Exhibit E

Benefit and Cost Analysis for ETL or PGL Compliance

April 6, 2012

DWR used outputs from modeling for the Central Valley Flood Protection Plan to crudely estimate the potential benefits of removing vegetation from the levees in compliance with ETL 1110-2-571, and the accompanying Benefit-Cost ratio using an April 2010 cost estimate for ETL compliance (Attached).

A fundamental assumption used in this estimate is that there would be a 5 percent improvement in levee performance resulting from vegetation removal. This is based on estimates developed from a 2009 geotechnical expert elicitation process convened by the U.S. Army Corps of Engineers' Sacramento District for developing levee performance curves for the American River Common Features Project General Reevaluation Report (Attached). An expert elicitation was needed because the effects of levee vegetation and other potential levee risk factors have not been scientifically quantified. A conclusion of that process was that vegetation is not a significant contributor to poor levee performance. Consistent with that, levee vegetation was indicated to have small contributions to levee performance curves, typically 5 percent or less. Based on that work, and DWR's experience and research, 5 percent is considered to be a reasonably conservative (high) estimate of the effect of levee vegetation on levee performance. This is especially true considering that: (1) the baseline is for implementation of DWR's levee vegetation management policy, which includes trimming and thinning for visibility and access, periodic inspections, removal of vegetation that poses an unacceptable threat to levee integrity, and gradual removal of much of the levee vegetation through life-cycle management, and (2) removal of vegetation may increase risk factors such as damage from burrowing animals and erosion.

Two approaches were used for developing the estimate of benefits of vegetation removal. The first approach used the HEC-FDA estimated annual flood damage reduction benefits achieved by the State Systemwide Investment Approach and assumed those benefits in each of the 112 damage areas analyzed in the model would be increased by 5 percent if vegetation was removed in compliance with the ETL. This simplistic approach assumes every damage area would have reduced damages, even if there is no vegetation to be removed (which would overestimate the benefit). The estimated annual reduced flood damages (benefits) were $5.5 million (Attached). Using the April 2010 DWR estimate of $6.5 billion present cost for systemwide vegetation removal (which would be less than the full estimated cost of ETL compliance), annualized over 50 years at a 6 percent discount rate, the annual cost would be $412 million. The estimated B/C is 0.01.

The second approach, used as a check on the reasonableness of the results of the first approach, was based on the Achieving the State Plan of Flood Control Design Capacity Approach. Using HEC-FDA, the current average annual damages estimated for the State Plan of

Flood Control levee system is $330 million. Restoring the levees to hold the design flow would reduce damages by 49 percent. Therefore, the average annual benefit for Achieving the State Plan of Flood Control Design Capacity would be about $160 million. Remaining average annual damages would be about $170 million. If removing the levee vegetation would improve overall system performance by another 5 percent, then average annual damages would be further reduced by about $8.5 million (0.05 x $170 million). This would be the benefit. When compared to an annual cost of $412 million, the resulting B/C is 0.02.

A more refined approach would develop new levee performance curves for the cases of with vegetation and without vegetation -- and run the models with these new curves. The levee performance curves for each damage area could be tailored to the specific levee and vegetation conditions representative of each damage area. However, these refinements to the analysis are unlikely to make a significant difference in the overall B/C for vegetation removal throughout the system. Considering that the crude estimate of B/C shows it is 0.02 or less, additional refined analysis is not recommended at this time.

CONCLUSION: USACE vegetation policy is requiring the State to make, or commit to make, an extremely unsound investment that returns, at most, a few pennies on the dollar.

FISCAL IMPACT REPORT

of

U. S. Army Corps of Engineers'

Vegetation Management Standards and Vegetation Variance Policy

for Levees and Flood Walls

Levee Repairs Branch

Levee Repairs and Floodplain Management Office

Division of Flood Management

Department of Water Resources

April 5, 2010

TABLE OF CONTENTS

FISCAL IMPACT

of

U. S. Army Corps of Engineers'

Vegetation Management Standards and Vegetation Variance Policy

for Levees and Flood Walls

1. Introduction

The U. S. Army Corps of Engineers (Corps) under the authority of the Water Resources Development Act (WRDA) of 1996, established mandatory vegetation management standards for levees, floodwalls, and appurtenant structures. These standards are contained in Engineer Technical Letter (ETL) 1110-2-571, *Guidelines for Landscape Planting and Vegetation Management at Levees, Floodwalls, Embankment Dams, and Appurtenant Structures* published on April 10, 2009. On February 4, 2010, the Corps issued a Policy Guidance Letter, *Process for Requesting a Variance from Vegetation Standards for Levees and Floodwalls* – 75 Fed. Reg. 6364-68 (Variance), which revises the procedures for obtaining variances from the ETL. Holders of existing variances must re-apply for a variance under the new Variance. The Corps has invited written comments on this policy guidance to be submitted by March 11, 2010 according to the notice published in the Federal Register on February 9, 2010.

The Variance is not consistent with on-site mitigation, may result in large amounts of vegetation removal, adds financial burden of finding off-site mitigation banks, may harm listed species, and subsequent mitigation to meet CEQA and NEPA requirements may be cost prohibitive. Thus, this Variance has financial implications for both the existing and new levee repairs. This study does not address the regulatory and legal consequences of such a drastic change in the implementation of new Corps vegetation policies.

2. Purpose

The purpose of this study is to estimate the financial cost of the ETL and Variance with respect to the 116 Critical Levee Repairs done during the period from 2006 to 2008, and based on this assessment, apply unit cost of compliance to assess the overall fiscal impact of the ETL Policy on 1,600 miles of the project levee system.

3. Background

As stated in Section 202(g) of WRDA, vegetation policy was originally established to provide a coherent and coordinated policy for vegetation management for levees, so as to address regional variations in levee management and resource needs. In general, the resulting policy set forth in Engineer Regulation (ER) 500–1–1, paragraph 5–22, allowed the project sponsor of a levee, in active status, to seek a variance from Corps standards to allow additional vegetation on or near levees when such vegetation would preserve, protect, and/or enhance natural resources and/or protect rights of Native Americans. However, the safety, structural integrity, and functionality of the levee, in addition to accessibility for inspection and flood fighting purposes, were to be retained.

The critical sites repaired by the Corps and the Department of Water Resources (DWR) under the Sacramento River Bank Protection Project and the PL 84-99 Rehabilitation Assistance program provided for new plantings on the waterside and landside to mitigate for the loss of shade and habitat affected by the repair. Almost all of the mitigation was on-site. Wherever possible, planting berms were constructed to accommodate new vegetation and in-stream woody materials for shade. In addition, off-site mitigation was provided for construction during winter and transplanting of elderberry shrubs (*Sambucus mexicana*), which were removed to facilitate construction.

4. Assessment Methodology

Financial impacts for the following two alternative options were assessed.

1) Full ETL Compliance
   ETL compliance for area extending 15 feet on the waterside and landside toe of the main levee section

2) ETL Compliance with Variance
   Meet ETL Policy for all landside and one third area from top of the levee on waterside slope

Sites were classified into three categories:

- Urban
- Non-urban fix in-place
- Non-urban setback

For the purposes of this cost estimate, it was assumed that all impacted urban levees would be fixed in place and all non-urban impacted levees would be remediated by constructing a widened levee section, sometimes referred to as an “adjacent setback levee” or “setback levee” that would allow vegetation and other encroachments to remain in place on the waterside. In the following text, the term “setback levee” is used.

To estimate costs for all 116 critical repair sites, site specific compliance estimates were prepared for both options using information for 30 critical erosion sites repaired by DWR in the Sacramento Flood Control System and 13 PL 84-99 sites in the Brannan-Andrus Levee Maintenance District. Using site parameters and cost information from 43 sites, a unit cost for a typical section representing each category was developed (see figures in Tables A-1 to A-3, Appendix A). The average cost of compliance for each category was applied to estimate costs for all 116 critical repair sites.

To assess a range of possible financial impacts, average linear feet compliance costs for urban and non-urban levees used for 116 critical repair sites were extrapolated to the overall system impact as follows: Using aerial photographs and LIDAR data available from different sources, the Levee Evaluations Branch of DWR has estimated the percentage of ETL impacted levee length by estimating presence of vegetation on the project levees.

Option 1: Full ETL Compliance

All urban levees are fix-in-place and non-urban levees are widened levees. For urban levees, 90% have been assumed with roads or major infrastructure and 10% non-urban levees have been assumed to have roads or infrastructure. About 23% of the project levees have some type of rock lining.

Urban and non-urban impacted levees assumptions are based on preliminary assessment of the system and will need further evaluation.

Option 2: ETL Compliance with Variance

Only the top one-third of the levee slope on waterside and all of landside will be rehabilitated to comply with ETL policy.

All urban levees are fix-in-place, and non-urban levees are widened levees. Also, for urban levees, 90% have been assumed to have roads or major infrastructure and 10% non-urban levees have been assumed with roads or infrastructure. About 23% of the project levees have some type of rock lining.

5. Construction Work for Compliance

To comply with ETL Policy, related construction work will include following activities:

1. Clearing, grubbing, and removal of existing trees by excavating to a depth of at least 5 feet for complete root structure removal. Root structure area is assumed to be extended to 1.75 times the tree canopy radius as shown in Table A-1.

2. Installing a root barrier to separate the root-free zone from the allowed vegetation zone
3. Repairing site and compacting for slope conformance
4. Salvaged existing rock protection will be put in place after tree removal and compaction with bedding material imported from outside. It is a fair assumption that salvaged rock is usable. However, this applies to rocked sites only and may not apply to overall levee system
5. Agricultural soil placed to fill rock voids and top upper one foot layer
6. Minimal landscaping including seeding, mulching, and erosion control fabric installation
7. Roads and impacted infrastructure relocations
8. Site incidental environmental compliance and controls during construction

6. Environmental Mitigation

As on-site mitigation for removed trees is not possible, off-site mitigation will be required and will consist of the following:

1. Land acquisition for off-site mitigation bank
2. Clearing, grubbing, and removal of existing land cover at selected locations
3. Tree planting at a ratio of 5:1 for each tree removed from existing repaired sites
4. Installation of fascine bundles and willow pole cuttings
5. Transplanting of elderberry shrubs for VELB mitigation
6. Irrigation and maintenance for at least 3 years

7. Unit Costs

Unit costs used in estimating fiscal impact are presented in Table C-1 (Appendix C) and are based on actual construction bids for levee repairs projects (Sacramento River Bank Protection Project and San Joaquin Flood Protection Project) received during the 2007-2009 period. The 2007 construction costs were in fact higher than the later two years due to economic downturn and market competition. However, overall these three years represent a reasonable base for estimating.

8. Cost Estimate Summary

For the full ETL Compliance Option, as presented in Tables A-1 to A-3 (Appendix A), average cost per linear feet for each category (urban, non-urban with fix in-place and non-urban with setbacks) was estimated based on 43 sites repaired by DWR. Off-site

Mitigation Bank Cost for environmental mitigation presented in table A-4 was included in each category's cost in Tables A-1 to A-3 (Appendix A).

This average cost also includes 40% soft costs for planning, environmental permitting, and engineering design for Off-site Mitigation Bank work.

For ETL Compliance with Variance Option, the average cost per linear feet for various categories is presented in Tables B-1 to B-3 (Appendix B).

The total ETL compliance cost summaries for all 116 critical repair sites for Option 1 for Full Compliance are given in Table A (Appendix A), and cost summaries for the Variance are given in Table B (Appendix B).

9. Estimated Levee System Fiscal Impact

Overall System Impact was estimated using per linear feet unit costs for urban and non-urban areas as follows: Using aerial photographs and other available LIDAR data, the Levee Evaluations Branch has estimated the percentage of ETL impacted levee length for each of the project levee reaches by estimating presence of vegetation on the project levees.

Option 1: Full ETL Compliance

All the urban impacted levees are fix-in-place and about 90% have been assumed to have roads. All impacted non-urban levees would be strengthened on landside by widening to provide standard structural prism outside of root zone of existing trees. About 10% of non-urban levees are assumed to have roads.

The overall estimated cost of ETL compliance is $7.5 billion. See Summary Table 1 on next page.

Option 2: ETL Compliance with Variance

All the urban impacted levees are fix-in-place and 90% have roads. All impacted non-urban levees would be strengthened on landside by widening to provide standard structural prism outside of root zone of existing trees. About 10% of non-urban levees are assumed to have roads.

The overall estimated cost of ETL Compliance with Variance is $6.5 billion. See Summary Table 2 on the following pages.

SUMMARY TABLE 1: SYSTEM ETL COMPLIANCE COST

EXHIBIT E. Attachment 1.

Urban Project Levees

Estimate cost to Fix-in-place: $ 4,120.00 (Refer Table A-1, Appendix A)
Estimate cost to Fix-in-place (With Road/ other major infrastructure): $ 5,430.00 (Refer Table A-2, Appendix A)
Weighted Average $ 4,251.00 (Assumed 90% have roads)

Protected Area Levee/River/Segment Name	Miles of Levee	Non-compliance USACE Veg (Mile)	Non-compliance USACE Veg (%)	Unit Cost (Per foot) (Fix-in-place)	Amount	Comments
RD 17	16.3	5.5	34	$ 4,251.0	$ 124,391,741.8	
RD 404	4.0	1.8	45	$ 4,251.0	$ 40,401,504.0	
SJAFCA Bear Creek	45.4	10.4	23	$ 4,251.0	$ 234,373,613.8	
SJAFCA Calaveras River	26.4	11.4	43	$ 4,251.0	$ 254,798,818.6	
Davis	19.6	0.8	4.3	$ 4,251.0	$ 18,916,882.0	
Woodland	16.4	2.7	16.2	$ 4,251.0	$ 59,632,619.9	
West Sacramento	21.3	13.0	61.2	$ 4,251.0	$ 292,587,692.0	
Sacramento River	15.6	15.2	97.3	$ 4,251.0	$ 340,692,416.1	Am River to Freeport
American River	23.2	20.9	90.1	$ 4,251.0	$ 469,178,176.9	
NEMDC East	12.0	4.0	33	$ 4,251.0	$ 88,883,308.8	Includes Dry/Robla/Magpie Creeks
NEMDC West	16.0	3.0	18.8	$ 4,251.0	$ 67,515,402.2	
Natomas Cross Canal	11.0	7.1	64.2	$ 4,251.0	$ 158,508,567.4	
Natomas Sac River	18.1	15.2	83.8	$ 4,251.0	$ 340,445,518.0	
Natomas American River	2.0	2.0	100	$ 4,251.0	$ 44,890,560.0	
Marysville	7.4	1.8	24	$ 4,251.0	$ 39,862,817.3	
Sutter Wadsworth	2.4	0.4	15	$ 4,251.0	$ 8,080,300.8	
Sutter Bypass E Levee	3.8	3.0	78	$ 4,251.0	$ 66,527,809.9	
Sutter Feather North	19.2	10.9	57	$ 4,251.0	$ 245,641,144.3	
Sutter Feather South	22.2	22.2	100	$ 4,251.0	$ 498,285,216.0	
RD 784 WPIC	6.3	0.3	5	$ 4,251.0	$ 7,070,263.2	
RD 784 Bear River	2.7	0.7	27	$ 4,251.0	$ 16,362,609.1	
RD 784 Feather River	6.6	2.4	36	$ 4,251.0	$ 53,329,985.3	On old alignmnet
RD 784 Yuba River	5.7	1.7	30	$ 4,251.0	$ 38,381,428.8	
				Subtotal:	**$ 3,508,758,396.0**	

Non-urban Project Levees

Estimated cost to Widen on Landside: $ 1,410.00 (Refer Table A-3, Appendix A)

Protected Area Levee/River/Segment Name	Miles of Levee	Non-compliance USACE Veg (Mile)	Non-compliance USACE Veg (%)	Unit Cost (Per foot)	Amount	Comments
Northern System						
Butte Slough (Segment 293)	8.0	7.6	95%	$ 1,410.00	$ 56,580,480.00	
Wadsworth Canal (segment 167 & 168)	6.8	3.4	50%	$ 1,410.00	$ 25,312,320.00	
Sutter Bypass (Segments 248, 163, 164, & 294)	46.9	44.6	95%	$ 1,410.00	$ 332,038,080.00	
Cache Creek (segment 41)	11.5	8.1	70%	$ 1,410.00	$ 60,302,880.00	
Willow Slough Bypass (Segments 169 & 297)	7.5	1.5	20%	$ 1,410.00	$ 11,167,200.00	
Yolo Bypass (Segments 171, 172, 173, 174, 295, 241, 393, & 150)	20.5	16.3	80%	$ 1,410.00	$ 121,350,240.00	
Sacramento Bypass (segment 156)	1.7	1.3	76%	$ 1,410.00	$ 9,678,240.00	
South Fork Putah Creek (segment 112)	7.0	2.8	40%	$ 1,410.00	$ 20,845,440.00	
Shag Slough Unknown Slough (Segments 152, & 153)	9.7	5.1	52%	$ 1,410.00	$ 37,968,480.00	
Hass Slough, Cache Slough, Main Pararie Slough, Barker Slough, Lindsey Slough, Ultis Slough, & unknown Slough (Segments 311, 312, 313, 314, 315, 249, 155, 251, 151,& 123)	43.1	27.5	64%	$ 1,410.00	$ 204,732,000.00	
Segment 316	5.0	1.0	20%	$ 1,410.00	$ 7,444,800.00	
Sacramento Deep Water Ship Channel (Segment 142)	15.4	6.9	45%	$ 1,410.00	$ 51,369,120.00	
Elks Slough (Segments 244 & 386)	18.9	18.9	100%	$ 1,410.00	$ 140,706,720.00	
Sutter Slough (Segments 305 & 309)	10.2	10.2	100%	$ 1,410.00	$ 75,936,960.00	
Segment 117	0.5	0.5	100%	$ 1,410.00	$ 3,871,296.00	
Miner Slough (Segments 304 & 309)	10.0	9.8	98%	$ 1,410.00	$ 72,959,040.00	
Elk Horn Slough (Segment 308)	3.6	3.0	85%	$ 1,410.00	$ 22,334,400.00	
Sutter Slough (segment 310)	2.3	2.3	100%	$ 1,410.00	$ 16,974,144.00	
Steamboat Slough (Segment 307, 113 & 122)	23.7	22.9	97%	$ 1,410.00	$ 170,485,920.00	
Georgiana Slough (Segments 129, 40 & 130)	23.7	23.7	100%	$ 1,410.00	$ 176,441,760.00	
Knights Landing Ridge Cut (Segments 216 & 217)	13.2	11.0	83%	$ 1,410.00	$ 81,892,800.00	
Best Slough (Segment 392)	4.19	0.2	5%	$ 1,410.00	$ 1,414,214.21	
Simmerly Slough/Jack Slough & Feather River (Segments 114, 385, 275, 62, & 52)	26.24	22.0	84%	$ 1,410.00	$ 164,095,303.68	
Yuba River (Segment 52)	4.64	4.6	100%	$ 1,410.00	$ 34,543,872.00	
Dry Creek (Segments 282, 138, 154,281, &135)	11.39	10.8	95%	$ 1,410.00	$ 80,552,736.00	
Feather River (Segment 247)	13.28	11.0	83%	$ 1,410.00	$ 82,041,696.00	
Bear River LB (Segment 246)	9.35	8.9	95%	$ 1,410.00	$ 66,109,824.00	
Bear River RB (Segment 240, & 250)	8.72	7.4	85%	$ 1,410.00	$ 55,165,968.00	
Yankee Slough LB (Segment 145)	3.64	3.5	95%	$ 1,410.00	$ 25,759,008.00	
Yankee Slough RB (Segment 144)	4.12	3.9	95%	$ 1,410.00	$ 29,109,168.00	
East Side Canal (Segment 285)	4.75	0.9	18%	$ 1,410.00	$ 6,365,304.00	
Natomas Cross Canal (Segment 284)	5.38	4.0	75%	$ 1,410.00	$ 30,002,544.00	
Bear River LB (Segment 283)	3.2	2.2	70%	$ 1,410.00	$ 16,378,560.00	

