems Haestad Methods. 1996. CulvertMaster v3.1.

California Department of Fish and Game. 2009. California Salmonid Stream Habitat Restoration Manual. PART XII Fish Passage Design and Implementation.

Caltrans. 2009. Fish Passage Design for Road Crossings. Appendix N Rock Weir Design.

———. 2005. District 1 Pilot Fish Passage Assessment Volume 1. Prepared by Environmental Resources Engineering Humboldt State University.

National Marine Fisheries Service. 2001. Guidelines for Salmonid Passage at Stream Crossings. NMFS Southwest Region.

US Department of Transportation. 1985. Hydraulic Design of Highway Culverts. HDS 5.

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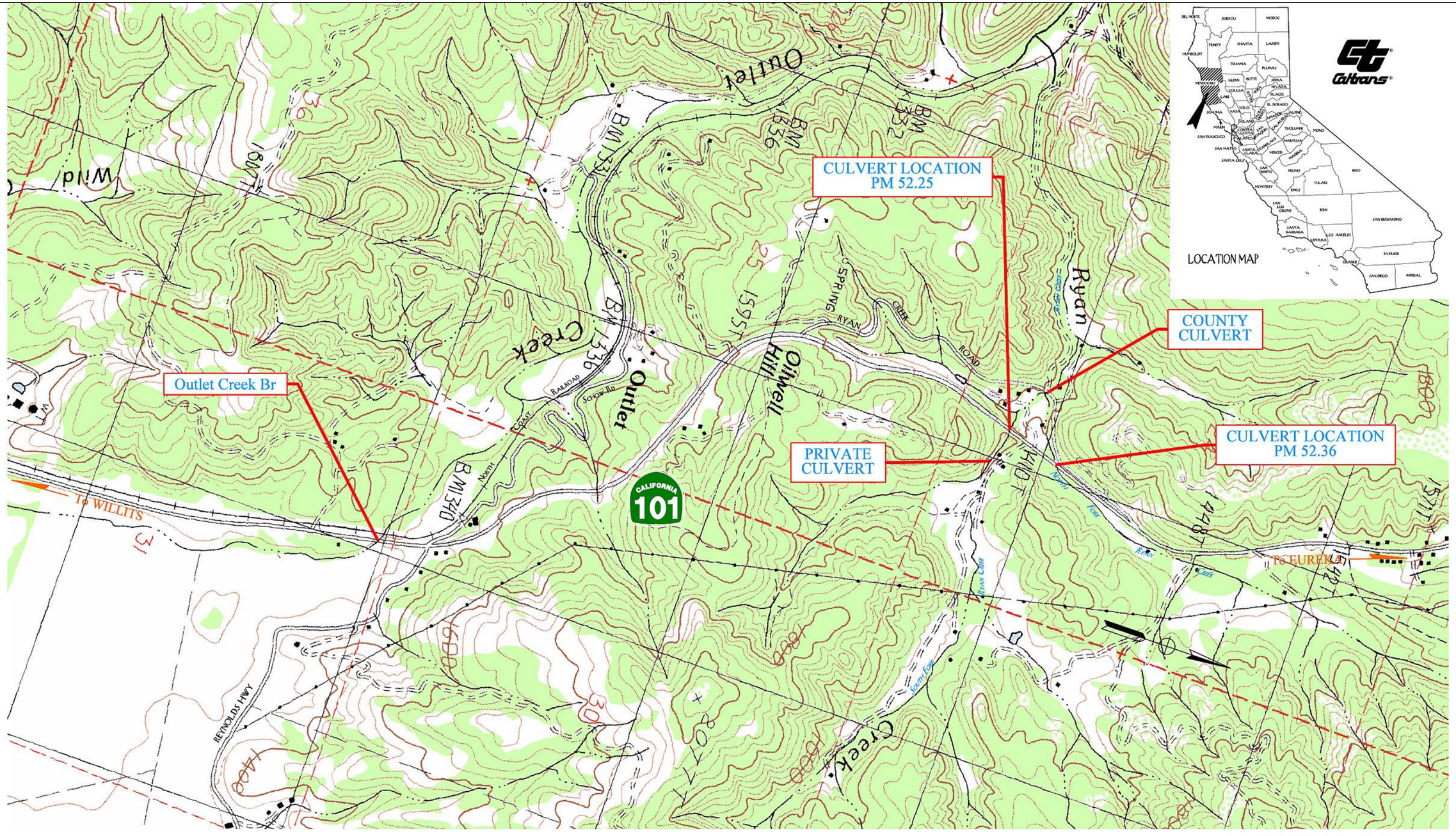

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PROJECT ID No.
PREPARED BY DESIGN M5
NOVEMBER 1, 2012

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SCALE

ATTACHMENT A-1

RYAN CREEK
FISH PASSAGE

WILLITS BYPASS 1602 PERMIT MITIGATION MEASURE

RYAN CREEK PROJECT ON ROUTE 101

NOTES:
1. THIS PLAN ACCURATE FOR FISH PASSAGE ONLY.
2. SEE LAYOUT PLANS FOR ACCURATE GEOMETRIC INFORMATION.
3. SEE UTILITY PLANS FOR ACCURATE UTILITY INFORMATION.

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
01	MEN	101	VAR		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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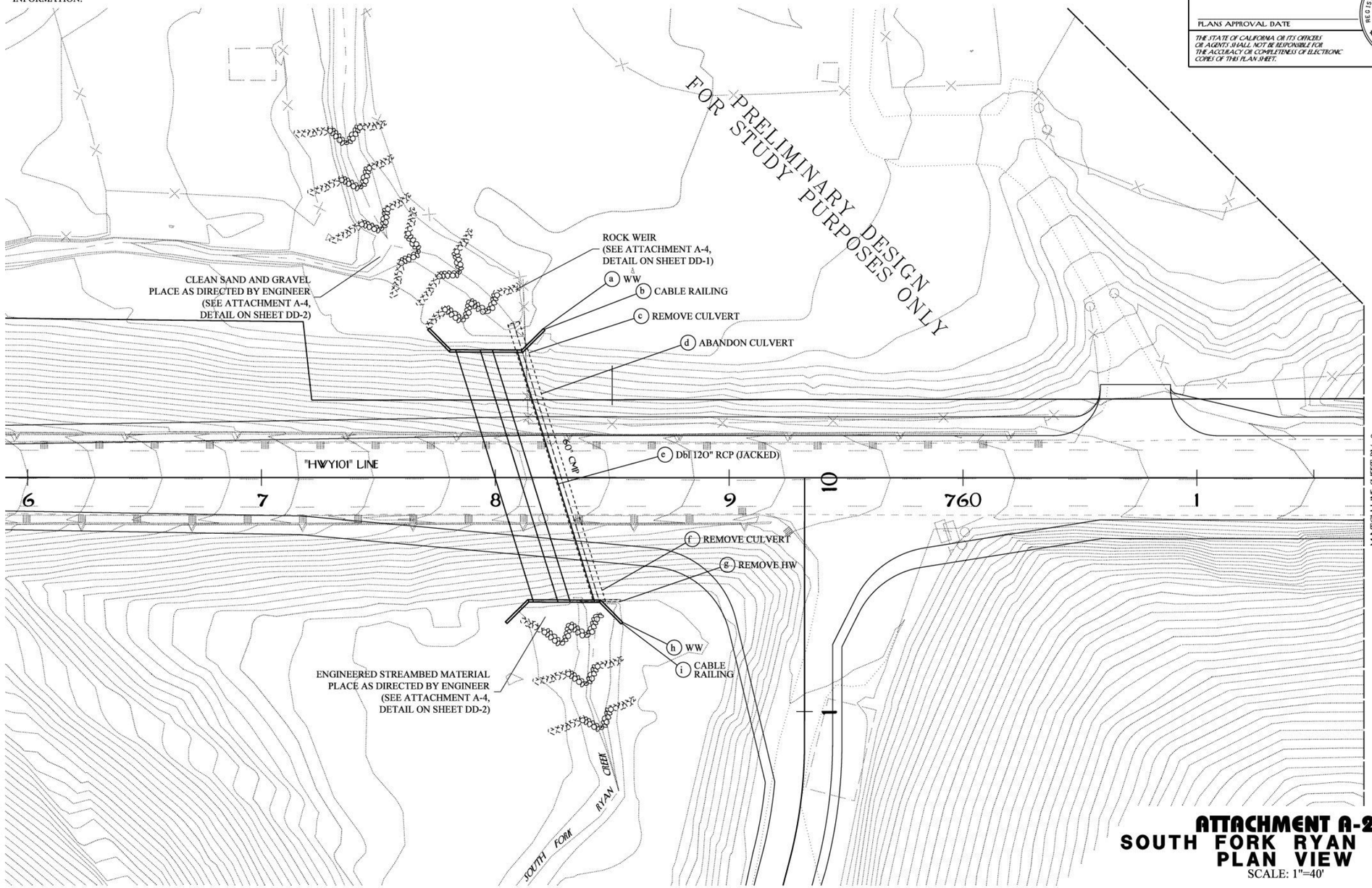

ATTACHMENT A-2
SOUTH FORK RYAN CREEK
PLAN VIEW
SCALE: 1"=40'

PV-1

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STATE OF CALIFORNIA ~ DEPARTMENT OF TRANSPORTATION
Caltrans
DIVISION OF DESIGN

FUNCTIONAL SUPERVISOR: DOUGLAS S. JONES
CALCULATED~DESIGNED BY: S FOSTER
CHECKED BY: R MIRANDA
REVISED BY
DATE REVISED

LAST REVISION 03-20-12
DATE PLOTTED => 01-OCT-2013
TIME PLOTTED => 12:02

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PROJECT NUMBER & PHASE 01000000051

NOTES:

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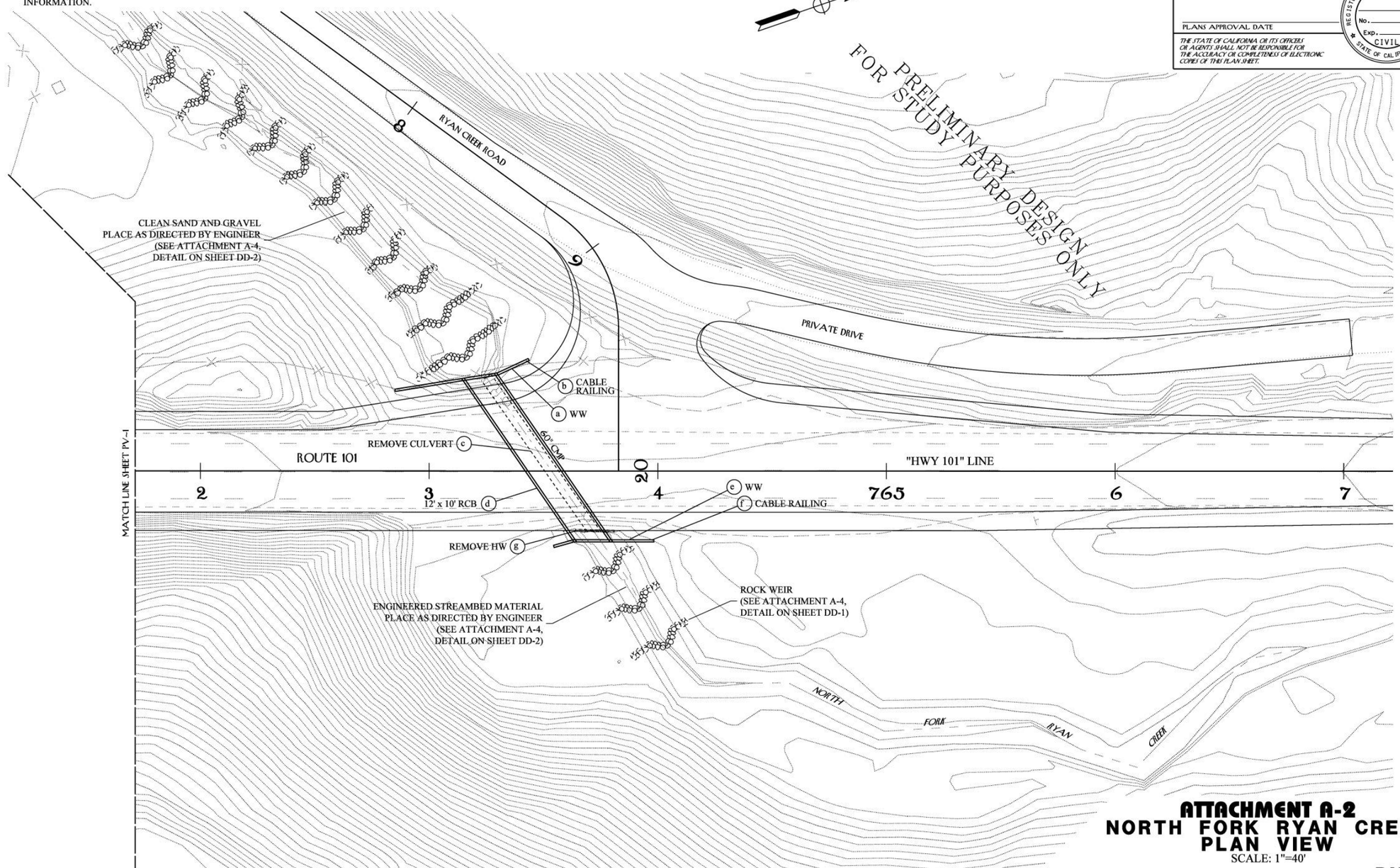

ATTACHMENT A-2
NORTH FORK RYAN CREEK
PLAN VIEW

SCALE: 1"=40'

PV-2

REVISED BY	S FOSTER
DATE REVISED	R MIRANDA
CALCULATED-DESIGNED BY	
CHECKED BY	
FUNCTIONAL SUPERVISOR	DOUGLAS S. JONES
STATE OF CALIFORNIA ~ DEPARTMENT OF TRANSPORTATION	DIVISION OF DESIGN

Caltrans

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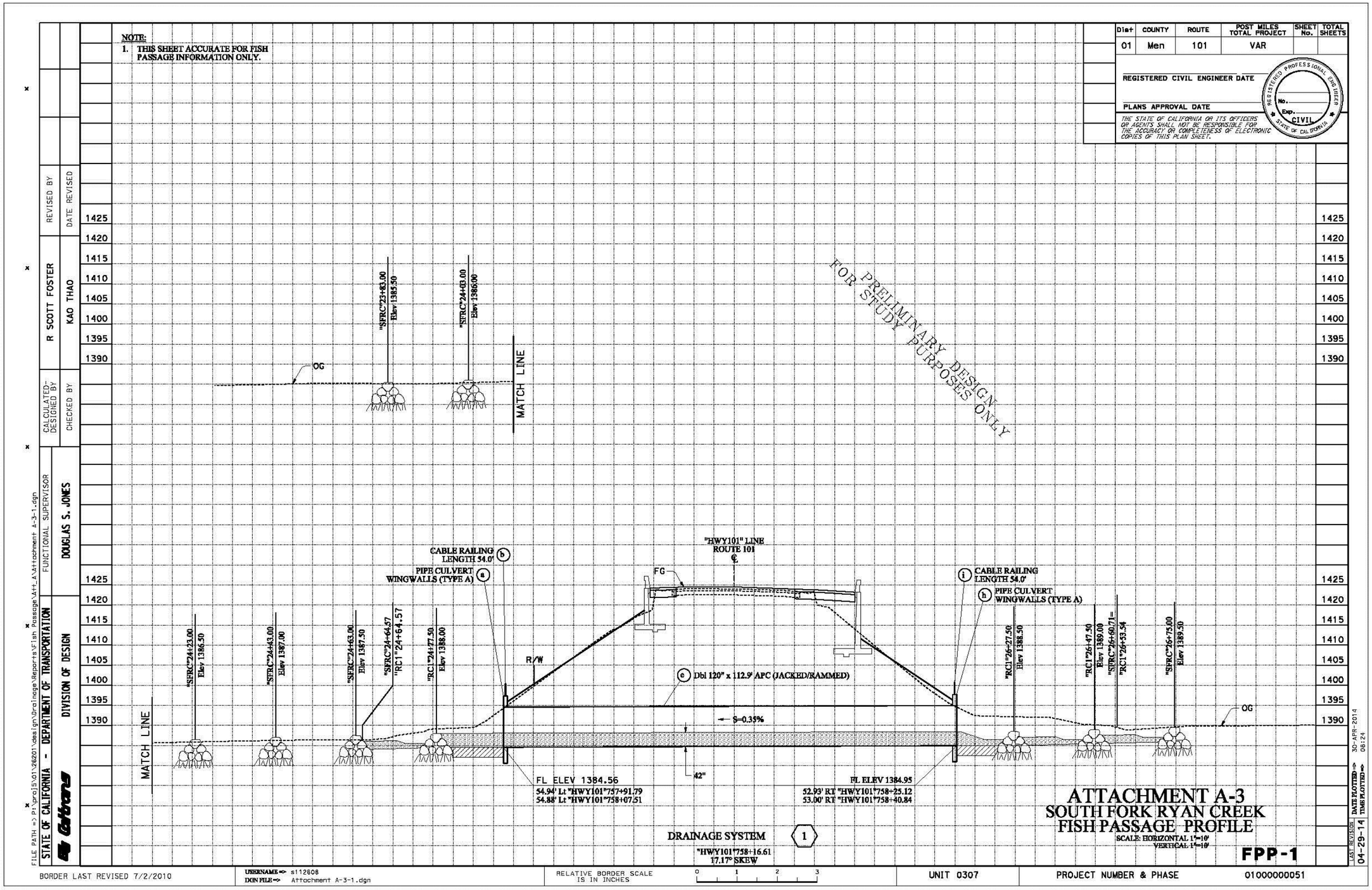
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ROUTE 101
POST MILES TOTAL PROJECT VAR
SHEET No.
TOTAL SHEETS
REGISTERED CIVIL ENGINEER DATE
PLANS APPROVAL DATE
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No.
Exp.
CIVIL
STATE OF CALIFORNIA
PRELIMINARY DESIGN FOR STUDY PURPOSES ONLY
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1420
1415
1410
1405
1400
1395
1390
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"SFRC"24+03.00 Elev 1386.00
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CABLE RAILING LENGTH 54.0'
PIPE CULVERT WINGWALLS (TYPE A)
"HWY101" LINE ROUTE 101 ℄
FG
R/W
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54.88' Lt "HWY101"758+07.51
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DRAINAGE SYSTEM 1
"HWY101"758+16.61
17.17° SKEW
ATTACHMENT A-3
SOUTH FORK RYAN CREEK
FISH PASSAGE PROFILE
SCALE: HORIZONTAL 1"=10'
VERTICAL 1"=10'
FPP-1
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
DIVISION OF DESIGN
FUNCTIONAL SUPERVISOR DOUGLAS S. JONES
CALCULATED-DESIGNED BY R SCOTT FOSTER
CHECKED BY KAO THAO
REVISED BY
DATE REVISED
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UNIT 0307
PROJECT NUMBER & PHASE 01000000051

NOTE:
1. THIS SHEET ACCURATE FOR FISH PASSAGE INFORMATION ONLY.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
01	Men	101	VAR		

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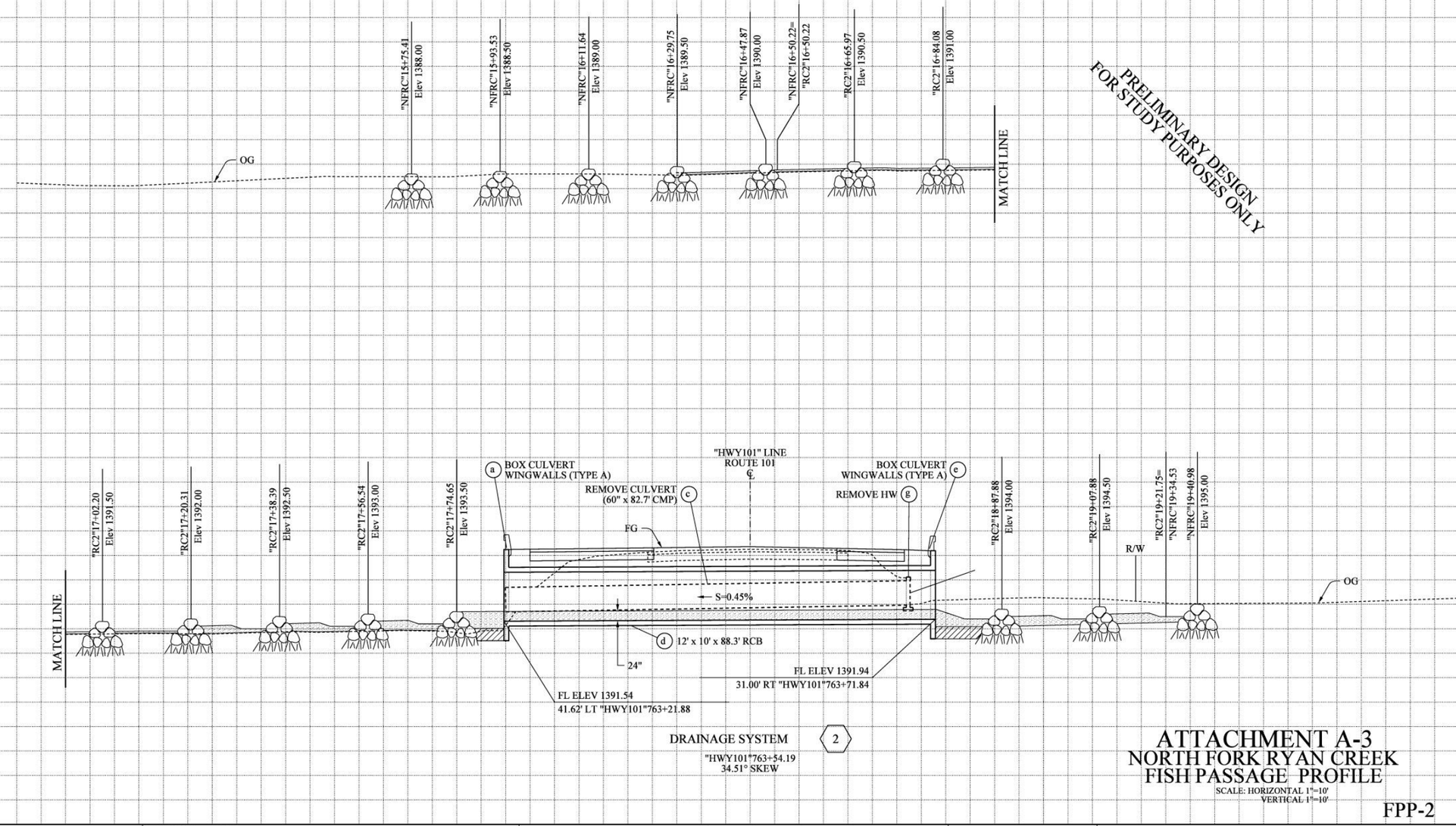

ATTACHMENT A-3
NORTH FORK RYAN CREEK FISH PASSAGE PROFILE

SCALE: HORIZONTAL 1"=10'
VERTICAL 1"=10'

FPP-2

FUNCTIONAL SUPERVISOR: DOUGLAS S. JONES
CALCULATED-DESIGNED BY: R SCOTT FOSTER
CHECKED BY: KAO THAO
REVISED BY / DATE REVISED
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
DIVISION OF DESIGN
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LAST REVISION 00-00-00

BORDER LAST REVISED 7/2/2010 | USERNAME => s112608 DGN FILE => Attachment A-3-2.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0307 | PROJECT NUMBER & PHASE 01000000051

NOTES:
1. THIS PLAN ACCURATE FOR FISH PASSAGE ONLY.
2.
3. PLACEMENT OF STONES 1, 2 AND 3 ARE TO BE DONE UNDER THE DIRECTION OF THE ENGINEER.

PRELIMINARY DESIGN FOR STUDY PURPOSES ONLY

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
01	Men	101	VAR		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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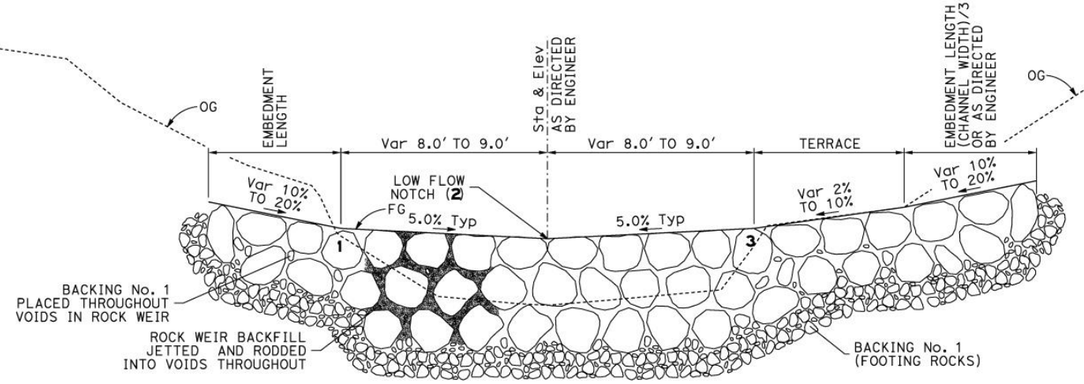
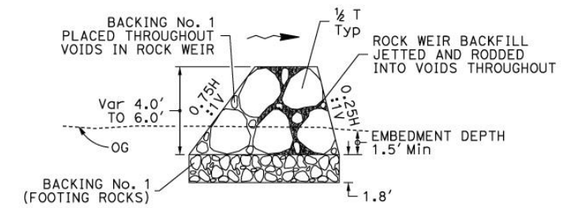
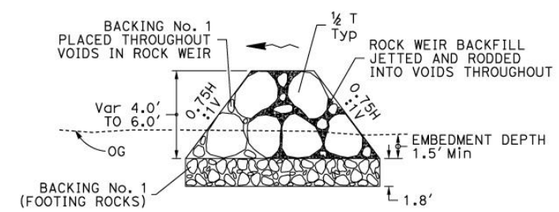


SECTION A-A



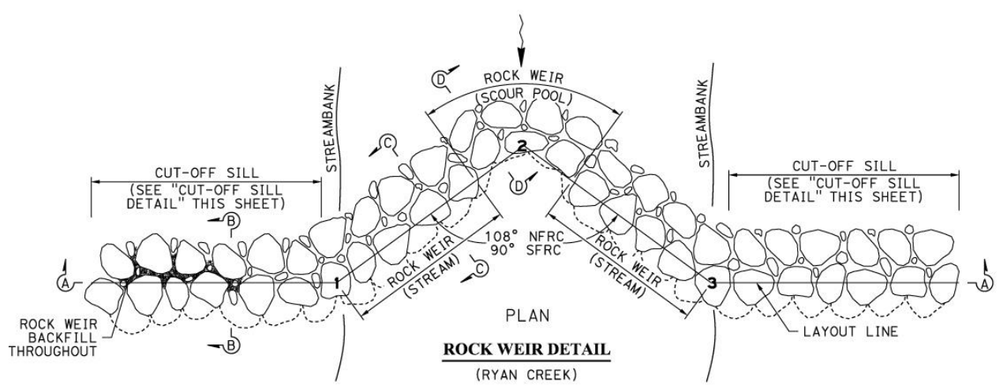
SECTION D-D

ROCK WEIR (SCOUR POOL)



SECTION C-C

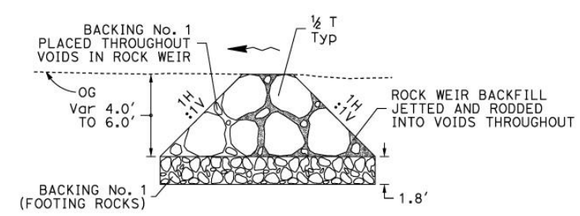
ROCK WEIR (STREAM)



PLAN

ROCK WEIR DETAIL

(RYAN CREEK)



SECTION B-B

CUT-OFF SILL (STREAM)

ATTACHMENT A-4
DRAINAGE DETAILS
NO SCALE

DD-1

REVISED BY	DATE REVISED

CALCULATED-DESIGNED BY	CHECKED BY
S FOSTER	R MIRANDA

FUNCTIONAL SUPERVISOR: DOUGLAS S. JONES

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
DIVISION OF DESIGN

FILE PATH => P:\proj5\01\26201\design\Drainage\Reports\Fish Passage\Attachment A-4.dgn

LAST REVISION 03-20-12 | DATE PLOTTED => 03-OCT-2013 | TIME PLOTTED => 13:06

BORDER LAST REVISED 7/2/2010 | USERNAME => s112608 | DGN FILE => Attachment A-4.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 20 40 60 | UNIT 0307 | PROJECT NUMBER & PHASE 01000000051

NOTES:
1. THIS PLAN ACCURATE FOR FISH PASSAGE ONLY.
2. ½T ROCKS FOR ROCK WEIR AND ROCK SILLS ARE PLACED INDIVIDUALY, PACKED TIGHTLY TOGETHER, AND HAVE A MINIMUM OF THREE CONTACT POINTS WITH ADJACENT ROCKS.
3. PLACEMENT OF STONES 1, 2 AND 3 ARE TO BE DONE UNDER THE DIRECTION OF THE ENGINEER.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
01	Men	101	VAR		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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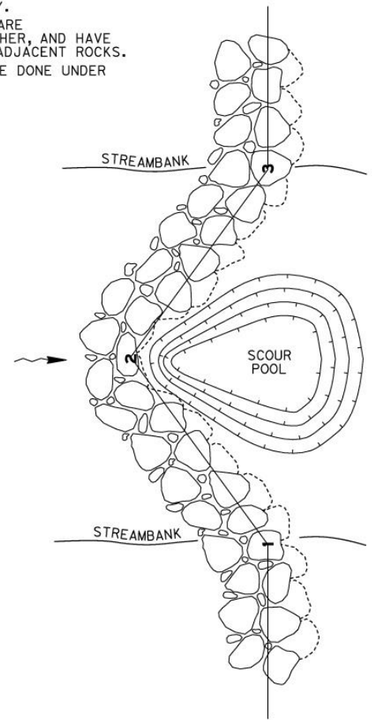
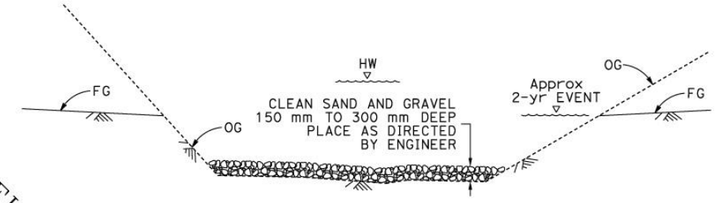
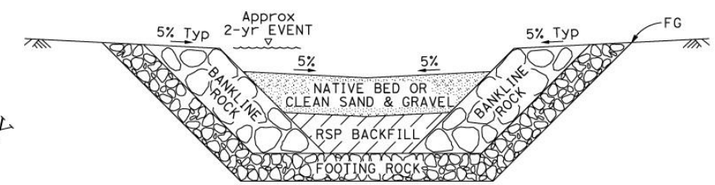




PLACING CLEAN SAND & GRAVEL IN EXISTING STREAMBED

Sta "SFRC"23+83.00 TO "SFRC"24+63.00
Sta "NFRC"15+75.41 TO "NFRC"17+20.31



NATIVE BED OR CLEAN SAND & GRAVEL

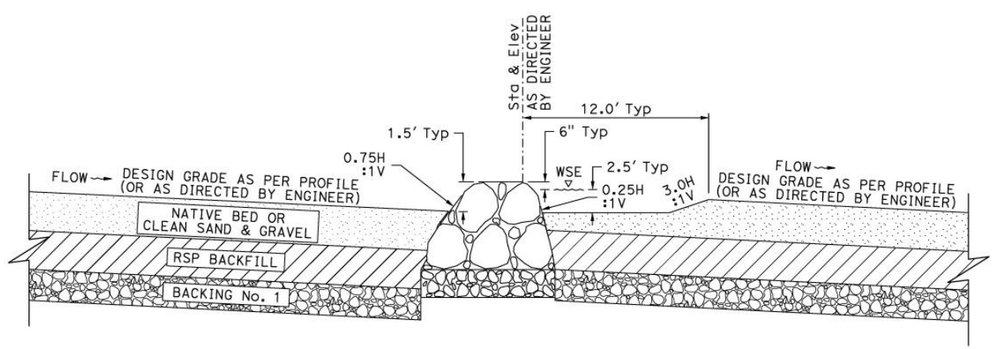
Sta "SFRC"24+63.00 TO "SFRC"26+75.00
Sta "NFRC"17+20.31 TO "NFRC"19+40.98

RSP BACKFILL

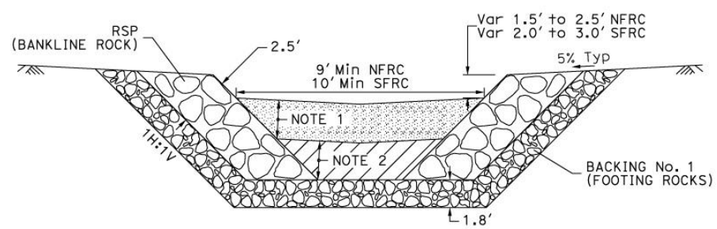
Sta "SFRC"24+77.50 TO "SFRC"24+98.28
Sta "SFRC"26+11.19 TO "SFRC"26+27.50
Sta "NFRC"17+74.65 TO "NFRC"17+83.88
Sta "NFRC"18+72.02 TO "NFRC"18+87.88

BANKLINE ROCK

Sta "SFRC"24+77.50 TO "SFRC"24+98.28
Sta "SFRC"26+11.19 TO "SFRC"26+27.50
Sta "NFRC"17+74.65 TO "NFRC"17+83.88
Sta "NFRC"18+72.02 TO "NFRC"18+87.88



SCOUR POOL DETAIL



NOTES
1. FOR SFRC 2.5', NFRC 2.0'.
2. FOR SFRC 2.5', NFRC 2.0'.

TYPICAL BANKLINE ROCK & ENGINEERED STREAMBED MATERIAL

FOR PRELIMINARY DESIGN STUDY PURPOSES ONLY

ATTACHMENT A-4
DRAINAGE DETAILS
NO SCALE

DD-2

REVISED BY	DATE REVISED

CALCULATED-DESIGNED BY: S FOSTER
CHECKED BY: R MIRANDA
FUNCTIONAL SUPERVISOR: DOUGLAS S. JONES

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
DIVISION OF DESIGN

FILE PATH => P:\proj5\01\26201\design\Drainage\Reports\Fish Passage\Attachment A-4.dgn

LAST REVISION 03-20-12 | DATE PLOTTED => 03-OCT-2013 | TIME PLOTTED => 11:46

BORDER LAST REVISED 7/2/2010 | USERNAME => s112608 | DGN FILE => Attachment A-4.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 20 40 60 | UNIT 0307 | PROJECT NUMBER & PHASE 01000000051

APPENDIX B

Alternative Designs to the Ryan Creek Fish Passage Design Proposal

A site visit to the Ryan Creek Culvert Replacement Project location was conducted on January 10, 2014. Participants included representatives from Caltrans, AECOM, NMFS, and CDFW. The attendance list is provided in Table 1. The objectives of the site visit were to provide an opportunity for NMFS and CDFW to view the project area, discuss and provide comments to the proposed fish passage designs, and to support a team approach to development of an appropriate and successful fish passage design on Ryan Creek. These efforts are intended to facilitate pre-permitting approval of the fish passage design among vested parties and the permit acquisition process.

Table 1
Attendance list for the January 10, 2014 site visit to Ryan Creek, Mendocino Co., CA

Name	Affiliation	Phone Number	Email
Steve Pagliughi	AECOM	916-715-5929	steve.pagliughi@aecom.com
Roy Leidy	AECOM	916-414-5855	roy.leidy@aecom.com
Scott Foster	Caltrans	530-741-4015	scott.foster@dot.ca.gov
Erik Schwab	Caltrans	916-274-0585	erik.schwab@dot.ca.gov
Douglas Jones	Caltrans	530-741-4027	douglas.jones@dot.ca.gov
Kara Brimhall	Caltrans	530-741-4054	kara.brimhall@dot.ca.gov
David White	NMFS	707-575-6810	david.k.white@noaa.gov
Tom Daugherty	NMFS	707-468-4057	tom.daugherty@noaa.gov
Scott Harris	CDFW	707-459-2238	scott.harris@wildlife.ca.gov
Mark Smelser	CDFW	707-441-3963	msmelser@wildlife.ca.gov
JoAnn Dunn	CDFW	707-441-2076	joann.dunn@wildlife.ca.gov

Written comments from NMFS and CDFW were provided to Caltrans following the January 10 site visit. The comments addressed the issues and design features associated with the project and included proposed modifications to existing designs. Caltrans assessed the feasibility of each proposed modification and selected several for potential inclusion in the final project designs. This attachment briefly summarizes the proposed modifications Caltrans is considering for inclusion in the final project designs. The designs for the proposed modifications are presented at the end of this attachment.

Alternative Designs to the Ryan Creek Fish Passage Design Proposal

The original designs for rock weir placement called for a 0.5-foot vertical elevational drop between rock weirs. The water surface elevation difference between weirs is consistent with fish passage criteria set forth in CDFW (2002) and NMFS (2001) culvert replacement guidance documents. NMFS and CDFW proposed increasing the vertical elevational drop distance to 1-foot between weirs to increase biological benefits. The modification allows for a greater distance between rock weirs and thus provides a greater quantity of salmonid pool/spawning habitat. Under the original designs, the horizontal distance between rock weirs on the South Fork ranges from 14.5 feet to 27.5 feet; on the North Fork the distance ranges from 18 feet to 33 feet. Under the modified designs, the horizontal distance between rock weirs on the South Fork ranges from approximately 50 feet to 135 feet; on the North Fork the distance ranges from approximately 44 feet to 115 feet.

Protecting the Project Area from the Existing Headcut

A head cut has formed in each fork of Ryan Creek as a result of a downstream culvert replacement project and both head cuts are migrating upstream. Caltrans has evaluated project alternatives and developed alternative designs to address the head cuts as far downstream of the project boundary as is practicable. The project boundary has been extended approximately 75.6 feet and 115.4 feet downstream in the South and North forks, respectively, under the alternative designs. Under these alternative designs, the most downstream rock band is located further downstream than the most downstream rock weir in the original design.

As discussed in the field, the head cut protection measure would consist of two rock chutes with a scour pool between them downstream of the rock weirs. The rock bands that make up the protection design are buried increasingly deeper in the river bed as the distance downstream of the fish passage design increases. In the South Fork, rock bands are buried 0.5-feet to 4-feet (the most downstream rock band) deeper under the alternative designs when compared to the original designs. In the North Fork, rock bands are buried 0.25-feet to 4.75-feet (the most downstream rock band) deeper under the alternative designs when compared to the original designs.

