Flood Risk Reduction Feasibility Study for:

Delta Legacy Community of Courtland, CA

Funded by California Department of Water Resources Small Communities Flood Risk Reduction Program

Submitted to:
Sacramento County Department of Water Resources

Submitted by:
GEI Consultants, Inc.
2868 Prospect Park Drive, Suite 400
Rancho Cordova, CA 95670
916-631-4500

August 30, 2021 DRAFT

Visit the Courtland Story Map for more details of the community, its history, and flood risk concerns: Courtland Story Map - Sacramento County Small Communities Flood Risk Reduction Program.[1]

[1] http://www.arcgis.com/apps/MapJournal/index.html?appid=0471b70d12d6444c8b65e27de4c8aaea

[This page intentionally left blank]

DRAFT

Table of Contents

DRAFT

DRAFT

DRAFT

DRAFT

Tables

DRAFT

Figures

DRAFT

Appendices

DRAFT

Acronyms and Abbreviations

AFOTF	Agricultural Floodplain Ordinance Task Force
APE	area of potential effect
AWSE	Assessment Water Surface Elevation (used for DWR NULE levee performance curves)
BFE	Base Flood Elevation
BWFS	Basin-Wide Feasibility Study
BW-12	Biggert-Waters Flood Insurance Reform Act of 2012
CCR	California Code of Regulations
CDFW	California Department of Fish and Wildlife
CEQA	California Environmental Quality Act
CFR	Code of Federal Regulations
cfs	cubic feet per second
Conservancy	Delta Conservancy
county	Sacramento County
CPT	cone penetration test
CRHR	California Register of Historical Resources
CRS	Community Rating System (developed by FEMA to reduce community specific NFIP premiums)
CTA	Courtland Town Association
CVFPB	Central Valley Flood Protection Board
CVFPP	Central Valley Flood Protection Plan
CVP	Central Valley Project
CVRMP	Central Valley Riparian Mapping Project
DCA	Delta Conveyance Authority
Delta	Sacramento-San Joaquin Delta
District	Reclamation District
DLIS	Delta Levees Investment Strategy
DPC	Delta Protection Commission

DRAFT

DSC	Delta Stewardship Council
DWR	California Department of Water Resources
EAD	Expected Annual Damages
EIR	Environmental Impact Report
EOP	Emergency Operations Plan
ESP	Emergency Safety Plan
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
FODSS	Flood Operation Decision Support System (developed by Sacramento County OES and Ca DWR
fps	feet per second
FSR	Feasibility Study Report
FSRP	Flood System Repair Project (developed by DWR)
ft.	feet
GAR	Geotechnical Assessment Report (developed by DWR)
GHAD	Geologic Hazard Abatement District
H&H	hydrologic and hydraulic
HFIAA	Homeowner Flood Insurance Affordability Act
HMP	Hazard Mitigation Plan
HOA	Homeowners Association
IWM	Integrated Water Management
Legal Delta	legally defined Sacramento-San Joaquin Delta
LHMP	Local Hazard Mitigation Plan
LMA	Local Maintaining Agency
LOI	Letter of Intent
LURMP	Land Use and Resource Management Plan (by Delta Protection Commission -DPC for Primary Zone of Delta)
M	million
MA	Structural-Based Management Action
NAVD 88	North American Vertical Datum 1988

DRAFT

NEPA	National Environmental Policy Act
NFIP	National Flood Insurance Program (developed by FEMA)
NOI	Notice of Intent
NRHP	National Register of Historic Places
NULE	Non-Urban Levee Evaluation (developed by Ca DWR)
OA	Operational Area
OES	Office of Emergency Services
O&M	operation and maintenance
OMRR&R	operation, maintenance, repair, rehabilitation, and replacement
PCS	Potential Conservation Sites
PL	Public Law
RD	Reclamation District
RFMP	Regional Flood Management Plan (component of CVFPP)
RM	river mile
RMA	routine maintenance agreement
ROW	right-of-way
RR&R	repair, rehabilitation, and replacement
RSP	rock slope protection
SB	Senate Bill
SCFRRP	Small Communities Flood Risk Reduction Program
SEMS	Standardized Emergency Management System
SFHA	Special Flood Hazard Area
SPA	Special Planning Area
SPFC	State Plan of Flood Control
SR	State Route
SRA	Shaded Riverine Aquatic (habitat)
SRFCP	Sacramento River Flood Control Project
SSJDNHA	Sacramento-San Joaquin Delta National Heritage Area
SWIF	System-wide Improvement Framework (administered by USACE; routed through CVFPB
SWP	State Water Project

DRAFT

U.S.	United States
USACE	U.S. Army Corps of Engineers
USBR	U.S. Bureau of Reclamation
USFWS	U.S. Fish and Wildlife Service
WSEL	water surface elevation

DRAFT

Executive Summary

In 2017, Sacramento County received grants from the California Department of Water Resources (DWR) Small Communities Flood Risk Reduction Program to complete feasibility studies to reduce flood risks to five Delta Legacy Communities in the north Delta, including: Hood, Courtland, Locke, West Walnut Grove/Ryde, and East Walnut Grove.

The scope of this study is to identify a potential suite of structural and non-structural flood risk reduction elements, develop Management Actions (MAs) based on these potential elements, develop and prepare implementation costs for each of the MAs, identify a preferred suite of MAs and other non-structural measures based on stakeholder and community input, and to develop an implementation plan which includes an implementation schedule and finance plan. The study considers potential solutions to reduce flood risk while sustaining agriculture and the regional economy, improving riverine habitat viability, addressing regional levee maintenance governance, and improving the resiliency and reliability of conveying fresh water through the Delta with an improved, multi-benefit leveed system in the Sacramento River Corridor upstream of the Delta Cross Channel.

Courtland is located along the left bank of the Sacramento River approximately 20 miles downstream and southwest of downtown Sacramento along the Sacramento River, and approximately 4.1 miles downstream of Hood. Levees which protect the tract of land known as the Pearson District, where the Delta Legacy of Courtland is located, are maintained by Reclamation District 551 (RD 551). Levees upstream from the community on the adjacent tract of land known as Randall Island are maintained by RD 755. In total, the collective Courtland study area which comprises both Pearson District and Randall Island is protected by nearly 16 miles of levees which provide protection from flows in the Sacramento River to the north and to the west, Snodgrass Slough to the east, and Delta Meadows Slough to the south.

The levees surrounding the Courtland study area were initially constructed prior to 1906 by local interests and were generally built using materials dredged from the adjacent Sacramento River and the nearby adjoining Snodgrass Slough to the east, and Delta Meadows Slough to the south. Over time, various improvements have been made to the levees in the study area located along the left bank of the Sacramento River and are now considered part of the State and federally authorized Sacramento River Flood Control Project (SRFCP) and are now part of State Plan of Flood Control (SPFC) levees. The levees on the east and south sides of RD 551 adjoining Snodgrass Slough, the RD 551 Borrow Ditch, and Delta Meadows have also been improved over time, but are not considered part of the federal and State authorized SRFCP nor a portion of the SPFC levee systems.

DRAFT

Sacramento County and its consultants developed this feasibility study in coordination with a planning committee comprised of residents living within the community of Courtland, including landowners and business owners that live within the community and within the two noted RDs, and representatives from RDs 551 and 755. Other representative participating stakeholders with interest and knowledge in providing enhanced flood protection for the Delta Legacy Community of Courtland, including residents and landowners within Courtland and agricultural landowners within the larger RD 551 and 755 basins, were also consulted. Several public stakeholder meetings were held to identify existing concerns and solicit feedback on the feasibility study process.

Structural-based Management Actions

A suite of eight potential structural-based MAs were formulated based on stakeholder discussions and available geotechnical data, including new geotechnical data collected in late summer/early fall of 2019 as part of this feasibility study. These structural-based MAs include repairing known erosion sites as identified by the District Engineer (MBK Engineers) for RDs 551 and 755; repairing known critical and serious seepage sites as previously identified by DWR in their Flood System Repair Project (FSRP); repairing and strengthening-in-place various portions of and/or the entirety of the RD 551 and 755 perimeter levee system(s); constructing a potential ring levee or an all-weather access road/flood-fight berm around Courtland; and securing 100-year Federal Emergency Management Agency (FEMA) 100-year accreditation for the community of Courtland.

These eight structural-based MAs can be paired with a suite of non-structural MAs, including the potential implementation of a community-based private flood insurance program developed specifically for the noted community and/or additional Delta Legacy Communities *via* either a homeowners association, Sacramento County, or other means such as a Geologic Hazard Abatement District (GHAD). The key non-structural action items for consideration are summarized below within this Executive Summary and in Section 7.3 of this Feasibility Study Report.

The MAs were evaluated qualitatively against the study's planning objectives of reducing risk to life; reducing risk to property damage; reducing probability of levee failure; reducing high, escalating National Flood Insurance Program (NFIP) flood insurance premiums; improved flood preparedness and response; enhancing resiliency and reliability of through-Delta water conveyance, and identifying multi-objective opportunities. Each of the MAs were also evaluated qualitatively relative to agricultural sustainability, local support, and cost.

With this trade-off analysis and a final stakeholder meeting held in November 2020, and follow-up presentations to the Delta Legacy Communities Board of Directors and regional Rotary Club meetings held November 2020 through June 2021, a recommended suite of structural-based MAs was further identified as follows:

DRAFT

- **Management Action 1**: Repair DWR FSRP Critical and Serious Sites in RD 755 (sequentially 1A thru 1B, with 1A presenting the greatest risk to Courtland)
    - 1A: Repair DWR FSRP Critical Site in RD 755
    - 1B: Repair DWR FSRP Serious Site in RD 755
- **Management Action 2**: Address Erosion Sites and Erosion Concerns on SPFC and Non-SPFC Levees
    - 2A: Address Erosion Sites on SPFC Levees Along Sacramento River Left Bank Identified by Local Maintaining Agency (LMA) Representatives – MBK Engineers
    - 2B: Address Potential Erosion Concerns on Non-SPFC Levees Adjoining Snodgrass Slough and Delta Meadows Slough
- **Management Action 3**: Repair and Strengthen-in-Place SPFC Levee Reach Immediately Adjacent to Courtland to Largely Address Through-Seepage Concerns and Potential Life Loss
- **Management Action 4**: All-Weather Access Road and Flood-Fight Berm for the community of Courtland
- **Management Action 5:** Potential Ring Levee and FEMA 100-yr. Certification for the community of Courtland was also recommended as an alternative to Management Action 4.

The estimated cost, net reduction in Expected Annual Damages (EADs) to the Courtland study area under existing conditions (without climate change adjustments), and the flood risk reduction payback period in years (excluding interest) associated with MAs 1, 2, 4, and 5 are summarized below. The cost for the recommended suite of relatively short-term MAs 1 through 4 is estimated at $59 million (M) in 2020 dollars. If MA 5 (ring levee & FEMA certification) is implemented in place of MA 4 (all-weather access road/flood-fight berm), the total estimated capital cost is $75M in 2020 dollars. Of the four MAs, collectively implementing MAs 1 and 2 provides the largest incremental value to the community of Courtland and the larger study area. With the implementation of these MAs, the total net reduction in EAD for the Courtland study area is estimated at $43M under existing conditions, and as high as $91M under future conditions with climate change adjustments. Repairing just the FSRP critical site in RD 755 (MA 1A) provides the next largest incremental value to the community and the larger study area, with a total net reduction of nearly $13M under existing conditions, and as high as $22M under future conditions with climate change adjustments. MAs 4 and 5 provide similar value to the Courtland study area with a total net reduction in EAD of around $6M, and as high as $13M under future conditions with climate change adjustments.

DRAFT

Table ES-1: Estimated Cost, Net Reduction in EAD and Flood Risk Reduction Payback Period Associated with the Recommended Suite of Management Actions

Management Action	Estimated Cost	Total Net Reduction in EAD to the Courtland Study Area under Existing Conditions[1]	Flood Risk Reduction Payback Period in Years (excluding interest)[2]
Repair of the FSRP Critical Seepage Site in RD 755 **(MA 1A)**	$1,267,000-$3,750,000	$12,800,000	0.3 years
Repair of the FSRP Critical and Serious Seepage Sites in RD 755 and Erosion Sites and Potential Erosion Concerns **(MA 1, 2)**	**Combined Total Cost of MA 1, MA 2:** $19,764,000-$39,966,000	$43,043,000	0.9 years
All-Weather Access Road/Flood Fight Berm for Courtland **(MA 4)**	$5,348,000	$6,101,000	0.9 years
Ring Levee System for Courtland & FEMA Certification **(MA 5)**	$25,176,000-$35,064,000	$6,312,000	5.6 years

[1] Net Reduction in EAD values are substantially greater under future conditions with climate change adjustments

[2] Flood risk reduction payback period in years is substantially shorter under future conditions with climate change adjustments

A key long-term MA (**MA 6**) contains State-wide multi-benefits by repairing and strengthening-in-place the Sacramento River left bank SPFC levee within the bounds of the study area between the upstream end of RD 755 (at River Mile [RM] 36.8) and the downstream end of RD 551 at Delta Meadows Slough (at RM 28.2) for a total of 8.6 miles. The same geotechnical remedial actions could improve the efficiency, resiliency, and reliability of improving the 8.6 miles along the left bank of the Delta's freshwater conveyance corridor along the Sacramento River between Delta Legacy Community of Freeport and the Delta Cross Channel. The current river channel and levee system collectively serve as a critical link of the through-Delta water conveyance system that conveys water *via* the State Water Project (SWP) and the Central Valley Project (CVP) to over 25M residences and over 3M acres of agricultural crops south of the Delta. The noted 8.6-mile stretch of the freshwater conveyance corridor is essential to continued and sustainable freshwater conveyance through the Delta with or without the introduction of a possible dual or isolated conveyance facility (including a tunnel) under consideration by the Delta Conveyance Authority (DCA). The 8.6-mile stretch of SPFC levees along the left bank of the Sacramento River between RD 755 and Delta Meadows Slough represents approximately 23 percent of the non-urban SPFC levee system along the freshwater conveyance corridor between Freeport and the Delta Cross Channel, and 14 percent of the entire 62 miles of the non-urban SPFC levee system along the freshwater conveyance corridor in the North Delta. The multi-benefit of improving both the water conveyance

DRAFT

system and the flood control system could gain wide acceptance and cost-sharing opportunities at the regional, State, and federal levels within and south of the Delta. The cost of this multi-benefit element is currently estimated between approximately $107M and $404M within the subject study area of Courtland. Implementation recommendations for the multi-benefit project include Courtland and its neighboring Delta Legacy Communities to meet and work with RFMP representatives, including the Sacramento Area Flood Control Agency, West Sacramento Flood Control Agency, Central Valley Flood Protection Board (CVFPB), and DWR Maintenance Area 9 (MA 9) to share and ideally implement their preferred alternative of how improving the limited number of SPFC levee miles along the Sacramento River in the North Delta will also improve the reliability and resiliency of conveying SWP and CVP water through the entire Delta, with or without an independent, isolated conveyance facility. The multi-benefit attributes of improving and modernizing the SPFC levee system in tandem with improving conveyance of SWP and CVP water through the Delta should also be presented and shared with the Delta Protection Commission, Delta Stewardship Council, and the Delta Conservancy.