SUMMARY TABLE 1: SYSTEM ETL COMPLIANCE COST

Protected Area Levee/River/Segment Name	Miles of Levee	Non-compliance USACE Veg (Mile)	Non-compliance USACE Veg (%)	Unit Cost (Per foot)	Amount	Comments
Southern System						
San Joaquin, E.of Patterson, Right Bank	19.0	11.5	61%	$ 1,410.00	$ 85,615,200.00	
San Joaquin, E.of Patterson, Left Bank	6.5	5.2	80%	$ 1,410.00	$ 38,712,960.00	
San Joaquin,From Newman to Salt Slough	7.4	5.0	68%	$ 1,410.00	$ 37,224,000.00	
SJ from Salt Slough to Convergence point	4.2	3.7	88%	$ 1,410.00	$ 27,545,760.00	
SJ from Salt Slough to Convergence point	4.3	4.2	97%	$ 1,410.00	$ 30,895,920.00	
Salt Slough	2.5	2.4	98%	$ 1,410.00	$ 17,867,520.00	
SJ from Convergence to Mariposa ByPass, Right Bank	7.7	7.6	99%	$ 1,410.00	$ 56,580,480.00	
SJ from Convergence to Mariposa ByPass, Left Bank	7.3	6.7	92%	$ 1,410.00	$ 49,880,160.00	
Maripossa By Pass, Right Bank	3.5	3.1	90%	$ 1,410.00	$ 23,078,880.00	
Maripossa By Pass, Left Bank	3.6	3.3	92%	$ 1,410.00	$ 24,195,600.00	
Maripossa By Pass to SJ, Right Bank	3.2	2.7	84%	$ 1,410.00	$ 19,728,720.00	
Maripossa By Pass to SJ, Left Bank	2.1	1.5	71%	$ 1,410.00	$ 11,167,200.00	
SJ Convergence to Bear Creek, Right Bank	3.7	3.2	91%	$ 1,410.00	$ 23,823,360.00	
SJ Convergence to Bear Creek,Left Bank	3.9	3.5	90%	$ 1,410.00	$ 25,684,560.00	
Bear Creek, Right Bank	3.5	2.5	71%	$ 1,410.00	$ 18,612,000.00	
Bear Creek,Left Bank	3.6	2.8	78%	$ 1,410.00	$ 20,845,440.00	
SJ Convergence to Owens Creek, Right Bank	4.3	3.2	74%	$ 1,410.00	$ 23,823,360.00	
SJ Convergence to Owens Creek,Left Bank	4.4	3.1	71%	$ 1,410.00	$ 23,078,880.00	
SJ From Owens Creek to Maripossa By Pass, Right Bank	1.7	1.7	100%	$ 1,410.00	$ 12,656,160.00	
SJ From Owens Creek to Maripossa By Pass,Left Bank	1.6	1.6	100%	$ 1,410.00	$ 11,539,440.00	
Owens Creek, Right Bank	0.8	0.8	100%	$ 1,410.00	$ 5,955,840.00	
Owens Creek,Left Bank	0.8	0.8	100%	$ 1,410.00	$ 5,955,840.00	
Eastside Bypass	5.5	5.5	100%	$ 1,410.00	$ 40,946,400.00	
San Joaquin River - Gravelly Ford to Upper Eastside Bypass - Right Bank	9.5	1.5	16%	$ 1,410.00	$ 11,167,200.00	
San Joaquin River - Gravelly Ford to Upper Eastside Bypass - Left Bank	8.9	2.5	28%	$ 1,410.00	$ 18,612,000.00	
Upper Eastside Bypass - SJR to Fresno River - Right Bank	16.2	2.5	15%	$ 1,410.00	$ 18,612,000.00	
Upper Eastside Bypass - SJR to Fresno River - Left Bank	16.2	7.1	44%	$ 1,410.00	$ 52,858,080.00	
Fresno River - Right Bank	9.8	8.2	84%	$ 1,410.00	$ 61,047,360.00	
Fresno River - Left Bank	9.6	9.1	95%	$ 1,410.00	$ 67,747,680.00	
Eastside Bypass - Fresno River to Berenda Slough - Right Bank	2.0	2.0	100%	$ 1,410.00	$ 14,889,600.00	
Eastside Bypass - Fresno River to Berenda Slough - Left Bank	2.0	1.4	70%	$ 1,410.00	$ 10,422,720.00	
Berenda Slough - Right Bank	3.5	2.9	83%	$ 1,410.00	$ 21,589,920.00	
Berenda Slough - Left Bank	4.1	3.6	88%	$ 1,410.00	$ 26,801,280.00	
Eastside Bypass - Berenda Slough to Ash Slough - Right Bank	3.0	3.0	100%	$ 1,410.00	$ 22,334,400.00	
Eastside Bypass - Berenda Slough to Ash Slough - Left Bank	3.0	0.2	7%	$ 1,410.00	$ 1,488,960.00	
Ash Slough - Right Bank	3.6	2.6	72%	$ 1,410.00	$ 19,356,480.00	
Ash Slough - Left Bank	4.6	3.5	76%	$ 1,410.00	$ 26,056,800.00	
Eastside Bypass - Ash Slough to SJR - Right Bank	10.2	4.7	46%	$ 1,410.00	$ 34,990,560.00	
Eastside Bypass - Ash Slough to SJR - Left Bank	10.6	7.5	71%	$ 1,410.00	$ 55,836,000.00	
Eastside Bypass - SJR to Mariposa Bypass - Right Bank	9.2	6.2	67%	$ 1,410.00	$ 46,157,760.00	
Eastside Bypass - SJR to Mariposa Bypass - Left Bank	9.5	8.0	84%	$ 1,410.00	$ 59,558,400.00	
Stockton Diverting Canal	4.4	2.9	66%	$ 1,410.00	$ 21,589,920.00	
San Joaquin River, Left bank- Stockton to Stanislaus River	25.2	14.8	59%	$ 1,410.00	$ 109,810,800.00	
San Joaquin River, Left bank- Stanislaus River to Grayson (west of Modesto)	9.5	6.2	65%	$ 1,410.00	$ 45,785,520.00	
San Joaquin River, Right bank- Stockton to Stanislaus River	16.5	7.7	47%	$ 1,410.00	$ 57,399,408.00	
San Joaquin River, Right bank- Stanislaus River to Grayson (west of Modesto)	9.6	5.1	53%	$ 1,410.00	$ 37,819,584.00	
Mormon Slough	2.2	1.1	53%	$ 1,410.00	$ 8,412,624.00	
Old River, Both sides- SJR to Salmon Slough	13.5	5.9	43%	$ 1,410.00	$ 43,626,528.00	
Paradise Cut, Both sides- SJR to Salmon Slough	12.0	7.5	62%	$ 1,410.00	$ 55,463,760.00	
Salmon Slough, Right bank	1.3	1.3	100%	$ 1,410.00	$ 9,678,240.00	
Stanislaus River, Both sides-SJR to Kiernan Ave. (west of Ripon)	15.4	14.0	91%	$ 1,410.00	$ 104,078,304.00	
San Joaquin River south of Chowchilla River-Right Bank	2.1	2.1	100%	$ 1,410.00	$ 15,634,080.00	
San Joaquin River south of Chowchilla River-Left Bank	4.8	4.8	100%	$ 1,410.00	$ 35,735,040.00	
				Subtotal:	**$ 4,041,905,206.00**	
				Total Full Compliance Cost:	**$ 7,550,663,602.00**	

SUMMARY TABLE 2: SYSTEM ETL COMPLIANCE COST (WITH VARIANCE)

Urban Project Levees

Estimate cost to Fix-in-place:	$ 2,790.00	(Refer Table B-1, Appendix B)
Estimate cost to Fix-in-place (With Road/ other major infrastructure):	$ 4,230.00	(Refer Table B-2, Appendix B)
Weighted Average:	$ 2,934.00	(Assumed 90% have roads)

Protected Area Levee/River/Segment Name	Miles of Levee	Non-compliance USACE Veg (Mile)	Non-compliance USACE Veg (%)	Unit Cost (Per foot) (Fix-in-place)	Amount	Comments
RD 17	16.3	5.5	34	$ 2,934.0	$ 85,854,003.84	
RD 404	4.0	1.8	45	$ 2,934.0	$ 27,884,736.00	
SJAFCA Bear Creek	45.4	10.4	23	$ 2,934.0	$ 161,762,451.84	
SJAFCA Calaveras River	26.4	11.4	43	$ 2,934.0	$ 175,859,735.04	
Davis	19.6	0.8	4.3	$ 2,934.0	$ 13,056,253.06	
Woodland	16.4	2.7	16.2	$ 2,934.0	$ 41,157,870.34	
West Sacramento	21.3	13.0	61.2	$ 2,934.0	$ 201,941,258.11	
Sacramento River	15.6	15.2	97.3	$ 2,934.0	$ 235,142,683.78	American River to Freeport
American River	23.2	20.9	90.1	$ 2,934.0	$ 323,822,340.86	
NEMDC East	12.0	4.0	33	$ 2,934.0	$ 61,346,419.20	Includes Dry/ Robla/ Magpie Creeks
NEMDC West	16.0	3.0	18.8	$ 2,934.0	$ 46,598,492.16	
Natomas Cross Canal	11.0	7.1	64.2	$ 2,934.0	$ 109,401,114.24	
Natomas Sac River	18.1	15.2	83.8	$ 2,934.0	$ 234,972,277.06	
Natomas American River	2.0	2.0	100	$ 2,934.0	$ 30,983,040.00	
Marysville	7.4	1.8	24	$ 2,934.0	$ 27,512,939.52	
Sutter Wadsworth	2.4	0.4	15	$ 2,934.0	$ 5,576,947.20	
Sutter Bypass E Levee	3.8	3.0	78	$ 2,934.0	$ 45,916,865.28	
Sutter Feather North	19.2	10.9	57	$ 2,934.0	$ 169,539,194.88	
Sutter Feather South	22.2	22.2	100	$ 2,934.0	$ 343,911,744.00	
RD 784 WPIC	6.3	0.3	5	$ 2,934.0	$ 4,879,828.80	
RD 784 Bear River	2.7	0.7	27	$ 2,934.0	$ 11,293,318.08	
RD 784 Feather River	6.6	2.4	36	$ 2,934.0	$ 36,807,851.52	On old alignmnet
RD 784 Yuba River	5.7	1.7	30	$ 2,934.0	$ 26,490,499.20	
				Subtotal:	**$ 2,421,711,864.00**	

Non-urban Project Levees

Estimated cost to Widen on Landside: $ 1,410.00 (Refer Table A-3, Appendix A)

Protected Area Levee/River/Segment Name	Miles of Levee	Non-compliance USACE Veg (Mile)	Non-compliance USACE Veg (%)	Unit Cost (Per foot)	Amount	Comments
Northern System						
Butte Slough (Segment 293)	8.0	7.6	95%	$ 1,410.00	$ 56,580,480.00	
Wadsworth Canal (segment 167 & 168)	6.8	3.4	50%	$ 1,410.00	$ 25,312,320.00	
Sutter Bypass (Segments 248, 163, 164, & 294)	46.9	44.6	95%	$ 1,410.00	$ 332,038,080.00	
Cache Creek (segment 41)	11.5	8.1	70%	$ 1,410.00	$ 60,302,880.00	
Willow Slough Bypass (Segments 169 & 297)	7.5	1.5	20%	$ 1,410.00	$ 11,167,200.00	
Yolo Bypass (Segments 171, 172, 173, 174, 295, 241, 393, & 150)	20.5	16.3	80%	$ 1,410.00	$ 121,350,240.00	
Sacramento Bypass (segment 156)	1.7	1.3	76%	$ 1,410.00	$ 9,678,240.00	
South Fork Putah Creek (segment 112)	7.0	2.8	40%	$ 1,410.00	$ 20,845,440.00	
Shag Slough Unknown Slough (Segments 152, & 153)	9.7	5.1	52%	$ 1,410.00	$ 37,968,480.00	
Hass Slough, Cache Slough, Main Pararie Slough, Barker Slough, Lindsey Slough, Ultis Slough, & unknown Slough (Segments 311, 312, 313, 314, 315, 249, 155, 251, 151,& 123)	43.1	27.5	64%	$ 1,410.00	$ 204,732,000.00	
Segment 316	5.0	1.0	20%	$ 1,410.00	$ 7,444,800.00	
Sacramento Deep Water Ship Channel (Segment 142)	15.4	6.9	45%	$ 1,410.00	$ 51,369,120.00	
Elks Slough (Segments 244 & 386)	18.9	18.9	100%	$ 1,410.00	$ 140,706,720.00	
Sutter Slough (Segments 305 & 309)	10.2	10.2	100%	$ 1,410.00	$ 75,936,960.00	
Segment 117	0.5	0.5	100%	$ 1,410.00	$ 3,871,296.00	
Miner Slough (Segments 304 & 309)	10.0	9.8	98%	$ 1,410.00	$ 72,959,040.00	
Elk Horn Slough (Segment 308)	3.6	3.0	85%	$ 1,410.00	$ 22,334,400.00	
Sutter Slough (segment 310)	2.3	2.3	100%	$ 1,410.00	$ 16,974,144.00	
Steamboat Slough (Segment 307, 113 & 122)	23.7	22.9	97%	$ 1,410.00	$ 170,485,920.00	
Georgiana Slough (Segments 129, 40 & 130)	23.7	23.7	100%	$ 1,410.00	$ 176,441,760.00	
Knights Landing Ridge Cut (Segments 216 & 217)	13.2	11.0	83%	$ 1,410.00	$ 81,892,800.00	
Best Slough (Segment 392)	4.19	0.2	5%	$ 1,410.00	$ 1,414,214.21	
Simmerly Slough/Jack Slough & Feather River (Segments 114, 385, 275, 62, & 52)	26.24	22.0	84%	$ 1,410.00	$ 164,095,303.68	
Yuba River (Segment 52)	4.64	4.6	100%	$ 1,410.00	$ 34,543,872.00	
Dry Creek (Segments 282, 138, 154,281, &	11.39	10.8	95%	$ 1,410.00	$ 80,552,736.00	
Feather River (Segment 247)	13.28	11.0	83%	$ 1,410.00	$ 82,041,696.00	
Bear River LB (Segment 246)	9.35	8.9	95%	$ 1,410.00	$ 66,109,824.00	
Bear River RB (Segment 240, & 250)	8.72	7.4	85%	$ 1,410.00	$ 55,165,968.00	
Yankee Slough LB (Segment 145)	3.64	3.5	95%	$ 1,410.00	$ 25,759,008.00	
Yankee Slough RB (Segment 144)	4.12	3.9	95%	$ 1,410.00	$ 29,109,168.00	
East Side Canal (Segment 285)	4.75	0.9	18%	$ 1,410.00	$ 6,365,304.00	
Natomas Cross Canal (Segment 284)	5.38	4.0	75%	$ 1,410.00	$ 30,002,544.00	
Bear River LB (Segment 283)	3.2	2.2	70%	$ 1,410.00	$ 16,378,560.00	

SUMMARY TABLE 2: SYSTEM ETL COMPLIANCE COST (WITH VARIANCE)

Protected Area Levee/River/Segment Name	Miles of Levee	Non-compliance USACE Veg (Mile)	Non-compliance USACE Veg (%)	Unit Cost (Per foot)	Amount	Comments
Southern System						
San Joaquin, E.of Patterson, Right Bank	19.0	11.5	61%	$ 1,410.00	$ 85,615,200.00	
San Joaquin, E.of Patterson, Left Bank	6.5	5.2	80%	$ 1,410.00	$ 38,712,960.00	
San Joaquin,From Newman to Salt Slough	7.4	5.0	68%	$ 1,410.00	$ 37,224,000.00	
SJ from Salt Slough to Convergence point	4.2	3.7	88%	$ 1,410.00	$ 27,545,760.00	
SJ from Salt Slough to Convergence point	4.3	4.2	97%	$ 1,410.00	$ 30,895,920.00	
Salt Slough	2.5	2.4	98%	$ 1,410.00	$ 17,867,520.00	
SJ from Convergence to Mariposa ByPass, Right Bank	7.7	7.6	99%	$ 1,410.00	$ 56,580,480.00	
SJ from Convergence to Mariposa ByPass, Left Bank	7.3	6.7	92%	$ 1,410.00	$ 49,880,160.00	
Maripossa By Pass, Right Bank	3.5	3.1	90%	$ 1,410.00	$ 23,078,880.00	
Maripossa By Pass, Left Bank	3.6	3.3	92%	$ 1,410.00	$ 24,195,600.00	
Maripossa By Pass to SJ, Right Bank	3.2	2.7	84%	$ 1,410.00	$ 19,728,720.00	
Maripossa By Pass to SJ, Left Bank	2.1	1.5	71%	$ 1,410.00	$ 11,167,200.00	
SJ Convergence to Bear Creek, Right Bank	3.7	3.2	91%	$ 1,410.00	$ 23,823,360.00	
SJ Convergence to Bear Creek,Left Bank	3.9	3.5	90%	$ 1,410.00	$ 25,684,560.00	
Bear Creek, Right Bank	3.5	2.5	71%	$ 1,410.00	$ 18,612,000.00	
Bear Creek,Left Bank	3.6	2.8	78%	$ 1,410.00	$ 20,845,440.00	
SJ Convergence to Owens Creek, Right Bank	4.3	3.2	74%	$ 1,410.00	$ 23,823,360.00	
SJ Convergence to Owens Creek,Left Bank	4.4	3.1	71%	$ 1,410.00	$ 23,078,880.00	
SJ From Owens Creek to Maripossa By Pass, Right Bank	1.7	1.7	100%	$ 1,410.00	$ 12,656,160.00	
SJ From Owens Creek to Maripossa By Pass,Left Bank	1.6	1.6	100%	$ 1,410.00	$ 11,539,440.00	
Owens Creek, Right Bank	0.8	0.8	100%	$ 1,410.00	$ 5,955,840.00	
Owens Creek,Left Bank	0.8	0.8	100%	$ 1,410.00	$ 5,955,840.00	
Eastside Bypass	5.5	5.5	100%	$ 1,410.00	$ 40,946,400.00	
San Joaquin River - Gravelly Ford to Upper Eastside Bypass - Right Bank	9.5	1.5	16%	$ 1,410.00	$ 11,167,200.00	
San Joaquin River - Gravelly Ford to Upper Eastside Bypass - Left Bank	8.9	2.5	28%	$ 1,410.00	$ 18,612,000.00	
Upper Eastside Bypass - SJR to Fresno River - Right Bank	16.2	2.5	15%	$ 1,410.00	$ 18,612,000.00	
Upper Eastside Bypass - SJR to Fresno River - Left Bank	16.2	7.1	44%	$ 1,410.00	$ 52,858,080.00	
Fresno River - Right Bank	9.8	8.2	84%	$ 1,410.00	$ 61,047,360.00	
Fresno River - Left Bank	9.6	9.1	95%	$ 1,410.00	$ 67,747,680.00	
Eastside Bypass - Fresno River to Berenda Slough - Right Bank	2.0	2.0	100%	$ 1,410.00	$ 14,889,600.00	
Eastside Bypass - Fresno River to Berenda Slough - Left Bank	2.0	1.4	70%	$ 1,410.00	$ 10,422,720.00	
Berenda Slough - Right Bank	3.5	2.9	83%	$ 1,410.00	$ 21,589,920.00	
Berenda Slough - Left Bank	4.1	3.6	88%	$ 1,410.00	$ 26,801,280.00	
Eastside Bypass - Berenda Slough to Ash Slough - Right Bank	3.0	3.0	100%	$ 1,410.00	$ 22,334,400.00	
Eastside Bypass - Berenda Slough to Ash Slough - Left Bank	3.0	0.2	7%	$ 1,410.00	$ 1,488,960.00	
Ash Slough - Right Bank	3.6	2.6	72%	$ 1,410.00	$ 19,356,480.00	
Ash Slough - Left Bank	4.6	3.5	76%	$ 1,410.00	$ 26,056,800.00	
Eastside Bypass - Ash Slough to SJR - Right Bank	10.2	4.7	46%	$ 1,410.00	$ 34,990,560.00	
Eastside Bypass - Ash Slough to SJR - Left Bank	10.6	7.5	71%	$ 1,410.00	$ 55,836,000.00	
Eastside Bypass - SJR to Mariposa Bypass - Right Bank	9.2	6.2	67%	$ 1,410.00	$ 46,157,760.00	
Eastside Bypass - SJR to Mariposa Bypass - Left Bank	9.5	8.0	84%	$ 1,410.00	$ 59,558,400.00	
Stockton Diverting Canal	4.4	2.9	66%	$ 1,410.00	$ 21,589,920.00	
San Joaquin River, Left bank- Stockton to Stanislaus River	25.2	14.8	59%	$ 1,410.00	$ 109,810,800.00	
San Joaquin River, Left bank- Stanislaus River to Grayson (west of Modesto)	9.5	6.2	65%	$ 1,410.00	$ 45,785,520.00	
San Joaquin River, Right bank- Stockton to Stanislaus River	16.5	7.7	47%	$ 1,410.00	$ 57,399,408.00	
San Joaquin River, Right bank- Stanislaus River to Grayson (west of Modesto)	9.6	5.1	53%	$ 1,410.00	$ 37,819,584.00	
Mormon Slough	2.2	1.1	53%	$ 1,410.00	$ 8,412,624.00	
Old River, Both sides- SJR to Salmon Slough	13.5	5.9	43%	$ 1,410.00	$ 43,626,528.00	
Paradise Cut, Both sides- SJR to Salmon Slough	12.0	7.5	62%	$ 1,410.00	$ 55,463,760.00	
Salmon Slough, Right bank	1.3	1.3	100%	$ 1,410.00	$ 9,678,240.00	
Stanislaus River, Both sides-SJR to Kiernan Ave. (west of Ripon)	15.4	14.0	91%	$ 1,410.00	$ 104,078,304.00	
San Joaquin River south of Chowchilla River-Right Bank	2.1	2.1	100%	$ 1,410.00	$ 15,634,080.00	
San Joaquin River south of Chowchilla River-Left Bank	4.8	4.8	100%	$ 1,410.00	$ 35,735,040.00	

Subtotal: $ 4,041,905,206.00

Total Full Compliance Cost: $ 6,463,617,070.00

10. Conclusion

According to the preliminary assessment presented in Section 9 of this report and based on repairs for 116 sites, the overall fiscal impact on the 1,600 miles of project levees varies from $7.5 billion for full ETL compliance to $6.5 billion for compliance with the Variance as described in the Policy Guidance Letter.