Extending the rock bands downstream and burying the rock bands increasingly deeper into the river bed are feature modifications designed for stabilization and protection from the downstream head cuts. The elevation change in each rock chute is 2 feet to maintain the appropriate channel grade. The slope between the bounding rock bands is 8% which falls within the guidelines set by Chapter XII of *CDFW Fish Passage Design and Implementation Manual*. The scour pool between the chutes is 50-feet which is sufficient to dissipate the energy within the pool. This design will protect the fish passage work from the head cut on both forks of Ryan Creek.

South Fork Culvert Alignment and the Active Channel Design

The active channel near Hwy 101 on the South Fork is 105 inches wide; the two culverts under the original designs are 120-inches in diameter and approximately 113 feet long. Each end of the culverts would be buried 42 inches which is 35 percent of the culvert height. The slope of the remediated culverts would be approximately 0.35 percent. Culvert diameter and burial depth under the original designs meet CDFW and NMFS design criteria.

The Active Channel Design is intended to allow the natural movement of bedload and formation of a stable bed within culverts. NMFS pointed out that using two large culverts may not achieve the intended result of the Active Channel methodology and suggested 1) increasing the height of one of the culverts on South Fork Ryan Creek, and 2) reducing the slope of the culverts on both forks to 0 percent. Caltrans incorporated these modifications into the alternative designs. The elevation of the at grade culvert on the South Fork has been decreased on the downstream end by 0.56-feet and by 0.95-feet on the upstream end. The elevation of the high flow culvert on the South Fork has been increased by 1.94-feet on the downstream end and by 1.55-feet on the upstream end. The modifications result in the high flow culvert having an elevation 2.50-feet greater than the at grade culvert and a 0 percent slope within both culverts. The elevation of the downstream end of the North Fork culvert has been reduced by 0.04-feet and by 0.44-feet on the upstream end resulting in a 0 percent slope within the culvert. These modifications should promote the fish passage potential during low flow periods and facilitate sediment transport.

NOTES:

1. THIS PLAN ACCURATE FOR FISH PASSAGE ONLY.
2. SEE LAYOUT PLANS FOR ACCURATE GEOMETRIC INFORMATION.
3. SEE UTILITY PLANS FOR ACCURATE UTILITY INFORMATION.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
01	Men	101	52.25 & 52.36		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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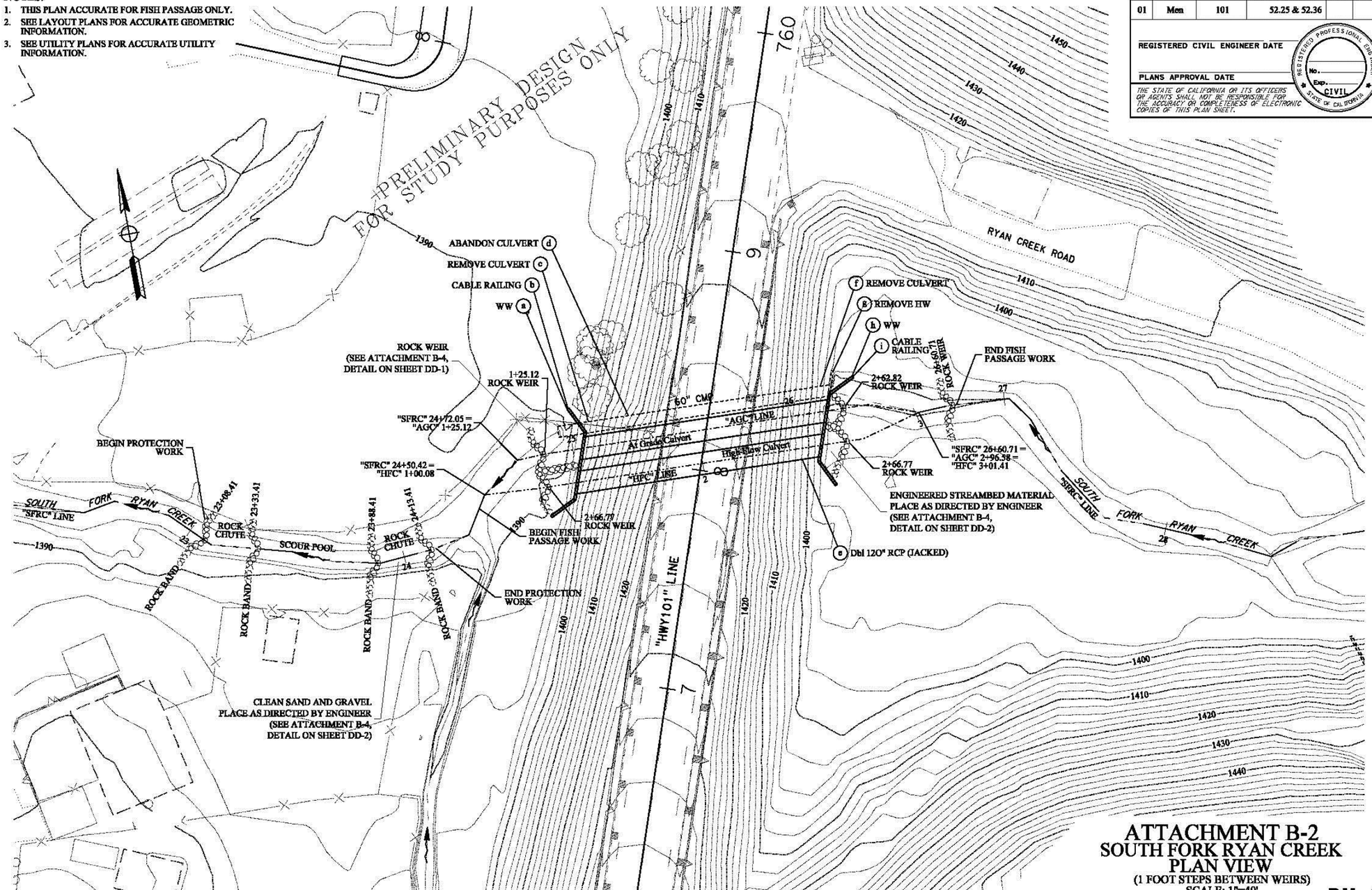

ATTACHMENT B-2
SOUTH FORK RYAN CREEK
PLAN VIEW
(1 FOOT STEPS BETWEEN WEIRS)
SCALE: 1"=40'

PV-1

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
DIVISION OF DESIGN
FUNCTIONAL SUPERVISOR: DOUGLAS S. JONES
CALCULATED-DESIGNED BY: S FOSTER
CHECKED BY: R MIRANDA
REVISED BY
DATE REVISED

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LAST REVISION 04-30-14
DATE PLOTTED => 06-MAY-2014
TIME PLOTTED => 06:59

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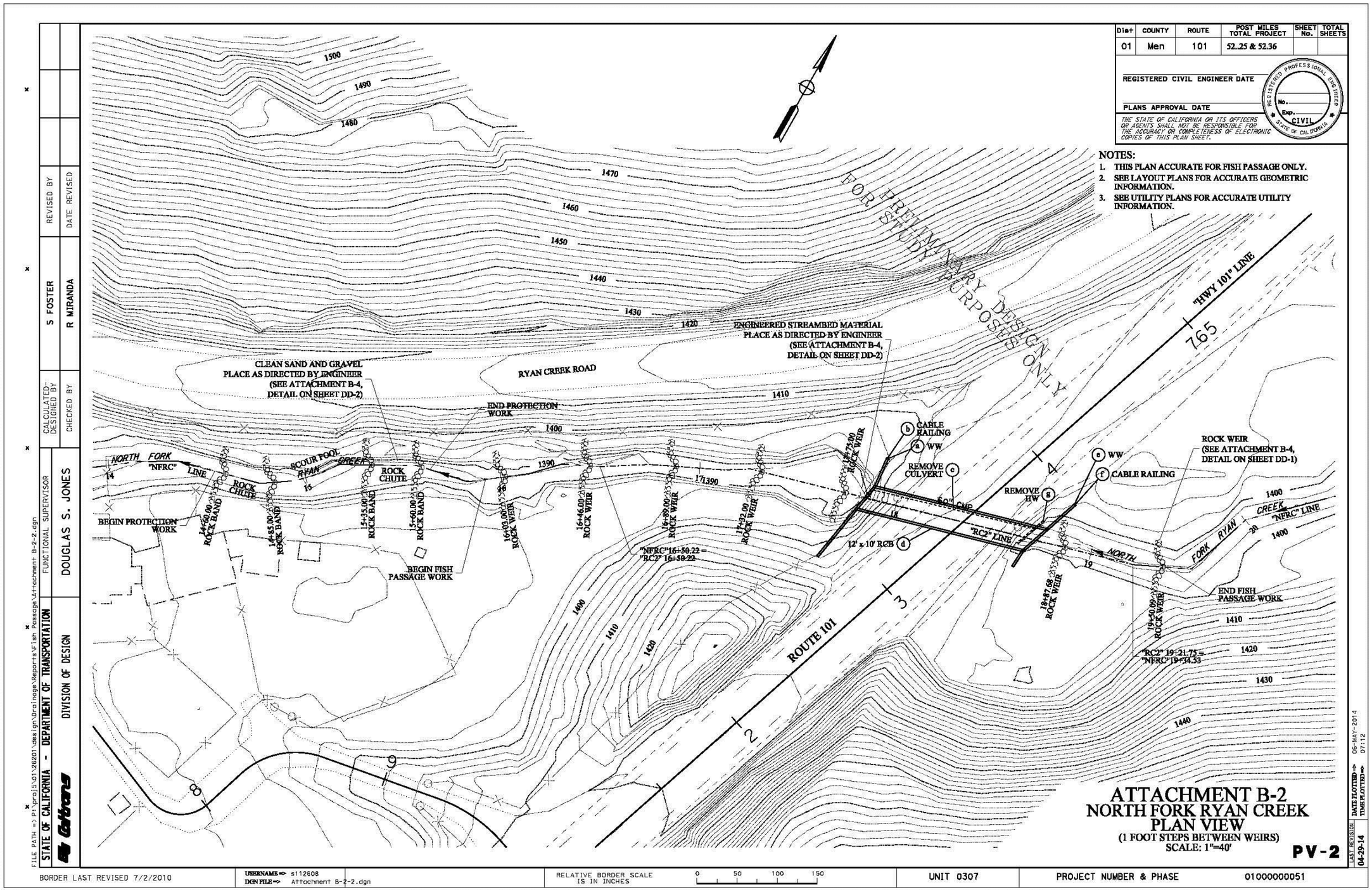
UNIT 0307
PROJECT NUMBER & PHASE 01000000051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REGISTERED CIVIL ENGINEER DATE
PLANS APPROVAL DATE
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1. THIS PLAN ACCURATE FOR FISH PASSAGE ONLY.
2. SEE LAYOUT PLANS FOR ACCURATE GEOMETRIC INFORMATION.
3. SEE UTILITY PLANS FOR ACCURATE UTILITY INFORMATION.
PRELIMINARY DESIGN FOR STUDY PURPOSES ONLY
"HWY 101" LINE
765
ENGINEERED STREAMBED MATERIAL PLACE AS DIRECTED BY ENGINEER (SEE ATTACHMENT B-4, DETAIL ON SHEET DD-2)
CLEAN SAND AND GRAVEL PLACE AS DIRECTED BY ENGINEER (SEE ATTACHMENT B-4, DETAIL ON SHEET DD-2)
RYAN CREEK ROAD
END PROTECTION WORK
BEGIN PROTECTION WORK
BEGIN FISH PASSAGE WORK
END FISH PASSAGE WORK
NORTH FORK "NFRC" LINE
SCOUR POOL
RYAN CREEK
ROCK CHUTE
ROCK BAND
ROCK WEIR
CABLE RAILING
WW
REMOVE CULVERT
REMOVE HW
60" CMP
12' x 10' RCB
"RC2" LINE
"NFRC" 16+50.22 = "RC2" 16+50.22
"RC2" 19+21.75 = "NFRC" 19+34.33
ROUTE 101
ROCK WEIR (SEE ATTACHMENT B-4, DETAIL ON SHEET DD-1)
NORTH FORK RYAN CREEK "NFRC" LINE
ATTACHMENT B-2
NORTH FORK RYAN CREEK
PLAN VIEW
(1 FOOT STEPS BETWEEN WEIRS)
SCALE: 1"=40'
PV-2
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
DIVISION OF DESIGN
FUNCTIONAL SUPERVISOR DOUGLAS S. JONES
CALCULATED-DESIGNED BY S FOSTER
CHECKED BY R MIRANDA
REVISED BY
DATE REVISED
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LAST REVISION 04-29-14
DATE PLOTTED => 06-MAY-2014
TIME PLOTTED => 07:12
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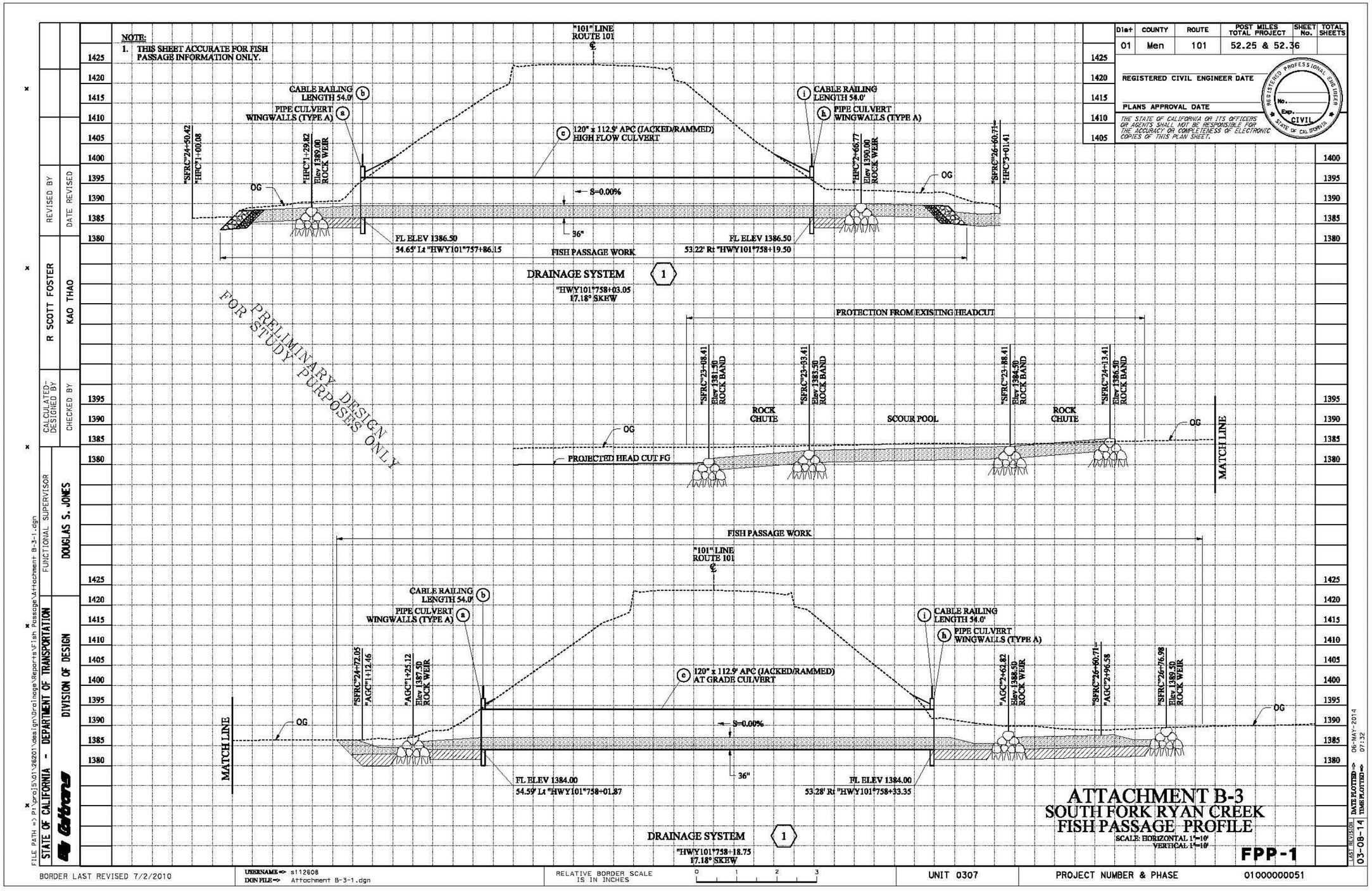
UNIT 0307
PROJECT NUMBER & PHASE 01000000051


NOTE:
1. THIS SHEET ACCURATE FOR FISH PASSAGE INFORMATION ONLY.
"101" LINE ROUTE 101 ℄
CABLE RAILING LENGTH 54.0'
PIPE CULVERT WINGWALLS (TYPE A)
120" x 112.9' APC (JACKED/RAMMED) HIGH FLOW CULVERT
"SFRC"24+50.42
"HFC"1+00.08
"HFC"1+29.82 Elev 1389.00 ROCK WEIR
"HFC"2+66.77 Elev 1390.00 ROCK WEIR
"SFRC"26+60.71
"HFC"3+01.41
OG
S=0.00%
36"
FL ELEV 1386.50
54.65' Lt "HWY101"757+86.15
FL ELEV 1386.50
53.22' Rt "HWY101"758+19.50
FISH PASSAGE WORK
DRAINAGE SYSTEM 1
"HWY101"758+03.05
17.18° SKEW
PRELIMINARY DESIGN FOR STUDY PURPOSES ONLY
PROTECTION FROM EXISTING HEADCUT
"SFRC"23+08.41 Elev 1381.50 ROCK BAND
"SFRC"23+93.41 Elev 1383.50 ROCK BAND
"SFRC"23+88.41 Elev 1384.50 ROCK BAND
"SFRC"24+13.41 Elev 1386.50 ROCK BAND
ROCK CHUTE
SCOUR POOL
ROCK CHUTE
PROJECTED HEAD CUT FG
MATCH LINE
"SFRC"24+72.05
"AGC"1+12.46
"AGC"1+25.12 Elev 1387.50 ROCK WEIR
120" x 112.9' APC (JACKED/RAMMED) AT GRADE CULVERT
"AGC"2+62.82 Elev 1388.50 ROCK WEIR
"SFRC"26+90.71
"AGC"2+96.58
"SFRC"26+76.98 Elev 1389.50 ROCK WEIR
FL ELEV 1384.00
54.59' Lt "HWY101"758+01.87
FL ELEV 1384.00
53.28' Rt "HWY101"758+33.35
DRAINAGE SYSTEM 1
"HWY101"758+18.75
17.18° SKEW
ATTACHMENT B-3
SOUTH FORK RYAN CREEK
FISH PASSAGE PROFILE
SCALE: HORIZONTAL 1"=10'
VERTICAL 1"=10'
FPP-1
Dist COUNTY ROUTE POST MILES TOTAL PROJECT SHEET No. TOTAL SHEETS
01 Men 101 52.25 & 52.36
REGISTERED CIVIL ENGINEER DATE
PLANS APPROVAL DATE
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Exp.
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STATE OF CALIFORNIA
REVISED BY
DATE REVISED
R SCOTT FOSTER
KAO THAO
CALCULATED-DESIGNED BY
CHECKED BY
DOUGLAS S. JONES
FUNCTIONAL SUPERVISOR
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
DIVISION OF DESIGN
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TIME PLOTTED => 07:32
LAST REVISED 03-08-14
BORDER LAST REVISED 7/2/2010
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DGN FILE => Attachment B-3-1.dgn
RELATIVE BORDER SCALE IS IN INCHES
UNIT 0307
PROJECT NUMBER & PHASE 01000000051

NOTE:
1. THIS SHEET ACCURATE FOR FISH PASSAGE INFORMATION ONLY.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
01	Men	101	52.25 & 52.36		

REGISTERED CIVIL ENGINEER DATE

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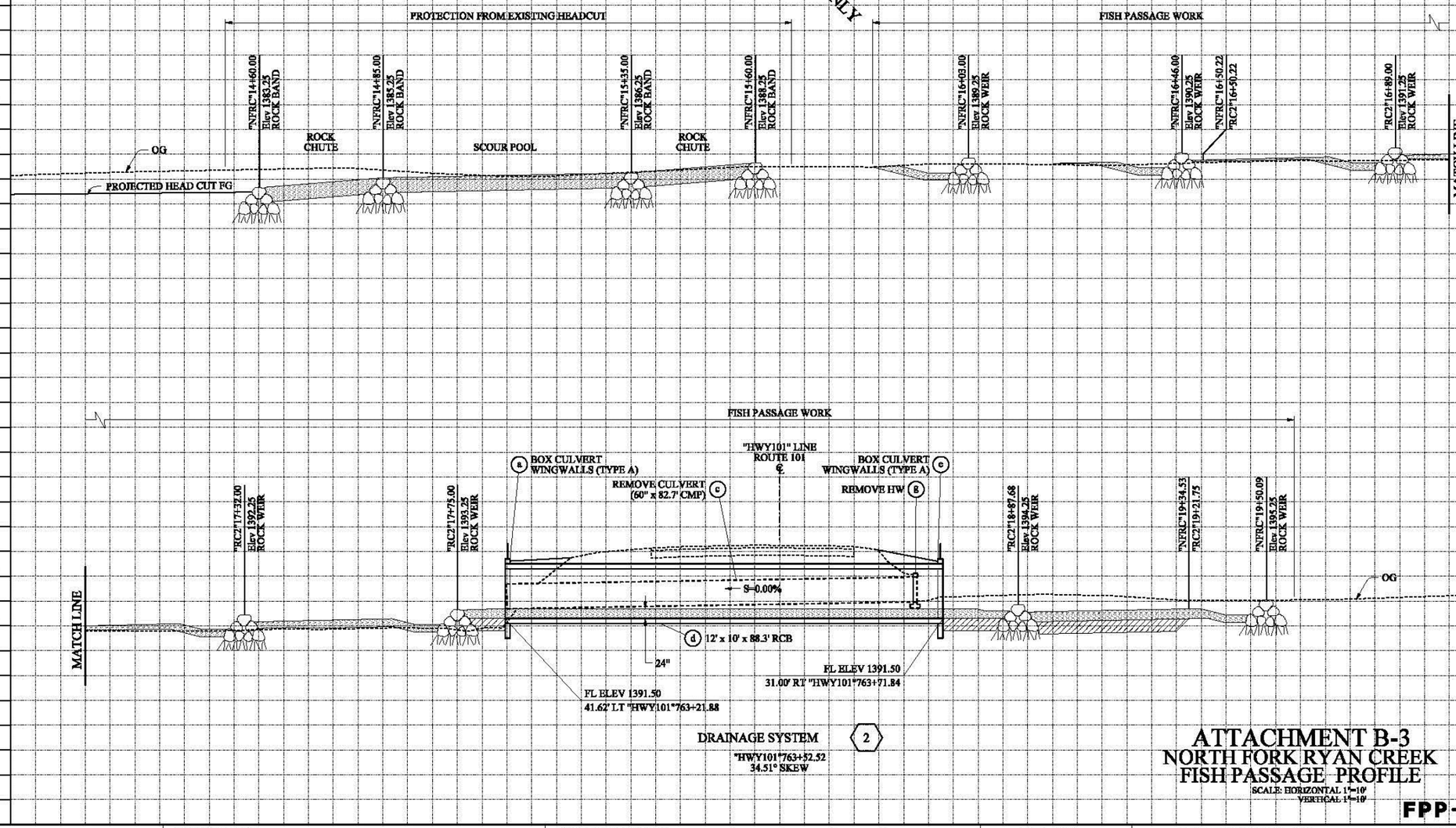

ATTACHMENT B-3
NORTH FORK RYAN CREEK FISH PASSAGE PROFILE

SCALE: HORIZONTAL 1"=10'
VERTICAL 1"=10'

FPP-2

REVISED BY | DATE REVISED
R SCOTT FOSTER | KAO THAO
CALCULATED-DESIGNED BY | CHECKED BY
FUNCTIONAL SUPERVISOR: DOUGLAS S. JONES
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
DIVISION OF DESIGN

FILE PATH => P:\proj\50112502010\design\Drawings\Reported\Fish Passage\Attachment B-3-2.dgn

LAST REVISION 03-08-14 | DATE PLOTTED => 06-MAY-2014 | TIME PLOTTED => 07:52

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NOTES:

1. THIS PLAN ACCURATE FOR FISH PASSAGE ONLY.
2. 1/2 T ROCKS FOR ROCK WEIRS AND ROCK SILLS ARE PLACED INDIVIDUALY, PACKED TIGHTLY TOGETHER, AND HAVE A MINIMUM OF THREE CONTACT POINTS WITH ADJACENT ROCKS.
3. PLACEMENT OF STONES 1, 2 AND 3 TO BE DONE AT THE DIRECTION OF THE ENGINEER.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
01	Men	101	52.25 & 52.36		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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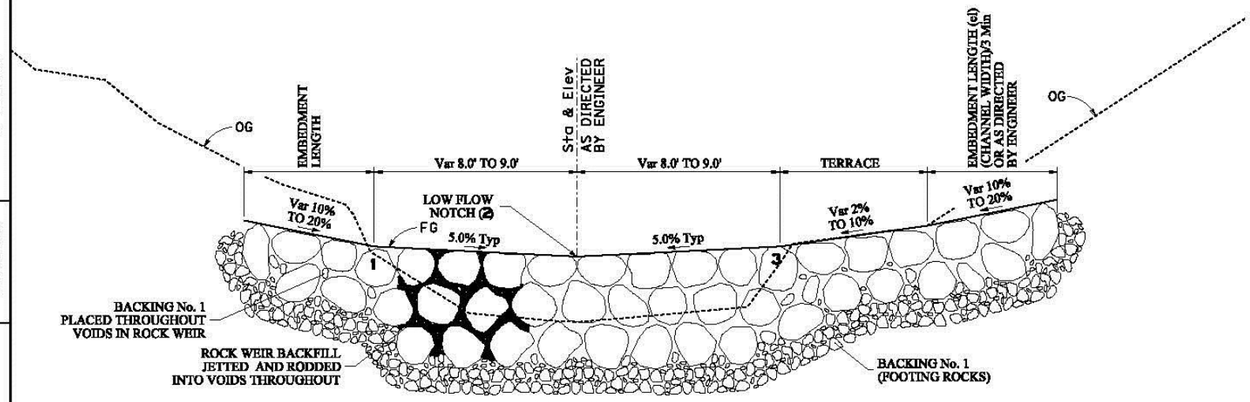
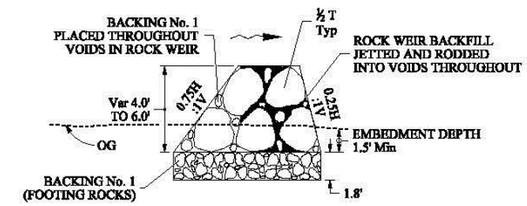
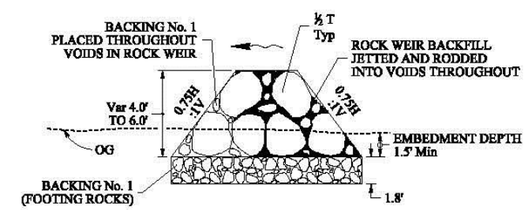


SECTION A-A



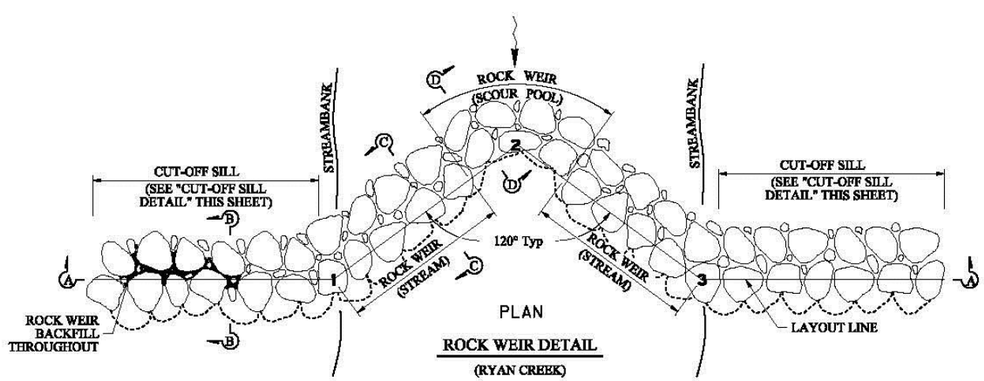
SECTION D-D

ROCK WEIR (SCOUR POOL)



SECTION C-C

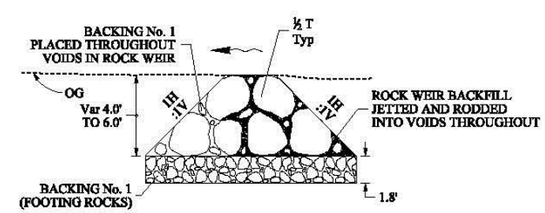
ROCK WEIR (STREAM)



PLAN

ROCK WEIR DETAIL

(RYAN CREEK)



SECTION B-B

CUT-OFF SILL (STREAM)

ATTACHMENT B-4
DRAINAGE DETAILS
NO SCALE

DD-1

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
DIVISION OF DESIGN
FUNCTIONAL SUPERVISOR: DOUGLAS S. JONES
CALCULATED-DESIGNED BY: S FOSTER
CHECKED BY: R MIRANDA
REVISED BY
DATE REVISED

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LAST REVISION 03-20-12
DATE PLOTTED => 06-MAY-2014
TIME PLOTTED => 07:55

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
01	Men	101	52.25 & 52.36		

REGISTERED CIVIL ENGINEER DATE

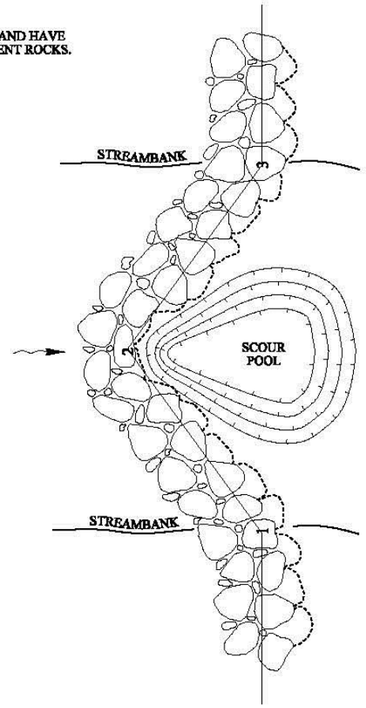
PLANS APPROVAL DATE

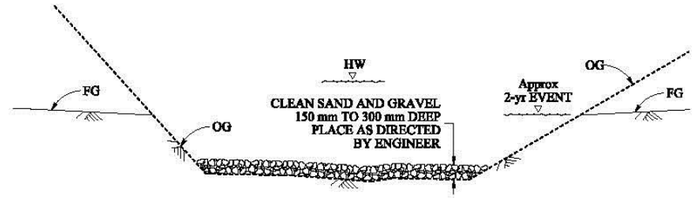
REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF ELECTRONIC COPIES OF THIS PLAN SHEET.

NOTES:

1. THIS PLAN ACCURATE FOR FISH PASSAGE ONLY.
2. 1/2 T ROCKS FOR ROCK WEIRS AND ROCK SILLS ARE PLACED INDIVIDUALY, PACKED TIGHTLY TOGETHER, AND HAVE A MINIMUM OF THREE CONTACT POINTS WITH ADJACENT ROCKS.
3. PLACEMENT OF STONES 1, 2 AND 3 TO BE DONE AT THE DIRECTION OF THE ENGINEER.





PLACING CLEAN SAND & GRAVEL IN EXISTING STREAMBED

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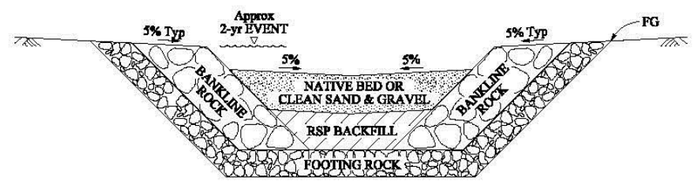
Sta "NFRC"15+75.41 TO "NFRC"17+20.31



NATIVE BED OR CLEAN SAND & GRAVEL

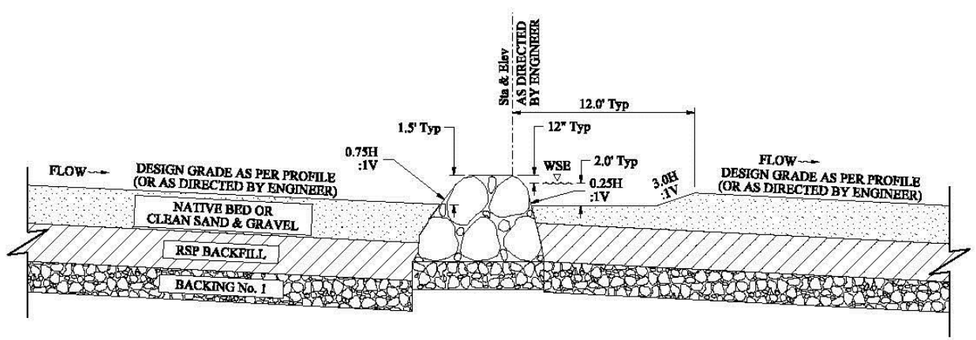
Sta "SFRC"24+63.00 TO "SFRC"26+75.00
Sta "NFRC"17+20.31 TO "NFRC"19+40.98

RSP BACKFILL

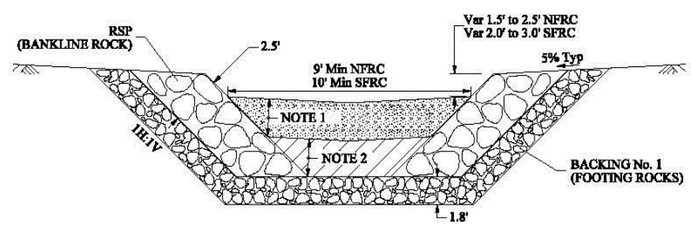
Sta "SFRC"24+77.50 TO "SFRC"24+98.28
Sta "SFRC"26+11.19 TO "SFRC"26+27.50
Sta "NFRC"17+74.65 TO "NFRC"17+83.88
Sta "NFRC"18+72.02 TO "NFRC"18+87.88

BANKLINE ROCK

Sta "SFRC"24+77.50 TO "SFRC"24+98.28
Sta "SFRC"26+11.19 TO "SFRC"26+27.50
Sta "NFRC"17+74.65 TO "NFRC"17+83.88
Sta "NFRC"18+72.02 TO "NFRC"18+87.88



SCOUR POOL DETAIL



NOTES
1. FOR SFRC 2.5', NFRC 2.0'.
2. FOR SFRC 2.5', NFRC 2.0'.

TYPICAL BANKLINE ROCK & ENGINEERED STREAMBED MATERIAL

ATTACHMENT B-4
DRAINAGE DETAILS
NO SCALE

DD-2

REVISED BY	DATE REVISED

CALCULATED-DESIGNED BY	CHECKED BY
S FOSTER	R MIRANDA

FUNCTIONAL SUPERVISOR: DOUGLAS S. JONES

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
DIVISION OF DESIGN

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LAST REVISED 03-08-14 | DATE PLOTTED => 06-MAY-2014 | TIME PLOTTED => 07:56

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GEOTECHNICAL DESIGN REPORT
RYAN CREEK SOUTH FORK FISH PASSAGE
HIGHWAY 101 NORTH OF WILLITS
MENDOCINO COUNTY, CALIFORNIA

August 31, 2015

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August 31, 2015
Project No. 20143390.073A

Mr. Vahid Khataokhotan
California Department of Transportation
Office of Geotechnical Design – West
Geotechnical Services-MS 16 (8th floor)
111 Grand Ave
Oakland, CA 94612

Subject: GEOTECHNICAL DESIGN REPORT
RYAN CREEK SOUTH FORK FISH PASSAGE
HIGHWAY 101 NORTH OF WILLITS
PM 52.25, EA: 01-262011
MENDOCINO COUNTY, CALIFORNIA

Dear Mr. Khataokhotan:

As requested, Kleinfelder and Bennett Trenchless Engineers have prepared the attached geotechnical design report for the Ryan Creek South Fork Fish Passage Project located on Highway 101 north of Willits at Mile Post MP 52.25 in Mendocino County, California. This report includes background information regarding the anticipated construction, the purpose of our services, results of previous investigations performed by Caltrans, discussion of the site surface and subsurface conditions encountered during field explorations, as well as geotechnical conclusions and recommendations for project design and construction. The appendices of this report include Logs of Test Borings, a previous geotechnical design report prepared by Caltrans for the project, as well as design and construction recommendations and non-standard special provisions regarding trenchless culvert installations.

We appreciate the opportunity to provide our services for this project. If you have questions regarding this report or if we may be of further assistance, please contact the undersigned.

Sincerely,

KLEINFELDER, INC.

REGISTERED PROFESSIONAL ENGINEER
STEVEN J. WIESNER
GE 3027
EXP. 6/30/16
GEOTECHNICAL
STATE OF CALIFORNIA

Steven J. Wiesner, PE, GE
Project Geotechnical Engineer

Kenneth G. Sorensen, PE, GE
Principal Geotechnical Engineer

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FIGURES

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2 Caltrans 2010 Standard Plan D90 Sheet

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A Caltrans 2015 Geotechnical Design Report and Boring Logs
B Geotechnical Laboratory Test Results
C Kleinfelder Boring Log, Field Report and Well Completion Report
D Caltrans Log of Test Boring Sheets
E Trenchless Installation Technical Memorandum & Cost Analysis
F Non-standard Special Provisions for Pipe Ramming

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GEOTECHNICAL DESIGN REPORT
RYAN CREEK SOUTH FORK FISH PASSAGE
HIGHWAY 101 NORTH OF WILLITS
MENDOCINO COUNTY, CALIFORNIA

1 INTRODUCTION

1.1 GENERAL

This report presents the results of a geotechnical investigation conducted for the proposed Ryan Creek South Fork Fish Passage Project located along Highway 101 north of the town of Willits near Mile Post MP 52.25 in Mendocino County, California. Caltrans originally performed a geotechnical investigation and prepared a preliminary geotechnical design report (GDR) for the fish passage project dated February 10, 2015 (Caltrans, 2015). That report did not fully address the proposed culvert installation method or the design of proposed culvert headwalls. Culvert installation methods are discussed in a technical memorandum prepared by Bennett trenchless Engineers which is included in Appendix E. Non-standard special provisions for a pipe ramming approach to culvert installation are presented in Appendix F. The design and construction of the culvert headwalls and wingwalls are addressed in this report and its appendices.

