Engineer's Report

Feather River West Levee Phase I ULDC Compliance

Station 512+00 to 1674+37 and Station 1769+31 to 2368+26

Sutter Butte Flood Control Agency

Sutter and Butte Counties, California

October 8, 2021

Certification

This Engineer's Report (Report) was prepared by the Sutter Butte Flood Control Agency (SBFCA) design team consisting of HDR Engineering, Inc. (HDR), Wood Rodgers, Inc. (Wood Rodgers), AECOM (legacy URS), Peterson Brustad, Inc. (PBI), and MHM, Inc. (MHM) for the sole purpose of supporting a finding that the Feather River West Levee (FRWL) Project provides an urban level of flood protection. This certification is made in accordance with the requirements, definitions, and descriptions in the State of California Department of Water Resources' (DWR) Urban Level of Flood Protection (ULOP) Criteria (November 2013), Section 2, EVD-1 and the Urban Levee Design Criteria (ULDC) (May, 2012), Section 7.0.

All information, calculations, definitions, restrictions, limitations and/or other pertinent data contained or referenced in this Report form the basis of this certification. This certification does not constitute a warranty or guarantee of performance, expressed or implied. This certification is made with respect to the Feather River West Levee (FRWL) north of the Star Bend Setback Levee (Station 512+00) and south of the Thermalito Afterbay (Station 2368+26), excluding Stations 1674+37 to 1769+31.

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CALIFORNIA DEPARTMENT OF WATER RESOURCES
URBAN LEVEE DESIGN CRITERIA COMPLIANCE

FEATHER RIVER WEST LEVEE
STA 512+00 thru STA 2368+26

I hereby certify that the planned work for the FRWL Project Phase I (from Station 512+00 to Station 2368+26, excluding Stations 1674+37 to 1769+31), has been completed and complies with the requirements of DWR's ULDC (May 2012), with the exceptions indicated. Furthermore, I hereby certify that the FRWL from Station 1674+37 to Station 1769+31 is a freeboard levee and is not needed to provide an urban level of flood protection.

Professional Engineer in Responsible Charge:

Michael W. Bessette
Executive Director, SBFCA
California Professional Engineer No. C-53088

6/11/2021
Date

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1 Introduction

1.1 Background

In 2007, six bills related to flood protection were passed in the California Legislature and signed by the Governor. Senate Bill 5 (SB5), as amended, requires land use agencies within the Sacramento-San Joaquin Valley to make findings related to an urban level of flood protection for urban and urbanizing areas within a flood hazard zone. SB5 defined the "urban level of flood protection" as the level of flood protection necessary to withstand flooding that has a 1-in-200 chance of occurring in any given year (200-year) using criteria developed by the State of California Department of Water Resources (DWR). SB5 defined "urban or urbanizing areas" as developed areas that have or are projected to have populations of 10,000 persons or more within ten (10) years.

In May 2012, DWR issued the Urban Levee Design Criteria (ULDC), which provides technical criteria for designing, constructing, operating, and maintaining a levee or floodwall for protection against a 200-year flood. In November 2013, DWR issued the Urban Level of Flood Protection (ULOP) Criteria, which are procedural criteria for developing findings related to flood protection based on substantial evidence in the record.

Sutter and Butte Counties and the cities of Yuba City and Live Oak intend to make a substantial evidence finding in 2021 in accordance with the ULOP procedures. In preparation for this, the Sutter Butte Flood Control Agency (SBFCA) has prepared this Engineer's Report (Report) to provide substantial evidence that the flood control facilities of the Feather River West Levee (FRWL), north of the Star Bend Setback Levee (Station 512+00) and south of the Thermalito Afterbay (Station 2368+26), complies with the ULDC and ULOP Criteria, with the noted exceptions, for providing a 200-year level of protection. It should be noted that the FRWL from Station 1674+37 to 1769+31 (Reaches 26 through 28) is considered a freeboard levee reach and is not covered in this Report. This Report discusses the FRWL flood control facilities and associated non-structural components required by the ULDC for protecting the urban and urbanizing areas.

1.2 Project Description

In 2010, property owners in Sutter and Butte Counties approved a property assessment to pay the local cost share for major levee repairs along the west bank of the Feather River. Since that time, SBFCA has embarked on improving 44-miles of existing levee through the FRWL Project. The FRWL Project begins at the confluence of the Feather River and Sutter Bypass in south Sutter County (Station 10+00) and continues to the Thermalito Afterbay in the north (Station 2368+26).

The FRWL Project is separated into two phases. Phase I includes work from Star Bend (Station 478+68) to the Thermalito Afterbay (Station 2368+00). Phase II includes work from the confluence of the Feather River and the Sutter Bypass to Star Bend. The Star Bend Setback Levee Project is from Stations 478+68 to 512+00 and is covered in a separate Engineer's Report prepared by Wood Rodgers, Inc. (Wood Rodgers). This

Report addresses the FRWL from Stations 512+00 to 2368+00, excluding Stations 1674+37 to 1769+31.

HDR Engineering, Inc. (HDR) and Wood Rodgers are the civil designers of the FRWL Project. Wood Rodgers is the Civil Engineer of Record for the FRWL Project between Stations 512+00 and 1433+83 and HDR is the Civil Engineer of Record for the FRWL Project between Stations 1433+83 and 2368+26 (excluding Station 1674+37 to 1769+31). An overview plan of the FRWL Project is shown on Figure 1 – Location Map.

Construction of the FRWL Project Phase I addressed in this report officially began on July 25, 2013 and was completed in November 2020. These features are designed to provide a 200-year level of flood protection.

1.3 Purpose

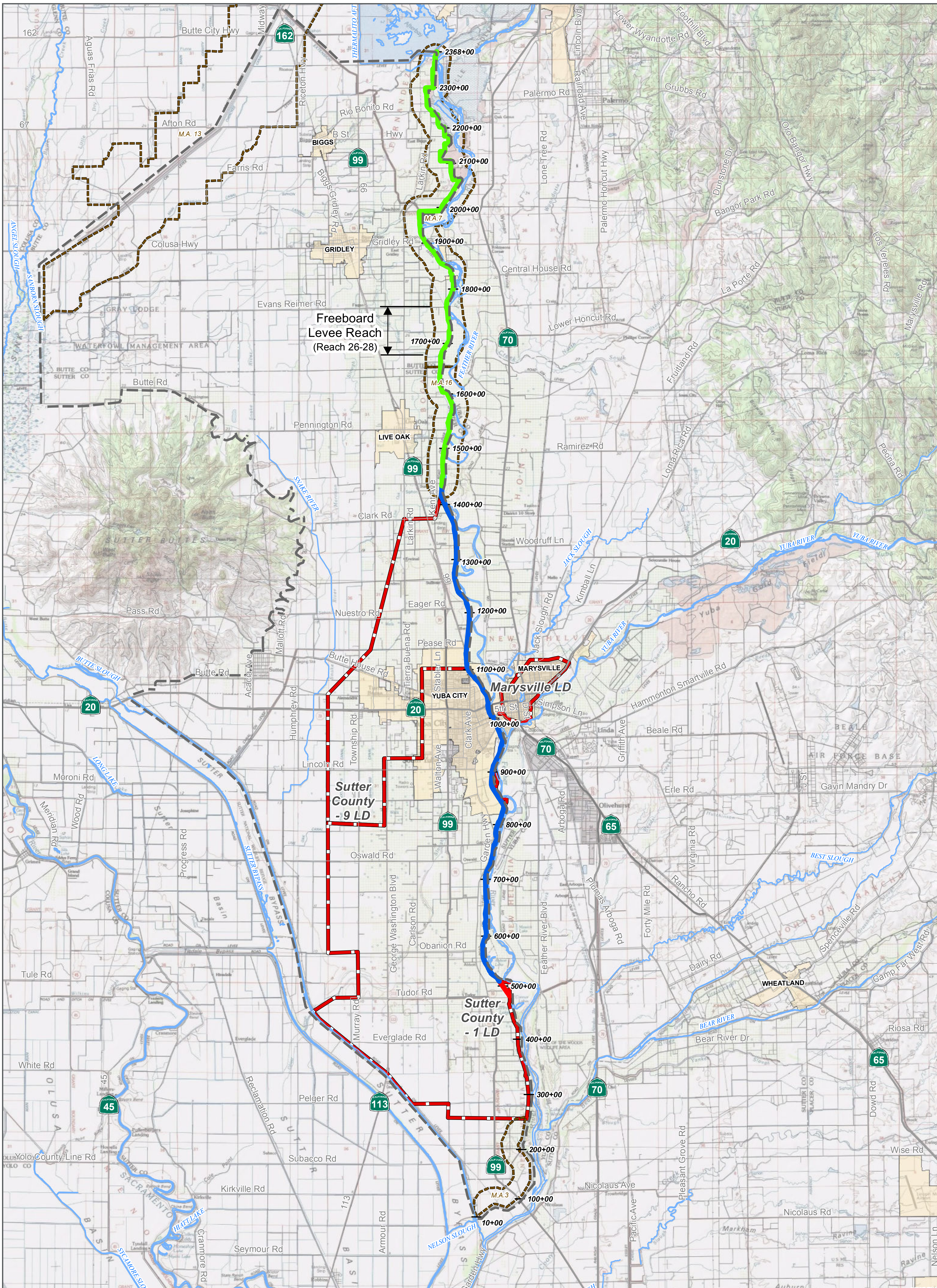
The purpose of this Report is to present substantial evidence for the land use agencies to make a Finding that the portion of the FRWL from Stations 512+00 to 1674+37 and Stations 1769+31 to 2368+26 meets ULDC criteria, with the noted exceptions. In order to make such a Finding, the ULOP Criteria (EVD-1) states:

"Substantial evidence in the record to support a finding related to an urban level of flood protection based on flood management facilities providing the required level of flood protection shall include the following, at a minimum:

- A report prepared by a Professional Civil Engineer registered in California to document the data and analyses for demonstrating that the property, development project, or subdivision has an urban level of flood protection.
- A report by an Independent Panel of Experts on the review of the report prepared by the Professional Civil Engineer.
- A response by the Professional Civil Engineer to the comments from the Independent Panel of Experts.
- Any additional data and information that cities or counties use to make the finding."

This Report is intended to serve as the first bullet in the list above. This Report is organized following the topics in Section 7.0 of the ULDC. For each ULDC topic, the following information is described:

- A summary of the applicable ULDC requirements
- Reference to documentation where detailed analyses have been performed to bring the FRWL into compliance with the ULDC



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MILES

Star Bend Levee Project
FRWL Designed by Wood Rodgers
FRWL Designed by HDR
DWR Maintenance Areas
Levee Districts

HDR

LOCATION MAP

FEATHER RIVER
WEST LEVEE PROJECT

MAY 2016 | FIGURE 1

PATH: G:\028_SBFCA\028_143618_SUTTER_BUTTES\MAP_DOCS\MXD\ARC10\SBFCA_ULOP_REPORT\F1_LOCATION_MAP.MXD - USER: AARNOLD - DATE: 5/3/2016

- Any exceptions to the ULDC that were taken during design and construction, if applicable.

At the end of each section, a certification page signed by the professional engineer(s) registered in the State of California in responsible charge of the work described is provided.

1.4 Limitations

This Report was prepared for the FRWL from Stations 512+00 to 1674+37 and Stations 1769+31 to 2368+26 in accordance with the requirements, definitions, and descriptions in DWR's ULOP Criteria and ULDC.

Findings made using this Report are defined as FND-1 through FND-4 in the ULOP Criteria. Periodic reviews under FND-3 and FND-4 must be performed at least every 5 years commencing with the initial finding, and consider changes in engineering standards and practice, changing hydrology, sea-level rise, climate change, physical changes in the system, new data, system performance, physical condition, and any other relevant factor affecting sustainable performance.

This Report is based on work previously performed by the SBFCA design team, review of as-build information, and review of local agency inspection reports. No additional analysis or attempt has been made to assess current conditions.

This Report shall expire or become invalid upon the earliest of any of the following events occurring:

- 20 years
- A periodic review of operations and maintenance is not performed within the 5-year time period identified in the ULOP Criteria.
- Interim measures to address damage and/or maintenance inadequacies identified in a periodic review are not addressed at the time of the subsequent periodic review.
- In the event SBFCA is unable to assert adequate progress in its annual report to the Central Valley Flood Protection Board (CVFPB).

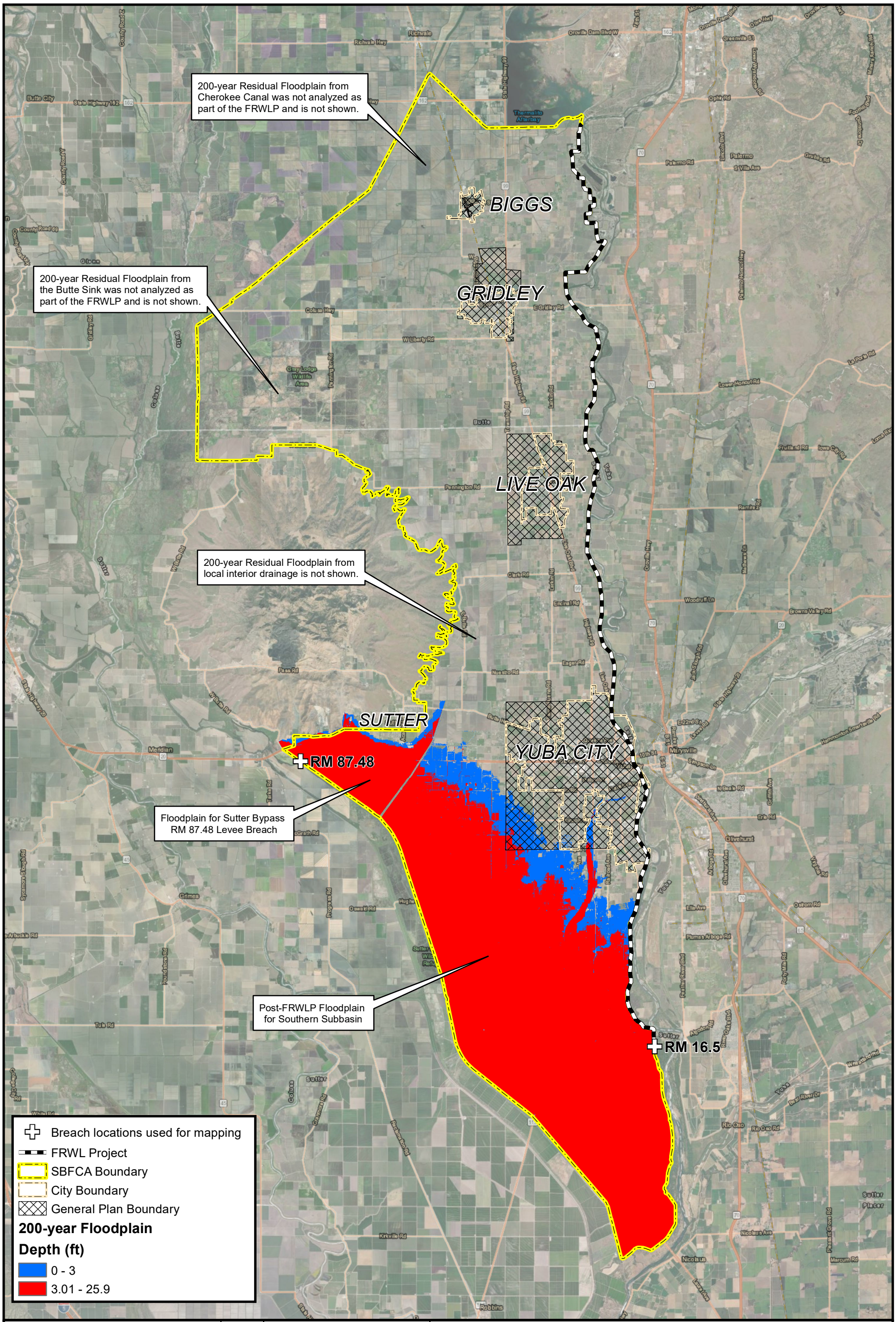
2 200-Year Floodplain Map

Once the FRWL Project Phase I is complete and the levee system meets ULDC requirements, the 200-year floodplain will be revised as shown in Figure 2 – Sutter Basin 200-Year Post FRWL Project Residual Floodplain Depths Greater than 3 ft. The details and development of the 200-year post-project floodplain map are discussed in *200-year Post-Feather River West Levee Project Floodplain Mapping* (PBI, 2021). The 200-year post-project floodplain map accounts for the completed FRWL Project Phase I and delineates the 200-year residual flooding due to a potential Sutter Bypass levee breach and a Feather River levee breach (south of Star Bend). It should be noted that flood risk from the Cherokee Canal and Butte Sink have not been analyzed or addressed in this Report as they were not part of the FRWL Project. It is acknowledged that other areas of shallow flooding or flooding from localized interior drainage is not accounted for in the Figure 2 map. However, the intent of the map is to identify and delineate the areas with 3' or greater depths of flooding, which are subject to findings under SB-5, and it is our opinion that the map accurately reflects this intent.

In addition, Reaches 26 through 28 (Stations 1674+37 to 1769+31) are not being remediated to provide a 200-year level of protection since these levees are located on high ground and the 200-year water surface would not contribute to the Sutter Basin floodplain if these levees were removed.

However, in these reaches, the 200-year water surface profile in the Feather River channel is higher than the channel invert of the Sutter-Butte Main Canal, which is located near the landside levee toe. Therefore, a study was conducted in 2012 to analyze the scenario of a breach on the FRWL flooding the Main Canal. The study found that a breach along this section of the FRWL would be fully contained by the Main Canal and would not cause flooding. The resulting water depth in the Main Canal due to a breach along the FRWL would be more than 4-feet below the top of the Main Canal banks and the flow rate would be within the nominal operating capacity of the Main Canal. Therefore, any flow that enters the Main Canal from a breach on the FRWL could be safely conveyed southwest to the Main Canal spillways.

Figure 2



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JUNE 2021

SUTTER BUTTE FLOOD CONTROL AGENCY

SUTTER BASIN 200-YEAR POST-FRWL PROJECT RESIDUAL FLOODPLAIN DEPTHS GREATER THAN 3 FT

3 Evaluation of the FRWL Project Phase I

In support of the Adequate Progress Finding, previously performed analyses and documents were evaluated and are discussed below for each topic in Section 7.0 of the ULDC. Table 3.1 below lists the topic within Section 7.0 of the ULDC and respective SBFCA design team member who authored each section.

Table 3.1 Summary of Engineer's Report ULDC Section Authors

DWR ULDC Section		Engineer's Report Section Developed By:
7.1	Design Water Surface Elevation	PBI
7.2	Minimum Top of Levee	PBI
7.3	Soil Sampling, Testing and Logging	AECOM
7.4	Slope Stability for Intermittently Loaded Levees	AECOM
7.5	Underseepage for Intermittently Loaded Levees	AECOM
7.6	Frequently Loaded Levees	PBI
7.7	Seismic Vulnerability	AECOM
7.8	Levee Geometry	HDR/WR
7.9	Interfaces and Transitions	AECOM
7.10	Erosion	HDR
7.11	Right-of-Way	HDR (Approach)
7.12	Encroachments	MHM
7.13	Penetrations	MHM
7.14	Floodwalls, Retaining Walls, and Closure Structures	HDR/WR
7.15	Animal Burrows	AECOM (Levee Stability)
7.16	Levee Vegetation	HDR/WR
7.17	Wind Setup and Wave Run-up	PBI
7.18	Security	HDR/WR
7.19	Sea Level Rise	PBI
7.20	Emergency Actions	PBI
8.0	O&M, Inspection, Monitoring, & Remediation of Poor Performance	HDR/WR

3.1 Design Water Surface Elevation (ULDC Section 7.1)

3.1.1 Applicable ULDC Requirements

The ULDC offers two options for determination of the Design Water Surface Elevation (DWSE) for urban and urbanizing areas: the Federal Emergency Management Agency (FEMA) Approach or the United States Army Corps of Engineers (USACE) Approach. The ULDC FEMA Approach was selected to develop the FRWL Project DWSE.

Under the FEMA Approach (ULDC Section 7.1.1), the DWSE is computed using the median 200-year discharge rate for the design storm event. The median discharge rate is to be determined from the best available results of recent flood-frequency studies and the channel models are to be configured using, or adjusted for, channel roughness values consistent with vegetation that is anticipated or likely to grow over the next 20 years. The hydraulic models are to use the following assumptions:

- Upstream, downstream, and nearby levees and floodwalls protecting urban areas are assumed to be raised to the median 200-year WSE plus 3 feet and not allowed to breach, even if overtopped. Overtopping flows are assumed to leave the channel and remain in the 200-year floodplain.
- All project levees and floodwalls are to be modeled to incorporate a minimum crown elevation equal to the authorized (usually the 1955/1957 profile) USACE design profiles and all such levees and floodwalls are to be allowed to overtop, act as weirs, and not breach for floods up to and including the median 500-year flood water surface elevation. Overtopping flows are assumed to leave the channel and remain in the 200-year floodplain.
- Non-project levees and floodwalls in non-urbanized areas in the region, to the extent they may affect the DWSE, are to be modeled at their existing or authorized height, whichever is higher, and to act as weirs without breaching if overtopped.
- Debris loading on bridges must be considered. Bridges with less than 3-feet of clearance above the DWSE may experience extraordinary debris loading that must be evaluated in addition to typical pier/bent debris loading. The evaluation should include historic and potential debris transport in the stream, an analysis of loading on the bridge, and analysis of backwater impacts on the DWSE in the vicinity of the bridge.

In addition, per ULDC Section 7.1.3, the Civil Engineer needs to consider the following:

- Whether upstream levee or floodwall breaches could produce overland flows that would reach the area protected by the levee system or increase the water surface elevation (WSE) along the levee system.
- Whether there is a bend in the channel that could cause superelevation along the outside of the bend to become a concern.
- Whether flooding in a nearby leveed area could fill that area and breach a nearby levee or floodwall, returning flow to the stream and increasing the DWSE for a portion of the levee system.

- Increasing the DWSE to account for the potential increases in WSE associated with climate change, updated hydrology, updated hydraulic models, and sea level rise.

3.1.2 Documentation of ULDC Compliance

When design of the FRWL Project started, the USACE *Sutter Basin Feasibility Study (*SBFS) was considered to be the most recent and up-to-date flood-frequency study. The SBFS derived much of its hydrology from the 2002 USACE Comprehensive Study. The Design Water Surface Profiles for the FRWL Project utilized the hydrology developed by the USACE and calibrated the hydraulic models to the 1997 and 2006 flood events.

However, DWR later published the Central Valley Hydrology Study (CVHS), which included updated flood-frequency curves at various index points along the Feather River. After the CVHS was released, SBFCA compared the CVHS and SBFS hydrology. At all locations along the FRWL, the 200-year peak flow values from the CVHS were less than the SBFS values. Therefore, no change to the DWSE was adopted. A comparison of the CVHS and SBFS 200-year peak flows is shown in Table 3.1-1.

Table 3.1-1. Comparison of SBFS vs. CVHS 200-Year Peak Flows

River	Reach	River Mile	USACE SBFS 200-Year Peak Flow (cfs)[1]	DWR CVHS 200-Year Peak Flow (cfs)[1]
Feather River	Upper	71.45	174,000	163,600
Feather River	Upper	50.84	171,800	166,500
Feather River	Jack SL-Yuba R	29.25	170,800	168,900
Feather River	Yuba R-Bear R	21.00	361,000	317,000
Feather River	Reach 35	12.00	407,200	353,500

[1] cfs – cubic feet per second

It should be noted that the USACE peak flow values decrease in the downstream direction, while the CHVS peak flows do not due to differences in the timing and routing of the tributary inflow hydrographs and attenuation.

As documented in PBI (2012a), (2012b), (2012c) and (2013a), the FRWL Project hydraulic model used the assumptions required in Section 7.1.1 of the ULDC and listed above in Section 3.1.1:

- Upstream, downstream, and nearby levees and floodwalls protecting urban areas were assumed to be raised to the median 200-year WSE plus 3 feet and not allowed to breach, even if overtopped. Overtopping flows were assumed to leave the channel and remain in the 200-year floodplain.
- All project levees and floodwalls were modeled to incorporate a minimum crown elevation equal to the authorized (usually the 1957 profile) USACE design profiles and all such levees and floodwalls were allowed to overtop, act as weirs, and not breach for floods up to and including the median 500-year flood water surface elevation. Overtopping flows were assumed to leave the channel and remain in the 200-year floodplain.

- Non-project levees and floodwalls in non-urbanized areas in the region, to the extent they may affect the DWSE, were modeled at their existing or authorized height, whichever is higher, and to act as weirs without breaching if overtopped.
- Debris loading on bridges was considered for bridges with less than 3-feet of clearance above the DWSE. For the Feather River, debris loading was analyzed as part of both the FRWL Project and the USACE SBFS hydraulic model. The studies found that in general debris had a relatively minimal effect on bridge cross-sections along the Feather River due to the large pier spacings and high bridge decks with the exception of the Union Pacific Railroad (UPRR) Bridge just north of Yuba City. At the UPRR Bridge the DWSE encroaches within 3-feet of the bridge deck. Therefore, to account for the potential backwater effects as part design of the FRWL Project rehabilitation measures, the DWSE was modeled to back up against the UPPR Bridge deck

The FRWL Project DWSE also incorporated the adjustments and considerations in Section 7.1.3 of the ULDC and listed above in Section 3.1.1.

For other upstream breaches that could produce overland flows, the Yuba River and Bear River are the only major tributaries upstream of the FRWL Project that are leveed. In general, breaches along these levees will result in decreased peak WSEs in the Feather River. Therefore, the urban areas (as defined by the ULDC) within the Sutter Basin are only impacted by 200-year Feather River flooding and flooding from local drainage. It should be noted that dams subject to oversight by the California Division of Safety of Dams, Federal Energy Regulatory Commission, USACE, or U.S. Department of the Interior, Bureau of Reclamation do not need to be considered per Section 3.0 of the ULOP since cities or counties are not allowed to supervise the operations and maintenance of these dams (per California Water Code Section 6026).

For superelevation, the USACE and ULDC calculation for superelevation is based upon the curvature of the flow lines at flood stage as documented in PBI (2013b). During a 200-year flood event, the vast majority of the Feather River bends are drowned and the flow lines are straight. For confirmation, superelevation was calculated per USACE Engineering Manual (EM) 1110-2-1601 at several locations along the FRWL to confirm that the design meets ULDC. The most critical location was just upstream of the Gridley Road Bridge, where superelevation was calculated to be approximately 0.2 ft. According to USACE EM 1110-2-1601, "If the total rise in water surface elevation due to superelevation is less than 0.5 feet, the normally determined channel freeboard should be adequate. No special treatment such as increased wall heights or invert banking and spiral transitions is required."

For flooding in nearby leveed areas (i.e. RD 784, Marysville), flow from potential levee breaches could fill the basins and burst levees downstream, thereby returning the flow to the main Feather River channel. The filling of the basins would take considerable time and by the time there would be concern of breach flows returning to the stream, the peak of the flood would likely have attenuated and therefore the potential for increasing WSE's in the Feather River main channel is low. Historical flood events in this area have shown that decreases in Feather River WSE have been observed when levee failures occur in nearby leveed areas.

Finally, for an additional conservative measure, the FRWL Project DWSE incorporated an additional one (1) foot where any remedial measures were required. The DWSE increase accounts for potential WSE increases associated with climate change, potential future sea level rise, updated hydrology, and other uncertainties as recommended in ULDC. No remedial measures were needed for Reaches 26 thru 28 (STA 1674+37 to 1769+31) since the 200-year DWSE is below the adjacent landside grade.

CALIFORNIA DEPARTMENT OF WATER RESOURCES
URBAN LEVEE DESIGN CRITERIA COMPLIANCE
SECTION 7.1 – Design Water Surface Elevation

FEATHER RIVER WEST LEVEE
STA 512+00 thru STA 2368+26

I hereby certify that the planned work for the FRWL Project Phase I (from Station 512+00 to Station 2368+26, excluding Stations 1674+37 to 1769+31), has been completed and complies with the requirements of DWR's ULDC Section 7.1 (May 2012). Furthermore, I hereby certify that the FRWL from Station 1674+37 to Station 1769+31 is a freeboard levee and is not needed to provide an urban level of flood protection.

Professional Engineer in Responsible Charge:

_____ __6/11/2021_

Chris Fritz
Peterson Brustad, Inc. Date
California Professional Engineer No. C-75004

3.2 Minimum Top of Levee (ULDC Section 7.2)

3.2.1 Applicable ULDC Requirements

Per ULDC Section 7.2, the Minimum Top of Levee (MTOL) is the required minimum elevation for the physical top of the levee to provide an adequate factor of safety that will contain the 200-year flood without being overtopped. The ULDC offers two options for determination of the MTOL: the FEMA Approach or USACE Approach. The ULDC FEMA Approach was selected to develop the FRWL Project MTOL.

Using the FEMA Approach, the MTOL is the higher of:

- DWSE plus three (3) feet, or
- DWSE plus the wind setup and wave run-up.

A specific wind-wave analysis needs to be completed using the DWSE in accordance with Section 7.17 of the ULDC. The FRWL Project wind-wave analysis is discussed in Section 3.17 of this Report.

3.2.2 Documentation of ULDC Compliance

As described in Section 3.17 below and included in PBI (2011a), the wind setup and wave run-up for the FRWL Project was determined to be less than three (3) feet. Therefore, based on the FEMA Approach, the MTOL is the DWSE plus three (3) feet.

A freeboard analysis was performed based on a recent top-of-levee survey conducted by the DWR for the Urban Levee Evaluation project and the DWSE developed in PBI (2013a). The freeboard analysis for the FRWL showed the MTOL is at least three (3) feet greater than the 200-year DWSE for all FRWL sections north of Star Bend (Station 512+00), except for approximately 40 feet of levee at the UPRR Bridge crossing (~ Station 1131+00).

In order to meet ULDC MTOL requirements at the UPRR Bridge crossing, a stop log closure structure has been included in the design of the FRWL Project Phase I. The stop log structure is described in Section 3.14 of this Report and the design is included in Wood Rodgers (2015b).

CALIFORNIA DEPARTMENT OF WATER RESOURCES
URBAN LEVEE DESIGN CRITERIA COMPLIANCE
SECTION 7.2 – Minimum Top of Levee

FEATHER RIVER WEST LEVEE
STA 512+00 thru STA 2368+26

I hereby certify that the planned work for the FRWL Project Phase I (from Station 512+00 to Station 2368+26, excluding Stations 1674+37 to 1769+31), has been completed and complies with the requirements of DWR's ULDC Section 7.2 (May 2012). Furthermore, I hereby certify that the FRWL from Station 1674+37 to Station 1769+31 is a freeboard levee and is not needed to provide an urban level of flood protection.

Professional Engineer in Responsible Charge:

_____ __6/11/2021_

Chris Fritz
Peterson Brustad, Inc. Date
California Professional Engineer No. C-75004

3.3 Soil Sampling, Testing and Logging (ULDC Section 7.3)

3.3.1 Applicable ULDC Requirements

Per Section 7.3 of the ULDC, soil sampling, testing, and logging should follow standard procedures described in current guidance documents from USACE; U.S. Department of the Interior, Bureau of Reclamation; DWR; and others – such as the USACE Sacramento District's Geotechnical Levee Practice Standard Operating Procedures and DWR's Division of Flood Management Soil and Rock Logging, Classification, Description and Presentation Manual (2009), exercising proper care to:

- Sample soils, especially soft soils, used for strength and deformation analysis in a way that minimizes disturbance.
- Evaluate hydraulic conductivity using appropriate grain size analyses (including hydrometer) along with confirmatory laboratory permeability testing. Where appropriate, perform field pumping/infiltration testing to measure in-situ properties.
- Perform consolidation tests that ensure the strain level exceeds virgin compression.
- Conduct strength tests with appropriately low strain rates and reflective of the low confining pressures near the landside levee toe.
- Use an appropriate field logging manual, such as appropriate American Society for Testing and Materials (ASTM) guidance and DWR's Division of Flood Management Soil and Rock Logging, Classification, Description and Presentation Manual.

The Sacramento District Geotechnical Levee Practice Standard Operating Procedures suggests that explorations should generally be located on 1,000 to 2,000 feet horizontal spacing, at the waterside toe, levee crown, landside toe, and on the landside of the levee.

3.3.2 Documentation of ULDC Compliance

Soil sampling, testing, and logging performed by AECOM (legacy URS) and its subcontractors for the FRWL Project and many of the historical borings (e.g. the DWR ULE project), were completed in accordance with the DWR Soil and Rock Logging, Classification, Description and Presentation Manual. Based on available information, geotechnical data from previous studies done by other firms or agencies were completed in accordance with the current USACE procedures at the time the work was performed. All laboratory testing done for this project and for the DWR ULE project were done following appropriate ASTM procedures in laboratories certified by the USACE.

Explorations

As documented in URS (2012c), field investigations for the FRWL Project design phase were completed between August 2010 and January 2012. During this period, a total of 182 explorations, including 93 borings and 89 Cone Penetration Test (CPT) soundings, were performed within the project area under the direction of AECOM (legacy URS). A total of 52 explorations were completed along the levee crest, 6 along the waterside, 88

along the landside levee toe, and 36 in the landside levee field to depths ranging from 5 to 170 feet below ground surface. These explorations were in addition to the 844 historical explorations, consisting of 484 borings and 360 CPTs.

Post-January 2012, an additional 189 borings and 43 CPTs were completed at specific locations along the FRWL alignment where the need for additional subsurface data was identified. This includes:

- 118 construction verification borings performed at 100-feet centers along the centerline of cutoff walls installed using deep mixed methods.
- 21 sonic borings completed in March/April 2017 for relief well installation work at Reach 7 (13 sonic borings) and at the UPRR crossing (8 sonic borings) at approximately Station 1131+00 between Reach 17 and 18.
- 11 CPTs and 3 borings completed in July 2017 for Reach 14 through 16 cutoff wall recommendations
- 5 CPTs completed in November 2017, near 5th Street Bridge for the Reach 16 Gap Closure.

Details of these additional explorations are presented in the following documents/Technical Memoranda:

- URS (2013a) – additional 8 borings.
- URS (2013b) – additional 3 borings.
- URS (2013c) – additional 2 borings.
- Magnus (2013) – additional 45 borings.
- Magnus (2014) – additional 25 borings.
- URS (2014a) – additional 2 borings.
- URS (2014b) – additional 4 CPTs and 5 borings.
- Magnus (2015) – additional 48 borings.
- URS (2015) – additional 12 CPTs and 3 borings.
- URS (2016a) – additional 8 CPTs.
- URS (2016b) – additional 3 CPTs.
- URS (2016c) – additional 24 borings
- Teichert Construction (2018) – 21 additional borings
- AECOM (2018a) – additional 11 CPTs and 3 borings
- AECOM (2018b) – additional 5 CPTs

An additional 13 sonic borings were completed between March and April 2017, as part of Details of these explorations are presented in Teichert Construction Submittal #52.2, Relief Well Close Out Resubmittal, September 28, 2018.

Laboratory Testing

As documented in URS (2012c), undisturbed soil samples of subsurface materials were collected from auger and mud-rotary borings in general accordance with ASTM D1587 for the purpose of sampling soft soil during drilling. Thin-wall, 3-inch outside diameter Shelby tubes were attached to a valved push-head assembly, lowered to the bottom of the cleaned borehole by drill rod and hydraulically pushed 24 inches (or portion thereof) into undisturbed soil.

As part of the laboratory testing work, a total of 518 sieve analyses and 43 hydrometer analyses were performed in general accordance with ASTM D422 and ASTM D1140, respectively. This data was used along with historical laboratory testing gradation data to estimate hydraulic conductivity values for different material types using Kozeny-Carman (2003) and Chapius (2004) equations correlated to grain size distribution. A total of 9 hydraulic conductivity tests on undisturbed samples were used to verify the Kozeny-Carman/Capius values.

A total of 17 consolidation tests were performed in general accordance with ASTM D2435 on undisturbed soil samples to develop stress strain curves and assess the degree of over-consolidation. A total of 64 historical consolidation tests performed in the project area were also used.

A total of 27 isotropically consolidated triaxial tests were performed on undisturbed soil samples in general accordance with ASTM D4767. This information was supplemented with an additional 119 historical test results to develop characteristic shear strength relationships for different material types.

3.3.3 Exceptions to ULDC

Some of the historical borings were performed by other agencies or firms and may not have been logged in compliance with all USACE and/or DWR procedures at the time they were performed. The resulting logs from these borings have been compared with those done for this project and are in general agreement with them.

As mentioned above in Section 3.3.1, the Sacramento District Geotechnical Levee Practice Standard Operating Procedures suggests that explorations should generally be located on 1,000 to 2,000 feet horizontal spacing at the waterside toe, levee crown, landside toe, and on the landside of the levee. The horizontal spacing of the explorations is generally within this range, but typically there are not four explorations at each 1,000 to 2,000 foot spacing due to access and environmental constraints associated with drilling on the waterside of the levee and outside of the levee right-of-way. However, during construction of the slurry cutoff walls, samples of excavated material were continuously logged and confirmatory borings were drilled by the Contractor at 100-foot spacing in the locations of the deep mix cutoff walls.

CALIFORNIA DEPARTMENT OF WATER RESOURCES
URBAN LEVEE DESIGN CRITERIA COMPLIANCE
SECTION 7.3 – Soil Sampling, Testing, and Logging

FEATHER RIVER WEST LEVEE
STA 512+00 thru STA 2368+26

I hereby certify that the planned work for the FRWL Project Phase I (from Station 512+00 to Station 2368+26, excluding Stations 1674+37 to 1769+31), has been completed and complies with the requirements of DWR's ULDC Section 7.3 (May 2012), with the exceptions indicated. Furthermore, I hereby certify that the FRWL from Station 1674+37 to Station 1769+31 is a freeboard levee and is not needed to provide an urban level of flood protection.

Professional Engineer in Responsible Charge:

Robert K Green _____ 6/11/2021

Robert K. Green
AECOM Date
California Professional Engineer No. GE-352

3.4 Slope Stability for Intermittently Loaded Levees (ULDC Section 7.4)

3.4.1 Applicable ULDC Requirements

Per Section 7.4.1 of the ULDC, landside slope stability analyses are to use appropriate phreatic surfaces based on the DWSE and Hydraulic Top of Levee (HTOL) (a separate slope stability analysis for HTOL is only needed if the HTOL is more than 0.5 foot above the DWSE). The steady-state phreatic surface is generally considered to be appropriate, but a lower phreatic surface may be justified for slope stability analysis depending on the duration of the design hydrograph, the composition and dimensions of the levee, and the levee's performance history. The lowest phreatic surface that could be justified for a homogeneous levee is along a straight line extending from the landside levee toe to the point where the DWSE (or HTOL) intersects the waterside levee slope. An exception is made for levees with a positive cutoff or internal drainage features.

If the phreatic surface corresponding to the DWSE or HTOL emerges on a landside levee slope consisting of erodible soils, then remediation will be required to prevent unraveling and progressive slope failure that may lead to a levee breach. In addition, a shallow slip surface in the lower portion of a levee constructed with non-cohesive materials and where seepage is exiting relatively high on the landward slope can lead to a progressive through-levee seepage/stability failure. Sound engineering judgment and guidance from USACE's EM 1110-2-1902 was applied to decide what constitutes a minor, insignificant slip surface versus a sliding surface that threatens the integrity of the levee.

Per Section 7.4.2 of the ULDC, the rapid drawdown analyses shall be considered from the DWSE. The amount of drawdown should be established based on site-specific data and/or hydrologic and hydraulics studies, using sound engineering judgment. As with the steady-state seepage stability analyses, shallow failures represented by small localized slips should be examined for their potential to narrow the crown width and possibly expose permeable layers within the embankment. Past performance of the levee under similar drawdown conditions should be examined. Slopes steeper than 3 Horizontal (H) to 1 vertical (V) (3H:1V), should be closely reviewed.

The factors of safety for each stability analyses per Section 7.4 of the ULDC are presented below in Table 3.4-1.

Table 3.4-1 ULDC Slope Stability Analyses Factors of Safety

Condition	Factor of Safety
DWSE – Landside	1.4 (intersect the levee crown and are greater than a few feet deep in the levee slope)
HTOL – Landside	1.2 (intersect the levee crown and are greater than a few feet deep in the levee slope)
Rapid Drawdown - Waterside	1.0 to 1.2 is required, depending on the extent to which the DWSE may have saturated the waterside levee slope

Notes: 1 – DWSE was taken as the 200 year WSE plus 1 foot
2 – HTOL DWSE was taken as the 200 year WSE plus 4 foot

For the rapid drawdown analysis condition, a factor of safety of 1.0 applies when the water level is unlikely to persist for long periods preceding drawdown and a factor of safety of 1.2 applies when the water level is likely to persist for long periods prior to drawdown. Based on the hydrograph developed for the FRWL Project, the peak water levels generally occur over short periods of time, therefore rapid drawdown criteria of 1.0 was selected as discussed in URS (2012b).

3.4.2 Documentation of ULDC Compliance

The slope stability analyses and evaluations performed for the FRWL Project were done following the DWR Guidance Document for Geotechnical Analyses and the design criteria developed for the FRWL Project as documented in URS (2010). The DWR guidance and FRWL Project criteria are in compliance with requirements in Section 7.4 of the ULDC and USACE EMs 1110-2-1902 and 1110-2-1913.

For the existing conditions analyses, including steady-state slope stability analyses, the FRWL Project Phase I was divided into 35 reaches for the purpose of analysis and evaluation. Based on the conclusions from the existing conditions analysis and other related information, it was considered that 25 reaches did not meet criteria and needed remediation (URS, 2011). A discussion of the reaches that meet the requirements in Section 7.4 of the ULDC and did not require remediation is included in URS (2011) and are shown below in Table 3.4-2.

Table 3.4-2 FRWL reaches that met ULDC Section 7.4 Criteria

FRWL Reach	Conclusion
12	Shanghai Bend area that was upgraded by constructing a setback levee with shallow cutoff wall as part of emergency work post-1997 flood under PI 84-99.
25 to 28	These levees were considered freeboard levees that met criteria and did not require upgrading
29	Short levee with flat slopes with no reported history of instability and the DWSE below the landside toe elevation and as such meets criteria.
39	Wide section of levee built from dredged tailings and meets criteria.

Those reaches that did not meet criteria in Section 7.4 of the ULDC were studied further. Steady-state seepage and stability analyses were performed on one to six cross-sections per reach. As documented in URS (2012b), a total of 51 cross-sections were analyzed to evaluate steady-state seepage and stability conditions. For the FRWL Project landside slope stability was typically controlled by underseepage pressures and once these were addressed, either by installation of a cutoff wall or seepage berm, large-scale instability that could impact the global stability of the levee was not an issue. However, localized slope flattening was recommended at one location between Station 2106+00 and 2113+00, where locally over-steepened slopes did not meet levee geometry criteria.

Rapid drawdown slope stability analysis was performed on 27 cross-sections. For Reaches 7 through 17, a WSE drop of 26 feet was used based on a review of gage data along the FRWL. For Reaches 18 through 41, a WSE drop of 15 feet was used. Based

on the analysis performed, an area at the transition between Reach 30 and 31 did not have an adequate factor of safety. This was in an area where active erosion has created overly steep waterside slopes.

At the Yuba City Raw Water Gap in the area of Station 1097+00 analysis indicated that landside stability criteria was not satisfied.

Additional slope stability analysis was performed as part of analysis for the following areas:

- Evaluation of existing cutoff wall in Reaches 14 through 16 (AECOM, 2018a)
- Evaluation of gap closure for Reach 16 (AECOM, 2018b).

Analysis of remediated conditions using proposed flood risk reduction measures shows that all reaches meet slope stability criteria presented in Section 7.4 of the ULDC.

CALIFORNIA DEPARTMENT OF WATER RESOURCES
URBAN LEVEE DESIGN CRITERIA COMPLIANCE
SECTION 7.4 – Slope Stability for Intermittently Loaded Levees

FEATHER RIVER WEST LEVEE
STA 512+00 thru STA 2368+26

I hereby certify that the planned work for the FRWL Project Phase I (from Station 512+00 to Station 2368+26, excluding Stations 1674+37 to 1769+31), has been completed and complies with the requirements of DWR's ULDC Section 7.4 (May 2012). Furthermore, I hereby certify that the FRWL from Station 1674+37 to Station 1769+31 is a freeboard levee and is not needed to provide an urban level of flood protection.

Professional Engineer in Responsible Charge:

Robert K Green

6/11/2021

Robert K. Green
AECOM
California Professional Engineer No. GE-352

Date

3.5 Underseepage for Intermittently Loaded Levees (ULDC Section 7.5)

3.5.1 Applicable ULDC Requirements

The levee underseepage criteria for intermittently loaded levees per Section 7.5 of the ULDC are presented below in Table 3.5-1.

Table 3.5-1 ULDC Seepage Criteria

Condition	Location	Exit Gradient
DWSE	Levee Toe	≤0.5 (for Y ≥ 112 pcf) (for Y < 112 pcf, FS > 1.6)
DWSE	Seepage Berm Toe	≤0.8
DWSE	Between Levee and Seepage Berm Toes	Interpolate between 0.5 and 0.8
DWSE	Bottom of Ditch	≤0.5 (with ditch modeled as dry)
HTOL	Levee Toe	≤0.6 (for Y ≥ 112 pcf) (for Y < 112 pcf, FS > 1.3)
HTOL	Seepage Berm Toe	≤0.8
HTOL	Bottom of Ditch	≤0.6 (with ditch modeled as dry)

A separate seepage analysis for HTOL is only needed if the HTOL is more than 0.5 foot above the DWSE.

Where a seepage berm is needed, the required minimum berm width is four times the levee height. In addition, instrumentation should also be included at the toe of the seepage berm as part of the remedial construction to measure actual piezometric conditions during elevated river stage conditions and compare to seepage model results. Further, the berm design should be expandable with sufficient space to either extend the berm footprint or install relief wells at the berm toe if it is deemed necessary in the future.

If relief wells are constructed for seepage control, exit gradient criteria and factors of safety for underseepage must be achieved midway between relief wells.

Notes:

- In calculating the factor of safety for underseepage, the following equations apply:

  $FS = i_c/i_e$

  $i_c = (\gamma_s - \gamma_w)/\gamma_w$

  where:

  FS = Factor of Safety

  i_c = critical gradient

  i_e = calculated exit gradient

  γ_s = saturated unit weight of soil (blanket layer)

  γ_w = unit weight of water (62.4 pcf)

3.5.2 Documentation of ULDC Compliance

The seepage analyses and underseepage evaluations performed by AECOM (legacy URS) for the FRWL Project were done following the DWR Guidance Document for Geotechnical Analyses and the design criteria developed for the FRWL Project (URS, 2010). The DWR guidance and FRWL Project criteria are in compliance with the requirements in Section 7.5 of the ULDC and USACE's EM 1110-2-1913, as modified by ETL 1110-2-569.

For the existing conditions analyses, the FRWL Project Phase I was divided into 35 reaches for the purpose of analysis and evaluation. Based on the conclusions of existing conditions analysis and other related information, it was considered that 25 reaches did not meet seepage criteria in Section 7.5 of the ULDC and needed remediation (URS, 2011). A discussion of the reaches that meet requirements in Section 7.5 of the ULDC and did not require remediation in included in URS (2011) are shown below in Table 3.5-2.

Table 3.5-2. FRWL Reaches that Met ULDC Section 7.5 Criteria

Reach	Conclusion
12	Shanghai Bend area that was upgraded by constructing a setback levee with shallow cutoff wall as part of emergency work post-1997 flood under PI 84-99.
25 to 28	These levees were considered freeboard levees that met criteria and did not require upgrading
29	Short levee with flat slopes with no reported history of seepage and the DWSE below the landside toe elevation and as such meets criteria.
39	Wide section of levee built from dredged tailings and meets criteria.

Those reaches that did not meet criteria in Section 7.5 of the ULDC were studied further. Steady-state seepage analyses were performed on one to six cross-sections per reach. As documented in URS (2012b), a total of 51 cross-sections were analyzed to evaluate steady-state seepage conditions. Due to existing site constraints and limited right-of-way, a seepage cutoff wall along the centerline of the levee was designed to provide the necessary seepage cutoff for the majority of the reaches. Seepage berms were used for Reaches 38, 40 and 41 where there was sufficient room landward of the levee toe.

Additional seepage analysis was performed as part of analysis for the following areas:

- Evaluation of existing cutoff wall in Reaches 14 through 16 (AECOM, 2018a)
- Evaluation of gap closure for Reach 16 (AECOM, 2018b).

At certain locations it was not possible to install a seepage cutoff wall or the cutoff wall alone was not adequate to address underseepage. These areas included:

- Reach 7 – in the area of Station 550+00 the seepage cutoff wall is "hanging" due to a thick aquifer and lack of a key-in layer at the bottom of the cutoff wall. Therefore, a system of relief wells were constructed to meet underseepage criteria (URS, 2016a).

- Union Pacific Railroad Crossing – due to permitting constraints a cutoff wall was not constructed in the Union Pacific Railroad right-of-way. Instead relief wells were installed to meet underseepage criteria (URS, 2016b).
- Yuba City Raw Water Gap – in the area of Station 1097+00 existing utilities pass beneath the levee and prevent a cutoff wall from being installed. Analysis indicated that underseepage criteria is satisfied, but landside stability criteria is not. Therefore, a stability berm were constructed in this area to meet criteria (URS, 2016d).

Piezometers were installed as part of the relief well design in Reach 7 and at the UPRR Crossing to allow ground water elevations to be monitored during high water events to evaluate the reduction in pore water pressures and evaluate performance. At the time of preparing this report there have been no high water incidents sufficient to generate flow from the relief wells installed at Reach 7 and the UPRR crossing. As such, an evaluation of performance has not been possible.

CALIFORNIA DEPARTMENT OF WATER RESOURCES
URBAN LEVEE DESIGN CRITERIA COMPLIANCE
SECTION 7.5 – Underseepage for Intermittently Loaded Levees

FEATHER RIVER WEST LEVEE
STA 512+00 thru STA 2368+26

I hereby certify that the planned work for the FRWL Project Phase I (from Station 512+00 to Station 2368+26, excluding Stations 1674+37 to 1769+31), has been completed and complies with the requirements of DWR's ULDC Section 7.5 (May 2012). Furthermore, I hereby certify that the FRWL from Station 1674+37 to Station 1769+31 is a freeboard levee and is not needed to provide an urban level of flood protection.

Professional Engineer in Responsible Charge:

Robert K Green _____ ___6/11/2021

Robert K. Green
AECOM Date
California Professional Engineer No. GE-352

3.6 Frequently Loaded Levees (ULDC Section 7.6)

3.6.1 Applicable ULDC Requirements

Per Section 7.6 of the ULDC, a frequently loaded levee is defined as a levee that experiences a WSE of one (1) foot or higher above the elevation of the landside levee toe at least once per day for more than 36 days per year on average. Section 7.6 of the ULDC includes more stringent requirements for frequently loaded levees.

3.6.2 Documentation of ULDC Compliance

Per PBI (2011b), the FRWL does not meet the ULDC definition of a frequently loaded levee. The analysis included in PBI (2011b), examined multiple gaging stations along the Feather River. For gaging station data over the past 15 years, the FRWL has been loaded for 14.9 days per year on average, which is well below the 36 days per year definition.

CALIFORNIA DEPARTMENT OF WATER RESOURCES
URBAN LEVEE DESIGN CRITERIA COMPLIANCE
SECTION 7.6 – Frequently Loaded Levees

FEATHER RIVER WEST LEVEE
STA 512+00 thru STA 2368+26

I hereby certify that the planned work for the FRWL Project Phase I (from Station 512+00 to Station 2368+26, excluding Stations 1674+37 to 1769+31), has been completed and complies with the requirements of DWR's ULDC Section 7.6 (May 2012). Furthermore, I hereby certify that the FRWL from Station 1674+37 to Station 1769+31 is a freeboard levee and is not needed to provide an urban level of flood protection.

Professional Engineer in Responsible Charge:

_____ __6/11/2021_

Chris Fritz
Peterson Brustad, Inc. Date
California Professional Engineer No. C-75004

3.7 Seismic Vulnerability (ULDC Section 7.7)

3.7.1 Applicable ULDC Requirements

Per Section 7.7 of the ULDC, a seismic vulnerability analysis of the levee system for 200-year return period ground motions is required to meet the urban level of flood protection. Peak ground accelerations can be estimated from the most current information developed by:

- U.S. Geological Survey
- DWR's ULE Program's Development of a 200-year Return Period Seismic Hazard Map (2012) for projects in the Sacramento-San Joaquin Valley
- USACE's Guidelines for Seismic Stability Evaluation of USACE Levees (2011)

The seismic vulnerability analysis should employ typical summer and winter WSEs or mean annual high and low tides over the period of gage record. Additionally, potential damages due to either tsunami or seiche wave loading must be considered for levees potentially exposed to such loading.

The seismic vulnerability analyses must make use of the most current seismologic interpretations of potential faulting and earthquake sources, together with recent acceleration and velocity attenuation relationships for the soil profiles being analyzed. The end product of the seismic vulnerability analyses should be estimates of deformations along the levee system and an overall estimate of the amount of damage that could be sustained during a 200-year earthquake.

For intermittently loaded levees (and floodwalls), Subsection 7.7.1 of the ULDC specifies that if seismic damage from 200-year-return-period ground motions is expected after the urban level of flood protection is achieved, a post-earthquake remediation plan is required as part of a flood safety plan that is developed in coordination with pertinent local, State, and federal agencies. At a minimum, the post-earthquake remediation plan must contain provisions for emergency preparations, mobilization, data gathering, actions, interim repairs, long-term repairs, and public notifications. Included in this plan is an estimate of the amount and extent of damage that might be sustained following an earthquake, and the general magnitude of earth and other materials that would be required to restore a modest level of flood protection within 8 weeks. This plan must also include a general set of repair procedures for the interim remediation of cracked and slumped levee sections, including general procedures for excavating and filling cracks, removing disturbed or slumped ground, and keying in new fill.

3.7.2 Documentation of ULDC Compliance

Since the Feather River west levees are intermittently loaded levees, the requirements detailed in ULDC Subsection 7.7.1 were used in the seismic vulnerability analyses for the FRWL Project. The following task were completed:

- Seismic Vulnerability Classifications and associated levels of damage were developed based on work done by Pells and Fell (2003) and Swaisgood (2014). Based on this work, four seismic vulnerability classifications were assigned: (i) None to Minor, (ii)

Moderate to Major, (iii) Severe, and (iv) Compromised. The level of damage associated with each classification is presented in the Table 3.7-1.

Table 3-7.1. Seismic Vulnerability Classifications and Damage Levels

Seismic Vulnerability Classification	Post-EQ F.S.	NCS* (%)	Typical Settlements for ~50-foot Adj. Levee Height (inches)	Maximum Longitudinal Crack Widths (inches)
None - Minor	≥ 1.2	< 0.2	< 1	< 1
Moderate-Major	1.0 ≤ F.S. < 1.2	0.2 – 1.5	1 - 9	1 - 6
Severe	0.9 ≤ F.S. < 1.0	1.5 - 5	9 - 30	6 - 20
Compromised	< 0.9	> 5	> 30	> 20

The rationale for selection of the four seismic vulnerability classifications and associated levels of damage is detailed in the Seismic Vulnerability Evaluation Report, October 2020, presented in Appendix A. The steps involved in the evaluation of Seismic Vulnerability Class and associated levels of damage are presented below:

- Reviewed liquefaction assessment and post-earthquake stability analyses results from previous studies (Feather River West Levee Project Geotechnical Design Recommendations Report (URS, 2012b) and in the Geotechnical Evaluation Report, Volume 2, Remedial Alternatives, Sutter Feather River Study (URS, 2015b)), and used this information to rank each reach and part thereof in accordance with the information presented in Table 3-7.1.
- Summarized Seismic Vulnerability Classification per reach, and part thereof, and estimated the total length of levee for each classification type for the project.
- Summarized flood water levels for 10-year and 200-year return periods and the minimum cross sections required to meet ULDC criteria for the flood levels, including a minimum of 3 feet of freeboard.
- For each damage level, identified conceptual levee repairs, methods, and borrow needs to restore the levees to 10-year levee cross section, including conceptual sketches for the repairs, potential borrow quantities, borrow locations, haul routes, and staging areas. Repairs to restore the 10-year cross-section would need to be completed on an emergency basis within 8 weeks of the earthquake event and are not required to meet seepage and underseepage requirements of the ULDC.
- For each damage level, identified levee repair methods to restore a 200-year level of protection following damage induced by a 200-year earthquake. Unlike the repairs outlined for restoring a 10-year levee section, only conceptual repair methods and sketches are presented per the ULDC requirements.

- Developed language to include within an Emergency Action Plan (EAP) to implement temporary and permanent repairs that would address the earthquake emergency, including the responsibility of key parties.

The above is presented as part of a Seismic Vulnerability Evaluation Report, October 2020, presented in Appendix A. Based on the findings of this report, the following levee miles are estimated for each Seismic Vulnerability Class:

- None to Minor 23.1 miles
- Moderate to Major 7.0 miles
- Severe 2.6 miles
- Compromised 0.7 miles

CALIFORNIA DEPARTMENT OF WATER RESOURCES
URBAN LEVEE DESIGN CRITERIA COMPLIANCE
SECTION 7.7 – Seismic Vulnerability

FEATHER RIVER WEST LEVEE
STA 512+00 thru STA 2368+26

I hereby certify that the planned work for the FRWL Project Phase I (from Station 512+00 to Station 2368+26, excluding Stations 1674+37 to 1769+31), has been completed and complies with the requirements of DWR's ULDC Section 7.7 (May 2012). Furthermore, I hereby certify that the FRWL from Station 1674+37 to Station 1769+31 is a freeboard levee and is not needed to provide an urban level of flood protection.

Professional Engineer in Responsible Charge:

Robert K Green _____ 6/11/2021_

Robert K. Green
AECOM
California Professional Engineer No. GE-352

Date

3.8 Levee Geometry (ULDC Section 7.8)

3.8.1 Applicable ULDC Requirements

Per Section 7.8 of the ULDC, minimum levee geometry criteria have previously been specified by various USACE and State guidance documents as shown in Table 3.8-1.

Table 3.8-1 Minimum Levee Geometry

Minimum Criteria	USACE EM 1110-2-1913	CVFPB Title 23	USACE Sacramento District Geotechnical Levee Practice SOP
Crown Width	10	20 (Major Streams) 12 (Minor Streams)	20 (Main Line, Major Tributary, and Bypass Levees) 12 (Minor Tributary Levees)
Waterside Levee Slope	2H:1V	3H:1V 4H:1V (bypass levee)	3H:1V
Landside Levee Slope	2H:1V	2H:1V 3H:1V (bypass levee)	3H:1V (New Levee) 2H:1V (existing levees with good performance)

In addition, new levees, or levees with extensive reconstruction, situated along major waterways, are required to have a minimum 20-foot-wide crown width and 3H:1V waterside and landside slopes (4H:1V waterside slope for bypass levee).

Steeper slopes than those shown in Table 3.8-1 are allowed where there is limited space available and the levee meets minimum seepage and stability criteria. Steeper waterside slopes are allowed where stability criteria are met and wavewash erosion does not result in levee breaching.

In addition, a patrol road is required to be designed, constructed and maintained to provide "all weather" access along the crown of the levee for inspection, maintenance and flood-fighting. A patrol road should also be provided near the toe of the seepage berm that is too wide for the levee crown patrollers to see seepage conditions at the berm toe.

3.8.2 Documentation of ULDC Compliance

As documented in Wood Rodgers (2012b), a surface model of the terrain was created at the onset of the FRWL Project using AutoCAD Land Development Desktop. Using Geographic Information System (GIS) tools, break lines were created at all grade breaks running longitudinal to the levee centerline. Cross-sections were then cut electronically at 100-foot intervals. At locations where the cross-section intersected the break lines, GIS was used to place a reference point (node) and to provide offset and elevation information from the beginning of the cross section to each node. The slope between nodes and the distance between nodes representing the levee crown hinge points was calculated.

The slope and width information generated in GIS was exported into a Microsoft Excel spreadsheet to tabulate the existing levee slopes and crown widths. The levee sections not meeting the minimum requirements were sent to the geotechnical engineers for slope stability analyses (URS, 2012a) (in addition to the slope stability analysis performed for

compliance with Section 7.4 of the ULDC). In addition to the geotechnical review, the existing levee sections were analyzed to determine whether a theoretical levee prism consisting of a 3H:1V waterside slope, 20-foot levee crown, and a 2H:1V landside slope is contained within the existing levee prism while providing a minimum of 3 feet of freeboard above the DWSE. If it was determined that the existing levee slopes were unstable or that the theoretical levee prism was not contained within the existing levee, the existing levee geometry was modified as part of the design as described below.

GIS identified 874 cross-sections where the calculated levee slope did not meet the minimum requirements. These sections were reviewed to determine if the slopes identified were a part of the levee prism or part of an adjacent feature. Slopes that were not a part of the levee section were filtered to create a spreadsheet that listed only those sections that contained levee section geometry problems. It included 568 locations which required further analysis to determine if the existing levee slopes were stable and if a theoretical levee prism was contained within the existing levee geometry.

In addition to the cross-sections that did not meet the minimum slope requirements, 150 cross-sections (81 in the southern half and 69 in the northern half) did not meet the minimum levee crown width requirement. Existing levee geometry at these locations was required to be modified as part of the levee reconstruction.

For the areas that do not require geometry modification, the FRWL Project specifications required the Contractor to perform field surveys of the levee prior to the start of construction, after completion of the levee de-grading operations, and after levee re-construction. This field survey will include cross- sections of the levee at 100-foot intervals. Each cross-section will capture major changes in levee grades, including the levee toes, degraded levee surface, crown hinge points, and crown centerline. These field surveys were used to ensure that the re-constructed levee restores the original levee geometry in areas where FRWL meets ULDC levee geometry requirements.

At locations where the existing levee slopes were not stable (URS, 2012a), or where there was not enough crown width to provide adequate operation and maintenance (O&M) access, modifications to meet the minimum levee geometry requirements were included in the construction plans. This re-construction was accomplished by holding the existing waterside toe point and performing all levee slope flattening and crown widening toward the landside of the levee. Where the FRWL was degraded to install the cutoff wall, the levee was re-constructed to provide a minimum 3H:1V waterside slope, a 20-foot levee crown, and 2H:1V landside slope. Section 7.8 of the ULDC allows slopes steeper than 3H:1V or crown widths less than 20 feet for reconstruction of existing levees where the levee has performed well, and it meets stability and seepage criteria.

Where FRWL Project Phase I construction occurred, six (6) inches of aggregate base was placed to provide an all weather access roadway on the levee crown. A 30-foot O&M corridor is also provided along the seepage berms to provide access and to inspect seepage conditions at the berm toe.

CALIFORNIA DEPARTMENT OF WATER RESOURCES
URBAN LEVEE DESIGN CRITERIA COMPLIANCE
SECTION 7.8 – Levee Geometry

FEATHER RIVER WEST LEVEE
STA 512+00 thru STA 1433+83

I hereby certify that the planned work for the FRWL Project Phase I (from Station 512+00 to Station 2368+26, excluding Stations 1674+37 to 1769+31), has been completed and complies with the requirements of DWR's ULDC Section 7.8 (May 2012). Furthermore, I hereby certify that the FRWL from Station 1674+37 to Station 1769+31 is a freeboard levee and is not needed to provide an urban level of flood protection.

Professional Engineer in Responsible Charge:

_____ _____6/11/2021

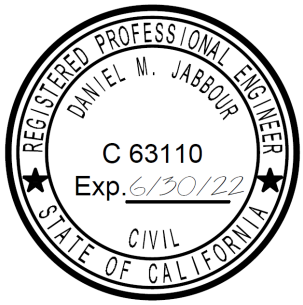
Jonathan L. Kors
Wood Rodgers, Inc. Date
California Professional Engineer No. C-59538

CALIFORNIA DEPARTMENT OF WATER RESOURCES
URBAN LEVEE DESIGN CRITERIA COMPLIANCE
SECTION 7.8 – Levee Geometry

FEATHER RIVER WEST LEVEE
STA 1433+83 thru STA 2368+26

I hereby certify that the planned work for the FRWL Project Phase I (from Station 512+00 to Station 2368+26, excluding Stations 1674+37 to 1769+31), has been completed and complies with the requirements of DWR's ULDC Section 7.8 (May 2012). Furthermore, I hereby certify that the FRWL from Station 1674+37 to Station 1769+31 is a freeboard levee and is not needed to provide an urban level of flood protection.

Professional Engineer in Responsible Charge:



_____ __6/11/2021

Daniel Jabbour
HDR Engineering, Inc. Date
California Professional Engineer No. C-63110

3.9 Interfaces and Transitions (ULDC Section 7.9)

3.9.1 Applicable ULDC Requirements

Section 7.9 of the ULDC requires:

- The Civil Engineer to consider, evaluate, and explicitly design for interfaces and transitions between different types of levee sections and features along the levee system.
- Evaluate and design appropriate overlaps, transitions, and connections between features to ensure the levee functions holistically, so that no levee reach is more susceptible to problems than an adjacent reach due to gaps in features, loading/demand concentrations, or other three-dimensional effects.

3.9.2 Documentation of ULDC Compliance

Transitions between and at the ends of different remedial measures or changes in geometry of remedial measures were evaluated during design to avoid three dimensional effects occurring around the ends of the remedial measures as documented in URS (2014b). Transitions include the following:

- Changes in type of remedial measure
- Changes in the thickness of the blanket layer
- Changes in the depth of the cutoff wall
- Penetrations (refer to Section 3.13 of this Report)

The general procedure for dealing with transitions is to overlap the remedial measures or carry on the more stringent measure (i.e. deeper wall) for a sufficient distance to allow for any excess seepage head to dissipate with distance. The evaluation process for transitions at changes in cutoff walls depths and between remediation types is covered in Hughes et. al (2015) Specific evaluation of transitions for the FRWL project are covered as part of the End Around Effects Technical Memorandum (URS, 2014b). At the northern end of the cutoff wall in Reach 19, the design explorations on the landside of the levee show a shallow, poorly graded sand aquifer and thin blanket condition at approximately Station 1242+00. End around effects evaluation indicated that a length of approximately 600 feet was needed to dissipate excess pore pressures. Taking into consideration information arising during construction and re-evaluating the design exploration data, it is considered that the cutoff wall at this location has created a thickened blanket layer with an exit gradient of less than 0.5 and meets criteria.

At Reach 7 and the UPRR Crossing, relief wells were installed in areas where a cutoff wall was not possible. Piezometers were installed as part of the relief well design to allow ground water elevations to be monitored during high water events to evaluate the reduction in pore water pressures and evaluate performance of the relief wells, particularly at the transition points with the cutoff wall north and south of the relief wells. At the time of preparing this report there have been no high water incidents sufficient to generate flow from the relief wells installed at Reach 7 and the UPRR crossing. As such, an evaluation of performance has not been possible.

CALIFORNIA DEPARTMENT OF WATER RESOURCES
URBAN LEVEE DESIGN CRITERIA COMPLIANCE
SECTION 7.9 – Interfaces and Transitions

FEATHER RIVER WEST LEVEE
STA 512+00 thru STA 2368+26

I hereby certify that the planned work for the FRWL Project Phase I (from Station 512+00 to Station 2368+26, excluding Stations 1674+37 to 1769+31), has been completed and complies with the requirements of DWR's ULDC Section 7.9 (May 2012). Furthermore, I hereby certify that the FRWL from Station 1674+37 to Station 1769+31 is a freeboard levee and is not needed to provide an urban level of flood protection.

Professional Engineer in Responsible Charge:

Robert K Green _____ __6/11/2021_

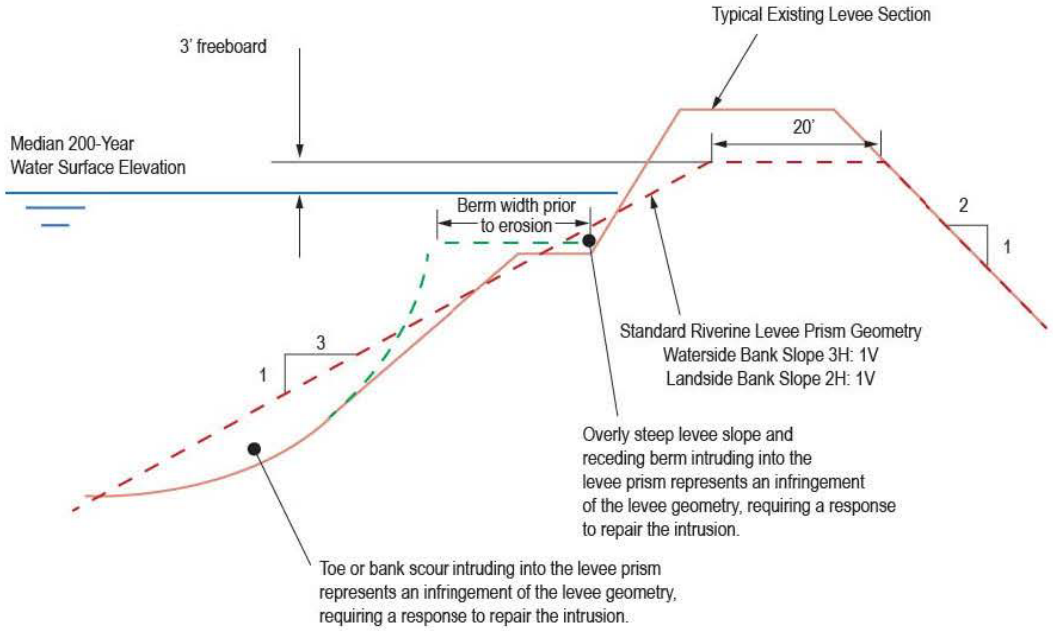
Robert K. Green
AECOM Date
California Professional Engineer No. GE-352

3.10 Erosion (ULDC Section 7.10)

3.10.1 Applicable ULDC Requirements

Per Section 7.10 of the ULDC, the Civil Engineer's analyses should consider the annual erosion surveys conducted under USACE's Sacramento River Bank Protection Project and the California Department of Water Resources (DWR) erosion surveys conducted on the San Joaquin River flood protection system. The downward projection of the theoretical 3H:1V waterside slope that remains within the natural stream bank has traditionally been considered to represent a minimum element of the slope stability for the overlying levee fill. An example of how the waterside projection is made is shown in Figure 3.10-1 below.

Figure 3.10-1 – Example of How to Project the Waterside Levee Slope for Determining Acceptable Bank Erosion (from Figure 7-4 ULDC).



Velocity and shear stress computations for assessment of erosion potential should follow methods described in USACE's EM 1110-2-1913 and EM 1110-2-1601. River channel hydraulics and migration can be assessed using the methods described in USACE's EM 1110-2-1416 and EM 1110-2-1418. Hydraulic models developed for the Sacramento River Bank Protection Project are available from USACE Sacramento District or from DWR.

Per the ULDC, consideration of dispersive soils within the vicinity and within the levee embankments should be evaluated. Based upon the geotechnical investigation performed and an evaluation on past performance history, dispersive soils are not considered an issue for the FRWL project. Furthermore, the installation of a cutoff wall tying into a zoned embankment over much of the project alignment addresses such conditions.

Design of erosion repairs and erosion protection conform to guidance in USACE documents cited above and in USACE's *Hydraulic Design Criteria* (1987), including flattening the slope, armoring the slope, and considering vegetation. Procedures for computation of wind setup and wave run-up for the purpose of evaluating erosion potential conform to requirements identified.

3.10.2 Documentation of ULDC Compliance

The FRWL is part of a dynamic riverine system that is constantly changing and requires constant monitoring for sediment movement and transport, including watching for signs of erosion along the banks and channel of the Feather River. The FRWL is inspected for signs of erosion by multiple agencies, including local maintaining agencies (LMAs), USACE, DWR and SBFCA on varying time intervals.

Local Maintaining Agencies

The LMAs are currently performing inspections of the FRWL every 90 days, including prior to the flood season, immediately following each major high water period, and at any other time deemed necessary by the LMA Superintendent as stated in USACE's Standard O&M Manual, each LMA is required to perform a detailed inspection. The findings of these inspections are to be reported to the Central Valley Flood Protection Board's (CVFPB) Chief Engineer through DWR's Flood Project Integrity and Inspection Branch (FPIIB). It is assumed that these inspections are being performed in accordance with the USACE's O&M Manual. The LMA responsible for each FRWL project segment is presented in Table 3.10-1 below.

Table 3.10-1. FRWL's Local Maintaining Agencies

Segment	Segment Name, Maintaining Agencies	Beg. Station	Beg. RM	End Station	End RM
1	Maintenance Area 07 (2044+00 – 2303+00) Hamilton Bend (2303+00 – 2368+00)	2044+00	53.3	2368+00	58.65
2	Maintenance Area 07	1726+00	46.8	2044+00	53.3
3	Levee District 09 (1408+00 – 1413+00) Maintenance Area 16 (1413+00 – 1655+50) Maintenance Area 07 (1655+50 – 1726+00	1408+00	38.3	1726+00	46.8
4	Levee District 01 (1090+00 – 1102+00) Levee District 09 (1102+00 – 1408+00)	1090+00	29.6	1408+00	38.3
5	Levee District 01	774+00	23.1	1090+00	29.6
6	Levee District 01	461+00	16.1	774+00	23.1
7[1]	Maintenance Area 03 (10+00 – 260+00) Levee District 01 (260+00 – 461+00)	10+00	7.0	461+00	16.1

[1] Not included in this EVD-1 finding station range.

USACE's Sacramento River Bank Protection Program

The FRWL is also inspected under the USACE's Sacramento River Bank Protection Program, which began conducting an annual erosion inventory in 1997. Ranking methodology and reconnaissance efforts have been consistently documented since 2003

as part of the USACE's Annual Report program. In the last ten years, inspections have been performed in 2010, 2011, 2012, 2013 2015, and 2017 along portions of the FRWL. The frequency of the USACE inspections and the releasing of finding reports are dependent upon available funding of the program.

There are three erosion sites included within the 2017 Annual Erosion Reconnaissance Field Report for the Sacramento River Bank Protection Project. As of 2017, these sites had not yet been identified as critical. All three of these sites are located outside of this EVD-1 finding station range.

Table 3.10-2 2012 Annual Erosion Reconnaissance Engineering Report Identified Erosion Sites

Erosion Site	Erosion Length	Levee Maintaining Agency	Economic Impact Area	2017 Field Notes
Feather River RM 12.3R	177	MA 3	Yuba City	Under progress, work in progress
Feather River RM 12.8R	293	MA 3	Yuba City	Under progress, work in progress
Feather River 47.5R	842	MA7	Live Oak	Vertical face into the levee prism, huge eddy

USACE's Sacramento District Feather River – Sutter Basin Protection Area Periodic Inspection Report No. 1

The USACE released the Sacramento District Feather River – Sutter Basin Protection Area Periodic Inspection Report No. 1 most recently in 2010. In January 2010, a 4-member inspection team walked the entire length of the FRWL over several weeks as part of the USACE's Periodic Inspection and documented the observable physical condition of the FRWL. Typically, the periodic inspections are performed every five years, dependent upon available funding. The USACE's 2010 Periodic Inspection of the Feather River Sutter Basin involved an assessment of the general condition of the levee system based on available data and visual inspections. The Periodic Inspection Report No. 1 endeavored to identify areas of concern relative to data gaps, current design criteria, operations and maintenance, rated items and safety issues. The Periodic Inspection Report No. 1 does not, however, rank the levee segment or specific sites in order of most in need of repair. It only states the overall status of the segment as acceptable, minimally acceptable, or unacceptable.

The FRWL inspection information for both the USACE's Sacramento River Bank Protection Program and the Periodic Inspection Report No. 1 is included in Table 3.10-3 below.

Table 3.10-3 FRWL Inspection Information

Inspection Program	Inspection Month and Year	Reach Inspected	Viewing Method
Sacramento River Bank Protection Program	October/November 2017	0+00 to 1278+00 (RM0 to RM34) 1278+00 to 2368+00 (RM35 to RM60)	Car[1] Car
Sacramento River Bank Protection Program	August 2015	0+00 to 10+00 (RM0 to RM7) 10+00 to 1278+00 (RM7 to RM34) 1278+00 to 2368+00 (RM35 to RM60)	Car[1] Boat Car
Sacramento River Bank Protection Program	September 2012	0+00 to 1278+00 (RM0 to RM34) 1278+00 to 2368+00 (RM35 to RM60)	Boat Car
Sacramento River Bank Protection Program	August/September 2011	0+00 to 1278+00 (RM0 to RM34) 1278+00 to 2368+00 (RM35 to RM60)	Boat Car
Sacramento River Bank Protection Program	June/July 2010	0+00 to 1300+00 (RM0 to RM35)	Boat
Sacramento River Bank Protection Program	September 2009	0+00 to 1158+35 (RM0 to RM31)	Boat, 4x4 vehicle
Sacramento River Bank Protection Program	October 2008	0+00 to 1158+35 (RM0 to RM31)	Boat, 4x4 vehicle
Sacramento River Bank Protection Program	October 2007	0+00 to 1158+35 (RM0 to RM31)	Boat, 4x4 vehicle
Sacramento River Bank Protection Program	2006	0+00 to 846+13 (RM0 to RM25)	Boat, 4x4 vehicle
Sacramento River Bank Protection Program	October 2005	0+00 to 846+13 (RM0 to RM25)	Boat
Sacramento River Bank Protection Program	September 2003	0+00 to 846+13 (RM0 to RM25)	Boat
Periodic Inspection Report No. 1	January 2010	0+00 to 2368+00 (RM0 to RM58.65)	Foot

[1]Due to low water levels, this reach was not accessible by boat.

DWR's Annual Flood Protection Inspection Summary Reports

This report is a compilation of data collected by various programs but primarily the data gathered by the Flood Project inspection and Assessment Branch (FPIAB). It includes information on Project levee maintenance of the State-Federal Flood Protection System derived from programs such as DWR inspections, DWR's summary of LMA annual reporting pursuant to Assembly Bill 156 (2007), United States Army Corps of Engineers' (USACE) Inspections, DWR's Erosion Survey in the San Joaquin River, Flood System Repair Project's point of interest data, and the USACE's Sacramento River Bank

Protection Project erosion data along with other relevant information. A report is compiled each year documenting the results of the Department's State Flood System inspections and any deficiencies that may be affecting the structural integrity of the system levees. This report is for use by the USACE, DWR, the CVFPB, LMAs, and other interested parties.

The most recent Annual Inspection Report was released in March of 2020. The Individual Summary Reports for 2020 are included in Appendix B of this report (Note, this is Appendix A in the full Annual Report posted online). DWR's latest Annual Reports can be located at this weblink: http://cdec.water.ca.gov/fsir.html

Additionally, HDR has reviewed the Fall 2020 Levee Maintenance Deficiency Summary Reports for each LMA. These are also included in Appendix B. The table below lists points of interest identified in both summary reports and provides a status of the site at the time this report was released.

It is assumed that in addition to the LMA inspection requirements listed in Section 3.10.2 above, the LMAs are paying closer attention and inspecting these points of interest during storm events.

Table 3.10-4 2020 Summary Reports Listed Points of Interest and Status

LMA	Site ID	Rating/Failure Mode	Start/End Levee Mile	Documented Report	Current Status
LD0001 (Sutter Co)	LD1-S-02 / FSRP-17-145	Critical/Erosion	5.02/5.43	Both	Repaired in 2020
LD0001 (Sutter Co)	--	Berm erosion Erosion/ Bank Caving	7.50; 7.69 – 7.74	Both	Rating – Acceptable but Monitor and Maintain
LD0001 (Sutter Co)	FSRP-17-273	Critical/Seepage	12.18-15.11	2020 Individual Summary Report	Initially identified by DWR in 2017; Repaired by SBFCA levee improvement project in 2018
Sutter Maintenance Yard MA0016	FSRP-17-143	Serious/Erosion	0.16	2020 Individual Summary Report	Site rated serious, but not critical. Site should be monitored by LMA during storm events.

Inspections

The assessment of erosion was conducted by the SBFCA project design team in 2012 to identify critical erosion sites. Results of the analysis are summarized in HDR's Erosion Assessment Report (2012). The assessment of erosion considered the following hazard factors:

- Compromised levee prism geometry
- Stream flow velocity
- Planform
- Erosion Rate
- Wind and Wave

A site was determined to be a critical site if the levee prism geometry was compromised due to erosion, or if the condition of the other hazard factors warranted this classification. A critical erosion site is one where it is estimated that additional erosion during future flood flows could be considered a threat to the levee integrity, and therefore it is necessary to provide erosion protection measures before the levee can be found to meet the ULDC requirements for erosion.

Table 1.3-4 below lists sites that may have a greater potential to progress into a critical erosion site based upon the listed hazard factors above. However, it is very difficult to predict if any of these sites will progress into a critical designation causing levee impacts at this time. The system was designed with setback levees to allow for some erosion and deposition patterns within the active and ever-changing river. Therefore, these listed sites in addition to the entire FRWL, must be monitored by the LMA through the on-going O&M.

One critical erosion site (Site 21), where the levee prism geometry had been compromised, was identified at the Gridley bridge. Additional survey and bathymetry data was obtained and the critical station range narrowed to two specific reaches from Stations 1900+00 to 1901+00 and 1907+00 to 1911+50. An erosion repair was designed for each site and constructed during the summer of 2016. These two sites are now protected with rock slope protection.

While erosion is constantly occurring along the river banks, it is difficult to predict future levee impacts at this time. The system was designed with setback levees to allow for erosion and deposition patterns within the active river.

Table 3.10-5 FRWL Identified Sites with Potential Levee Safety Risk Due to Erosion

Location and Description of Identified Sites with Potential Levee Safety Risk Due to Erosion				Results from Assessment of Erosion Hazard Factors								Findings	Recommendations
Site Location			Erosion Concern	Compromised Levee Prism		Stream Flow Velocity[1]			Planform	Erosion Rate[2]	Wind and Wave Height	Site Condition	Recommendations
Site Number	Reach	Project Station(s)	Erosion Concern	Projection of the 3H:1V levee slope free of erosion?	Berm width is greater than 35 feet?	HEC-RAS Cross-Section(s)	200YR Right OB Velocity (ft/s)	200YR Channel Velocity (ft/s)	Planform	Measured Average Erosion Rate between 1968 - 1986 (feet/year)	Calculated Wind and Wave Height (ft)	Critical or Not Critical?	Monitor as part of on-going O&M or Action required for levee certification
1	4	340+00 - 360+00	Feather River in close proximity to levee.	Yes	Yes	14.5 14.25 14.0	3.45 3.02 3.78	8.38 9.23 9.64	Outside Slight Bend	0.0	Wave runup contained within freeboard	Not Critical No encroachment into ULDC defined prism; berm width greater than 35 ft.	Maintenance monitoring as part of on-going O&M
2	5	415+00	Feather River in close proximity to levee.	Yes	Yes	15.75 15.50 15.25	2.62 2.94 2.67	8.66 9.02 9.23	Outside Slight Bend	0.0	Wave runup contained within freeboard	Not Critical No encroachment into ULDC defined prism; berm width greater than 35 ft.	Maintenance monitoring as part of on-going O&M
3	7	565+00 563+00 - 568+76	Identified waterside slope instability. Waterside slope instability due to rapid drawdown when levee breach occurred on east bank of Feather River (in RD 784)	Yes	Yes	19.50 19.25 19.00	1.98 1.88 1.85	4.71 3.84 3.52	Straight	0.0	Wave runup contained within freeboard	Not Critical No encroachment into ULDC defined prism; velocities lower than permissible velocities.	Maintenance monitoring as part of on-going O&M
4	7	592+34	Identified waterside slope erosion Grouted riprap placed by USACE in 1968, Levee erosion noted by citizens in 1991.	Yes	Yes	20.00 19.75 19.5	2.05 1.88 1.98	4.92 4.86 4.71	Straight	0.0	Wave runup contained within freeboard	Not Critical No encroachment into ULDC defined prism; berm width greater than 35 ft.	Maintenance monitoring as part of on-going O&M
5	8	596+00 - 654+75	Unknown cause of 26 documented sink holes	Yes	Yes	20.5 20.25 20	1.80 2.05 2.05	5.28 5.23 4.92	Straight	2.1	Wave runup contained within freeboard	Not Critical No encroachment into ULDC defined prism; berm width greater than 35 ft.	Maintenance monitoring as part of on-going O&M
6	9	654+75 - 706+50	Documented bank and levee erosion	Yes	Yes	21.75 21.25 20.75	2.42 1.40 2.08	7.42 6.71 5.96	Straight	2.7	Wave runup contained within freeboard	Not Critical No encroachment into ULDC defined prism; berm width greater than 35 ft due to over widened levee.	Maintenance monitoring as part of on-going O&M

Location and Description of Identified Sites with Potential Levee Safety Risk Due to Erosion				Results from Assessment of Erosion Hazard Factors								Findings	Recommendations
Site Location			Erosion Concern	Compromised Levee Prism		Stream Flow Velocity[1]			Planform	Erosion Rate[2]	Wind and Wave Height	Site Condition	Recommendations
Site Number	Reach	Project Station(s)	Erosion Concern	Projection of the 3H:1V levee slope free of erosion?	Berm width is greater than 35 feet?	HEC-RAS Cross-Section(s)	200YR Right OB Velocity (ft/s)	200YR Channel Velocity (ft/s)	Planform	Measured Average Erosion Rate between 1968 - 1986 (feet/year)	Calculated Wind and Wave Height (ft)	Critical or Not Critical?	Monitor as part of on-going O&M or Action required for levee certification
7	10	706+50 - 774+00	Feather River in close proximity to levee	Yes	Yes	23 22.75 22.5 22	1.89 2.08 2.44 2.03	7.40 7.45 8.27 6.01	Straight	0.5	Wave runup contained within freeboard	Not Critical No encroachment into ULDC defined prism; berm width greater than 35 ft.	Maintenance monitoring as part of on-going O&M
8	11	774+00 - 830+00	Feather River in close proximity to levee	Yes	Yes	24.25 23.75 23.25	2.25 1.13 3.18	4.47 6.41 7.06	Outside Bend	5.9	Wave runup contained within freeboard	Not Critical No encroachment into ULDC defined prism; berm width greater than 35 ft.	Maintenance monitoring as part of on-going O&M
9	11&12	821+00 - 842+00	Documented headcut (clay plug) per SRBPP[3]	Yes	Yes	25 24.75 24.5 24.25 24	3.09 3.09 2.77 2.25 2.46	5.72 5.97 4.91 4.47 5.57	Outside Bend	5.9	Wave runup contained within freeboard	Not Critical No encroachment into ULDC defined prism; berm width greater than 35 ft.	Maintenance monitoring as part of on-going O&M
10	13	845+00 – 927+00	Historic levee failure zone	Yes	Yes	26.5 26.25 26 25.75 25.5 25.25	1.00 2.33 2.51 2.62 2.77 2.02	6.29 5.48 4.52 4.22 4.12 4.31	Outside Bend	3.3	Wave runup contained within freeboard	Not Critical No encroachment into ULDC defined prism; berm width greater than 35 ft.	Maintenance monitoring as part of on-going O&M

Location and Description of Identified Sites with Potential Levee Safety Risk Due to Erosion				Results from Assessment of Erosion Hazard Factors								Findings	Recommendations
Site Location			Erosion Concern	Compromised Levee Prism		Stream Flow Velocity[1]			Planform	Erosion Rate[2]	Wind and Wave Height	Site Condition	Recommendations
Site Number	Reach	Project Station(s)	Erosion Concern	Projection of the 3H:1V levee slope free of erosion?	Berm width is greater than 35 feet?	HEC-RAS Cross-Section(s)	200YR Right OB Velocity (ft/s)	200YR Channel Velocity (ft/s)	Planform	Measured Average Erosion Rate between 1968 - 1986 (feet/year)	Calculated Wind and Wave Height (ft)	Critical or Not Critical?	Monitor as part of on-going O&M or Action required for levee certification
11	15	954+40 - 968+50	Feather River in close proximity to levee	Yes	Yes	27.25 26.999 26.75	2.53 1.34 1.30	6.72 6.59 6.17	Inside Bend, Confluence with Yuba River	0.0	Wave runup contained within freeboard	Not Critical No encroachment into ULDC defined prism; berm width greater than 35 ft due to over widened levee.	Maintenance monitoring as part of on-going O&M
12	16	1000+00 - 1035+21	2009 Levee repair zone and additional potential erosion area near Fifth Street Bridge per SRBPP[3]	Yes	Yes	28.5 28.324 28.307 28.25 28	2.39 1.86 1.81 1.65 1.48	4.33 4.50 4.44 4.82 5.49	Outside Bend	4.9	Wave runup contained within freeboard	Not Critical No encroachment into ULDC defined prism; berm width greater than 35 ft.	Maintenance monitoring as part of on-going O&M
13	18	1136+32 - 1153+14	Sinkhole site in 1966, site repaired in 1966	Yes	Yes	30.75 30.5 30.25	1.56 1.64 1.46	3.70 3.75 2.98	Straight	8.6	Wave runup contained within freeboard	Not Critical No encroachment into ULDC defined prism; berm width greater than 35 ft.	Maintenance monitoring as part of on-going O&M
14	18	1173+78	Sinkhole site from 1986, repair history unknown	Yes	Yes	31.5 31.25 31	1.34 1.43 1.38	3.11 3.39 3.40	Straight	0.0	Wave runup contained within freeboard	Not Critical No encroachment into ULDC defined prism; berm width greater than 35 ft.	Maintenance monitoring as part of on-going O&M
15	19	1270+00 1266+45 - 1271+00	Historic erosion zone, This is a site the MHM has worked with LD9 to repair over the years but it did not require any repair after 1997. Recollection that site experiences more damage during mid-range flows. Bank protection placed by USACE as early as 1974.	Yes	Yes	34.07 33.5 33.25	0.96 1.16 0.91	1.68 2.19 2.92	Outside Bend	0.0	Wave runup contained within freeboard	Not Critical No encroachment into ULDC defined prism; velocities lower than permissible velocities.	Maintenance monitoring as part of on-going O&M

Location and Description of Identified Sites with Potential Levee Safety Risk Due to Erosion				Results from Assessment of Erosion Hazard Factors								Findings	Recommendations
Site Location			Erosion Concern	Compromised Levee Prism		Stream Flow Velocity[1]			Planform	Erosion Rate[2]	Wind and Wave Height	Site Condition	Recommendations
Site Number	Reach	Project Station(s)	Erosion Concern	Projection of the 3H:1V levee slope free of erosion?	Berm width is greater than 35 feet?	HEC-RAS Cross-Section(s)	200YR Right OB Velocity (ft/s)	200YR Channel Velocity (ft/s)	Planform	Measured Average Erosion Rate between 1968 - 1986 (feet/year)	Calculated Wind and Wave Height (ft)	Critical or Not Critical?	Monitor as part of on-going O&M or Action required for levee certification
16	19	1213+85 - 1297+83	Levee repair zone	Yes	Yes	33.00 32.75 32.25	1.14 0.93 1.20	3.03 2.75 2.85	Bend	0.0	Wave runup contained within freeboard	Not Critical No encroachment into ULDC defined prism; berm width greater than 35 ft.	Maintenance monitoring as part of on-going O&M
17	22	1433+83 - 1503+83	Identified potential erosion area due to 90 degree angle bend	Yes	Yes	40.49 40.19 39.45 39.23 38.71	1.57 1.75 1.46 1.27 0.63	3.79 3.98 4.90 4.95 3.90	Outside Bend	1.4	Wave runup contained within freeboard	Not Critical No encroachment into ULDC defined prism; berm width greater than 35 ft due to over widened levee.	Maintenance monitoring as part of on-going O&M
18	23	1503+83 - 1609+37 1515+63 - 1534+67	Identified waterside slope erosion. Grouted riprap placed by USACE in 1968, Levee erosion noted by citizens in 1991.	Yes	Yes	44.23 43.34 42.19 41.2	1.88 0.99 1.68 1.48	3.48 4.47 4.37 3.83	Straight & Bend	0.0	Wave runup contained within freeboard	Not Critical No encroachment into ULDC defined prism; velocities near permissible velocities.	Maintenance monitoring as part of on-going O&M
19	28	1765+00	Site Ranking 177th in the 2011 SRBPP.[3] Feather River in close proximity to levee.	Yes	Yes	48.07 47.7 47.55	2.29 0.81	7.35 7.07 7.58	Outside Bend	1.4	Wave runup contained within freeboard	Not Critical No encroachment into ULDC defined prism; berm width greater than 35 ft.	Maintenance monitoring as part of on-going O&M
20	30	1842+00	Feather River in close proximity to levee	Yes	Yes	49.78 49.38 49.21	2.28 1.04 1.35	8.46 7.26 6.37	Outside Slight Bend	1.7	Wave runup contained within freeboard	Not Critical No encroachment into ULDC defined prism; berm width greater than 35 ft.	Maintenance monitoring as part of on-going O&M

Location and Description of Identified Sites with Potential Levee Safety Risk Due to Erosion				Results from Assessment of Erosion Hazard Factors								Findings	Recommendations
Site Location			Erosion Concern	Compromised Levee Prism		Stream Flow Velocity[1]			Planform	Erosion Rate[2]	Wind and Wave Height	Site Condition	Recommendations
Site Number	Reach	Project Station(s)	Erosion Concern	Projection of the 3H:1V levee slope free of erosion?	Berm width is greater than 35 feet?	HEC-RAS Cross-Section(s)	200YR Right OB Velocity (ft/s)	200YR Channel Velocity (ft/s)	Planform	Measured Average Erosion Rate between 1968 - 1986 (feet/year)	Calculated Wind and Wave Height (ft)	Critical or Not Critical?	Monitor as part of on-going O&M or Action required for levee certification
21	30/31	1895+00 - 1920+00	Identified slope stability due to rapid drawdown near Gridley Bridge	No	No	50.498 50.489 50.487 50.2	0.69 - 0.12 1.10	9.68 9.39 9.24 8.89	Straight & Bend	0.0	Wave runup contained within freeboard	Critical Encroachment into the ULDC defined prism.	Action required for levee certification
22	31	1920+00 - 1958+00	Feather River in close proximity to levee	Yes	Yes	51.1777 51.04 50.84 50.7 50.59 50.498	1.37 0.40 - - - 0.69	4.37 3.82 6.73 7.72 11.40 9.68	Outside Bend	0.0	Wave runup contained within freeboard	Not Critical No encroachment into ULDC defined prism; berm width greater than 35 ft.	Maintenance monitoring as part of on-going O&M
23	40	2328+00	High hydraulic model results	Yes	Yes	58.26 57.95 57.7	2.03 4.84 3.83	6.99 9.84 12.12	Bend	0.0	Wave runup contained within freeboard	Not Critical No encroachment into ULDC defined prism; berm width greater than 35 ft.	Maintenance monitoring as part of on-going O&M

[1] Stream flow velocities were taken from HEC-RAS model results provided by PBI on August 8, 2011.

[2] Measured erosion rates between 1968 - 1986 were taken from Water Engineering & Technology, Inc. two documents, *Geomorphic Analysis and Bank Protection Alternatives Report for Sacramento River (RM 78-194) and Feather River (RM 028)* , dated May 1990, and *Geomorphic Analysis and Bank Protection Alternatives for Sacramento River River (RM 0-78), Feather River (RM 28-61),Yuba River (RM 0-11), Bear River (RM 0-17), American River (RM 0-23), and portions of Three Mile, Steamboat, Sutler, Miner, Georgiana, Elk and Cache Sloughs* , dated June 1991

[3] The Sacramento River Bank Protection Project's 2011 Annual Erosion Reconnaissance Engineering Report documents known erosion sites and ranking, if requiring repair.

Erosion Attributed to Wind and Wave Run-up

The FRWL Project wind and wave run-up analysis documented in PBI (2011) was reviewed to determine whether run-up is causing erosion that would deem a site as critical. If a levee does not have adequate freeboard and is prone to wave overtopping, the probability of a levee failure can be greater.

Based on PBI's study results, the wind and wave run-up expected is less than three (3) feet and contained within the levee freeboard. Additionally, where cutoff walls were installed, a significant portion of the waterside slope was removed, re-built and hydroseeded to reduce the potential for erosion. This, coupled with past performance, indicates that wave run-up is relatively minor and can be assumed not to be a major cause of erosion.

Wave erosion from boat wake is another possible source of erosion to the levees, however, is not significantly prevalent on this reach of the Feather River.

CALIFORNIA DEPARTMENT OF WATER RESOURCES
URBAN LEVEE DESIGN CRITERIA COMPLIANCE
SECTION 7.10 – Erosion

FEATHER RIVER WEST LEVEE
STA 512+00 thru STA 2368+26

I hereby certify that the planned work for the FRWL Project Phase I (from Station 512+00 to Station 2368+26, excluding Stations 1674+37 to 1769+31), has been completed and complies with the requirements of DWR's ULDC Section 7.10 (May 2012). Furthermore, I hereby certify that the FRWL from Station 1674+37 to Station 1769+31 is a freeboard levee and is not needed to provide an urban level of flood protection.

Professional Engineer in Responsible Charge:

_ _____ 6/11/2021__

Elizabeth K. Mesbah
HDR Engineering, Inc. Date
California Professional Engineer No. C-73078

3.11 Right-of-Way (ULDC Section 7.11)

3.11.1 Applicable ULDC Requirements

Per Section 7.11 of the ULDC, Right-of-Way requirements were established to meet the following three objectives:

I. Allow adequate room for maintenance, inspection, patrolling during high water, and flood-fighting.

II. To the extent practical, adequate right-of-way should be available to provide additional room to expand flood protection facilities in the future.

III. Prohibit excavations and land modifications that would endanger the integrity of the levee or floodwall.

To meet the first objective, the ULDC requires the following:

1. Fee title or an easement for the entire levee prism or flood protection features, such as berms or relief wells, extending to a minimum of 20 feet beyond the landside toe of the flood protection system is required. For flood protection features such as berms or relief wells, the minimum 20-foot-wide landside zone must extend past the edge of these facilities. Fee title is preferred, but easements are allowed. If the rights for the 20-foot-wide landside zone have not been acquired and/or are a major challenge to acquire, the ULDC allows for the following:
    a. Where the adjoining landside properties are currently undeveloped and are currently largely agricultural or open space, the city or county must develop and adopt a long-term right-of-way plan establishing the following:
        i. General plan policies, building standards or an ordinance that prevents, to the extent allowable by law, incompatible structures or excavations in the 20-foot-wide landside zone until it is acquired.
        ii. A realistic plan and target schedule for acquiring the rights for the 20-foot-wide landside zone.
    b. Where the adjoining landside properties are already developed within 20 feet of the landside toe of the levee, but acquiring the 20-foot-wide landside zone presents a major challenge, the ULDC offers two options:
        i. Option 1: Obtain permanent rights (fee title or easement) for a clear zone having only a 10-foot width beyond the landside levee toe (or other flood protection feature such as a berm or relief well).
        ii. Option 2: Obtain permanent rights to meet visibility requirements as established by the CVFPB in Title 23 for a width of 20 feet beyond the landside levee toe (or other flood protection feature such as a berm or relief well). Title 23 visibility requirements pertain to visibility through fencing, walls, structures, and for controlling vegetation.
2. Where there is sufficient area to do so without resulting in the loss of sensitive riparian habitat, the ULDC recommends that consideration should be given to acquiring a 15-foot-wide zone waterward of the waterside levee toe. This waterside

zone would be used to facilitate levee inspection and maintenance and for maintaining a firebreak next to a levee slope that is routinely burned.

To meet the second objective, the ULDC recommends acquiring right-of-way that has a width equal to at least four times the levee height or 50 feet, whichever is greater, landward of the 20-foot clear zone for longer-term flood protection.

To meet the third objective, the ULDC recommends that the city of county adopt restrictions on excavations within 200 to 400 feet of the levee toe. Restrictions should address any excavation or land modification that would endanger the integrity of the levee or flood protection feature by increasing seepage or uplift.

Additional Requirements by DWR for EIP Funding

DWR has been providing the majority of the funds for the design and construction work associated with the FRWL Project through DWR's Early Implementation Project (EIP) program and the Urban Flood Risk Reduction (UFRR) program. As a condition of this funding, DWR issued the following right-of-way requirements in a December 5, 2011 letter from Noel Lerner, DWR's Chief of the Flood Projects Office, to William H. Edgar, Executive Director of the Sutter Butte Flood Control Agency:

- For undeveloped land along the landside levee toe, permanent rights-of-way must be obtained for a distance of 30 feet (versus 20 feet mandated by the ULDC) landward beyond the landside levee toe. Where there are additional flood protection elements beyond the landside levee toe such as a berm or relief well, the right-of-way must extend 30 feet landward beyond these elements.
- The 30-foot landside width can be obtained as either fee or easement.
- The rights for the first 20 feet beyond the levee toe or flood protection feature must include the right to keep this portion clear and accessible for levee maintenance and inspection, and the potential for placing fence or similar demarcation where appropriate.
- The outer or landward 10 feet, that is the corridor between 20 and 30 feet landward of the landside levee toe or flood protection feature, can be used for agriculture, recreation or beneficial uses so long as flood protection is the dominant right.
- For undeveloped land on the waterside, the right-of-way requirements include acquiring permanent rights for 15 feet beyond the levee toe or flood protection feature and the right to keep this portion clear and accessible for levee maintenance and inspection.
- The 15-foot width on the waterside can be obtained as either fee or easement.

These requirements do not pertain to currently developed areas where there are residential or commercial structures, or infrastructure such as electrical switchyards, or canals within 30 feet of the levee toe.

3.11.2 Documentation of ULDC Compliance

The following subsections detail the general right-of-way approach adopted by SBFCA for the FRWL Project to meet the requirements ULDC Section 7.11 and the additional requirements imposed by DWR.

Fee versus Easement

The ULDC recommends that right-of-way for flood protection facilities are acquired in fee instead of easements. DWR's EIP staff has also urged acquiring right-of-way in the form of fee title. Moreover, as a condition of funding the FRWL Project, DWR is also requiring that permanent rights be acquired for the ability to fence along the edges of the right-of-way and to exclude other uses on the levee. In order to obtain the necessary property rights for flood protection and to meet the requirements set by DWR, SBFCA determined that ***most*** of the right-of-way to be acquired for the FRWL Project will need to be in fee title. However, there are exceptions where easements were acquired instead due to compelling or necessary reasons (e.g. the need for construction access is a temporary condition). Obtaining easements instead of fee title in these instances will not compromise flood protection.

Conversion of Existing Levee Easements to Fee Title

For much, if not most, of the levee reaches in the FRWL Project, there are already easements that are owned by various public agencies including the State of California, Levee District No. 1, Levee District No. 9 or Reclamation District 777, city of Yuba City, Sutter County, and Butte County. These easements are each unique with respect to the language used and the rights granted. Some of the easements cover the entire levee prism and some only partially cover the levee. Some of the easements extend out beyond the levee prism, while others do not. Also, there are multiple levee easements on some properties. These easements generally allow for routine access and maintenance. Where the FRWL Project work is anticipated, SBFCA intends to acquired fee title for the entire levee footprint in most cases to: (i) ensure that SBFCA has rights to fully modify or rehabilitate the levee for necessary flood protection (ii) existing easement rights are overburdened by the FRWL Project work, and (iii) meet the requirements set by DWR's EIP funding conditions (see above). In essence, at FRWL Project locations, these existing easements are being changed to fee title in most cases. Where such easements do not already exist or are incomplete, fee title will also be acquired to accommodate the FRWL Project. In addition to the levee footprint, land occupied by other new FRWL Project flood control features will also be acquired in fee, in most cases.

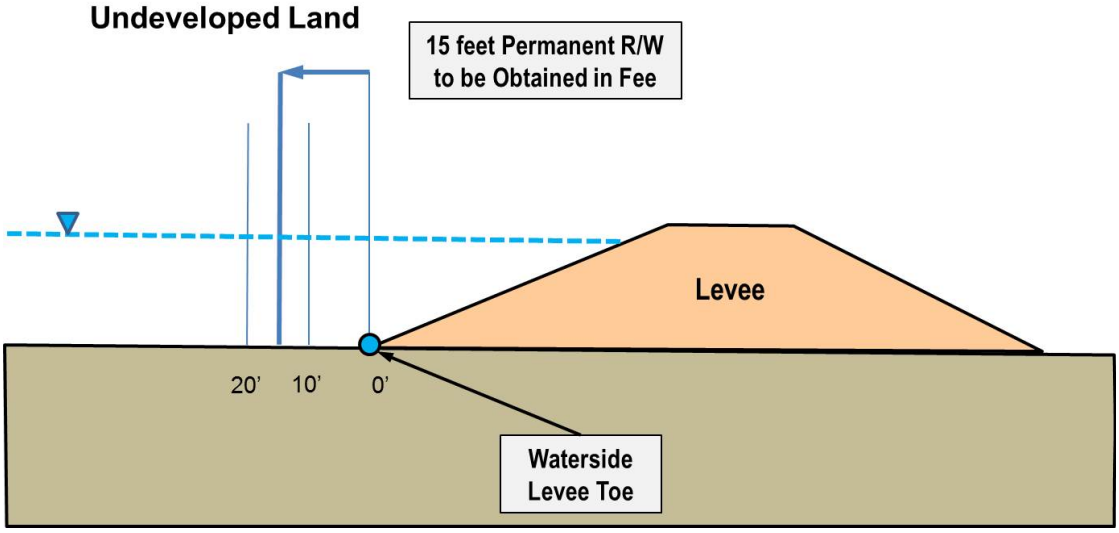
General Approach for Waterside Right-of-Way Acquisitions

The majority of the Feather River West Levee is setback from the main channel of the Feather River itself. Where the levee is setback from the river SBFCA obtained waterside real estate at FRWL Project work locations. Waterside real estate requirements for the FRWL Project are different depending upon whether the waterside land is already developed and has permanent structures such as houses or major agricultural/industrial buildings near the levee.

Where development is already present along the waterside toe, no additional real estate is required and was not acquired.

In undeveloped areas, permanent rights for 15 feet waterward of the waterside toe were and include the right to keep this portion clear and accessible for levee maintenance and inspection. This is necessary for flood protection and is also required as a condition of funding for the EIP project. In general, the rights will in the form of fee title as illustrated below in Figure 3.11.1.

Figure 3.11-1 Right-of-Way Acquisition for Undeveloped Land Waterside of the Levee



General Approach for Landside Right-of-Way Acquisition

Landside real estate requirements for the FRWL Project are significantly more complicated and depend not only on whether the land was already developed, but also on what type of levee remediation is either already present or added as part of the FRWL Project. The different types of landside acquisition are as follows:

Landside Right-of-Way Acquisition for Developed Land (Structures Present)

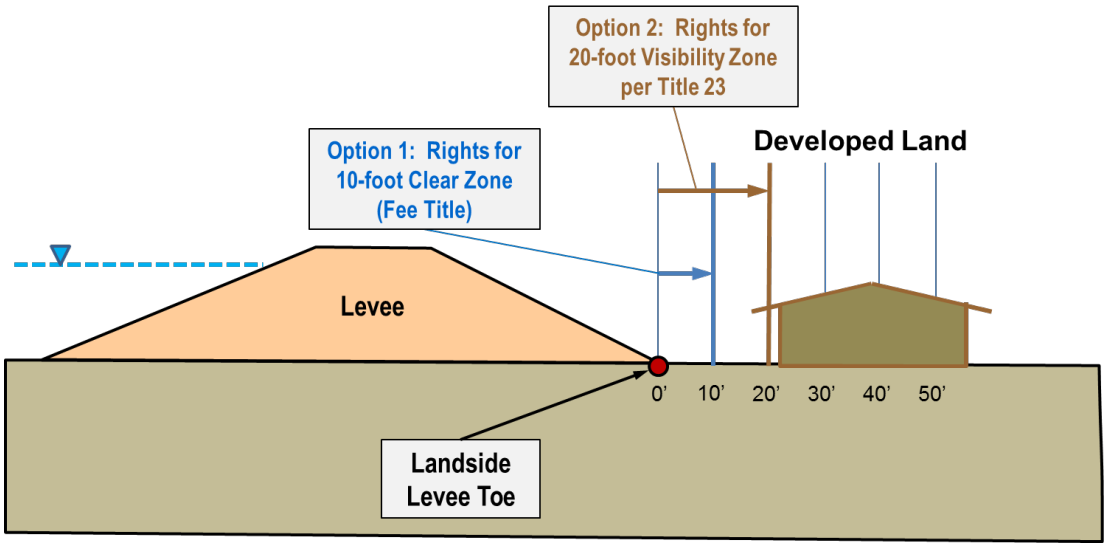
The ULDC generally requires a minimum of 20 feet of permanent landside right-of-way to provide a clear zone for routine and emergency operations and maintenance. However, for land that has already been developed and where acquiring additional right-of-way for a 20-foot clear zone would be a major challenge, the FRWL Project can meet ULDC requirements using either of the following two options:

- Option 1: Obtain permanent rights (fee title) for a clear zone having only a 10-foot width beyond the landside levee toe or other flood protection feature.
- Option 2: Obtain permanent rights to meet visibility requirements as established by the CVFPB in Title 23 for a width of 20 feet beyond the landside levee toe or other flood protection feature. Title 23 visibility requirements pertain to visibility through fencing, walls, structures, and for controlling vegetation. Walls, fences, vegetative screens or other physical obstructions which restrict the ability to conduct inspections

of the landside toe and adjacent 20 feet shall be modified or removed to allow for visual inspection of the ground surface.