Non-Structural Measures

In addition to the key structural-based MAs highlighted above, several non-structural measures were evaluated for their potential to reduce residual flood risks. These non-structural measures can be implemented independent of, or in combination with, the structural-based improvements. This study recommends the following key non-structural measures for implementation, some of which are already in the early stages of implementation:

- Voluntary structural elevation of residential and commercial structures.
- Wet or dry floodproofing residential, commercial, and agricultural structures.
- Improved emergency response for the Courtland study area and adjoining RDs in the Lower-Sacramento - North Delta Regional Flood Management Plan (RFMP) region.
- Implementation of a community-based flood-risk insurance program Specific to the community of Courtland in lieu of or in tandem with the current FEMA NFIP. The nearby city of Isleton has taken the initial steps in implementing a similar insurance program and there may be some local economies of scale for Courtland and other nearby Delta Legacy Communities in the North Delta to pool their resources together and possibly be a pilot test case for establishing a regionally based insurance program for rural communities in the Delta and greater Central Valley. In addition to reducing flood insurance rates the program can also be tailored to buy-down risks by establishing and setting aside local cost-share funds to improve and implement flood risk reduction MAs outlined above and non-structural measures outlined herein.
- Updating the Sacramento County Local Hazard Mitigation Plan and formalizing potential relief cut locations within RD 551
- Continued and improved public education and awareness

DRAFT

- Support continued actions to improve and maintain high NFIP Community Rating System (CRS) score for Sacramento County/Courtland
- Continued State support for refinements and Amendments to the NFIP *via* Agricultural Floodplain Ordinance Task Force and H.R. 3167
- Improved governance between RDs 551 and 755, other regional RDs in the north Delta, and a potentially establishing a Homeowners Association or GHAD for establishing a community-based flood insurance program and reducing flood risks within the community of Courtland

DRAFT

1. Introduction

The California Department of Water Resources (DWR) Small Communities Flood Risk Reduction Program (SCFRRP) and the Regional Flood Management Plans (RFMPs) were created following adoption of the 2012 Central Valley Flood Protection Plan (CVFPP) by the Central Valley Flood Protection Board (CVFPB). Both the RFMPs and SCFRRP were created by the CVFPB and DWR and are intended to be locally developed flood risk programs authored by regional flood control agencies, Local Maintaining Agencies (LMAs), local Reclamation Districts (RDs), local land-use planning entities such as counties and cities, and the residents of the communities protected by State Plan of Flood Control (SPFC) levees. The RFMP program consists of six regional plans within the extent of the CVFPP, three within the Sacramento River Basin and three within the San Joaquin River Basin. The Lower Sacramento River/North Delta RFMP, completed in July of 2014 (herein referred to as the 2014 RFMP), encompasses the greater Sacramento River corridor, the Yolo and Sacramento Bypass systems, and the north Delta Legacy Communities along the Lower Sacramento River system between Sacramento and Rio Vista. Small communities, as defined in the CVFPP, are communities protected by SPFC levees with populations between 200 and 10,000, but exceptions were made to include Delta Legacy communities with populations of less than 200, such as Locke and Ryde.

The SCFRRP is very similar to the DWR 5-year plans developed for and by the levee districts throughout the Delta where the LMAs or RDs are tasked with identifying where their greatest risks are to flooding, and each of the LMAs or RDs prioritize repairs and improvements to their levee systems to minimize flood risks. The key difference between the two programs is the SCFRRP focuses more on the densely populated portions of land tracts protected by SPFC levees; whereas the Delta 5-year plans focus more on the perimeter levee systems protecting the tracts/islands within the Delta independent of whether the levees are SPFC or non-SPFC levee systems.

1.1 Intent of Senate Bill 5 for Small Communities

The Central Valley periodically experiences devastating floods. One of the most recent large events in 1997 led to passage of the Central Valley Flood Protection Act of 2008, also known as Senate Bill (SB) 5. SB 5 requires DWR to prepare a strategic, systemwide flood protection plan for SPFC[1] facilities in the Sacramento-San Joaquin Valley. The 2012 CVFPP was the first iteration of this plan, and SB 5 mandates that it be updated on 5-year intervals.

Regarding small communities, SB 5 requires cities, counties, and State and local flood management agencies to collaborate to provide cost-effective strategies for reducing flood risk.

[1] In summary, the SPFC includes the State and federal flood control works, lands, programs, plans, conditions, and mode of maintenance and operations of the SRFCP described in Section 8350 of the California Water Code, and of flood control projects in the Sacramento River and San Joaquin River watersheds for which the State (DWR or CVFPB) has provided assurances of nonfederal cooperation to the United States.

DRAFT

The bill also called for development of funding mechanisms to finance flood protection responsibilities at the local level. To this end, the 2012 CVFPP included many broad goals for improved flood management for areas protected by SPFC facilities, including small communities and portions of the Sacramento-San Joaquin Delta (Delta).

The SCFRRP focuses specifically on reducing flood risks for small communities protected by SPFC facilities, including areas designated as Delta Legacy Communities. Small communities are defined as communities protected by SPFC facilities with a population of less than 10,000 residents. Delta Legacy Communities are a subset of small communities, located within the legally defined (Legal) Delta, which have cultural, historic, and ambiance value that give the Delta a distinctive sense of place (Delta Protection Commission [DPC], 2012) (Figure 1-1).

Under the SCFRRP, Sacramento County (county), as the local land-use planning entity, was awarded a DWR grant in 2017 on behalf of the community of Courtland, to prepare a feasibility study to identify and prioritize flood risk reduction Management Actions (MA). For the purposes of this report, the community of Courtland refers to the densely populated community of Courtland. In addition to Courtland there are seven additional Delta Legacy Communities that received grant funds to prioritize flood risk reduction measures in the Sacramento River corridor of the North Delta. Those Legacy communities include: Hood, Locke, East Walnut Grove, West Walnut Grove/Ryde, Clarksburg, Rio Vista, and the city of Isleton,.

DRAFT

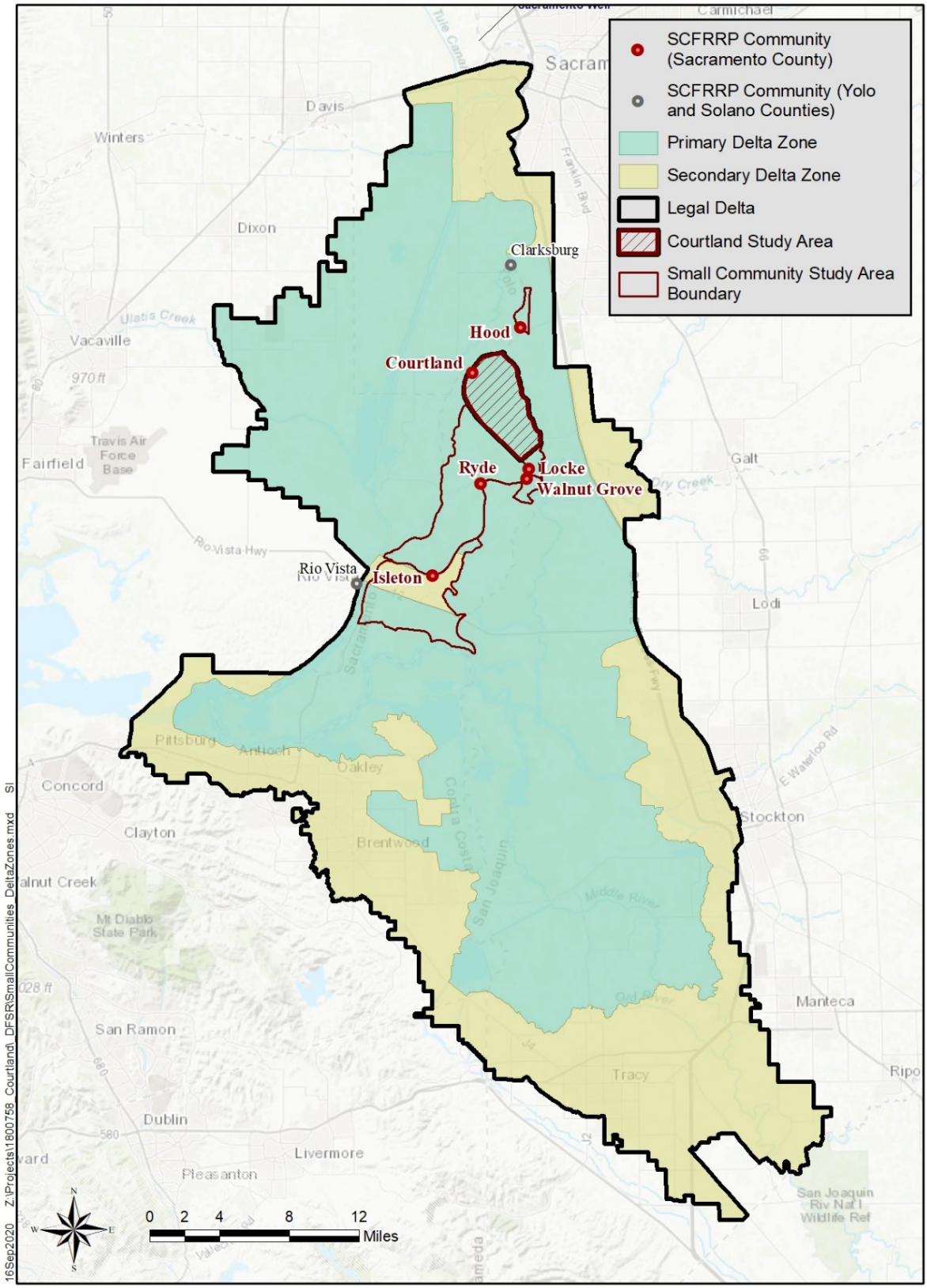


Figure 1-1. Delta Legacy Communities Participating in the DWR Small Communities Flood Risk Reduction Program

1.2 Goals and Scope of the Study

As described in the 2012 and subsequent 2017 CVFPP Update, the goal of the State as well as the Delta Legacy Communities is to improve SPFC levees and applicable adjoining non-SPFC levees protecting small communities to achieve 100-year (1% annual chance) flood protection, as defined by the Federal Emergency Management Agency (FEMA). Consistent with this goal, the goal of this feasibility study is to develop, evaluate, and prioritize structural and non-structural flood risk reduction measures for the Courtland study area, which would also strengthen and modernize SPFC levees within the study area upstream of the existing Delta Cross Channel, and to ultimately achieve 100-year flood protection and meet FEMA 100-year certification criteria.

Structural Flood Risk Reduction Measures

- Repair/strengthen in-place existing levee system(s)
- Strengthen existing levee(s)/embankments with cut-off walls, seepage berms, stability berms, etc.
- Repair existing erosion sites on levee systems
- Address and correct known encroachments/deficiencies in levee systems that pose threat to levee integrity
- New setback levee in place of existing levee system segments

The flood risk reduction measures to be developed include multi-benefit objectives for Courtland and its agricultural, recreation, and socioeconomic attributes, where possible, as well as statewide water conveyance benefits along the Sacramento River. Improvements of the SPFC levee system protecting the Courtland study area can collectively enhance the resiliency and reliability of through-Delta water conveyance upstream of the Delta Cross Channel.

Non-Structural Flood Risk Reduction Measures

- New ring levee system(s) and/or new cross levee to isolate smaller areas (communities) from a larger perimeter levee system that may be more susceptible to levee failures
- New all-weather access roads or flood-fight berms to address and potentially fend-off rising flood water that may occur in other portions of a large RD compared to a small fractional area (community) protected by a larger perimeter levee system
- Voluntary elevation of structures, ideally for potential flood depths greater than 3-5 feet (ft)
- Wet or dry floodproofing of structures, ideally for flood depths less than 5 ft, and some agricultural structures for flood depths greater than 5 ft
- Securing FEMA accreditation by executing a number of combined structural and non-structural measures pursuant to 44 CFR §65.10
- Improved Emergency Response; Local Hazard Mitigation Plans, Flood Emergency Safety Plans, and potential relief cuts
- Alternatives to FEMA's National Flood Insurance Program – community- and flood-risk based insurance programs with or without formation of a Geologic Hazard Abatement District
- Public awareness and education of local and regional flood risks
- Improved governance between neighboring LMAs/RDs and communities
- Regional/local flood easements and flood flow/channel conveyance enhancements
- Acquisitions and relocations of structures and residents

While 100-year flood protection is the goal of the State and the Delta Legacy Communities, there are concerns that improvement of the flood control system could encourage development, thereby potentially increasing flood risk. However, within the Primary Zone of the Delta (Figure 1-1), there are significant restrictions within the 2013 Delta Plan adopted by the Delta Stewardship Council (DSC) that do not permit development to occur by displacing agricultural land uses. As a result, improvements identified in

DRAFT

this study are not expected to induce development and/or result in increased flood risk within the Courtland study area.

1.3 State's Interest in the Delta

The State of California has broad interests in integrated water management within the Delta which must be considered within the context of this feasibility study, including:

- *Water Supply Reliability* – The State supports the availability and conveyance of surface water (when available based on hydrologic conditions), timely delivery, and adequate water quality for urban and agricultural water users. Water from north of Delta sources is delivered through the Delta by DWR, *via* the State Water Project (SWP), State Water Contractors, and the United States (U.S.) Bureau of Reclamation, *via* the Central Valley Project (CVP).
- SWP and CVP supplies conveyed south of Delta serve approximately 3M acres of agricultural lands and a population of 25M.
- The entire volume of water conveyed by the SWP and CVP currently passes directly by Courtland *via* the SPFC-leveed channel of the Sacramento River.
- The 8.6 miles of SPFC levees along the left/east bank of the Sacramento River managed by RD 551 and RD 755 protecting the Courtland study area also serve as a vital element of the primary through-Delta water conveyance channel in the North Delta, with or without an isolated conveyance system, as presently proposed by the CA.

Sustainable Delta – the State supports investments that contribute to Delta sustainability and resiliency in the face of sea level rise and climate change, which will likely result in higher and longer duration of flood stages.

- *Delta Ecosystem Protection, Enhancement, and Restoration* – The State supports integrating flood and water management with ecosystem restoration actions that may include, riparian, tidal marsh, freshwater marsh, and floodplain habitats.
- *Preserving the Unique Characteristics of the Delta* – Delta Legacy Communities have a distinct natural, agricultural, and cultural heritage with the State recognizing the importance of preserving and enhancing the unique characteristics of these Delta Legacy Communities. Through numerous initiatives, the State has prioritized support for the preservation and revitalization of these communities, as well as the Delta agricultural economy and culture, fishing, boating, waterfowl and upland game bird hunting, wildlife viewing, and recreation. In addition to the State's recognition of significant cultural values, the entire Legal Delta has received the distinction as California's one and only National Heritage Area, designated by Congress in March 2019.

DRAFT

- *Providing Appropriate Levels of Flood Protection* – The State, through DWR, has a long history of cost-sharing with federal and local agencies on projects that provide benefits to the local, State, and national economic interests. Although operation and maintenance (O&M) is coordinated through LMAs in the Delta, for most areas, the State ultimately has O&M responsibility for SPFC facilities, including SPFC channel maintenance and also an interest in providing technical and financial assistance for levee maintenance and rehabilitation of non-SPFC facilities within the Delta.

The State's investment in integrated water management must contribute to a sustainable Delta. Therefore, this feasibility study defines which actions could potentially contribute the most to Delta sustainability and how levee investment metrics are defined, tracked, and measured.

1.4 Courtland's Need for Improved Flood Protection

Courtland is one of eight Delta Legacy Communities located along the Lower Sacramento River Corridor in the North Delta participating in the SCFRRP (Figure 1-2). The levees surrounding the community of Courtland were initially constructed prior to 1906 by local interests and were generally built using materials dredged from the adjacent Sacramento River and nearby adjoining sloughs. Various improvements have been made to the SPFC levees along the Sacramento River over the years, including levee reconstruction and bank protection work at multiple locations. In 2006, FEMA reached out to Sacramento County and the levee maintenance districts, including RDs 551 and 755, to learn if adequate documentation supported certification of the levees. In 2012, FEMA updated the flood insurance rate maps (FIRMs) and the Pearson District, including Courtland, were collectively mapped as a Special Flood Hazard Area (SFHA) Zone AE.