As part of the preliminary GDR (Caltrans, 2015) two test borings were advanced in the area of the proposed south fork passage culverts. During preparation of this report, an additional boring was drilled about 10 feet south of the existing borings because it was recommended to move the south culvert further south to provide at least 10 feet of clearance between the two proposed culvert pipes. In addition, installation of a piezometer was recommended to monitor site groundwater levels. Therefore, the boring was converted to a standpipe piezometer with a 1.9-inch-diameter PVC casing.

Conclusions and recommendations presented in this report are based on the subsurface conditions encountered in subsurface explorations conducted at the site by Caltrans and Kleinfelder, our review of the previous GDR (Caltrans 2015), and results of engineering analysis and recommendations for pipe ramming operations by Bennett Trenchless Engineers. Recommendations presented herein should not be extrapolated to other areas or used for other projects without Kleinfelder's prior review.

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1.2 PROJECT DESCRIPTION

The south fork of Ryan Creek generally runs from east to west and currently passes below Highway 101 through existing 60-inch-diameter, corrugated metal pipe (CMP) culvert. At the existing culvert crossing, U.S. Highway 101 consists of a two-lane highway built on about 30 to 35 feet of embankment fill. It is proposed to replace the existing culvert with two 10-foot-diameter culverts to allow fish passage.

The south fork culverts are the subject of this geotechnical design report as they will be installed using trenchless installation methods through the embankment. After completion of the pipe installation through the embankment, the pipes will be extended approximately 20 feet from the toes of the embankment slopes where the culvert headwalls, end walls, and wing walls will be constructed (see Figure 1, Drainage Plan). This is to accommodate the potential for a future roadway and embankment widening project. The future widening project would result in a wider roadway surface with 2H:1V (horizontal to vertical) embankment slopes. The future fill slopes would extend to the tops of the headwalls. Therefore, the walls will need to be designed for a 2H:lV backslope. The headwalls will be approximately 15 to 16 feet tall with about 4 feet extending below the inverts of the pipes. The culvert headwalls, end walls, and wing walls are proposed as Caltrans Type A, B, or C retaining walls, per Standard Plan D90. Standard Plan Sheet D90 is presented as Figure 2.

1.3 SCOPE OF SERVICES

The scope of services for this study was outlined in Task Order No. TO83473 dated March 18, 201, and included the following:

- A visual site reconnaissance to investigate the surface conditions at the project site
- A description of the proposed project
- Review of previous explorations performed for the project and included in the Caltrans GDR (Caltrans 2015)
- A supplemental field investigation that included drilling one boring within the area of the proposed south fork culvert crossing to explore the subsurface conditions and install a piezometer

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- A summary of our subsurface investigative procedures and methods and a description of the surficial and subsurface site conditions encountered during the field investigation
- Recommendations related to the geotechnical aspects of:
    - Foundation design and construction for retaining walls including bearing capacity, lateral resistance, estimated settlements and embedment depth
    - Lateral earth pressures for design of retaining walls
    - General earthwork recommendations
- Appendices including logs of borings, laboratory test results, Log of Test Borings sheets, and Caltrans 2015 GDR for the project.
- Appendices containing design recommendations, cost analysis of applicable trenchless construction methods, and non-standard special provisions for pipe ramming by Bennett Trenchless Engineers.

1.4 PREVIOUS STUDIES

Our understanding of the existing subsurface information was based on review of the following documents:

- Memorandum, Department of Transportation, Geotechnical Design Report for Ryan Creek Fish Passage, dated February 10, 2015
- Drainage Plan – Option 1 drawing, dated June 4, 2015.

Additionally, we reviewed the following technical papers which detail calculations for the purpose of preparing our design recommendations:

- Al Atik, L., and Sitar, N., (2010) “Seismic Earth Pressures on Canteliver Retaining Structures,” American Society of Civil Engineers, Journal of Geotechnical and Geoenvironmental Engineering, October 2010.

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- Seed, H.B and Whitman, R.V., (1970), Design of Earth Retaining Structures for Dynamic Loads, ASCE Specialty Conference, Lateral Stresses in the Ground and Design of Earth Retaining Structures, 1970, pp. 103-147.

1.5 POLICY EXCEPTIONS

No known exceptions to Caltrans policy were made in the geotechnical evaluation for the culverts for this project. Within the culvert headwall and wingwall areas, geotechnical borings could not be drilled due to dense vegetation and access limitations. Therefore, the wall foundation areas were evaluated by observation of the work area by a Kleinfelder Geotechnical Engineer accompanied by a Caltrans professional.

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2 SITE INVESTIGATIONS

2.1 GENERAL

As previously mentioned, Caltrans previously performed a geotechnical investigation at the project site which included performing two test borings and laboratory testing of soil samples. The results of the investigation were summarized in a GDR (Caltrans 2015) which is presented in Appendix A. Additional laboratory tests on soil samples collected from the Caltrans borings (Caltrans 2015) were performed following review of the boring data by Kleinfelder. Laboratory test results are presented in Appendix B.

Presented in the following sections of this report and its appendices are the results of an additional boring performed by Kleinfelder just south of the Caltrans borings as well as geotechnical recommendations for the proposed culvert walls, recommendations for pipe ramming, non-standard special provisions for pipe ramming, and a cost analysis of applicable trenchless construction methods.

2.2 SUBSURFACE EXPLORATIONS

2.2.1 Subsurface Explorations

As part of our investigation, the subsurface conditions at the site were further explored after the Caltrans GDR by drilling one boring approximately 10 feet to the south of Boring R-14-002 that was previously drilled in the northbound lane. The boring was drilled to a depth of approximately 50 feet below the existing roadway surface. The boring was drilled using an Acker MPCA truck-mounted drill rig equipped with a continuous punch core system. The boring was designated as R-15-001. A Kleinfelder Certified Engineering Geologist maintained a log of the boring, measured or estimated site groundwater levels, visually classified the soils encountered according to the Unified Soil Classification System (American Society for Testing and Materials International [ASTM] D2488 visual-manual procedure) and obtained both disturbed and relatively undisturbed samples of the subsurface materials. The boring was located in the field by measuring from existing features and previous boring patches with a tape measure. Therefore, the location of Boring R-15-001 shown on the Log of Test Borings should be considered accurate to the degree

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implied by that method. A log of the boring is provided in Appendix C along with a field report documenting the drilling observations. The locations of all borings performed for this investigation are shown on the Log of Test Borings sheets in Appendix D.

2.2.2 Sampling Procedures

Soil core samples were obtained from Boring R-15-001 using a 3.7-inch-diameter punch core system. The punch core system used a mud-rotary drilling and punch-core wireline sampling system. This sampler has a 5-foot-long inner core barrel latched to the outer core barrel that was used to core through the soil. The sampler can be extended ahead of the coring drill bit cutting head. After each coring run, the inner barrel was unlatched and lifted to the surface by a retrieval device connected to the wireline. The core retrieved from the sampler was stored in core boxes. The amount of sample retrieved varied in the punch core for each core run for the samplers driven. The percent recovery is noted on the boring log.

2.2.3 Piezometer Construction

After completion of drilling, a standpipe piezometer was constructed in the borehole. The piezometer was constructed in order to verify groundwater depths within the embankment area and was constructed by placing 1.9-inch-diameter schedule 40 PVC pipe into the borehole. The lower approximately 20 feet of pipe consisted of a 0.020-inch slotted screen section, and the upper approximately 30 feet of pipe consisted of solid-walled pipe. The section between depths of about 28 to 50 feet was surrounded by a sand filter pack. About a 6-foot-thick bentonite transition seal was placed over the filter pack, and the remainder was backfilled to the ground surface with cement grout. The grout consisted of Portland Type I & II cement and water. The well completion report for the standpipe piezometer is presented in Appendix C.

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3 SITE CONDITIONS

3.1 SITE DESCRIPTION

At the time of our field investigation the site consisted of a heavily forested area with dense vegetation consisting of low lying brush and tall redwood trees. The embankment at the location of the proposed culvert crossings was approximately 30 to 35 feet tall. At the time of our site reconnaissance at the culver wall foundation areas (June 2015), about 6 to 12 inches of water was running in the creek. The active stream channel was about 2 to 3 feet wide.

The locations of the proposed culvert walls are within the existing creek bed and flood plain where exposed gravel and cobble deposits were observed at the surface and within the active creek channel banks throughout the wall foundation areas.

3.2 SITE SUBSURFACE CONDITIONS

The following descriptions provide a general summary of the subsurface conditions encountered during the site reconnaissance and field exploration program. For more detailed descriptions of the actual conditions encountered at specific boring locations, refer to the boring logs in Appendices A and C, and the Log of Test Boring sheets presented in Appendix D.

In Borings R-14-001 and R-14-002 drilled as part of the previous investigation (Caltrans 2015), the subsurface soils encountered consisted of embankment fill material consisting of medium dense to dense poorly-graded sand with varying amounts of gravel. The fill material extended to depths of about 31½ feet below the roadway and was underlain by sandy silt and poorly-graded sand with silt to a depth of about 40 feet in Borings R-14-001 and Boring R-14-002. Between depths of about 32 and 40 feet in Boring R-14-002, the silt encountered is interpreted to be soft or decomposed rock. Both borings were terminated in siltstone or sandstone bedrock.

In Boring R-15-001 drilled as part of the current investigation, the subsurface soils encountered consisted of fill material consisting of interbedded layers of poorly-graded sand with silt, poorly-graded gravel with clay and sand, and clayey sand with gravel. The fill material extended to a depth of about 29½ feet below the roadway and was underlain by clayey sand with gravel, poorly-

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graded sand with gravel and clayey gravel with sand to a depth of about 45 feet below the roadway surface. The sand and gravel soil was underlain by moderately weathered sandstone bedrock which extended beyond the maximum depth explored of about 50 feet below the roadway surface.

In the proposed culvert wall foundation areas, the soils encountered during our site reconnaissance generally consisted of well-graded gravel with sand and cobbles up to about 4 inches in maximum dimension. Observation of the creek channel and banks indicates these soils are at least 4 feet deep, and the upper 3 to 4 feet of soil appears to contain abundant roots. Based on the conditions encountered in the borings drilled through the roadway embankment, sands and gravels were encountered at similar elevation, as well as a weak silt layer above the bedrock surface in Boring R-14-002. Although abundant gravels and cobbles were not noted in the boring logs, presumably due to the small diameters of the borings, it is likely that the sandy layers described in the borings at the creek bed elevation contain gravel and small cobbles. The sands and gravels encountered in the borings were underlain by silt, siltstone and sandstone bedrock. The elevation of the competent bedrock surface appears to range from about 1383.50 to about 1378.0 in the borings.

3.3 SITE GROUNDWATER LEVELS

Groundwater levels in the borings drilled as part of the previous investigation were measured at about 30 feet below the roadway surface, which corresponds to approximate elevations of about 1387.50 to 1388.50 feet, based on the project datum. As part of this current investigation, groundwater was measured in Boring R-15-001 at a depth of about 26½ feet (about Elevation 1397) at the time of drilling. As previously mentioned, Boring R-15-001 was converted into a piezometer. On June 8, 2015, piezometer measurements were taken and groundwater was measured at a depth of 34.92 feet below the roadway surface, which roughly corresponds with an elevation of about 1388.50 feet.

Groundwater conditions at the site may change in the future due to various influences including seasonal infiltration, well pumping, and other factors that are beyond the scope of this study. Based on the above information, groundwater should be expected at the approximate water elevation in the adjacent creek.

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4 DESIGN RECOMMENDATIONS

4.1 GENERAL

As part of this investigation, Kleinfelder evaluated the use of Type A, B, and C cast-in-place concrete retaining walls for the culvert headwalls and wingwalls in accordance with Standard Plan sheet D90. These walls utilize a spread foundation. Due to the presence of sandy and gravelly soils underlain by shallow bedrock, spread foundations for pipe culvert headwalls and wingwalls (Case II) are considered appropriate for this project. Since the footing will likely be founded below the present groundwater level, dewatering of the foundation excavations should be anticipated. In addition, removal of major trees and brush throughout the work area is needed and will likely result in root removal excavations extending at least 3 feet below the present ground surface.

4.2 CULVERT HEADWALL AND WINGWALL FOUNDATIONS

4.2.1 Footing Elevations and Excavations

Footings for the proposed culvert headwalls and wingwalls are expected to vary in bearing elevation. The culverts are to be installed with no slope and with invert elevations of 1386.50 and 1384.00 feet for the south and north culverts, respectively. The headwalls will extend 4 feet below the pipe inverts. The wing walls on either side of the headwalls will have footing bottom elevations as shown in Table 4.1 below:

Table 4.1
Headwall and Wingwall Foundation Elevations

Wall Element	Bottom Elevation (feet, msl)
Upstream Headwall	1383.77 to 1379.48
Upstream South Wingwall	1383.77
Upstream North Wingwall	1379.48
Downstream Headwall	1383.50 to 1378.50
Downstream South Wingwall	1383.50
Downstream North Wingwall	1378.50

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The elevation of the competent bedrock surface from the borings is estimated at about 1378 feet. For that bedrock depth and wall configuration, the wingwall footings would bear on either sand and gravel channel deposits, weak silt and/or decomposed rock, or firm siltstone/sandstone bedrock. The anticipated excavation depths below original ground in the wall areas range from about 10 feet at the downstream south wingwall to about 15½ feet at the upstream north wingwall.

According to the borings, the proposed north wingwall footing bottoms are situated very near the bedrock elevation. The south wingwall footings are situated about 3½ to 5½ feet above the bedrock elevation Since the proposed foundation excavations will extend below the creek level, it is anticipated that any soils above bedrock will be saturated and unstable upon excavation. In addition, weak silts may exist that will not satisfy the bearing requirements for the proposed Type A, B, or C culvert headwalls. As a result, we recommend footings be extended to firm bedrock at an elevation of about 1378 feet, or as appropriate based on the observed field conditions. To accomplish this, footing areas should be excavated to firm rock, as approved by the geotechnical engineer during construction, dewatered, and backfilled to the proposed footing bottom elevation with lean concrete or cementitious slurry mixture that has a compressive strength of at least 150 psi after 28 days of curing. The concrete slurry backfill zone should extend laterally at least 5 feet beyond the sides and front of the structural wall footings.

Since the subsurface conditions at the headwall and wingwall areas have not been explored, we recommend consideration be given to excavating several test pits in the wingwall areas to evaluate the depth to firm bedrock at the start of construction so that the depth of excavation and slurry backfilling can be assessed. We recommend the contractor provide line items in their bids for foundation over-excavation and backfilling.

4.2.2 Bearing Capacity

Shallow spread foundations for headwalls and wingwalls should have their bearing surfaces situated at least 3 feet below the lowest adjacent subgrade and engage firm siltstone or sandstone bedrock. Alternatively, the footing bottoms can be underlain by lean concrete or cementitious slurry mixture that extends to the bedrock surface, as discussed above.

The retaining walls will be on the order of 15 to 16 feet in maximum height. Effective foundation width and net bearing stress for a 16-foot-tall wall, as shown on Standard Plan D90 for culvert headwalls and wingwalls (Case II), is presented in Table 4.2 below.

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Table 4.2
Culvert Headwall and Wingwall (Case II) Spread Foundation Details

Effective Foundation Width (feet)	Net Bearing Stress (psf)
9.43	3,700

The ultimate bearing pressure on firm rock was evaluated using published shear strength correlations (Terzaghi & Peck, 1967) and our engineering judgment. For standard penetration test (SPT) blow counts in siltstone bedrock exceeding 20 blows per foot, the estimated undrained shear strength is 4,000 psf or more. Based on that rock strength, an ultimate bearing pressure of 23,000 psf should be used for design. This value is based on a submerged foundation condition. We recommend a factor of safety of at least 3 be used for static footing design with regard to bearing failure. When considering seismic forces, the factor of safety for bearing failure should be at least 1.5.

4.2.3 Estimated Settlement

Total settlement of the retaining walls supported by spread foundations is expected to be on the order of ¼ inch for the presently proposed construction and less than about ½-inch following the final widening of the embankment. Settlement is expected to occur rapidly and should be essentially complete shortly after initial application of the loads.

4.2.4 Lateral Resistance

Resistance to lateral loads (including those due to wind or seismic forces) may be provided by frictional resistance between the bottoms of concrete foundations and the underlying soils and by passive soil pressure against the sides of the foundations. An allowable coefficient of friction of 0.35 may be used between cast-in-place concrete foundations and the underlying rock. This value contains a factor of safety of about 1.5. The allowable, submerged passive resistance in compacted on-site soil, structure backfill or weak rock may be taken as 170 pcf equivalent fluid weight. This value was derived with a factor of safety of at least 1.5 and corresponds with a lateral deflection of about ½ inch.

It is anticipated that the headwall and wingwall footings will be constructed in open excavations that will be backfilled following pipe ramming and headwall/wingwall construction. To achieve the design values presented herein, footing backfill should consist of structure backfill or similar

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material that has an angle of internal friction of at least 34 degrees and moist unit weight of at least 120 pcf.

4.3 RETAINING WALL EARTH PRESSURES

4.3.1 General

Structure backfill should be placed behind the retaining walls, conforming to the requirements of the Caltrans Standard Specifications, Section 19. Recommendations are presented in the following sections for lateral earth pressures, wall drainage, as well as backfill placement and deflection considerations.

4.3.2 Static Lateral Earth Pressures

Recommended lateral earth pressures on retaining walls under static conditions are presented below:

Active Earth Pressure (P_A) = 51 psf/ft for 2H:1V sloping backfill
At-rest Earth Pressure (P_0) = 55 psf/ft for 2H:1V sloping backfill

The above values are equivalent fluid weights in pounds per square foot (psf) per foot of backfill depth. The above lateral earth pressures were developed based on a moist soil unit weight of 120 pcf, angle of internal friction (phi) of 34 degrees, and zero cohesion (structure backfill material). If backfill material is used with greater soil unit weights or lower internal friction angles, the lateral earth pressures should be re-evaluated.

It should be noted that per Standard Plan sheet D90, an equivalent fluid weight of 36 psf/ft was used. This roughly corresponds to the structure backfill material parameters referenced above, a level backfill condition, and an active earth pressure condition. We recommend these earth pressures and wall conditions be checked as part of the design.

Active earth pressure may be used for design of walls that are able to rotate freely at the top (can move at least 0.001H) if such deflections are acceptable. If walls are restrained from lateral movements at the top, at-rest earth pressures should be used. The earth pressures under static conditions act at a height of ⅓H above the base of the wall, reflective of a triangular pressure distribution along the height of the wall starting with zero at the top. The above earth pressures

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assume a 2H:1V sloping backfill above the wall and a drainage system behind the wall (e.g., no hydrostatic pressures). In addition to the earth pressures above, a traffic surcharge load of 250 pounds per square foot (psf) should be added where the wall backfill materials are subjected to traffic loads.

4.3.3 Seismic Lateral Earth Pressures

Horizontal accelerations during seismic events may impart additional lateral earth pressures on the retaining walls. For culvert headwalls designed using the at-rest earth pressure, a seismic increment of earth pressure may not need to be added to the static lateral earth pressure. However, since these headwalls and wingwalls are relatively large, we have evaluated the seismic increment of earth pressure for use in design.

The design ARS curve was included in the previously prepared GDR and is presented in Appendix A. Per the GDR, the PGA is about 0.79g. According to AASHTO Guide Specifications for LRFD Seismic Bridge Design (2011), a horizontal seismic coefficient (K_h) can be taken as 0.5 PGA provided a few inches of permanent displacement of the wall is permitted. A pseudo static slope stability analysis was performed assuming a unit weight of backfill of about 120 pcf and a friction angle of 34 degrees. Based on the results of our analysis, we recommend a value of 60 pounds per cubic foot (pcf) equivalent fluid pressure be used to calculate the additional seismically-induced earth pressure. The additional seismic pressure will have a triangular pressure distribution. The resultant seismic force should be assumed to act at ⅓H above the base of the wall. The seismic earth pressure is in addition to the static lateral earth pressure.

4.3.4 Wall Drainage

Adequate drainage should be provided behind the retaining walls in accordance with the appropriate Caltrans standard plans to reduce the potential for the buildup of hydrostatic pressure behind the walls.

4.3.5 Backfill Placement

All backfill should be placed and compacted in accordance with Section 19 of Caltrans Standard Specifications. Light equipment should be used during retaining wall backfill compaction to minimize possible overstressing and/or yielding of the wall.

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4.3.6 Wall Deflections

Properly constructed retaining wall backfill may experience some settlement or deflection after construction. This is the result of normal deflection of the wall required to develop the active earth pressure and/or possible settlement of relatively deep backfills. This post-construction "settling in period" will vary with wall type, size, and construction details. This anticipated wall movement should be taken into account during overall project design. Where such deformations are unacceptable, the walls should be designed to resist the at-rest earth pressures or be backfilled and allowed to deflect prior to constructing final grades or improvements above the wall backfill zone or constructing any seals between the culvert pipes and headwall. The latter case will require monitoring of wall movements until they are complete. This could take several months.

4.4 CONSTRUCTION DEWATERING

As previously mentioned in Section 3.3, groundwater should be expected at the approximate water elevation in the creek. We anticipate the bottoms of the retaining wall foundation excavations will be approximately 5 to 7 feet below the water level in the creek. The bottoms of the foundation excavations should expose firm siltstone or sandstone bedrock. Dewatering and/or surface water control/bypassing will likely be necessary to permit construction under dry conditions. The surface water should be controlled and directed away from the foundation excavations through the use of temporary bypass measures coupled with trench drains and/or sumps and pumps within the work area. Such systems should be capable of maintaining water levels below the proposed footing bottom elevations.

The dewatering system for the project should be designed by a state-registered civil engineer experienced in dewatering and shoring applications. The system should be designed to reduce the potential for excessive erosion, soil dispersion, piping, and associated loss of ground. The lowering of groundwater levels produces additional effective stresses on the soils below the original water level. These additional pressures may cause consolidation of the materials beneath the roadway embankment fill, which can lead to settlement. Based on the anticipated depth of groundwater lowering and the height and length of the roadway embankment above, settlement associated with shallow dewatering is anticipated to be minimal and should not affect the performance of the roadway section above.

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4.5 SETTLEMENT MONITORING

It is often appropriate to perform settlement monitoring of improvements adjacent to dewatered areas in order to reduce the potential for excessive settlement. In addition, monitoring of the embankment during pipe ramming operations is recommended. Recommendations for settlement monitoring are provided in non-standard special provisions included in Appendix F of this report.

4.6 EARTHWORK CONSTRUCTION

The following presents recommendations for general earthwork criteria for use in constructing engineered fills and embankments. Previous sections should be reviewed for specific or supplemental earthwork recommendations.

4.6.1 Site Stripping and Clearing

Prior to general site grading, surface vegetation, organic topsoil, and any debris should be removed and disposed of outside the construction limits. Due to the heavily forested area with trees on the order of 100 feet tall, the presence of relatively deep root zones are likely to exist. These root zones should be removed during foundation excavations.

Although not encountered or identified during our investigation, it is possible that buried objects, such as abandoned utility lines, foundations, etc., exist on site. If encountered within the area of construction, these items should be removed and disposed of off-site. Existing utility pipelines that extend beyond the limits of the proposed construction and will be abandoned in-place should be plugged with cement grout to prevent migration of soil and/or water. All excavations resulting from removal activities should be cleaned of loose or disturbed material and dish-shaped with sides sloped 3H:1V (horizontal to vertical) or flatter to permit access for compaction equipment.

4.6.2 Temporary Excavations

Construction site safety generally is the sole responsibility of the Contractor, who should also be solely responsible for the means, methods, and sequencing of construction operations. The Contractor should be aware that slope height, slope inclination, or excavation depths (including utility trench excavations) should in no case exceed those specified in local, state, and/or federal safety regulations (e.g., OSHA Health and Safety Standards for Excavations, 29 CFR Part 1926,

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or successor regulations). Flatter slopes and/or trench shields may be required if loose, cohesionless soils and/or water are encountered along the slope face. Heavy construction equipment, building materials, excavated soil, and vehicular traffic should not be allowed within a lateral distance equal to one-third the slope height from the top of any excavation. During wet weather, earthen berms or other methods should be used to prevent runoff water from entering all excavations. All runoff water or groundwater encountered within excavations should be collected and disposed of outside the construction limits.

4.6.3 Permanent Slopes

The future fill slope for the embankment is anticipated to be 2H:1V or flatter. Such a slope is expected to be globally stable provided earthwork is performed in accordance with the recommendations contained in this report and the Caltrans Standard Specifications Section 19.

4.6.4 Fill Materials

Any required fill or backfill should be constructed in accordance with the recommendations contained herein and in latest edition of the Caltrans Standard Specifications. It is recommended that the geotechnical engineer sample and test proposed import fill materials to confirm their suitability prior to being transported to the site.

4.6.5 Engineered Fill

All fill soils, either native or imported, that are required to bring the site to final grade should be placed and compacted in accordance with Section 19-5 of the Caltrans Standard Specifications. Fills exceeding 5 feet in thickness should be compacted to at least 95 percent relative compaction for their full depth. Additional fill lifts should not be placed if the previous lift did not meet the required dry density or if soil conditions are not stable. Disking and/or blending may be required to uniformly moisture condition soils used for engineered fill.

4.6.6 Wet/Unstable Subgrade Mitigation

If site grading is performed during or following extended periods of rainfall, the moisture content of the near-surface soils may be significantly above optimum. This condition, if encountered, could seriously delay grading by causing an unstable subgrade condition. Typical remedial measures include disking and aerating the soils during dry weather, mixing the soils with dryer materials,

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removing and replacing the soils with an approved fill material, stabilization with a geotextile fabric or grid, or mixing the soils with an approved hydrating agent such as a lime or cement product. The geotechnical engineer should be consulted prior to implementing any remedial measure to observe the unstable subgrade condition and provide site-specific recommendations.

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5 ADDITIONAL SERVICES

5.1 PLANS AND SPECIFICATIONS REVIEW

We recommend Kleinfelder conduct a general review of final plans and specifications to evaluate that our recommendations have been properly interpreted and implemented during design. In the event Kleinfelder is not retained to perform this recommended review, we will assume no responsibility for misinterpretation of our recommendations.

5.2 PROJECT BID SUPPORT

It has been our experience that contractors bidding on the project often contact us to discuss the geotechnical aspects of the project. Informal contacts between Kleinfelder and an individual contractor could result in misleading or incomplete information provided to the contractor. Therefore, we recommend a pre-bid meeting be held to answer any questions about the report prior to submittal of bids. If this is not possible, questions or clarifications regarding this report should be directed to the project owner or his designated representative. After consultation with Kleinfelder, the project owner (or his representative) should provide clarifications or additional information to all contractors bidding the project.

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6 LIMITATIONS

This report presents information for design and construction for the proposed Ryan Creek Fish Passage Project located along Highway 101 north of the town of Willits in Mendocino County, California. The conclusions and recommendations in this report are invalid if:

- The assumed structural or grading details change
- The report is used for adjacent or other property
- Any other change is implemented which materially alters the project from that proposed at the time this report was prepared.

Recommendations contained in this report are based on the materials encountered in Caltrans Borings R-14-001 and R-14-002, Boring R-15-001 drilled as part of Kleinfelder's field investigation, as well as geologic interpretation based on published articles and geologic data, and our present knowledge of the proposed construction. The exploratory borings were extended to depths of about 45 to 50 feet below the ground surface, and are located in the general area of the pipe crossing and retaining walls at the South Fork of Ryan Creek along Highway 101.

It is possible that soil conditions could vary between or beyond the points explored. If the scope of the proposed construction changes from that described in this report, we should be notified immediately in order that a review may be made and any supplemental recommendations provided.

We have prepared this report in substantial accordance with the generally accepted geotechnical engineering practice as it exists in the site area at the time of our study. No warranty expressed or implied is made.

This report may be used only by the client and only for the purposes stated, within a reasonable time from its issuance. Land use, site conditions (both on site and off site) or other factors may change over time, and additional work may be required with the passage of time. Any party other than the client who wishes to use this report shall notify Kleinfelder of such intended use. Based on the intended use of the report, Kleinfelder may require that additional work be performed and that an updated report be issued. Non-compliance with any of these requirements by the client

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or anyone else will release Kleinfelder from any liability resulting from the use of this report by any unauthorized party.

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
01	Men	101	VAR		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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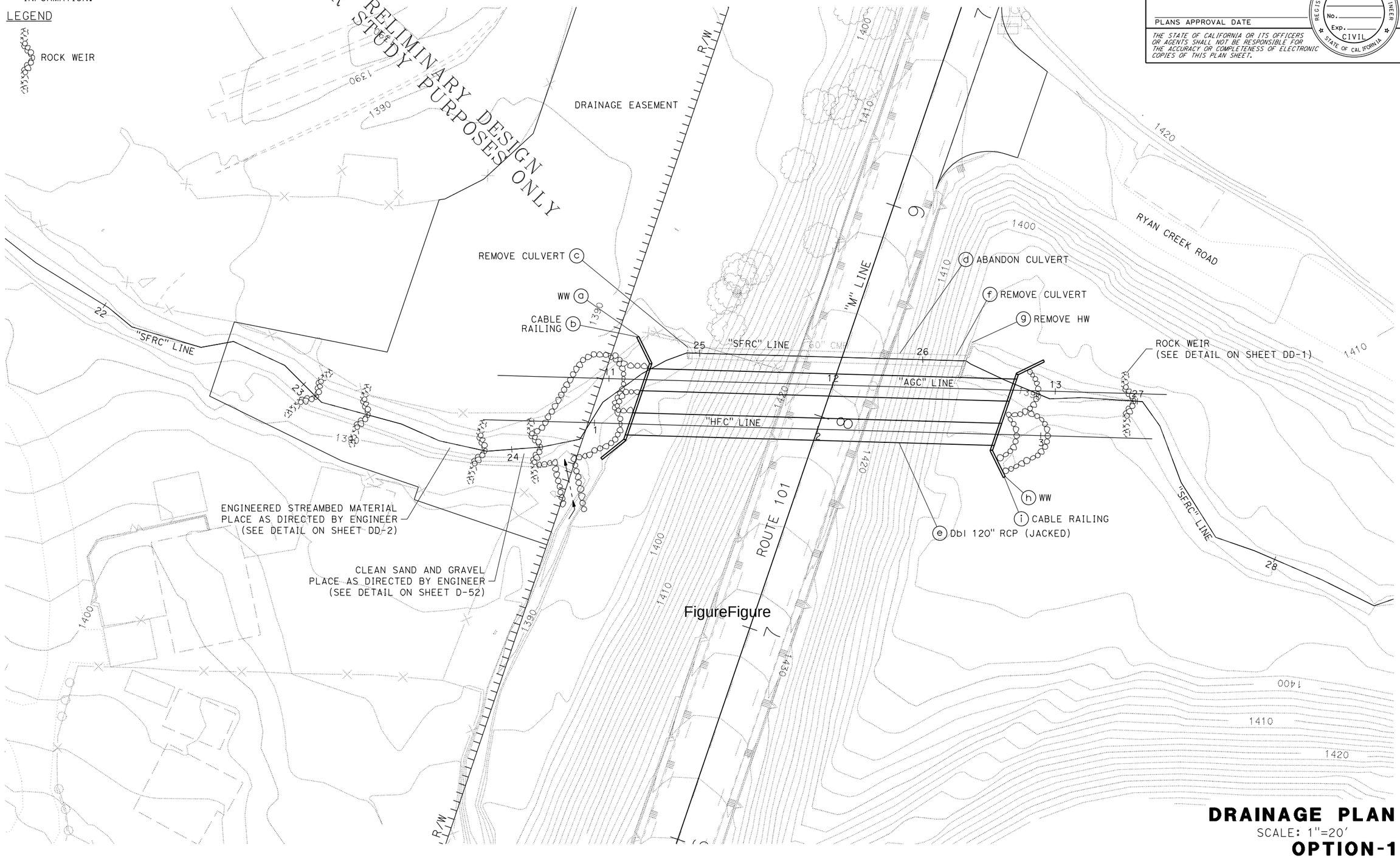
NOTES:

1. THIS PLAN ACCURATE FOR DRAINAGE ONLY.
2. SEE LAYOUT PLANS FOR ACCURATE GEOMETRIC INFORMATION.
3. SEE UTILITY PLANS FOR ACCURATE UTILITY INFORMATION.

LEGEND

ROCK WEIR



DRAINAGE PLAN

SCALE: 1"=20'

OPTION-1

REVISED BY	DATE REVISED

CALCULATED-DESIGNED BY	S FOSTER
CHECKED BY	R MIRANDA
FUNCTIONAL SUPERVISOR	DOUGLAS S. JONES

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans DIVISION OF DESIGN

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FIGURE 1

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
01	Men	101	VAR		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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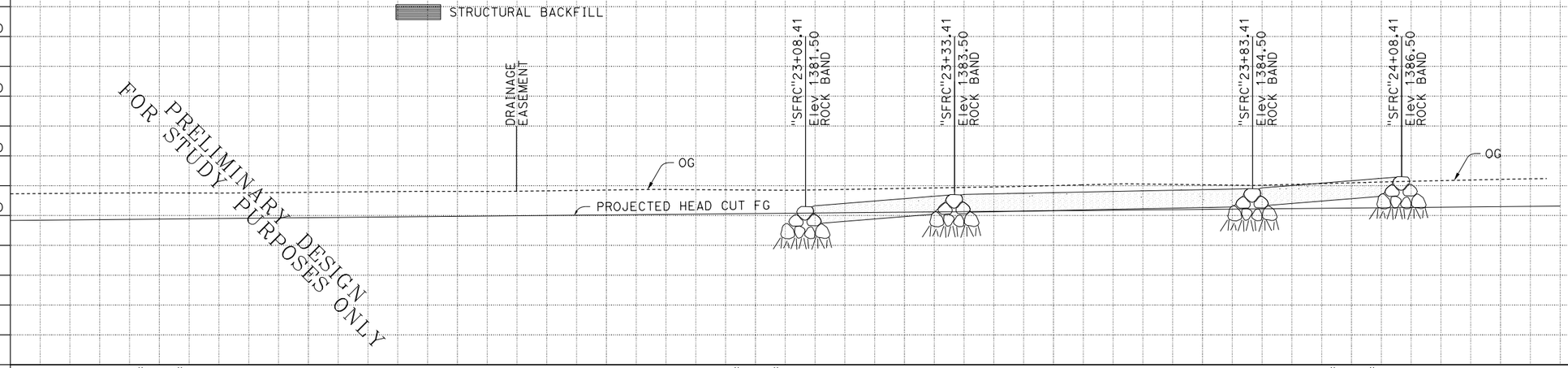
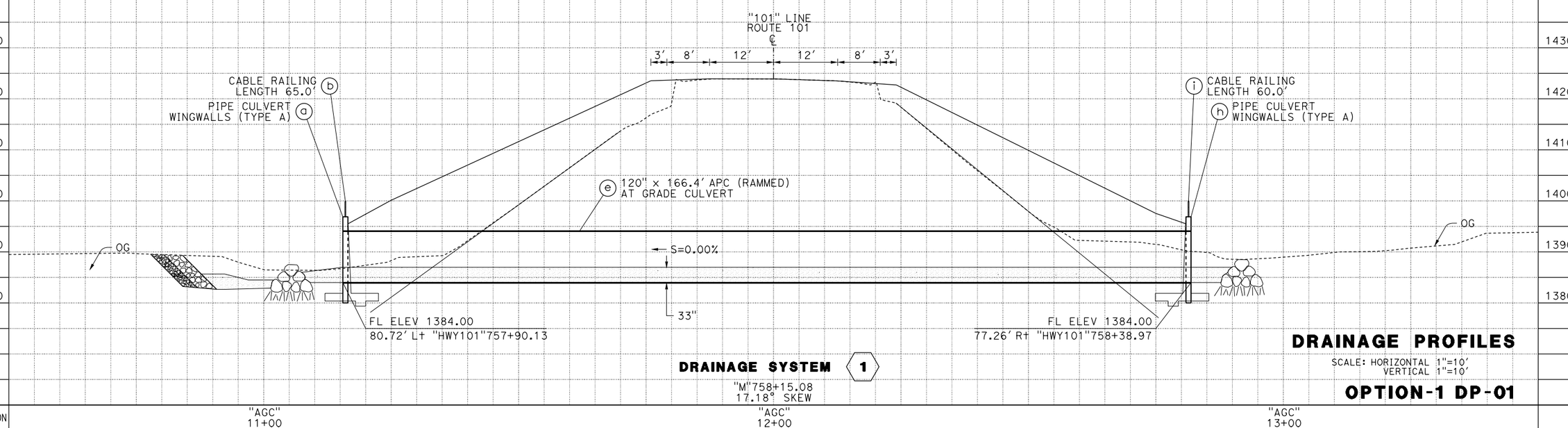
LEGEND
- ENGINEERED STREAMBED MATERIAL
- RSP BACKFILL
- BANKLINE ROCK
- BACKING No. 1
- ROCK WEIR
- STRUCTURAL BACKFILL





DRAINAGE SYSTEM 1

"M"758+15.08
17.18° SKEW

DRAINAGE PROFILES

SCALE: HORIZONTAL 1"=10′
VERTICAL 1"=10′

OPTION-1 DP-01

REVISED BY | DATE REVISED

R SCOTT FOSTER | RODOLFO MIRANDA

CALCULATED-DESIGNED BY | CHECKED BY

FUNCTIONAL SUPERVISOR: DOUGLAS S. JONES

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
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FIGURE 1