Depending on the circumstances, these rights were acquired as part of the FRWL Project or they may be acquired over time as described in the ULDC. Both of the landside right-of-way options for landside developed lands. Figure 3.11.2 illustrates the general approach for acquiring right-of-way on the landside of the levee when structures were present.

Figure 3.11-2 Right-of-Way Acquisition for Developed Land Landward of the Levee

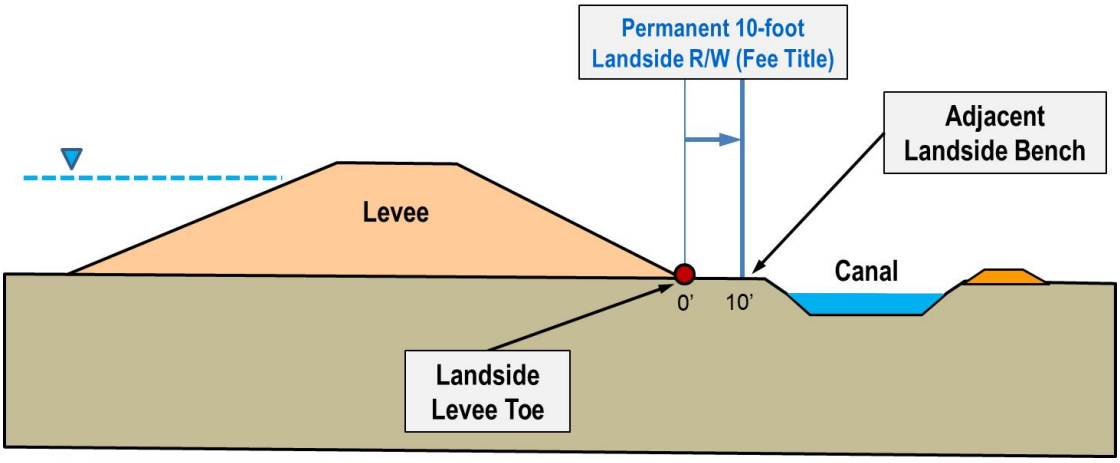


Landside Right-of-Way Acquisition for Developed Land (Canals Present)

In several reaches of the FRWL Project, irrigation canals are present along or near the landside levee toe. These canals can be regarded as structures and thus their footprints represent *"developed"* land. Further, they are not elements of the flood protection system and typically the critical seepage and stability areas are expected to be within the canal footprint rather than landward of the canal. The general right-of-way acquisition approach for landside canals adjacent to the levee followed the general ULDC criteria outlined above for developed land. Again, depending on the circumstances, these rights were acquired as part of the FRWL Project or they may be acquired over time as described in the ULDC.

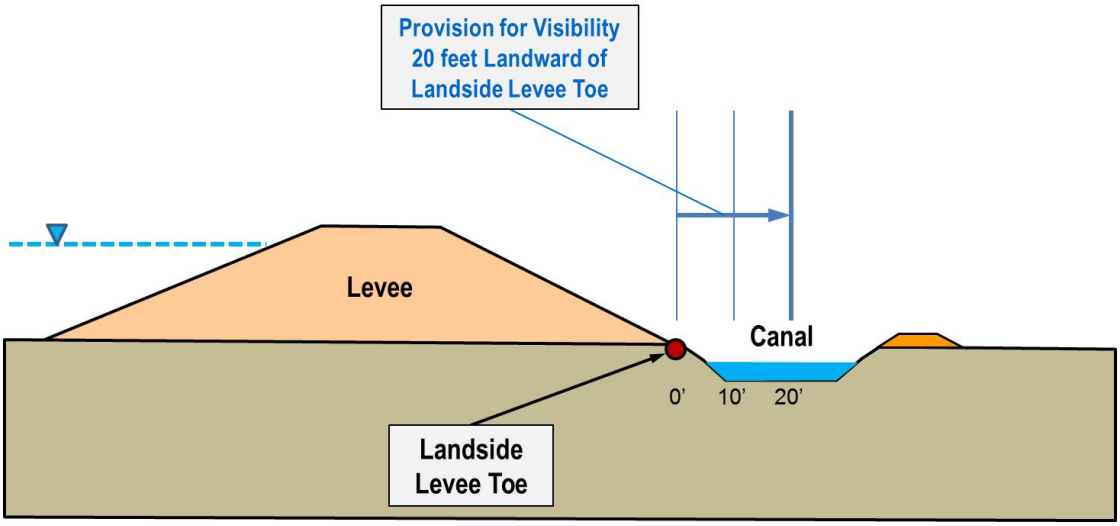
- Option 1: If there is a bench immediately landward of the landside levee toe between the levee and the canal, a permanent right-of-way (in fee title) will be obtained for a width of up to 10 feet (see Figure 3.11.3).

Figure 3.11-3 Right-of-Way Acquisition for Adjacent Landside Bench (where present) Between Landside Levee Toe and Canal



- Option 2: Where a landside bench is not present between the landside levee toe and the canal, permanent rights to meet visibility requirements as established by the CVFPB in Title 23 were obtained (see Figure 3.11.4).

Figure 3.11-4 Right-of-Way Acquisition for 20-feet of Visibility Where Landside Bench is not Present Between Landside Levee Toe and Canal



Landside Right-of-Way Acquisition for Undeveloped Land

SBFCA acquired 20 feet of land in fee title landward of the landside levee toe in undeveloped areas to meet flood protection needs and ULDC requirements. In addition, as a condition of EIP and UFRR funding for necessary flood control purposes, SBFCA acquired an additional 10-foot easement landward of the minimum 20-foot clear zone, for a total of 30 feet for undeveloped landside areas.

However, the additional 10-foot easement could allow land uses such as agriculture and recreation as long as permanent structures are not added. The rights for the first 20 feet beyond the levee toe or flood protection feature include the right to keep this portion clear and accessible for levee maintenance and inspection, and also the potential for placing a fence or similar demarcation where appropriate. Figures 3.11-5 and 3.11-6

illustrate the general approach for landside right-of-way acquisition for undeveloped land landward of the levee toe and landward of the flood protection feature (relief wells), respectively.

Figure 3.11-5 Right-of-Way Acquisition for Undeveloped Land Landward of the Levee

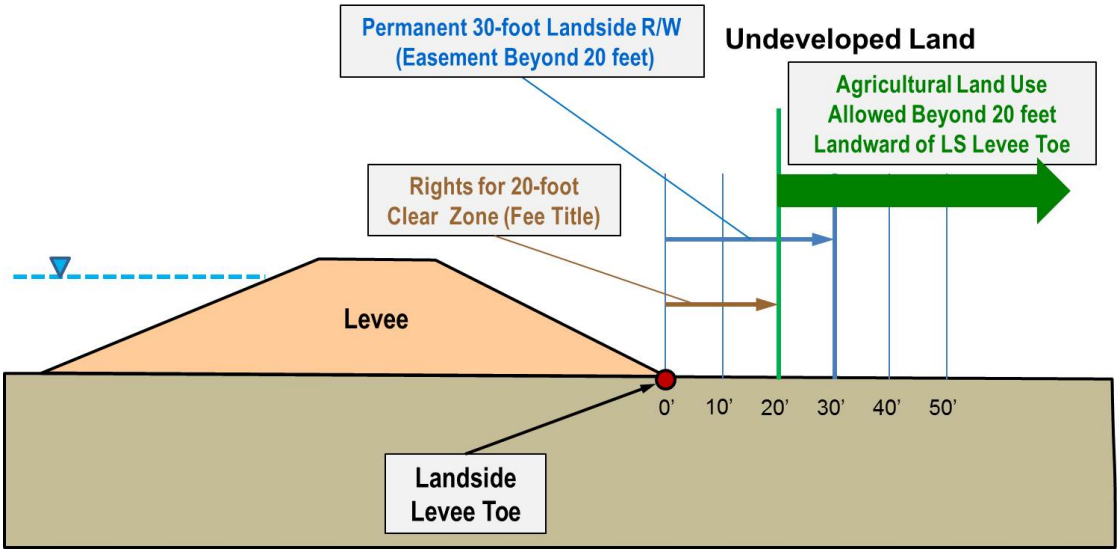
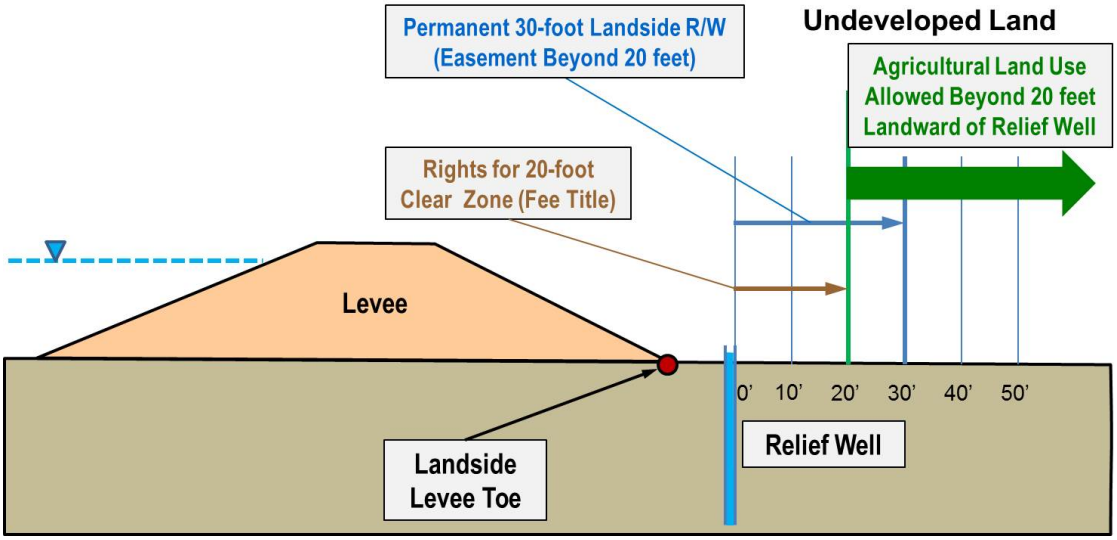


Figure 3.11-6 Right-of-Way Acquisition for Undeveloped Land Landward of the Levee with a Relief Well System



A summary of the general right-of-way acquisitions for the FRWL Project are summarized in Table 3.11-1.

Table 3.11-1. Summary of General Right-of-Way Acquisitions for the FRWL Project

Levee Side	Level of Development Beyond Levee Toe	Required Permanent Right-of-Way	Additional Temporary Construction Easement
Levee and Flood Protection Facilities Footprint	Undeveloped/Developed	Convert Existing Easements to Fee Title	None
Waterside	Undeveloped/No Structures Present	15 feet waterward of waterside levee toe (Fee Title)	None
	Developed/Structures Present	None	None
Landside	Undeveloped/No Structures Present	30 feet* landward of landside levee toe (or other flood protection element such as a berm or relief well). First 20 feet to be obtained in fee, landward or outer 10 feet to be obtained as easement.	0 to 10 feet landward of 30 feet of permanent R/W requirements; none where no levee rehabilitation is needed
	Developed/Structures Present	Either 10 feet landward of landside levee toe (or flood protection element) or 20 feet of visibility landward of landside levee toe (or flood protection element) per Title 23 requirements Depending on the circumstances, these rights may be acquired as part of the FRWLP or they may be acquired over time as described in the ULDC.	None beyond permanent R/W requirements
	Developed Area/Landside Canal Present	Obtain fee title up to 10 feet landward of levee toe if adjacent bench is present between landside levee toe and canal or Obtain rights for 20 feet of visibility per Title 23 requirements landward of landside levee toe if a bench between levee toe and canal does not exist Depending on the circumstances, these rights may be acquired as part of the FRWLP or they may be acquired over time as described in the ULDC.	0 to 10 feet landward of landside canal embankment toe in Undeveloped areas

Note: * Denotes that landward 10 feet of this 30-foot landside right-of-way may be used for agricultural or recreation purposes as long as no permanent structures are constructed.

For FRWL Project Phase I, it was not possible to obtain 20-feet of permanent landside right-of-way at all locations. However, SBFCA has a right-of-way plan in place for the entire reach of Phase 1 to either acquire 20 feet of permanent landside right-of-way or obtain permanent rights (fee title) for a clear zone having only a 10-foot width beyond the landside levee toe (or flood protection feature) or permanent rights to meet visibility requirements as established by the CVFPB in Title 23 for a width of 20-feet beyond the landside levee toe in the future.

Appendix C shows SBFCA's acquisition approach for all of the parcels along the FRWL Project Phase 1. As per ULDC criteria SBFCA is also planning to publicize a realistic target schedule for acquiring the property rights or meeting visibility requirements for the levee reaches for noncompliant parcels.

Based on the information discussed above, the FRWL Phase 1 Project meets the ULDC Right-of-Way (ULDC Section 7.11) requirements.

CALIFORNIA DEPARTMENT OF WATER RESOURCES
URBAN LEVEE DESIGN CRITERIA COMPLIANCE
SECTION 7.11 – Right-of-Way

FEATHER RIVER WEST LEVEE
STA 512+00 thru STA 2368+26

I hereby certify that the planned work for the FRWL Project Phase I (from Station 512+00 to Station 2368+26, excluding Stations 1674+37 to 1769+31), has been completed and complies with the requirements of DWR's ULDC Section 7.11 (May 2012). Furthermore, I hereby certify that the FRWL from Station 1674+37 to Station 1769+31 is a freeboard levee and is not needed to provide an urban level of flood protection.

Professional Engineer in Responsible Charge:

6/11/2021

Michael Bessette
Executive Director, SBFCA — Date
California Professional Engineer No. C-53088

3.12 Encroachments (Excluding Penetrations, Closure Structures, and Levee Vegetation) (ULDC Section 7.12)

3.12.1 Applicable ULDC Requirements

Per Section 7.12 of the ULDC, the Civil Engineer needs to assess existing encroachments and render an opinion as to their impact on the reliable performance of the levee/floodwall for the full range of loading up to the HTOL. The opinion needs to consider all encroachments within the channel, on the levee, and within the landside right-of-way, irrespective of whether the property rights have been acquired. Due to the limitation of analytical tools for assessing the impacts of the encroachments, the civil engineer needs to exercise sound engineering judgment in rendering this opinion.

A hazard assessment needs to be performed for each existing encroachment, whether permitted or not. Encroachments with a potential to be a high hazard need to have a full engineering evaluation, to demonstrate that the hazard is acceptable, or be removed or modified.

All existing encroachments are to be authorized by the agency responsible for permitting encroachments along the levee (or floodwall) or removed. The following criteria are to be used to determine if an encroachment is acceptable for meeting an urban level of flood protection:

- All existing encroachments considered a high hazard are to be removed or modified to restore the reliability of the levee/floodwall. Encroachment removal or modification shall be performed under the direction of a civil engineer and should address, at a minimum, seepage and slope stability issues and the structural integrity of the levee. In addition, the encroachment removal or modification must not significantly diminish hydraulic capacity of the channel or hinder operations and maintenance. A proposed removal or modification plan shall be approved by the levee maintaining agency and the CVFPB.
- For other existing encroachments which are not considered to be a high hazard, but either: (1) have not been permitted, or (2) interfere with operation, maintenance, or flood fight capability, the city or county is required to have an encroachment remediation plan in place, or reference such a plan.

3.12.2 Documentation of ULDC Compliance

In the winter of 2010, the USACE performed a periodic inspection of the Sutter Basin Protection Area levee system. Results of this inspection were presented in the *Final Periodic Inspection Report No. 1 for the Feather River – Sutter Basin Protection Area, Periodic Inspection – January 2010, Submitted to USACE Sacramento District [CESPK], Submitted by GHT2, April 20, 2010*. As part of this inspection, encroachments along the FRWL were identified.

In addition to the USACE inspection, the SBFCA design team performed field inspections to identify encroachments. A list of encroachments developed from the SBFCA design team field inspection and verified from the USACE inspection is included in MHM

(2020a) and (2020b). The encroachment list included in MHM (2020a) and (2020b) does not include encroachments between Stations 1674+37 and 1769+31.

Encroachments that were identified during the field inspection were then classified to be low hazard, moderate hazard, or high hazard. A high hazard was determined to be a feature that could directly result in a levee failure. No high hazard encroachments were identified on the FRWL Project Phase I. A moderate hazard was determined to be a feature that if it were to fail would result in a need for flood fight. Without the flood fight effort, the moderate hazard could become a high hazard and result in a levee failure. A moderate hazard should have a program to replace, rehabilitate, or relocate the feature so there is no to low hazard. A low hazard was determined to be a feature that would not result in a levee failure. An encroachment that is properly operated and maintained would be considered a low hazard. The hazard rating is shown in the tables included in MHM (2020b).

All devices and features that are incorporated into the levee as part of the levee improvement projects initially designed, permitted, and constructed by the USACE or DWR and subsequently by SBFCA (e.g. access ramps, stability and seepage berms, relief wells, security fencing and gates, drainage ditch, piezometers, monitoring wells, settlement monuments, inclinometers, sign posts) are not considered encroachments. These features are shown on the as-Built Record Drawings and incorporated into the Supplemental O&M Manuals. These items were constructed and incorporated as integral parts of the flood control system approved by the USACE and CVFPB.

In addition, annual inspections of the FRWL shall occur and more detailed inspections of encroachments shall occur every Five (5) years.

3.12.3 Exceptions to ULDC

As noted above, no high hazard encroachments were identified on the FRWL Project Phase I. Moderate and low hazard encroachments are identified in the tables below.

Existing encroachments that don't have an encroachment permit, but an encroachment permit is in the process of being obtained as part of the planned work, were rated as moderate hazards. For the purpose of meeting ULDC requirements, these encroachments are considered exceptions but were reviewed and determined to not have an impact levee integrity or flood safety. The planned work that will be completed in order to comply with the requirements listed in ULDC Section 7.12, without exceptions, is included in Tables 3.12-1 through 3.12-3 below.

SBFCA is currently working on modifying and/or obtaining encroachment permits along the FRWL Project Phase I and anticipates obtaining them within five (5) years.

Table 3.12-1. Encroachments Planned Work – Project Area B (Starr Bend Road to Shanghai Bend Road)

Feature	Approximate Location	Description	Hazard Rating and Comments
Landside 12 kV Overhead Power Line	Station 749+50 to 761+50 Unit 144 LM 8.89 to LM 9.12	Power poles (4) running at or within levee toe.	**Low Hazard**
			Encroachment does not impact levee stability.
			Power poles and lines are maintained by PG&E and are in operable condition. No performance issues with this power line crossing have been identified.
			SBFCA will work with PG&E to relocate the powerlines to the west side of Garden Highway or obtain a variance to allow poles to remain.
			The encroachment is not covered by CVFPB Permit. SBFCA will work with PG&E to obtain an encroachment permit for this crossing or have the poles relocated.

Table 3.12-2 - Encroachments Planned Work – Project Area C (Shanghai Bend Road to Campbell Road)

Feature	Approximate Location	Description	Hazard Rating and Comments
PG&E Natural Gas Pipeline at Landside Toe	Station 930+00 to 951+25 Unit 144 LM 12.31 to LM 12.71	Natural gas pipeline running parallel to landside levee toe from toe to ten (10) feet.	**Low Hazard**
			Access ramp does not meet Title 23 requirements.
			Encroachment does not impact levee stability. Pipeline does not meet setback standards and needs to be relocated.
			Natural gas pipeline is maintained by PG&E and are in operable condition. No performance issues with this gas line have been identified
			SBFCA and LD 1 will work with PG&E to relocate the gas line to the west side of Second Street. The encroachment is not covered by CVFPB Permit. LD 1 made this a requirement for an endorsement of Pipeline 124 A work. Abandonment in-place was not an option allowed by LD 1 during the endorsement of Pipeline 124A work.
Landside 12 kV Overhead Power Line	Station 958+95 to 971+60 Unit 144	Power poles (6) running at or within fifteen (15) of levee toe.	**Low Hazard**
			Facilities meet Title 23 setback requirements.
			Encroachment does not impact levee stability.

Table 3.12-2 - Encroachments Planned Work – Project Area C (Shanghai Bend Road to Campbell Road)

Feature	Approximate Location	Description	Hazard Rating and Comments
	LM 12.86 to LM 13.10		Power poles and lines are maintained by PG&E and are in operable condition. No performance issues with this power line crossing have been identified
			The facilities have pending CVFPB Permit 19332 currently being processed.
12 kV Overhead Power Line Levee Crossing	Station 971+70 Unit 144 LM 13.10	PG&E 12 kV Overhead powerline crossing poles	**Low Hazard**
			Power poles and lines are maintained by PG&E and are in operable condition. No performance issues with this power line crossing have been identified
			Power poles shall be located outside of the levee ROW or 15 feet, whichever is great, from levee toes. Cables have a clearance over the levee crown of at least 21 feet in accordance with CVFPB requirements. Poles and cables do not present adverse impacts for levee operation and maintenance as long as the poles remain standing with the lines properly attached to the poles.
			SBFCA will work with PG&E to relocate the power poles to a minimum of 15 feet away from levee toes or to obtain a variance to allow pole to remain.
			The facilities have pending CVFPB Permit 19333 currently being processed.
Stout Residence House and associated improvements	Station 973+30 Unit 144 LM 13.13	House and associated improvements within 15 feet of levee toe	**Moderate Hazard**
			Does not meet Title 23 requirements.
			Adequate width does not exist for inspection, maintenance, and potential flood fight.
			SBFCA will work with property owner to relocate the improvements to a minimum of 15 feet away from levee toe. SBFCA is in the process of amending permits to allow access for inspections.

Table 3.12-2 - Encroachments Planned Work – Project Area C (Shanghai Bend Road to Campbell Road)

Feature	Approximate Location	Description	Hazard Rating and Comments
			SBFCA will work with Property Owner and CVFPB to amend encroachment permit no. 16425 BD once adequate clearance is established for inspection, maintenance, and flood fight or an operation and maintenance (O&M) agreement shall be completed and entered into with CVFPB outlining O&M and flood flight activities including access onto the property for inspections.
Brockman Residence House and associated improvements	Station 974+25 Unit 144 LM 13.15	House and associated improvements within 5 feet of levee toe	**Moderate Hazard**
			Does not meet Title 23 requirements.
			Adequate width does not exist for inspection, maintenance, and potential flood fight.
			SBFCA will work with property owner to relocate the improvements to outside of Levee ROW or to fifteen (15) feet from levee toe, whichever is greater. SBFCA is in the process of amending permits to allow access for inspections.
			SBFCA will work with Property Owner and CVFPB to amend encroachment permit no. 16426 BD once adequate clearance is established for inspection, maintenance, and flood fight or an operation and maintenance (O&M) agreement shall be completed and entered into with CVFPB outlining O&M and flood flight activities including access onto the property for inspections.
Garage and associated improvements	Station 975+40 Unit 144 LM 13.17	Garage and associated improvements within 5 feet of levee toe	**Moderate Hazard**
			Does not meet Title 23 requirements.
			Adequate width does not exist for inspection, maintenance, and potential flood fight.
			SBFCA will work with property owner to relocate the improvements to outside of Levee ROW or to fifteen (15) feet from levee toe, whichever is greater. SBFCA is in the process of amending permits to allow access for inspections.

Table 3.12-2 - Encroachments Planned Work – Project Area C (Shanghai Bend Road to Campbell Road)

Feature	Approximate Location	Description	Hazard Rating and Comments
			SBFCA will work with Property Owner and CVFPB to amend encroachment permit no. 16427 BD once adequate clearance is established for inspection, maintenance, and flood fight or an operation and maintenance (O&M) agreement shall be completed and entered into with CVFPB outlining O&M and flood flight activities including access onto the property for inspections.
Coble Residence Shed and associated improvements	Station 976+10 Unit 144 LM 13.18	Shed and associated improvements within 5 feet of levee toe	**Moderate Hazard**
			Does not meet Title 23 requirements.
			Adequate width does not exist for inspection, maintenance, and potential flood fight.
			SBFCA will work with property owner to relocate the improvements to outside of Levee ROW or to fifteen (15) feet from levee toe, whichever is greater. SBFCA is in the process of amending permits to allow access for inspections.
			SBFCA will work with Property Owner and CVFPB to amend encroachment permit no. 16428 BD once adequate clearance is established for inspection, maintenance, and flood fight or an operation and maintenance (O&M) agreement shall be completed and entered into with CVFPB outlining O&M and flood flight activities including access onto the property for inspections.
Filby Residence fencing and associated improvements	Station 978+80 Unit 144 LM 13.23	Chain link fencing and gates and associated improvements within 5 feet of levee toe	**Low Hazard**
			Does not meet Title 23 requirements.
			Adequate width does not exist for inspection, maintenance, and potential flood fight.
			SBFCA will work with property owner to relocate the improvements to outside of Levee ROW or to fifteen (15) feet from levee toe, whichever is greater. SBFCA is in the process of amending permits to allow access for inspections.

Table 3.12-2 - Encroachments Planned Work – Project Area C (Shanghai Bend Road to Campbell Road)

Feature	Approximate Location	Description	Hazard Rating and Comments
			SBFCA will work with Property Owner and CVFPB to amend encroachment permit no. 16429 BD once adequate clearance is established for inspection, maintenance, and flood fight or an operation and maintenance (O&M) agreement shall be completed and entered into with CVFPB outlining O&M and flood flight activities including access onto the property for inspections.
Sandoval Residence Shed and associated improvements	Station 979+40 Unit 144 LM 13.25	Shed and see through fencing and associated improvements within 5 feet of levee toe	**Moderate Hazard**
			Does not meet Title 23 requirements.
			Adequate width does not exist for inspection, maintenance, and potential flood fight.
			SBFCA will work with property owner to relocate the improvements to outside of Levee ROW or to fifteen (15) feet from levee toe, whichever is greater. SBFCA is in the process of amending permits to allow access for inspections.
			SBFCA will work with Property Owner and CVFPB to amend encroachment permit no. 16430 BD once adequate clearance is established for inspection, maintenance, and flood fight or an operation and maintenance (O&M) agreement shall be completed and entered into with CVFPB outlining O&M and flood flight activities including access onto the property for inspections.
Shed and associated improvements	Station 979+90 Unit 144 LM 13.25	Shed and fencing and associated improvements within 10 feet of levee toe	**Moderate Hazard**
			Does not meet Title 23 requirements.
			Adequate width does not exist for inspection, maintenance, and potential flood fight.
			SBFCA will work with property owner to relocate the improvements to outside of Levee ROW or to fifteen (15) feet from levee toe, whichever is greater. SBFCA is in the process of amending permits to allow access for inspections.

Table 3.12-2 - Encroachments Planned Work – Project Area C (Shanghai Bend Road to Campbell Road)

Feature	Approximate Location	Description	Hazard Rating and Comments
			SBFCA will work with Property Owner and CVFPB to amend encroachment permit no. 16431 BD once adequate clearance is established for inspection, maintenance, and flood fight or an operation and maintenance (O&M) agreement shall be completed and entered into with CVFPB outlining O&M and flood flight activities including access onto the property for inspections.
Stevenson Residence Fencing and associated improvements	Station 980+15 Unit 144 LM 13.26	Chain link fencing and associated improvements within 10 feet of levee toe	**Low Hazard**
			Does not meet Title 23 requirements.
			Adequate width does not exist for inspection, maintenance, and potential flood fight.
			SBFCA will work with property owner to relocate the improvements to outside of Levee ROW or to fifteen (15) feet from levee toe, whichever is greater. SBFCA is in the process of amending permits to allow access for inspections.
			SBFCA will work with Property Owner and CVFPB to amend encroachment permit no. 16432 BD once adequate clearance is established for inspection, maintenance, and flood fight or an operation and maintenance (O&M) agreement shall be completed and entered into with CVFPB outlining O&M and flood flight activities including access onto the property for inspections.

Table 3.12-2 - Encroachments Planned Work – Project Area C (Shanghai Bend Road to Campbell Road)

Feature	Approximate Location	Description	Hazard Rating and Comments
Ron Souza Residence Shed, Fencing, and associated improvements	Station 981+25 Unit 144 LM 13.28	Shed, Chain link fencing, and associated improvements within 5 to 15 feet of levee toe	**Moderate Hazard**
			Does not meet Title 23 requirements.
			Adequate width does not exist for inspection, maintenance, and potential flood fight.
			SBFCA will work with property owner to relocate the improvements to outside of Levee ROW or to fifteen (15) feet from levee toe, whichever is greater. SBFCA is in the process of amending permits to allow access for inspections.
			SBFCA will work with Property Owner and CVFPB to amend encroachment permit no. 16433 BD once adequate clearance is established for inspection, maintenance, and flood fight or an operation and maintenance (O&M) agreement shall be completed and entered into with CVFPB outlining O&M and flood flight activities including access onto the property for inspections.
Coakley Residence Building, Fencing, and associated improvements	Station 981+25 Unit 144 LM 13.28	Building, fencing, and associated improvements on slope to 15 feet of levee toe	**Moderate Hazard**
			Does not meet Title 23 requirements.
			Adequate width does not exist for inspection, maintenance, and potential flood fight.
			SBFCA will work with property owner to relocate the improvements to outside of Levee ROW or to fifteen (15) feet from levee toe, whichever is greater. SBFCA is in the process of amending permits to allow access for inspections.
			SBFCA will work with Property Owner and CVFPB to amend encroachment permit no. 16434 BD once adequate clearance is established for inspection, maintenance, and flood fight or an operation and maintenance (O&M) agreement shall be completed and entered into with CVFPB outlining O&M and flood flight activities including access onto the property for inspections.
Albrecht Residence	Station 984+50	Building, fencing, and associated	**Moderate Hazard**
			Does not meet Title 23 requirements.

Table 3.12-2 - Encroachments Planned Work – Project Area C (Shanghai Bend Road to Campbell Road)

Feature	Approximate Location	Description	Hazard Rating and Comments
Building and associated improvements	Unit 144 LM 13.34	improvements within 10 feet of levee toe	Adequate width does not exist for inspection, maintenance, and potential flood fight.
			SBFCA will work with property owner to relocate the improvements to outside of Levee ROW or to fifteen (15) feet from levee toe, whichever is greater. SBFCA is in the process of amending permits to allow access for inspections.
			SBFCA will work with Property Owner and CVFPB to amend encroachment permit no. 16435 BD once adequate clearance is established for inspection, maintenance, and flood fight or an operation and maintenance (O&M) agreement shall be completed and entered into with CVFPB outlining O&M and flood flight activities including access onto the property for inspections.
Koball Residence Fencing and associated improvements	Station 985+30 Unit 144 LM 13.36	Chain link fencing and associated improvements within 5 feet of levee toe	**Low Hazard**
			Does not meet Title 23 requirements.
			Adequate width does not exist for inspection, maintenance, and potential flood fight.
			SBFCA will work with property owner to relocate the improvements to outside of Levee ROW or to fifteen (15) feet from levee toe, whichever is greater. SBFCA is in the process of amending permits to allow access for inspections.
			SBFCA will work with Property Owner and CVFPB to amend encroachment permit no. 16436 BD once adequate clearance is established for inspection, maintenance, and flood fight or an operation and maintenance (O&M) agreement shall be completed and entered into with CVFPB outlining O&M and flood flight activities including access onto the property for inspections.
Wilkins Residence Structure, Fencing, and	Station 986+00 Unit 144 LM 13.37	Green house structure, retaining wall, fencing and associated	**Moderate Hazard**
			Does not meet Title 23 requirements.
			Adequate width does not exist for inspection, maintenance, and potential flood fight.

Table 3.12-2 - Encroachments Planned Work – Project Area C (Shanghai Bend Road to Campbell Road)

Feature	Approximate Location	Description	Hazard Rating and Comments
associated improvements		improvements on slope to within 10 feet of levee toe	SBFCA will work with property owner to relocate the improvements to outside of Levee ROW or to fifteen (15) feet from levee toe, whichever is greater. SBFCA is in the process of amending permits to allow access for inspections.
			SBFCA will work with Property Owner and CVFPB to amend encroachment permit no. 16437 BD once adequate clearance is established for inspection, maintenance, and flood fight or an operation and maintenance (O&M) agreement shall be completed and entered into with CVFPB outlining O&M and flood flight activities including access onto the property for inspections.
Sanders Residence Swimming Pool, Retaining Wall, and associated improvements	Station 986+75 Unit 144 LM 13.38	Swimming pool, retaining wall, fencing, and associated improvements on slope to within 10 feet of levee toe	**Moderate Hazard**
			Does not meet Title 23 requirements.
			Adequate width does not exist for inspection, maintenance, and potential flood fight.
			SBFCA will work with property owner to relocate the improvements to outside of Levee ROW or to fifteen (15) feet from levee toe, whichever is greater. SBFCA is in the process of amending permits to allow access for inspections.
			SBFCA will work with Property Owner and CVFPB to amend encroachment permit no. 16438 BD once adequate clearance is established for inspection, maintenance, and flood fight or an operation and maintenance (O&M) agreement shall be completed and entered into with CVFPB outlining O&M and flood flight activities including access onto the property for inspections.

Table 3.12-2 - Encroachments Planned Work – Project Area C (Shanghai Bend Road to Campbell Road)

Feature	Approximate Location	Description	Hazard Rating and Comments
Poole Residence Building, Retaining Wall, and associated improvements	Station 987+60 Unit 144 LM 13.40	Building, retaining wall, fencing, concrete stairs, and associated improvements on slope to within 10 feet of levee toe	**Moderate Hazard**
			Does not meet Title 23 requirements.
			Adequate width does not exist for inspection, maintenance, and potential flood fight.
			SBFCA will work with property owner to relocate the improvements to outside of Levee ROW or to fifteen (15) feet from levee toe, whichever is greater. SBFCA is in the process of amending permits to allow access for inspections.
			SBFCA will work with Property Owner and CVFPB to amend encroachment permit no. 16439 BD once adequate clearance is established for inspection, maintenance, and flood fight or an operation and maintenance (O&M) agreement shall be completed and entered into with CVFPB outlining O&M and flood flight activities including access onto the property for inspections.
Barr Residence Building, Retaining Wall, and associated improvements	Station 988+50 Unit 144 LM 13.42	Building, retaining wall, fencing, concrete stairs, and associated improvements on slope to within 10 feet of levee toe	**Moderate Hazard**
			Does not meet Title 23 requirements.
			Adequate width does not exist for inspection, maintenance, and potential flood fight.
			SBFCA will work with property owner to relocate the improvements to outside of Levee ROW or to fifteen (15) feet from levee toe, whichever is greater. SBFCA is in the process of amending permits to allow access for inspections.
			SBFCA will work with Property Owner and CVFPB to amend encroachment permit no. 16440 BD once adequate clearance is established for inspection, maintenance, and flood fight or an operation and maintenance (O&M) agreement shall be completed and entered into with CVFPB outlining O&M and flood flight activities including access onto the property for inspections.
Hall Residence Garage, Shed,	Station 989+20	Garage, shed, retaining wall,	**Moderate Hazard**
			Does not meet Title 23 requirements.

Table 3.12-2 - Encroachments Planned Work – Project Area C (Shanghai Bend Road to Campbell Road)

Feature	Approximate Location	Description	Hazard Rating and Comments
Retaining wall, and associated improvements	Unit 144 LM 13.43	fencing, concrete stairs, and associated improvements on slope to within 10 feet of levee toe	Adequate width does not exist for inspection, maintenance, and potential flood fight.
			SBFCA will work with property owner to relocate the improvements to outside of Levee ROW or to fifteen (15) feet from levee toe, whichever is greater. SBFCA is in the process of amending permits to allow access for inspections.
			SBFCA will work with Property Owner and CVFPB to amend encroachment permit no. 16441 BD once adequate clearance is established for inspection, maintenance, and flood fight or an operation and maintenance (O&M) agreement shall be completed and entered into with CVFPB outlining O&M and flood flight activities including access onto the property for inspections.
McClendon Residence Building, Fencing, and associated improvements	Station 989+75 Unit 144 LM 13.44	2 story house, fencing, retaining wall, concrete stairs, and associated improvements on slope to within 10 feet of levee toe	**Moderate Hazard**
			Does not meet Title 23 requirements.
			Adequate width does not exist for inspection, maintenance, and potential flood fight.
			SBFCA will work with property owner to relocate the improvements to outside of Levee ROW or to fifteen (15) feet from levee toe, whichever is greater. SBFCA is in the process of amending permits to allow access for inspections.
			SBFCA will work with Property Owner and CVFPB to amend encroachment permit no. 16442 BD once adequate clearance is established for inspection, maintenance, and flood fight or an operation and maintenance (O&M) agreement shall be completed and entered into with CVFPB outlining O&M and flood flight activities including access onto the property for inspections.
Dennis McCarly Residence Garage, Shop, Fencing, and	Station 990+50 Unit 144 LM 13.46	Garage, Shop, fencing, retaining wall, concrete stairs, and associated	**Moderate Hazard**
			Does not meet Title 23 requirements.
			Adequate width does not exist for inspection, maintenance, and potential flood fight.

Table 3.12-2 - Encroachments Planned Work – Project Area C (Shanghai Bend Road to Campbell Road)

Feature	Approximate Location	Description	Hazard Rating and Comments
associated improvements		improvements on slope to within 10 feet of levee toe	SBFCA will work with property owner to relocate the improvements to outside of Levee ROW or to fifteen (15) feet from levee toe, whichever is greater. SBFCA is in the process of amending permits to allow access for inspections.
			SBFCA will work with Property Owner and CVFPB to amend encroachment permit no. 16443 BD once adequate clearance is established for inspection, maintenance, and flood fight or an operation and maintenance (O&M) agreement shall be completed and entered into with CVFPB outlining O&M and flood flight activities including access onto the property for inspections.
Frank McCarly Residence Shed, Retaining Wall, Shop, Fencing, and associated improvements	Station 991+00 Unit 144 LM 13.47	Shed, green house structure, fencing, retaining wall, concrete stairs, and associated improvements on slope to within 10 feet of levee toe	**Moderate Hazard**
			Does not meet Title 23 requirements.
			Adequate width does not exist for inspection, maintenance, and potential flood fight.
			SBFCA will work with property owner to relocate the improvements to outside of Levee ROW or to fifteen (15) feet from levee toe, whichever is greater. SBFCA is in the process of amending permits to allow access for inspections.
			SBFCA will work with Property Owner and CVFPB to amend encroachment permit no. 16444 BD once adequate clearance is established for inspection, maintenance, and flood fight or an operation and maintenance (O&M) agreement shall be completed and entered into with CVFPB outlining O&M and flood flight activities including access onto the property for inspections.

Table 3.12-2 - Encroachments Planned Work – Project Area C (Shanghai Bend Road to Campbell Road)

Feature	Approximate Location	Description	Hazard Rating and Comments
Cosker Residence Shed, Retaining Wall, Shop, Fencing, and associated improvements	Station 992+00 Unit 144 LM 13.48	Structure, fencing, retaining wall, concrete stairs, and associated improvements on slope to within 10 feet of levee toe	**Moderate Hazard**
			Does not meet Title 23 requirements.
			Adequate width does not exist for inspection, maintenance, and potential flood fight.
			SBFCA will work with property owner to relocate the improvements to outside of Levee ROW or to fifteen (15) feet from levee toe, whichever is greater. SBFCA is in the process of amending permits to allow access for inspections.
			SBFCA will work with Property Owner and CVFPB to amend encroachment permit no. 16445 BD once adequate clearance is established for inspection, maintenance, and flood fight or an operation and maintenance (O&M) agreement shall be completed and entered into with CVFPB outlining O&M and flood flight activities including access onto the property for inspections.
Fletcher Building, Retaining Wall, and associated improvements	Station 999+25 to 1000+40 Unit 144 LM 13.62 to 13.64	Building, retaining wall, and associated improvements at slope to within 10 feet of levee toe	**Moderate Hazard**
			Facilities meet Title 23 requirements.
			Adequate width does not exist for inspection, maintenance, and potential flood fight.
			SBFCA will work with property owner to relocate the improvements to outside of Levee ROW or to fifteen (15) feet from levee toe, whichever is greater. SBFCA is in the process of amending permits to allow access for inspections.
			SBFCA will work with Property Owner and CVFPB to amend encroachment permit no. 16447 BD once adequate clearance is established for inspection, maintenance, and flood fight or an operation and maintenance (O&M) agreement shall be completed and entered into with CVFPB outlining O&M and flood flight activities including access onto the property for inspections.

Table 3.12-2 - Encroachments Planned Work – Project Area C (Shanghai Bend Road to Campbell Road)

Feature	Approximate Location	Description	Hazard Rating and Comments
City of Yuba City Pump House, Concrete Stairs	Station 1005+80 Unit 144 LM 13.75	Concrete stairs located landside slope of levee and pump house with water well within 10 feet of levee.	**Moderate Hazard**
			Facility does not meet Title 23 requirements
			Encroachment does not impact levee stability, levee O&M, or flood fighting access.
			Concrete Stairs, Pump House, and water well are maintained by City of Yuba City and are in operable condition. No performance issues have been identified.
			SBFCA will work with Property Owner and CVFPB to amend encroachment permit no. 16450 BD once adequate clearance is established for inspection, maintenance, and flood fight or an operation and maintenance (O&M) agreement shall be completed and entered into with CVFPB outlining O&M and flood flight activities including access onto the property for inspections.
Retaining Wall	Station 1010+00 Unit 144 LM 13.83	Five (5) foot high retaining wall at the landside toe.	**Moderate Hazard**
			Facilities do not meet Title 23 requirements
			Encroachment does not impact levee stability, levee O&M, or flood fighting access. Wood Rodger performed the stability analysis.
			Retaining wall is not currently being maintained. No performance issues have been identified. Wall was identified on USACE PI.
			This retaining wall does not have a CVFPB Encroachment Permit. SBFCA will work with property owner to remove and dispose retaining wall or obtain new CVFPB encroachment permit. No encroachment permit will be required if wall removed.
Retaining Wall	Station 1010+00 to 1011+50 Unit 144 LM 13.83 to 13.85	Two (2) foot high retaining wall at the landside toe.	**Moderate Hazard**
			Facilities do not meet Title 23 requirements
			Encroachment does not impact levee stability, levee O&M, or flood fighting access. Wood Rodger performed the stability analysis.
			No performance issues have been identified. Wall was identified on USACE PI.
			This retaining wall has a pending CVFPB Permit No. 19266.

Table 3.12-2 - Encroachments Planned Work – Project Area C (Shanghai Bend Road to Campbell Road)

Feature	Approximate Location	Description	Hazard Rating and Comments
PG&E Natural Gas Pipeline at Landside Toe	Station 1042+50 to 1080+50 Unit 144 LM 14.44 to LM 15.16	Natural gas pipeline running parallel to landside levee toe from five (5) to ten (10) feet.	**Low Hazard**
			Gas line does not meet Title 23 clearance requirements.
			Encroachment does not impact levee stability, levee O&M, or flood fighting access
			Natural gas pipeline is maintained by PG&E and is in an operable condition. No performance issues with this gas line have been identified.
			SBFCA will work with PG&E to relocate the gas line to outside of the Levee ROW or to fifteen (15) feet away from the levee landside toe, whichever is greater or obtain a variance. The encroachment is not covered by CVFPB Permit. SBFCA will work with PG&E to obtain an individual CVFPB encroachment permit with variance or have gas line relocated so the pipeline will not require an encroachment permit.
Sutter Extension Water District – Sutter Butte Main Canal	Station 1428+50 to 1449+00 Unit 148 LM 5.60 to LM 5.99	Sutter Butte Main Canal is a high lined earth irrigation canal.	**Moderate Hazard**
			The levee adjacent to the Sutter Butte Main canal does not meet Title 23 requirements.
			Sutter Butte Main is operated and maintained by Sutter Extension Water District and is in operable condition. No performance issues other than typical erosion and bank sloughing have been identified
			AECOM has performed geotechnical analysis of the channel bank and levee slope. No stability issues were noted.
			This Sutter Butte Main Canal does not have a CVFPB Encroachment Permit. The Canal was constructed prior to the levee construction. SBFCA has been working with DWR to obtain an operating agreement with Sutter Extension Water District.
12 kV Overhead Power Line Levee Crossing	Station 1429+68 Unit 148	PG&E 12 kV Overhead	**Low Hazard**
			Line crossing does meet Title 23 clearance standards.

Table 3.12-2 - Encroachments Planned Work – Project Area C (Shanghai Bend Road to Campbell Road)

Feature	Approximate Location	Description	Hazard Rating and Comments
	LM 5.63	powerline crossing	Power poles and lines are maintained by PG&E and are in operable condition. No performance issues with this power line crossing have been identified
			Power poles are not located outside of Levee ROW or more than fifteen (15) feet away from levee toes. Cables shall have a clearance over the levee crown of at least twenty-one (21) feet in accordance with CVFPB requirements or meet PUC General Order 95 whichever is greater. Poles and cables do not present adverse impacts for levee operation and maintenance as long as the poles remain standing with the lines properly attached to the poles.
			This utility has a pending CVFPB Permit No. 19338.
60 kV Overhead Power Line Levee Crossing	Station 1429+98 Unit 148 LM 5.63	PG&E 60 kV Overhead powerline crossing	**Low Hazard**
			Line crossing does meet Title 23 clearance standards.
			Power poles and lines are maintained by PG&E and are in operable condition. No performance issues with this power line crossing have been identified
			Power poles are not located outside of Levee ROW or more than fifteen (15) feet away from levee toes. Cables shall have a clearance over the levee crown of at least twenty-one (21) feet in accordance with CVFPB requirements or meet PUC General Order 95 whichever is greater. Poles and cables do not present adverse impacts for levee operation and maintenance as long as the poles remain standing with the lines properly attached to the poles.
			This utility has a pending CVFPB Permit No. 19339.
12 kV Overhead Power Pole Guy water at	Station 1439+90 Unit 148	PG&E guy wire and anchor located in	**Low Hazard**
			Line crossing does meet Title 23 clearance standards.

Table 3.12-2 - Encroachments Planned Work – Project Area C (Shanghai Bend Road to Campbell Road)

Feature	Approximate Location	Description	Hazard Rating and Comments
landside levee toe	LM 5.82	landside slope of levee.	The guy wire and anchor are maintained by PG&E and is in operable condition. No performance issues with this guy wire and anchor have been identified
			Power poles are not located outside of Levee ROW or more than fifteen (15) feet away from levee toes. Cables shall have a clearance over the levee crown of at least twenty-one (21) feet in accordance with CVFPB requirements or meet PUC General Order 95 whichever is greater. Poles and cables do not present adverse impacts for levee operation and maintenance as long as the poles remain standing with the lines properly attached to the poles.
			This utility has a pending CVFPB Permit No. 19340.
Gushi Residence Septic Tank, Water Well, Structures, Fencing, and associated improvements	Station 1470+15 Unit 148 LM 0.19 (MA16)	Septic tank, leach field, water well, walkway, fencing and associated improvements on slope to within 10 feet of levee toe	**Moderate Hazard**
			Facilities do not meet Title 23 requirements.
			Adequate width does not exist for inspection, maintenance, and potential flood fight.
			SBFCA will work with property property owner to relocate to outside of Levee ROW or to more than fifteen (15) feet from levee toe, whichever is greater.
			SBFCA will work with Property Owner and CVFPB to amend encroachment permit no. 17168 BD once adequate clearance is established for inspection, maintenance, and flood fight or an operation and maintenance (O&M) agreement shall be completed and entered into with CVFPB outlining O&M and flood flight activities including access onto the property for inspections.

Table 3.12-2 - Encroachments Planned Work – Project Area C (Shanghai Bend Road to Campbell Road)

Feature	Approximate Location	Description	Hazard Rating and Comments
Wayne Sue Residence Structures, Water Well, Structures, Fencing, and associated improvements	Station 1485+00 Unit 148 LM 0.46 (MA16)	Two Structures, water well, fencing and associated improvements on slope to within 10 feet of levee toe	**Moderate Hazard**
			Facilities do not meet Title 23 requirements.
			Adequate width exists for inspection, maintenance, and potential flood fight.
			SBFCA will work with property owner to relocate to outside of Levee ROW or to more than fifteen (15) feet from levee toe, whichever is greater.
			SBFCA will work with Property Owner and CVFPB to amend encroachment permit no. 17139 BD once adequate clearance is established for inspection, maintenance, and flood fight or an operation and maintenance (O&M) agreement shall be completed and entered into with CVFPB outlining O&M and flood flight activities including access onto the property for inspections.
Butte Water District Landside Access Ramp	Station 1610+50 Unit 148 LM 2.85 (MA16)	Landside Access Ramp	**Low Hazard**
			Access ramp meets Title 23 requirements.
			Encroachment does not impact levee stability, levee O&M, or flood fighting access.
			Access ramp is required to be maintained by Butte Water District and is in operable condition. No performance issues with this ramp have been identified.
			The encroachment has CVFPB Encroachment Permit No. 19272.
Butte Water District – Sutter Butte Main Canal	Station 1610+50 to 1623+50 Unit 148 LM 2.85 to LM 3.10 (MA16)	Sutter Butte Main Canal is a high lined earth irrigation canal.	**Moderate Hazard**
			The levee adjacent to the Sutter Butte Main canal does not meet Title 23 requirements.
			Sutter Butte Main is operated and maintained by Butte Water District and is in operable condition. No performance issues other than typical erosion and bank sloughing have been identified
			AECOM has performed geotechnical analysis of the channel bank and levee slope. No stability issues were noted.

Table 3.12-2 - Encroachments Planned Work – Project Area C (Shanghai Bend Road to Campbell Road)

Feature	Approximate Location	Description	Hazard Rating and Comments
			This Sutter Butte Main Canal does not have a CVFPB Encroachment Permit. The Canal was constructed prior to the levee construction. SBFCA has been working with DWR and the CVFPB to obtain an operating agreement with Sutter Extension Water District.

Table 3.12-3 - Encroachments Planned Work – Project Area D (Campbell Road to Afterbay)

Feature	Approximate Location	Description	Hazard Rating and Comments
12 kV Overhead Power Line Levee Crossing	Station 1653+15 Unit 148 LM 3.66 (MA16)	PG&E 12 kV Overhead powerline crossing	**Low Hazard**
			Line crossing does not meet Title 23 clearance standards.
			Power poles and lines are maintained by PG&E and are in operable condition. No performance issues with this power line crossing have been identified
			Power poles are not located outside of Levee ROW or more than fifteen (15) feet away from levee toes. Cables shall have a clearance over the levee crown of at least twenty-one (21) feet in accordance with CVFPB requirements or meet PUC General Order 95 whichever is greater. Poles and cables do not present adverse impacts for levee operation and maintenance as long as the poles remain standing with the lines properly attached to the poles.
			This utility has a pending CVFPB Encroachment Permit No. 1671-1.
12 kV Overhead Power Line Levee Crossing	Station 1675+98 Unit 152 LM 0.01 (MA7)	PG&E 12 kV Overhead powerline crossing	**Low Hazard**
			Line crossing does not meet Title 23 clearance standards.
			Power poles and lines are maintained by PG&E and are in operable condition. No performance issues with this power line crossing have been identified

Table 3.12-3 - Encroachments Planned Work – Project Area D (Campbell Road to Afterbay)

Feature	Approximate Location	Description	Hazard Rating and Comments
			Power poles are not located outside of Levee ROW or more than fifteen (15) feet away from levee toes. Cables shall have a clearance over the levee crown of at least twenty-one (21) feet in accordance with CVFPB requirements or meet PUC General Order 95 whichever is greater. Poles and cables do not present adverse impacts for levee operation and maintenance as long as the poles remain standing with the lines properly attached to the poles.
			This utility has a CVFPB Encroachment Permit No. 3692. SBFCA will work with PG&E to amend a CVFPB encroachment permit once pole relocated or variance obtained.
Butte Water District – Sutter Butte Main Canal	Station 1902+50 to 1958+00 Unit 152 LM 4.30 to LM 5.35	Sutter Butte Main Canal is a high lined earth irrigation canal	**Moderate Hazard**
			The levee adjacent to the Sutter Butte Main canal does not meet Title 23 requirements.
			Sutter Butte Main is operated and maintained by Butte Water District and is in operable condition. No performance issues other than typical erosion and bank sloughing have been identified
			AECOM has performed geotechnical analysis of the channel bank and levee slope. No stability issues were noted.
			This Sutter Butte Main Canal does not have a CVFPB Encroachment Permit. The Canal was constructed prior to the levee construction. SBFCA has been working with DWR and the CVFPB to obtain an operating agreement with Sutter Extension Water District.
Shop Structure	Station 2282+05 to 2282+75 Unit 152 LM 11.49 to LM 11.50	Shop Structure within and adjacent to waterside levee slope. Not in theoretical levee prism.	**Moderate Hazard**
			Structure does not meet Title 23 clearance standards.
			Encroachment does not impact levee stability, levee O&M, or flood fighting access.
			SBFCA has performed an analysis to determine the structure is not a high hazard and does not impact levee stability. SBFCA placed rip rap on waterside levee slope to address potential erosion related to the location of the structure.

Table 3.12-3 - Encroachments Planned Work – Project Area D (Campbell Road to Afterbay)

Feature	Approximate Location	Description	Hazard Rating and Comments
			This structure does not have a CVFPB Encroachment Permit. SBFCA will work with landowner to obtain a CVFPB encroachment permit for the structure. SBFCA submitted a CVFPB encroachment to allow the structure to remain in the floodway. It should be noted that the structure is shown on the USACE as-built drawings when the project levee was originally constructed. The pending encroachment permit is 19403.

Table 3.12-4 - Encroachments Near-Term Planned Work – Project Area D (Campbell Road to Afterbay)

Feature	Approximate Location	Description	Hazard Rating and Comments
12 kV Overhead Power Line Levee Crossing	Station 1653+15 Unit 148 LM 3.66 (MA16)	PG&E 12 kV Overhead powerline crossing	**Low Hazard**
			Line crossing does not meet Title 23 clearance standards.
			Power poles and lines are maintained by PG&E and are in operable condition. No performance issues with this power line crossing have been identified
			Power poles are not located more than thirty (30) feet from landside toe and fifteen (15) feet from waterside levee toes. Cables have a clearance over the levee crown of at least twenty-five (25) feet in accordance with CVFPB requirements. Poles and cables do not present adverse impacts for levee operation and maintenance as long as the poles remain standing with the lines properly attached to the poles.
			This utility has a pending CVFPB Encroachment Permit No. 1671-1.
12 kV Overhead Power Line Levee Crossing	Station 1675+98 Unit 152 LM 0.01 (MA7)	PG&E 12 kV Overhead powerline crossing	**Low Hazard**
			Line crossing does not meet Title 23 clearance standards.
			Power poles and lines are maintained by PG&E and are in operable condition. No performance issues with this power line crossing have been identified

Table 3.12-4 - Encroachments Near-Term Planned Work – Project Area D (Campbell Road to Afterbay)

Feature	Approximate Location	Description	Hazard Rating and Comments
			Power poles are not located more than thirty (30) feet from landside toe and fifteen (15) feet from waterside levee toes. Cables have a clearance over the levee crown of at least twenty-five (25) feet in accordance with CVFPB requirements. Poles and cables do not present adverse impacts for levee operation and maintenance as long as the poles remain standing with the lines properly attached to the poles.
			This utility has a CVFPB Encroachment Permit No. 3692. SBFCA will work with PG&E to amend a CVFPB encroachment permit once pole relocated or variance obtained.
Butte Water District – Sutter Butte Main Canal	Station 1902+50 to 1958+00 Unit 152 LM 4.30 to LM 5.35	Sutter Butte Main Canal is a high lined earth irrigation canal	**Moderate Hazard**
			The levee adjacent to the Sutter Butte Main canal does not meet Title 23 requirements.
			Sutter Butte Main is operated and maintained by Butte Water District and is in operable condition. No performance issues other than typical erosion and bank sloughing have been identified
			AECOM has performed geotechnical analysis of the channel bank and levee slope. No stability issues were noted.
			This Sutter Butte Main Canal does not have a CVFPB Encroachment Permit. The Canal was constructed prior to the levee construction. SBFCA has been working with CVFPB to obtain an operating agreement with Sutter Extension Water District.
Shop Structure	Station 2282+05 to 2282+75 Unit 152 LM 11.49 to LM 11.50	Shop Structure within and adjacent to waterside levee slope. Not in theoretical levee prism.	**Moderate Hazard**
			Structure does not meet Title 23 clearance standards.
			Encroachment does not impact levee stability, levee O&M, or flood fighting access.
			SBFCA is performed an analysis to determine the structure is not a high hazard and does not impact levee stability. SBFCA placed rip rap on waterside levee slope to address potential erosion related to the location of the structure.

Table 3.12-4 - Encroachments Near-Term Planned Work – Project Area D (Campbell Road to Afterbay)

Feature	Approximate Location	Description	Hazard Rating and Comments
			This utility does not have a CVFPB Encroachment Permit. SBFCA will work with landowner to obtain a CVFPB encroachment permit for structure or to have the structure removed.

CALIFORNIA DEPARTMENT OF WATER RESOURCES
URBAN LEVEE DESIGN CRITERIA COMPLIANCE
SECTION 7.12 – Encroachments (Excluding Penetrations, Closure Structures, and Levee Vegetation)

FEATHER RIVER WEST LEVEE
STA 512+00 to STA 1674+37 and STA 1769+31 to STA 2368+26

I hereby certify that the planned work for the FRWL Project Phase I (from Station 512+00 to Station 2368+26, excluding Stations 1674+37 to 1769+31), has been completed and complies with the requirements of DWR's ULDC Section 7.12 (May 2012) with exceptions indicated. Furthermore, I hereby certify that the FRWL from Station 1674+37 to Station 1769+31 is a freeboard levee and is not needed to provide an urban level of flood protection.

Professional Engineer in Responsible Charge:

6/11/2021

Sean M. Minard
M H M Incorporated
California Professional Engineer No. C52593

Date

3.13 Penetrations (ULDC Section 7.13)

3.13.1 Applicable ULDC Requirements

Per Section 7.13 of the ULDC, the Civil Engineer needs to assess existing penetrations and render an opinion as to their impact on the reliable performance of the levee/floodwall for the full range of loading up to the HTOL. Due to the limitations of analytical tools for assessing the impacts of penetrations, the Civil Engineer needs to exercise sound engineering judgment in rendering this opinion.

A hazard assessment needs to be performed for each penetration, whether permitted or not. Penetrations with a potential to be a high hazard need to have a full engineering evaluation, to demonstrate that the hazard is acceptable, or be removed or modified. All penetrations are to be authorized by the agency responsible for permitting penetrations along the levee (or floodwall), removed, or properly abandoned. Operation and maintenance of the penetration shall comply with the conditions required by the approved permit application.

Per the ULDC, the following criteria are to be used to determine if a penetration was acceptable for meeting an urban level of flood protection:

- All existing penetrations considered high hazard shall be removed or modified to restore the reliability of the levee/floodwall.
- Pressure pipes/conduits crossing beneath the levee crown must be above the DWSE (1957 WSE profile or 200-year DWSE, whichever is greater) and outside of the landside and waterside slope of the theoretical levee prism. Exceptions were allowed outside of the landside and waterside slope of levee prism if it is determined not to be feasible.
- Pressure pipes/conduits must be equipped with a positive cutoff valve waterside of the levee crown. All pressure pipes/conduits temporally removed for the construction of cutoff walls will be reviewed to determine if they need to be replaced or modified in accordance with Title 23 requirements. Any pipelines that are permitted and newer than 1995 shall be assumed reusable and only the portion above the working platform will be removed and replaced. The pipe crossings will be modified to include a positive closure device and anti-siphon, as needed. Pipelines between 1985 and 1995 will be upgraded as needed and will be reviewed on a case by case basis. New pipe material will be used for any portion removed. All pipelines older than 1985 will be completely removed and replaced within twenty (20) feet of landside toe and fifteen (15) feet of waterside toe.
- Gravity pipes beneath the levee crown shall meet Title 23 criteria (i.e. 30 inches minimum, positive closure device, proper pipe material). All gravity pipelines will be reviewed to determine if they need to be replaced or modified. Any pipelines that are permitted and newer than 1995 shall be assumed reusable and only the portion above the working platform will be removed and replaced. The pipe crossings will be modified to include a positive closure device and anti-siphon, as needed. Pipelines between 1985 and 1995 will be upgraded as needed and will be reviewed on a case by case basis. New pipe material will be used for any portion removed. All pipelines older than 1985 will be completely removed and replaced within twenty (20) feet of landside toe and fifteen (15) feet of waterside toe.

- No plastic pipe will be used.
- For other existing penetrations which are not considered to be a high hazard but have not been permitted, the city or county is required to have a penetration remediation plan in place, or reference such a plan.

3.13.2 Documentation of ULDC Compliance

In 2011, MHM compiled an inventory of utility penetrations for the FRWL Project Phase I (MHM, 2020a) and (2020c) and has continued to maintain since 2011. The penetration list included in MHM (2020a) and (2020c) does not include penetrations between Stations 1674+37 and 1769+31. SBFCA will certify that the FRWL from Station 1674+37 to Station 1769+31 is a freeboard levee and is not needed to provide an urban level of flood protection from a 200-year flood. The purpose of the inventory was to obtain information on the location and elevation of the utility, identify any historic problems at the utility penetration, and to obtain information on the maintenance, condition, and integrity of the utility penetrations. Activities associated with the inventory included (1) a review of available information pertaining to the utilities and (2) discussions about utility maintenance and performance with utility engineers and LMA representatives.

The penetrations identified that were identified during the field inspection were then classified to be low hazard, moderate hazard, or high hazard. A high hazard was determined to be a feature that could directly result in a levee failure. There are no High Hazard penetrations for the FRWL Project Phase I. A moderate hazard was determined to be a feature that if it were to fail would result in a need for flood fight. Without the flood fight effort, the moderate hazard could become a high hazard and result in a levee failure. A moderate hazard should have a program to replace, rehabilitate, or relocate the feature such there is no to low hazard. A low hazard was determined to be a feature that would not result in a levee failure. A penetration that is within its theoretical life and properly operated and maintained would be considered a low hazard. The hazard rating is shown in the tables included in MHM (2020c).

Annual inspections shall occur and more detailed inspections shall include every five (5) years. For instance, on pipe penetrations, a pressure test or pipe video shall occur to verify the integrity of the pipe.

3.13.3 Exceptions to ULDC

As noted above, no high hazard penetrations were identified on the FRWL Project Phase I. Moderate and low hazard penetrations are identified in the tables below.

Existing penetrations with no pressure tests and/or pipe video inspections completed within the past five to 10 years were rated as moderate hazards. For the purpose of meeting ULDC requirements, these penetrations are considered exceptions but were reviewed and determined to not have an impact levee integrity or flood safety due to their age. It should be noted that these penetrations were constructed as a part of the FRWL Project Phase I. Additionally, as of the date of this report, all penetrations older than 10 years have had pressure tests and/or pipe video inspections.

The planned work that will be completed in order to comply with the requirements listed in ULDC Section 7.13, without exceptions, is included in Tables 3.13-1 below.

SBFCA is currently working with penetration owners to obtain copies of pressure test results and/or video inspections of the penetrations listed in the table below. It is anticipated that any penetration with pressure tests and/video inspections older than 5 years will have such tests performed as follows:

- Approximately 20% completed within one (1) year,
- Approximately 50% completed within two (2) years,
- 100% completed within five (5) years.

Additionally, it is anticipated that all encroachment permits for penetrations will be obtained within 3 years.

Table 3.13-1 – Penetrations Planned Work – Project Area C (Shanghai Bend Road to Campbell Road)

Feature	Approximate Location	Description	Invert Elevation	Hazard Rating and Comments
Pacific Gas and Electric Natural Gas Pipeline	Station 913+19 Unit 144 LM 11.99	2-12 inch OD steel pipe and 1-2 inch steel pipes.	Approximately 78.6 (200 - Year Elevation 75.40)	**Moderate Hazard**
				Pipeline installation date is unknown. No problems have been identified at this location due to the pipeline.
				SBFCA is working with PG&E to obtain a letter that attests to regular inspections with no problems detected.
				Remaining life of pipeline exceeds five (5) years. PG&E shall program funds for pipe replacement within next five (5) to ten (10) years.
				Pipe has sufficient cover to withstand vehicular traffic on the levee crown and has adequate strength to withstand levee loading, per USACE EM-1110-2-1913, Chapter 8.
				Pipe material meets the requirements per USACE EM-1110-2-2902, Chapter 7.
				SBFCA will work with PG&E to install positive closure device at waterside hinge in accordance with ULDC requirements and replace pipeline or provide proof on pipeline integrity. A minimum, they will need to meet Title 23 requirements for a positive closure within ten (10) feet of landside toe.

Table 3.13-1 – Penetrations Planned Work – Project Area C (Shanghai Bend Road to Campbell Road)

Feature	Approximate Location	Description	Invert Elevation	Hazard Rating and Comments
				SBFCA is working with the encroachment owner to obtain pressure test results or video test results since pipeline is over five (5) years old and no testing data could be provided by utility owner. CVFPB has started the notice of violation process with PG&E to obtain the required inspection data for the pipeline.
				Utility does not have a CVFPB Encroachment Permit. SBFCA will work with PG&E to obtain an individual encroachment permit for this utility.
Pacific Gas and Electric Natural Gas Pipeline	Station 1073+41 Unit 144 LM 15.03	16 inch steel pipe	Approximately 81.2 (200-Year Elevation 78.68)	**Moderate Hazard**
				Pipeline installed in 1955. No problems have been identified at this location due to the pipeline.
				SBFCA is working with PG&E to obtain a letter that attests to regular inspections with no problems detected.
				Remaining life of pipeline exceeds five (5) years.
				Pipe has sufficient cover to withstand vehicular traffic on the levee crown and has adequate strength to withstand levee loading, per USACE EM-1110-2-1913, Chapter 8.
				Pipe material meets the requirements per USACE EM-1110-2-2902, Chapter 7.
				SBFCA will work with PG&E to install positive closure device at waterside hinge in accordance with ULDC requirements or obtain a variance. PG&E will develop program for pipe replacement or provide proof on pipeline integrity. At minimum a positive closure device needs to be installed within ten (10) feet of landside per Title 23.

Table 3.13-1 – Penetrations Planned Work – Project Area C (Shanghai Bend Road to Campbell Road)

Feature	Approximate Location	Description	Invert Elevation	Hazard Rating and Comments
				SBFCA is working with the encroachment owner to obtain pressure test results or video test results since pipeline is over five (5) years old and no testing data could be provided by utility owner. CVFPB has started the notice of violation process with PG&E to obtain the required inspection data for the pipeline.
				Utility does not have a CVFPB Encroachment Permit. SBFCA will work with PG&E to obtain an individual encroachment permit for this utility.
Pacific Gas and Electric Natural Gas Pipeline	Station 1079+91 Unit 144 LM 15.15	8-inch steel pipe	Approximately 82.0 (200-Year Elevation 78.68)	**Low Hazard**
				Pipeline installed in 2014 under CVFPB Permit No. 18912.
				SBFCA is working with PG&E to obtain a letter that attests to regular inspections with no problems detected.
				CVFPB granted PG&E a variance to Title 23, § 123(d)(7) to exclude requirement for positive closure device within ten (10) feet of levee toe. The USACE also reviewed the variance request and according to CVFPB concurred with request. There is a positive closure device within 80 feet of landside levee toe.
				Pipe has sufficient cover to withstand vehicular traffic on the levee crown and has adequate strength to withstand levee loading, per USACE EM-1110-2-1913, Chapter 8.
				Pipe meets CVFPB Title 23 Requirements

Table 3.13-1 – Penetrations Planned Work – Project Area C (Shanghai Bend Road to Campbell Road)

Feature	Approximate Location	Description	Invert Elevation	Hazard Rating and Comments
				SBFCA will work with PG&E to install positive closure device at waterside hinge in accordance with ULDC requirements and included in the LD 1 endorsement conditions. CVFPB has started the notice of violation process with PG&E to obtain the required inspection data for the pipeline.
Kinder Morgan Petroleum Products Pipeline	Station 1132+09 Unit 144 LM 16.14	8-5/8-inch steel pipeline	Approximately 78 (200-Year Elevation 79.26)	**Moderate Hazard**
				Kinder Morgan Petroleum Products Pipeline will be modified as part of the West Feather River Levee Repair Project in 2016 under CVFPB Permit 18793-4 BD. Pipeline was installed in 1960.
				SBFCA is working with Kinder Morgan to obtain a letter that attests to regular inspections with no problems detected.
				No problems have been identified at this location due to the pipeline.
				SBFCA will work with Kinder Morgan to install positive closure device at waterside hinge in accordance with ULDC requirements and replace pipeline or obtain proof on pipeline integrity. ULDC criteria for positive closure device does not apply to existing pipes but Title 23 requires positive closure within 10 feet of landside toe. Because of situation, recommend meeting ULDC and variance to install at waterside hinge from CVFPB.
				SBFCA is working with the encroachment owner to obtain pressure test results or video test results since pipeline is over five (5) years old and no testing data could be provided by utility owner.
				SBFCA has been working with CVFPB to amend individual encroachment permit no. 3823 BD.

Table 3.13-1 – Penetrations Planned Work – Project Area C (Shanghai Bend Road to Campbell Road)

Feature	Approximate Location	Description	Invert Elevation	Hazard Rating and Comments
Pacific Gas and Electric Natural Gas Pipeline	Station 1135+31 Unit 148 LM 0.05 (LD 9)	16-inch steel pipe	Approximately 81.5 (200-Year Elevation 79.31)	**Moderate Hazard**
				Pipeline installation date is unknown.
				No problems have been identified at this location due to the pipeline.
				SBFCA is working with PG&E to obtain a letter that attests to regular inspections with no problems detected.s
				Pipe has sufficient cover to withstand vehicular traffic on the levee crown and has adequate strength to withstand levee loading, per USACE EM-1110-2-1913, Chapter 8.
				Pipe material meets the requirements per USACE EM-1110-2-2902, Chapter 7.
				SBFCA is working with the encroachment owner to obtain pressure test results or video test results since pipeline is over five (5) years old and no testing data could be provided by utility owner. CVFPB has started the notice of violation process with PG&E to obtain the required inspection data for the pipeline.
				SBFCA will work with PG&E to install positive closure device at waterside hinge in accordance with ULDC requirements and replace pipeline or obtain proof on pipeline integrity. ULDC criteria for positive closure device does not apply to existing pipes but Title 23 requires positive closure within 10 feet of landside toe. Because of situation, recommend meeting ULDC and variance to install at waterside hinge from CVFPB.
				Utility does not have a CVFPB Encroachment Permit. SBFCA will work with CVFPB to obtain an individual encroachment permit.

CALIFORNIA DEPARTMENT OF WATER RESOURCES
URBAN LEVEE DESIGN CRITERIA COMPLIANCE
SECTION 7.13 – Penetrations

FEATHER RIVER WEST LEVEE
STA 512+00 to STA 1674+37 and STA 1769+31 to STA 2368+26

I hereby certify that the planned work for the FRWL Project Phase I (from Station 512+00 to Station 2368+26, excluding Stations 1674+37 to 1769+31), has been completed and complies with the requirements of DWR's ULDC Section 7.13 (May 2012) with exceptions indicated. Furthermore, I hereby certify that the FRWL from Station 1674+37 to Station 1769+31 is a freeboard levee and is not needed to provide an urban level of flood protection.

Professional Engineer in Responsible Charge:

_____ _6/11/2021
Sean M. Minard Date
M H M Incorporated
California Professional Engineer No. C-52593

3.14 Floodwalls, Retaining Walls, and Closure Structures (ULDC Section 7.14)

3.14.1 Applicable ULDC Requirements

Per Section 7.14 of the ULDC, floodwalls, retaining walls, and closure structure require:

- Current USACE design guidance to be followed for special features such as floodwalls, retaining walls, and closure structures included in EM 1110-2-1913, EM 1110-2-2502, Engineering Circular (EC) 1110-2-6067, and Engineering Technical Letter (ETL) 1110-2-571.
- All global slope stability and embankment through-seepage and underseepage safety criteria requirements are applicable for floodwalls, retaining walls, and closure structures on levees.
- The Civil Engineer to evaluate and address the potential for the floodwall to induce settlement in the levee.
- Floodwalls and retaining walls should only be used where it is impractical to use a conventional earth embankment, such as where there is insufficient space due to pre-existing improvements. If floodwalls are proposed on a levee, they should only be used for supplemental freeboard along the levee crest and should account for impacts on O&M.
- The Civil Engineer needs to provide the following information for closure structures: maintaining entity, levee mile, Global Positioning System coordinates, Board permit number (if applicable), structure details, length of time to close structure, location and type of materials for closure, structure dimensions, age, and performance history.
- Closure structures need to be tested at least once a year before the flood season so that crews responsible for implementing the structures are familiar with their operation and to provide assurance that all parts are present and in working order.

3.14.2 Documentation of ULDC Compliance

Floodwalls

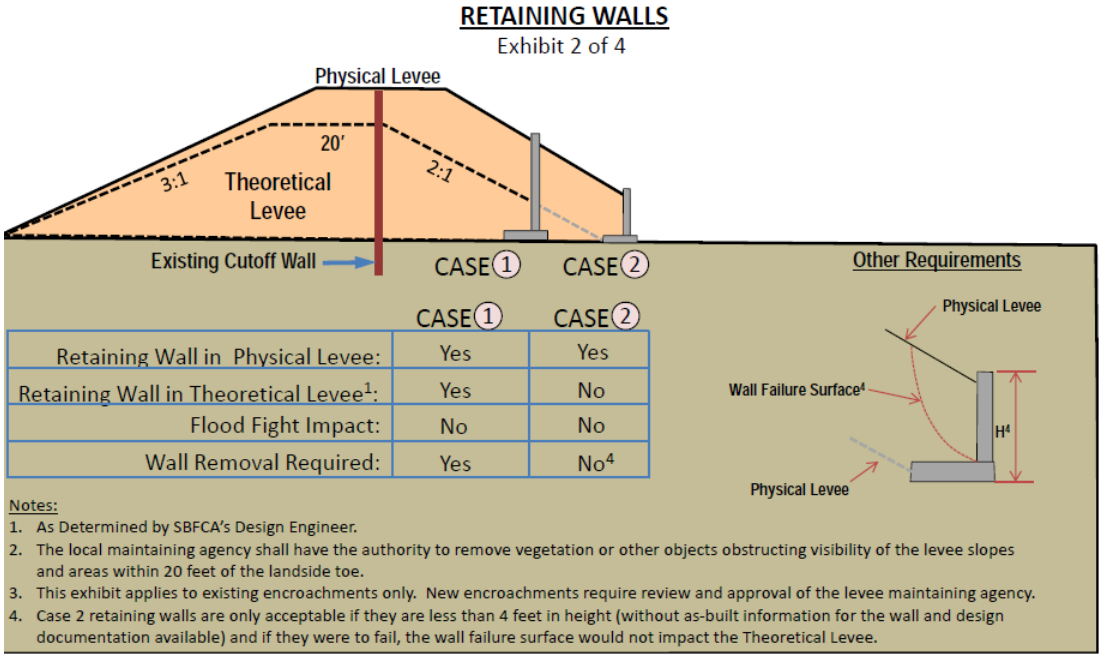
The FRWL Project Phase I has no existing or proposed floodwalls.

Retaining Walls

As shown on Figure 3.14-1, retaining walls fit into two categories:

1) Case 1 - Encroach upon the theoretical levee
2) Case 2- Situated outside of the theoretical levee, but within the physical levee.

Figure 3.14-1 FRWL Project Retaining Wall Cases



	CASE 1	CASE 2
Retaining Wall in Physical Levee:	Yes	Yes
Retaining Wall in Theoretical Levee[1]:	Yes	No
Flood Fight Impact:	No	No
Wall Removal Required:	Yes	No[4]

For the FRWL Project, Case 1 walls were considered a high hazard and, where identified, would be subject to removal. In addition, Case 2 retaining walls were considered high hazard where retaining walls exceeded four (4) feet in height and no As-Built plans were available to verify the wall design, or where the wall would compromise the theoretical levee if a wall failure occurred. There are no retaining walls on the FRWL Project identified as Case 1 or Case 2 walls considered a high hazard due to height or to the potential to compromise the theoretical levee upon failure.

There is an existing retaining wall on the FRWL at 2nd Street in Yuba City (approximately between Stations 986+00 and 996+50). The 2nd Street retaining wall structure is classified as a Case 2 wall, but not considered a high hazard due to height or the potential to compromise the theoretical levee upon failure as discussed in Wood Rodgers (2015c). There are no new proposed retaining walls as part of the FRWL Project.

Closure Structures

There is one existing closure structure along the FRWL at the UPRR Bridge crossing at Station 1130+07 (Wood Rodgers, 2014 and 2015a). The structure was not sufficient to provide three (3) feet of freeboard over the 200-year DWSE. Therefore, design plans for a new closure structure across the UPRR to address levee freeboard deficiencies were prepared (Wood Rodgers, 2015b). The new UPRR Bridge closure structure, constructed in 2019, consists of a permanent foundation and temporary aluminum panels that would be installed during a high water event. Details about the UPRR Bridge closure structure are included in Table 3.14-1 below.

Table 3.14-1. UPRR Bridge Closure Structure Information

Levee Mile	Feather River West Levee Station 1130+07
GPS Coordinates	39°10'7.77"N, 121°37'21.49"W
Board Permit Number (if applicable)	SBFCA has applied for a permit, but the application has not been processed yet.
Structure Details	Concrete retaining walls adjacent to UPRR crossing cap levee ends. Concrete piers and galvanized steel plates form cutoff under railroad. Removable aluminum panels act as the closure device, with rubberized seals at joints/seams.
Time to Close Structure	4 to 6 hours to close, see FRWL Gap Closure plans for closure procedure, sheet C-506.
Location and Type of Materials for Closure	Closure panels are aluminum, stored by LD1 off site.
Structure Dimensions	Structure is approx. 4' high, with a top elevation just above the finished grade of 85.2, extending down to the existing ground (ex UPRR track elevation is 81.48). Retaining walls are approx. 40' to 45' in length parallel to the UPRR tracks (39'-11" west of tracks, 44'-2" east of tracks. Retaining wall foundation is 4' in width, with a total closure gap of 26' between inside face of retaining walls, for a total width of 32'.
Age of Structure	Has not been constructed at this time.
Performance History	Has not been constructed at this time.

Although SBFCA is the lead agency responsible for the construction of the UPRR Bridge closure structure, Levee District No. 1 (LD1) of Sutter County will ultimately be responsible for the O&M of the closure structure. The closure structure components are stored at the LD1 office located at 250 Second Street, Yuba City, California 95991.

Based on the information discussed above, the FRWL Phase 1 Project Levee meets the ULDC floodwalls, retaining walls, and closure structure requirements.

CALIFORNIA DEPARTMENT OF WATER RESOURCES
URBAN LEVEE DESIGN CRITERIA COMPLIANCE
SECTION 7.14 – Floodwalls, Retaining Walls, and Closure Structures

FEATHER RIVER WEST LEVEE
STA 512+00 thru STA 1433+83

I hereby certify that the planned work for the FRWL Project Phase I (from Station 512+00 to Station 2368+26, excluding Stations 1674+37 to 1769+31), has been completed and complies with the requirements of DWR's ULDC Section 7.14 (May 2012). Furthermore, I hereby certify that the FRWL from Station 1674+37 to Station 1769+31 is a freeboard levee and is not needed to provide an urban level of flood protection.

Professional Engineer in Responsible Charge:

_____ ___6/11/2021__

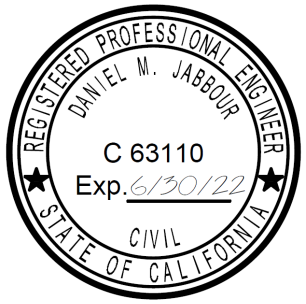
Jonathan L. Kors
Wood Rodgers — Date
California Professional Engineer No. C-59538

CALIFORNIA DEPARTMENT OF WATER RESOURCES
URBAN LEVEE DESIGN CRITERIA COMPLIANCE
SECTION 7.14 – Floodwalls, Retaining Walls, and Closure Structures

FEATHER RIVER WEST LEVEE
STA 1433+83 thru STA 2368+26

I hereby certify that the planned work for the FRWL Project Phase I (from Station 512+00 to Station 2368+26, excluding Stations 1674+37 to 1769+31), has been completed and complies with the requirements of DWR's ULDC Section 7.14 (May 2012). Furthermore, I hereby certify that the FRWL from Station 1674+37 to Station 1769+31 is a freeboard levee and is not needed to provide an urban level of flood protection.

Professional Engineer in Responsible Charge:



6/11/2021

Daniel Jabbour6/
HDR Engineering, Inc.
California Professional Engineer No. C-63110

Date

3.15 Animal Burrows (ULDC Section 7.15)

3.15.1 Applicable ULDC Requirements

Per Section 7.15 of the ULDC, the following criteria should be used to limit the potential for burrowing animal damage:

- Individual or networked animal burrows may completely traverse a levee section.
- There is no effective method to completely exclude burrowing animals from occupying grass-covered levees.
- Rodenticide-treated baits are the most economical of all approaches to rodent population reduction.
- DWR and other flood control agencies have found that (1) excavating and backfilling, and (2) grouting are effective methods for repairing burrows. Grouting is more cost effective. A common and effective grout mix is made up of 9 parts cement, 1 part bentonite, and water added to achieve 8 to10 inches of slump. Grout is pumped at low pressures to avoid damaging the embankment, starting low and proceeding up the levee slope.
- Levee dragging should only occur after burrows are repaired.
- Burrows temporarily covered for fumigation should be marked for later excavation and repair.
- Extra vigilance in monitoring and repair of burrows is needed for frequently loaded levees.
- For certain situations, such as short levee reaches, permanent burrowing animal barriers should be considered in designs.

It should be noted that, USACE's Levee Owner's Manual for Non-federal Flood Control Works (2006) states that burrowing animal control techniques involving fumigation, bait stations, bait broadcasting, or trapping have proven effective in certain situations, but regulatory agencies over various jurisdictions may have different requirements for environmental compliance.

3.15.2 Documentation of ULDC Compliance

The original design for the FRWL Project called for a full levee degrade to address animal burrows that were identified during the investigation phase in portions of the levee. However, during construction the area proposed for full levee degrade was identified as a culturally sensitive site.

From a geotechnical perspective, the purpose of the full levee degrade was to remove existing animal burrows that appear to be prevalent in this area that could provide preferential seepage paths through the levee. Therefore, a cutoff wall was constructed in this area to control the seepage through the levee. The cutoff wall along the centerline of the levee was designed to meet the requirements of Section 7.4 of the ULDC (AECOM, 2016). Given the cultural constraints, the outer shell of material was recompacted after

cutoff wall construction to remove the entranceway to existing animal burrows and deter animals from creating new burrows.

On-going effective animal control is an important part of O&M and must be done in compliance with the requirements of ULDC Section 7.15.

CALIFORNIA DEPARTMENT OF WATER RESOURCES
URBAN LEVEE DESIGN CRITERIA COMPLIANCE
SECTION 7.15 – Animal Burrows

FEATHER RIVER WEST LEVEE
STA 512+00 thru STA 2368+26

I hereby certify that the planned work for the FRWL Project Phase I (from Station 512+00 to Station 2368+26, excluding Stations 1674+37 to 1769+31), has been completed and complies with the requirements of DWR's ULDC Section 7.15 (May 2012). Furthermore, I hereby certify that the FRWL from Station 1674+37 to Station 1769+31 is a freeboard levee and is not needed to provide an urban level of flood protection.

Professional Engineer in Responsible Charge:

Robert K Green _____ 6/11/2021

Robert K. Green
AECOM Date
California Professional Engineer No. GE-352

3.16 Levee Vegetation (ULDC Section 7.16)

3.16.1 Applicable ULDC Requirements

Per Section 7.16 of the ULDC, the following criteria are to be used for managing vegetation on levees protecting urban and urbanizing areas:

- An engineering inspection and evaluation shall be conducted to identify trees and other woody vegetation (alive and dead) on the levee and within 15 feet of the levee toe that pose an unacceptable threat to the integrity of the levee. Identified trees shall be removed and associated root balls and roots shall be appropriately remediated.
- As part of routine operation and maintenance responsibilities of the LMA, trees and other woody vegetation that are not removed must be monitored to identify changed conditions that cause any of these remaining trees and other woody vegetation to pose an unacceptable threat to levee integrity.
- New levees are to be designed, constructed, and maintained according to ETL 1110-2-571.
- In cases of levee repair or improvement, vegetation shall be removed as required to meet objectives of the specific project and may not be replaced in the vegetation management zone. However, vegetation on other sections of the levee, not affected by the construction activity may remain in place, natural revegetation may be allowed outside of the vegetation management zone, and replanting may be allowed on a planting berm.
- For levees with existing vegetation within the vegetation management zone, the vegetation is to be trimmed up 5 feet above the ground and thinned for visibility and access. Brush, trees, and other woody vegetation less than four inches in diameter at breast height, weeds or other such vegetation over 12 inches high are to be removed in an authorized manner.
- The vegetation management zone is located from 15 feet landward of the landside levee toe (or landside berm toe) to 20 feet waterward of the waterside levee crown hinge point.

3.16.2 Documentation of ULDC Compliance

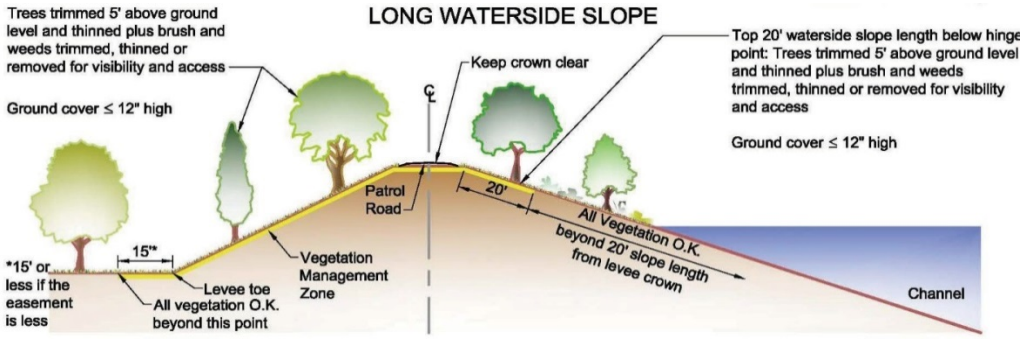
As part of the FRWL Project, an engineering inspection and evaluation was conducted to identify trees and other woody vegetation (alive or dead) on the levee and within 15 feet of the landside levee toe that posed an unacceptable threat to the integrity of the levee. Based on the engineering inspection and evaluation, trees and other woody vegetation that did not pose an unacceptable threat to the levee were not removed as documented in Wood Rodgers (2012a). In addition, waterside vegetation below the vegetation management zone was left in place without trimming or thinning, unless it posed an unacceptable threat to levee integrity.

At locations where cutoff walls were proposed, all vegetation on the levee was removed in order to construct the cutoff wall (as indicated on the plan and profile sheets in the design plans). Some trees at the levee landside toe were also removed to provide

temporary construction easement for the levee improvements contractor. The overall approach to levee vegetation for the FRWL Project was to follow ULDC requirements for tree removal and life-cycle management.

With completion of the FRWL Project Phase I, the levee conforms to the cross-section shown in Figure 3.16-1. The completed cross-section provides for levee integrity, visibility, and accessibility for inspections, maintenance, and flood fight operations, while at the same time protecting important and critical environmental resources, including the remaining shaded riverine aquatic habitat along many levees.

Figure 3.16-1 Levee Vegetation Cross-Section per ULDC Section 7.16



3.16.3 Exceptions to ULDC

There are still trees remaining that do not pose a threat to the levee integrity and they are shown on the plans.

CALIFORNIA DEPARTMENT OF WATER RESOURCES
URBAN LEVEE DESIGN CRITERIA COMPLIANCE
SECTION 7.16 –Levee Vegetation

FEATHER RIVER WEST LEVEE
STA 512+00 thru STA 1433+83

I hereby certify that the planned work for the FRWL Project Phase I (from Station 512+00 to Station 2368+26, excluding Stations 1674+37 to 1769+31), has been completed and complies with the requirements of DWR's ULDC Section 7.16 (May 2012), with exceptions indicated. Furthermore, I hereby certify that the FRWL from Station 1674+37 to Station 1769+31 is a freeboard levee and is not needed to provide an urban level of flood protection.

Professional Engineer in Responsible Charge:

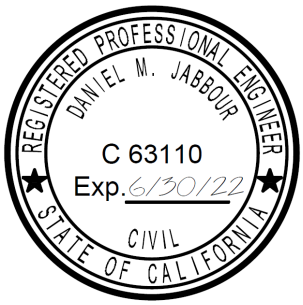
_____ __6/11/2021
Jonathan L. Kors
Wood Rodgers Date
California Professional Engineer No. C-59538

CALIFORNIA DEPARTMENT OF WATER RESOURCES
URBAN LEVEE DESIGN CRITERIA COMPLIANCE
SECTION 7.16 –Levee Vegetation

FEATHER RIVER WEST LEVEE
STA 1433+83 thru STA 2368+26

I hereby certify that the planned work for the FRWL Project Phase I (from Station 512+00 to Station 2368+26, excluding Stations 1674+37 to 1769+31), has been completed and complies with the requirements of DWR's ULDC Section 7.16 (May 2012), with exceptions indicated. Furthermore, I hereby certify that the FRWL from Station 1674+37 to Station 1769+31 is a freeboard levee and is not needed to provide an urban level of flood protection.

Professional Engineer in Responsible Charge:



6/11/2021

Daniel Jabbour
HDR Engineering, Inc.
California Professional Engineer No. C-63110

Date

3.17 Wind Setup and Wave Run-up (ULDC Section 7.17)

3.17.1 Applicable ULDC Requirements

Per Section 7.17 of the ULDC, the wind setup and wave run-up distances must be computed and added to the median 200-year DWSE to determine the required elevation of the MTOL or floodwall. The setup and run-up must also be computed and considered for analysis of erosion and overtopping impacts.

The Civil Engineer has discretion in selection of the method used to evaluate the wind setup and wave run-up. However, guidance for computing the setup and run-up is provided in:

- USACE's EM 1110-2-1100
- USACE's EC 1110-2-6067
- Wave Overtopping of Sea Defenses and Related Structures: Assessment Manual (2007)
- FEMA's Final Draft Guidelines for Coastal Flood Hazard Analysis and Mapping for the Pacific Coast for the United States (2005)
- Mississippi Coastal Flood Hazard Project: Wave Run-up Method (2008)

3.17.2 Documentation of ULDC Compliance

For the FRWL Project, an analysis was conducted to calculate the wind setup and wave run-up values as documented in PBI (2011a). The wind setup and wave run-up calculations are based on the potential wind speed, wind direction, fetch length, and water depth. The wind setup and wave run-up analysis shows that in all cases the calculated combined wind setup and wave run-up is less than three (3) feet. Therefore, the FRWL Project does not require additional freeboard to account for the effects of wind setup and wave run-up.

CALIFORNIA DEPARTMENT OF WATER RESOURCES
URBAN LEVEE DESIGN CRITERIA COMPLIANCE
SECTION 7.17 – Wind Setup and Wave Run-up

FEATHER RIVER WEST LEVEE
STA 512+00 thru STA 2368+26

I hereby certify that the planned work for the FRWL Project Phase I (from Station 512+00 to Station 2368+26, excluding Stations 1674+37 to 1769+31), has been completed and complies with the requirements of DWR's ULDC Section 7.17 (May 2012). Furthermore, I hereby certify that the FRWL from Station 1674+37 to Station 1769+31 is a freeboard levee and is not needed to provide an urban level of flood protection.

Professional Engineer in Responsible Charge:

_____ ___6/11/2021_

Chris Fritz
Peterson Brustad, Inc. Date
California Professional Engineer No. C-75004

3.18 Security (ULDC Section 7.18)

3.18.1 Applicable ULDC Requirements

Per Section 7.18 of the ULDC, a security plan is required to protect urban and urbanizing area levee systems (including closure structures and other appurtenances) from acts of terrorism and other malicious or negligent acts. The security plan identifies security personnel, responsibilities, resources, and measures. The security plan should be made available to qualified officials within and outside of the LMAs. The agency/agencies responsible for levee maintenance must consider and prioritize vulnerabilities and employ an array of security measures from the following:

Networked Detection

Networked detection provides for monitoring and reporting of security information between the LMAs and the intelligence community which is comprised of multiple federal, state, and local agencies.

Deterrence

The deterrence program should consist of appropriate visible security measures such as fences, gates, and signage, and should maintain a physical presence at the levees during flood watch patrols.

Physical Security

Physical security is divided between deterrence (discussed above), access control, intrusion detection, and levee-performance alerting mechanisms.

Intrusion Interdiction during High Threat Periods

Intrusion interdiction capabilities are determined by the preparedness and willingness of the local first responders. The goal is to facilitate awareness of and a commitment to providing a swift response to intrusions reported during high-water or increased threat periods.

3.18.2 Documentation of ULDC Compliance

Currently, respective LMAs are responsible for the security of levees and other State Plan of Flood Control facilities in their jurisdiction. The LMAs within the FRWL Project and their areas of responsibility are identified below in Table 3.18-1.

Table 3.18-1. LMA Area of Responsibility

Agency	Station	Description (approximate locations)
Levee District (Sutter) 1	Begin: 280+90 End: 1132.61.05	From Cypress Avenue to 1.9 mi upstream from Hwy 20 Bridge crossing
Levee District 9	Begin: 1132.61.05 End: 1460+00	From 1.9 mi upstream from Hwy 20 Bridge crossing To Pasco Road
Maintenance Area 16 - Sutter Yard	Begin: 1460+00 End: 1675+50	From Pasco Road to Sutter/Butte County line
Maintenance Area 7 – Sutter Yard	Begin: 1675+50 End: 2285+00	From Sutter/Butte County line to End Project at Thermalito Afterbay

For providing physical security to the levees and other State Plan of Flood Control facilities, access is controlled and restricted to local LMA personnel and local property owners. The locations of existing gates are shown on the plans. Gates in construction areas were removed and reinstalled upon completion of construction. Installation of new gates to provide security was not required for the FRWL Project Phase I.

As recommend in DWR's Superintendent's Guide, gates, barricades, and signs have been installed for the purpose of prohibiting and discouraging the use of flood control project facilities by unauthorized traffic, such as trespassing, vandalism, recreational vehicles, and expansion of housing and industrial developments. Property owners must obtain a permit from the CVFPB before altering or installing any additional items on the levee. Visibility should be maintained by eliminating tall vegetation and replacing reflectors when necessary.

Superintendents of state and local LMAs who are responsible for the maintenance of federal flood control project facilities are also responsible for flood emergency preparedness and response. This includes responsibility for training personnel in flood fighting methods and patrolling the levee during high-water events. Protocols have been well established for patrolling the levees on a 24-hour basis once the water level is above the monitor stage. LMA personnel are also participating in state-sponsored training workshops and tabletop exercises to update and validate the security and evacuation plans related to levee security and breaches.

The Flood Safety Pans for the respective LMAs will be used as their "Security Plans". These plans describe the resources available to cope with various emergencies, and measures applicable to each type of emergency or security threat. LMAs have developed close working relationships with law enforcement, fire, and emergency response organizations to assist in any emergency or during security threat situations. Until a permanent security director has been assigned for the overall Feather River West Levee system, the General Managers for respective LMAs will serve as the security director for their areas.

The Flood Safety Plans outline planned response to flood emergencies in Sutter County or those emergencies affecting LMAs responsibilities. The Flood Safety Plans provide information, policies, and procedures that will guide and assist LMAs in efficiently handling flood emergencies. These plans address flood preparedness, levee patrols,

flood fight, evacuation procedures, floodwater removal, and related subjects. These plans allow implementation of the California Standardized Emergency Management System (SEMS). When used in conjunction with the California Emergency Plan and other local emergency plans, they will facilitate multi-agency and multi-jurisdictional coordination, particularly among LMAs, local governments, and State agencies in flood emergency operations. The following section describes the key component of the Flood Safety Plans.

Flood Safety Plans:

- Establishes the emergency management organization for responding to flood emergencies.
- Identifies the policies, responsibilities, and procedures required to protect the health and safety of residents from the effects of flood emergencies.
- Establishes operational procedures associated with field response to flood emergencies and the recovery process.
- Identifies policies for after-action analyses and follow-on activities.

Organization and Assignment of Responsibilities

LMAs are responsible for the levees in coordination with their engineers, Sutter County Operational Area, DWR, and USACE, and may request additional mutual aid partners via Inland Region's Regional Emergency Operations Center REOC.

Direction, Control, and Coordination

Each LMA establishes overall policies and priorities, and its General Manager will assume responsibility during emergencies. An Incident Commander will be appointed and report to the General Manager during emergencies. The Incident Commander will coordinate individual flood fight crews, including those acquired under Mutual Aid from other agencies.

Communications

A Public Information Officer (PIO) will coordinate communications, and may request additional personnel from the local Radio Amateurs Civil Emergency Services (RACES) and via Mutual Aid. They will utilize the Emergency Alert System (EAS) and Emergency Digital Information Service (EDIS), as well as local radio systems, to distribute information.

Administration, Finance, and Logistics

LMAs have developed and maintain the Flood Safety Plan in accordance with California Master Mutual Aid Agreement, and is responsible for record keeping and resource tracking.

Plan Development and Maintenance

LMA's General Manager has primary responsibility for the plan development, review and maintenance, training and exercise, and evaluation of the Flood Safety Plan and its updates.

Authorities and Maintenance

See the Flood Safety Plan for a list of sources providing authority for planning, conducting, and/or supporting flood emergency operations at the federal, state, and local level.

Flood Fight Plan Element

At the River Warning Stages or by notification of a potential problem by a levee patrol, LMA shall establish necessary staging areas for supplies, equipment, and personnel. Emergency responders will be dispatched as needed from these locations to address any problems that arise.

Floodwater Removal Element

LMA may employ relief cuts and/or temporary pumping as needed to remove floodwater.

Evacuation Plan

Sutter County EOC is responsible for the decision to evacuate, and will relay evacuation instructions to the public via the POI, the Joint Information Center, and the EOC.

Requirements for Siting New Essential Services Buildings

Enforcement of the new Flood Safety Plan will not require any new service buildings.

Levee Patrol Element

Each LMA staff shall patrol the levee when water levels meet specific criteria, with patrol frequencies increasing as water levels rise.

CALIFORNIA DEPARTMENT OF WATER RESOURCES
URBAN LEVEE DESIGN CRITERIA COMPLIANCE
SECTION 7.18 – Security

FEATHER RIVER WEST LEVEE
STA 512+00 thru STA 1433+83

I hereby certify that the planned work for the FRWL Project Phase I (from Station 512+00 to Station 2368+26, excluding Stations 1674+37 to 1769+31), has been completed and complies with the requirements of DWR's ULDC Section 7.18 (May 2012). Furthermore, I hereby certify that the FRWL from Station 1674+37 to Station 1769+31 is a freeboard levee and is not needed to provide an urban level of flood protection.

Professional Engineer in Responsible Charge:

_____ __6/11/2021

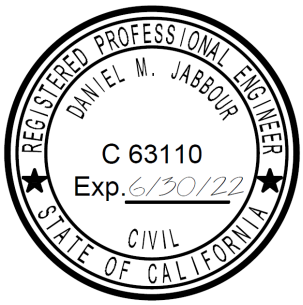
Jonathan L. Kors
Wood Rodgers Date
California Professional Engineer No. C-59538

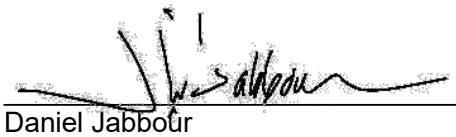
CALIFORNIA DEPARTMENT OF WATER RESOURCES
URBAN LEVEE DESIGN CRITERIA COMPLIANCE
SECTION 7.18 – Security

FEATHER RIVER WEST LEVEE
STA 1433+83 thru STA 2368+26

I hereby certify that the planned work for the FRWL Project Phase I (from Station 512+00 to Station 2368+26, excluding Stations 1674+37 to 1769+31), has been completed and complies with the requirements of DWR's ULDC Section 7.18 (May 2012). Furthermore, I hereby certify that the FRWL from Station 1674+37 to Station 1769+31 is a freeboard levee and is not needed to provide an urban level of flood protection.

Professional Engineer in Responsible Charge:





Daniel Jabbour
HDR Engineering, Inc.
California Professional Engineer No. C-63110

6/11/3021
Date

3.19 Sea Level Rise (ULDC Section 7.19)

3.19.1 Applicable ULDC Requirements

Per Section 7.19 of the ULDC, the effects of sea level rise are to be estimated and addressed for the duration during which the ULOP Finding is valid. Section 7.19 of ULDC also advises the Civil Engineer to consider a range of estimates and prepare for future expansion and structural raises to address long-term sea level rise.

3.19.2 Documentation of ULDC Compliance

Sea level rise guidance is provided in USACE's ETL 1100-2-1 and EC 1165-2-212. In addition, a sensitivity analysis was recently completed by DWR as part of the *Sacramento River Basin-Wide Feasibility Study* (BWFS)[1] to evaluate how far upstream backwater could extend up the Yolo Bypass and how sea-level rise could potentially impact levee freeboard. The BWFS used mean estimates of sea-level rise in 2062 (38.8 centimeters, or 1.27 feet) for the primarily climate change analysis, with select additional runs with a high estimate (83.1 centimeters, or 2.73 feet) for sensitivity studies. The BWFS estimates for 2062 exceed the required timeframe stated in ULDC (20-year maximum) and are thus conservative for the FRWL Project.

DWR's results indicate that the extremely high tidal condition estimated in the BWFS would not propagate upstream past the Yolo Bypass Lisbon gage. Therefore, the river stage at the Libson gage will be controlled by riverine flows even with sea level rise. The FRWL Project is located upstream of the Lisbon gage and is outside the influence of sea level rise. In addition, as a conservative measure, the design water surface profile includes an additional one (1) foot of height to account for uncertainties such as the potential for future sea level rise.

[1] *Draft Basin-Wide Feasibility Studies Sacramento River Basin,* California Department of Water Resources, March 2016.

CALIFORNIA DEPARTMENT OF WATER RESOURCES
URBAN LEVEE DESIGN CRITERIA COMPLIANCE
SECTION 7.19 – Sea Level Rise

FEATHER RIVER WEST LEVEE
STA 512+00 thru STA 2368+26

I hereby certify that the planned work for the FRWL Project Phase I (from Station 512+00 to Station 2368+26, excluding Stations 1674+37 to 1769+31), has been completed and complies with the requirements of DWR's ULDC Section 7.19 (May 2012). Furthermore, I hereby certify that the FRWL from Station 1674+37 to Station 1769+31 is a freeboard levee and is not needed to provide an urban level of flood protection.

Professional Engineer in Responsible Charge:

_____ __6/11/2021_

Chris Fritz
Peterson Brustad, Inc. Date
California Professional Engineer No. C-75004

3.20 Emergency Actions (ULDC Section 7.20)

3.20.1 Applicable ULDC Requirements

Section 7.20 of the ULDC states that although emergency actions, such as flood-fighting, are expected to be employed as needed to prevent levee breaches and floodwall failures wherever feasible, they may not be relied upon for an ULOP Finding for a given area. However, there are two exceptions:

1. Closure structures that meet the requirements contained in the "Floodwalls, Retaining Walls, and Closure Structures" section (see chapter 3.14 of this Report) may be assumed effective and relied upon for performing as designed.
2. Flood relief structures such as culverts, gates, weirs, pumping plants, and levee relief cuts may be assumed effective and relied upon for performing as designed provided they are identified in an approved flood relief plan in the O&M manual (and/or in the flood safety plan) for the project.

Section 7.20.1 of the ULDC outlines the requirements for flood relief structures. Section 7.20.2 of the ULDC also states that each public agency responsible for the public safety of residents protected by levees and floodwalls must have a plan for flood events and other natural or man-made flood-related incidents that could result in human casualties, property destruction, and economic losses and lists the important components of a flood safety plan.

3.20.2 Documentation of ULDC Compliance

For the FRWL Project, item number 1 above applies to the UPRR Bridge closure structure, which is described in Section 3.14 of this Report. The UPRR Bridge closure structure meets the requirements in Section 7.14 of the ULDC and therefore is assumed to be effective and relied upon for performing as designed. SBFCA is not relying on any measures identified in item number 2 above to meet ULDC criteria.

For complying with Section 7.20.2 o the ULDC, SBFCA developed a Flood Safety Plan for the Sutter Basin as required by CA Water Code Section 9650 (David Ford Consulting Engineers, 2015). In addition, several other emergency flood related plans are currently in effect, including the Sutter County Emergency Operations Plan, Sutter County Local Hazard Mitigation Plan, Butte County Emergency Operations Plan, and the Butte County Local Hazard Mitigation Plan. These plans establish an emergency management organization and assign functions and tasks consistent with California's Standardized Emergency Management System (SEMS) and the National Incident Management System (NIMS), as well as provides for the integration and coordination of planning efforts of multiple jurisdictions within the counties. These plans also outline the community's response plans for multi-hazard events, as well as the community's plans for hazard mitigation efforts.

SBFCA's Flood Safety Plan, in addition to the County plans, clearly outlines the appropriate actions in the event of a flood emergency and meets the various stated requirements in Section 7.20.2 or the ULDC.

CALIFORNIA DEPARTMENT OF WATER RESOURCES
URBAN LEVEE DESIGN CRITERIA COMPLIANCE
SECTION 7.20 – Emergency Actions

FEATHER RIVER WEST LEVEE
STA 512+00 thru STA 2368+26

I hereby certify that the planned work for the FRWL Project Phase I (from Station 512+00 to Station 2368+26, excluding Stations 1674+37 to 1769+31), has been completed and complies with the requirements of DWR's ULDC Section 7.20 (May 2012). Furthermore, I hereby certify that the FRWL from Station 1674+37 to Station 1769+31 is a freeboard levee and is not needed to provide an urban level of flood protection.

Professional Engineer in Responsible Charge:

_____ ___6/11/2021_

Chris Fritz
Peterson Brustad, Inc. Date
California Professional Engineer No. C-75004

3.21 O&M, Inspection, Monitoring, and Remediation of Poor Performance (ULDC Section 8.0)

3.21.1 Applicable ULDC Requirements

Per Section 8.0 of the ULDC, the following O&M related requirements apply:

- The levee system must have an O&M manual consistent with USACE requirements (except as may be appropriate to deviate from those requirements to comply with the ULDC).
- All facilities necessary for providing the ULOP must be operated and maintained by an identified public agency possessing the authority and resources to do so.
- USACE standard inspection requirements for project levees are applicable for all levees and floodwalls considered to provide the urban level of flood protection, including the requirement for a public agency (or agencies) to routinely operate and maintain the levee system and inspect the entire levee system at least every 90 days and after every high-water event.
- Damage and maintenance inadequacies identified from inspections should be prioritized and addressed in a timely manner, not awaiting the periodic review process.
- It is rarely possible or practical to be certain of all the engineering properties of levees and their foundations. Consequently, there will usually be some degree of uncertainty that justifies both robust regular inspections and high-water monitoring programs for levees and floodwalls protecting urban and urbanizing areas, with all of the attendant appurtenances and features (such as all-weather access roads on levee crowns and near the toe of wide landside berms).
- Monitoring during high-water must provide for a thorough visual inspection of both the waterside and landside levee slope (and landside berm toe area) at intervals of no more than one hour.
- The levee system must have a levee security plan that meets the requirements described in Section 7.18 of the ULDC.
- The levee system must have a flood safety plan that meets the requirements described in Section 7.20 of the ULDC.

Other requirements may also apply such as a post-earthquake remediation plan, a right-of-way plan, an encroachment remediation plan, a penetration remediation plan, or a flood relief plan, depending on the situation.