The levees protecting the community of Courtland not only fall short of meeting current modern levee design standards to provide a 100-year level of flood protection (pursuant to FEMA accreditation standards in the Code of Federal Regulations (CFR), Chapter 1, Subchapter B, Part 65, Section 65.10 [44 CFR §65.10]), but they also contain critical and serious sites under the DWR Flood System Repair Project (FSRP) that still warrant immediate attention for repair, preferably by 2024 or earlier.

Also, in 2012, the Biggert-Waters Flood Insurance Reform Act (BW-12) was passed putting into motion substantial annual increases to flood insurance costs until premiums are rated based on the elevation certificate. The unfortunate oversite in this is that the FEMA premiums don't recognize that the homes in Courtland are protected by a levee system. that has stood the test of time since the early 1900s. Consequently, whether or not one believes the flood hazard to be of concern, the cost of flood insurance administered by FEMA under the current National Flood Insurance Program (NFIP) has certainly become a large and continuously growing concern.

DRAFT

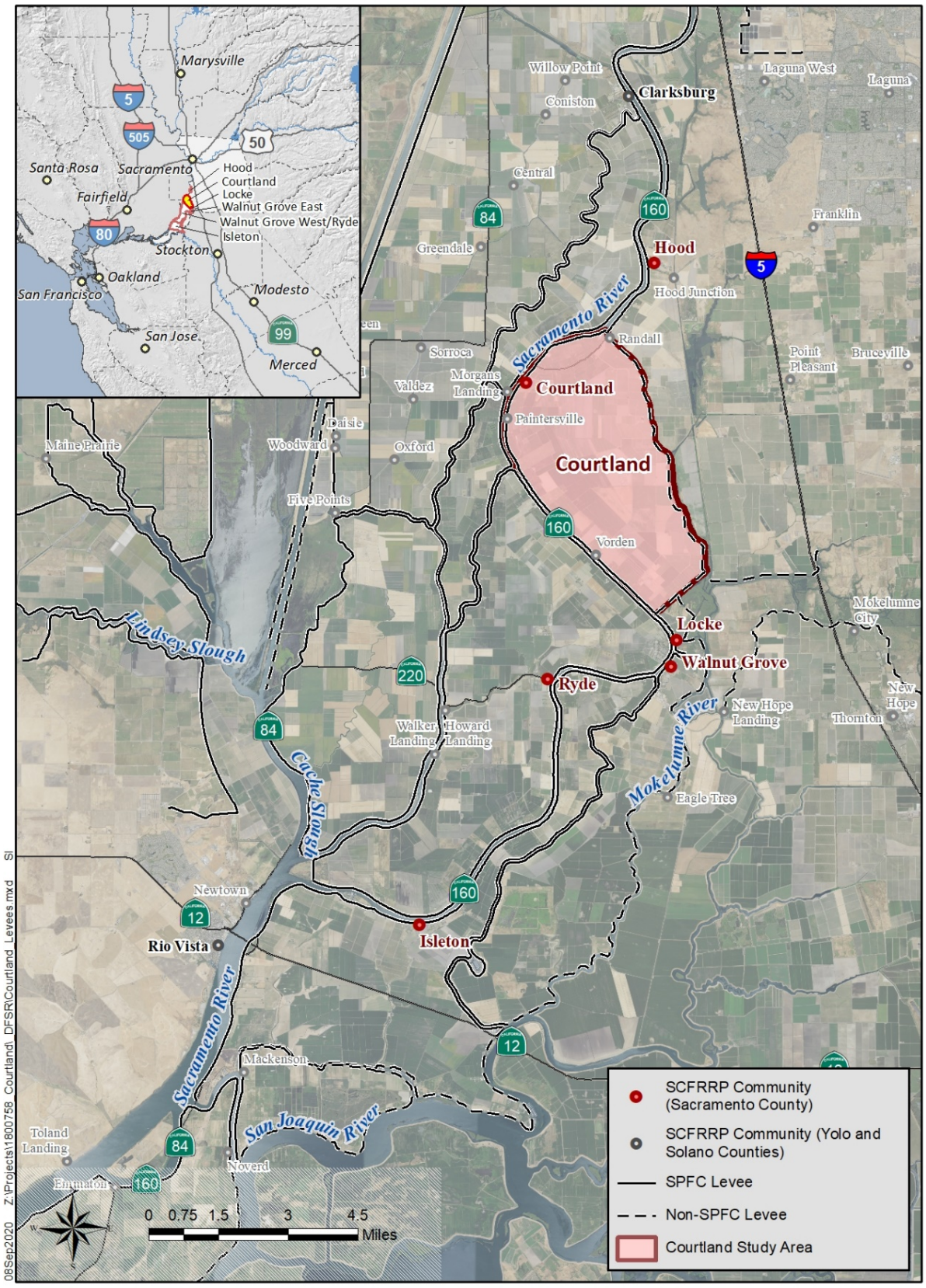


Figure 1-2. Delta Legacy Communities Participating in the SCFRRP.

1.5 Study Area and Location

The study area for this SCFRRP effort includes the community of Courtland and the larger 9,200-acre agricultural area shared between RD 551 and RD 755. RD 551 encompasses the tract of land known as Pearson District and RD 755 includes the adjacent Randall Island (Figure 1-3).

The densely populated community of Courtland within RD 551 encompasses approximately 146 acres and sits at an elevation of 8 to 12 feet (ft) (North American Vertical Datum 1988 [NAVD 88]) along the east (left) bank of the Sacramento River, south of Hood. Elevations and flood depths provided herein are referenced to NAVD 88. RD 551 is the primary LMA for this area and maintains 14.1 miles of levee (6.8 miles are SPFC levees along the left or east bank of the Sacramento River, and 7.3 miles are non-SPFC levees along Snodgrass Slough and Delta Meadows[2]). The RD 551 levee system protects approximately 8,800 acres, including the community of Courtland, which primarily consists of agricultural lands planted in permanent crops. Courtland sits within the boundaries of RD 551. RD 755 maintains 1.8 miles of SPFC levee system along the left or east bank of the Sacramento River to protect approximately 400 acres of primarily permanent orchard crops and two large fresh produce packaging facilities of regional significance. RD 755 is hydrologically connected to RD 551 as the two districts are separated by a slightly raised section of State Route (SR)

160. A levee breach of the SPFC levees on the left bank of the Sacramento River within RD 551 or 755 could very likely result in the inundation of significant portions of RDs 551 and 755 and the community of Courtland.

DRAFT

[2] In addition to other flood management facilities, the SPFC includes "Project levees," which were constructed by USACE as part of federal-State flood control projects and were turned over to the State for O&M ("assurances"). The State has generally passed on the responsibility for routine maintenance of Project levees to LMAs. The SPFC relies on many other non-SPFC features, such as non-State or federal reservoirs to regulate flows and reduce loading on the system and private levees in the Central Valley or non-project (local) levees in the Delta, for which the State has not provided assurances.

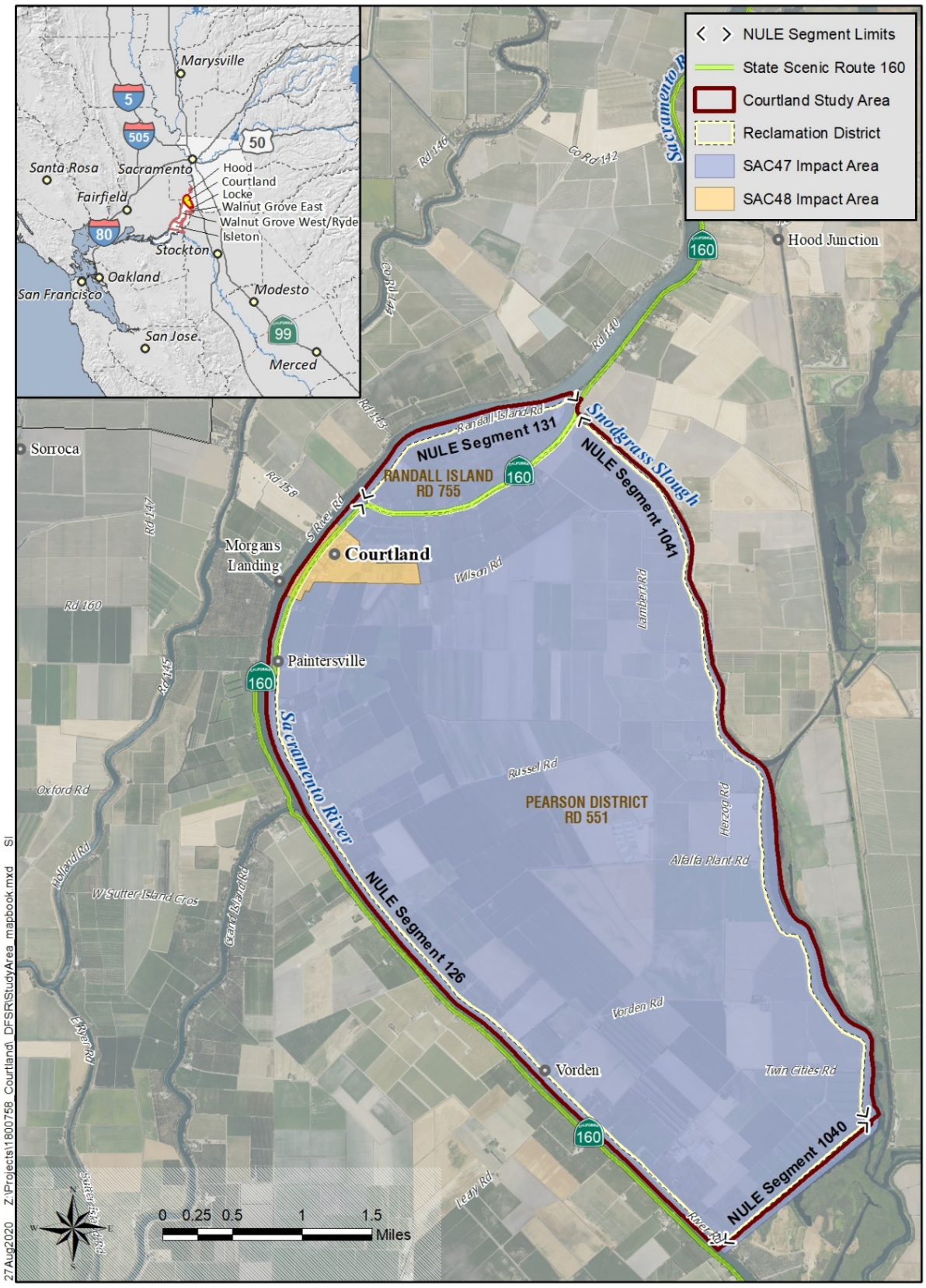


Figure 1-3. Courtland Study Area

1.6 Public Outreach and Engagement

This feasibility study has been prepared in close coordination with the community of Courtland and agencies with a shared interest in a safe, sustainable, and vibrant Delta. Sacramento County has been engaged with local planning groups for each Delta Legacy Community in Sacramento County to share the story of each community, help the public understand flood risks, and share possible flood risk reduction planning documents and solutions for the future.

Visit the Courtland Story Map for more details: Courtland Story Map – Sacramento County Small Communities Flood Risk Reduction Program.[3]

1.6.1 Stakeholder Identification and Outreach

The residents and business owners of Courtland have been invited and encouraged to participate in this planning effort that is intended to be developed from within the community of Courtland. This feasibility study has been prepared in close coordination with representative stakeholders with interest and knowledge in providing enhanced flood protection for Courtland. Stakeholders include representatives of RDs 551 and 755, landowners and NFIP policy holders within RDs 551 and 755, the Courtland Planning Committee (established specifically for this feasibility study), Courtland Town Association (CTA), Sacramento County, State and federal agencies (including FEMA), and non-governmental agencies with interests at the nexus of ecosystem restoration and flood risk solutions within and beyond the Delta. Community residents and landowners within Courtland have been encouraged to stay engaged in this process through implementation of both structural-based MAs and non-structural measures.

1.6.2 Common Stakeholders for Courtland

The project team has met with RDs 551 and 755 at various regular RD Board meetings in 2018 through early 2021 to obtain recommendations from the RDs and local interest on flood risk reduction measures, review plan progress, and coordinate geotechnical investigations.

1.6.2.1 Courtland Town Association

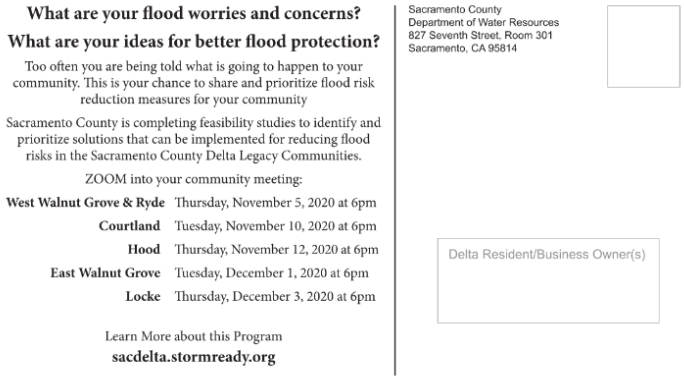
The CTA consists of 15 members of the Courtland community and within the 95615 ZIP code beyond the immediate community of Courtland and RDs 551 and 755. The CTA plans for and raises funds to make improvements within Courtland and in the surrounding community. This group serves as the local governing body for Courtland.

[3] Courtland Story Map - Sacramento County Small Communities Flood Risk Reduction Program: http://www.arcgis.com/apps/MapJournal/index.html?appid=0471b70d12d6444c8b65e27de4c8aaea

DRAFT

1.6.3 Communications and Engagement

The goal of this feasibility study is to have the flood risk reduction solutions developed, promoted, and prioritized by the community of Courtland, including areas beyond the community of Courtland and within RDs 551 and 755. The feasibility study began by developing a planning committee initially comprised of people that live within the community and within the two noted RDs. The committee is comprised of the following members: John Stump, Tim Hodgson, Pam Hodgson, Topher Chan, Kurt Jonson, Doug Chan, and Doug Hemly.



Meeting fatigue has occurred in the Delta due to the multitude of planning processes that have been performed, particularly in the last decade. Thus, the planning committee acted as representatives that could help guide the study through development prior to being released to the entire community and residents and business owners within both RDs. The study process began with the development of an interactive Story Map on Sacramento County's Storm Ready website[4] (published in September of 2018) that describes the community, its importance to the region, its current flood risk, and recommended solutions to reduce that risk.

An initial meeting with the planning committee as well as trustees from RDs 551 and 755 was held in June 2018. The purpose of this meeting was to identify existing concerns, brainstorm opportunities, and develop an array of potential solutions. This meeting acted as a guide to direct the study. The concerns identified were to secure protection from upstream flooding, determination of costs to repair a breach *versus* enhancing the system to meet current modern levee standards, growth limitations due to floodplain development restrictions within the primary zone of the Delta, flood evacuation timing, and limited geotechnical data.

The opportunities identified during this meeting included improving governance between RDs 755 and 551 and the residents/business owners of Courtland, pursuing the multi-benefit

[4] http://sacdelta.stormready.org

opportunities of repairing and strengthening-in-place the levee system that will collectively improve the resiliency and reliability of through-Delta water conveyance, and possibly protecting wintering birds in the low area in the center of RD 551.

Structural MAs and non-structural measures were discussed. The group's highest priority structural MAs were identified as fixing the weakest links within the levee system. The group also expressed the desire to obtain FEMA's 100-year certification and evaluate costs associated with doing so. A concept was initiated in the 2012 CVFPP to construct a 'ring levee' around the back side of Courtland. The ring levee would isolate the community from flooding in the event a levee breach in RDs 551 or 755 were to occur outside of the immediate community. There was initial concern that a ring levee surrounding Courtland could increase inundation levels if a break occurred immediately adjacent to the community of Courtland. However, it was noted during this meeting that when implemented correctly with other structural improvements, a ring levee would not necessarily increase inundation levels. The group also expressed concerns that a potential ring levee could strand or isolate agricultural lands adjacent to Courtland that support other nearby homes and businesses also considered to be part of the larger community within the two noted RDs. There is also the potential issue of funding maintenance of a new ring levee and setting up a new LMA for a new ring levee system. It was pointed out to the planning committee that a short ring levee combined with strengthening the levee fronting the community in order to remove the community of Courtland from the FEMA floodplain was much more cost effective than improving and accrediting the entire 15.9 miles of perimeter levees encompassing the entire study area, including both RDs 551 and 755.