NOTE:
1. THIS SHEET ACCURATE FOR DRAINAGE INFORMATION ONLY.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
01	Men	101	VAR		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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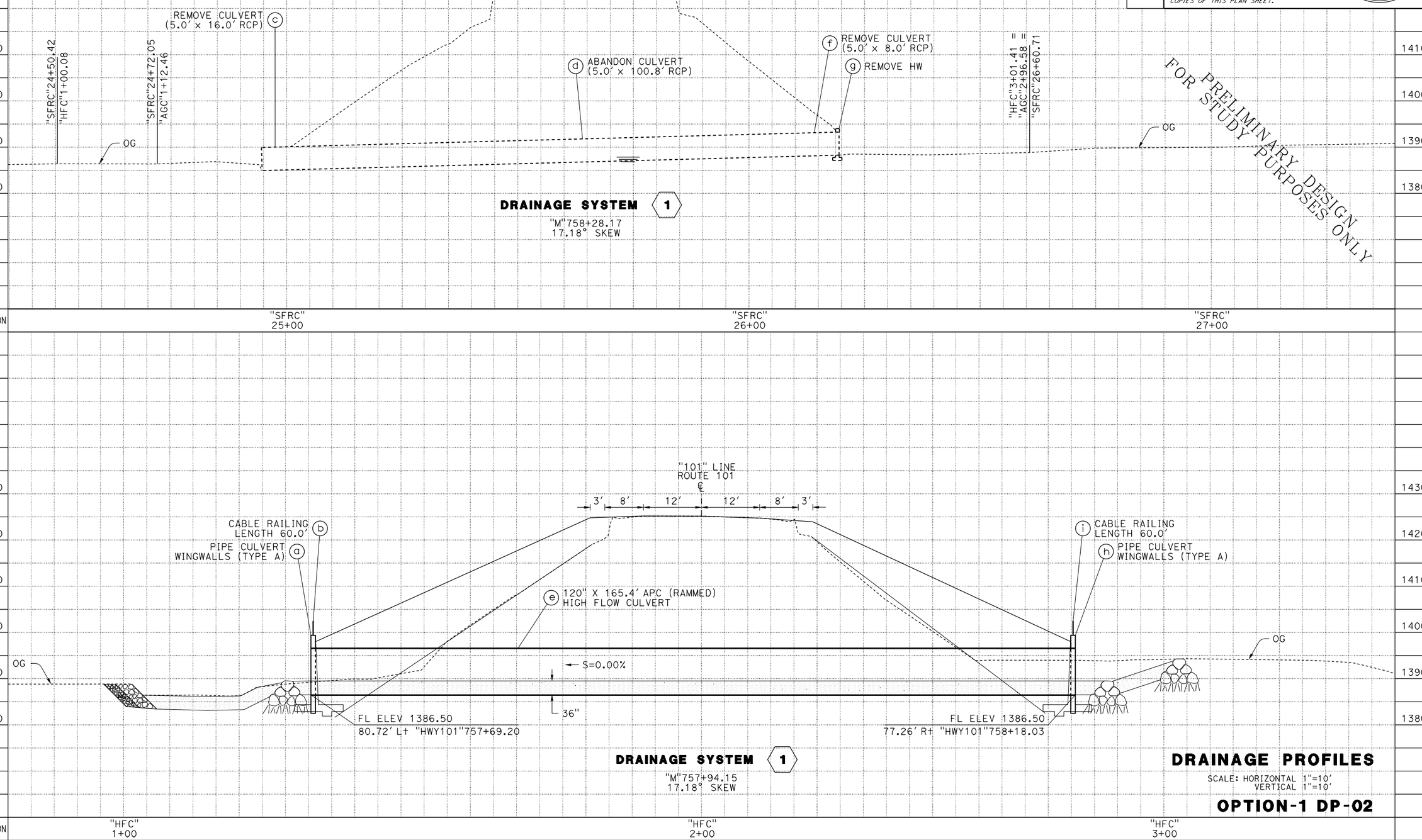

PRELIMINARY DESIGN FOR STUDY PURPOSES ONLY

DRAINAGE PROFILES

SCALE: HORIZONTAL 1"=10'
VERTICAL 1"=10'

OPTION-1 DP-02

REVISED BY	DATE REVISED

R SCOTT FOSTER — RODOLFO MIRANDA — CALCULATED-DESIGNED BY — CHECKED BY

DOUGLAS S. JONES — FUNCTIONAL SUPERVISOR

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
DIVISION OF DESIGN
Caltrans

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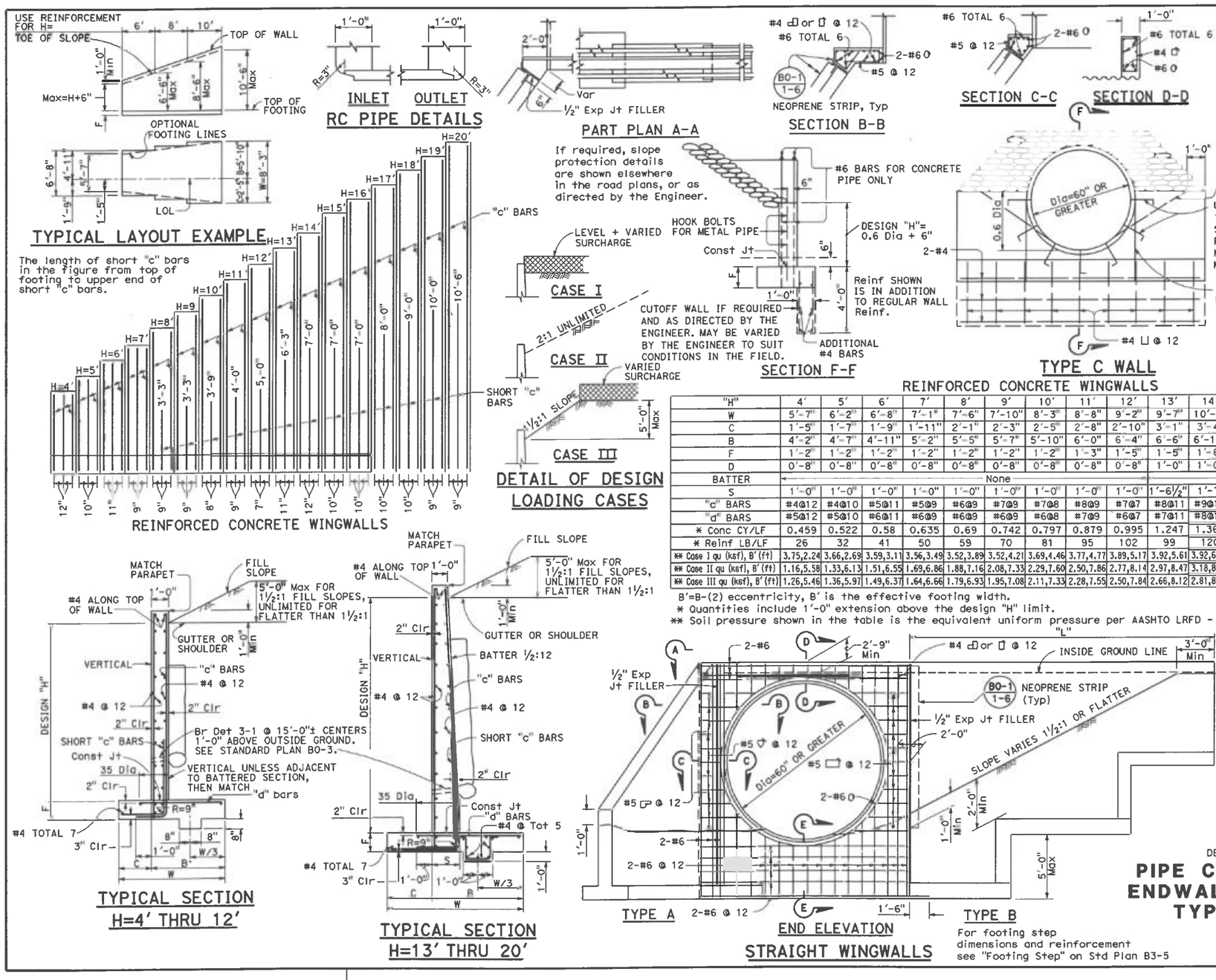
FIGURE 1



REINFORCED CONCRETE WINGWALLS

"H"	4'	5'	6'	7'	8'	9'	10'	11'	12'	13'	14'	15'	16'	17'	18'	19'	20'
W	5'-7"	6'-2"	6'-8"	7'-1"	7'-6"	7'-10"	8'-3"	8'-8"	9'-2"	9'-7"	10'-2"	10'-6"	11'-1"	11'-6"	11'-11"	12'-5"	12'-10"
C	1'-5"	1'-7"	1'-9"	1'-11"	2'-1"	2'-3"	2'-5"	2'-8"	2'-10"	3'-1"	3'-4"	3'-6"	3'-8"	3'-10"	4'-0"	4'-2"	4'-4"
B	4'-2"	4'-7"	4'-11"	5'-2"	5'-5"	5'-7"	5'-10"	6'-0"	6'-4"	6'-6"	6'-10"	7'-0"	7'-5"	7'-8"	7'-11"	8'-3"	8'-6"
F	1'-2"	1'-2"	1'-2"	1'-2"	1'-2"	1'-2"	1'-2"	1'-3"	1'-5"	1'-5"	1'-6"	1'-6"	1'-8"	1'-10"	1'-10"	2'-0"	2'-0"
D	0'-8"	0'-8"	0'-8"	0'-8"	0'-8"	0'-8"	0'-8"	0'-8"	0'-8"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"
BATTER	None										½:12						
S	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-6½"	1'-7"	1'-7½"	1'-8"	1'-8½"	1'-9"	1'-9½"	1'-10"
"c" BARS	#4@12	#4@10	#5@11	#5@9	#6@9	#7@9	#7@8	#8@9	#7@7	#8@11	#9@12	#10@10	#10@10	#10@10	#10@9	#10@9	#11@9
"d" BARS	#5@12	#5@10	#6@11	#6@9	#6@9	#6@9	#6@8	#7@9	#6@7	#7@11	#8@12	#8@10	#9@10	#9@10	#9@9	#9@9	#10@9
* Conc CY/LF	0.459	0.522	0.58	0.635	0.69	0.742	0.797	0.879	0.995	1.247	1.368	1.448	1.611	1.772	1.865	2.043	2.143
* Reinf LB/LF	26	32	41	50	59	70	81	95	102	99	120	156	171	181	190	217	267
** Case I qu (ksf), B'(ft)	3.75,2.24	3.66,2.69	3.59,3.11	3.56,3.49	3.52,3.89	3.52,4.21	3.69,4.46	3.77,4.77	3.89,5.17	3.92,5.61	3.92,6.18	4.03,6.40	4.13,6.95	4.28,7.26	4.39,7.57	4.65,7.82	4.85,8.02
** Case II qu (ksf), B'(ft)	1.16,5.58	1.33,6.13	1.51,6.55	1.69,6.86	1.88,7.16	2.08,7.33	2.29,7.60	2.50,7.86	2.77,8.14	2.97,8.47	3.18,8.93	3.41,9.05	3.70,9.43	4.02,9.58	4.26,9.80	4.57,10.05	4.82,10.27
** Case III qu (ksf), B'(ft)	1.26,5.46	1.36,5.97	1.49,6.37	1.64,6.66	1.79,6.93	1.95,7.08	2.11,7.33	2.28,7.55	2.50,7.84	2.66,8.12	2.81,8.59	3.00,8.69	3.22,9.10	3.49,9.18	3.65,9.79	3.89,9.74	4.07,9.96

B'=B-(2) eccentricity, B' is the effective footing width.
* Quantities include 1'-0" extension above the design "H" limit.
** Soil pressure shown in the table is the equivalent uniform pressure per AASHTO LRFD - 11.6.3.2

NOTES:

Unit Stresses: fy = 60,000 psi
f'c = 3,600 psi
Earth density: 120 pcf
Equivalent fluid pressure: 36 pcf
Elevation, length and angle of flare of wings may be varied by the Engineer to suit conditions encountered in the field. Wall height may be exceeded by 6" before going to the next greater "H".

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS

REGISTERED CIVIL ENGINEER

May 20, 2011
PLANS APPROVAL DATE

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STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

PIPE CULVERT HEADWALLS, ENDWALLS AND WINGWALLS TYPES A, B AND C

NO SCALE

D90

10-4-10

2010 STANDARD PLAN D90

FIGURE 2

APPENDIX A
Caltrans 2015 Geotechnical Design Report and Boring Logs

LIST OF ATTACHMENTS

Caltrans GDR Dated February 10, 2014

Caltrans Boring Log R-14-001

Caltrans Boring Log R-14-002

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State of California
DEPARTMENT OF TRANSPORTATION

California State Transportation Agency

Memorandum

Serious drought
Help Save Water!

To: Mr. DAVID NEUMANN
Office of Design and Technical Services
Branch B
Division of Engineering Services

Date: February 10, 2015

Attention: Lance Warren

File: 01-MEN-101-PM 52.0/52.6
01-26201
EFIS: 0112000205
RYAN CREEK FISH PASSAGE

From: VAHID KHATAOKHOTAN
Transportation Engineer
Office of Geotechnical Design – West
Geotechnical Services
Division of Engineering Services

HOOSHMAND NIKOUI
Chief, Branch A
Office of Geotechnical Design – West
Geotechnical Services
Division of Engineering Services

RON KARPOWICZ
Engineering Geologist
Office of Geotechnical Design – West
Geotechnical Services
Division of Engineering Services

Subject : GEOTECHNICAL DESIGN REPORT FOR RYAN CREEK FISH PASSAGE

INTRODUCTION

Per your request dated June of 2014, the Office of Geotechnical Design West (OGD-W) has prepared this Geotechnical Design Report (GDR) for the above referenced proposed pipe ramming project and cut-and cover project across State Route 101, PM 52.25 and 52.36. The pipe ramming segment is designed by the Office of Structures Design and the cut and cover segment is designed by District Design. The two project sites are located north of Willits, in Mendecino County (See Figure 1).

The scope of work performed by OGDW included site reconnaissance, reviewing specific site geology, preparing LOTB for the cut and cover site from already produced data, performing subsurface explorations for the pipe jacking site, and preparing this GDR.

PROJECT DESCRIPTION

Route 101 is a two-lane highway built on approximately 10 ft high embankment fill at North Fork and 30 ft high embankment fill at South Fork of Ryan Creek. The project calls for

replacing two existing 60-inch CMP cross culverts crossing State Route 101 at the South and North Forks of Ryan Creek as described below:

- ***North Fork***

  At the North Fork (SR-101, PM 52.36), remediation of the pipe culverts includes removing the 60 inch CMP culvert, and replacing it with a 12 by 10 ft RCB. The flow in the existing 60 inch culvert is from East to West side of the SR 101 (North Fork Ryan Creek). At this location, the embankment is about 12 ft high, with the existing pipe having a circa 7 ft clearance to the top of the pavement.

- ***South Fork***

  At the South Fork (SR-101, PM 52.25), remediation of the pipe culverts includes construction of two new 10 ft diameter steel pipe, jacked next to the existing 60 inch CMP. The flow in the existing 60 inch culvert is from East to West side of the SR 101 (South Fork Ryan Creek). At this location, the embankment is about 35 ft high, with about 38 ft of distance to the top of the existing pipe.

SITE GEOLOGY

Regional Geologic Overview

The project is located in the Coast Range Geomorphic Province of Central California, a series of northwest-trending mountain ranges (2,000 to 4,000, occasionally 6,000 ft elevation above sea level), and intermountain valleys, bounded in the east by the Great Valley and to the west by the Pacific Ocean. The Coast Ranges are composed of thick Cenozoic sedimentary and volcanic strata overlying Mesozoic metamorphic basement rock. The northern and southern ranges are separated by a depression containing the San Francisco Bay. The Coast Ranges are subparallel to the active San Andreas Fault, which is more than 600 miles long, extending from Pt. Arena to the Gulf of California.

Site Geology

According to the Geologic Map of California, Ukiah Sheet (Jennings and Strand, 1960) the site is located in an area underlain by undivided marine sedimentary bedrock (k). Their map provides no description of this unit. No landslides are mapped in the vicinity of the site. The relevant portion of the geologic map is included as Figure 2, Vicinity Geologic Map.

Fault and Seismic Data

According to the boring logs, the subsurface soils consist of 30 to 40 ft of loose to dense sandy materials underlain by soft sandstone and/or greywacke. Hence, the soil profile of the project site can be classified as between upper bound of Class D (stiff soil) and lower bound of Class C (very dense soil and soft rock). The corresponding shear wave velocity of top 100 ft (30 m) V_{S30} is chosen to be 1200 ft/s.

Table 1 below lists nearby seismic faults, their distances to the project site, and maximum magnitudes they can generate. These data are from the latest California Seismic Hazard Map (version 2.3.06). Using Caltrans ARS Online tool, both probabilistic and deterministic seismic hazard analyses were performed. The probabilistic analysis was performed using USGS Probabilistic Seismic Hazard Deaggregation model, with a 975-year return period (5% probability of exceedence in 50 years). The resulting ARS curves are shown in Figure x. The probabilistic curve yields higher amplitudes for all periods and thus is recommended as the design ARS curve, with a PGA of 0.79g. Note that this curve has accounted for the near-fault effect.

Table 1. Nearby Seismic Faults, Distances, and Magnitudes

Fault Name	Fault ID	Fault Type	Distance (km)	Max. Magnitude (Mw)
Maacama fault zone (North section)	66	SS	2.3	7.4
San Andreas (Offshore) 2011 CFM	54	SS	46.3	8
San Andreas (North Coast) 2011 CFM	80	SS	52.6	8

Groundwater

At the time of our field investigation, groundwater was encountered in both borings at a depth of about 35 ft below the surface. For construction purposes, groundwater level should to be at the same elevation of the water in creek. However, groundwater levels are subject to fluctuations as seasonal precipitation in and around the creek.

Corrosion

Corrosion studies are conducted in accordance with the requirements of California Test Method No. 643. Based on the test results from the Materials Engineering Testing Services (METS) of Caltrans, this site is considered non-corrosive. Table 2 below shows the corrosion test results:

Table 2. Corrosion Results Table for Ryan Fish Creek Passage

Location	Depth	Min. Resistivity	PH	Chloride Content	Sulfate Content
	(ft)	(ohm-cm)		(ppm)	(ppm)
R-14-001	31.5 to 35	9462	6.81	N/A	N/A
R-14-002	36.5 to 40	4799	6.59	N/A	N/A

Criteria for soil to be corrosive: Chloride concentration greater than or equal to 500 ppm, sulfate concentration greater than or equal to 2000 ppm, or the pH is 5.5 or less.

SUBSURFACE CONDITIONS

- ***North Fork***

Subsurface investigations for this site were performed in 2006. There were four bore holes done on the roadway pavement, at the four corners of the proposed pipe (see Figure 4). Based on the records received from these logs, the near surface fill materials (below pavement, from 0 to about 18ft) within the project area are primarily coarse gravel and silty sand. These materials have loose to medium dense densities. Below these layers, the materials turn into very dense sand or greywacke.

- ***South Fork***

Subsurface investigations for this site were performed in December of 2014. There were two bore holes drilled to a depth of about 48ft and 45ft, one at each side of the proposed pipes (see Figure 5). The boreholes drilled here indicate that the embankment consist of about 30ft of fill materials, medium dense to dense gravelly sand. Below the embankment, within the top half of pipe ramming operation, approximately 5 ft thick layer of medium dense sand exist. Between the depths of 35 to 45 ft, within the bottom half of pipe ramming operation, both boreholes indicate materials to be of medium stiff to stiff sandy clays/ silt having SPT blow count ranging from 8 to 24 blows/ft. Both borings indicate soft sandstone below the depth of 45 ft. A profile view of the proposed culvert with related soil stratigraphy is shown in Figure 6.

Log of test boring sheets will be provided when completed.

FOUNDATION RECOMMENDATIONS

- ***North Fork***

The proposed design for this site is to remove the existing 60-inch CMP, by means of cut & cover method. Since the excavation is more than 5 ft deep, shoring needs to be installed per

Cal OSHA's requirements. Once the existing pipe is removed, a 12' X 10' X 89' Reinforced Concrete Box is to be constructed. The information obtained from the bore holes indicates that the bottom elevation of the box culvert lies in the area where soil densities are low. Therefore, we recommend an extra 2 ft of excavation below the bottom elevation of the Reinforced Concrete Box, proper compaction of the in situ soil at the bottom of excavation, placement of Subgrade Enhancement Geotextile Class B1 of Standard Specification Section 88-1.02O and then placing 2 ft thick structural backfill material compacted to 95% relative compaction. The box culvert shall then be constructed on top of compacted structure backfill material.

- ***South Fork***

The proposed design for this site is to abandon the existing 60-inch CMP, and replacing it by ramming a double 120" (10') diameter 113' long steel pipe. The new pipes will be rammed next (south side) to the existing 60-inch CMP pipe, approximately 30' (top of the pipe) below the roadway surface. Please note that the pipe ramming operations will be below the groundwater according the boring logs and thus, dewatering system may be required at the ramming and receiving ends.

The pipe ramming operations shall be in accordance with NSSP prepared by Office of Structures design. We strongly recommend placement of settlement hubs in a grid system, across the rammed pipe on the roadway prior to operation to monitor roadway settlement.

Any questions regarding the above recommendations should be directed to Vahid Khataokhotan at (510) 622-1729, or Hooshmand Nikoui (510)286-4811, of the Office of Geotechnical Design-West.

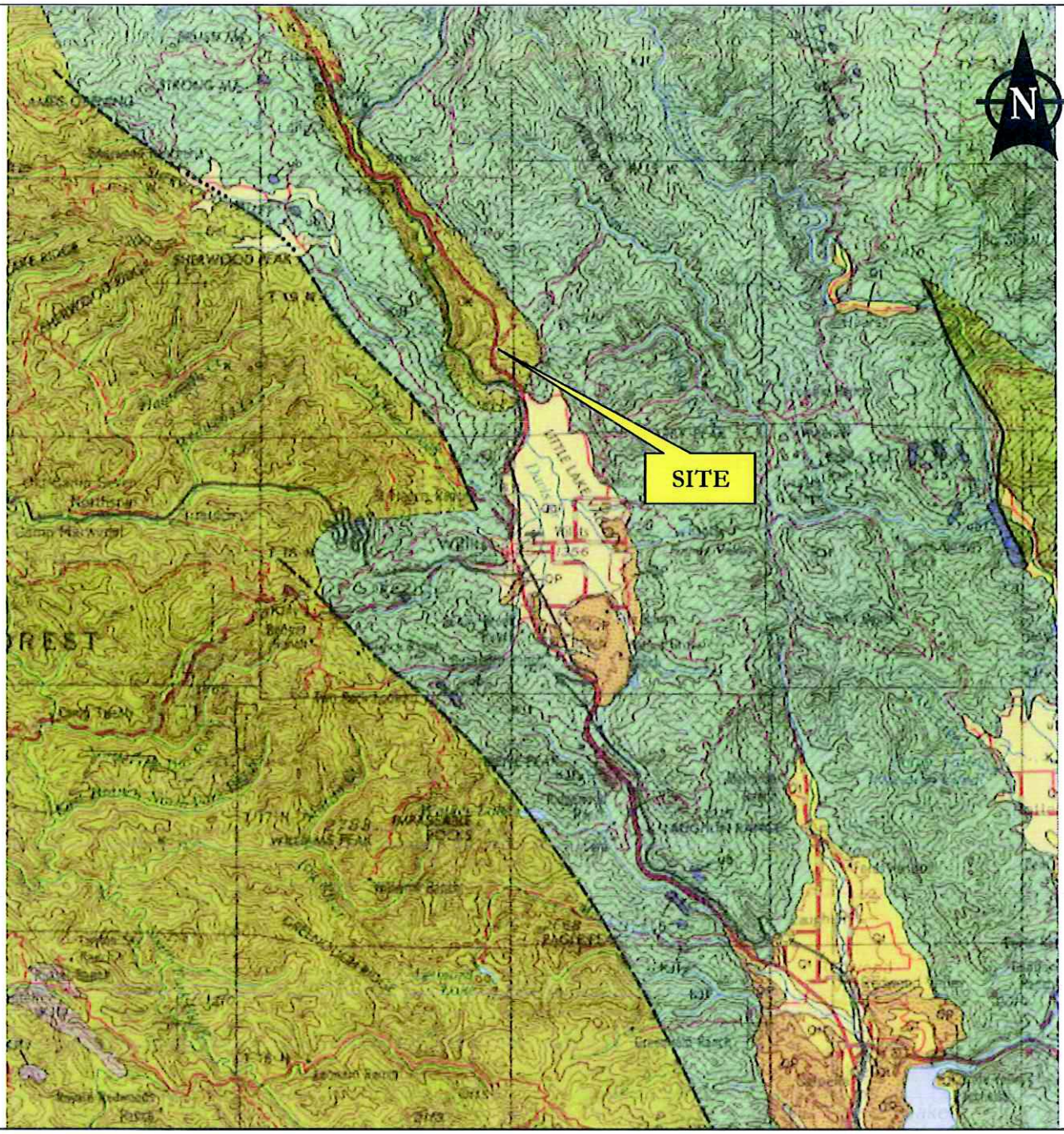
Attachments:

c: TPokrywka, HNikoui, Daily File
Project Manager
District Design Chief

VKhataokhotan/mm

REGISTERED PROFESSIONAL ENGINEER
VAHID KHATA-O-KHOTAN
No. 66980
Exp. 09/16
CIVIL
STATE OF CALIFORNIA

Figure 1
01-26201
01-MEN-101-PM 52.2/52.36
Ryan Fish Creek



LEGEND

K	Undivided Cretaceous marine
KJf	Franciscan group

Base: Geologic Map of California, Ukiah Sheet (Jennings and Strand, 1960)
Not to scale

Caltrans	RYAN CREEK FISH PASSAGE HIGHWAY 253 PM 52 MENDOCINO COUNTY, CALIFORNIA	VICINITY GEOLOGIC MAP
	DECEMBER 2014	FIGURE 2

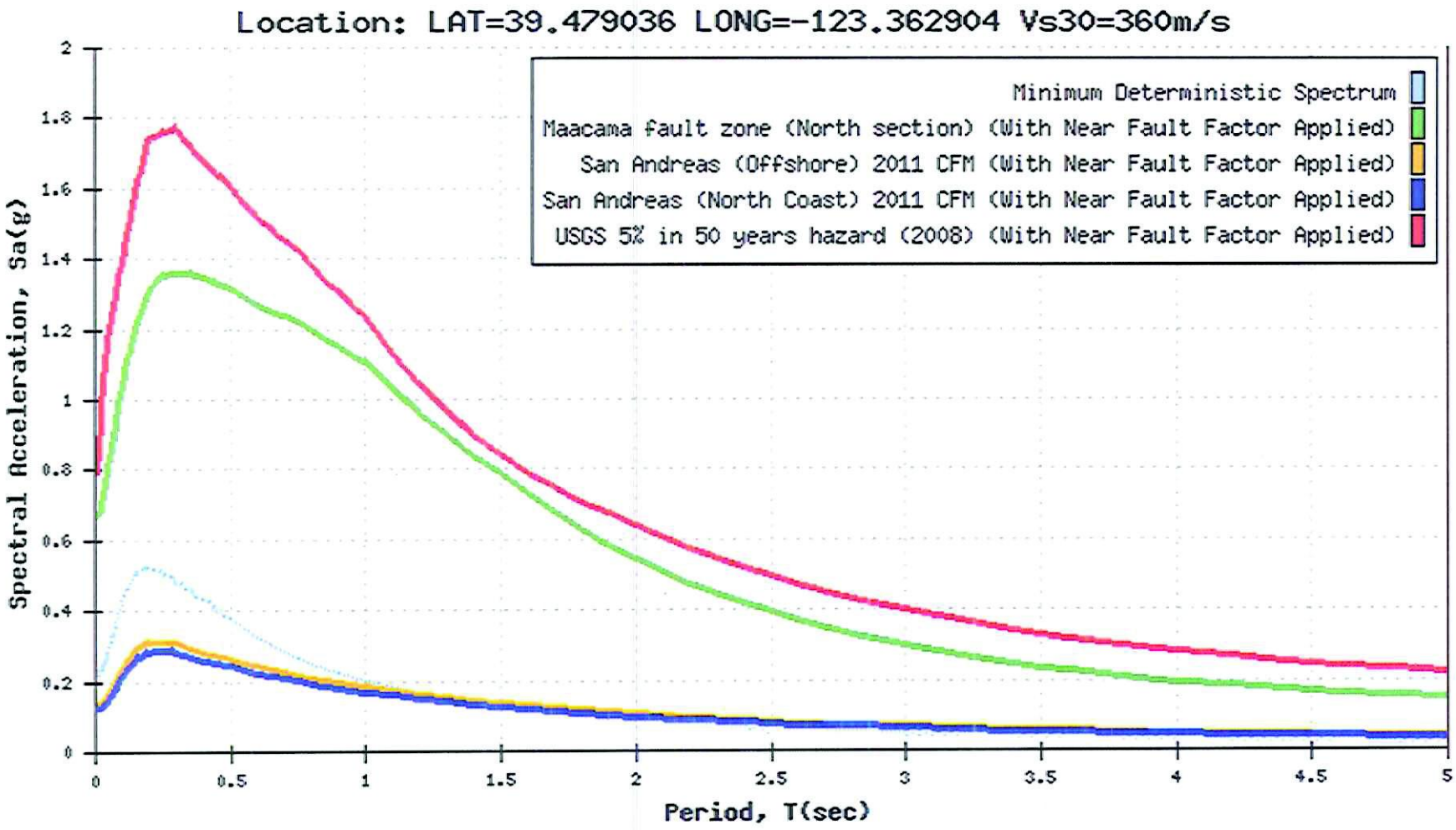
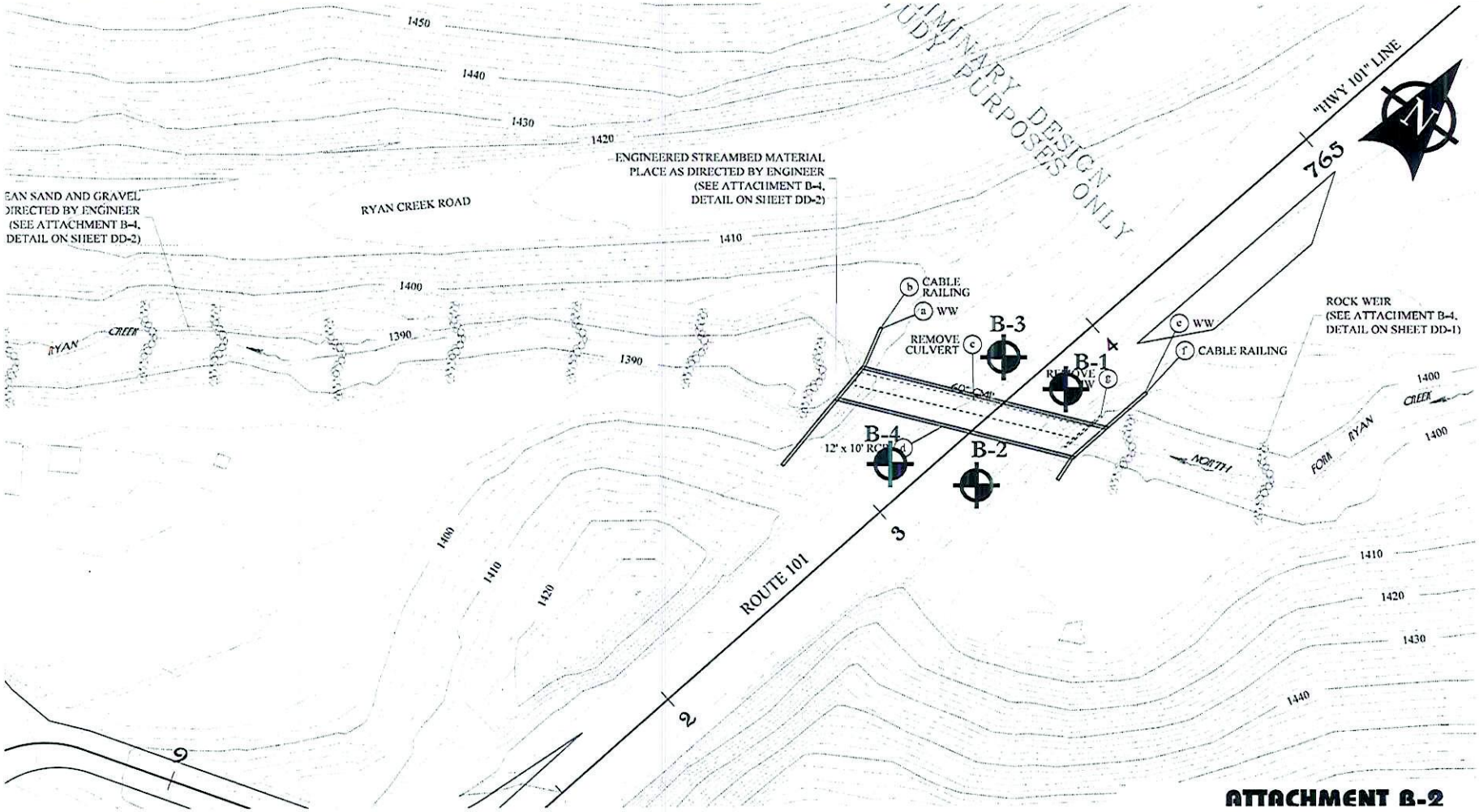


Figure 3
01-26201
01-MEN-101-PM 52.2/52.36
Ryan Fish Creek



ATTACHMENT B-2

Legend

Approximate location of vertical boring

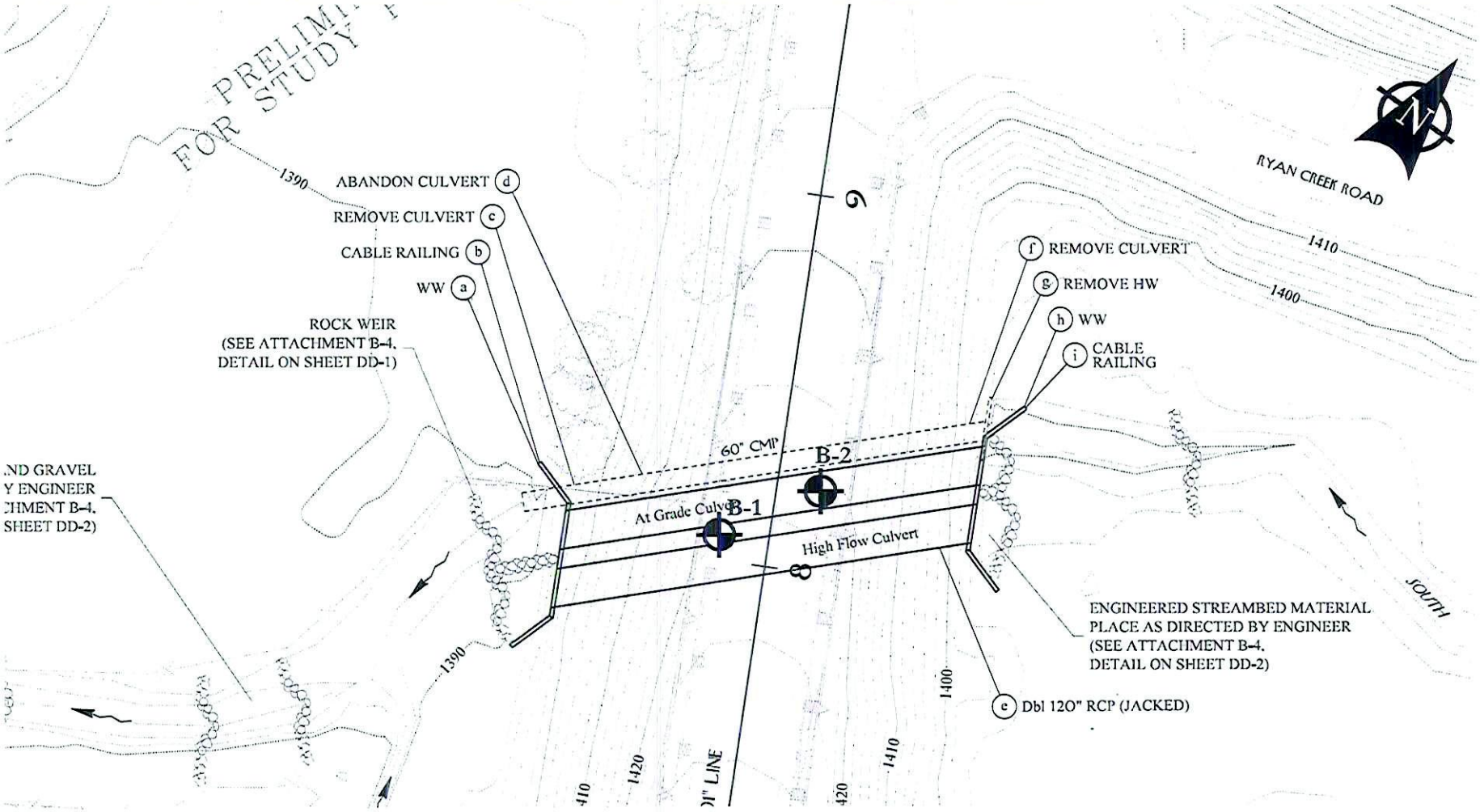
Caltrans

BORING LOCATION MAP

NORTH FORK RYAN CREEK
SR 101 P.M. 52.36
MENDOCINO COUNTY, CALIFORNIA

JANUARY 2015

FIGURE 4



Legend

Approximate location of vertical boring

Caltrans	BORING LOCATION MAP
SOUTH FORK RYAN CREEK SR 101 P.M. 52.25 MENDOCINO COUNTY, CALIFORNIA	
JANUARY 2015	FIGURE 5

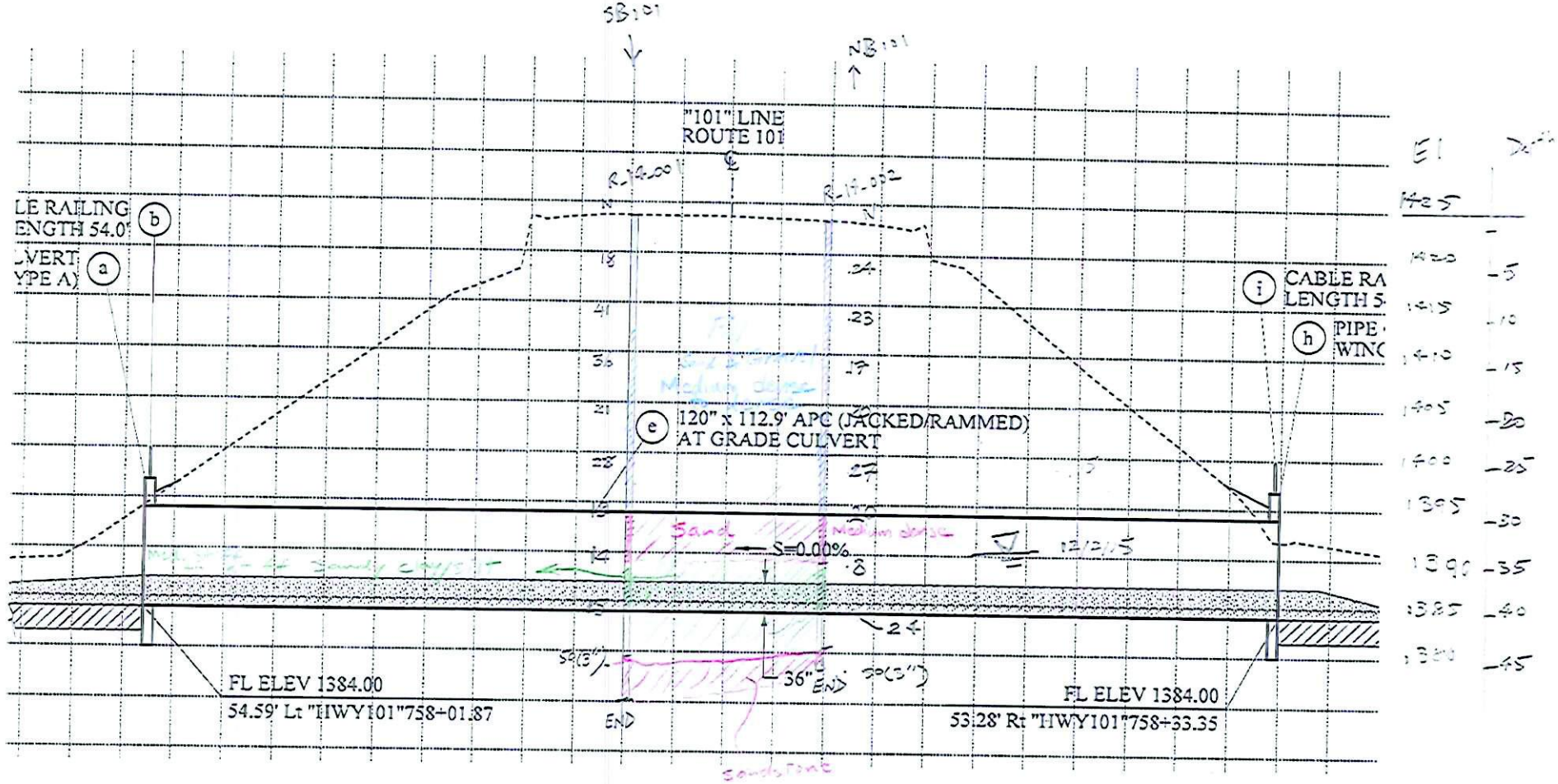


Figure 6. Soil Stratigraphy of South Fork

01-26201

01-MEN-101-PM 52.2

Ryan Fish Creek

DRAFT

LOGGED BY / BEGIN DATE / COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
V. Khotan		R-14-001
DRILLING CONTRACTOR: Caltrans	BOREHOLE LOCATION (Offset, Station, Line): 7.0' Lt Sta 757+85 cl	SURFACE ELEVATION: 1423.5 ft
DRILLING METHOD: Rotary Wash	DRILL RIG: CS 2000 (track)	BOREHOLE DIAMETER
SAMPLER TYPE(S) AND SIZE(S) (ID): SPT	SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi: 1.41%
BOREHOLE BACKFILL AND COMPLETION	GROUNDWATER READINGS: DURING DRILLING 35.0 ft; AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING: 50.0 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 (18).												
			Fill.												
1418.50	5		Poorly graded SAND (SP); medium dense; light brown; dry; coarse SAND ; nonplastic fines.	X	1	11 10 18	28	67							
1413.50	10		Poorly graded SAND with GRAVEL (SP); dense; brown; few GRAVEL.	X	2	35 25 16	41	67							
1408.50	15			X	3	16 20 16	36	67							
1403.50	20		Medium dense.	X	4	9 11 10	21	67							
1398.50	25			X	5	13 13 15	28	67							
1393.50	30		Poorly graded SAND (SP); medium dense; olive gray.	X	6	7 10 9	19	67							
1388.50	35		Poorly graded SAND with SILT (SP-SM); dark gray; wet; medium plasticity fines.	X	7	8 6 8	14	67							
1383.50	40		Rock.	X	8	8 6 9	15	67							