3.21.2 Documentation of ULDC Compliance

USACE O&M Manuals

USACE O&M Manuals SAC 143, SAC 144, SAC 148, SAC 152 and SAC 160 cover the FRWL Project area from the confluence of the Feather River and the Sutter Bypass in south Sutter County (Station 10+00) to Thermalito Afterbay in the north (Station

2370+00). O&M Manuals SAC 144, 148, and 152 are currently being updated. O&M Manual SAC 143 covers the southern portion of the levee system, from the Sutter Bypass confluence to the beginning of Unit 144, and is outside the FRWL Project Phase I limits. O&M Manual SAC 160 is no longer needed since it is the manual for the Sutter Main Canal headworks structure situated south of the Thermalito Afterbay, which is being buried in fill as part of FRWL Project Area D.

USACE Inspection Standards

As prescribed in the USACE O&M Manuals, DWR and the respective LMAs inspect the entire FRWL system under their jurisdiction four times every year and after every high-water event. The fall and spring inspections are conducted jointly by DWR and LMA personnel, and the other two inspections are done by LMA staff.

Repair of Damage and Maintenance Inadequacies

SBFCA is working with local LMAs to prioritize and address maintenance inadequacies in a timely manner. SBFCA is also working on developing a SWIF for the FRWL. A letter of intent to develop a SWIF was approved by the USACE on February 24, 2014, and the SWIF will be completed soon. As the cost of addressing all the maintenance deficiencies will be in the millions of dollars, preparing a SWIF is a way to efficiently coordinate and prioritize a consistent approach to addressing the identified deficiencies over time.

In the SWIF, the deficiencies will be evaluated and ranked according to their relative risk with the objective of correcting the worst deficiencies first so that the flood risk reduction is optimized.

Accounting for Uncertainties in Operations and Maintenance

The O&M Manuals will include inspection standards appropriate for the FRWL Project that provide robust regular inspections and high-water monitoring programs.

Monitoring During Periods of High Water

LMA staff patrols the levee during high-water situations. Protocols will be revised to comply with the ULDC requirement. Monitoring during high water will provide for a thorough visual inspection of both the waterside and landside levee slope (and landside berm toe area) at intervals of no more than 1 hour. The revised protocols will be contained in the updated O&M Manuals.

Levee Security Plan

Details of the levee security plan are included in Section 3.18 of this Report.

Flood Safety Plan

Details of the flood safety plan are included in Section 3.20 of this Report and in David Ford Consulting Engineers (2015) Sutter Butte Flood Control Agency: Flood Safety Plan, April 2015.

CALIFORNIA DEPARTMENT OF WATER RESOURCES
URBAN LEVEE DESIGN CRITERIA COMPLIANCE
SECTION 8.0 – O&M, Inspection, Monitoring, and Remediation of Poor Performance

FEATHER RIVER WEST LEVEE
STA 512+00 thru STA 1433+83

I hereby certify that an Operation and Maintenance Manual exists for the FRWL Project Phase I (from Station 512+00 to Station 1433+83) and that O&M is performed in accordance with the requirements of DWR's ULDC Section 8.0 (May 2012).

Professional Engineer in Responsible Charge:

_____ __6/11/2021

Jonathan L. Kors
Wood Rodgers Date
California Professional Engineer No. C-59538

CALIFORNIA DEPARTMENT OF WATER RESOURCES
URBAN LEVEE DESIGN CRITERIA COMPLIANCE
SECTION 8.0 – O&M, Inspection, Monitoring, and Remediation of Poor Performance

FEATHER RIVER WEST LEVEE
STA 1433+83 thru STA 2368+26

I hereby certify that an Operation and Maintenance Manual exists for the FRWL Project Phase I (from Station 1433+83 to Station 2368+26, excluding Stations 1674+37 to 1769+31) and that O&M is performed in accordance with the requirements of DWR's ULDC Section 8.0 (May 2012).

Professional Engineer in Responsible Charge:

6/11/2021

Daniel M. Jabbour
HDR Engineering, Inc.
California Professional Engineer No. C-63110

Date

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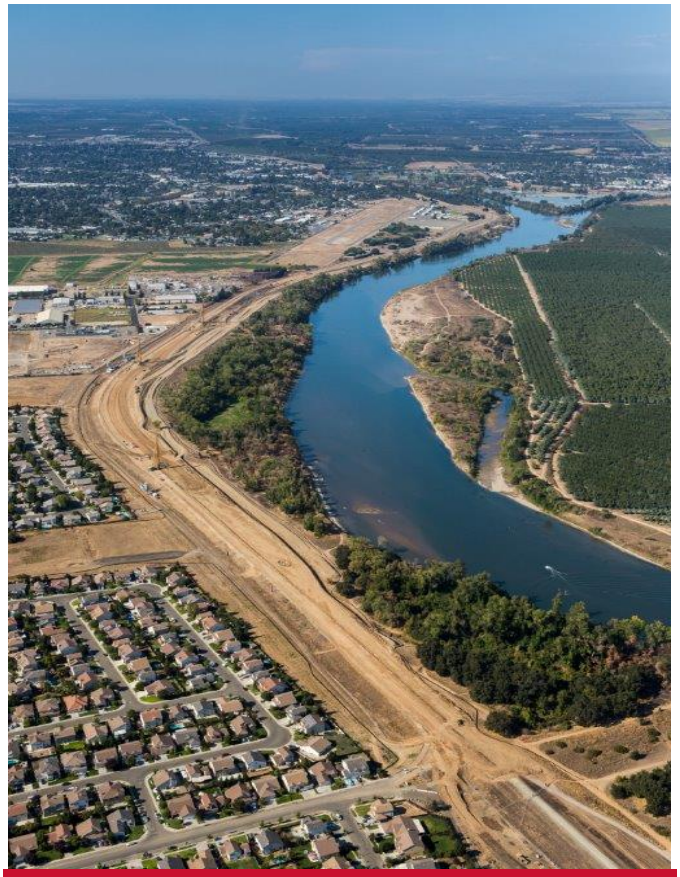
Appendix A. Seismic Vulnerability Report



Seismic Vulnerability Evaluation Report

Feather River West Levee Project

Sutter-Butte Flood Control Agency

Sutter and Butte Counties, California

March 12, 2021

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Appendix B – Summary Tables and Post-earthquake Slope Stability Analysis Results from 2015 URS Seismic Vulnerability Analyses of Feather River West Levees.

Appendix C - Levee Cross Sections along the FRWLP

Appendix D - Table Summarizing both Previous and Current Damage Level Estimates for the FRWLP Levees

1. INTRODUCTION AND SCOPE OF WORK

1.1 Purpose

The purpose of this report is to document the seismic vulnerabilities of the west levees along the Feather River that protect urban and urbanizing areas in the Sutter-Butte region. Specifically, these are Levee Reaches 7 through 41 of the Feather River West Levee Project (FRWLP; excluding Reaches 26, 27, and 28, which are classified as no work reaches because the landward ground surfaces are higher than the 200-year design water surfaces in these reaches). The location of the FRWLP is shown in Figure 1.

The requirement to analyze and document seismic vulnerabilities of levees protecting urban and urbanizing areas is contained in the Department of Water Resources (DWR) Urban Levee Design Criteria (ULDC; DWR, 2012). Meeting this requirement, as well as several others in the ULDC, is necessary in order for local communities to make a finding that the levees provide a 200-year urban level of flood protection (see DWR publication Urban Level of Flood Protection, 2013).

1.2 ULDC Seismic Vulnerability Analysis Requirements

Section 7.7 and Subsection 7.7.1 (Intermittently Loaded Levees) of the ULDC specify details of the analysis necessary to assess seismic vulnerability. Since the Feather River west levees are intermittently loaded levees, the requirements detailed in Subsection 7.7.1 were used in this evaluation. The following requirements are specified in the different ULDC sections.

1.2.1 ULDC Section 7.7 Seismic Vulnerability

The following requirements for a seismic vulnerability analysis of the levee system are set forward in Section 7.7 of the ULDC:

- An analysis of seismic vulnerability of the levee system for 200-year return period ground motions is required using typical summer and winter water surface elevations.
- The most common mode of earthquake-induced damage of earthen levees is expected to be lateral spreading and cracking that would be associated with potential strength losses in the levees and their foundations. Such earthquake-induced strength losses could occur in cohesionless soils by liquefaction, or in soft, clayey soils by cyclic softening. Consequently, analyses for liquefaction potential using recent correlations between field penetration tests and liquefaction potential as well as post-liquefaction residual shear strengths should be used. Residual shear strengths are then used in slope stability and/or deformation analyses to estimate potential deformation and settlement of the levee, as well as the potential for longitudinal and transverse cracking.

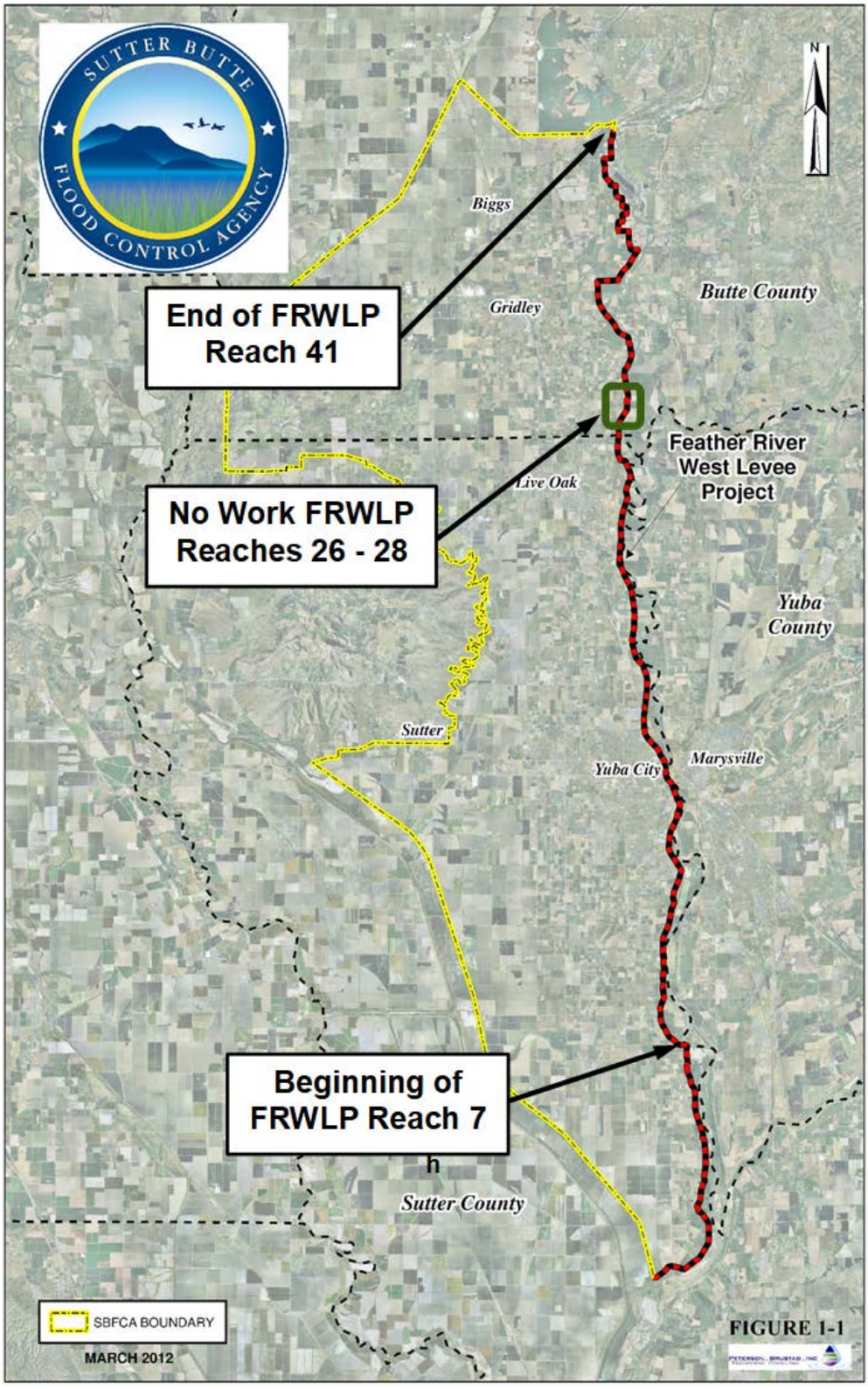

Figure 1: Feather River West Levee Project (from PBI, 2012)

1.2.2 ULDC Subsection 7.7.1 Intermittently Loaded Levees

If seismic damage is expected after all 200-year flood improvements are in place for an intermittently loaded levee, a post-earthquake remediation plan is required. At a minimum, the post-earthquake remediation plan must contain provisions for emergency preparations, mobilization, data gathering, actions, interim repairs, long-term repairs, and public notifications. The plan must also include a general set of repair procedures for the interim remediation of cracked and slumped levee sections, including general procedures for excavating and filling cracks, removing disturbed or slumped ground, and keying in new fill. Specific considerations for the interim repairs for intermittently loaded levees include:

- An estimate is to be developed of the general magnitude and locations of damage expected throughout the levee system along with the amounts and locations of material needed to restore the levee system's grade and dimensions (e.g. appropriate crown width such as 20 feet along a major stream and 3:1 levee slopes) sufficient for protection against the 10-year flood, with 3 feet of freeboard.
- The interim repairs would need to restore a 10-year grade (typically a 10-year WSE plus 3 feet) and associated geometry (referenced herein as the 10-year cross section) within 8 weeks or less to avoid prolonged exposure of the community during flood season.
- Borrow areas and/or stockpiles that could easily provide the materials needed for interim repairs need to be identified. Such materials should meet the levee fill requirements of the USACE Sacramento District's Geotechnical Levee Practice Standard Operating Procedures (2008).
- Haul routes for fill placement need to be identified.
- Slope protection for the newly placed fill needs to be included.
- To the extent that seismic damage to the levee system would be so significant and widespread that it would be infeasible to restore 10-year grade and geometry within eight weeks, seismic strengthening of the existing levee is required to provide the urban level of flood protection.
- The public should be informed as quickly as possible after a damaging earthquake as to system damages and the resulting interim level of protection that will be provided.

1.3 Scope of Work

The scope of work associated with the seismic vulnerability evaluation intended to meet Section 7.1 and Subsection 7.7.1 of the ULDC for the FRWLP is as follows:

Summarize previous analyses presented in AECOM's (formerly URS) FRWLP Geotechnical Design Recommendations Report (URS, 2012). Use these and similar previous analysis Chapter 1 provides an introduction and documents the scope of work for the seismic vulnerability evaluation.

Chapter 2 documents the approach and criteria used in the seismic vulnerability evaluation.

Chapter 3 summarizes the results of the seismic vulnerability assessments and describes the seismic vulnerabilities for different levee reaches and subreaches within the FRWLP.

Chapter 4 describes the types of repairs needed to restore both a 10-year levee section on an emergency basis, and the types of repairs needed to restore a 200-year level of flood protection by levee reach, along with general quantities associated with borrow needs, excavation, and levee reconstruction. A high level summary of results is presented.

Chapter 5 provides considerations for potential updates to an EAP that addresses emergency and permanent repairs.

Chapter 6 provides a list of references.

Appendix A contains summary tables and post-earthquake slope stability analysis results from previous seismic assessments of the Feather River west levees completed by URS in 2012.

Appendix B contains summary tables and post-earthquake slope stability analysis results from previous seismic assessments of the Feather River west levees completed by URS in 2015.

Appendix C provides existing levee cross sections for different locations along the FRWLP and shows minimum geometries associated with a 10-year and a 200-year level of flood protection.

Appendix D provides a table summarizing both previous and current damage level estimates for the FRWLP levees, and the rationales for the current estimates.

- results to assign seismic vulnerability classification based on estimated damage levels for the Feather River west levees.
- Develop seismic vulnerability estimates based on estimated damage levels and characterize how much of each reach and part thereof would sustain different levels of post-earthquake distress. For the purposes of this evaluation, four seismic vulnerability classes/damage levels have be assigned: (i) *None to Minor*, (ii) *Moderate to Major*, (iii) *Severe*, and (iv) *Compromised*. These damage levels are consistent with those developed by Swaisgood (2014) and Pells and Fell (2003).
- Summarize flood water levels for 10-year and 200-year return periods and the minimum cross sections required to meet ULDC criteria for the flood levels, including a minimum of 3 feet of freeboard.
- For each damage level, identify conceptual levee repairs, methods, and borrow needs to restore the levees to 10-year levee cross section. This would include conceptual sketches for the repairs, potential borrow quantities, borrow locations, haul routes, and staging areas. These repairs would need to be completed on an emergency basis within 8 weeks of the earthquake event. It should be noted that only the 10-year cross section (10-year WSE plus 3 feet) needs to be restored – it is not required that the temporary, emergency repairs meet seepage and underseepage requirements of the ULDC.
- For each damage level, identify conceptual levee repair methods to restore a 200-year level of protection following damage induced by a 200-year earthquake. This is expected to be a much more substantial set of repairs that would occur months or years after the earthquake event. Unlike the repairs outlined for restoring a 10-year levee section, only conceptual repair methods and sketches are included in the scope. For actual repairs to restore a 200-year level of protection, detailed designs and approvals would be required. Detailed quantity estimates, borrow area locations, and haul routes are not required for this task.

- Language will be developed to include within an Emergency Action Plan (EAP) to implement temporary and permanent repairs that would address the earthquake emergency, including the responsibility of key parties.
- A Seismic Vulnerability Report will be developed documenting all of the subtasks listed above. Both a Draft and Final version of the report will be developed, with the Final report addressing SBFCA comments on the Draft report.

1.4 Report Organization

This report is organized as follows:

Chapter 1 provides an introduction and documents the scope of work for the seismic vulnerability evaluation.

Chapter 2 documents the approach and criteria used in the seismic vulnerability evaluation.

Chapter 3 summarizes the results of the seismic vulnerability assessments and describes the seismic vulnerabilities for different levee reaches and subreaches within the FRWLP.

Chapter 4 describes the types of repairs needed to restore both a 10-year levee section on an emergency basis, and the types of repairs needed to restore a 200-year level of flood protection by levee reach, along with general quantities associated with borrow needs, excavation, and levee reconstruction. A high level summary of results is presented.

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2. APPROACH AND CRITERIA

2.1 General Approach

The approach for completing the current seismic vulnerability evaluation utilized seismic stability analyses previously completed for the Feather River west levees and applies those results to estimate both the levels of levee damage and needed repairs along the reaches and subreaches of the FRWLP.

There are two previous sets of seismic analyses for the Feather River west levees available for review contained in the following documents prepared by URS (now part of AECOM):

1. "*Geotechnical Design Recommendations Report, Feather River West Levee Project, Segments 1 through 6*," Prepared by URS for Sutter-Butte Flood Control Agency and HDR Engineering, Inc., October 2012.
2. "*Geotechnical Evaluation Report, Volume 2, Remedial Alternatives, Sutter Feather River Study Area*," Prepared by URS for the California Department of Water Resources as part of the Urban Levee Evaluations Project, March 2015.

In both of these reports, URS evaluated borehole and cone penetration test (CPT) data available along the Feather River west levees. They then selected locations with foundation layers having relatively low penetration resistance, indicative of potential liquefiable materials, and performed liquefaction triggering analyses and slope stability analyses for the 200-year level of ground shaking, using reduced shear strengths where liquefaction was indicated. Post-earthquake static slope stability analyses with reduced shear strengths for liquefied materials were performed in both studies. If the post-earthquake factor of safety was less than 1.0, the levee was considered compromised or subject to a high Seismic Vulnerability classification. The 2012 URS analyses also performed simplified deformation analyses if the calculated factor of safety was above 1.0 using yield acceleration values and simplified Newmark analysis approaches. The seismic vulnerabilities of the levees were then assessed and assigned different seismic vulnerability classifications based on the level of deformation estimated.

The approach used in the current seismic vulnerability evaluation documented in this report is similar. It uses the analysis results from the two previous studies to inform what foundation materials and characteristics lead to different levee deformations and damage. With this information, the foundation geology along different levee reaches and subreaches is assessed, and estimates made as to the different percentages of the levee reach or subreach that would experience the four different damage levels (i.e. *None to Minor*, *Moderate to Major*, *Severe*, and *Compromised*). The total estimated lengths for the different levels of levee damage is then compiled for purposes of satisfying ULDC requirements for a post-earthquake remediation plan.

This chapter of the report describes the following elements in developing the approach and criteria for the current seismic vulnerability evaluation:

Section 2.1: General Approach

Section 2.2: Seismic Loading – Peak Ground Accelerations for 200-year Return Period

Section 2.3: Estimated Damage for Levee Reaches without Foundation Liquefaction

Section 2.4: Examples of Severe Levee Damage Resulting from Earthquake-induced Liquefaction

Section 2.5: Approach for Current Seismic Vulnerability Evaluation

Section 2.6: Approach and Damage Level Criteria for Current Seismic Vulnerability Evaluation

2.2 Seismic Loading – Peak Ground Accelerations for 200-year Return Period

Shown in Figure 2 is a seismic hazard map showing peak ground accelerations (PGA) contours for the northern portion of the Central Valley for a 200-year return period. The map is from the 2015 DWR Guidance Document for Geotechnical Analyses produced by URS for the Urban Levee Evaluations (ULE) Project (URS, 2015b; Figure 6-2 of that guidance document). It assumes stiff soil site conditions (i.e., soils having a shear wave velocity V_{S30} = 335 meters/second). Both of the previous URS studies (2012 and 2015a) used this seismic hazard map, or a variation of this map, for their analyses. The map shows that the 200-year PGA for the FRWLP would generally be between 0.11g and 0.13g, which are relatively low levels of peak acceleration. In fact, these are probably comparable to the lowest such accelerations for a 200-year return period anywhere in California. Significantly higher PGA values are indicated for locations further to the west and closer to the higher seismically active areas of the San Francisco Bay Area.

2.3 Estimated Damage for Levee Reaches without Foundation Liquefaction

Estimates of earthquake-induced damage for levees that do not experience liquefaction in either the levee embankment or foundation were developed using the following studies:

- Swaisgood, James R. (2014), “Behavior of Embankment Dams During Earthquake.”
- Pells, S. and Fell, R. (2003), “Damage and cracking of embankment dams by earthquake and the implications for internal erosion and piping.”

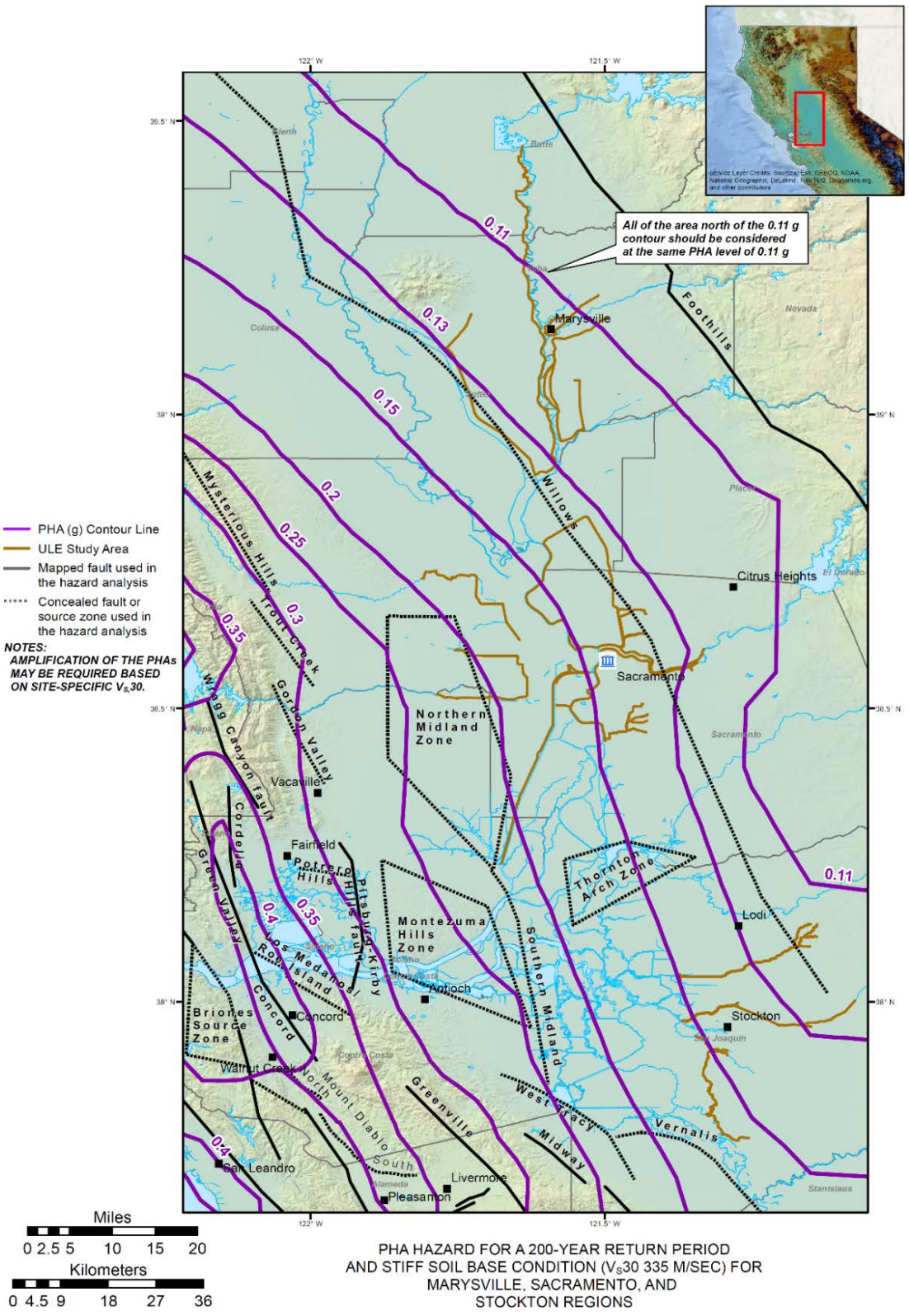

Figure 2: PGA Hazard Map for a 200-year Return Period and Stiff Soil Condition (Vs30 = 335 meters/second) for the Northern Central Valley (from URS, 2015a)

Figures 3 and 4 show earthquake-induced damage levels for embankment dams that sustained different levels of earthquake shaking, but where extensive liquefaction did not develop within the dams or their foundations. Both Swaisgood (2014) and Pells and Fell (2003) indicate that for a relatively low peak ground accelerations (PGA) of about 0.11g – 0.13g for earthquake magnitudes ranging up to 6.5 to 7.0, the level of estimated damage sustained by an embankment dam that did not experience liquefaction would be as follows:

- Upper end of ***No Damage*** to lower end of ***Minor Damage*** (see Figures 3 and 4).
- Approximate Normalized Crest Settlement (NCS; crest settlement divided by embankment height – sometimes including foundation thickness in height – see Figure 3) would be about 0.03 percent.

The estimated crest settlement assuming an NCS of 0.03 percent and a levee height of between 15 and 30 feet would be less than 1/8 of an inch (1 to 3 mm). According to Pells and Fell (2003), longitudinal crack widths on the order of 3/8 of an inch (10 mm) would be expected for this level of shaking. If foundation layers were included as part of the height, as assumed by Swaisgood, say up to 2 times the levee heights, then the expected crest settlement might range between 3/16 and 5/16 of an inch (4 to 8 mm), as shown in Table 1 below.

Table 1: Expected Crest Settlements for Levee Embankments using Damage Correlations from Swaisgood (2014) and Pells and Fell (2003)

Earthquake PGA = 0.11g – 0.13g Normalized Crest Settlement, NCS (%)	Levee Height (feet)	Settlement Estimated Considering only Levee Height (DH)		Settlement Estimated Considering Levee Height DH plus Foundation Thickness AT (2 x DH)	
		Height DH (feet)	Estimated Settlement (inches) [mm]	Height DH + 2DH (feet)	Estimated Settlement (inches) [mm]
0.03	15	15	0.05 [1]	45	0.16 [4]
	20	20	0.07 [2]	60	0.22 [5]
	25	25	0.09 [2]	75	0.27 [7]
	30	30	0.11 [3]	90	0.32 [8]

Results in Table 1 are small settlements for embankments that do not develop liquefaction.

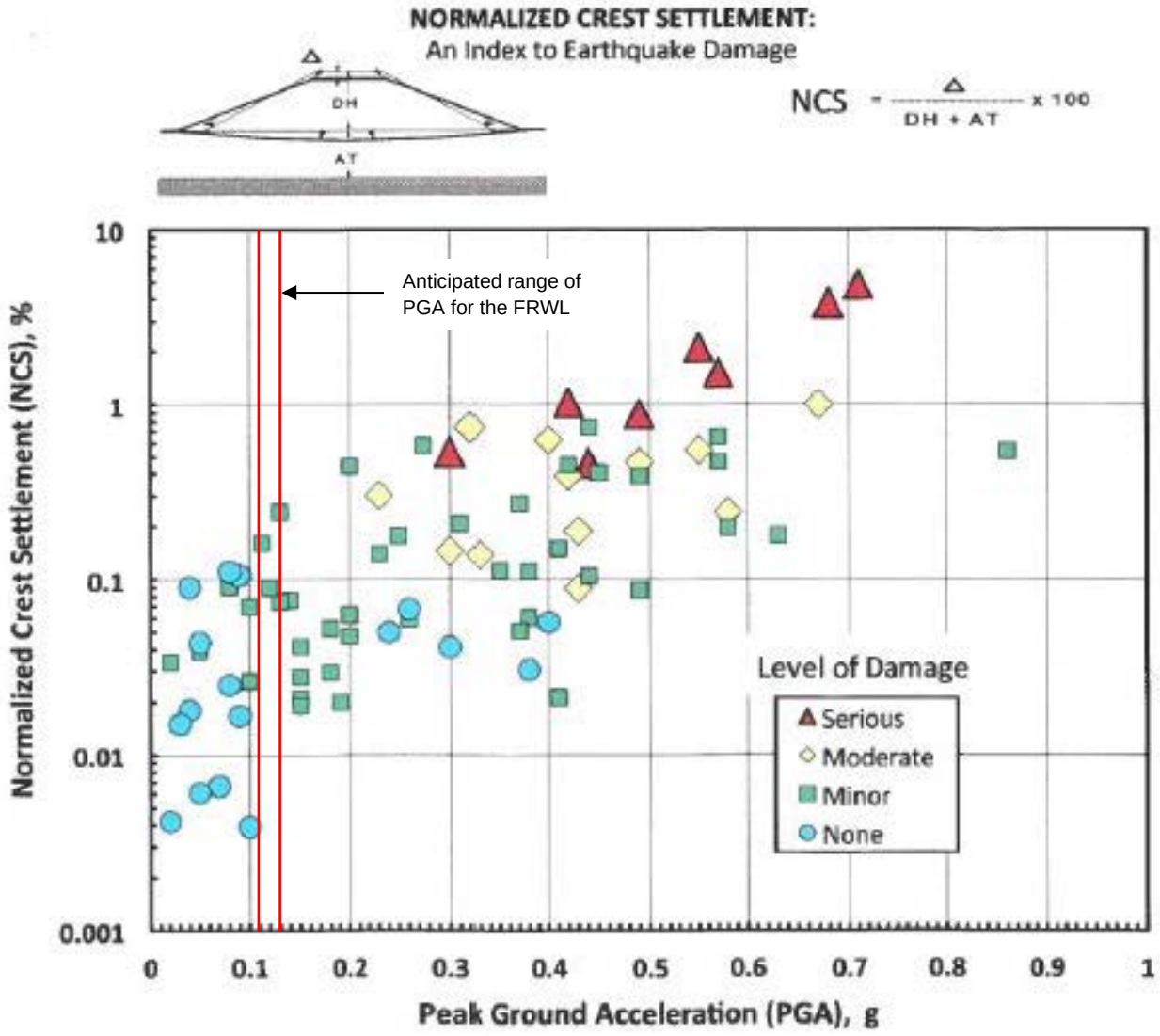

Figure 3. Settlements and Damage for Embankment Dams during Earthquake Shaking – excluding liquefaction settlement/damage (from Swaisgood, 2014)

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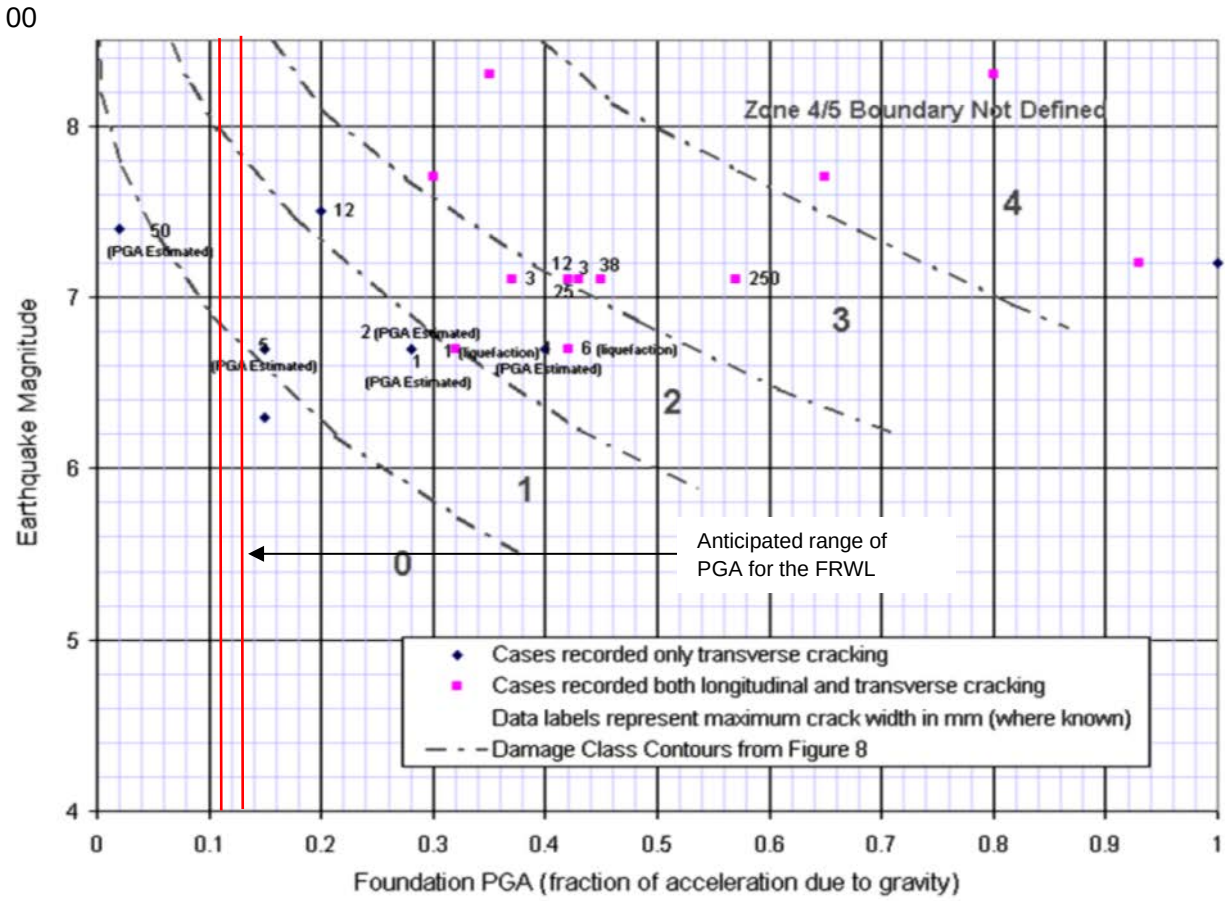

Damage Class		Maximum Longitudinal Crack Width (mm)	Maximum Relative Crest Settlement (%)
Number	Description		
0	No or Slight	< 10	< 0.03
1	Minor	10 - 30	0.03 – 0.2
2	Moderate	30 - 80	0.2 – 0.5
3	Major	80 - 150	0.5 – 1.5
4	Severe	150 - 500	1.5 – 5
5	Collapse	> 500	> 5

Figure 4: Contours of damage class versus earthquake magnitude and peak ground accelerations for earthfill dams (from Pells and Fell, 2003)

2.4 Examples of Severe Levee Damage Resulting from Earthquake-induced Liquefaction

Most levees outside of estuarial regions are only intermittently loaded by high river stages. Thus, when earthquakes occur, they are not generally retaining water and the embankments and upper portions of the levee foundation are not saturated, and therefore not susceptible to liquefaction. Further, many natural alluvial soils are relatively resistant to liquefaction during low levels of earthquake shaking. As a result, most levee reaches where the levee is founded on natural alluvium

perform relatively well for minor to moderate earthquake shaking. However, the alluvial deposits associated with cross drainage channels or paleochannels that previously drained to the river are often relatively recent, potentially loose, and saturated. Such deposits in the foundation can be more liquefiable and subject to significant strength loss following low to moderate earthquake shaking. This is often why following an earthquake, most of the levee system will have performed relatively well except where geologic changes, such as in-filled channels, result in localized liquefaction in the foundation and severe damage to the levee.

The typical mode of severe damage for a levee overlying liquefied foundation layers is lateral spreading of one or both slopes, and large settlements of the central crest. The following subsections provide three examples of severe levee damage from strong earthquake shaking:

2.4.1 Collapsed Naruse River Levee in 2011 Magnitude 9 Tohoku Earthquake

A diagram illustrating pre- and post-earthquake geometries of a levee following the 2011 Magnitude 9 Tohoku Earthquake is shown in Figure 5. The diagram shows that the levee essentially collapsed as a result of a flow slide on its landward slope.

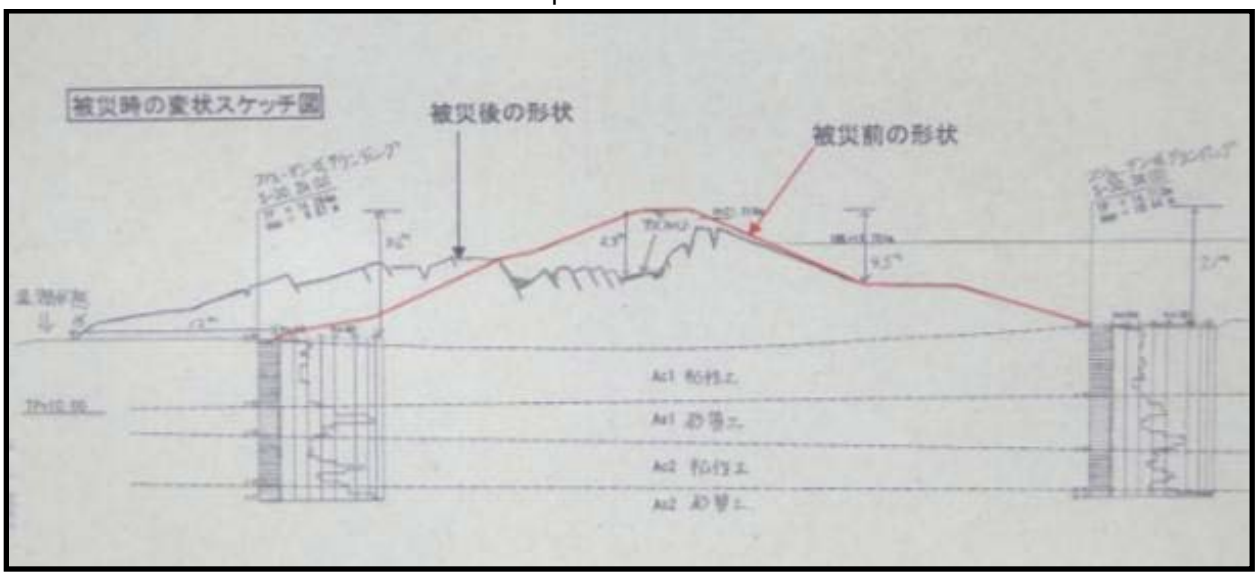

Figure 5: Drawing Depicting a Collapsed Naruse River Levee Due to a Landside Flow Slide Damage Induced by Foundation Liquefaction Following the 2011 Magnitude 9 Tohoku Earthquake (from MLIT, 2011)

The flow slide was caused by liquefaction of foundation sediments following very strong shaking, estimated to have a PGA between approximately 0.3g and 0.7g, and over 2 minutes of strong shaking – a very extreme loading. Figure 6 presents a photograph of a collapsed segment on the landside slope of the Naruse Left River Levee. Landside groundwater levels were generally higher than those beneath the waterside slopes due to Japanese farming and irrigation practices near the levee on the landside.

Figure 6: Photograph of Collapsed Naruse River Levee Due to a Landside Flow Slide Resulting from Foundation Liquefaction Following the 2011 Magnitude 9 Tohoku Earthquake (from MLIT, 2011)

2.4.2 Severe Damage on Naruse River Levee in 2011 Magnitude 9 Tohoku Earthquake

Figure 7 presents a photograph of a different segment of the Naruse River Left Levee following the 2011 Magnitude 9 Tohoku Earthquake. This levee segment experienced severe damage in the form of landside lateral spreading and settlement. The crown of the levee settled approximately 3 feet and the landside slope spread laterally about 2 to 3 feet. This resulted in several longitudinal cracks with widths as large as 1 foot at the surface on the crown of the levee and in the landside slope. The levee at this location was only about 15 feet high. If we take the levee height only, the 3 feet of crown settlement would be equivalent to an NCS of about 20 percent ([3/15] = 0.20). If a portion of the foundation is included in this normalization, say 1 to 2 levee heights into the foundation, the NCS would be between 7 and 14 percent ([3/45] = 0.07; [3/30] = 0.14). Either way, the NCS exceeds 5 percent and would be considered by Pells and Fell (2003) to be equivalent to either severe damage (based on crack widths) or a complete collapse of the levee based on normalized settlement (see Figure 4).

GEER 2011 (photo: L. F. Harder)

Figure 7: Photograph of Damaged Naruse River Levee Due to Landside Lateral Spreading Resulting from Foundation Liquefaction Following the 2011 Magnitude 9 Tohoku Earthquake (Photograph taken by L. F. Harder, April 21, 2011; see Harder et al., 2011)

2.4.3 Severe Damage on Pajaro River Levee in 1989 Magnitude 7.1 Loma Prieta Earthquake

Figure 8 presents a photograph of severe damage to the Pajaro River Levee following the 1989 Magnitude 7.1 Loma Prieta Earthquake. Along the Pajaro River levee, there was extensive liquefaction noted in the free field beyond the levee toe in the form of sand boils, and the approximate 6-foot-high levee experienced longitudinal cracking along the levee crown for much of its length. The relatively small levee is close to the steep river channel, with waterside berm widths ranging from 0 to 90 feet. In the area of the most serious damage, approximately 1,000 feet in length, as depicted in Figure 8, the levee spread laterally towards the river channel by approximately 2 feet, and a graben formed in the levee crown. In this most seriously damaged segment of the levee, the dropped block of the graben was up to approximately 1 foot below the adjacent portions of the levee, and the longitudinal cracks along the edges of the graben were up to 18 inches in width and up to 8 feet in depth (Miller and Roycroft, 2004; Perlea et al., 2013). Peak ground accelerations at the ground surface were estimated to be approximately 0.33g.

Figure 8: Photograph of Pajaro River Levee Crown Damaged by Foundation Liquefaction during the 1989 Magnitude 7.1 Loma Prieta Earthquake (from Perlea et al., 2013)

If 1 foot is assumed as the level of levee crown settlement and divide by the approximate 6-foot height of the levee, the NCS would be approximately 17 percent. If we include the estimated depth of liquefaction and lateral spreading beneath the levee crown, the height would be 16 feet, and the NCS would be about 6 percent. Either way, the NCS exceeds 5 percent and would be considered by Pells and Fell (2003) to be equivalent to either severe damage (based on crack widths) or a complete collapse of the levee based on normalized settlement (see Figure 4).

2.5 Approach for Current FRWL Seismic Vulnerability Evaluation

The following approach has been used for performing the current seismic vulnerability evaluation:

1. Review previous seismic stability analyses performed in URS (2012) and URS (2015a) and utilize the results as follows:
    a. Utilize the post-earthquake slope stability factors of safety without adjustments. These analyses were performed without pseudostatic loadings, but employing post-earthquake residual shear strengths for liquefied soil layers. Note that these stability analyses considered site conditions that exist after completion of the levee improvements that were part of the FRWLP. In performing these analyses, river levels were considered representing the mean summer and the mean winter conditions, in compliance with the ULDC. The higher of the two river levels was used in the analyses.

These analyses appear to be somewhat conservative as it is assumed that the entire potentially liquefiable layers have liquefied. This assumption has been carried into this evaluation. For the most part, the most critical post-earthquake sliding surfaces were waterside surfaces sliding through the bottom of the critical liquefied layers (see Figure 9). Waterward sliding surfaces were typically more critical than landward sliding surfaces because the adjoining river channels on the waterside resulted in lower ground surfaces and less passive sliding surfaces (see Figure 9). All of the post-earthquake slope stability analyses carried out within the FRWLP by URS (2012) and URS (2015a) are shown in Appendix A.

b. Utilize the deformation results determined by URS (2012) using yield accelerations and Newmark-type sliding block deformation analyses, but with adjustments. These were for levee sections in the URS (2012) evaluations where the post-earthquake factors of safety were above 1.0, but below 1.2. These analyses are intended to calculate the deformations that are induced by inertial forces during actual earthquake shaking. However, in this previous URS studies, the analyses appear to have calculated yield accelerations using post-earthquake residual shear strengths for liquefiable layers. Thus, the analyses appear to have assumed that the liquefiable layers actually liquefied at the beginning of earthquake shaking and the entire failure mass is then subjected to the entire earthquake intertial forces. This is overly conservative as with such low PGA (0.11g – 0.13g) it would take most of the earthquake shaking event to trigger major pore pressure increases, and there would also need to be time for pore pressure and void ratio redistribution that would lead to residual shear strength. As a result, the calculated lateral displacements were used in the current study, but were reduced by applying a factor of 0.5 – comparable to having liquefaction develop midway through the earthquake shaking. Crest settlements associated with the sliding block deformations were assumed to be 70 percent of the overall displacement, the same assumption used in the previous URS analyses and recommended in the ULE guidance document.

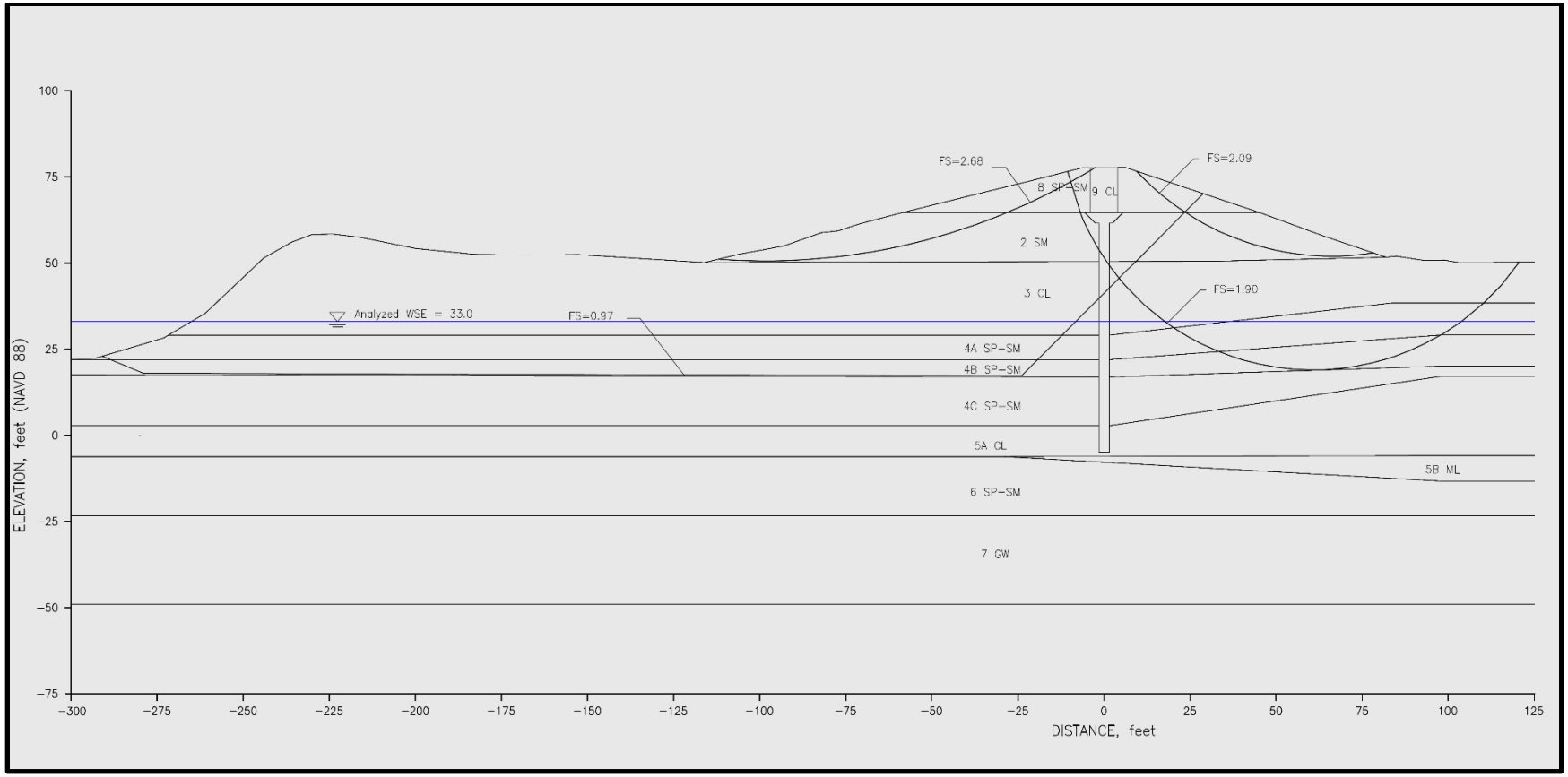

Figure 9: Post Earthquake Slope Stability Analysis Results for Reach 10 of the Feather River West Levee at Station 733+84 – Minimum Post-Earthquake Factor of Safety = 0.97 (from URS, 2012)

2. Estimates of post-liquefaction settlement induced by volumetric strains were developed and added to those associated with the Newmark-type deformations. This is recommended in the Geotechnical Guidance document developed for the DWR ULE Project – see Section 6.9 (URS, 2015b). This guidance document recommends that the correlation developed by Wu and Seed (2004) be used for this purpose. As shown in Figure 10, this correlation is based on corrected Standard Penetration Test (SPT) resistance (SPT (N1)60cs blowcounts) and cyclic stress ratio (CSR) induced by the earthquake. For a PGA of 0.11g – 0.13g postulated for a 200-year earthquake along the Feather River, CSR values would be expected to be approximately between 0.1 and 0.2, and closer to 0.1 beneath the levee (see URS, 2012). For a 20-foot-thick liquefied sand layer in the levee foundation with SPT (N1)60cs blowcounts of about 12, the volumetric strain that might be induced by the earthquake would be about 2 percent, leading to a potential settlement of about 5 inches (0.02 x 20 feet x 12 inches/foot).
3. Volumetric settlements were not calculated during the previous URS evaluations. For the current evaluation, per ULE guidance, the post-liquefaction volumetric settlement was estimated and added to those developed employing the Newmark approach as described above when post-earthquake slope stability factors of safety were above 1.0.

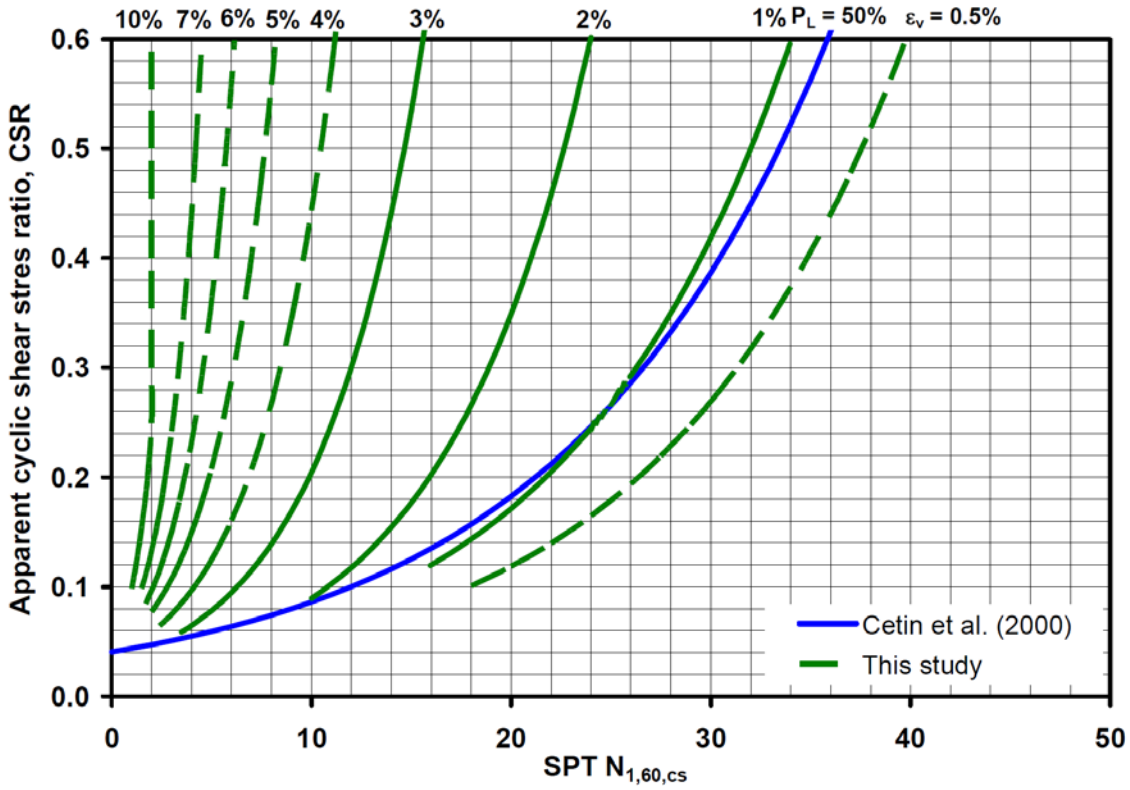

Figure 10: Correlation between CSR, SPT $(N_1)_{60cs}$ Blowcounts, and Reconsolidation Volumetric Strain (Wu and Seed, 2004)

4. The results of the analyses, with adjustments are then summarized. There were 12 such analyses performed for different levee sections in URS (2012) and 6 such analyses in URS (2015a) performed for different levee sections within the FRWLP. This is done as follows:
    - For each levee section analyzed, the minimum post-earthquake slope stability factor of safety calculated is summarized.
    - For sections with minimum post-earthquake slope stability factors of safety between 1.0 and 1.2, settlements associated with pseudostatic loading and volumetric strains were also summarized. These settlements were then normalized to obtain NCS values by dividing the estimated results by the depth of critical liquefaction/depth of sliding beneath the levee crown (equivalent levee height).
    - The results of each section were then assigned a damage level classification based on the post-earthquake factor of safety and/or the NCS using criteria developed for the current seismic vulnerability evaluation.

2.6 Approach and Damage Level Criteria for Current Seismic Vulnerability Evaluation

2.6.1 Previous Criteria

Previous criteria available or used for assessing potential damage levels induced by earthquake shaking is relatively limited, but is as follows:

- DWR ULDC Section 7.7 Seismic Vulnerability Criteria (2012)
- URS/DWR ULE Geotechnical Guidance Document (2015b)
- URS/HDR Geotechnical Design Recommendations Report for FRWLP (2012)

These criteria are summarized below:

DWR ULDC Section 7.7 Seismic Vulnerability Criteria (2012)

DWR's ULDC Section 7.7 does not specify damage levels or classifications for intermittently loaded levees such as the Feather River west levees. However, for frequently loaded levees, such as those in the central Sacramento-San Joaquin Delta, Section 7.7.2 states that for frequently loaded levees with less than 5 feet of freeboard, earthquake-induced deformations should be limited to less than 3 feet of total deformation and about 1 foot of vertical settlement. Presumably, levees which sustain deformations and settlements less than these values would be expected by DWR to have a reasonable chance of not failing during a routine level of water or flood loading.

2012 URS/HDR Geotechnical Recommendations Report for FRWLP (URS/HDR, 2012)

In the 2012 URS/HDR Geotechnical Recommendations Report for the FRWLP (URS, 2012), the criteria shown in Table 2. It is based upon the criteria established in Table 6-1 in the 2011 version of the URS/DWR ULE Geotechnical Guidance document available in 2012, and uses four vulnerability classes (Probably Uncompromised, Possibly Compromised, Likely Compromised, and Compromised. This criterion is based on NCS values, potential damage to internal structures such as cutoff walls, and residual freeboard remaining above a 10-year flood water surface.

Table 2: Criteria for Seismic Vulnerability of Feather River West Levees in 2012 URS Geotechnical Recommendations Report (from Table 7 in Technical Memorandum attached to the report, in URS/HDR, 2012)

Amount of Vertical Deformation Relative to Landside Levee Height (percent)	Significant Damage to Internal Structures (e.g., Cutoff Walls)	Remaining Freeboard for Post Seismic Evaluation (10-Year Flood Water Surface Elevation)	Post-Seismic Flood[1] Protection Ability (Vulnerability Class)
< 5	No	>1 foot	Probably Uncompromised
<10	Possibly	>1 foot	Possibly Compromised
<20	Likely if Existing	None	Likely Compromised
Unlimited, > 10 feet (Flow Slide Condition)	Yes	None	Compromised

Note:
[1] The section must pass each of the three criteria at a given level, or it should be rated at the next poorer post seismic flood protection ability classification (i.e. vulnerability class).

URS/DWR ULE Geotechnical Guidance Document (2015b)

In the final version of the Guidance Document for Geotechnical Analysis developed by URS for DWR's ULE program, published in 2015, the criteria shown in Table 3 was recommended:

Table 3: Criteria for Seismic Vulnerability of Intermittently Loaded Levees (from Table 6-1 in URS/DWR, 2015b)

Amount of Crown[2] Displacement Relative to Landside Levee Height (percent)	Potential for Significant Damage to Internal Structures (e.g., Cutoff Walls)	Remaining Freeboard [2] for Post Seismic Evaluation (10-Year Flood WSE +3 feet) [3]	Vulnerability Class[4] (Post-Seismic Flood Protection Ability)
< 10	No	>0.3 m (1 foot)	Low Vulnerability
<20	Possibly	Between 0 and >0.3 m (1 foot)	Medium Vulnerability
≥20 (Flow Slide Condition)	Yes	None	High Vulnerability

Note:
1 This table applies to intermittently-loaded levees. See Section 6.11 for information about frequently-loaded levees.
2 Vertical crown displacements can be estimated at 0.7 times the deviatoric deformation from simplified deformation analysis (such as Newmark type displacement), and by adding volumetric displacement as applicable.
3 Based on ULDC criteria for intermittently-loaded levees (Section 7.7.1 of ULDC [DWR, 2012]).
4 Analyses results must pass each of the criteria in the first three columns of the table at a given vulnerability class (the last column), or the corresponding segment should be rated at the next higher vulnerability class.

Criteria for three seismic vulnerability classes (Low, Medium, and High) were established, again based on NCS, potential for significant damage to internal structures such as cutoff wall, and remaining residual freeboard for a 10-year levee section. This was also the criteria adopted by URS in its 2015 ULE Geotechnical Evaluation Report for the Sutter Feather River Study Area (URS 2015a).

One important aspect to note is that the assessment of seismic vulnerability class includes multiple criteria that probably all need to be met for a particular vulnerability class. In many cases, the performance of a levee might fall in one vulnerability classification for one criterion while another criterion would place it another classification. For example, if the estimated earthquake-induced settlement in a particular levee reach was about 4 feet for a 20-foot-high levee, this would correspond to about a 20 percent relative settlement (4 feet / 20 feet), which would place it in the ***High Vulnerability*** classification. On the other hand, if the same reach had significant supplemental freeboard above the 10-year flood level plus 3 feet elevation, say 7 feet, for the same reach, then there would be 3 feet of residual freeboard left above a 10-year flood plus 3 feet elevation after shaking (7 feet of supplemental freeboard – 4 feet of settlement = 3 feet of residual, supplemental freeboard). This would be more than the 1 foot of residual supplemental freeboard above the 10-year flood level plus 3 feet that would qualify it to be classified as ***Low Vulnerability*** for that criterion. In this study, it appears that the higher vulnerability class was selected if more than one classification was possible.

2.6.2 Current Criteria for Damage Level Classification

The criteria for estimating different damage levels in the current seismic vulnerability evaluation builds upon the previous URS studies (URS 2012; URS 2015a; and URS 2015b) and utilizes the results from the slope stability and deformation analyses performed for those studies. However, the previous studies were more oriented towards basic screening studies as to the maximum level of damage in each reach rather than overall estimates of damage.

In the current evaluation, the intent is to estimate not only the maximum damage level in each reach, but also the amount of different levels of damage and the quantities needed to complete emergency repairs to restore the levees to a 10-year cross section in each reach. To this end, modifications were made to previous criteria to update it to be consistent with observations of embankment dams and to account for some of the conservative assumptions employed in the two previous URS evaluations:

1. The first modification was to focus initially on the damage levels that might be induced in any particular levee reach. This would be based on post-earthquake slope stability factors of safety and normalized crest settlement, including both Newmark-type vertical displacements during shaking and volumetric settlements within liquefied layers. Analysis results from sections both within and outside of the reaches would be used for this. For each levee reach or subreach, the percentages of the reach/subreach that would sustain different damage levels would be estimated. For example, a hypothetical levee reach or subreach might have 60% of its length experience None to Minor damage, 30 percent might experience Moderate to Major damage, and 10 percent might experience Severe damage. These estimates would be based on reviewing the geotechnical conditions within the foundations of the levees for the reaches and matching the conditions to those used in previous analyses conducted in the area (URS, 2012 and URS, 2015a). Results of different analyses for different damage levels would then be applied to the ranges in foundation conditions that were found to exist

beneath the levees in each reach or subreach. The damage levels reflect the impacts of a potential 200-year earthquake on the levee to provide a 200-year level of flood protection.

After estimating the percentages of different damage levels in each reach, the deformed levee section for each damage level would be compared against the cross sections associated with the 10-year and 200-year water surface elevations (WSE). Repairs to restore a 10-year levee section would need to be completed on an emergency basis within 8 weeks of the earthquake event. It should be noted again that only the 10-year cross section needs to be restored. It is not required that the temporary repairs meet ULDC seepage or underseepage requirements.

Details of the repairs needed for different damage levels are outlined in Chapter 4. Quantities for different repair efforts and materials are also provided for the emergency repairs to restore a 10-year levee cross section.

2. Details regarding factors of safety for post-earthquake slope stability, deformation calculations, and normalized crest settlement associated with different vulnerability or damage classifications have been modified from previous studies:

    a. For a post-earthquake slope stability factor of safety greater than 1.2 and a NCS value less than 0.2 percent, the expected damage level would be None – Minor. This is generally consistent with previous studies, but with the addition of the NCS criterion. However, if the post-earthquake slope stability factor of safety was approximately 1.5 or higher, the NCS criterion could be exceeded and the estimated damage level would remain at None – Minor.

    b. For a post-earthquake slope stability factor of safety between 0.9 and 1.0, the levee slope is regarded as unstable, but extremely large vertical movements would not be indicated because the instability is marginal, particularly since the sliding surfaces are largely wedge-shaped with principally lateral movements indicated. For factors of safety less than 0.9, however, large movements are considered possible.

    c. The use of 5, 10, and 20 percent normalized levee crown settlements in the previous URS studies for conditions where post-earthquake slope stability factors of safety are between 1.0 and 1.2 are relatively high levels of deformation compared to the values used in the studies by Swaisgood (2014) and Pells and Fell (2003), shown in Figures 3 and 4. For these other studies, normalized crest settlements above 1.5 percent would be considered serious to severe, and values above 5 percent would be considered equivalent to a complete collapse. However, the previous URS studies only considered the levee embankment height in normalizing the crown settlement. Swaisgood (2014) considered the depth of the foundation beneath the embankment as well, which would result in lower normalized values. Further, due to the sloping river channel waterward of the levees, it would seem appropriate to include the depth of the bottom of the river channel, or at least to the depth of sliding, in the height determination for deformation normalization since this is the height interval that deformations are actually developing. So, the following modifications were made:

        i. Damage level classifications for the current seismic vulnerability evaluation were guided by NCS criteria used by Swaisgood (2014) and Pells and Fell (2003).

ii. NCS was calculated using the depth of potential sliding beneath the crown (e.g. if the levee embankment was 20 feet high and the depth of potential sliding in the foundation was 40 feet below the base of the levee, then the adjusted levee height would be 60 feet (20 feet + 40 feet = 60 feet).

The above procedures and revisions were used to establish different levels of expected damage associated with different post-earthquake factors of safety and deformation estimates. These are summarized in Table 4. Also shown in this table are the general magnitudes of crest settlement and width of cracking expected for each damage level (adapted from Swaisgood, 2014, and Pells and Fell, 2003).

Table 4: Current Criteria for Damage Level Classification

Description	Post-EQ F.S.	NCS* (%)	Typical Settlements for ~50-foot Adj. Levee Height (inches)	Maximum Longitudinal Crack Widths (inches)
None - Minor	> 1.2	< 0.2I**	< 1	< 1
Moderate-Major	1.0 < F.S. < 1.2	0.2 – 1.5	1 - 9	1 - 6
Severe	0.9 < F.S. < 1.0	1.5 - 5	9 - 30	6 - 20
Compromised	< 0.9	> 5	> 30	> 20

* Based on Adjusted Levee Height which includes depth of sliding into the foundation

** If Post-earthquake slope stability factor of safety was very high (e.g. ~1.5 or higher), than Levee Damage Classification remained at "*None – Minor*" even if the NCS values slightly or moderately exceeded 0.2 percent

The criteria shown in Table 4 above were used throughout the current seismic vulnerability evaluation.

2.6.3 Damage Levels Estimated by Previous URS Evaluations Considering Current Criteria

The post-earthquake slope stability analysis results and deformation analyses for the sections analyzed in URS (2012) and URS (2015a) are summarized in Tables 5 and 6, respectively. Analysis results summaries and slope stability analysis cross sections from the previous 2012 and 2015 URS studies are provided in Appendix A and Appendix B, respectively. For each section previously analyzed, the damage level classification associated with the results using the criteria in the current evaluation, as summarized in Table 4, is also presented together with a color associated with the damage level classification. Also highlighted with the same color are the analysis results that controlled the determination of this classification (i.e. post-earthquake factor of safety or NCS).

Table 5: Summary of Slope Stability Analysis Results, Estimated Settlements, and Damage Level Classifications for Analysis Sections using Current Damage Level Classification Criteria (adapted from URS, 2012)

Reach[1] Previous Vulnearab. Class	Analysi[1] Section	Critical [1] Layer	Soil[1] Type	Thick.[1] (feet)	SPT [1] $(N_1)_{60cs}$	Critical[1] Post-EQ F.S.	Estimated[1] Newmark Displacement (feet)	Adjusted[2] Newmark Displacement (feet)	Adjusted[3] Vertical Displacement (feet)	Volumetric[4] Settlement (feet)	Total[5] Settlement (feet)	Adj. [6] Levee Height (feet)	NCS[7] (%)	DLC[8]
7b *Likely Comp.*	539+30	4B	SP-SM	20	12	1.04	6.5	3.3	2.3	0.4	2.7	58	4.7	Severe
8 *Comp.*	623+86	6	SP	17	8	0.95	-	-	-	-	-	85	-	Severe
		8A	SC-SM	10	11									
9b *Probably Uncomp.*	683+00	6	SP	15	16	1.18	0.8	0.4	0.3	0.4	0.7	63	1.1	Mod. - Major
		8	SP	24	13									
10b *Comp.*	733+84	4B	SP-SM	7	7	0.97	-	-	-	-	-	61	-	Severe
13 *Comp.*	871+00	5B	SP-SM	5	6	0.77	-	-	-	-	-	46	-	Comp.
15 *Comp.*	958+83	5A	SM	10	8	0.54	-	-	-	-	-	58	-	Comp.
17 *Possibly Comp.*	1116+00	2B	ML	13	12	1.12	1.5	0.75	0.5	0.5	1.0	54	1.9	Severe
19a *Likely Comp.*	1224+00	2B	SM	25	12	1.17	10	5	3.5	0.5	4.0	63	6.3	Comp.
21 *Probably Uncomp*	1378+87	5B	ML	5	12	2.04	-	-	-	-	-	38	-	Minor
33 *Probably Uncomp*	2047+50	4	SP-SM	16	13	1.82	-	-	-	-	-	46	-	Minor
37 *Probably Uncomp*	2276+76	3	SP	5	11	1.13	0.9	0.45	0.3	0.1	0.4	31	1.3	Mod. - Major
40 *Probably Uncomp*	2332+91	4B	GW	3	18	2.18	-	-	-	-	-	37	-	Minor

Table 6: Summary of Slope Stability Analysis Results, Estimated Settlements, and Damage Level Classifications for Analysis Sections from Geotechnical Evaluation Report – Sutter Feather River Study Area using Current Damage Level Classification Criteria (adapted from URS, 2015a)

Reach[1] (Previous Vulnerability Class)	Analysi[1] Section	Critical[1] Layer	Soil[1] Type	Thick[1] (feet)	SPT[1] $(N_1)_{60cs}$	Critical[1] Post-EQ F.S.	Estimated[1] Newmark Displacement (feet)	Adjusted[2] Newmark Displacement (feet)	Adjusted[3] Vertical Displacement (feet)	Volumetric[4] Settlement (feet)	Total[5] Settlement (feet)	Adj.[6] Levee Height (feet)	NCS[7] (%)	DLC[8]
7b (High)	539+15	4	SP-SM	7	6.5	0.96	-		-	-	-	53	-	Severe
8/9/10a (Low)	599+00 to 722+00	No Liquef.	-	-	-	-	-	-	-	-	-	-	-	Minor
10b (High)	733+69	4	SP-SM	8	5.5	0.85	-	-	-	-	-	85	-	Comp.
10b/ 10c / 11 (Low)	745+30 to 831+00	No Liquef.	-	-	-	-	-	-	-	-	-	-	-	Minor
12/13 (High)	870+75	5	SP-SM	17	9	0.78	-	-	-	-	-	61	-	Comp.
13 (Low)	878+00 to 907+00	Partial Liquef.	SP-SM	17	9	2.42	-	-	-	-	-	61	-	Minor
13/14/ 15/16a/16b (High)	907+00 to 996+80	Used Sta. 870+75	SP-SM	5-20	4.5	0.78	-	-	-	-	-	61	-	Comp.
16b – 21 (Low)	996+80 to 1433+83	No Liquef.	-	-	-	-	-	-	-	-	-	-	-	Minor
22 – 29 (Low)	1433+83 to 1813+33	No Liquef.	-	-	-	-	-	-	-	-	-	-	-	Minor
30 (Low)	1826+797	3	SP	10 - 19	6.5	1.47	-	-	-	-	0.5	50	1.0	Minor
31 – 34 (Low)	1902+00 to 2182+00	No Liquef.	-	-	-	-	-	-	-	-	-	-		Minor
35 (Low)	2211+15	3	SW/ SM/GM	4	9	1.62	-	-	-	-	0.4	36	1.1	Minor
36 – 41 (Low)	2224+00 to 2368+00	No Liquef.	-	-	-	-	-	-	-	-	-	-	-	Minor

Notes:

[1] Reach, Analysis Sections, Critical Layers, Soil Types, Layer Thicknesses, SPT blowcounts, Critical Post-EQ Factor of Safety, and Estimated Newmark Displacement from URS (2012) and (URS 2015a) – note: Reach numbers and stationing have been converted to SBFCA FRWLP numbering and stationing

[2] Adjusted Newmark Displacement taken as half of previously calculated Newmark Displacement by URS (2012) and URS (2015a) due to overly conservative assumption that foundation soil layer was liquefied at the beginning of earthquake shaking

[3] Adjusted Vertical Displacement is 70 percent of the Adjusted Newmark Displacement

[4] Volumetric settlement estimated from Wu and Seed (2004) and Figure 10

[5] Total Settlement is the sum of the Newmark vertical settlement and the Volumetric Settlement

[6] Adjusted Levee Height is the distance from the levee crown to the depth of sliding beneath the levee crown – typically the bottom of the critical liquefied soil layer

[7] NCS is the Total Settlement divided by the Adjusted Levee Height

[8] DLC is the Damage Level Classification based on Normalized Crest Settlement and criteria suggested by Swaisgood (2014) and Pells and Fell (2003)

3. RESULT OF SEISMIC VULNERABILITY ASSESSMENTS

3.1 Summary

The development of the seismic damage levels estimated for the current seismic vulnerability assessment is summarized in a table presented in Appendix D. It includes previous seismic vulnerability estimates from the URS (2012) and URS (2015a) evaluations, as well as the percentages of each levee reach estimated in the current assessment that might sustain a portion of the four different damage levels (i.e. *None to Minor*, *Moderate to Major*, *Severe*, and *Compromised*). It also provides summaries of the geotechnical conditions beneath the levees to help justify the damage levels estimated. Presented in Table 7 is a summary of the damage level percentages estimated for each reach.

Table 7: Summary of Estimated Damage Levels for FRWLP for 200-year Seismic Loading

Reach No.	Begin Station	End Station	Length (feet)	Previous Classifications		Current Estimated Damage Level Classifications (percent)			
				2012 FRWL GDRR	2015 FRWL ULE	Comp.	Severe	Moderate - Major	None - Minor
7a	510.37	526	1,563	Possibly Compromised	High	**0**	**0**	**0**	**100**
7b	526	599	7,300	Likely Compromised	High and Low	**0**	**30**	**20**	**50**
8	599	655	5,600	Compromised	Low	**0**	**20**	**30**	**50**
9a	655	674	1,900	Compromised	Low	**0**	**0**	**20**	**80**
9b	674	695	2,100	Probably Uncompromised	Low	**0**	**0**	**20**	**80**
9c	695	707	1,200	Possibly Compromised	Low	**0**	**0**	**20**	**80**
10a	707	722	1,500	Possibly Compromised	Low	**0**	**0**	**10**	**90**
10b	722	754	3,200	Compromised	High and Low	**5**	**15**	**20**	**60**
10c	754	774	2,000	Possibly Compromised	Low	**0**	**0**	**10**	**90**
11	774	831	5,700	Possibly Compromised	Low	**0**	**10**	**40**	**50**
12	831	845	1,400	Possibly Compromised	High	**10**	**10**	**30**	**50**
13	845	927	8,200	Compromised	High and Low	**25**	**25**	**25**	**25**
14	927	954	2,700	Compromised	High	**40**	**25**	**25**	**10**
15	954	968	1,400	Compromised	High	**25**	**25**	**25**	**25**
16a	968	993	2,500	Compromised	High	**0**	**20**	**30**	**50**
16b	993	1080	8,700	Possibly Compromised	High and Low	**0**	**10**	**20**	**70**

Reach No.	Begin Station	End Station	Length (feet)	Previous Classifications		Current Estimated Damage Level Classifications (percent)			
				2012 FRWL GDRR	2015 FRWL ULE	Comp.	Severe	Moderate - Major	None - Minor
17	1080	1131	5,100	Possibly Compromised	Low	**0**	**10**	**10**	**80**
18a	1131	1136	500	Possibly Compromised	Low	**0**	**0**	**30**	**70**
18b	1136	1170	3,400	Likely Compromised	Low	**0**	**10**	**30**	**60**
18c	1170	1214	4,400	Possibly Compromised	Low	**0**	**15**	**25**	**60**
19a	1214	1245	3,100	Likely Compromised	Low	**5**	**15**	**20**	**60**
19b	1245	1298	5,300	Probably Uncompromised	Low	**0**	**0**	**10**	**90**
20	1298	1374	7,600	Probably Uncompromised	Low	**0**	**0**	**20**	**80**
21	1374	1434	6,000	Probably Uncompromised	Low	**0**	**0**	**30**	**70**
22	1434	1504	7,000	Probably Uncompromised	Low	**0**	**0**	**20**	**80**
23	1504	1609	10,500	Probably Uncompromised	Low	**0**	**0**	**10**	**90**
24	1609	1624	1,500	Probably Uncompromised	Low	**0**	**0**	**5**	**95**
25	1624	1674	5,000	Probably Uncompromised	Low	**0**	**0**	**5**	**95**
26	1674	1707	3,300	**No Work Reaches** (Landward Ground Surfaces above 200-year WSE)					
27	1707	1722	1,500						
28	1722	1769	4,700						
29	1769	1813	4,400	Probably Uncompromised	Low	**0**	**0**	**5**	**95**
30	1813	1902	8,900	Probably Uncompromised	Low	**0**	**5**	**30**	**65**
31	1902	1958	5,600	Probably Uncompromised	Low	**0**	**5**	**25**	**70**
32	1958	1989	3,100	Probably Uncompromised	Low	**0**	**10**	**25**	**65**
33	1989	2122	13,300	Probably Uncompromised	Low	**0**	**10**	**25**	**65**
34	2122	2182	6,000	Probably Uncompromised	Low	**0**	**5**	**25**	**70**
35	2182	2224	4,200	Probably Uncompromised	Low	**0**	**5**	**15**	**80**
36	2224	2259	3,500	Probably Uncompromised	Low	**0**	**0**	**30**	**70**
37	2259	2290	3,100	Probably Uncompromised	Low	**0**	**0**	**30**	**70**
38	2290	2303	1,300	Probably Uncompromised	Low	**0**	**0**	**0**	**100**
39	2303	2319	1,600	Probably Uncompromised	Low	**0**	**0**	**0**	**100**
40	2319	2359	4,000	Probably Uncompromised	Low	**0**	**0**	**20**	**80**
41	2359	2368	900	Probably Uncompromised	Low	**0**	**0**	**0**	**100**

Presented in Table 8 is a summary of the total number of miles along the FRWL that might sustain different levels of damage induced by 200-year earthquake loadings.

Table 8: Summary of FRWLP Levee Distances for Different Seismic Damage Levels

Current Assessment of Potential Damage Level Classifications	Total Levee Length for Potential Damage Level for 200-year Earthquake Loading (miles)
Compromised	0.7
Severe	2.6
Moderate - Major	7.0
None - Minor	23.1
Total Number of Miles Evaluated	33.4

It should be noted that the above totals reflect a conservative estimate as no single earthquake is likely to induce a 200-year level of earthquake loading across all 33 miles evaluated. It is more likely that the actual damage during a single 200-year earthquake would be on the order of approximately 50 percent of the lengths given in Table 8. However, for planning purposes, we have utilized the lengths shown above in Table 8.

4. ESTIMATED REPAIRS NECESSARY TO RESTORE A 10-YEAR LEVEE CROSS SECTION AND A 200-YEAR LEVEL OF FLOOD PROTECTION

4.1 Repair Approaches - General

Repairs to earthquake-induced damage to levees have in the past generally focused on two phases of repair:

1. Emergency, interim repairs that are completed under emergency conditions within a few days to weeks following the earthquake, and long-term repairs. As outlined in Chapter 2, the ULDC requires that levees damaged by an earthquake up to a 200-year return period be reconstructed to have a minimum cross section for a 10-year flood (10-year WSE plus 3 feet) and that this emergency repair should be completed within 8 weeks of the earthquake event.
2. Long-term, permanent repairs to restore the pre-existing levee integrity – for the FRWLP this would be to a 200-year urban level of flood protection. This latter repair would require a more detailed evaluation of the levee damage and be expected to be completed at least a year, if not several years, after the earthquake event.

4.1.1 Emergency Repairs - General

Emergency, interim repairs generally consist of trenching/excavating large cracks, filling remaining cracks and excavations, and restoring at least partial freeboard consistent with a 10-year levee section. Shown in Figure 11 are schematic diagrams illustrating the sequence for a typical emergency repair used to restore interim flood protection for river levees following the 2011 Magnitude 9 Tohoku, Japan Earthquake. These diagrams show partial removal of the damaged levee crown, filling of cracks that extend down past the excavation, and rebuilding the excavated upper portion of the levee. In some cases, articulated concrete mats placed over geosynthetic fabrics were used on the waterward slopes to provide slope protection against wave or current erosion (see Figures 12 and 13). In many cases, blue plastic tarps (geomembranes) were also used to keep precipitation from entering unfilled cracks and reducing the stability of the damaged slopes. In some cases where the levees were extremely damaged or near total collapse, it was more expedient to build a new adjacent levee for interim repairs (see Figure 14).

4.1.2 Long-term Permanent Repairs - General

Long-term permanent repairs typically require major reconstruction or even entire replacement of the levee embankment, and either some removal and replacement of portions of the foundation, or some type of foundation improvement. For severe and compromised levees, this would likely result in at least a partial replacement of damaged cutoff walls. For long reaches of levees, this could require repairs costing tens to hundreds of millions of dollars, depending upon the lengths of repairs needed.

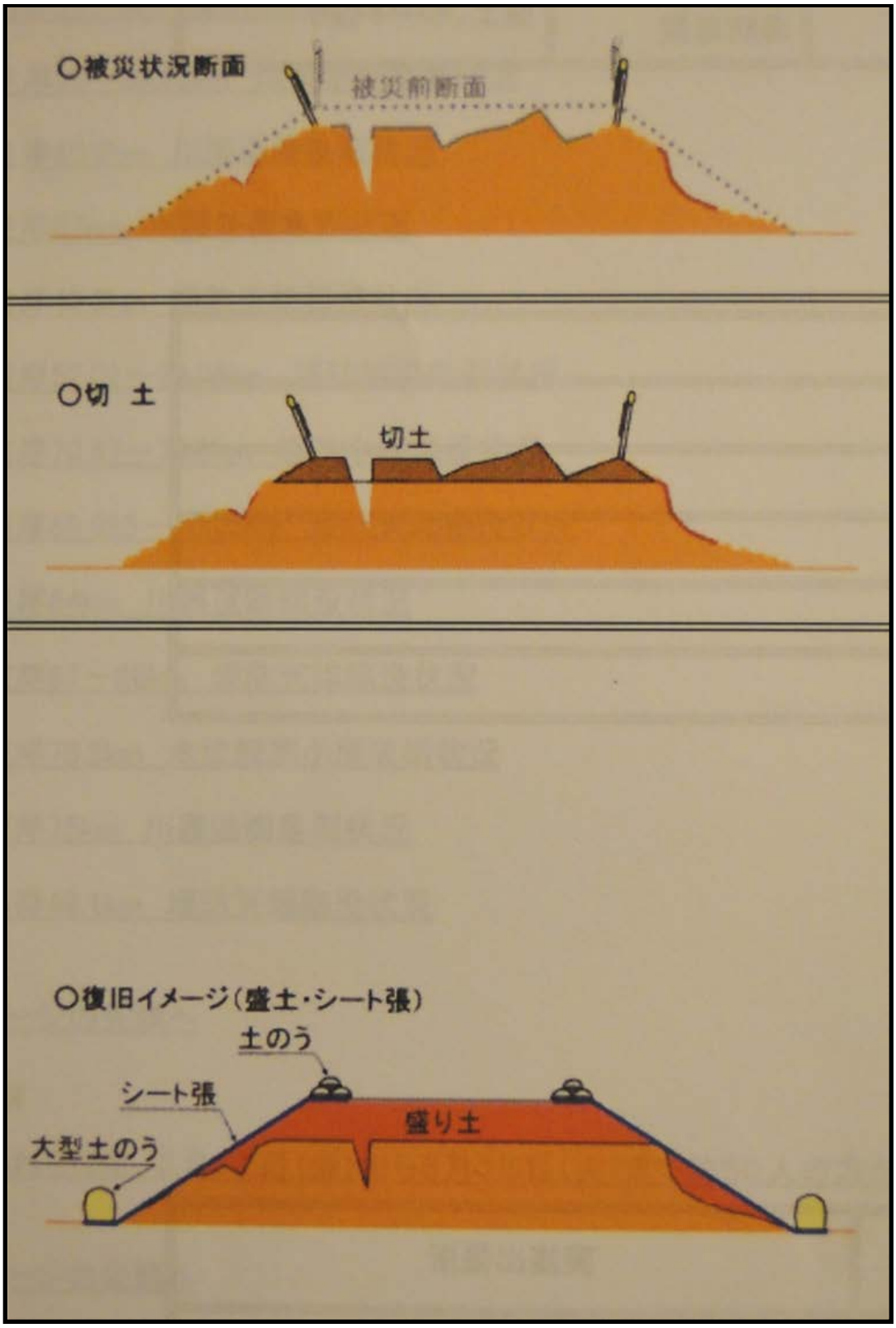

Figure 11: Drawing Depicting Interim Levee Repair Approach by Removing Upper Portion of Damaged Levee, Filling Cracks, and Rebuilding Upper Levee Portion following 2011 Magnitude 9 Tohoku Earthquake (from MLIT and Harder et al., 2011)

GEER 2011 (photo: L. F. Harder)

Figure 12: Photograph of Interim Levee Repair on Naruse River Levee Incorporating Articulated Concrete Mats and Geosynthetic Fabric for Waterside Slope Protection following 2011 Magnitude 9 Tohoku Earthquake (from MLIT and Harder et al., 2011)

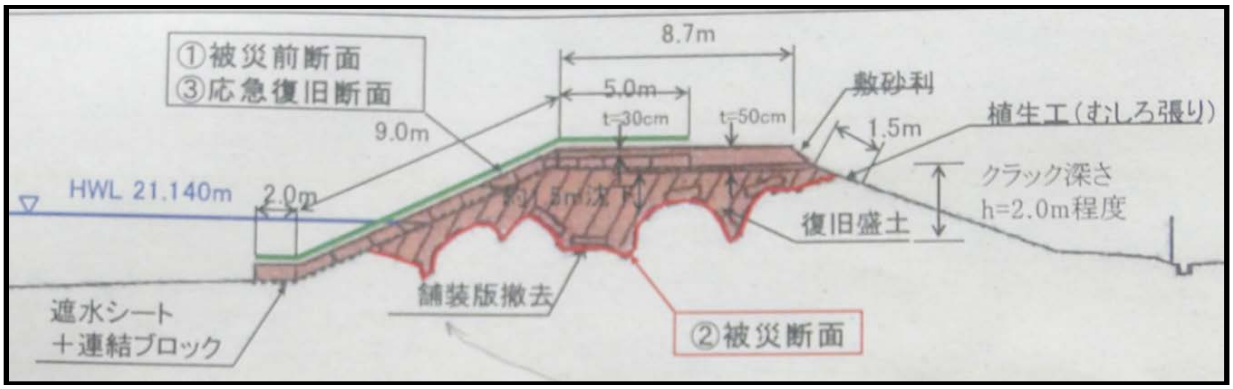

Figure 13: Drawing Depicting Interim Levee Repair Approach Incorporating Articulated Concrete Mats and Geosynthetic Fabrics for Waterside Slope Protection following 2011 Magnitude 9 Tohoku Earthquake (from MLIT and Harder et al., 2011)

GEER 2011 (photo: L. F. Harder)

Figure 14: Photograph of Adjacent Levee Section Constructed on side of Collapsed Naruse River Levee to Provide Interim Flood Protection following 2011 Magnitude 9 Tohoku Earthquake (from MLIT and Harder et al., 2011)

4.2 Emergency Repairs to Provide 10-year Levee Section for FRWLP

Emergency repairs to provide a 10-year levee section for the FRWLP following a 200-year earthquake are estimated to be relatively small efforts. The reasons for this are as follows:

1. The 200-year earthquake for the FRWLP produces relatively low levels of shaking with PGA values of about 0.11g to 0.13g, as previously discussed. Therefore, the amount of damage would be expected to be small compared to levels sustained during larger earthquakes and higher levels and durations of shaking, such as for the 2011 Magnitude 9 Tohoku, Japan, Earthquake and the 1989 Magnitude 7.1 Loma Prieta Earthquake.
2. The FRWLP 10-year levee section typically represents a section that is only about half the height and volume of the existing levee section.

As a result, even a levee that experiences serious damage with partial collapse will have sufficient remnant height to retain a 10-year levee section. Appendix C provides 72 transverse cross sections at select locations along the 35-mile length of the FRWLP. These cross sections show the actual (existing) levee geometry, the 200-year inscribed theoretical minimum design geometry (20-foot-wide crown at 3 feet above the 200-year water surface), and the 10-year inscribed theoretical minimum design cross geometry (20-foot-wide crown at 3 feet above the 10-year water surface). These sections show that there currently exists a significant amount of freeboard above the 200-year theoretical levee crown for most sections, typically ranging from a couple of feet to up to 10 feet. In

addition, the 10-year levee geometry is significantly narrower and has a lower crown height, typically 4 to 9 feet below the 200-year theoretical levee crown. Shown in Figure 15 is a typical levee section using a 25-foot embankment height, a 200-year inscribed theoretical design cross section 5 feet below the actual existing crown, and a 10-year inscribed theoretical design cross section 7 feet below the 200-year theoretical crown. The figure also shows the 3-foot-wide soil bentonite (SB) cutoff wall in the lower portion of the levee and into the foundation as well as the 8-foot-wide central clayey core above the cutoff wall in the upper portion of the levee (typical of the FRWLP). The typical 10-year section shown is only about 13 feet high (about half of the 25-foot-high actual levee section), has 12 feet of existing freeboard, and also represents only about a half of the existing cross section in terms of area or volume.

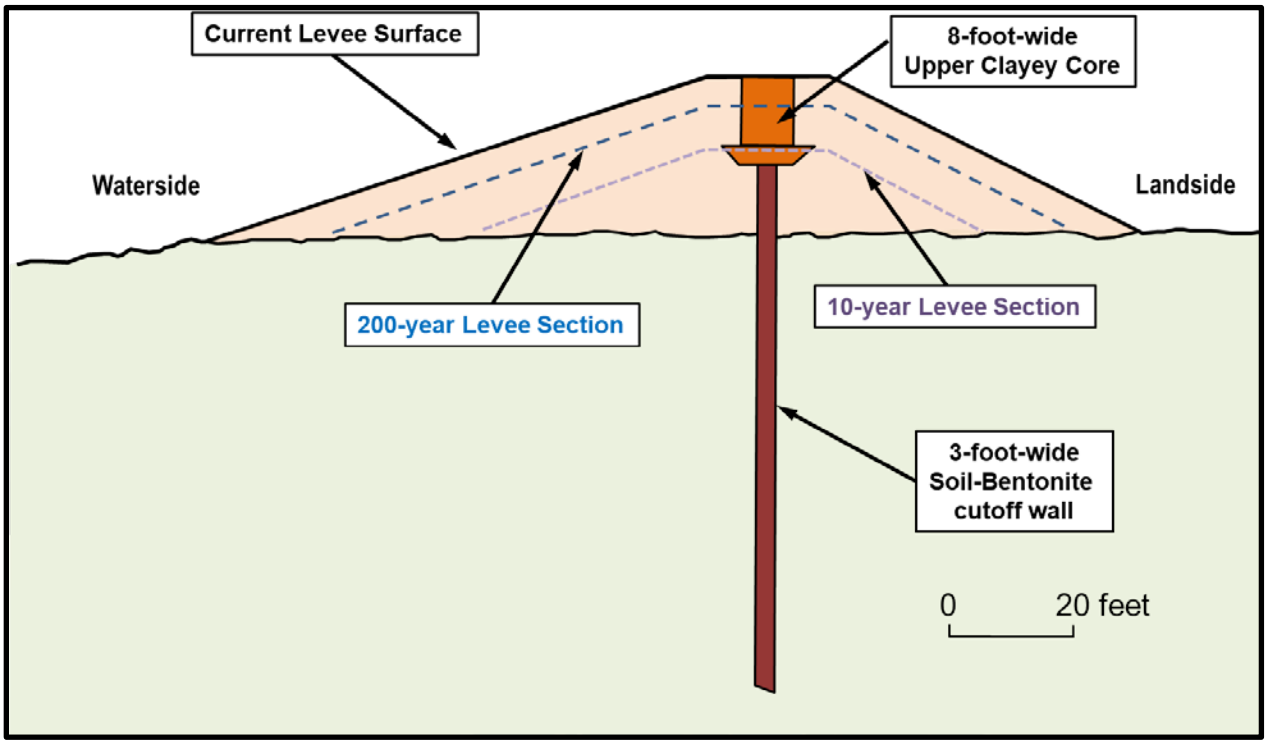

Figure 15: Typical Feather River West Levee with Inscribed 200-year and 10-year Theoretical Design Sections Shown (dashed lines)

The above considerations result in the following general assessment for 10-year levee repairs:

- There will be no need to import significant amounts of additional borrow material as the 10-year levee section is only about half of the existing levee section, and even with heavy damage to the levee there will be available material in the displaced levee to fill cracks and/or restore portions of the displaced levee section.
- For most potential damage levels, the principal effort would be to fill/close major cracks and to ensure vehicle traffic/access along the top of the damaged levee crown, although not specifically required in the ULDC. A limited import of road (aggregate) base would be expected as part of the interim restoration of the levee crown. We have estimated that a total of approximately 4,800 tons[1] of road base might be needed to restore the 10-year

[1] Assumes 2.0 miles of levee (50% of 2.6 miles of 'Severe' and 100% of 0.7 miles of 'Compromised" levee sections) will require import of road base to form a 12 foot wide by 6 inch deep compacted section with an in-place density of 150 pounds per cubic foot.

levee section following a 200-year earthquake, such materials can be obtained at the following local suppliers:

- Butte Sand and Gravel, 10373 S. Butte Road, Sutter, CA 95982, Phone: 530-696-2486
- Teichert Aggregates - Marysville, 4249 Hammonton-Smartville Rd, Marysville, CA 95901, Phone: 530-743-6111

- For severe and compromised levee damage levels, some associated dozer work to smooth out the distorted, displaced waterside slope would also be necessary to reduce the potential for wave damage. In most places, the existing waterside slope of the levee is not armored for erosion, so no additional slope protection would generally be needed. However, reseeding of the reworked waterside slopes would be needed in such areas. It should also be noted that, given that the 10-year inscribed levee section represents only about half of the existing levee section and that earthquake-induced displacements are expected to be primarily waterward. Thus, there is a significant amount of levee material waterward of the inscribed 10-year levee section and that there often could be 30 to 50 feet of horizontal scour before the 10-year section was actually exposed.

Section 4.4 provides more specific details on the amounts and expected reach lengths estimated for different damage levels together with the levels of repairs necessary to restore a 10-year levee section.

4.3 Permanent Repairs to Provide 200-year Levee Section for FRWLP

Long-term permanent repairs to restore a 200-year level of levee protection for the FRWLP following a 200-year earthquake would be much greater than those associated with providing a 10-year levee section and would include the following:

- Remove portions of the cracked, damaged levee section. For Severe and Compromised levee sections, at least the upper half of the levee would need to be removed and could range up to the entire levee section.
- For Severe and Compromised levee sections, the SB cutoff wall would be expected to have been completely offset by levee displacements. As a result, it would be expected that replacement cutoff walls would need to be constructed to depths ranging from 40 feet and up to their previous constructed depths.
- The damaged levee section would have to be reconstructed back to its approximate previous cross section, and at least to its previous crown elevation. It would be expected that most of the material for this would come from the distorted, displaced levee and that relatively little new borrow would be needed. However, as part of this reconstruction, the central clayey core within the upper portion of the levee embankment over the SB cutoff wall would need to be reconstructed, and this would require importing new borrow material for the central clayey core.
- The new rebuilt levee crown would require new road base and this material would have to be imported.
- The reworked/rebuilt waterside slopes would have to be reseeded.

In some circumstances and levee reaches, additional geotechnical explorations in the form of trenching, boreholes, or cone penetration test soundings would be useful to investigate the extents of subsurface deformations, cracking, and limits of different levels of repair. This could be particularly relevant for determining the level of damage to cutoff walls and the depths of any replacement cutoff walls.

Section 4.4 provides more specific details on the amounts and expected reach lengths estimated for different damage levels together with the levels of repairs necessary to restore a 200-year level of flood protection.

4.4 Emergency and Permanent Repairs for Different Levee Damage Levels

This section presents emergency repair efforts needed to restore a 10-year levee section and permanent repair efforts likely necessary to restore a 200-year level of flood protection for the different levels of potential earthquake-induced damage. Figures 16 through 18 present schematic illustrations of the level of displacement, settlement, and damage for damage levels *Moderate to Major*, *Severe*, and *Compromised.* The *None to Minor* damage levels would involves settlements of less than 1 inch with cracks up to 1 inch wide and would essentially look like the "Current Levee Surface" depicted in Figure 15. Each of these schematic damage presentations are based on the typical existing levee section shown in Figure 15. The estimated displacements of the levees and the repairs necessary to restore both the 10-year levee section and the 200-year urban level of flood protection are also summarized in these figures.

4.4.1 Moderate to Major Levee Damage

Figure 16 presents a schematic illustration of the level of displacement, settlement, and cracking associated with a *Moderate to Major* damage level assuming a nominal adjusted levee height of 50 feet:

- Displacements of up to 1 foot – mainly waterward
- Crown settlement of up to about 9 inches
- Longitudinal cracking common – up to 6 inches in width, and open depths extending down 6 to 8 feet
- Potential partial offset of the SB cutoff wall

It may be observed that the majority of the levee section remains intact. The repairs to restore a 10-year levee section would include the following:

- Track-walking to close larger cracks and make crown road passable – placement of material into and/or geomembranes over unfilled cracks and overlay with road base.
- Track-walking cracks and disturbed areas on waterside slope, reseed disturbed areas.
- No significant import of levee or road base materials.

The repairs to restore a 200-year level of flood protection would include the following:

- Trench/dozer excavations of remaining larger cracks and backfilling with recompacted materials. Alternatively, the upper 8 feet or so of the levee slopes and center section could be excavated and reconstructed.

- Restoration of waterside and landside slopes and settled levee crown to original profile, including placement of additional central clayey core up to previous crown elevation.

4.4.2 Severe Levee Damage

Figure 17 presents a schematic illustration of the level of displacement, settlement, and cracking associated with a *Severe* damage level assuming a nominal adjusted levee height of 50 feet:

- Displacements of up to 3½ feet – mainly waterward
- Crown settlement of up to about 30 inches
- Longitudinal cracking common – up to 20 inches in width, and open depths extending down 15 feet
- Possible complete dislocation/offset of SB cutoff wall

It may be observed that remaining levee section, although damaged, remains significantly above the 10-year levee section. The repairs to restore a 10-year levee section would include the following:

- Track-walking to close larger cracks and make crown road passable and place additional road base as needed – placement of material into and/or geomembranes over unfilled cracks and overlay with road base on levee crown.
- Track-walking cracks and disturbed areas on waterside slope, reseed disturbed areas. Geomembrances/geofabrics anchored with articulated concrete mats may be used to provide waterside slope protection as well.
- Generally, no significant import of levee materials. Some amount of road base material would likely need to be imported, perhaps on the order of 2,400 tons per mile. Since there were approximately 2.6 miles of FRWLP assessed to have a potential *Severe* level of levee damage, this would indicate that a total of approximately 3,100 tons[2] of road base might be needed for the *Severe* level of damage.

[2] Assumes 1.3 miles (50 percent of reaches with a seismic vulnerability class of Severe) would require import of aggregate base to restore a 12-foot-wide by 6 inch deep section compacted to 150 pounds per cubic foot.

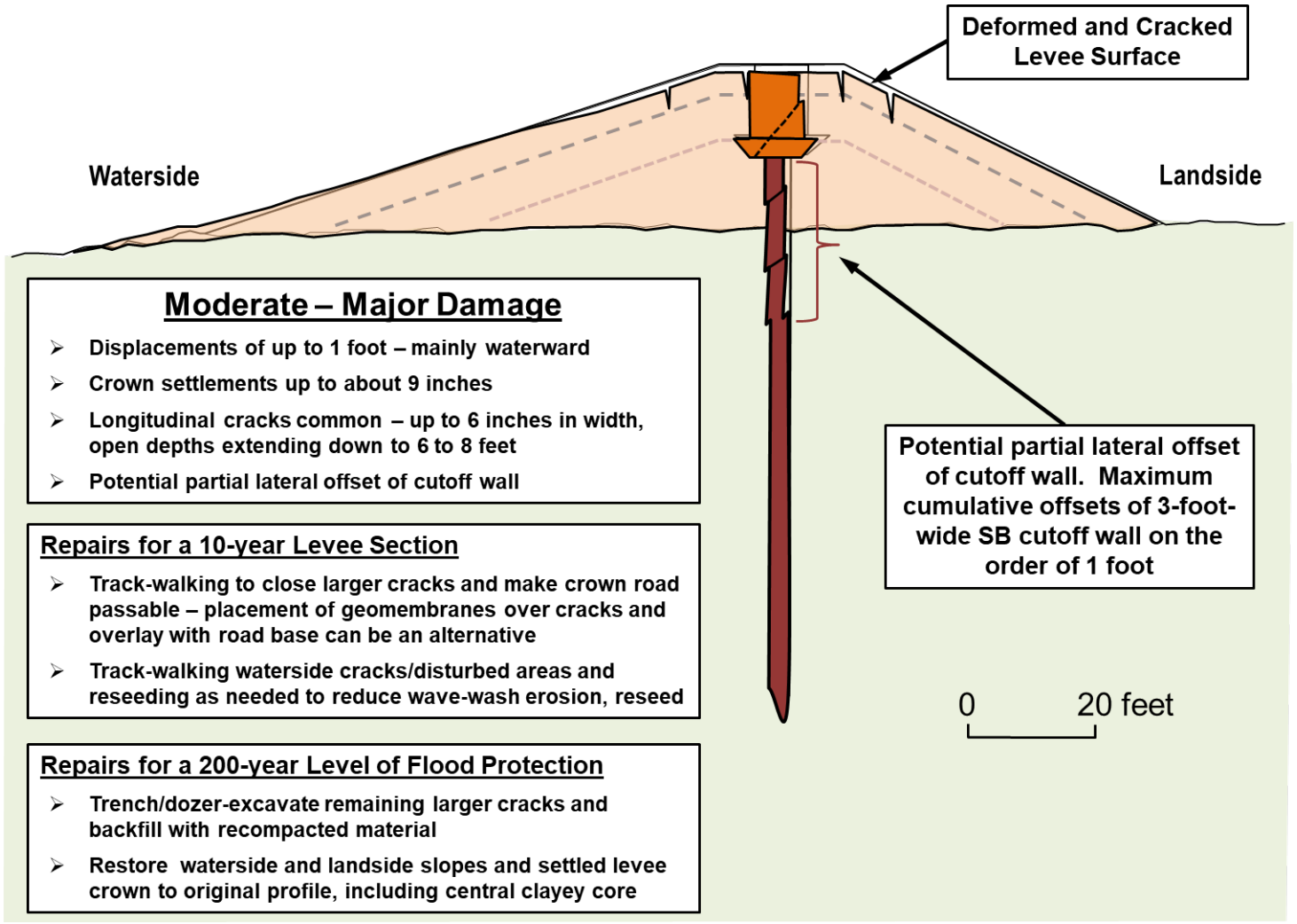

Figure 16: Schematic Illustration of Displacements, Settlement, and Cracking Associated with *Moderate – Major* Damage and Repairs Necessary to Restore a 10-year Levee Section and a 200-year Level of Flood Protection

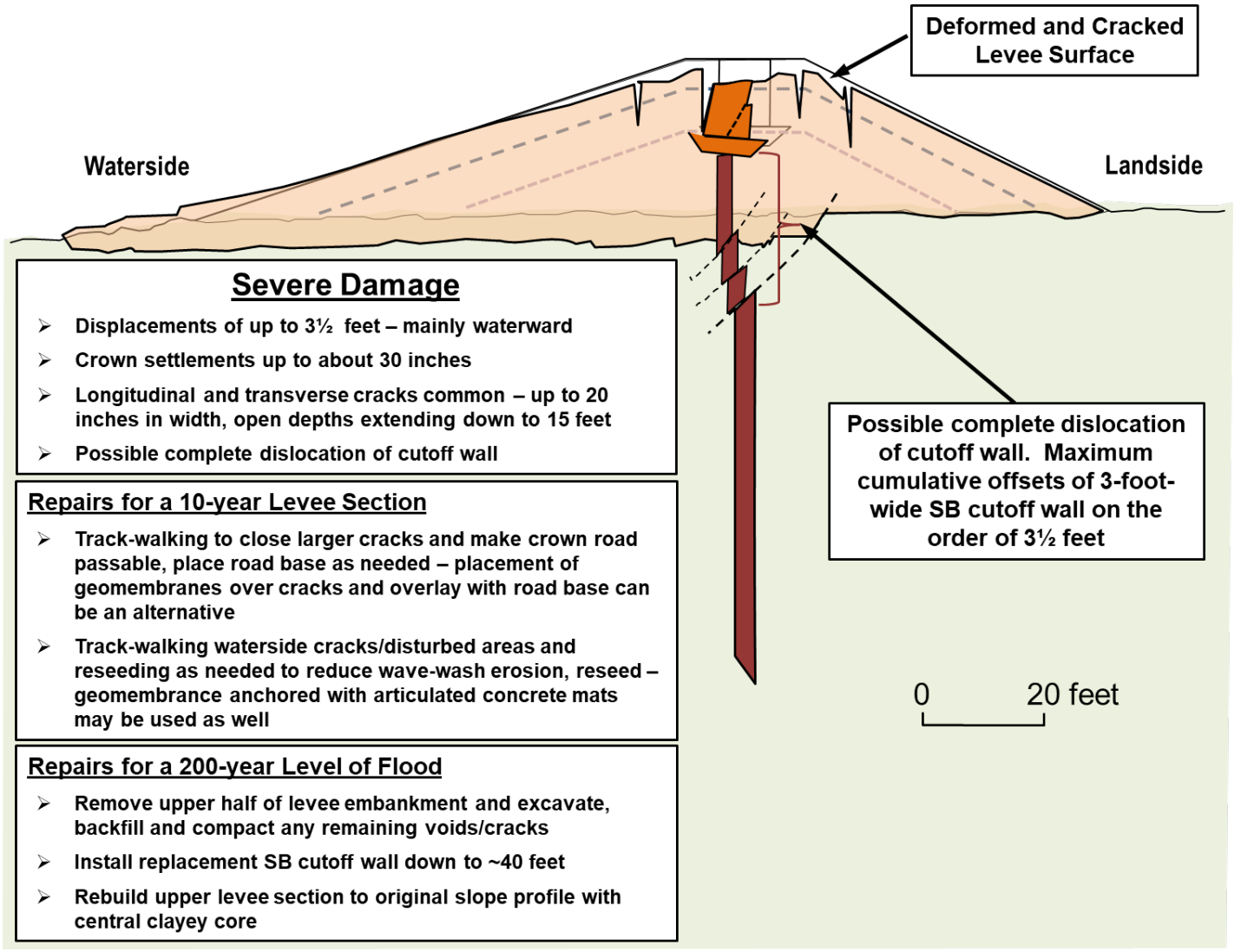

Figure 17: Schematic Illustration of Displacements, Settlement, and Cracking Associated with *Severe* Damage and Repairs Necessary to Restore a 10-year Levee Section and a 200-year Level of Flood Protection

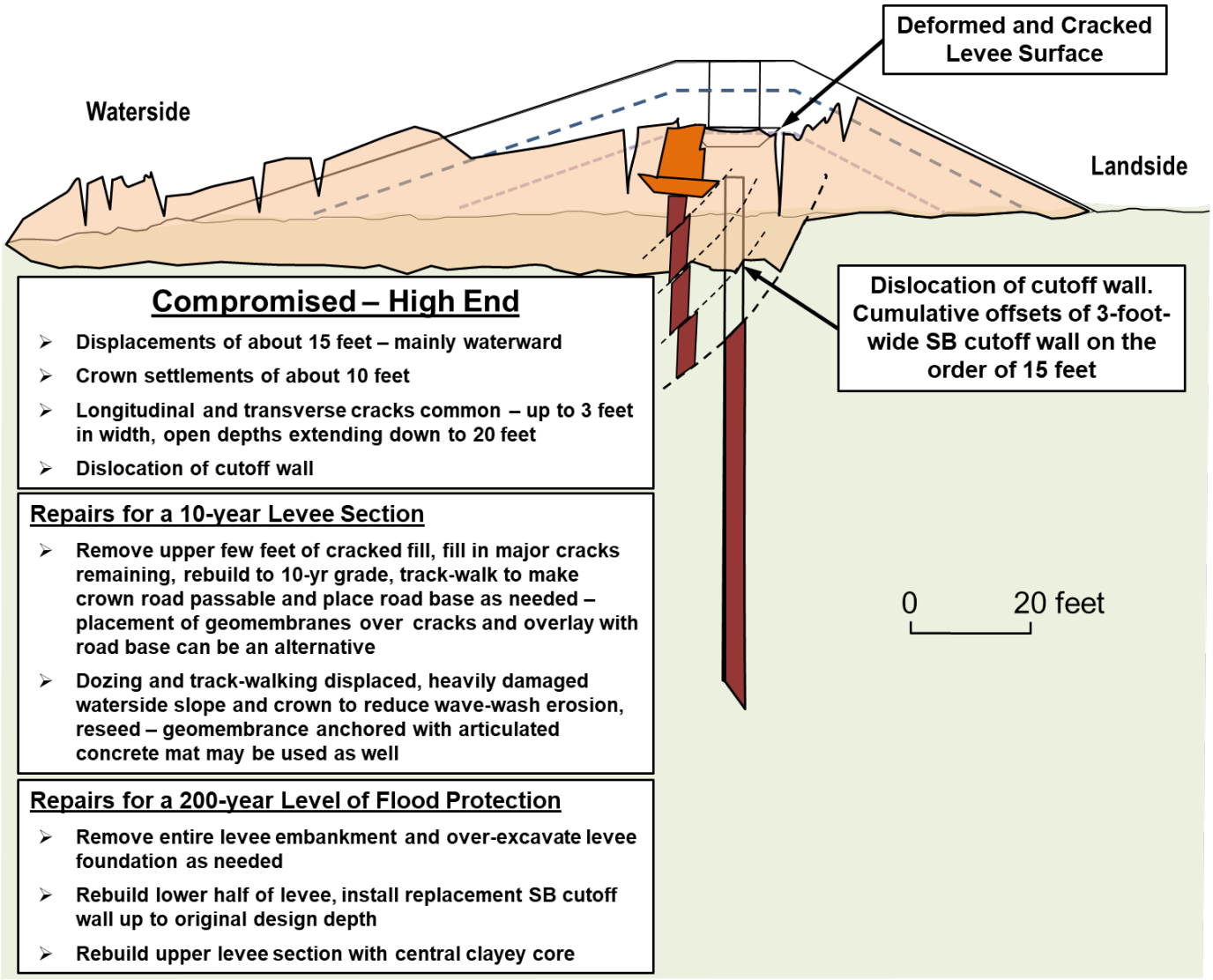

Figure 18: Schematic Illustration of Displacements, Settlement, and Cracking Associated with *Compromised* Damage and Repairs Necessary to Restore a 10-year Levee Section and a 200-year Level of Flood Protection

The repairs to restore a 200-year level of flood protection for the *Severe* damage level would include the following:

- ✓ Excavate and remove the upper half of the levee embankment and excavate, backfill, and compact any remaining voids/cracks.
- ✓ Install replacement SB cutoff wall down to depths of approximately 40 feet below the top of a degraded levee elevation, or about half the levee height. Depending upon the ability to "sandwich" or tie into the existing SB cutoff wall, replacement depths might need to extend only to the bottom of the displacements and sheared sections of the wall.
- ✓ Rebuild upper levee section to original slope profile with central clayey core and road base on crown.
- ✓ Reseed rebuilt levee.