Non-structural measures discussed included improvements to the emergency communication system by updating the phone tree for emergency notification, as well as working with FEMA and/or others to reduce flood insurance premiums. A common non-structural measure is to raise houses so that the lowest inhabitable floor space is safely above the flood hazard elevation on a firm, flood resistant foundation.

Following this meeting, the Story Map for Courtland was drafted and in August 2018, the online Story Map[5] was presented to the CTA for review and to garner more input.

RDs 551 and 755 felt that additional data regarding the existing levee system would help in this planning effort. In spring of 2019, the study team reached out to individual landowners, as well as RDs 551 and 755 to perform geotechnical explorations. This included identification of Cone Penetration Tests (CPTs) locations in select areas around RD 551 to fill in data gaps and obtain an improved picture of levee hazard classifications and performance. Assurances were made to the RDs and landowners that such investigations would not cause any detriment to property or the levee system. The geotechnical investigations were completed in late summer/early fall of 2019.

[5] http://sacdelta.stormready.org/

DRAFT

As the geotechnical data was analyzed and the suite of structural and non-structural MAs were developed, the study team met again with the community members to discuss initial findings from the geotechnical evaluations, as well as to evaluate MAs in February of 2020. Unfortunately, this meeting conflicted with a meeting on the Delta Conveyance Project, which took precedent for many community members and led to low participation. Rough cost information and different flood insurance strategies were presented. The community members present were receptive to the idea of community-based flood insurance as a non-structural option. They also reinforced the idea of a prioritized repair of the existing system and wanted to get a better handle on the wide range of repair and strengthen in-place costs for: (1) known erosion sites in both RDs; (2) DWR FSRP sites in RD 755; and (3) full levee modernization costs associated with bringing the separate SPFC and non-SPFC levee segments up to current standards to meet FEMA's 100-year accreditation standards pursuant to 44 CFR §65.10.[6] To achieve accreditation standards for the existing levees protecting the community of Courtland, significant costs would be associated with meeting the current through- and under-seepage criteria. To meet the noted criteria would entail construction of costly cutoff walls within the levee prism and/or wide seepage berms along the landward side of the existing levee embankments.

A close review of the FEMA regulations, in particular 44 CFR §65.10 (b) *Design criteria* (4) *Embankment and foundation stability,* indicates certain through seepage and underseepage criteria and factors of safety must be adhered to meet full certification criteria. In the North Delta where there are significant sandy soil materials underlying the levee systems initially built over 150 years ago and periodically upgraded decades ago, the levees still fall well short of meeting current, modern engineering and FEMA accreditation standards. To meet such standards, most all of the levees in the North Delta, including the SPFC and non-SPFC levees protecting the community of Courtland, need to be retrofitted with either seepage cutoff walls and/or a combination of seepage/stability berms which are very costly and can cost in excess of $15M per mile.

As the draft feasibility study report was composed, the study team sought feedback from the District Engineer (MBK Engineers) for RDs 551 and 755 to provide existing levee data and known issues to help inform and prioritize remediation actions. The planning committee, as well as the public, were provided a draft feasibility study report in November 2020 for their review, which was followed by a virtual meeting also in November 2020 to discuss the report and receive additional input. During the November 2020 meeting, stakeholders reiterated the need to address the DWR FSRP sites in RD 755 as well as the challenges associated with doing so particularly since the remaining Proposition 1E FSRP funds are quickly diminishing. MBK Engineers requested that the feasibility study identify the current level(s) of flood protection for the levees within the Courtland study area, and noted that based on previous evaluations, there

[6] To learn more about achieving a 100-year level of flood protection pursuant to the current FEMA accreditation standards: https://www.fema.gov/sites/default/files/documents/fema_levee-guidance.pdf

DRAFT

are no noted erosion concerns along the non-SPFC levees on Snodgrass Slough and Delta Meadows Slough.

This input was incorporated into the final report submitted to the Sacramento County Board of Supervisors for consideration of adoption by December of 2021. Additional stakeholder input regarding the preference, prioritization, and implementation of MAs and accompanying non-structural measures summarized in Sections 7 and 8 was also sought between the development of the draft and final Feasibility Study Report (FSR).

A summary of outreach meetings held for the Courtland study area is provided in Table 1-1.

Table 1-1. Outreach Community Meetings for the Courtland Study Area.

Date	Event/Location	Address	Host Organization	Attendance
6/5/2018	RD 551 District Office	129 Primasing Ave, Courtland	SCFRRP Study Team	10
8/15/2018	Courtland Library	170 Primasing Ave, Courtland	CTA	8
3/6/2019	RD 551 District Office	129 Primasing Ave, Courtland	RD 551 Meeting	11
5/14/2019	RD 551 District Office	129 Primasing Ave, Courtland	RD 551 Meeting	7
2/19/2020	Kiononia Hall	14120 Grand Ave, Walnut Grove	SCFRRP Study Team	7
10/02/2020	RD 551 Conference Call Meeting	--	RD 551 Board and SCFRRP Study Team	
11/10/2020	Virtual Zoom Meeting	--	SCFRRP Study Team	9

Additional RD 551 Board meetings were held in January to March 2021 with community team members in attendance to further advance implementation of MA 1 – Repair of the DWR FSRP Critical and Serious Repair Sites within RD 755.

1.6.4 Coordination with Key Agencies within the Delta

This feasibility study has been prepared in coordination with the Delta stakeholders, which include representatives of LMAs, landowners and FEMA NFIP policy holders within RDs 551 and 755, the CTA, Delta Legacy Communities Task Force, Sacramento County, State and federal agencies, and non-governmental agencies with environmental interests that are knowledgeable about the flood risks and potential solutions within the Delta.

Although many agencies are involved in the Delta, three regional agencies are heavily involved in land use policy and sustainability in this region and thus have a special interest in SPFC improvements, as detailed below.

DRAFT

1.6.4.1 Delta Protection Commission

The DPC is focused on conservation of agricultural land and supporting economically sustainable agricultural operations in the Delta. The DPC maintains and implements the Land Use and Resource Management Plan (LURMP) for the Primary Zone of the Delta. City and County General Plans and future projects that affect land use in the five Delta counties must be consistent with the LURMP and are subject to review by the DPC.

1.6.4.2 Delta Stewardship Council

The DSC was created to achieve the State mandated coequal goals for the Delta. The DSC also drafted, updates and administers the Delta Plan, a long-term management plan with recommendations to further the coequal goals, in a manner that protects and enhances the unique cultural, recreational, natural resources, and agricultural values of the Delta as an evolving place. All proposed projects within the Delta must be consistent with the Delta Plan, which precludes displacement of agricultural land uses with non-agricultural land uses and subsequent structural solutions, such as improving and modifying the existing levee systems identified in this study for the community of Courtland, which may be subject to a consistency determination by the DSC.

1.6.4.3 Delta Conservancy

The Delta Conservancy (Conservancy) is the primary State agency focused on the implementation of ecosystem restoration in the Delta and supports efforts that advance environmental protection and the economic well-being of Delta residents. The Conservancy collaborates and cooperates with local communities and other parties to preserve, protect, and to restore the natural resources, economy, and agriculture of the Delta and Suisun Marsh. The Conservancy also collaborates on Delta branding and marketing, the Delta Carbon Program, invasive species control, and the California Department of Fish and Wildlife (CDFW) Delta Conservation Framework. The Conservancy's Delta Public Lands Strategy includes integrated conservation for publicly funded lands in the Delta.

DSC Delta Plan Coequal Goals

1) Providing a more reliable water supply for California and
2) Protecting, restoring, and enhancing the Delta ecosystem.

"The coequal goals shall be achieved in a manner that protects and enhances the unique cultural, recreational, natural resource, and agricultural values of the Delta as an evolving place." (CA Water Code §85054)

1.7 Related Plans, Programs and Studies

Many plans influence flood management in the Delta, as summarized below. In particular, this study aggregates and uses evaluations from the CVFPP and DWR's Non-Urban Levee Evaluations (NULE) Program and FSRP to inform the development and prioritization of flood risk reduction measures for the Courtland study area.

DRAFT

1.7.1 Central Valley Flood Protection Plan

The CVFPP, mentioned previously, proposed improvements to SPFC levees, and where applicable, Delta (non-SPFC) levees, ecosystem enhancements, and flood risk reduction measures for small communities. The CVFPP identifies structural and non-structural options to protect small communities from the 100-year flood and is the basis for selecting flood risk reduction elements and MAs considered in this feasibility study, including (DWR, 2012a):

1. Reconstructing or repairing perimeter levees in-place or making improvements to existing SPFC perimeter levees and non-SPFC levees that could impact and/or enhance the performance of SPFC levees.
2. Protecting small communities "in-place" using ring levees, training levees, or floodwalls when improvements do not exceed a certain predetermined cost threshold.
3. Implementing non-structural improvements, such as developing flood fight berms, raising and elevating structures, floodproofing, willing seller purchases, and/or relocating structures when the in-place improvements described above are not feasible.

1.7.2 Sacramento River Basin-Wide Feasibility Study

The Sacramento River Basin-Wide Feasibility Study (BWFS) was prepared subsequent to the 2012 CVFPP and focused on a multi-benefit approach to expansion of the flood bypasses. Solutions proposed in the BWFS germane to the Courtland study area include addressing system capacity constraints to allow for improved conveyance through widening the Yolo and Sacramento Bypasses and Fremont and Sacramento Weirs. These expansions and modifications are underway and are expected to provide a reduction in flood stage of 1 to 2 feet along segments of the Sacramento River adjacent to Delta Legacy Communities, as depicted in Figure 1-4.. The noted expansions and modifications to the upstream Sacramento and American rivers/bypasses will help neutralize some of the basin-wide impacts of climate change in the Lower Sacramento River as most all excess flows will be diverted into the bypass systems with metered or controlled flows being routed downstream of the American River into the Lower Sacramento River in the North Delta. However, it should be noted that the Sacramento River BWFS did not fully address climate change impacts. This could result in higher flood flows and stages within the Morrison Creek, Cosumnes and Mokelumne River watersheds that can collectively or individually impact flood stages in Snodgrass Slough and downstream flood stages in the Mokelumne River that may increase the risk of flooding to the community of Courtland.

DRAFT

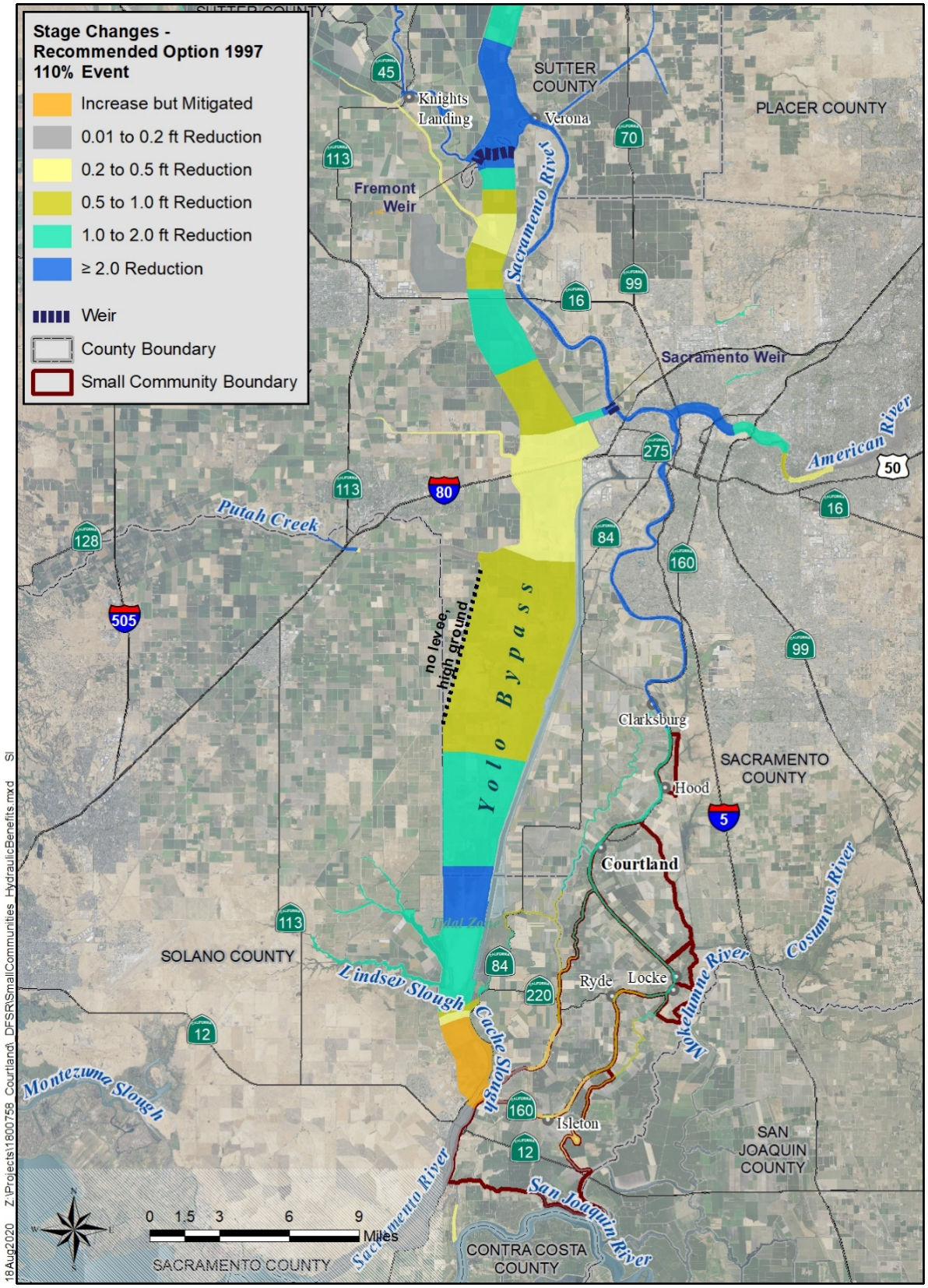


Figure 1-4. Flood Stage Reductions as a Result of the BWFS Expansions and Modifications.

1.7.3 Lower Sacramento River/Delta North Regional Flood Management Plan

The 2014 RFMP was developed by FloodProtect, a regional working group, as the regional follow-on to DWR's 2012 CVFPP. The 2014 RFMP was funded by DWR but drafted by local agencies and identified pre-feasibility level regional flood management solutions (FloodProtect, 2014).

The 2014 RFMP recommended further flood risk reduction feasibility studies for many small communities and Delta Legacy Communities, including Courtland. Additionally, the 2014 RFMP identified Potential Conservation Sites (PCS) offering ecosystem multi-benefits near Courtland, namely: PCS-13 (habitat enhancements along the left [and right] bank of the Sacramento River to connect 11 miles of riparian river corridor between RM 35 near Sutter Slough and RM 46 near Freeport); and PCS-15 (Zacharias Island/Snodgrass Slough habitat enhancements southeast of Courtland, by replacing up to 3,500 acres of existing, seasonally inundated farmland into off-channel habitat for endangered salmonids).

1.7.4 Delta Levees Investment Strategy

The Delta Levees Investment Strategy (DLIS) was prepared by the DSC as a follow-up to the Delta Plan to identify funding priorities for State investments in Delta levees. Funding priorities were developed using a risk-based analysis, which quantified risks to people, property and infrastructure, water supply reliability, ecosystems, and the Delta as a place, by developing estimates of flooding probability due to seismic and hydrologic events.