The estimated cost of full ETL compliance for 116 critical repair sites is $350 million. For compliance with the Variance, the total estimated cost is $250 million.

There may be additional costs of CEQA, NEPA, and ESA compliance related to Resources Agencies' programmatic documents. Environmental mitigation costs estimated in this report include 40% soft costs for design and environmental permitting. At least 15% of this cost is for Resource Agency programmatic assessments, biological opinions, approvals, and support. However, implementation is dependent upon Resource Agencies' decisions, and if a jeopardy opinion is issued due to severe environmental impacts, agencies may not let implementation go forward.

Appendix A

Costs for Full ETL Compliance

TABLE A: FULL ETL COMPLIANCE COSTS

Sacramento River Bank Protection Program

Sac Bank Critical Repair - Urban and Non-urban - Fix In Place (Highway/County Road on Levee Crown)								
No.	Water Body	River Mile	Site Name	RD / MA	Length (ft)	Average Unit Cost per Foot[1]	Total	Comments
DWR								
1	Cache Slough	16.5L	CAS 16.5L	RD 501	495	$ 5,430.00	$ 2,687,850.00	
2	Sacramento River	20.8L	SAC 20.8L	RD 556	660	$ 5,430.00	$ 3,583,800.00	
3	Sacramento River	26.5L	SAC 26.5L	RD 554	837	$ 5,430.00	$ 4,544,910.00	
4	Sacramento River	32.5R	SAC 32.5R	RD 349	2350	$ 5,430.00	$ 12,760,500.00	
5	Sacramento River	43.3R	SAC 43.3R	RD 307	895	$ 5,430.00	$ 4,859,850.00	
6	Sacramento River	56.1R	SAC 56.1R	RD 900	970	$ 5,430.00	$ 5,267,100.00	
7	Sacramento River	56.8R	SAC 56.8R	RD 900	770	$ 5,430.00	$ 4,181,100.00	
8	Sacramento River	70.7R	SAC 70.7R	RD 827	639	$ 5,430.00	$ 3,469,770.00	
9	Sacramento River	71.7R	SAC 71.7R	RD 1600	900	$ 5,430.00	$ 4,887,000.00	
10	Sacramento River	73.0R	SAC 73.0R	RD 1600	437	$ 5,430.00	$ 2,372,910.00	
11	Sacramento River	85.6R	SAC 85.6R	RD 730	1226	$ 5,430.00	$ 6,657,180.00	
12	Sacramento River	164.0R	SAC 164.0R	MA 1	1000	$ 5,430.00	$ 5,430,000.00	
13	Steamboat Slough	16.2R	STE 16.2R	RD 501	430	$ 5,430.00	$ 2,334,900.00	
USACE								
1	Sacramento River	16.9L	SAC 16.9L	BALMD	210	$ 5,430.00	$ 1,140,300.00	
2	Sacramento River	26.9L	SAC 26.9L	RD 554	528	$ 5,430.00	$ 2,867,040.00	
3	Sacramento River	33.0R	SAC 33.0R	RD 349	326	$ 5,430.00	$ 1,770,180.00	
4	Sacramento River	33.3R	SAC 33.3R	RD 349	235	$ 5,430.00	$ 1,276,050.00	
5	Sacramento River	34.5R	SAC 34.5R	RD 150	623	$ 5,430.00	$ 3,382,890.00	
6	Sacramento River	43.7R	SAC 43.7R	RD 307	1090	$ 5,430.00	$ 5,918,700.00	
7	Sacramento River	44.7R	SAC 44.7R	RD 307	1585	$ 5,430.00	$ 8,606,550.00	
8	Sacramento River	47.0L	SAC 47.0L	MA 9	1156	$ 5,430.00	$ 6,277,080.00	
9	Sacramento River	47.9R	SAC 47.9R	RD 307	1031	$ 5,430.00	$ 5,598,330.00	
10	Sacramento River	48.2R	SAC 48.2R	RD 307	1039	$ 5,430.00	$ 5,641,770.00	
11	Sacramento River	49.6L	SAC 49.6L	MA 9	298	$ 5,430.00	$ 1,618,140.00	
12	Sacramento River	49.9L	SAC 49.9L	MA 9	268	$ 5,430.00	$ 1,455,240.00	
13	Sacramento River	50.2L	SAC 50.2L	MA 9	1473	$ 5,430.00	$ 7,998,390.00	
14	Sacramento River	50.4L	SAC 50.4L	MA 9	329	$ 5,430.00	$ 1,786,470.00	
15	Sacramento River	53.1L	SAC 53.1L	City of Sac	1170	$ 5,430.00	$ 6,353,100.00	
16	Sacramento River	56.7L	SAC 56.7L	City of Sac	1673	$ 5,430.00	$ 9,084,390.00	
17	Sacramento River	62.5R	SAC 62.5R	RD 537	255	$ 5,430.00	$ 1,384,650.00	
18	Sacramento River	68.9L	SAC 68.9L	RD 1000	786	$ 5,430.00	$ 4,267,980.00	
19	Sacramento River	69.9R	SAC 69.9R	RD 827	1632	$ 5,430.00	$ 8,861,760.00	
20	Sacramento River	72.2R	SAC 72.2R	RD 1600	1728	$ 5,430.00	$ 9,383,040.00	
21	Sacramento River	123.5L	SAC 125.3L	RD 70	524	$ 5,430.00	$ 2,845,320.00	
22	Steamboat Slough	19.0R	STE 19.0R	RD 501	552	$ 5,430.00	$ 2,997,360.00	
23	Steamboat Slough	19.4R	STE 19.4R	RD 501	272	$ 5,430.00	$ 1,476,960.00	
					30392	**Sub Total:**	$ 165,028,560.00	

Sac Bank Critical Repair - Non-Urban - Fix-in-place								
No.	Water Body	River Mile	Site Name	RD / MA	Length (ft)	Average Unit Cost per Foot[2]	Total	Comments
DWR								
1	Bear River	1.2L	BEA 1.2L	RD 1001	1133	$ 4,120.00	$ 4,667,960.00	
2	Bear River	2.4L	BEA 2.4L	RD 1001	1150	$ 4,120.00	$ 4,738,000.00	
3	Bear River	10.1R	BEA 10.1R	RD 2103	917	$ 4,120.00	$ 3,778,040.00	
4	Butte Creek	LM 14.0R	BUT 14.0R	MA 5	1005	$ 4,120.00	$ 4,140,600.00	
5	Cache Creek	LM 0.8L	CAC 0.8L	DWR	965	$ -	$ -	ETL Compliant
6	Cache Creek	LM 1.1L	CAC 1.1L	DWR	862	$ -	$ -	ETL Compliant
7	Cache Creek	LM 2.4L	CAC 2.4L	DWR	893	$ -	$ -	ETL Compliant
8	Cache Slough	21.8R	CAS 21.8R	RD 2060	2455	$ 4,120.00	$ 10,114,600.00	
9	Sacramento River	99.5R	SAC 99.5R	RD 108	910	$ 4,120.00	$ 3,749,200.00	
10	Sacramento River	130.8R	SAC 130.8R	Westside LD	470	$ 4,120.00	$ 1,936,400.00	
11	Sacramento River	141.4R	SAC 141.4R	Westside LD	2381	$ 4,120.00	$ 9,809,720.00	
12	Sacramento River	145.9L	SAC 145.9L	DWR	1207	$ 4,120.00	$ -	ETL Compliant
13	Sacramento River	154.5R	SAC 154.5R	MA 1	1289	$ 4,120.00	$ 5,310,680.00	
14	Sacramento River	182.0R	SAC 182.0R	LD 1R	4100	$ 4,120.00	$ 16,892,000.00	
15	Sutter Slough	24.8L	SSL 24.8L	RD 349	1415	$ 4,120.00	$ 5,829,800.00	
16	Sutter Slough	25.4R	SSL 25.4R	RD 999	1150	$ 4,120.00	$ 4,738,000.00	
USACE								
1	Sacramento River	78.0L	SAC 78.0L	RD 1000	1058	$ 4,120.00	$ 4,358,960.00	
2	Sacramento River	99.3R	SAC 99.3R	RD 108	397	$ 4,120.00	$ 1,635,640.00	
3	Steamboat Slough	22.7R	STE 22.7R	RD 349	210	$ 4,120.00	$ 865,200.00	
					23967	**Sub Total:**	$ 82,564,800.00	

Grand Total Sacramento Bank Protection Project: $ 247,593,360.00

PL-84 Program

PL 84-99 Rehabilitation - Urban and Non-urban - Fix in Place (Highway/County Road on Levee Crown)

No.	Water Body	River Mile	Site Name	RD / MA	Length (ft)	Average Unit Cost	Total	Comments
				USACE				
1	Sacramento River	21.8 R	20051230-002-023	RD 3	198	$5,430.00	$1,075,140.00	farm house/ HWY 160
2	Sacramento River	28.1 R	20051230-002-034	RD 3	66	$5,430.00	$358,380.00	farm house?/ HWY 160
3	Sacramento River	28.7 R	20051230-002-038	RD 3	148	$5,430.00	$803,640.00	farm house?/ HWY 160
4	Steamboat Slough	25.4 L	20051230-002-002	RD 3	140	$5,430.00	$760,200.00	Grand Island Road
5	Steamboat Slough	25.0 L	20051230-002-004	RD 3	205	$5,430.00	$1,113,150.00	Grand Island Road
6	Steamboat Slough	24.3 L	20051230-002-005	RD 3	129	$5,430.00	$700,470.00	Grand Island Road
7	Steamboat Slough	22.2 L	20051230-002-007	RD 3	30	$5,430.00	$162,900.00	Grand Island Road
8	Sacramento River	32.5 R	20051230-002-042	RD 3	280	$5,430.00	$1,520,400.00	HWY 160
9	Sacramento River	42.8 R	20051230-005-007	RD 999	303	$5,430.00	$1,645,290.00	HWY 160
10	Sacramento River	43.0 R	20051230-005-008	RD 999	148	$5,430.00	$803,640.00	HWY 160/ residence ?
11	Sacramento River	43.3 R	20051230-005-009	RD 999	200	$5,430.00	$1,086,000.00	County Road E9
				DWR				
1	Sacramento River	10.7 L	20051230-039-001	BALMD	609	$5,430.00	$3,306,870.00	HWY 160
2	Sacramento River	10.9 L	20051230-039-002	BALMD	268	$5,430.00	$1,455,240.00	HWY 160
3	Sacramento River	11.1 L	20051230-039-003	BALMD	391	$5,430.00	$2,123,130.00	HWY 160
4	Sacramento River	11.2 L	20051230-039-004	BALMD	204	$5,430.00	$1,107,720.00	HWY 160
5	Sacramento River	12.5 L	20051230-039-005	BALMD	338	$5,430.00	$1,835,340.00	HWY 160
6	Sacramento River	12.6 L	20051230-039-006	BALMD	413	$5,430.00	$2,242,590.00	HWY 160
7	Sacramento River	12.7 L	20051230-039-007	BALMD	367	$5,430.00	$1,992,810.00	HWY 160
8	Sacramento River	12.8 L	20051230-039-008	BALMD	689	$5,430.00	$3,741,270.00	HWY 160
9	Sacramento River	12.9 L	20051230-039-009	BALMD	346	$5,430.00	$1,878,780.00	HWY 160
10	Sacramento River	13.4 L	20051230-039-010	BALMD	252	$5,430.00	$1,368,360.00	HWY 160
11	Sacramento River	13.6 L	20051230-039-011	BALMD	291	$5,430.00	$1,580,130.00	HWY 160
12	Sacramento River	15.3 L	20051230-039-012	BALMD	331	$5,430.00	$1,797,330.00	HWY 160
13	Sacramento River	15.4 L	20051230-039-013	BALMD	331	$5,430.00	$1,797,330.00	HWY 160
14	Sacramento River	39.1 R	20051230-006-010	RD 150	1753	$5,430.00	$9,518,790.00	County Road E9
15	Sacramento River	40.6 R	20051230-006-013	RD 150	104	$5,430.00	$564,720.00	County Road E9
16	Sacramento River	41.0 R	20051230-006-014	RD 150	52	$5,430.00	$282,360.00	County Road E9
17	Sacramento River	41.4 R	20051230-006-015	RD 150	256	$5,430.00	$1,390,080.00	County Road E9
18	Sacramento River	41.6 R	20051230-006-018	RD 150	837	$5,430.00	$4,544,910.00	County Road E9
19	Sacramento River	42.0 R	20051230-006-019	RD 150	178	$5,430.00	$966,540.00	County Road E9
					9857	**Sub Total:**	$53,523,510.00	

PL 84-99 Rehabilitation - Non-Urban -Fix in Place

No.	Water Body	River Mile	Site Name	RD / MA	Length (ft)	Average Unit Cost	Total	Comments
				USACE				
1	Sutter Bypass	74.8 R	20051230-008-001	RD1500	400	$4,120.00	$1,648,000.00	
2	Yuba River	1.85 L	20051230-014-001	RD 10	150	$4,120.00	$618,000.00	
3	Dry Creek	7.5 L	20051230-036-001	RD 2103	450	$4,120.00	$1,854,000.00	
4	Dry Creek	7.1 L	20051230-036-002	RD 2103	200	$4,120.00	$824,000.00	
5	Sutter Bypass	87.8 R	20051230-019-001	RD 70	150	$4,120.00	$618,000.00	
6	Feather River	18.7 L	20051230-025-002	RD 784	200	$4,120.00	$824,000.00	spge brm / rlf wlls
7	Feather River	13.3 L	20051230-025-003	RD 784	400	$4,120.00	$1,648,000.00	drainage canal/ str.
8	Deer Creek	0.85 L	20051230-0017-003	Tehama PWD	300	$4,120.00	$1,236,000.00	
9	WPIC	0.90 L	20051230-025-008	RD 784	60	$4,120.00	$247,200.00	drainage canal/ str.
10	Yolo Bypass	47.7 L	20051230-012-001	RD 827	60	$4,120.00	$247,200.00	drainage canal/ str.?
11	S.J. River	104.5 L	20060404-007-001	RD 1602	440	$4,120.00	$1,812,800.00	farm house
				DWR				
1	San Joaquin River	LM 1.63	20060404-001-004	LSJLD	75	$4,120.00	$309,000.00	
2	San Joaquin River	LM 1.68	20060404-001-005	LSJLD	85	$4,120.00	$350,200.00	
3	Chowchilla ByPass	LM 12.40	20060404-001-020	LSJLD	100	$4,120.00	$412,000.00	
4	Chowchilla ByPass	LM 12.51	20060404-001-021	LSJLD	340	$4,120.00	$1,400,800.00	
5	Butte Creek	LM 0.8 L	20051230-034-002	MA 5	40	$4,120.00	$164,800.00	residence
6	Butte Creek	LM 2.08 L	20051230-034-003	MA 5	250	$4,120.00	$1,030,000.00	
7	Sacramento Bypass	LM 0.15 L	20051230-037-003	SMY/DWR	75	$4,120.00	$309,000.00	
8	Sacramento Bypass	LM 0.25 L	20051230-037-004	SMY/DWR	75	$4,120.00	$309,000.00	
9	Sacramento Bypass	LM 1.25 R	20051230-037-002	SMY/DWR	170	$4,120.00	$700,400.00	
10	Chowchilla ByPass	LM 13.50	20060404-001-011	LSJLD	120	$4,120.00	$494,400.00	
11	Chowchilla ByPass	LM 13.76	20060404-001-012	LSJLD	125	$4,120.00	$515,000.00	
12	Chowchilla ByPass	LM 13.87	20060404-001-013	LSJLD	45	$4,120.00	$185,400.00	
					4310	**Sub Total:**	$17,757,200.00	

Grand Total PL 84-99 Rehabilitation Project: $71,280,710.00

San Joaquin Flood Protection Program and Special Projects

San Jaoquin River System Critical Repair Sites - Urban - and non-Urban - Fix In Place								
No.	Water Body	River Mile	Site Name	RD / MA	Length	Average Units Cost per Foot	Total	Comments
1	San Joaquin River	42.3R	SJ RM42.3R	RD 404	210	$4,120.00	$865,200.00	
2	San Joaquin River	41.4R	SJ RM42.5R	RD 405	837	$4,120.00	$3,448,440.00	
3	San Joaquin River	42.5R	SJ RM42.5R	RD 406	528	$4,120.00	$2,175,360.00	
4	San Joaquin River	42.8R	SJ RM42.8R	RD 407	623	$4,120.00	$2,566,760.00	
5	Mormon Slough	LM 11.8R	MS LM 11.8R	SJFCA				Complies with Veg Guidelines
						Sub Total:	**$9,055,760.00**	

San Jaoquin River System Critical Repair Sites - Non-urban - with Setback Alternative								
No.	Water Body	River Mile	Site Name	RD / MA	Length	Average Units Cost per Foot	Total	Comments
1	Paradise Cut	LM3.86L	PC LM 3.86L	RD 2058	1090	$4,120.00	$4,490,800.00	
	Special Projects:							
1	Sacramento River	200.0R	SAC 200.0R	Hamilton City	800	$4,120.00	$3,296,000.00	
2	Cache Creek	11.7L	CAC 11.7L	Huff's Corner	350	$0.00	$0.00	Complies with Veg Guidelines
					4438	**Sub Total:**	**$7,786,800.00**	

Footnotes:

Refer to TABLE A-1

Refer to TABLE A-2

Refer to TABLE A-3

Grand Total San Joaquin River System : $16,842,560.00

Full ETL Compliance Cost (For Repair Sites):