4.4.3 Compromised Levee Damage

Figure 18 presents a schematic illustration of the level of displacement, settlement, and cracking associated with a *Compromised* damage level assuming a nominal adjusted levee height of 50 feet:

- Displacements of 3½ feet to 15 feet – mainly waterward
- Crown settlement of 2½ to 10 feet
- Longitudinal and transverse cracking common – greater than 20 inches in width, and open depths extending down 20 feet
- Complete dislocation/offset of SB cutoff wall

The schematic shown in Figure 18 probably represents the high end of a Compromised levee damage level.

It may be observed even with this extreme level of damage, the displaced and cracked levee section still remains at or above the 10-year levee section. The repairs to restore a 10-year levee section would include the following:

- ✓ Remove upper few feet of cracked fill, fill in major cracks remaining, rebuild to 10-year grade, track-walk to make crown road passable and place road based as needed. Placement of materials into and/or geomembranes placed over unfilled cracks and overlaid with road base on levee crown.
- ✓ Dozing and track-walking displaced, heavily damaged waterside slope and crown to reduce wave-wash erosion. Geomembrances/geofabrics anchored with articulated concrete mats may be used to provide waterside slope protection, as needed.
- ✓ Generally, no significant import of levee materials. Some amount of road base material would need to be imported, perhaps on the order of 2,400 tons per mile[3]. Since there were approximately 0.7 miles of FRWLP assessed to have a potential Compromised level of levee damage, this would indicate that a total of approximately 1,700 tons of road base might be needed for the Compromised level of damage.

The repairs to restore a 200-year level of flood protection would include the following:

[3] Assumes 12 foot wide by 6 inch deep section compacted to 150 pounds per cubic foot.

- ✓ Excavate and remove the entire levee embankment and upper portions of levee foundation as needed. Excavate, backfill, and compact any remaining voids/cracks.
- ✓ Rebuild lower half of levee embankment and install replacement SB cutoff wall down to depths up to full wall depths. Depending upon the ability to "sandwich" or tie into the existing SB cutoff wall, replacement depth might need to extend only to the bottom of the displacements and sheared sections of the wall.
- ✓ Rebuild upper levee section to original slope profile with central clayey core and road base on crown.
- ✓ Reseed rebuilt levee.

4.5 Summary of Seismic Vulnerability

Table 9 presents a summary of the seismic vulnerability and repair estimates for restoring both a 10-year levee section. In general, there is no need for borrow import for restoring a 10-year levee section, although up to 4,800 tons of road base may be needed to help assure vehicle traffic on the damaged levee crowns

Table 9: Summary of Levee Damage Levels for a 200-year Earthquake Loading and Repairs for the FRWLP to Restore a 10-year Levee Section

Seismic Damage Level	Number of Levee Miles	Needs for Restoring 10-year Levee Section		
		Levee Borrow (cubic yard/mile)	Road Base (tons/mile)	Road Base (tons)
None to Minor	23.1	0	0	0
Moderate to Major	7.0	0	0	0
Severe	2.6	0	1,200*	3,100*
Compromised	0.7	0	2,400*	1,700*
Total	33.4	0	NA	4,800

* For reaches classified as Severe, it was assumed that only 50 percent of the levee sections would require new Road Base. For reaches classified as Compromised, it was assumed that 100 percent of the levee sections would require new Road Base.

5. EMERGENCY ACTION PLAN CONSIDERATIONS FOR SEISMIC VULNERABILITY

5.1 Background

The FRWLP currently operates under a draft Emergency Operating Plan (EAP), dated December 13, 2010. Separate EAPs have been developed for the three local maintaining agencies that are responsible for implementing the plans, namely Maintenance Area 7 (MA-7), Levee District 1 (LD-1) and Levee District 9 (LD-9). The focus of the existing EAP is on actions that should be taken in response to flood conditions.

As part of this seismic vulnerability evaluation, additions that should be made to the EAPs are outlined to include a comprehensive response plan both for flood and seismic scenarios. The seismic considerations that will be added to the EAP's will include the triggering event, parties that are responsible to carry out the plan, communication protocols, areas susceptible to levee damage during a seismic event, and likely temporary repairs that will be required under an emergency response action. Those anticipated updates to the EAPs are described further below.

5.2 Planning for the Response to a Seismic Event

5.2.1 Triggering Earthquake

This seismic vulnerability evaluation for the FRWLP was conducted considering a seismic event with a recurrence period of 200 years and estimated peak ground accelerations (PGAs) of between 0.11g and 0.13 g. For the EAP update, an earthquake that could trigger the need for EAP activities related to seismic distress will be any event that results in a PGA in Yuba City equal to or greater than 0.05g, or any earthquake that is felt by human beings within the Sutter-Butte Basin.

5.2.2 Initial Response

Following a triggering seismic event, the EAP will identify the initial inspections that should be conducted to evaluate levee damage and who will conduct those inspections. Those initial inspections should prioritize the levee reaches that have been identified in this report as being most susceptible to potential earthquake-induced damage, namely Reaches 10b, 12, 13, 14, 15 and 19a. A site plan identifying estimated seismic vulnerability, and those most vulnerable locations, will be included in the EAP update. Following initial inspections of those reaches considered to be most potentially susceptible to earthquake-induced damage, the EAP should require an inspection be conducted for the remaining reaches including reaches 26 through 28 (no work reaches).
The EAP should also require that ***Penetrations***, especially pipelines, need to be evaluated following earthquake events. For pipelines within damaged levees, fluid flows through the pipelines should be halted until the assessments are completed. Pipelines within levees which have experienced Severe or Compromised levels of damage should be presumed to be damaged and not used until confirmed to have no damage or are repaired or replaced. Pipelines without valve closures near the toes of such levees should be plugged as soon as

possible after the earthquake, and certainly within 8 weeks following the earthquake, to assure no fluid flows through the pipeline sections within the levee and/or its foundation.

5.2.3 Repairs for 10-year levee restoration

The EAP will include a description of the anticipated damage to the most vulnerable reaches of the FRWL, which have been described in this report. The EAP will also include the levee repairs that may be required following a seismic event to restore the levee so that it will be able to pass a flood event with a 10-year recurrence interval. The EAP update will include a description of these temporary repairs, typical levee cross sections with the repairs shown, anticipated material quantities and potential borrow sources for those materials. The EAP will note that these temporary repairs are to be completed within eight weeks of the triggering seismic event.

5.2.4 Repairs needed for 200-year levee restoration

This report also describes the permanent repairs that may be required to restore the levees to their current 200-year level of flood protection. The EAP update will not include those permanent repairs, but rather will only focus on temporary repairs.

5.3 Updates to EAP

We anticipate that these detailed updates to the FRWL EAPs to include the seismic event response will be developed and implemented within the next 12 months. Those EAP updates will be led by SBFCA and will be reviewed and adopted by the responsible local maintaining agencies.

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Appendix A - Summary Tables and Post-earthquake Slope Stability Analysis Results from 2012 URS Seismic Vulnerability Analyses of Feather River West Levees.

This appendix provides summary tables and slope stability analysis results from the 2012 URS Seismic Vulnerability Analyses of Feather River West Levees as part of the Feather River West Levee Project. They include:

- Table 8-4 – a summary of the seismic vulnerability evaluation results for each levee reach (see Table 2 in main text for assessment criteria).
- Table D-13 – a summary of the layering and material properties used for each slope stability model.
- Table D-14 – a summary of the slope stability results calculated for each slope stability model.
- Figures illustrating critical post-earthquake shallow and deep potential sliding surfaces and their computed factors of safety for different levee sections.

The results of the 2012 evaluations, including the information contained in this appendix, were used as partial input to the current seismic vulnerability assessment as shown in Appendix D.

Table 8-4. Seismic Vulnerability Evaluation Results.

Reach	PHA (g)	Beginning Station	Ending Station	Seismic Vulnerability Class	Rationale for Seismic Vulnerability Class Selection
7	0.125	510+37	526+00	Possibly Compromised	Judged based on the subsurface soil conditions (presence of thin layers of no to low plasticity shallow foundation materials) and the results of the seismic analysis performed at Station 539+30.
7	0.125	526+00	598+87	Likely Compromised	The liquefiable zone (very loose to medium dense) is up to 25 feet thick, and located within 1 levee height; the estimated maximum seismic deformation for the seismic analysis section at Station 539+30 is about 6.5 feet (Newmark-type).
8	0.125	598+87	654+75	Compromised	The liquefiable zone (very loose to medium dense) is up to 25 feet in thickness, and located within 2 levee height; the post-earthquake factor of safety at Station 623+86 is less than 1.0.
9	0.125	654+75	674+00	Compromised	The liquefiable zone (very loose to medium dense) is up to 25 feet in thickness, and located within 2 levee height; judged based on the results of the seismic analysis performed at Station 623+86.
9	0.125	674+00	695+00	Probably Uncompromised	The liquefiable zone (medium dense) is up to 10 feet in thickness and located within 2 levee height; the estimated maximum seismic deformation for the seismic analysis section at Station 683+00 is about 0.8 feet (Newmark-type).
9	0.125	695+00	706+50	Possibly Compromised	The liquefiable zone (medium dense) is up to 10 feet in thickness and located within 1 levee height; judged based on the results of the seismic analysis performed at Station 683+00.
10	0.125	706+50	722+00	Possibly Compromised	The liquefiable zone is up to 15 feet in thickness and located within 1 levee height; judged based on the results of the seismic analysis performed at Station 683+00.

Table 8-4. Seismic Vulnerability Evaluation Results.

Reach	PHA (g)	Beginning Station	Ending Station	Seismic Vulnerability Class	Rationale for Seismic Vulnerability Class Selection
10	0.125	722+00	754+00	Compromised	The liquefiable zone (loose to medium dense) is up to 15 feet in thickness and located within 1 levee height; the post-earthquake factor of safety at Station 733+84 is less than 1.0.
10	0.125	754+00	774+00	Possibly Compromised	The liquefiable zone (loose to medium dense) is up to 15 feet in thickness and located within 1 levee height; judged based on the subsurface soil conditions and available CPT and blow count data.
11	0.125	774+00	831+00	Possibly Compromised	
12	0.125	831+00	845+00	Possibly Compromised	The localized liquefiable zones of up to 30 feet exist within 2 levee height; judged based on the subsurface soil conditions and available CPT and blow count data.
13	0.125	845+00	927+00	Compromised	The liquefiable zone (very loose to medium dense) is up to 30 feet in thickness and located within 2 levee height; the post-earthquake factor of safety at Station 871+00 is less than 1.0.
14	0.125	927+00	954+00	Compromised	The liquefiable zone (very loose to medium dense) is up to 20 feet in thickness and located within 1 levee height; judged based on the results of the seismic analyses performed at Stations 871+00 and 958+83.
15	0.125	954+00	968+00	Compromised	The liquefiable zone (loose to medium dense) is up to 30 feet in thickness and located within 2 levee height; the post-earthquake factor of safety at Station 958+83 is less than 1.0.
16	0.125	968+00	993+00	Compromised	The liquefiable zone (medium dense) is up to 10 feet in thickness and located within 2 levee height; judged based on the results of the seismic analysis performed at Station 958+83.

Table 8-4. Seismic Vulnerability Evaluation Results.

Reach	PHA (g)	Beginning Station	Ending Station	Seismic Vulnerability Class	Rationale for Seismic Vulnerability Class Selection
16	0.125	993+00	1080+00	Possibly Compromised	The localized liquefiable zones (medium dense) of up to 10 feet in thickness exist within 2 levee height; judged based on the results of the seismic analysis performed at Station 1116+00.
17	0.125	1080+00	1130+86	Possibly Compromised	The liquefiable zone (loose to medium dense) is up to 40 feet in thickness and located within 2 levee height; the estimated maximum seismic deformation for the seismic analysis section at Station 1116+00 is about 1.5 feet (Newmark-type).
18	0.125	1130+86	1136+00	Possibly Compromised	The liquefiable zone (medium dense) is up to 15 feet in thickness and located within 1 levee height; judged based on the results of the seismic analysis performed at Station 1116+00.
18	0.125	1136+00	1170+00	Likely Compromised	The liquefiable zone (loose to medium dense) is up to 25 feet in thickness and located within 2 levee height; judged based on the results of the seismic analysis performed at Station 1224+00.
18	0.125	1170+00	1213+85	Possibly Compromised	The liquefiable zone (medium dense) is up to 10 feet in thickness; judged based on the results of the seismic analysis performed at Station 1116+00, and CPT and blow count data.
19	0.125	1213+85	1243+00	Likely Compromised	The liquefiable zone (loose to medium dense) is up to 30 feet in thickness and located within 2 levee height; the estimated maximum seismic deformation for the seismic analysis section at Station 1224+00 is about 10 feet (Newmark-type).
19	0.125	1243+00	1297+83	Probably Uncompromised	The liquefiable zone is up to 15 feet in thickness and located below 2 levee height; judged based on the results of the seismic analysis performed at Station 1378+83.
20	0.125	1297+83	1374+33	Probably Uncompromised	No liquefiable zones identified

Table 8-4. Seismic Vulnerability Evaluation Results.

Reach	PHA (g)	Beginning Station	Ending Station	Seismic Vulnerability Class	Rationale for Seismic Vulnerability Class Selection
21	0.125	1374+33	1433+83	Probably Uncompromised	The liquefiable zone (loose to medium dense) is up to 15 feet in thickness and located below 2 levee height; the minimum factor of safety calculated for Pseudo-static stability analysis at Station 1378+83 is greater than 1.0.
22	0.125	1433+83	1503+83	Probably Uncompromised	The localized liquefiable zones of up to 5 feet in thickness exist below 2 levee height; judged based on the results of the seismic analyses performed at Stations 2047+50 and 1378+83.
23	0.11	1503+83	1609+37	Probably Uncompromised	
24	0.11	1609+37	1623+86	Probably Uncompromised	The localized liquefiable zones (medium dense) of up to 5 feet in thickness exist within 2 levee height; judged based on the results of the seismic analyses performed at Stations 2047+50 and 1378+83.
25	0.11	1623+86	1674+37	Probably Uncompromised	The localized liquefiable zones of up to 5 feet in thickness exist below 2 levee height; judged based on the results of the seismic analyses performed at Stations 2047+50 and 1378+83.
26	0.11	1674+37	1707+11	Probably Uncompromised	
27	0.11	1707+11	1721+60	Probably Uncompromised	No liquefiable zones identified
28	0.11	1721+60	1769+31	Probably Uncompromised	No liquefiable zones identified
29	0.11	1769+31	1813+33	Probably Uncompromised	The localized liquefiable zones (medium dense) of up to 5 feet in thickness exist below 2 levee height; judged based on the results of the seismic analysis performed at Station 2047+50.
30	0.11	1813+33	1902+00	Probably Uncompromised	The liquefiable zone (loose to medium dense) is up to 15 feet in thickness and located within 2 and/or below 2 levee height; judged based on the results of the seismic analysis performed at Station 2047+50.
31	0.11	1902+00	1958+00	Probably Uncompromised	The liquefiable zone (medium dense) is up to 5 feet in thickness and located below 1 levee height; judged based on the results of the seismic analysis performed at Station 2047+50.

Table 8-4. Seismic Vulnerability Evaluation Results.

Reach	PHA (g)	Beginning Station	Ending Station	Seismic Vulnerability Class	Rationale for Seismic Vulnerability Class Selection
32	0.11	1958+00	1989+00	Probably Uncompromised	No liquefiable zones identified
33	0.11	1989+00	2122+00	Probably Uncompromised	The liquefiable zone (medium dense) is up to 15 feet in thickness and located within 2 levee height; the minimum factor of safety calculated for Pseudo-static stability analysis at Station 2047+50 is greater than 1.0.
34	0.11	2122+00	2182+00	Probably Uncompromised	The liquefiable zone is up to 5 feet in thickness and located within 2 levee height; judged based on the results of the seismic analysis performed at Station 2276+76.
35	0.11	2182+00	2224+00	Probably Uncompromised	The liquefiable zone (loose) is up to 5 feet in thickness and located within 2 levee height; judged based on the results of the seismic analysis performed at Station 2276+76.
36	0.11	2224+00	2259+00	Probably Uncompromised	The localized liquefiable zones (medium dense) of up to 10 feet in thickness exist within 2 levee height; judged based on the results of the seismic analysis performed at Station 2276+76.
37	0.11	2259+00	2290+00	Probably Uncompromised	The liquefiable zone (loose to medium dense) is up to 5 feet in thickness and located within 1 levee height; the estimated maximum seismic deformation for the seismic analysis section at Station 2276+76 is about 0.9 feet (Newmark-type).
38	0.11	2290+00	2303+00	Probably Uncompromised	No liquefiable zones identified
39	0.11	2303+00	2319+00	Probably Uncompromised	No liquefiable zones identified
40	0.11	2319+00	2359+00	Probably Uncompromised	The liquefiable zone (loose to medium dense) is up to 10 feet in thickness and located within 1 levee height; the minimum factor of safety calculated for Pseudo-static stability analysis at Station 2332+91 is greater than 1.0.
41	0.11	2359+00	2368+00	Probably Uncompromised	No liquefiable zones identified

Table D-13 Summary of $N_{160,cs}$ and selected strength parameters for liquefiable layers

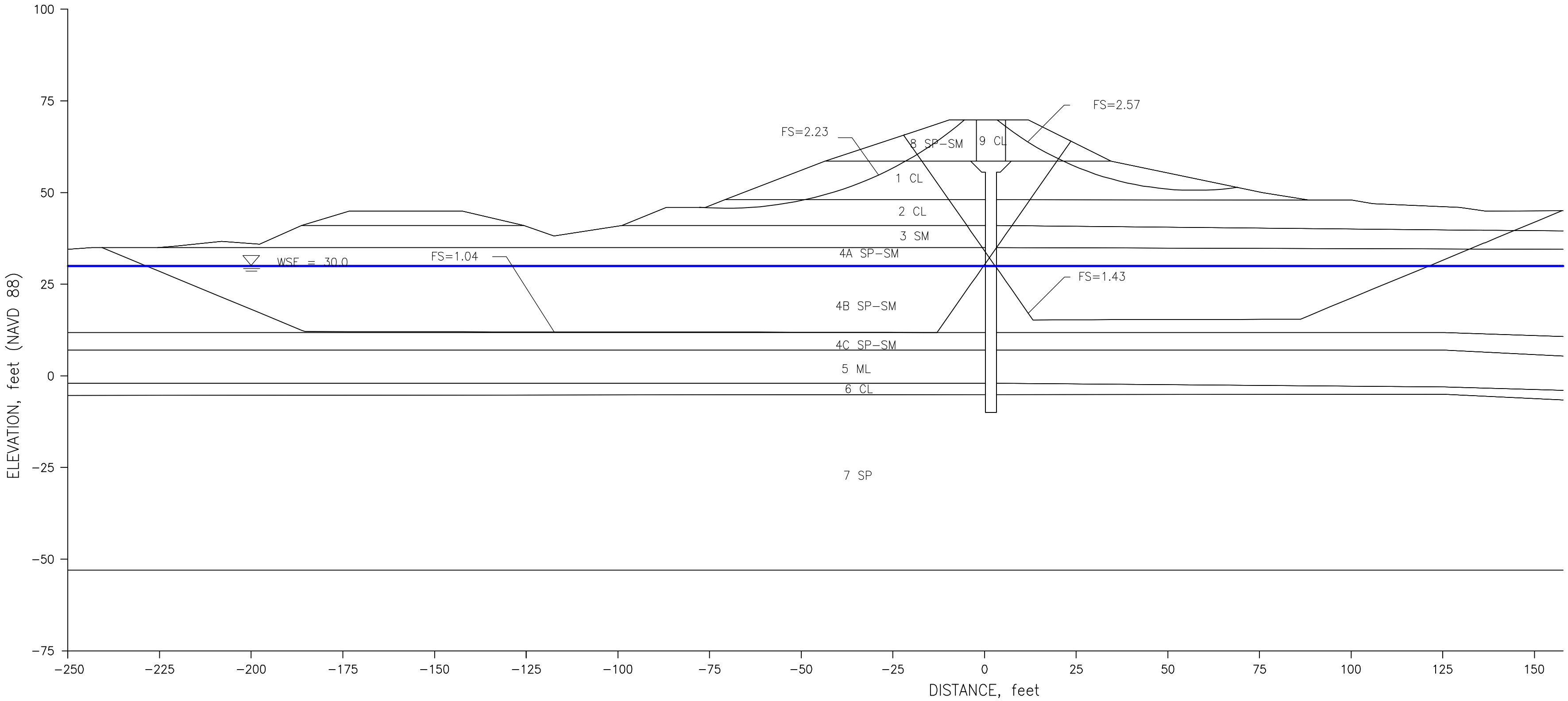
Reach	section	Layer No.	Soil Type	Thickness (ft)	$N_{160,cs}$	Avg $N_{160,cs}$	Used $N_{160,cs}$	S_{ur} (psf)	Seismic Vulnerability
7	539+30	4B	SP-SM	20	-	-	12*	360	Likely compromised
8	623+86	6	SP	17	8, 7, 12	9	8	160	Compromised
		8A	SC/SM	10	11,13	12	11	290	
9	683+00	6	SP	15	16,18	17	16	720	Probably uncompromised
		8	SP	24	13, 13, 14, 15, 15	14	13	430	
10	733+84	4B	SP-SM	7	17, 7, 4, 13	10	7	130	Compromised
		5B	ML	7	17, 19, 3	13	3	70	
13	871+00	5B	SP-SM	5	9,4	6.5	6	100	Compromised
		5C	SP-SM	22	12,13,14	13	12	360	
15	958+83	4B	CL	8	9	9	9	190	Compromised
		5A	SM	10	7,9	8	8	160	
		5B	SM	7	13,13	13	13	430	
17	1116+00	2B	ML	13	6,12,13,16,15	12.4	12	360	Possibly compromised
		3	SM	3	14	14	14	520	
		4B	ML	17	12,13, 12,12	12	12	360	
19	1224+00	2B	SM	25	14,13,10,16,14,15,13	13.6	12	360	Likely compromised
21	1378+87	5B	ML	5	12	12	12	360	Probably uncompromised
33	2047+50	4	SP-SM	16	14,13,13	13	13	430	Probably uncompromised
37	2276+76	3	SP	5	11	11	11	290	Probably uncompromised
40	2332+91	4B	GW	3	18	18	18	940	Probably uncompromised
		6B	GP	5	10	10	10	240	

Note:

* Based on CPT data (qc,1 mod = 50 to 80 tsf)

Table D-14 Summary of Seismic Slope Stability Analysis Results

Analysis Section	Reach	Potential Slip Surface	Factor of Safety for Post-earthquake Stability Analysis	Pseudo-static Stability Analysis for Sections with Post-earthquake Factor of Safety > 1.0					Deformation Analysis for Sections with Factor of Safety for 0.5*Kmax < 1.0			Seismic Vulnerability Assessment
				PHA (g)	Levee shape	Kmax (g)	0.5*Kmax (g)	Factor of Safety for 0.5*Kmax	Ky (g)	Newmark Displacement (ft)	Vertical Displacement (ft)	
539+30	7	Landside, shallow	2.57	0.125	Less Symmetric	0.150	0.075	2.05				Likely compromised
		Landside, deep	1.43			0.115	0.058	1.05				
		Waterside, shallow	2.23			0.150	0.075	1.80				
		Waterside, deep	1.04			0.115	0.058	0.74	0.007	6.5	4.5	
623+86	8	Landside, shallow	2.04									Compromised
		Landside, deep	1.31									
		Waterside, shallow	3.05									
		Waterside, deep	0.95									
683+00	9	Landside, shallow	2.63	0.125	Symmetric	0.113	0.057	1.82				Probably uncompromised
		Landside, deep	1.93			0.100	0.050	1.51				
		Waterside, shallow	4.37			0.113	0.057	2.75				
		Waterside, deep	1.18			0.100	0.050	< 1.0	0.030	0.8	0.6	
733+84	10	Landside, shallow	2.09									Compromised
		Landside, deep	1.90									
		Waterside, shallow	2.68									
		Waterside, deep	0.97									
871+00	13	Landside, shallow	2.02									Compromised
		Landside, deep	1.05									
		Waterside, shallow	2.22									
		Waterside, deep	0.77									
958+83	15	Landside, shallow	2.04									Compromised
		Landside, deep	1.82									
		Waterside, shallow	0.96									
		Waterside, deep	0.54									
1116+00	17	Landside, shallow	1.95	0.125	Symmetric	0.130	0.065	1.63				Possibly compromised
		Landside, deep	1.68			0.100	0.050	1.40				
		Waterside, shallow	1.47			0.130	0.065	1.21				
		Waterside, deep	1.12			0.100	0.050	0.88	0.025	1.5	1.1	
1224+00	19	Landside, shallow	1.80	0.125	Symmetric	0.130	0.065	1.32				Likely compromised
		Landside, deep	1.95			0.100	0.050	1.43				
		Waterside, shallow	2.75			0.130	0.065	> 1.0				
		Waterside, deep	1.17			0.100	0.050	0.75	0.015	10.0	7.0	
1378+83	21	Landside, shallow	1.91	0.125	Less Symmetric	0.150	0.075	1.60				Probably uncompromised
		Landside, deep	2.93			0.115	0.058	2.74				
		Waterside, shallow	2.16			0.150	0.075	1.50				
		Waterside, deep	2.04			0.115	0.058	1.67				
2047+50	33	Landside, shallow	1.91	0.110	Symmetric	0.120	0.060	1.34				Probably uncompromised
		Landside, deep	2.01			0.095	0.048	1.66				
		Waterside, shallow	2.12			0.120	0.060	1.75				
		Waterside, deep	1.82			0.095	0.048	1.40				
2276+76	37	Landside, shallow	1.88	0.110	Less Symmetric	0.140	0.070	1.59				Probably uncompromised
		Landside, deep	1.68			0.110	0.055	1.37				
		Waterside, shallow	1.55			0.140	0.070	1.24				
		Waterside, deep	1.13			0.110	0.055	0.90	0.030	0.9	0.6	
2332+91	40	Landside, shallow	3.06	0.110	Less Symmetric	0.140	0.070	2.50				Probably uncompromised
		Landside, deep	3.21			0.110	0.055	2.56				
		Waterside, shallow	2.01			0.140	0.070	1.72				
		Waterside, deep	2.18			0.110	0.055	1.82				



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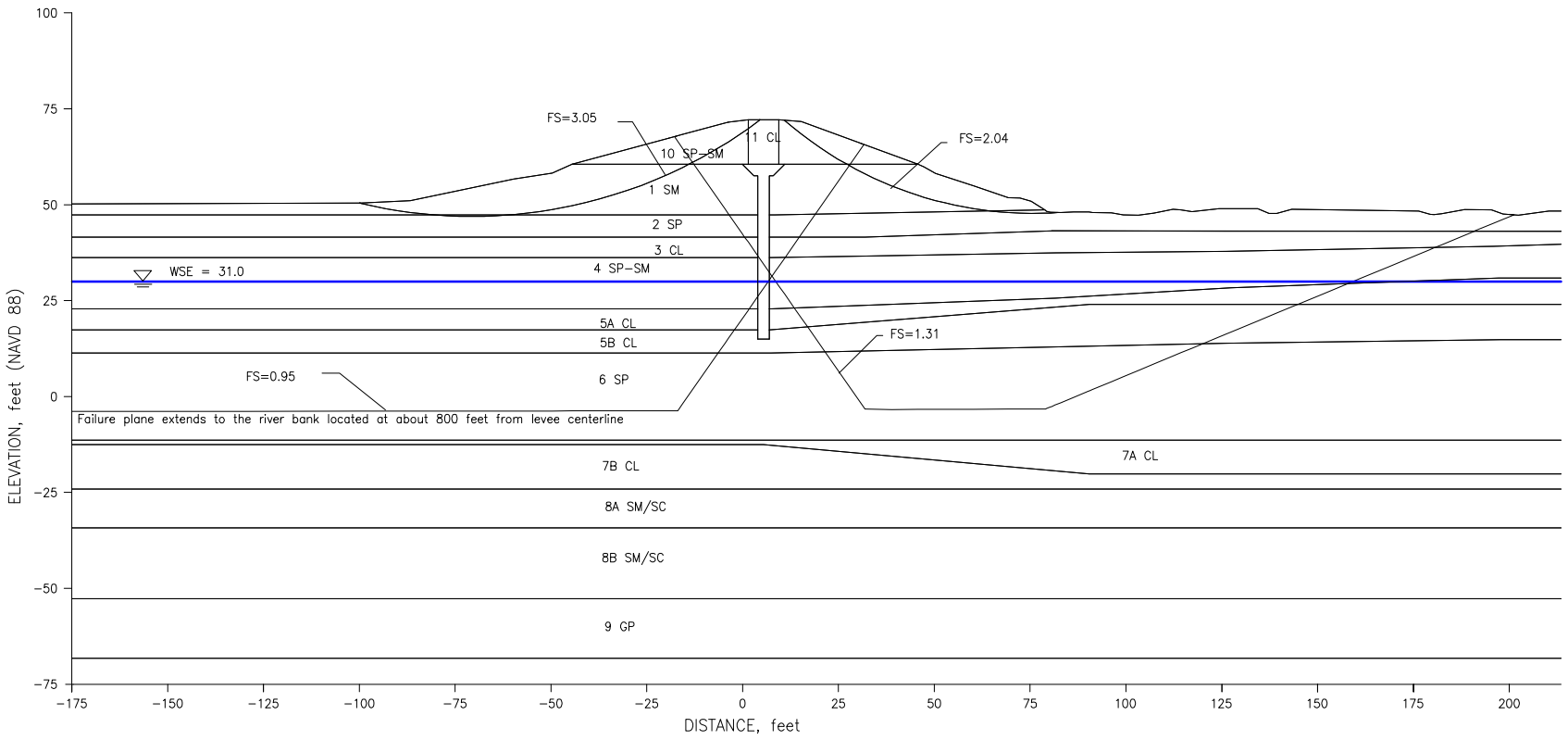
		TASK ORDER TO4	CHECKED BY Kanax		FIGURE D–R07–1
		DATE February 2012			



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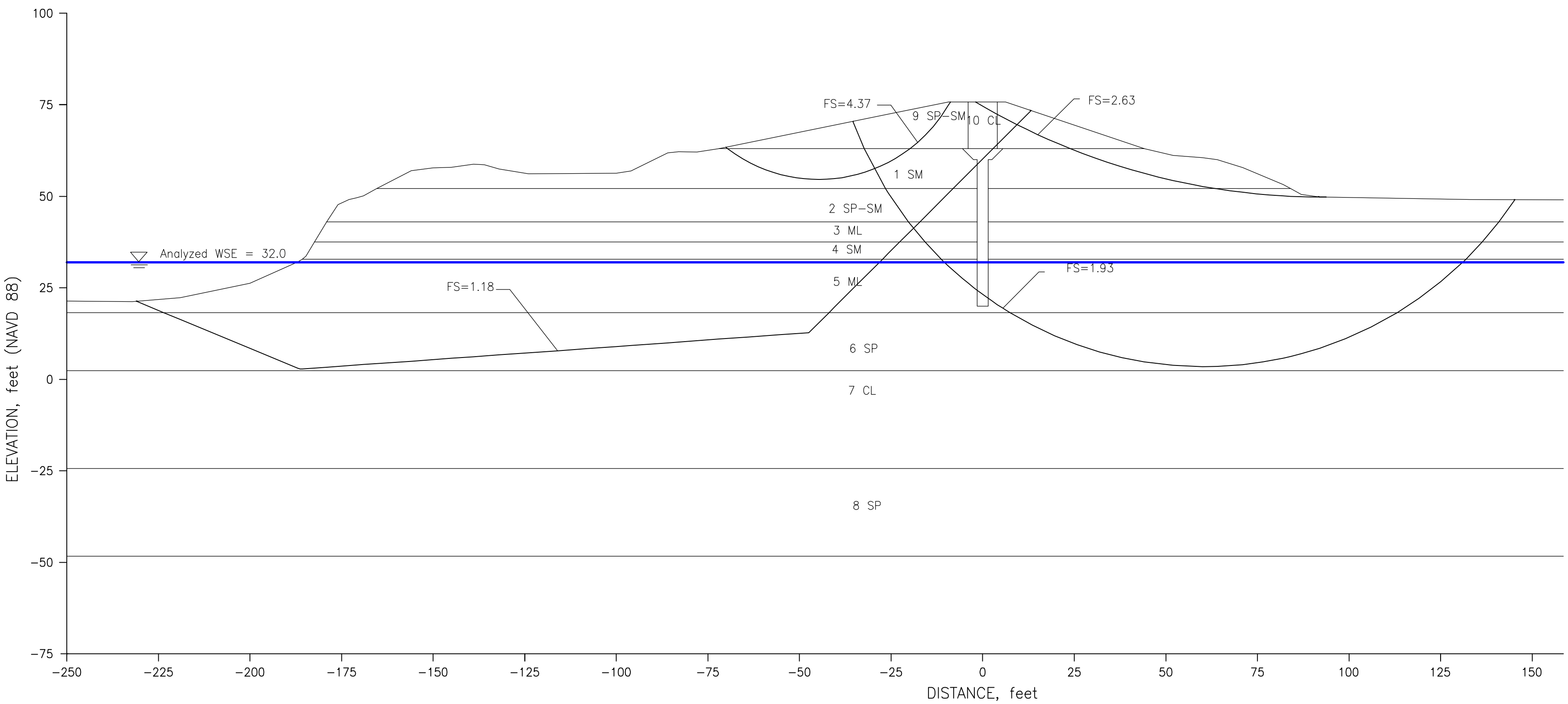

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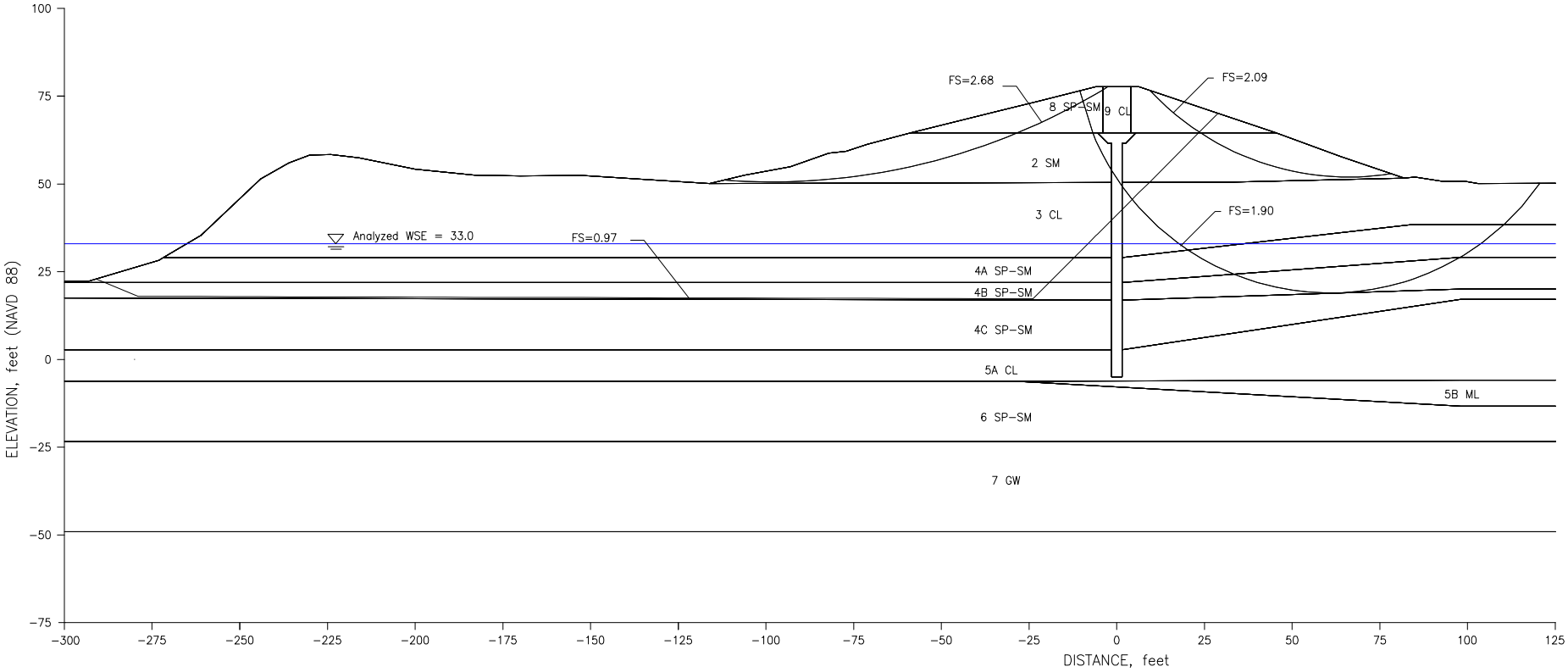
Post Earthquake Slope Stability Analysis Results with Mitigation Measures
Station 683+00
Reach 9

FIGURE
D−R09−2



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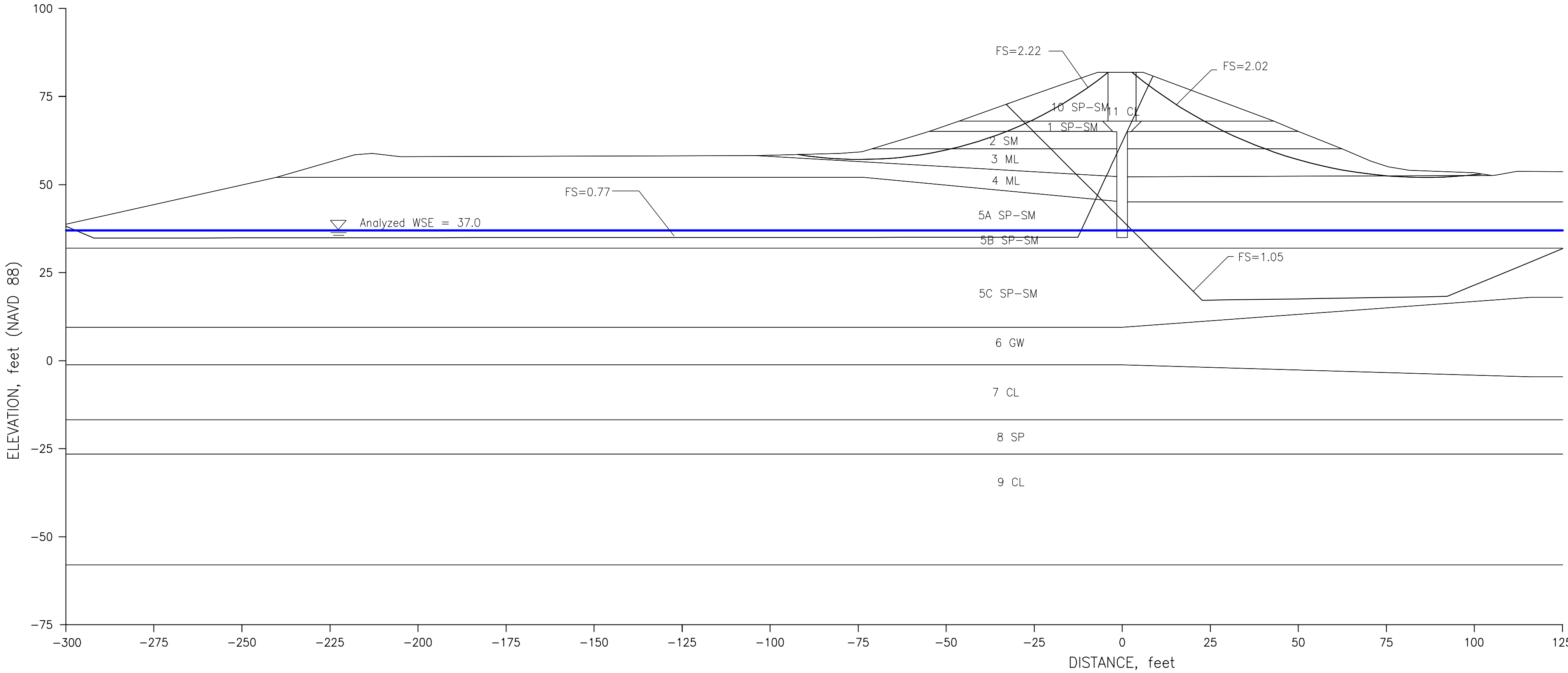
Post Earthquake Slope Stability Analysis Results with Mitigation Measures
Station 733+84
Reach 10

FIGURE
D-R10-1



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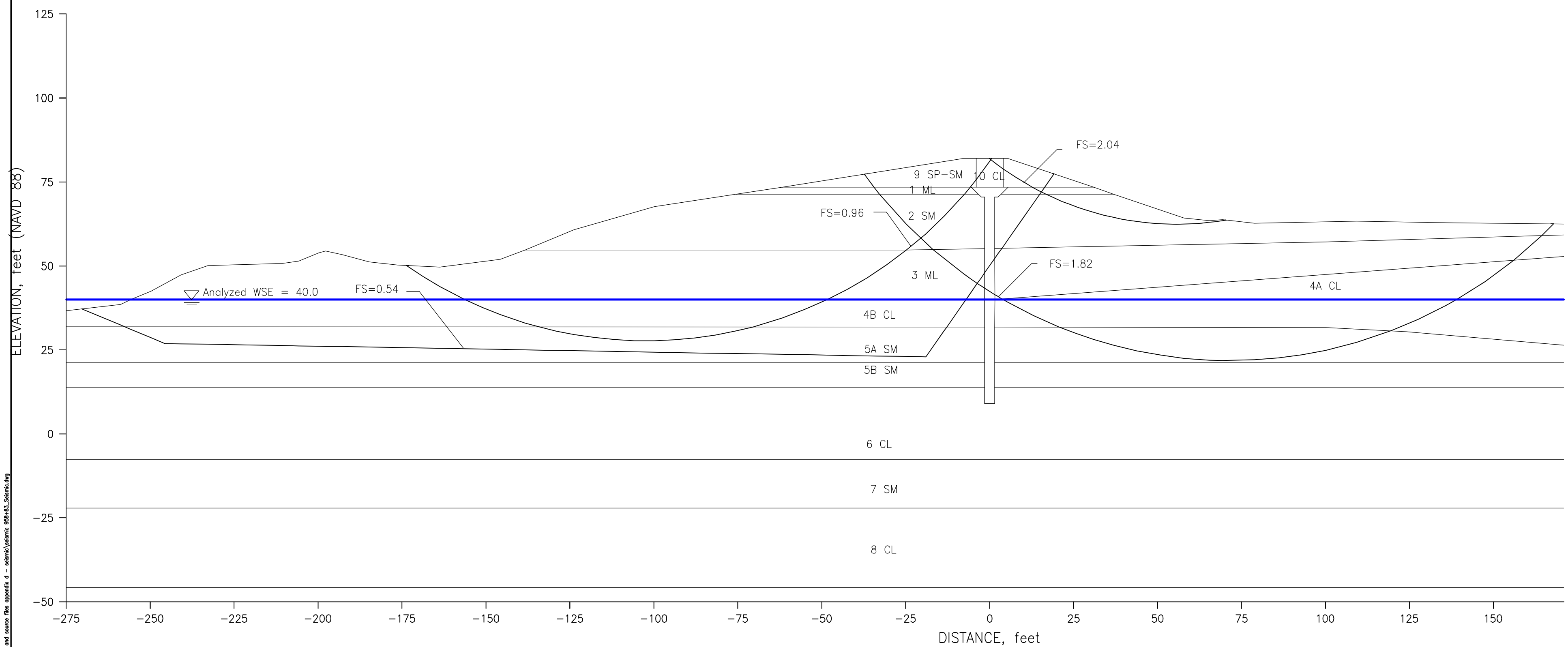

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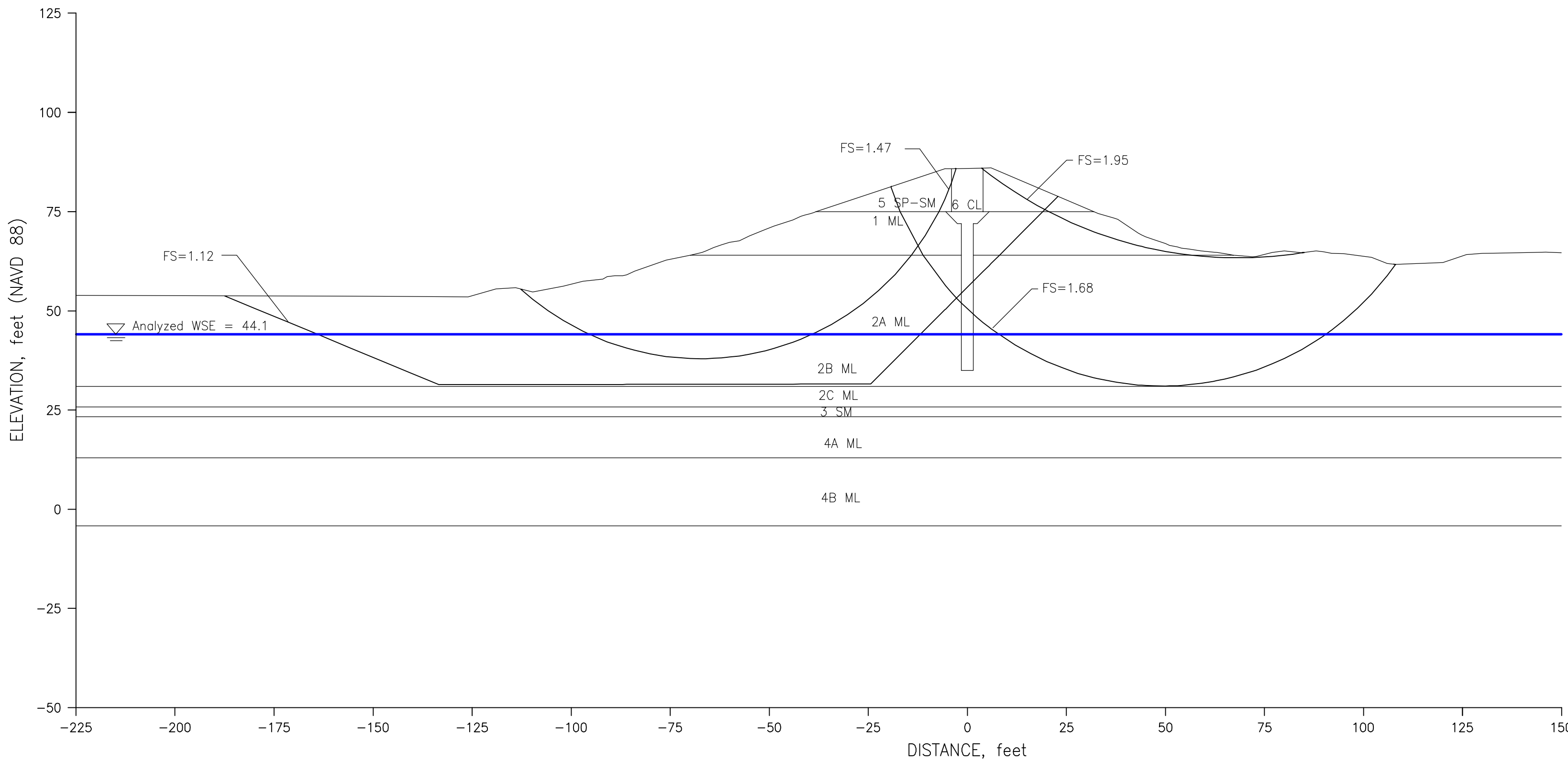
FOR 65% DESIGN

Post Earthquake Slope Stability Analysis Results with Mitigation Measures
Station 958+83
Reach 15

FIGURE
D-R15-1



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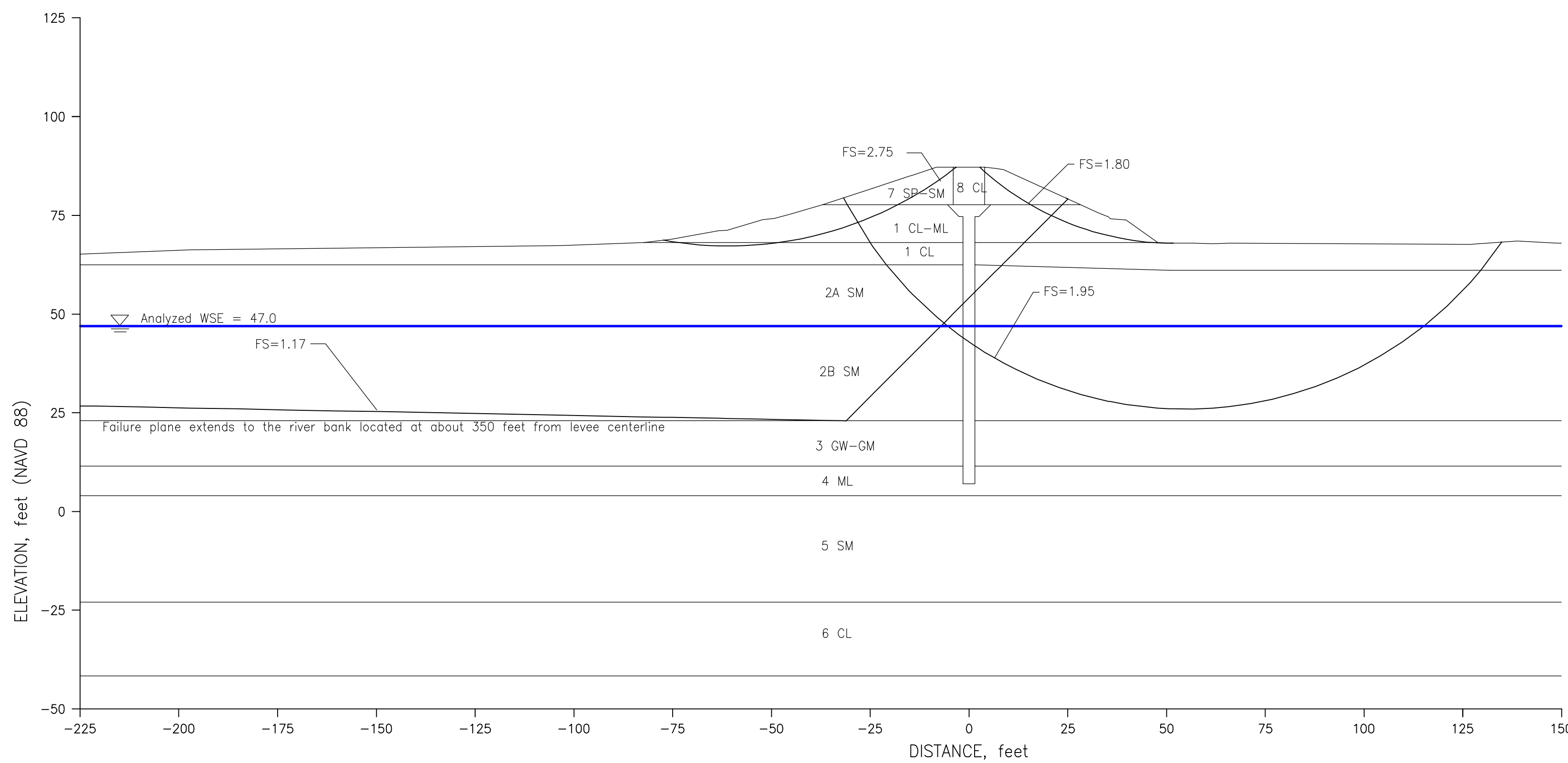

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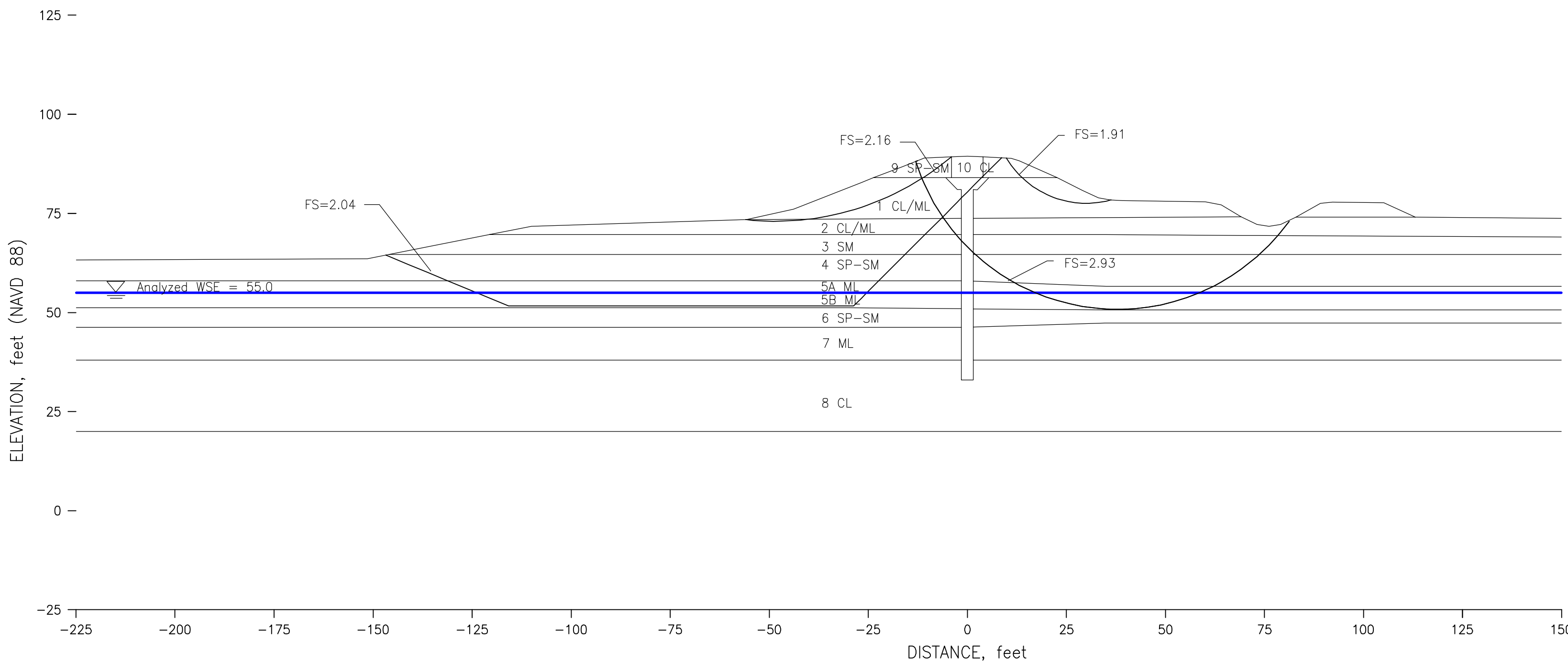
Post Earthquake Slope Stability Analysis Results with Mitigation Measures
Station 1224+00
Reach 19

FIGURE
D-R19-1



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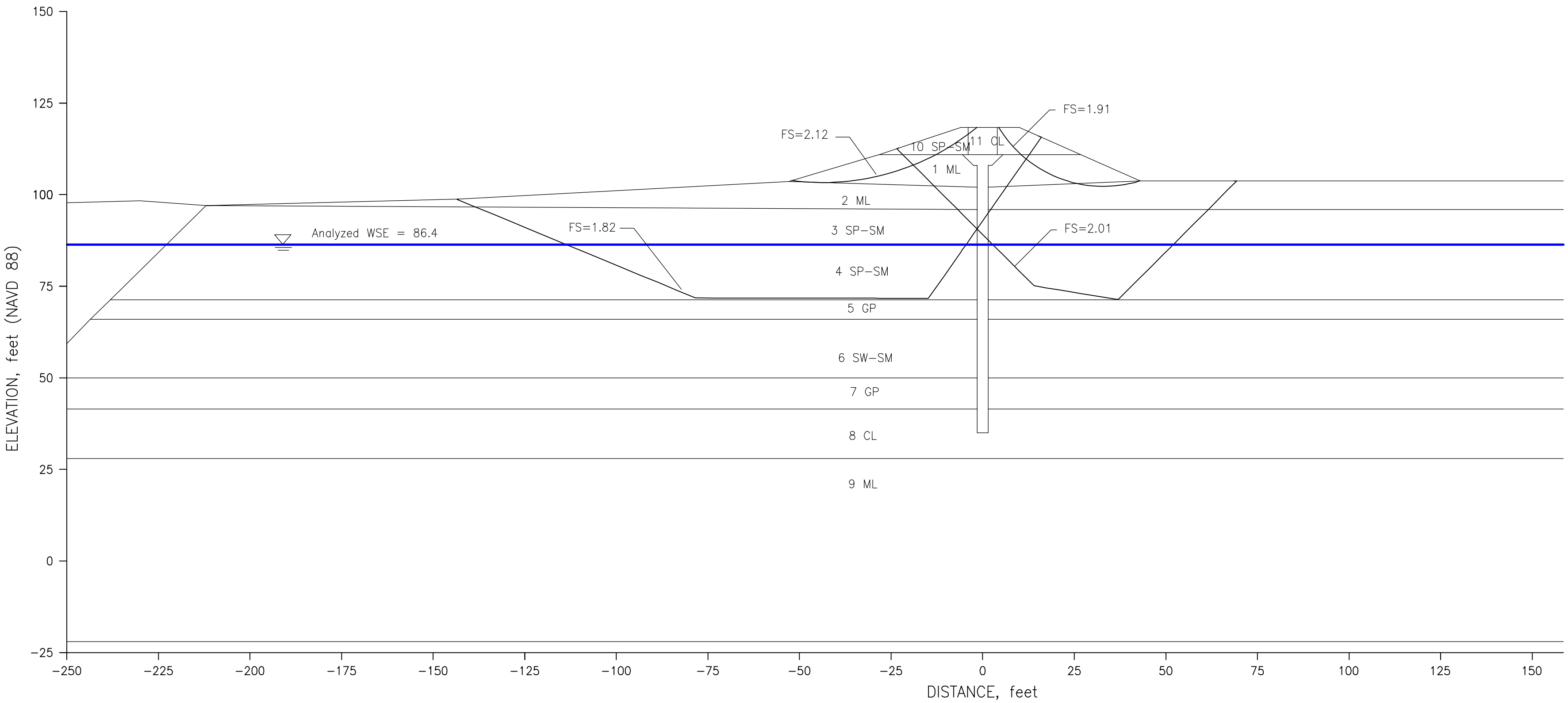
TASK ORDER TO4				
DATE February 2012	CHECKED BY Kanax			



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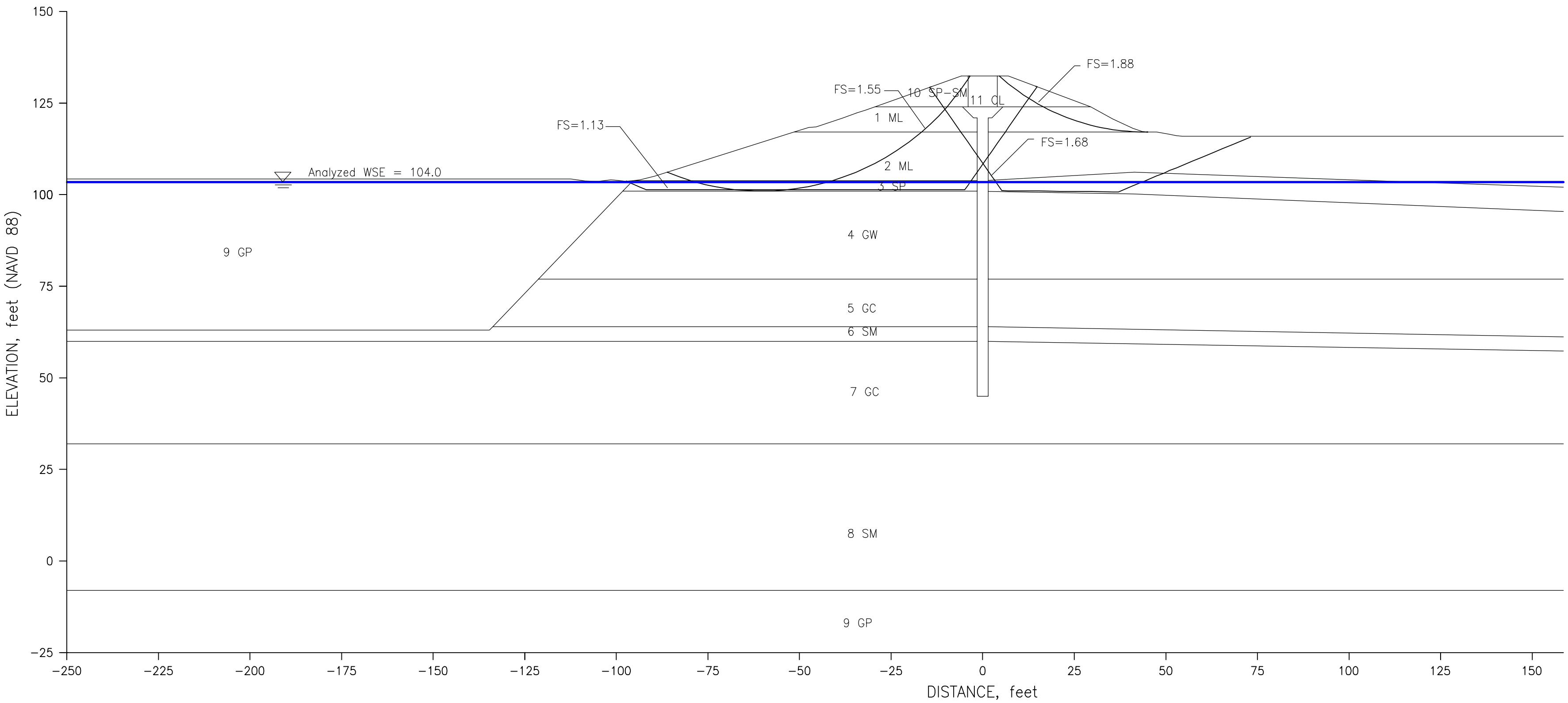
PROJECT NUMBER	17326712
TASK ORDER	T04
DATE	February 2012
PREPARED BY	C. Tsai
CHECKED BY	Kanax

FEATHER RIVER WEST LEVEE PROJECT
GEOTECHNICAL RECOMMENDATIONS REPORT
FOR 65% DESIGN

Post Earthquake Slope Stability Analysis Results with Mitigation Measures
Station 2047+50
Reach 33

FIGURE
D-R33-1



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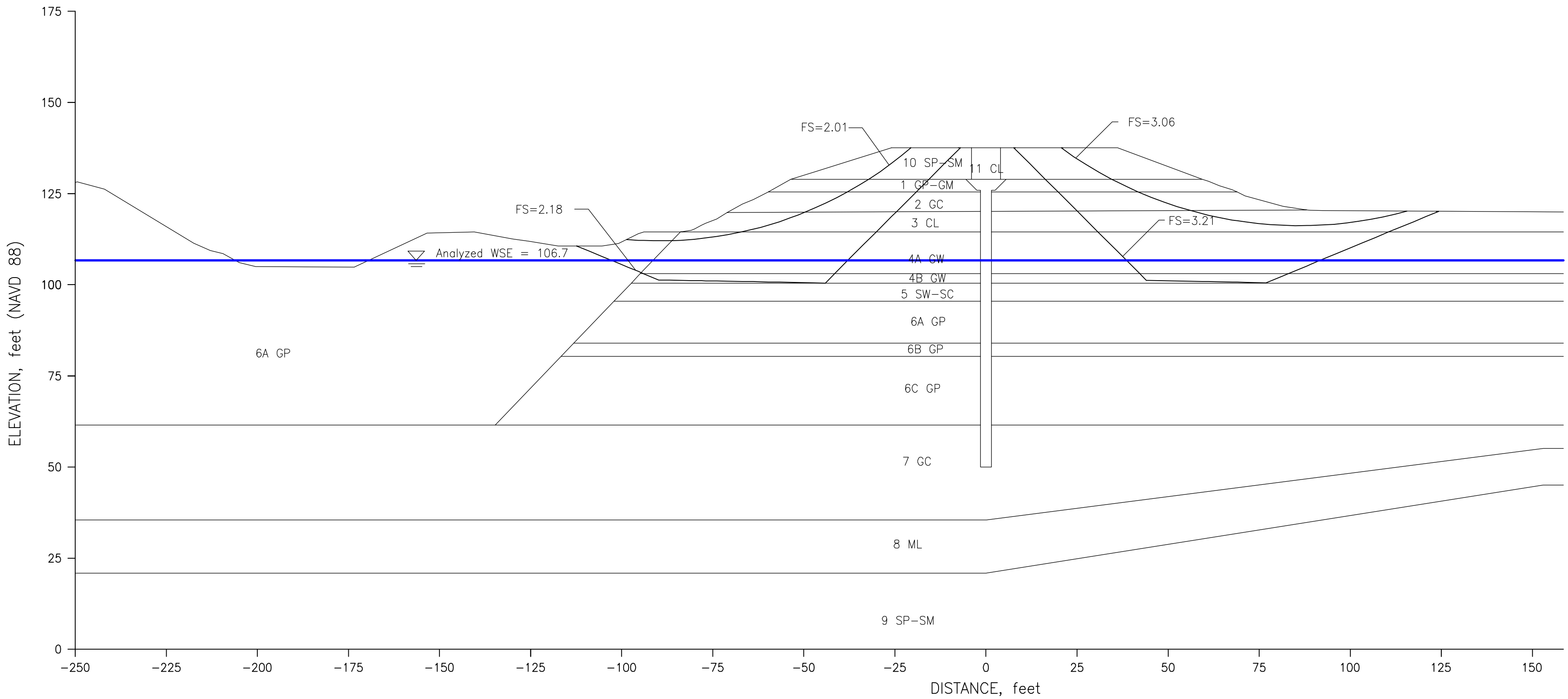


Sutter Butte Flood Control Agency

URS in association with: blackburn consulting

PROJECT NUMBER 17326712	PREPARED BY C. Tsai	FEATHER RIVER WEST LEVEE PROJECT GEOTECHNICAL RECOMMENDATIONS REPORT FOR 65% DESIGN	Post Earthquake Slope Stability Analysis Results with Mitigation Measures Station 2332+91 Reach 40	FIGURE D-R40-1
TASK ORDER T04	CHECKED BY Kanax			
DATE February 2012				

Appendix B – Summary Tables and Post-earthquake Slope Stability Analysis Results from 2015 URS Seismic Vulnerability Analyses of Feather River West Levees.

This appendix provides summary tables and slope stability analysis results from the 2015 URS Seismic Vulnerability Analyses of Feather River West Levees as part of the DWR Urban Levee Evaluation Program. They include:

- An Excel spreadsheet table summarizing the results of the analyses and assessments for each levee reach/subreach (see Table 3 in main text for assessment criteria).
- Figures depicting a) penetration test data; b) cross sections with borehole data used to develop slope stability models, and c) critical post-earthquake shallow and deep potential sliding surfaces and their computed factors of safety

The results of the 2015 evaluations, including those contained in this appendix, were used as partial input to the current seismic vulnerability assessment as shown in Appendix D.

Table C-2: Summary of Seismic Vulnerability Evaluations

Study Area: Sutter Feather River Study Area

Seismic Segment ID	River/ Channel	Beginning Station	End Station	Liquefiable Layer (Yes/No)	Analysis Section	PHA	Post-Seismic Slope Stability Analysis										Seismic Deformation Analysis							Seismic Vulnerability Classification					Comments
							Depth and Thickness of Liquefiable Layer(s), and Post Seismic Strength(s)						Waterside Post-Seismic FS	Landside Post-Seismic FS	Is Seismic Deformation Analysis Needed?	Comment on Analysis	Pseudo-Static Slope Stability FS with K = 0.5 K_{max}	Is $FS_{pseudo-static} \geq 1.0$	Yield Acceleration, K_y	K_{max} for minimum K_y/K_{max}	Minimum K_y/K_{max}	Estimated Newmark Type Horizontal Displacement (feet)	Estimated Volumetric Settlement (Feet)	Estimated Freeboard Loss (feet)	Amount of Vertical Displacement Relative to Landside Levee Height (percent)	Potential for Significant Damage to Internal Structures (e.g. Cutoff Walls)	Remaining Freeboard for Post Seismic Evaluation (10-Yr Flood WSE + 3 feet)	Vulnerability Class (Post-Seismic Flood Protection Ability)	
							Depth from Waterside Toe	Depth from Landside Toe	Thickness	Range of $(N_1)_{60\text{-}cs}$ for Liquefaction Triggering[1]	Median $(N_1)_{60\text{-}cs\text{-}Sur}$ for Post-Seismic Strength[1]	Post-Seismic Strength																	
1	Feather River Right Bank	2166+22	2204+80	No		0.13																			<10	No	> 0.3 m (1 ft)	Low Vulnerability	Segment 1 is non-liquefiable.
2	Feather River Right Bank	2204+80	2337+00	Yes	2252+00	0.13	Likely Liquefiable 15 feet Less Likely Liquefiable 37 feet	Likely Liquefiable 11 feet Less Likely Liquefiable 39 feet	Likely Liquefiable 10 to 30 feet Less Likely Liquefiable 5 to 10 feet	Likely Liquefiable 2 to 13 Less Likely Liquefiable 8 to 9	Likely Liquefiable 6 Less Likely Liquefiable N/A	Likely Liquefiable Sur = 105 psf Less Likely Liquefiable ϕ'=24 degrees	0.39 (Wedge) 0.54 (Circular)	0.44 (Wedge) 0.59 (Circular)	No	As FS_{SYC}<1.0, this section is considered high vulnerability.									>20	No	None	High Vulnerability	Segment 2 is considered High Vulnerability based on post seismic stability analysis results.
3	Feather River Right Bank	2337+00	2391+00	Yes	2354+50	0.13	Likely Liquefiable Exposed at waterside	Likely Liquefiable 13 feet	Likely Liquefiable 4 feet	Likely Liquefiable 10 to 11	Likely Liquefiable 10	Likely Liquefiable Sur = 240 psf	1.18 (Wedge) 1.80 (Circular)	1.89 (Wedge) 2.55 (Circular)	Yes	Since 1.0<FS_{SYC}<1.3, seismic deformation analysis was performed.	0.90	No	0.04	0.12	0.29	0.7		0.5	2	No	> 0.3 m (1 ft)	Low Vulnerability	Segment 3 is considered Low Vulnerability based on post seismic stability analysis.
4	Feather River Right Bank	2391+00	2634+10	Yes		0.13																			<10	No	> 0.3 m (1 ft)	Low Vulnerability	Segment 4 is non-liquefiable with the exception of one thin, localized likely liquefiable layer encountered in one of the landside borings at about 23 feet below the landside toe and one thin, localized less likely liquefiable layer encountered at about 27 feet below the landside toe. Considering the depth and limited extent of these layers, as well as the Segment 3 analysis results, Segment 4 is classified as Low Vulnerability.
5	Feather River Right Bank	2634+10	2669+70	Yes		0.13																			<10	No	> 0.3 m (1 ft)	Low Vulnerability	Segment 5 is a part of Star Bend setback levee, which is located farther away from the river channel. This segment contains a localized 3- to 7-foot thick less likely liquefiable layer at about 20 feet below the landside levee toe and one boring showing a localized approximately 13-foot thick likely and less likely liquefiable SP layer at about 17 feet below the landside levee toe. The recorded blow count data from this boring were continuous pairs from SPT and MCAL samples, and may therefore be unreliable. In addition, adjacent borings show higher blow counts in SP material at about the same depth. Therefore, considering the depth and localized nature of liquefiable layers identified in this segment, as well as the blow count data in the SP material and the presence of the setback levee, Segment 5 is classified as Low Vulnerability.
6	Feather River Right Bank	2669+70	2692+00	No		0.13																			<10	No	> 0.3 m (1 ft)	Low Vulnerability	Segment 6 is non-liquefiable.
7	Feather River Right Bank	2692+00	2712+00	Yes	2705+35	0.13	Less Likely Liquefiable 16 feet Likely Liquefiable 21 feet Less Likely Liquefiable 28 feet	Less Likely Liquefiable 18 feet Likely Liquefiable 23 feet Less Likely Liquefiable 30 feet	Less Likely Liquefiable 5 feet Likely Liquefiable 7 feet Less Likely Liquefiable 5 feet	Less Likely Liquefiable 7 to 8 Likely Liquefiable 6 Less Likely Liquefiable 9	Less Likely Liquefiable N/A Likely Liquefiable 6.5 Less Likely Liquefiable N/A	Less Likely Liquefiable ϕ'=27 degrees Likely Liquefiable Sur = 115 psf Less Likely Liquefiable ϕ'=27 degrees	0.96 (Wedge) 1.42 (Circular)	1.53 (Wedge) 2.13 (Circular)	No	As FS_{SYC}<1.0, this section is considered high vulnerability.									>20	No	None	High Vulnerability	Segment 7 is considered High Vulnerability based on post seismic stability analysis results.
8	Feather River Right Bank	2712+00	2877+00	Yes		0.13																			<10	No	> 0.3 m (1 ft)	Low Vulnerability	Segment 8 is non-liquefiable with the exception of two localized locations: one location included a total of 15-foot thick less likely and likely liquefiable layers encountered in one of the landside borings at about 24 feet below the landside toe, and the other location included a 13-foot thick less likely liquefiable layer encountered at about 39 feet below the landside toe. Considering the depth and limited extent of these layers Segment 8 is classified as Low Vulnerability.
9	Feather River Right Bank	2877+00	2911+50	Yes	2899+89	0.12	Likely Liquefiable 20 feet (exposed at the river channel)	Likely Liquefiable 24 feet	Likely Liquefiable 8 feet	Likely Liquefiable 3 to 6	Likely Liquefiable 5.5	Likely Liquefiable Sur = 95 psf	0.85 (Wedge) 1.90 (Circular)	1.45 (Wedge) 1.76 (Circular)	No	As FS_{SYC}<1.0, this section is considered high vulnerability.									>20	No	None	High Vulnerability	Segment 9 is considered High Vulnerability based on post seismic stability analysis results.
10	Feather River Right Bank	2911+50	2998+00	No		0.12																			<10	No	> 0.3 m (1 ft)	Low Vulnerability	Segment 10 is non-liquefiable.

Table C-2: Summary of Seismic Vulnerability Evaluations

Study Area: Sutter Feather River Study Area

Seismic Segment ID	River/ Channel	Beginning Station	End Station	Liquefiable Layer (Yes/No)	Analysis Section	PHA	Post-Seismic Slope Stability Analysis									Seismic Deformation Analysis							Seismic Vulnerability Classification					Comments
							Depth and Thickness of Liquefiable Layer(s), and Post Seismic Strength(s)						Waterside Post-Seismic FS	Landside Post-Seismic FS	Is Seismic Deformation Analysis Needed?	Comment on Analysis	Pseudo-Static Slope Stability FS with K = 0.5 K_{max}	Is $FS_{pseudo-static} \geq 1.0$	Yield Acceleration, K_y	K_{max} for minimum K_y/K_{max}	Minimum K_y/K_{max}	Estimated Newmark Type Horizontal Displacement (feet)	Estimated Volumetric Settlement (Feet)	Estimated Freeboard Loss (feet)	Amount of Vertical Displacement Relative to Landside Levee Height (percent)	Potential for Significant Damage to Internal Structures (e.g. Cutoff Walls)	Remaining Freeboard for Post Seismic Evaluation (10-Yr Flood WSE + 3 feet)	Vulnerability Class (Post-Seismic Flood Protection Ability)	
							Depth from Waterside Toe	Depth from Landside Toe	Thickness	Range of $(N_1)_{60\text{-}cs}$ for Liquefaction Triggering[1]	Median $(N_1)_{60\text{-}cs\text{-}Sur}$ for Post-Seismic Strength[1]	Post-Seismic Strength																
11A	Feather River Right Bank	2998+00	3044+20	Yes	3037+05	0.12	Likely Liquefiable 21 feet	Likely Liquefiable 17 feet	Likely Liquefiable 17 feet	Likely Liquefiable 4 to 10	Likely Liquefiable 9	Likely Liquefiable Sur = 200 psf	0.78 (Wedge) 1.50 (Circular)	0.91 (Wedge) 1.09 (Circular)	No	As FS_{Sys}<1.0, this section is considered high vulnerability.									>20	No	None	High Vulnerability	Segment 11A is considered High Vulnerability based on post seismic stability analysis results.
11B	Feather River Right Bank	3044+20	3073+00	Yes	3037+05	0.12	Less Likely Liquefiable 21 feet	Less Likely Liquefiable 17 feet	Less Likely Liquefiable 17 feet	Less Likely Liquefiable 6 to 8	Less Likely Liquefiable NA	Less Likely Liquefiable ϕ'=22 degrees	2.94 (Wedge) 3.16 (Circular)	2.42 (Wedge) 2.59 (Circular)	No	As FS_{Sys}>1.3, this section is considered low vulnerability.									<10	No	> 0.3 m (1 ft)	Low Vulnerability	Segment 11B is considered Low Vulnerability based on post-seismic stability analysis results.
11C	Feather River Right Bank	3073+00	3163+00	Yes		0.12	Likely Liquefiable 21 feet	Likely Liquefiable 17 feet	Likely Liquefiable 5 to 20 feet	Likely Liquefiable 2 to 6	Likely Liquefiable 4.5	Likely Liquefiable Sur = 70 psf													>20	No	None	High Vulnerability	The liquefaction and geometry characteristics of Segment 11C are similar to those of Segment 11A. Since Segment 11A is High Vulnerability, Segment 11C is also considered High Vulnerability.
12	Feather River Right Bank	3163+00	3598+50	Yes		0.12																			<10	No	> 0.3 m (1 ft)	Low Vulnerability	Segment 12 is non-liquefiable with the exception of localized thin likely and less likely liquefiable layers encountered at about 20 feet or deeper below the landside toe. Considering the depth and limited extent of these layers, as well as the Segment 14 and 16 analysis results, Segment 12 is classified as Low Vulnerability.
13	Feather River Right Bank	3598+50	3983+50	No		0.11																			<10	No	> 0.3 m (1 ft)	Low Vulnerability	Segment 13 is non-liquefiable.
14	Feather River Right Bank	3983+50	4004+00	Yes	3992+99	0.11	Likely Liquefiable 20 feet	Likely Liquefiable 18 feet	Likely Liquefiable 10 to 19 feet	Likely Liquefiable 2 to 7	Likely Liquefiable 6.5	Likely Liquefiable Sur = 115 psf	2.51 (Wedge) 2.98 (Circular)	1.47 (Wedge) 1.81 (Circular)	No	As FS_{Sys}>1.3, this section is considered low vulnerability.									<10	No	> 0.3 m (1 ft)	Low Vulnerability	Segment 14 is considered Low Vulnerability based on post-seismic stability analysis results.
15	Feather River Right Bank	4004+00	4367+50	Yes		0.11																			<10	No	> 0.3 m (1 ft)	Low Vulnerability	Segment 15 is non-liquefiable with the exception of a localized thin less likely liquefiable layer encountered about 15 feet below the landside toe. Considering the depth and limited extent of this layer, as well as the Segment 14 and 16 analysis results, Segment 15 is classified as Low Vulnerability.
16	Feather River Right Bank	4367+50	4378+00	Yes	4377+35	0.11	Likely Liquefiable 8 feet	Likely Liquefiable 15 feet	Likely Liquefiable 4 feet	Likely Liquefiable 7	Likely Liquefiable 9	Likely Liquefiable Sur = 200 psf	1.62 (Wedge) 1.96 (Circular)	2.84 (Wedge) 3.50 (Circular)	No	As FS_{Sys}>1.3, this section is considered low vulnerability.									<10	No	> 0.3 m (1 ft)	Low Vulnerability	Segment 16 is considered Low Vulnerability based on post-seismic stability analysis results.
17	Feather River Right Bank	4378+00	4534+54	Yes		0.11																			<10	No	> 0.3 m (1 ft)	Low Vulnerability	Segment 17 is non-liquefiable with the exception of three localized locations: one location included a 4-foot thick likely liquefiable layer encountered in one of the landside borings at about 13 feet below the landside toe, and the other two locations included thin less likely liquefiable layers at about 12 feet and 20 feet below the landside toe. Considering the depth and limited extent of these layers, as well as the Segment 14 and 16 analysis results, Segment 17 is classified as Low Vulnerability.

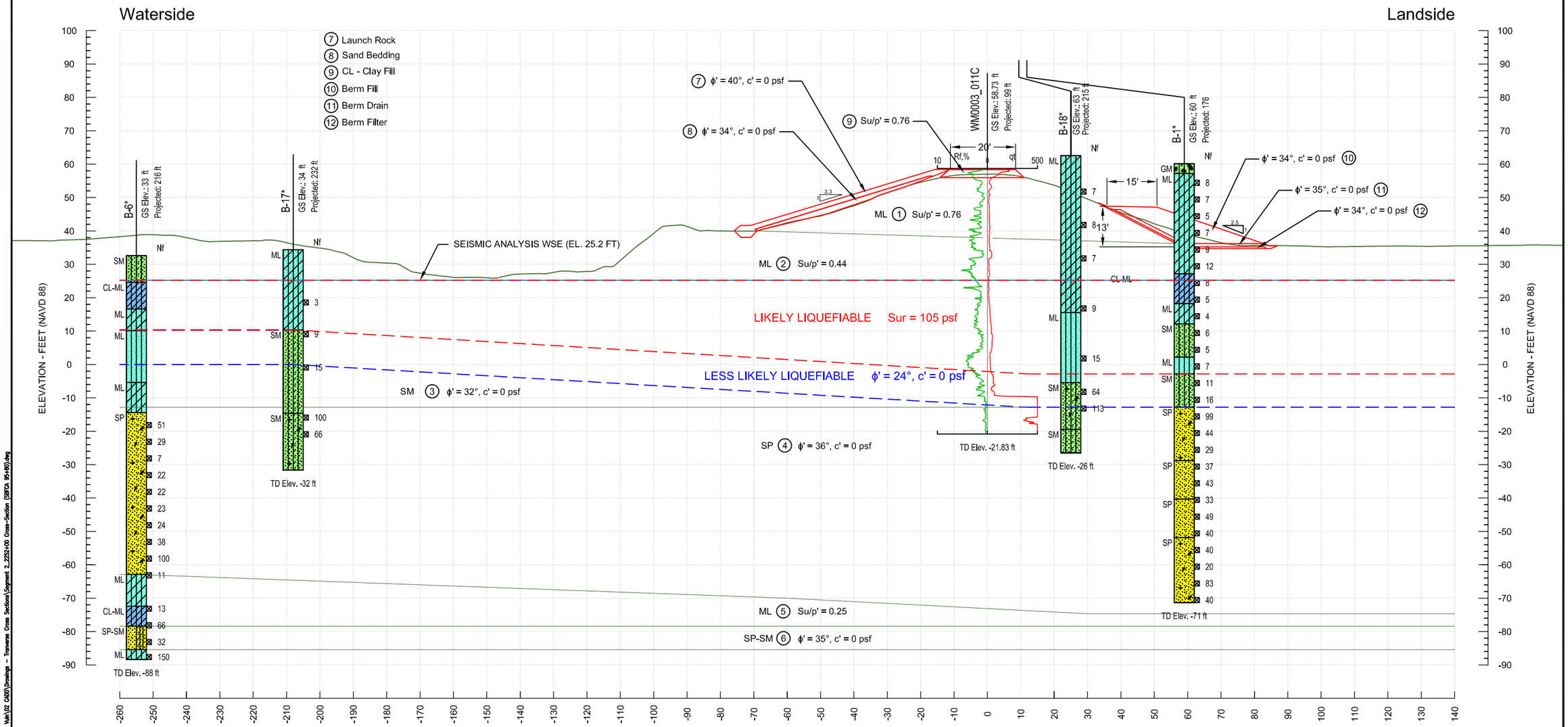
Notes:

[1]Fines content correction factors are based on Cetin et al. (2004) for liquefaction triggering and Seed and Harder (1990) for post-seismic strength. Therefore, the range of $(N_1)_{60\text{-}cs}$ values and the median $(N_1)_{60\text{-}cs\text{-}Sur}$ value are not comparable. See cited references for clarification.

[2]Depth is measured from the toe of the landside spoil bench.

[3]Layer is not present on the landside.

SOIL PROFILE



0 15 30 60 90

SCALE IN FEET

Department of Water Resources
Division of Flood Management

in association with: URS, GEI Consultants

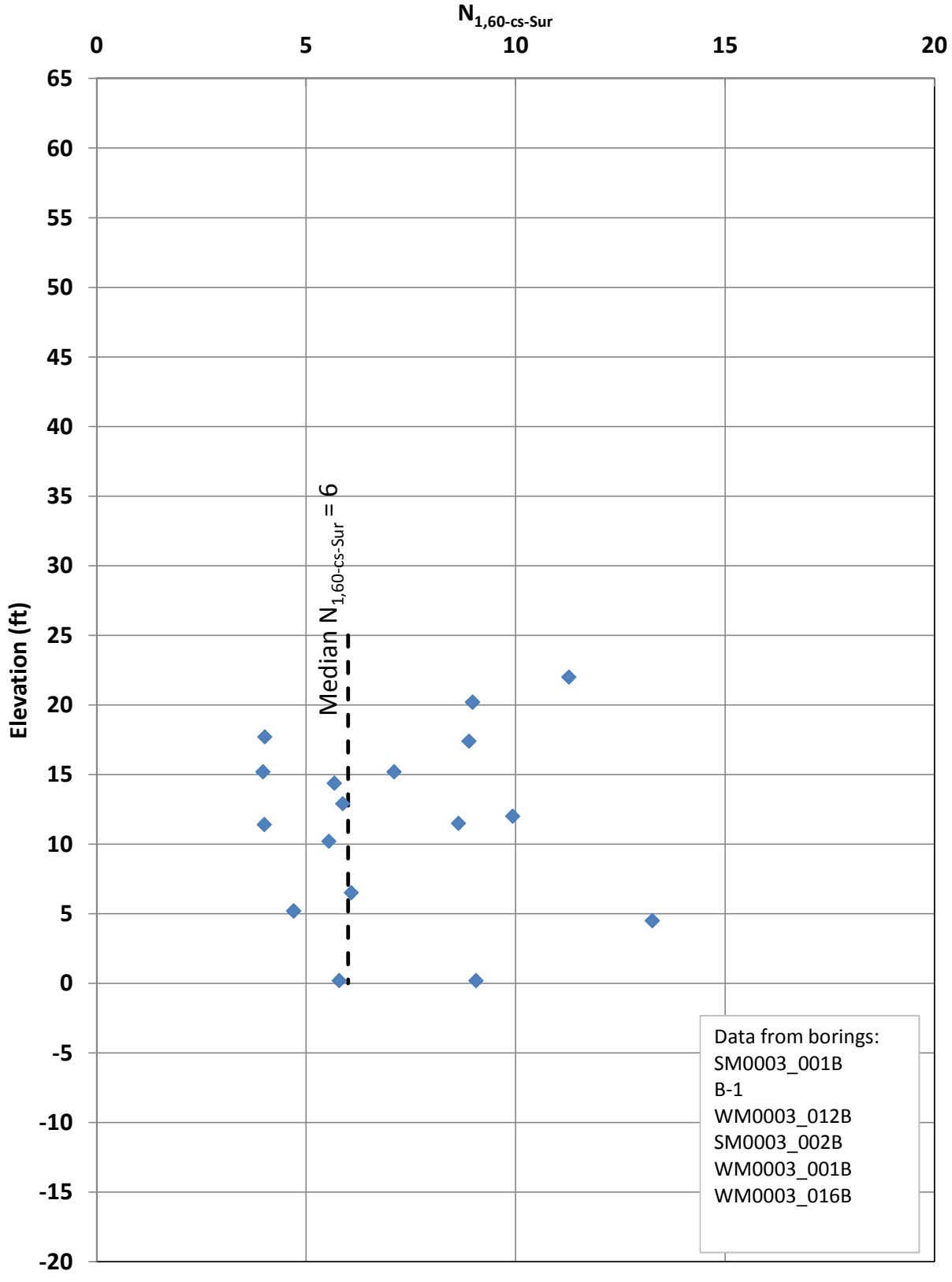
Analysis Section Station 2252+00
Segment 2
Drained Stability Berm
Sutter Feather River Study Area

URBAN LEVEE EVALUATIONS

Figure C-S2-1

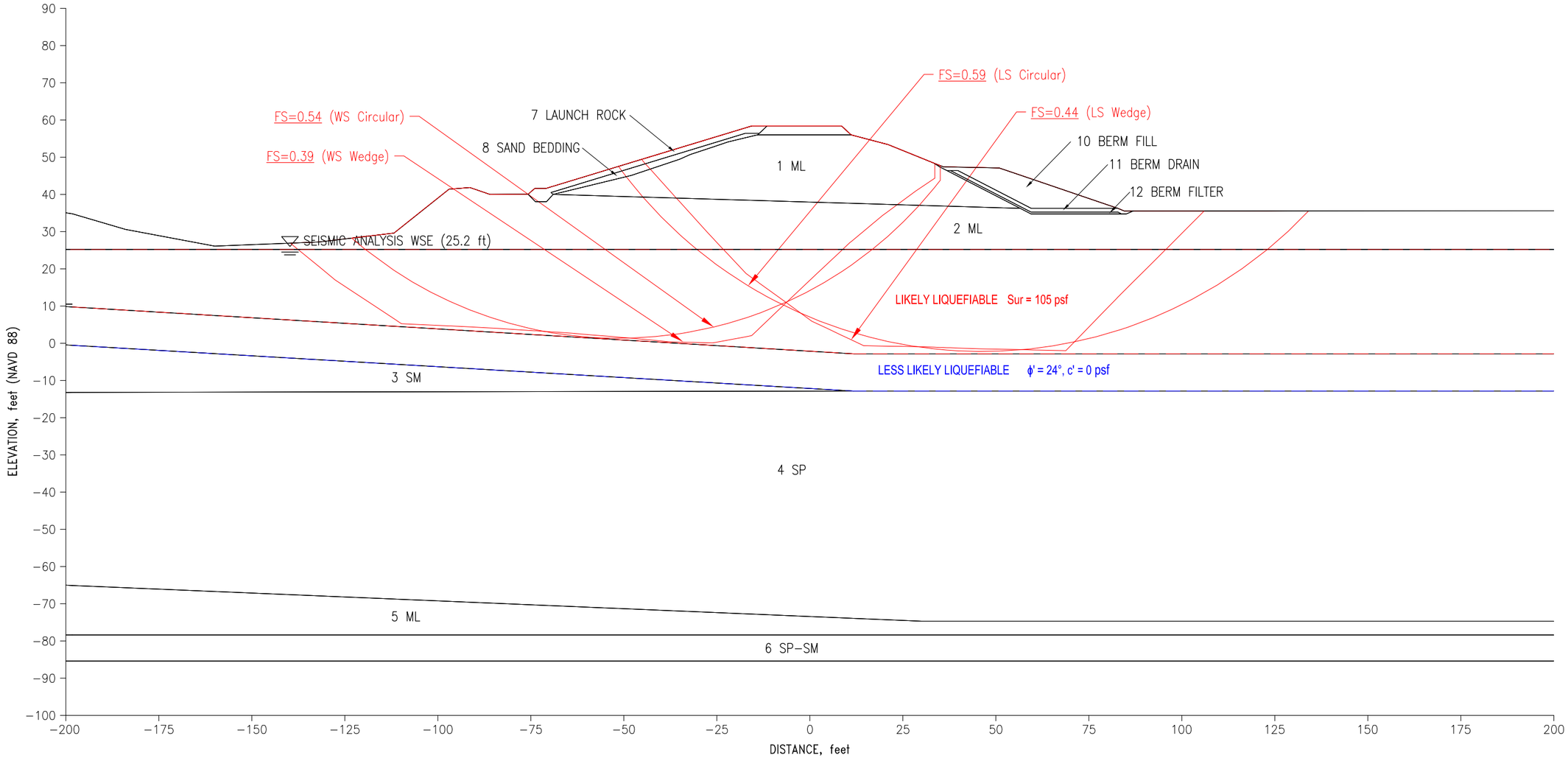
PLOT BY: ERIC_LAUM – Feb 23, 2015 – 10:38:37am
DRAWING: G:\URS-7415\Work2\cm\Feather Riv Meet GER\06 Seismic Veh\02 CADD\Drawings – Transverse Cross Sections\Segment 2_2252+00 Cross-Section (SBFSA 85-180).dwg

STUDY AREA: Sutter Feather River
Segment 2



Note: $N_{1,60\text{-cs-Sur}}$ values based on Seed & Harder (1990)

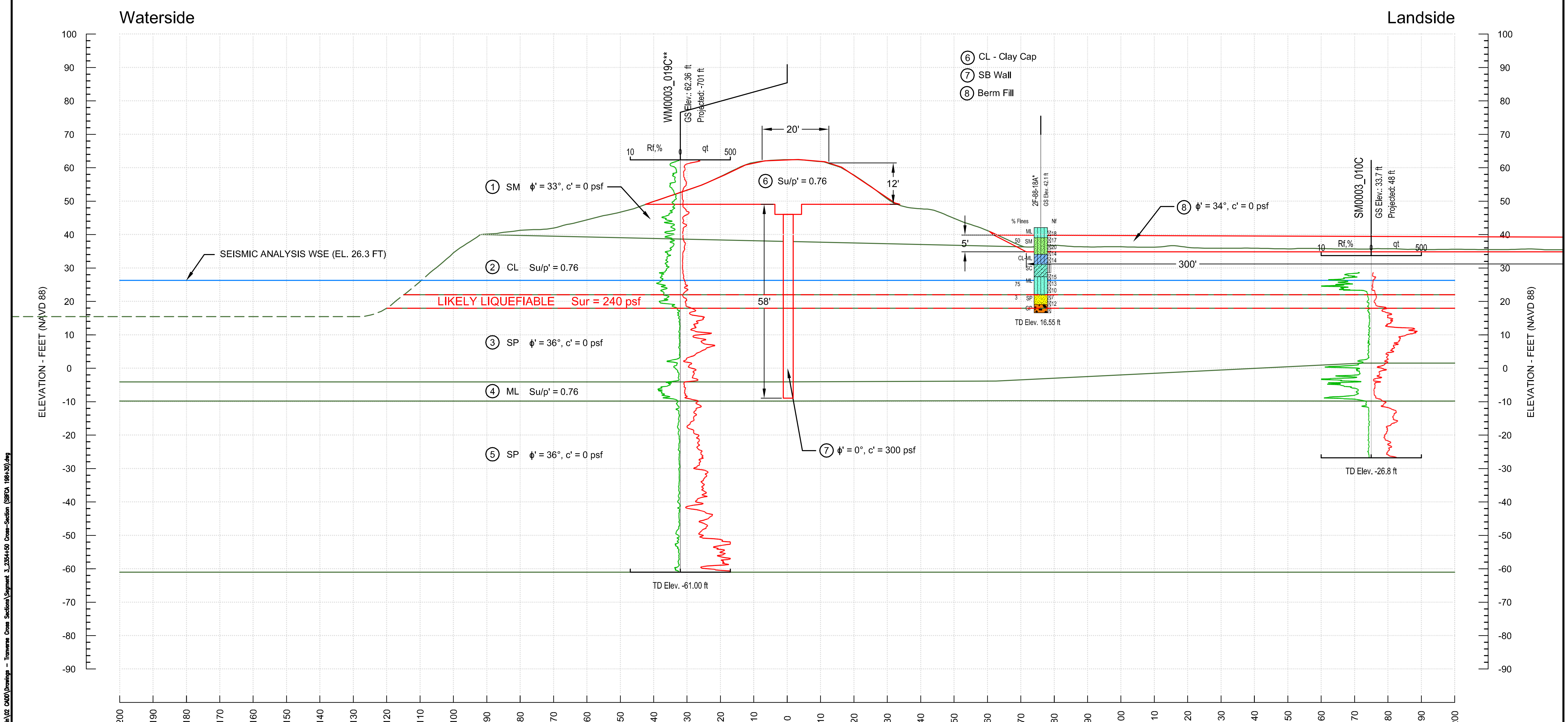
Figure C-S2-2



Department of Water Resources Division of Flood Management	URS	CONTRACT NUMBER 4600008101	PREPARED BY B. Choy	SUTTER FEATHER RIVER STUDY AREA URBAN LEVEE EVALUATIONS	POST SEISMIC STABILITY ANALYSIS RESULTS DRAINED STABILITY BERM SEGMENT 2 – STATION 2252+00
		TASK ORDER U33	CHECKED BY K. Kanagalingam		FIGURE C-S2-3

PLOT BY: ERIK_JULIAN – Feb 23, 2015 – 11:30:45am
DRAWING: G:\DWR-7418\WorkZone\feather riv west ger\06 seismic vuln\02 CADD\drawings – seismic stab results\01 Seismic Figures\Segment 2 – Station 2252+00.dwg

SOIL PROFILE



Waterside
Landside
ELEVATION - FEET (NAVD 88)
WM0003_019C**
GS Elev.: 62.36 ft
Projected: -701 ft
Rf,%
qt
20'
12'
58'
5'
300'
① SM ϕ' = 33°, c' = 0 psf
② CL Su/p' = 0.76
③ SP ϕ' = 36°, c' = 0 psf
④ ML Su/p' = 0.76
⑤ SP ϕ' = 36°, c' = 0 psf
⑥ Su/p' = 0.76
⑦ ϕ' = 0°, c' = 300 psf
⑧ ϕ' = 34°, c' = 0 psf
⑥ CL - Clay Cap
⑦ SB Wall
⑧ Berm Fill
SEISMIC ANALYSIS WSE (EL. 26.3 FT)
LIKELY LIQUEFIABLE Sur = 240 psf
TD Elev. -61.00 ft
TD Elev. 16.55 ft
SM0003_010C
GS Elev.: 33.7 ft
Projected: 48 ft
TD Elev. -26.8 ft

0 15 30 60 90
SCALE IN FEET

Department of Water Resources
Division of Flood Management

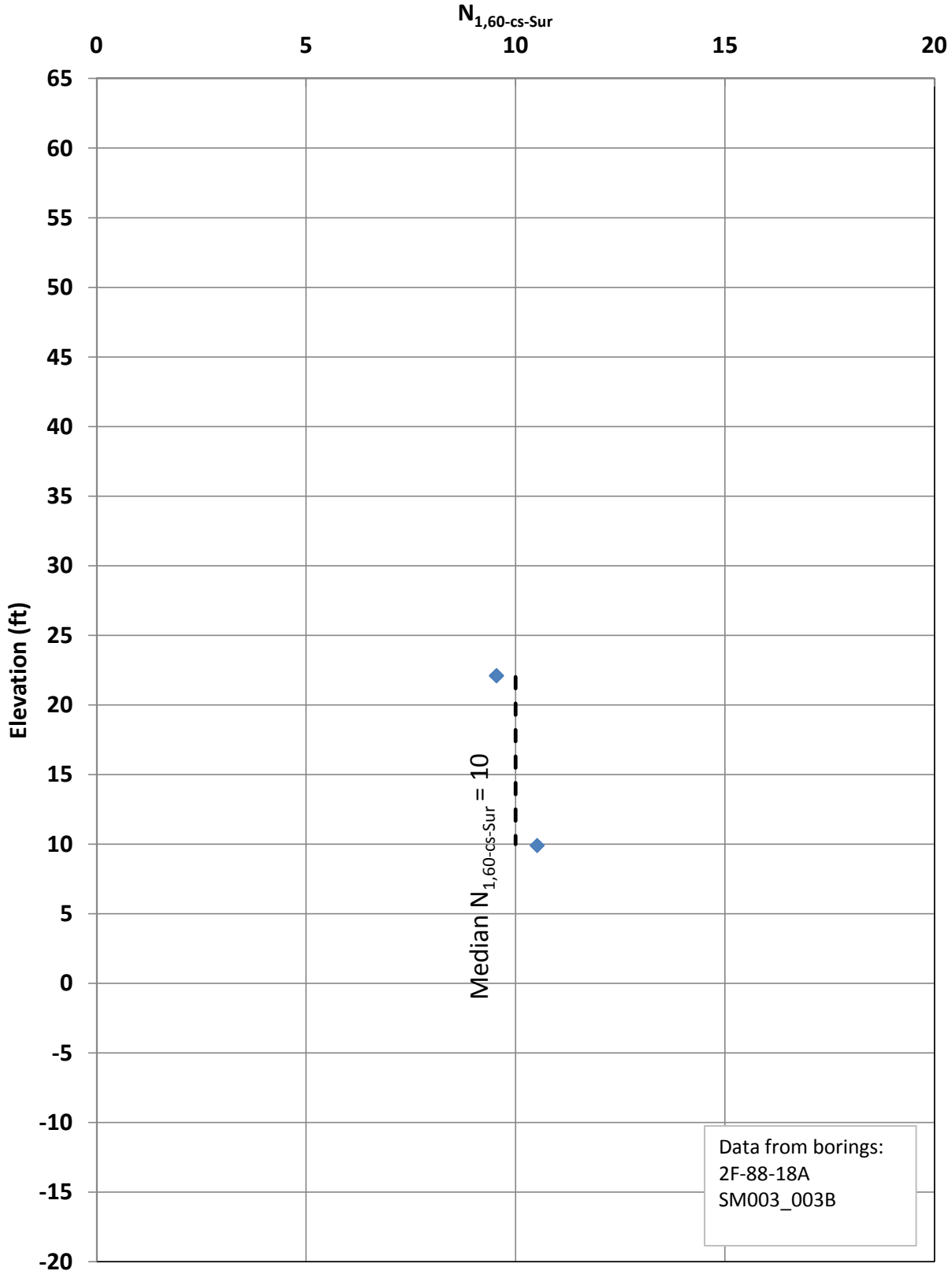
URS
in association with:
GEI Consultants

Analysis Section Station 2354+50
Segment 3
SB Cutoff Wall and Seepage Berm
Sutter Feather River Study Area

URBAN LEVEE EVALUATIONS

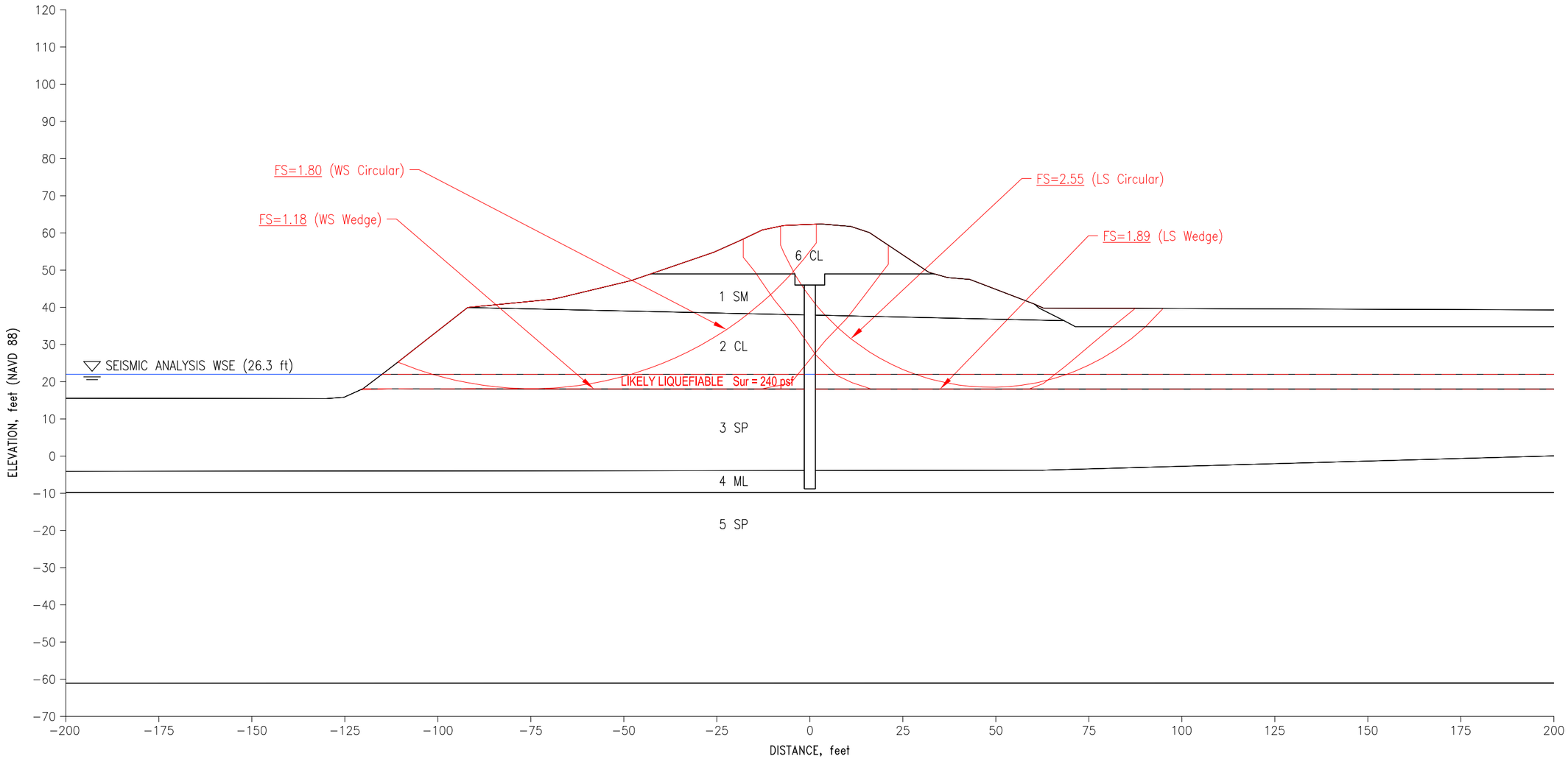
Figure C-S3-1

STUDY AREA: Sutter Feather River
Segment 3

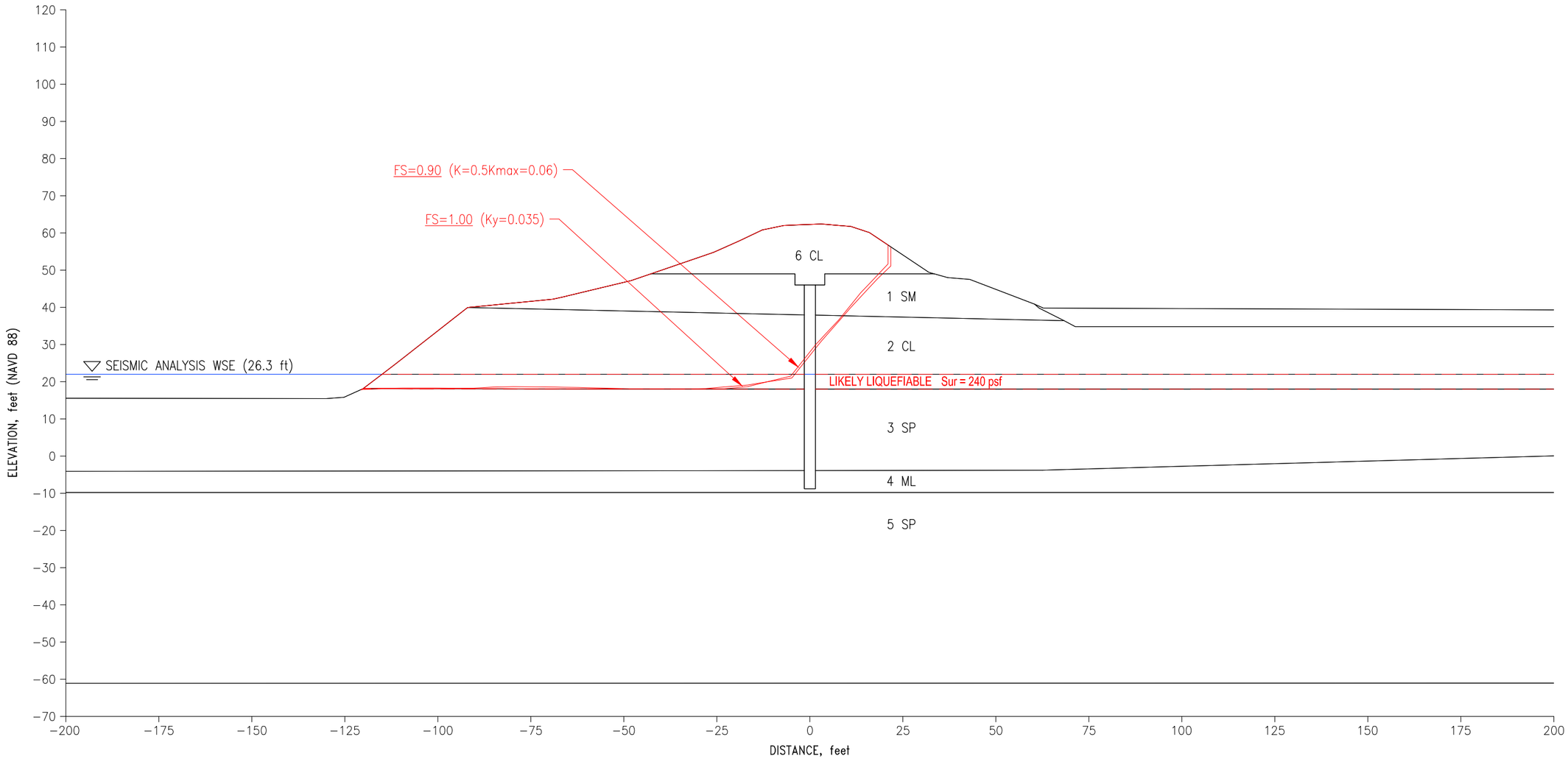


Note: $N_{1,60\text{-cs-Sur}}$ values based on Seed & Harder (1990)