(continued)

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

REPORT TITLE				HOLE ID
BORING RECORD				R-14-001
DIST. 01	COUNTY MEN	ROUTE 101	POSTMILE 52.3	PROJECT ID 0112000205
PROJECT OR BRIDGE NAME: Ryan-Fish Creek				
BRIDGE NUMBER	PREPARED BY	DATE	SHEET 1 of 2	

5 BR - STANDARD RYAN-FISH CEEK.GPJ CALTRANS LIBRARY (FEB 2013).GLB 3/18/15

DRAFT

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
1378.50	45		(SANDSTONE); grayish blue; hard.	X	9	50		17							
1373.50	50		Bottom of borehole at 50.0 ft bgs												
1368.50	55		This Boring Record was developed in accordance with the Caltrans Soil & Rock Logging, Classification, and Presentation Manual (2010) except as noted on the Soil or Rock Legend or below.												
1363.50	60														
1358.50	65														
1353.50	70														
1348.50	75														
1343.50	80														
1338.50	85														
1333.50	90														

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

REPORT TITLE				HOLE ID
BORING RECORD				R-14-001
DIST. 01	COUNTY MEN	ROUTE 101	POSTMILE 52.3	PROJECT ID 0112000205
PROJECT OR BRIDGE NAME Ryan-Fish Creek				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET 2 of 2

5 BR - STANDARD RYAN-FISH CEEK.GPJ CALTRANS LIBRARY (FEB 2013).GLB 3/18/15

DRAFT

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
V. Khotan				R-14-002
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Caltrans			7.0' Rt Sta 758+05 cl	1422.5 ft
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Rotary Wash			CS 2000 (track)	
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
SPT				1.41%
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING 35.0 ft AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
				45.0 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 (18).												
1417.50	5		Poorly graded SAND (SP); medium dense; light brown; dry; fill.	X	1	9 13 11	24	100							
1412.50	10		Trace fine GRAVEL ; fill.	X	2	12 12 11	23	100							
1407.50	15		Poorly graded SAND with GRAVEL (SP); brown.	X	3	8 5 12	17	100							
1402.50	20		No recovery.	X	4	12 9 11	20	0							
1397.50	25		Poorly graded SAND with GRAVEL (SP); dense; brown; trace fine GRAVEL.	X	5	12 16 11	27	100							
1392.50	30		Poorly graded SAND (SP); medium dense; bluish gray.	X	6	8 9 11	20	100							
1387.50	35		SANDY SILT (ML); bluish gray; soft.	X	7	2 4 4	8	19							
1382.50	40			X	8	4 10 14	24								

(continued)

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

REPORT TITLE				HOLE ID
BORING RECORD				R-14-002
DIST. 01	COUNTY MEN	ROUTE 101	POSTMILE 52.3	PROJECT ID 0112000205
PROJECT OR BRIDGE NAME Ryan-Fish Creek				
BRIDGE NUMBER	PREPARED BY	DATE	SHEET 1 of 2	

5 BR - STANDARD RYAN-FISH CEEK.GPJ CALTRANS LIBRARY (FEB 2013).GLB 3/18/15

DRAFT

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
			SEDIMENTARY ROCK (SILTSTONE).												
1377.50	45		Bottom of borehole at 45.0 ft bgs	X	9	50									
1372.50	50		This Boring Record was developed in accordance with the Caltrans Soil & Rock Logging, Classification, and Presentation Manual (2010) except as noted on the Soil or Rock Legend or below.												
1367.50	55														
1362.50	60														
1357.50	65														
1352.50	70														
1347.50	75														
1342.50	80														
1337.50	85														
1332.50	90														

5 BR - STANDARD RYAN-FISH CEEK.GPJ CALTRANS LIBRARY (FEB 2013).GLB 3/18/15

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

REPORT TITLE				HOLE ID
BORING RECORD				R-14-002
DIST. 01	COUNTY MEN	ROUTE 101	POSTMILE 52.3	PROJECT ID 0112000205
PROJECT OR BRIDGE NAME Ryan-Fish Creek				
BRIDGE NUMBER	PREPARED BY	DATE	SHEET 2 of 2	

APPENDIX B
Geotechnical Laboratory Test Results

LIST OF ATTACHMENTS

Gradation Analysis Test Results for Boring R-14-001
Gradation Analysis Test Results for Boring R-14-002

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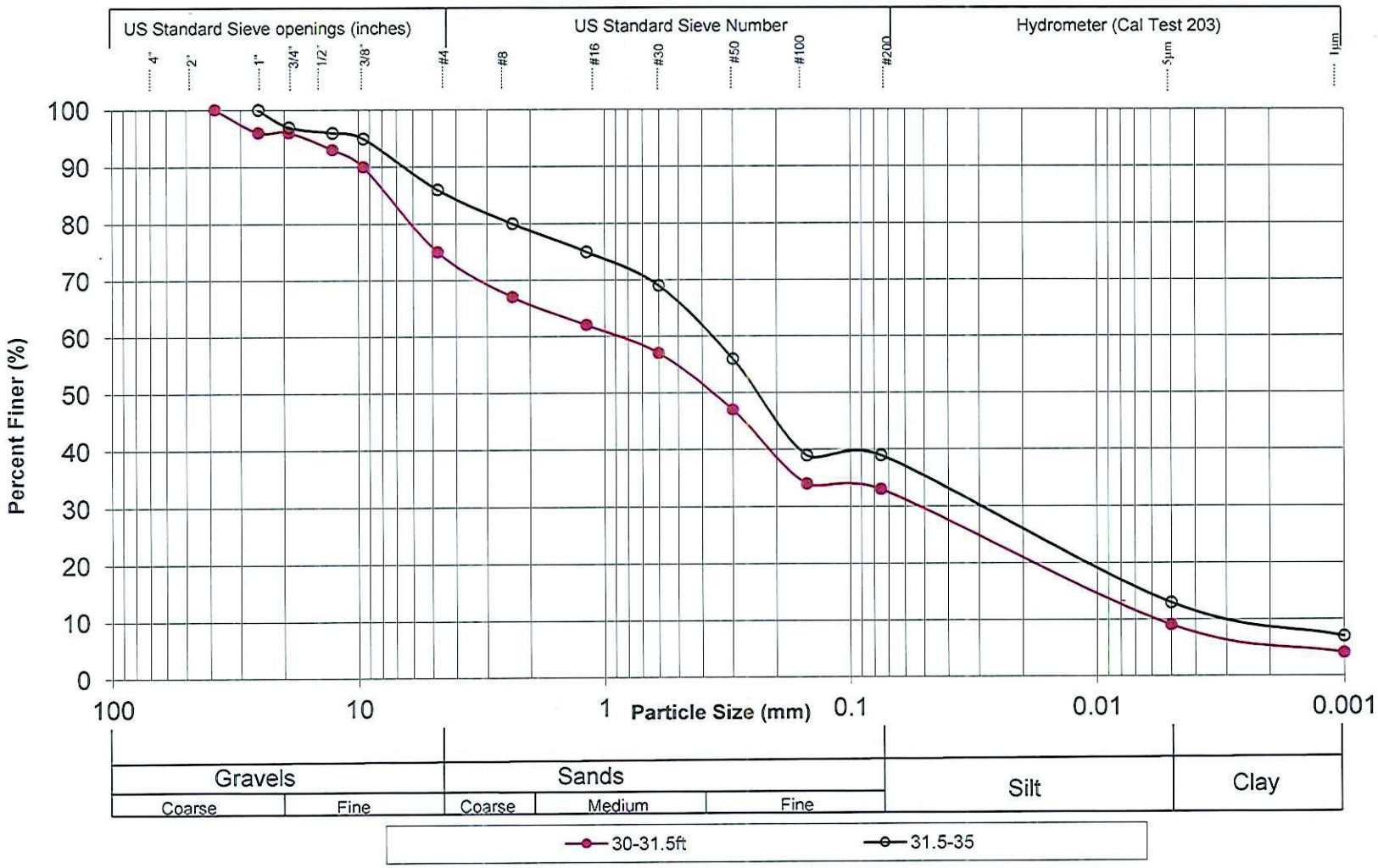
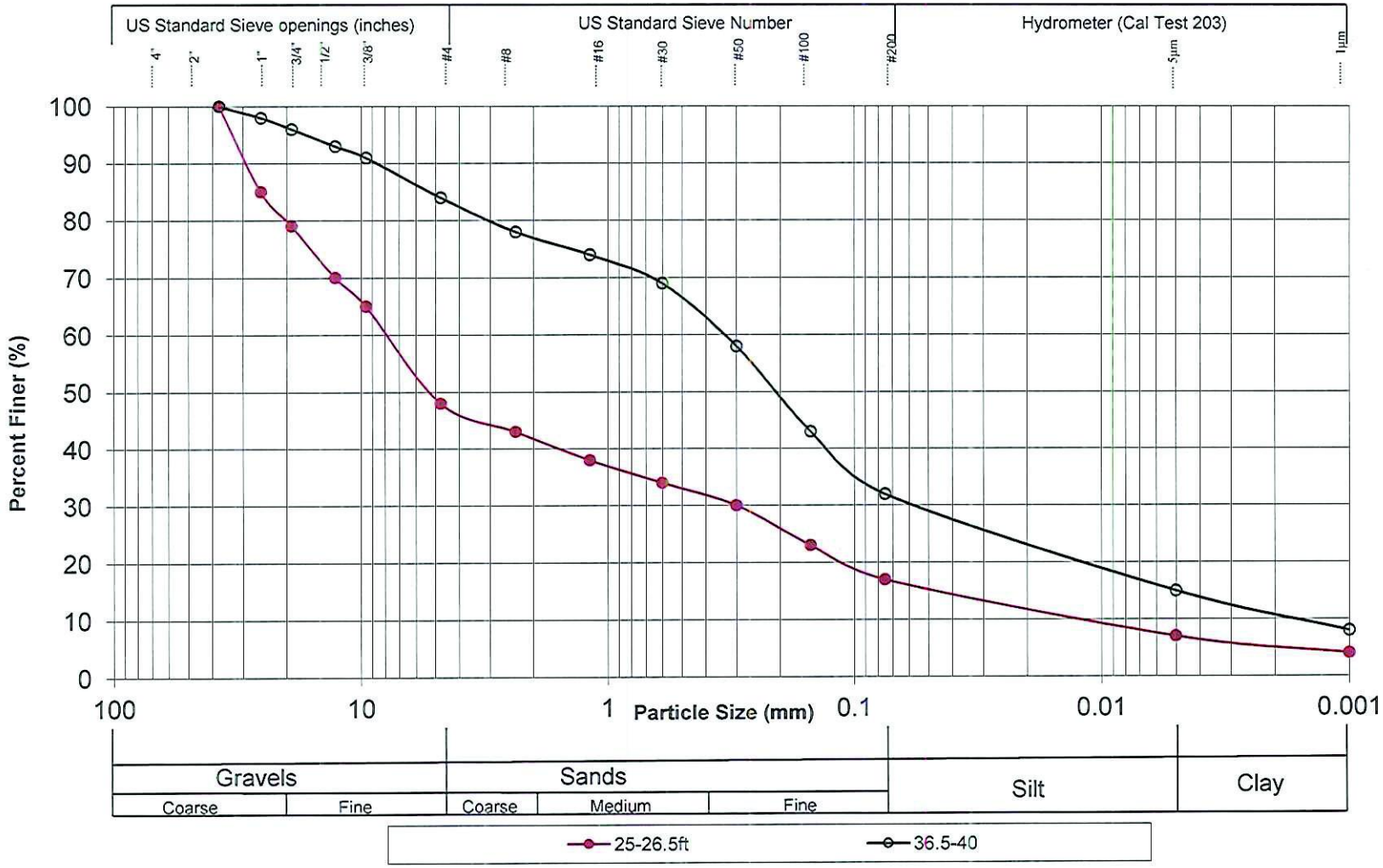
Gradation Analysis Test Results R-14-001



Gradation Analysis Test Results R-14-002



APPENDIX C
Kleinfelder Boring Log, Field Report and Well Completion Report

LIST OF ATTACHMENTS

Kleinfelder Boring Log R-15-001

Kleinfelder Drilling Field Report

Well Completion Report

Copyright 2015 Kleinfelder

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
J Richmond	4-30-15	4-30-15	ft / ft Not Available	R-15-001
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Caltrans Drilling Company			757+90/7' E	~1,423.50 ft Not Available
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Core			Acker MPCA	3.7 in
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
94 mm punch core			Auto; 140 lbs / 30-inch drop	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS: DURING DRILLING 26.5 ft; AFTER DRILLING (DATE) Not Applicable	TOTAL DEPTH OF BORING
Monitoring Well				50.2 ft

ELEVATION (ft)	DEPTH (ft)	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 (12").	C01			100						
		AGGREGATE BASE (12").	C02			100						
		SANDY LEAN CLAY with GRAVEL (CL); hard; brown; dry; 5% fine to coarse, subrounded gravel; 25% coarse to fine sand; 70% fines; (FILL).				100						
1420.00		POORLY-GRADED SAND with SILT (SP-SM); dense; light brown, light yellowish brown, orange; dry; 90% fine sand; 10% fines; (SANDSTONE DERIVED FILL).	C03									
	5					33						Switch to mud rotary, 94 mm punch, SPT, AWJ
1415.00		weathered, soft sandstone clast remnants.	C04									
	10					32						Adjust shoe position
		POORLY-GRADED GRAVEL with CLAY AND SAND (GP-GC); medium dense; brown, yellowish brown; 30% fine to coarse, subrounded gravel; 60% coarse to fine sand; 10% fines; (RUBBLE FILL).	C05									
1410.00												
	15	subangular gravel, max.3 in. dia.; (SANDSTONE FRAGMENTS).				53						
1405.00			C06									
	20					37						Circulation loss 20' to 25'
		3" layers of loose to medium dense Clayey SAND.										
1400.00			C07									
	25					43						
		CLAYEY SAND with GRAVEL (SC); loose to medium dense; gray, grayish blue, olive gray; wet; 10% fine, subangular gravel; 75% coarse to fine sand; 15% fines; occasional rootlets; organic decomposition; (RUBBLE FILL).	C08									
1395.00	30											

(continued)

KLEINFELDER
Bright People. Right Solutions.

REPORT TITLE				HOLE ID
BORING RECORD				R-15-001
DIST. 01	COUNTY Mendocino	ROUTE 101	POSTMILE 52.25	EA 01-262011
PROJECT OR BRIDGE NAME: TO83473 RYAN CREEK FISH PASSAGE				
BRIDGE NUMBER	PREPARED BY Ajm	DATE 5-7-15	SHEET 1 of 2	

PLOTTED: 06/23/2015 09:44 AM BY: Dross
gINT FILE: PROJECTWISE: 20143390_073_to83473 Ryan Creek Fish Passage.gpj
gINT TEMPLATE: L:KLF_STANDARD_GINT_LIBRARY_2015.GLB [CLIENT_CALTRANS BORING RECORD MET/ENG]

ELEVATION (ft)	DEPTH (ft)	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
	30	CLAYEY SAND with GRAVEL (SC); loose to medium dense; gray, grayish blue, olive gray; wet; 10% fine, subangular gravel; 75% coarse to fine sand; 15% fines; occasional rootlets; organic decomposition; (RUBBLE FILL).	C09			33						
1390.00		CLAYEY SAND with GRAVEL (SC); soft to medium hard; gray, grayish blue, olive gray; wet; 10% fine, subangular to subrounded gravel, max.1 in. dia.; 75% coarse to fine sand; 15% fines; occasional rootlets; organic decomposition; increased gravel content; (ALLUVIUM /DEBRIS FLOW DEPOSIT). wood fragments at 35.5'.										
	35		C10			17						Easy drilling 35' to 40'
1385.00		minimal - no recovery.										
	40		S11	10 7 4	11	NR						No recovery
						45						
		POORLY-GRADED SAND with GRAVEL (SP); loose; gray; wet; subrounded gravel; 85% coarse, rounded sand; 15% fines; (ALLUVIUM).	C12									Continued easy drilling
1380.00												
	45	CLAYEY GRAVEL with SAND (GC); dense; grayish blue; wet; 60% subangular gravel, max.2 in. dia.; 25% coarse to fine sand.	S13	50		NR						Pump turned off (sample recovered)
		SEDIMENTARY BEDROCK (SANDSTONE TO META-SANDSTONE) dark gray to grayish blue; moderately weathered; soft to moderately hard; locally, massively, intenselly fractured with locally moderately fractured zones; occasional quartz veinlets; (no HCL reaction).	C14			110						
						80						
1375.00			C15									
	50	Bottom of borehole at 50.2 ft bgs	S16	50		NR						
1370.00												
	55											
1365.00												
	60											
1360.00												
	65											

KLEINFELDER
Bright People. Right Solutions.

REPORT TITLE				HOLE ID
BORING RECORD				R-15-001
DIST. 01	COUNTY Mendocino	ROUTE 101	POSTMILE 52.25	EA 01-262011
PROJECT OR BRIDGE NAME TO83473 RYAN CREEK FISH PASSAGE				
BRIDGE NUMBER	PREPARED BY Ajm		DATE 5-7-15	SHEET 2 of 2

PLOTTED: 06/23/2015 09:44 AM BY: Dross
gINT FILE: PROJECTWISE: 20143390_073_to83473 Ryan Creek Fish Passage.gpj
gINT TEMPLATE: L:\KLF_STANDARD_GINT_LIBRARY_2015.GLB [CLIENT_CALTRANS BORING RECORD MET/ENG]

DAILY FIELD REPORT – DRILLING OBSERVATION
State of California, Department of Transportation

Project Title: Consultant Services Including Obtaining Drilling Permit for Exploratory Drilling Requiring C-57 License for Ryan Creek Fish Passage Project in Mendocino County

Project Identification: EA: 01-262011

Name of Observer: Jeff Richmond
Location: Mendocino US Route 101 PM 52.25
Objective: Drilling Observation, Logging

Date: 4/30/15
Time Arrived: 7:30
Time Departed: 5:00
Weather Conditions: Clear

Please complete one table per CPT or Boring Advanced. *C = Caltrans K = Kleinfelder*

	Boring ID and Type:	R-15-001 Mud Rotary	
Date/Time Drilling Started	4/30/15 9:00	Date/Time Drilling Completed	4/30/15 17:00
	Date/Time Grouting Completed	4/30/15 4:00	
C	USA Contacted (Date and Ticket Number)	---	
K	USA Contacted (Date and Ticket Number)	4/10/15 0162850	
K	USA Marks Checked Prior To Beginning Drilling	Yes	
K	Private Utility Locator Cleared Boring (Y or N)	No	
K	Permit Approved and in File (Y or N)	Yes	
K	Permitting Agency Name	Mendocino County Environmental Health	
K	Permit Number	HZ236549	
K	Health and Safety Meeting Conducted	Yes	
	Total Depth Planned	50’	
	Total Depth Actual	50.2’	
Daily Time Started	7:30	Daily Time Ended	5:00
K	Grout Inspection Scheduled	Yes	
	Grout Inspector Name and Telephone Number	William Nalty 707 234 6625	
	Grout Inspection Conducted (Y or N), Time on Site	Released	
	Groundwater Encountered (If Yes – Depth to Water)	26.5’ (based on soil saturation, creek elev.)	
	Grout Mix/Ratio Per Permit (Pounds Per Gallon)	6 gallons per 94lbs Portland cement	
	Grout Mix/Ratio Used (Pounds Per Gallon)	9 gallons with (3) 47 lb sacks	
	Photos Taken	Yes	

Signature: _____ Date: 4/30/15

DAILY FIELD REPORT – DRILLING OBSERVATION

State of California, Department of Transportation

Daily Observations:

07:30 Arrived on site. Inspected USA markings; no visible conflict noted.

07:45 Conducted site safety meeting with CAS traffic control employees and Caltrans Drilling Services crew.

08:00 CAS setting up lane closure.

09:00 Set up drill rig on R-15-001. Drill to total depth of 50'.

11:30 Install monitoring well pipe: 20' of screened pipe under 30' solid pipe with endcap. Screened interval sanded with 4x50 lb bags of #8 sand to 27.6' below ground surface (bgs). Bentonite chips placed to 27.6' bgs and hydrated for :30 (intermediate seal). Neat cement grout (9 gals water with (3) 47 lb bags cement) placed from 22' bgs to surface by tremie method.

14:00 Set surface completion (traffic rated well box). Clean up site and prepare for demobilization.

17:00 Rig mobilized off site. CAS removed traffic control and re-opened lane. Left site.

DAILY FIELD REPORT – DRILLING OBSERVATION

State of California, Department of Transportation

BOREHOLE BACKFILL DATA SHEET

Date: 5/19/2015

OFFICE OF GEOTECHNICAL SUPPORT

Instructions: Complete this form and upload into GeoDOG

PROJECT INFORMATION

On-Site Geoprofessional	Telephone No.	Approving Senior Signature / Initial	Telephone No.
Jeff Richmond	707-571-1883		

Geographic Name / Bridge Name	District	County	Route	Post Miles
Ryan Creek	01	MEN	101	52.25

Project No. / EA	Phase	Sub-Object	Activity	Drilling Leadworker or CPT Technician
20153390/01-262011				Donnie Douglas

LEA: Mendocino County Env. Health LEA Inspector: William Nalty LEA Phone No.: 707-234-6625

☒ C-57 Work C-57 License No.: 467252

Drilling/Push:

Boring Number: R-15-001 Depth to Groundwater (ft): n/a ☒ GW not encounted

Boring Type: ☐ CPT ☒ Mud Rotary ☐ Hollow Stem Augers Other: _____

Hole diameter: 3.7 (in) Total Depth: 50.2 (ft) ☒ Vertical Inclined: n/a (degrees)

Slope Inclinometer Installed[1]? ☐ Yes ☒ No Length: n/a (ft) Diameter: n/a (in)

Sealing Materials:

Sealed full depth? ☐ Yes ☒ No If no, sealing interval: From: 0 (ft bgs[2]) To: 22 (ft bgs)

Proportions used: 6 gallons per 94# sack of cement 0 % Bentonite (if allowed)

Calculated Grout Volume: 14.4 (gallons[3]) Grout Take (actual) : 17.4 (gallons)

Bentonite Chips: diameter: 3/8 (in) Calculated bags needed[4]: 3 Actual bags used: 3

Placement:

From Surface: ☐ Tremie: ☒ Flush Thread: ☐ Drill Steel: ☐ Diameter: _____ (in)

Pump Make: ☒ Moyno ☐ Gardnerdenver ☐ Chemgrout

Directions:
This form is to be completed for all boreholes and soundings by the individual logging the boring.
This form is to be archived on GeoDOG by the geoprofessional.
This form comes in two formats. There is a page 1 format and a additional page format. Always use page 1, but use additional pages as necessary.

[1] If a Slope Inclinometer was installed and it has drilled holes or slots to measure water, then it is a Stand Pipe Piezometer and a Well Completion Report is required.

[2] BGS means Below Ground Surface

[3] dia ____ (in) times dia ____ (in) times depth _____ (ft) times 0.0408 = _____ gallons

[4] See the information on the back of the Bentonite Chip bag

*The free Adobe Reader may be used to view and complete this form. However, software must be purchased to complete, save, and reuse a saved form.

File Original with DWR

State of California

Well Completion Report

Refer to Instruction Pamphlet

No. e0267274

Page 1 of 3

Owner's Well Number R-15-001

Date Work Began 04/30/2015 Date Work Ended 4/30/2015

Local Permit Agency Mendocino County Environmental Health

Permit Number HZ236549 Permit Date 4/28/15

DWR Use Only – Do Not Fill In

State Well Number/Site Number

N Latitude W Longitude

APN/TRS/Other

Geologic Log

Orientation ⊙ Vertical ○ Horizontal ○ Angle Specify

Drilling Method Direct Rotary Drilling Fluid Fresh Water

Depth from Surface Feet	to Feet	Description (Describe material, grain size, color, etc)
		Please reference the attached Caltrans log:
		R-15-001

Total Depth of Boring 50.2 Feet

Total Depth of Completed Well 50.2 Feet

Well Owner

Name Caltrans

Mailing Address 1835 6th Street

City Eureka State CA Zip 95501

Well Location

Address Highway 101 Postmile 52.25, northbound lane

City Willits County Mendocino

Latitude ___ Deg. ___ Min. ___ Sec. N Longitude ___ Deg. ___ Min. ___ Sec. W

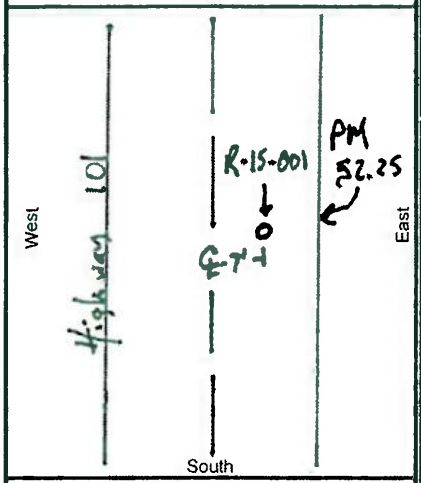
Datum WGS84 Dec. Lat. 39.480 Dec. Long. -123.363

APN Book ___ Page ___ Parcel ___

Township ___ Range ___ Section ___

Location Sketch

(Sketch must be drawn by hand after form is printed.)



Illustrate or describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. **Please be accurate and complete.**

Activity

⊙ New Well
○ Modification/Repair
○ Deepen
○ Other ___
○ Destroy
Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

○ Water Supply
☐ Domestic ☐ Public
☐ Irrigation ☐ Industrial
○ Cathodic Protection
○ Dewatering
○ Heat Exchange
○ Injection
⊙ Monitoring
○ Remediation
○ Sparging
○ Test Well
○ Vapor Extraction
○ Other ___

Water Level and Yield of Completed Well

Depth to first water ___ (Feet below surface)

Depth to Static Water Level ___ (Feet) Date Measured ___

Estimated Yield * ___ (GPM) Test Type ___

Test Length ___ (Hours) Total Drawdown ___ (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size if Any (Inches)
0	30	3.7	Blank	PVC Sch. 40	0.15	1.9	n/a	
30	50	3.7	Screen	PVC Sch. 40	0.15	1.9	Slot	

Annular Material

Depth from Surface Feet	to Feet	Fill	Description
0	22	Cement	
22	28	Bentonite	3/8 chips, hydrated
28	50	Filter Pack	#8 sand

Attachments

☑ Geologic Log
☐ Well Construction Diagram
☐ Geophysical Log(s)
☐ Soil/Water Chemical Analyses
☑ Other site location map

Attach additional information, if it exists.

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

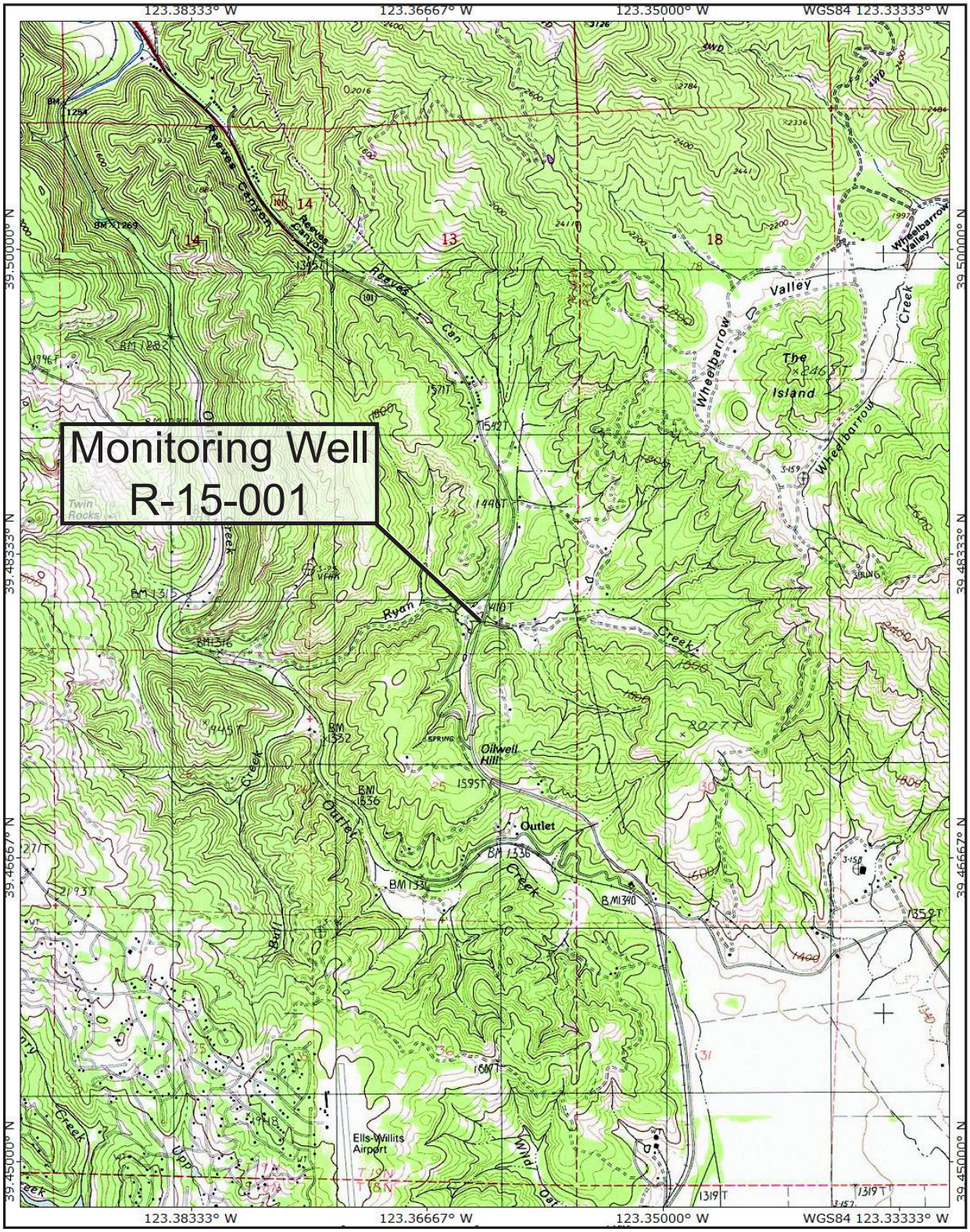
Name Joseph Zilles, Kleinfelder
Person, Firm or Corporation

550 West C Street San Diego CA 92101
Address City State Zip

Signed [signature] 05/19/15 467252
C-57 Licensed Water Well Contractor Date Signed C-57 License Number

DWR 188 REV. 1/2006

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM



Reference: National Geographic Holdings, 2000

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3000 1500 0 3000

APPROXIMATE SCALE (feet)

KLEINFELDER

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www.kleinfelder.com

PROJECT NO.	20143390
DRAWN	MAY 2015
DRAWN BY	JCR
CHECKED BY	
FILE NAME	Site Location.ai

SITE LOCATION
MONITORING WELL R-15-001

HIGHWAY 101 POSTMILE 52.25
MENDOCINO COUNTY, CALIFORNIA

PLATE

1

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
J Richmond	4-30-15	4-30-15	ft / ft Not Available	R-15-001
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Caltrans Drilling Company			757+90/7' E	~1,423.50 ft Not Available
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Core			Acker MPCA	3.7 in
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
94 mm punch core			Auto; 140 lbs / 30-inch drop	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS: DURING DRILLING 26.5 ft; AFTER DRILLING (DATE) Not Applicable	TOTAL DEPTH OF BORING
Monitoring Well				50.2 ft

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample Location	Sample/Run#	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Relative Strength	Drilling Method	Casing Depth	Discontinuity Description Fracture#: (Depth), Type, Relative Dip, Density or Spacing. Degree of Infilling, Infilling Type, Aperture, Surface Weathering, JRC
	0	ASPHALT CONCRETE (12")		C01			100							
		AGGREGATE BASE (12")		C02			100							
		SANDY LEAN CLAY with GRAVEL (CL); hard; brown; dry; 5% fine to coarse, subrounded gravel; 25% coarse to fine sand; 70% fines; (FILL)					100							
1420.00		POORLY-GRADED SAND with SILT (SP-SM); dense; light brown, light yellowish brown, orange; dry; 90% fine sand; 10% fines; (SANDSTONE DERIVED FILL)		C03										
	5						33							
				C04										
1415.00		weathered, soft sandstone clast remnants												
	10						32							
		POORLY-GRADED GRAVEL with CLAY AND SAND (GP-GC); medium dense; brown, yellowish brown; 30% fine to coarse, subrounded gravel; 60% coarse to fine sand; 10% fines; (RUBBLE FILL)		C05										
1410.00														
	15	subangular gravel, max.3 in. dia.; (SANDSTONE FRAGMENTS)					53							
				C06										
1405.00														
	20						37							
		3" layers of loose to medium dense Clayey SAND		C07										
1400.00														
	25						43							
		CLAYEY SAND with GRAVEL (SC); loose to medium dense; gray, grayish blue, olive gray; wet; 10% fine, subangular gravel; 75% coarse to fine sand; 15% fines; occasional rootlets; organic decomposition; (ALLUVIUM/DEBRIS FLOW DEPOSIT		C08										
1395.00	30													

(continued)

DRAFT

KLEINFELDER
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REPORT TITLE				HOLE ID
BORING RECORD				R-15-001
DIST.	COUNTY	ROUTE	POSTMILE	EA
01	Mendocino	101	52.25	01-262011
PROJECT OR BRIDGE NAME				
TO83473 RYAN CREEK FISH PASSAGE				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	Ajm		5-7-15	1 of 2

PLOTTED: 05/21/2015 09:58 AM BY: AMay
gINT FILE: PROJECTWISE: 20143390_073_to83473 Ryan Creek Fish Passage.gpj
gINT TEMPLATE: PROJECTWISE: KLF_STANDARD_GINT_LIBRARY_2015.GLB [CLIENT_CALTRANS (KLF MOD WITH ROCK)]

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample Location	Sample/Run#	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Relative Strength	Drilling Method	Casing Depth	Discontinuity Description Fracture#: (Depth), Type, Relative Dip, Density or Spacing. Degree of Infilling, Infilling Type, Aperture, Surface Weathering, JRC
	30	CLAYEY SAND with GRAVEL (SC); loose to medium dense; gray, grayish blue, olive gray; wet; 10% fine, subangular gravel; 75% coarse to fine sand; 15% fines; occasional rootlets; organic decomposition; (ALLUVIUM/DEBRIS FLOW DEPOSIT		S			58							
				C09										
1390.00		soft to medium hard; subangular to subrounded gravel, max.1 in. dia. increased gravel content wood fragments at 35.5'					17							
	35			C10										
1385.00		minimal - no recovery												
	40			S11	10 7 4	11	NR							
							45							
		POORLY-GRADED SAND with GRAVEL (SP); loose; gray; wet; subrounded gravel; 85% coarse, rounded sand; 15% fines; (ALLUVIUM)		C12										
1380.00														
		CLAYEY GRAVEL with SAND (GC); dense; grayish blue; wet; 60% subangular gravel, max.2 in. dia.; 25% coarse to fine sand		S13	50		NR							
	45						110							
		SEDIMENTARY BEDROCK (SANDSTONE TO META-SANDSTONE) dark gray to grayish blue; moderately weathered; soft to moderately hard; locally, massively, intenselly fractured with locally moderately fractured zones; occasional quartz veinlets; (no HCL reaction)		C14										
							80							
1375.00				C15										
	50	Bottom of borehole at 50.2 ft bgs		S16	50		NR							
1370.00														
	55													
1365.00														
	60													
1360.00														
	65													

DRAFT

KLEINFELDER
Bright People. Right Solutions.