Sacramento Bank Protection Project

Fix in Place Alternative = $247,593,360.00

PL 84-99 Rehabilitation Project

Fix in Place Alternative = $71,280,710.00

San Joaquin Flood Protection & Special Projects

Fix in Place Alternative = $16,842,560.00

Grand Total - ETL Compliance for Erosion Repairs Sites: $335,716,630.00

TABLE A-1 : Unit cost for full ETL Compliance: Urban Levee Fix-in-place

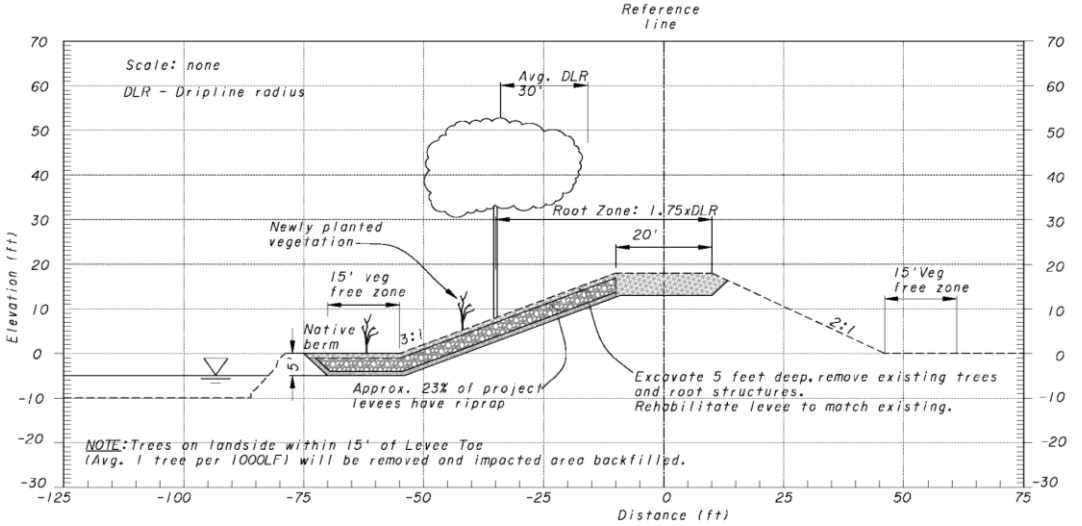
Remove trees, Fix-in-place and Offsite mitigation for removed trees

Design estimate considerations:

Length of repair (feet) :	100
Average waterside slope (H:V) :	3 : 1
Average Levee Height (ft) :	18
Clear berm width at waterside toe (ft):	15
Crown Width (ft) :	20
Excavation Depth for Root Removal (ft) :	5

Soft Costs

Escalation to bid-point of construction:	2%
Market at bid time reserve :	2%
Change order reserve :	1%
Design contingency :	10%
Environmental Permitting and Legal :	12%
Engineering during construction :	0.5%
Construction Management/Site inspection :	12.5%
Estimated Soft Costs (total):	**40%**



Item No.	Description	Unit	Quantity per 100 LF	Unit Price[2]	Total $ / 100 LF	Comments
1	MOBILIZATION AND DEMOBILIZATION[1]	LS		10%	$ 9,541.96	10% of items 2 to 11
2	CLEARING, GRUBBING, AND REMOVAL OF EXISTING AND PLANTED TREES	ACRE	0.18	$ 12,500.00	$ 2,266.99	
3	EXCAVATE TO 5' DEPTH (ROOT STRUCTURE REMOVAL) [3, 4]	CY	1988.66	$ 18.00	$ 35,795.83	
4	BEDDING (IMPORTED)	CY	255.56	$ 50.00	$ 12,777.78	
5	INSTALL SALVAGED ROCK SLOPE PROTECTION [5]	CY	189.11	$ 25.00	$ 4,727.78	
6	RECOMPACT EXCAVATED NATIVE SOIL 6 (with 20% shrinkage loss)	CY	1543.99	$7.50	$ 11,579.93	
7	AG SOIL (IMPORTED SOIL FILL IN ROCK VOIDS AND PLACE TOP 1' LAYER)	CY	256.96	$ 30.00	$ 7,708.69	
8	AGGREGATE BASE	TON	54.44	$ 50.00	$ 2,722.22	
9	EROSION CONTROL (SEEDING, MULCHING, FABRIC,etc...)	ACRE	0.18	$ 15,000.00	$ 2,720.39	
10	ENCROACHMENT (INTAKE PIPES, DOCKS, OTHER INFRASTRUCTURE) COSTS[7]	EA	0.10	$ 150,000.00	$ 15,000.00	
11	LINEAR ROOT BARRIER AT END OF VEG FREE ZONE (5 FT DEEP)	SF	1000.00	$ 0.12	$ 120.00	
12	ENVIRONMENTAL INCIDENTAL ONSITE COSTS (10%)	LS		10%	$ 8,996.16	10% of items 1 through 9 and 11

Assumptions:

1. Assumes cost is fixed percentage (10%) of construction costs.
2. Unit Prices based on 2008/2009 bid results for DWR Levee Repair projects.
3. Excavation of existing repair site to 5-ft. depth will disturb almost all of impacted repair area resulting loss of existing bedding and agricultural soil.
4. On the landside of the levee slope there are on average 0.5 trees (based on evaluation of sampled sites).
5. Existing rock slope protection assumed salvagable rock during root removal process. About 23% of the levee system is assumed to be rock-lined to some extent.
6. Recompaction of excavated native soils is assumed. About 77% of the levee system is assumed to be un-lined.
7. Encroachment costs represent on average 1 encroachment per 1,000 feet and average cost is $150,000.

Subtotal construction items :	$	113,957.72	(Per 100 foot)
Estimated Soft Costs :	$	45,583.09	(Per 100 foot)
Vegetation policy compliance construction cost :	$	159,540.81	(Per 100 foot)
Vegetation policy compliance cost :	*$*	*1,595.41*	(Per foot)
Offsite mitigation costs for tree removal :	*$*	*1,570.00*	(Per foot)
Construction Contingencies (30%) :	*$*	*949.62*	(Per foot)
Unit Cost for ETL Compliance :	**$**	**4,115.03**	(Per foot)
Rounded off:	$	4,120.00	(Per foot)

TABLE A-2 : Unit cost for full ETL Compliance: Urban Levee with Major Road / Infrastructure on Levee :

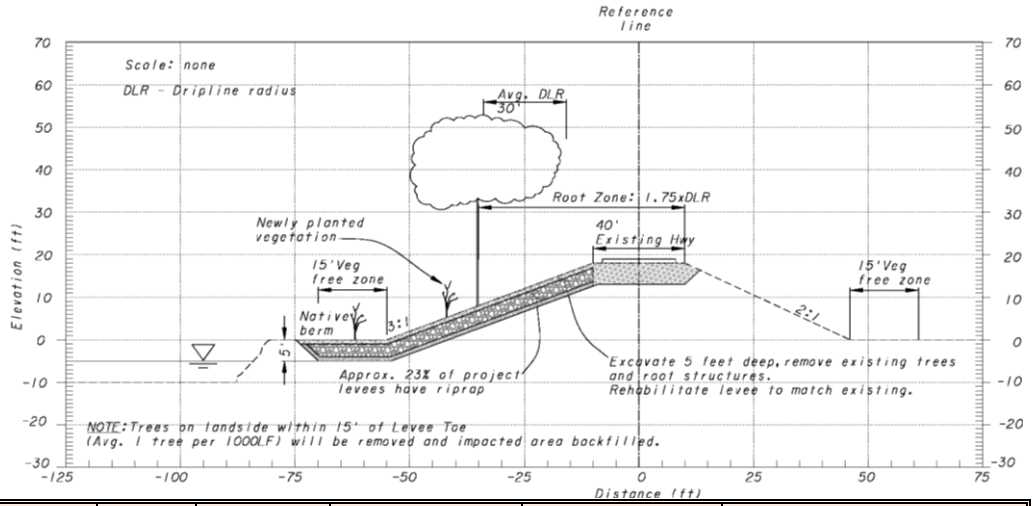
Remove trees, Fix-in-place and offsite mitigation for removed trees

Design estimate considerations:

Length of repair (ft):	100
Average waterside slope (H:V) :	3 : 1
Average Levee Height (ft):	18
Clear berm width at waterside toe (ft):	15
Crown Width (ft)	40
Excavation Depth for Root Removal (ft) :	5

Soft Costs

Escalation to bid-point of construction:	2%
Market at bid time reserve:	2%
Change order reserve:	1%
Design and Engineering:	10%
Environmental Permitting and Legal:	12%
Engineering during construction:	0.5%
Construction Management/Site inspection :	12.5%
Estimated Soft Costs (total):	**40%**



Item No.	Description	Unit	Quantity per 100 LF	Unit Price[2]	Total $ / 100 LF	Comments
1	MOBILIZATION AND DEMOBILIZATION[1]	LS		10%	$ 15,517.21	10% of items 2 through 11
2	CLEARING, GRUBBING, AND REMOVAL OF EXISTING AND PLANTED TREES	ACRE	0.18	$ 12,500.00	$ 2,266.99	
3	EXCAVATE TO 5' DEPTH (ROOT STRUCTURE REMOVAL) [3, 4]	CY	2359.03	$ 18.00	$ 42,462.50	
4	BEDDING (IMPORTED)	CY	255.56	$ 50.00	$ 12,777.78	
5	INSTALL SALVAGED ROCK SLOPE PROTECTION [5]	CY	189.11	$ 25.00	$ 4,727.78	
6	RECOMPACT EXCAVATED NATIVE SOIL 6 (with 20% shrinkage loss)	CY	1914.36	$ 7.50	$ 14,357.71	
7	AG SOIL (IMPORTED SOIL FILL IN ROCK VOIDS AND TOP 1' LAYER)[3]	CY	256.96	$ 30.00	$ 7,708.69	
8	RECONSTRUCT 2-LANE MAJOR ROAD	MILE	0.019	$ 2,800,000.00	$ 53,030.30	
9	EROSION CONTROL (SEEDING, MULCHING, FABRIC,etc...)	ACRE	0.18	$ 15,000.00	$ 2,720.39	
10	ENCROACHMENT (INTAKE PIPES, DOCKS, OTHER INFRASTRUCTURE) COSTS [6]	EA	0.10	$ 150,000.00	$ 15,000.00	
11	LINEAR ROOT BARRIER AT END OF VEG FREE ZONE (5 FT DEEP)	SF	1000.00	$ 0.12	$ 120.00	
12	ENVIRONMENTAL INCIDENTAL ONSITE COSTS (10%)	LS		10%	$ 15,568.93	10% of items 1 through 9 and 11

Assumptions:
1. Assumes cost is fixed percentage (10%) of construction costs.
2. Unit Prices based on 2008/2009 bid results for DWR Levee Repair projects.
3. Excavation of existing repair site to 5-ft. depth will disturb almost all of impacted repair area resulting loss of existing bedding and agricultural soil.
4. On the landside of the levee slope there are on average 0.5 trees (based on evaluation of sampled sites).
5. Existing rock slope protection assumed salvagable rock during root removal process. About 23% of the levee system is assumed to be rock-lined to some extent.
6. Recompaction of excavated native soils is assumed. About 77% of the levee system is assumed to be un-lined.
7. Encroachment costs represent on average 1 encroachment per 1,000 feet and average cost is $150,000.

Subtotal construction items :	$	186,258.28	(Per 100 foot)
Estimated Soft Costs :	$	74,503.31	(Per 100 foot)
Vegetation policy compliance construction cost :	$	260,761.59	(Per 100 foot)
Vegetation policy compliance construction cost:	*$*	*2,607.62*	(Per Foot)
Offsite mitigation costs for tree removal :	*$*	*1,570.00*	(Per Foot)
Construction Contingencies (30%) :	*$*	*1,253.28*	(Per Foot)
Unit Cost for ETL Compliance :	**$**	**5,430.90**	(Per Foot)
Rounded off :	$	5,430.00	(Per Foot)

TABLE A-3 : Unit cost for full ETL Compliance: Case 3: Non-urban Levee

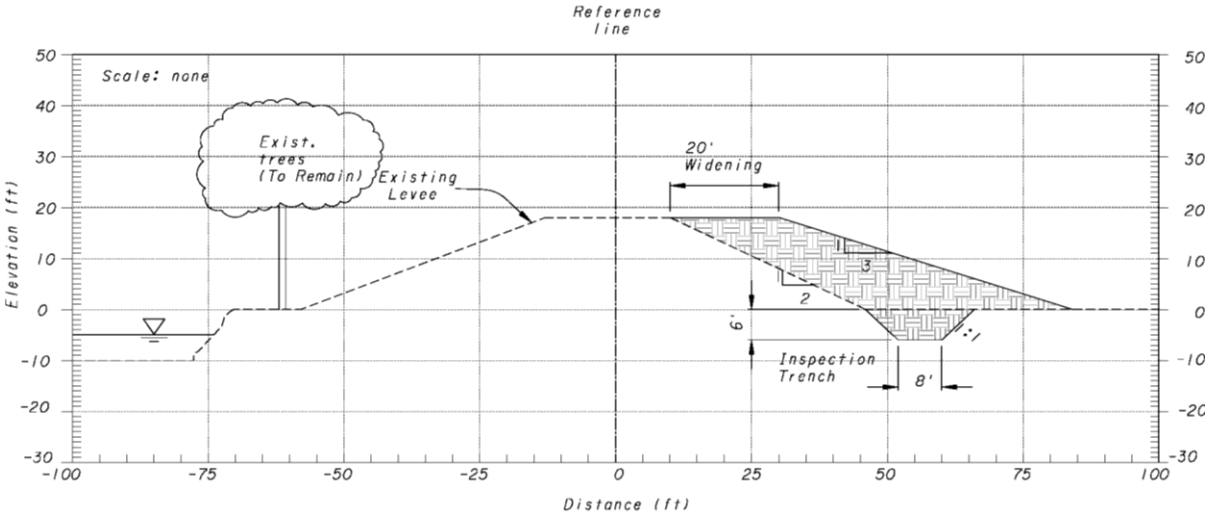
Leave the non-compliant levee in place and widen the levee on landside by additional 20 feet

Design estimate considerations:

Length of repair (ft) :	100
Average waterside slope (H:V) :	3:1
New landside slope (H:V) :	3:1
Levee widening width (ft) :	20
Average Height of existing levee (ft) :	18

Soft Costs

Escalation to bid-point of construction:	2%
Market at bid time reserve:	2%
Change order reserve:	1%
Design and Engineering:	10%
Environmental Permitting and Legal:	12%
Engineering during construction:	0.5%
Construction Management/Site inspection :	12.5%
Estimated Soft Costs (total):	**40%**



Item No.	Description	Unit	Quantity per 100 LF	Unit Price[2]	Total $ / 100 LF	Comments
1	MOBILIZATION AND DEMOBILIZATION[1]	LS		10%	$ 5,010.44	10% of items 2 to 6
2	CLEARING AND GRUBBING	ACRE	0.20	$ 12,500.00	$ 2,553.95	
3	INSPECTION TRENCH EXCAVATION	CY	311.11	$ 7.50	$ 2,333.33	
4	IMPORTED EMBANKMENT FILL	CY	2200.00	$ 20.00	$ 44,000.00	
5	EROSION CONTROL (SEEDING, MULCHING)	ACRE	0.20	$ 5,000.00	$ 1,021.58	
6	AGGREGATE BASE (Aprox. 20% for redressing of access road)	TON	3.91	$ 50.00	$ 195.56	redressing of existing access road
7	REAL ESTATE LAND COSTS[3]	ACRE	0.09	$ 17,500.00	$ 1,526.63	estimated repair footprint +10%
8	ENCROACHMENT (INTAKE PIPES, DOCKS, OTHER INFRASTRUCTURE) COSTS [4]	EA	0.10	$ 150,000.00	$ 15,000.00	
9	ENVIRONMENTAL INCIDENTAL ONSITE COSTS (10%)	LS		10%	$ 5,664.15	10% of items 1 to 7

Assumptions:
1. Assumes cost is fixed percentage (10%) of construction costs.
2. Unit Prices based on 2008/2009 bid results for DWR Levee Repair projects.
3. Assumes willing/cooperating seller of orchard/agricultural land.
4. Encroachment costs represent on average 1 encroachment per 1,000 feet and average cost is $150,000.

Subtotal construction items :	$ 77,305.64	(Per 100 foot)
Estimated Soft Costs :	$ 30,922.25	(Per 100 foot)
Vegetation policy compliance construction cost :	$ 108,227.89	(Per 100 foot)
Vegetation policy compliance construction cost:	*$ 1,082.28*	(Per foot)
Offsite mitigation costs for tree removal :	*$ -*	(No offsite mitigation needed)
Construction Contingencies (30%) :	*$ 324.68*	(Per foot)
Unit Cost for ETL Compliance :	**$ 1,406.96**	(Per foot)
Rounded off:	$ 1,410.00	(Per foot)

TABLE A-4 : Unit cost for full ETL Compliance: Offsite mitigation for removed Trees :

Design estimate considerations:

Assumed Length of repair (ft): 100
Average waterside slope (H:V) : 3:1
Average landside slope (H:V) : 2:1
Crown width (ft) : 20
Height of existing levee (ft) : 18
Key Excavation Area (sf) : 84

Soft Costs

Design and Engineering: 10%
Environmental Permitting and Legal: 15%
Estimated Soft Costs (total): 25%

Item No.	Description	Unit	Quantity per 100 LF	Unit Price[2]	Total $/ 100 LF	Comments
1	MOBILIZATION AND DEMOBILIZATION[1]	LS		10%	$ 2,326.57	10% of Items 2, 3, 6 to 9
2	CLEARING AND GRUBBING[2]	ACRE	0.82	$ 12,500.00	$ 10,275.05	At offsite mitigation location
3	LAND COSTS - EXIST. TREE 5:1 (30' x 30') x 2.5 TREES / 100' [3]	ACRE	0.27	$ 17,500.00	$ 4,745.61	
4	LAND COSTS - PLANTED TREE PLANTING 5:1 (30' x 30') x 5 TREES / 100FT [3]	ACRE	0.54	$ 17,500.00	$ 9,491.22	
5	LAND COSTS - WILLOW POLE CUTTING - 1:1 (3' x 3') x 41 / 100FT [4]	ACRE	0.01	$ 17,500.00	$ 148.24	
6	INSTALL TREE[2]	EA	37.50	$ 125.00	$ 4,687.50	At offsite mitigation location
7	IRRIGATION AND PLANT ESTABLISHMENT - 3 YEARS[2]	EA	37.50	$ 45.00	$ 1,687.50	At offsite mitigation location
8	INSTALL FASCINE BUNDLES[2]	EA	7.00	$ 150.00	$ 1,050.00	At offsite mitigation location
9	INSTALL WILLOW POLE CUTTINGS[2,4]	EA	41.00	$ 20.00	$ 820.00	At offsite mitigation location
10	ELDERBERRY SHRUB MITIGATION ~ 1.8 SHRUB / 100' (AVERAGE)[5]	EA	1.80	$ 50,400.00	$ 90,720.00	Pay to mitigation bank

Subtotal construction items : $ 125,951.69 (Per 100 feet)
Estimated Soft Costs : $ 31,487.92 (Per 100 feet)
Estimated Total Cost : **$ 157,439.61** (Per 100 feet)

Unit Cost of off-site mitigation for removed trees and elderberry : **$ 1,574.40** **(Per foot)**

Rounded off: $ 1,570.00

Assumptions:
1. Assumes cost is fixed percentage (10%) of construction costs.
2. Unit Prices based on 2008/2009 bid results for DWR Levee Repair projects.
3. Assumes trees removed from Repair Site to be mitigated with 5 new trees planted off-site. Each tree needs 30 ft. by 30 ft. site with about 5% additional land for irrigation and access. Based on sampled erosion repair sites, there are on average 2 existing trees and 5 planted trees within impacted area per 100-ft. of repaired site length.
4. Willow pole cutting installations need average 3 ft. by 3 ft. area. Based on the sampled erosion repair sites, there are on average 41 pole cuttings per 100-ft. of repaired site length.
5. Elderberry unit cost is based on Mitigation Bank calculation. Each 5 ft. by 5 ft. canopy area is assumed s one elderberry shrub. Based on the sampled erosion repair sites, there are on average 1.8 shrubs per 100-ft. of repaired site length.