Figure C-S3-2



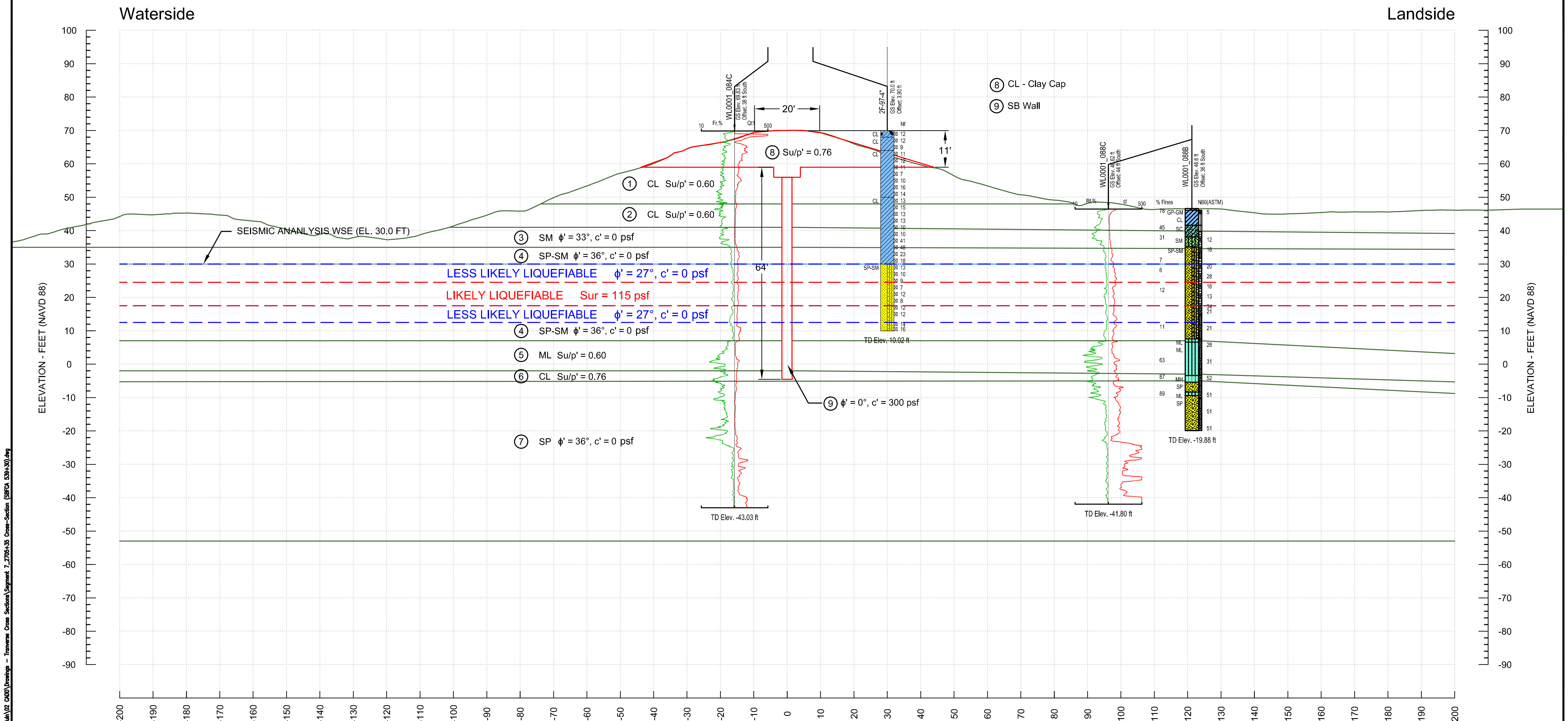
Department of Water Resources Division of Flood Management	URS	CONTRACT NUMBER 4600008101	PREPARED BY B. Choy	SUTTER FEATHER RIVER STUDY AREA URBAN LEVEE EVALUATIONS	POST SEISMIC STABILITY ANALYSIS RESULTS SB CUTOFF WALL AND SEEPAGE BERM SEGMENT 3 – STATION 2354+50
		TASK ORDER U33	CHECKED BY K. Kanagalingam		FIGURE C–S3–3



Department of Water Resources Division of Flood Management	URS	CONTRACT NUMBER 4600008101	PREPARED BY B. Choy	SUTTER FEATHER RIVER STUDY AREA URBAN LEVEE EVALUATIONS	PSEUDO-STATIC STABILITY ANALYSIS WATERSIDE WEDGE SEGMENT 3 STATION 2354+50
		TASK ORDER U33	CHECKED BY K. Kanagalingam		FIGURE C-S3-4

PLOT BY: ERIK_JULIAN – Feb 23, 2015 – 11:27:51am
DRAWING: G:\DWR-7418\WorkZone\feather riv west ger\06 seismic vuln\02 CADD\drawings – seismic stab results\01 Seismic Figures\C-S3-4 Segment 3 – Station 2354+50.dwg

SOIL PROFILE



Waterside
Landside
ELEVATION - FEET (NAVD 88)
SEISMIC ANANLYSIS WSE (EL. 30.0 FT)
(8) CL - Clay Cap
(9) SB Wall
20'
11'
64'
(8) Su/p' = 0.76
(1) CL Su/p' = 0.60
(2) CL Su/p' = 0.60
(3) SM ϕ' = 33°, c' = 0 psf
(4) SP-SM ϕ' = 36°, c' = 0 psf
LESS LIKELY LIQUEFIABLE ϕ' = 27°, c' = 0 psf
LIKELY LIQUEFIABLE Sur = 115 psf
LESS LIKELY LIQUEFIABLE ϕ' = 27°, c' = 0 psf
(4) SP-SM ϕ' = 36°, c' = 0 psf
(5) ML Su/p' = 0.60
(6) CL Su/p' = 0.76
(7) SP ϕ' = 36°, c' = 0 psf
(9) ϕ' = 0°, c' = 300 psf
WL0001_084C
2F-97-4*
WL0001_088C
WL0001_088B
TD Elev. -43.03 ft
TD Elev. 10.02 ft
TD Elev. -41.80 ft
TD Elev. -19.88 ft

0 15 30 60 90
SCALE IN FEET

Department of Water Resources
Division of Flood Management

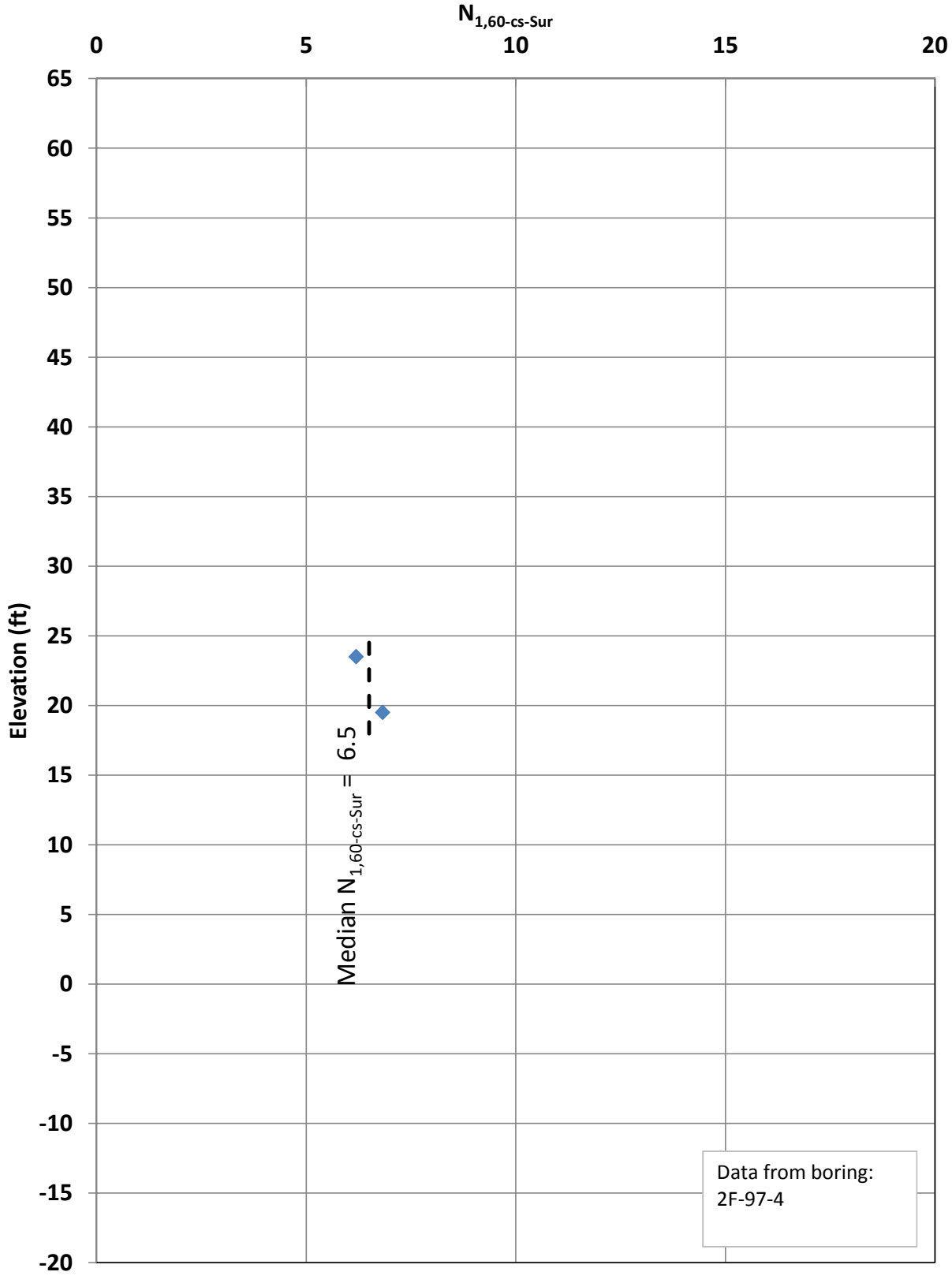
URS
in association with:
GEI Consultants

Analysis Section Station 2705+35
Segment 7
Soil Betonite (SB) Cutoff Wall
Feather River Study Area

URBAN LEVEE EVALUATIONS

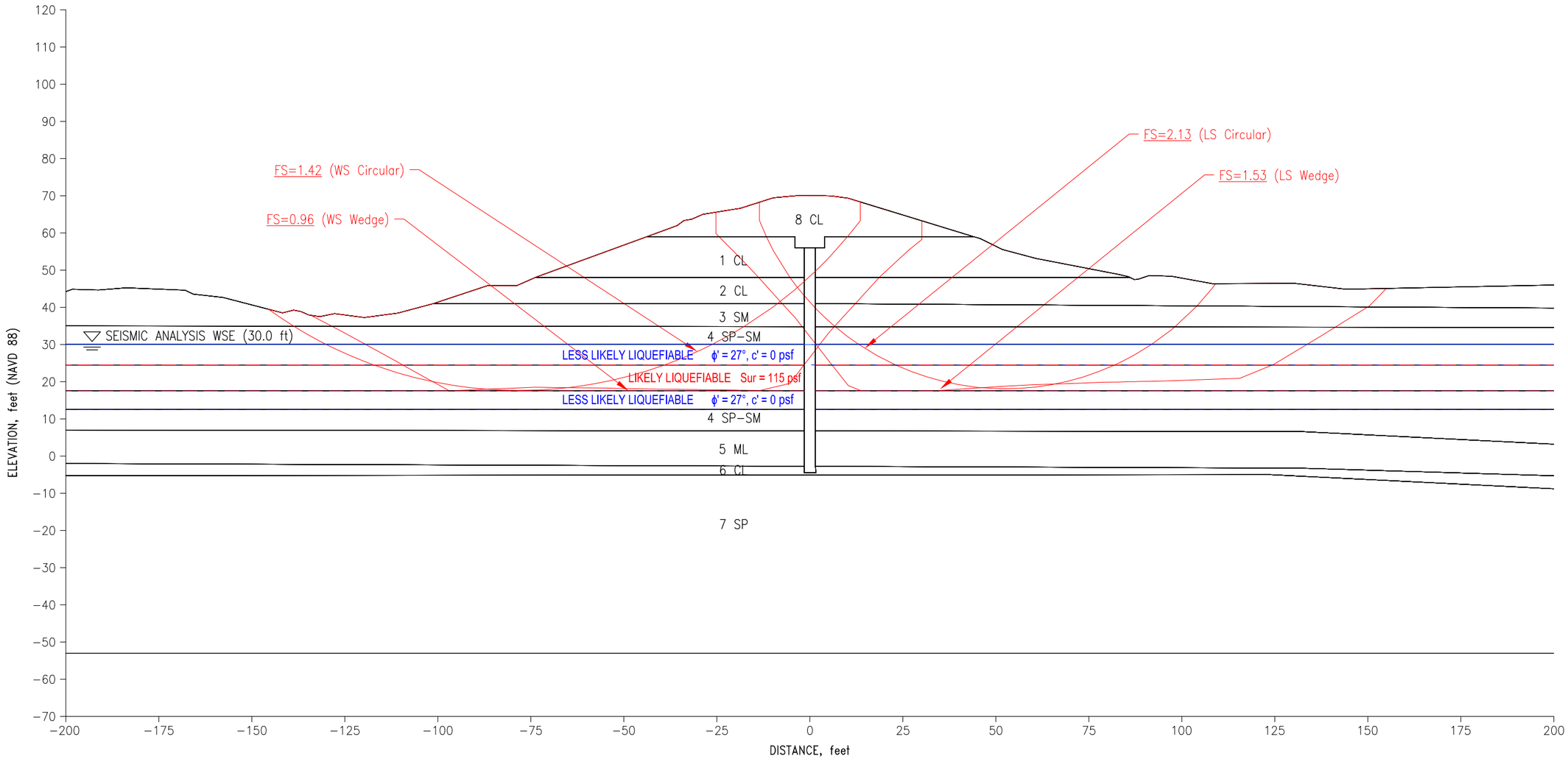
Figure C-S7-1

STUDY AREA: Sutter Feather River
Segment 7



Note: $N_{1,60\text{-cs-Sur}}$ values based on Seed & Harder (1990)

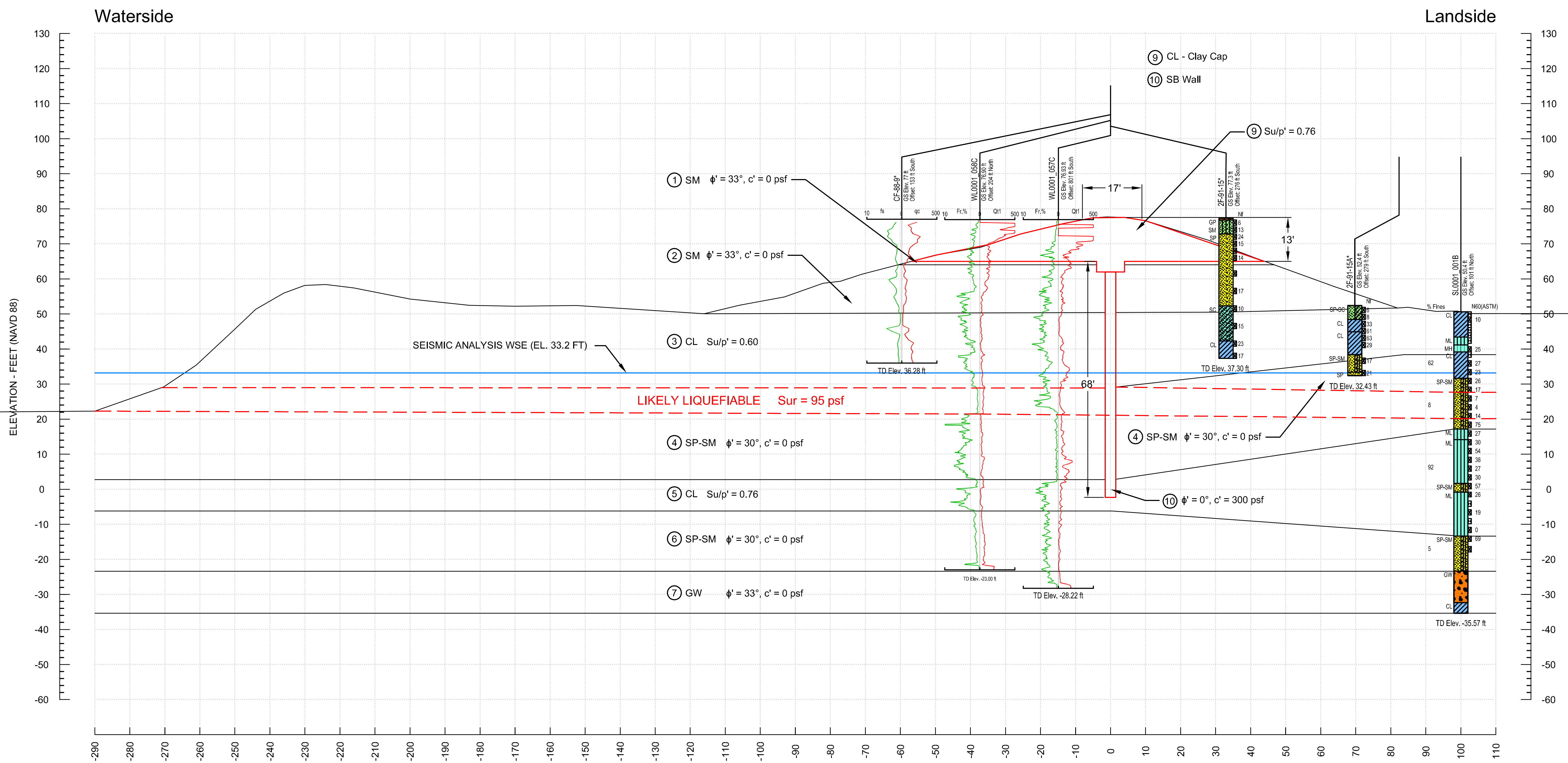
Figure C-S7-2



Department of Water Resources Division of Flood Management	URS	CONTRACT NUMBER 4600008101	PREPARED BY B. Choy	SUTTER FEATHER RIVER STUDY AREA URBAN LEVEE EVALUATIONS	POST SEISMIC STABILITY ANALYSIS RESULTS SOIL BENTONITE (SB) CUTOFF WALL SEGMENT 7 - STATION 2705+35
		TASK ORDER U33	CHECKED BY K. Kanagalingam		FIGURE C-S7-3

PLOT BY: ERIK_JULIAN - Feb 23, 2015 - 11:25:03am
DRAWING: G:\DWR-7418\WorkZone\feather riv west ger\06 seismic vuln\02 CADD\drawings - seismic stab results\01 Seismic Figures\C-S7-3 Segment 7 - Station 2705+35.dwg

SOIL PROFILE



0 15 30 60 90 SCALE IN FEET	

Department of Water Resources
Division of Flood Management

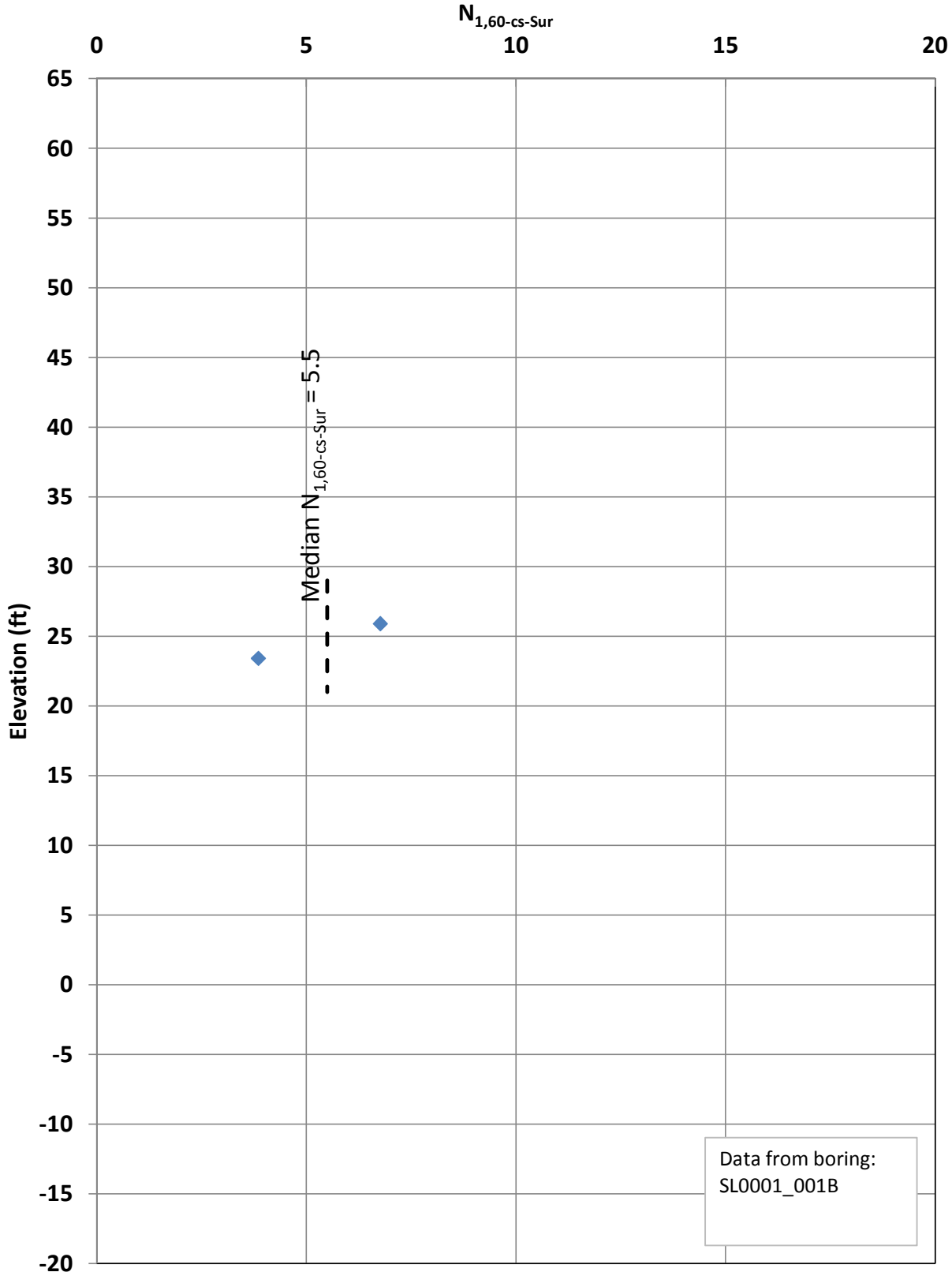
URS in association with: GEI Consultants

Analysis Section Station 2899+89
Segment 9
Soil-Bentonite (SB) Cutoff Wall
Sutter Feather River Study Area

URBAN LEVEE EVALUATIONS

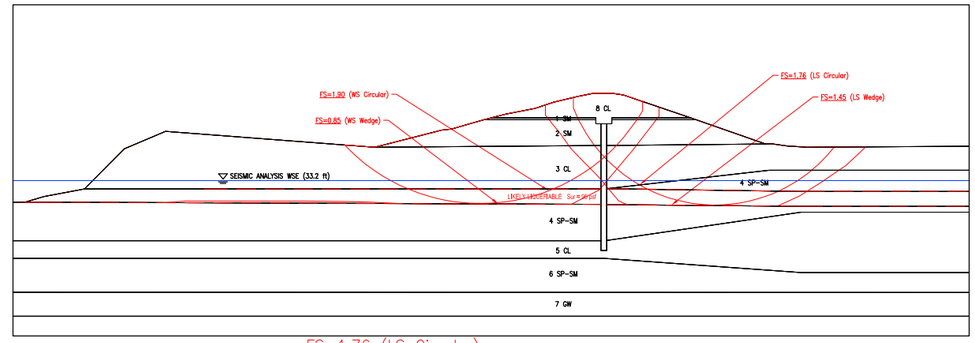
Figure C-S9-1

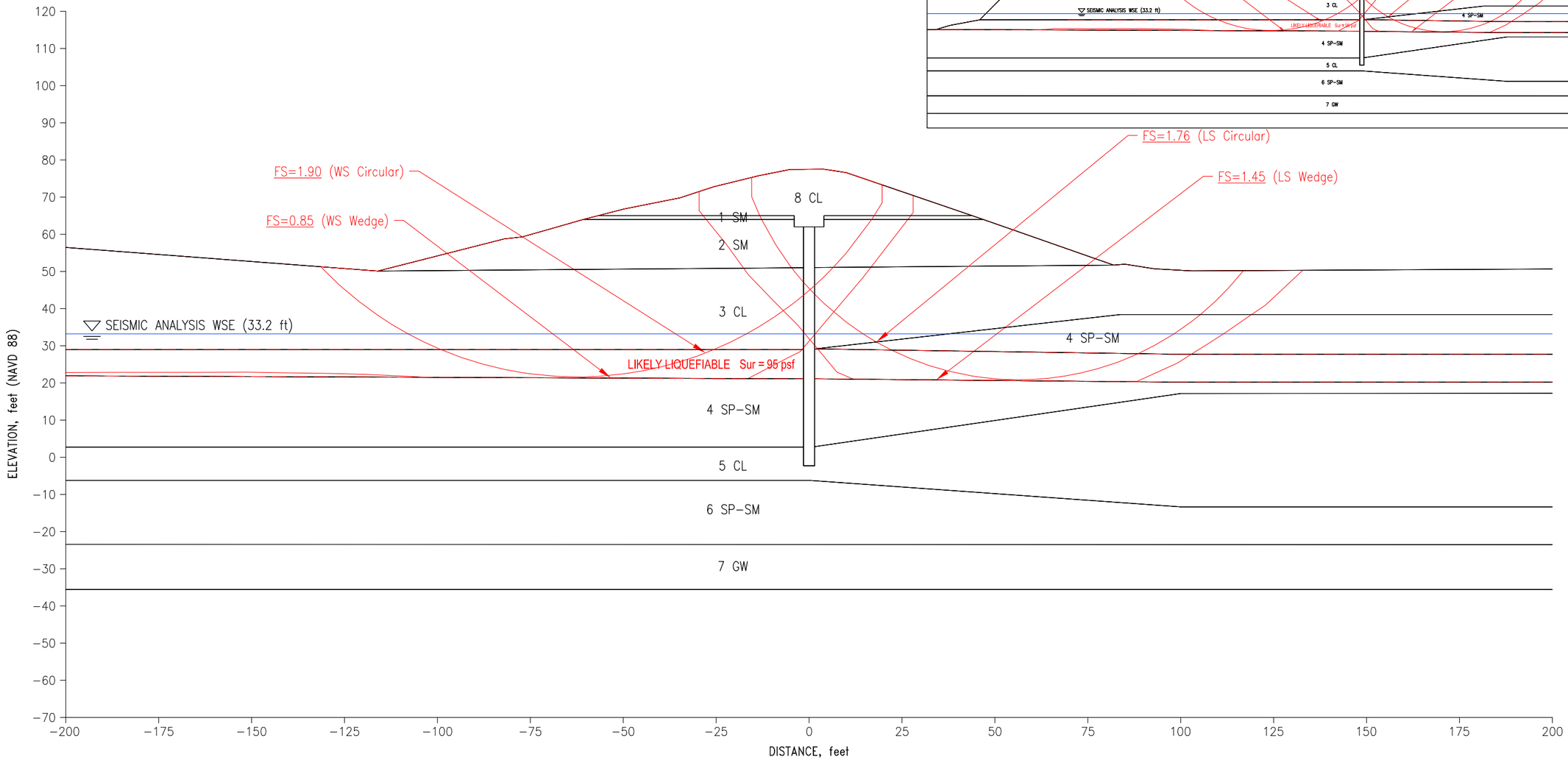
STUDY AREA: Sutter Feather River
Segment 9



Note: $N_{1,60\text{-cs-Sur}}$ values based on Seed & Harder (1990)

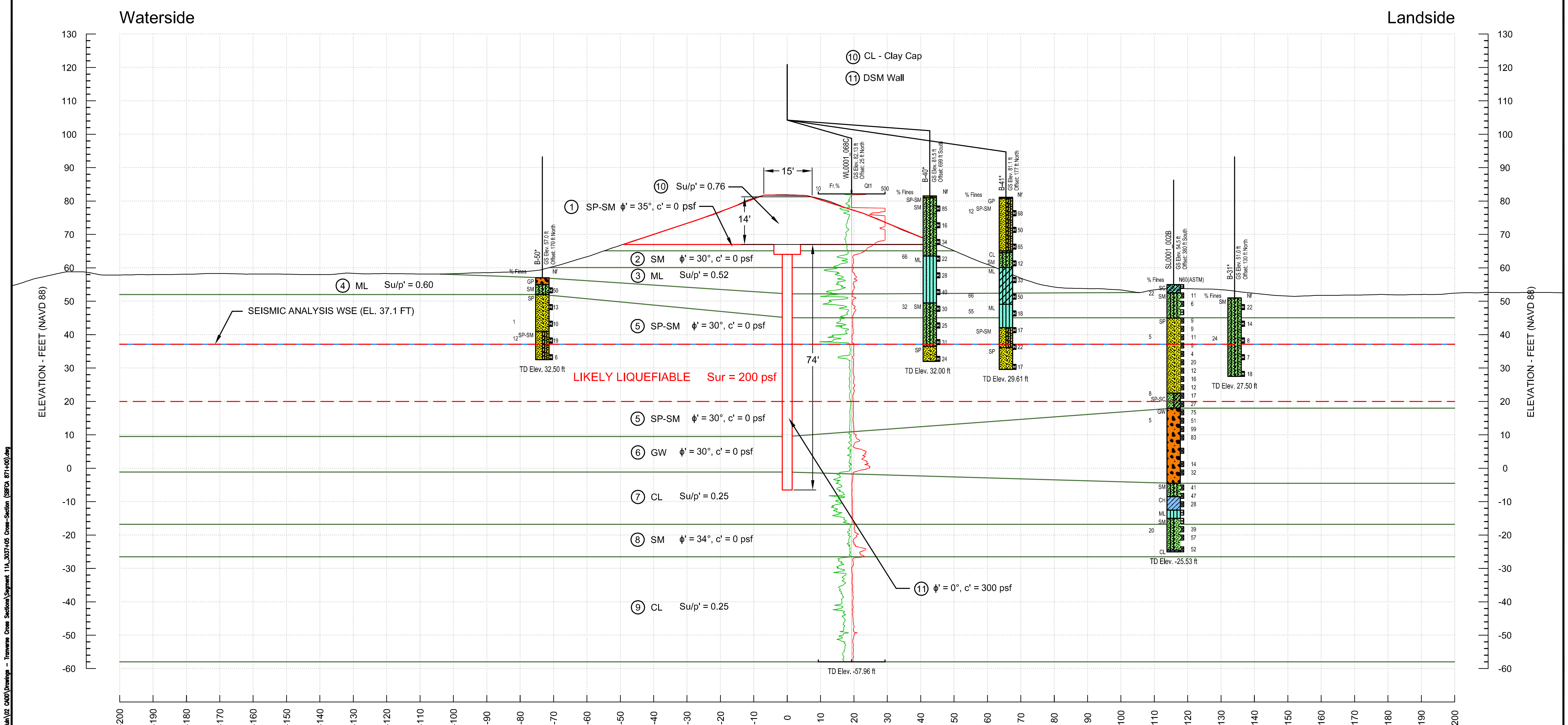
Figure C-S9-2





Department of Water Resources Division of Flood Management	URS	CONTRACT NUMBER 4600008101	PREPARED BY B. Choy	SUTTER FEATHER RIVER STUDY AREA URBAN LEVEE EVALUATIONS	POST SEISMIC STABILITY ANALYSIS RESULTS SOIL BENTONITE (SB) CUTOFF WALL SEGMENT 9 – STATION 2899+89
		TASK ORDER U33	CHECKED BY K. Kanagalingam		FIGURE C–S9–3

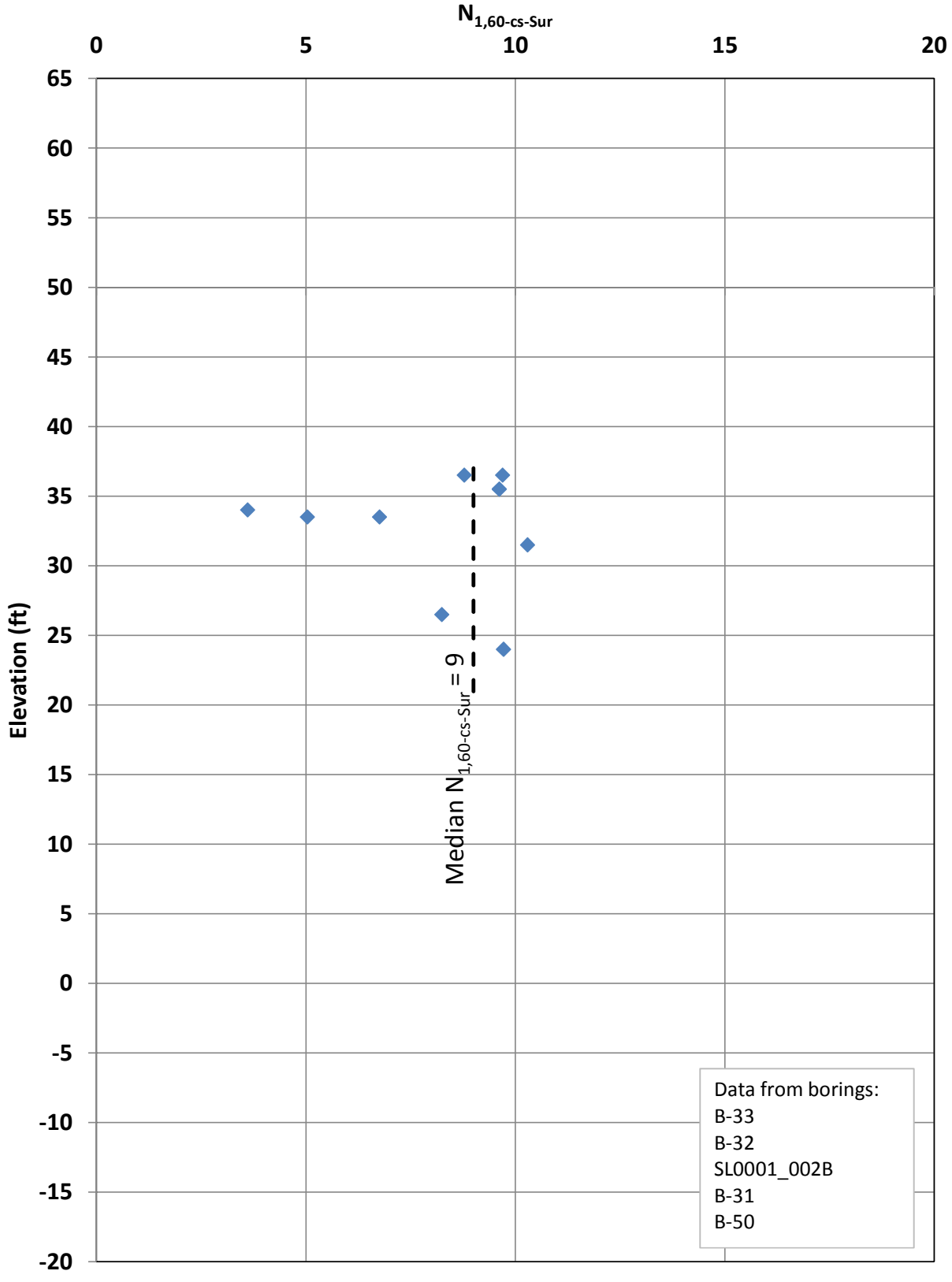
SOIL PROFILE



0 15 30 60 90 SCALE IN FEET	Department of Water Resources Division of Flood Management	URS in association with: GEI Consultants	Analysis Section Station 3037+05 Segment 11A Deep Soil Mixing (DSM) Cutoff Wall Sutter Feather River Study Area URBAN LEVEE EVALUATIONS

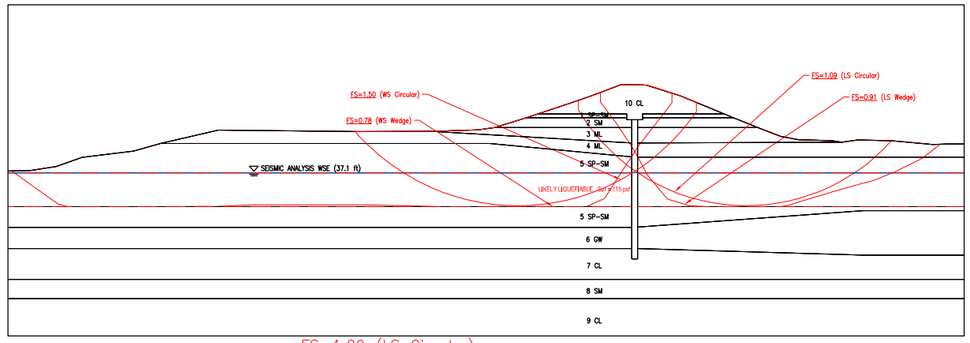
Figure C-S11A-1

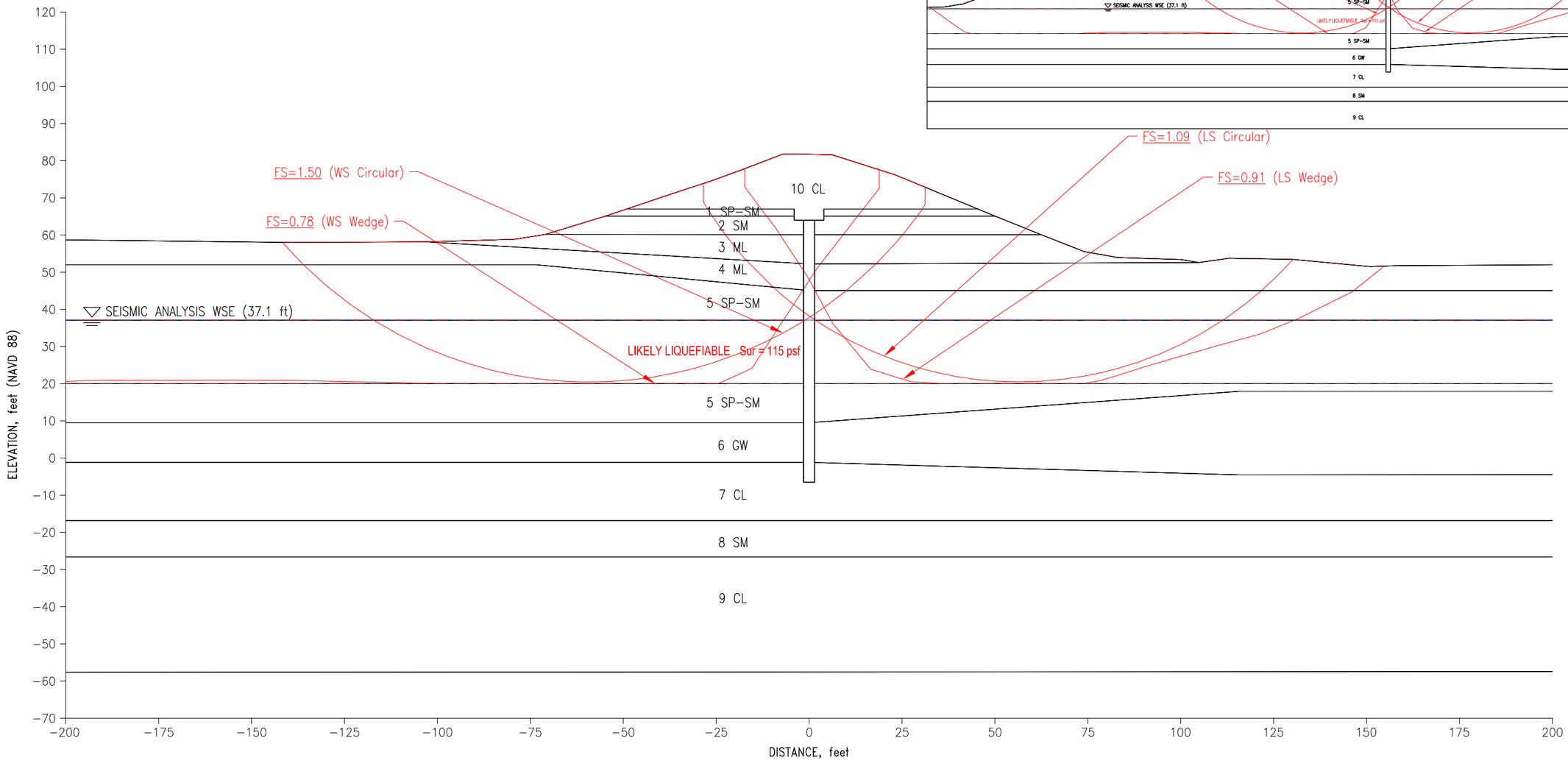
STUDY AREA: Sutter Feather River
Segment 11A



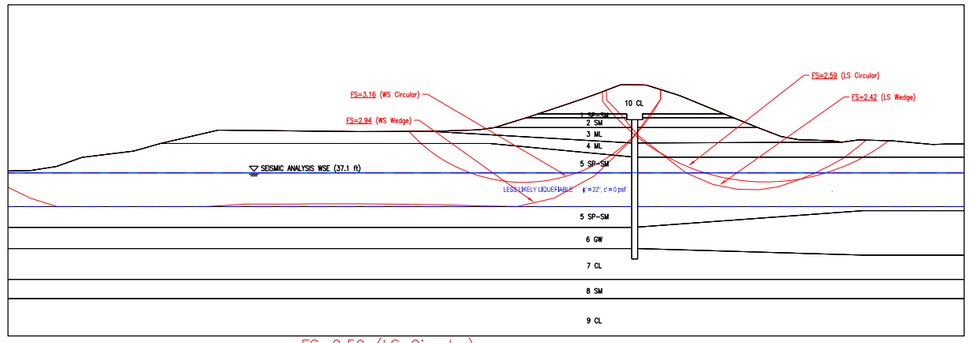
Note: $N_{1,60\text{-cs-Sur}}$ values based on Seed & Harder (1990)

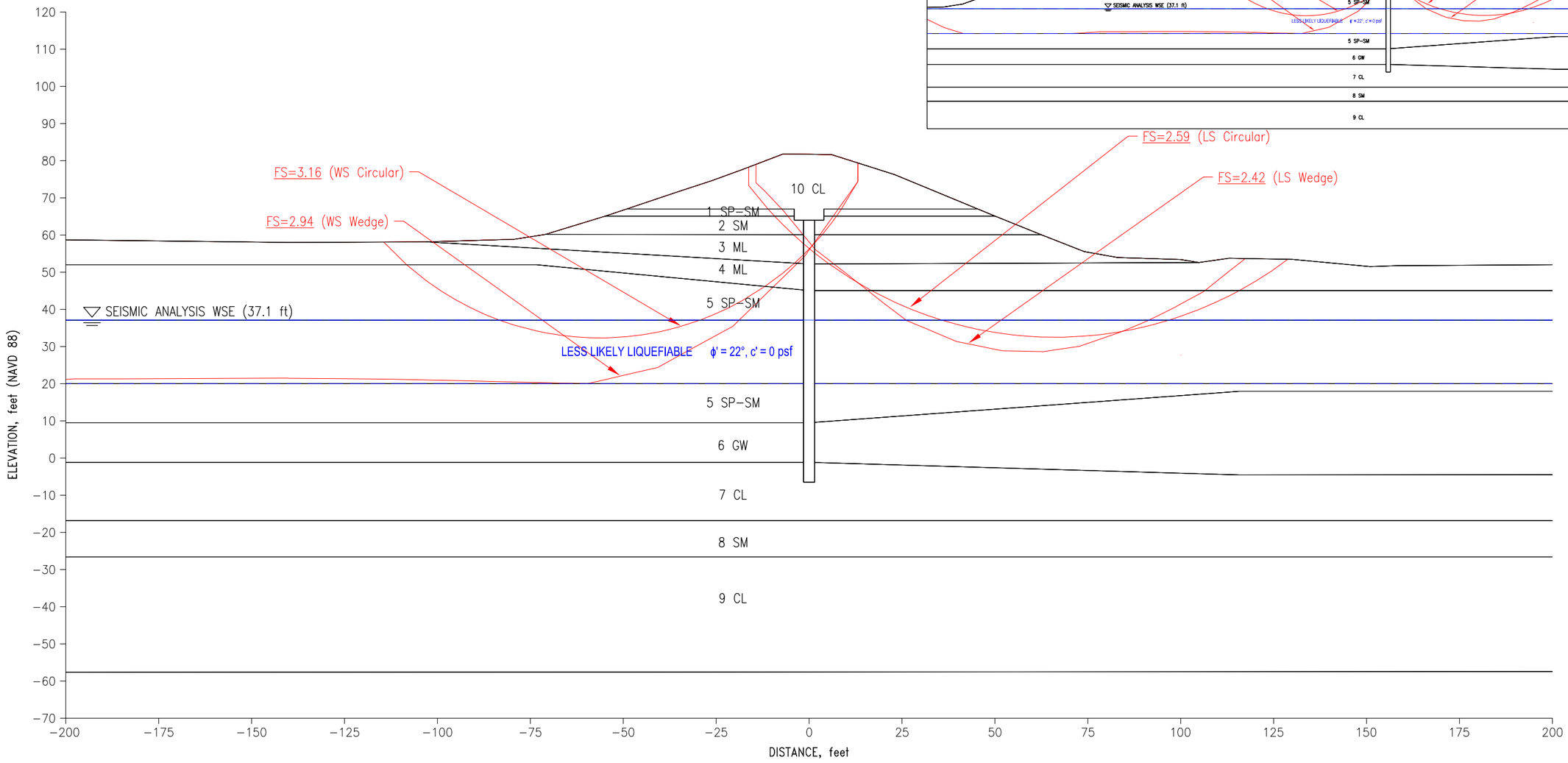
Figure C-S11A-2





Department of Water Resources Division of Flood Management	URS	CONTRACT NUMBER 4600008101	PREPARED BY B. Choy	SUTTER FEATHER RIVER STUDY AREA URBAN LEVEE EVALUATIONS	POST SEISMIC STABILITY ANALYSIS RESULTS DEEP SOIL MIXING (DSM) CUTOFF WALL SEGMENT 11A – STATION 3037+50
		TASK ORDER U33	CHECKED BY K. Kanagalingam		FIGURE C–S11A–3





PLOT BY: ERIK_JULIAN – Feb 23, 2015 – 11:19:24am
DRAWING: G:\DWR-7418\WorkZone\feather riv west ger\06 seismic vuln\02 CADD\drawings – seismic stab results\01 Seismic Figures\C-S11B-1 Segment 11B – Station 3037+05.dwg

Department of Water Resources
Division of Flood Management

URS

CONTRACT NUMBER 4600008101	PREPARED BY E. Julian
TASK ORDER U33	CHECKED BY K. Kanagalingam

SUTTER FEATHER RIVER STUDY AREA
URBAN LEVEE EVALUATIONS

POST SEISMIC STABILITY ANALYSIS RESULTS
DEEP SOIL MIXING (DSM) CUTOFF WALL
SEGMENT 11B – STATION 3037+50

FIGURE
C–S11B–1

SOIL PROFILE

Waterside

Landside

8 Launch Rock

9 Sand Bedding

9 ϕ' = 34°, c' = 0 psf

8 ϕ' = 40°, c' = 0 psf

10 ϕ' = 34°, c' = 0 psf

11 ϕ' = 35°, c' = 0 psf

12 ϕ' = 34°, c' = 0 psf

10 Berm Fill

11 Berm Drain

12 Berm Filter

SEISMIC ANALYSIS WSE (EL. 70.4 FT)

ML (1) Su/p' = 0.44

SM (2) ϕ' = 32°, c' = 0 psf

SP (3) ϕ' = 33°, c' = 0 psf

SC (4) ϕ' = 34°, c' = 0 psf

GP-GC (5) ϕ' = 36°, c' = 0 psf

GC (6) ϕ' = 36°, c' = 0 psf

SW-SC (7) ϕ' = 34°, c' = 0 psf

LIKELY LIQUEFIABLE Sur = 115 psf

WM0007_004S
GS Elev. 110.3 ft
Offset -112 ft North

2F-97-10"
GS Elev. 88.4 ft
Offset 263 ft South

2F-97-9"
GS Elev. 89.7 ft
Offset 504 ft South

TD Elev. 28.38 ft

TD Elev. 29.69 ft

TD Elev. -38.12 ft

ELEVATION - FEET (NAVD 88)

0 15 30 60 90

SCALE IN FEET

Department of Water Resources
Division of Flood Management

in association with: URS / GEI Consultants

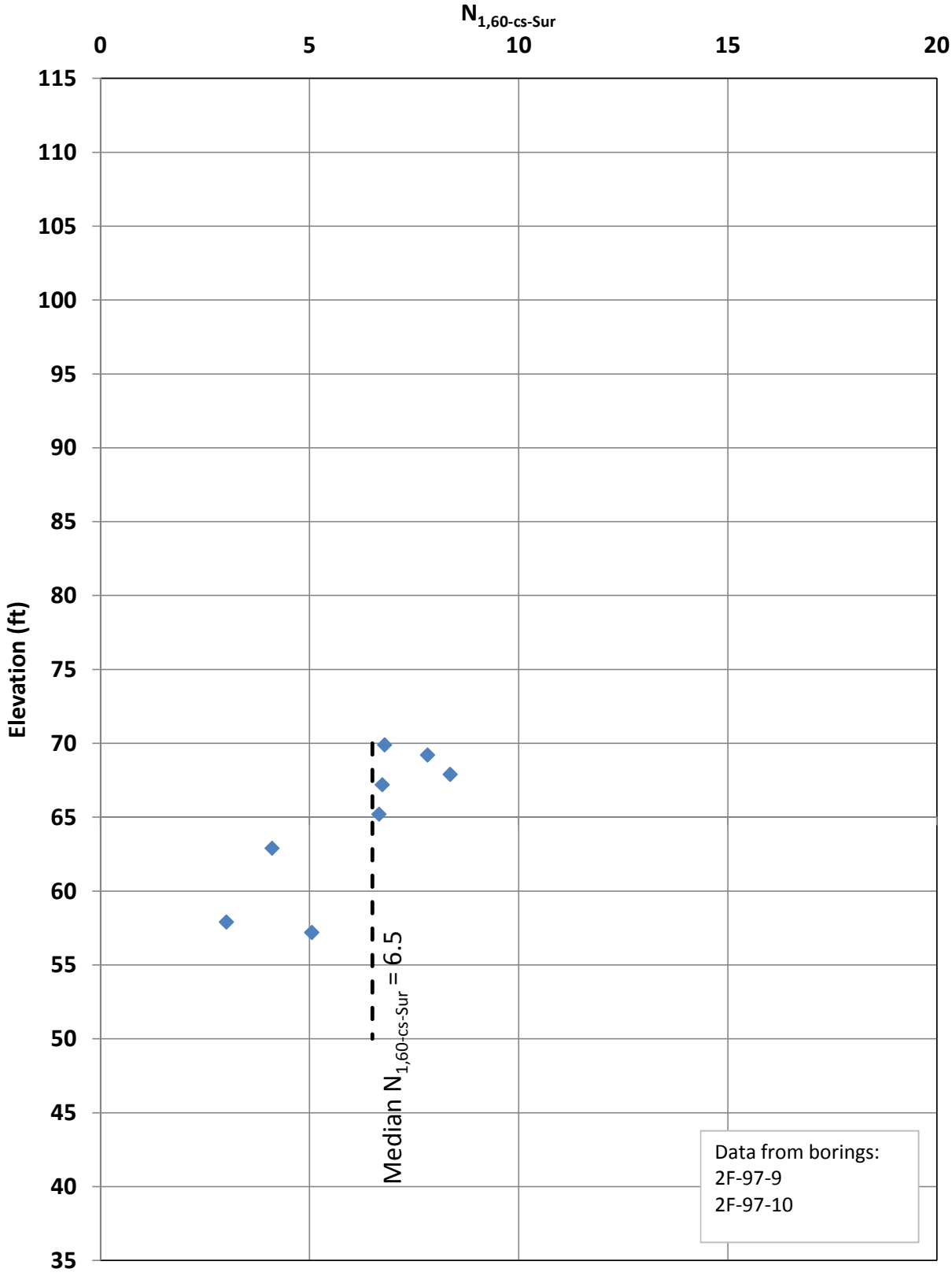
Analysis Section Station 3992+99
Segment 14
Drained Stability Berm
Sutter Feather River Study Area

URBAN LEVEE EVALUATIONS

Figure C-S14-1

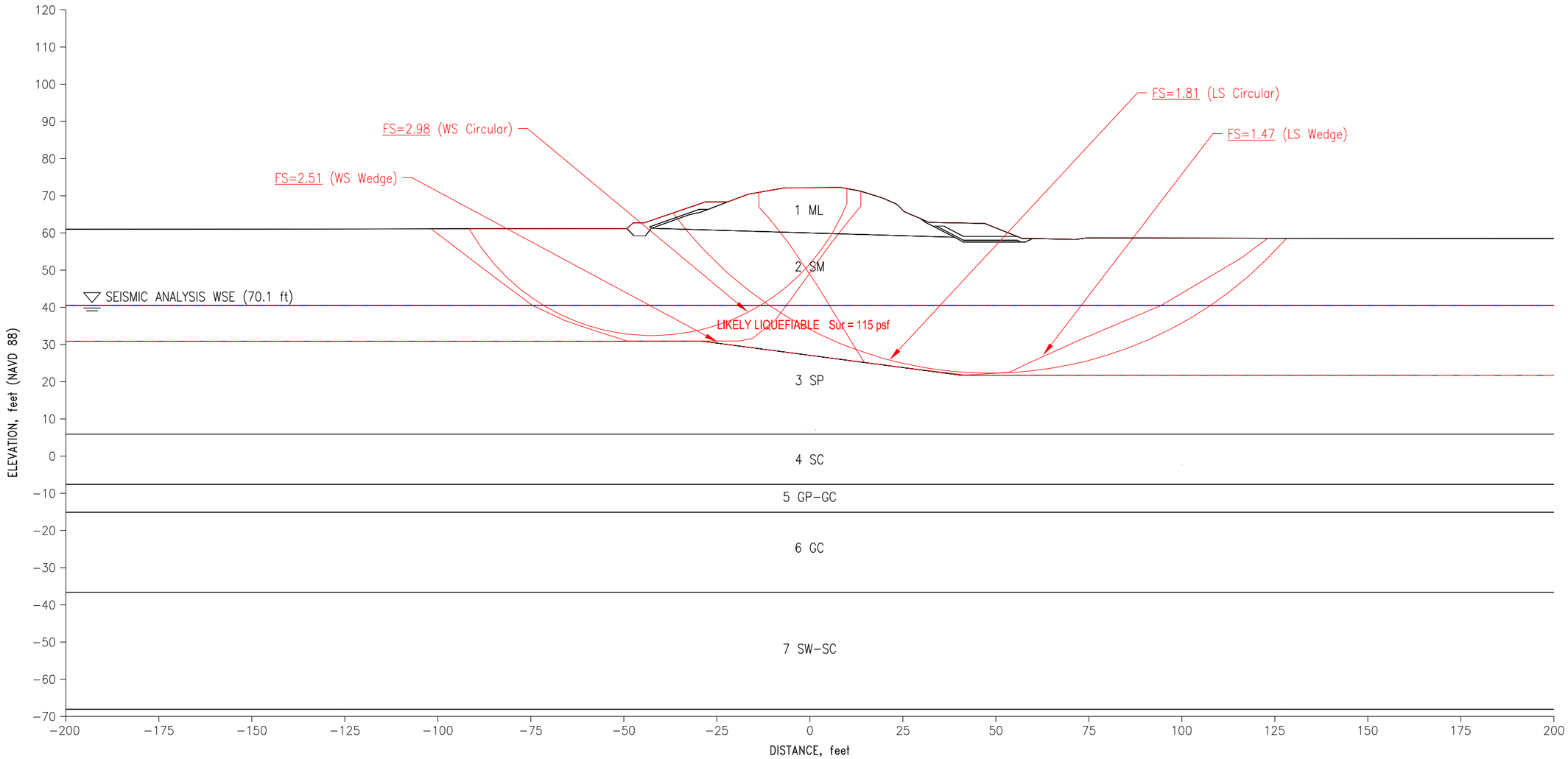
PLOT BY: ERIK_AHJAH – Feb 23, 2015 – 10:47:59am
DRAWING: G:\Work\7418\Work\Zone\Feather Riv Meet GER\06 Seismic Vish\02 CAD\Drawings – Transverse Cross Sections\Segment 14_3992+99 Cross-Section (SSPTA 1825+94).dwg

STUDY AREA: Sutter Feather River
Segment 14



Note: $N_{1,60\text{-cs-Sur}}$ values based on Seed & Harder (1990)

Figure C-S14-2



Department of Water Resources
Division of Flood Management

URS

CONTRACT NUMBER	PREPARED BY
4600008101	B. Choy
TASK ORDER	CHECKED BY
U33	K. Kanagalingam

SUTTER FEATHER RIVER STUDY AREA
URBAN LEVEE EVALUATIONS

POST SEISMIC STABILITY ANALYSIS RESULTS
DRAINED STABILITY BERM
SEGMENT 14 - STATION 3992+99

FIGURE
C-S14-3

SOIL PROFILE

Waterside

Landside

ELEVATION - FEET (NAVD 88)

(5) Berm Fill
(6) Berm Drain
(7) Berm Filter

(5) ϕ' = 34°, c' = 0 psf
(6) ϕ' = 35°, c' = 0 psf
(7) ϕ' = 34°, c' = 0 psf

ML (1) Su/p' = 0.76

GP (1a) ϕ' = 36°, c' = 0 psf

SEISMIC ANALYSIS WSE (EL. 100.1 FT)

GW (3) ϕ' = 36°, c' = 0 psf

ML (2) Su/p' = 0.76

10'

5'

3'

130'

LIKELY LIQUEFIABLE Sur = 200 psf

GW (3) ϕ' = 36°, c' = 0 psf

CL (4) Su/p' = 0.25

WM0007_061S
GS Elev. 125.8 ft
Offset 400 ft South

WM0007_062B
GS Elev. 130.2 ft
Offset 70 ft North

WM0007_062S
GS Elev. 126.3 ft
Offset 79 ft North

SHA0027_004B
GS Elev. 169.8 ft
Offset 32 ft North

% Fines

N60(ASTM)

TD Elev. 85.19 ft

TD Elev. 40.58 ft

TD Elev. 46.34 ft

TD Elev. 71.82 ft

HORIZONTAL DISTANCE - FEET

SCALE IN FEET

0 15 30 60 90

Department of Water Resources
Division of Flood Management

in association with: URS / GEI Consultants

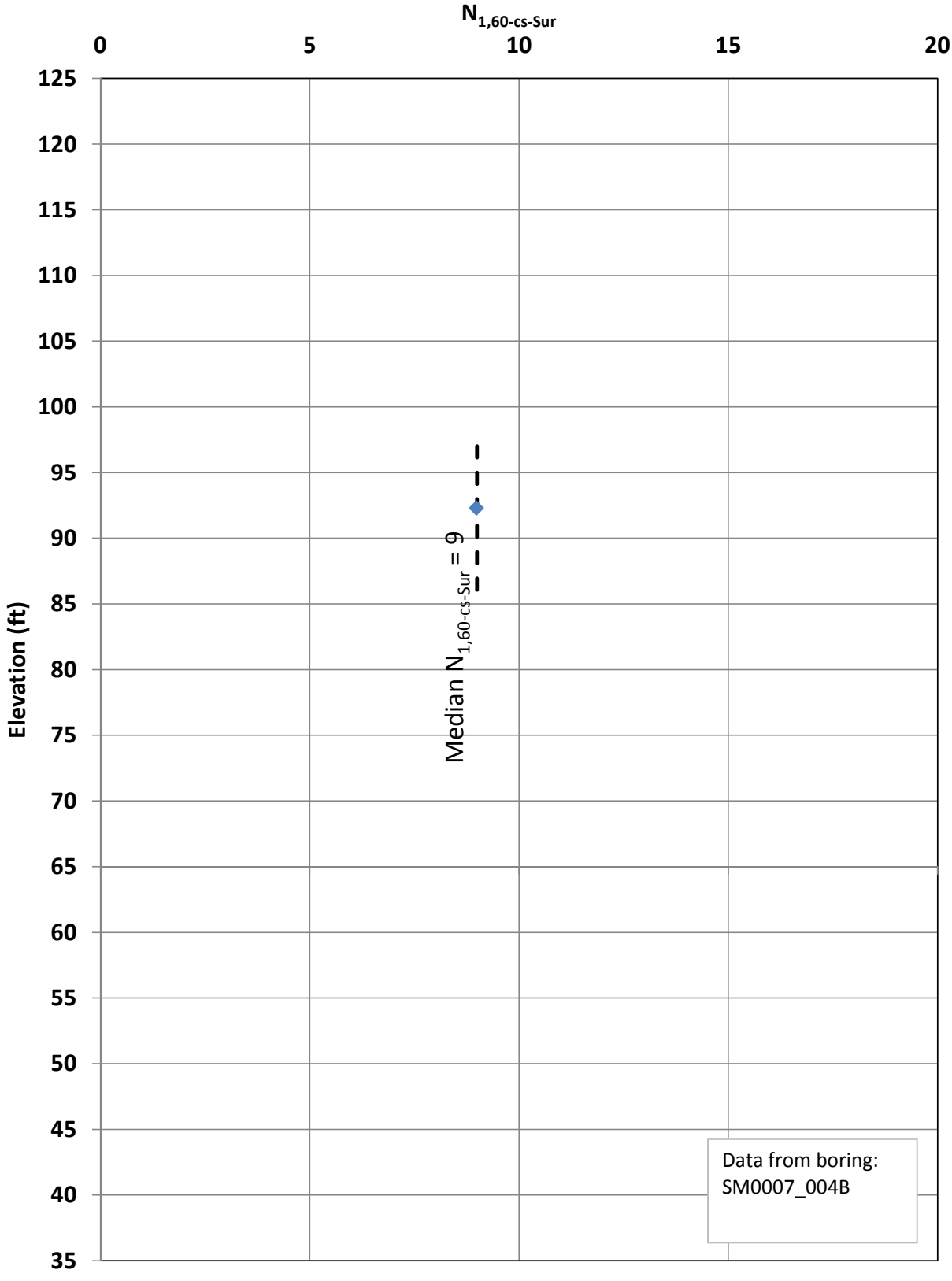
Analysis Section Station 4377+35
Segment 16
Combination Seepage-Stability Berm
Sutter Feather River Study Area

URBAN LEVEE EVALUATIONS

Figure C-S16-1

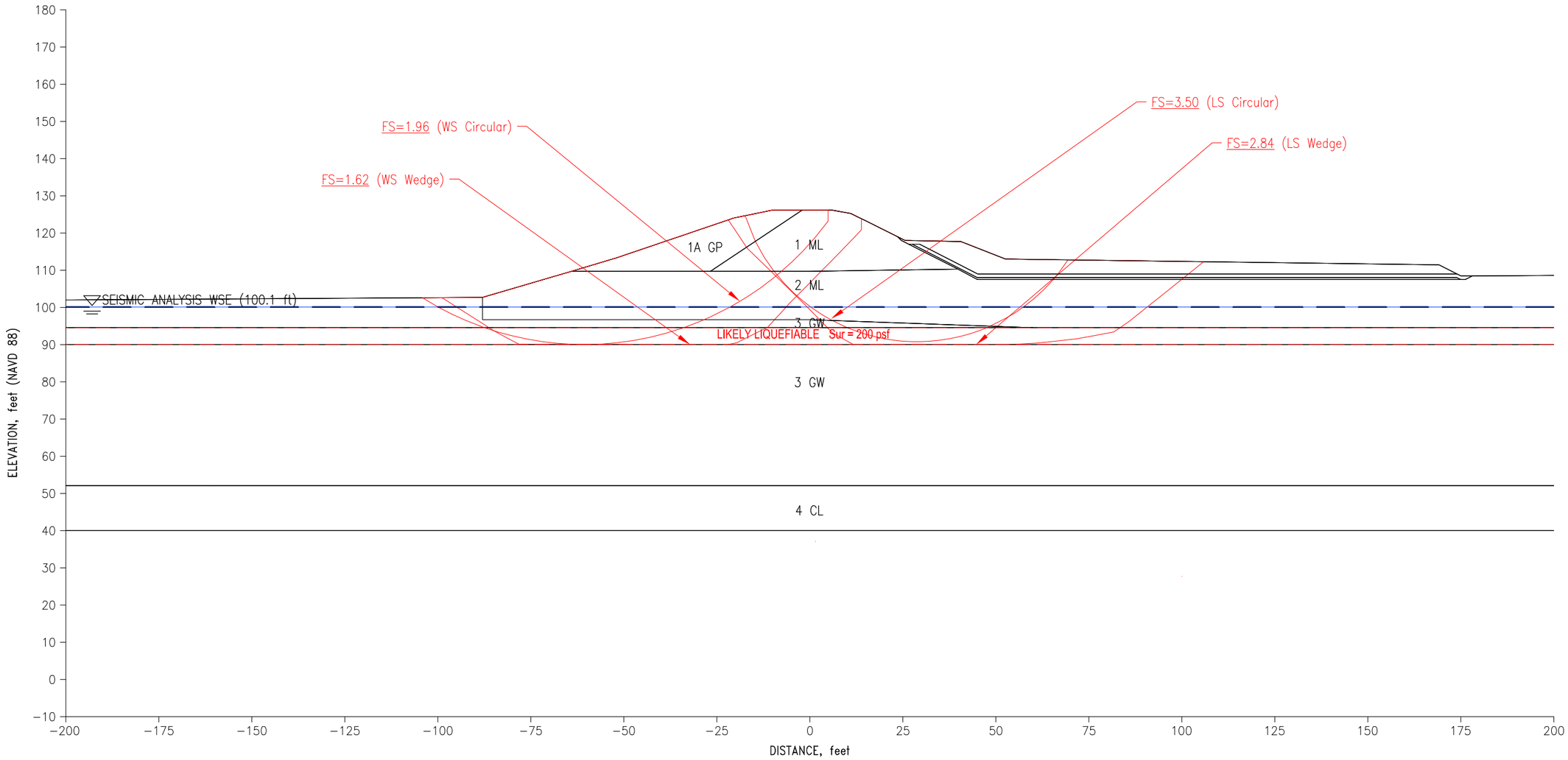
PLOT BY: EBK_AUM – Feb 23, 2015 – 10:50:43am
DRAWING: G:\UWR-7418\Work\Zone1\Feather Riv Meet GER\06 Seismic Vuln\02 CAD\Drawings – Transverse Cross Sections\Segment 16_4377+35 Cross-Section (SSPCA 12211+30).dwg

STUDY AREA: Sutter Feather River
Segment 16



Note: $N_{1,60\text{-}cs\text{-}Sur}$ values based on Seed & Harder (1990)

Figure C-S16-2



Department of Water Resources
Division of Flood Management

CONTRACT NUMBER 4600008101	PREPARED BY B. Choy
TASK ORDER U33	CHECKED BY K. Kanagalingam

SUTTER FEATHER RIVER STUDY AREA
URBAN LEVEE EVALUATIONS

POST SEISMIC STABILITY ANALYSIS RESULTS
COMBINATION SEEPAGE-STABILITY BERM
SEGMENT 16 - STATION 4377+35

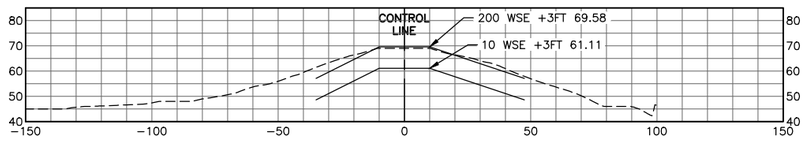
FIGURE
C-S16-3

PLOT BY: ERIK.JULIAN - Feb 23, 2015 - 11:17:50am
DRAWING: G:\DWR-7418\WorkZone\feather riv west ger\06 seismic vuln\02 CADD\drawings - seismic stab results\01 Seismic Figures\C-S16-3 Segment 16 - Station 4377+35.dwg

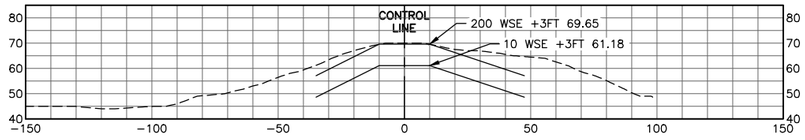
Appendix C - Levee Cross Sections along the FRWLP

This appendix provides cross sections of the Feather River West Levee depicting the existing as-built levee cross sections, the projected/required 200-year ULDC levee cross section, and the projected 10-year levee cross section. These cross sections illustrate the relative sizes of the levee sections needed to meet different levels of protection, and the fact that the 10-year levee cross section is typically less than half the height as the 200-year cross section. These cross sections were used in evaluating the repairs needed to restore 10-year and 200-year cross sections following a 200-year earthquake.

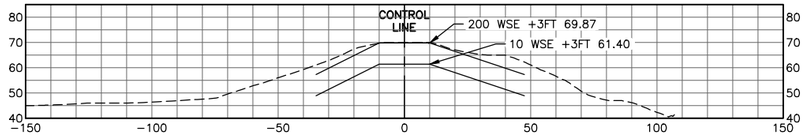
539+30



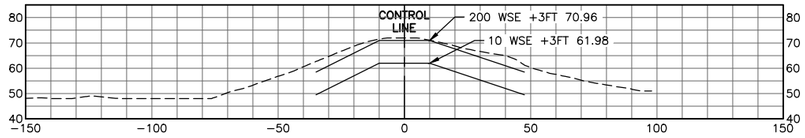
545+50



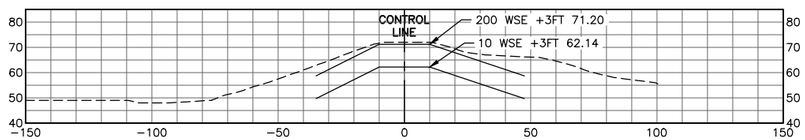
565+50



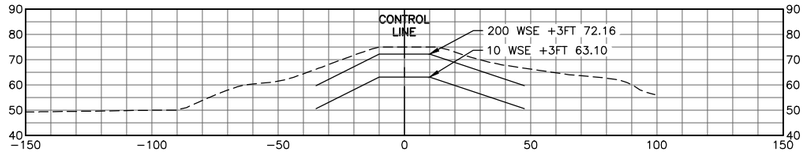
623+86



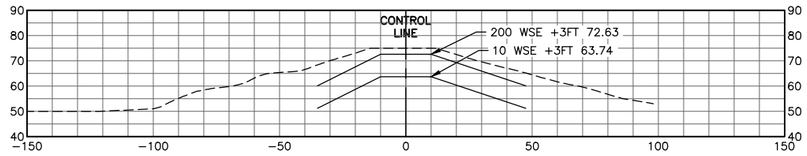
636+00



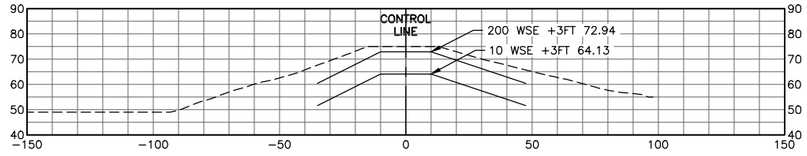
683+00



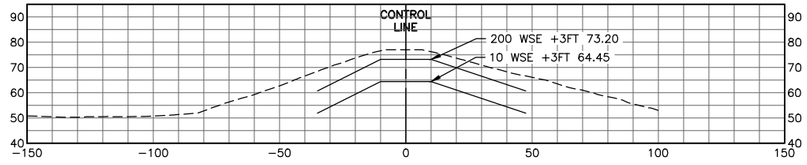
705+84



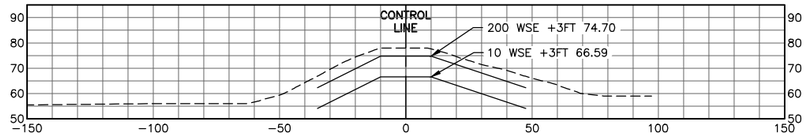
721+00



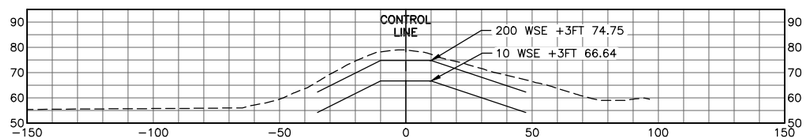
733+84



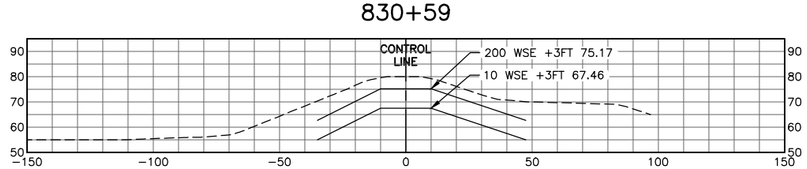
808+85



810+00



830+59



NOTES:

1. WATERSIDE IS TO THE RIGHT (POSITIVE HORIZONTAL DIRECTION) AND LANDSIDE IS TO THE LEFT (NEGATIVE HORIZONTAL DIRECTION).
2. THE LEVEE TEMPLATES SHOW INCLUDES A 20–FOOT WIDE CROWN WIDTH, 3:1 WATERSIDE SLOPES AND 2:1 LANDSIDE SLOPES.
3. ELEVATION DATUM IS NAV88.
4. FOR ILLUSTRATION PURPOSE ONLY. NOT FOR DESIGN.

30 15 0 30 60

HORIZ AND VERT SCALE: 1"=30'

REV.	DATE	BY	CHK.	APPR.	DESCRIPTION

REV.	DATE	BY	CHK.	APPR.	DESCRIPTION

DESIGNED BY: C. KRIVANEC
DRAWN BY: A. JACKSON
IN CHARGE:
PROJECT MANAGER: D. JABBOUR
DATE: 8/14/2020

SUBMITTED

APPROVED

SUTTER BUTTE FLOOD CONTROL AGENCY

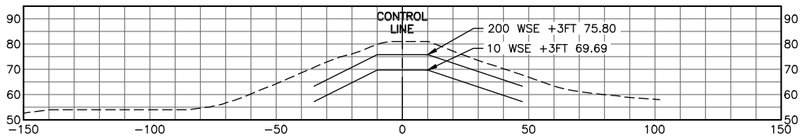
EXISTING LEVEE GEOMETRY AND 200–YEAR AND 10–YEAR LEVEE TEMPLATES
LEVEE CROSS SECTIONS
STA 539+30 TO 830+59

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING, ADJUST SCALES FOR REDUCED PLOTS
0 1"

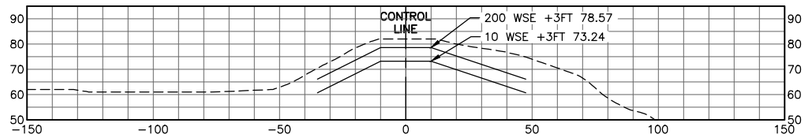
DRAWING NO. XS01

SHEET

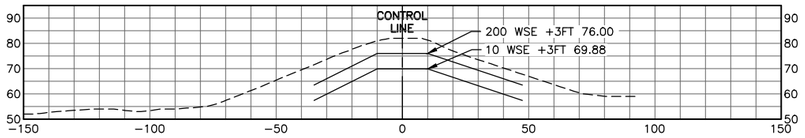
861+33



997+00



871+00



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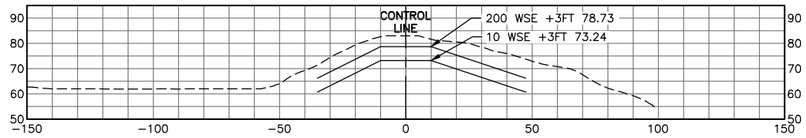
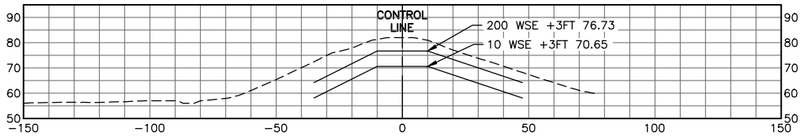
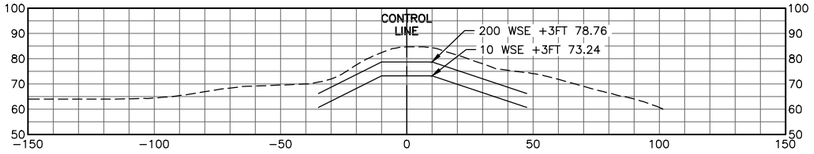


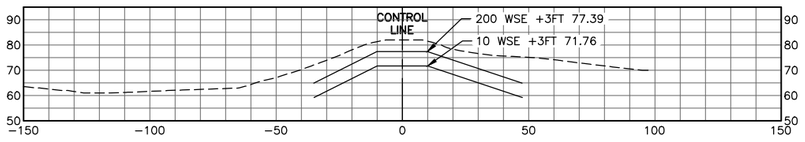
907+00



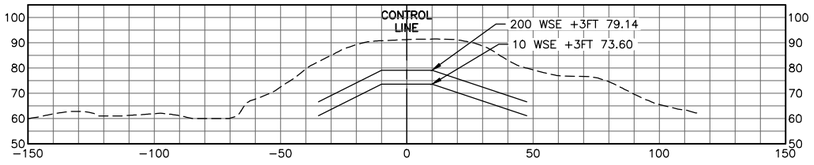
1006+20



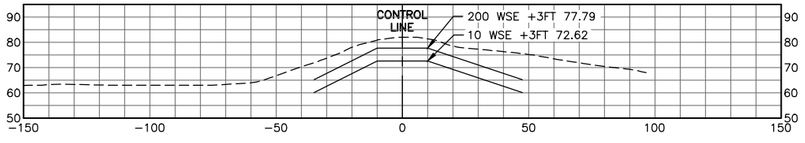
939+33



1025+00



958+83



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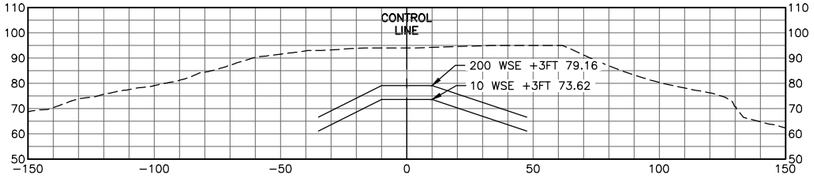
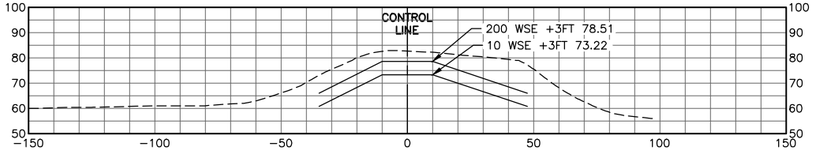
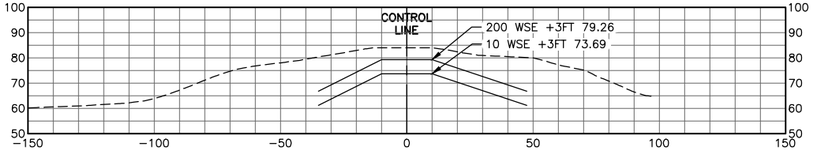


993+80



1031+00



NOTES:

1. WATERSIDE IS TO THE RIGHT (POSITIVE HORIZONTAL DIRECTION) AND LANDSIDE IS TO THE LEFT (NEGATIVE HORIZONTAL DIRECTION).
2. THE LEVEE TEMPLATES SHOW INCLUDES A 20–FOOT WIDE CROWN WIDTH, 3:1 WATERSIDE SLOPES AND 2:1 LANDSIDE SLOPES.
3. ELEVATION DATUM IS NAV88.
4. FOR ILLUSTRATION PURPOSE ONLY. NOT FOR DESIGN.

30 15 0 30 60

HORIZ AND VERT SCALE: 1"=30'

REV.	DATE	BY	CHK.	APPR.	DESCRIPTION

REV.	DATE	BY	CHK.	APPR.	DESCRIPTION

DESIGNED BY: C. KRIVANEC
DRAWN BY: A. JACKSON
IN CHARGE:
PROJECT MANAGER: D. JABBOUR
DATE: 8/14/2020

SUBMITTED

APPROVED

SUTTER BUTTE FLOOD CONTROL AGENCY

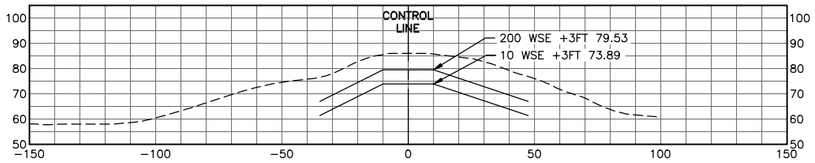
EXISTING LEVEE GEOMETRY AND 200–YEAR AND 10–YEAR LEVEE TEMPLATES
LEVEE CROSS SECTIONS
STA 861+33 TO 1031+00

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING, ADJUST SCALES FOR REDUCED PLOTS
0 1"

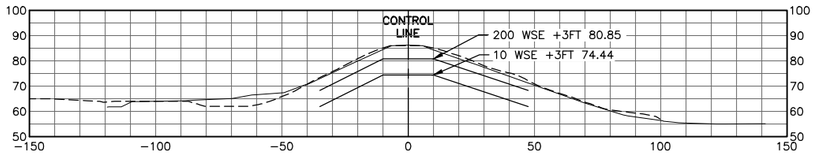
DRAWING NO. XS02

SHEET

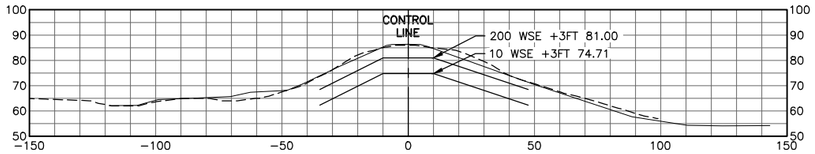
1043+88



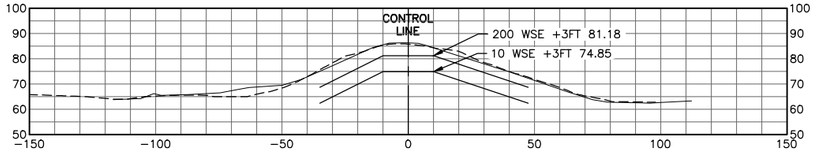
1108+86



1116+00



1125+00



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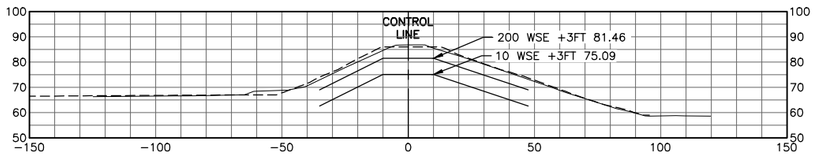

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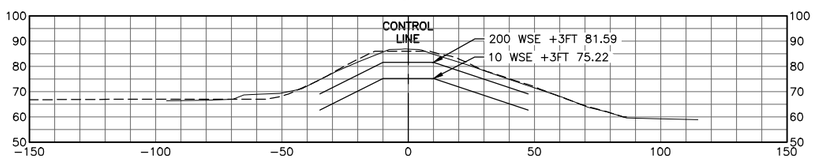

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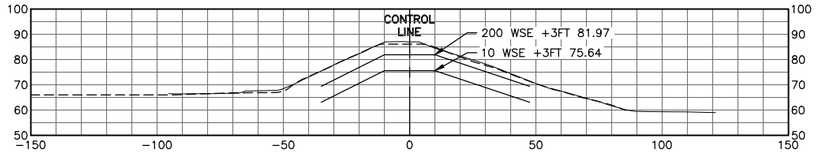

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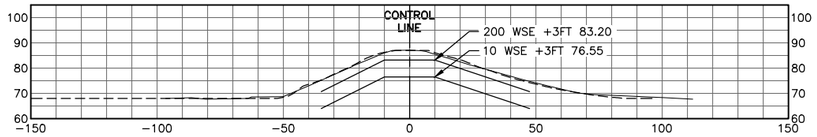

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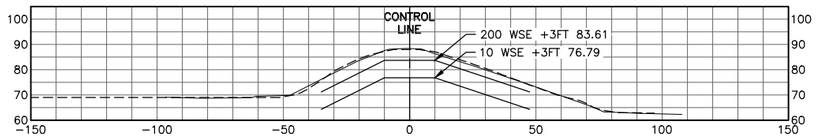

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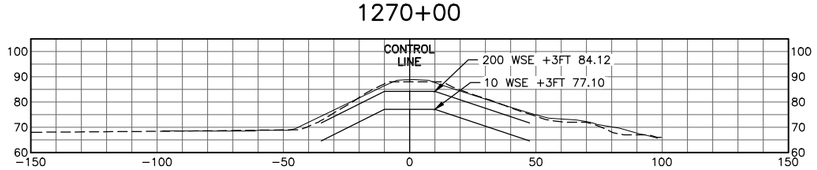

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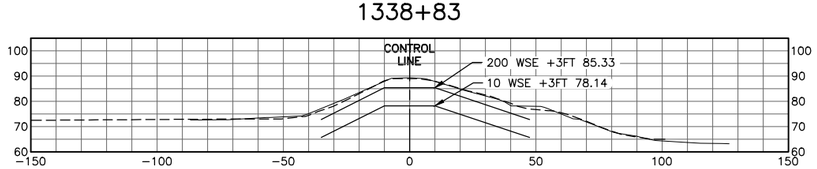

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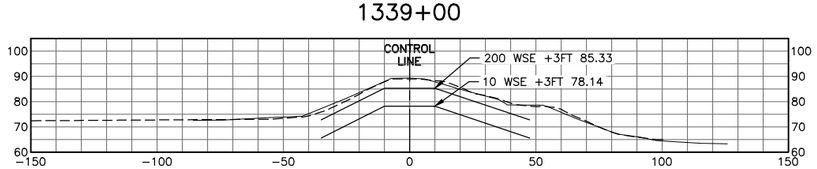

NOTES:

1. WATERSIDE IS TO THE RIGHT (POSITIVE HORIZONTAL DIRECTION) AND LANDSIDE IS TO THE LEFT (NEGATIVE HORIZONTAL DIRECTION).
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3. ELEVATION DATUM IS NAV88.
4. FOR ILLUSTRATION PURPOSE ONLY. NOT FOR DESIGN.

30 15 0 30 60

HORIZ AND VERT SCALE: 1"=30'

REV.	DATE	BY	CHK.	APPR.	DESCRIPTION

REV.	DATE	BY	CHK.	APPR.	DESCRIPTION

DESIGNED BY: C. KRIVANEC
DRAWN BY: A. JACKSON
IN CHARGE:
PROJECT MANAGER: D. JABBOUR
DATE: 8/14/2020

SUBMITTED | APPROVED

SUTTER BUTTE FLOOD CONTROL AGENCY

EXISTING LEVEE GEOMETRY AND 200–YEAR AND 10–YEAR LEVEE TEMPLATES
LEVEE CROSS SECTIONS
STA 1043+88 TO 1339+00

VERIFY SCALES
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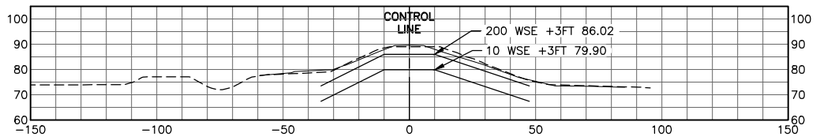
0 1"

DRAWING NO. XS03 | SHEET

1378+83



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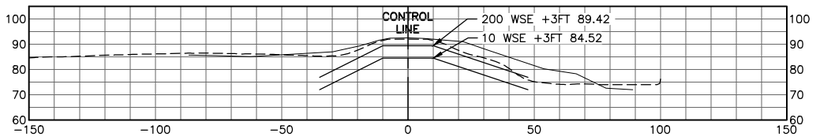

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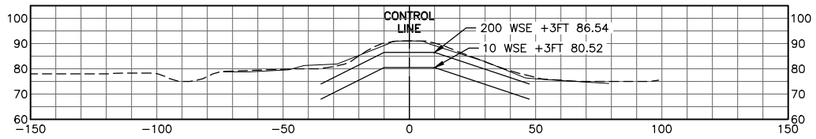

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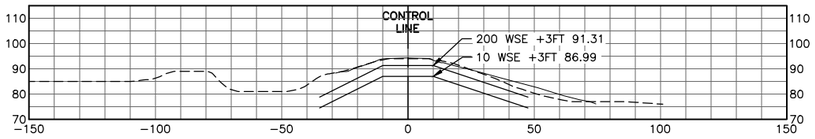

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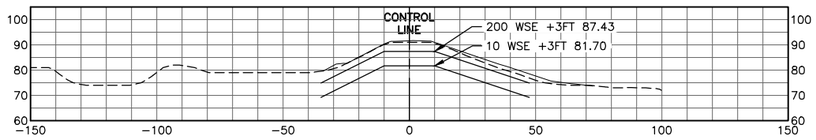

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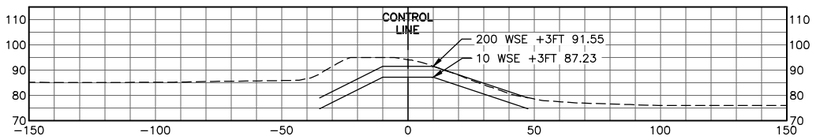

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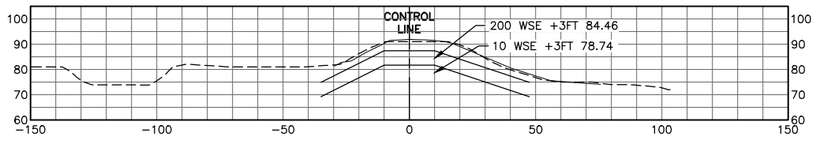

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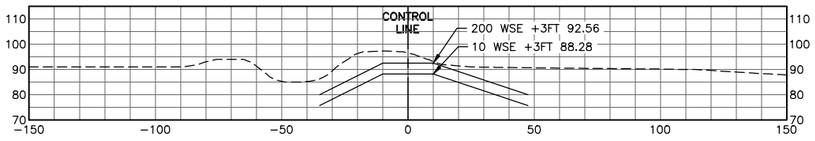

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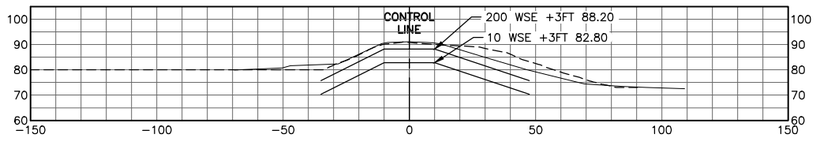

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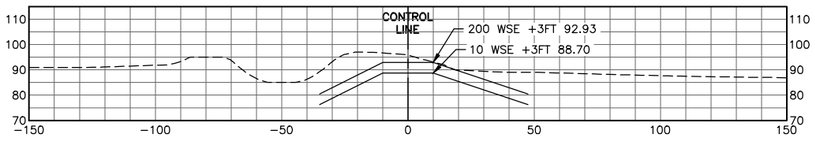

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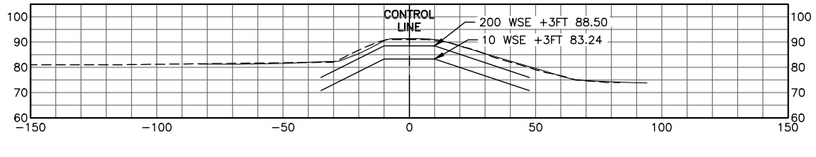

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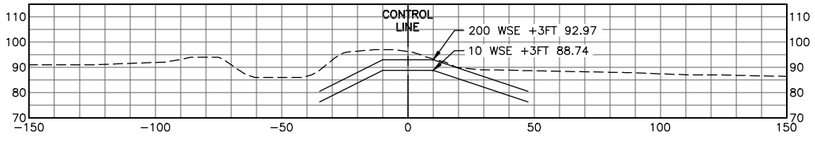

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30 15 0 30 60

HORIZ AND VERT SCALE: 1"=30'

REV.	DATE	BY	CHK.	APPR.	DESCRIPTION

REV.	DATE	BY	CHK.	APPR.	DESCRIPTION

DESIGNED BY: C. KRIVANEC
DRAWN BY: A. JACKSON
IN CHARGE:
PROJECT MANAGER: D. JABBOUR
DATE: 8/14/2020

SUBMITTED

APPROVED

SUTTER BUTTE FLOOD CONTROL AGENCY

EXISTING LEVEE GEOMETRY AND 200–YEAR AND 10–YEAR LEVEE TEMPLATES
LEVEE CROSS SECTIONS
STA 1378+83 TO 1710+00

VERIFY SCALES
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DRAWING NO. XS04

SHEET

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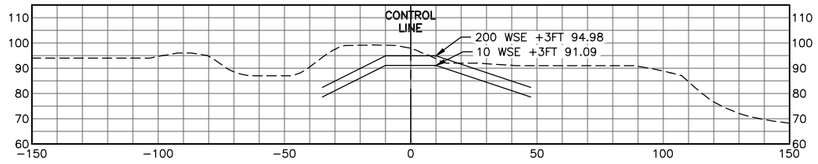

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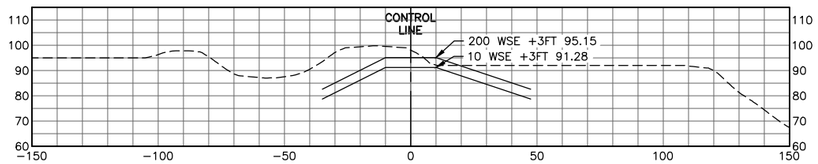

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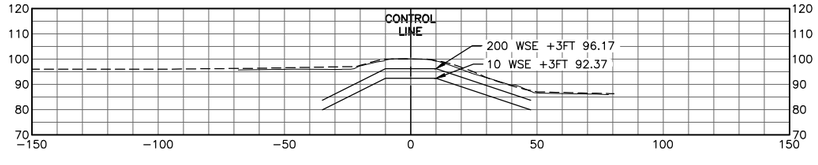

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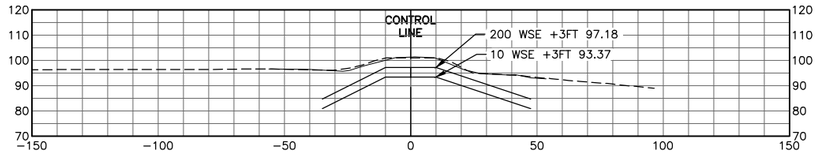

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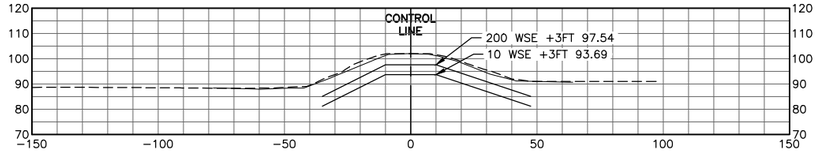

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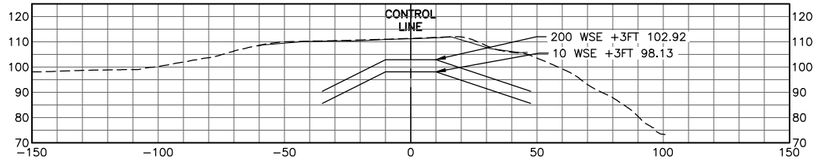

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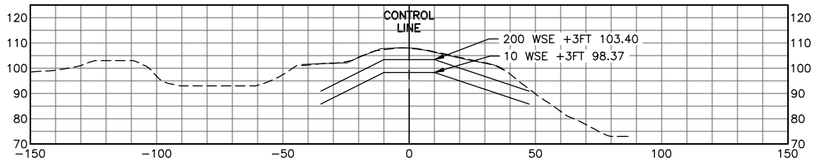

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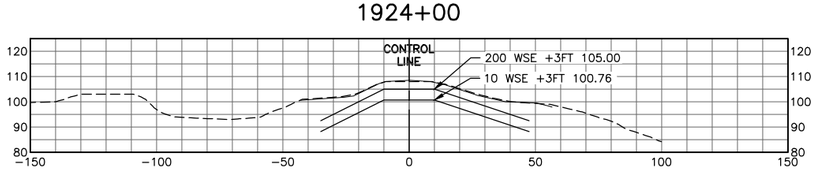

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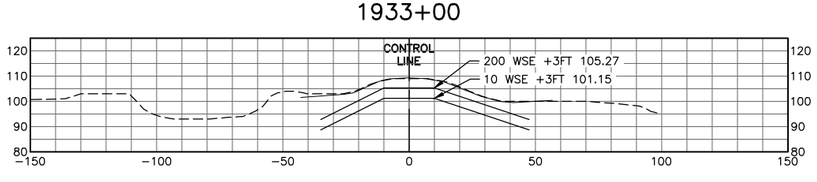

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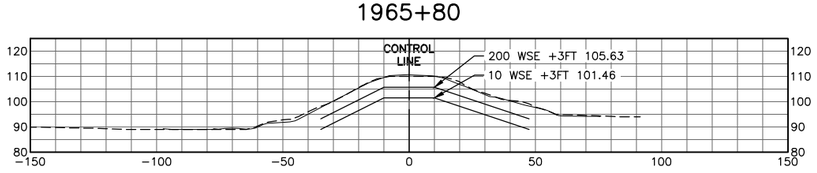

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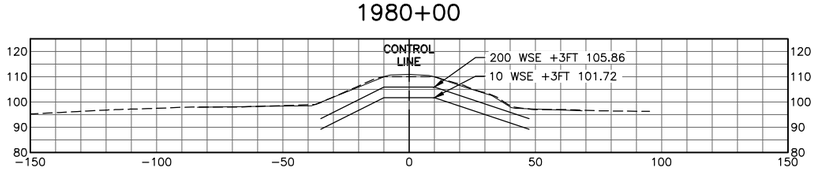

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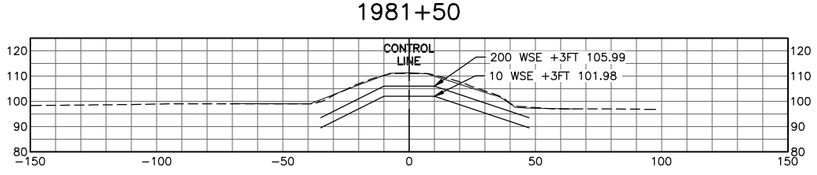

NOTES:

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30 15 0 30 60

HORIZ AND VERT SCALE: 1"=30'

REV.	DATE	BY	CHK.	APPR.	DESCRIPTION

REV.	DATE	BY	CHK.	APPR.	DESCRIPTION

DESIGNED BY: C. KRIVANEC
DRAWN BY: A. JACKSON
IN CHARGE:
PROJECT MANAGER: D. JABBOUR
DATE: 8/14/2020

SUBMITTED

APPROVED

SUTTER BUTTE FLOOD CONTROL AGENCY

EXISTING LEVEE GEOMETRY AND 200–YEAR AND 10–YEAR LEVEE TEMPLATES
LEVEE CROSS SECTIONS
STA 1760+87 TO 1981+50

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING. ADJUST SCALES FOR REDUCED PLOTS
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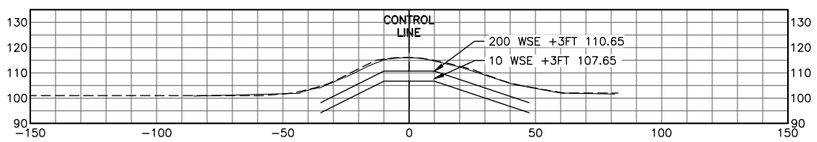
DRAWING NO. XS05

SHEET

2047+00



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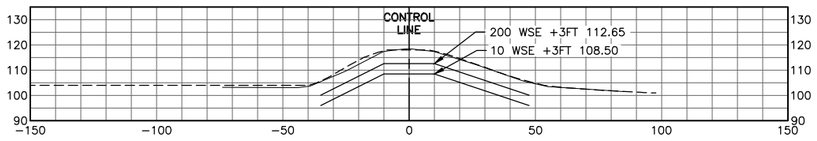

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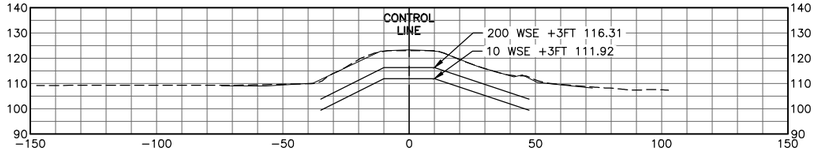

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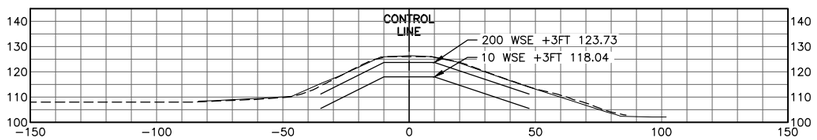

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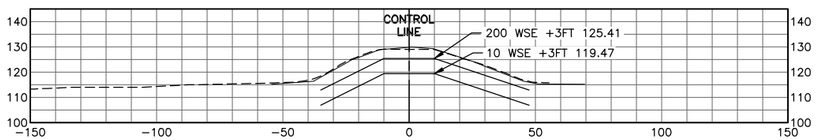

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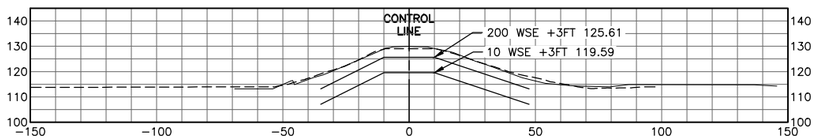

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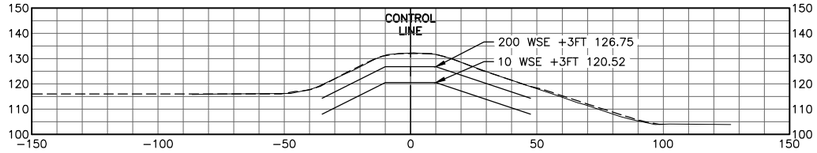

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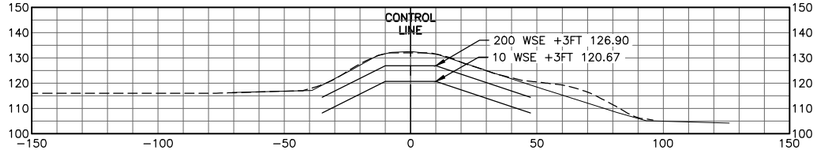

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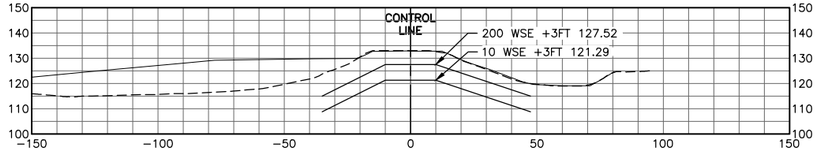

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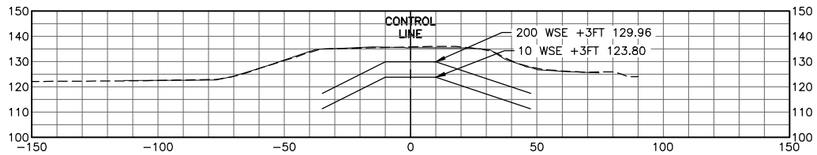

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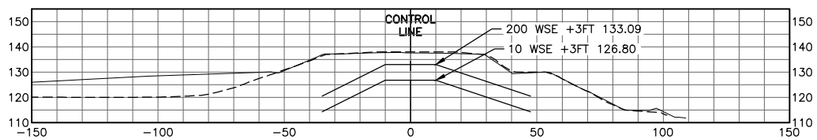

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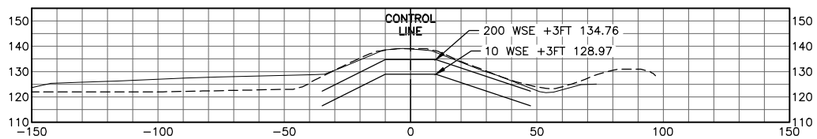

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30 15 0 30 60

HORIZ AND VERT SCALE: 1"=30'

REV.	DATE	BY	CHK.	APPR.	DESCRIPTION

REV.	DATE	BY	CHK.	APPR.	DESCRIPTION

DESIGNED BY: C. KRIVANEC
DRAWN BY: A. JACKSON
IN CHARGE:
PROJECT MANAGER: D. JABBOUR
DATE: 8/14/2020

SUBMITTED

APPROVED

SUTTER BUTTE FLOOD CONTROL AGENCY

EXISTING LEVEE GEOMETRY AND 200–YEAR AND 10–YEAR LEVEE TEMPLATES
LEVEE CROSS SECTIONS
STA 1698+85 TO 1902+00

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING. ADJUST SCALES FOR REDUCED PLOTS
0 1"

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SHEET

Appendix D - Table Summarizing both Previous and Current Damage Level Estimates for the FRWLP Levees

This appendix consists of an Excel spreadsheet summary table summarizing the results of the previous 2012 (Appendix A) and 2015 (Appendix B) post-earthquake levee evaluations together with the estimated seismic damage levels developed in the current seismic vulnerability assessment (see Table 4 in main text for criteria). It also includes the estimated percentages of each of the four different damage levels used in the current assessment (i.e. *None to Minor*, *Moderate to Major*, *Severe*, and *Compromised*) that might occur within each levee reach. These percentages were developed using the results of previous analyses together with qualitative evaluations of the geotechnical conditions along each levee reach/subreach. The table also provides summaries of the geotechnical conditions beneath the levees to help justify the different percentage of each damage level estimated. A summary version of this table is presented as Table 7 in the main text.