The DSC's goal was to develop a list of very-high priority and high priority islands and tracts by quantifying risks using several metrics, such as expected annual fatalities and Expected Annual Damages (EAD). Seventeen islands were identified as very-high priority and 36 islands and tracts were identified as high priority (DSC, 2017). However, the Courtland study area was placed in the "Other Priority" category, based on many variables, and was not highly prioritized for State investments under the initial DLIS prioritization process (Figure 1-5).

DRAFT

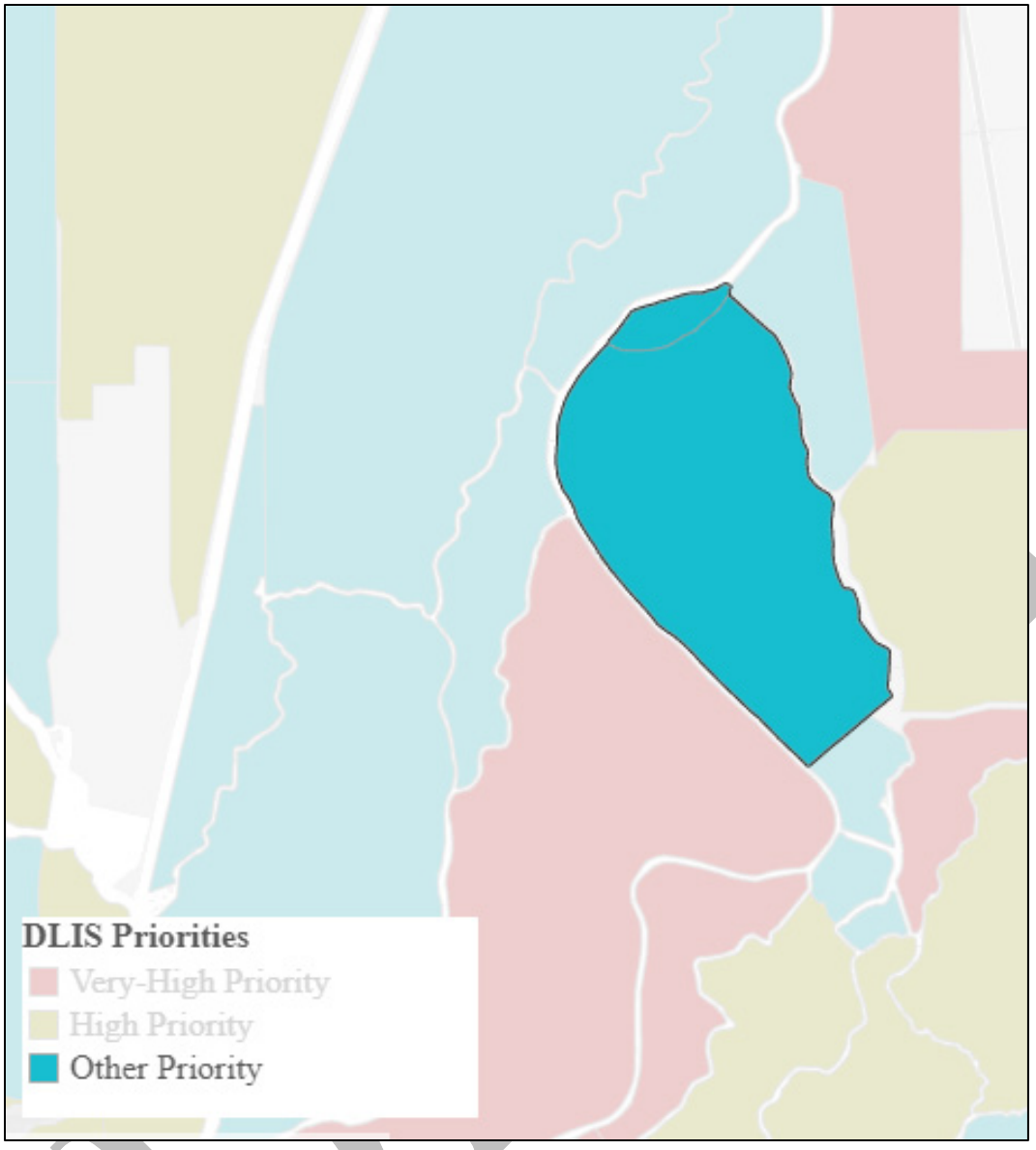


Figure 1-5. DLIS Analysis – Overall Prioritization (Rand Corporation, 2020)

It should be noted that the DSC is in the current process of updating their DLIS, based upon more current data and updated methodologies. A representation of the initial DLIS analysis (annual probability of flooding due to a hydrologic event) is shown in Figure 1-6. The Courtland study area was initially estimated to have an annual probability of 0.9 (RD 755) to 1.7 percent (RD 551) of flooding as a result of a hydrologic event according to DLIS. This annual probability of flooding is largely based upon levee geometry, namely freeboard levels relative to overtopping, combined with information provided in the Delta Risk Management Strategy, and not the current geotechnical characteristics of the RD 551 and 755 levee system.

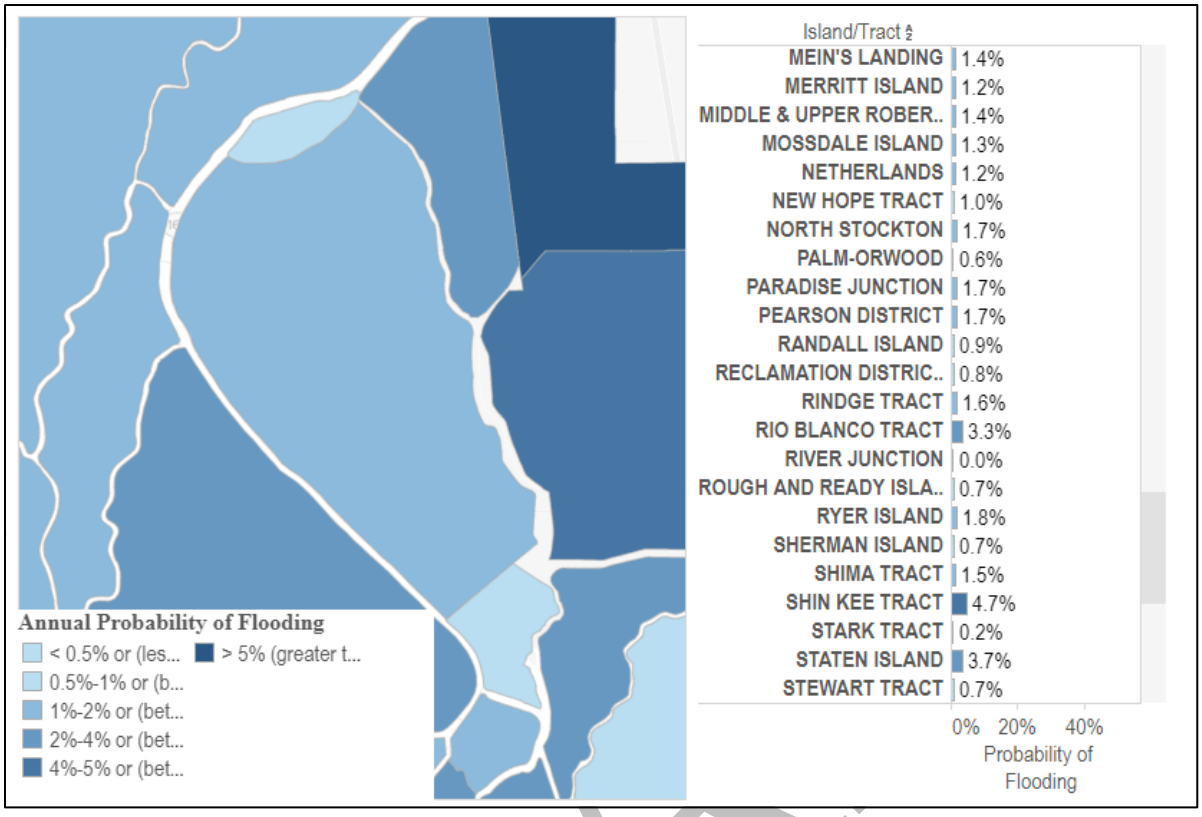


Figure 1-6. DLIS Analysis - Hydrologic Event (Rand Corporation, 2020)

The rulemaking process to adopt regulations implementing the DLIS is ongoing. However, the interactive DLIS Decision Support Tool representing the current prioritization and analysis framework is publicly accessible online here.[7]

1.7.5 Flood System Repair Project

The DWR FSRP was funded by $150M of Proposition 1E funding and its purpose is to assist LMAs in reducing flood risk on a cost-sharing basis. Through the FSRP, LMAs are provided technical and financial support to repair documented critical or serious problems with flood protection. The master database from the FSRP identifies levees with past performance problems for seepage, slope instability, erosion, and other problems (FloodProtect, 2014). There is one critical site and one serious site identified by the FSRP along the left, east bank levee of the Sacramento River within NULE Segment 131 (RD 755) that collectively pose imminent flood threats to the community of Courtland, requiring priority attention. It is hoped that this feasibility study in combination with the DWR FSRP can assist RDs 755/551 and the community of Courtland in prioritizing and implementing the remaining repairs of the known and documented FSRP critical and serious sites by 2022-24.

[7] https://www.rand.org/pubs/tools/TL266/tool.html

DRAFT

1.7.6 Non-Urban Levee Evaluations

DWR's NULE program evaluated non-urban levees against geotechnical criteria likely to impact levee performance, including stability, through seepage, underseepage, and erosion. In general, the program was administered using a phased approach in communities with less than 10,000 residents and included Phase 1 preliminary geotechnical evaluations using historical data for all NULE levees and Phase 2 geotechnical field investigations to further evaluate those levees protecting more than 1,000 persons. NULE levee segments were assigned ratings based on potential failure mode and placed in an overall hazard category for which recommendations and cost estimates were prepared. Data from the NULE program are currently used in conjunction with LMA inspection reports and data from the FSRP to characterize SPFC and non-SPFC levees and to inform future State, regional, and local flood planning and financing efforts.

The results of Phase 1 NULE studies for the study area are detailed in 0 and in 2.1.1. However, the Courtland study area did not meet the population threshold for NULE Phase 2 studies, and therefore geotechnical investigations were not conducted as part of that study. Therefore, site-specific geotechnical conditions were warranted, and CPT soundings and accompanying soil sample lab tests were conducted as part of this study in 2019 to further inform this feasibility study (*see* 0 for additional information).

1.7.7 Levee System-Wide Improvement Framework

As of August 2020, RD 551 developed a draft a Letter of Intent (LOI) to move forward with preparation of a System-Wide Improvement Framework (SWIF) plan. The SWIF will be developed with the support and assistance of the CVFPB and in collaboration with the U.S. Army Corps of Engineers (USACE) and environmental, cultural, and historical resource agencies, as well as other interested parties. Simultaneously, the LMAs (RDs 551 and 755) will be making repairs that address system-wide issues and correct unacceptable inspection items in a prioritized manner to optimize flood risk reduction. USACE's approval of the LOI will allow the noted LMAs to remain active in the Public Law (PL) 84-99 rehabilitation program for a period of 2 years while the SWIF is being prepared. It is important to recognize that PL 84-99 does not equate to the more rigorous certification process to obtain a 100-year level of flood protection pursuant to 44 CFR §65.10 FEMA accreditation standards.

DRAFT

2. Existing Conditions

2.1 Existing Conditions

2.1.1 Topography and Levees

Ground elevation for the Courtland study area is highest immediately adjacent to the levees (12-16 ft., NAVD 88 primarily in RD 755) and slopes toward the center of RD 551 (-12 to -8 ft., NAVD 88) (Figure 2-1). Top of levee elevations vary from approximately 25 to 33 feet within the study area, with highest levee elevations located on the northerly upstream portion of the basin in RD 755. The community of Courtland sits at an elevation of 8 to 12 feet NAVD 88 near the landward base of the adjacent Sacramento River levee in comparison to the larger study area that is 4 feet or greater below sea level (less than - 4.0 NAVD 88), near the center of RD 551.

The study area consists of 15.9 miles of levees, including DWR NULE Segments 126, 131, 1040, and 1041 (Figure 2-1). Of these, approximately 8.6 miles are SPFC levees along the Sacramento River (NULE Segment 131 – RD 755, 1.8 miles and NULE Segment 126 – RD 551, 6.8 miles), and the remaining 7.3 miles are non-SPFC levees operated and maintained by RD 551 and located along Snodgrass Slough to the east, and the Delta Meadows Slough to the south (NULE Segment 1041 – 5.9 miles and NULE Segment 1040 – 1.4 miles, respectively) (URS, 2011a). NULE Segment 1041 protects the study area from flooding east of RD 551 from the Stone Lakes National Wildlife Refuge and Snodgrass Slough, and south from the Cosumnes and Mokelumne River systems (MBK, 2012).

As part of the 2017 update to the CVFPP, flood risk was assessed by defining impact areas with associated index points within the San Joaquin and Sacramento River Basins. Within this context, defined flood risks were quantified at discrete index points with impact area-specific levee performance curves. The levee performance curves were developed to be representative of a levee reach protecting the impact area, typically the worst case. The Courtland study area was aggregated into two impact areas: SAC 48 (Courtland) and SAC 47 (remainder of RD 551 and all of RD 755) (Figure 2-1). Due to their hydrologic connection, RD 755 was not considered separately in the 2017 CVFPP analysis but is included as part of SAC 47 RD 551 – Pearson District. The levee performance curves for the Courtland study area are being updated as a result of geotechnical explorations conducted during the course of this study.

DRAFT

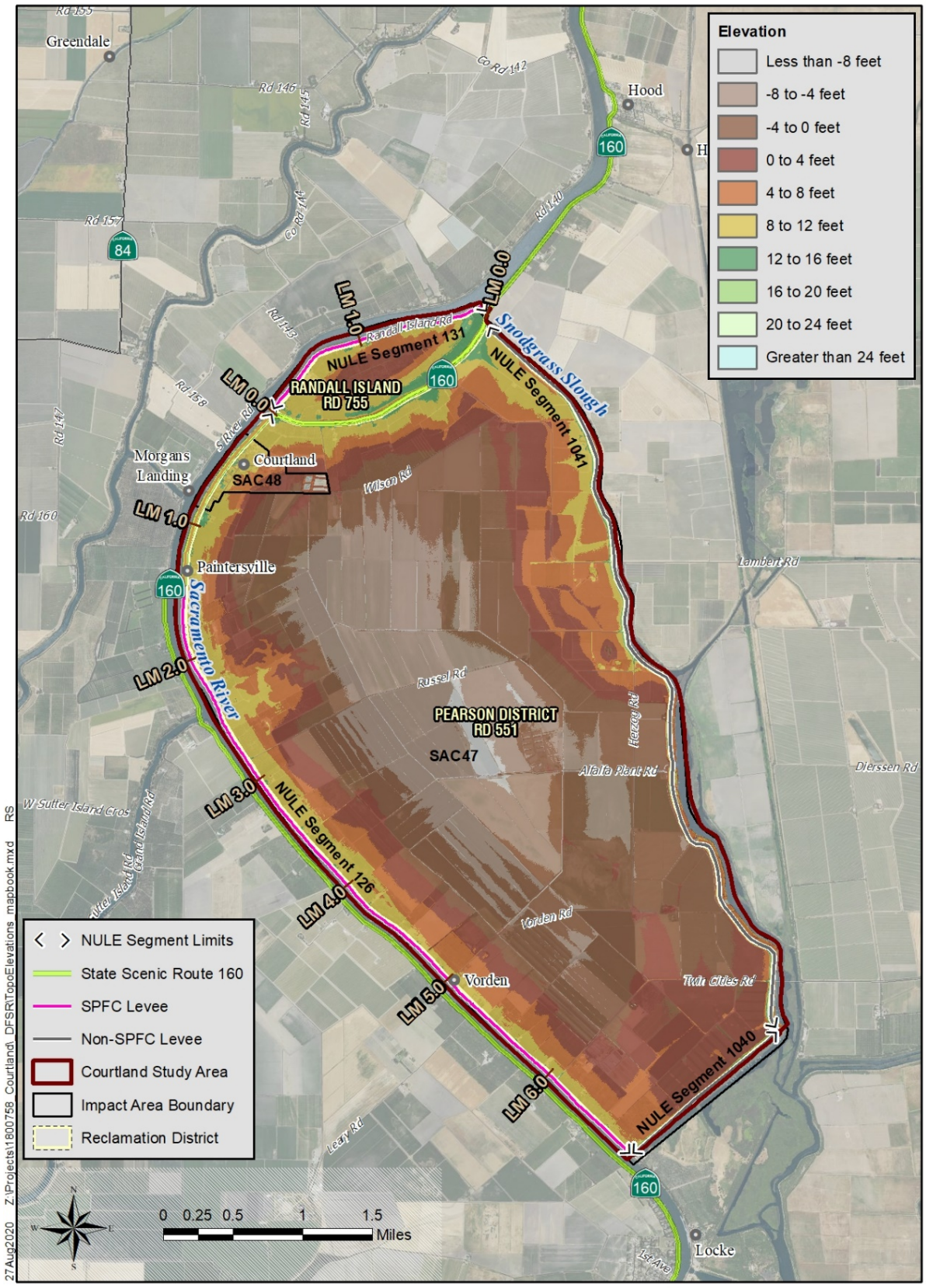


Figure 2-1. Study Area Ground Elevations, Levees and CVFPP Impact Areas.