Appendix B

Costs for ETL Compliance with Variance

TABLE B: ETL COMPLIANCE COSTS with VARIANCE

(Variance - All landside and only upper 1/3rd waterside levee slope complies with ETL guidelines)

Sacramento River Bank Protection Program

Sac Bank Critical Repair - Urban and Non-urban - Fix In Place (Highway/County Road on Levee Crown)								
No.	Water Body	River Mile	Site Name	RD / MA	Length (ft)	Average Unit Cost per Foot[1]	Total	Comments
DWR								
1	Cache Slough	16.5L	CAS 16.5L	RD 501	495	$ 4,230.00	$ 2,093,850.00	
2	Sacramento River	20.8L	SAC 20.8L	RD 556	660	$ 4,230.00	$ 2,791,800.00	
3	Sacramento River	26.5L	SAC 26.5L	RD 554	837	$ 4,230.00	$ 3,540,510.00	
4	Sacramento River	32.5R	SAC 32.5R	RD 349	2350	$ 4,230.00	$ 9,940,500.00	
5	Sacramento River	43.3R	SAC 43.3R	RD 307	895	$ 4,230.00	$ 3,785,850.00	
6	Sacramento River	56.1R	SAC 56.1R	RD 900	970	$ 4,230.00	$ 4,103,100.00	
7	Sacramento River	56.8R	SAC 56.8R	RD 900	770	$ 4,230.00	$ 3,257,100.00	
8	Sacramento River	70.7R	SAC 70.7R	RD 827	639	$ 4,230.00	$ 2,702,970.00	
9	Sacramento River	71.7R	SAC 71.7R	RD 1600	900	$ 4,230.00	$ 3,807,000.00	
10	Sacramento River	73.0R	SAC 73.0R	RD 1600	437	$ 4,230.00	$ 1,848,510.00	
11	Sacramento River	85.6R	SAC 85.6R	RD 730	1226	$ 4,230.00	$ 5,185,980.00	
12	Sacramento River	164.0R	SAC 164.0R	MA 1	1000	$ 4,230.00	$ 4,230,000.00	
13	Steamboat Slough	16.2R	STE 16.2R	RD 501	430	$ 4,230.00	$ 1,818,900.00	
USACE								
1	Sacramento River	16.9L	SAC 16.9L	BALMD	210	$ 4,230.00	$ 888,300.00	
2	Sacramento River	26.9L	SAC 26.9L	RD 554	528	$ 4,230.00	$ 2,233,440.00	
3	Sacramento River	33.0R	SAC 33.0R	RD 349	326	$ 4,230.00	$ 1,378,980.00	
4	Sacramento River	33.3R	SAC 33.3R	RD 349	235	$ 4,230.00	$ 994,050.00	
5	Sacramento River	34.5R	SAC 34.5R	RD 150	623	$ 4,230.00	$ 2,635,290.00	
6	Sacramento River	43.7R	SAC 43.7R	RD 307	1090	$ 4,230.00	$ 4,610,700.00	
7	Sacramento River	44.7R	SAC 44.7R	RD 307	1585	$ 4,230.00	$ 6,704,550.00	
8	Sacramento River	47.0L	SAC 47.0L	MA 9	1156	$ 4,230.00	$ 4,889,880.00	
9	Sacramento River	47.9R	SAC 47.9R	RD 307	1031	$ 4,230.00	$ 4,361,130.00	
10	Sacramento River	48.2R	SAC 48.2R	RD 307	1039	$ 4,230.00	$ 4,394,970.00	
11	Sacramento River	49.6L	SAC 49.6L	MA 9	298	$ 4,230.00	$ 1,260,540.00	
12	Sacramento River	49.9L	SAC 49.9L	MA 9	268	$ 4,230.00	$ 1,133,640.00	
13	Sacramento River	50.2L	SAC 50.2L	MA 9	1473	$ 4,230.00	$ 6,230,790.00	
14	Sacramento River	50.4L	SAC 50.4L	MA 9	329	$ 4,230.00	$ 1,391,670.00	
15	Sacramento River	53.1L	SAC 53.1L	City of Sac	1170	$ 4,230.00	$ 4,949,100.00	
16	Sacramento River	56.7L	SAC 56.7L	City of Sac	1673	$ 4,230.00	$ 7,076,790.00	
17	Sacramento River	62.5R	SAC 62.5R	RD 537	255	$ 4,230.00	$ 1,078,650.00	
18	Sacramento River	68.9L	SAC 68.9L	RD 1000	786	$ 4,230.00	$ 3,324,780.00	
19	Sacramento River	69.9R	SAC 69.9R	RD 827	1632	$ 4,230.00	$ 6,903,360.00	
20	Sacramento River	72.2R	SAC 72.2R	RD 1600	1728	$ 4,230.00	$ 7,309,440.00	
21	Sacramento River	123.5L	SAC 125.3L	RD 70	524	$ 4,230.00	$ 2,216,520.00	
22	Steamboat Slough	19.0R	STE 19.0R	RD 501	552	$ 4,230.00	$ 2,334,960.00	
23	Steamboat Slough	19.4R	STE 19.4R	RD 501	272	$ 4,230.00	$ 1,150,560.00	
					30392	**Sub Total:**	$ 128,558,160.00	

Sac Bank Critical Repair - Urban and Non-urban - Fix In Place								
No.	Water Body	River Mile	Site Name	RD / MA	Length (ft)	Average Unit Cost per Foot[2]	Total	Comments
DWR								
1	Bear River	1.2L	BEA 1.2L	RD 1001	1133	$ 2,790.00	$ 3,161,070.00	
2	Bear River	2.4L	BEA 2.4L	RD 1001	1150	$ 2,790.00	$ 3,208,500.00	
3	Bear River	10.1R	BEA 10.1R	RD 2103	917	$ 2,790.00	$ 2,558,430.00	
4	Butte Creek	LM 14.0R	BUT 14.0R	MA 5	1005	$ 2,790.00	$ 2,803,950.00	
5	Cache Creek	LM 0.8L	CAC 0.8L	DWR	965	$ -	$ -	ETL Compliant
6	Cache Creek	LM 1.1L	CAC 1.1L	DWR	862	$ -	$ -	ETL Compliant
7	Cache Creek	LM 2.4L	CAC 2.4L	DWR	893	$ -	$ -	ETL Compliant
8	Cache Slough	21.8R	CAS 21.8R	RD 2060	2455	$ 2,790.00	$ 6,849,450.00	
9	Sacramento River	99.5R	SAC 99.5R	RD 108	910	$ 2,790.00	$ 2,538,900.00	
10	Sacramento River	130.8R	SAC 130.8R	Westside LD	470	$ 2,790.00	$ 1,311,300.00	
11	Sacramento River	141.4R	SAC 141.4R	Westside LD	2381	$ 2,790.00	$ 6,642,990.00	
12	Sacramento River	145.9L	SAC 145.9L	DWR	1207	$ -	$ -	ETL Compliant
13	Sacramento River	154.5R	SAC 154.5R	MA 1	1289	$ 2,790.00	$ 3,596,310.00	
14	Sacramento River	182.0R	SAC 182.0R	LD 1R	4100	$ 2,790.00	$ 11,439,000.00	
15	Sutter Slough	24.8L	SSL 24.8L	RD 349	1415	$ 2,790.00	$ 3,947,850.00	
16	Sutter Slough	25.4R	SSL 25.4R	RD 999	1150	$ 2,790.00	$ 3,208,500.00	
USACE								
1	Sacramento River	78.0L	SAC 78.0L	RD 1000	1058	$ 2,790.00	$ 2,951,820.00	
2	Sacramento River	99.3R	SAC 99.3R	RD 108	397	$ 2,790.00	$ 1,107,630.00	
3	Steamboat Slough	22.7R	STE 22.7R	RD 349	210	$ 2,790.00	$ 585,900.00	
					23967	**Sub Total:**	$ 55,911,600.00	

Grand Total Sacramento Bank Protection Project: $ 184,469,760.00

PL-84 Program

PL 84-99 Rehabilitation - Urban and Non-urban - Fix in Place (Highway/County Road on Levee Crown)								
No.	Water Body	River Mile	Site Name	RD / MA	Length (ft)	Average Unit Cost per Foot[1]	Total	Comments
USACE								
1	Sacramento River	21.8 R	20051230-002-023	RD 3	198	$4,230.00	$837,540.00	farm house/ HWY 160
2	Sacramento River	28.1 R	20051230-002-034	RD 3	66	$4,230.00	$279,180.00	farm house?/ HWY 160
3	Sacramento River	28.7 R	20051230-002-038	RD 3	148	$4,230.00	$626,040.00	farm house?/ HWY 160
4	Steamboat Slough	25.4 L	20051230-002-002	RD 3	140	$4,230.00	$592,200.00	Grand Island Road
5	Steamboat Slough	25.0 L	20051230-002-004	RD 3	205	$4,230.00	$867,150.00	Grand Island Road
6	Steamboat Slough	24.3 L	20051230-002-005	RD 3	129	$4,230.00	$545,670.00	Grand Island Road
7	Steamboat Slough	22.2 L	20051230-002-007	RD 3	30	$4,230.00	$126,900.00	Grand Island Road
8	Sacramento River	32.5 R	20051230-002-042	RD 3	280	$4,230.00	$1,184,400.00	HWY 160
9	Sacramento River	42.8 R	20051230-005-007	RD 999	303	$4,230.00	$1,281,690.00	HWY 160/ Adj residence ?
10	Sacramento River	43.0 R	20051230-005-008	RD 999	148	$4,230.00	$626,040.00	HWY 160/ residence
11	Sacramento River	43.3 R	20051230-005-009	RD 999	200	$4,230.00	$846,000.00	County Road E9
DWR								
1	Sacramento River	10.7 L	20051230-039-001	BALMD	609	$4,230.00	$2,576,070.00	HWY 160
2	Sacramento River	10.9 L	20051230-039-002	BALMD	268	$4,230.00	$1,133,640.00	HWY 160
3	Sacramento River	11.1 L	20051230-039-003	BALMD	391	$4,230.00	$1,653,930.00	HWY 160
4	Sacramento River	11.2 L	20051230-039-004	BALMD	204	$4,230.00	$862,920.00	HWY 160
5	Sacramento River	12.5 L	20051230-039-005	BALMD	338	$4,230.00	$1,429,740.00	HWY 160
6	Sacramento River	12.6 L	20051230-039-006	BALMD	413	$4,230.00	$1,746,990.00	HWY 160
7	Sacramento River	12.7 L	20051230-039-007	BALMD	367	$4,230.00	$1,552,410.00	HWY 160
8	Sacramento River	12.8 L	20051230-039-008	BALMD	689	$4,230.00	$2,914,470.00	HWY 160
9	Sacramento River	12.9 L	20051230-039-009	BALMD	346	$4,230.00	$1,463,580.00	HWY 160
10	Sacramento River	13.4 L	20051230-039-010	BALMD	252	$4,230.00	$1,065,960.00	HWY 160
11	Sacramento River	13.6 L	20051230-039-011	BALMD	291	$4,230.00	$1,230,930.00	HWY 160
12	Sacramento River	15.3 L	20051230-039-012	BALMD	331	$4,230.00	$1,400,130.00	HWY 160
13	Sacramento River	15.4 L	20051230-039-013	BALMD	331	$4,230.00	$1,400,130.00	HWY 160
14	Sacramento River	39.1 R	20051230-006-010	RD 150	1753	$4,230.00	$7,415,190.00	County Road E9
15	Sacramento River	40.6 R	20051230-006-013	RD 150	104	$4,230.00	$439,920.00	County Road E9
16	Sacramento River	41.0 R	20051230-006-014	RD 150	52	$4,230.00	$219,960.00	County Road E9
17	Sacramento River	41.4 R	20051230-006-015	RD 150	256	$4,230.00	$1,082,880.00	County Road E9
18	Sacramento River	41.6 R	20051230-006-018	RD 150	837	$4,230.00	$3,540,510.00	County Road E9
19	Sacramento River	42.0 R	20051230-006-019	RD 150	178	$4,230.00	$752,940.00	County Road E9
					9857	**Sub Total:**	$41,695,110.00	

PL 84-99 Rehabilitation - Urban and Non-urban -Fix in Place								
No.	Water Body	River Mile	Site Name	RD / MA	Length (ft)	Average Unit Cost per Foot[2]	Total	Comments
USACE								
1	Sutter Bypass	74.8 R	20051230-008-001	RD1500	400	$2,790.00	$1,116,000.00	
2	Yuba River	1.85 L	20051230-014-001	RD 10	150	$2,790.00	$418,500.00	
3	Dry Creek	7.5 L	20051230-036-001	RD 2103	450	$2,790.00	$1,255,500.00	
4	Dry Creek	7.1 L	20051230-036-002	RD 2103	200	$2,790.00	$558,000.00	
5	Sutter Bypass	87.8 R	20051230-019-001	RD 70	150	$2,790.00	$418,500.00	
6	Feather River	18.7 L	20051230-025-002	RD 784	200	$2,790.00	$558,000.00	spge brm / rlf wlls
7	Feather River	13.3 L	20051230-025-003	RD 784	400	$2,790.00	$1,116,000.00	drainage canal/ str.
8	Deer Creek	0.85 L	20051230-0017-003	Tehama PWD	300	$2,790.00	$837,000.00	
9	WPIC	0.90 L	20051230-025-008	RD 784	60	$2,790.00	$167,400.00	drainage canal/ str.
10	Yolo Bypass	47.7 L	20051230-012-001	RD 827	60	$2,790.00	$167,400.00	drainage canal/ str.
11	S.J. River	104.5 L	20060404-007-001	RD 1602	440	$2,790.00	$1,227,600.00	farm house
DWR								
1	San Joaquin River	LM 1.63	20060404-001-004	LSJLD	75	$2,790.00	$209,250.00	
2	San Joaquin River	LM 1.68	20060404-001-005	LSJLD	85	$2,790.00	$237,150.00	
3	Chowchilla ByPass	LM 12.40	20060404-001-020	LSJLD	100	$2,790.00	$279,000.00	
4	Chowchilla ByPass	LM 12.51	20060404-001-021	LSJLD	340	$2,790.00	$948,600.00	
5	Butte Creek	LM 0.8 L	20051230-034-002	MA 5	40	$2,790.00	$111,600.00	residence
6	Butte Creek	LM 2.08 L	20051230-034-003	MA 5	250	$2,790.00	$697,500.00	
7	Sacramento Bypass	LM 0.15 L	20051230-037-003	SMY/DWR	75	$2,790.00	$209,250.00	
8	Sacramento Bypass	LM 0.25 L	20051230-037-004	SMY/DWR	75	$2,790.00	$209,250.00	
9	Sacramento Bypass	LM 1.25 R	20051230-037-002	SMY/DWR	170	$2,790.00	$474,300.00	
10	Chowchilla ByPass	LM 13.50	20060404-001-011	LSJLD	120	$2,790.00	$334,800.00	
11	Chowchilla ByPass	LM 13.76	20060404-001-012	LSJLD	125	$2,790.00	$348,750.00	
12	Chowchilla ByPass	LM 13.87	20060404-001-013	LSJLD	45	$2,790.00	$125,550.00	
					4310	**Sub Total:**	$12,024,900.00	

Grand Total PL 84-99 Rehabilitation Project: $53,720,010.00

San Joaquin Flood Protection Program and Special Projects

San Jaoquin River System Critical Repair Sites - Urban and Non-urban - Fix In Place								
No.	Water Body	River Mile	Site Name	RD / MA	Length	Average Units Cost per Foot [2]	Total	Comments
1	San Joaquin River	42.3R	SJ RM42.3R	RD 404	210	$2,790.00	$585,900.00	
2	San Joaquin River	41.4R	SJ RM42.5R	RD 405	837	$2,790.00	$2,335,230.00	
3	San Joaquin River	42.5R	SJ RM42.5R	RD 406	528	$2,790.00	$1,473,120.00	
4	San Joaquin River	42.8R	SJ RM42.8R	RD 407	623	$2,790.00	$1,738,170.00	
5	Mormon Slough	LM 11.8R	MS LM 11.8R	SJFCA				Complies with Veg Guidelines
						Sub Total:	**$6,132,420.00**	

San Jaoquin River System Critical Repair Sites - Non-urban - Fix In Place								
No.	Water Body	River Mile	Site Name	RD / MA	Length	Average Units Cost per Foot [2]	Total	Comments
1	Paradise Cut	LM3.86L	PC LM 3.86L	RD 2058	1090	$2,790.00	$3,041,100.00	
	Special Projects:							
1	Sacramento River	200.0R	SAC 200.0R	Hamilton City	800	$2,790.00	$2,232,000.00	
2	Cache Creek	11.7L	CAC 11.7L	Huff's Corner	350	$0.00	$0.00	Complies with Veg Guidelines
					4438	**Sub Total:**	**$5,273,100.00**	

Grand Total San Joaquin River System and Special Projects: **$11,405,520.00**

Footnotes:

1. Refer to TABLE B-1

2. Refer to TABLE B-2

ETL Compliance Cost with Variance (For Repair Sites) :

(All landside and upper 1/3rd slope on waterside levee slope complies with ETL)

Sacramento Bank Protection Project

Fix in Place Alternative = $184,469,760.00

PL 84-99 Rehabilitation Project

Fix in Place Alternative = $53,720,010.00

San Joaquin Flood Protection & Special Projects

Fix in Place Alternative = $11,405,520.00

Grand Total for Erosion Repairs Sites: **$249,595,290.00** (Fix in Place with offsite environmental mitigation)

TABLE B-1 : Unit cost for ETL Compliance (With Variance): Typical Levee

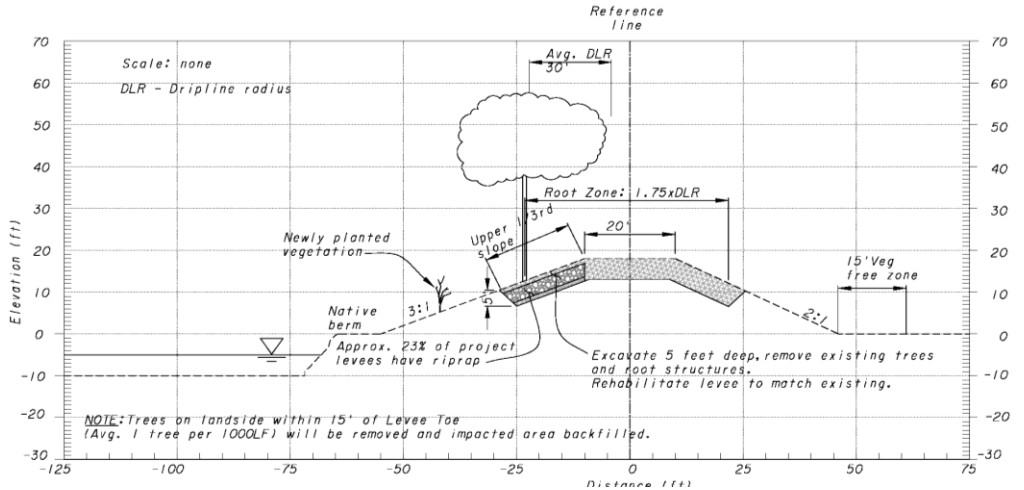
Remove trees, Fix repair in place and Offsite mitigation for removed trees

Design estimate considerations:

Length of repair (ft) :	100
Average waterside slope:	3 : 1
Average Levee Height (ft):	18
Clear levee slope (Top 1/3rd) (ft):	19
Crown Width (ft)	20
Excavation Depth for Root Removal (ft) :	5

Soft Costs

Escalation to bid-point of construction :	2%
Market at bid time reserve :	2%
Change order reserve :	1%
Design and Engineering :	10%
Environmental Permitting and Legal :	12%
Engineering during construction :	0.5%
Construction Management/Site inspection :	12.5%
Estimated Soft Costs (total):	**40%**



Item No.	Description	Unit	Quantity per 100 LF	Unit Price[2]	Total $ / 100 LF	Comments
1	MOBILIZATION AND DEMOBILIZATION[1]	LS		10%	$ 5,281.80	10% of items 2 to 11
2	CLEARING, GRUBBING, AND REMOVAL OF EXISTING AND PLANTED TREES[3]	ACRE	0.06	$ 12,500.00	$ 688.71	
3	EXCAVATE TO 5' DEPTH (ROOT STRUCTURE REMOVAL) [3, 4]	CY	1062.73	$ 18.00	$ 19,129.17	
4	BEDDING (IMPORTED)[4]	CY	70.37	$ 50.00	$ 3,518.52	
5	INSTALL SALVAGED ROCK SLOPE PROTECTION [5]	CY	61.33	$ 25.00	$ 1,533.33	
6	RECOMPACT EXCAVATED NATIVE SOIL [6] (with 20% shrinkage loss)	CY	931.03	$7.50	$ 6,982.71	
7	AG SOIL (IMPORTED SOIL FILL IN ROCK VOIDS AND TOP 1' LAYER)	CY	70.82	$ 30.00	$ 2,124.74	
8	AGRREGATE BASE	TON	54.44	$ 50.00	$ 2,722.22	
9	EROSION CONTROL (SEEDING, MULCHING, FABRIC,etc...)	ACRE	0.07	$ 15,000.00	$ 998.62	
10	ENCROACHMENT (INTAKE PIPES, DOCKS, OTHER INFRASTRUCTURE) COSTS[7]	EA	0.10	$ 150,000.00	$ 15,000.00	
11	LINEAR ROOT BARRIER AT END OF VEGETATION FREE ZONE (5 FT DEEP)	SF	1000.00	$ 0.12	$ 120.00	
12	ENVIRONMENTAL INCIDENTAL ONSITE COSTS (10%)	LS		10%	$ 4,309.98	10% of items 1 to 9 and 11

Assumptions:
1. Assumes cost is fixed percentage (10%) of construction costs.
2. Unit Prices based on 2008/2009 bid results for DWR Levee Repair projects.
3. Landside averages 0.5 tree per 100 ft. of levee within ETL vegetation-free zone based on sampled erosion repair sites.
4. Excavation of existing repair site to 5-ft. depth will disturb almost all of impacted area resulting in loss of existing bedding and soil.
5. Rock slope protection is assumed salvagable rock during root removal process. About 23% of the levee system is assumed to be rock-lined to some extent.
6. Recompaction of excavated native soils is assumed. About 77% of the levee system is assumed to be un-lined.
7. Encroachment costs represent on average 1 encroachment per 1,000 feet and average cost is $150,000.