REPORT TITLE				HOLE ID
BORING RECORD				**R-15-001**
DIST. **01**	COUNTY **Mendocino**	ROUTE **101**	POSTMILE **52.25**	EA **01-262011**
PROJECT OR BRIDGE NAME **TO83473 RYAN CREEK FISH PASSAGE**				
BRIDGE NUMBER	PREPARED BY **Ajm**		DATE **5-7-15**	SHEET **2 of 2**

PLOTTED: 05/21/2015 09:58 AM BY: AMay
gINT FILE: PROJECTWISE: 20143390_073_to83473 Ryan Creek Fish Passage.gpj
gINT TEMPLATE: PROJECTWISE: KLF_STANDARD_GINT_LIBRARY_2015.GLB [CLIENT_CALTRANS (KLF MOD WITH ROCK)]

*The free Adobe Reader may be used to view and complete this form. However, software must be purchased to complete, save, and reuse a saved form.

File Original with DWR

State of California

Well Completion Report

Refer to Instruction Pamphlet

No. e0267274

Page 1 of 3

Owner's Well Number R-15-001

Date Work Began 04/30/2015 Date Work Ended 4/30/2015

Local Permit Agency Mendocino County Environmental Health

Permit Number HZ236549 Permit Date 4/28/15

DWR Use Only – Do Not Fill In

State Well Number/Site Number

N Latitude W Longitude

APN/TRS/Other

Geologic Log

Orientation ◉ Vertical ○ Horizontal ○ Angle Specify

Drilling Method Direct Rotary Drilling Fluid Fresh Water

Depth from Surface Feet	to Feet	Description (Describe material, grain size, color, etc)
		Please reference the attached Caltrans log:
		R-15-001

Total Depth of Boring 50.2 Feet

Total Depth of Completed Well 50.2 Feet

Well Owner

Name Caltrans

Mailing Address 1835 6th Street

City Eureka State CA Zip 95501

Well Location

Address Highway 101 Postmile 52.25, northbound lane

City Willits County Mendocino

Latitude ___ Deg. ___ Min. ___ Sec. N Longitude ___ Deg. ___ Min. ___ Sec. W

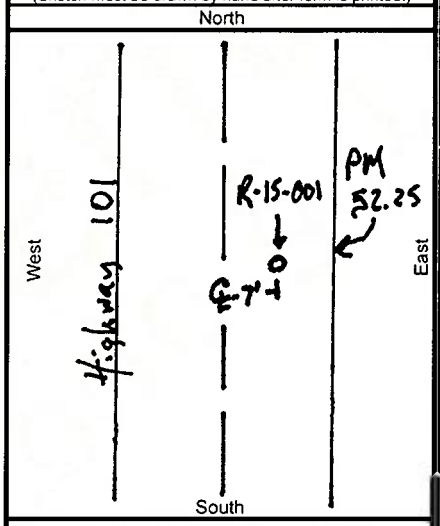
Datum WGS84 Dec. Lat. 39.480 Dec. Long. -123.363

APN Book ___ Page ___ Parcel ___

Township ___ Range ___ Section ___

Location Sketch

(Sketch must be drawn by hand after form is printed.)



Illustrate or describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. **Please be accurate and complete.**

Activity

◉ New Well
○ Modification/Repair
○ Deepen
○ Other ___
○ Destroy
Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

○ Water Supply
☐ Domestic ☐ Public
☐ Irrigation ☐ Industrial
○ Cathodic Protection
○ Dewatering
○ Heat Exchange
○ Injection
◉ Monitoring
○ Remediation
○ Sparging
○ Test Well
○ Vapor Extraction
○ Other ___

Water Level and Yield of Completed Well

Depth to first water ___ (Feet below surface)

Depth to Static Water Level ___ (Feet) Date Measured ___

Estimated Yield * ___ (GPM) Test Type ___

Test Length ___ (Hours) Total Drawdown ___ (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size if Any (Inches)
0	30	3.7	Blank	PVC Sch. 40	0.15	1.9	n/a	
30	50	3.7	Screen	PVC Sch. 40	0.15	1.9	Slot	

Annular Material

Depth from Surface Feet	to Feet	Fill	Description
0	22	Cement	
22	28	Bentonite	3/8 chips, hydrated
28	50	Filter Pack	#8 sand

Attachments

☑ Geologic Log
☐ Well Construction Diagram
☐ Geophysical Log(s)
☐ Soil/Water Chemical Analyses
☑ Other site location map

Attach additional information, if it exists.

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name Joseph Zilles, Kleinfelder
Person, Firm or Corporation

550 West C Street (Address) San Diego (City) CA (State) 92101 (Zip)

Signed ___ (C-57 Licensed Water Well Contractor) 05/19/15 (Date Signed) 467252 (C-57 License Number)

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

APPENDIX D
Caltrans Log of Test Boring Sheets

LIST OF ATTACHMENTS

Log of Test Borings 1 of 5
Log of Test Borings 2 of 5
Log of Test Borings 3 of 5
Log of Test Borings 4 of 5
Log of Test Borings 5 of 5

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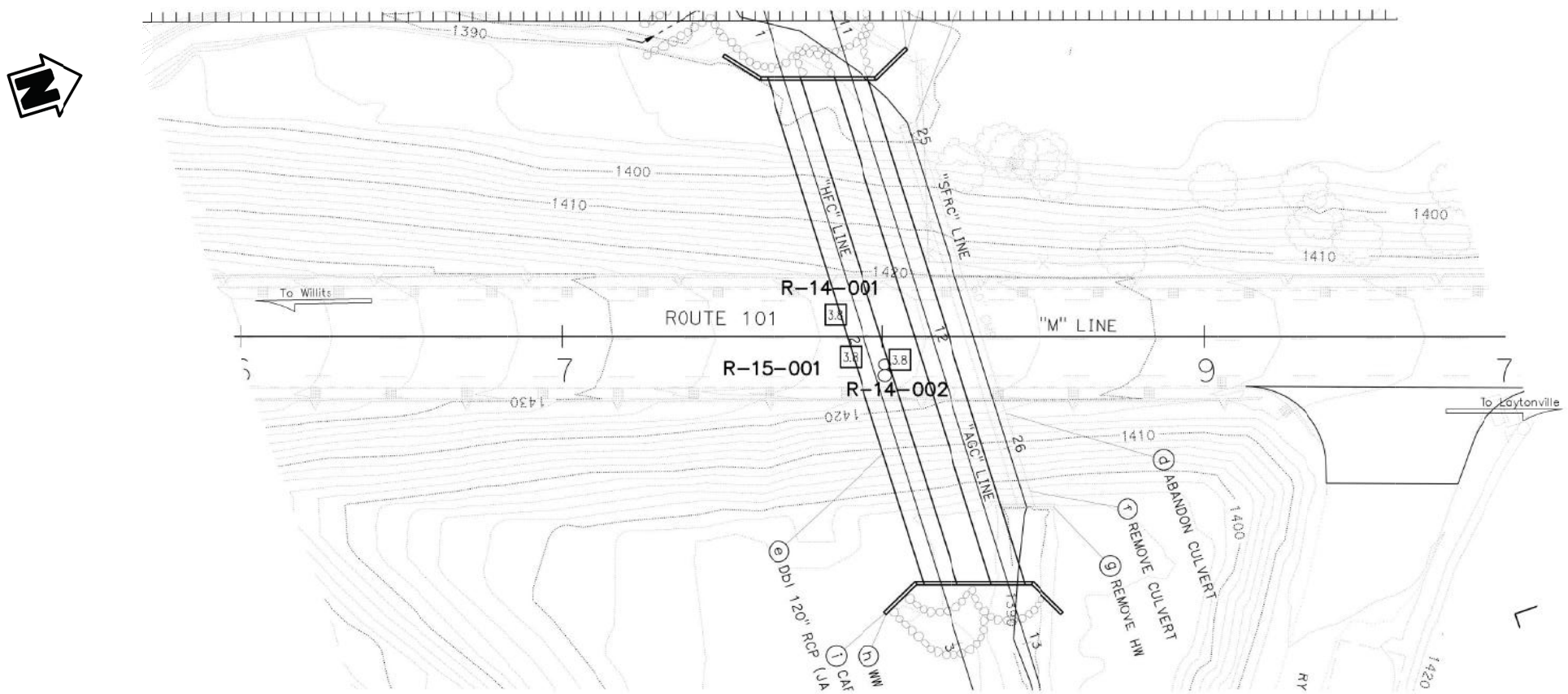


PLAN
1"=20'

Notes:

1. This LOTB sheet was prepared generally in accordance with the Caltrans Soil & Rock Logging, Classification, and Presentation Manual (June 2007).
2. Samples were taken using a Punch Core sampler with an inside diameter (I.D.) of 2" and an outside diameter (O.D.) of 3.7".
3. 1.4" samples were taken using a SPT split-barrel sampler with an inside diameter (I.D.) of 1.4" and an outside diameter (O.D.) of 2".
4. The soil descriptions and classifications, including consistency and apparent density descriptors, used by the field personnel for the exploration boreholes shown on these sheets are generally based on the Caltrans Soil and Rock Logging, Classification, and Presentation Manual, Division of Engineering Services, Geotechnical Services, (June 2007).
6. All Test Borings utilized a 140-pound automatic hammer with a 30-inch drop to advance the driven sampler. The SPT N-values shown on the Log of Test Boring (LOTB) sheets were actual values recorded in the field. The apparent density descriptors shown on the LOTB sheets are based on the actual SPT N-values recorded in the field. Consistency descriptors shown on the LOTB sheets are based field observations.
7. Blowcount of 50/5" means 50 blows per 5" penetration.

No.	Revision Description	Date	Approved
1	95% Submittal, Not For Construction	5/4/15	KS
2			

THE COUNTY OF PLACER, ITS OFFICERS, OR ITS AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF ELECTRONIC COPIES OF THIS DOCUMENT.

RYAN CREEK FISH PASSAGE
HIGHWAY 101 PM 52.25
LOG OF TEST BORINGS 1 OF 5

PLACER COUNTY CALIFORNIA
DEPARTMENT OF PUBLIC WORKS

DATE: 04/24/2015
DESIGN: D. ROSS
DRAW: D. ROSS
CHECK:

REGISTERED PROFESSIONAL ENGINEER
KENNETH G. SORENSEN
6E2520
9/30/2015
STATE OF CALIFORNIA

DATE: 9/30/2016

CONSTRUCTION CONTRACT NO.
1200
PROJECT NO.
PC2899

SCALE
HORIZ: AS SHOWN
VERT: NA
SCALE REFERENCE
0 1"

DRAWING
S-13

SHEET NO.
13 of 17

L:\2015\Projects\2014396.073A\cad\Temp working LOTB\LOTB-1.dwg

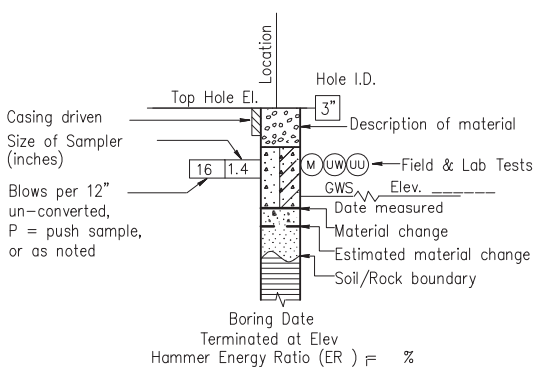
REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

CEMENTATION	
Description	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.

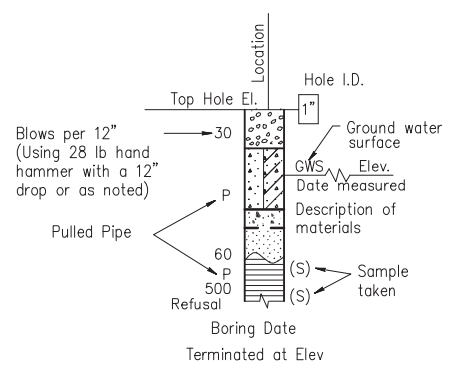
BOREHOLE IDENTIFICATION		
Symbol	Hole Type	Description
Size	A	Auger Boring
Size	R P	Rotary drilled boring Rotary percussion boring (air)
Size	R	Rotary drilled diamond core
Size	HD HA	Hand driven (1–inch soil tube) Hand Auger
●	D	Dynamic Cone Penetration Boring
▲	CPT	Cone Penetration Test (ASTM D 5778–95)
□	O	Other – Bulk Sample
Note: Size in inches.		

CONSISTENCY OF COHESIVE SOILS				
Description	Unconfined Compressive Strength (tsf)	Pocket Penetrometer Measurement (tsf)	Torvane Measurement (tsf)	Field Approximation
Very Soft	< 0.25	< 0.25	< 0.12	Easily penetrated several inches by fist
Soft	0.25 to 0.50	0.25 to 0.50	0.12 to 0.25	Easily penetrated several inches by thumb
Medium Stiff	0.50 to 1.0	0.50 to 1.0	0.25 to 0.50	Penetrated several inches by thumb with moderate effort
Stiff	1 to 2	1 to 2	0.50 to 1.0	Readily indented by thumb but penetrated only with great effort
Very Stiff	2 to 4	2 to 4	1.0 to 2.0	Readily indented by thumbnail
Hard	> 4.0	> 4.0	> 2.0	Indented by thumbnail with difficulty

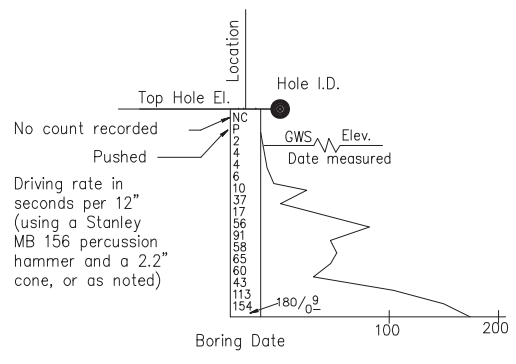
PLASTICITY OF FINE–GRAINED SOILS	
Description	Criteria
Nonplastic	A 1/8–inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread 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.



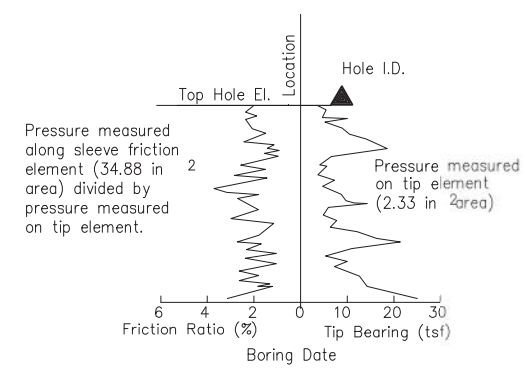
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

NOTE:
The Contractor shall verify all controlling field dimensions before ordering or fabricating any material.

No.	Revision Description	Date	Approved
1	95% Submittal, Not For Construction	5/4/15	KS
2			

THE COUNTY OF PLACER, ITS OFFICERS, OR ITS AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF ELECTRONIC COPIES OF THIS DOCUMENT.

RYAN CREEK FISH PASSAGE
HIGHWAY 101 PM 52.25
LOG OF TEST BORINGS 2 OF 5

PLACER COUNTY CALIFORNIA
DEPARTMENT OF PUBLIC WORKS

DATE: 04/24/2015
DESIGN: D. ROSS
DRAW: D. ROSS
CHECK:

REGISTERED PROFESSIONAL ENGINEER KENNETH G. SCHENTER GE2520 9/30/2015 STATE OF CALIFORNIA

DATE: 9/30/2016

CONSTRUCTION CONTRACT NO.
1200
PROJECT NO.
PC2899

SCALE
HORIZ: AS SHOWN
VERT: NA

SCALE REFERENCE
0 "

DRAWING
S–14

SHEET NO.
14 of 17

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REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

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 ORGANIC 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

NOTE:
The Contractor shall verify all controlling field dimensions before ordering or fabricating any material.

FIELD AND LABORATORY TESTING

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

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 12 inches)
Very loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	> 50

MOISTURE

Description	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

Description	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%

PARTICLE SIZE

Description		Size
Boulder		> 12"
Cobble		3" to 12"
Gravel	Coarse	3/4" to 3"
	Fine	No. 4 to 3/4"
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

No.	Revision Description	Date	Approved
1	95% Submittal, Not For Construction	5/4/15	KS
2			

THE COUNTY OF PLACER, ITS OFFICERS, OR ITS AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF ELECTRONIC COPIES OF THIS DOCUMENT.

RYAN CREEK FISH PASSAGE
HIGHWAY 101 PM 52.25
LOG OF TEST BORINGS 3 OF 5

PLACER COUNTY CALIFORNIA

DEPARTMENT OF PUBLIC WORKS

DATE: 04/24/2015
DESIGN: D. ROSS
DRAW: D. ROSS
CHECK:

REGISTERED PROFESSIONAL ENGINEER KENNETH G. SORENSEN GE2520 9/30/2016 STATE OF CALIFORNIA

DATE: 9/30/2016

CONSTRUCTION CONTRACT NO. 1200
PROJECT NO. PC2899
SCALE
HORIZ: AS SHOWN
VERT: NA
SCALE REFERENCE 0 ____ "

DRAWING S-15

SHEET NO. 15 of 17

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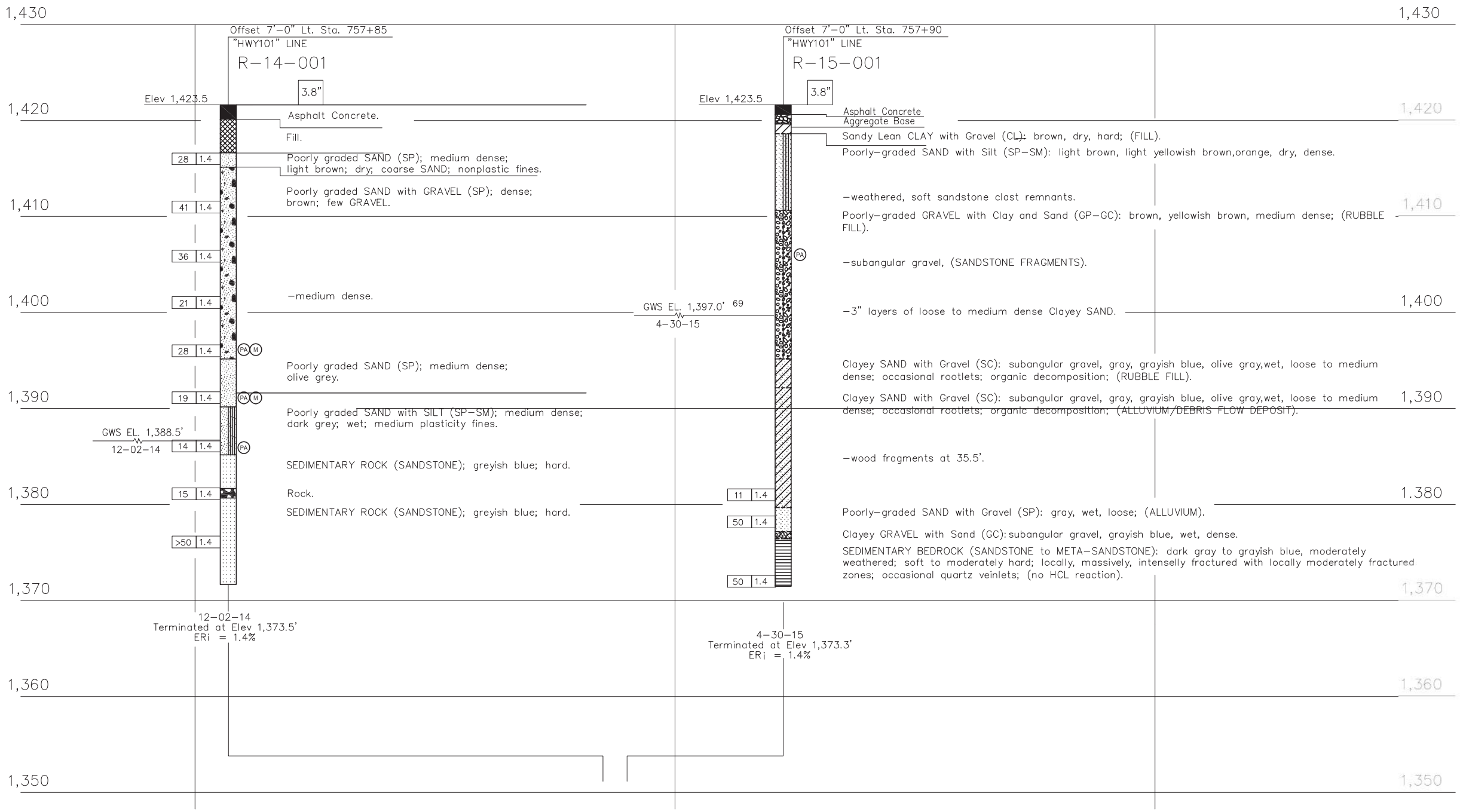
FOR PLAN VIEW AND ADDITIONAL NOTES, SEE
"LOG OF TEST BORINGS" SHEET 1 OF 5



PROFILE
HOR. 1"=10'
VER. 1"=5'

NOTE:
The Contractor shall verify all controlling field dimensions before ordering or fabricating any material.

No.	Revision Description	Date	Approved
1	95% Submittal, Not For Construction	5/4/15	KS
2			

THE COUNTY OF PLACER, ITS OFFICERS, OR ITS AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF ELECTRONIC COPIES OF THIS DOCUMENT.

RYAN CREEK FISH PASSAGE
HIGHWAY 101 PM 52.25
LOG OF TEST BORINGS 4 OF 5

PLACER COUNTY CALIFORNIA
DEPARTMENT OF PUBLIC WORKS

DATE: 04/24/2015
DESIGN: D. ROSS
DRAW: D. ROSS
CHECK:

REGISTERED PROFESSIONAL ENGINEER
KENNETH G. SORENSEN
GE2520
9/30/2016
STATE OF CALIFORNIA

DATE: 9/30/2016

CONSTRUCTION CONTRACT NO.
1200
PROJECT NO.
PC2899

SCALE
HORIZ: AS SHOWN
VERT: NA

SCALE REFERENCE
0 1"

DRAWING
S-16

SHEET NO.
16 of 17

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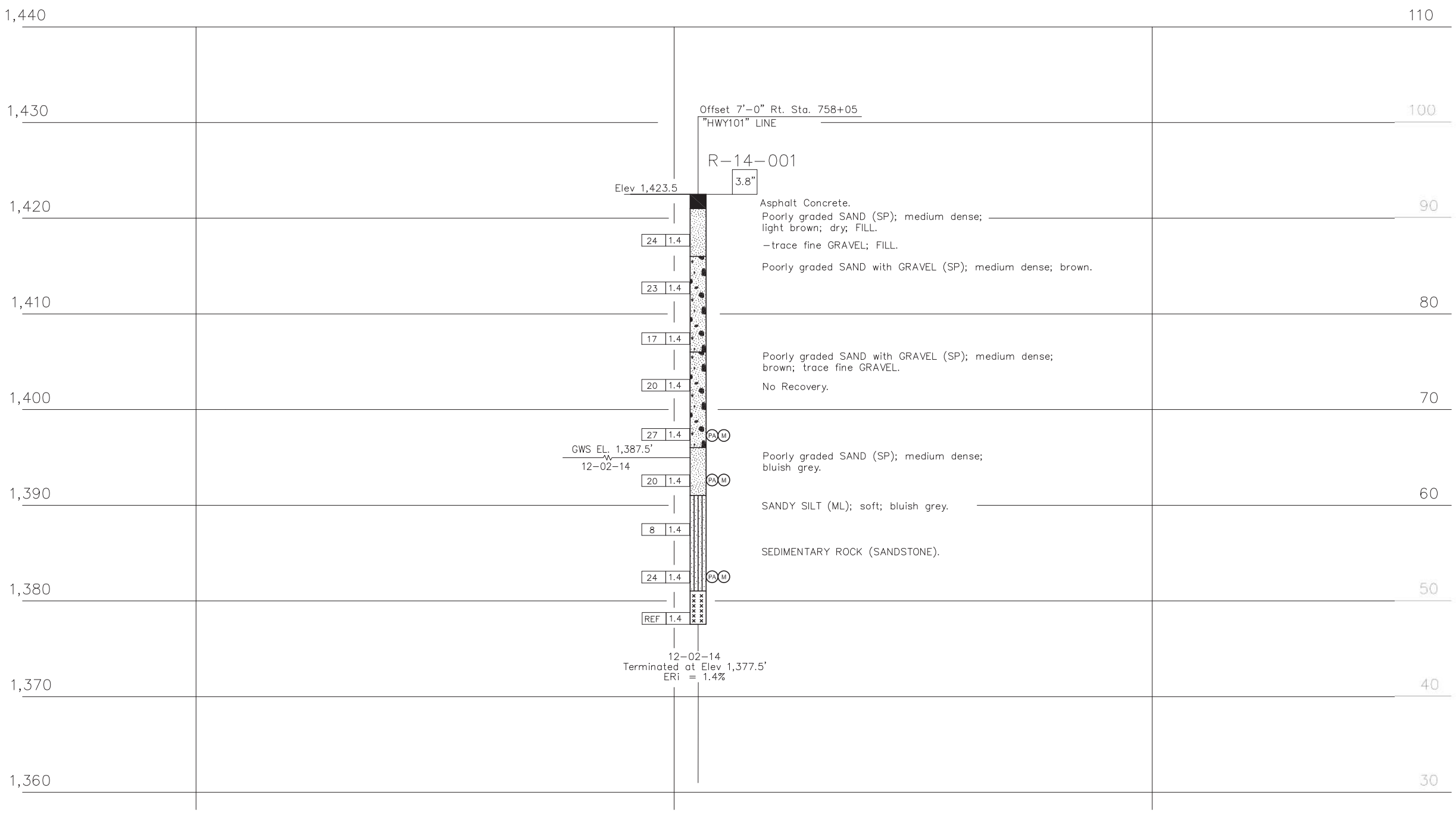
FOR PLAN VIEW AND ADDITIONAL NOTES, SEE
"LOG OF TEST BORINGS" SHEET 1 OF 5



PROFILE
HOR. 1"=10'
VER. 1"=5'

NOTE:
The Contractor shall verify all controlling field dimensions before ordering or fabricating any material.

No.	Revision Description	Date	Approved
1	95% Submittal, Not For Construction	5/4/15	KS
2			

THE COUNTY OF PLACER, ITS OFFICERS, OR ITS AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF ELECTRONIC COPIES OF THIS DOCUMENT.

RYAN CREEK FISH PASSAGE
HIGHWAY 101 PM 52.25
LOG OF TEST BORINGS 4 OF 5

PLACER COUNTY CALIFORNIA

DEPARTMENT OF PUBLIC WORKS

DATE: 04/24/2015
DESIGN: D. ROSS
DRAW: D. ROSS
CHECK:

REGISTERED PROFESSIONAL ENGINEER KENNETH G. SCHLEIMER GE2520 9/30/2016 STATE OF CALIFORNIA

DATE: 9/30/2016

CONSTRUCTION CONTRACT NO.
1200
PROJECT NO.
PC2899

SCALE
HORIZ: AS SHOWN
VERT: NA

SCALE REFERENCE
0 1"

DRAWING
S-17

SHEET NO.
17 of 17

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APPENDIX E
Trenchless Installation Technical Memorandum & Cost Analysis

LIST OF ATTACHMENTS

Bennett Trenchless Engineers Technical Memorandum
120-Inch Steel Casing Specifications
Pipe Ramming Specifications
Settlement Instrumentation and Monitoring Specifications
Settlement Monitoring Plan

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TECHNICAL MEMORANDUM

BENNETT trenchless engineers

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Folsom, CA 95630
Ph 916.294.0095
Fx 916.294.0098

Date: June 9, 2015

To: Ken Sorensen, PE, GE, Kleinfelder

Prepared By: Kathryn Wallin, Senior Scientist
David Bennett, PhD, PE

CALTRANS

Ryan Creek Fish Passage Mitigation – South Fork

TRENCHLESS INSTALLATION OF TWIN LARGE DIAMETER CULVERTS

Background

As a subconsultant to Kleinfelder, Inc., Bennett Trenchless has been contracted to evaluate feasible construction methods, draft non-standard special provisions (trenchless specifications), and provide drawing edits for the trenchless installation of twin 120-inch diameter culverts beneath Highway 101 in Willits, CA as part of the Caltrans Fish Passage Mitigation Project for the Willits Bypass. Trenchless methods are required to install the 113-foot long culverts to avoid disruptions from deep open-cut construction to traffic on Highway 101. Candidate construction methods compatible with the diameter and length of the proposed crossings are pipe ramming, open-shield pipe jacking, and microtunneling.

This Technical Memorandum (TM) describes the geotechnical conditions, work space restrictions, and schedule constraints for the trenchless components of the project. This TM discusses the evaluation of the alternative construction methods for the anticipated conditions. Recommendations for construction method and staging area are also provided, and settlement risks are evaluated.

Description of Proposed Crossing

Sheets PV-1 and FPP-1 of the project Drawings show the plan and profile of the proposed crossings, respectively. The Drawings indicate the twin 120-inch diameter steel casings will each be approximately 113 feet long. The slope of the pipe is shown as 0%, with the invert of the northern, at-grade culvert at Elevation 1384.0, and the invert of the southern, high-flow

culvert at Elevation 1386.5. Earth cover between the pipe crowns and Highway 101 will be approximately 26 to 28 feet. There are no known underground utilities in the project area.

The upstream area, on the east side of the crossing is heavily wooded riparian habitat. Access to the east side would require extensive tree removal to facilitate mobilization and operation of the large equipment and materials required for trenchless operations.

The downstream area on the west side of the crossing has several open areas adjacent to the culvert outlet. However, the thick vegetation around the existing culvert outlet and creek banks will need to be removed to provide adequate work area for the trenchless operations. Access to the west side of the project would be via private landowner's driveway which is currently at a 12% grade. An overhead electric line runs along the western shoulder of Highway 101 over the driveway, and transitions to the toe of the embankment where it crosses above the culvert outlet. The overhead electric line will need to be relocated prior to mobilization to the site.

After discussions with Caltrans environmental and right-of-way staff regarding these challenges, Caltrans decided that the trenchless operations will launch from the downstream, western side of the crossings.

Anticipated Ground Conditions

A Geotechnical Design Report was drafted by Caltrans staff that described the conditions anticipated for the Ryan Creek Fish Passage pipe installations. Two geotechnical borings were conducted by Caltrans in 2014 for the South Fork culverts: Boring R-14-001 located on the west side of the northbound shoulder, and R-14-002, located on the east side of the southbound shoulder. An additional boring, R-15-001, was conducted by Kleinfelder in April, 2015 just south of the two Caltrans borings.

We noted some inconsistencies between recorded blow-counts and consistency descriptions in the two Caltrans boring logs. However, all three borings show similar ground conditions. The Highway 101 embankment is generally uniform medium dense to dense poorly graded sand with gravel and silt. The pipe invert will be at approximately the base of the embankment fill. Ground conditions anticipated along the pipe alignment are predominantly medium dense poorly graded sand with approximately 15% subrounded gravel to 1.0-inch and firm to stiff sandy clay and silt. Sandstone was encountered at approximate Elevation 1,378 feet, approximately 6 feet beneath the pipe invert. The boring log for R-15-001 indicated the presence of some wood fragments, but did not indicate the presence of large pieces of wood that would prevent completion of the trenchless operations.

Groundwater was encountered during drilling of the Caltrans borings drilled 12/2/14 at an elevation corresponding to approximate pipe springline, i.e. from Elevation 1387.5 to 1388.5 feet, which is also the approximate creek flowline. The Kleinfelder boring R-15-001 encountered more gravel than the Caltrans borings and encountered groundwater on April 30, 2015 at Elevation 1397 feet, which is at or 2 feet above the pipe crowns. A subsequent piezometer reading on June 8, 2015 from the Kleinfelder boring has shown that the groundwater level had dropped to approximate Elevation 1390, similar to the groundwater

level encountered in the Caltrans borings. The high permeability soils encountered in all of the geotechnical borings indicate that groundwater will likely fluctuate with the water level in the creek.

Evaluation of Trenchless Construction Alternatives

Feasible construction methods for the proposed pipe diameter, length, and anticipated ground conditions described above are pipe ramming, open-shield pipejacking, and microtunneling. Each of these trenchless construction alternatives are described in more detail in Appendix A. The feasibility and construction considerations for each method are discussed below.

Pipe Ramming

Pipe ramming is likely the most cost effective trenchless construction method for the diameter and length of pipe proposed on the project. Although pipe ramming is a non-steerable construction method, the line and grade of the pipe installation for these culverts is not critical as they will be partially filled with several feet of soil and gravel to create a fish habitat. The accuracy for pipe ramming operations is highly dependent on an accurate survey and ensuring that the pipes are aligned properly prior to launch. To ensure that the pipe support rails remain at the appropriate elevation and grade throughout the ramming process, a concrete work slab will be needed in the launch area for both pipelines. Typical accuracies for pipe ramming are ± 2% of drive length. Because of the accuracy limitations, we recommend providing a clear space of at least 5 feet between the existing culvert and the at-grade culvert, and increasing the clear space from 5 feet to 10 feet clear between the two new culverts.

The equipment and work area required for pipe ramming operations are less than for open-shield pipejacking and microtunneling. A smaller required work area reduces easement and tree removal requirements. The equipment required on-site for this project includes a large crane capable of handling the heavy pipe (~20 tons/pipe), air compressors capable of producing at least 3,600 to 4,800 cfm, spoil removal equipment (skid steer, loader, trackhoe, and dump trucks), the pneumatic hammer, guiderails and an adaptor cone to transfer the load from the hammer to the pipe. The work area will also need to accommodate pipe storage within reach of the crane since it will be difficult if not impossible to relocate the pipe segments with traditional construction equipment (i.e. loaders, excavators, and fork lifts). Alternatively, the contractor may elect to have a staged delivery of the pipe from the manufacturer to reduce pipe storage area.

Based on our review of pertinent literature, the minimum pipe wall thickness recommended for a 120-inch diameter pipe ram 113-feet long is 1.5 inches. However, we have not conducted an analysis to confirm the recommendation. The thicker wall is required to withstand the ramming forces and to prevent pipe collapse during installation. In addition a thickened cutting shoe and lead section will be required to reinforce the pipe. The pipe for this project may require 3-4 months to manufacture. In addition, the adaptor cone and hammer may have long lead times and limited availability. Pipe ramming installations of this diameter are near the upper end of the technology's capabilities and will require an experienced contractor. Minimum technical contractor qualifications must be incorporated into the non-standard special provisions for the project to ensure successful completion of the project.

Construction schedule for the pipe ramming operations is anticipated to be 3 to 4 months, not including pipe acquisition, utility relocates, driveway improvements, tree removal, stream diversion, headwall construction, site restoration, and weir construction. The schedule could be reduced by allowing night work for welding operations. Depending on the available work area and the sequence of construction events, it may also be possible to reduce the construction schedule through simultaneous excavation of the spoils from the first culvert while the second culvert is rammed into place. However, if the work area is marginal, it may be difficult to safely operate excavation equipment during ramming and welding operations.

Open-Shield Pipejacking

Open-shield pipejacking is a feasible installation method for the trenchless components of the Ryan Creek Fish Mitigation Project. Open shield pipejacking provides greater accuracy (± 2 to 3 inches) than pipe ramming due to the articulated steerable shield at the face. However, in unstable or flowing ground conditions, the open-face of the machine can result in over-excavation, which can lead to settlement of overlying utilities and surfaces. Over-excavation is of special concern due to the large diameter of the proposed pipe. Even 1% over-excavation for this project could result in an additional 0.4 inches of settlement at the ground surface. If groundwater is at or above the pipe springline, an open-faced machine would likely have an unacceptable risk of over-excavation in the anticipated soil conditions.

Significantly more work area is required for open-shield pipejacking than for pipe ramming. As is true for both open-shield pipejacking and microtunneling, a thrust block is required to provide adequate thrust reaction for the jacking frame. Typically, a shaft is required to install the tunnel at the appropriate elevation, and the soil behind the shaft wall provides the thrust reaction. For the Ryan Creek project, the launch side is more or less at grade. Therefore, a concrete block wide enough to provide thrust reaction for both drives would need to be constructed. For example, the thrust block shown in Figure 1 was used for a 1,400-foot long microtunneling drive with 60-inch pipe in clay soil. Additional equipment that would be required at the jacking shaft concurrent with tunneling equipment would include generators, tool trailers, and spoil removal equipment. Typically, open-shield pipejacking operations require 6,000 -10,000 ft^2 of useable space at the jacking shaft.

Figure 1. A thrust block would be necessary for open-shield pipejacking or microtunneling, but not pipe ramming.

Unlike pipe ramming, the contractor will need access to the opposite side of the crossing to retrieve the machine after the drive is complete. A much larger area of tree removal would be required to mobilize a crane and truck to the opposite side of the crossing. It is our understanding that this level of clearing is undesirable due to environmental impacts.

The hydraulic jacks that provide the thrust to the pipe string do not require as robust a pipe as pipe ramming. For a crossing of this diameter and length, a pipe wall of 0.75-inches would likely be sufficient to withstand installation loads. Therefore, the 20-foot pipe sections would be ~13 tons, as opposed to ~20 tons for the 1.5-inch thick pipe required for pipe ramming. Reducing the pipe thickness not only reduces cost for materials and shipping, but also reduces the size of the crane required to maneuver the pipe, and the time required to weld each joint. Alternatively, open-shield pipejacking and microtunneling can also use a machined press-fit jointed pipe, such as Permalok. Press-fit joints can be made much more quickly than welded joint, especially for thick-walled, large-diameter pipe.

The anticipated construction schedule for open-shield pipejacking is approximately 2 to 3 months, not including pipe acquisition, utility relocates, driveway improvements, tree removal, stream diversion, headwall construction, site restoration, or weir construction.

Microtunneling

Microtunneling is a feasible installation method for the trenchless components of the Ryan Creek Fish Mitigation Project. Of the three methods described in this TM, microtunneling provides the best accuracy (± 1 to 2 inches), and provides a mechanically stabilized face that will reduce risk of over-excavation in unstable or flowing ground conditions that could lead to settlement. Microtunneling is the most technically advanced method of the three methods considered. It is also the most expensive and requires the most work area.

The work area required for microtunneling operations is similar to that for open-shield pipejacking, with the exception that microtunneling requires use of a slurry separation plant. The separation plant separates the excavated spoils from the slurry used to transport the cuttings from the face. The separation plant must have easy truck access for spoil removal and must run continuously throughout tunneling operations. As with open-shield pipejacking, microtunneling would also require construction of a thrust block and access to the upstream side for retrieval of the tunneling machine.

The anticipated construction schedule for microtunneling is similar to that for open-shield pipejacking: approximately 2 to 3 months, not including pipe acquisition, utility relocates, driveway improvements, tree removal, stream diversion, headwall construction, site restoration, or weir construction.