Table D1 - Summary of Previous and Current Damage Level Estimates for the FRWLP Levees (Estimated Percentage)

Reach #	Station From	Station To	Length (ft)	Typical Levee Height in Reach (ft)	Minimum Height in Reach (ft)	Maximum Height in Reach (ft)	Average Height Above 10 Year WSE + 3 Feet Freeboard (ft)	2012 FRWL GDRR Seismic Cross Section and Analysis Results	Adjusted Levee Height (ft)	2012 FRWL GDRR Seismic Classification	2015 ULE GER Equivalent Seismic Segment	2015 ULE GER Seismic Cross Section and Analysis Results	Adjusted Levee Height (ft)	2015 FRWL ULE Seismic Classification	Assumed Seismic* Profile for Estimating Vertical Displcement (ft)	2020 Seismic Vulnerability Classification Percentage of Reach Affected (%)				Reasoning for Current Revised Assessment of Potential Damage Levels
																Compromised (NCS >5%)	Severe (NCS 1.5 to 5%)	Moderate - Major (NCS0.2 to 1.5%)	None - Minor (NCS < 0.2%)	
7a	510.37	526	1563	22 to 25	22	25	9.0	Not Analysed - judged based on subsurface soil conditions (thin no to low plasticity soils)	NA	Possibly Compromised	7	NA	NA	High based on post seimsic analysis results at Station 539+15	54	0	0	0	100	Generally moderately dense to dense clayey foundation at least 60 feet below levee.
7b	526	599	7300	22 to 26	22	26	8.7	Up to 25 feet thick liquefiable zone. Minimum pseudo-static FOS less than 1 for analysis at Station 539+30 and vertical displacemnt of 4.5 feet.	58	Likely Compromised	7 and 8	Minimum Post Seismic FOS of 0.96 on waterside at Station 539+15	53	High to Station 545+80 based on post seimsic analysis results at Station 539+16 Low upstream of Station 539+16	58	0	30	20	50	Foundation sand layers range from moderately loose to dense. SPT blowcounts between Stations 549 and 599 generally indicate denser sands. Analyses for relatively loose sand at Station 539 indicate marginal stability: FS = 1.04 (URS, 2012) and 0.96 (URS, 2015a). Vertical displacement of 2.7 feet and NCS of 4.7% calculated by (URS, 2012)
8	599	655	5600	24 to 25	24	25	10.0	Up to 25 feet thick liquefiable zone. Post earthquake F.S. of 0.95 @ Station 623+86.	84	Compromised	8	NA	NA	Low Assessed as generally non-liquefiable	84	0	20	30	50	Foundation sand layers range from moderately loose to dense. URS (2015a) found this subreach to be generally non-liquefiable. However, the URS (2012) analysis found marginal post-earthquake stability: FS = 0.95 for Station 623+86 model.
9a	655	674	1900	22 to 27	22	27	11.9	Not Analyzed - judged based on subsurface soil conditions (up to 25 feet thick liquefiable zone) and analysis results at St. 623+86.	NA	Compromised	8	NA	NA	Low Assessed as generally non-liquefiable	54	0	0	20	80	Foundation layers mostly composed of moderately dense silt layers with occaisonal thin sand layers. URS (2015a) found this subreach to be non-liquefiable.
9b	674	695	2100	24 to 26	24	26	12.8	Up to 10 feet thick liquefiable zone. Minimum pseudo-static FOS less than 1 for analysis at Station 683+00 and vertical displacemnt of 0.6 feet.	73	Probably Uncompromised	8	NA	NA	Low Assessed as generally non-liquefiable	73	0	0	20	80	Foundation layers mostly composed of moderately dense silt layers with occiaonal thin sand layers. URS (2015a) found this subreach to be generally non-liquefiable. However, based on the URS (2012) analysis for the Station 683+00 model, thin sand layers could liquefy and potential NCS values could be as high as 1.1 percent.
9c	695	707	1200	25 to 26	25	26	12.4	Not Analysed -Up to 10 feet thick liquefiable zone. 0.6 feet vertical displacement based on analysis at Station 683+00 Model	NA	Possibly Compromised	8	NA	NA	Low Assessed as generally non-liquefiable	54	0	0	20	80	Foundation layers mostly composed of moderately dense silt and clay layers with occiaonal thin sand layers. URS (2015a) found this subreach to be generally non-liquefiable. However, based on the URS (2012) analysis for the Station 683+00 model, thin sand layers could liquefy and potential NCS values could be as high as 1.1 percent.
10a	707	722	1500	25 to 28	25	28	12.0	Not Analysed - Up to 10 feet thick liquefiable zone. 0.6 feet vertical displacement based on analysis at Station 683+00 Model	NA	Possibly Compromised	8 and 9	NA	NA	Low Assessed as generally non-liquefiable	54	0	0	10	90	Foundation layers include 25-foot-thick dense sand and gravel layer beneath a 25-30-foot-thick clay blanket.URS (2015a) found this subreach to be generally non-liquefiable.
10b	722	754	3200	26 to 28	26	28	12.5	Up to 15 feet liquefiale zone. Flow slide/unstable based on analysis at Station 733+84 with marginal post-earthquake F.S = 0.97	61	Compromised	9 and 10	Minimum Post Seismic FOS of 0.85 on waterside at Station 733+69	58	High to Station 745+30 based on post seimsic analysis results at Station 733+69 Low upstream of Station 745+30	61	5	15	20	60	Foundation layers mostly moderately dense to dense silt, clay, and silty sand layers, some relatively clean sand layers with low SPT blowcounts. URS (2012) calculated marginal post-earthquake F.S. = 0.97 for Station 733+84 model; URS (2015a) calculated F.S. = 0.85 for same location.
10c	754	774	2000	27 to 28	27	28	12.5	Not Analysed - judged based on subsurface soil conditions (up to 15 feet liquefiable zone)	NA	Possibly Compromised	10	NA	NA	Low Assessed as non-liquefiable	54	0	0	10	90	Foundation layers mostly moderately dense to dense silt, clay, and silty sand layers, some relatively clean sand layers. URS (2015a) found this subreach to be non-liquefiable.
11	774	831	5700	23 to 25	23	25	12.1	Not Analysed - judged based on subsurface soil conditions (up to 15 feet liquefiable zone)	NA	Possibly Compromised	10	NA	NA	Low Assessed as non-liquefiable	54	0	10	40	50	Foundation layers consist of moderately dense to dense silts and clays with thin to thick layers of SP-SM which range from moderately loose to dense. URS (2015a) found this subreach to be non-liquefiable.
12	831	845	1400	23 to 26	23	26	12.8	Not Analysed - judged based on subsurface soil conditions (up to 30 feet liquefiable zone)	NA	Possibly Compromised	11A	NA	NA	High based on post seimsic analysis results at Station 870+75	54	10	10	30	50	Foundation layers consist of moderately dense to dense silts and clays with thin to thick layers of SP-SM which range from loose to dense. High seismic vulnerability based on post seismic FOS at St 870+75 (URS, 2015a), which is similar to conditions at St 843+00.
13	845	927	8200	22 to 28	22	28	11.2	Liquefiable zone up to 30 feet thick. Flow slide/unstable in some areas based on analysis at Station 871+00 with post-earthquake F.S = 0.77.	50	Compromised	11A, 11B and 11C	Minimum Post Seismic FOS of 0.78 on waterside at Station 870+85 for Segment 11A and FOS of 2.42 on the landside for modified layering to represent Segment 11B.	62	High to station 878+00 and upstream of 906+80 based on post seimsic analysis results at Station 870+76 Low between Station 878+00 and 906+80 based on adjusted post seismic analysis results at Station 870+85	62	25	25	25	25	Foundatiion layers consist of moderately dense to dense silt, clay, and silty sand layers, several thin and thick SP and SP-SM layers with low SPT blowcounts. URS (2012) calculated low post-earthquake F.S. = 0.77 for Station 871+00 model; URS (2015a) calculated F.S. = 0.78 for for same location. URS (2015a) found Segment 11B (Station 878 to 907) to be Low seismic vulnerability based on post seismic FOS of 2.42.
14	927	954	2700	19 to 22	19	22	10.2	Not Analysed - up to 20 feet liquefiable zone. Potential flow slide/unstable in some areas based on analysis at Stations 871+00 and 958+83 with post eartquake F.S. =<0.77.	NA	Compromised	11C	NA	NA	High based on post seimsic analysis results at Station 870+76 in Segment 11C	54	40	25	25	10	Foundation layering and materials similar to Reach 13. Subsurface conditions at Stations 940+00, 949+00, 953+50 and 955+00 have conditions similar to that analyzed at Station 870+85 in Reach 13 with a FOS of 0.78 (URS, 2015a).
15	954	968	1400	18 to 19	18	19	9.4	Up to 30 feet thick liquefiable zone. Potential flow slide/unstable in some areas based on analysis at Station 958+83 with post eartquake F.S. = 0.54.	68	Compromised	11C	NA	NA	High based on post seimsic analysis results at Station 870+76 in Segment 11C	68	25	25	25	25	Foundation layering and materials similar to Reach 13.
16a	968	993	2500	14 to 20	14	20	9.3	Not Analysed - up to 10 feet liquefiable zone. Potential flow slide/unstable in some areas based on analysis at Station 958+83 with post eartquake F.S. = 0.54.	NA	Compromised	11C	NA	NA	High based on post seimsic analysis results at Station 870+76 in Segment 11C	54	0	20	30	50	Foundation layers consist mostly of moderately dense to dense silts, clays, and silty sands. CPT soundings indicate relatively thin sand layers in places with low penetration resistance. Thick, loose sand layers are not present in this reach based on subsurface data.
16b	993	1080	8700	20 to 31	20	31	13.7	Not Analysed - judged based on subsurface soil conditions (up to 10 feet thick liquefiable zone).	NA	Possibly Compromised	11C and 12	NA	NA	High to Station 996+80 based on post seimsic analysis results at Station 870+76 in Segment 11C Low upstream of 996+80 as generally non-liquefiable	54	0	10	20	70	Foundation layers consist mostly of moderately dense to dense silts, clays, silty sands, and clean sands. CPT soundings indicate relatively thin sand layers in places with low penetration resistance, and a thick sand layer at Station 1007 with relatively low penetration resistance. URS (2015a) indicated that this reach was generally non-liquefiable with 'Low' seismic vulnerability.

Table D1 - Summary of Previous and Current Damage Level Estimates for the FRWLP Levees (Estimated Percentage)

Reach #	Station From	Station To	Length (ft)	Typical Levee Height in Reach (ft)	Minimum Height in Reach (ft)	Maximum Height in Reach (ft)	Average Height Above 10 Year WSE + 3 Feet Freeboard (ft)	2012 FRWL GDRR Seismic Cross Section and Analysis Results	Adjusted Levee Height (ft)	2012 FRWL GDRR Seismic Classification	2015 ULE GER Equivalent Seismic Segment	2015 ULE GER Seismic Cross Section and Analysis Results	Adjusted Levee Height (ft)	2015 FRWL ULE Seismic Classification	Assumed Seismic* Profile for Estimating Vertical Displacement (ft)	2020 Seismic Vulnerability Classification Percentage of Reach Affected (%)				Reasoning for Current Revised Assessment of Potential Damage Levels
																Compromised (NCS >5%)	Severe (NCS 1.5 to 5%)	Moderate - Major (NCS0.2 to 1.5%)	None - Minor (NCS < 0.2%)	
17	1080	1130.86	5086	20 to 26	20	26	11.5	Liquefiable zone up to 40 feet thick. Minimum pseudo-static FOS less than 1 for analysis at Station 1116+00 and vertical displacemnt of 1.1 feet.	55	Possibly Compromised	12	NA	NA	Low Assessed as generally non-liquefiable	55	0	10	10	80	Foundation layers consist mostly of moderately dense to dense silts, clays, silty sands, and clean sands. CPT soundings indicate occaisonal thin sand layers in places with low penetration resistance. SPT blowcounts relatively low in silty sand and sandy silt at Station 1116+00 analysis location. URS (2015a) indicated that this reach was generally non-liquefiable with 'Low' seismic vulnerability.
18a	1130.86	1136	514	14 to 22	14	22	11.0	Not Analysed - judged based on subsurface soil conditions (up to 15 feet thick liquefiable zone). Vertical displacement of 1 feet based on analysis at Station 1116+00.	NA	Possibly Compromised	12	NA	NA	Low Assessed as generally non-liquefiable	54	0	0	30	70	Two borholes in this short reach indicate relatively low SPT resistance in shallow sand layers, but these layers appear to be above the groundwater level (shown as Elevation 44 in the Station 1116 model by URS; 2012). URS (2015a) indicated that his reach was generally non-liquefiably with 'Low' seismic vulnerability.
18b	1136	1170	3400	19 to 21	19	21	11.3	Not Analysed - judged based on subsurface soil conditions (up to 25 feet thick liquefiable zone). Vertical displacement of 7 feet based on analysis at Station 1224+00.	NA	Likely Compromised	12	NA	NA	Low Assessed as generally non-liquefiable	54	0	10	30	60	Foundation layers consist mostly of moderately dense to dense silts, clays, silty sands, and clean sands. CPT soundings indicate occaisonal sand layers in places with low penetration resistance. URS (2015a) indicated that this reach was generally non-liquefiable with 'Low' seismic vulnerability.
18c	1170	1213.85	4385	18 to 20	18	20	11.0	Not Analysed - judged based on subsurface soil conditions (up to 10 feet thick liquefiable zone). Vertical displacement of 1 feet based on analysis at Station 1116+00.	NA	Possibly Compromised	12	NA	NA	Low Assessed as generally non-liquefiable	54	0	15	25	60	Foundation layers consist mostly of moderately dense to dense silts, clays, silty sands, and sands. SPT blowcounts generally relatively high, some CPT soundings (e.g. Station1180 indicate moderately loose sand layers in upper portion of foundation). URS (2015a) indicated that this reach was generally non-liquefiable with 'Low' seismic vulnerability.
19a	1213.85	1245	3115	18 to 19	18	19	10.5	Liquefiable zone up to 30 feet thick. Minimum pseudo-static FOS less than 1 for analysis at Station 1224+00 and vertical displacemnt of 7 feet.	64	Likely Compromised	12	NA	NA	Low Assessed as generally non-liquefiable	64	5	15	20	60	Foundation layers consist mostly of moderately dense to dense silts, clays, silty sands, and sands. A few layers of silty sand and sand with moderately low penetration resistance. URS (2012) analysis for Station 1224+00 found post-earthquake F.S. = 1.17, but with up to 4 feet of settlement. URS (2015a) indicated that this reach was generally non-liquefiable with 'Low' seismic vulnerability.
19b	1245	1297.83	5283	18 to 20	18	20	10.9	Not Analysed - judged based on subsurface soil conditions (up to 15 feet thick liquefiable zone) and post earthquake F.S > 1 based on analysis at Station 1378+83.	NA	Probably Uncompromised	12	NA	NA	Low Assessed as generally non-liquefiable	54	0	0	10	90	Foundation layers appear to all be moderately dense to dense and not liquefiable. URS (2012) calculated high factors of safety for Station 1378+83 analysis model. URS (2015a) indicated that this reach was generally non-liquefiable with 'Low' seismic vulnerability.
20	1297.83	1374.33	7650	15 to 18	15	18	10.3	Not Analysed - judged based on subsurface soil conditions (no liquefiable zones) and post earthquake F.S >1 based on analysis at Station 1378+83.	NA	Probably Uncompromised	12	NA	NA	Low Assessed as generally non-liquefiable	54	0	0	20	80	Foundation layers appear to be generall moderately dense to dense and not liquefiable except for a few silty sand layers with moderately low penetration resistance. URS (2012) calculated high factors of safety for Station 1378+83 analysis model. URS (2015a) indicated that this reach was generally non-liquefiable with 'Low' seismic vulnerability.
21	1374.33	1433.83	5950	11	11	11	9.6	Liquefiable zone up to 15 feet thick. Minimum pseudo-static FOS greater than 1 for analysis at Station 1378+83	38	Probably Uncompromised	12 and 13	NA	NA	Low Assessed as generally non-liquefiable	38	0	0	30	70	Foundation layers appear to be generall moderately dense to dense and not liquefiable except for a few relatively clean sand layers at shallow depths - many of which appear to be above the groundwater level modeled at Elevation 55 feet in URS 2012 model at Station 1378+83. URS (2012) calculated high factors of safety for Station 1378+83 analysis model. URS (2015a) indicated that this reach was generally non-liquefiable with 'Low' seismic vulnerability.
22	1433.83	1503.83	7000	10 to 14	10	14	9.0	Not Analysed - judged based on subsurface soil conditions (up to 5 feet thick liquefiable zones) and post earthquake F.S >1 based on analysis at Station 1378+83 and 2047+50.	NA	Probably Uncompromised	13	NA	NA	Low Assessed as generally non-liquefiable	54	0	0	20	80	Foundation layers appear to be generall moderately dense to dense and not liquefiable except for a few relatively clean sand layers at shallow depths - many of which appear to be above the groundwater level modeled at Elevation 55 feet in URS 2012 model at Station 1378+83. URS (2012) calculated high factors of safety for Station 1378+83 analysis model. URS (2015a) indicated that this reach was generally non-liquefiable with 'Low' seismic vulnerability.
23	1503.83	1609.37	10554	7 to 10	7	10	7.3	Not Analysed - judged based on subsurface soil conditions (up to 5 feet thick liquefiable zones) and post earthquake F.S >1 based on analysis at Station 1378+83 and 2047+50.	NA	Probably Uncompromised	13	NA	NA	Low Assessed as generally non-liquefiable	54	0	0	10	90	Foundation layers appear to be generall moderately dense to dense and not liquefiable except for a few silty sand layers with moderately low penetration resistance. URS (2015a) indicated that this reach was generally non-liquefiable with 'Low' seismic vulnerability.
24	1609.37	1623.86	1449	7 to 10	7	10	7.2	Not Analysed - judged based on subsurface soil conditions (up to 5 feet thick liquefiable zones) and post earthquake F.S >1 based on analysis at Station 1378+83 and 2047+50.	NA	Probably Uncompromised	13	NA	NA	Low Assessed as generally non-liquefiable	54	0	0	5	95	Foundation layers generally appear to be relatively dense and not liquefiable. URS (2015a) indicated that this reach was generally non-liquefiable with 'Low' seismic vulnerability.
25	1623.86	1674.37	5051	6 to 10	6	10	7.2	Not Analysed - judged based on subsurface soil conditions (up to 5 feet thick liquefiable zones) and post earthquake F.S >1 based on analysis at Station 1378+83 and 2047+50.	NA	Probably Uncompromised	13	NA	NA	Low Assessed as generally non-liquefiable	54	0	0	5	95	Foundation layers generally appear to be relatively dense and not liquefiable. URS (2015a) indicated that this reach was generally non-liquefiable with 'Low' seismic vulnerability.
26	1674.37	1707.11	3274	6 to 8	6	8	7.9	Not Analysed - judged based on subsurface soil conditions (up to 5 feet thick liquefiable zones) and post earthquake F.S >1 based on analysis at Station 1378+83 and 2047+50.	NA	Probably Uncompromised	13	NA	NA	Low Assessed as generally non-liquefiable	54	NO WORK REACHES				NO WORK REACHES
27	1707.11	1721.6	1449	5 to 6	5	6	7.1	Not Analysed - judged based on subsurface soil conditions (no liquefiable zones).	NA	Probably Uncompromised	13	NA	NA	Low Assessed as generally non-liquefiable	54					
28	1721.6	1769.31	4771	4 to 6	4	6	7.0	Not Analysed - judged based on subsurface soil conditions (no liquefiable zones).	NA	Probably Uncompromised	13	NA	NA	Low Assessed as generally non-liquefiable	54					
29	1769.31	1813.33	4402	4 to 6	4	6	7.2	Not Analysed - judged based on subsurface soil conditions (up to 5 feet thick liquefiable zones) and post earthquake F.S >1 based on analysis at Station 2047+50.	NA	Probably Uncompromised	13	NA	NA	Low Assessed as generally non-liquefiable	54	0	0	5	95	Foundation layers generally clayey, moderately dense to dense and not liquefiable. URS (2015a) indicated that this reach was gnerally non-liquefiable with 'Low' seismic vulnerability.

Table D1 - Summary of Previous and Current Damage Level Estimates for the FRWLP Levees (Estimated Percentage)

Reach #	Station From	Station To	Length (ft)	Typical Levee Height in Reach (ft)	Minimum Height in Reach (ft)	Maximum Height in Reach (ft)	Average Height Above 10 Year WSE + 3 Feet Freeboard (ft)	2012 FRWL GDRR Seismic Cross Section and Analysis Results	Adjusted Levee Height (ft)	2012 FRWL GDRR Seismic Classification	2015 ULE GER Equivalent Seismic Segment	2015 ULE GER Seismic Cross Section and Analysis Results	Adjusted Levee Height (ft)	2015 FRWL ULE Seismic Classification	Assumed Seismic* Profile for Estimating Vertical Displacement (ft)	2020 Seismic Vulnerability Classification Percentage of Reach Affected (%)				Reasoning for Current Revised Assessment of Potential Damage Levels
																Compromised (NCS >5%)	Severe (NCS 1.5 to 5%)	Moderate - Major (NCS0.2 to 1.5%)	None - Minor (NCS < 0.2%)	
30	1813.33	1902	8867	11 to 22	11	22	7.9	Not Analysed - judged based on subsurface soil conditions (up to 15 feet thick liquefiable zones) and post earthquake F.S >1 based on analysis at Station 2047+50.	NA	Probably Uncompromised	13 to 15	Minimum Post Seismic FOS of 1.47 on landside at Station 1826+79	50	Low based on post seismic analysis results at Station 1826+79 and general assesent of non-liquefiable foundation soils	50	0	5	30	65	Foundation layers generally moderately dense to dense, but several boreholes and CPT soundings found shallow layers of silty sand with low penetration resistance, particularly between Stations 1820 and 1825. URS (2015a) indicated that this reach was generally non-liquefiable with 'Low' seismic vulnerability. URS (2015a) found high post-earthquake factor of safety (1.47) for analysis of Station 1827 model.
31	1902	1958	5600	6 to 9	6	9	9.4	Not Analysed - judged based on subsurface soil conditions (up to 5 feet thick liquefiable zones) and post earthquake F.S >1 based on analysis at Station 2047+50.	NA	Probably Uncompromised	15	NA	NA	Low Assessed as generally non-liquefiable	54	0	5	25	70	Foundation layers generally moderately dense to dense except for a few modetately loose to moderately dense shallow sandy silt layers. URS (2015a) indicated that this reach was generally non-liquefiable with 'Low' seismic vulnerability.
32	1958	1989	3100	12 to 23	12	23	8.2	Not Analysed - judged based on subsurface soil conditions (no liquefiable zones).	NA	Probably Uncompromised	15	NA	NA	Low Assessed as generally non-liquefiable	54	0	10	25	65	Several shallow sand layers in this reach with loose to moderate densities indicated by penetration resistance, particularly between Station 1960 and 1966. URS (2012) found high post earthquake factors of safety for analyses of Station 2211 model in Reach 35. URS (2015a) indicated that this reach was generally non-liquefiable with 'Low' seismic vulnerability.
33	1989	2122	13300	10 to 15	10	15	8.9	Liquefiable zone up to 15 feet thick. Minimum pseudo-static FOS greater than 1 for analysis at Station 2047+50	47	Probably Uncompromised	15	NA	NA	Low Assessed as generally non-liquefiable	47	0	10	25	65	Several shallow silty sand layers in this reach with moderately loose to moderately densities indicated by penetration resistance. URS (2012) found high post earthquake factors of safety for analyses of Station 2047+50 model (1.82) and URS (2015a) also found high post earhtquake factors of safety (1.62) in nearby Reach 35. URS (2015a) indicated that this reach was generally non-liquefiable with 'Low' seismic vulnerability.
34	2122	2182	6000	12 to 15	12	15	9.7	Not Analysed - judged based on subsurface soil conditions (up to 5 feet thick liquefiable zones) and post earthquake F.S >1 based on analysis at Station 2276+76.	NA	Probably Uncompromised	15	NA	NA	Low Assessed as generally non-liquefiable	54	0	5	25	70	Foundation layers appear to be moderately dense to dense, but several shallow shallow silty sand layers are found in this reach with moderately loose to moderately densities indicated by penetration resistance. URS (2012) found high post earthquake factors of safety for analyses of Station 2047+50 model (1.82) in Reach 33 and URS (2015a) also found high post earhtquake factors of safety (1.62) in nearby Reach 35. URS (2015a) indicated that this reach was generally non-liquefiable with 'Low' seismic vulnerability.
35	2182	2224	4200	12 to 16	12	16	8.8	Not Analysed - judged based on subsurface soil conditions (up to 5 feet thick liquefiable zones) and post earthquake F.S >1 based on analysis at Station 2276+76.	NA	Probably Uncompromised	15 to 17	Post Seismic FOS of 1.62 on waterside at Station 2211+15	36	Low based on post seismic analysis results at Station 2211+15 and general assesent of non-liquefiable foundation soils	36	0	5	15	80	Foundation layers appear to be moderately dense to dense, but several shallow shallow silty sand layers are found in this reach with moderately loose to moderately densities indicated by penetration resistance. URS (2012) found high post earthquake factors of safety for analyses of Station 2047+50 model (1.82) in Reach 33 and URS (2015a) also found high post earhtquake factors of safety (1.62) in nearby Reach 35. URS (2015a) indicated that this reach was generally non-liquefiable with 'Low' seismic vulnerability.
36	2224	2259	3500	12 to 17	12	17	9.7	Not Analysed - judged based on subsurface soil conditions (up to 10 feet thick liquefiable zones) and post earthquake F.S >1 based on analysis at Station 2276+76.	NA	Probably Uncompromised	17	NA	NA	Low Assessed as generally non-liquefiable	54	0	0	30	70	Foundation layers appear to be moderately dense to dense, but there are occaisonal shallow layers of sandy silt with moderate densities. URS (2012) found marginal factors of safety (1.12) and up to 0.4 feet of potential settlement for analysis at Station 2276+76 in nearby Reach 37. URS (2015a) indicated that this reach was generally non-liquefiable with 'Low' seismic vulnerability.
37	2259	2290	3100	15 to 17	15	17	11.0	Liquefiable zone up to 5 feet thick. Minimum pseudo-static FOS < 1 for analysis at Station 2276+76 and vertical displacemnt of 0.6 feet.	32	Probably Uncompromised	17	NA	NA	Low Assessed as generally non-liquefiable	32	0	0	30	70	Foundation layers appear to be moderately dense to dense, but there are occaisonal shallow layers of sandy silt with moderately densities, and a few places with relatively clean sands with low SPT blowcounts, particularly near Station 2276 - some of these layers may be above the groundwater level and be unsaturated. URS (2012) found factors of safety (1.13) and up to 0.4 feet of potential settlement for analysis at Station 2276+76 in this reach. URS (2015a) indicated that this reach was generally non-liquefiable with 'Low' seismic vulnerability.
38	2290	2303	1300	14 to 23	14	23	13.2	Not Analysed - judged based on subsurface soil conditions (no liquefiable zone).	NA	Probably Uncompromised	17	NA	NA	Low Assessed as generally non-liquefiable	54	0	0	0	100	Limited amount of penetration data for this short reach and there are larger amounts of gravel layers, but foundation layers appear to be moderately dense to dense. URS (2012) found marginal factors of safety (1.13) and up to 0.4 feet of potential settlement for analysis at Station 2276+76 in nearby Reach 37. URS (2015a) indicated that this reach was generally non-liquefiable with 'Low' seismic vulnerability.
39	2303	2319	1600	12 to 13	12	13	11.4	Not Analysed - judged based on subsurface soil conditions (no liquefiable zone).	NA	Probably Uncompromised	17	NA	NA	Low Assessed as generally non-liquefiable	54	0	0	0	100	Levee embankment and foundation composed principally of gravel in this reach - probably not liquefiable at these low PGA levels (0.11g). 2012 URS analysis of Station 2332+91 in adjacent Reach 40 yielded high post-earhtquake factors of safety (2.31). URS (2015a) indicated that this reach was generally not liquefiable.
40	2319	2359	4000	15 to 25	15	25	9.7	Liquefiable zone up to 10 feet thick. Minimum pseudo-static FOS greater than 1 for analysis at Station 2332+91.	37	Probably Uncompromised	17	NA	NA	Low Assessed as generally non-liquefiable	37	0	0	20	80	Levee embankment and foundation composed principally of gravel in this reach - probably not liquefiable at these low PGA levels (0.11g) Occaisonal shallow layers of moderately loose sand in upper foundation (e.g. near Station Station 2334 - 2337, some of which may be above groundwater level and unsaturated based on groundwater elevation of 106.7 used in 2012 URS Station 2332+91 analysis. 2012 URS analysis of Station 2332+91 in this reach yielded high post-earhtquake factors of safety (2.31). URS (2015a) indicated that this reach was generally not liquefiable.
41	2359	2368	900	8 to 17	8	17	9.7	Not Analysed - judged based on subsurface soil conditions (no liquefiable zone).	NA	Probably Uncompromised	17	NA	NA	Low Assessed as generally non-liquefiable	54	0	0	0	100	Limited penetration test data in this short reach. Levee embankment and upper foundation generally composed of clay, with mostly gravel extending to depth beneath the upper clay foundation. URS (2015a) indicated that this reach was generally not liquefiable.

Notes
* Assumed seismic profile is the greater of the Adjusted Levee Height from the 2012 or 2015 studies. If no values available then the average profile of 54 feet was assumed.

Table D2 - Summary of Previous and Current Damage Level Estimates for the FRWLP Levees (Estimated Length (ft))

Reach #	Station From	Station To	Length (ft)	Typical Levee Height in Reach (ft)	Minimum Height in Reach (ft)	Maximum Height in Reach (ft)	Average Height Above 10 Year WSE + 3 Feet Freeboard (ft)	2012 FRWL GDRR Seismic Cross Section and Analysis Results	Adjusted Levee Height (ft)	2012 FRWL GDRR Seismic Classification	2015 ULE GER Equivalent Seismic Segment	2015 ULE GER Seismic Cross Section and Analysis Results	Adjusted Levee Height (ft)	2015 FRWL ULE Seismic Classification	Assumed Seismic* Profile for Estimating Vertical Displcement (ft)	2020 Seismic Vulnerability Classification Length of Reach Affected (Feet)				Reasoning for Current Revised Assessment of Potential Damage Levels
																Compromised (NCS >5%)	Severe (NCS 1.5 to 5%)	Moderate - Major (NCS0.2 to 1.5%)	None - Minor (NCS < 0.2%)	
7a	510.37	526	1563	22 to 25	22	25	9.0	Not Analysed - judged based on subsurface soil conditions (thin no to low plasticity soils)	NA	Possibly Compromised	7	NA	NA	High based on post seimsic analysis results at Station 539+15	54	0	0	0	1563	Generally moderately dense to dense clayey foundation at least 60 feet below levee.
7b	526	599	7300	22 to 26	22	26	8.7	Up to 25 feet thick liquefiable zone. Minimum pseudo-static FOS less than 1 for analysis at Station 539+30 and vertical displacemnt of 4.5 feet.	58	Likely Compromised	7 and 8	Minimum Post Seismic FOS of 0.96 on waterside at Station 539+15	53	High to Station 545+80 based on post seimsic analysis results at Station 539+16 Low upstream of Station 539+16	58	0	2190	1460	3650	Foundation sand layers range from moderately loose to dense. SPT blowcounts between Stations 549 and 599 generally indicate denser sands. Analyses for relatively loose sand at Station 539 indicate marginal stability: FS = 1.04 (URS, 2012) and 0.96 (URS, 2015a). Vertical displacement of 2.7 feet and NCS of 4.7% calculated by (URS, 2012)
8	599	655	5600	24 to 25	24	25	10.0	Up to 25 feet thick liquefiable zone. Post earthquake F.S. of 0.95 @ Station 623+86.	84	Compromised	8	NA	NA	Low Assessed as generally non-liquefiable	84	0	1120	1680	2800	Foundation sand layers range from moderately loose to dense. URS (2015a) found this subreach to be generally non-liquefiable. However, the URS (2012) analysis found marginal post-earthquake stability: FS = 0.95 for Station 623+86 model.
9a	655	674	1900	22 to 27	22	27	11.9	Not Analyzed - judged based on subsurface soil conditions (up to 25 feet thick liquefiable zone) and analysis results at St. 623+86.	NA	Compromised	8	NA	NA	Low Assessed as generally non-liquefiable	54	0	0	380	1520	Foundation layers mostly composed of moderately dense silt layers with occaisonal thin sand layers. URS (2015a) found this subreach to be non-liquefiable.
9b	674	695	2100	24 to 26	24	26	12.8	Up to 10 feet thick liquefiable zone. Minimum pseudo-static FOS less than 1 for analysis at Station 683+00 and vertical displacemnt of 0.6 feet.	73	Probably Uncompromised	8	NA	NA	Low Assessed as generally non-liquefiable	73	0	0	420	1680	Foundation layers mostly composed of moderately dense silt layers with occiaonal thin sand layers. URS (2015a) found this subreach to be generally non-liquefiable. However, based on the URS (2012) analysis for the Station 683+00 model, thin sand layers could liquefy and potential NCS values could be as high as 1.1 percent.
9c	695	707	1200	25 to 26	25	26	12.4	Not Analysed -Up to 10 feet thick liquefiable zone. 0.6 feet vertical displacement based on analysis at Station 683+00 Model	NA	Possibly Compromised	8	NA	NA	Low Assessed as generally non-liquefiable	54	0	0	240	960	Foundation layers mostly composed of moderately dense silt and clay layers with occiaonal thin sand layers. URS (2015a) found this subreach to be generally non-liquefiable. However, based on the URS (2012) analysis for the Station 683+00 model, thin sand layers could liquefy and potential NCS values could be as high as 1.1 percent.
10a	707	722	1500	25 to 28	25	28	12.0	Not Analysed - Up to 10 feet thick liquefiable zone. 0.6 feet vertical displacement based on analysis at Station 683+00 Model	NA	Possibly Compromised	8 and 9	NA	NA	Low Assessed as generally non-liquefiable	54	0	0	150	1350	Foundation layers include 25-foot-thick dense sand and gravel layer beneath a 25-30-foot-thick clay blanket.URS (2015a) found this subreach to be generally non-liquefiable.
10b	722	754	3200	26 to 28	26	28	12.5	Up to 15 feet liquefiale zone. Flow slide/unstable based on analysis at Station 733+84 with marginal post-earthquake F.S = 0.97	61	Compromised	9 and 10	Minimum Post Seismic FOS of 0.85 on waterside at Station 733+69	58	High to Station 745+30 based on post seimsic analysis results at Station 733+69 Low upstream of Station 745+30	61	160	480	640	1920	Foundation layers mostly moderately dense to dense silt, clay, and silty sand layers, some relatively clean sand layers with low SPT blowcounts. URS (2012) calculated marginal post-earthquake F.S. = 0.97 for Station 733+84 model; URS (2015a) calculated F.S. = 0.85 for same location.
10c	754	774	2000	27 to 28	27	28	12.5	Not Analysed - judged based on subsurface soil conditions (up to 15 feet liquefiable zone)	NA	Possibly Compromised	10	NA	NA	Low Assessed as non-liquefiable	54	0	0	200	1800	Foundation layers mostly moderately dense to dense silt, clay, and silty sand layers, some relatively clean sand layers. URS (2015a) found this subreach to be non-liquefiable.
11	774	831	5700	23 to 25	23	25	12.1	Not Analysed - judged based on subsurface soil conditions (up to 15 feet liquefiable zone)	NA	Possibly Compromised	10	NA	NA	Low Assessed as non-liquefiable	54	0	570	2280	2850	Foundation layers consist of moderately dense to dense silts and clays with thin to thick layers of SP-SM which range from moderately loose to dense. URS (2015a) found this subreach to be non-liquefiable.
12	831	845	1400	23 to 26	23	26	12.8	Not Analysed - judged based on subsurface soil conditions (up to 30 feet liquefiable zone)	NA	Possibly Compromised	11A	NA	NA	High based on post seimsic analysis results at Station 870+75	54	140	140	420	700	Foundation layers consist of moderately dense to dense silts and clays with thin to thick layers of SP-SM which range from loose to dense. High seismic vulnerability based on post seismic FOS at St 870+75 (URS, 2015a), which is similar to conditions at St 843+00.
13	845	927	8200	22 to 28	22	28	11.2	Liquefiable zone up to 30 feet thick. Flow slide/unstable in some areas based on analysis at Station 871+00 with post-earthquake F.S = 0.77.	50	Compromised	11A, 11B and 11C	Minimum Post Seismic FOS of 0.78 on waterside at Station 870+85 for Segment 11A and FOS of 2.42 on the landside for modified layering to represent Segment 11B.	62	High to station 878+00 and upstream of 906+80 based on post seimsic analysis results at Station 870+76 Low between Station 878+00 and 906+80 based on adjusted post seismic analysis results at Station 870+85	62	2050	2050	2050	2050	Foundatiion layers consist of moderately dense to dense silt, clay, and silty sand layers, several thin and thick SP and SP-SM layers with low SPT blowcounts. URS (2012) calculated low post-earthquake F.S. = 0.77 for Station 871+00 model; URS (2015a) calculated F.S. = 0.78 for for same location. URS (2015a) found Segment 11B (Station 878 to 907) to be Low seismic vulnerability based on post seismic FOS of 2.42.
14	927	954	2700	19 to 22	19	22	10.2	Not Analysed - up to 20 feet liquefiable zone. Potential flow slide/unstable in some areas based on analysis at Stations 871+00 and 958+83 with post eartquake F.S. =<0.77.	NA	Compromised	11C	NA	NA	High based on post seimsic analysis results at Station 870+76 in Segment 11C	54	1080	675	675	270	Foundation layering and materials similar to Reach 13. Subsurface conditions at Stations 940+00, 949+00, 953+50 and 955+00 have conditions similar to that analyzed at Station 870+85 in Reach 13 with a FOS of 0.78 (URS, 2015a).
15	954	968	1400	18 to 19	18	19	9.4	Up to 30 feet thick liquefiable zone. Potential flow slide/unstable in some areas based on analysis at Station 958+83 with post eartquake F.S. = 0.54.	68	Compromised	11C	NA	NA	High based on post seimsic analysis results at Station 870+76 in Segment 11C	68	350	350	350	350	Foundation layering and materials similar to Reach 13.
16a	968	993	2500	14 to 20	14	20	9.3	Not Analysed - up to 10 feet liquefiable zone. Potential flow slide/unstable in some areas based on analysis at Station 958+83 with post eartquake F.S. = 0.54.	NA	Compromised	11C	NA	NA	High based on post seimsic analysis results at Station 870+76 in Segment 11C	54	0	500	750	1250	Foundation layers consist mostly of moderately dense to dense silts, clays, and silty sands. CPT soundings indicate relatively thin sand layers in places with low penetration resistance. Thick, loose sand layers are not present in this reach based on subsurface data.
16b	993	1080	8700	20 to 31	20	31	13.7	Not Analysed - judged based on subsurface soil conditions (up to 10 feet thick liquefiable zone).	NA	Possibly Compromised	11C and 12	NA	NA	High to Station 996+80 based on post seimsic analysis results at Station 870+76 in Segment 11C Low upstream of 996+80 as generally non-liquefiable	54	0	870	1740	6090	Foundation layers consist mostly of moderately dense to dense silts, clays, silty sands, and clean sands. CPT soundings indicate relatively thin sand layers in places with low penetration resistance, and a thick sand layer at Station 1007 with relatively low penetration resistance. URS (2015a) indicated that this reach was generally non-liquefiable with 'Low' seismic vulnerability.

Table D2 - Summary of Previous and Current Damage Level Estimates for the FRWLP Levees (Estimated Length (ft))

Reach #	Station From	Station To	Length (ft)	Typical Levee Height in Reach (ft)	Minimum Height in Reach (ft)	Maximum Height in Reach (ft)	Average Height Above 10 Year WSE + 3 Feet Freeboard (ft)	2012 FRWL GDRR Seismic Cross Section and Analysis Results	Adjusted Levee Height (ft)	2012 FRWL GDRR Seismic Classification	2015 ULE GER Equivalent Seismic Segment	2015 ULE GER Seismic Cross Section and Analysis Results	Adjusted Levee Height (ft)	2015 FRWL ULE Seismic Classification	Assumed Seismic* Profile for Estimating Vertical Displacement (ft)	2020 Seismic Vulnerability Classification Length of Reach Affected (Feet)				Reasoning for Current Revised Assessment of Potential Damage Levels
																Compromised (NCS >5%)	Severe (NCS 1.5 to 5%)	Moderate - Major (NCS0.2 to 1.5%)	None - Minor (NCS < 0.2%)	
17	1080	1130.86	5086	20 to 26	20	26	11.5	Liquefiable zone up to 40 feet thick. Minimum pseudo-static FOS less than 1 for analysis at Station 1116+00 and vertical displacemnt of 1.1 feet.	55	Possibly Compromised	12	NA	NA	Low Assessed as generally non-liquefiable	55	0	508.6	508.6	4068.8	Foundation layers consist mostly of moderately dense to dense silts, clays, silty sands, and clean sands. CPT soundings indicate occaisonal thin sand layers in places with low penetration resistance. SPT blowcounts relatively low in silty sand and sandy silt at Station 1116+00 analysis location. URS (2015a) indicated that this reach was generally non-liquefiable with 'Low' seismic vulnerability.
18a	1130.86	1136	514	14 to 22	14	22	11.0	Not Analysed - judged based on subsurface soil conditions (up to 15 feet thick liquefiable zone). Vertical displacement of 1 feet based on analysis at Station 1116+00.	NA	Possibly Compromised	12	NA	NA	Low Assessed as generally non-liquefiable	54	0	0	154.2	359.8	Two borholes in this short reach indicate relatively low SPT resistance in shallow sand layers, but these layers appear to be above the groundwater level (shown as Elevation 44 in the Station 1116 model by URS; 2012). URS (2015a) indicated that his reach was generally non-liquefiably with 'Low' seismic vulnerability.
18b	1136	1170	3400	19 to 21	19	21	11.3	Not Analysed - judged based on subsurface soil conditions (up to 25 feet thick liquefiable zone). Vertical displacement of 7 feet based on analysis at Station 1224+00.	NA	Likely Compromised	12	NA	NA	Low Assessed as generally non-liquefiable	54	0	340	1020	2040	Foundation layers consist mostly of moderately dense to dense silts, clays, silty sands, and clean sands. CPT soundings indicate occaisonal sand layers in places with low penetration resistance. URS (2015a) indicated that this reach was generally non-liquefiable with 'Low' seismic vulnerability.
18c	1170	1213.85	4385	18 to 20	18	20	11.0	Not Analysed - judged based on subsurface soil conditions (up to 10 feet thick liquefiable zone). Vertical displacement of 1 feet based on analysis at Station 1116+00.	NA	Possibly Compromised	12	NA	NA	Low Assessed as generally non-liquefiable	54	0	657.75	1096.25	2631	Foundation layers consist mostly of moderately dense to dense silts, clays, silty sands, and sands. SPT blowcounts generally relatively high, some CPT soundings (e.g. Station1180 indicate moderately loose sand layers in upper portion of foundation). URS (2015a) indicated that this reach was generally non-liquefiable with 'Low' seismic vulnerability.
19a	1213.85	1245	3115	18 to 19	18	19	10.5	Liquefiable zone up to 30 feet thick. Minimum pseudo-static FOS less than 1 for analysis at Station 1224+00 and vertical displacemnt of 7 feet.	64	Likely Compromised	12	NA	NA	Low Assessed as generally non-liquefiable	64	155.75	467.25	623	1869	Foundation layers consist mostly of moderately dense to dense silts, clays, silty sands, and sands. A few layers of silty sand and sand with moderately low penetration resistance. URS (2012) analysis for Station 1224+00 found post-earthquake F.S. = 1.17, but with up to 4 feet of settlement. URS (2015a) indicated that this reach was generally non-liquefiable with 'Low' seismic vulnerability.
19b	1245	1297.83	5283	18 to 20	18	20	10.9	Not Analysed - judged based on subsurface soil conditions (up to 15 feet thick liquefiable zone) and post earthquake F.S > 1 based on analysis at Station 1378+83.	NA	Probably Uncompromised	12	NA	NA	Low Assessed as generally non-liquefiable	54	0	0	528.3	4754.7	Foundation layers appear to all be moderately dense to dense and not liquefiable. URS (2012) calculated high factors of safety for Station 1378+83 analysis model. URS (2015a) indicated that this reach was generally non-liquefiable with 'Low' seismic vulnerability.
20	1297.83	1374.33	7650	15 to 18	15	18	10.3	Not Analysed - judged based on subsurface soil conditions (no liquefiable zones) and post earthquake F.S >1 based on analysis at Station 1378+83.	NA	Probably Uncompromised	12	NA	NA	Low Assessed as generally non-liquefiable	54	0	0	1530	6120	Foundation layers appear to be generall moderately dense to dense and not liquefiable except for a few silty sand layers with moderately low penetration resistance. URS (2012) calculated high factors of safety for Station 1378+83 analysis model. URS (2015a) indicated that this reach was generally non-liquefiable with 'Low' seismic vulnerability.
21	1374.33	1433.83	5950	11	11	11	9.6	Liquefiable zone up to 15 feet thick. Minimum pseudo-static FOS greater than 1 for analysis at Station 1378+83	38	Probably Uncompromised	12 and 13	NA	NA	Low Assessed as generally non-liquefiable	38	0	0	1785	4165	Foundation layers appear to be generall moderately dense to dense and not liquefiable except for a few relatively clean sand layers at shallow depths - many of which appear to be above the groundwater level modeled at Elevation 55 feet in URS 2012 model at Station 1378+83. URS (2012) calculated high factors of safety for Station 1378+83 analysis model. URS (2015a) indicated that this reach was generally non-liquefiable with 'Low' seismic vulnerability.
22	1433.83	1503.83	7000	10 to 14	10	14	9.0	Not Analysed - judged based on subsurface soil conditions (up to 5 feet thick liquefiable zones) and post earthquake F.S >1 based on analysis at Station 1378+83 and 2047+50.	NA	Probably Uncompromised	13	NA	NA	Low Assessed as generally non-liquefiable	54	0	0	1400	5600	Foundation layers appear to be generall moderately dense to dense and not liquefiable except for a few relatively clean sand layers at shallow depths - many of which appear to be above the groundwater level modeled at Elevation 55 feet in URS 2012 model at Station 1378+83. URS (2012) calculated high factors of safety for Station 1378+83 analysis model. URS (2015a) indicated that this reach was generally non-liquefiable with 'Low' seismic vulnerability.
23	1503.83	1609.37	10554	7 to 10	7	10	7.3	Not Analysed - judged based on subsurface soil conditions (up to 5 feet thick liquefiable zones) and post earthquake F.S >1 based on analysis at Station 1378+83 and 2047+50.	NA	Probably Uncompromised	13	NA	NA	Low Assessed as generally non-liquefiable	54	0	0	1055.4	9498.6	Foundation layers appear to be generall moderately dense to dense and not liquefiable except for a few silty sand layers with moderately low penetration resistance. URS (2015a) indicated that this reach was generally non-liquefiable with 'Low' seismic vulnerability.
24	1609.37	1623.86	1449	7 to 10	7	10	7.2	Not Analysed - judged based on subsurface soil conditions (up to 5 feet thick liquefiable zones) and post earthquake F.S >1 based on analysis at Station 1378+83 and 2047+50.	NA	Probably Uncompromised	13	NA	NA	Low Assessed as generally non-liquefiable	54	0	0	72.45	1376.55	Foundation layers generally appear to be relatively dense and not liquefiable. URS (2015a) indicated that this reach was generally non-liquefiable with 'Low' seismic vulnerability.
25	1623.86	1674.37	5051	6 to 10	6	10	7.2	Not Analysed - judged based on subsurface soil conditions (up to 5 feet thick liquefiable zones) and post earthquake F.S >1 based on analysis at Station 1378+83 and 2047+50.	NA	Probably Uncompromised	13	NA	NA	Low Assessed as generally non-liquefiable	54	0	0	252.55	4798.45	Foundation layers generally appear to be relatively dense and not liquefiable. URS (2015a) indicated that this reach was generally non-liquefiable with 'Low' seismic vulnerability.
26	1674.37	1707.11	3274	6 to 8	6	8	7.9	Not Analysed - judged based on subsurface soil conditions (up to 5 feet thick liquefiable zones) and post earthquake F.S >1 based on analysis at Station 1378+83 and 2047+50.	NA	Probably Uncompromised	13	NA	NA	Low Assessed as generally non-liquefiable	54	NO WORK REACHES				NO WORK REACHES
27	1707.11	1721.6	1449	5 to 6	5	6	7.1	Not Analysed - judged based on subsurface soil conditions (no liquefiable zones).	NA	Probably Uncompromised	13	NA	NA	Low Assessed as generally non-liquefiable	54					
28	1721.6	1769.31	4771	4 to 6	4	6	7.0	Not Analysed - judged based on subsurface soil conditions (no liquefiable zones).	NA	Probably Uncompromised	13	NA	NA	Low Assessed as generally non-liquefiable	54					
29	1769.31	1813.33	4402	4 to 6	4	6	7.2	Not Analysed - judged based on subsurface soil conditions (up to 5 feet thick liquefiable zones) and post earthquake F.S >1 based on analysis at Station 2047+50.	NA	Probably Uncompromised	13	NA	NA	Low Assessed as generally non-liquefiable	54	0	0	220.1	4181.9	Foundation layers generally clayey, moderately dense to dense and not liquefiable. URS (2015a) indicated that this reach was gnerally non-liquefiable with 'Low' seismic vulnerability.

Table D2 - Summary of Previous and Current Damage Level Estimates for the FRWLP Levees (Estimated Length (ft))

Reach #	Station From	Station To	Length (ft)	Typical Levee Height in Reach (ft)	Minimum Height in Reach (ft)	Maximum Height in Reach (ft)	Average Height Above 10 Year WSE + 3 Feet Freeboard (ft)	2012 FRWL GDRR Seismic Cross Section and Analysis Results	Adjusted Levee Height (ft)	2012 FRWL GDRR Seismic Classification	2015 ULE GER Equivalent Seismic Segment	2015 ULE GER Seismic Cross Section and Analysis Results	Adjusted Levee Height (ft)	2015 FRWL ULE Seismic Classification	Assumed Seismic* Profile for Estimating Vertical Displcement (ft)	2020 Seismic Vulnerability Classification Length of Reach Affected (Feet)				Reasoning for Current Revised Assessment of Potential Damage Levels
																Compromised (NCS >5%)	Severe (NCS 1.5 to 5%)	Moderate - Major (NCS0.2 to 1.5%)	None - Minor (NCS < 0.2%)	
30	1813.33	1902	8867	11 to 22	11	22	7.9	Not Analysed - judged based on subsurface soil conditions (up to 15 feet thick liquefiable zones) and post earthquake F.S >1 based on analysis at Station 2047+50.	NA	Probably Uncompromised	13 to 15	Minimum Post Seismic FOS of 1.47 on landside at Station 1826+79	50	Low based on post seismic analysis results at Station 1826+79 and general assesent of non-liquefiable foundation soils	50	0	443.35	2660.1	5763.55	Foundation layers generally moderately dense to dense, but several boreholes and CPT soundings found shallow layers of silty sand with low penetration resistance, particularly between Stations 1820 and 1825. URS (2015a) indicated that this reach was generally non-liquefiable with 'Low' seismic vulnerability. URS (2015a) found high post-earthquake factor of safety (1.47) for analysis of Station 1827 model.
31	1902	1958	5600	6 to 9	6	9	9.4	Not Analysed - judged based on subsurface soil conditions (up to 5 feet thick liquefiable zones) and post earthquake F.S >1 based on analysis at Station 2047+50.	NA	Probably Uncompromised	15	NA	NA	Low Assessed as generally non-liquefiable	54	0	280	1400	3920	Foundation layers generally moderately dense to dense except for a few modetately loose to moderately dense shallow sandy silt layers. URS (2015a) indicated that this reach was generally non-liquefiable with 'Low' seismic vulnerability.
32	1958	1989	3100	12 to 23	12	23	8.2	Not Analysed - judged based on subsurface soil conditions (no liquefiable zones).	NA	Probably Uncompromised	15	NA	NA	Low Assessed as generally non-liquefiable	54	0	310	775	2015	Several shallow sand layers in this reach with loose to moderate densities indicated by penetration resistance, particularly between Station 1960 and 1966. URS (2012) found high post earthquake factors of safety for analyses of Station 2211 model in Reach 35. URS (2015a) indicated that this reach was generally non-liquefiable with 'Low' seismic vulnerability.
33	1989	2122	13300	10 to 15	10	15	8.9	Liquefiable zone up to 15 feet thick. Minimum pseudo-static FOS greater than 1 for analysis at Station 2047+50	47	Probably Uncompromised	15	NA	NA	Low Assessed as generally non-liquefiable	47	0	1330	3325	8645	Several shallow silty sand layers in this reach with moderately loose to moderately densities indicated by penetration resistance. URS (2012) found high post earthquake factors of safety for analyses of Station 2047+50 model (1.82) and URS (2015a) also found high post earhtquake factors of safety (1.62) in nearby Reach 35. URS (2015a) indicated that this reach was generally non-liquefiable with 'Low' seismic vulnerability.
34	2122	2182	6000	12 to 15	12	15	9.7	Not Analysed - judged based on subsurface soil conditions (up to 5 feet thick liquefiable zones) and post earthquake F.S >1 based on analysis at Station 2276+76.	NA	Probably Uncompromised	15	NA	NA	Low Assessed as generally non-liquefiable	54	0	300	1500	4200	Foundation layers appear to be moderately dense to dense, but several shallow shallow silty sand layers are found in this reach with moderately loose to moderately densities indicated by penetration resistance. URS (2012) found high post earthquake factors of safety for analyses of Station 2047+50 model (1.82) in Reach 33 and URS (2015a) also found high post earhtquake factors of safety (1.62) in nearby Reach 35. URS (2015a) indicated that this reach was generally non-liquefiable with 'Low' seismic vulnerability.
35	2182	2224	4200	12 to 16	12	16	8.8	Not Analysed - judged based on subsurface soil conditions (up to 5 feet thick liquefiable zones) and post earthquake F.S >1 based on analysis at Station 2276+76.	NA	Probably Uncompromised	15 to 17	Post Seismic FOS of 1.62 on waterside at Station 2211+15	36	Low based on post seismic analysis results at Station 2211+15 and general assesent of non-liquefiable foundation soils	36	0	210	630	3360	Foundation layers appear to be moderately dense to dense, but several shallow shallow silty sand layers are found in this reach with moderately loose to moderately densities indicated by penetration resistance. URS (2012) found high post earthquake factors of safety for analyses of Station 2047+50 model (1.82) in Reach 33 and URS (2015a) also found high post earhtquake factors of safety (1.62) in nearby Reach 35. URS (2015a) indicated that this reach was generally non-liquefiable with 'Low' seismic vulnerability.
36	2224	2259	3500	12 to 17	12	17	9.7	Not Analysed - judged based on subsurface soil conditions (up to 10 feet thick liquefiable zones) and post earthquake F.S >1 based on analysis at Station 2276+76.	NA	Probably Uncompromised	17	NA	NA	Low Assessed as generally non-liquefiable	54	0	0	1050	2450	Foundation layers appear to be moderately dense to dense, but there are occaisonal shallow layers of sandy silt with moderate densities. URS (2012) found marginal factors of safety (1.12) and up to 0.4 feet of potential settlement for analysis at Station 2276+76 in nearby Reach 37. URS (2015a) indicated that this reach was generally non-liquefiable with 'Low' seismic vulnerability.
37	2259	2290	3100	15 to 17	15	17	11.0	Liquefiable zone up to 5 feet thick. Minimum pseudo-static FOS < 1 for analysis at Station 2276+76 and vertical displacemnt of 0.6 feet.	32	Probably Uncompromised	17	NA	NA	Low Assessed as generally non-liquefiable	32	0	0	930	2170	Foundation layers appear to be moderately dense to dense, but there are occaisonal shallow layers of sandy silt with moderately densities, and a few places with relatively clean sands with low SPT blowcounts, particularly near Station 2276 - some of these layers may be above the groundwater level and be unsaturated. URS (2012) found factors of safety (1.13) and up to 0.4 feet of potential settlement for analysis at Station 2276+76 in this reach. URS (2015a) indicated that this reach was generally non-liquefiable with 'Low' seismic vulnerability.
38	2290	2303	1300	14 to 23	14	23	13.2	Not Analysed - judged based on subsurface soil conditions (no liquefiable zone).	NA	Probably Uncompromised	17	NA	NA	Low Assessed as generally non-liquefiable	54	0	0	0	1300	Limited amount of penetration data for this short reach and there are larger amounts of gravel layers, but foundation layers appear to be moderately dense to dense. URS (2012) found marginal factors of safety (1.13) and up to 0.4 feet of potential settlement for analysis at Station 2276+76 in nearby Reach 37. URS (2015a) indicated that this reach was generally non-liquefiable with 'Low' seismic vulnerability.
39	2303	2319	1600	12 to 13	12	13	11.4	Not Analysed - judged based on subsurface soil conditions (no liquefiable zone).	NA	Probably Uncompromised	17	NA	NA	Low Assessed as generally non-liquefiable	54	0	0	0	1600	Levee embankment and foundation composed principally of gravel in this reach - probably not liquefiable at these low PGA levels (0.11g). 2012 URS analysis of Station 2332+91 in adjacent Reach 40 yielded high post-earhtquake factors of safety (2.31). URS (2015a) indicated that this reach was generally not liquefiable.
40	2319	2359	4000	15 to 25	15	25	9.7	Liquefiable zone up to 10 feet thick. Minimum pseudo-static FOS greater than 1 for analysis at Station 2332+91.	37	Probably Uncompromised	17	NA	NA	Low Assessed as generally non-liquefiable	37	0	0	800	3200	Levee embankment and foundation composed principally of gravel in this reach - probably not liquefiable at these low PGA levels (0.11g) Occaisonal shallow layers of moderately loose sand in upper foundation (e.g. near Station Station 2334 - 2337, some of which may be above groundwater level and unsaturated based on groundwater elevation of 106.7 used in 2012 URS Station 2332+91 analysis. 2012 URS analysis of Station 2332+91 in this reach yielded high post-earhtquake factors of safety (2.31). URS (2015a) indicated that this reach was generally not liquefiable.
41	2359	2368	900	8 to 17	8	17	9.7	Not Analysed - judged based on subsurface soil conditions (no liquefiable zone).	NA	Probably Uncompromised	17	NA	NA	Low Assessed as generally non-liquefiable	54	0	0	0	900	Limited penetration test data in this short reach. Levee embankment and upper foundation generally composed of clay, with mostly gravel extending to depth beneath the upper clay foundation. URS (2015a) indicated that this reach was generally not liquefiable.
																3935.75	13791.95	36750.95	121790.35	
																0.7	2.6	7.0	23.1	

Notes
* Assumed seismic profile is the greater of the Adjusted Levee Height from the 2012 or 2015 studies. If no values available then the average profile of 54 feet was assumed.

Table D3 - Summary of Previous and Current Damage Level Estimates for the FRWLP Levees (Estimated Vertical Settlement (ft))

Reach #	Station From	Station To	Length (ft)	Typical Levee Height in Reach (ft)	Minimum Height in Reach (ft)	Maximum Height in Reach (ft)	Average Height Above 10 Year WSE + 3 Feet Freeboard (ft)	2012 FRWL GDRR Seismic Cross Section and Analysis Results	Adjusted Levee Height (ft)	2012 FRWL GDRR Seismic Classification	2015 ULE GER Equivalent Seismic Segment	2015 ULE GER Seismic Cross Section and Analysis Results	Adjusted Levee Height (ft)	2015 FRWL ULE Seismic Classification	Assumed Seismic* Profile for Estimating Vertical Displcement (ft)	2020 Seismic Vulnerability Classification Maximum Vertical Displacement within Reach (feet)				Reasoning for Current Revised Assessment of Potential Damage Levels
																Compromised	Severe	Moderate - Major	None - Minor	
7a	510.37	526	1563	22 to 25	22	25	9.0	Not Analysed - judged based on subsurface soil conditions (thin no to low plasticity soils)	NA	Possibly Compromised	7	NA	NA	High based on post seimsic analysis results at Station 539+15	54	0	0	0	0.108	Generally moderately dense to dense clayey foundation at least 60 feet below levee.
7b	526	599	7300	22 to 26	22	26	8.7	Up to 25 feet thick liquefiable zone. Minimum pseudo-static FOS less than 1 for analysis at Station 539+30 and vertical displacemnt of 4.5 feet.	58	Likely Compromised	7 and 8	Minimum Post Seismic FOS of 0.96 on waterside at Station 539+15	53	High to Station 545+80 based on post seimsic analysis results at Station 539+16 Low upstream of Station 539+16	58	0	2.9	0.87	0.116	Foundation sand layers range from moderately loose to dense. SPT blowcounts between Stations 549 and 599 generally indicate denser sands. Analyses for relatively loose sand at Station 539 indicate marginal stability: FS = 1.04 (URS, 2012) and 0.96 (URS, 2015a). Vertical displacement of 2.7 feet and NCS of 4.7% calculated by (URS, 2012)
8	599	655	5600	24 to 25	24	25	10.0	Up to 25 feet thick liquefiable zone. Post earthquake F.S. of 0.95 @ Station 623+86.	84	Compromised	8	NA	NA	Low Assessed as generally non-liquefiable	84	0	4.2	1.26	0.168	Foundation sand layers range from moderately loose to dense. URS (2015a) found this subreach to be generally non-liquefiable. However, the URS (2012) analysis found marginal post-earthquake stability: FS = 0.95 for Station 623+86 model.
9a	655	674	1900	22 to 27	22	27	11.9	Not Analyzed - judged based on subsurface soil conditions (up to 25 feet thick liquefiable zone) and analysis results at St. 623+86.	NA	Compromised	8	NA	NA	Low Assessed as generally non-liquefiable	54	0	0	0.81	0.108	Foundation layers mostly composed of moderately dense silt layers with occaisonal thin sand layers. URS (2015a) found this subreach to be non-liquefiable.
9b	674	695	2100	24 to 26	24	26	12.8	Up to 10 feet thick liquefiable zone. Minimum pseudo-static FOS less than 1 for analysis at Station 683+00 and vertical displacemnt of 0.6 feet.	73	Probably Uncompromised	8	NA	NA	Low Assessed as generally non-liquefiable	73	0	0	1.095	0.146	Foundation layers mostly composed of moderately dense silt layers with occiaonal thin sand layers. URS (2015a) found this subreach to be generally non-liquefiable. However, based on the URS (2012) analysis for the Station 683+00 model, thin sand layers could liquefy and potential NCS values could be as high as 1.1 percent.
9c	695	707	1200	25 to 26	25	26	12.4	Not Analysed -Up to 10 feet thick liquefiable zone. 0.6 feet vertical displacement based on analysis at Station 683+00 Model	NA	Possibly Compromised	8	NA	NA	Low Assessed as generally non-liquefiable	54	0	0	0.81	0.108	Foundation layers mostly composed of moderately dense silt and clay layers with occiaonal thin sand layers. URS (2015a) found this subreach to be generally non-liquefiable. However, based on the URS (2012) analysis for the Station 683+00 model, thin sand layers could liquefy and potential NCS values could be as high as 1.1 percent.
10a	707	722	1500	25 to 28	25	28	12.0	Not Analysed - Up to 10 feet thick liquefiable zone. 0.6 feet vertical displacement based on analysis at Station 683+00 Model	NA	Possibly Compromised	8 and 9	NA	NA	Low Assessed as generally non-liquefiable	54	0	0	0.81	0.108	Foundation layers include 25-foot-thick dense sand and gravel layer beneath a 25-30-foot-thick clay blanket.URS (2015a) found this subreach to be generally non-liquefiable.
10b	722	754	3200	26 to 28	26	28	12.5	Up to 15 feet liquefiale zone. Flow slide/unstable based on analysis at Station 733+84 with marginal post-earthquake F.S = 0.97	61	Compromised	9 and 10	Minimum Post Seismic FOS of 0.85 on waterside at Station 733+69	58	High to Station 745+30 based on post seimsic analysis results at Station 733+69 Low upstream of Station 745+30	61	10	3.05	0.915	0.122	Foundation layers mostly moderately dense to dense silt, clay, and silty sand layers, some relatively clean sand layers with low SPT blowcounts. URS (2012) calculated marginal post-earthquake F.S. = 0.97 for Station 733+84 model; URS (2015a) calculated F.S. = 0.85 for same location.
10c	754	774	2000	27 to 28	27	28	12.5	Not Analysed - judged based on subsurface soil conditions (up to 15 feet liquefiable zone)	NA	Possibly Compromised	10	NA	NA	Low Assessed as non-liquefiable	54	0	0	0.81	0.108	Foundation layers mostly moderately dense to dense silt, clay, and silty sand layers, some relatively clean sand layers. URS (2015a) found this subreach to be non-liquefiable.
11	774	831	5700	23 to 25	23	25	12.1	Not Analysed - judged based on subsurface soil conditions (up to 15 feet liquefiable zone)	NA	Possibly Compromised	10	NA	NA	Low Assessed as non-liquefiable	54	0	2.7	0.81	0.108	Foundation layers consist of moderately dense to dense silts and clays with thin to thick layers of SP-SM which range from moderately loose to dense. URS (2015a) found this subreach to be non-liquefiable.
12	831	845	1400	23 to 26	23	26	12.8	Not Analysed - judged based on subsurface soil conditions (up to 30 feet liquefiable zone)	NA	Possibly Compromised	11A	NA	NA	High based on post seimsic analysis results at Station 870+75	54	10	2.7	0.81	0.108	Foundation layers consist of moderately dense to dense silts and clays with thin to thick layers of SP-SM which range from loose to dense. High seismic vulnerability based on post seismic FOS at St 870+75 (URS, 2015a), which is similar to conditions at St 843+00.
13	845	927	8200	22 to 28	22	28	11.2	Liquefiable zone up to 30 feet thick. Flow slide/unstable in some areas based on analysis at Station 871+00 with post-earthquake F.S = 0.77.	50	Compromised	11A, 11B and 11C	Minimum Post Seismic FOS of 0.78 on waterside at Station 870+85 for Segment 11A and FOS of 2.42 on the landside for modified layering to represent Segment 11B.	62	High to station 878+00 and upstream of 906+80 based on post seimsic analysis results at Station 870+76 Low between Station 878+00 and 906+80 based on adjusted post seismic analysis results at Station 870+85	62	10	3.1	0.93	0.124	Foundatiion layers consist of moderately dense to dense silt, clay, and silty sand layers, several thin and thick SP and SP-SM layers with low SPT blowcounts. URS (2012) calculated low post-earthquake F.S. = 0.77 for Station 871+00 model; URS (2015a) calculated F.S. = 0.78 for for same location. URS (2015a) found Segmnet 11B (Station 878 to 907) to be Low seismic vulnerability based on post seismic FOS of 2.42.
14	927	954	2700	19 to 22	19	22	10.2	Not Analysed - up to 20 feet liquefiable zone. Potential flow slide/unstable in some areas based on analysis at Stations 871+00 and 958+83 with post eartquake F.S. =<0.77.	NA	Compromised	11C	NA	NA	High based on post seimsic analysis results at Station 870+76 in Segment 11C	54	10	2.7	0.81	0.108	Foundation layering and materials similar to Reach 13. Subsurface conditions at Stations 940+00, 949+00, 953+50 and 955+00 have conditions similar to that analyzed at Station 870+85 in Reach 13 with a FOS of 0.78 (URS, 2015a).
15	954	968	1400	18 to 19	18	19	9.4	Up to 30 feet thick liquefiable zone. Potential flow slide/unstable in some areas based on analysis at Station 958+83 with post eartquake F.S. = 0.54.	68	Compromised	11C	NA	NA	High based on post seimsic analysis results at Station 870+76 in Segment 11C	68	10	3.4	1.02	0.136	Foundation layering and materials similar to Reach 13.
16a	968	993	2500	14 to 20	14	20	9.3	Not Analysed - up to 10 feet liquefiable zone. Potential flow slide/unstable in some areas based on analysis at Station 958+83 with post eartquake F.S. = 0.54.	NA	Compromised	11C	NA	NA	High based on post seimsic analysis results at Station 870+76 in Segment 11C	54	0	2.7	0.81	0.108	Foundation layers consist mostly of moderately dense to dense silts, clays, and silty sands. CPT soundings indicate relatively thin sand layers in places with low penetration resistance. Thick, loose sand layers are not present in this reach based on subsurface data.
16b	993	1080	8700	20 to 31	20	31	13.7	Not Analysed - judged based on subsurface soil conditions (up to 10 feet thick liquefiable zone).	NA	Possibly Compromised	11C and 12	NA	NA	High to Station 996+80 based on post seimsic analysis results at Station 870+76 in Segment 11C Low upstream of 996+80 as generally non-liquefiable	54	0	2.7	0.81	0.108	Foundation layers consist mostly of moderately dense to dense silts, clays, silty sands, and clean sands. CPT soundings indicate relatively thin sand layers in places with low penetration resistance, and a thick sand layer at Station 1007 with relatively low penetration resistance. URS (2015a) indicated that this reach was generally non-liquefiable with 'Low' seismic vulnerability.

Table D3 - Summary of Previous and Current Damage Level Estimates for the FRWLP Levees (Estimated Vertical Settlement (ft))

Reach #	Station From	Station To	Length (ft)	Typical Levee Height in Reach (ft)	Minimum Height in Reach (ft)	Maximum Height in Reach (ft)	Average Height Above 10 Year WSE + 3 Feet Freeboard (ft)	2012 FRWL GDRR Seismic Cross Section and Analysis Results	Adjusted Levee Height (ft)	2012 FRWL GDRR Seismic Classification	2015 ULE GER Equivalent Seismic Segment	2015 ULE GER Seismic Cross Section and Analysis Results	Adjusted Levee Height (ft)	2015 FRWL ULE Seismic Classification	Assumed Seismic* Profile for Estimating Vertical Displcement (ft)	2020 Seismic Vulnerability Classification Maximum Vertical Displacement within Reach (feet)				Reasoning for Current Revised Assessment of Potential Damage Levels
																Compromised	Severe	Moderate - Major	None - Minor	
17	1080	1130.86	5086	20 to 26	20	26	11.5	Liquefiable zone up to 40 feet thick. Minimum pseudo-static FOS less than 1 for analysis at Station 1116+00 and vertical displacemnt of 1.1 feet.	55	Possibly Compromised	12	NA	NA	Low Assessed as generally non-liquefiable	55	0	2.75	0.825	0.11	Foundation layers consist mostly of moderately dense to dense silts, clays, silty sands, and clean sands. CPT soundings indicate occaisonal thin sand layers in places with low penetration resistance. SPT blowcounts relatively low in silty sand and sandy silt at Station 1116+00 analysis location. URS (2015a) indicated that this reach was generally non-liquefiable with 'Low' seismic vulnerability.
18a	1130.86	1136	514	14 to 22	14	22	11.0	Not Analysed - judged based on subsurface soil conditions (up to 15 feet thick liquefiable zone). Vertical displacement of 1 feet based on analysis at Station 1116+00.	NA	Possibly Compromised	12	NA	NA	Low Assessed as generally non-liquefiable	54	0	0	0.81	0.108	Two borholes in this short reach indicate relatively low SPT resistance in shallow sand layers, but these layers appear to be above the groundwater level (shown as Elevation 44 in the Station 1116 model by URS; 2012). URS (2015a) indicated that his reach was generally non-liquefiably with 'Low' seismic vulnerability.
18b	1136	1170	3400	19 to 21	19	21	11.3	Not Analysed - judged based on subsurface soil conditions (up to 25 feet thick liquefiable zone). Vertical displacement of 7 feet based on analysis at Station 1224+00.	NA	Likely Compromised	12	NA	NA	Low Assessed as generally non-liquefiable	54	0	2.7	0.81	0.108	Foundation layers consist mostly of moderately dense to dense silts, clays, silty sands, and clean sands. CPT soundings indicate occaisonal sand layers in places with low penetration resistance. URS (2015a) indicated that this reach was generally non-liquefiable with 'Low' seismic vulnerability.
18c	1170	1213.85	4385	18 to 20	18	20	11.0	Not Analysed - judged based on subsurface soil conditions (up to 10 feet thick liquefiable zone). Vertical displacement of 1 feet based on analysis at Station 1116+00.	NA	Possibly Compromised	12	NA	NA	Low Assessed as generally non-liquefiable	54	0	2.7	0.81	0.108	Foundation layers consist mostly of moderately dense to dense silts, clays, silty sands, and sands. SPT blowcounts generally relatively high, some CPT soundings (e.g. Station1180 indicate moderately loose sand layers in upper portion of foundation). URS (2015a) indicated that this reach was generally non-liquefiable with 'Low' seismic vulnerability.
19a	1213.85	1245	3115	18 to 19	18	19	10.5	Liquefiable zone up to 30 feet thick. Minimum pseudo-static FOS less than 1 for analysis at Station 1224+00 and vertical displacemnt of 7 feet.	64	Likely Compromised	12	NA	NA	Low Assessed as generally non-liquefiable	64	10	3.2	0.96	0.128	Foundation layers consist mostly of moderately dense to dense silts, clays, silty sands, and sands. A few layers of silty sand and sand with moderately low penetration resistance. URS (2012) analysis for Station 1224+00 found post-earthquake F.S. = 1.17, but with up to 4 feet of settlement. URS (2015a) indicated that this reach was generally non-liquefiable with 'Low' seismic vulnerability.
19b	1245	1297.83	5283	18 to 20	18	20	10.9	Not Analysed - judged based on subsurface soil conditions (up to 15 feet thick liquefiable zone) and post earthquake F.S > 1 based on analysis at Station 1378+83.	NA	Probably Uncompromised	12	NA	NA	Low Assessed as generally non-liquefiable	54	0	0	0.81	0.108	Foundation layers appear to all be moderately dense to dense and not liquefiable. URS (2012) calculated high factors of safety for Station 1378+83 analysis model. URS (2015a) indicated that this reach was generally non-liquefiable with 'Low' seismic vulnerability.
20	1297.83	1374.33	7650	15 to 18	15	18	10.3	Not Analysed - judged based on subsurface soil conditions (no liquefiable zones) and post earthquake F.S >1 based on analysis at Station 1378+83.	NA	Probably Uncompromised	12	NA	NA	Low Assessed as generally non-liquefiable	54	0	0	0.81	0.108	Foundation layers appear to be generall moderately dense to dense and not liquefiable except for a few silty sand layers with moderately low penetration resistance. URS (2012) calculated high factors of safety for Station 1378+83 analysis model. URS (2015a) indicated that this reach was generally non-liquefiable with 'Low' seismic vulnerability.
21	1374.33	1433.83	5950	11	11	11	9.6	Liquefiable zone up to 15 feet thick. Minimum pseudo-static FOS greater than 1 for analysis at Station 1378+83	38	Probably Uncompromised	12 and 13	NA	NA	Low Assessed as generally non-liquefiable	38	0	0	0.57	0.076	Foundation layers appear to be generall moderately dense to dense and not liquefiable except for a few relatively clean sand layers at shallow depths - many of which appear to be above the groundwater level modeled at Elevation 55 feet in URS 2012 model at Station 1378+83. URS (2012) calculated high factors of safety for Station 1378+83 analysis model. URS (2015a) indicated that this reach was generally non-liquefiable with 'Low' seismic vulnerability.
22	1433.83	1503.83	7000	10 to 14	10	14	9.0	Not Analysed - judged based on subsurface soil conditions (up to 5 feet thick liquefiable zones) and post earthquake F.S >1 based on analysis at Station 1378+83 and 2047+50.	NA	Probably Uncompromised	13	NA	NA	Low Assessed as generally non-liquefiable	54	0	0	0.81	0.108	Foundation layers appear to be generall moderately dense to dense and not liquefiable except for a few relatively clean sand layers at shallow depths - many of which appear to be above the groundwater level modeled at Elevation 55 feet in URS 2012 model at Station 1378+83. URS (2012) calculated high factors of safety for Station 1378+83 analysis model. URS (2015a) indicated that this reach was generally non-liquefiable with 'Low' seismic vulnerability.
23	1503.83	1609.37	10554	7 to 10	7	10	7.3	Not Analysed - judged based on subsurface soil conditions (up to 5 feet thick liquefiable zones) and post earthquake F.S >1 based on analysis at Station 1378+83 and 2047+50.	NA	Probably Uncompromised	13	NA	NA	Low Assessed as generally non-liquefiable	54	0	0	0.81	0.108	Foundation layers appear to be generall moderately dense to dense and not liquefiable except for a few silty sand layers with moderately low penetration resistance. URS (2015a) indicated that this reach was generally non-liquefiable with 'Low' seismic vulnerability.
24	1609.37	1623.86	1449	7 to 10	7	10	7.2	Not Analysed - judged based on subsurface soil conditions (up to 5 feet thick liquefiable zones) and post earthquake F.S >1 based on analysis at Station 1378+83 and 2047+50.	NA	Probably Uncompromised	13	NA	NA	Low Assessed as generally non-liquefiable	54	0	0	0.81	0.108	Foundation layers generally appear to be relatively dense and not liquefiable. URS (2015a) indicated that this reach was generally non-liquefiable with 'Low' seismic vulnerability.
25	1623.86	1674.37	5051	6 to 10	6	10	7.2	Not Analysed - judged based on subsurface soil conditions (up to 5 feet thick liquefiable zones) and post earthquake F.S >1 based on analysis at Station 1378+83 and 2047+50.	NA	Probably Uncompromised	13	NA	NA	Low Assessed as generally non-liquefiable	54	0	0	0.81	0.108	Foundation layers generally appear to be relatively dense and not liquefiable. URS (2015a) indicated that this reach was generally non-liquefiable with 'Low' seismic vulnerability.
26	1674.37	1707.11	3274	6 to 8	6	8	7.9	Not Analysed - judged based on subsurface soil conditions (up to 5 feet thick liquefiable zones) and post earthquake F.S >1 based on analysis at Station 1378+83 and 2047+50.	NA	Probably Uncompromised	13	NA	NA	Low Assessed as generally non-liquefiable	54	NO WORK REACHES				
27	1707.11	1721.6	1449	5 to 6	5	6	7.1	Not Analysed - judged based on subsurface soil conditions (no liquefiable zones).	NA	Probably Uncompromised	13	NA	NA	Low Assessed as generally non-liquefiable	54					
28	1721.6	1769.31	4771	4 to 6	4	6	7.0	Not Analysed - judged based on subsurface soil conditions (no liquefiable zones).	NA	Probably Uncompromised	13	NA	NA	Low Assessed as generally non-liquefiable	54					
29	1769.31	1813.33	4402	4 to 6	4	6	7.2	Not Analysed - judged based on subsurface soil conditions (up to 5 feet thick liquefiable zones) and post earthquake F.S >1 based on analysis at Station 2047+50.	NA	Probably Uncompromised	13	NA	NA	Low Assessed as generally non-liquefiable	54	0	0	0.81	0.108	Foundation layers generally clayey, moderately dense to dense and not liquefiable. URS (2015a) indicated that this reach was gnerally non-liquefiable with 'Low' seismic vulnerability.

Table D3 - Summary of Previous and Current Damage Level Estimates for the FRWLP Levees (Estimated Vertical Settlement (ft))

Reach #	Station From	Station To	Length (ft)	Typical Levee Height in Reach (ft)	Minimum Height in Reach (ft)	Maximum Height in Reach (ft)	Average Height Above 10 Year WSE + 3 Feet Freeboard (ft)	2012 FRWL GDRR Seismic Cross Section and Analysis Results	Adjusted Levee Height (ft)	2012 FRWL GDRR Seismic Classification	2015 ULE GER Equivalent Seismic Segment	2015 ULE GER Seismic Cross Section and Analysis Results	Adjusted Levee Height (ft)	2015 FRWL ULE Seismic Classification	Assumed Seismic* Profile for Estimating Vertical Displcement (ft)	2020 Seismic Vulnerability Classification Maximum Vertical Displacement within Reach (feet)				Reasoning for Current Revised Assessment of Potential Damage Levels
																Compromised	Severe	Moderate - Major	None - Minor	
30	1813.33	1902	8867	11 to 22	11	22	7.9	Not Analysed - judged based on subsurface soil conditions (up to 15 feet thick liquefiable zones) and post earthquake F.S >1 based on analysis at Station 2047+50.	NA	Probably Uncompromised	13 to 15	Minimum Post Seismic FOS of 1.47 on landside at Station 1826+79	50	Low based on post seismic analysis results at Station 1826+79 and general assesent of non-liquefiable foundation soils	50	0	2.5	0.75	0.1	Foundation layers generally moderately dense to dense, but several boreholes and CPT soundings found shallow layers of silty sand with low penetration resistance, particularly between Stations 1820 and 1825. URS (2015a) indicated that this reach was generally non-liquefiable with 'Low' seismic vulnerability. URS (2015a) found high post-earthquake factor of safety (1.47) for analysis of Station 1827 model.
31	1902	1958	5600	6 to 9	6	9	9.4	Not Analysed - judged based on subsurface soil conditions (up to 5 feet thick liquefiable zones) and post earthquake F.S >1 based on analysis at Station 2047+50.	NA	Probably Uncompromised	15	NA	NA	Low Assessed as generally non-liquefiable	54	0	2.7	0.81	0.108	Foundation layers generally moderately dense to dense except for a few modetately loose to moderately dense shallow sandy silt layers. URS (2015a) indicated that this reach was generally non-liquefiable with 'Low' seismic vulnerability.
32	1958	1989	3100	12 to 23	12	23	8.2	Not Analysed - judged based on subsurface soil conditions (no liquefiable zones).	NA	Probably Uncompromised	15	NA	NA	Low Assessed as generally non-liquefiable	54	0	2.7	0.81	0.108	Several shallow sand layers in this reach with loose to moderate densities indicated by penetration resistance, particularly between Station 1960 and 1966. URS (2012) found high post earthquake factors of safety for analyses of Station 2211 model in Reach 35. URS (2015a) indicated that this reach was generally non-liquefiable with 'Low' seismic vulnerability.
33	1989	2122	13300	10 to 15	10	15	8.9	Liquefiable zone up to 15 feet thick. Minimum pseudo-static FOS greater than 1 for analysis at Station 2047+50	47	Probably Uncompromised	15	NA	NA	Low Assessed as generally non-liquefiable	47	0	2.35	0.705	0.094	Several shallow silty sand layers in this reach with moderately loose to moderately densities indicated by penetration resistance. URS (2012) found high post earthquake factors of safety for analyses of Station 2047+50 model (1.82) and URS (2015a) also found high post earhtquake factors of safety (1.62) in nearby Reach 35. URS (2015a) indicated that this reach was generally non-liquefiable with 'Low' seismic vulnerability.
34	2122	2182	6000	12 to 15	12	15	9.7	Not Analysed - judged based on subsurface soil conditions (up to 5 feet thick liquefiable zones) and post earthquake F.S >1 based on analysis at Station 2276+76.	NA	Probably Uncompromised	15	NA	NA	Low Assessed as generally non-liquefiable	54	0	2.7	0.81	0.108	Foundation layers appear to be moderately dense to dense, but several shallow shallow silty sand layers are found in this reach with moderately loose to moderately densities indicated by penetration resistance. URS (2012) found high post earthquake factors of safety for analyses of Station 2047+50 model (1.82) in Reach 33 and URS (2015a) also found high post earhtquake factors of safety (1.62) in nearby Reach 35. URS (2015a) indicated that this reach was generally non-liquefiable with 'Low' seismic vulnerability.
35	2182	2224	4200	12 to 16	12	16	8.8	Not Analysed - judged based on subsurface soil conditions (up to 5 feet thick liquefiable zones) and post earthquake F.S >1 based on analysis at Station 2276+76.	NA	Probably Uncompromised	15 to 17	Post Seismic FOS of 1.62 on waterside at Station 2211+15	36	Low based on post seismic analysis results at Station 2211+15 and general assesent of non-liquefiable foundation soils	36	0	1.8	0.54	0.072	Foundation layers appear to be moderately dense to dense, but several shallow shallow silty sand layers are found in this reach with moderately loose to moderately densities indicated by penetration resistance. URS (2012) found high post earthquake factors of safety for analyses of Station 2047+50 model (1.82) in Reach 33 and URS (2015a) also found high post earhtquake factors of safety (1.62) in nearby Reach 35. URS (2015a) indicated that this reach was generally non-liquefiable with 'Low' seismic vulnerability.
36	2224	2259	3500	12 to 17	12	17	9.7	Not Analysed - judged based on subsurface soil conditions (up to 10 feet thick liquefiable zones) and post earthquake F.S >1 based on analysis at Station 2276+76.	NA	Probably Uncompromised	17	NA	NA	Low Assessed as generally non-liquefiable	54	0	0	0.81	0.108	Foundation layers appear to be moderately dense to dense, but there are occaisonal shallow layers of sandy silt with moderate densities. URS (2012) found marginal factors of safety (1.12) and up to 0.4 feet of potential settlement for analysis at Station 2276+76 in nearby Reach 37. URS (2015a) indicated that this reach was generally non-liquefiable with 'Low' seismic vulnerability.
37	2259	2290	3100	15 to 17	15	17	11.0	Liquefiable zone up to 5 feet thick. Minimum pseudo-static FOS < 1 for analysis at Station 2276+76 and vertical displacemnt of 0.6 feet.	32	Probably Uncompromised	17	NA	NA	Low Assessed as generally non-liquefiable	32	0	0	0.48	0.064	Foundation layers appear to be moderately dense to dense, but there are occaisonal shallow layers of sandy silt with moderately densities, and a few places with relatively clean sands with low SPT blowcounts, particularly near Station 2276 - some of these layers may be above the groundwater level and be unsaturated. URS (2012) found factors of safety (1.13) and up to 0.4 feet of potential settlement for analysis at Station 2276+76 in this reach. URS (2015a) indicated that this reach was generally non-liquefiable with 'Low' seismic vulnerability.
38	2290	2303	1300	14 to 23	14	23	13.2	Not Analysed - judged based on subsurface soil conditions (no liquefiable zone).	NA	Probably Uncompromised	17	NA	NA	Low Assessed as generally non-liquefiable	54	0	0	0	0.108	Limited amount of penetration data for this short reach and there are larger amounts of gravel layers, but foundation layers appear to be moderately dense to dense. URS (2012) found marginal factors of safety (1.13) and up to 0.4 feet of potential settlement for analysis at Station 2276+76 in nearby Reach 37. URS (2015a) indicated that this reach was generally non-liquefiable with 'Low' seismic vulnerability.
39	2303	2319	1600	12 to 13	12	13	11.4	Not Analysed - judged based on subsurface soil conditions (no liquefiable zone).	NA	Probably Uncompromised	17	NA	NA	Low Assessed as generally non-liquefiable	54	0	0	0	0.108	Levee embankment and foundation composed principally of gravel in this reach - probably not liquefiable at these low PGA levels (0.11g). 2012 URS analysis of Station 2332+91 in adjacent Reach 40 yielded high post-earhtquake factors of safety (2.31). URS (2015a) indicated that this reach was generally not liquefiable.
40	2319	2359	4000	15 to 25	15	25	9.7	Liquefiable zone up to 10 feet thick. Minimum pseudo-static FOS greater than 1 for analysis at Station 2332+91.	37	Probably Uncompromised	17	NA	NA	Low Assessed as generally non-liquefiable	37	0	0	0.555	0.074	Levee embankment and foundation composed principally of gravel in this reach - probably not liquefiable at these low PGA levels (0.11g) Occaisonal shallow layers of moderately loose sand in upper foundation (e.g. near Station Station 2334 - 2337, some of which may be above groundwater level and unsaturated based on groundwater elevation of 106.7 used in 2012 URS Station 2332+91 analysis. 2012 URS analysis of Station 2332+91 in this reach yielded high post-earhtquake factors of safety (2.31). URS (2015a) indicated that this reach was generally not liquefiable.
41	2359	2368	900	8 to 17	8	17	9.7	Not Analysed - judged based on subsurface soil conditions (no liquefiable zone).	NA	Probably Uncompromised	17	NA	NA	Low Assessed as generally non-liquefiable	54	0	0	0	0.108	Limited penetration test data in this short reach. Levee embankment and upper foundation generally composed of clay, with mostly gravel extending to depth beneath the upper clay foundation. URS (2015a) indicated that this reach was generally not liquefiable.
																60	56.25	30.105		

Notes

* Assumed seismic profile is the greater of the Adjusted Levee Height from the 2012 or 2015 studies. If no values available then the average profile of 54 feet was assumed.

Appendix B. Select Annual Inspection Reports

Appendix **A**

Sacramento River Individual Agency Summary Reports

Sacramento River Basin includes 85 local maintaining Areas that maintain Project Levees, Structures, and Channels. Out of 85 Areas, there are 37 RDs, 19 NAs, 14 STs, 10 MAs and 5 LDs. Appendix A includes an index of the Sacramento River Basin Areas, a system map to show the locations of each reporting Area, and individual Area summary profiles.

Appendix A includes:

- Sacramento River Basin Area Index
- Sacramento System Map
- Individual local Area Summary Profiles, Sacramento River Basin

Sacramento System LMAs

1
NA 18-Shea Levee
1 inch = 4,500 feet
Shea Levee

2
NA 15-Plumas Co.
Lake Almanor
1 inch = 1 miles
Plumas County

3
NA 9-Lake Co.
MA 17-Sutter Yard
Clear Lake
1 inch = 3 miles
Lake County

1 2 3
Full Extent

Tehama Co Flood Control & Water Conservation District
Tehama
Plumas
Butte
Butte Co.
Chico
M&T Ranch
MA5-Sutter Yard
Glenn
Willows
LD1G
LD2
LD3
Thermalito Reservoir
Lake Oroville
MA13-Sutter Yard
HamiltonBend
MA7-Sutter Yard
New Bullards Bar Reservoir
Yuba
MA16-Sutter Yard
Honcut Creek
RD10
LD9
East-West Interceptor
Wadsworth Canal
Marysville
Sutter
Sutter Buttes
Colusa
ST3
MA1-Sutter Yard
Colusa
MA12-Sutter Yard
RD70
Yuba City
RD2103
RD784
LD1S
RD1660
Nevada
Sacramento River West Side Levee District
RD817
MA3-Sutter Yard
Nelson Bend
Tisdale-Sutter Yard
East Levee Sutter Bypass
RD1500
RD108
Yolo
Placer
Yolo CSA 6
Knights Landing
West Levee Yolo Bypass
Cache-Yolo Co
Cache-Sac Yard
West Levee Yolo Bypass
RD827
RD785
RD2035
Willow-Sac Yard
RD900
Putah-Sac Yard
RD765
RD307
RD2068
RD2098
RD2104
RD0787
RD1001
East Levee Yolo Bypass
RD1600
RD537
Folsom Lake
Sacramento Bypass
RD1000
MA4-Sac Yard
ARFCD
City of Sacramento
RD999
MA9-Sac Yard
RD150
RD755
RD551
RD349
RD369
RD554
RD556
RD563
RD1601
Lake Berryessa
Napa
Sonoma
Solano
RD2060
RD536
RD501
RD3
Solano Co Public Works
BALMD
RD341
San Pablo Bay
Vallejo
Suisun Bay
Pittsburg
Lodi
Stockton
Sacramento

Project Levees
Roads
Cities
Watershed
Counties
NA - Named Area
LD - Levee District
MA - Maintenance Area
RD - Reclamation District
Version of December 2018

N W E S

0 5 10 20
Scale in Miles

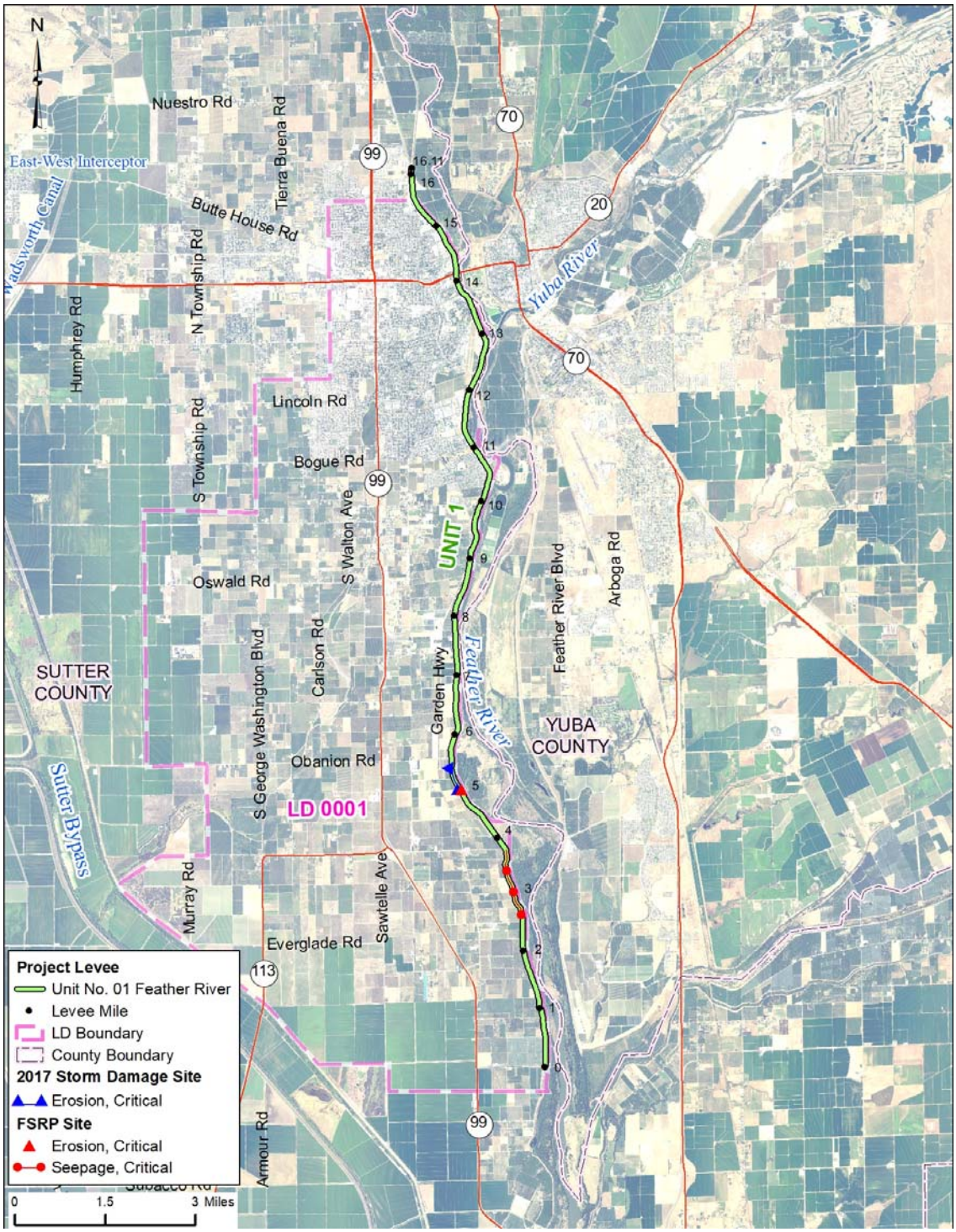
Levee District No. 0001 (Sutter County)

Counties

Sutter County

Contact

Andrew Stresser
General Manager
243 Second St
Yuba City CA 95991
Phone: (530) 673-2454



LD 1S

LMA Short Name : LD0001S ‡		Bank	Length (Miles)
Unit No. 01	Feather River	RB	16.11

Threat Assessment & Recommendations

- The LMA should continue to maintain the area at the high level seen during the last inspection.

DWR Levee Inspection Summary

Fall 2020 Overall Rating: A

Rated Item	Fall 2020 M Miles	Fall 2020 U Miles	Fall 2020 M+4U Miles	Fall 2020 Threshold %	Change M Miles	Change U Miles	Change M+4U Miles	Change Threshold % **
Animal Control	0.01	--	0.01	**0.06**	0.01	--	0.01	**0.06**
DWR UCIP Field Study	--	--	--	**--**	--	--	--	**0.00**
LMA Totals:	0.01	0.00	0.01	**0.06**	0.01	0.00	0.01	**0.06**

‡ Some areas within the LMA are under construction and as such, the contractor has operation and maintenance obligations in those areas during project construction and closeout.

** 'Change Threshold %' is a comparison between 2019 and 2020 data.
A negative number indicates an improvement. A positive number indicates a decline.

DWR Structure Inspection Summary

No Structures Inspected in this District.

DWR Channel Inspection Summary

No Channels Inspected in this District.

USACE 2017 Sacramento River Erosion Summary

No Supplemental Erosion Sites.

USACE Inspection Ratings Summary - PL 84-99 Rehabilitation Program

System Name	Length (Miles)	Status	Date
Feather River right bank - Sutter Bypass east bank	0.49	Active	2/24/2014

2017 Storm Damage Sites

Unit No. 01 Feather River

Site Designation	Rating	Repair Type	Start LM	End LM	Latitude	Longitude
LD1-S-02	Critical	Erosion	5.02	5.43	39.018322	-121.610275

DWR 2020 Flood System Repair Project Summary

Unit No. 01 Feather River, RB

POI Number	Category	Failure Mode	Start LM	End LM	Latitude	Longitude
FSRP-13-64	Critical	Seepage	2.60	3.76	38.987740	-121.592090
FSRP-17-145	Critical	Erosion	5.02		39.018322	-121.610275
FSRP-17-273	Critical	Seepage	12.18	15.11	39.117240	-121.604120

DWR Summary of Local Maintaining Agency Report

Part 1 Information known to the Local Agency that is relevant to the condition or performance of the Project Levee (or jurisdictional Non-Project Levee)

The Agency reported berm erosion at LM 5.39 and LM 7.50, and sediment accumulation between LM 9.40 and LM 10.00.

Part 2 Information identifying known conditions that might impair or compromise the level of flood protection provided by the Project Levee (or jurisdictional Non-Project Levee)

The Agency reported levee erosion at LM 5.39 and LM 7.50, and levee erosion on an access road on the waterside adjacent to Abbott Lake between LM 4.90 and LM 5.70 that has been identified as a potential PL 84-99 fix; the start date is currently undetermined.

Part 3 A summary of maintenance performed by the Local Agency during the previous fiscal year

The Agency provided a list of expenses and maintenance activities performed on all levee units. Activities include mobile equipment costs, roadway maintenance, slope dragging, and vegetation control by burning and spraying. The reported total maintenance cost for the previous fiscal year was $120,350.

Part 4 A statement of work and estimated cost for operation and maintenance of the Project Levee (or jurisdictional Non-Project Levee) for the current fiscal year, as approved by the Local Agency

The Agency provided a list of planned expenses and maintenance activities for all levee units. Expenses include the cost of gate maintenance, mobile equipment, roadway maintenance, slope dragging, and vegetation control by burning and spraying. The reported total cost for the current fiscal year is $385,000, which corresponds to $23,898 per levee mile.

Part 5 Any other readily available information contained in the records of the Local Agency relevant to the condition or performance of the Project Levee (or jurisdictional Non-Project Levee), as determined by the CVFPB or DWR

The Agency reported that there is no additional information relevant to levee condition or performance.

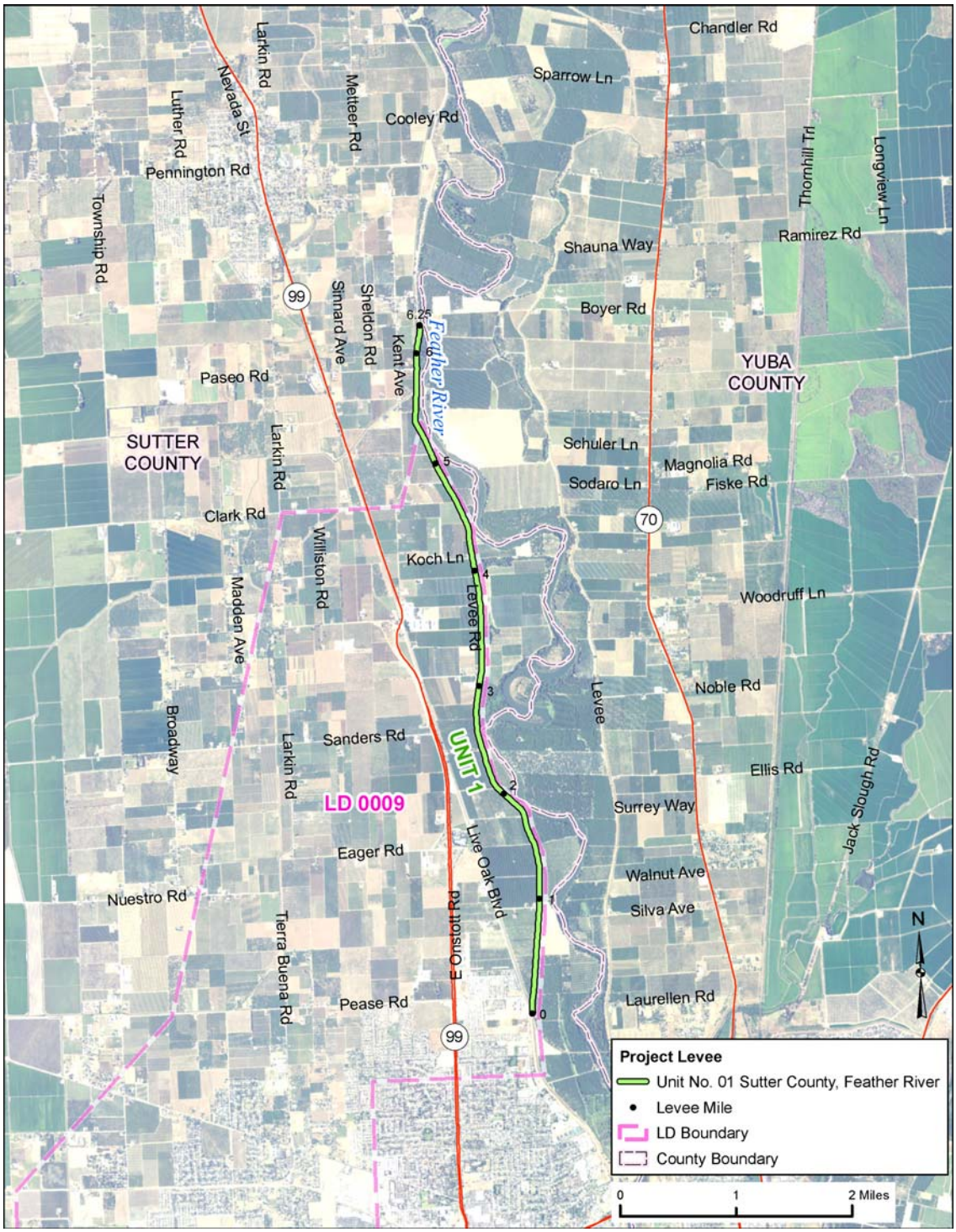
Levee District No. 0009 (Sutter County)

Counties

Sutter County

Contact

Chris Schmidl
Director
1250 Hermansen Avenue
Live Oak CA 95953
Phone: (530) 695-2139



LMA Short Name :	LD0009	Bank	Length (Miles)
Unit No. 01	Sutter County, Feather River	RB	6.25

Threat Assessment & Recommendations

- The LMA should continue to maintain the area at the high level seen during the last inspection.

DWR Levee Inspection Summary

Fall 2020 Overall Rating: A

Rated Item	Fall 2020 M Miles	Fall 2020 U Miles	Fall 2020 M+4U Miles	Fall 2020 Threshold %	Change M Miles	Change U Miles	Change M+4U Miles	Change Threshold % **
Animal Control	--	--	--	**--**	-0.01	--	-0.01	**-0.16**
LMA Totals:	0.00	0.00	0.00	**0.00**	-0.01	0.00	-0.01	**-0.16**

** 'Change Threshold %' is a comparison between 2019 and 2020 data.
A negative number indicates an improvement. A positive number indicates a decline.

DWR Structure Inspection Summary

No Structures Inspected in this District.

DWR Channel Inspection Summary

No Channels Inspected in this District.

USACE 2017 Sacramento River Erosion Summary

No Supplemental Erosion Sites.

USACE Inspection Ratings Summary - PL 84-99 Rehabilitation Program

System Name	Length (Miles)	Status	Date
Feather River right bank - Sutter Bypass east bank	0.49	Active	2/24/2014

DWR Summary of Local Maintaining Agency Report

Part 1 Information known to the Local Agency that is relevant to the condition or performance of the Project Levee (or jurisdictional Non-Project Levee)

The Agency reported that there is no new information relevant to levee condition or performance.

Part 2 Information identifying known conditions that might impair or compromise the level of flood protection provided by the Project Levee (or jurisdictional Non-Project Levee)

The Agency reported levee erosion, major settlement, sloughing, and loss of grade as relevant impairments or compromising conditions.

Part 3 A summary of maintenance performed by the Local Agency during the previous fiscal year

The Agency did not provide any summary of maintenance activities performed during the previous fiscal year.

Part 4 A statement of work and estimated cost for operation and maintenance of the Project Levee (or jurisdictional Non-Project Levee) for the current fiscal year, as approved by the Local Agency

The Agency provided a list of planned expenses and maintenance activities for all levee units. Expenses include the cost of k-rail and concrete blocks to prevent unauthorized vehicle access, insurance and dues, legal, administrative, and management services, mobile equipment, rodent baiting and trapping, slope dragging, and vegetation control by burning and spraying. The reported total cost for the current fiscal year is $86,000, which corresponds to $13,760 per levee mile.

Part 5 Any other readily available information contained in the records of the Local Agency relevant to the condition or performance of the Project Levee (or jurisdictional Non-Project Levee), as determined by the CVFPB or DWR

The Agency reported that there is no additional information relevant to levee condition or performance.

Sutter Maintenance Yard Hamilton Bend

Counties

Butte County

Contact

Joel Farias
Utility Craftsworker Superintendent
P.O Box 40
Sutter CA 95982
Phone: (530) 755-0071

LMA Short Name : ST0005		Bank	Length (Miles)
Unit No. 01	Feather River Hamilton Bend	RB	3.39

Threat Assessment & Recommendations

- There is vegetation that significantly impacts access and visibility in this Area.
- The LMA should focus more on controlling vegetation to maintain visibility and access.
- The LMA should focus more on controlling woody vegetation.

DWR Levee Inspection Summary

Fall 2020 Overall Rating: U

Rated Item	Fall 2020 M Miles	Fall 2020 U Miles	Fall 2020 M+4U Miles	Fall 2020 Threshold %	Change M Miles	Change U Miles	Change M+4U Miles	Change Threshold % **
Vegetation	0.02	1.59	6.38	**187.95**	--	--	--	**0.00**
Trim / Thin Trees	--	2.32	9.28	**273.38**	--	--	--	**0.00**
DWR UCIP Field Study	--	--	--	**--**	--	--	--	**0.00**
LMA Totals:	0.02	3.91	15.66	**461.33**	0.00	0.00	0.00	**0.00**

** 'Change Threshold %' is a comparison between 2019 and 2020 data.
A negative number indicates an improvement. A positive number indicates a decline.

DWR Structure Inspection Summary

No Structures Inspected in this District.

DWR Channel Inspection Summary

No Channels Inspected in this District.

USACE 2017 Sacramento River Erosion Summary

No Supplemental Erosion Sites.