Subtotal construction items :	$ 62,409.80	(Per 100 foot)
Estimated Soft Costs :	$ 24,963.92	(Per 100 foot)
Exist. trees stability repair cost on lower 2/3rd : (10%)	$ 6,240.98	(Per 100 foot)
Estimated Construction Cost :	$ 93,614.70	(Per 100 foot)
Vegetation policy compliance construction cost :	*$ 936.15*	(Per foot)
Offsite mitigation costs for tree removal :	*$ 1,210.00*	(Per foot)
Construction Contingencies (30%) :	*$ 643.84*	(Per foot)
Unit Cost for ETL Variance Compliance :	**$ 2,789.99**	(Per foot)
Rounded off:	$ 2,790.00	(Per foot)

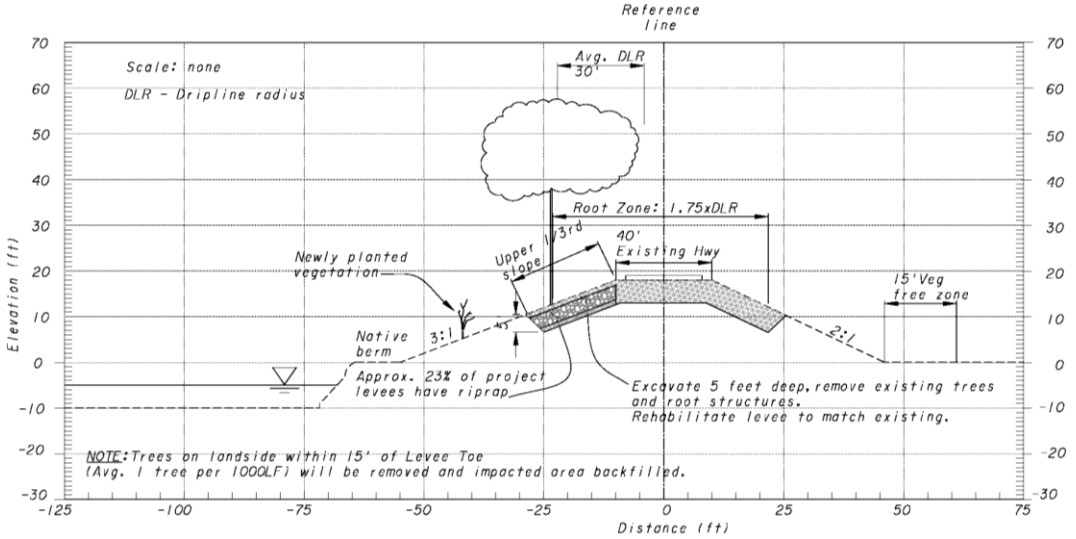
TABLE B-2 : Unit cost for ETL Compliance (With Variance): Levee with Major Infrastructure / Road
Remove trees, Fix-in-place and Offsite mitigation for removed trees

Design estimate considerations:

Assumed length of repair (ft) :	100
Average waterside slope:	3 : 1
Averagre Levee Height (ft):	18
Clear levee slope (Top 1/3rd) (ft):	19
Crown Width (ft)	40
Excavation Depth for Root Removal (ft) :	5

Soft Costs

Escalation to bid-point of construction:	2%
Market at bid time reserve:	2%
Change order reserve:	1%
Design and Engineering:	10%
Environmental Permitting and Legal:	12%
Engineering during construction:	0.5%
Construction Management/Site Inspection :	12.5%
Estimated Soft Costs (total):	**40%**



Item No.	Description	Unit	Quantity per 100 LF	Unit Price[2]	Total $ / 100 LF	Comments
1	MOBILIZATION AND DEMOBILIZATION[1]	LS		10%	$ 12,494.50	10% of items 2 to 11
2	CLEARING, GRUBBING, AND REMOVAL OF EXISTING AND PLANTED TREES	ACRE	0.06	$ 12,500.00	$ 688.71	
3	EXCAVATE TO 5' DEPTH (ROOT STRUCTURE REMOVAL) [3, 4]	CY	1433.10	$ 18.00	$ 25,795.83	
4	BEDDING (IMPORTED)[3]	CY	70.37	$ 50.00	$ 3,518.52	
5	INSTALL SALVAGED ROCK SLOPE PROTECTION [5]	CY	61.33	$ 25.00	$ 1,533.33	
6	RECOMPACT EXCAVATED NATIVE SOIL [6] (with 20% shrinkage loss)	CY	1301.40	$7.50	$ 9,760.49	
7	AG SOIL (IMPORTED SOIL FILL IN ROCK VOIDS AND TOP 1' LAYER)	CY	70.82	$ 30.00	$ 2,124.74	
8	RECONSTRUCT 2-LANE MAJOR ROAD (WITH SAME DESIGN)	MILE	0.02	$2,800,000.00	$ 53,030.30	
9	EROSION CONTROL (SEEDING, MULCHING, FABRIC,etc...)	ACRE	0.07	$ 15,000.00	$ 998.62	
10	ENCROACHMENT (INTAKE PIPES, DOCKS, OTHER INFRASTRUCTURE) COSTS[7]	EA	0.10	$ 150,000.00	$ 15,000.00	
11	LINEAR ROOT BARRIER AT END OF VEG FREE ZONE (5 FT DEEP)	SF	1000.00	$ 0.12	$ 120.00	
12	ENVIRONMENTAL INCIDENTAL ONSITE COSTS (10%)	LS		10%	$ 11,006.50	10% of items 1 to 9 and 11

Subtotal construction items :	$	136,071.55	(Per 100 foot of repair)
Estimated Soft Costs :	$	54,428.62	(Per 100 foot of repair)
Exist. trees stability repair cost on lower 2/3rd : (10%)	$	13,607.16	(Per 100 foot of repair)
Estimated Construction Cost :	$	204,107.33	(Per 100 foot of repair)
Vegetation policy compliance construction cost :	*$*	*2,041.07*	(per foot)
Offsite mitigation costs for tree removal (Table B3):	*$*	*1,210.00*	(per foot)
Construction Contingencies (30%) :	*$*	*975.32*	(per foot)
Unit Cost for ETL Variance Compliance :	**$**	**4,226.40**	(per foot)
Rounded off:	$	4,230.00	(per foot)

Assumptions:
1. Assumes cost is fixed percentage (10%) of construction costs.
2. Unit Prices based on 2008/2009 bid results for DWR Levee Repair projects.
3. Excavation of existing repair site to 5-ft. depth will disturb almost all of impacted area resulting in loss of existing bedding and soil.
4. Landside averages 0.5 tree per 100 ft. of levee within ETL vegetation-free zone based on sampled erosion repair sites.
5. Rock slope protection is assumed salvagable rock during root removal process. About 23% of the levee system is assumed to be rock-lined to some extent.
6. Recompaction of excavated native soils is assumed. About 77% of the levee system is assumed to be un-lined.
7. Encroachment costs represent on average 1 encroachment per 1,000 feet and average cost is $150,000.

TABLE B-3 : Unit cost for ETL Compliance (With Variance): Offsite Mitigation for Removed Trees

Design estimate considerations:

Assumed Length of repair (ft) : 100
Average waterside slope (H:V) : 3:1
Average landside slope (H:V) : 2:1
Crown width (ft) : 20
Height of existing levee (ft) : 18

Soft Costs

Design and Engineering:	10%
Environmental Permitting and Legal:	15%
Estimated Soft Costs (total):	**25%**

Item No.	Description	Unit	Quantity per 100 LF	Unit Price[2]	Total $/ 100 LF	Comments
1	MOBILIZATION AND DEMOBILIZATION[1]	LS		10%	$ 8,802.74	
2	CLEARING AND GRUBBING	ACRE	0.20	$ 12,500.00	$ 2,440.60	At off-site mitigation location
3	LAND COSTS - EXIST. TREE 5:1 (30' x 30') x 0.8 TREES / 100' [3]	ACRE	0.09	$ 17,500.00	$ 1,518.60	
4	LAND COSTS - PLANTED TREE PLANTING 5:1 (30' x 30') x 1 TREES / 100 FT [3]	ACRE	0.11	$ 17,500.00	$ 1,898.24	
5	INSTALL TREE[2]	EA	9.00	$ 125.00	$ 1,125.00	At off-site mitigation location
6	IRRIGATION AND PLANT ESTABLISHMENT - 3 YEARS[2]	EA	9.00	$ 45.00	$ 405.00	At off-site mitigation location
7	ELDERBERRY SHRUB MITIGATION ~ 1.6 SHRUB per 100 ft (AVERAGE)[6]	EA	1.60	$ 50,400.00	$ 80,640.00	

Assumptions:
1. Assumes cost is fixed percentage (10%) of construction costs.
2. Unit Prices based on 2008/2009 bid results for DWR Levee Repair projects.
3. Assumes trees removed from Repair Site to be mitigated with 5 new trees planted off-site. Each tree needs 30 ft. by 30 ft. site with about 5% additional land for irrigation and access.
4. Based on the sampled erosion repair sites, there are on average 0.3 existing tree and 1 planted tree within Upper 1/3rd of the levee slope per 100 feet.
5. Elderberry unit cost is based on Mitigation Bank calculation. Each 5 ft. by 5 ft. elderberry shrub. Canopy area is assumed as one elderberry shrub. Based on the sampled erosion repair sites, there are on average 1.6 shrubs per 100 feet on the upper 1/3 of the levee slope.

Subtotal construction items :	$ 96,830.18	(Per 100 foot)	
Estimated Soft Costs :	$ 24,207.55	(Per 100 foot)	
Estimated Total Cost :	$ 121,037.73	(Per 100 foot)	
Unit cost of off-site mitigation for removed trees and elderberry :	**$ 1,210.38**	**(Per foot)**	
Rounded off :	$ 1,210.00	(Per foot)	

Appendix C

Unit Costs for Estimating Fiscal Impacts

TABLE C-1 : Reference of Units Costs of Construction

Unit Cost Estimate

No.	CONSTRUCTION COSTS	UNIT	UNIT COST	REFERENCE	NOTE
1	MOBILIZATION AND DEMOBILIZATION	LS	10%	SAC BANKS	10% OF CONSTRUCTION COSTS
2	CLEARING AND GRUBBING	ACRE	$12,500.00	SAC BANKS	BID SUMMARY SJFPP 2008 SITES QUOTES $15,000
3	EXCAVATION / COMPACTION (GENERAL EARTHWORK)	CY	$7.50	SAC BANKS	
4	EXCAVATION OF ROCK REPAIR AREA AND ROCK SALVAGE	CY	$18.00	ESTIMATE	
5	IMPORTED EMBANKMENT FILL	CY	$20.00	SAC BANKS	
6	EROSION CONTROL (SEEDING, MULCHING, FABRIC,etc...)	ACRE	$15,000.00	SAC BANKS	
7	AGGREGATE BASE	TON	$50.00	URS 2007	$35 PER CY ESTIMATE
8	REAL ESTATE COSTS	ACRE	$17,500.00	ESTIMATE	LAND AND RIGHT OF WAY (RURAL LAND)
9	LAUNCH ROCK PLACEMENT	TON	$45.00	SAC BANKS	
10	ROCK SLOPE PROTECTION (SALVAGED AND WORKED IN PALCE)	TON	$25.00	SAC BANKS	
11	CLEAN SAND	TON	$50.00	BID SJFPP 2008 SITES	
12	AG SOIL (IMPORTED SOIL FILL IN ROCK VOIDS AND TOP 1' LAYER)	TON	$30.00	ESTIMATE	
13	LANDSCAPING (AG SOIL, PLANTS, ETC)	ACRE	$160,000.00	SAC BANKS	
14	ENVIRONMENTAL INCIDENTAL ON-SITE COST (10%)	LS	10%	ESTIMATE	WS,% OF CONSTRUCTION COST EXCLUDING REAL ESTATE
15	MAJOR ROAD RECONSTRUCTION	MILE	$2,800,000.00	ESTIMATE	RECONSTRUCTION OF ROAD WITH EXISTING ALIGNMENT (AB, AC, STRIPING AND SIGNAGE, GUADRRAIL)

American River Common Features GRR Geotechnical Expert Elicitation

DAY 1

Project:	American River Common Features GRR
Date:	Wednesday, June 17th, 2009 8:00 am to 5:00 pm USACE – Sacramento District, Room 1424
Facilitator:	Michael Ramsbotham (MDR), USACE
Meeting Called By:	Mary Perlea (MPP), USACE, Project Geotechnical Engineer

ATTENDEES
See Attendance Record (to be attached at end of finalized meeting minutes)

MEETING MINUTES

Call to order at 8:15 am
The meeting was called to order at approximately 8:15 am by the Facilitator, Michael Ramsbotham (MDR).

Introductions and Sign-In
A few minutes was spent on introductions and attendees signing the attendance list.

Identify EOE Team / Affiliation and Observers / Participants
The following attendees were recognized as Panel Members, meaning they would be voting on various items during this 2-day meeting:

- Paul Devereux, RD1000
- Les Harder, HDR, Inc.
- Mike Inamine (Mike I.), DWR
- Ed Ketchum, US Army Corps of Engineers
- Steve Mahnke, DWR
- Henri Mulder, US Army Corps of Engineers
- Mike Nolan (Mike N.), Consultant to City of Sacramento Utilities Department
- Tom Smith, Ayres Associates
- Mohsen Tovana, US Army Corps of Engineers

The following observers participated at the meeting

- Peter Ghelfi, SAFCA
- Jesse Hogan, US Army Corps of Engineers
- Dan Tibbitts, US Army Corps of Engineers
- Kevin Knuuti, US Army Corps of Engineers
- Jeff Taylor, US Army Corps of Engineers
- Joe Sciadrone, US Army Corps of Engineers

Introductory Comments by Attendees
Mary Perlea opened the meeting by requesting introductory comments from the audience.

Kevin Knutti thanked everyone for their time in being there. He stated he realized everyone's schedules are busy and really appreciates them making time for this meeting. Dan Tibbitts concurred with Kevin's comments and advised he hopes this meeting will bring about resolution on various tasks in which there is currently little-to none criteria in setting up judgment of the levee performance curves.

Pete Ghelfi commented that he is attending the meeting as an observer and will try to play that role. He feels it is important to be able to see within the black box a little bit and welcomes the opportunity to work together.

Kevin added that the Corps' Sacramento District is taking the lead for the Corps on a couple of items. It is recognized that this is one area where the Corps' policy has problems. While this issue is recognized by some, it

American River Common Features GRR Geotechnical Expert Elicitation

will allow further discussion with others within the Corps to begin refining the Corps' policy.

Ed Ketchum concurred with Kevin's comment. He included the statement that this is very important work and the values that come out of this meeting will affect the national economic plan. This has a huge influence on Benefit/ Cost ratio and everything else.

This part of the meeting concluded with Steve Mahnke noting that there is a partnering of many of the attendees, so it is very important to see this issue from the Corps' perspective.

Introductory Comments by Facilitator

MDR led the group in an informal discussion regarding the different meeting elements. Those discussion points included:

The Purpose/Expected Outcome of the 2-Day meeting:

- The purpose is to assist the Corps in development of the geotechnical judgment curves for the American River Common Features GRR (ARCF-GRR) project
- MDR added the judgment curves impact Economics and inquired as to the expected outcome. It was noted that Melanie Garland will provide meeting minutes of the 2-day discussion and Mary will provide a report that captures the summary, conclusions and recommendations. In addition, Mary will include revised judgment and fragility curves for the ARCF-GRR. The outcome of these discussions may lead to policy change, new Corps' guidance and/or a revised ETL.

Rules of Engagement

- Directions to accommodations was provided
- If a break is needed, the group was encouraged to suggest it
- MDR stated the discussions should be informal as he wanted everyone to be engaged and provide frank input freely
- MDR added that he hoped to see general information to final analysis and specific circumstances with the American River
- Side bar conversations were to be minimal
- Avoidance of "group" think and independent voice of opinions was supported

Review of Agenda / Scope

A brief review of the agenda and scope of discussion was held

Questions and Answers

- MDR led the attendees in an overall questions and answers period to familiarize themselves more on the general topic at hand. This was done to gain a better understanding of the role they were asked to play. The following discussion took place:

  Seepage and stability was brought up. Mary clarified they are only discussing judgment curves here as the seepage and stability components were straightforward. Mary added that the intent was to discuss poor performance first and then see if we can come to conclusion on chances of failure. Ed feels the seepage and stability will need to be discussed as well. Mary responded that they will not be left out; however, they will not be judged in this forum. She iterated that the final will include all of them, but the geotechnical analysis is already known and is not based on subjective discussion. Mary's scope is to decide on judgment curves first.

  Les Harder commented that he assumed "failure" would be clarified. Mary responded by saying that "failure" equals poor performance or breach. MDR added that this may continue to be refined during the meeting. If we are coming up with judgment curves on vegetation, encroachment, etc., it will depend on how robust the levees are. They may have a different set of curves for the levee based on this and seepage/stability. Mary stated information will be provided. Judgment (erosion, penetration, vegetation, encroachment) is what Mary needed the full panel for. The others have already been decided. Then, there is likelihood of failure being discussed.

  In the geotechnical analysis that includes stability, seepage and judgment, Mike Nolan inquired if judgment is weighted the same as seepage and stability, or if its weighting can be

American River Common Features GRR Geotechnical Expert Elicitation

reduced in the risk-based / FDA model. MDR responded that the hope is to get into this more in depth as they look into poor performance after taking a look from the judgment perspective. It was noted that FDA uses the total combined curve. Ed stated weighting will likely be based on folks' past experience. Pete added that in this forum, the group was hoping to make a judgment on judgment.

Mary discussed some of the work that had already been done by URS in regards to Erosion Analysis. She conveyed that she did not believe the Corps provided URS with the information needed for the evaluation, so erosion analysis will likely need to be revised. URS identified the highly erodible area which was considered by Mary on the initial judgment curves.

Ed asked if recommendations could be made to Headquarters (HQ) based on this meeting. Mary answered by stating this is the first time this has been done. The conclusion will be included in the CF GRR study that will be provided to the Headquarters, but the scope is not to provide recommendation to the Headquarter policies.

Paul Devereaux questioned whether the current procedure was over predicting or under predicting failure? Mary advised she provided all preliminary curves already. The curves will be revised based on the panel recommendation.

Henri Mulder asked about the current guidance ETL. Dan responded by advising him yes, the current guidance ETL 1110-2-556 was being used, however, it is only one paragraph regarding the judgment fragility curves and not much guidance provided. It is expected the guidance ETL will be revised, but in the meantime, that was part of the purpose for the 2-day meeting.

- At this point, MDR noted the discussion had gotten off track and reminded the group, that while flood fighting had been a huge discussion, the purpose was to resolve the judgment curve issue. This effort that includes erosion, vegetation, penetration and encroachment was a difference that he had seen in previous efforts. As far as he could tell, it had never been done consistently. In his opinion, whoever analyzes the "without project" conditions needs to be the same person to analyze it for "with project".

  Mike Inamine questioned why the group wasn't just looking at failure and what in the FDA model came close to this. Ed responded it has a national impact so the benefits from this project will be for others as well. Mary added that poor performance is indicative of a weaker levee for future events and may lead to levee failure. While it may not be a "failure", it has the propensity for failure and damages. Mike I. countered that they are looking at a fuzzy area that would result in a breach or such poor performance that it would result to what?