Recommendations
All three alternative trenchless construction methods evaluated are technical feasible. As discussed, substantial tree removal and grading would be required to allow retrieval of a tunneling machine from the eastern side with high environmental impacts. In addition, the environmental impact and cost for construction of a thrust block for both open-shield pipe jacking and microtunneling makes both of those technologies unfavorable. Therefore, the recommended trenchless construction method for the Ryan Creek Fish Passage project is pipe ramming.

Evaluation of Settlement Risk
Settlement risk for the recommended pipe ramming alternative was evaluated for the highway travel lanes. The clearance between the crown of the casing and the feature of interest is one of the most important factors in determining settlement risks. The Drawings show:

- The crowns of the twin 120-inch casings at Elevation 1396.5 and 1394 feet
- Highway 101 is at approximate Elevation 1423 to 1424.5 feet
- Approximate depth of cover above pipe crown is 26 to 28 feet.

Settlement
Systematic settlements associated with pipe ramming are primarily caused by the collapse of the overcut, or annular space, between the casing/cuttershoe and the excavated bore. The overcut is necessary for pipe ramming to reduce the frictional resistance between the surface of the pipe and the soil. The surrounding soil may collapse onto the pipe during or after ramming. The movement of soil into the annulus can result in settlements above the bore. Systematic settlement risks may be reduced by increasing the earth cover or by limiting the radial overcut, within reasonable limits.

To evaluate the settlement risk for the proposed Highway 101 crossing, we conducted the settlement analysis using an empirical approach first developed by Schmidt (1969) and Peck (1969), and modified by Cording and Hansmire (1975) for soft ground open shield tunneling. The method was adapted to microtunneling by Bennett (1998) and can also be used to evaluate settlements for pipe ramming projects. This method approximates the shape of the

settlement trough above a pipe rammed installation using an inverted normal probability distribution curve, as shown in Figure 2.

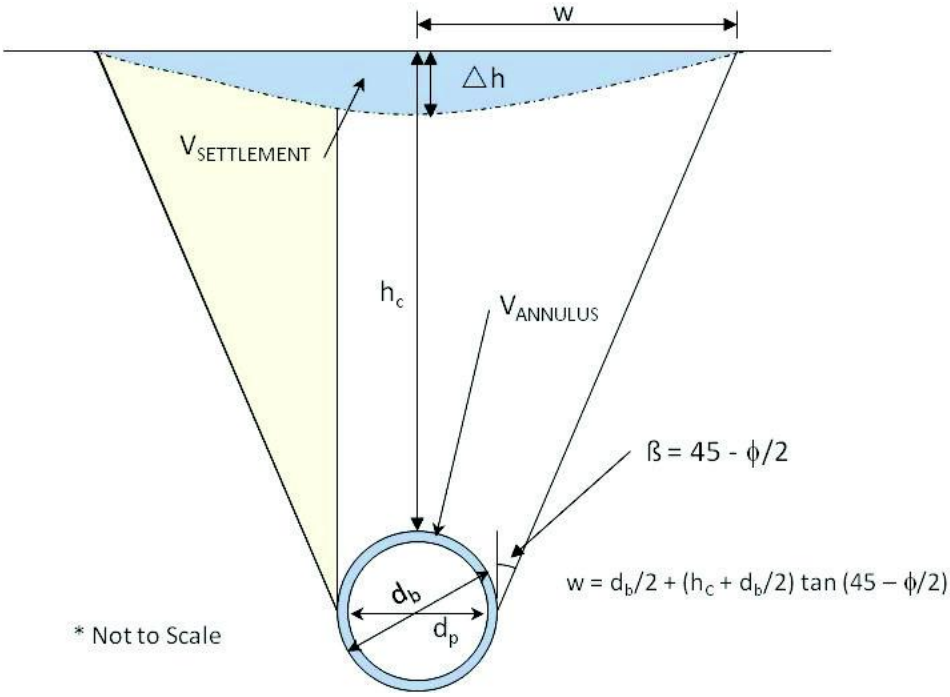


Figure 2: Geometric Relationships and Equations for Calculating Settlement due to Soil Movement into the Annular Space

The maximum predicted settlement occurs above the centerline of the pipe, and decreases to near zero at locations near the edge of the settlement trough. The maximum estimated settlement is directly proportional to the volume of material "lost" to a collapsing annular space, and inversely proportional to vertical clearance above the bore, as the predicted settlement trough gets wider and shallower. For the Ryan Creek Fish Passage project, the casing pipe is 120-inch OD steel. Our settlement analysis assumed that the casing pipe would be installed with a 1.0-inch radial overcut (122-inch outer diameter cutting shoe), based on typical good practices.

We used a residual soil friction angle (ϕ) of 28°, a representative value for the medium dense to dense poorly graded sand and gravel encountered during the geotechnical investigation. We assumed that approximately 33% of the annular space volume will contribute to settlements above the bore due to two factors: soil mass loosening or dilation and soil strength (arching).

Soil mass loosening occurs in dense soils when the soils dilate, or become less dense, as they collapse into the annular space around the pipe. The medium dense to dense granular soils expected along the alignment are likely to exhibit soil loosening behavior. Arching is a phenomenon where the interaction of the individual soil particles physically prevents the soil from collapsing completely onto the pipe. The high internal friction of the medium dense to dense granular soils will lead to arching within the soil mass, further reducing observed settlement. Considering these factors and the soil conditions encountered in the geotechnical

investigation, we believe it is reasonable to estimate that not more than one-third of the annular space will contribute to settlement.

Maximum expected settlements were then estimated for the Highway 101 ROW, which has a minimum vertical cover of 26 feet near the shoulder for the northern crossing. The anticipated settlement at the ground surface is estimated to be 0.44 inches assuming good practices and no over-excavation. The Highway 101 roadway should reasonably withstand the estimated settlement without adversely affecting the service life of the roadway or the safety of motorists. (One-half inch is a reasonable value of maximum allowable settlement.)

Settlement can be monitored from the ground surface with surface and sub-surface monitoring points. The surface monitoring points are typically surveyor's nails that can be surveyed from the shoulder without requiring traffic control. The subsurface monitoring points consist of a rebar rod installed within a casing with the rebar tip embedded in the soil at the elevation to be monitored. Ground movements associated with trenchless construction can propagate through the soil slowly to the surface. Therefore the subsurface monitoring points are more useful for assessing the settlement risk during construction when means and methods can be altered to minimize ground movement if settlement approaches the threshold.

A settlement instrumentation and monitoring non-standard special provision (NSSP) will be developed to outline a plan for the number and layout of monitoring points, the frequency of measurement, and the duration for monitoring after construction is complete. The NSSP will also require the contractor to install and monitor the settlement points prior to excavation work to determine a baseline elevation. In coordination with Caltrans, maximum allowable levels of settlement will be developed and described in the NSSP, as well as action levels established as one-half of the maximum allowable settlement. The NSSP will outline steps to be taken if the action level is reached, including personnel to be notified.

Conclusions

1. Trenchless construction of the twin 120-inch diameter 113-foot long culverts beneath Highway 101 can be successfully completed using trenchless construction methods.

2. The recommended construction method for the Ryan Creek Fish Passage is pipe ramming due to the environmental and work area constraints. Pipe ramming at the proposed diameter and length is near the upper end of the capabilities of the technology and will require an experienced contractor to successfully complete the project.

3. Our analysis of settlement risk assumed good workmanship, a radial overcut on the cutter shoe of 1.0 inches, a casing OD of 120.0 inches, a residual soil friction angle of 28°, and a settlement trough volume of 33% of the annular volume. Representative soil properties were selected based on review of the geotechnical investigation data report, and nearby boring logs prepared by Caltrans and Kleinfelder, Inc. for this project.

4. We assumed that an adequate soil plug would be maintained at the face of the pipe to avoid excessive settlement associated with face losses that could result if face pressures drop below active earth pressures.

5. Settlement incidents may occur during or after construction operations as the disturbed soil moves around the casing. A Settlement Instrumentation and Monitoring Plan will be developed in the NSSP to monitor soil behavior and is an important component of the project.

6. Bennett Trenchless Engineer's evaluation of settlement risk indicated that the anticipated settlement of Highway 101 will be less than 0.5 inches, which is considered an allowable value.

APPENDIX A:

Description of Alternative Trenchless Construction Methods

Introduction

Candidate construction methods that could be considered for the trenchless installation of twin 120-inch casings beneath Highway 101 are described in the following paragraphs, along with applications and limitations. The methods described include open-shield pipejacking, microtunneling, and pipe ramming.

Open-Shield Pipejacking

Open-shield pipejacking is a trenchless construction method whereby pipes are sequentially jacked horizontally through the ground from a jacking shaft to a reception shaft. Pipejacking has been in use in the US for well over 100 years. As is true for all pipejacking methods, jacking and reception shafts are required at the ends of individual drives. A casing pipe can be jacked initially, and the product pipe placed inside after the drive is completed. Alternatively, a carrier pipe can be directly jacked into place. Pipe materials that are suitable for direct-jacking include steel pipe, reinforced concrete pipe (RCP), polymer concrete pipe (PCP), vitrified clay pipe (VCP), and centrifugally cast fiberglass reinforced polymer mortar pipe (CCFRPM).

Excavation via open-shield pipejacking requires workers inside the pipe to monitor and/or perform the excavation, steering, and spoil removal. The propulsion jacks are operated by a separate worker from the jacking shaft. The removal of material may be accomplished using a cutterwheel, roadheader, excavator arm, or hand mining operations and is completed within an open shield attached to the leading section of pipe. Excavated material is placed on a conveyor that deposits the material into a muck bucket set on a haul cart. The haul cart travels in and out of the tunnel on rails allowing removal of the excavated material by lifting the muck bucket out of the shaft. Open-shield pipejacking equipment is shown in Figure A1.

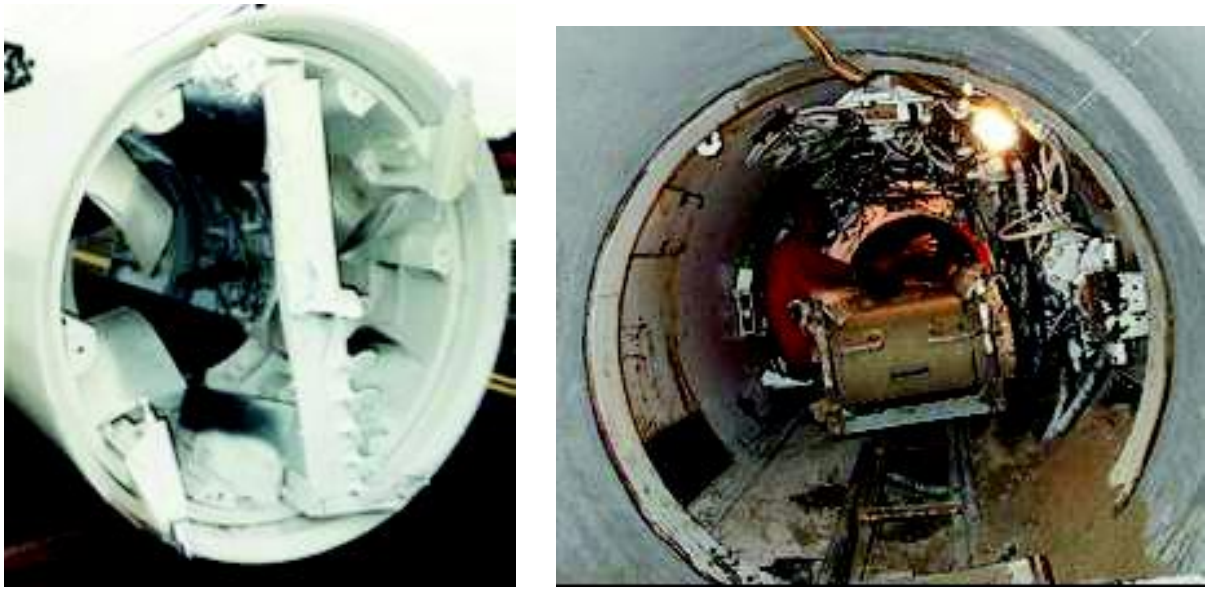


Figure A1. Open-Shield Pipejacking Machine with Operator in Shield

Typical drive lengths are less than 800 feet, although drives of 1,700 feet or longer are possible. Because personnel entry is required for pipejacking, the recommended minimum diameter is approximately 48 inches. Diameters of 36 to 168 inches have been successfully installed using open-shield pipejacking.

Open-shield pipejacking is typically used in stable soil types, i.e. medium to stiff clay, silt and silty and clayey sands with some cohesion, relatively low permeability, or in soils that have been dewatered or otherwise pre-stabilized by ground improvement methods such as grouting. Low inflow volumes of groundwater can be managed as long as the face of the tunnel remains stable. The advantage of an open shield is that it allows personnel access to the face for the excavation and removal of cobbles and boulders. However, open-shield pipejacking cannot provide the level of face support provided by microtunneling. In soft silt and clay, or loose sandy soils, especially below groundwater, open-shield pipejacking methods can cause voids above the pipeline which can result in surface settlements. On the other hand, open-shield pipejacking is better-suited for dealing with cobbles and boulders than microtunneling.

Control of line and grade is typically accomplished using a laser for guidance and an articulated steering head operated using hydraulic or manual jacks for the steering system. The guidance system usually consists of a reference laser mounted in the jacking shaft that transmits its beam to a target in the open-shield machine. Guidance is not continuous as the muck cart typically blocks the laser during pipejacking. Therefore, the resulting line and grade control is less precise for open-shield pipejacking than for microtunneling. However, the laser position can be monitored after each muck cart is hauled out to achieve typical tolerances of plus or minus one to three inches.

A work area of app. 6,000 to 12,000 square feet is required at the jacking shaft. Work area at the reception shaft can be smaller. Off-site staging areas for some tools and excess pipe can be used to reduce staging area at each shaft. Jacking shafts are typically approximately 12 to 16 feet wide by 18 to 30 feet long. Reception shafts are typically approximately 12 feet by 12 feet.

Microtunneling

Microtunneling is a remotely controlled, guided, pipejacking process that provides continuous positive control of earth and groundwater pressures at the face of the excavation. The microtunneling machine (MTBM) and jacking pipes are pushed into the ground from a jacking shaft to a reception shaft on opposite sides of the crossing as shown in Figure A2. The carrier or product pipe may be jacked directly or installed inside an oversized casing in a separate operation. Pipe materials that can be jacked directly into place are similar to those used for open-shield pipejacking and include steel pipe, reinforced concrete pipe (RCP), polymer concrete pipe (PCP), vitrified clay pipe (VCP), and centrifugally cast fiberglass reinforced polymer mortar pipe (CCFRPMP).

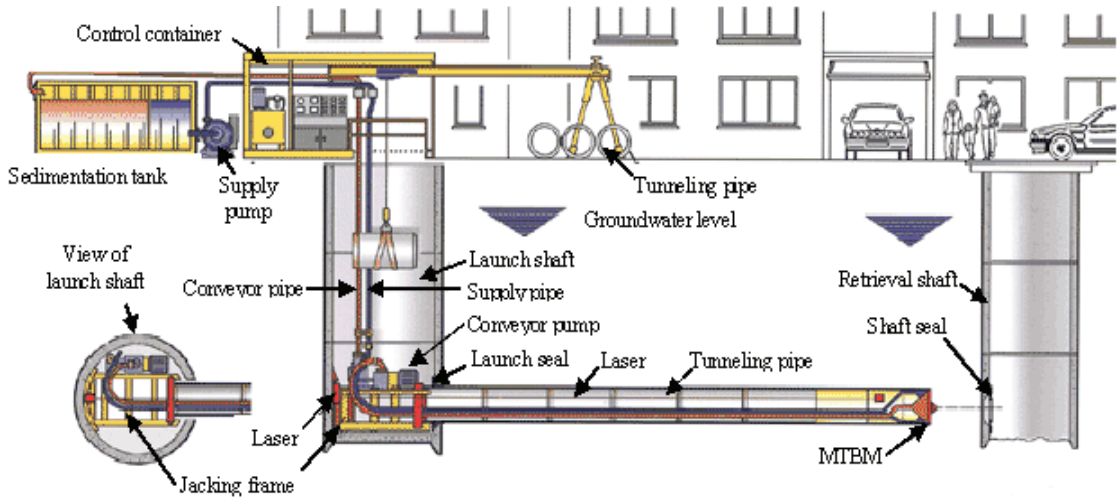


Figure A2. Schematic of a typical microtunneling operation (Courtesy of Herrenknecht)

A cutterwheel excavates material at the face as the machine is jacked forward. The excavated material is mixed with clean slurry and pumped to the surface for separation and muck removal. Due to this slurry removal system and remote control operation, the microtunneling process does not require routine personnel entry into the pipe.

Microtunneling machines have a closed face, as shown in Figure A3, limiting the size of rock that can be ingested. Most machines are only capable of handling cobbles and boulders less than or equal to 20 to 30 percent of the outside diameter of the shield. In addition, large quantities of smaller cobbles can stall an MTBM by clogging the crushing chamber with rocks before they can be crushed and ingested. Therefore, microtunneling is not a preferred method when large quantities of cobbles and boulders are anticipated.

Figure A3. 72-inch Microtunneling Machine (Courtesy of Akkerman)

Microtunneling is the preferred construction method when high groundwater pressures are anticipated, few (or no) cobbles and boulders are anticipated, and when surface settlements must be minimized. Slurry pressure and mechanical face pressure are used to support the face of the excavation when ground conditions are loose or soft. In high groundwater conditions the slurry excavation system prevents inflow of water into the pipeline. Microtunneling is

typically used in a wide variety of soil types, including rock and stable soils to loose, flowing, or otherwise unstable soils.

Pipes from 24 to approximately 120-inch diameter have been installed using microtunneling. Drive lengths of over 3,000 feet have been completed, though typical drive lengths are 800 feet or less. This is due to the fact that jacking forces increase with drive distance, and may limit practically achievable drive distances. In pipe larger than approximately 30 inches, intermediate jacking stations can be used to achieve longer drive distances. However, for pipes smaller than 30 inches, intermediate jacking stations cannot be used.

Microtunneling provides continuous control of line and grade by use of a guidance system and steering jacks. The guidance system usually consists of a reference laser mounted in the jacking shaft that transmits its beam onto a target mounted inside the articulated section of the MTBM. This information and other operational performance information are transmitted through wire cables to the MTBM control cabin at the surface where the MTBM is remotely controlled. Through continuous monitoring and control of the MTBM, tolerances of plus or minus one to two inches are typically achievable.

Typical shaft dimensions for microtunneling are approximately 12 to 20 feet wide by 20 to 35 feet long for jacking shafts and 12 to 16 feet wide by 12 to 20 feet long for reception shafts. The depths are based partly on the required clearance below the crossing feature, and partly on applications, e.g. gravity sewer.

Pipe Ramming

Pipe ramming is a trenchless technology which uses a pneumatic percussive hammer to drive a steel casing into the ground. The hammer is mounted on the rear of the trailing end of the casing along with an adaptor cone which transfers the energy of the hammer to the pipe. A thickened cutting shoe is welded to the leading edge of the casing. The process is not steerable, so careful set-up and survey control are needed to ensure the installation complies with design line and grade tolerances. Typically, a 20- or 40-foot casing section is placed on a set of rails or a cradle at correct line and grade and is driven into the ground along the design alignment by the force applied through the percussive hammer. The casing envelopes the soil and rock as it is advanced by the hammer. When each casing section has been driven completely into the ground, the hammer and adapter are removed, another casing section is lowered into place, the sections are welded together, the hammer and adapter are re-attached, and the process is repeated. The spoils are cleaned out of the casing at the end of the drive, or periodically during driving.

Pipe ramming has been successfully applied to casing diameters as large as 144 inches and on drives as long as 250 feet or more. Pipe ramming can be especially effective in ground conditions that include cobbles and boulders, because the cobbles and boulders can be ingested into the casing and cleaned out later. Cobbles and boulders can present obstructions to other methods including microtunneling, pipejacking, and auger boring. Figure A4 illustrates a schematic of the pipe ramming method.

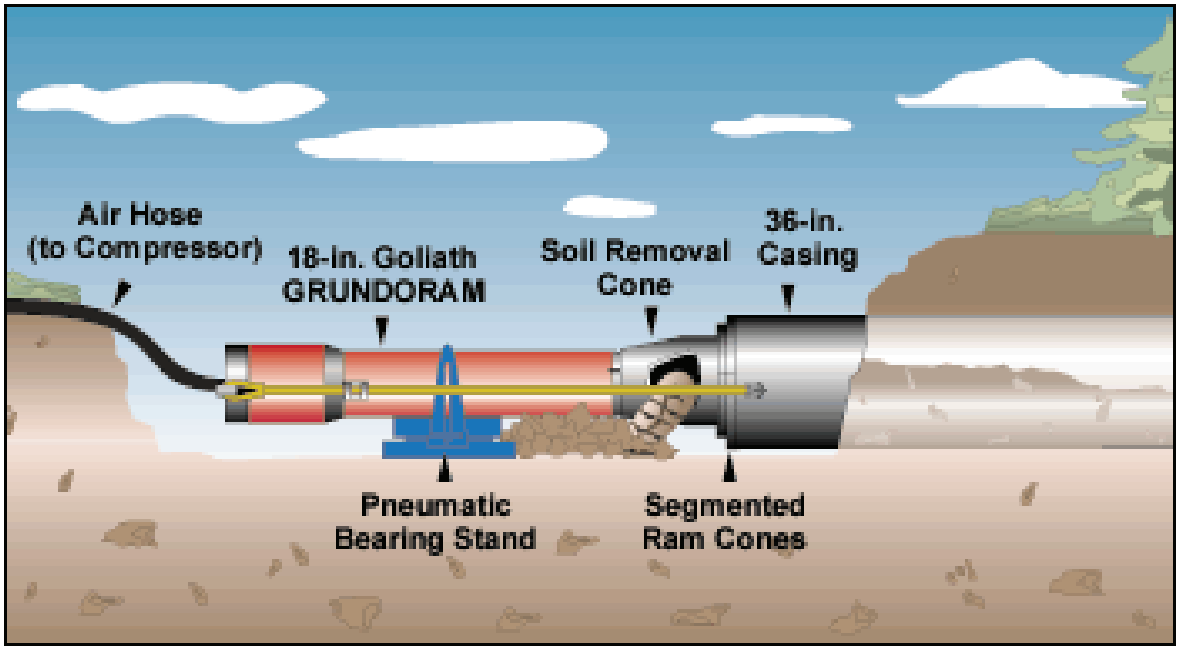


Figure A4: Schematic of Pipe Ramming, Courtesy TT Technologies

Comparison

A summary of the methods described is presented in Table 1.

Table 1: Summary of Trenchless Method Alternatives

Method	Open Shield Pipejacking	Microtunneling	Pipe Ramming
Applicable Pipe Diameters	42” to 168”	12” to 120”	12” to 144”
Typical Drive Lengths	< 800’	< 800’	< 250’
Typical Jacking Shaft Dimensions*	12’ by 20’ to 20’ by 30’	12’ x 20’ to 20’x 30’	12’ by 45’ to 24’ by 65’
Relative Cost	$$$	$$$$	$$$
Relative Schedule Duration	High	High	Low to Moderate
Cobbles/Boulders	Yes	Challenging	Yes

**Reception shafts are typically smaller*

10-1. 120-INCH STEEL CASING

GENERAL

Summary

The section provides the minimum requirements for manufacturing, furnishing, and transporting twin 120-inch steel casing pipes to be installed by pipe ramming. The Contractor must provide all labor, equipment and materials to install steel casing pipes at the location shown on the Drawings.

Design Criteria

The Contractor is fully responsible for the design of steel casing pipes that meet or exceed the performance requirements of this project and that are specifically designed for installation by pipe ramming.

The Contractor must design the casing pipes to account for all installation and service loads including ramming loads, external groundwater and earth loads, traffic loads, practical consideration for handling, shipping, and other construction operations, and any other live or dead loads reasonably anticipated.

A Professional Engineer licensed in the State of California must seal and sign the steel casing pipe designs. The Contractor must submit certification that the design prepared by the registered engineer was used.

The allowable ramming stresses must not exceed 50 percent of the minimum steel yield stress.

The Contractor must provide steel casing pipes with a nominal 120-inch diameter, a minimum wall thickness of 1.50 inches, and furnished in lengths that are compatible with Contractor's allowable work areas and Contractor's approved work plan.

The leading pipe must use thickened cutting shoes of appropriate shape to strengthen the lead edges and to guide soil movement into the pipe.

Submittals

Submittals must provide sufficient detail to allow the Engineer to judge whether the proposed materials will meet the Contract requirements. All drawings must be legible with dimensions accurately shown and clearly marked in English. Poor-quality drawings and photographs will be rejected.

Do not start work until the Engineer accepts:

1. Shop drawings illustrating the details of the casing pipe, cutting shoes, grout/lubrication ports, joint details, and miscellaneous items to be furnished and fabricated for the pipe. Drawings must show dimensions, tolerances, wall thickness, properties and strengths, and other pertinent information. Submit these items for review by the Engineer at least fifteen (15) days prior to fabrication.
2. Calculations in a neat, legible format. Prepare calculations by or under direct supervision of a Professional Engineer licensed in State of California, who must stamp and sign calculations, including:
   - 2.1 Calculations must confirm that pipe ramming capacity is adequate to resist anticipated ramming loads with a minimum factor of safety of two (2) against minimum steel yield stress.

2.2 Calculations must confirm that pipe capacity is adequate to safely support all other anticipated loads, including earth and groundwater pressures, traffic, surcharge loads, transport, and handling loads.

MATERIALS

Steel casing pipe must be new, smooth-wall, carbon steel pipe conforming to ASTM Specification A139, Grade B and have an expected service of 50 years.

Steel casing pipe must be fabricated with either longitudinal weld or spiral-wound seams. All girth weld seams must be ground flush.

Prior to delivery of the pipe, end/internal bracing must be furnished and installed, as recommended by the manufacturer, for protection during shipping, storage, and installation.

Contractor will bear sole responsibility for furnishing and installing steel casing pipe with dimensional tolerances that are compatible with design criteria and proposed installation methods that meet or exceed the dimensional tolerances.

Dimensional Tolerances

The minimum wall thickness at any point must be at least 87.5 percent of the nominal wall thickness.

Steel pipe must have an outside circumference that is within 1.0 percent of the nominal circumference.

The outside diameter of the pipe must be within 1/8 inch of the nominal outside diameter.

Steel pipe must have a roundness such that the difference between the major and minor outside diameters is less than 0.5 percent of the specified nominal outside diameter or ¼ inch, whichever is less.

Steel pipe must have a maximum allowable straightness deviation of 1/8 inch in any 10-foot length.

All steel pipe must have square ends. The ends of pipe sections must not vary by more than 1/8 inch at any point from a true plane perpendicular to the axis of the pipe and passing through the center of the pipe at the end.

When pipe ends have to be beveled for welding, the ends will be beveled on the outside.

CONSTRUCTION

Steel casing pipes must be installed in accordance with “Pipe Ramming” of these special provisions.

The Contractor must achieve steel casing pipe connections by full penetration field butt welding. Weld pipe in accordance with pipe and hammer manufacturers’ recommendations.

Field butt welding for casing pipe connections must be completed in accordance with Section 8.3 – “Welding”.

MEASUREMENT AND PAYMENT

The contract price paid per lineal foot for 120-inch steel casing must include full compensation for furnishing all labor, materials, tools, equipment, and incidentals as shown on plans and as described in these special provisions, and for doing all the work involved in pipe ramming, complete in place, including furnishing and pumping lubricating fluids, removing and disposing of excess excavated material, and installation and removal of the working slab, as shown on the plans, as specified in these special provisions, and as directed by the Engineer,

10-2. PIPE RAMMING

GENERAL

Summary

These special provisions will govern requirements, design and all work in connection with installing steel casing by pipe ramming at the location indicated on the Plans. The Contractor must furnish all labor, equipment, and materials necessary for site preparation and pipe ramming installation of new twin 120-inch diameter steel casings.

Definitions

pipe ramming: A non-steerable trenchless pipe installation system whereby an open-ended steel casing is driven through the ground using a percussive hammer. The soil may remain in the casing until the bore has been completed or may be removed at intervals during the installation by water, auguring, jet-cutting, or manual excavation to reduce frictional resistance. Once the crossing is completed, all soil is removed from the casing.

casing: A pipe installed by pipe ramming that supports the ground and provides a stable underground support system.

lubrication/injection system: A port located within the casing pipe fitted with a one-way valve for injection of lubrication material or grout into the annular space between the pipe and the ground.

settlement point: A point with elevation and spatial location established by survey prior to construction. The point is re-surveyed periodically to monitor ground movements. The point may be a nail, pin, subsurface settlement rod, borehole extensometer, or other device that can be readily located and surveyed.

obstruction: Objects located wholly or partially within the cross-sectional area penetrated by the casing pipe that prevent the forward movement of the casing after all diligent efforts by the Contractor to advance past the object have failed.

Design Criteria

Pipe ramming equipment selected for the project, including the pneumatic hammer, cutting shoe, steel casing, and lubrication injection system will be suitable for, and capable of, efficiently advancing through the existing ground conditions.

The maximum radial overcut must be one (1) inch. The minimum radial overcut must be one-half (0.5) inch. The radial overcut must be determined as the difference between the maximum diameter created by the cutting shoe or overcut band (whichever is greater) and the outer diameter of the casing, divided by two.

The Contractor must provide a lubrication injection system to inject pipe lubricant around the exterior of the casing pipe to decrease frictional resistance. Lubrication materials may include a mixture of bentonite and/or polymers and water. Lubrication ports and pipes must be provided as necessary in the casing pipe to allow for lubrication along the exterior of the pipe string.

The Contractor must dispose of all excavated material from the pipe ramming and pit construction in accordance with Section 7.13 – “Disposal of Material Outside the Highway Right of Way.”

The soil removal system must be capable of being operated in a manner which will prevent loss of ground outside the casing during any intermediate spoil removal. The Contractor must leave a sufficient soil plug inside the casing at all times to prevent sloughing of soils outside the leading edge of the casing. The Contractor must use supplemental stabilization (such as sand bag walls) to prevent soil from sloughing or flowing into the casing during ramming that may lead to over-excavation of soil outside the leading edge of the casing.

The Contractor must prepare the launch area with a concrete working slab to properly support the pipe guide rails and pipe. The Contractor must take special care when setting the pipe guide rails in the pit to ensure correctness of the alignment.

The Contractor must drive the casing from the downstream to the upstream end.

The Contractor's methods and equipment must control surface settlement above the casings to prevent damage to existing utilities, facilities, surface features, and improvements. Ground movements (settlement/heave) must be limited to values that do not cause damage or distress to surface features, utilities, or improvements. Ground movements must not be allowed to exceed the maximum allowable values specified in "Settlement Instrumentation and Monitoring" in these special provisions. The Contractor will be responsible for any damage to existing features, improvements, or utilities, and must repair any damage to the satisfaction of the Engineer, at no additional cost to the State, and without schedule extension.

The Contractor must use a hammer frame and ramming cone system to develop a uniform distribution of ramming forces around the perimeter of the casing pipe.

The Contractor is responsible for pipe design for ramming loads and acceptable fabrication tolerances. Maximum installation loads applied to the casing pipe must not exceed fifty percent (50%) of the ultimate compressive strength of the pipe material or the maximum allowable strength of the pipe as established by the manufacturer, whichever is lower.

The Contractor must determine casing thickness to safely resist all installation and service loads. The casing must not be less than one and one-half (1.50) inches thick.

Submittals

Submittals must provide sufficient detail to allow the Engineer to judge whether the proposed equipment, materials, and procedures will meet the Contract requirements. All drawings must be legible showing accurate dimensions and marked clearly in English. Low-quality drawings and photographs will not be accepted.

Do not start work until the Engineer has accepted the following:

Pipe Ramming Equipment Submittal: Submit the following describing the pipe ramming equipment and construction methods to be employed:

1. Detailed drawing and performance information for the pneumatic hammer, including dimensions and noise rating.
2. Detail drawings and specifications for the cutting shoe that will be used. Submit the excavation diameter based upon the outermost dimensions of the cutting shoe. Provide the radial overcut which is the difference between the maximum excavation diameter and the outer diameter of the casing pipe, divided by two.

3. Details and performance information for the air compressors and air handling system that will be used, including capacity and noise ratings.
4. Details of the thrust cone and adapter that will be used to connect the pneumatic hammer to the steel casing.

Submit work area layout drawings detailing dimensions and locations of all equipment and materials, including pipe storage, air compressors, crane, and ancillary equipment. Layout drawings must be to scale, or show correct dimensions. The Contractor's layout drawings must show that all equipment and operations must be completely contained within the allowable work areas shown on the Plans.

Submit details of crane dimensions and capacity.

Submit details on face stabilization and the method of controlling loss of ground at all times, including the period during launch of the casing.

Submit details of the spoil removal, storage, transport, and disposal equipment and procedures including the location of the spoil disposal site. Provide written documentation from the disposal site(s) indicating that they will accept the spoil and are in compliance with applicable regulations.

Submit the schedule for all pipe ramming work, identifying all major construction activities as independent items. The schedule must include, as a minimum:

1. mobilization
2. stream diversion
3. soil excavation at launch side
4. headwall footing and working slab construction
5. equipment setup
6. pipe ramming for each casing
7. welding operations
8. soil removal for each casing
9. site restoration, cleanup, and demobilization.

The schedule must also include the work hours and workdays for each activity, and a written description of the construction activities. The schedule will be reviewed by the Engineer and must be updated and resubmitted by the Contractor every week or more frequently if requested by the Engineer.

Submit methods for establishing line and grade of the casing prior to launch of the pipe ram.

Submit details of supplemental soil stabilization measures (sand bag walls, etc.) that will be used inside the casing to prevent soil from sloughing or flowing into the casing during hammering.

Submit details of pipe lubrication injection system and pipe lubricants to be used during pipe ramming, including manufacturer's literature and Material Safety Data Sheets. Include a description of proposed lubrication procedures during ramming. Confirm that sufficient volume of lubricant will be pumped at all times to completely fill the annular space outside the pipe.

Submit the names and resumes of the project superintendent, operators, and site safety representative. Submit name and resume for hammer manufacturer's

representative if Contractor elects to use manufacturer's representative to meet operator experience requirements. Submit personnel qualifications in accordance with the Qualifications section of this specification. Provide qualifications and training records for site safety representative, personnel responsible for air quality monitoring, and licensed surveyor.

Submit contingency plans for dealing with the following problem scenarios while satisfying the specifications. These plans must also include the observations and measurements required to clearly identify the cause of the problems.

1. Casing unable to advance
2. Possible obstructions (including boulders, old foundations, existing culvert, metallic debris, or reinforced concrete)
3. Insufficient ramming capacity
4. Machine or component malfunction
5. Strong hydrocarbon smell detected. Combustible gas meter readings in the tunnel exceed 10% of LEL for methane or possible volatile organic compounds.
6. Survey measurements indicate settlement deformations exceed allowable limits.
7. Stream flows increase significantly as a result of storms, and threaten to overwhelm bypass system.

Submit a Safety Plan for the pipe ramming operations including air monitoring equipment and procedures, and provisions for lighting, ventilation, and electrical system safeguards.

Provide copies of any Contractor obtained permits and agreements.

Submit survey results of rails and cradles, prior to launch.

The following daily records must be submitted to the onsite Engineer by noon on the day following the shift for which the data or records were taken.

1. Installation Records: The Contractor must provide complete casing installation records to the Engineer. These records must include, at a minimum: date, time, name of operator, pipe ram identification, installed pipe number and corresponding length, rate of advance, hammer strokes per minute, operating pressure, volume and extent of any intermediate spoil removed, problems encountered with the pipe ramming equipment or casing, and durations and reasons for delays. Manually recorded observations must be made at intervals of at least four times per 20-foot pipe, whenever conditions change, and as directed by the Engineer. At least seven (7) days prior to the launch of the pipe ram, the Contractor must submit samples of the installation record forms.
2. Lubrication Records: The Contractor must provide lubrication records to the Engineer. These records must include the injection locations along the pipe string, lubrication type and additives, and amount, in gallons, of lubricant pumped throughout a drive. The record will also include the type of additive used and date, time, and drive distance when used.
3. Survey measurements of pipe alignment.

Provide certified pipe installation as-builts after completion of the Work.

Quality Control and Assurance

Qualifications

Failure to meet the qualification requirements is failure to fulfill the Contract and the Contractor will be required to obtain a subcontractor that meets the qualification requirements.

The project superintendent must have at least three (3) years of pipe ramming experience and must have worked on at least two (2) projects of similar diameter and length in similar ground conditions using equipment similar to the equipment required for this project.

The operator must have at least three (3) years of pipe ramming experience and must have worked on at least two (2) pipe ramming projects of similar diameter and length and in similar ground conditions using equipment similar to the equipment required for this project. The Contractor may substitute a full-time on-site manufacturer's representative with the requisite experience to fulfill the operator experience requirements.

The project superintendent and operator must have worked on at least one pipe ramming project with a diameter of at least 96-inches and a single drive length of at least 100 feet.

The site safety representative and personnel responsible for air quality monitoring must be experienced in tunnel construction and must have current certification by CalOSHA.

The surveyor responsible for line-and-grade control must be a Licensed Surveyor registered in the State of California who has prior experience in similar projects.

Field Quality Control

Provide at least 72 hours advance written notice to Engineer of the planned launch of the pipe ram.

All work by the Contractor must be done in the presence of the Engineer unless the Engineer grants prior written approval to perform such work in Engineer's absence.

The Contractor must immediately notify the Engineer, in writing, when any problems are encountered with equipment or materials, or if the Contractor believes the conditions encountered are materially and significantly different than those represented within the Contract Documents.

Inspection of work by the Engineer shall be in accordance with Section 5-1.08 – "Inspection."

MATERIALS

Pneumatic Hammer

The Contractor must use pneumatic pipe ramming equipment manufactured by TT Technologies Inc., Vermeer HammerHead, or an Engineer-approved equal.

Pipe

All pipe to be installed by pipe ramming must safely support all installation and service loads, as confirmed by Contractor's approved submittals, and must conform to

requirements shown on the Plans and in "120-Inch Steel Casing" of these Special Provisions.

CONSTRUCTION

General Requirements

Pipe ramming must not begin until all required submittals have been provided, reviewed, and approved by the Engineer. Pipe ramming must not begin until all settlement monitoring instruments have been installed and surveyed and the data has been submitted to the Engineer for acceptance.

The Contractor must perform all work in accordance with Section 7-1.01F – "Air Pollution Control" and Section 7-1.01G – Water Pollution".

The Contractor must perform all work so as not to damage roadways, adjacent structures, landscaped areas, or existing utilities. The Contractor must immediately repair any damage to original or better condition and to the satisfaction of the Engineer and at no additional cost to the State.