Levee miles associated with each impact area are summarized in Table 2-1 below.

Table 2-1. Levee Miles for SAC 47 and SAC 48 (URS, 2011a)

	Levee Miles		
CVFPP Impact Area	**SPFC Levee**	**Non-SPFC Levee**	**Total**
SAC 47: RD 755 and RD 551, less SAC 48 (9,642 acres)	8.0	7.3	15.3
SAC 48: Courtland (146 acres)	0.6	0.0	0.6
Total Courtland Study Area (9,788 acres)	8.6	7.3	15.9

The DWR NULE program reviewed and summarized NULE Segment geometry based on Light Detection and Ranging (commonly known as LiDAR) topography collected for DWR's Central Valley Floodplain Evaluation and Delineation between October 2008 and February 2009. Documented geometry information for the levees in the study area is summarized in Table 2-2.

Table 2-2. Summary of Levee Geometry (URS, 2011a)

Levee Segment Location	NULE Segment	Approximate Levee Height	Approximate Crown Width	Approximate Landside Slopes	Approximate Waterside Slopes
Left Bank Sacramento River – RD 755 (SPFC levee)	131	14-20 ft. above the landside toe	20-30 ft.	1.7H:1V to 3H:1V	1.7H:1V to 3H:1V
Left Bank Sacramento River – RD 551 (SPFC levee)	126	15-22 ft. above the landside toe	20-40 ft.	1.5H:1V to 3H:1V	1.8H:1V to 3.3H:1V
Right Bank Delta Meadows Slough - RD 551 (Non-SPFC levee)	1040	16-27 ft. above the landside toe	10-15 ft.	4.5H:1V to 6H:1V	3H:1V to 4H:1V
Right Bank Snodgrass Slough - RD 551 (Non-SPFC levee)	1041	22-30 ft. above the landside toe	10-25 ft.	4H:1V to 6H:1V	3H:1V to 4H:1V

2.1.2 Geomorphology

Geomorphology (bed and bank erosion and sediment deposition) mapping developed for the DWR NULE program indicates the levees along the Sacramento River and Meadow Slough primarily overlie historical overbank deposits (Rob) likely consisting of interbedded sand, silt, and clay deposited during high-stage flow, overtopping channel banks (Figure 2-2). Localized areas of historical crevasse splay deposits (Rcs) are also present. The crevasse splay deposits are

DRAFT

likely to consist of fine to coarse sand with minor lenses of gravel deposited from breaching of natural levees. The available DWR NULE geomorphology mapping for Snodgrass Slough is less detailed but indicates that the northern half of the levee segment overlies natural levee deposits and the southern half overlies flood basin deposits. The natural levee deposits likely consist of interbedded silt, sand, and clay. The soils in the floodplain deposits are likely finer-grained, consisting primarily of silt and clay. Peat deposits are mapped beneath the levee in the surficial geology mapping over an approximate 0.7-mile extent, starting approximately 1.75 miles upstream from the confluence with Meadows Slough. The mapped peat deposits extent is within a 1.4-mile section of the non-SPFC NULE Segment 1041 levee, from approximately 1.5 miles upstream of the confluence with Meadows Slough to 2.9 miles upstream of this same confluence. *See* 0 for additional information on existing geotechnical conditions within the study area, which includes the collection and evaluation of 10 recent CPT explorations and subsequent laboratory data that were gathered in 2019 as a component of this feasibility study.

Levees within the study area which are built on sandy soil materials are of particular note since these levees can be particularly impacted by through seepage and underseepage, which can result in levee failure if left unchecked. In these areas where the levees are more susceptible to seepage and underseepage, remediations to address these vulnerabilities are generally more costly, requiring deeper vertical cutoff walls or wider combination seepage/stability berms. Retrofitting these levees, which is required to secure FEMA accreditation, can often cost upwards of $15M or more per mile. Click here to read FEMA's guidance for levee certification that lists a number of additional criteria that must be met in addition to the underlying seepage problems that are prevalent throughout the North Delta and other leveed areas within the Sacramento and San Joaquin River Basins.[1]

DRAFT

[1] https://www.fema.gov/sites/default/files/documents/fema_levee-guidance.pdf

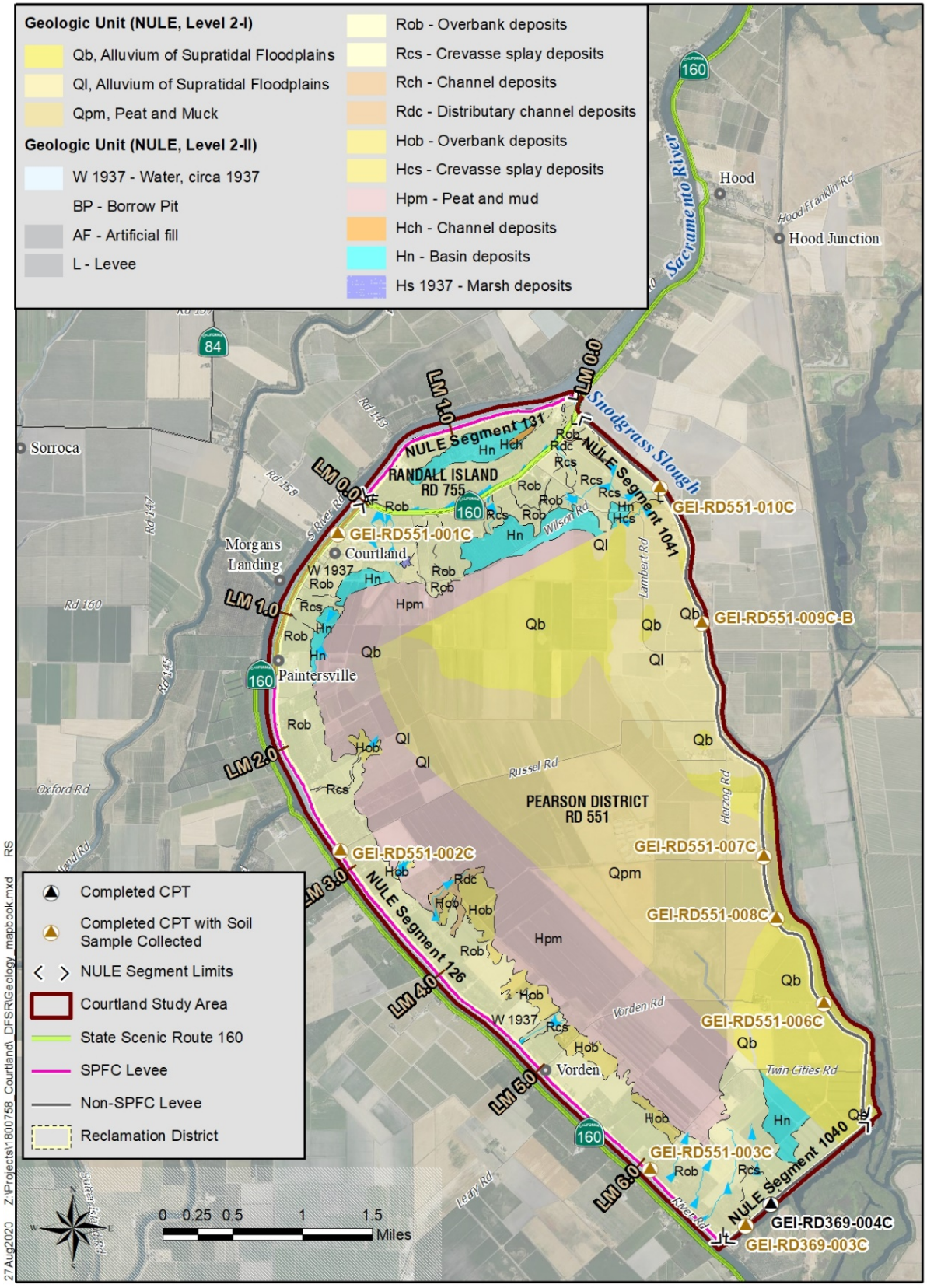


Figure 2-2. Geomorphology within the Study Area.

2.1.3 Population, Communities, and Land Use

Courtland's 2010 population as reported in the 2010 Census was 355 residents. Between 2016 and 2018 the median household income declined from $76,528 to $59,489 (United States Census Bureau, 2010). Courtland is not a disadvantaged community as defined by the State of California.

Sacramento County has designated Courtland as a Special Planning Area (SPA). The community is subject to the County's SPA ordinance which drives land use planning and development. Allowed land uses in Courtland and approved locations per the ordinance are shown in Figure 2-3.

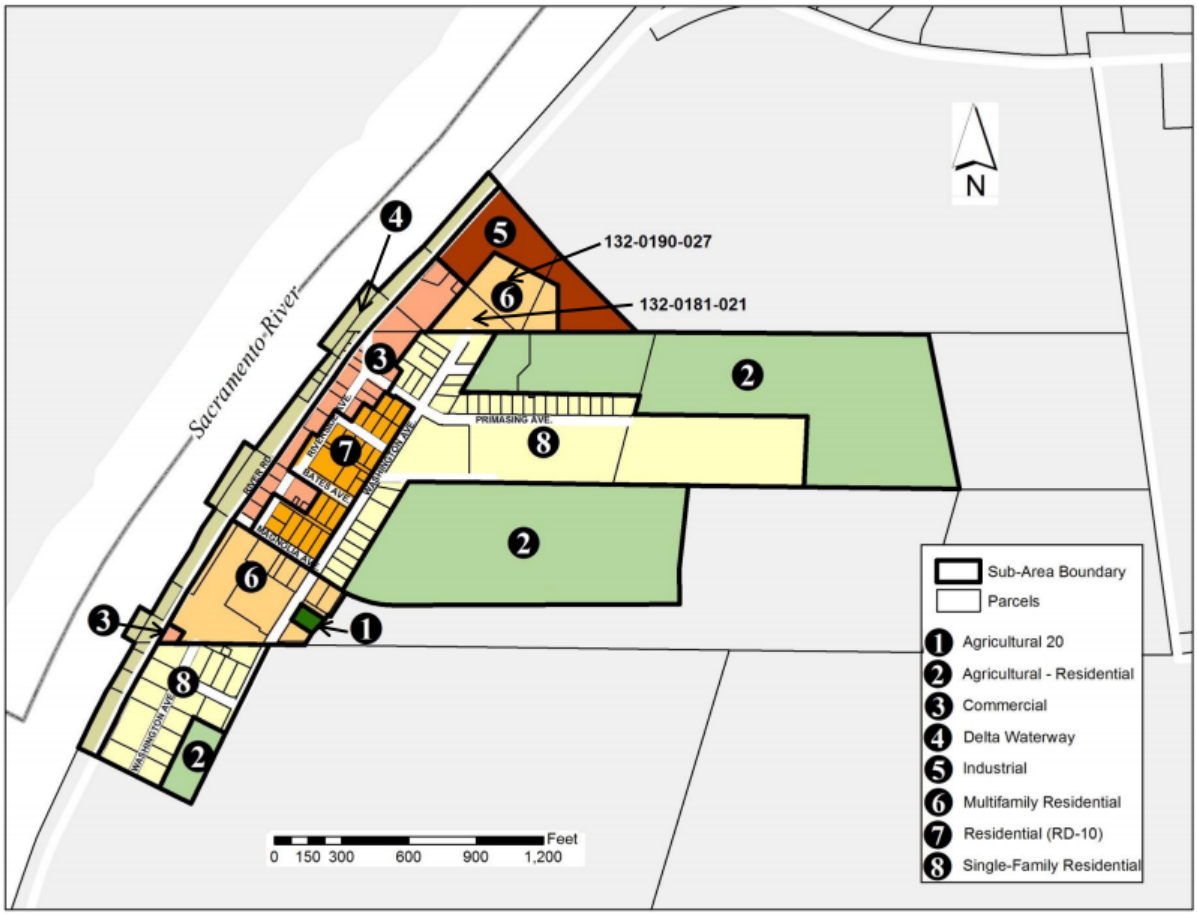


Figure 2-3. Courtland Special Planning Area (County of Sacramento, 2017a)

Courtland is within the Primary Zone of the Legal Delta which means that local and county general plans and land use decisions must also be consistent with the Delta Plan. However, limited development within Courtland along with several other communities in the Delta (Hood, Ryde, Walnut Grove) is permitted within 23 California Code of Regulations (CCR) Section 5010 (*Locate New Urban Development Wisely)* and exempt from 23 CCR Section 5013 (*Require Flood Protection for Residential Development in Rural Areas)* of the Delta Plan (**Figure 2-4**). Section 5010 of the Delta Plan requires new residential, commercial, and industrial development to be limited to those areas designated by city or county general plans, while Section 5013 prescribes floodproofing requirements for new residential development. While land use must still be consistent with the county's SPA ordinance, the exemption from Section 5013 allows for development within the immediate community to be unconstrained by Delta-specific floodproofing requirements. Together with the county's SPA ordinance, these land use requirements help prevent uninhibited growth which can sometimes result from improvements to the flood control system in other portions of the Central Valley outside of the Primary Zone of the Delta.

Managing Rural Floodplains to Avoid Increased Flood Risk

As stated in the Delta Plan, "to reduce the risk to lives, property, and State interests in the Delta, additional standards are needed to address new residential development…the policies in [the Delta Plan] are designed to reduce risk while *preserving the Delta's unique character and agricultural way of life.* **These policies should be construed as those required to provide the minimum level of flood protection and should not be viewed as encouraging development in flood prone Delta areas.** Consistent with existing law, urban development in the Primary Zone should remain prohibited."