USACE Inspection Ratings Summary - PL 84-99 Rehabilitation Program

System Name	Length (Miles)	Status	Date
Feather River - Hamilton - northeast of Afterbay	3.68	Inactive	7/22/2014
Feather River right bank - Sutter Bypass east bank	0.49	Active	2/24/2014

DWR Summary of Local Maintaining Agency Report

Part 1 Information known to the Local Agency that is relevant to the condition or performance of the Project Levee (or jurisdictional Non-Project Levee)

The Agency referred to the DWR inspection report. The Spring 2020 Inspection Report provided unacceptable ratings for trimming/thinning trees and vegetation.

Part 2 Information identifying known conditions that might impair or compromise the level of flood protection provided by the Project Levee (or jurisdictional Non-Project Levee)

The Agency referred to the DWR inspection report. The Spring 2020 Inspection Report provided unacceptable ratings for trimming/thinning trees and vegetation.

Part 3 A summary of maintenance performed by the Local Agency during the previous fiscal year

The Agency provided a list of expenses and maintenance activities performed on all levee units. Activities include inspections. The reported total maintenance cost for the previous fiscal year was $6,000.

Part 4 A statement of work and estimated cost for operation and maintenance of the Project Levee (or jurisdictional Non-Project Levee) for the current fiscal year, as approved by the Local Agency

The Agency provided a list of planned expenses and maintenance activities for all levee units. Expenses include the cost of inspections. The reported total cost for the current fiscal year is $6,000, which corresponds to $1,770 per levee mile.

Part 5 Any other readily available information contained in the records of the Local Agency relevant to the condition or performance of the Project Levee (or jurisdictional Non-Project Levee), as determined by the CVFPB or DWR

The Agency reported that there is no additional information relevant to levee condition or performance.

Sutter Maintenance Yard Maintenance Area 0007

Counties

Butte County

Contact

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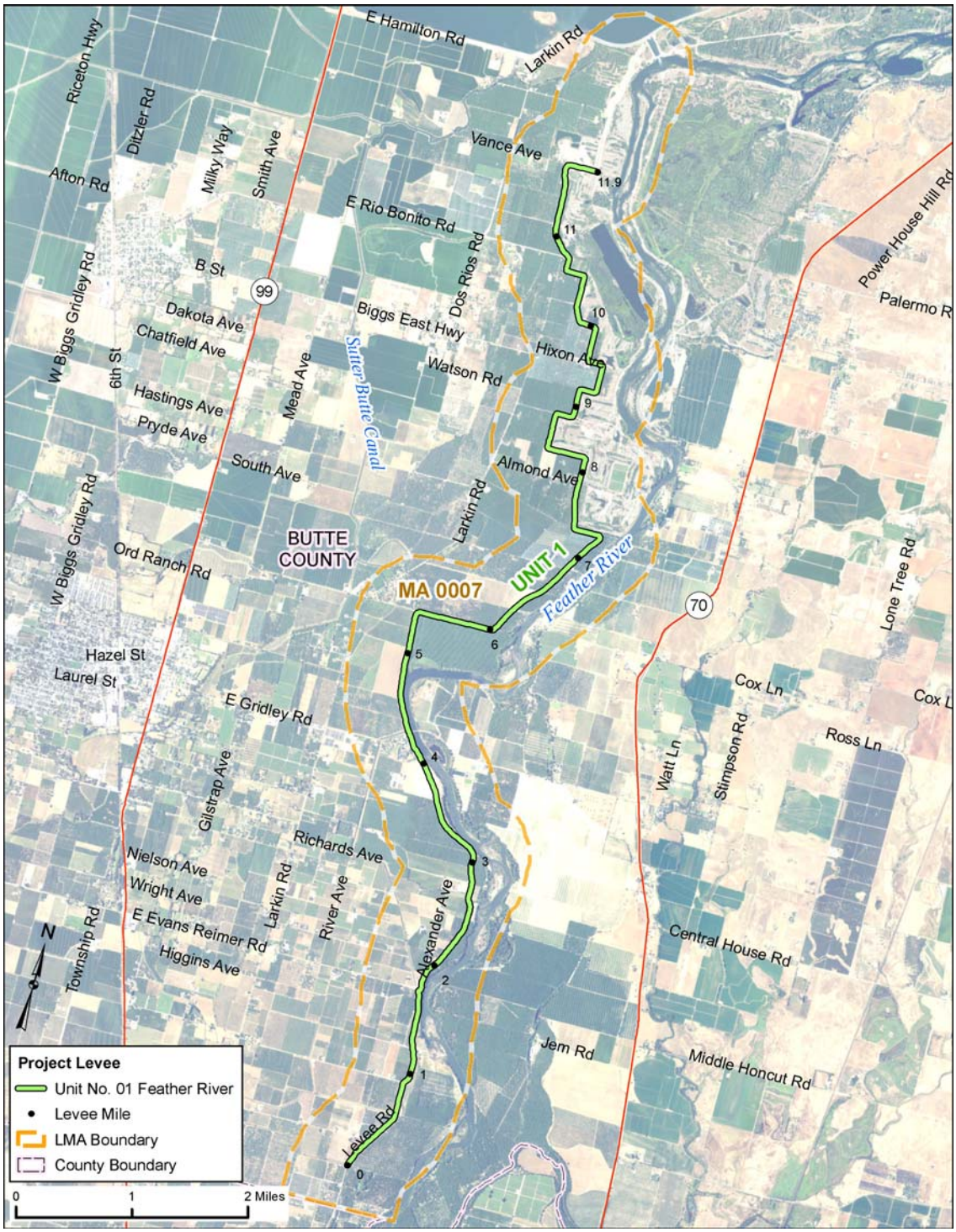
Sutter CA 95982
Phone: (530) 755-0071



LMA Short Name : MA0007		Bank	Length (Miles)
Unit No. 01	Feather River	RB	11.90

Threat Assessment & Recommendations

- The LMA should continue to maintain the area at the high level seen during the last inspection.

DWR Levee Inspection Summary

Fall 2020 Overall Rating: A

Rated Item	Fall 2020 M Miles	Fall 2020 U Miles	Fall 2020 M+4U Miles	Fall 2020 Threshold %	Change M Miles	Change U Miles	Change M+4U Miles	Change Threshold % **
DWR UCIP Field Study	--	--	--	**--**	--	--	--	**0.00**
DWR UCIP LMA Responsibility	--	--	--	**--**	--	--	--	**0.00**
LMA Totals:	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	**0.00**

** 'Change Threshold %' is a comparison between 2019 and 2020 data.
A negative number indicates an improvement. A positive number indicates a decline.

DWR Structure Inspection Summary

No Structures Inspected in this District.

DWR Channel Inspection Summary

No Channels Inspected in this District.

USACE 2017 Sacramento River Erosion Summary

Unit No. 01 Feather River, R

Site ID	River Mile	Start LM	End LM	Status	Rating
FHR 47.5 R	47.50	1.55	1.71	Eroding	A/W

USACE Inspection Ratings Summary - PL 84-99 Rehabilitation Program

System Name	Length (Miles)	Status	Date
Feather River right bank - Sutter Bypass east bank	0.49	Active	2/24/2014

DWR Summary of Local Maintaining Agency Report

Part 1 Information known to the Local Agency that is relevant to the condition or performance of the Project Levee (or jurisdictional Non-Project Levee)

The Agency referred to the DWR inspection report. The Spring 2020 Inspection Report provided unacceptable ratings for encroachments and utility crossings.

Part 2 Information identifying known conditions that might impair or compromise the level of flood protection provided by the Project Levee (or jurisdictional Non-Project Levee)

The Agency referred to the DWR inspection report. The Spring 2020 Inspection Report provided unacceptable ratings for encroachments and utility crossings.

Part 3 A summary of maintenance performed by the Local Agency during the previous fiscal year

The Agency provided a list of expenses and maintenance activities performed on all levee units. Activities include encroachment control, inspections, minor structure repair/maintenance, patrolling, restoration, roadways, rodent control by baiting and trapping, slope dragging, and vegetation control by burning, mowing, and other. The reported total maintenance cost for the previous fiscal year was $132,913.

Part 4 A statement of work and estimated cost for operation and maintenance of the Project Levee (or jurisdictional Non-Project Levee) for the current fiscal year, as approved by the Local Agency

The Agency provided a list of planned expenses and maintenance activities for all levee units. Expenses include the cost of encroachment control, environmental support, inspections, maintenance yard overhead, minor structure repair/maintenance, mobile equipment costs, patrolling, restoration, roadways, rodent control by baiting and trapping, slope dragging, surveying and engineering, and vegetation control by burning, mowing, and spraying. The reported total cost for the current fiscal year is $148,000, which corresponds to $12,437 per levee mile.

Part 5 Any other readily available information contained in the records of the Local Agency relevant to the condition or performance of the Project Levee (or jurisdictional Non-Project Levee), as determined by the CVFPB or DWR

The Agency reported that there is no additional information relevant to levee condition or performance.

Sutter Maintenance Yard Maintenance Area 0016

Counties

Sutter County

Contact

Joel Farias
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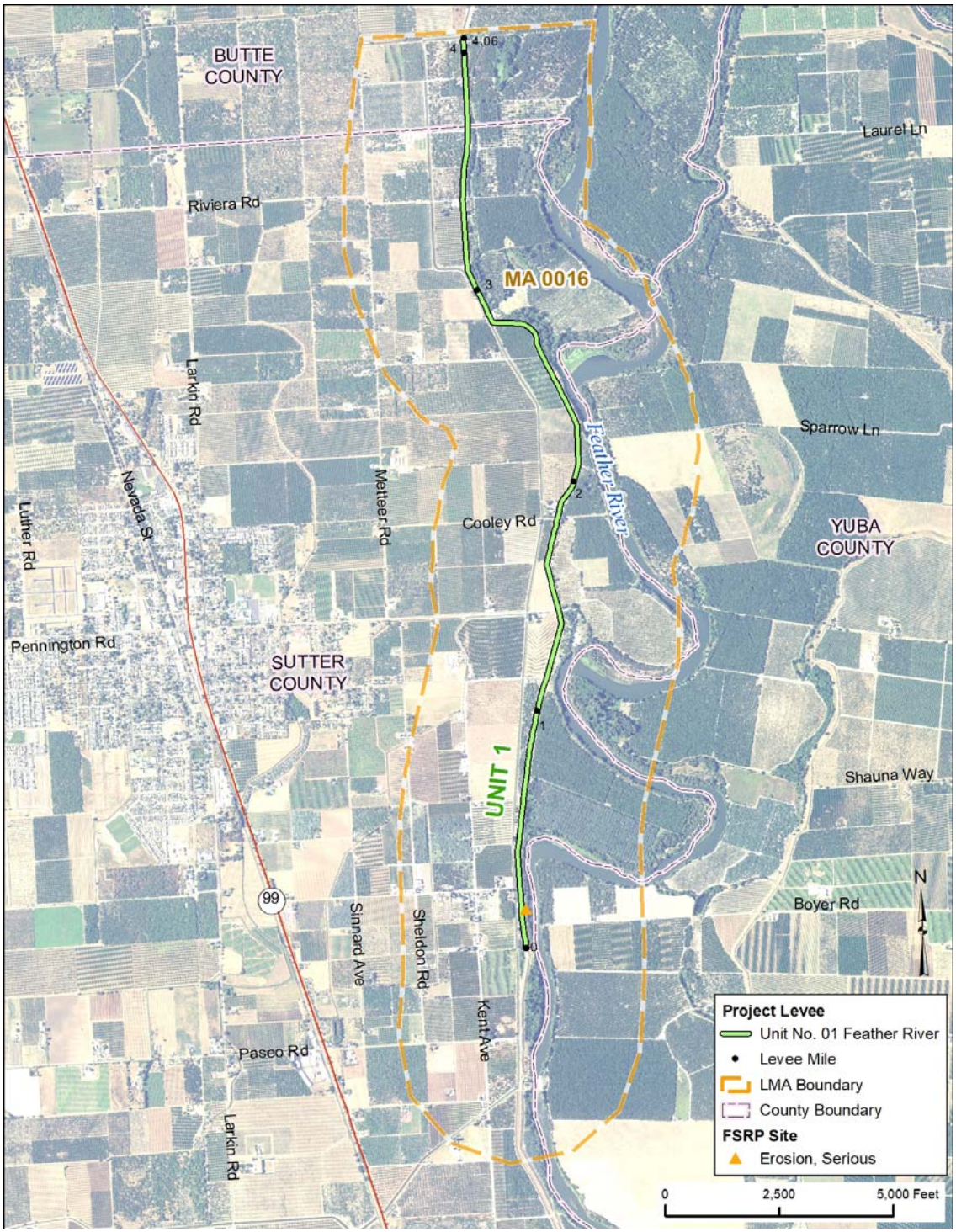
Sutter CA 95982
Phone: (530) 755-0071



LMA Short Name : MA0016		Bank	Length (Miles)
Unit No. 01	Feather River	RB	4.06

Threat Assessment & Recommendations

- The LMA should continue to maintain the area at the high level seen during the last inspection.

DWR Levee Inspection Summary

Fall 2020 Overall Rating: A

Rated Item	Fall 2020 M Miles	Fall 2020 U Miles	Fall 2020 M+4U Miles	Fall 2020 Threshold %	Change M Miles	Change U Miles	Change M+4U Miles	Change Threshold % **
DWR UCIP Field Study	--	--	--	**--**	--	--	--	**0.00**
DWR UCIP LMA Responsibility	--	--	--	**--**	--	--	--	**0.00**
LMA Totals:	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	**0.00**

** 'Change Threshold %' is a comparison between 2019 and 2020 data.
A negative number indicates an improvement. A positive number indicates a decline.

DWR Structure Inspection Summary

No Structures Inspected in this District.

DWR Channel Inspection Summary

No Channels Inspected in this District.

USACE 2017 Sacramento River Erosion Summary

No Supplemental Erosion Sites.

USACE Inspection Ratings Summary - PL 84-99 Rehabilitation Program

System Name	Length (Miles)	Status	Date
Feather River right bank - Sutter Bypass east bank	0.49	Active	2/24/2014

DWR 2020 Flood System Repair Project Summary

Unit No. 01 Feather River, RB

POI Number	Category	Failure Mode	Start LM	End LM	Latitude	Longitude
FSRP-17-143	Serious	Erosion	0.16		39.258105	-121.636314

DWR Summary of Local Maintaining Agency Report

Part 1 Information known to the Local Agency that is relevant to the condition or performance of the Project Levee (or jurisdictional Non-Project Levee)

The Agency referred to the DWR inspection report. The Spring 2020 Inspection Report showed no unacceptable ratings.

Part 2 Information identifying known conditions that might impair or compromise the level of flood protection provided by the Project Levee (or jurisdictional Non-Project Levee)

The Agency referred to the DWR inspection report. The Spring 2020 Inspection Report showed no unacceptable ratings.

Part 3 A summary of maintenance performed by the Local Agency during the previous fiscal year

The Agency provided a list of expenses and maintenance activities performed on all levee units. Activities include encroachment control, inspections, minor structure repair/maintenance, patrolling, restoration, roadways, rodent control by baiting and trapping, slope dragging, and vegetation control by burning, mowing, and other. The reported total maintenance cost for the previous fiscal year was $84,713.

Part 4 A statement of work and estimated cost for operation and maintenance of the Project Levee (or jurisdictional Non-Project Levee) for the current fiscal year, as approved by the Local Agency

The Agency provided a list of planned expenses and maintenance activities for all levee units. Expenses include the cost of encroachment control, environmental support, inspections, maintenance yard overhead, minor structure repair/maintenance, mobile equipment costs, restoration, roadways, rodent control by baiting and trapping, slope dragging, surveying and engineering, and vegetation control by burning, mowing, and spraying. The reported total cost for the current fiscal year is $96,000, which corresponds to $23,645 per levee mile.

Part 5 Any other readily available information contained in the records of the Local Agency relevant to the condition or performance of the Project Levee (or jurisdictional Non-Project Levee), as determined by the CVFPB or DWR

The Agency reported that there is no additional information relevant to levee condition or performance.

Flood Control Project Maintenance
Levee Inspections

Fall 2020 Levee Maintenance Deficiency Summary Report

Sacramento River Basin

LD0001S‡ **Levee District No. 0001 (Sutter County)**	Overall LMA Rating	Total LMA Miles						
	A	**16.11**						
Rated Item	Maintenance Deficiency				Enforcement		Design & System Obsolescence	
	M Miles	U Miles	M + 4U Miles	Threshold %	M Miles	U Miles	M Miles	U Miles
Earthen Levee								
Encroachments					0.01			
Animal Control	0.01		0.01	0.06%				
Supplemental								
DWR UCIP Field Study					0.11			
LMA Totals:	0.01	0.00	0.01	0.06%	0.12	0.00	0.00	0.00

Unit No. 01 Feather River RB LD0001S	Overall Unit Rating	Total Unit Miles						
	A	**16.11**						
Rated Item	Maintenance Deficiency				Enforcement		Design & System Obsolescence	
	M Miles	U Miles	M + 4U Miles	Threshold %	M Miles	U Miles	M Miles	U Miles
Earthen Levee								
Encroachments					0.01			
Animal Control	0.01		0.01	0.06%				
Supplemental								
DWR UCIP Field Study					0.11			
Unit Totals:	0.01	0.00	0.01	0.06%	0.12	0.00	0.00	0.00

‡ Some areas within the LMA are under construction and as such, the contractor has operation and maintenance obligations in those areas during project construction and closeout.

State of California - Department of Water Resources - Division of Flood Management - Flood Project Integrity & Inspection Branch

Flood Control Project Maintenance
Levee Inspections

LMA District Cover Sheet

Levee District No. 0001 (Sutter County)

	Spring (March - May)	Summer ** (June - August)	Fall (September - November)	Winter ** (December - February)
† Overall LMA Rating (Fall Only)			**A**	

** Non-receipt of Summer or Winter Inspection Reports may effect overall annual rating.

† SPRING INSPECTIONS: Overall maintenance ratings are not determined for the spring inspection results. Individual maintenance deficiencies are rated using the same criteria in the spring and in the fall.

FALL INSPECTIONS: The overall maintenance rating shown above is based on operation and maintenance deficiencies identified within the attached unit inspection reports. This rating is not intended to be an indiction of risk.

Comments

Flood Control Project Maintenance
Levee Inspections

Unit Cover Sheet

Levee District No. 0001 (Sutter County)

Waterway	Bank	Unit Miles
Unit No. 01 Feather River	Right	16.11

	Spring (March - May)	Summer (June - August)	(September - November) Fall	Winter (December - February)
Unit Maintenance Rating (Fall Only)			**A**	
Date of Inspection	3/17/2020 - 3/17/2020		10/13/2020 - 10/13/2020	
DWR Inspector	Sterling York		Brooks Weisser	
Accompanied By	Andrew Stresser LD0001S			

Summer & Winter Inspections

The Local Maintaining Agency (LMA) is responsible for summer and winter inspections. The LMA is required to submit a report regarding summer and winter inspections to the California Department of Water Resources (DWR).

DWR must be informed on the:
a) completion of the inspection
b) any changes other than the results of normal maintenance
c) corrections to deficiencies noted in this report

If additional items are noted, further documentation of those items must also be submitted.

The LMA should submit this information to DWR using the LMA web application tool available at:

http://cdec.water.ca.gov/lma.html

If the LMA is unable to submit information on this webpage, please contact DWR for assistance.

The LMA should submit the information and any associated documentation by September 30 for summer inspections and March 31 for winter inspections.

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Levee District No. 0001 (Sutter County)

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	16.11	10/13/2020 10/13/2020	Brooks Weisser

LM Start		Rating **	A	Issue No.	**4**
LM End		Issue Type +	Ma	Location *	
Category	Earthen Levee			GPS Latitude/Longitude	
				Start	End
Item	Operations & Maintenance Manuals			°	°
				°	°
DWR ID	DWR_LD0001S_01_s _ 2013_4				

Comment Code

Inspector Comment

O&M manuals are stored at the district office at 243 2nd St, Yuba City, CA.

No Photos

LM Start		Rating **	A	Issue No.	**5**
LM End		Issue Type +	Ma	Location *	
Category	Earthen Levee			GPS Latitude/Longitude	
				Start	End
Item	Emergency Supplies & Equipment			°	°
				°	°
DWR ID	DWR_LD0001S_01_s _ 2013_5				

Comment Code

Inspector Comment

Supplies and flood fight equipment are stored at the district office. They also went in with RD784 in their large stockpile of flood fight supplies located in their district.

No Photos

LM Start		Rating **	A	Issue No.	**6**
LM End		Issue Type +	Ma	Location *	
Category	Earthen Levee			GPS Latitude/Longitude	
				Start	End
Item	Flood Preparedness & Training			°	°
				°	°
DWR ID	DWR_LD0001S_01_s _ 2013_6				

Comment Code

Inspector Comment

The district employees attend the Flood Fight class put on by DWR and RD784 annually. Pending RxR closure structure training LM 16.10.

No Photos

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiancy Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Levee District No. 0001 (Sutter County)

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	16.11	10/13/2020 10/13/2020	Brooks Weisser

LM Start	**0.00**	Rating **	A/W	Issue No.	**15**
LM End	**4.34**	Issue Type +	Ma	Location *	CR
Category	Earthen Levee			GPS Latitude/Longitude	
				Start	End
Item	Crown Surface / Depressions / Rutting			38.950976 °	39.010657 °
				-121.585753 °	-121.602887 °
DWR ID	DWR_LD0001S_01_s _ 2020_15				

Comment Code

C1 : Add appropriate material and re-grade the levee to bring the crown above the design elevation.

Inspector Comment

USACE Project completed, O&M manual and levee have not been turned over to LMA. This section is not maintained yet, Fall 2020.

Photo 1 of 1 : FA_2020_LD0001S_433_15_20201019_00042.jpg

View looking downstream of completed construction, but levee has not been turned over to LMA, Fall 2020.

LM Start	**0.36**	Rating **	M	Issue No.	**27**
LM End	**0.36**	Issue Type +	En	Location *	
Category	Supplemental			GPS Latitude/Longitude	
				Start	End
Item	DWR UCIP Field Study			38.956192 °	38.956192 °
				-121.585510 °	-121.585510 °
DWR ID	18653				

Comment Code

Inspector Comment

DS_ID:18653
FS_ID:41624
EP_NO: 4667
Repair Type: Non-Urgent
EVAL Issue:
Crossing Status: Found
UCIP Comments: 04/12/2013 Abandoned crossing. Concrete box on both sides found. Pipe remainings are found on WS. (DWR UCIP - P. Amatya)
FIELD_STRUCT_DESC: *ABANDONED* 36-inch steel irrigation pipe through the levee, 10 feet below the crown. Concrete box found on each side. Pipe remains found on the waterside (WS) after the removal of 40 feet of 36-inch steel pipe from a spur levee and 20 feet of 36-inch steel pipe from the landside (LS) slope of the Feather River Levee. (Plans for removal of a portion and filling with concrete a portion of an abandoned 36-inch steel pipe through the levee authorized under Permit No. 4667, 1964 - Levee District No. 1 of Sutter County [LD0001S]). [Additional Reference(s): USACE Sacramento O&M Manual 144, August 1955, (Station 735+57)].
FS Date: 4/12/2013

Photo 1 of 3 : UCIP_FA_2020_41624_18769.jpg

Crown view- overview of both sides of the levee

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiancy Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Levee District No. 0001 (Sutter County)

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	16.11	10/13/2020 10/13/2020	Brooks Weisser

LM Start	**0.36**	Rating **	M	Issue No.	**27 (cont)**
LM End	**0.36**	Issue Type +	En	Location *	
Category	Supplemental			GPS Latitude/Longitude	
				Start	End
Item	DWR UCIP Field Study			38.956192 °	38.956192 °
				-121.585510 °	-121.585510 °
DWR ID	18653				

Photo 2 of 3 : UCIP_FA_2020_41624_18768.jpg

WS- abandoned pipe near power pole (right)

LM Start	**0.36**	Rating **	M	Issue No.	**27 (cont)**
LM End	**0.36**	Issue Type +	En	Location *	

Photo 3 of 3 : UCIP_FA_2020_41624_18767.jpg

WS- abandoned pipe near power pole (top)

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiancy Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Levee District No. 0001 (Sutter County)

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	16.11	10/13/2020 10/13/2020	Brooks Weisser

LM Start	**1.85**	Rating **	M	Issue No.	**28**
LM End	**1.85**	Issue Type +	En	Location *	
Category	Supplemental			GPS Latitude/Longitude	
				Start	End
Item	DWR UCIP Field Study			38.977002 °	38.977002 °
				-121.591199 °	-121.591199 °
DWR ID	17917				

Comment Code

Inspector Comment

DS_ID:17917
FS_ID:53068
EP_NO: N/A
Repair Type: Non-Urgent
EVAL Issue:
Crossing Status: Not Found
UCIP Comments: 10/15/2018 Pipe not found. Pipe removed as part of the Project Area A Feather River West Levee Project. Contacted LMA to obtain as-built drawings showing the pipe removal through the levee. Crossing has been downgraded from Urgent to Non-Urgent, waiting to receive as-built drawings pertaining to levee improvement project for this section of the levee. (O. Magana - DWR UCIP)07/20/2016 Same as previous comment, although pipe is open on the waterside (WS) and capped on the LS. Note that this section of levee will likely be reconstructed as part of Project Area A of the Feather River West Levee Project (Star Bend to Sutter Bypass). (K. Fazel - UCIP)05/23/2016 Needs proper abandonment; pipe open on both ends (courtesy of Sterling York, DWR Inspector). (K. Fazel - UCIP)
FIELD_STRUCT_DESC: *REMOVED* 8-inch steel pipe of an unknown purpose through the levee, 4.6 feet below the crown. Siphon breaker in a 24-inch corrugated metal pipe (CMP) riser on the landside (LS) shoulder, not found in 2016. [Additional Reference(s): DWR Levee Log, 2005. USACE Sacramento O&M Manual 144, August 1955, (Station 657+00), As-Built Drawing No. 4-4-205-1].
FS Date: 10/16/2018

Photo 1 of 3 : UCIP_FA_2020_53068_75107.jpg

Pipe visible on WS slope. Photo courtesy of Sterling York, DWR Inspector.

LM Start	**1.85**	Rating **	M	Issue No.	**28 (cont)**
LM End	**1.85**	Issue Type +	En	Location *	

Photo 2 of 3 : UCIP_FA_2020_53068_75108.jpg

Pipe open on LS end. Photo courtesy of Sterling York, DWR Inspector.

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiency Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Levee District No. 0001 (Sutter County)

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	16.11	10/13/2020 10/13/2020	Brooks Weisser

LM Start	**1.85**	Rating **	M	Issue No.	**28 (cont)**
LM End	**1.85**	Issue Type +	En	Location *	
Category	Supplemental			GPS Latitude/Longitude	
				Start	End
Item	DWR UCIP Field Study			38.977002 °	38.977002 °
				-121.591199 °	-121.591199 °
DWR ID	17917				

Photo 3 of 3 : UCIP_FA_2020_53068_76120.jpg

LS view: pipe appears to be capped, though in a rudimentary fashion.

LM Start	**2.21**	Rating **	M	Issue No.	**29**
LM End	**2.21**	Issue Type +	En	Location *	
Category	Supplemental			GPS Latitude/Longitude	
				Start	End
Item	DWR UCIP Field Study			38.982135 °	38.982135 °
				-121.591974 °	-121.591974 °
DWR ID	17915				

Comment Code

Inspector Comment

DS_ID:17915
FS_ID:11383
EP_NO: N/A
Repair Type: Non-Urgent
EVAL Issue:
Crossing Status: Found
UCIP Comments: 04/12/2013 Siphon breaker cap missing. Sump pump and gate valve at landward toe not found may be due to dense vegetation. (DWR UCIP - P. Amatya)
FIELD_STRUCT_DESC: 8-inch coated steel pipe of an unknown purpose through the levee, 4.6 feet below the crown. Siphon breaker in a corrugated metal pipe (CMP) riser on the landside (LS) slope. [Additional Reference(s): DWR Levee Log, 2005. USACE Sacramento O&M Manual 144, August 1955, (Station 638+07)].
FS Date: 4/12/2013

Photo 1 of 3 : UCIP_FA_2020_11383_18782.jpg

WS- 8-inch steel pipe and disconnected pvc pipe on levee slope

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiancy Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Levee District No. 0001 (Sutter County)

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	16.11	10/13/2020 10/13/2020	Brooks Weisser

LM Start	**2.21**	Rating **	M	Issue No.	**29 (cont)**
LM End	**2.21**	Issue Type +	En	Location *	
Category	Supplemental			GPS Latitude/Longitude	
				Start	End
Item	DWR UCIP Field Study			38.982135 °	38.982135 °
				-121.591974 °	-121.591974 °
DWR ID	17915				

Photo 2 of 3 : UCIP_FA_2020_11383_18781.jpg

WS-a disconnected pvc pipe on levee slope

LM Start	**2.21**	Rating **	M	Issue No.	**29 (cont)**
LM End	**2.21**	Issue Type +	En	Location *	

Photo 3 of 3 : UCIP_FA_2020_11383_18780.jpg

LS- CMP riser on levee slope with dense vegetation.

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiancy Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Levee District No. 0001 (Sutter County)

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	16.11	10/13/2020 10/13/2020	Brooks Weisser

LM Start	**2.42**	Rating **	M	Issue No.	**30**
LM End	**2.42**	Issue Type +	En	Location *	
Category	Supplemental			GPS Latitude/Longitude	
				Start	End
Item	DWR UCIP Field Study			38.985223 °	38.985223 °
				-121.591922 °	-121.591922 °
DWR ID	18667				

Comment Code

Inspector Comment

DS_ID:18667
FS_ID:41787
EP_NO: N/A
Repair Type: Non-Urgent
EVAL Issue:
Crossing Status: Found
UCIP Comments: 04/12/2013 Pipe appears to be abandoned and should be verified as having been done so properly. - concrete standpipe with 10-inch steel pipe.- concrete wing wall- no pipe- abandoned structure- a pump found on other side of the levee (WS) but not sure whether it is associated with this crossing. (DWR UCIP - P. Amatya)
FIELD_STRUCT_DESC: *ABANDONED* 24-inch gravity drainage pipe of an unknown material under the landside (LS) approach, at an unknown depth. Plans to install a 10-inch corrugated iron gravity drainage culvert under the LS approach, at an unknown depth. Crossing not found in the O&M Manual.
FS Date: 4/12/2013

Photo 1 of 3 : UCIP_FA_2020_41787_18793.jpg

LS- overview of landside with concrete standpipe

LM Start	**2.42**	Rating **	M	Issue No.	**30 (cont)**
LM End	**2.42**	Issue Type +	En	Location *	

Photo 2 of 3 : UCIP_FA_2020_41787_18792.jpg

LS- abandoned wing wall- no pipe

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiancy Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Levee District No. 0001 (Sutter County)

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	16.11	10/13/2020 10/13/2020	Brooks Weisser

LM Start	**2.42**	Rating **	M	Issue No.	**30 (cont)**
LM End	**2.42**	Issue Type +	En	Location *	
Category	Supplemental			GPS Latitude/Longitude	
				Start	End
Item	DWR UCIP Field Study			38.985223 °	38.985223 °
				-121.591922 °	-121.591922 °
DWR ID	18667				

Photo 3 of 3 : UCIP_FA_2020_41787_18791.jpg

LS- concrete standpipe with disconnected steel pipe

LM Start	**3.42**	Rating **	M	Issue No.	**31**
LM End	**3.42**	Issue Type +	En	Location *	
Category	Supplemental			GPS Latitude/Longitude	
				Start	End
Item	DWR UCIP Field Study			38.998858 °	38.998858 °
				-121.596746 °	-121.596746 °
DWR ID	17918				

Comment Code

Inspector Comment

DS_ID:17918
FS_ID:41348
EP_NO: N/A
Repair Type: Non-Urgent
EVAL Issue:
Crossing Status: Indicator Found
UCIP Comments: 04/08/2013 Only an abandoned steel structure on water and a concrete structure on WS Levee slope found. Need to verify pipe was properly abandoned. (DWR UCIP - P. Amatya)
FIELD_STRUCT_DESC: *ABANDONED* 8-inch steel pipe of an unknown purpose through the levee, 4.1 feet below the crown. Siphon breaker on the landside (LS) slope. Butterfly shutoff valve on the LS slope. Concrete standpipe and pump at the LS toe. Pipe discharges into borrow pit on the waterside (WS). [Additional Reference(s): DWR Levee Log, 2005. USACE Sacramento O&M Manual 144, August 1955, (Station 574+20)].
FS Date: 4/8/2013

Photo 1 of 3 : UCIP_FA_2020_41348_18882.jpg

WS- abandoned concrete structure on levee slope

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiancy Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Levee District No. 0001 (Sutter County)

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	16.11	10/13/2020 10/13/2020	Brooks Weisser

LM Start	**3.42**	Rating **	M	Issue No.	**31 (cont)**
LM End	**3.42**	Issue Type +	En	Location *	
Category	Supplemental			GPS Latitude/Longitude	
				Start	End
Item	DWR UCIP Field Study			38.998858 °	38.998858 °
				-121.596746 °	-121.596746 °
DWR ID	17918				

Photo 2 of 3 : UCIP_FA_2020_41348_18881.jpg

WS- abandoned steel structure on waterway

LM Start	**3.42**	Rating **	M	Issue No.	**31 (cont)**
LM End	**3.42**	Issue Type +	En	Location *	

Photo 3 of 3 : UCIP_FA_2020_41348_18880.jpg

Overview of landside of the levee- no pipes visible. Dense vegetation.

LM Start	**5.02**	Rating **	A/W	Issue No.	**25**
LM End	**5.43**	Issue Type +	Ma	Location *	
Category	Supplemental			GPS Latitude/Longitude	
				Start	End
Item	2017 Storm Damage			39.018322 °	39.023753 °
				-121.610275 °	-121.613171 °
DWR ID	LD1-S-02				

Comment Code

Inspector Comment

The erosion site is planned for PL 84-99 Repair in 2020.
Site ID No:145
Site Designation:LD1-S-02
Rating: Critical

Photo 1 of 3 : LEVAL_FA_2020_145_1767.jpg

The erosion site is planned for PL 84-99 Repair in 2020.

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiancy Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Levee District No. 0001 (Sutter County)

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	16.11	10/13/2020 10/13/2020	Brooks Weisser

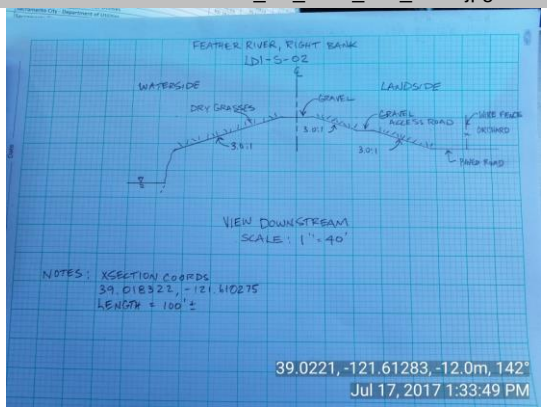
LM Start	**5.02**	Rating **	A/W	Issue No.	**25 (cont)**
LM End	**5.43**	Issue Type +	Ma	Location *	
Category	Supplemental			GPS Latitude/Longitude	
				Start	End
Item	2017 Storm Damage			39.018322 °	39.023753 °
				-121.610275 °	-121.613171 °
DWR ID	LD1-S-02				

Photo 2 of 3 : LEVAL_FA_2020_145_1768.jpg

The erosion site is planned for PL 84-99 Repair in 2020.

LM Start	**5.02**	Rating **	A/W	Issue No.	**25 (cont)**
LM End	**5.43**	Issue Type +	Ma	Location *	

Photo 3 of 3 : LEVAL_FA_2020_145_1769.jpg



The erosion site is planned for PL 84-99 Repair in 2020.

LM Start	**7.61**	Rating **	M	Issue No.	**16**
LM End	**7.61**	Issue Type +	En	Location *	LS
Category	Earthen Levee			GPS Latitude/Longitude	
				Start	End
Item	Encroachments			39.054824 °	39.054824 °
				-121.611330 °	-121.611330 °
DWR ID	DWR_LD0001S_01_f _ 2020_16				

Comment Code
EQ : Equipment

Inspector Comment
Farm equipment parked in easement along levee to needs to be moved, Fall 2020.

Photo 1 of 1 : FA_2020_LD0001S_433_16_20201019_00041.jpg

View of farm equipment parked in the easement along landside toe, Fall 2020.

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiancy Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Levee District No. 0001 (Sutter County)

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	16.11	10/13/2020 10/13/2020	Brooks Weisser

LM Start	**7.69**	Rating **	A/W	Issue No.	**19**
LM End	**7.74**	Issue Type +	Ma	Location *	WS
Category	Earthen Levee			GPS Latitude/Longitude	
				Start	End
Item	Erosion / Bank Caving			39.055986 °	39.056710 °
				-121.611301 °	-121.611331 °
DWR ID	LD1-S-03				

Comment Code

E1 : Note and monitor erosion site.

Inspector Comment

This was a 2017 Storm Damage site for erosion.
Site ID No:146
Site Designation:LD1-S-03

Photo 1 of 3 : LEVAL_FA_2020_146_4051.jpg

LM Start	**7.69**	Rating **	A/W	Issue No.	**19 (cont)**
LM End	**7.74**	Issue Type +	Ma	Location *	WS

Photo 2 of 3 : LEVAL_FA_2020_146_4053.jpg

LM Start	**7.69**	Rating **	A/W	Issue No.	**19 (cont)**
LM End	**7.74**	Issue Type +	Ma	Location *	WS

Photo 3 of 3 : LEVAL_FA_2020_146_4054.jpg

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiancy Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Levee District No. 0001 (Sutter County)

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	16.11	10/13/2020 10/13/2020	Brooks Weisser

LM Start	**7.87**	Rating **	M	Issue No.	**17**
LM End	**7.87**	Issue Type +	Ma	Location *	LS
Category	Earthen Levee			GPS Latitude/Longitude	
				Start	End
Item	Animal Control			39.058591 °	39.058591 °
				-121.611422 °	-121.611422 °
DWR ID	DWR_LD0001S_01_f _ 2020_17				

Comment Code

A3 : No rodents visible, but rodent burrows visible; need to backfill and compact or grout burrows.

Inspector Comment

No rodent activity noted, but holes need to be backfilled, Fall 2020

Photo 1 of 1 : FA_2020_LD0001S_433_17_20201019_00043.jpg

View of rodent holes on land side slope, Fall 2020.

LM Start	**11.99**	Rating **	M	Issue No.	**32**
LM End	**11.99**	Issue Type +	En	Location *	
Category	Supplemental			GPS Latitude/Longitude	
				Start	End
Item	DWR UCIP Field Study			39.114856 °	39.114856 °
				-121.605821 °	-121.605821 °
DWR ID	17932				

Comment Code

Inspector Comment

DS_ID:17932
FS_ID:41841
EP_NO: N/A
Repair Type: Non-Urgent
EVAL Issue:
Crossing Status: Indicator Found
UCIP Comments: 04/05/2013 Need to install Gasline Markers.Fenced control station.Indicator on LS across concrete ditch.Found road markings.(DWR UCIP - P. Amatya)
FIELD_STRUCT_DESC: 1 of 2: 16-inch natural gas pipeline of an unknown material through the levee, 3 feet below the crown. PG&E gas line crossing sign on the waterside (WS) shoulder. [Additional Reference(s): DWR Levee Log, 2005].
FS Date: 4/5/2013

Photo 1 of 3 : UCIP_FA_2020_41841_19538.jpg

Levee Crown: gasline indicator/markings on crown road.

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiancy Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Levee District No. 0001 (Sutter County)

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	16.11	10/13/2020 10/13/2020	Brooks Weisser

LM Start	**11.99**	Rating **	M	Issue No.	**32 (cont)**
LM End	**11.99**	Issue Type +	En	Location *	
Category	Supplemental			GPS Latitude/Longitude	
				Start	End
Item	DWR UCIP Field Study			39.114856 °	39.114856 °
				-121.605821 °	-121.605821 °
DWR ID	17932				

Photo 2 of 3 : UCIP_FA_2020_41841_19537.jpg

LS- fenced control station across concrete ditch

LM Start	**11.99**	Rating **	M	Issue No.	**32 (cont)**
LM End	**11.99**	Issue Type +	En	Location *	

Photo 3 of 3 : UCIP_FA_2020_41841_19534.jpg

LS- fenced control station with indicators

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiancy Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Levee District No. 0001 (Sutter County)

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	16.11	10/13/2020 10/13/2020	Brooks Weisser

LM Start	**12.00**	Rating **	M	Issue No.	**33**
LM End	**12.00**	Issue Type +	En	Location *	
Category	Supplemental			GPS Latitude/Longitude	
				Start	End
Item	DWR UCIP Field Study			39.114856 °	39.114856 °
				-121.605821 °	-121.605821 °
DWR ID	18880				

Comment Code

Inspector Comment

DS_ID:18880
FS_ID:41889
EP_NO: N/A
Repair Type: Non-Urgent
EVAL Issue:
Crossing Status: Indicator Found
UCIP Comments: 04/05/2013 Need to contact owner to install gasline markers.Fenced control station on LS.Indicator on LS across concrete channel.Road markings. (DWR UCIP - P. Amatya)
FIELD_STRUCT_DESC: 2 of 2: 16-inch natural gas pipeline of an unknown material through the levee, 3 feet below the crown. PG&E gas line crossing sign on the waterside (WS) shoulder. [Additional Reference(s): DWR Levee Log, 2005].
FS Date: 4/5/2013

Photo 1 of 3 : UCIP_FA_2020_41889_19566.jpg

Levee Crown: road markings on road pavement

LM Start	**12.00**	Rating **	M	Issue No.	**33 (cont)**
LM End	**12.00**	Issue Type +	En	Location *	

Photo 2 of 3 : UCIP_FA_2020_41889_19565.jpg

LS- fenced control station across concrete ditch.

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiancy Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Levee District No. 0001 (Sutter County)

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	16.11	10/13/2020 10/13/2020	Brooks Weisser

LM Start	**12.00**	Rating **	M	Issue No.	**33 (cont)**
LM End	**12.00**	Issue Type +	En	Location *	
Category	Supplemental			GPS Latitude/Longitude	
				Start	End
Item	DWR UCIP Field Study			39.114856 °	39.114856 °
				-121.605821 °	-121.605821 °
DWR ID	18880				

Photo 3 of 3 : UCIP_FA_2020_41889_19564.jpg

LS- fenced control station with gasline indicator across concrete ditch.

LM Start	**13.51**	Rating **	C	Issue No.	**18**
LM End	**13.69**	Issue Type +	Ma	Location *	WS
Category	Earthen Levee			GPS Latitude/Longitude	
				Start	End
Item	Slope Stability			39.135376 °	39.137718 °
				-121.604841 °	-121.606288 °
DWR ID	DWR_LD0001S_01_s _ 2020_18				
Comment Code					
S2 : Repair the levee slope damaged by foot traffic and prevent access where possible.					
Inspector Comment					
Foot ramp has been removed, Fall 2020.					

No Photos

LM Start	**13.87**	Rating **	C	Issue No.	**26**
LM End	**13.87**	Issue Type +	Ma	Location *	CR
Category	Earthen Levee			GPS Latitude/Longitude	
				Start	End
Item	Crown Surface / Depressions / Rutting			39.139734 °	39.139734 °
				-121.608477 °	-121.608477 °
DWR ID	DWR_LD0001S_01_f _ 2018_26				
Comment Code					
C2 : Repair depressions or ruts in the crown or slope.					
Inspector Comment					
Construction is complete.					

No Photos

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* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiancy Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Levee District No. 0001 (Sutter County)

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	16.11	10/13/2020 10/13/2020	Brooks Weisser

LM Start	**14.35**	Rating **	M	Issue No.	**34**
LM End	**14.35**	Issue Type +	En	Location *	
Category	Supplemental			GPS Latitude/Longitude	
				Start	End
Item	DWR UCIP Field Study			39.146494 °	39.146494 °
				-121.609715 °	-121.609715 °
DWR ID	18640				

Comment Code

Inspector Comment

DS_ID:18640
FS_ID:41887
EP_NO: N/A
Repair Type: Non-Urgent
EVAL Issue:
Crossing Status: Indicator Found
UCIP Comments: 04/05/2013 Need to contact ownder to determin status of crossing and install signs if appropriate. (DWR UCIP - P. Amatya)
FIELD_STRUCT_DESC: 18-inch steel natural gas pipeline through the levee, at an unknown depth. [Additional Reference(s): Sutter-Butte Flood Control Agency, Volume 3, As-Built Drawing No. GC-120, Sheet 58, no reference to any crossings at this location. USACE Sacramento O&M Manual 144, August 1955, (Station 1473+60)].
FS Date: 4/5/2013

Photo 1 of 3 : UCIP_FA_2020_41887_19571.jpg

WS- USA road marking and floodway area

LM Start	**14.35**	Rating **	M	Issue No.	**34 (cont)**
LM End	**14.35**	Issue Type +	En	Location *	

Photo 2 of 3 : UCIP_FA_2020_41887_19570.jpg

WS- USA road marking on pavement

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiancy Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Levee District No. 0001 (Sutter County)

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	16.11	10/13/2020 10/13/2020	Brooks Weisser

LM Start	**14.35**	Rating **	M	Issue No.	**34 (cont)**
LM End	**14.35**	Issue Type +	En	Location *	
Category	Supplemental			GPS Latitude/Longitude	
				Start	End
Item	DWR UCIP Field Study			39.146494 °	39.146494 °
				-121.609715 °	-121.609715 °
DWR ID	18640				

Photo 3 of 3 : UCIP_FA_2020_41887_19569.jpg

LS- overview. No sign post or indicator found.

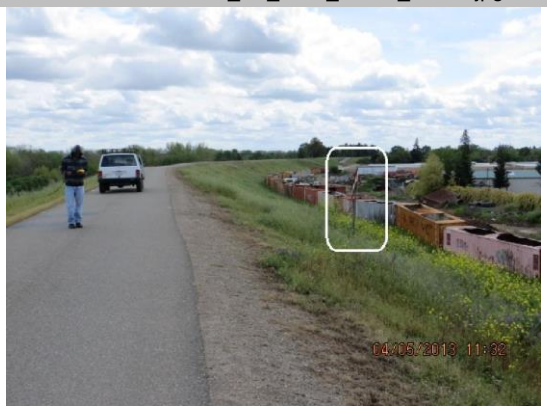
LM Start	**15.03**	Rating **	M	Issue No.	**35**
LM End	**15.03**	Issue Type +	En	Location *	
Category	Supplemental			GPS Latitude/Longitude	
				Start	End
Item	DWR UCIP Field Study			39.154970 °	39.154970 °
				-121.615617 °	-121.615617 °
DWR ID	17923				

Comment Code

Inspector Comment

DS_ID:17923
FS_ID:12092
EP_NO: N/A
Repair Type: Non-Urgent
EVAL Issue:
Crossing Status: Indicator Found
UCIP Comments: 04/05/2013 Only a gasline indicator found on LS.Needs gasline marker also on WS.(DWR UCIP - P. Amatya)
FIELD_STRUCT_DESC: 16-inch natural gas pipeline of an unknown material through the levee, 3.5 feet below the crown. Pipeline protected in place as part of the Feather River West Levee Reconstruction Project. Marker installed on the landside (LS). [Additional Reference(s): DWR Levee Log, 2005. Sutter-Butte Flood Control Agency, Volume 3, As-Built Drawing No. C-124, Sheet 62, (Station 1073+41)].
FS Date: 4/5/2013

Photo 1 of 2 : UCIP_FA_2020_12092_19624.jpg



LS- overview of gasline marker on levee slope

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiancy Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Levee District No. 0001 (Sutter County)

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	16.11	10/13/2020 10/13/2020	Brooks Weisser

LM Start	**15.03**	Rating **	M	Issue No.	**35 (cont)**
LM End	**15.03**	Issue Type +	En	Location *	
Category	Supplemental			GPS Latitude/Longitude	
				Start	End
Item	DWR UCIP Field Study			39.154970 °	39.154970 °
				-121.615617 °	-121.615617 °
DWR ID	17923				

Photo 2 of 2 : UCIP_FA_2020_12092_19623.jpg

LS- gasline marker on levee slope

LM Start	**15.15**	Rating **	M	Issue No.	**36**
LM End	**15.15**	Issue Type +	En	Location *	
Category	Supplemental			GPS Latitude/Longitude	
				Start	End
Item	DWR UCIP Field Study			39.156241 °	39.156241 °
				-121.617210 °	-121.617210 °
DWR ID	18644				

Comment Code

Inspector Comment

DS_ID:18644
FS_ID:12104
EP_NO: 17259
Repair Type: Non-Urgent
EVAL Issue:
Crossing Status: Indicator Found
UCIP Comments: 04/05/2013 Found an indicator only on LS. Needs an indicator also on WS.(DWR UCIP - P. Amatya)
FIELD_STRUCT_DESC: *REMOVED* 8.375-inch-wide electrolysis test station (ETS) at a depth of 4 feet was connected to the existing 8-inch steel natural gas pipeline within the waterside (WS) levee toe. Pipeline has been removed as part of the Feather River West Levee Reconstruction Project. [Additional Reference(s): Sutter-Butte Flood Control Agency, Volume 3, As-Built Drawing No. C-124, Sheet 62, (Station 1079+91), no replacement pipe mentioned].
FS Date: 4/5/2013

Photo 1 of 3 : UCIP_FA_2020_12104_19642.jpg

WS- needs a gasline indicator.

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiancy Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Levee District No. 0001 (Sutter County)

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	16.11	10/13/2020 10/13/2020	Brooks Weisser

LM Start	**15.15**	Rating **	M	Issue No.	**36 (cont)**
LM End	**15.15**	Issue Type +	En	Location *	
Category	Supplemental			GPS Latitude/Longitude	
				Start	End
Item	DWR UCIP Field Study			39.156241 °	39.156241 °
				-121.617210 °	-121.617210 °
DWR ID	18644				

Photo 2 of 3 : UCIP_FA_2020_12104_19641.jpg

LS- gasline indicators on levee slope and across.

LM Start	**15.15**	Rating **	M	Issue No.	**36 (cont)**
LM End	**15.15**	Issue Type +	En	Location *	

Photo 3 of 3 : UCIP_FA_2020_12104_19640.jpg

LS- overview of gasline indicators on levee slope and across.

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiancy Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Levee District No. 0001 (Sutter County)

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	16.11	10/13/2020 10/13/2020	Brooks Weisser

LM Start	**16.11**	Rating **	M	Issue No.	**37**
LM End	**16.11**	Issue Type +	En	Location *	
Category	Supplemental			GPS Latitude/Longitude	
				Start	End
Item	DWR UCIP Field Study			39.168830 °	39.168830 °
				-121.622628 °	-121.622628 °
DWR ID	18645				

Comment Code

Inspector Comment

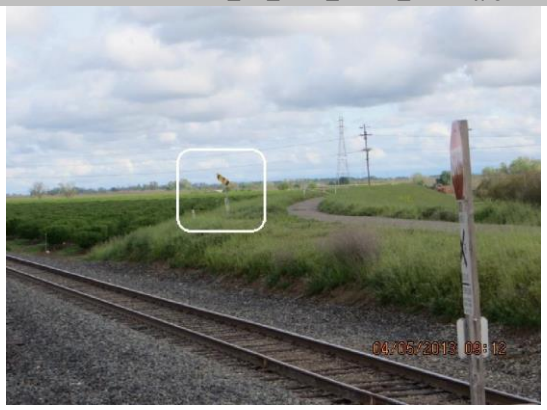
DS_ID:18645
FS_ID:41888
EP_NO: 3823
Repair Type: Non-Urgent
EVAL Issue:
Crossing Status: Indicator Found
UCIP Comments: 04/05/2013 Need to contact owner to determine status of crossing and install markers if appropriate. Several lines in area. (DWR UCIP - P. Amatya)
FIELD_STRUCT_DESC: 8-inch steel natural gas pipeline through the levee and overflow area, 3.3 feet below the crown. (Plans for installation of a steel pipeline through the levee authorized under Permit No. 3823, 1961 - Southern Pacific Pipe Lines, Inc.).
FS Date: 4/5/2013

Photo 1 of 2 : UCIP_FA_2020_41888_19709.jpg

Railway and levee crossing and gasline sign across the railway

LM Start	**16.11**	Rating **	M	Issue No.	**37 (cont)**
LM End	**16.11**	Issue Type +	En	Location *	

Photo 2 of 2 : UCIP_FA_2020_41888_19708.jpg



Gasline sign across the railway

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiancy Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Fall 2020 Levee Maintenance Deficiency Summary Report

Sacramento River Basin

LD0009 **Levee District No. 0009 (Sutter County)**	Overall LMA Rating	Total LMA Miles						
	A	**6.25**						
Rated Item	Maintenance Deficiency				Enforcement		Design & System Obsolescence	
	M Miles	U Miles	M + 4U Miles	Threshold %	M Miles	U Miles	M Miles	U Miles
Earthen Levee								
Encroachments					0.34			
LMA Totals:	0.00	0.00	0.00	0.00%	0.34	0.00	0.00	0.00

Unit No. 01 Sutter County, Feather River RB LD0009	Overall Unit Rating	Total Unit Miles						
	A	**6.25**						
Rated Item	Maintenance Deficiency				Enforcement		Design & System Obsolescence	
	M Miles	U Miles	M + 4U Miles	Threshold %	M Miles	U Miles	M Miles	U Miles
Earthen Levee								
Encroachments					0.34			
Unit Totals:	0.00	0.00	0.00	0.00%	0.34	0.00	0.00	0.00

State of California - Department of Water Resources - Division of Flood Management - Flood Project Integrity & Inspection Branch

Flood Control Project Maintenance
Levee Inspections

LMA District Cover Sheet

Levee District No. 0009 (Sutter County)

	Spring (March - May)	Summer ** (June - August)	Fall (September - November)	Winter ** (December - February)
† Overall LMA Rating (Fall Only)			**A**	

** Non-receipt of Summer or Winter Inspection Reports may effect overall annual rating.

† SPRING INSPECTIONS: Overall maintenance ratings are not determined for the spring inspection results. Individual maintenance deficiencies are rated using the same criteria in the spring and in the fall.

FALL INSPECTIONS: The overall maintenance rating shown above is based on operation and maintenance deficiencies identified within the attached unit inspection reports. This rating is not intended to be an indiction of risk.

Comments

Flood Control Project Maintenance
Levee Inspections

Unit Cover Sheet

Levee District No. 0009 (Sutter County)

Waterway	Bank	Unit Miles
Unit No. 01 Sutter County, Feather River	Right	6.25

	Spring (March - May)	Summer (June - August)	(September - November) Fall	Winter (December - February)
Unit Maintenance Rating (Fall Only)			**A**	
Date of Inspection	3/17/2020 - 3/17/2020		10/13/2020 - 10/13/2020	
DWR Inspector	Sterling York		Brooks Weisser	
Accompanied By	Andrew Stresser LD0001S		Andrew Stresser LD0001S	

Summer & Winter Inspections

The Local Maintaining Agency (LMA) is responsible for summer and winter inspections. The LMA is required to submit a report regarding summer and winter inspections to the California Department of Water Resources (DWR).

DWR must be informed on the:
a) completion of the inspection
b) any changes other than the results of normal maintenance
c) corrections to deficiencies noted in this report

If additional items are noted, further documentation of those items must also be submitted.

The LMA should submit this information to DWR using the LMA web application tool available at:

http://cdec.water.ca.gov/lma.html

If the LMA is unable to submit information on this webpage, please contact DWR for assistance.

The LMA should submit the information and any associated documentation by September 30 for summer inspections and March 31 for winter inspections.

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Levee District No. 0009 (Sutter County)

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Sutter County, Feather River	Right	6.25	10/13/2020 10/13/2020	Brooks Weisser

LM Start		Rating **	A	Issue No.	**4**
LM End		Issue Type +	Ma	Location *	
Category	Earthen Levee			GPS Latitude/Longitude	
				Start	End
Item	Emergency Supplies & Equipment			°	°
				°	°
DWR ID	DWR_LD0009_01_s _ 2013_4				

Comment Code

Inspector Comment

LD 9 has flood fight supplies on hand and coordinates with other local levee districts in the flood fight supply staging program.

No Photos

LM Start		Rating **	A	Issue No.	**5**
LM End		Issue Type +	Ma	Location *	
Category	Earthen Levee			GPS Latitude/Longitude	
				Start	End
Item	Operations & Maintenance Manuals			°	°
				°	°
DWR ID	DWR_LD0009_01_s _ 2013_5				

Comment Code

Inspector Comment

The levee district has stated in the past that they have a copy of the O&M manuals.

No Photos

LM Start		Rating **	A	Issue No.	**6**
LM End		Issue Type +	Ma	Location *	
Category	Earthen Levee			GPS Latitude/Longitude	
				Start	End
Item	Flood Preparedness & Training			°	°
				°	°
DWR ID	DWR_LD0009_01_s _ 2013_6				

Comment Code

Inspector Comment

The district has attended the Flood Fight class put on by RD 784 and DWR.

No Photos

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiancy Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Levee District No. 0009 (Sutter County)

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Sutter County, Feather River	Right	6.25	10/13/2020 10/13/2020	Brooks Weisser

LM Start	**0.09**	Rating **	C	Issue No.	**18**
LM End	**0.09**	Issue Type +	Ma	Location *	LS
Category	Earthen Levee			GPS Latitude/Longitude	
				Start	End
Item	Animal Control			39.170064 °	39.170064 °
				-121.622563 °	-121.622563 °
DWR ID	DWR_LD0009_01_f _ 2016_18				

Comment Code

A3 : No rodents visible, but rodent burrows visible; need to backfill and compact or grout burrows.

Inspector Comment

Rodent holes have been repaired, Fall 2020.

No Photos

LM Start	**5.66**	Rating **	M	Issue No.	**20**
LM End	**6.00**	Issue Type +	En	Location *	LS
Category	Earthen Levee			GPS Latitude/Longitude	
				Start	End
Item	Encroachments			39.247349 °	39.252258 °
				-121.637341 °	-121.637077 °
DWR ID	DWR_LD0009_01_f _ 2016_20				

Comment Code

DT : Ditch

Inspector Comment

A ditch is located at the toe of the levee on the landside.

Photo 1 of 1 : FA_2020_LD0009_202_20_20201019_00003.jpg

View looking upstream of ditch at the toe of the levee on the landside, Fall 2020.

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable	A : Acceptable N : Not Inspected/Rated	Ma : Maintenance Deficiency
WS : Water Side	M : Minimally Acceptable C : Corrected	Ob : Design & System Obsolescence
CR : Crown	U : Unacceptable A/W : Acceptable but Monitor & Maintain	En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Fall 2020 Levee Maintenance Deficiency Summary Report

Sacramento River Basin

MA0007 **Sutter Maintenance Yard Maintenance Area 0007**	Overall LMA Rating **A**	Total LMA Miles **11.90**						
Rated Item	Maintenance Deficiency				Enforcement		Design & System Obsolescence	
	M Miles	U Miles	M + 4U Miles	Threshold %	M Miles	U Miles	M Miles	U Miles
Earthen Levee								
Encroachments					0.98			
Supplemental								
DWR UCIP Field Study					0.22	0.01		
DWR UCIP LMA Responsibility								
LMA Totals:	0.00	0.00	0.00	0.00%	1.20	0.01	0.00	0.00

Unit No. 01 Feather River RB MA0007	Overall Unit Rating **A**	Total Unit Miles **11.90**						
Rated Item	Maintenance Deficiency				Enforcement		Design & System Obsolescence	
	M Miles	U Miles	M + 4U Miles	Threshold %	M Miles	U Miles	M Miles	U Miles
Earthen Levee								
Encroachments					0.98			
Supplemental								
DWR UCIP Field Study					0.22	0.01		
DWR UCIP LMA Responsibility								
Unit Totals:	0.00	0.00	0.00	0.00%	1.20	0.01	0.00	0.00

State of California - Department of Water Resources - Division of Flood Management - Flood Project Integrity & Inspection Branch

Flood Control Project Maintenance
Levee Inspections

LMA District Cover Sheet

Sutter Maintenance Yard Maintenance Area 0007

	Spring (March - May)	Summer ** (June - August)	Fall (September - November)	Winter ** (December - February)
† Overall LMA Rating (Fall Only)			**A**	

** Non-receipt of Summer or Winter Inspection Reports may effect overall annual rating.

† SPRING INSPECTIONS: Overall maintenance ratings are not determined for the spring inspection results. Individual maintenance deficiencies are rated using the same criteria in the spring and in the fall.

FALL INSPECTIONS: The overall maintenance rating shown above is based on operation and maintenance deficiencies identified within the attached unit inspection reports. This rating is not intended to be an indiction of risk.

Comments

Flood Control Project Maintenance
Levee Inspections

Unit Cover Sheet

Sutter Maintenance Yard Maintenance Area 0007

Waterway	Bank	Unit Miles
Unit No. 01 Feather River	Right	11.90

	Spring (March - May)	Summer (June - August)	(September - November) Fall	Winter (December - February)
Unit Maintenance Rating (Fall Only)			**A**	
Date of Inspection	3/18/2020 - 3/18/2020		9/17/2020 - 9/17/2020	
DWR Inspector	Sterling York		Brooks Weisser	
Accompanied By	Shawn Freitag Sutter Maintenance Yard		Shawn Freitag Sutter Maintenance Yard	
	Bob Duffey Sutter Maintenance Yard		Bob Duffey Sutter Maintenance Yard	

Summer & Winter Inspections

The Local Maintaining Agency (LMA) is responsible for summer and winter inspections. The LMA is required to submit a report regarding summer and winter inspections to the California Department of Water Resources (DWR).

DWR must be informed on the:
a) completion of the inspection
b) any changes other than the results of normal maintenance
c) corrections to deficiencies noted in this report

If additional items are noted, further documentation of those items must also be submitted.

The LMA should submit this information to DWR using the LMA web application tool available at:

http://cdec.water.ca.gov/lma.html

If the LMA is unable to submit information on this webpage, please contact DWR for assistance.

The LMA should submit the information and any associated documentation by September 30 for summer inspections and March 31 for winter inspections.

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Sutter Maintenance Yard Maintenance Area 0007

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	11.90	09/17/2020 09/17/2020	Brooks Weisser

LM Start		Rating **	A	Issue No.	**1**
LM End		Issue Type +	Ma	Location *	
Category	Earthen Levee			GPS Latitude/Longitude	
				Start	End
Item	Operations & Maintenance Manuals			°	°
				°	°
DWR ID	DWR_MA0007_01_s _ 2013_1				

Comment Code

Inspector Comment

The O&M manuals are located at the Sutter Maintenance Yard.

No Photos

LM Start		Rating **	A	Issue No.	**3**
LM End		Issue Type +	Ma	Location *	
Category	Earthen Levee			GPS Latitude/Longitude	
				Start	End
Item	Emergency Supplies & Equipment			°	°
				°	°
DWR ID	DWR_MA0007_01_s _ 2013_3				

Comment Code

Inspector Comment

Emergency supplies and equipment are stored at the Sutter Maintenance Yard.

No Photos

LM Start		Rating **	A	Issue No.	**4**
LM End		Issue Type +	Ma	Location *	
Category	Earthen Levee			GPS Latitude/Longitude	
				Start	End
Item	Flood Preparedness & Training			°	°
				°	°
DWR ID	DWR_MA0007_01_s _ 2013_4				

Comment Code

Inspector Comment

Sutter Maintenance Yard employees attend the annual Flood Fight class put on by DWR.

No Photos

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable	A : Acceptable N : Not Inspected/Rated	Ma : Maintenance Deficiancy
WS : Water Side	M : Minimally Acceptable C : Corrected	Ob : Design & System Obsolescence
CR : Crown	U : Unacceptable A/W : Acceptable but Monitor & Maintain	En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Sutter Maintenance Yard Maintenance Area 0007

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	11.90	09/17/2020 09/17/2020	Brooks Weisser

LM Start	**0.31**	Rating **	N	Issue No.	**69**
LM End	**0.37**	Issue Type +	Ma	Location *	WS
Category	Earthen Levee			GPS Latitude/Longitude	
				Start	End
Item	Trim / Thin Trees			39.314991 °	39.315693 °
				-121.635038 °	-121.634459 °
DWR ID	DWR_MA0007_01_s _ 2016_69				

Comment Code

T5 : Tree stumps.

Inspector Comment

Several tree stumps at WS levee toe.

Photo 1 of 1 : FA_2020_MA0007_200_69_20200929_00080.jpg

View looking downstream at several tree stumps on the waterside levee toe.

LM Start	**0.32**	Rating **	M	Issue No.	**32**
LM End	**0.32**	Issue Type +	En	Location *	WS
Category	Earthen Levee			GPS Latitude/Longitude	
				Start	End
Item	Encroachments			39.315020 °	39.315020 °
				-121.635017 °	-121.635017 °
DWR ID	DWR_MA0007_01_f _ 2020_32				

Comment Code

DE : Debris

Inspector Comment

Large debris pile on water side levee toe needs to be removed, Fall 2020.

Photo 1 of 1 : FA_2020_MA0007_200_32_20200929_00081.jpg

View of debris pile on waterside levee toe, Fall 2020.

LM Start	**0.56**	Rating **	A/W	Issue No.	**68**
LM End	**0.56**	Issue Type +	Ob	Location *	LS
Category	Earthen Levee			GPS Latitude/Longitude	
				Start	End
Item	Erosion / Bank Caving			39.317974 °	39.317974 °
				-121.632542 °	-121.632542 °
DWR ID	DWR_MA0007_01_s _ 2016_68				

Comment Code

E1 : Note and monitor erosion site.

Inspector Comment

Eroding slope due to irrigation ditch on landside slope has been repaired but should be monitored, Fall 2020.

Photo 1 of 1 : FA_2020_MA0007_200_68_20200929_00082.jpg

View of repair to the erosion site on landside ditch, Fall 2020.

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable	A : Acceptable N : Not Inspected/Rated	Ma : Maintenance Deficiency
WS : Water Side	M : Minimally Acceptable C : Corrected	Ob : Design & System Obsolescence
CR : Crown	U : Unacceptable A/W : Acceptable but Monitor & Maintain	En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Sutter Maintenance Yard Maintenance Area 0007

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	11.90	09/17/2020 09/17/2020	Brooks Weisser

LM Start	**1.28**	Rating **	M	Issue No.	**70**
LM End	**1.28**	Issue Type +	En	Location *	
Category	Supplemental			GPS Latitude/Longitude	
				Start	End
Item	DWR UCIP Field Study			39.328045 °	39.328045 °
				-121.632840 °	-121.632840 °
DWR ID	16929				

Comment Code

Inspector Comment

DS_ID:16929
FS_ID:58339
EP_NO: N/A
Repair Type: Non-Urgent
EVAL Issue: Pipe Not Found
Crossing Status: Not Found
UCIP Comments: 05/07/2019 Record has been updated to Non-Urgent due to unknown status of pipe through the levee. DMP Geophysics study did not confirm pipe through the levee. Record will remain in database until future levee improvement project can confirm removal of pipe. (O. Magana - DWR UCIP)12/07/2018 Encroachment Owner Information: Drainage District No. 1 c/o Jeff Spensce, District Engineer, PO Box 876, Gridley, CA 95948, 1-530-671-1008. Information obtained from the Levee_Encroachment_listing_11288.pdf which was received from SBFCA. (O. Magana - DWR UCIP)
08/16/2017 Unknown status of pipe. This pipe was not part of the Feather River West Levee Improvements, Project D. Pipe is located outside the project limits. Project Improvements began at Station (Sta) 1765+00 (MA0007 about LM 1.73) to Sta 2303+50 (ST0005 about LM 1.23), refer to record drawings for the Feather River West Levee Improvement Plans Station 1765+00 to 2368+26, Project D details. (O. Magana - DWR UCIP)
08/02/2017 Unknown if crossing was modified, not shown in record drawings. (O. Magana - DWR UCIP)
05/16/2016 Feather River West Levee Improvement Project--Levee currently under construction. (A. Freitag - DWR Sutter Yard)06/10/2015 Unable to locate. (A. Freitag - DWR Sutter Yard)11/06/2013 Unable to locate. (A. Freitag - DWR Sutter Yard)05/13/2013 SBFCA project recommends replacing in accordance with title 23. (A. Freitag - DWR Sutter Yard)12/29/2014 Unable to locate. (A. Freitag - DWR Sutter Yard)05/19/2014 Same as last inspection. (A. Freitag - DWR Sutter Yard)
FIELD_STRUCT_DESC: 16-inch pipe approximately 15 feet below the crown. Emergency pipe repair completed March 3, 2002. [Additional Reference(s): DWR Levee Log, 2005 (HLM 1.27)]
FS Date: 5/7/2019 12:49:00 PM

Photo 1 of 1 : UCIP_FA_2020_58339_80638.jpg

Overview of levee where pipe should be looking d/s. No signs of pipe.

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiancy Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Sutter Maintenance Yard Maintenance Area 0007

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	11.90	09/17/2020 09/17/2020	Brooks Weisser

LM Start	**1.55**	Rating **	U	Issue No.	**71**
LM End	**1.55**	Issue Type +	En	Location *	
Category	Supplemental			GPS Latitude/Longitude	
				Start	End
Item	DWR UCIP Field Study			39.331934 °	39.331934 °
				-121.633246 °	-121.633246 °
DWR ID	16928				

Comment Code

Inspector Comment

DS_ID:16928
FS_ID:58340
EP_NO: N/A
Repair Type: Urgent
EVAL Issue: Pipe Integrity
Crossing Status: Found
UCIP Comments: 09/04/2019 Photos provided by M. Bellomy with Flood Maintenance Office have been uploaded to record. Photos highlight the extent of damage on LS slope. (O. Magana - DWR UCIP)05/08/2019 LMA Supervisor, Shawn Freitag, has completed a temporary repair to prevent water from flowing from LS irrigation ditch to WS. Burrow hole on LS has been plugged and concrete bags have been placed to prevent water from entering the pipe and causing further damage to the pipe section through levee. Crossing will continued to be monitored by LMA. Need to coordinate with DWR DMP to address permanent solution for abandoned crossing. (O. Magana - DWR UCIP)

05/07/2019 Record has been updated from Non-Urgent to Urgent due to pipe integrity issues found. DWR UCIP was notified by LMA Supervisor, Shawn Freitag, of pipe leak observed on LS and causing flooding to WS. Burrow hole is allowing flow to enter pipe. Hole present on pipe section near the concrete headwall. Erosion (sloughing) observed on LS slope. Pipe section tied to WS concrete box that runs parallel to levee was flooding Kiwi Orchard. Section of concrete distribution box was removed to allow for proper drainage and prevent flooding to Kiwi Orchard. Measures by LMA Supervisor are being pursued to stop flow through pipe to prevent further erosion damage through the levee (damage identified during DWR DMP Phase 1 internal video inspection). Record has been updated to reflect the DMP Phase 1 inspection report, crossing has been upgraded from Non-Urgent to Urgent based on the condition of the pipe through the levee. (O. Magana - DWR UCIP)12/07/2018 Encroachment owner information: Sukhraj Singh Pamma, 9850 Sheldon Avenue, Live Oak, CA 95953-9784, 1-530-695-2490. The CVFPB sent an encroachment violation notice on August 16, 2011 to Mr. and Ms. Ratana. Information obtained from the Levee_Encroachment_listing_11288.pdf which was received from SBFCA. Need to coordinate with CVFPB to determine status of permit. (O. Magana - DWR UCIP)
08/09/2017 Crossing is still present, no modifications were made to this crossing. Crossing still appears to be abandoned and not in use, recommend contacting owner to determine status of crossing. This pipe was not part of the Feather River West Levee Improvements, Project D. Pipe is located outside the project limits. Project Improvements began at Station (Sta) 1765+00 (MA0007 about LM 1.73) to Sta 2303+50 (ST0005 about LM 1.23), refer to record drawings for the Feather River West Levee Improvement Plans Station 1765+00 to 2368+26, Project D details. (O. Magana - DWR UCIP)08/02/2017 Unknown if crossing

Photo 1 of 3 : UCIP_FA_2020_58340_79201.jpg

LS view: Internal view of pipe condition during DMP Phase 1 Inspection.

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiancy Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Sutter Maintenance Yard Maintenance Area 0007

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	11.90	09/17/2020 09/17/2020	Brooks Weisser

was modified, not shown in record drawings. (O. Magana - DWR UCIP) 05/16/2016 Feather River West Levee Improvement Project--Levee currently under construction. (A. Freitag - DWR Sutter Yard)06/10/2015 Same as last inspection. (A. Freitag - DWR Sutter Yard)12/29/2014 Same as last inspection. (A. Freitag - DWR Sutter Yard)05/19/2014 Same as last inspection. (A. Freitag - DWR Sutter Yard)11/06/2013 Same as last inspection. (A. Freitag - DWR Sutter Yard)05/13/2013 SBFCA project recommends replacing in accordance with title 23. (A. Freitag - DWR Sutter Yard)05/10/2013 Same as last inspection. LS scour behind structure needs to be repaired. (A. Freitag - DWR Sutter Yard) 10/31/2012 crossing appears abandoned, slide gate is missing on landward side; wood frame remains on LS; scour hole present on LS, 3 feet by 3 feet, near wood frame. (O. Magana - DWR UCIP)
FIELD_STRUCT_DESC: 12-inch corrugated metal drainage pipe through the levee, 8.2 feet below the crown. Slide gate on the landside (LS) is no longer present. Concrete "U" headwall at the waterside (WS) toe. Irrigation ditch located on the LS. [Additional Reference(s): DWR Levee Log, 2005 (HLM 1.55)]
FS Date: 5/7/2019 12:40:00 PM

LM Start	**1.55**	Rating **	U	Issue No.	**71 (cont)**
LM End	**1.55**	Issue Type +	En	Location *	

Photo 2 of 3 : UCIP_FA_2020_58340_79230.jpg

LS view: section of levee has slipped at pipe crossing.

LM Start	**1.55**	Rating **	U	Issue No.	**71 (cont)**
LM End	**1.55**	Issue Type +	En	Location *	

Photo 3 of 3 : UCIP_FA_2020_58340_79229.jpg

LS view: hole visible on LS, appears to be linked to burrow hole that is allowing flow to go into pipe.

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiancy Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Sutter Maintenance Yard Maintenance Area 0007

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	11.90	09/17/2020 09/17/2020	Brooks Weisser

LM Start	**1.55**	Rating **	A/W	Issue No.	**9**
LM End	**1.71**	Issue Type +	Ma	Location *	WS
Category	Supplemental			GPS Latitude/Longitude	
				Start	End
Item	2017 USACE Erosion Survey			39.332000 °	39.334240 °
				-121.633178 °	-121.633908 °
DWR ID	DWR_MA0007_01_f _ 2018_9				

Comment Code

Inspector Comment

2017 Site ID: FHR 47.5 R
Status: Eroding
2017 Field Notes: Vertical face into the levee prism, huge eddy.
Site History: 2011 - The toe of the levee has been excavated by the land owner. Small holes throughout the site have been filled with a plaster like substance. Large canal on landside slope and over the levee toe.

No Photos

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiancy Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Sutter Maintenance Yard Maintenance Area 0007

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	11.90	09/17/2020 09/17/2020	Brooks Weisser

LM Start	**1.71**	Rating **	M	Issue No.	**72**
LM End	**1.71**	Issue Type +	En	Location *	
Category	Supplemental			GPS Latitude/Longitude	
				Start	End
Item	DWR UCIP Field Study			39.334294 °	39.334294 °
				-121.634008 °	-121.634008 °
DWR ID	20816				

Comment Code

Inspector Comment

DS_ID:20816
FS_ID:57380
EP_NO: 11987
Repair Type: Non-Urgent
EVAL Issue: Unauthorized Modification or Non-Compliant Permit
Crossing Status: Found
UCIP Comments: 05/07/2019 Crossing has been modified. Need to contact owner to determine permit authorizing new modifications on both WS and LS. (O. Magana - DWR UCIP)12/07/2018 New encroachment owner information: Sukhraj Singh Pamma, 9850 Sheldon Avenue, Live Oak, CA 95953-9784, 1-530-695-2490. Information obtained from the Levee_Encroachment_listing_11288.pdf received from SBFCA. The permit listed in the pdf file is 11987. This permit was issued to the Cox Brothers in 1977. Need to have new owner apply for Permit Name Change with the CVFPB. (O. Magana - DWR UCIP) 08/09/2017 It appears that this pipe is used to water the orchard located on the WS. Dense vegetation present along the WS slope, recommend clearing vegetation to allow for proper inspection of levee slope. No permit has been identified since 2012. (O. Magana - DWR UCIP)08/02/2017 After reviewing record drawings it appears this crossing has remained. This pipe was not part of the Feather River West Levee Improvements, Project D. Pipe is located outside the project limits. Project Improvements began at Station (Sta) 1765+00 (MA0007 about LM 1.73) to Sta 2303+50 (ST0005 about LM 1.23), refer to record drawings for the Feather River West Levee Improvement Plans Station 1765+00 to 2368+26, Project D details. (O. Magana - DWR UCIP)
05/16/2016 Feather River West Levee Improvement Project--Levee currently under construction.06/10/2015 Crossing has been modified since last inspection. 3' black plastic pipe is now running through the metal pipe and the difference was capped and welded. (A. Freitag - DWR Sutter Yard)12/29/2014 Same as last inspection. (A. Freitag - DWR Sutter Yard)05/19/2014 Same as last inspection. (A. Freitag - DWR Sutter Yard)11/06/2013 Same as last inspection. (A. Freitag - DWR Sutter Yard)05/13/2013 SBFCA project recommends removal. Permit number and owner in detailed report book. (A. Freitag - DWR Sutter Yard)05/07/2013 Same as last inspection. Recommend finding owner. (A. Freitag - DWR Sutter Yard)10/30/2012 Crossing was installed about 1 foot deep--need permit authorizing work. (O. Magana - DWR Sutter Yard)
FIELD_STRUCT_DESC: 12-inch steel irrigation pipe through the levee, 1 foot below the crown. Crossing on the landside (LS) is attached to a weir above ground. Siphon breaker located on the waterside (WS). No opening on the WS. (12-inch pipe across the berm, levee, and Sutter-Butte Canal was authorized under Permit 11987, 1977 - Cox Brothers). [Additional Reference(s): Sutter Butte Flood Control Agency (SBFCA) Feather River West Levee Project, Volume 4 of 6 (Project D) Feather

Photo 1 of 3 : UCIP_FA_2020_57380_77330.jpg

LS view: pipe visible along LS canal.

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiancy Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Sutter Maintenance Yard Maintenance Area 0007

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	11.90	09/17/2020 09/17/2020	Brooks Weisser

River West Levee Improvement Plans Sta 1765+00 to 2368+26, 2016, Volume 4-SBFCA_Record_Drawings_Project D_2017.05.16.pdf, Drawing No. C-101].
FS Date: 5/7/2019 12:40:00 PM

LM Start	**1.71**	Rating **	M	Issue No.	**72 (cont)**
LM End	**1.71**	Issue Type +	En	Location *	

Photo 2 of 3 : UCIP_FA_2020_57380_77331.jpg

Overview of levee crown at crossing looking downstream.

LM Start	**1.71**	Rating **	M	Issue No.	**72 (cont)**
LM End	**1.71**	Issue Type +	En	Location *	

Photo 3 of 3 : UCIP_FA_2020_57380_77332.jpg

WS view: dense vegetation along WS slope.

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiency Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Sutter Maintenance Yard Maintenance Area 0007

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	11.90	09/17/2020 09/17/2020	Brooks Weisser

LM Start	**1.72**	Rating **	M	Issue No.	**73**
LM End	**1.72**	Issue Type +	En	Location *	
Category	Supplemental			GPS Latitude/Longitude	
				Start	End
Item	DWR UCIP Field Study			39.334336 °	39.334336 °
				-121.634046 °	-121.634046 °
DWR ID	16927				

Comment Code

Inspector Comment

DS_ID:16927
FS_ID:57381
EP_NO: N/A
Repair Type: Non-Urgent
EVAL Issue: Unauthorized Encroachment, installed decades prior
Crossing Status: Found
UCIP Comments: 05/07/2019 Record remains Non-Urgent, no permit has been identified for this crossing. Internal inspection has been completed but no pipe evaluation by DMP is available yet. Need to determine if pipe is mainly used for drainage or irrigation. (O. Magana - DWR UCIP)12/07/2018 Encroachment owner information: Sukhraj Singh Pamma, 9850 Sheldon Avenue, Live Oak, CA 95953-9784, 1-530-695-2490. Information obtained from the Levee_Encroachment_listing_11288.pdf which was received from SBFCA. Need to coordinate with CVFPB to determine status of permit. (O. Magana - DWR UCIP)
08/09/2017 Crossing is still present, unable to confirm is crossing is still in use. Recommend contacting owner to determine status, remove dense vegetation blocking outlet, and to obtain permit authorizing crossing. (O. Magana - DWR UCIP)08/02/2017 After reviewing record drawings it appears this crossing has remained. This pipe was not part of the Feather River West Levee Improvements, Project D. Pipe is located outside the project limits. Project Improvements began at Station (Sta) 1765+00 (MA0007 about LM 1.73) to Sta 2303+50 (ST0005 about LM 1.23), refer to record drawings for the Feather River West Levee Improvement Plans Station 1765+00 to 2368+26, Project D details. (O. Magana - DWR UCIP)
05/16/2016 Feather River West Levee Improvement Project--Levee currently under construction.06/10/2015 WS headwall is still damaged and no repairs were made to this pipe. Looks like the SBFCA project skipped over this area so pipe was not replaced as it was listed to be. (A. Freitag - DWR Sutter Yard)12/29/2014 Same as last inspection. (A. Freitag - DWR Sutter Yard)05/19/2014 Same as last inspection. (A. Freitag - DWR Sutter Yard)11/06/2013 Same as last inspection. (A. Freitag - DWR Sutter Yard)05/13/2013 SBFCA project recommends replacing with accordance to title 23. (A. Freitag - DWR Sutter Yard)05/07/2013 Same as last inspection, however exposed rebar on WS headwall does not impede structure performance. (A. Freitag - DWR Sutter Yard)10/31/2012 WS headwall rebar exposed. This crossing was listed in the USACE Periodic Inspections as ID# USACE_CESPK_MA07_2010_a_0051 however, no issue listed. (O. Magana - DWR UCIP)
FIELD_STRUCT_DESC: 10-inch polyvinyl chloride (PVC) pipe encased in a 12-inch corrugated metal irrigation pipe through the levee, 7 feet below the crown. Concrete U-shaped headwall at the waterside (WS) toe. Concrete headwall and slide gate on the landside (LS). Concrete weir in the canal. (Existing 10-inch PVC pipe and 12-inch corrugated

Photo 1 of 3 : UCIP_FA_2020_57381_77335.jpg

LS view: screw gate and concrete headwall visible on LS.

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiancy Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Sutter Maintenance Yard Maintenance Area 0007

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	11.90	09/17/2020 09/17/2020	Brooks Weisser

metal [concrete indicated in record drawings] irrigation pipe crossing remained during the Feather River West Levee Improvements, Project D). [Additional Reference(s): DWR Levee Log, 2005 (HLM 1.71). Sutter Butte Flood Control Agency (SBFCA) Feather River West Levee Project, Volume 4 of 6 (Project D) Feather River West Levee Improvement Plans Sta 1765+00 to 2368+26, 2016, Volume 4-SBFCA_Record_Drawings_Project D_2017.05.16.pdf, Drawing No. C-101].
FS Date: 5/7/2019 12:41:00 PM

LM Start	**1.72**	Rating **	M	Issue No.	**73 (cont)**
LM End	**1.72**	Issue Type +	En	Location *	

Photo 2 of 3 : UCIP_FA_2020_57381_77336.jpg

Overview of levee crown at crossing.

LM Start	**1.72**	Rating **	M	Issue No.	**73 (cont)**
LM End	**1.72**	Issue Type +	En	Location *	

Photo 3 of 3 : UCIP_FA_2020_57381_77337.jpg

WS view: guardrail along the WS slope and concrete headwall visible on WS.

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiancy Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Sutter Maintenance Yard Maintenance Area 0007

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	11.90	09/17/2020 09/17/2020	Brooks Weisser

LM Start	**1.76**	Rating **	M	Issue No.	**74**
LM End	**1.76**	Issue Type +	Ma	Location *	
Category	Supplemental			GPS Latitude/Longitude	
				Start	End
Item	DWR UCIP LMA Responsibility			39.334868 °	39.334868 °
				-121.633773 °	-121.633773 °
DWR ID	16926				

Comment Code

Inspector Comment

DS_ID:16926
FS_ID:58358
EP_NO: N/A
Repair Type: Non-Urgent
EVAL Issue: Safety Issue
Crossing Status: Found
UCIP Comments: 05/07/2019 Record remains Non-Urgent, no permit has been identified for the structure. Recommend adding covers to the CMP risers located on the WS as a safety measure. DMP internal inspection is still pending. It is unclear who the owner and maintainer is for this structure. LMA will need to coordinate with CVFPB to determine true owner. (O. Magana - DWR UCIP)12/07/2018 Encroachment Owner is Butte Water District c/o Mark Orme, District Manager, 735 Virginia Street, Gridley, CA 95948, 1-530-846-3100. Information obtained from the Levee_Encroachment_listing_11288.pdf obtained from SBFCA which also indicates CVFPB Permit Process - New Permit. Need to coordinate with CVFPB to determine status of permit. (O. Magana - DWR UCIP)
08/09/2017 Dual 60-inch pipes are still present--no modifications appear to have been made to this structure. No permit or owner has been identified. Need to contact owner to notify of safety issue regarding the missing covers for CMP riser. (O. Magana - DWR UCIP)08/02/2017 After reviewing record drawings it appears this crossing has remained. Project Improvements begin at Station (Sta) 1765+00 (MA0007 about LM 1.73) to Sta 2303+50 (ST0005 about LM 1.23), refer to record drawings for the Feather River West Levee Improvement Plans Station 1765+00 to 2368+26, Project D details. MA0007 project details include NO CUTOFF WALL from Sta 1765+00 (MA0007 about LM 1.73) to 1815+00 (MA0007 about LM 2.64) and LEVEE DEGRADE AND RECONSTRUCTION WITH CUT OFF WALL from Sta 1817+00 (MA0007 about LM 2.69) to Sta 2289+00, Sta 2287+00 to Sta 2290+00 (MA0007 about LM 11.60). (O. Magana - DWR UCIP)
05/16/2016 Feather River West Levee Improvement Project--Levee currently under construction. (A. Freitag - DWR Sutter Yard)06/10/2015 Debris still present in risers and pipes were not replaced with the SBFCA project. (A. Freitag - DWR Sutter Yard)12/29/2014 Same as last inspection. (A. Freitag - DWR Sutter Yard)05/19/2014 Same as last inspection. (A. Freitag - DWR Sutter Yard)11/06/2013 Same as last inspection. (A. Freitag - DWR Sutter Yard)05/13/2013 SBFCA project recommends replacing in accordance with title 23. (A. Freitag - DWR Sutter Yard)05/07/2013 Same debris issue as last inspection. Recommend repairing top cover to prevent falls. Wheel to open gate chained and locked so could not verify gate operation. (A. Freitag - DWR Sutter Yard)10/31/2012 Debris inside riser could prevent slide gate from closing. This crossing was listed in the USACE Periodic Inspections as ID#

Photo 1 of 3 : UCIP_FA_2020_58358_77346.jpg

Overview of levee crown looking upstream towards crossings.

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiancy Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Sutter Maintenance Yard Maintenance Area 0007

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	11.90	09/17/2020 09/17/2020	Brooks Weisser

USACE_CESPK_MA07_2010_a_0060 however, no issues noted. (O. Magana - DWR UCIP)
FIELD_STRUCT_DESC: 1 of 2: 60-inch corrugated metal gravity drainage pipe through the levee, 12.5 feet below the crown. Slide gate in a 78-inch corrugated metal pipe (CMP) well on the waterside (WS) slope. Concrete bulkheads on both ends. Reinforced concrete spillway on the WS end. (Existing 60-inch corrugated metal gravity drainage pipe crossing remained during the Feather River West Levee Improvements, Project D). [Additional Reference(s): DWR Levee Log, 2005 (HLM 1.76). USACE Sacramento O&M Manual, Unit 152, March 1957, Revised 29 Dec 2016, (Station 1+90), listed as two 60-inch CMPs. Sutter Butte Flood Control Agency (SBFCA) Feather River West Levee Project, Volume 4 of 6 (Project D) Feather River West Levee Improvement Plans Sta 1765+00 to 2368+26, 2016, Volume 4-SBFCA_Record_Drawings_Project D_2017.05.16.pdf, Drawing No. C-101].
FS Date: 5/7/2019 12:42:00 PM

LM Start	**1.76**	Rating **	M	Issue No.	**74 (cont)**
LM End	**1.76**	Issue Type +	Ma	Location *	

Photo 2 of 3 : UCIP_FA_2020_58358_77351.jpg

LS view: concrete headwall with dual 60-inch crossings visible from LS.

LM Start	**1.76**	Rating **	M	Issue No.	**74 (cont)**
LM End	**1.76**	Issue Type +	Ma	Location *	

Photo 3 of 3 : UCIP_FA_2020_58358_77342.jpg

LS view: view of canal looking west from crossing.

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiancy Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Sutter Maintenance Yard Maintenance Area 0007

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	11.90	09/17/2020 09/17/2020	Brooks Weisser

LM Start	**1.76**	Rating **	M	Issue No.	**75**
LM End	**1.76**	Issue Type +	Ma	Location *	
Category	Supplemental			GPS Latitude/Longitude	
				Start	End
Item	DWR UCIP LMA Responsibility			39.334886 °	39.334886 °
				-121.633783 °	-121.633783 °
DWR ID	17011				

Comment Code

Inspector Comment

DS_ID:17011
FS_ID:58359
EP_NO: N/A
Repair Type: Non-Urgent
EVAL Issue: Safety Issue
Crossing Status: Found
UCIP Comments: 05/07/2019 Record remains Non-Urgent, no permit has been identified for the structure. Recommend adding covers to the CMP risers located on the WS as a safety measure. DMP internal inspection is still pending. It is unclear who the owner and maintainer is for this structure. LMA will need to coordinate with CVFPB to determine true owner. (O. Magana - DWR UCIP)12/07/2018 Encroachment Owner is Butte Water District c/o Mark Orme, District Manager, 735 Virginia Street, Gridley, CA 95948, 1-530-846-3100. Information obtained from the Levee_Encroachment_listing_11288.pdf obtained from SBFCA which also indicates CVFPB Permit Process - New Permit. Need to coordinate with CVFPB to determine status of permit. (O. Magana - DWR UCIP)
08/09/2017 Dual 60-inch pipes are still present--no modifications appear to have been made to this structure. No permit or owner has been identified. Need to contact owner to notify of safety issue regarding the missing covers for CMP riser. (O. Magana - DWR UCIP)08/02/2017 After reviewing record drawings it appears this crossing has remained. Project Improvements begin at Station (Sta) 1765+00 (MA0007 about LM 1.73) to Sta 2303+50 (ST0005 about LM 1.23), refer to record drawings for the Feather River West Levee Improvement Plans Station 1765+00 to 2368+26, Project D details. MA0007 project details include NO CUTOFF WALL from Sta 1765+00 (MA0007 about LM 1.73) to 1815+00 (MA0007 about LM 2.64) and LEVEE DEGRADE AND RECONSTRUCTION WITH CUT OFF WALL from Sta 1817+00 (MA0007 about LM 2.69) to Sta 2289+00, Sta 2287+00 to Sta 2290+00 (MA0007 about LM 11.60). (O. Magana - DWR UCIP)
05/16/2016 Feather River West Levee Improvement Project--Levee currently under construction. (A. Freitag - DWR Sutter Yard)06/10/2015 Debris still present inside riser and pipe was not replaced with the SBFCA project. (A. Freitag - DWR Sutter Yard)12/29/2014 Same as last inspection. (A. Freitag - DWR Sutter Yard)05/19/2014 Same as last inspection. (A. Freitag - DWR Sutter Yard)11/06/2013 Same as last inspection. (A. Freitag - DWR Sutter Yard)05/13/2013 SBFCA project recommends replacing in accordance with title 23. (A. Freitag - DWR Sutter Yard)05/07/2013 Same as last inspection. Recommend constructing cover to prevent falls. Wheel to operate gate chained and locked so gate operation could not be verified. (A. Freitag - DWR Sutter Yard)10/31/2012 no cover; debris inside riser could prevent slide gate from closing. This crossing was listed in the USACE Periodic Inspections as ID#

Photo 1 of 3 : UCIP_FA_2020_58359_77352.jpg

Overview of levee crown looking upstream towards crossings.

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable	A : Acceptable N : Not Inspected/Rated	Ma : Maintenance Deficiancy
WS : Water Side	M : Minimally Acceptable C : Corrected	Ob : Design & System Obsolescence
CR : Crown	U : Unacceptable A/W : Acceptable but Monitor & Maintain	En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Sutter Maintenance Yard Maintenance Area 0007

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	11.90	09/17/2020 09/17/2020	Brooks Weisser

USACE_CESPK_MA07_2010_a_0060 however, no issues noted. (O. Magana - DWR UCIP)
FIELD_STRUCT_DESC: 2 of 2: 60-inch corrugated metal gravity drainage pipe through the levee, 12.5 feet below the crown. Slide gate in a 78-inch corrugated metal pipe (CMP) well on the waterside (WS) slope. Concrete bulkheads on both ends. Reinforced concrete spillway on the WS end. (Existing 60-inch corrugated metal gravity drainage pipe crossing remained during the Feather River West Levee Improvements, Project D). [Additional Reference(s): DWR Levee Log, 2005 (HLM 1.76). USACE Sacramento O&M Manual, Unit 152, March 1957, Revised 29 Dec 2016, (Station 1+90), listed as two 60-inch CMPs. Sutter Butte Flood Control Agency (SBFCA) Feather River West Levee Project, Volume 4 of 6 (Project D) Feather River West Levee Improvement Plans Sta 1765+00 to 2368+26, 2016, Volume 4-SBFCA_Record_Drawings_Project D_2017.05.16.pdf, Drawing No. C-101].
FS Date: 5/7/2019 12:42:00 PM

LM Start	1.76	Rating **	M	Issue No.	75 (cont)
LM End	1.76	Issue Type +	Ma	Location *	

Photo 2 of 3 : UCIP_FA_2020_58359_77357.jpg

LS view: concrete headwall with dual 60-inch crossings.

LM Start	1.76	Rating **	M	Issue No.	75 (cont)
LM End	1.76	Issue Type +	Ma	Location *	

Photo 3 of 3 : UCIP_FA_2020_58359_77358.jpg

LS view: canal located on LS, photo taken from levee crown looking west.

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiancy Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Sutter Maintenance Yard Maintenance Area 0007

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	11.90	09/17/2020 09/17/2020	Brooks Weisser

LM Start	**1.94**	Rating **	M	Issue No.	**76**
LM End	**1.94**	Issue Type +	En	Location *	
Category	Supplemental			GPS Latitude/Longitude	
				Start	End
Item	DWR UCIP Field Study			39.337442 °	39.337442 °
				-121.633500 °	-121.633500 °
DWR ID	25499				

Comment Code

Inspector Comment

DS_ID:25499
FS_ID:58362
EP_NO: N/A
Repair Type: Non-Urgent
EVAL Issue: Levee Improvement Project
Crossing Status: Found
UCIP Comments: 05/07/2019 Record has been updated from No Action Needed to Non-Urgent, no permit has been issued by the CVFPB for this pipe. Second paddle marker located along the LS slope is down. No other issues were observed during inspection. (O. Magana - DWR UCIP)08/09/2017 Crossing field verified, photos added to record, and coordinates updated. No permit has been issued however, markers show owner as WAL (or Waller Family Revocable Trust c/o Sandra A. Waller. Will need to update permit information when the CVFPB issues permit for this crossing. (O. Magana - DWR UCIP)08/08/2017 Crossing was installed under the Feather River West Levee Improvements, Project D. Project Improvements begin at Station (Sta) 1765+00 (MA0007 about LM 1.73) to Sta 2303+50 (ST0005 about LM 1.23), refer to record drawings for the Feather River West Levee Improvement Plans Station 1765+00 to 2368+26, Project D details. MA0007 project details include NO CUTOFF WALL from Sta 1765+00 (MA0007 about LM 1.73) to 1815+00 (MA0007 about LM 2.64) and LEVEE DEGRADE AND RECONSTRUCTION WITH CUT OFF WALL from Sta 1817+00 (MA0007 about LM 2.69) to Sta 2289+00, Sta 2287+00 to Sta 2290+00 (MA0007 about LM 11.60). (O. Magana - DWR UCIP)
FIELD_STRUCT_DESC: 24-inch inside diameter gravity drainage pipe of an unknown material through the levee, 4.5 feet below the crown. 18-inch drainage layer at the pipe inlet at the landside (LS) toe. Existing ground regraded to provide a smooth transition to inlet structure on the landside (LS) end. Access control grate inside the inlet structure. Gate riser structure with positive shutoff valve on the waterside (WS) shoulder. Flap gate and outfall structure with riprap on the waterside (WS) end. Existing ground regraded to provide a smooth transition at the outlet. (Existing 24-inch gravity drainage pipe crossing removed [refer to DSID 16925] and replaced portion within construction limit with a new 24-inch gravity drainage pipe crossing during the Feather River West Levee Improvements, Project D). [Additional Reference(s): Sutter Butte Flood Control Agency (SBFCA) Feather River West Levee Project, Volume 4 of 6 (Project D) Feather River West Levee Improvement Plans Sta 1765+00 to 2368+26, Volume 4-SBFCA_Record_Drawings_Project D_2017.05.16.pdf, Drawing No. C-509].
FS Date: 5/7/2019 12:44:00 PM

Photo 1 of 3 : UCIP_FA_2020_58362_77116.jpg

Overview of WS at crossing.

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiancy Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Sutter Maintenance Yard Maintenance Area 0007

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	11.90	09/17/2020 09/17/2020	Brooks Weisser

LM Start	**1.94**	Rating **	M	Issue No.	**76 (cont)**
LM End	**1.94**	Issue Type +	En	Location *	
Category	Supplemental			GPS Latitude/Longitude	
				Start	End
Item	DWR UCIP Field Study			39.337442 °	39.337442 °
				-121.633500 °	-121.633500 °
DWR ID	25499				

Photo 2 of 3 : UCIP_FA_2020_58362_77117.jpg

Overview of levee crown at crossing.

LM Start	**1.94**	Rating **	M	Issue No.	**76 (cont)**
LM End	**1.94**	Issue Type +	En	Location *	

Photo 3 of 3 : UCIP_FA_2020_58362_77118.jpg

Overview of LS at crossing. Markers along pipe alignment indicating pipe depth of 4-feet (near levee shoulder) and 3-feet near toe.

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable	A : Acceptable N : Not Inspected/Rated	Ma : Maintenance Deficiency
WS : Water Side	M : Minimally Acceptable C : Corrected	Ob : Design & System Obsolescence
CR : Crown	U : Unacceptable A/W : Acceptable but Monitor & Maintain	En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Sutter Maintenance Yard Maintenance Area 0007

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	11.90	09/17/2020 09/17/2020	Brooks Weisser

LM Start	**2.09**	Rating **	M	Issue No.	**77**
LM End	**2.09**	Issue Type +	En	Location *	
Category	Supplemental			GPS Latitude/Longitude	
				Start	End
Item	DWR UCIP Field Study			39.339266 °	39.339266 °
				-121.631847 °	-121.631847 °
DWR ID	25500				

Comment Code

Inspector Comment

DS_ID:25500
FS_ID:58364
EP_NO: N/A
Repair Type: Non-Urgent
EVAL Issue: Levee Improvement Project
Crossing Status: Found
UCIP Comments: 05/07/2019 Record has been updated from No Action Need to Non-Urgent, no permit has been issued yet by the CVFPB for this pipe. No other issues were observed during inspection. (O. Magana - DWR UCIP)08/09/2017 Crossing field verified, photos added to record, and coordinates updated. No permit has been issued however, markers show owner as WAL (or Waller Family Revocable Trust c/o Sandra A. Waller). Will need to update permit information when the CVFPB issues permit for this crossing. (O. Magana - DWR UCIP)08/08/2017 Crossing was installed under the Feather River West Levee Improvements, Project D. Project Improvements begin at Station (Sta) 1765+00 (MA0007 about LM 1.73) to Sta 2303+50 (ST0005 about LM 1.23), refer to record drawings for the Feather River West Levee Improvement Plans Station 1765+00 to 2368+26, Project D details. MA0007 project details include NO CUTOFF WALL from Sta 1765+00 (MA0007 about LM 1.73) to 1815+00 (MA0007 about LM 2.64) and LEVEE DEGRADE AND RECONSTRUCTION WITH CUT OFF WALL from Sta 1817+00 (MA0007 about LM 2.69) to Sta 2289+00, Sta 2287+00 to Sta 2290+00 (MA0007 about LM 11.60). (O. Magana - DWR UCIP)
FIELD_STRUCT_DESC: 24-inch inside diameter gravity drainage pipe of an unknown material through the levee, 4 feet below the crown. 18-inch drainage layer at the pipe inlet at the landside (LS) toe. Existing ground regraded to provide a smooth transition to inlet structure on the landside (LS) end. Access control rack inside the inlet structure. Gate riser structure with positive shutoff valve on the waterside (WS) shoulder. Flap gate and outfall structure with riprap on the waterside (WS) end. Existing ground regraded to provide a smooth transition at the outlet. (Existing 24-inch corrugated metal gravity drainage pipe crossing removed and replaced portion within construction limit with a new 24-inch gravity drainage pipe crossing during the Feather River West Levee Improvements, Project D). [Additional Reference(s): Sutter Butte Flood Control Agency (SBFCA) Feather River West Levee Project, Volume 4 of 6 (Project D) Feather River West Levee Improvement Plans Sta 1765+00 to 2368+26, 2016, Volume 4-SBFCA_Record_Drawings_Project D_2017.05.16.pdf, Drawing No. C-511].
FS Date: 5/7/2019 12:44:00 PM

Photo 1 of 3 : UCIP_FA_2020_58364_77138.jpg

Overview of WS looking downstream at crossing.

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiancy Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Sutter Maintenance Yard Maintenance Area 0007

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	11.90	09/17/2020 09/17/2020	Brooks Weisser

LM Start	**2.09**	Rating **	M	Issue No.	**77 (cont)**
LM End	**2.09**	Issue Type +	En	Location *	
Category	Supplemental			GPS Latitude/Longitude	
				Start	End
Item	DWR UCIP Field Study			39.339266 °	39.339266 °
				-121.631847 °	-121.631847 °
DWR ID	25500				

Photo 2 of 3 : UCIP_FA_2020_58364_77139.jpg

Overview of levee crown looking downstream at crossing.

LM Start	**2.09**	Rating **	M	Issue No.	**77 (cont)**
LM End	**2.09**	Issue Type +	En	Location *	

Photo 3 of 3 : UCIP_FA_2020_58364_77140.jpg

Overview of LS looking downstream at crossing.