Whenever there is a condition that is likely to endanger the stability of the excavation or adjacent structures, the Contractor must operate with a full crew 24 hours a day, including weekends and holidays, without interruption, until those conditions no longer jeopardize stability.

Site Preparation

The Contractor must survey the elevations and slopes of working slab surfaces and confirm that the Work can be completed in accordance with alignment and grade shown on Plans.

The Contractor must stabilize the soils at the entry location as necessary to stabilize any weak, running or flowing soils. The Contractor must confirm that the ground has been stabilized to the extent that ground will remain stable without movement of soil or water during and after the work is completed.

Pipe Handling

Transport the casing pipe to the launching area without damage. Transport methods must be acceptable to pipe manufacturer. Damaged casing pipe must not be used in the Work, unless permitted in writing by the Engineer. Set the pipe to be rammed on properly braced and supported guide rails.

Distribute axial forces from the pneumatic hammer to the casing pipe uniformly through a thrust cone to prevent damage to the ends of the pipe. Axial ramming forces applied to the pipe must not exceed the specified allowable compressive stresses of the casing pipe.

Ram pipe sections into position following the design line and grade without damaging the pipe. In the event a section of pipe is damaged the Contractor, with written approval from the Engineer, will make temporary repairs to the pipe and must continue installing the pipe if possible.

Pipe Ramming

Pipe ramming must be completed in accordance with approved submittals, and all applicable permit conditions.

The Contractor must survey the location, orientation, and grade of the guide rails to ensure they are on the proper line and grade and to verify that they are properly supported. Take special care when setting the guide rails in the launching area to ensure stability and accuracy of the alignment and grade. Guide rails must be securely attached to the concrete working slab, with supplementary steel beams, concrete, or grout if necessary, to prevent movement or shifting during the work.

Pipe ramming operations must control surface settlement and heave above the pipeline to prevent damage to the roadway, existing facilities, and improvements. The Contractor must repair any damage resulting from construction activities, at no additional cost to the State and without extension of schedule for completion. The Contractor must modify equipment and procedures as required to avoid recurrence of excessive settlements, heave, or damage.

Each pipe section must be rammed forward in such a way to provide complete and adequate ground support at all times.

Lubrication must be applied to the external surfaces of the pipe through injection nozzles to reduce skin friction.

Completely contain, transport, and dispose of all excavated materials away from the construction site. All spoils must be contained in trucks, tanks, or other containers at all times. Use only the disposal sites identified in approved submittals for muck disposal.

During as-built survey or prior, clearly mark stationing on interior surface of casing at 20 foot maximum intervals.

Control of Line and Grade

The State will establish the survey control points indicated on the Plans, at ground surface. The Contractor must verify these control points by survey prior to the start of construction, and must confirm positions or report any errors or discrepancies in writing to the Engineer.

After confirming all established survey control points, the Contractor must use these control points to furnish and maintain all reference lines and grades for casing installation. Submit to Engineer copies of field notes used to establish all lines and grades. Contractor must check guide rail setup prior to beginning each drive. Contractor must perform survey checks of the line-and-grade of the installed casing pipe on a daily basis during pipe ramming operations. The Contractor is fully responsible for the accuracy of the Work and the correction of it, as required.

The Contractor must install casing pipe to within 1 ft per 100 feet of casing in both vertical and horizontal dimensions.

If the pipe installation does not meet the specified tolerance, the Contractor must correct the installation including any necessary redesign of the pipeline or structures and acquisition of necessary easements. All corrective work must be performed by the Contractor at no additional cost to the State and without schedule extension, and is subject to the written approval of the Engineer.

Obstructions

The Contractor must notify the Engineer immediately if the pipe ramming operations should encounter an object or condition that prevents the forward progress of the casing. The Contractor must submit a plan to correct the condition, and remove, clear, or otherwise make it possible for the casing pipe to advance past any and all objects or obstructions that impede forward progress. The Contractor must proceed with removal of the object or obstruction by methods submitted by the Contractor and accepted by the Engineer. The Contractor will receive compensation for removal of obstructions, as defined as metallic debris, reinforced concrete, whole trees, rocks and other hard objects larger than 30% of the outer diameter of the casing pipe, which cannot be broken up by the cutting shoe with diligent effort, and that are partially or wholly within the cross-sectional area of the casing. New and unforeseen work shall be in accordance with Section 4-1.03 – "Extra Work". The Engineer must be provided an opportunity to view the obstruction prior to removal. Any removal process that does not allow direct inspection of the nature and position of the obstruction will not be considered for payment.

The Contractor will not receive additional compensation for removing, clearing, or otherwise making it possible for the casing pipe to advance past objects consisting of cobbles, boulders, wood, non-reinforced concrete, and other nonmetallic objects or debris with maximum lateral dimensions less than 30% of the outer diameter of the casing pipe.

Cleanup and Restoration

After completion of the pipe installation, the Contractor must remove all construction debris, oil, grease, and other materials from the pipe, and all Contractor and project work areas. The Contractor must remove the working slab entirely and the streambed must be restored as shown on the Plans.

The Contractor must complete restoration of the work area as soon as possible after completion of the Work. The Contractor must restore and repair any damage resulting from surface settlement caused by excavation or pipe ramming. Any property damaged or destroyed must be restored to a condition equal to or better than existing prior to construction. Restoration must be completed no later than thirty (30) days after the pipe ramming is complete. This provision for restoration must include all property affected by the pipe ramming construction operations.

MEASUREMENT AND PAYMENT

Full compensation for pipe ramming is included in the contract unit price paid per foot for 120-inch steel casing, and no separate payment will be made therefore.

10-3. SETTLEMENT INSTRUMENTATION AND MONITORING

GENERAL

Summary

The work specified in this section includes furnishing, installing, and monitoring settlement instrumentation to monitor ground movements around and above pipe ramming and excavations. The Work includes: installing surface control points, furnishing monitoring equipment, and recording observations and measurements from the monitoring points on a periodic basis before, during, and after the Work.

Minimum instrumentation requirements and locations are shown on the Plans. Additionally, the Contractor must modify means and methods, install other instrumentation as necessary, and monitor ground conditions and ground response to achieve specified project requirements and to prevent damage to existing structures and facilities.

Submittals

Submittals must provide sufficient detail to allow the Engineer to judge whether or not the proposed equipment, materials, and procedures will meet the Contract requirements. All drawings must be legible with dimensions accurately shown and clearly marked in English units. Poor-quality drawings and photographs will be rejected. Review and acceptance of the Contractor's submittals by the Engineer must not be construed in any way as relieving the Contractor of its responsibilities under this Contract.

Do not start work until the Engineer accepts the following five items:

1. Description of the means and methods for installing the surface control points
2. Proposed schedule for installing the surface control points
3. Confirmation that the locations of the monitoring points will be as shown on the Plans
4. Description of the methods and materials for protecting the surface control points
5. Surveying personnel qualifications

The Contractor must submit surveyed baseline measurements of all monitoring points at least seven (7) days prior to commencing pipe ramming operations.

The Contractor must submit all reports of monitoring data to the Engineer. Provide reports of monitoring surface control point data to the Engineer by noon of the day following the shift for which the measurements were taken.

Quality Control and Assurance

The land surveyor performing the work must be licensed in the State of California and have experience surveying for the detection of structural or surface deformations.

Install all monitoring points within one-half (0.5) foot of the horizontal and vertical location shown on the Plans or as directed by the Engineer.

The Contractor must obtain written acceptance from the Engineer for new instrument location and elevation if actual field conditions prevent installation of instruments at the location shown on the Plans.

Surveying for monitoring settlement instrumentation must be referenced to the same control points and benchmarks established for setting out the work. Control points must be tied to benchmarks and other monuments outside of the zone of influence of the operations.

Installation of instrumentation must, at all times, be performed in the presence of the Engineer.

MATERIALS

In asphalt or concrete paved areas, establish surface control points by approved surveyor's nail driven flush with the surface.

In landscaped areas, establish surface control points by driving a 2-inch by 2-inch by 18-inch long timber stake flush with the ground. Each control point must have a tag or marking indicating the station and offset from centerline.

CONSTRUCTION

General

Install instrumentation at the locations shown on the Drawings, and as approved by the Engineer. Install instruments in accordance with the approved installation schedule.

The Contractor must provide access and assistance to the Engineer for obtaining supplemental monitoring data, as requested by Engineer.

Establish system of surface control points. Control point locations are shown on the Drawings. If the control points cannot be installed at locations shown on the drawings, alternative locations will be determined jointly by the Engineer and Contractor in the field prior to construction.

Surveying of surface control points will consist of determining the elevation of each control point with respect to a benchmark selected by the Engineer to an accuracy of 0.01 foot.

Monitoring Frequency

Install and perform a baseline survey of all surface settlement monitoring devices at least seven (7) days prior to the commencement of pipe ramming operations.

Obtain survey measurements at one-day intervals after beginning the work until the pipe is completely installed.

Survey surface control points on a weekly basis for one month after substantial completion of the pipe ramming work, or until 2 consecutive surveys indicate no changes, whichever is longer.

Provide data from readings of surface control points to the Engineer within 24 hours of reading.

Allowable Deformations

Settlement of the roadway must be controlled by the Contractor's operations and must be less than one-half (0.5) inch. If deformations exceed one-half inch or cause damage to the roadway, the Contractor must repair all damage at no cost to the State.

Instrument Protection, Maintenance, and Repair

Protect the surface control points from damage. Replace or repair damaged installations prior to continuing the work unless permitted otherwise in writing by the Engineer.

Abandonment of Instruments

All surface control points on public property will remain in place at the completion of the Work. Remove all surface control points on private property during the cleanup and restoration work, or as required by the Engineer.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
01	Men	101	VAR		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

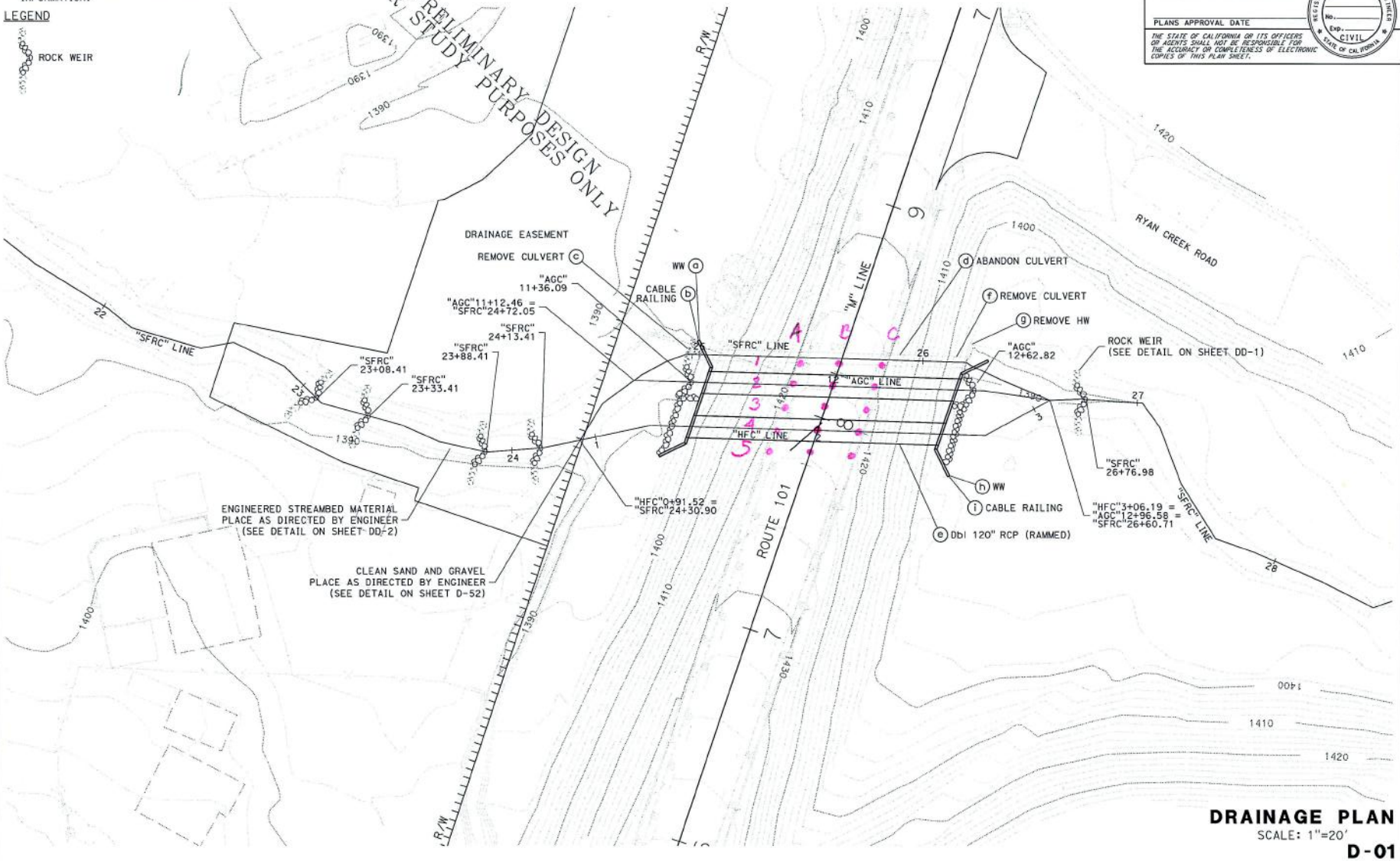
THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF ELECTRONIC COPIES OF THIS PLAN SHEET.

NOTES:

1. THIS PLAN ACCURATE FOR DRAINAGE ONLY.
2. SEE LAYOUT PLANS FOR ACCURATE GEOMETRIC INFORMATION.
3. SEE UTILITY PLANS FOR ACCURATE UTILITY INFORMATION.

LEGEND

ROCK WEIR



DRAINAGE PLAN

SCALE: 1"=20'

D-01

REVISED BY	DATE REVISED

CALCULATED-DESIGNED BY	CHECKED BY
S FOSTER	R MIRANDA

FUNCTIONAL SUPERVISOR: DOUGLAS S. JONES

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans
DIVISION OF DESIGN

FILE PATH => P:\proj5\01\25201\design\Drafting\0112000205 1a001.dgn

LAST REVISION 05-29-15 | DATE PLOTTED => 29-MAY-2015 | TIME PLOTTED => 14:55

BORDER LAST REVISED 7/2/2010 | USERNAME => s112608 | DGN FILE => 0112000205 1a001.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 50 100 150 | UNIT 0307 | PROJECT NUMBER & PHASE 01000000051

MEASUREMENT AND PAYMENT

Full compensation for settlement instrumentation and monitoring is included in the contract unit price paid per foot for 120-inch Steel Casing, and no separate payment will be made therefore.

APPENDIX F
Non-standard Special Provisions for Pipe Ramming

LIST OF ATTACHMENTS

Nonstandard Special Provisions for Settlement Instrumentation and Monitoring

Nonstandard Special Provisions for 120-Inch Steel Casing

Nonstandard Special Provisions for Pipe Ramming

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Add to section 70:
70-10 SETTLEMENT INSTRUMENTATION AND MONITORING

70-10.01 GENERAL

70-10.01A Summary

Section 70-10 includes specifications for furnishing, installing, and monitoring settlement instrumentation to monitor ground movements around and above pipe ramming and excavations. The Work includes: installing surface control points, furnishing monitoring equipment, and recording observations and measurements from the monitoring points on a periodic basis before, during, and after the Work.

Instrumentation requirements and locations shown are a minimum. Additionally, you must modify means and methods, install other instrumentation as necessary, and monitor ground conditions and ground response to achieve specified project requirements and to prevent damage to existing structures and facilities.

70-10.01B Submittals

Before beginning work, submit:

1. Description of the means and methods for installing the surface control points
2. Proposed schedule for installing the surface control points
3. Confirmation that the locations of the monitoring points will be as shown on the Plans
4. Description of the methods and materials for protecting the surface control points
5. Surveying personnel qualifications

Submit surveyed baseline measurements of all monitoring points at least seven (7) days before commencing pipe ramming operations.

Submit all reports of monitoring data to the Engineer. Provide reports of monitoring surface control point data to the Engineer by noon of the day following the shift for which the measurements were taken.

70-10.01C Quality Control and Assurance

The land surveyor performing the work must be registered in the State and have experience surveying for the detection of structural or surface deformations.

Install all monitoring points within one-half (0.5) foot of the horizontal and vertical location shown the Plans or as directed by the Engineer.

Obtain written acceptance from the Engineer for new instrument location and elevation if actual field conditions prevent installation of instruments at the location shown.

Reference surveying for monitoring settlement instrumentation to the same control points and benchmarks established for setting out the work. Tie control points to benchmarks and other monuments outside of the zone of influence of the operations.

Perform installation of instrumentation in the presence of the Engineer.

70-10.02 MATERIALS

In asphalt or concrete paved areas, establish surface control points by an inscribed marking or approved surveyor's nail driven flush with the surface.

In landscaped areas, establish surface control points by driving a 2-inch by 2-inch by 18-inch long timber stake flush with the ground. Each control point must have a tag or marking indicating the station and offset from centerline.

70-10.03 CONSTRUCTION

70-10.03A General

Install instrumentation at the locations shown, and as approved by the Engineer. Install instruments in accordance with the approved installation schedule.

Provide access and assistance to the Engineer for obtaining supplemental monitoring data, as requested by Engineer.

70-10.03B Monitoring Frequency

Install and perform a baseline survey of all surface settlement monitoring devices at least seven (7) days prior to the commencement of pipe ramming operations.

Obtain survey measurements at one-day intervals after beginning the work until the pipe is completely installed.

Survey surface control points on a weekly basis for one month after substantial completion of the pipe ramming work, or until 2 consecutive surveys indicate no changes, whichever is longer.

Provide data from readings of surface control points to the Engineer within 24 hours of reading.

70-10.03C Surface Control Points

Establish system of surface control points at the locations shown. If the control points cannot be installed at locations shown, alternative locations will be determined jointly by the Engineer and Contractor in the field prior to construction.

Surveying of surface control points will consist of determining the elevation of each control point with respect to a benchmark selected by the Engineer to an accuracy of 0.01 foot.

Provide data from readings of surface control points to the Engineer within 24 hours of reading.

70-10.03D Allowable Deformations

Control settlement of the roadway, which must be less than one-half (0.5) inch. If deformations exceed one-half inch or cause damage to the roadway, repair all damage at no cost to the State.

70-10.03E Instrument Protection, Maintenance, and Repair

Protect the surface control points from damage. Replace or repair damaged installations prior to continuing the work unless permitted otherwise in writing by the Engineer.

70-10.03F Abandonment of Instruments

Surface control points on public property will remain in place at the completion of the Work. Remove surface control points on private property during the cleanup and restoration work, or as required by the Engineer.

70-10.04 PAYMENT

Not used.

Add to section 70:
70-9 120-INCH STEEL CASING

70-9.01 GENERAL

70-9.01A Summary

Section 70-9 includes specifications for furnishing and installing twin 120-inch steel casing pipe by pipe ramming as shown.

70-9.01B Submittals

Fifteen days before fabrication, submit for review 120-inch Steel Casing Plan, including:

1. Shop drawings illustrating the details of the casing pipe, grout/lubrication ports, joint details, and miscellaneous items to be furnished and fabricated for the pipe. Drawings must show dimensions, tolerances, wall thickness, properties and strengths, and other pertinent information.
2. Calculations in a neat, legible format. Calculations must be signed and sealed by an engineer registered as a civil engineer in the State. Calculations must confirm that:
    - 2.1 Pipe ramming capacity is adequate to resist anticipated ramming loads with a minimum factor of safety of two (2) against minimum steel yield stress.
    - 2.2 Pipe capacity is adequate to safely support all other anticipated loads, including earth and groundwater pressures, traffic, surcharge loads, transport, and handling loads.
    - 2.3 Jointing method will support all loading conditions and allow efficient transfer of the percussive hammer energy along he pipe string to the leading edge of the casing

Provide sufficient detail to allow the Engineer to judge whether the proposed materials will meet the Contract requirements.

Drawings must be legible with dimensions accurately shown and clearly marked in English.

Low-quality drawings and photographs will be rejected.

70-9.01C Design Criteria

Design steel casing pipe that meet or exceed the performance requirements of this project and that is specifically designed for installation by pipe ramming.

Design casing pipe to account for all installation and service loads including ramming loads, external groundwater and earth loads, traffic loads, practical consideration for handling, shipping, and other construction operations, and any other live or dead loads reasonably anticipated.

The allowable ramming stresses must not exceed 50 percent of the minimum steel yield stress.

Provide steel casing pipe with a nominal 120-inch diameter, a minimum wall thickness of 1.50 inches, and furnished in lengths that are compatible with Contractor's allowable work areas and Contractor's approved work plan.

The leading pipe must use thickened cutting shoes of appropriate shape to strengthen the lead edges and to guide soil movement into the pipe.

70-9.02 MATERIALS

70-9.02A Steel Casing Pipe

Steel casing pipe must:

1. Be new, smooth-wall, carbon steel pipe conforming to ASTM A139, Grade B
2. Be fabricated with either longitudinal weld or spiral-wound seams. All girth weld seams must be ground flush.

Prior to delivery of the pipe, end/internal bracing must be furnished and installed, as recommended by the manufacturer, for protection during shipping, storage, and installation.

70-9.02B Dimensional Tolerances

Furnish and install steel casing pipe with dimensional tolerances that are compatible with design criteria and proposed installation methods that meet or exceed the dimensional tolerances.

The minimum wall thickness at any point must be at least 87.5 percent of the nominal wall thickness.

Steel pipe must have an outside circumference that is within 1.0 percent of the nominal circumference.

The outside diameter of the pipe must be within 1/8 inch of the nominal outside diameter.

Steel pipe must have a roundness such that the difference between the major and minor outside diameters is less than 0.5 percent of the specified nominal outside diameter or ¼ inch, whichever is less.

Steel pipe must have a maximum allowable straightness deviation of 1/8 inch in any 10-foot length.

Steel pipe must have square ends. The ends of pipe sections must not vary by more than 1/8 inch at any point from a true plane perpendicular to the axis of the pipe and passing through the center of the pipe at the end.

70-9.03 CONSTRUCTION

Installation of steel casing pipes must comply with section 70-8

Field butt welding for casing pipe connections must comply with section 55-1.02B(7)

70-9.04 PAYMENT

120-inch steel casing is measured along the centerline of the pipe and parallel with the slope line. The payment includes the work involved in pipe ramming, including furnishing and pumping lubricating fluids, removing and disposing of excess excavated material, installation and removal of the working slab, settlement and heave instrumentation and monitoring, furnishing pipe, accessories and incidentals.

Add to section 70:
70-8 PIPE RAMMING

70-8.01 GENERAL

70-8.01A Summary

Section 70-8 includes specifications for designing and installing steel casing by pipe ramming at the location shown.

Furnish all labor, equipment, and materials necessary for:

1. Site preparation
2. Installation of new twin 120-inch diameter steel casings by pipe ramming

70-8.01B Definitions

casing: A pipe installed by pipe ramming that supports the ground and provides a stable underground support system.

lubrication/injection system: A port located within the casing pipe fitted with a one-way valve for injection of lubrication material or grout into the annular space between the pipe and the ground.

pipe ramming: A non-steerable trenchless pipe installation system whereby an open-ended steel casing is driven through the ground using a percussive hammer. The soil may remain in the casing until the bore has been completed or may be removed at intervals during the installation by water, auguring, jet-cutting, or manual excavation to reduce frictional resistance. Once the crossing is completed, all soil is removed from the casing.

settlement point: A point with elevation and spatial location established by survey prior to construction in accordance with section 70-10. The point is re-surveyed periodically to monitor ground movements. The point may be a nail, pin, subsurface settlement rod, borehole extensometer, or other device that can be readily located and surveyed.

70-8.01C Submittals

Submittals must provide sufficient detail to allow the Engineer to judge whether the proposed equipment, materials, and procedures will meet the Contract requirements. All drawings must be legible showing accurate dimensions and marked clearly in English. Low-quality drawings and photographs will not be accepted.

Provide all submittals to the Engineer no later than ten (10) working days prior to the beginning of construction and must receive approval of the submittal from the Engineer as a condition of beginning work.

Submit the following describing the pipe ramming equipment and construction methods to be employed:

1. Detailed drawing and performance information for the pneumatic hammer, including dimensions and noise rating.
2. Detail drawings and specifications for the cutting shoe that will be used. Submit the excavation diameter based upon the outermost dimensions of the cutting shoe. Provide the radial overcut which is the difference between the maximum excavation diameter and the outer diameter of the casing pipe, divided by two.
3. Details and performance information for the air compressors and air handling system that will be used, including capacity and noise ratings.
4. Details of the thrust cone and adapter that will be used to connect the pneumatic hammer to the steel casing.

Submit work area layout drawings detailing dimensions and locations of all equipment and materials, including pipe storage, air compressors, crane, and ancillary equipment. Layout drawings must be to scale, or show correct dimensions. Layout drawings must show that all equipment and operations must be completely contained within the allowable work areas shown.

Submit details of crane dimensions, capacity, and operations plan.

Submit details on face stabilization and the method of controlling loss of ground at all times, including the period during launch of the casing.

Submit details of the spoil removal, storage, transport, and disposal equipment and procedures including the location of the spoil disposal site. Provide written documentation from the disposal site(s) indicating that they will accept the spoil and are in compliance with applicable regulations.

Schedule must comply with section 8-1.02.

Submit the schedule for all pipe ramming work, identifying all major construction activities as independent items. The schedule must include, as a minimum:

1. mobilization
2. stream diversion
3. soil excavation at launch side
4. headwall footing and working slab construction
5. equipment setup
6. pipe ramming for each casing
7. welding operations
8. soil removal for each casing
9. site restoration, cleanup, and demobilization.

The schedule must also include the work hours and workdays for each activity, and a written description of the construction activities. The schedule will be reviewed by the Engineer and must be updated and resubmitted every week or more frequently if requested by the Engineer.

Submit methods for establishing line and grade of the casing prior to launch of the pipe ram.

Submit details of supplemental soil stabilization measures (sand bag walls, etc.) that will be used inside the casing to prevent soil from sloughing or flowing into the casing during hammering.

Submit details of pipe lubrication injection system and pipe lubricants to be used during pipe ramming, including manufacturer's literature and Material Safety Data Sheets. Include a description of proposed lubrication procedures during ramming. Confirm that sufficient volume of lubricant will be pumped at all times to completely fill the annular space outside the pipe.

Submit the names and resumes of the project superintendent, operators, and site safety representative. Submit name and resume for hammer manufacturer's representative if you elect to use manufacturer's representative to meet operator experience requirements. Submit personnel qualifications in accordance with section 70-8.01E. Provide qualifications and training records for site safety representative, personnel responsible for air quality monitoring, and licensed surveyor.

Submit contingency plans for dealing with the following problem scenarios while satisfying the specifications. These plans must also include the observations and measurements required to clearly identify the cause of the problems.

1. Casing unable to advance
2. Possible obstructions (including boulders, old foundations, existing culvert, metallic debris, or reinforced concrete)
3. Insufficient ramming capacity
4. Machine or component malfunction
5. Strong hydrocarbon smell detected. Combustible gas meter readings in the tunnel exceed 10% of LEL for methane or possible volatile organic compounds.
6. Survey measurements indicate settlement deformations exceed allowable limits.
7. Stream flows increase significantly as a result of storms, and threaten to overwhelm bypass system.

Submit a Safety Plan for the pipe ramming operations including air monitoring equipment and procedures, and provisions for lighting, ventilation, and electrical system safeguards.

Provide copies of any obtained permits and agreements.

The following daily records must be submitted to the onsite Engineer by noon on the day following the shift for which the data or records were taken.

1. Installation Records: Provide complete casing installation records to the Engineer. These records must include, at a minimum: date, time, name of operator, pipe ram identification, installed pipe number and corresponding length, rate of advance, hammer strokes per minute, operating pressure, volume and extent of any intermediate spoil removed, problems encountered with the pipe ramming equipment or casing, and durations and reasons for delays. Manually recorded observations must be made at intervals of at least four times per 20-foot pipe, whenever conditions change, and as directed by the Engineer. Submit samples of the installation record forms at least seven (7) days prior to the launch of the pipe ram.
2. Lubrication Records: Provide lubrication records to the Engineer. These records must include the injection locations along the pipe string, lubrication type and additives, and amount, in gallons, of lubricant pumped throughout a drive. The record will also include the type of additive used and date, time, and drive distance when used.
3. Survey measurements of pipe alignment.

Submit survey results of rails and cradles, prior to launch.

Submit Quality Control Plan in compliance with section 70-8.01D.

70-8.01D Quality Control and Assurance

70-8.01D(1) Qualifications

Failure to meet the qualification requirements is failure to fulfill the Contract and you will be required to obtain a subcontractor that meets the qualification requirements.

The project superintendent must have at least three (3) years of pipe ramming experience and must have worked on at least two (2) projects of similar diameter and length in similar ground conditions using equipment similar to the equipment required for this project.

The operator must have at least three (3) years of pipe ramming experience and must have worked on at least two (2) pipe ramming projects of similar diameter and length and in similar ground conditions using equipment similar to the equipment required for this project. You may substitute a full-time on-site manufacturer's representative with the requisite experience to fulfill the operator experience requirements.

The project superintendent and operator must have worked on at least one pipe ramming project with a diameter of at least 96-inches and a single drive length of at least 100 feet. The operator must also have completed at least one pipe ramming drive of at least 96 inches and a length of at least 100 feet.

The site safety representative and personnel responsible for air quality monitoring must be experienced in tunnel construction and must have current certification by CalOSHA.

The surveyor responsible for line-and-grade control must be a Licensed Surveyor registered in the State of California who has prior experience in similar projects.

70-8.01D(2) Field Quality Control

Provide at least 72 hours advance written notice to Engineer of the planned launch of the pipe ram.

Work must be done in the presence of the Engineer unless the Engineer grants prior written approval to perform such work in Engineer's absence.

Immediately notify the Engineer, in writing, when any problems are encountered with equipment or materials, or if you believe the conditions encountered are materially and significantly different than those represented within the Contract Documents.

Before starting work, conduct a mandatory pre-installation meeting attended by personnel who are involved in the work, including:

1. Project superintendent
2. Supervisory personnel

3. Grouting foreman
4. Subcontractors

Schedule a time and date for the pre-construction meeting that is acceptable to the Engineer. Furnish a facility for the pre-construction meeting within 5 miles of the job site or at another location acceptable to the Engineer.

70-8.01E Design Criteria

Pipe ramming equipment selected for the project, including the pneumatic hammer, cutting shoe, steel casing, and lubrication injection system will be suitable for, and capable of, efficiently advancing through the existing ground conditions.

The maximum radial overcut must be one (1) inch. The minimum radial overcut must be one-half (0.5) inch. The radial overcut must be determined as the difference between the maximum diameter created by the cutting shoe or overcut band (whichever is greater) and the outer diameter of the casing, divided by two.

Install and use a lubrication injection system to inject pipe lubricant around the exterior of the casing pipe to decrease frictional resistance. Lubrication materials may include a mixture of bentonite and/or polymers and water. Lubrication ports and pipes must be provided as necessary in the casing pipe to allow for lubrication along the exterior of the pipe string.

Dispose of all excavated material from the pipe ramming and pit construction.

The soil removal system must be capable of being operated in a manner which will prevent loss of ground outside the casing during any intermediate spoil removal. Leave a sufficient soil plug inside the casing at all times to prevent sloughing of soils outside the leading edge of the casing. Use supplemental stabilization (such as sand bag walls) to prevent soil from sloughing or flowing into the casing during ramming that may lead to over-excavation of soil outside the leading edge of the casing.

Prepare the launch area with a concrete working slab to properly support the pipe guide rails and pipe. Take special care when setting the pipe guide rails in the pit to ensure correctness of the alignment.

Drive the casing from the downstream to the upstream end.

Methods and equipment must control surface settlement above the casings to prevent damage to existing utilities, facilities, surface features, and improvements. Ground movements (settlement/heave) must be limited to values that do not cause damage or distress to surface features, utilities, or improvements. Ground movements must not be allowed to exceed the maximum allowable values specified in section 70-10. You are responsible for any damage to existing features, improvements, or utilities, and must repair any damage to the satisfaction of the Engineer, at no additional cost to the State, and without schedule extension.

Use a hammer frame and ramming cone system to develop a uniform distribution of ramming forces around the perimeter of the casing pipe.

You are responsible for pipe design for ramming loads and acceptable fabrication tolerances. Maximum installation loads applied to the casing pipe must not exceed fifty percent (50%) of the ultimate compressive strength of the pipe material or the maximum allowable strength of the pipe as established by the manufacturer, whichever is lower.

Determine casing thickness to safely resist all installation and service loads. The casing must not be less than one and one-half (1.50) inches thick.

70-8.02 MATERIALS

70-8.02A Pneumatic Hammer

Use pneumatic pipe ramming equipment manufactured by TT Technologies Inc., Vermeer HammerHead, or an Engineer-approved equal.

70-8.02B Pipe

Pipe to be installed by pipe ramming must safely support all installation and service loads, as confirmed by your approved submittals, and must comply with section 70-9 and to requirements shown.

70-8.03 CONSTRUCTION

70-8.03A General

Do not begin pipe ramming until:

1. Required submittals have been provided, reviewed, and approved by the Engineer
2. Settlement monitoring instruments have been installed and surveyed and the data has been submitted to the Engineer for acceptance in accordance with section 70-10.

Work must comply with section 14-9.02 and section 13-1.

Perform all work so as not to damage roadways, adjacent structures, landscaped areas, or existing utilities. Immediately repair any damage to original or better condition and to the satisfaction of the Engineer and at no additional cost to the State.

Whenever there is a condition that is likely to endanger the stability of the excavation or adjacent structures, operate with a full crew 24 hours a day, including weekends and holidays, without interruption, until those conditions no longer jeopardize stability.

70-8.03B Site Preparation

Survey the elevations and slopes of working slab surfaces and confirm that the Work can be completed in accordance with alignment and grade shown.

Stabilize the soils at the entry location as necessary to stabilize any weak, running or flowing soils. Confirm that the ground has been stabilized to the extent that ground will remain stable without movement of soil or water during and after the work is completed.

70-8.03C Pipe Handling

Transport the casing pipe to the launching area without damage. Transport methods must be acceptable to pipe manufacturer. Damaged casing pipe must not be used in the Work, unless permitted in writing by the Engineer. Set the pipe to be rammed on properly braced and supported guide rails.

Distribute axial forces from the pneumatic hammer to the casing pipe uniformly through a thrust cone to prevent damage to the ends of the pipe. Axial ramming forces applied to the pipe must not exceed the specified allowable compressive stresses of the casing pipe.

Ram pipe sections into position following the design line and grade without damaging the pipe. In the event a section of pipe is damaged, with written approval from the Engineer, make temporary repairs to the pipe and must continue installing the pipe if possible.

70-8.03D Pipe Ramming

Pipe ramming must be completed in accordance with approved submittals, and all applicable permit conditions.

Survey the location, orientation, and grade of the guide rails to ensure they are on the proper line and grade and to verify that they are properly supported. Take special care when setting the guide rails in the launching area to ensure stability and accuracy of the alignment and grade. Guide rails must be securely attached to the concrete working slab, with supplementary steel beams, concrete, or grout if necessary, to prevent movement or shifting during the work.

Control surface settlement and heave above the pipeline to prevent damage to the roadway, existing facilities, and improvements. Repair any damage resulting from construction activities, at no additional cost to the State and without extension of schedule for completion. Modify equipment and procedures as required to avoid recurrence of excessive settlements, heave, or damage.

Ram each pipe section forward in such a way to provide complete and adequate ground support at all times.

Apply lubrication to the external surfaces of the pipe through injection nozzles to reduce skin friction.

Any lubrication spills must be immediately contained and cleaned up in accordance with section X-X.XX

Completely contain, transport, and dispose of all excavated materials away from the construction site. All spoils must be contained in trucks, tanks, or other containers at all times. Use only the disposal sites identified in approved submittals for muck disposal.

During as-built survey or prior, clearly mark stationing on interior surface of casing at 20 foot maximum intervals.

70-8.03E Control of Line and Grade

Establish the survey control points on the ground surface as shown. Verify these control points by survey prior to the start of construction. Confirm positions or report any errors or discrepancies in writing to the Engineer.

After confirming all established survey control points, use these control points to furnish and maintain all reference lines and grades for casing installation. Submit to Engineer copies of field notes used to establish all lines and grades. Check guide rail setup prior to beginning each drive. Perform survey checks of the line-and-grade of the installed casing pipe on a daily basis during pipe ramming operations. Ensure accuracy of the work and the correction of it, as required.

Install casing pipe to within 1 ft per 100 feet of casing in both vertical and horizontal dimensions.

If the pipe installation does not meet the specified tolerance, correct the installation including any necessary redesign of the pipeline or structures and acquisition of necessary easements. Perform all corrective work at no additional cost to the State and without schedule extension, and is subject to the written approval of the Engineer.

70-8.03F Obstructions

Notify the Engineer immediately if the pipe ramming operations should encounter an object or condition that prevents the forward progress of the casing. Submit a plan to correct the condition, and remove, clear, or otherwise make it possible for the casing pipe to advance past any and all objects or obstructions that impede forward progress. Proceed with removal of the object or obstruction by methods submitted and accepted by the Engineer. You will receive compensation for removal of obstructions, as defined as metallic debris, reinforced concrete, whole trees, rocks and other hard objects larger than 30% of the outer diameter of the casing pipe, which cannot be broken up by the cutting shoe with diligent effort, and that are partially or wholly within the cross-sectional area of the casing. New and unforeseen work shall be in accordance with section 4-1.05. The Engineer must be provided an opportunity to view the obstruction prior to removal. Any removal process that does not allow direct inspection of the nature and position of the obstruction will not be considered for payment.

You will not receive additional compensation for removing, clearing, or otherwise making it possible for the casing pipe to advance past objects consisting of cobbles, boulders, wood, non-reinforced concrete, and other nonmetallic objects or debris with maximum lateral dimensions less than 30% of the outer diameter of the casing pipe.

70-8.03G Cleanup and Restoration

After completion of the pipe installation, remove all construction debris, oil, grease, and other materials from the pipe, and all project work areas. Remove the working slab entirely and restore the streambed as shown.

Complete restoration of the work area as soon as possible after completion of the Work. Restore and repair any damage resulting from surface settlement caused by excavation or pipe ramming. Resolve any property damaged or destroyed to a condition equal to or better than existing prior to construction. Complete restoration no later than thirty (30) days after the pipe ramming is complete. This provision for restoration must include all property affected by the pipe ramming construction operations.

70-8.04 MEASUREMENT AND PAYMENT

Not Used