DRAFT

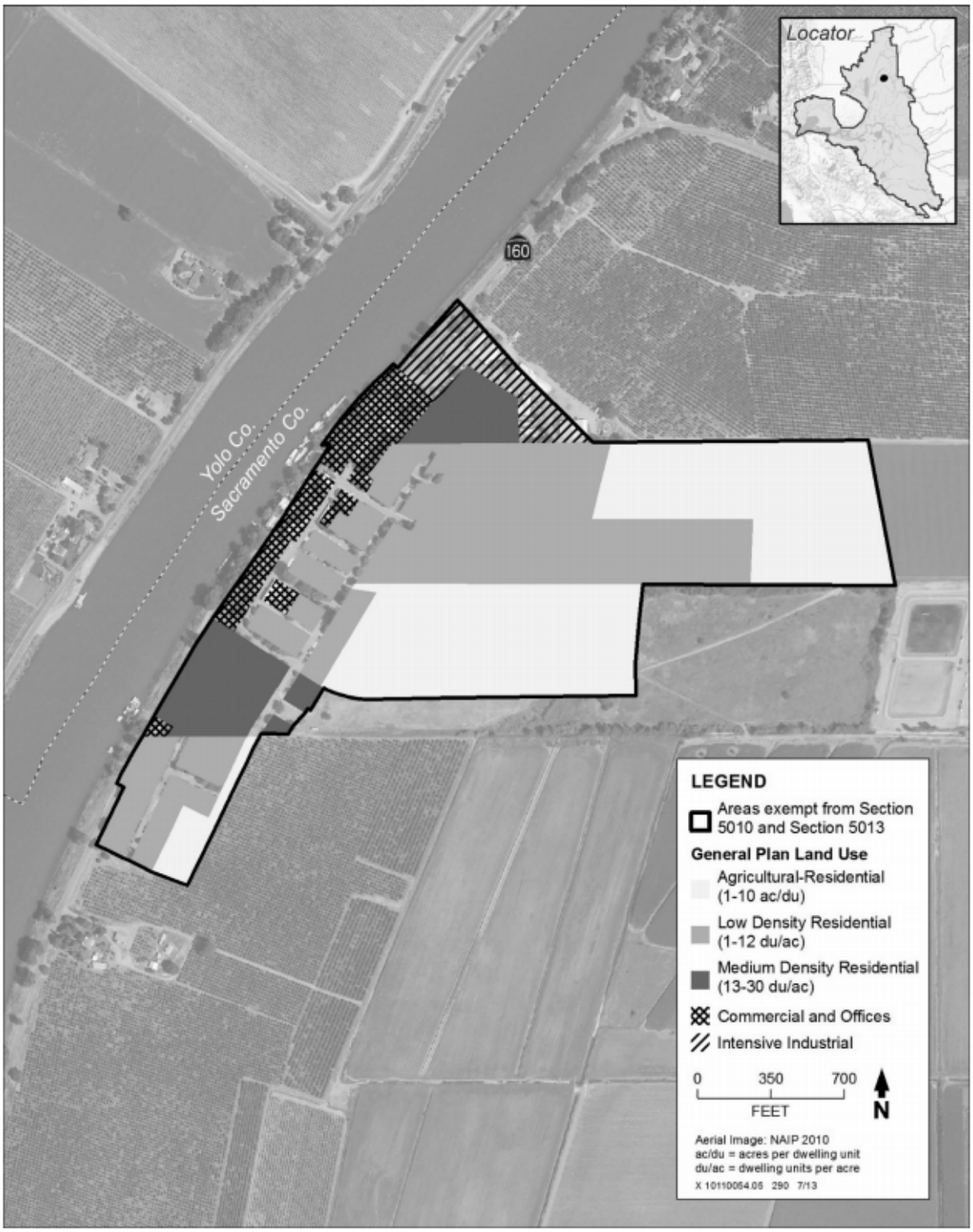


Figure 2-4. Courtland Land Use under the Delta Plan (DSC, 2013)

2.1.4 Hydrology and Hydraulics

The Courtland study area is bounded by the Lower Sacramento River and Snodgrass Slough and its tributary waterways. These waterways are influenced by tidal conditions from the San Francisco Bay. The Sacramento River watershed is approximately 27,500 square miles and drains north to south. Flows in the Sacramento River are regulated by four major upstream reservoirs, namely, Shasta, Oroville, New Bullards Bar, and Folsom. The upstream Yolo Bypass and Sacramento Bypass channels are currently designed and operated to divert as much as 75 percent of the total flood flows from the Lower Sacramento River. Systemwide improvements are planned and identified in the 2017 CVFPP Update to enlarge the Sacramento and Yolo Bypass and Weirs upstream of the Delta which will divert or shunt greater amounts of flood flows (greater than 75%) away from the Lower Sacramento River immediately adjacent to the Courtland study area, including Courtland. A stage reduction of approximately 1.5 feet will occur in the Sacramento River at Courtland during a high flow event (110% of the 1997 flow event) as indicated in Figure 1-4 following the full implementation of the planned enlargements of the upstream bypasses and weirs.

Estimated existing 100-year flows and future 100-year peak flows adjusted for climate change and sea level rise which account for future systemwide improvements, along with predetermined USACE 1957 design flow and profile, are summarized in Table 2-3. Additional information on how these peak flows were estimated can be found in Appendix I. The existing 100-year peak flow in the Sacramento River from Elk Slough to Sutter Slough is approximately 113,300 cubic feet per second (cfs). However, downstream of Courtland flows are reduced to near 91,260 cfs from Sutter Slough to Steamboat Slough and to 65,200 cfs from Steamboat Slough to Georgiana Slough due to distributary flows out of the Sacramento River main stem and tidal conditions. For each reach, the future 100-year peak flow is approximately 10 percent lower than the existing 100-year peak flow due to favorable upstream, system-wide improvements at the Sacramento and Yolo Bypass/Weirs.

Table 2-3. Sacramento River 100- Year Peak Flows and USACE 1957 Design Flows

Reach	Existing 100-Year Peak Flow (cfs)	Future 100-Year Peak Flow (cfs)	USACE 1957 Design Flows
Sacramento River, Elk Slough to Sutter Slough	113,300	100,650	110,000
Sacramento River, Sutter Slough to Steamboat Slough	91,260	81,040	85,000
Sacramento River, Steamboat Slough to Georgiana Slough	66,300	59,200	56,500

It should be noted that, at some locations, the 100-year water surface profile “With Future Conditions” (including the upstream system-wide bypass/weir improvements, climate change

DRAFT

adjustments and downstream sea level rise adjustments) is 1 to 2 feet higher than the USACE 1957 profile grade that is used as a guide for the operations and maintenance of the RD 551 and 755 perimeter levee system (Figure 2-5). *See* Appendix I for further details on the water surface elevations, current and future, that are anticipated for the Sacramento River and Snodgrass Slough surrounding the Courtland study area.

It also should be noted that the H&H models and information presented in supporting Appendix I were not deployed in connection with conducting the EAD analyses that were performed by HDR (Appendix E – August 2021) in connection with this Feasibility Study. The EAD analyses for the Courtland SCFRRP study efforts were conducted consistent with the same hydrologic and hydraulic models deployed for the most recent CVFPP planning efforts. The EAD evaluations for current hydraulic conditions were performed consistent with the concurrent efforts for the 2022 CVFPP updates; whereas EAD future conditions with adjustments for climate change, inclusive of sea level adjustments, were conducted consistent with the adjustments developed for the previous 2017 CVFPP planning efforts.

2.1.5 Water Resources and Water Conveyance

Delta waterways are important to North Delta communities and the State's water supply system. Courtland lies along the Sacramento River upstream of the Delta Cross Channel. Snodgrass Slough and Meadows Slough are also adjacent to RD 551 and the Courtland study area. These waterways provide vital agricultural water supply to local farmers and also convey water to areas throughout the State of California south of the Delta.

DRAFT

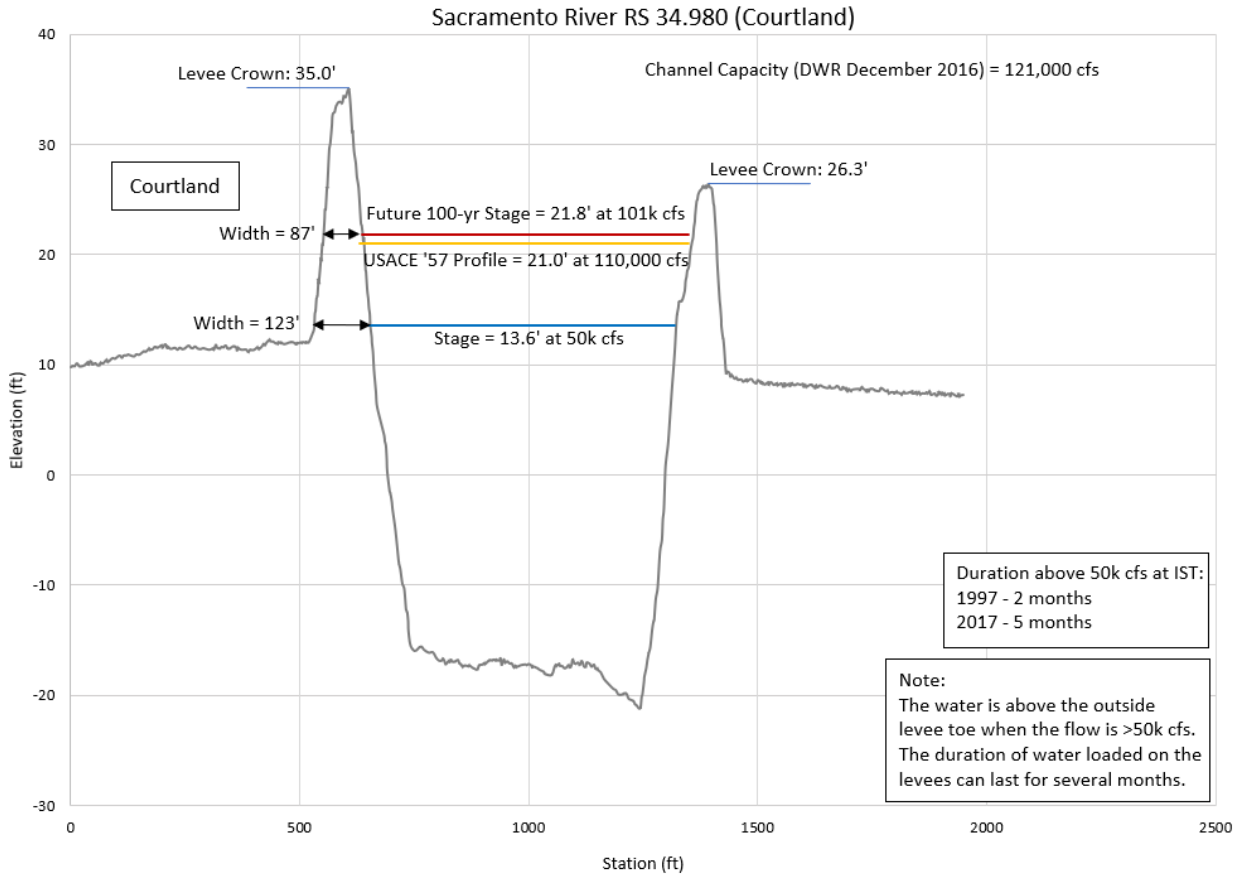


Figure 2-5. Cross Section at Sacramento River Station 34.980 at Courtland Viewing Downstream

2.1.6 Existing Infrastructure

The community of Courtland is served by the Sacramento Regional County Sanitation District, whose regional wastewater treatment plant is located on the north side of Elk Grove, approximately 10 miles northeast of Courtland. Prior to having access to the Regional Sanitation Plant, the community utilized a set of local wastewater treatment settling ponds located just east of Courtland's Bates Elementary School.

Critical infrastructure within the study area is shown in Figure 2-6. Critical infrastructure includes SR 160, county maintained paved roads, local bridges, schools, Courtland Fire Station No. 1, gaging stations, water wells, oil/gas wells, and RD 551 drainage pumps. Culverts and associated road drainage are maintained by the Sacramento County Department of Transportation in partnership with Caltrans.

DRAFT

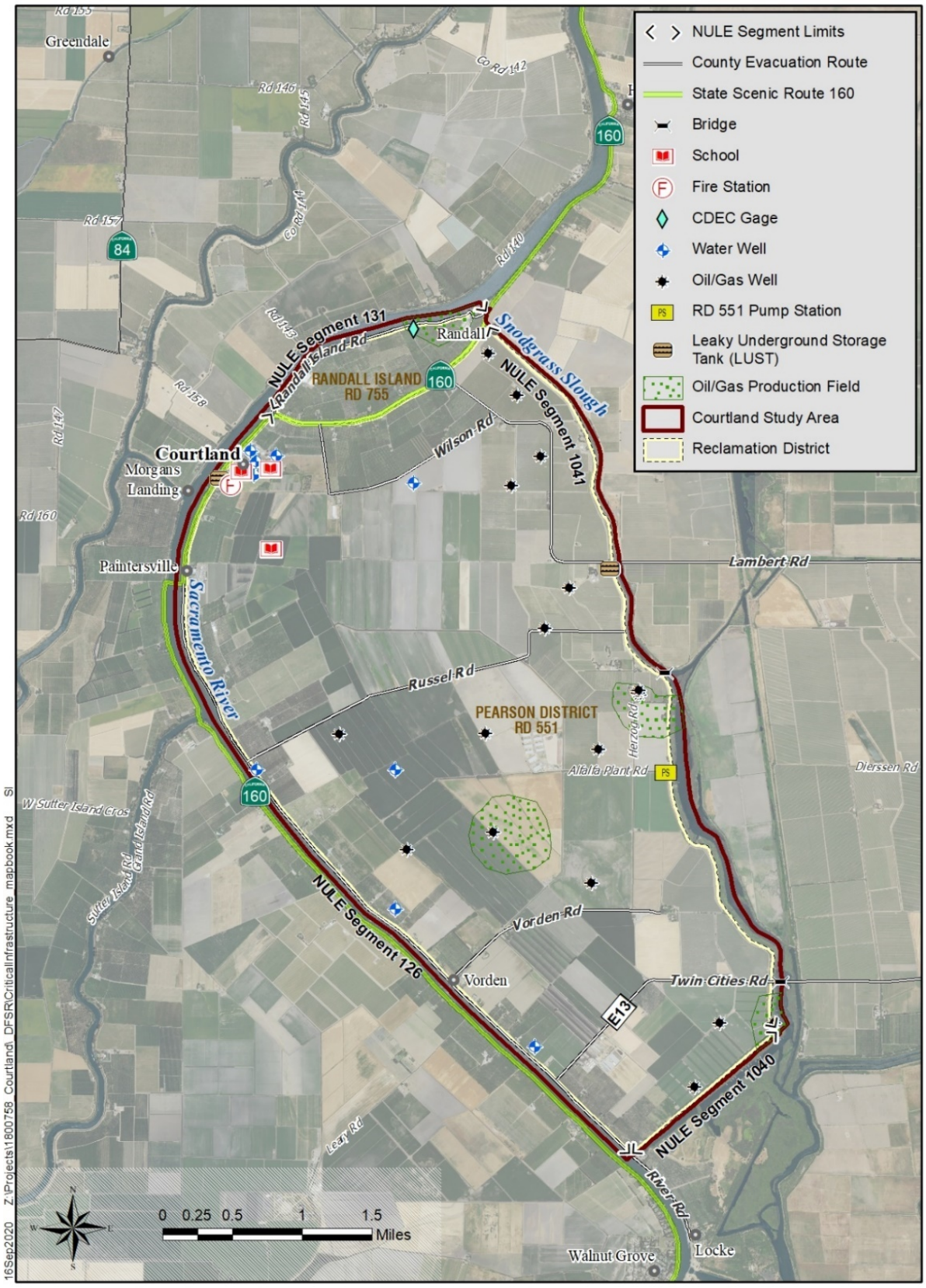


Figure 2-6. Critical Infrastructure within the Study Area

Infrastructure is a critical input in evaluating flood damage, which informs flood risk. The 2017 CVFPP Update inventoried structures, vehicles, highways, and streets within the Courtland study area to evaluate the annualized EAD for the Courtland study area, which were updated during the course of this study as part of the 2022 CVFPP Update. These inventories are largely provided within the discussion of flood risk to the study area in Section 3.1.1.4.