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiancy Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Sutter Maintenance Yard Maintenance Area 0007

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	11.90	09/17/2020 09/17/2020	Brooks Weisser

LM Start	**2.24**	Rating **	M	Issue No.	**78**
LM End	**2.24**	Issue Type +	En	Location *	
Category	Supplemental			GPS Latitude/Longitude	
				Start	End
Item	DWR UCIP Field Study			39.341208 °	39.341208 °
				-121.630773 °	-121.630773 °
DWR ID	25501				

Comment Code

Inspector Comment

DS_ID:25501
FS_ID:57386
EP_NO: N/A
Repair Type: Non-Urgent
EVAL Issue: Levee Improvement Project
Crossing Status: Found
UCIP Comments: 05/07/2019 Record has been updated from No Action Needed to Non-Urgent, no permit has been issued yet by the CVFPB. Second paddle marker is down on the LS slope. (O. Magana - DWR UCIP)08/09/2017 Crossing was field verified and photographed. Photos added. No permit shown but pipe marker shows owner as WAL (Waller family Revocable Trust c/o Sandra A Waller). Permit will be updated when CVFPB issues one. (O. Magana - DWR UCIP)08/08/2017 Crossing was installed under the Feather River West Levee Improvements, Project D. Project Improvements begin at Station (Sta) 1765+00 (MA0007 about LM 1.73) to Sta 2303+50 (ST0005 about LM 1.23), refer to record drawings for the Feather River West Levee Improvement Plans Station 1765+00 to 2368+26, Project D details. MA0007 project details include NO CUTOFF WALL from Sta 1765+00 (MA0007 about LM 1.73) to 1815+00 (MA0007 about LM 2.64) and LEVEE DEGRADE AND RECONSTRUCTION WITH CUT OFF WALL from Sta 1817+00 (MA0007 about LM 2.69) to Sta 2289+00, Sta 2287+00 to Sta 2290+00 (MA0007 about LM 11.60). (O. Magana - DWR UCIP)
FIELD_STRUCT_DESC: 36-inch inside diameter gravity drainage pipe of an unknown material through the levee, 9.7 feet below the crown. 18-inch drainage layer at the pipe inlet at the landside (LS) toe. Connection manhole with existing 24-inch gravity pipe near the landside (LS) toe. Gate riser structure with positive shutoff valve on the waterside (WS) shoulder. Plug and cap on WS end of pipe. Temporary 4-inch by 4-inch marker post above WS end of pipe. (Existing 24-inch corrugated metal irrigation pipe crossing removed and replaced portion within construction limit with a new 36-inch through pipe crossing within construction limits during the Feather River West Levee Improvements, Project D). [Additional Reference(s): Sutter Butte Flood Control Agency (SBFCA) Feather River West Levee Project, Volume 4 of 6 (Project D) Feather River West Levee Improvement Plans Sta 1765+00 to 2368+26, 2016, Volume 4-SBFCA_Record_Drawings_Project D_2017.05.16.pdf, Drawing No. C-513].
FS Date: 5/7/2019 12:45:00 PM

Photo 1 of 3 : UCIP_FA_2020_57386_77126.jpg

Overview of WS

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiancy Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Sutter Maintenance Yard Maintenance Area 0007

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	11.90	09/17/2020 09/17/2020	Brooks Weisser

LM Start	**2.24**	Rating **	M	Issue No.	**78 (cont)**
LM End	**2.24**	Issue Type +	En	Location *	
Category	Supplemental			GPS Latitude/Longitude	
				Start	End
Item	DWR UCIP Field Study			39.341208 °	39.341208 °
				-121.630773 °	-121.630773 °
DWR ID	25501				

Photo 2 of 3 : UCIP_FA_2020_57386_77127.jpg

Overview of LS

LM Start	**2.24**	Rating **	M	Issue No.	**78 (cont)**
LM End	**2.24**	Issue Type +	En	Location *	

Photo 3 of 3 : UCIP_FA_2020_57386_77128.jpg

Overview of levee crown looking downstream

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiancy Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Sutter Maintenance Yard Maintenance Area 0007

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	11.90	09/17/2020 09/17/2020	Brooks Weisser

LM Start	**2.36**	Rating **	M	Issue No.	**79**
LM End	**2.36**	Issue Type +	En	Location *	
Category	Supplemental			GPS Latitude/Longitude	
				Start	End
Item	DWR UCIP Field Study			39.342859 °	39.342859 °
				-121.629909 °	-121.629909 °
DWR ID	20817				

Comment Code

Inspector Comment

DS_ID:20817
FS_ID:57387
EP_NO: N/A
Repair Type: Non-Urgent
EVAL Issue: Levee Improvement Project
Crossing Status: Found
UCIP Comments: 05/07/2019 Record has been updated from No Action Needed to Non-Urgent, no permit has been issued for new pipe. Permit 17213 does not account for improvements made in 2016. Paddle marker is down on the LS slope. (O. Magana - DWR UCIP)08/09/2017 Crossing was field verified and photographed. Photos updated. Permit number and ownership added to description. Owners address Sandra A Waller, 585 Cowee Avenue, Gridley, CA 95948. (O. Magana - DWR UCIP)08/02/2017 Crossing was rehabilitated under the Feather River West Levee Improvements, Project D. Project Improvements begin at Station (Sta) 1765+00 (MA0007 about LM 1.73) to Sta 2303+50 (ST0005 about LM 1.23), refer to record drawings for the Feather River West Levee Improvement Plans Station 1765+00 to 2368+26, Project D details. MA0007 project details include NO CUTOFF WALL from Sta 1765+00 (MA0007 about LM 1.73) to 1815+00 (MA0007 about LM 2.64) and LEVEE DEGRADE AND RECONSTRUCTION WITH CUT OFF WALL from Sta 1817+00 (MA0007 about LM 2.69) to Sta 2289+00, Sta 2287+00 to Sta 2290+00 (MA0007 about LM 11.60). (O. Magana - DWR UCIP)
5/16/2016 Feather River West Levee Improvement Project--Levee currently under construction. New gate valve, referenced as STA 1799+44, will be installed as indicated in the project Plans for Construction of Feather River West Levee Project, Project Area A, Feather River West Levee Improvement Plans, Sta 1765+00 to 2368+26, Volume 3 of 5. (O. Magana - DWR UCIP)06/10/2015 Air vac is still bent over. (A. Freitag - DWR Sutter Yard)12/29/2014 Same as last inspection. (A. Freitag - DWR Sutter Yard)05/19/2014 Same as last inspection. (A. Freitag - DWR Sutter Yard)11/06/2013 Air vac bent over and both metal posts are laying at toe of levee. (A. Freitag - DWR Sutter Yard)05/13/2013 Permit number and owner in detailed report book. (A. Freitag - DWR Sutter Yard)05/07/2013 Need to find owner of structure. (A. Freitag - DWR Sutter Yard)10/30/2012 Need permit authorizing work. (O. Magana - DWR UCIP)
FIELD_STRUCT_DESC: 8-inch irrigation siphon pipe of an unknown material, 2.3 feet below the crown. Air release valve on the waterside (WS) shoulder protected by two metal bollards. (Existing 8-inch pressurized pipe crossing protected in place. 2 feet of the pipe on the landside (LS) of the gate valve removed and replaced with 8-inch inside diameter pressurized pipe of an unknown material. Existing air release valve and two metal bollards removed and disposed. Existing valve opening plugged. Two 8-inch C509 standard FL by FL Mueller A-2360 resiliant wedge or approved equal gate valves installed, one on the WS

Photo 1 of 3 : UCIP_FA_2020_57387_77133.jpg

Overview of levee crown looking downstream

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiancy Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Sutter Maintenance Yard Maintenance Area 0007

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	11.90	09/17/2020 09/17/2020	Brooks Weisser

shoulder, the other near the LS toe. 1-inch APCO 1437 combination air valve installed on the WS shoulder. 4-foot by 4-foot by 3.5-foot valve utility box installed with a tamper-proof bolted solid cover on the WS shoulder. 2-foot by 3-foot by 2.5-foot valve utility box installed with a tamper-proof bolted solid cover near the LS toe. This work was completed during the Feather River West Levee Improvements, Project D). (Permit No. 17213, 2000- Waller Family Revocable Trust c/o Sandra A Waller). [Additional Reference(s): Sutter Butte Flood Control Agency (SBFCA) Feather River West Levee Project, Volume 4 of 6 (Project D) Feather River West Levee Improvement Plans Sta 1765+00 to 2368+26, 2016, Volume 4-SBFCA_Record_Drawings_Project D_2017.05.16.pdf, Drawing No. C-515, pipe rehabilitated].
FS Date: 5/7/2019 12:40:00 PM

LM Start	2.36	Rating **	M	Issue No.	79 (cont)
LM End	2.36	Issue Type +	En	Location *	

Photo 2 of 3 : UCIP_FA_2020_57387_77134.jpg

Overview of LS with alignment markers

LM Start	2.36	Rating **	M	Issue No.	79 (cont)
LM End	2.36	Issue Type +	En	Location *	

Photo 3 of 3 : UCIP_FA_2020_57387_77135.jpg

overview of WS

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiancy Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Sutter Maintenance Yard Maintenance Area 0007

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	11.90	09/17/2020 09/17/2020	Brooks Weisser

LM Start	**2.56**	Rating **	M	Issue No.	**80**
LM End	**2.56**	Issue Type +	En	Location *	
Category	Supplemental			GPS Latitude/Longitude	
				Start	End
Item	DWR UCIP Field Study			39.345638 °	39.345638 °
				-121.629607 °	-121.629607 °
DWR ID	25502				

Comment Code

Inspector Comment

DS_ID:25502
FS_ID:58370
EP_NO: N/A
Repair Type: Non-Urgent
EVAL Issue: Levee Improvement Project
Crossing Status: Found
UCIP Comments: 05/07/2019 Record has been updated from No Action Needed to Non-Urgent, no permit has been issued by the CVFPB. No other issues were observed during inspection. (O. Magana - DWR UCIP)08/09/2017 Crossing was field verified and photographed. Photos added. No known permit for crossing but alignment markers show owner as PKA (Peekema Ranch LP, 905 Alexander Ave, Gridley, CA 95948.) Permit will be updated when CVFPB issues one. (A. Freitag - DWR Sutter Yard)08/08/2017 Crossing was installed under the Feather River West Levee Improvements, Project D. Project Improvements begin at Station (Sta) 1765+00 (MA0007 about LM 1.73) to Sta 2303+50 (ST0005 about LM 1.23), refer to record drawings for the Feather River West Levee Improvement Plans Station 1765+00 to 2368+26, Project D details. MA0007 project details include NO CUTOFF WALL from Sta 1765+00 (MA0007 about LM 1.73) to 1815+00 (MA0007 about LM 2.64) and LEVEE DEGRADE AND RECONSTRUCTION WITH CUT OFF WALL from Sta 1817+00 (MA0007 about LM 2.69) to Sta 2289+00, Sta 2287+00 to Sta 2290+00 (MA0007 about LM 11.60). (O. Magana - DWR UCIP)
FIELD_STRUCT_DESC: 24-inch inside diameter gravity drainage pipe of an unknown material through the levee, 4.6 feet below the crown. 18-inch drainage layer at the pipe inlet at the landside (LS) toe. Inlet structure on the landside (LS) end. Existing ground regraded to provide smooth transition to inlet. Gate riser structure with positive shutoff valve on the waterside (WS) shoulder. Flap gate, outfall structure, and riprap on the WS end. Existing ground regraded to provide smooth transition at outlet. (Existing 24-inch corrugated metal gravity drainage pipe crossing removed and replaced portion within construction limit with a new 24-inch gravity drainage pipe crossing during the Feather River West Levee Improvements, Project D). [Additional Reference(s): Sutter Butte Flood Control Agency (SBFCA) Feather River West Levee Project, Volume 4 of 6 (Project D) Feather River West Levee Improvement Plans Sta 1765+00 to 2368+26, 2016, Volume 4-SBFCA_Record_Drawings_Project D_2017.05.16.pdf, Drawing No. C-517]
FS Date: 5/7/2019 12:45:00 PM

Photo 1 of 3 : UCIP_FA_2020_58370_77149.jpg

Overview of WS

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiancy Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Sutter Maintenance Yard Maintenance Area 0007

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	11.90	09/17/2020 09/17/2020	Brooks Weisser

LM Start	**2.56**	Rating **	M	Issue No.	**80 (cont)**
LM End	**2.56**	Issue Type +	En	Location *	
Category	Supplemental			GPS Latitude/Longitude	
				Start	End
Item	DWR UCIP Field Study			39.345638 °	39.345638 °
				-121.629607 °	-121.629607 °
DWR ID	25502				

Photo 2 of 3 : UCIP_FA_2020_58370_77150.jpg

Overview of levee crown looking downstream

LM Start	**2.56**	Rating **	M	Issue No.	**80 (cont)**
LM End	**2.56**	Issue Type +	En	Location *	

Photo 3 of 3 : UCIP_FA_2020_58370_77151.jpg

Overview of LS

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiancy Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Sutter Maintenance Yard Maintenance Area 0007

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	11.90	09/17/2020 09/17/2020	Brooks Weisser

LM Start	**2.73**	Rating **	M	Issue No.	**81**
LM End	**2.73**	Issue Type +	En	Location *	
Category	Supplemental			GPS Latitude/Longitude	
				Start	End
Item	DWR UCIP Field Study			39.347977 °	39.347977 °
				-121.630337 °	-121.630337 °
DWR ID	25503				

Comment Code

Inspector Comment

DS_ID:25503
FS_ID:57389
EP_NO: N/A
Repair Type: Non-Urgent
EVAL Issue: Levee Improvement Project
Crossing Status: Found
UCIP Comments: 05/07/2019 Record has been updated from No Action Needed to Non-Urgent, no permit has been issued for this crossing. Second paddle marker located at LS toe has been bent. No other issues were recorded during inspection. (O. Magana - DWR UCIP)08/09/2017 Crossing was field verified and photographed. Photos added. No known permit for crossing but alignment markers show owner as GSD (City of Gridley c/o Bruce Nash, 685 Kentucky Street, Gridley, CA 95948.) Permit will be updated when CVFPB issues one. (A. Freitag - DWR Sutter Yard)08/08/2017 Crossing was installed under the Feather River West Levee Improvements, Project D. Project Improvements begin at Station (Sta) 1765+00 (MA0007 about LM 1.73) to Sta 2303+50 (ST0005 about LM 1.23), refer to record drawings for the Feather River West Levee Improvement Plans Station 1765+00 to 2368+26, Project D details. MA0007 project details include NO CUTOFF WALL from Sta 1765+00 (MA0007 about LM 1.73) to 1815+00 (MA0007 about LM 2.64) and LEVEE DEGRADE AND RECONSTRUCTION WITH CUT OFF WALL from Sta 1817+00 (MA0007 about LM 2.69) to Sta 2289+00, Sta 2287+00 to Sta 2290+00 (MA0007 about LM 11.60). (O. Magana - DWR UCIP)
FIELD_STRUCT_DESC: 36-inch inside diameter gravity drainage pipe of an unknown material through the levee, 24.1 feet below the crown. 18-inch drainage layer at the pipe inlet at the landside (LS) toe. Two connection manholes, one off the landside (LS) toe, the other off the waterside (WS) toe, where the 36-inch gravity drainage pipe connects to the existing 24-inch gravity drainage pipe near the construction limits. Gate riser structure with positive shutoff valve on the waterside (WS) shoulder. (Existing 24-inch corrugated metal gravity drainage pipe crossing removed and replaced portion within construction limit with a new 36-inch gravity drainage pipe crossing during the Feather River West Levee Improvements, Project D). [Additional Reference(s): Sutter Butte Flood Control Agency (SBFCA) Feather River West Levee Project, Volume 4 of 6 (Project D) Feather River West Levee Improvement Plans Sta 1765+00 to 2368+26, 2016, Volume 4-SBFCA_Record_Drawings_Project D_2017.05.16.pdf, Drawing No. C-519].
FS Date: 5/7/2019 12:45:00 PM

Photo 1 of 3 : UCIP_FA_2020_57389_77187.jpg

Overview of WS

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiancy Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Sutter Maintenance Yard Maintenance Area 0007

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	11.90	09/17/2020 09/17/2020	Brooks Weisser

LM Start	**2.73**	Rating **	M	Issue No.	**81 (cont)**
LM End	**2.73**	Issue Type +	En	Location *	
Category	Supplemental			GPS Latitude/Longitude	
				Start	End
Item	DWR UCIP Field Study			39.347977 °	39.347977 °
				-121.630337 °	-121.630337 °
DWR ID	25503				

Photo 2 of 3 : UCIP_FA_2020_57389_77188.jpg

Overview of levee crown looking downstream

LM Start	**2.73**	Rating **	M	Issue No.	**81 (cont)**
LM End	**2.73**	Issue Type +	En	Location *	

Photo 3 of 3 : UCIP_FA_2020_57389_77189.jpg

Overview of LS

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiency Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Sutter Maintenance Yard Maintenance Area 0007

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	11.90	09/17/2020 09/17/2020	Brooks Weisser

LM Start	**3.02**	Rating **	M	Issue No.	**82**
LM End	**3.02**	Issue Type +	En	Location *	
Category	Supplemental			GPS Latitude/Longitude	
				Start	End
Item	DWR UCIP Field Study			39.352159 °	39.352159 °
				-121.631209 °	-121.631209 °
DWR ID	25504				

Comment Code

Inspector Comment

DS_ID:25504
FS_ID:57390
EP_NO: N/A
Repair Type: Non-Urgent
EVAL Issue: Levee Improvement Project
Crossing Status: Found
UCIP Comments: 05/07/2019 Record has been updated from No Action Needed to Non-Urgent, no permit has been issued by the CVFPB. Second LS marker has been bent. No other issues were identified during inspection. (O. Magana - DWR UCIP)08/08/2017 Crossing was installed under the Feather River West Levee Improvements, Project D. Project Improvements begin at Station (Sta) 1765+00 (MA0007 about LM 1.73) to Sta 2303+50 (ST0005 about LM 1.23), refer to record drawings for the Feather River West Levee Improvement Plans Station 1765+00 to 2368+26, Project D details. MA0007 project details include NO CUTOFF WALL from Sta 1765+00 (MA0007 about LM 1.73) to 1815+00 (MA0007 about LM 2.64) and LEVEE DEGRADE AND RECONSTRUCTION WITH CUT OFF WALL from Sta 1817+00 (MA0007 about LM 2.69) to Sta 2289+00, Sta 2287+00 to Sta 2290+00 (MA0007 about LM 11.60). (O. Magana - DWR UCIP)
FIELD_STRUCT_DESC: 36-inch inside diameter irrigation pipe of an unknown material through the levee, 14.1 feet below the crown. 18-inch drainage layer at the pipe inlet at the landside (LS) toe. Gate riser structure with positive shutoff valve on the waterside (WS) shoulder. Ends of new and existing pipes plugged and capped. Marker post at the WS end of the new pipe. C-900 riser with 8-inch Waterman Type 1 sunshine alfalfa valve, or approved equal, with 6-inch-thick by 12-inch-wide concrete collar near the landside (LS) end of the new pipe. (Existing 24-inch corrugated metal pipe [CMP], 18-inch gravity drainage pipe [indicated in record drawings], and 12-inch steel gravity drainage pipe crossing removed and replaced portion within construction limit with a new 36-inch irrigation pipe crossing during the Feather River West Levee Improvements, Project D). [Additional Reference(s): Sutter Butte Flood Control Agency (SBFCA) Feather River West Levee Project, Volume 4 of 6 (Project D) Feather River West Levee Improvement Plans Sta 1765+00 to 2368+26, 2016, Volume 4-SBFCA_Record_Drawings_Project D_2017.05.16.pdf, Drawing No. C-521].
FS Date: 5/7/2019 12:46:00 PM

Photo 1 of 3 : UCIP_FA_2020_57390_77178.jpg

Overview of WS looking downstream at crossing.

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiancy Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Sutter Maintenance Yard Maintenance Area 0007

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	11.90	09/17/2020 09/17/2020	Brooks Weisser

LM Start	**3.02**	Rating **	M	Issue No.	**82 (cont)**
LM End	**3.02**	Issue Type +	En	Location *	
Category	Supplemental			GPS Latitude/Longitude	
				Start	End
Item	DWR UCIP Field Study			39.352159 °	39.352159 °
				-121.631209 °	-121.631209 °
DWR ID	25504				

Photo 2 of 3 : UCIP_FA_2020_57390_77179.jpg

Overview of levee crown looking downstream at crossing.

LM Start	**3.02**	Rating **	M	Issue No.	**82 (cont)**
LM End	**3.02**	Issue Type +	En	Location *	

Photo 3 of 3 : UCIP_FA_2020_57390_77180.jpg

Overview of LS looking downstream at crossing.

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiancy Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Sutter Maintenance Yard Maintenance Area 0007

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	11.90	09/17/2020 09/17/2020	Brooks Weisser

LM Start	**3.32**	Rating **	M	Issue No.	**83**
LM End	**3.32**	Issue Type +	En	Location *	
Category	Supplemental			GPS Latitude/Longitude	
				Start	End
Item	DWR UCIP Field Study			39.354549 °	39.354549 °
				-121.635326 °	-121.635326 °
DWR ID	25506				

Comment Code

Inspector Comment

DS_ID:25506
FS_ID:57391
EP_NO: N/A
Repair Type: Non-Urgent
EVAL Issue: Levee Improvement Project
Crossing Status: Found
UCIP Comments: 05/07/2019 Record has been updated from No Action Needed to Non-Urgent, no permit has been issued by the CVFPB. No other issues were recorded during inspection. (O. Magana - DWR UCIP)08/08/2017 Crossing was installed under the Feather River West Levee Improvements, Project D. Project Improvements begin at Station (Sta) 1765+00 (MA0007 about LM 1.73) to Sta 2303+50 (ST0005 about LM 1.23), refer to record drawings for the Feather River West Levee Improvement Plans Station 1765+00 to 2368+26, Project D details. MA0007 project details include NO CUTOFF WALL from Sta 1765+00 (MA0007 about LM 1.73) to 1815+00 (MA0007 about LM 2.64) and LEVEE DEGRADE AND RECONSTRUCTION WITH CUT OFF WALL from Sta 1817+00 (MA0007 about LM 2.69) to Sta 2289+00, Sta 2287+00 to Sta 2290+00 (MA0007 about LM 11.60). (O. Magana - DWR UCIP)
FIELD_STRUCT_DESC: 18-inch inside diameter pressurized steel (assumed) sewer force main through the levee, 2.6 feet below the crown. 18-inch Class 250 FL by FL side actuated resilient wedge gate valve, American Flow Control Series 2500 or an approved equal, on the waterside (WS) shoulder. 2-inch APCO sewage air vacuum valve, Model 401 or an approved equal, on the WS shoulder. 5.5-foot by 7-foot by 4.5-foot valve utility box with a tamper proof bolted cover, on the WS shoulder. 18-inch side actuated Class 250 FL by FL resilient wedge gate valve, American Flow Control Series 2500 or an approved equal, and water valve box, D. and L. Supply K-6016 traffic rated monument ring and cover or an approved equal, one near the landside (LS) end and one near the WS end of the new 18-inch pipe. New 18-inch pipe and existing steel sewer force main connected in accordance with specifications. New pipe inside diameter matched with existing pipe inside diameter at both points of connection, about 10 feet beyond the construction limit on both the LS and the WS. Levee reconstructed with levee embankment fill, Soil Type 2, to meet minimum pipe cover requirements. (Existing 18-inch steel sewer force main crossing removed and replaced portion within construction limit with a new 18-inch steel [assumed] sewer force main crossing during the Feather River West Levee Improvements, Project D). [Additional Reference(s): DWR Levee Log, 2005. USACE Sacramento O&M Manual 152, March 1957 (Station 69+00). Sutter Butte Flood Control Agency (SBFCA) Feather River West Levee Project, Volume 4 of 6 (Project D) Feather River West Levee Improvement Plans Sta 1765+00 to 2368+26, 2016, Volume 4-SBFCA_Record_Drawings_Project D_2017.05.16.pdf, Drawing No. C-523]

Photo 1 of 3 : UCIP_FA_2020_57391_77194.jpg

Overview of WS looking downstream at crossing.

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiancy Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Sutter Maintenance Yard Maintenance Area 0007

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	11.90	09/17/2020 09/17/2020	Brooks Weisser

FS Date: 5/7/2019 12:46:00 PM

LM Start	**3.32**	Rating **	M	Issue No.	**83 (cont)**
LM End	**3.32**	Issue Type +	En	Location *	

Photo 2 of 3 : UCIP_FA_2020_57391_77195.jpg

Overview of levee crown looking downstream at crossing.

LM Start	**3.32**	Rating **	M	Issue No.	**83 (cont)**
LM End	**3.32**	Issue Type +	En	Location *	

Photo 3 of 3 : UCIP_FA_2020_57391_77196.jpg

Overview of LS looking downstream at crossing.

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiancy Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Sutter Maintenance Yard Maintenance Area 0007

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	11.90	09/17/2020 09/17/2020	Brooks Weisser

LM Start	**4.39**	Rating **	M	Issue No.	**39**
LM End	**5.35**	Issue Type +	En	Location *	LS
Category	Earthen Levee			GPS Latitude/Longitude	
				Start	End
Item	Encroachments			39.366547 °	39.380071 °
				-121.647523 °	-121.650558 °
DWR ID	DWR_MA0007_01_s _ 2012_39				

Comment Code

DT : Ditch

Inspector Comment

A landside irrigation ditch is located at the levee toe.

Photo 1 of 1 : FA_2020_MA0007_200_39_20200821_00001.jpg

View looking upstream landside at an irrigation ditch at the levee toe, Fall 2020.

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiancy Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Sutter Maintenance Yard Maintenance Area 0007

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	11.90	09/17/2020 09/17/2020	Brooks Weisser

LM Start	**5.33**	Rating **	M	Issue No.	**84**
LM End	**5.33**	Issue Type +	En	Location *	
Category	Supplemental			GPS Latitude/Longitude	
				Start	End
Item	DWR UCIP Field Study			39.379838 °	39.379838 °
				-121.650611 °	-121.650611 °
DWR ID	25511				

Comment Code

Inspector Comment

DS_ID:25511
FS_ID:57501
EP_NO: N/A
Repair Type: Non-Urgent
EVAL Issue: Levee Improvement Project
Crossing Status: Found
UCIP Comments: 05/07/2019 Record has been updated from No Action Needed to Non-Urgent, no permit has been issued by the CVFPB. No other issues were recorded during inspection. (O. Magana - DWR UCIP)08/09/2017 Crossing field verified, photos added to record, and coordinates updated. No permit has been issued will need to update permit information when the CVFPB issues permit for this crossing. (O. Magana - DWR UCIP)08/08/2017 Crossing was installed under the Feather River West Levee Improvements, Project D. Project Improvements begin at Station (Sta) 1765+00 (MA0007 about LM 1.73) to Sta 2303+50 (ST0005 about LM 1.23), refer to record drawings for the Feather River West Levee Improvement Plans Station 1765+00 to 2368+26, Project D details. MA0007 project details include NO CUTOFF WALL from Sta 1765+00 (MA0007 about LM 1.73) to 1815+00 (MA0007 about LM 2.64) and LEVEE DEGRADE AND RECONSTRUCTION WITH CUT OFF WALL from Sta 1817+00 (MA0007 about LM 2.69) to Sta 2289+00, Sta 2287+00 to Sta 2290+00 (MA0007 about LM 11.60). (O. Magana - DWR UCIP)
FIELD_STRUCT_DESC: 36-inch inside diameter gravity irrigation pipe of an unknown material through the levee, 10 feet below the crown. 18-inch drainage layer at the pipe inlet at the landside (LS) toe. Inlet structure with riprap and sheet pile on the landside (LS) end at the Sutter-Butte Main Canal. Gate riser structure with positive shutoff valve on the waterside (WS) shoulder. Connected to existing 24-inch gravity irrigation pipe at the WS toe, 107 feet from the center of the crown, within 5 feet of the construction limit. Marker post at the same location on the WS toe. There may also be a marker post on the WS or LS shoulder. (Existing 24-inch corrugated metal gravity irrigation pipe crossing removed and replaced within construction limits with a new 36-inch gravity irrigation pipe crossing during the Feather River West Levee Improvements, Project D). [Additional Reference(s): Sutter Butte Flood Control Agency (SBFCA) Feather River West Levee Project, Volume 4 of 6 (Project D) Feather River West Levee Improvement Plans Sta 1765+00 to 2368+26, 2016, Volume 4-SBFCA_Record_Drawings_Project D_2017.05.16.pdf, Drawing No. C-529].
FS Date: 5/7/2019 12:46:00 PM

Photo 1 of 3 : UCIP_FA_2020_57501_77165.jpg

Overview of WS looking downstream at crossing.

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiancy Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Sutter Maintenance Yard Maintenance Area 0007

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	11.90	09/17/2020 09/17/2020	Brooks Weisser

LM Start	**5.33**	Rating **	M	Issue No.	**84 (cont)**
LM End	**5.33**	Issue Type +	En	Location *	
Category	Supplemental			GPS Latitude/Longitude	
				Start	End
Item	DWR UCIP Field Study			39.379838 °	39.379838 °
				-121.650611 °	-121.650611 °
DWR ID	25511				

Photo 2 of 3 : UCIP_FA_2020_57501_77166.jpg

Overview of levee crown looking downstream at crossing.

LM Start	**5.33**	Rating **	M	Issue No.	**84 (cont)**
LM End	**5.33**	Issue Type +	En	Location *	

Photo 3 of 3 : UCIP_FA_2020_57501_77167.jpg

Overview of LS looking downstream at crossing.

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiancy Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Sutter Maintenance Yard Maintenance Area 0007

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	11.90	09/17/2020 09/17/2020	Brooks Weisser

LM Start	**5.38**	Rating **	M	Issue No.	**85**
LM End	**5.38**	Issue Type +	En	Location *	
Category	Supplemental			GPS Latitude/Longitude	
				Start	End
Item	DWR UCIP Field Study			39.380377 °	39.380377 °
				-121.649344 °	-121.649344 °
DWR ID	25512				

Comment Code

Inspector Comment

DS_ID:25512
FS_ID:58342
EP_NO: N/A
Repair Type: Non-Urgent
EVAL Issue: Levee Improvement Project
Crossing Status: Found
UCIP Comments: 05/07/2019 Record has been updated from No Action Needed to Non-Urgent, no permit has been issued by the CVFPB. No other issues were recorded during inspection. (O. Magana - DWR UCIP)08/09/2017 Crossing was field verified and photographed. Photos added. Current levee is incorrect and needs to be CLM 5.417. GPS coordinates were updated. No permit on record but it will be added when the CVFPB issues one. (A. Freitag - DWR UCIP)08/08/2017 Crossing was installed under the Feather River West Levee Improvements, Project D. Project Improvements begin at Station (Sta) 1765+00 (MA0007 about LM 1.73) to Sta 2303+50 (ST0005 about LM 1.23), refer to record drawings for the Feather River West Levee Improvement Plans Station 1765+00 to 2368+26, Project D details. MA0007 project details include NO CUTOFF WALL from Sta 1765+00 (MA0007 about LM 1.73) to 1815+00 (MA0007 about LM 2.64) and LEVEE DEGRADE AND RECONSTRUCTION WITH CUT OFF WALL from Sta 1817+00 (MA0007 about LM 2.69) to Sta 2289+00, Sta 2287+00 to Sta 2290+00 (MA0007 about LM 11.60). (O. Magana - DWR UCIP)
FIELD_STRUCT_DESC: 36-inch inside diameter gravity drainage pipe of an unknown material, 18.9 feet below the crown. 18-inch drainage layer at the pipe inlet at the landside (LS) toe. Inlet structure on the landside (LS) end. Gate riser structure with positive shutoff valve on the waterside (WS) shoulder. Flap gate, outfall structure, and riprap at outlet on the waterside (WS) end. Drainage channel regraded as required to provide a smooth transition at the inlet and the outlet. (Two existing 60-inch corrugated metal gravity drainage pipe crossings removed and replaced portion within construction limit with a new 36-inch gravity drainage pipe crossing during the Feather River West Levee Improvements, Project D). [Additional Reference(s): Sutter Butte Flood Control Agency (SBFCA) Feather River West Levee Project, Volume 4 of 6 (Project D) Feather River West Levee Improvement Plans Sta 1765+00 to 2368+26, 2016, Volume 4-SBFCA_Record_Drawings_Project D_2017.05.16.pdf, Drawing No. C-531].
FS Date: 5/7/2019 12:39:00 PM

Photo 1 of 3 : UCIP_FA_2020_58342_77218.jpg

Overview of levee crown looking downstream

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiancy Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Sutter Maintenance Yard Maintenance Area 0007

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	11.90	09/17/2020 09/17/2020	Brooks Weisser

LM Start	**5.38**	Rating **	M	Issue No.	**85 (cont)**
LM End	**5.38**	Issue Type +	En	Location *	
Category	Supplemental			GPS Latitude/Longitude	
				Start	End
Item	DWR UCIP Field Study			39.380377 °	39.380377 °
				-121.649344 °	-121.649344 °
DWR ID	25512				

Photo 2 of 3 : UCIP_FA_2020_58342_77219.jpg

Overview of WS

LM Start	**5.38**	Rating **	M	Issue No.	**85 (cont)**
LM End	**5.38**	Issue Type +	En	Location *	

Photo 3 of 3 : UCIP_FA_2020_58342_77220.jpg

Overview of LS

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiancy Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Sutter Maintenance Yard Maintenance Area 0007

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	11.90	09/17/2020 09/17/2020	Brooks Weisser

LM Start	**6.25**	Rating **	M	Issue No.	**86**
LM End	**6.25**	Issue Type +	En	Location *	
Category	Supplemental			GPS Latitude/Longitude	
				Start	End
Item	DWR UCIP Field Study			39.383420 °	39.383420 °
				-121.635950 °	-121.635950 °
DWR ID	25513				

Comment Code

Inspector Comment

DS_ID:25513
FS_ID:58344
EP_NO: 4591
Repair Type: Non-Urgent
EVAL Issue: Levee Improvement Project
Crossing Status: Found
UCIP Comments: 05/07/2019 Record has been updated from No Action Needed to Non-Urgent, no permit has been issued by the CVFPB. Recommend auditing Permit No. 4591 to determine if modifications made under the levee improvement project are assumed under current permit or if new permit will be issued. No other issues were recorded during inspection. (O. Magana - DWR UCIP)08/09/2017 Crossing was visited and field verified. Coordinates updated to show pipes new location (39.38342, -121.63595). CLM will need to be updated also. Photos added. (A. Freitag - DWR Sutter Yard)08/08/2017 Crossing was installed under the Feather River West Levee Improvements, Project D. Project Improvements begin at Station (Sta) 1765+00 (MA0007 about LM 1.73) to Sta 2303+50 (ST0005 about LM 1.23), refer to record drawings for the Feather River West Levee Improvement Plans Station 1765+00 to 2368+26, Project D details. MA0007 project details include NO CUTOFF WALL from Sta 1765+00 (MA0007 about LM 1.73) to 1815+00 (MA0007 about LM 2.64) and LEVEE DEGRADE AND RECONSTRUCTION WITH CUT OFF WALL from Sta 1817+00 (MA0007 about LM 2.69) to Sta 2289+00, Sta 2287+00 to Sta 2290+00 (MA0007 about LM 11.60). (O. Magana - DWR UCIP)
FIELD_STRUCT_DESC: 7-inch inside diameter pressurized pipe of an unknown material or purpose, 3.2 feet below the crown. 8-inch C509 standard FL by FL gate valve, Mueller A-2360 resilient wedge or an approved equal, one on the waterside (WS) shoulder and the other off the landside (LS) toe. Combination siphon breaker and air relief valve, 1-inch APCO or an approved equal, on the WS shoulder. 5-foot by 5-foot by 4-foot valve utility box with a tamper proof bolted solid cover on the WS shoulder. 2-foot by 3-foot by 4-foot valve utility box with a tamper proof bolted solid cover off the LS toe. Ends of new pipe and existing pipe plugged and capped. Marker post off the WS toe. Levee reconstructed with levee embankment fill, Soil Type 2, to meet minimum pipe cover requirements. (Existing 7-inch steel pressurized pipe crossing removed and replaced portion within construction limit with a new 7-inch pressurized pipe crossing during the Feather River West Levee Improvements, Project D, pipe remains under Permit No. 4591, 1965 [pipe upgraded 2015] - Jack Mariani SR TR ETAL; 7-inch pipe upgraded under the SBFCA levee improvement project of approximately 11.4 miles, work authorized under Permit No. 18793-3, 2014 - Sutter Butte Flood Control Agency). [Additional Reference(s): Sutter Butte Flood Control Agency (SBFCA) Feather River West Levee Project, Volume 4 of 6 (Project D) Feather River West Levee

Photo 1 of 3 : UCIP_FA_2020_58344_77246.jpg

Overview of WS

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiancy Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Sutter Maintenance Yard Maintenance Area 0007

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	11.90	09/17/2020 09/17/2020	Brooks Weisser

Improvement Plans Sta 1765+00 to 2368+26, 2016, Volume 4-SBFCA_Record_Drawings_Project D_2017.05.16.pdf, Drawing No. C-533]
FS Date: 5/7/2019 12:39:00 PM

LM Start	**6.25**	Rating **	M	Issue No.	**86 (cont)**
LM End	**6.25**	Issue Type +	En	Location *	

Photo 2 of 3 : UCIP_FA_2020_58344_77247.jpg

Overview of levee crown looking downstream

LM Start	**6.25**	Rating **	M	Issue No.	**86 (cont)**
LM End	**6.25**	Issue Type +	En	Location *	

Photo 3 of 3 : UCIP_FA_2020_58344_77248.jpg

Overview of LS

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiancy Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Sutter Maintenance Yard Maintenance Area 0007

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	11.90	09/17/2020 09/17/2020	Brooks Weisser

LM Start	**6.49**	Rating **	M	Issue No.	**87**
LM End	**6.49**	Issue Type +	En	Location *	
Category	Supplemental			GPS Latitude/Longitude	
				Start	End
Item	DWR UCIP Field Study			39.386167 °	39.386167 °
				-121.633122 °	-121.633122 °
DWR ID	25526				

Comment Code

Inspector Comment

DS_ID:25526
FS_ID:58345
EP_NO: N/A
Repair Type: Non-Urgent
EVAL Issue: Levee Improvement Project
Crossing Status: Found
UCIP Comments: 05/07/2019 Record has been updated from No Action Needed to Non-Urgent, no permit has been issued by the CVFPB. No other issues were recorded during inspection. (O. Magana - DWR UCIP)07/09/2018 As-built drawings show work deleted however, field visit shows pipe was installed. No permit has been identified for this crossing. (O. Magana - DWR UCIP)
08/08/2017 Crossing was installed under the Feather River West Levee Improvements, Project D. Project Improvements begin at Station (Sta) 1765+00 (MA0007 about LM 1.73) to Sta 2303+50 (ST0005 about LM 1.23), refer to record drawings for the Feather River West Levee Improvement Plans Station 1765+00 to 2368+26, Project D details. MA0007 project details include NO CUTOFF WALL from Sta 1765+00 (MA0007 about LM 1.73) to 1815+00 (MA0007 about LM 2.64) and LEVEE DEGRADE AND RECONSTRUCTION WITH CUT OFF WALL from Sta 1817+00 (MA0007 about LM 2.69) to Sta 2289+00, Sta 2287+00 to Sta 2290+00 (MA0007 about LM 11.60). (O. Magana - DWR UCIP)
FIELD_STRUCT_DESC: 12-inch pressurized steel (assumed) irrigation pipe through the levee, 2.8 feet below the levee crown. 12-inch C509 FL by FL gate valve, Mueller A-2360 Resilient Wedge or an approved equal, on the waterside (WS) shoulder. Utility box with cover houses a combination siphon breaker and air relief valve located on the WS. (Existing 22-inch steel pipe was removed and replaced with a new 12-inch steel pressure irrigation pipe during the Feather River West Levee Improvements, Project D). [Additional Reference(s): Sutter Butte Flood Control Agency (SBFCA) Feather River West Levee Project, Volume 4 of 6 (Project D) Feather River West Levee Improvement Plans Sta 1765+00 to 2368+26, 2016, Volume 4-SBFCA_Record_Drawings_Project D_2017.05.16.pdf, Drawing No. C-535, STA 2017+70]
FS Date: 5/7/2019 12:39:00 PM

Photo 1 of 3 : UCIP_FA_2020_58345_80697.jpg

Overview of levee crown looking u/s towards crossing.

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiancy Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Sutter Maintenance Yard Maintenance Area 0007

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	11.90	09/17/2020 09/17/2020	Brooks Weisser

LM Start	**6.49**	Rating **	M	Issue No.	**87 (cont)**
LM End	**6.49**	Issue Type +	En	Location *	
Category	Supplemental			GPS Latitude/Longitude	
				Start	End
Item	DWR UCIP Field Study			39.386167 °	39.386167 °
				-121.633122 °	-121.633122 °
DWR ID	25526				

Photo 2 of 3 : UCIP_FA_2020_58345_80698.jpg

WS view: concrete vault with cover and paddle marker visible on WS pipe alignment.

LM Start	**6.49**	Rating **	M	Issue No.	**87 (cont)**
LM End	**6.49**	Issue Type +	En	Location *	

Photo 3 of 3 : UCIP_FA_2020_58345_80699.jpg

WS view: close up view of paddle marker located on WS toe.

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiancy Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Sutter Maintenance Yard Maintenance Area 0007

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	11.90	09/17/2020 09/17/2020	Brooks Weisser

LM Start	**7.70**	Rating **	M	Issue No.	**88**
LM End	**7.70**	Issue Type +	En	Location *	
Category	Supplemental			GPS Latitude/Longitude	
				Start	End
Item	DWR UCIP Field Study			39.398336 °	39.398336 °
				-121.630529 °	-121.630529 °
DWR ID	16960				

Comment Code

Inspector Comment

DS_ID:16960
FS_ID:58443
EP_NO: 17895
Repair Type: Non-Urgent
EVAL Issue: Pipe Not Found
Crossing Status: Not Found
UCIP Comments: 05/07/2019 Record has been updated from No Action Needed to Non-Urgent, no pipe was found during inspection. Photos taken to show that there is no evidence of 5-inch line. Need to coordinate with CVFPB to find out if pipe permit was withdrawn. (O. Magana - DWR UCIP)08/09/2017 Field confirmed no signs of crossing at this location, levee section removed and rebuilt with slurry wall. No photos were taken at this location. Recommend taking photos of current condition at this site and append to this record. (O. Magana - DWR UCIP)08/08/2017 Pre-construction drawings, for construction drawings, show this crossing removed and replaced, however record drawings (post-construction) do not reference this crossing. Need to follow up with consultants responsible for record drawings to determine status of this crossing -- conflicting information between pre- and post-construction drawings. Project Improvements begin at Station (Sta) 1765+00 (MA0007 about LM 1.73) to Sta 2303+50 (ST0005 about LM 1.23), refer to record drawings for the Feather River West Levee Improvement Plans Station 1765+00 to 2368+26, Project D details. MA0007 project details include NO CUTOFF WALL from Sta 1765+00 (MA0007 about LM 1.73) to 1815+00 (MA0007 about LM 2.64) and LEVEE DEGRADE AND RECONSTRUCTION WITH CUT OFF WALL from Sta 1817+00 (MA0007 about LM 2.69) to Sta 2289+00, Sta 2287+00 to Sta 2290+00 (MA0007 about LM 11.60). (O. Magana - DWR UCIP)
05/16/2016 Feather River West Levee Improvement Project--Levee currently under construction. Crossing, referenced as STA 2084+03, will be removed and replaced as indicated in the project Plans for Construction of Feather River West Levee Project, Project Area A, Feather River West Levee Improvement Plans, Sta 1765+00 to 2368+26, Volume 3 of 5. (A. Freitag - DWR Sutter Yard)06/10/2015 Minor erosion still present near air vent. (A. Freitag - DWR Sutter Yard)12/30/2014 Same as last inspection. (A. Freitag - DWR Sutter Yard)05/19/2014 Same as last inspection. (A. Freitag - DWR Sutter Yard)11/07/2013 Same as last inspection. (A. Freitag - DWR Sutter Yard)11/05/2012 localized erosion at air vent located on WS shoulder; this crossing appears to have leaking at the air vent--will need to determine reason for erosion at air vent (vehicles going over vent?); also recommend installing utility marker. (O. Magana - DWR UCIP)
FIELD_STRUCT_DESC: *UNCLEAR status* 5-inch steel irrigation pipe through the levee, at an unknown depth. Pipe connects to an existing pipe within the overflow area of the Feather River. (5-inch irrigation line authorized under Permit No. 17895, 2005 - John Kucek. 0.75-inch

Photo 1 of 3 : UCIP_FA_2020_58443_65923.jpg

View of LS and levee crown looking upstream towards crossing.

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiancy Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

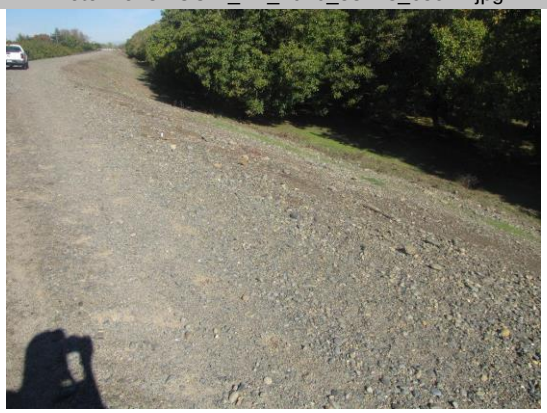
Sutter Maintenance Yard Maintenance Area 0007

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	11.90	09/17/2020 09/17/2020	Brooks Weisser

micro sprinkler line authorized under Permit No. 17895-A, 2005 - John Kucek. Existing 5-inch aluminum irrigation pipe crossing removed and disposed portion within construction limit during the Feather River West Levee Improvements, Project D). [Additional Reference(s): Sutter Butte Flood Control Agency (SBFCA) Feather River West Levee Project, Volume 4 of 6 (Project D) Feather River West Levee Improvement Plans Sta 1765+00 to 2368+26, 2016, Volume 4-SBFCA_Record_Drawings_Project D_2017.05.16.pdf, Drawing No. C-134, not shown in record drawings].
FS Date: 5/7/2019 12:47:00 PM

LM Start	7.70	Rating **	M	Issue No.	88 (cont)
LM End	7.70	Issue Type +	En	Location *	

Photo 2 of 3 : UCIP_FA_2020_58443_65922.jpg



View of WS and levee crown looking upstream towards crossing.

LM Start	7.70	Rating **	M	Issue No.	88 (cont)
LM End	7.70	Issue Type +	En	Location *	

Photo 3 of 3 : UCIP_FA_2020_58443_65921.jpg

Photo 1 of 2. View of localized erosion at air vent located on WS shoulder.

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiency Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Sutter Maintenance Yard Maintenance Area 0007

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	11.90	09/17/2020 09/17/2020	Brooks Weisser

LM Start	**8.23**	Rating **	M	Issue No.	**89**
LM End	**8.23**	Issue Type +	En	Location *	
Category	Supplemental			GPS Latitude/Longitude	
				Start	End
Item	DWR UCIP Field Study			39.404565 °	39.404565 °
				-121.632864 °	-121.632864 °
DWR ID	25527				

Comment Code

Inspector Comment

DS_ID:25527
FS_ID:58394
EP_NO: N/A
Repair Type: Non-Urgent
EVAL Issue: Levee Improvement Project
Crossing Status: Found
UCIP Comments: 05/07/2019 Record has been updated from No Action Needed to Non-Urgent, no permit has been issued by the CVFPB authorizing pipe. No other issues were recorded during inspection. (O. Magana - DWR UCIP)
FIELD_STRUCT_DESC: 2-inch pressurized pipe of an unknown material or purpose through the levee, 3 feet below the crown. [Additional Reference(s): Sutter Butte Flood Control Agency (SBFCA) Feather River West Levee Project, Volume 4 of 6 (Project D) Feather River West Levee Improvement Plans Sta 1765+00 to 2368+26, 2016, Volume 4-SBFCA_Record_Drawings_Project D_2017.05.16.pdf, Drawing No. C-137 and C-543].
FS Date: 5/7/2019

Photo 1 of 3 : UCIP_FA_2020_58394_80707.jpg

LS view: overview of LS.

LM Start	**8.23**	Rating **	M	Issue No.	**89 (cont)**
LM End	**8.23**	Issue Type +	En	Location *	

Photo 2 of 3 : UCIP_FA_2020_58394_80708.jpg

Overview of levee crown looking u/s towards pipe crossing.

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiancy Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Sutter Maintenance Yard Maintenance Area 0007

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	11.90	09/17/2020 09/17/2020	Brooks Weisser

LM Start	**8.23**	Rating **	M	Issue No.	**89 (cont)**
LM End	**8.23**	Issue Type +	En	Location *	
Category	Supplemental			GPS Latitude/Longitude	
				Start	End
Item	DWR UCIP Field Study			39.404565 °	39.404565 °
				-121.632864 °	-121.632864 °
DWR ID	25527				

Photo 3 of 3 : UCIP_FA_2020_58394_80709.jpg

WS view: overview of WS.

LM Start	**8.61**	Rating **	M	Issue No.	**90**
LM End	**8.61**	Issue Type +	En	Location *	
Category	Supplemental			GPS Latitude/Longitude	
				Start	End
Item	DWR UCIP Field Study			39.406614 °	39.406614 °
				-121.637384 °	-121.637384 °
DWR ID	25528				

Comment Code

Inspector Comment

DS_ID:25528
FS_ID:55084
EP_NO: N/A
Repair Type: Non-Urgent
EVAL Issue: Levee Improvement Project
Crossing Status: Found
UCIP Comments: 05/07/2019 Record has been updated from No Action Needed to Non-Urgent, no permit has been issued by the CVFPB authorizing pipe. No other issues were recorded during inspection. (O. Magana - DWR UCIP)
FIELD_STRUCT_DESC: 2-inch steel irrigation pipe through the levee, 3 feet below the levee crown. Concrete vault located at the waterside (WS) shoulder. (2-inch irrigation line installed under the Feather River Levee Improvement Project; Existing 2-inch irrigation pipe crossing removed and disposed portion within construction limit during the Feather River West Levee Improvements, Project D authorized under Permit No. 18793-3, 2014 - Sutter Butte Flood Control Agency). [Additional Reference(s): Sutter Butte Flood Control Agency (SBFCA) Feather River West Levee Project, Volume 4 of 6 (Project D) Feather River West Levee Improvement Plans Sta 1765+00 to 2368+26, 2016, Volume 4-SBFCA_Record_Drawings_Project_D_2017.05.16.pdf, Drawing No. C-545].
FS Date: 5/7/2019

Photo 1 of 3 : UCIP_FA_2020_55084_80715.jpg

Overview of levee crown looking u/s towards pipe crossing.

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiancy Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Sutter Maintenance Yard Maintenance Area 0007

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	11.90	09/17/2020 09/17/2020	Brooks Weisser

LM Start	**8.61**	Rating **	M	Issue No.	**90 (cont)**
LM End	**8.61**	Issue Type +	En	Location *	
Category	Supplemental			GPS Latitude/Longitude	
				Start	End
Item	DWR UCIP Field Study			39.406614 °	39.406614 °
				-121.637384 °	-121.637384 °
DWR ID	25528				

Photo 2 of 3 : UCIP_FA_2020_55084_80716.jpg

LS view: paddle marker along pipe alignment.

LM Start	**8.61**	Rating **	M	Issue No.	**90 (cont)**
LM End	**8.61**	Issue Type +	En	Location *	

Photo 3 of 3 : UCIP_FA_2020_55084_80717.jpg

Overview of levee crown looking d/s towards pipe crossing.

LM Start	**9.65**	Rating **	C	Issue No.	**45**
LM End	**9.65**	Issue Type +	En	Location *	LS
Category	Earthen Levee			GPS Latitude/Longitude	
				Start	End
Item	Encroachments			39.416384 °	39.416384 °
				-121.634503 °	-121.634503 °
DWR ID	DWR_MA0007_01_s _ 2012_45				

Comment Code
BU : Building

Inspector Comment
Trailer on landside toe has been removed, Fall 2020.

No Photos

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiancy Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Sutter Maintenance Yard Maintenance Area 0007

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	11.90	09/17/2020 09/17/2020	Brooks Weisser

LM Start	**10.86**	Rating **	M	Issue No.	**91**
LM End	**10.86**	Issue Type +	En	Location *	
Category	Supplemental			GPS Latitude/Longitude	
				Start	End
Item	DWR UCIP Field Study			39.428980 °	39.428980 °
				-121.643322 °	-121.643322 °
DWR ID	25515				

Comment Code

Inspector Comment

DS_ID:25515
FS_ID:57400
EP_NO: N/A
Repair Type: Non-Urgent
EVAL Issue: Levee Improvement Project
Crossing Status: Found
UCIP Comments: 05/07/2019 Record has been updated from No Action Needed to Non-Urgent, no permit has been issued by the CVFPB authorizing pipe. Unable to confirm if pipe was installed during the Feather River West Levee Improvement Plans. No other issues were recorded during inspection. (O. Magana - DWR UCIP)08/09/2017 No evidence was found of crossing through the levee. The only indicator of a potential telephone crossing is from a riser that is located about 200-feet from WS shoulder, see photos. Feather River West Levee Improvements, Project D, Drawing No. C-151 indicates conduit was installed--depth unknown. No permit is currently available. Need to coordinate with CVFPB regarding the permits issued for the crossings authorized under Feather River West Levee Improvements project. (O. Magana - DWR UCIP)08/08/2017 Crossing was installed under the Feather River West Levee Improvements, Project D. Project Improvements begin at Station (Sta) 1765+00 (MA0007 about LM 1.73) to Sta 2303+50 (ST0005 about LM 1.23), refer to record drawings for the Feather River West Levee Improvement Plans Station 1765+00 to 2368+26, Project D details. MA0007 project details include NO CUTOFF WALL from Sta 1765+00 (MA0007 about LM 1.73) to 1815+00 (MA0007 about LM 2.64) and LEVEE DEGRADE AND RECONSTRUCTION WITH CUT OFF WALL from Sta 1817+00 (MA0007 about LM 2.69) to Sta 2289+00, Sta 2287+00 to Sta 2290+00 (MA0007 about LM 11.60). (O. Magana - DWR UCIP)
FIELD_STRUCT_DESC: Telephone conduit of an unknown size or material through the levee, at an unknown depth. (Existing 0.75-inch telephone conduit crossing removed and replaced portion within construction limit with a new telephone conduit crossing). [Additional Reference(s): Sutter Butte Flood Control Agency (SBFCA) Feather River West Levee Project, Volume 4 of 6 (Project D) Feather River West Levee Improvement Plans Sta 1765+00 to 2368+26, 2016, Volume 4-SBFCA_Record_Drawings_Project D_2017.05.16.pdf, Drawing No. C-151].
FS Date: 5/7/2019 12:48:00 PM

Photo 1 of 3 : UCIP_FA_2020_57400_77245.jpg

WS view: overview of WS, riser visible off paved road near palm trees.

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiancy Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Sutter Maintenance Yard Maintenance Area 0007

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	11.90	09/17/2020 09/17/2020	Brooks Weisser

LM Start	**10.86**	Rating **	M	Issue No.	**91 (cont)**
LM End	**10.86**	Issue Type +	En	Location *	
Category	Supplemental			GPS Latitude/Longitude	
				Start	End
Item	DWR UCIP Field Study			39.428980 °	39.428980 °
				-121.643322 °	-121.643322 °
DWR ID	25515				

Photo 2 of 3 : UCIP_FA_2020_57400_77244.jpg

WS view: riser located about 200-feet + from levee crown. This is the only evidence of potential telephone conduit.

LM Start	**10.86**	Rating **	M	Issue No.	**91 (cont)**
LM End	**10.86**	Issue Type +	En	Location *	

Photo 3 of 3 : UCIP_FA_2020_57400_80721.jpg

LS view: overview of LS looking towards crossing.

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiancy Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Sutter Maintenance Yard Maintenance Area 0007

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	11.90	09/17/2020 09/17/2020	Brooks Weisser

LM Start	**11.12**	Rating **	M	Issue No.	**92**
LM End	**11.12**	Issue Type +	En	Location *	
Category	Supplemental			GPS Latitude/Longitude	
				Start	End
Item	DWR UCIP Field Study			39.432143 °	39.432143 °
				-121.645516 °	-121.645516 °
DWR ID	25516				

Comment Code

Inspector Comment

DS_ID:25516
FS_ID:57401
EP_NO: N/A
Repair Type: Non-Urgent
EVAL Issue: Levee Improvement Project
Crossing Status: Found
UCIP Comments: 05/07/2019 Record has been updated from No Action Needed to Non-Urgent, no permit has been issued by the CVFPB authorizing pipe. Paddle marker located on LS shoulder has been bent. No other issues were recorded during inspection. (O. Magana - DWR UCIP)08/08/2017 Crossing was installed under the Feather River West Levee Improvements, Project D. Project Improvements begin at Station (Sta) 1765+00 (MA0007 about LM 1.73) to Sta 2303+50 (ST0005 about LM 1.23), refer to record drawings for the Feather River West Levee Improvement Plans Station 1765+00 to 2368+26, Project D details. MA0007 project details include NO CUTOFF WALL from Sta 1765+00 (MA0007 about LM 1.73) to 1815+00 (MA0007 about LM 2.64) and LEVEE DEGRADE AND RECONSTRUCTION WITH CUT OFF WALL from Sta 1817+00 (MA0007 about LM 2.69) to Sta 2289+00, Sta 2287+00 to Sta 2290+00 (MA0007 about LM 11.60). (O. Magana - DWR UCIP)
FIELD_STRUCT_DESC: 36-inch inside diameter gravity drainage pipe of an unknown material through the levee, 17 feet below the crown. 18-inch drainage layer at the pipe inlet at the landside (LS) toe. Existing ground regraded off the LS toe to provide a smooth transition to the pipe inlet. Gate riser structure with positive shutoff valve on the waterside (WS) shoulder. 36-inch flap gate, outfall structure, and riprap R90 at the pipe outlet at the WS toe. Existing ground regraded off the WS toe to provide a smooth transition to the pipe outlet. (Existing 24-inch corrugated metal gravity drainage pipe crossing removed and replaced portion within construction limit with a new 36-inch gravity drainage pipe crossing during the Feather River West Levee Improvements, Project D). [Additional Reference(s): Sutter Butte Flood Control Agency (SBFCA) Feather River West Levee Project, Volume 4 of 6 (Project D) Feather River West Levee Improvement Plans Sta 1765+00 to 2368+26, 2016, Volume 4-SBFCA_Record_Drawings_Project D_2017.05.16.pdf, Drawing No. C-553].
FS Date: 5/7/2019 12:48:00 PM

Photo 1 of 3 : UCIP_FA_2020_57401_77233.jpg

Overview of levee crown looking upstream toward crossing.

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiency Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Sutter Maintenance Yard Maintenance Area 0007

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	11.90	09/17/2020 09/17/2020	Brooks Weisser

LM Start	**11.12**	Rating **	M	Issue No.	**92 (cont)**
LM End	**11.12**	Issue Type +	En	Location *	
Category	Supplemental			GPS Latitude/Longitude	
				Start	End
Item	DWR UCIP Field Study			39.432143 °	39.432143 °
				-121.645516 °	-121.645516 °
DWR ID	25516				

Photo 2 of 3 : UCIP_FA_2020_57401_77243.jpg

Overview of WS slope at crossing.

LM Start	**11.12**	Rating **	M	Issue No.	**92 (cont)**
LM End	**11.12**	Issue Type +	En	Location *	

Photo 3 of 3 : UCIP_FA_2020_57401_77234.jpg

Overview of levee crown looking downstream at crossing.

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiency Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Sutter Maintenance Yard Maintenance Area 0007

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	11.90	09/17/2020 09/17/2020	Brooks Weisser

LM Start	**11.35**	Rating **	M	Issue No.	**93**
LM End	**11.35**	Issue Type +	En	Location *	
Category	Supplemental			GPS Latitude/Longitude	
				Start	End
Item	DWR UCIP Field Study			39.435497 °	39.435497 °
				-121.645712 °	-121.645712 °
DWR ID	25517				

Comment Code

Inspector Comment

DS_ID:25517
FS_ID:57402
EP_NO: N/A
Repair Type: Non-Urgent
EVAL Issue: Levee Improvement Project
Crossing Status: Found
UCIP Comments: 05/07/2019 Record has been updated from No Action Needed to Non-Urgent, no permit has been issued by the CVFPB authorizing pipe. No other issues were recorded during inspection. (O. Magana - DWR UCIP)08/08/2017 Crossing was installed under the Feather River West Levee Improvements, Project D. Project Improvements begin at Station (Sta) 1765+00 (MA0007 about LM 1.73) to Sta 2303+50 (ST0005 about LM 1.23), refer to record drawings for the Feather River West Levee Improvement Plans Station 1765+00 to 2368+26, Project D details. MA0007 project details include NO CUTOFF WALL from Sta 1765+00 (MA0007 about LM 1.73) to 1815+00 (MA0007 about LM 2.64) and LEVEE DEGRADE AND RECONSTRUCTION WITH CUT OFF WALL from Sta 1817+00 (MA0007 about LM 2.69) to Sta 2289+00, Sta 2287+00 to Sta 2290+00 (MA0007 about LM 11.60). (O. Magana - DWR UCIP)
FIELD_STRUCT_DESC: 36-inch inside diameter gravity drainage pipe of an unknown material through the levee, 14.5 feet below the crown. 18-inch drainage layer at the pipe inlet at the landside (LS) toe. Existing ground regraded off the LS toe to provide a smooth transition to the pipe inlet. Gate riser structure with positive shutoff valve on the waterside (WS) shoulder. 36-inch flap gate, outfall structure, and riprap R90 at the pipe outlet at the WS toe. Existing ground regraded off the WS toe to provide a smooth transition to the pipe outlet. (Existing 24-inch corrugated metal gravity drainage pipe crossing and existing 36-inch corrugated metal pipe (CMP) riser removed and replaced portion within construction limit with a new 36-inch gravity drainage pipe during the Feather River West Levee Improvements, Project D). [Additional Reference(s): Sutter Butte Flood Control Agency (SBFCA) Feather River West Levee Project, Volume 4 of 6 (Project D) Feather River West Levee Improvement Plans Sta 1765+00 to 2368+26, 2016, Volume 4-SBFCA_Record_Drawings_Project D_2017.05.16.pdf, Drawing No. C-556].
FS Date: 5/7/2019 12:48:00 PM

Photo 1 of 3 : UCIP_FA_2020_57402_77213.jpg

Overview of levee crown looking upstream at crossing.

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiancy Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Sutter Maintenance Yard Maintenance Area 0007

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	11.90	09/17/2020 09/17/2020	Brooks Weisser

LM Start	**11.35**	Rating **	M	Issue No.	**93 (cont)**
LM End	**11.35**	Issue Type +	En	Location *	
Category	Supplemental			GPS Latitude/Longitude	
				Start	End
Item	DWR UCIP Field Study			39.435497 °	39.435497 °
				-121.645712 °	-121.645712 °
DWR ID	25517				

Photo 2 of 3 : UCIP_FA_2020_57402_77208.jpg

WS view: gate riser structure located on WS shoulder.

LM Start	**11.35**	Rating **	M	Issue No.	**93 (cont)**
LM End	**11.35**	Issue Type +	En	Location *	

Photo 3 of 3 : UCIP_FA_2020_57402_77212.jpg

WS view: paddle marker visible just above concrete headwall with guard rails.

LM Start	**11.49**	Rating **	M	Issue No.	**40**
LM End	**11.49**	Issue Type +	En	Location *	WS
Category	Earthen Levee			GPS Latitude/Longitude	
				Start	End
Item	Encroachments			39.437454 °	39.437454 °
				-121.646024 °	-121.646024 °
DWR ID	DWR_MA0007_01_s _ 2016_40				

Comment Code
BU : Building

Inspector Comment
No permit was found for this structure.

Photo 1 of 1 : FA_2020_MA0007_200_40_20200929_00079.jpg

View showing structure on the waterside looking downstream.

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiancy Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Sutter Maintenance Yard Maintenance Area 0007

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	11.90	09/17/2020 09/17/2020	Brooks Weisser

LM Start	**11.52**	Rating **	M	Issue No.	**94**
LM End	**11.52**	Issue Type +	En	Location *	
Category	Supplemental			GPS Latitude/Longitude	
				Start	End
Item	DWR UCIP Field Study			39.437909 °	39.437909 °
				-121.646239 °	-121.646239 °
DWR ID	25519				

Comment Code

Inspector Comment

DS_ID:25519
FS_ID:57403
EP_NO: N/A
Repair Type: Non-Urgent
EVAL Issue: Levee Improvement Project
Crossing Status: Found
UCIP Comments: 05/07/2019 Record has been updated from No Action Needed to Non-Urgent, no permit has been issued by the CVFPB authorizing pipe. No other issues were recorded during inspection. (O. Magana - DWR UCIP)08/08/2017 Crossing was installed under the Feather River West Levee Improvements, Project D. Project Improvements begin at Station (Sta) 1765+00 (MA0007 about LM 1.73) to Sta 2303+50 (ST0005 about LM 1.23), refer to record drawings for the Feather River West Levee Improvement Plans Station 1765+00 to 2368+26, Project D details. MA0007 project details include NO CUTOFF WALL from Sta 1765+00 (MA0007 about LM 1.73) to 1815+00 (MA0007 about LM 2.64) and LEVEE DEGRADE AND RECONSTRUCTION WITH CUT OFF WALL from Sta 1817+00 (MA0007 about LM 2.69) to Sta 2289+00, Sta 2287+00 to Sta 2290+00 (MA0007 about LM 11.60). (O. Magana - DWR UCIP)
FIELD_STRUCT_DESC: 36-inch inside diameter gravity drainage pipe of an unknown material through the levee, 14.7 feet below the crown. 18-inch drainage layer at the pipe inlet at the landside (LS) toe. Existing ground regraded off the LS toe to provide a smooth transition to the flared end section inlet structure. Gate riser structure with positive shutoff valve on the waterside (WS) shoulder. 36-inch flap gate, outfall structure, and riprap R90 at the pipe outlet at the WS toe. (Existing 24-inch corrugated metal gravity drainage pipe crossing removed, relocated, and replaced portion within construction limit with a new 36-inch gravity drainage pipe crossing during the Feather River West Levee Improvements, Project D). [Additional Reference(s): Sutter Butte Flood Control Agency (SBFCA) Feather River West Levee Project, Volume 4 of 6 (Project D) Feather River West Levee Improvement Plans Sta 1765+00 to 2368+26, 2016, Volume 4-SBFCA_Record_Drawings_Project D_2017.05.16.pdf, Drawing No. C-562].
FS Date: 5/7/2019 12:49:00 PM

Photo 1 of 3 : UCIP_FA_2020_57403_77203.jpg

Overview of WS slope and levee crown, looking downstream from crossing.

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiancy Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Sutter Maintenance Yard Maintenance Area 0007

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	11.90	09/17/2020 09/17/2020	Brooks Weisser

LM Start	**11.52**	Rating **	M	Issue No.	**94 (cont)**
LM End	**11.52**	Issue Type +	En	Location *	
Category	Supplemental			GPS Latitude/Longitude	
				Start	End
Item	DWR UCIP Field Study			39.437909 °	39.437909 °
				-121.646239 °	-121.646239 °
DWR ID	25519				

Photo 2 of 3 : UCIP_FA_2020_57403_77204.jpg

Overview of levee crown and LS slope, looking downstream from crossing.

LM Start	**11.52**	Rating **	M	Issue No.	**94 (cont)**
LM End	**11.52**	Issue Type +	En	Location *	

Photo 3 of 3 : UCIP_FA_2020_57403_77205.jpg

LS view: toe road and paddle marker near concrete headwall.

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiancy Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Fall 2020 Levee Maintenance Deficiency Summary Report

Sacramento River Basin

MA0016 **Sutter Maintenance Yard Maintenance Area 0016**	Overall LMA Rating **A**	Total LMA Miles **4.06**						
Rated Item	Maintenance Deficiency				Enforcement		Design & System Obsolescence	
	M Miles	U Miles	M + 4U Miles	Threshold %	M Miles	U Miles	M Miles	U Miles
Earthen Levee								
Encroachments					0.25			
Supplemental								
DWR UCIP Field Study					0.02			
DWR UCIP LMA Responsibility								
LMA Totals:	0.00	0.00	0.00	0.00%	0.27	0.00	0.00	0.00

Unit No. 01 Feather River RB MA0016	Overall Unit Rating **A**	Total Unit Miles **4.06**						
Rated Item	Maintenance Deficiency				Enforcement		Design & System Obsolescence	
	M Miles	U Miles	M + 4U Miles	Threshold %	M Miles	U Miles	M Miles	U Miles
Earthen Levee								
Encroachments					0.25			
Supplemental								
DWR UCIP Field Study					0.02			
DWR UCIP LMA Responsibility								
Unit Totals:	0.00	0.00	0.00	0.00%	0.27	0.00	0.00	0.00

State of California - Department of Water Resources - Division of Flood Management - Flood Project Integrity & Inspection Branch

Flood Control Project Maintenance
Levee Inspections

LMA District Cover Sheet

Sutter Maintenance Yard Maintenance Area 0016

	Spring (March - May)	Summer ** (June - August)	Fall (September - November)	Winter ** (December - February)
† Overall LMA Rating (Fall Only)			**A**	

** Non-receipt of Summer or Winter Inspection Reports may effect overall annual rating.

† SPRING INSPECTIONS: Overall maintenance ratings are not determined for the spring inspection results. Individual maintenance deficiencies are rated using the same criteria in the spring and in the fall.

FALL INSPECTIONS: The overall maintenance rating shown above is based on operation and maintenance deficiencies identified within the attached unit inspection reports. This rating is not intended to be an indiction of risk.

Comments

Flood Control Project Maintenance
Levee Inspections

Unit Cover Sheet

Sutter Maintenance Yard Maintenance Area 0016

Waterway	Bank	Unit Miles
Unit No. 01 Feather River	Right	4.06

	Spring (March - May)	Summer (June - August)	(September - November) Fall	Winter (December - February)
Unit Maintenance Rating (Fall Only)			**A**	
Date of Inspection	3/18/2020 - 3/18/2020		9/17/2020 - 9/17/2020	
DWR Inspector	Sterling York		Brooks Weisser	
Accompanied By	Shawn Freitag Sutter Maintenance Yard		Shawn Freitag Sutter Maintenance Yard	
	Bob Duffey Sutter Maintenance Yard		Bob Duffey Sutter Maintenance Yard	

Summer & Winter Inspections

The Local Maintaining Agency (LMA) is responsible for summer and winter inspections. The LMA is required to submit a report regarding summer and winter inspections to the California Department of Water Resources (DWR).

DWR must be informed on the:
a) completion of the inspection
b) any changes other than the results of normal maintenance
c) corrections to deficiencies noted in this report

If additional items are noted, further documentation of those items must also be submitted.

The LMA should submit this information to DWR using the LMA web application tool available at:

http://cdec.water.ca.gov/lma.html

If the LMA is unable to submit information on this webpage, please contact DWR for assistance.

The LMA should submit the information and any associated documentation by September 30 for summer inspections and March 31 for winter inspections.

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Sutter Maintenance Yard Maintenance Area 0016

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	4.06	09/17/2020 09/17/2020	Brooks Weisser

LM Start		Rating **	A	Issue No.	**3**
LM End		Issue Type +	Ma	Location *	
Category	Earthen Levee			GPS Latitude/Longitude	
				Start	End
Item	Operations & Maintenance Manuals			°	°
				°	°
DWR ID	DWR_MA0016_01_s _ 2013_3				

Comment Code

Inspector Comment

The O&M manuals are located at the Sutter Maintenance Yard.

No Photos

LM Start		Rating **	A	Issue No.	**4**
LM End		Issue Type +	Ma	Location *	
Category	Earthen Levee			GPS Latitude/Longitude	
				Start	End
Item	Flood Preparedness & Training			°	°
				°	°
DWR ID	DWR_MA0016_01_s _ 2013_4				

Comment Code

Inspector Comment

Sutter maintenance yard employees attend the annual Flood Fight class put on by DWR.

No Photos

LM Start		Rating **	A	Issue No.	**5**
LM End		Issue Type +	Ma	Location *	
Category	Earthen Levee			GPS Latitude/Longitude	
				Start	End
Item	Emergency Supplies & Equipment			°	°
				°	°
DWR ID	DWR_MA0016_01_s _ 2013_5				

Comment Code

Inspector Comment

Emergency supplies and equipment are stored at the Sutter Maintenance Yard.

No Photos

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable	A : Acceptable N : Not Inspected/Rated	Ma : Maintenance Deficiancy
WS : Water Side	M : Minimally Acceptable C : Corrected	Ob : Design & System Obsolescence
CR : Crown	U : Unacceptable A/W : Acceptable but Monitor & Maintain	En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Sutter Maintenance Yard Maintenance Area 0016

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	4.06	09/17/2020 09/17/2020	Brooks Weisser

LM Start	**0.14**	Rating **	M	Issue No.	**9**
LM End	**0.14**	Issue Type +	En	Location *	LS
Category	Earthen Levee			GPS Latitude/Longitude	
				Start	End
Item	Encroachments			39.257832 °	39.257832 °
				-121.636640 °	-121.636640 °
DWR ID	DWR_MA0016_01_f _ 2020_9				

Comment Code

DE : Debris

Inspector Comment

Debris pile against levee toe should be removed, Fall 2020

Photo 1 of 1 : FA_2020_MA0016_302_9_20200929_00011.jpg

View of debris pile on landside levee toe, Fall 2020.

LM Start	**0.43**	Rating **	M	Issue No.	**10**
LM End	**0.43**	Issue Type +	En	Location *	LS
Category	Earthen Levee			GPS Latitude/Longitude	
				Start	End
Item	Encroachments			39.262054 °	39.262054 °
				-121.636609 °	-121.636609 °
DWR ID	DWR_MA0016_01_f _ 2020_10				

Comment Code

BU : Building

Inspector Comment

Unpermitted building located on the landside levee toe should be removed, Fall 2020.

Photo 1 of 1 : FA_2020_MA0016_302_10_20200929_00012.jpg

View of building on landside levee toe, Fall 2020

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable	A : Acceptable N : Not Inspected/Rated	Ma : Maintenance Deficiency
WS : Water Side	M : Minimally Acceptable C : Corrected	Ob : Design & System Obsolescence
CR : Crown	U : Unacceptable A/W : Acceptable but Monitor & Maintain	En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Sutter Maintenance Yard Maintenance Area 0016

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	4.06	09/17/2020 09/17/2020	Brooks Weisser

LM Start	**1.44**	Rating **	M	Issue No.	**15**
LM End	**1.44**	Issue Type +	En	Location *	
Category	Supplemental			GPS Latitude/Longitude	
				Start	End
Item	DWR UCIP Field Study			39.276170 °	39.276170 °
				-121.632598 °	-121.632598 °
DWR ID	25460				

Comment Code

Inspector Comment

DS_ID:25460
FS_ID:57714
EP_NO: N/A
Repair Type: Non-Urgent
EVAL Issue: Levee Improvement Project
Crossing Status: Found
UCIP Comments: 05/22/2019 Record has been updated from No Action Needed to Non-Urgent, no permit has been issued for this crossing. (O. Magana - DWR UCIP)05/22/2017 Crossing appears to be in good condition. Pipe has been selected to be internally cleaned and inspected as part of the DMP project. (A. Freitag - DWR Sutter Yard)12/01/2016 Crossing appears to be in good condition. (A. Freitag - DWR Sutter Yard)06/21/2016 Inspector's notes and photos related to new pipe from DS_ID 17175 have been transferred. Pipe record (DS_ID 17175) has been retired since pipe was removed from the levee and a new pipe was installed. (O. Magana - DWR UCIP)05/26/2016 Crossing appears to be in good condition. (A. Freitag - DWR Sutter Yard)06/08/2015 Pipe has been replaced with the completion of the SBFCA project in this area. New headwall and flap gate on WS toe and a new positive closure structure was added on the WS shoulder. Manhole access cover located near the LS toe. Pipe depth markers are present on LS and WS slopes and levee crown. (A. Freitag - DWR Sutter Yard)
FIELD_STRUCT_DESC: 36-inch concrete pipe through the levee, approximately 16 feet below the crown. Pipe encased in controlled low-strength material (CLSM) through the levee. Gate riser structure with positive shutoff device located on waterside (WS) slope. Concrete headwall located on WS end. Guardrail attached to WS concrete headwall. Riprap located at drainage outlet. Manhole located on the landside (LS). Structure markers located on both WS and landside (LS). Crossing referenced as Reclamation District (RD) 777 - Storm Drain (SD) Lateral 7. Crossing was installed, to replace the existing 36-inch drainage pipe listed under the USACE O&M Manual 148 dated August 1955, under the Feather River West Levee Improvement Project in 2015. [Additional Reference(s): Feather River West Levee Project, Volume 4 of 6, Feather River West Levee Improvement Plans, STA 1433+83 to 1626+00, Drawing No. C-506, Sheet 206, Referenced Station 1536+12 (New Pipe Install)].
FS Date: 5/22/2019 3:45:00 PM

Photo 1 of 3 : UCIP_FA_2020_57714_75282.jpg

WS marker indicating location and depth of pipe through slope.

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiancy Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Sutter Maintenance Yard Maintenance Area 0016

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	4.06	09/17/2020 09/17/2020	Brooks Weisser

LM Start	**1.44**	Rating **	M	Issue No.	**15 (cont)**
LM End	**1.44**	Issue Type +	En	Location *	
Category	Supplemental			GPS Latitude/Longitude	
				Start	End
Item	DWR UCIP Field Study			39.276170 °	39.276170 °
				-121.632598 °	-121.632598 °
DWR ID	25460				

Photo 2 of 3 : UCIP_FA_2020_57714_75283.jpg

WS concrete headwall and flap gate.

LM Start	**1.44**	Rating **	M	Issue No.	**15 (cont)**
LM End	**1.44**	Issue Type +	En	Location *	

Photo 3 of 3 : UCIP_FA_2020_57714_75284.jpg

WS view photo taken from levee crown looking at WS slope.

LM Start	**2.85**	Rating **	M	Issue No.	**14**
LM End	**3.08**	Issue Type +	En	Location *	LS
Category	Earthen Levee			GPS Latitude/Longitude	
				Start	End
Item	Encroachments			39.293675 °	39.296748 °
				-121.636615 °	-121.638192 °
DWR ID	DWR_MA0016_01_s _ 2012_14				

Comment Code
DT : Ditch

Inspector Comment
An agricultural ditch is located at the landside slope and toe.

Photo 1 of 1 : FA_2020_MA0016_302_14_20200929_00016.jpg

View of agricultural ditch at the landside slope and toe.

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiancy Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Sutter Maintenance Yard Maintenance Area 0016

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	4.06	09/17/2020 09/17/2020	Brooks Weisser

LM Start	**2.86**	Rating **	M	Issue No.	**16**
LM End	**2.86**	Issue Type +	En	Location *	
Category	Supplemental			GPS Latitude/Longitude	
				Start	End
Item	DWR UCIP Field Study			39.293774 °	39.293774 °
				-121.636612 °	-121.636612 °
DWR ID	25458				

Comment Code

Inspector Comment

DS_ID:25458
FS_ID:57712
EP_NO: N/A
Repair Type: Non-Urgent
EVAL Issue: Levee Improvement Project
Crossing Status: Found
UCIP Comments: 05/22/2019 Record has been updated from No Action Needed to Non-Urgent, no permit has been issued by the CVFPB authorizing this pipe. (O. Magana - DWR UCIP)05/22/2017 Crossing appears to be in good condition. Pipe has been selected to be internally cleaned and inspected as part of the DMP project. (A. Freitag - DWR Sutter Yard)12/01/2016 Crossing appears to be in good condition. (A. Freitag - DWR Sutter Yard)06/21/2016 Inspector's notes and photos related to new pipe from DS_ID 17175 have been transferred. Pipe record (DS_ID 17175) has been retired since pipe was removed from the levee and a new pipe was installed. (O. Magana - DWR UCIP)05/26/2016 Crossing appears to be in good condition. (A. Freitag - DWR Sutter Yard)06/08/2015 Pipe has been replaced with the completion of the SBFCA project in this area. Pipe is now a 36-inch corrugated metal pipe. New headwall and flap gate located at WS toe with a new positive closure structure on WS shoulder. LS inlet was replaced and pipe markers to show the location and depth are located all along the pipe alignment. (A. Freitag - DWR Sutter Yard)
FIELD_STRUCT_DESC: 36-inch concrete pipe through the levee, approximately 14 feet below the crown. Pipe encased in controlled low-strength material (CLSM) through the levee. Pipe buried under Sutter Butte Main Canal. 20-foot by 30-foot reinforced concrete pad installed at the bottom of Sutter Butte Main Canal and Canal layered with rock slope protection. Gate riser structure with positive shutoff device located on the waterside (WS) slope. Concrete headwall located on the WS end. Guardrail attached to the WS concrete headwall. Riprap located at the drainage outlet. Structure markers located on both the WS and landside (LS). Crossing referenced as Reclamation District (RD) 777 - Storm Drain (SD) Lateral 12. Crossing was installed, to replace the existing 18-inch drainage pipe listed under the USACE O&M Manual 148 dated August 1955, under the Feather River West Levee Improvement Project in 2015. [Additional Reference(s): Feather River West Levee Project, Volume 4 of 6, Feather River West Levee Improvement Plans, STA 1433+83 to 1626+00, Drawing No. C-507, Sheet 207, Referenced Station 1610+95 (New Pipe Install)].
FS Date: 5/22/2019 3:46:00 PM

Photo 1 of 3 : UCIP_FA_2020_57712_75286.jpg

WS view of positive closure structure.

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiancy Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Sutter Maintenance Yard Maintenance Area 0016

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	4.06	09/17/2020 09/17/2020	Brooks Weisser

LM Start	**2.86**	Rating **	M	Issue No.	**16 (cont)**
LM End	**2.86**	Issue Type +	En	Location *	
Category	Supplemental			GPS Latitude/Longitude	
				Start	End
Item	DWR UCIP Field Study			39.293774 °	39.293774 °
				-121.636612 °	-121.636612 °
DWR ID	25458				

Photo 2 of 3 : UCIP_FA_2020_57712_75287.jpg

WS view of guardrail attached to concrete headwall. Marker located on WS.

LM Start	**2.86**	Rating **	M	Issue No.	**16 (cont)**
LM End	**2.86**	Issue Type +	En	Location *	

Photo 3 of 3 : UCIP_FA_2020_57712_75288.jpg

WS view of headwall and flap gate.

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiancy Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Sutter Maintenance Yard Maintenance Area 0016

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	4.06	09/17/2020 09/17/2020	Brooks Weisser

LM Start	**4.07**	Rating **	M	Issue No.	**17**
LM End	**4.07**	Issue Type +	Ma	Location *	
Category	Supplemental			GPS Latitude/Longitude	
				Start	End
Item	DWR UCIP LMA Responsibility			39.311127 °	39.311127 °
				-121.637606 °	-121.637606 °
DWR ID	17123				

Comment Code

Inspector Comment

DS_ID:17123
FS_ID:58700
EP_NO: N/A
Repair Type: Non-Urgent
EVAL Issue: Unauthorized Encroachment, installed decades prior
Crossing Status: Found
UCIP Comments: 05/22/2019 Record has been updated from No Action Needed to Non-Urgent, need to clarify owner. Unclear the purpose of this pipe. The pipe transfers water from LS to WS and then the flow is diverted via a WS canal that runs parallel along levee for about 0.92 miles. This crossing might be used to irrigate orchards located on the WS. Need to contact owner to clarify purpose of this structure. (O. Magana - DWR UCIP)05/22/2017 Crossing appears to be in good condition. (A. Freitag - DWR Sutter Yard)12/01/2016 Crossing appears to be in good condition. (A. Freitag - DWR Sutter Yard)05/26/2016 Crossing appears to be in good condition. (A. Freitag - DWR Sutter Yard)06/08/2015 Pipe appears to be in good condition. No noticeable issues to report. Pipe was listed to be replaced with the SBFCA project but the project did not take place in this area. (A. Freitag - DWR Sutter Yard)12/29/2014 Same as last inspection. (A. Freitag - DWR Sutter Yard)05/19/2014 Same as last inspection. (A. Freitag - DWR Sutter Yard)11/06/2013 Same as last inspection. (A. Freitag - DWR Sutter Yard)05/14/2013 Slide gate opened allowing water to flow through, debris problem has been cleared and the gates seem to be functioning properly. SBFCA project recommends replacing in accordance with title 23. (A. Freitag - DWR Sutter Yard)12/11/2012 Lock missing from concrete well access door- this should be replaced. Some debris blocking preventing flap gate from completely closing. (W. Wylie - DWR UCIP)
FIELD_STRUCT_DESC: 48-inch by 72-inch reinforced concrete drainage culvert through the levee, 20.5 feet below the crown. Slide gate in a concrete well on the waterside (WS) slope. Siphon breaker/air vent on the WS shoulder at the concrete well. [Additional Reference(s): DWR Levee Log, 2005. USACE Sacramento O&M Manual 148, August 1955, (Station 683+25)].
FS Date: 5/22/2019 3:50:00 PM

Photo 1 of 3 : UCIP_FA_2020_58700_65785.jpg

Slide gate, concrete well, siphon breaker/air vent and open channel on WS of levee.

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiancy Ob : Design & System Obsolescence En : Enforcement

Flood Control Project Maintenance
Levee Inspections

Levee Inspection Report By Mile - Fall 2020

Sutter Maintenance Yard Maintenance Area 0016

Waterway	Bank	Unit Miles	Inspection Start/End	Inspector
Unit No. 01 Feather River	Right	4.06	09/17/2020 09/17/2020	Brooks Weisser

LM Start	**4.07**	Rating **	M	Issue No.	**17 (cont)**
LM End	**4.07**	Issue Type +	Ma	Location *	
Category	Supplemental			GPS Latitude/Longitude	
				Start	End
Item	DWR UCIP LMA Responsibility			39.311127 °	39.311127 °
				-121.637606 °	-121.637606 °
DWR ID	17123				

Photo 2 of 3 : UCIP_FA_2020_58700_65784.jpg

Pumping plant and slide gate on LS accross canal. (no access from levee).

LM Start	**4.07**	Rating **	M	Issue No.	**17 (cont)**
LM End	**4.07**	Issue Type +	Ma	Location *	

Photo 3 of 3 : UCIP_FA_2020_58700_65783.jpg

Cocrete headwall and flap gate on WS toe.

* Location	** Rating	+ Issue Type
LS : Land Side N/A : Not Applicable WS : Water Side CR : Crown	A : Acceptable N : Not Inspected/Rated M : Minimally Acceptable C : Corrected U : Unacceptable A/W : Acceptable but Monitor & Maintain	Ma : Maintenance Deficiancy Ob : Design & System Obsolescence En : Enforcement

Appendix C. Acquisition Approach Table

Summary of Parcel Acquisitions Within 30FT Offset LS/15 FT Offset WS of Flood Protection Feature

Count	Parcel Station Range	APN	PROPERTY OWNER	Project Area	Acquisition Approach	Developed Parcel Compliance Option
1	0510-0514	PER 2009-12778	LEVEE DISTRICT NO. 1	B	1	-
2	0511-0522	PER APN MAP	LEVEE DISTRICT NO. 1	B	1	-
3	0512-0521	23-300-053	SINGH	B	1	-
4	0522-0532	23-300-052	SINGH	B	1	-
5	0522-0532	NO APN	UNKNOWN	B	1	-
6	0532-0556	23-300-086	SIERRA GOLD LAND	B	1	-
7	0539-0586	23-300-126	STATE OF CALIFORNIA	B	1	-
8	0555-0602	23-300-085	SIERRA GOLD LAND	B	1	-
9	0586-0630	23-300-127	STATE OF CALIFORNIA	B	1	-
10	0602-0629	23-300-084	SIERRA GOLD LAND	B	1	-
11	0629-0642	23-253-016	SIERRA GOLD LAND	B	1	-
12	0630-0634	23-253-011	STATE OF CALIFORNIA	B	2	-
13	0634-0638	23-253-009	STATE OF CALIFORNIA	B	2	-
14	0638-0646	23-253-008	STATE OF CALIFORNIA	B	2	-
15	0642-0646	23-253-015	BAINS	B	1	-
16	0646-0649	23-253-006	FEATHER WATER DIST	B	1	-
17	0646-0649	23-253-007	FEATHER WATER DIST	B	1	
18	0649-0661	23-253-023	BERG	B	1	-
19	0653-0655	23-253-022	HOLMES	B	1	-
20	0661-0664	23-234-011	QUEEN OF PEACE ORATORY	B	1	-
21	0661-0669	23-234-014	BERG	B	1	-
22	0664-0667	23-234-008	BERG	B	1	-
23	0670-0674	23-234-003	SIERRA GOLD LAND	B	1	-
24	0674-0678	23-234-004	JOHAL	B	1	-
25	0678-0689	23-234-005	JOHAL	B	1	-
26	0689-0708	23-180-019	LOW	B	1	-
27	0689-0708	PER 138 OR 100	LD1	B	1	
28	0708-0708	PER 735 OR 1	COUNTY OF SUTTER	B	1	-
29	0708-0737	23-180-005	YOKOHARI	B	1	-
30	0708-0737	PER 151 OR 23	LEVEE DISTRICT NO. 1	B	1	-
31	0709-0751	PER 38 OR 269	LD1	B	1	

Acquisition Approach:
1 – Existing or Acquired 30'/15' of Permanent Landside/Waterside Right of Way.
2 – Obtained Right of Entry, Levee Easement to be Acquired.
3 – Developed Parcel.
4 – Developed Parcel (City of Yuba City Area).
5 – Outside Program Acquisition (Reach 26, 27, 28).

Developed Parcel Compliance Options:
Option 1: Obtain 10' fee beyond levee feature.
Option 2: Obtain 20' visibility beyond levee feature.

Summary of Parcel Acquisitions Within 30FT Offset LS/15 FT Offset WS of Flood Protection Feature

Count	Parcel Station Range	APN	PROPERTY OWNER	Project Area	Acquisition Approach	Developed Parcel Compliance Option
32	0737-0751	23-180-006	YOKOHARI	B	1	-
33	0751-0766	23-040-020	LEVEE DISTRICT NO. 1	B	2	-
34	0751-0792	23-040-077	CITY OF YUBA CITY	B	1	-
35	0764-0774	23-040-019	MC FEELY	B	3	2
36	0764-0774	PER 151 OR 95	LEVEE DISTRICT NO. 1	B	1	-
37	0774-0792	23-040-014	TAKHAR	B	1	-
38	0792-0804	23-040-018	TAKHAR	B	1	-
39	0792-0821	23-040-050	CITY OF YUBA CITY	B	1	-
40	0821-0836	23-040-078	STATE OF CALIFORNIA	B	1	-
41	0821-0837	55-010-019-A	DEPARTMENT OF FISH & GAME	B	1	-
42	0822-0834	23-040-051	STATE OF CALIFORNIA	B	1	
43	0833-0843	55-180-080	CITY OF YUBA CITY	B	1	-
44	0835-0843	PER 2002-0011724	SACRAMENTO-SAN JOAQUIN DRAINAGE DISTRICT	B	1	-
45	0843-0845	PER 829 O.R. 362	STATE OF CALIFORNIA	B	1	-
46	0844-0845	PER 800 O.R. 3	HAUS	B	2	
47	0845-0911	23-040-036	COUNTY OF SUTTER	C	1	-
48	0848-0866	22-090-013	COUNTY OF SUTTER	C	1	-
49	0866-0882	22-090-012	COUNTY OF SUTTER	C	1	-
50	0882-0905	22-090-010	COUNTY OF SUTTER	C	1	-
51	0905-0912	22-090-007	COUNTY OF SUTTER	C	1	-
52	0911-0912	53-500-048	SUTTER SIERRA PROPERTIES LLC	C	1	-
53	0912-0966	20-160-071	COUNTY OF SUTTER	C	2	-
54	0953-0973	PER 96 DEEDS 211	LEVEE DISTRICT NO. 1	C	1	-
55	0972-0986	PER 114 OR 419	LEVEE DISTRICT NO. 1	C	1	-
56	0973-0986	PER 70 O.R. 449	O'BANION	C	2	
57	0973-0973	52-570-004	STOUT	C	4	2
58	0974-0974	52-570-003	BROCKMAN	C	4	2
59	0975-0975	52-570-001	SMITH	C	4	2
60	0975-0975	52-570-002	PERNOD	C	4	2
61	0976-0976	52-580-009	COBLE	C	4	2
62	0976-0979	52-580-008	LEVEE DISTRICT NO. 1	C	4	2

Acquisition Approach:
1 – Existing or Acquired 30'/15' of Permanent Landside/Waterside Right of Way.
2 – Obtained Right of Entry, Levee Easement to be Acquired.
3 – Developed Parcel.
4 – Developed Parcel (City of Yuba City Area).
5 – Outside Program Acquisition (Reach 26, 27, 28).

Developed Parcel Compliance Options:
Option 1: Obtain 10' fee beyond levee feature.
Option 2: Obtain 20' visibility beyond levee feature.

Summary of Parcel Acquisitions Within 30FT Offset LS/15 FT Offset WS of Flood Protection Feature

Count	Parcel Station Range	APN	PROPERTY OWNER	Project Area	Acquisition Approach	Developed Parcel Compliance Option
63	0979-0979	52-580-006	HODGES	C	4	2
64	0979-0979	52-580-007	FILBY	C	4	2
65	0980-0980	52-580-004	STEVENSON	C	4	2
66	0980-0980	52-580-005	YUBA SUTTER BODY SHOP INC	C	4	2
67	0980-0982	52-580-003	SOUZA	C	4	2
68	0982-0984	52-580-015	COAKLEY	C	4	2
69	0984-0984	52-552-007	ALBRECHT	C	4	2
70	0985-0985	52-552-006	EDWARDS	C	4	2
71	0986-0986	52-552-005	WILKINS	C	4	2
72	0987-0987	52-552-004	SANDERS	C	4	2
73	0988-0988	52-552-002	MACKENSEN	C	4	2
74	0988-0988	52-552-003	POOLE	C	4	2
75	0989-0989	52-552-001	SIMS	C	4	2
76	0990-0990	52-535-006	MC CARLEY	C	4	2
77	0990-0990	52-535-007	ANDERSON	C	4	2
78	0991-0991	52-535-005	MC CARLEY	C	4	2
79	0992-0992	52-535-004	BENATAR	C	4	2
80	0993-0993	52-535-003	FALCOCCHIA	C	1	-
81	0993-0993	PER 114 O.R. 269	LEVEE DISTRICT NO. 1	C	1	
82	0993-0994	NO APN	COUNTY OF SUTTER	C	2	-
83	0994-0997	52-534-001 (W'LY)	COUNTY OF SUTTER	C	2	-
84	0994-0997	52-534-001 (E'LY)	LEVEE DISTRICT NO. 1	C	2	2
85	0997-0998	NO APN	COUNTY OF SUTTER	C	2	-
86	0998-1001	NO APN	LEVEE DISTRICT NO. 1 (TO BE CONFIRMED)	C	2	-
87	0999-0999	52-516-003	SCHNEIDER	C	4	2
88	1000-1000	52-516-005	FLETCHER	C	4	2
89	1000-1001	NO APN	COUNTY OF SUTTER	C	2	-
90	1001-1002	PER 114 O.R. 249	LEVEE DISTRICT NO. 1	C	1	-
91	1001-1003	52-515-014	PAQUETTE	C	4	2
92	1002-1002	PER 1997-01075	CITY OF YUBA CITY	C	1	-
93	1003-1003	PER 1996-17272	CITY OF YUBA CITY	C	1	-

Acquisition Approach:
1 – Existing or Acquired 30'/15' of Permanent Landside/Waterside Right of Way.
2 – Obtained Right of Entry, Levee Easement to be Acquired.
3 – Developed Parcel.
4 – Developed Parcel (City of Yuba City Area).
5 – Outside Program Acquisition (Reach 26, 27, 28).

Developed Parcel Compliance Options:
Option 1: Obtain 10' fee beyond levee feature.
Option 2: Obtain 20' visibility beyond levee feature.

Summary of Parcel Acquisitions Within 30FT Offset LS/15 FT Offset WS of Flood Protection Feature

Count	Parcel Station Range	APN	PROPERTY OWNER	Project Area	Acquisition Approach	Developed Parcel Compliance Option
94	1003-1004	52-515-017	MULCAHY	C	4	2
95	1004-1005	PER 114 OR 313 &122 OR 222	LEVEE DISTRICT NO. 1	C	2	-
96	1004-1006	52-515-012	KANADA	C	4	2
97	1005-1006	NO APN	CITY OF YUBA CITY	C	1	-
98	1006-1007	52-490-003	CITY OF YUBA CITY	C	1	-
99	1007-1009	52-490-002	CITY OF YUBA CITY	C	1	
100	1007-1028	NO APN	LEVEE DISTRICT NO. 1 (TO BE CONFIRMED)	C	2	-
101	1008-1010	52-490-001	BOUDAMES	C	4	1
102	1010-1010	NO APN	CITY OF YUBA CITY	C	1	1
103	1010-1011	52-471-008	DHAMI	C	4	1
104	1011-1011	52-471-007	BLANCHARD	C	4	1
105	1011-1011	PER 122 OR 215	LEVEE DISTRICT NO. 1	C	1	-
106	1012-1012	52-471-015	LAW	C	4	2
107	1013-1013	52-471-021	DHAMI	C	4	1
108	1014-1015	52-471-020	LEVEE DISTRICT NO. 1	C	2	-
109	1016-1016	NO APN	COUNTY OF SUTTER	C	2	-
110	1016-1021	52-450-017	BOCK INDUSTRIAL CONDO ASSOC	C	4	2
111	1019-1021	PER 1288 O.R. 570	LEVEE DISTRICT NO. 1	C	2	-
112	1019-1029	52-430-003	LEVEE DISTRICT NO. 1 & SSJDD	C	1	-
113	1021-1024	52-430-004	LEVEE DISTRICT NO. 1	C	2	-
114	1022-1025	52-430-008	FLETCHER	C	4	-
115	1025-1027	NO APN	CAL TRANS	C	2	-
116	1027-1031	PER 439 OR 526	CITY OF YUBA CITY	C	1	-
117	1028-1051	51-550-003	LAMON	C	1	-
118	1029-1052	PER 128 OR 13	LEVEE DISTRICT NO. 1 & SSJDD	C	1	-
119	1038-1044	PER 210 OR 310	CITY OF YUBA CITY	C	1	-
120	1039-1070	51-530-022	CITY OF YUBA CITY	C	2	
121	1042-1052	51-530-020	LAMON	C	1	-
122	1052-1078	51-530-023	CITY OF YUBA CITY	C	2	-
123	1052-1079	51-530-021-A	JAEGER	C	1	-
124	1052-1079	51-530-021-B	JAEGER	C	1	-

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Count	Parcel Station Range	APN	PROPERTY OWNER	Project Area	Acquisition Approach	Developed Parcel Compliance Option
125	1070-1111	51-580-004	BHATTI	C	1	
126	1079-1080	51-470-001	COUNTY OF SUTTER	C	1	-
127	1080-1111	51-580-005	BHATTI	C	1	-
128	1081-1092	51-490-027	LEVEE DISTRICT NO. 1	C	2	-
129	1093-1111	51-580-007	LEVEE DISTRICT NO. 1	C	2	-
130	1096-1103	51-580-020	ROBERT BANES LAND LEVELING	C	1	-
131	1111-1129	51-580-009	BAINS	C	1	-
132	1112-1128	PER P DEEDS 419 (1 OF 2)	LEVEE DISTRICT NO. 1	C	2	
133	1113-1124	18-070-002	BOONE DECLARATION	C	1	
134	1125-1135	PER 830 O.R. 207	CITY OF YUBA CITY	C	2	
135	1128-1135	UPRR	UNION PACIFIC RAILROAD	C	2	2
136	1132-1138	18-070-001	DI FIORE ENTERPRISES	C	1	
137	1133-1138	10-270-009	WILBUR	C	1	-
138	1135-1139	PER P DEEDS 419 (2 OF 2)	LEVEE DISTRICT NO. 1	C	2	
139	1138-1165	10-270-010	WILBUR	C	3	1
140	1139-1167	10-270-007	RIVER BEND ORCHARDS	C	1	
141	1139-1209	PER P DEEDS 103 (1 OF 2)	LEVEE DISTRICT NO. 9	C	1	
142	1165-1179	10-270-005	WILBUR	C	1	-
143	1167-1182	10-270-004	RIVER BEND ORCHARDS	C	1	
144	1179-1208	10-270-001	WILBUR	C	1	-
145	1182-1208	10-270-003	WILBUR	C	1	
146	1209-1239	10-220-046	SINGH	C	1	-
147	1209-1239	10-220-053	SINGH	C	1	-
148	1209-1240	PER P D 138	LEVEE DISTRICT NO. 9	C	1	-
149	1239-1281	PER P DEEDS 103 (2 OF 2)	LEVEE DISTRICT NO. 9	C	1	
150	1240-1267	10-220-008	RICHLAND ENTERPRISES	C	1	-
151	1267-1273	10-170-052	RICHLAND ENTERPRISES	C	1	-
152	1267-1281	10-170-013	DEPARTMENT OF FISH & GAME	C	1	
153	1267-1280	889 O.R. 86	SULLIVAN	C	2	
154	1274-1280	10-170-054	SJB FARMS LLC	C	1	-
155	1281-1291	10-170-010	DEPARTMENT OF FISH & GAME	C	1	

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Count	Parcel Station Range	APN	PROPERTY OWNER	Project Area	Acquisition Approach	Developed Parcel Compliance Option
156	1281-1293	10-170-050	FILTER	C	3	1
157	1294-1307	10-170-012	FILTER	C	1	-
158	1294-1307	10-170-017	OWEN	C	3	2
159	1307-1315	10-170-015	FILTER	C	1	
160	1307-1315	10-170-043	ALBERTINI	C	1	-
161	1315-1330	10-130-041	RIVER BOTTOM RANCH	C	1	
162	1315-1331	10-130-043	RIVER BOTTOM RANCH	C	1	-
163	1315-1346	PER P DEEDS 123	LEVEE DISTRICT NO. 9	C	1	
164	1329-1339	10-130-040	MICHELI	C	1	
165	1331-1339	10-130-028	MICHELI	C	1	-
166	1339-1347	10-130-005	MICHELI	C	1	-
167	1339-1347	10-130-014	MICHELI	C	1	
168	1347-1347	LOT B PER 2 S 31	WOODWORTH	C	2	-
169	1347-1374	47 D 216	HANEY & BRUCE	C	2	
170	1347-1361	10-130-013	FILTER	C	1	
171	1347-1364	10-120-004	FILTER	C	1	-
172	1362-1374	10-130-012	SCHMIDL	C	1	
173	1364-1374	10-120-003	DHOOT	C	1	-
174	1374-1375	LOT B PER 2 S 31	SCHMIDL	C	2	-
175	1374-1380	10-062-004	SCHMIDL	C	1	
176	1375-1385	PARCEL-B	UNKNOWN-B	C	2	
177	1375-1520	PER 41 DEEDS 222	BUTTE COUNTY CANAL COMPANY	C	3	2
178	1380-1385	10-062-003	DPM	C	1	
179	1381-1392	10-061-003	DPM	C	1	
180	1385-1392	NO APN	UNKNOWN	C	2	-
181	1392-1399	10-061-002	DPM	C	1	-
182	1399-1420	10-045-005	NICHOLS	C	1	-
183	1420-1430	10-045-002	SMITH	C	1	-
184	1430-1433	09-305-002	SUTTER EX WATER DIST	C	3	2
185	1430-1440	09-305-003	SMITH	C	1	
186	1440-1453	09-304-002	REEVES	C	1	-

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Count	Parcel Station Range	APN	PROPERTY OWNER	Project Area	Acquisition Approach	Developed Parcel Compliance Option
187	1454-1460	09-295-003-B	GHAG	C	1	-
188	1460-1467	09-295-005	MC COOL	C	3	1
189	1467-1473	09-295-008	GUSHI	C	3	1
190	1474-1480	09-295-022	LEA	C	1	-
191	1480-1488	09-240-006	SUTTER BUTTE DUSTERS INC	C	3	2
192	1481-1487	09-242-011	SACRAMENTO-SAN JOAQUIN DRAINAGE DISTRICT	C	1	
193	1487-1494	09-240-007	WAYNE SUE	C	1	-
194	1494-1520	09-240-010	SHUBAT	C	3	2
195	1520-1533	09-230-004	DEKENS	C	2	-
196	1520-1536	09-230-001	SACRAMENTO-SAN JOAQUIN DRAINAGE DISTRICT	C	1	
197	1521-1536	09-230-005	BAINS	C	1	-
198	1536-1546	09-130-006	HATAMIYA	C	1	-
199	1536-1546	09-130-007	FILTER	C	1	
200	1546-1556	09-130-008	FILTER	C	1	-
201	1546-1556	09-130-010	HATAMIYA	C	1	-
202	1557-1560	09-130-011	BERRY	C	3	1
203	1557-1581	09-130-003	BERRY	C	1	
204	1560-1582	09-130-012	HATAMIYA	C	3	1
205	1582-1594	09-120-008-B	PAMMA	C	1	-
206	1582-1611	SBCC PARCEL-A	SUTTER BUTTE CANAL COMPANY	C	3	2
207	1595-1609	09-050-002	SMITH	C	1	-
208	1595-1611	09-050-003	RANCHO SANTA MARIA	C	1	-
209	1595-1615	09-050-001	RANCHO SANTA MARIA	C	3	2
210	1611-1624	SBCC PARCEL-B	SUTTER BUTTE CANAL COMPANY	C	3	2
211	1616-1624	09-050-004	SMITH	C	1	-
212	1624-1639	09-030-007	MMD RANCHES	C	3	1
213	1639-1654	09-030-001	MMD RANCHES	C	1	-
214	1639-1654	09-030-002	MELBAY FARMS	C	1	
215	1654-1661	024-210-020	MELBAY FARMS	D	1	
216	1654-1661	024-210-012	MELBAY FARMS	D	1	-
217	1661-1665	024-210-028	JORDAN	D	1	

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Count	Parcel Station Range	APN	PROPERTY OWNER	Project Area	Acquisition Approach	Developed Parcel Compliance Option
218	1661-1665	024-210-029	JORDAN	D	3	1
219	1665-1675	024-210-024	CUTTS	D	2	
220	1665-1675	024-210-035	OTTERSON RANCH	D	1	-
221	1675-1707	MAIN BUTTE CANAL	MAIN BUTTE CANAL	D	5	N/A
222	1675-1707	024-210-010	CHANDON RANCH	D	5	N/A
223	1708-1725	024-180-044	PEEKEMA RANCH	D	5	N/A
224	1708-1756	PER MAP	SUTTER BUTTE CANAL COMPANY	D	5	N/A
225	1724-1726	024-180-069	PEEKEMA RANCH	D	5	N/A
226	1726-1731	024-180-068	PEEKEMA RANCH	D	5	N/A
227	1731-1734	024-180-023	ROBBINS RANCH	D	5	N/A
228	1734-1737	024-180-022	ROBBINS RANCH	D	5	N/A
229	1737-1744	024-180-042	ROBBINS RANCH	D	5	N/A
230	1744-1745	024-180-043	ALEXANDER	D	5	N/A
231	1745-1749	024-180-052	ALEXANDER	D	5	N/A
232	1745-1756	024-180-051	RATANA	D	5	N/A
233	1756-1767	024-180-036	PAMMA	D	5	N/A
234	1756-1767	PER 90 D 301	BUTTE COUNTY CANAL COMPANY	D	5	N/A
235	1766-1767	024-180-037	SACRAMENTO & SAN JOAQUIN DRAINAGE DIST	D	1	-
236	1767-1768	NO APN	BUTTE COUNTY CANAL COMPANY	D	5	N/A
237	1768-1786	024-130-052	WALLER	D	1	-
238	1768-1786	024-130-053	WALLER	D	1	-
239	1786-1806	024-130-051	WALLER	D	1	-
240	1786-1806	024-130-055	WALLER	D	1	-
241	1806-1816	024-130-046	PEEKEMA RANCH	D	1	-
242	1806-1816	024-130-047	PEEKEMA RANCH	D	1	
243	1816-1823	024-130-049	CITY OF GRIDLEY	D	1	-
244	1823-1868	024-220-018	FARMLAND RESERVE	D	1	-
245	1823-1868	024-220-019	FARMLAND RESERVE	D	1	-
246	1864-1868	024-220-004	JOHL	D	1	-
247	1868-1888	024-220-028	JOHL	D	1	-
248	1868-1896	024-220-017	MATHEWS CONTRACTING	D	1	-

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Count	Parcel Station Range	APN	PROPERTY OWNER	Project Area	Acquisition Approach	Developed Parcel Compliance Option
249	1880-1901	024-220-030	HOUSING AUTHORITY	D	3	1
250	1901-1902	NO APN	COUNTY OF BUTTE	D	1	-
251	1902-1941	025-200-141	BAINS	D	3	2
252	1938-1994	025-180-007	CILKER	D	1	-
253	1941-1957	SUTTER BUTTE CANAL	SUTTER BUTTE CANAL	D	3	2
254	1958-1964	025-180-025	MARIANI	D	1	-
255	1964-1993	025-180-024	MARIANI	D	1	-
256	1993-2006	025-180-016	MARIANI	D	1	-
257	1993-2006	025-180-017	MARIANI	D	1	-
258	2006-2021	025-180-015	CHAMBERS	D	1	-
259	2006-2021	025-180-026	MARIANI	D	1	-
260	2021-2037	025-180-019	CHAMBERS	D	1	-
261	2021-2037	025-180-023	KRAMER	D	1	-
262	2037-2073	025-130-025	DIETHRICH	D	1	-
263	2037-2073	025-130-030	CHAMBERS	D	1	
264	2037-2073	025-130-031	CHAMBERS	D	1	-
265	2073-2092	025-130-009	KUCEK	D	1	-
266	2073-2092	025-130-010	KUCEK	D	1	-
267	2092-2096	025-130-043	FRAWLEY	D	1	-
268	2092-2105	025-130-028	SACRAMENTO & SAN JOAQUIN DRAINAGE DIST	D	1	
269	2096-2117	025-130-042	MOFFITT	D	1	-
270	2117-2123	025-130-004	HODGES & KENNEDY	D	1	-
271	2123-2138	025-140-008	MOFFITT	D	1	-
272	2138-2139	PER 2286 O.R. 542	COUNTY OF BUTTE	D	1	-
273	2139-2158	025-150-016	MOFFITT	D	1	-
274	2139-2158	025-150-017	MOFFITT	D	1	-
275	2140-2146	025-140-004	STATE OF CALIFORNIA	D	1	
276	2146-2166	025-150-028	SACRAMENTO & SAN JOAQUIN DRAINAGE DIST	D	1	
277	2158-2186	025-150-029	JAMES BANES RANCH	D	3	1
278	2159-2186	025-150-008	JAMES BANES RANCH	D	3	1
279	2163-2165	025-150-030	JAMES BANES RANCH	D	1	

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Count	Parcel Station Range	APN	PROPERTY OWNER	Project Area	Acquisition Approach	Developed Parcel Compliance Option
280	2166-2178	025-150-035	JAMES BANES RANCH	D	1	
281	2166-2179	025-150-026	JAMES BANES RANCH	D	1	-
282	2177-2193	025-150-020	SACRAMENTO & SAN JOAQUIN DRAINAGE DIST	D	1	
283	2186-2196	025-150-007	JAMES BANES RANCH	D	1	-
284	2186-2196	025-150-019	STATE OF CALIFORNIA (DWR)	D	2	
285	2196-2201	025-050-013	STATE OF CALIFORNIA (DWR)	D	2	
286	2196-2201	025-050-014	SACRAMENTO & SAN JOAQUIN DRAINAGE DIST	D	1	
287	2196-2207	025-050-004	JAMES BANES RANCH	D	1	-
288	2201-2203	025-050-020	SACRAMENTO & SAN JOAQUIN DRAINAGE DIST	D	1	
289	2201-2207	025-050-019	STATE OF CALIFORNIA	D	2	
290	2207-2217	025-050-017	CARRDI	D	1	-
291	2207-2217	025-050-018	CARRDI	D	1	-
292	2217-2230	025-050-002-B	BILL	D	1	-
293	2217-2230	025-050-025	COUNTY OF BUTTE	D	1	
294	2230-2245	025-050-015	SACRAMENTO & SAN JOAQUIN DRAINAGE DIST	D	1	-
295	2230-2245	025-050-021	SACRAMENTO & SAN JOAQUIN DRAINAGE DIST	D	1	-
296	2238-2240	025-050-024	DIETHRICH	D	3	2
297	2240-2242	025-050-023	REESON	D	1	-
298	2242-2245	025-050-022	ROGERS	D	1	-
299	2245-2262	025-290-022	WILLIAMS	D	1	-
300	2245-2275	025-290-021	WILLIAMS	D	1	-
301	2245-2304	025-290-020	STATE OF CALIFORNIA	D	1	
302	2262-2275	025-290-025	WILLIAMS	D	1	-
303	2275-2289	025-290-027	FREDERICKS	D	3	1
304	2275-2290	025-290-018	SACRAMENTO & SAN JOAQUIN DRAINAGE DIST	D	1	-
305	2289-2292	025-280-018	RUSSELL	D	1	-
306	2292-2304	PER 93-012568	COUNTY OF BUTTE	D	1	
307	2292-2308	025-280-019	MATHEWS READYMIX	D	1	-
308	2296-2304	PER 86 OR 329	COUNTY OF BUTTE	D	1	
309	2304-2304	025-290-019	STATE OF CALIFORNIA	D	2	
310	2308-2318	025-280-020	MATHEWS READYMIX	D	1	-

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311	2318-2332	025-280-010	SACRAMENTO & SAN JOAQUIN DRAINAGE DIST	D	1	
312	2318-2332	025-280-011	STORM	D	1	-
313	2332-2345	025-280-007	STORM	D	1	-
314	2332-2345	030-280-008	STATE OF CALIFORNIA	D	2	
315	2347-2372	030-340-033	STATE OF CALIFORNIA	D	2	2
316	2358-2360	NO APN	STATE OF CALIFORNIA	D	2	2

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