  Les added to combine them equally as the curves should be scaled the same. Mike I. commented that looking at poor performance as definition while Mike N. advised performance to him is no inundation if that is what is being used for economic analysis in the Corps' FDA model.

  Mary asserted that for now we are looking at existing conditions of the levee as performance, however, Henri and Mike N. both felt the group should be looking at both.

  Pete suggested displaying a probability curve with seepage and stability to reflect how judgment affects it by applying those components. In regards to economic analysis, he queried as to whether or not it needed to be limited. Les agreed, however, added that they should be applied under the same criteria or at least comparable in terms to what "failure" means.

  MDR responded by explaining that is partly the way it has been done based on the current guidance and trying to be consistent nationwide. He conveyed that what is happening in the

American River Common Features GRR Geotechnical Expert Elicitation

economic study is determining what the benefits are versus the cost. He further went on to express that he felt it was a mistake to take economic criteria and applying it to performance. He added that, in his mind, to get to the true level of protection, a different approach should be taken.

Background Presentation / Project Overview - MPP

Mary provided the team with a presentation of the ARCF-GRR with a description of the three primary areas: Natomas Basin, American River North Basin, and American River South Basin. These three primary areas were analyzed by URS who determined the critical reaches considering seepage, stability, and erosion based on 100-year high water elevation. The map Mary showed the group had seepage, stability, erosion and height deficiency plotted in reaches in the three different primary areas and reflected the areas that ARCF-GRR encompasses. Mary added that based on another URS analysis, for a 200-year event (not displayed), erosion was everywhere.

Mary reported that eventually, the ARCF-GRR team may breakout the Natomas Basin from the other basins due to priority.

It was noted that the damages shown on the map are determined based on a deterministic analysis considering a minimum factor of safety 1.4 for stability and 1.6 (gradient higher than 0.5) for under seepage for the 100-year flood event. The deterministic analysis was conducted determining the weakest cross sections within a reach considering the worst geotechnical parameters. Geotechnical R&U analysis made for the index points (as selected by the deterministic analysis as the critical points on a reach) uses the average values (or the most credible values) applying a coefficient of variation based on statistical analysis. The R&U determine the risk of failure due to stability and under seepage applying the coefficients of variation around the mean values considering the factor of safety of 1.

Mary walked the group through a specific sample to illustrate the engineering R&U fragility curves determined by seepage and stability R&U analysis versus the judgmental portion of the R&Y combined fragility curves.
Ed inquired if a variation across the levee for vegetation and encroachment were being looked at the same as is done for under seepage and stability. Mary responded no, that for the judgment curve, items are looked at within the reach where for the stability and under seepage it was considered the critical cross section representing a reach, with average parameters and their coefficient of variation. Ed countered by asking if they should look at the average condition along the reach. Mary answered by advising they have some index points where seepage and stability are not an issue, however, vegetation and encroachment are. Ed replied by asking if the integral of the area underneath is what is taken into consideration. Mary confirmed. She added that she will describe the specifics of each reach when they get to each reach section.

Most Likely Failure Modes Identification – Team

This part of the meeting consisted of the team being polled in relation to identifying what causes a levee to go into failure mode, that is, what causes levees to fail or breach. Nineteen different causes were identified as listed at the end of this section.

After the various factors where identified, the panel was asked to vote which ones are most likely to cause a levee to fail. The number listed to the side reflects the number of votes it received during this particular exercise in relation to their view of its significance to causing a failure mode.

- Under seepage – piping / stability - 9
- Overtopping - 4
- Stability - 6
- Erosion – waterside, scour - 7
- Through – seepage (internal erosion) - 4
- Closure structures - 0
- Penetrations through foundation - 1
- Seepage through animal holes – 6
- Uprooted trees - 0
- Human intervention - 0
- Seismic – overtopping - 0
- Seismic – seepage - 0
- Seismic – stability - 0
- Through – seepage (stability) - 4

American River Common Features GRR Geotechnical Expert Elicitation

- Penetrations through levee -5
- Encroachment (pools) - 0
- Wave/Wind erosion leads to overtopping - 0
- Wave erosion - 0
- Ditches (seepage / encroachment) - 0

After this vote, much discussion was held as to how the different failure modes interact and impact one another.

Mohsen inquired about the levee failure in RD 784 in '97. Ed advised the erosion moved back faster than they could do the flood fighting and it became larger at the crescent as it worked its way back to the levee. Mohsen stated his point is that some of these breaches have occurred on some good levees in relation to the inspection point. Ed advised he said that he's seen where erosion has affected the seepage, which has impacted the stability.

Identification of Significant Failure Modes – Panel Votes

The panel was asked to consider the top seven significant failure modes identified from the previous exercise and vote in regards to how they see the likelihood of a failure mode caused by one of these factors. The results (with the number of votes received) are provided below:

- Under seepage – 10
- Through seepage - 8
- Erosion = Analysis* - 7 / *Research analytical methods – use existing tools to form judgment.
- Overtopping - 4
- Penetrations - 6
- Stability - 6
- Rodents - 6

It was determined that when considering "Other Failure Modes" (sense on how these relate to those identified as most important), judgment is very important, but should not be more about 20%.

Relative Ranking and Contribution of Significant Failure Modes (weighting factor 0 – 100%) – no flood fighting - Team

The panel was then asked to conduct a relative ranking of the significant failure modes with no flood fighting involved. The results were as follows:

- Erosion
- Penetrations
- Rodents
- Others

After another vote, it was determined that the Top 3 may contribute 10-25% to a levee breach or failure.

Discussion of Importance of Judgment Curve – Team

A lengthy discussion was held with the team as far as the importance of the judgment curve and the various components that should be included.

It was noted that certain components are currently being considered in the evaluations and analytical models. These include erosion, penetration, vegetation (includes rodents, beavers, squirrels, etc.), and encroachment. The team felt there were other components that should be considered as well. These include as-builts/knowledge of construction/maintenance, the separation of rodents from vegetation, swimming pool encroachments, penetrations through the levee, and penetrations through levee foundation.

After much discussion, the team came to the consensus that the following components are what need to be considered:

- Encroachments
- Erosion
- Penetrations
  - Through levee
  - Through foundation
- Rodents

American River Common Features GRR Geotechnical Expert Elicitation

- Beaver
- Squirrel
- Vegetation
  - Trees
  - Brush
- Maintenance – Overall

It was noted that failure considers the overall reliability of the levee.

Dan advised they are trying to define a methodology of performance curves to apply to both "with" and "without project" conditions. Mike N. responded by asking if this shouldn't be done in parallel to Economics. Dan explained there is a difference between the two based on the performance of the levee. Mary added to this by explaining the goal in their economic analyses is to determine damages based on levee failure. MDR then conveyed to the team that where Mary needs the most support is in determining how to do this.

Mike I. stated that collectively there is not a way to quantify how they feel about a specific section. Les asked Mike I. If there was a way to tell how the seepage and stability curves are being used. Mike I. responded by stating there was, as another category of judgment. He went on to say that on its own, erosion may not be an issue, however, when the section is looked at collectively, it causes "heartburn". Further, individually they may not add up to such a bad score, however, collectively it poses an issue.

Pete contributed to the discussion by inquiring as to how much should judgment affect the curve. Tom Smith added that how comfortable one is with the data they have is an important component. Dan stated in his mind it is more reach-specific.

Les expressed concern about using the term "judgment". He wanted to look at analytical components and temper them. MDR agreed we need to revise the agenda to include "relative importance of judgment". Judgment can be based on non-analytical info as well as analytical inputs. Non-analytical should look at best estimates; while analytical is the best estimate with Co-efficient Of Variations (COV). Henri and Paul both commented that the analytical stuff is what points to failure on the weaker levees. Judgment is still important.

It was noted that consideration of agreement in failure modes & influence, importance of the economic model versus level of protection & public safety can have a difference on the basis of risk and communication. It is important to define the level of performance versus economics.

Discussion of Need for Specific Performance Curve for Unique Flaw / Failure Mode – Team
MDR led the group in a discussion of specific performance curves needed for unique flaws or failure modes. In this discussion failure modes or flaws not covered in typical analysis were looked at. MDR advised it is important to recognize these specific potential failures as they may need to be included in a special curve for special instances, current or future.

Pumping stations/plants, drainage ditches, and farmer water supply wells were some items that were mentioned as having an impact on levee performance. Henri noted that some items could be categorized under "maintenance". Mary commented that while she agrees it can be a failure mode, the problem with maintenance is that it cannot be added in remediation (the sponsors are responsible for the maintenance) or included in the remediation action for the feasibility study.

A question was posed as to whether or not the failure modes should be analyzed or just included in the judgment. It was suggested that special / unique failure modes should be considered for inclusion as a special curve if analytical methods are available. Les commented that his sense was that this should be captured under the various categories under judgment. Mike N. cautioned the team not to double-up and compounding the "unknowns".

Change in Agenda
At this point of the meeting, a decision was made to change the agenda by fast forwarding to looking at the various sites individually versus the development of generalized performance curves for each component.

Site-Specific Performance Curves for Various Situations / Flaws – MDR / MPP
The purpose of this section was to provide Mary with feedback on specifics. For the first site, Mary presented a

specific scenario for components of the judgment curve. The team discussed and provided input to the judgment curve.

SITE 1 – Natomas Basin, Sacramento River close to American River at location of Pump Station #1 on the Sacramento River

- **GENERAL CONDITIONS:**
  - Sandy foundation and seepage issues. Seepage analysis shows a very high risk due to under seepage (high hydraulic gradients). Based on URS erosion analysis, this area is flagged as high risk when the water is at the highest elevation, but Mary isn't sure the analyses assessed the existing conditions such as vegetation, riverbank protection and encroachments on the waterside including apartment houses constructed on fill placed on the river berm to the crest of the levee. Mary also sees penetration issues here from pipes from the RD 1000 pump station, pressurized pipes and other. Ed advised the Corps found old wood, concrete, etc. when the Corps studied the area for improvement. Paul noted there are a lot of structures within the entire reach such as restaurants, businesses, etc. On some areas of the reach the levee is oversized, with the crest as much as 60 feet wide. The existing conditions include the following:
  - A deep soil/cement/bentonite wall to be constructed under WRDA'99 authorization
  - No gap
  - An existing shallow slurry wall (30' to 40')
  - Generally the levee crest is 40 feet wide except the area where it is further overbuilt
  - The levee is constructed of sand (typical dredge fill) with containment berm
  - The side slope is as everywhere else 1V:3H on the waterside and 1V:2H on the landside
  - Tom added that this is a unique piece of the river and high water elevations should have lower velocities due to Sacramento Bypass on the upper end which diverts the water in the Yolo Bypass

Scenario #1 – VEGETATION

- **CONDITIONS (and discussion on conditions):**
  - In specific to vegetation, the trees go up to the top of the levee on both sides (water and land). Rodents are an issue, too.
  - Trees - 10 years old in levee
  - Possible roots
  - Henri feels the numbers on Mary's proposed curves are way too high on vegetation
  - Les drove a clarification discussion regarding openness to changing the categories. It was decided the Corps is willing to do this, however, Mary advised she cannot drop vegetation based on Corps policy
  - Clarifying point: vegetation goes to extent of the levee. It is everywhere and oversized
  - Mohsen asked how the tree roots behave near slurry walls. Do they penetrate the wall or what? Ed advised composition of the wall influences the behavior of the roots and their strength.
  - Tom advised the wind affects the trees on levees more than anything else, so he is challenging the current curve result. He thinks the failure mode for trees on levees is windfall.
  - MDR advised we are now looking at redefining failure in this case as poor performance. The meeting's objective is to redefine the judgmental curves based on people opinion with experience on the Sacramento River system.
  - Trees are in 40' crown width section in vicinity of the pump station and at the top of the levee. Are they so bad that they would require human intervention such as flood fighting or levee repairs later? The scenario would be something that might affect the performance of the levee with tree gone needing immediate action such as flood fight:
    - For 60' crown width reach on the overbuilt levee (vote taken after earlier misunderstanding on issue / scope):
      - After removing the high and low factors, the average was 5.14%
    - For 40' reach considering the water at top of levee:
      - After removing the high and low factors, the average was 5.14%
    - For 40' reach considering the water at half of levee height :
      - After removing the high and low factors, the average was 9.14%

American River Common Features GRR Geotechnical Expert Elicitation

- Results must be consistent with other analytical approaches
- Mary wants to know how much does water velocity change impact the removal of the trees from the levee slope and cause holes in the slope. The Sacramento Bypass Weir is open at elevation 27 feet and at some point the velocity goes to 0 and then upstream it goes to 2 feet per second back towards the Weir (per Tom Smith). Tom advised this is such a small percent as associated with vegetation. The problem with trees is wind and erosion. Ed recommended 2% from 28 all the way across to top of levee.

Scenario #2 - ENCROACHMENTS

- **CONDITIONS (and discussion on conditions):**
  - Homes on waterside (difficult to inspect) – multi-million $ homes
  - All of the housing on the water side brings water & utilities together, which makes it difficult to inspect.
  - Restaurants
  - Apartments
  - On the land side, this is an Urban area. The city has a pump station there and there are some ranchettes further up.
  - Most of the encroachments are on the waterside and at the top of levee & berm.
  - Lack of inspection due to fences and hedges
  - Visibility is poor and access is difficult as people will not permit inspections
  - Paul advised there has been work in regards to the inspection – not resolved, but in progress
  - Interventions can be done
    - Inspections
    - Maintenance
  - Mary is most concerned with encroachment (particularly swimming pool and landscaping) causing seepage issues
  - Les noted that they need to be looking at this as a serious condition – safety factor of 1. Problem of Encroachments commensurate with limiting P(S) = 1
  - Ed noted both the seepage and stability analytical methods cannot include the encroachments, however, encroachments can impact seepage and stability
  - Mohsen stated he was more concerned about the leach fields that were put in this area some years ago. He doesn't believe there was anything to regulate their placement.
  - The question was posed if encroachments contribute to the development of a problem in regards to the safety of the levee. It was determined it was higher than trees, but lower than utilities.
    - For 40' crown width reach considering the water at top of levee:
      - After removing the high and low factors, the average was 6.57%
      - Influence factors
        - Operational issues
        - Impact on seepage & stability
        - Water at top of levee
  - ~~e~~ MDR brought up the issue of whether or not encroachments should be kept in our evaluation. In some areas, they are significant and others are not. Henri stated he didn't think it is significant enough. He felt in cases where we aren't able to drive or walk on the levees, they should be considered. Paul agreed with Henri on the American River, but on Sacramento River he felt it should be considered. Mary advised she has to include them for consistency, however, she can put the impact as 0 wherein that's the case.
  - Pete & Les suggested we continue this process and see where we are on it after we've looked at few more areas and then revisit it.

Scenario #3 - PENETRATIONS

- **CONDITIONS (and discussion on conditions)**
  - Shallow slurry cut-off wall
  - Utility lines through the levee
  - Pump 1A and Pump 1B are constructed differently and Corps is evaluating this matter per Joe S and is being evaluated under WRDA 96-99. There could be some potential seepage under the boxed culvert. This should be analyzed as a seepage model.
  - Structure was built in 1915. Inspection of the inside is being done and the Corps is awaiting the results.

- The discharge lines from the pump station have flap gates and hand cranks that are 1914 vintage. There is seepage at joints into conduit.
- This is the only issue in this area that is not characterized.
- Mary stated she needs to know if seepage in an issue in regards to the culvert. The response was that seepage is an issue with the culvert and it is being looked at. However, the authorized repair is only for the cut-off wall, does not include discharge line replacement or repair so seepage along the conduit and structural failure of the culvert remain issues. For the existing condition, Mary has no idea as to what is there. Repair of the conduit would be considered in the CF GRR alternatives.
- A question was posed a far as what the chance is the culvert would damage the levees. MDR noted that if this culvert is this big of a problem, then they need to get engineering involved. This culvert is critical for the entire reach.
- Paul advised this has been an ongoing issue with SAFCA for some time.
- Ed commented that if we pulled the culvert out, then we need to look at the utilities along the rest of the reach. His concern that this one spot will mask things for the entire reach.
- MDR made a decision that at this point we are going to discuss utility penetrations along the reach eliminating the discharge lines from the pumping plant, accepting that these need further civil investigation and special design.
- Paul advised there are some other utilities along the waterside as well as some utility crossings. It is a mixed bag. There is also a big sewer force main and some irrigation lines. These are the ones that Paul is aware of.
- Steve Mahnke mentioned there was a sewer line along I-80 that caved at the installation by directional drilling and this is a concern. The levee settled a couple of inches and a big subsidence was observed under an abandoned house. Ed stated he thought that was going to be put into a judgment. He added that he was not planning to pull that out. Ed asked Steve if the collapse was mitigated. Steve responded that he did not think so. Paul advised pressure grouting was added and impact of seepage was looked at. Mary was involved in the repair of the site that included compaction grouting and backfilling the subsidence. The levee is monitored monthly for any further movements and the reports provided to Mary for information. So far, the repair of the area shows to be satisfactory so there is no more concern regarding this line.
- Paul advised there are some pressurized gas lines as well. These are transmission gas lines and fuel lines that go under the levee.
- It was noted there are lots of utilities; some of which go high, some go low, some are in good shape and others are not.
- A vote was called in regards to Utilities' impact on the levee for the reach from the Sacramento Bypass to the American River:
  - For 40' reach at top of levee (with the water at the upper 3 feet):
    - After removing the high and low factors, the average was 10.29%
    - Influence factors
      - Uncertainty biggest failure
      - Slurry wall cut off shallow, the pipes were not relocated during cut-off wall construction
      - Sewer problem
      - Rectified/Fixed
      - Concerns on directional drilling
      - Sewer line controlled closer
  - Another vote was called for the same conditions with the sewer line being considered:
    - Considering the high and low factors, the average was 19.44%
    - After removing the high and low factors, the average was 16%
  - A third vote was called for the same conditions without sewer line, but considering penetrations in general for this reach:
    - Considering the high and low factors, the average was 6.11%
    - After removing the high and low factors, the average was 5.43%
- Les noted that we need to remember what was said earlier today and not to look at worse conditions. The group is supposed to look at standard deviations. Mary's point was that it

American River Common Features GRR Geotechnical Expert Elicitation

must be included in this case because it's the worse condition and the best is zero. In order to get average, she must consider it.
- o Pete commented that it sounds like it's the same type of thing as the culvert.

SUGGESTIONS FOR DAY 2

The meeting shifted to a discussion led by MDR as to what could make the discussions better on Day 2.

- Ed suggested Mary go back and provide the details on the scenarios she wants answers to.
- A question was raised if other panels are going to be held on GRR. Ed said perhaps and MDR recommended they make the panels smaller if they do.
- Mike I said he saw the discussions as useful. He thinks we need to go back to our original premise that all of these together only contribute 20% to the judgment. It was agreed that the reach the team just reviewed is different. After this one, is 20% appropriate for judgment?
- Mike N. asked as far as the overall scope was the objective still to get all areas done as originally laid out in the agenda. Dan advised that all areas are needed in order for them to breakout Natomas.
- Tom added that each reach is different and expressed he didn't think the team was going to race through them.
- Les suggested that, for tomorrow, to pick the ones that have the best range of things, i.e., typical versus extreme. Mary advised she doesn't have any "typical".
- A need to prioritize work was expressed
- A recommendation was given to pick a range of sites to get broad feedback.

Day 1 Concluded at 5:15 pm

DAY 2

Project:	American River Common Features GRR
Date:	Thursday, June 18th, 2009 8:00 am to 4:30 pm USACE – Sacramento District, Room 1424
Facilitator:	Michael Ramsbotham (MDR), USACE
Meeting Called By:	Mary Perlea (MPP), USACE, Project Geotechnical Engineer

ATTENDEES

See Attendance Record (to be attached at end of finalized meeting minutes)

MEETING MINUTES

Sign-In

Day 2 of the meeting commenced at 8:00 am with team members signing in.

Introductory Comments - MDR

MDR led the group with introductory comments. Mary iterated where the meeting ended yesterday in regards to Utilities and the sewer line. She expressed a desire to revisit it this morning in regards to its impact on the levee safety due to the age of the pipe. This is unknown to her at this point.

MDR conveyed his belief that the conclusion drawn was that it should be analyzed separately, giving it a full engineering evaluation and not "lump summed" in this evaluation. He advised we are not going to review it under this judgment curve, but on its own curve supported by additional analysis. He iterated that it should not be "eliminated" but handled separately by a civil engineer, possibly as its own reach.

Ed stated he understood WRDA 96-99 was going to take care of the under seepage portion. The pipe itself was

American River Common Features GRR Geotechnical Expert Elicitation

where we were going to do a separate evaluation. Henri said if WRDA 96 covers it, it's probably not going to be the weak link anymore; in addition, it's being maintained. Steve added that with it being made of concrete, it should have long life. Mike I stated he thought it could be a weak link. Ed expressed concern about the pipe joints. Additional concern was expressed regarding who has authority. Ed advised they need to go back and discuss with the PM organization and see where it stands with the WRDA 96. Dan stated they have already made the argument and can argue that repair/replacement of pipe may be accomplished under WRDA 96-99, if needed.

MDR reminded the group the purpose of the meeting is to get through as many of these scenarios as possible in order to give Mary guidance in completing the curves.

RESUMPTION OF SITE 1 DISCUSSIONS FROM DAY 1

Scenario #4 – ANIMAL BURROWS (RODENTS)

- **CONDITIONS (and discussion on conditions)**
  - Animal burrows (low density)
    - 4' to ? in depth
  - There is no history of beaver dens / damage
    - Beaver – low
    - Squirrel – located more near the toe, but can be anywhere on the slope
  - Rodent abatement program is reactive
  - Levee is average of 40' wide
  - There is lots of housing and development (on both sides)
  - Cut off wall = 35'
  - A vote was called for these conditions:
    - Considering the high and low factors, the average was 2.78%
    - After removing the high and low factors, the average was 2.71%
    - Conclusion: Animal burrows not a significant issue at this site

Scenario #5 – EROSION

- **CONDITIONS (and discussion on conditions)**
  - No Sacramento Bank Erosion Site documented per Tom Smith
  - Houses & Encroachments add some problem
  - Per Tom Smith, no history of erosion; the Sacramento Bypass Weir is at elevation 27 ft, no issue; velocity changes upstream
  - Sand covers the site. It is a very sandy site and there is a unique hydraulic condition that keeps that site scoured out. It has been fixed, so Tom stated he doesn't see a threat of erosion to the reach
  - Erosion from the river at high flow is not a problem; however, it could be with one of those intermediate flows with the water below the elevation 27 feet (below the Sacramento Bypass Weir)
  - Wind wave erosion may be an issue as much as stream velocity?
  - Tom advised they have documented no erosion in this part of the river due to wind wave – short term duration.
  - A vote was called for these conditions:
    - Considering the high and low factors, the average was 4.11%
    - After removing the high and low factors, the average was 3.86%
    - Conclusion: Erosion not an issue overall at this site

SUMMARY OF COMPONENTS ON THIS REACH (PREDICTING ALL WOULD EQUAL 10-25%)

- (General) Utilities (without sewer) 6%
- Vegetation 2-3%
- Erosion 4%
- Encroachment 7%
- Rodents 3%
- TOTAL 22-23% … not in the formulary method
- FORMULARY METHOD / JUDGMENT = 80.6% … 19.5% PROBABILITY OF FAILURE

The group decided to take a different rating approach on the subsequent sites. It was decided to discuss all conditions at the individual sites and then vote on all judgment components at the same time. If further discussion is needed, additional votes could be taken. The numbers next to each of the components reflect the average after excluding the highest and lowest factor.

American River Common Features GRR Geotechnical Expert Elicitation

SITE 2 – NATOMAS **CROSS CANAL – DOWNSTREAM OF HIGHWAY 99 / VESTAL DRAIN (24' TO 43.5' landside of the levee toe)**

- **GENERAL CONDITIONS:**
  - Vestal Drain Canal is near the levee
  - Historical seepage problems / remediated
  - Waterside stability at one location
  - Other slips on water side
  - Several phases of remediation
  - Grass only on the levee they regularly burn
  - Embankment constructed of fat clay
  - Cracks – 3' deep
  - There is a landside berm and chimney drain
  - Crest at 43' high / 20' wide
  - A vote was called with these conditions at the top of levee elevation of 43.5'. The results and additional discussion points follow:
    - Utilities – 5%
      - Few, but old
      - 2 Pump Stations
      - Water intake
      - Pipes are 3' wide and are penetrating the levees a little over mid-height
      - Pressurized coated steel pipes that are coated below the 200-year water level
    - Vegetation – 1%
      - Agricultural area on the landside
      - A few trees on water side
    - Erosion – 2.7%
      - Erosion from wind wave pretty low, not an issue
      - Flow velocity is low
      - Erosion at outfall structures mostly
    - Encroachments – 1%
      - Highway 99
    - Rodents - 6.5%
      - Yes, east end – beaver and beaver dams in the berm; no ground squirrel
    - Total 16%
      - The group was satisfied with these numbers

SITE 3 – AMERICAN RIVER SOUTH – CLOSE TO CAPITAL CITY FREEWAY BRIDGE

- **GENERAL CONDITIONS:**
  - Deep slurry cut-off wall except the window at the bridge that will be closed as WRDA 99
  - SAFCA is placing additional rock onto the levee, but doesn't go up to the crest
  - River Park flood fight in'55 for erosion
  - Cap City Freeway flood fight in '86 for erosion
  - H Street Bridge
  - All part of historical Erosion – Vegetation covers portion of the levee; Stone protection placed on 5 sites
  - Tom provided Dan's team last week with a report about the erosion and the existing hard layers in lower American River. This has a lot of the detail that will be included in the CGF GRR alternatives.
  - Downstream of Watt North bank and head cut to sewer line there is potential for channel erosion
  - In regards to velocity on levee, 1 – 2 fps for a discharge of 145,000 to 160,000 cfs. The discharge when the water is at the top of the levee is 192,000 cfs.
  - Significantly Encroached with houses, swimming pools and other
  - Trees on Levee / Some toppling with wind events
  - Considering entire Reach A from Mayhew to end of River Park, a vote was called with these conditions considering the water at the top of levee elevation of 60'. The results and

American River Common Features GRR Geotechnical Expert Elicitation

additional discussion points follow:

- Utilities – 3.86%
  - Many gravity lines penetrations
  - Some windows in the slurry cut-off wall remain but supposed to be closed
- Vegetation – 3.00%
  - Vegetation reaches top of levee on both land and water side of levee
- Erosion – 31.43%
  - Some historical erosion issues
- Encroachment – 3.57%
  - Lots of houses with swimming pools
  - Homes close to the levee
- Rodents – 2.43%
  - Rodent issues (not bad – rodent abatement and grouting programs are active)
- Total is 44% / Overall average was 31%
  - Conclusion: >

- A second vote was taken under the same conditions for erosion only considering the water at the top of the levee. The results were:
  - Average of 60%
- A third vote was taken under the same conditions for erosion only at 145 cfs at 6 feet below the top of the levee. The results were:
  - Average of 36%
- Mary inquired if we could consider the same threat on the North side. The response was yes, the same mechanism should be considered. Paul noted the North side is not encroached, so the encroachment may be less on the North side.
- With the significant erosion risk, the group noted that this failure method should be pulled out of the judgment curves on this reach and treated with an analytical approach similar to the seepage and stability.

SITE 4 – SACRAMENTO RIVER SOUTH – FROM AMERICAN RIVER DOWN TO LITTLE POCKET

- **GENERAL CONDITIONS:**
  - Levee is 14'high
  - There is a small floodwall, about 4 feet on the landside that works mainly as a retaining wall for the fill placed on the landside. The floodwall is high on the waterside. Railroad lines are on the landside fill. The City will construct the Riverside Promenade along this reach.
  - Numerous encroachments
  - Lot of seepage, mostly clear water, particularly at I-5.
  - 'Boat' I-5 Section is problematic
  - Pioneer Reservoir – relief wells and seepage berm
  - Erosion - "Concrete" rumble placed on the waterside slope that is less efficient for erosion but attracts rodents
  - Mary doesn't know if penetrations are controlled, but there are many of them
  - Closure sections are upstream of Old Sac
  - Just downstream of confluence with American River – some erosion
  - Sutter Road presents a weak link
    - *highest-tallest levee section*
    - *erosion issue*
    - *small slips at entrance*
  - Sac Bank sites are not finished
  - Erosion site at downstream end of reach jus above Little Pocket = at RM 55.2
  - I-5 higher than levee
  - Section very steep
  - Nothing "typical" about this reach.
  - Beavers are active
  - Stan Solida Cave in void at Sac RM 56.7L
  - Erosion site at Captain's Table is being considered as part of this
  - There are some relief wells
  - A vote was called with these conditions considering the water at the top of levee elevation.

American River Common Features GRR Geotechnical Expert Elicitation

The results and additional discussion points follow:
- Utilities – 5.43%
- Vegetation – 4.71%
- Erosion – 15.71%
- Encroachment – 5.71%
- Rodents – 7.86%

o 2nd vote taken after discussion had the following results:
- Utilities – 7.14%
- Vegetation – 3.14%
- Erosion – 13.57%
- Encroachment – 6.00%
- Rodents – 6.43%
- Medians were as follows:
  - Utilities - 7
  - Vegetation - 3
  - Erosion - 15
  - Encroachment - 5
  - Rodents – 5
- On lower Sacramento River, it's not just erosion from wind wave, but velocity is involved as well.

SHAPE OF THE CURVES DISCUSSION:
The group diverted from ranking the components for specific sites to holding a brief discussion regarding the shape of the curves. Highlights of the discussion included:
- The shape of the curve may vary
- 0 P(f) not necessarily at toe of levee
- 0 P(f) could be somewhere above the toe
- Specific characteristics of levee will impact shape / inflection points
- Generally concave up to design walls surface of defect
- Risk may not start at elevation of landside levee toe.
- Judgment curves are to deal with miscellaneous conditions not analyzed in seepage and/or stability analyses.

SITE 5 – SACRAMENTO RIVER - LITTLE POCKET (RM 54 to 56)

▪ **GENERAL CONDITIONS:**
- o Top of Levee is 41' with 20' wide
- o Steep waterside slopes
- o Deep Cutoff wall
- o We do not own right-of-way / access is limited / no immediate access/fences and gates all along the levee slopes and crown
- o A lot of room on the waterside for rodents – hard to mitigate, but not an apparent problem
- o A lot of vegetation / trees & plants
- o Seepage a problem before cutoff wall
- o Lots of penetrations
- o Bend in the river – large berm / erosion not an issue
- o A lot of encroachments
  - ▪ *Swimming Pools – some go to the toe of the levees*
  - ▪ *Tennis Court – cracked up due to under seepage or perhaps just normal wear?*
  - ▪ *Sprinklers all over the place*
- o A vote was called with these conditions at the top of levee elevation. The results and additional discussion points follow:
  - Utilities – 4.43%
  - Vegetation – 2.71%
  - Erosion – 8.43%
  - Encroachment – 6.43%
  - Rodents – 3.43%

American River Common Features GRR Geotechnical Expert Elicitation

- Medians:
  - Utilities - 5
  - Vegetation - 2
  - Erosion - 8
  - Encroachment - 6
  - Rodents – 3
- After further discussion it was determined that a second vote was not needed.
- A special note:
  - *It will be important for Mary to go back and compare the feedback on various sites for the same issue. It should also be noted that information is based on conditions today and are subject to change.*

SITE 6 – ARCADE CREEK

- **GENERAL CONDITIONS:**
  - There is a pump station
  - Levee height deficiency - Water is at top of levee
  - Levee embankments aren't as bad as the others
  - Levee constructed of clay material and it is less erosive
  - No trees on these levees
  - Levees were raised in the 1990s
  - T-wall exists
  - Arcade Creek is a narrow, deep and fast-acting canal
  - Some of the tallest floodwalls – up to 20'
  - Beavers are an issue
    - Have had collapses due to them upstream of Norwood bridge on the north side
    - Not many squirrel
  - Deep drainage canal on North side where it meets NEMDC. The city has an 8 foot deep concrete line channel
  - No slurry walls
  - Some older utilities cross the levees
  - Several pump stations that came in with the Folsom Dam Project and are likely around 60-years old
  - Protected agricultural area at one time, now highly developed
  - Access is good
  - Few encroachments
  - Water has high velocity, but not aware of erosion issues
  - A vote was called with these conditions at the top of levee elevation. The results and additional discussion points follow:
    - Utilities – 3.86%
    - Vegetation – 1%
    - Erosion – 2.71%
    - Encroachment – 2.86%
    - Rodents – 5.43%
    - Medians:
      - Utilities - 5
      - Vegetation - 1
      - Erosion - 3
      - Encroachment - 3
      - Rodents – 5
  - A second vote with the same conditions was called for utilities and rodents only after further discussion. The results and additional discussion points follow:
    - Utilities – 6.86%
    - Vegetation –
    - Erosion –
    - Encroachment –
    - Rodents – 8.29%
    - Medians:

American River Common Features GRR Geotechnical Expert Elicitation

- Utilities - 7
- Vegetation -
- Erosion -
- Encroachment -
- Rodents – 8

SITE 7 – SACRAMENTO RIVER BIG POCKET

- **GENERAL CONDITIONS:**
  - This is a narrow levee, only about 20‘ wide
  - It is asphalt paved
  - Sump132 is an active seepage site. Relief wells have been put in to fix and bring the new intake into compliance
  - Slurry wall stops at Cliff’s Marina, where railroad track leaves the levee
  - Known utilities were cut and relocated
  - Old irrigation line was plugged last summer
  - Encroachments are dramatic (same as in Little Pocket, but may have some going into the levee)
    - *Cliff’s Marina*
    - *Railroad prohibits inspection of the levee*
    - *Swimming Pools*
    - *Houses and fences*
  - Public highway at toe
  - Trees go to the crest of the levee and cover most of the levee center line
    - *6 ft tree in diameter on the levee*
  - Erosion issues? Yes, numerous erosion sites at this part of the levee; on West Sac after Mason’s Bend, there is a scour / straightens up downstream at Garcia Bend There have been a lot of repair work in this area (6-8 sites repaired) after 2006 flooding. Critical site repair has been completed. Repairs may not include key in trench
  - No berm. It is right at the toe of the levee
  - Made of silty sand and sand; there is also some sort of organic crust, not clay
  - Soil / Cement / Bentonite slurry wall
  - Active Erosion Reach
  - Minimal rodent activity
  - Wind wave – minimal erosion
  - Boat wake / wave issue at lower water, but this is a summer elevation issue
  - A vote was called with these conditions at the top of levee elevation. The results and additional discussion points follow:
    - Utilities – 3.86%
    - Vegetation – 3.29%
    - Erosion – 13.14%
    - Encroachment – 7.43%
    - Rodents – 3.29%
    - Medians:
      - Utilities - 3
      - Vegetation - 2
      - Erosion - 15
      - Encroachment - 7
      - Rodents – 3
    - Conclusion: The group feels this erosion is just as bad as Little Pocket (although Little Pocket higher).
  - A second vote with the same conditions was called for erosion only after further discussion. The results and additional discussion points follow:
    - Utilities –
    - Vegetation –
    - Erosion – 16.29%
    - Encroachment –
    - Rodents -

American River Common Features GRR Geotechnical Expert Elicitation

- Medians:
  - Utilities -
  - Vegetation -
  - Erosion - 16
  - Encroachment -
  - Rodents –
  - Encroachment -
  - Rodents –

Site 7 concluded the rankings portion of the meeting for specific sites.

QUESTION FROM DAN:
MDR advised the team he had a question from the Project Manager, Dan Tibbitts, to pose to the panel:

"On the components below, are there any other problem reaches that we did not cover, i.e., "reaches of concern"?

Les stated he feels the 5-6 sites that we've rated should cover the other 21 sites. Mike I agreed.

After further discussion, the following areas were identified to be of concern for the component described:

UTILITIES:
- Natomas: Pump Station 1 & 2
- Pleasant Grove Creek Canal
- Del Paso Blvd Flood Gate

VEGETATION:
- North of I-5 along Sacramento River

EROSION:
- Wind wave – Sacramento River just below Cross Canal

ENCROACHMENTS:
- None

RODENTS:
- None

QUESTION FROM MARY: SPD1 SAYS SENSITIVITY ANALYSIS NEEDS TO BE DONE IF THE LEVEE FAILS OR JUST POOR PERFORMANCE? PROBABILITY OF POOR PERFORMANCE VERSUS PROBABILITY OF BREACH?
The group proceeded to have a lively discussion on these questions. Highlights / comments of the discussion included:

- As water goes up, human intervention will be less successful. You would be pulling your crews off at that point due to danger level.
- Ability to mitigate the risk with human intervention increases as water surface goes down.
- Can you easily translate P(f) to P(breach)?
- Do we have any chances to prevent failure?
- What is the affect of flood fighting?
- What are the chances of going from poor performance to failure?
- Intervention is either successful or not; if successful, no breach; if not successful, can have breach or no breach (depends if the correct problem has been detected).
- No intervention?
- Success is defined as stopping the progression of the levee failure / breach**.**
- Don't want to count flood fighting first
- Henri commented it is almost like you need another curve
- Economics group is wanting these sensitivity analysis
- This can be looked at as a "correction factor", however, one is the real curve
- Paul noted that the curves will be different depending where you are in the country.
- Toe of levee does not appear to be an issue
- 33% of the levee height eventually to be considered as less likely the poor performance to lead to failure
- Mike I suggested Mary refers back to historical data and that this discussion is purely conjecture. He doesn't feel it can be done in this forum without empirical data.
- MDR iterated to Mary that she has to look at each curve and evaluate them on this topic individually. She would need another Expert Elicitation to cover this topic

American River Common Features GRR Geotechnical Expert Elicitation

- This topic of discussion ended without resolution

LESSONS LEARNED / RECOMMENDATIONS TO CORPS – Discussion started at 4:20 pm

MDR led the team in a discussion on the lessons learned, to include recommendations to the Corps, as a result of this 2-day meeting and the feedback they have provided. Highlights / comments include:

- Vegetation does not contribute significantly to P (poor performance)
- Local sponsors with knowledge & experience in maintaining the levee is extremely valuable to the discussion as well as the history of such information
- Need biased and unbiased opinions
- Confidence in prediction were on the reaches where folks had experience and knowledge
- Need better "read ahead" performance history
- Les asked MDR what he thought about having nine panelists. Les commented that he thought it worked out well in regards to consensus. MDR responded that in order to get to what we needed to talk about, it was good to have a broad group; but to try to accomplish 27 sites, it was too many people. Smaller groups normally result in faster answers; however, larger groups likely produce better answers. For this, he felt it went well. Having a panel of nine was valuable in this case.
- Ed expressed he felt the generalized discussion first was good and then going to site specific worked well. Start up with general discussion was helpful for him.
- Les added having clear set of definition and purpose/goal would have been helpful. Further, he said he thought we got there, it just took a while.
- Mike I felt the way we got through things this afternoon went very well.
- Paul suggested that a more expedient voting method would have been helpful and helped things to move forward.
- Mike N noted that judgment curves are important and can significantly affect performance / economic results. He would like to see a cap on how judgment affects the overall decision. Inclusion of judgment curves make "flaws" / failures more frequent and likely increases average annual damages: as components increase, P(f) increases. He expressed a summary of data developed simultaneously as debate proceeds would be good.
- Need separate evaluation for critical site P(f) high and not included in judgment.
- Mike N. inquired about how rodents are being looked at. From discussion, it seems that beavers are of much more concern than squirrels.
- There was an determined need to separate out:
  - Pump Plant 1?
  - Sewer Line?
- What happens now as far as information collected these past two days?
  - Melanie will compose a draft of the meeting minutes to be distributed to the Expert Elicitation attendees
  - Attendees will be asked to provide comments by tracking changes within a specified time
  - Melanie will finalize minutes
  - Mary will then compile report to include summary, statistical information as well as the revised curves. The report will require the signatures of everyone.
  - Once produced, she will provide a copy to all
- Henri noted that while the curves developed by the panel are much lower than Mary's, it doesn't mean the existing conditions considering encroachment, penetration and vegetation are desirable. He advised there is a need to keep probability approach separate from deterministic.
- Dan advised the team they have an array of alternatives that will comply with environmental or with SAFCA's (for which they will likely need a variance).

Wrap-Up Comments – Team

MDR solicited wrap-up comments from the team.

Ed told the team of a vegetation issue he experienced in Lompoc with cottonwood after a large storm. It took out the bridge and flooded the area. It was a big hindrance.

Day 2 Concluded at 5:10 pm