2.1.7 Biological Resources

According to the U.S. Fish and Wildlife Service (USFWS) National Wetland Inventory database, riverine, freshwater forested/shrub wetland, and emergent wetland features are found in the study area. The Sacramento River is the primary aquatic feature within the study area, located adjacent to the western boundary of the study area. Snodgrass Slough, situated on the east boundary of the study area drains the Stone Lake National Wildlife Refuge and flows into the Delta Meadows Slough/State Park at the southeastern boundary of the study area. Irrigation ditches that traverse across agricultural lands throughout the study area provide drainage, particularly to the low-lying agricultural properties within RD 551. The drainage water is eventually pumped by RD 551 into the adjacent waterways.

The majority of the Courtland study area is designated as prime farmland (Figure 2-7). Farmland of local importance is located within the densely populated community of Courtland, with some unique farmland located on the eastern border of the study area along Snodgrass Slough.

When conducting work on the waterside slopes, particularly below the ordinary high-water lines in any waterways in the North Delta, and particularly within the Lower Sacramento River and adjoining sloughs, work is normally limited to the short 3-month construction period of August 1 through October 31 due to the presence of special-status and endangered fish species and supporting habitat.

DRAFT

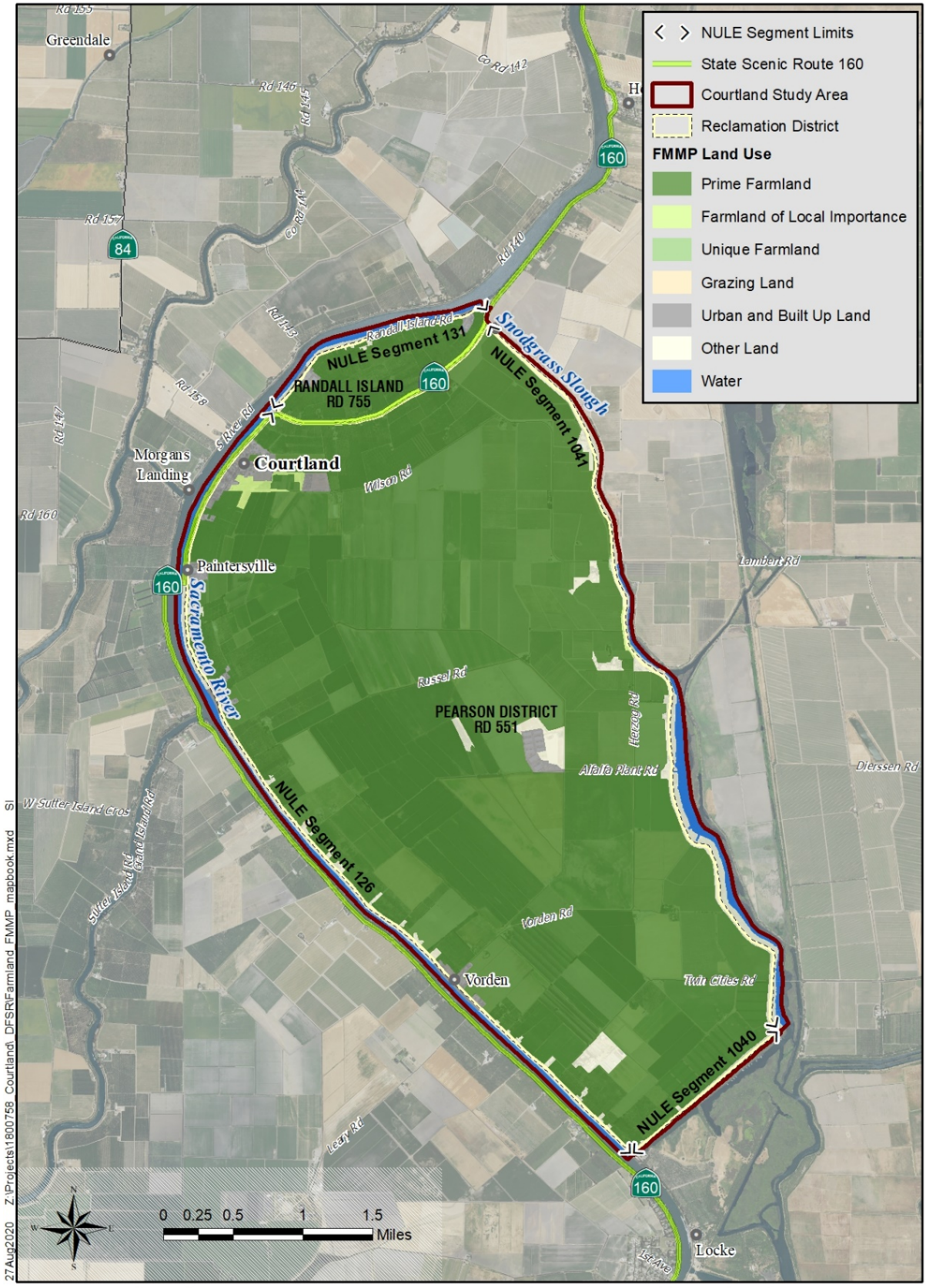


Figure 2-7. Farmland Designations within the Study Area

Vegetation classifications include a crosswalk between Central Valley Riparian Mapping Project (CVRMP) and the U.S. National Vegetation Classification Standard, whereby habitat is defined by CVRMP. There are nine vegetation communities within the study area (Figure 2-8). The majority of the study area is comprised of cropland, including permanent orchards and vineyards, seasonal corn, alfalfa, and other miscellaneous row crops. Landside vegetation directly adjacent to the levee in the agricultural landscape is typically orchard and vineyard, including pear, cherry, and grape. Other vegetation types within the study area include riparian forest, riparian scrub, marsh, and seasonal wetland.

Twenty nine special-status plant species and 32 special-status wildlife species are documented or have potential to occur in the study area. The study area also supports suitable habitat for five special-status fish species. Designated USFWS and National Marine Fisheries Service critical habitat and Essential Fish Habitat also occur within the Sacramento River and border the study area.

See Appendix B for additional information on biological resources within the study area.

DRAFT

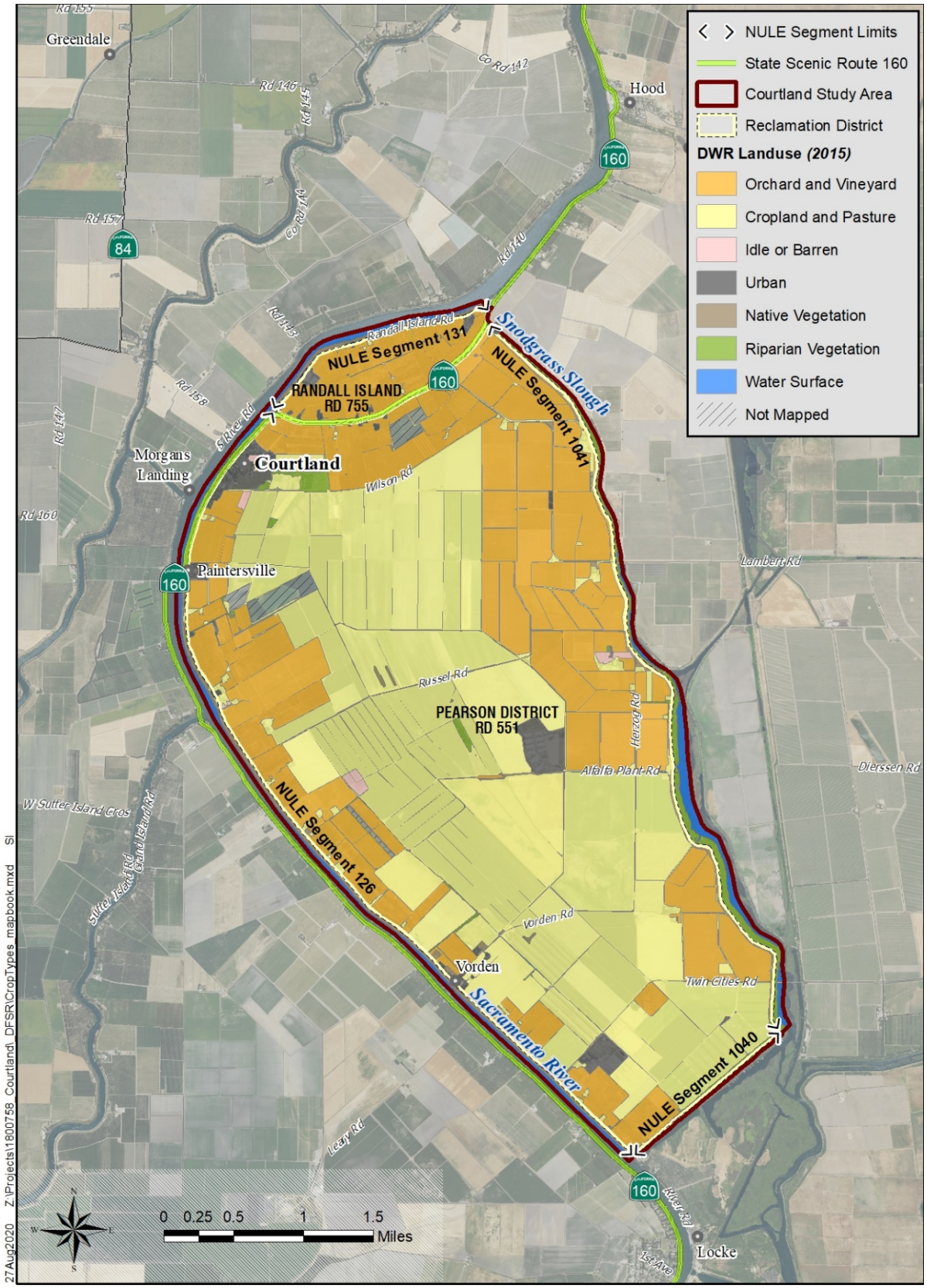


Figure 2-8. Crop Types within the Study Area

2.1.8 Cultural Resources

According to a records search conducted at the North Central Information Center, a total of 16 cultural resources are within the study area. Of those, five are prehistoric archaeological sites and the remaining 11 are built environmental resources dating to the historic era. Two of the built environment resources, Runyon House and Paintersville Bridge (P-34-002396), have been determined eligible for listing in the National Register of Historic Places (NRHP) and the California Register of Historical Resources (CRHR). None of the other identified resources have been evaluated. The built environment resources are located in various locations from the eastern portion of the study area (Herzog Road) to Courtland and along SR 160/River Road between Vorden and Courtland. Some of the resources do not have specific addresses (e.g., the levees).

Information provided by Sacramento County indicates an additional 11 cultural resources within the study area. All of the resources are built environment resources dating to the historic era. None of the resources have been formally evaluated for listing in either the NRHP or CRHR, but from written descriptions two of the resources appear to be eligible for listing in the NRHP and CRHR, the George B. Green House and another unnamed property.

In addition to the above resources, there are also historic resources located within the Courtland study area, including the Hemly House, Runyon House, and the Masonic Lodge (Figure 2-9).

In addition to the above resources located within the Courtland study area, the entire study area is itself a part of the Sacramento-San Joaquin Delta National Heritage Area (SSJDNHA). Established on March 12, 2019, the SSJDNHA, the first National Heritage Area established in California, supports historic preservation, natural resource conservations, recreation, heritage tourism, and educational projects within and beyond the Primary Zone of the Delta, but otherwise has no effect on water rights, property rights, or hunting and fishing rights within the designated area. *See* Appendix C for additional information on cultural resources within the study area.

DRAFT

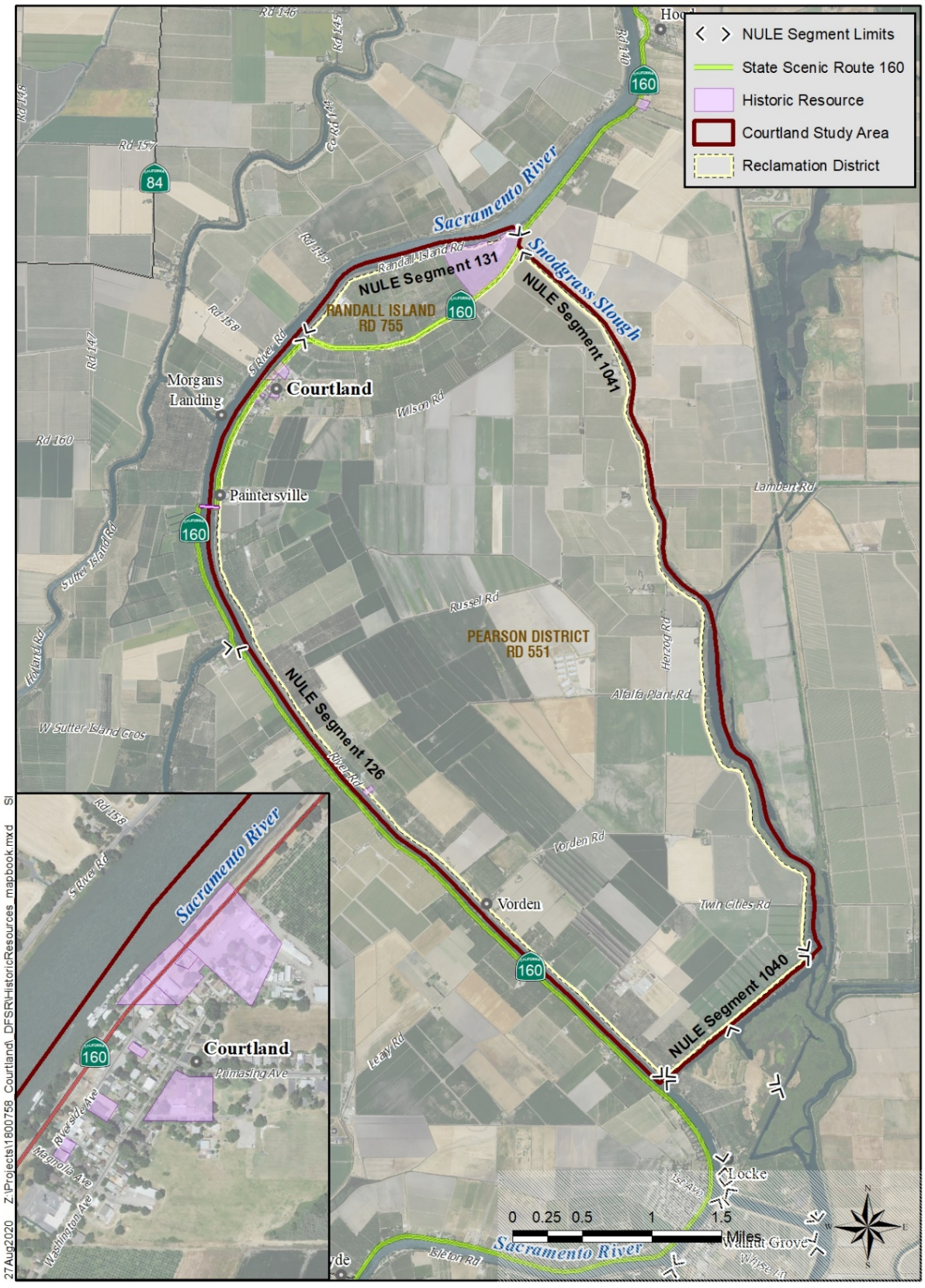


Figure 2-9. Historic Resources within the Study Area.

3. Problems, Opportunities and Constraints

3.1 Problems

In order for Courtland to safely thrive into the future as the wonderful place that it is, the issue of flood risk must be addressed. There are about 16 miles of levees surrounding the Courtland study area and a breach anywhere would cause widespread flooding putting Courtland at risk of significant flood damage, including the damage / loss of homes and potential loss of lives.

Other issues for the study area include escalating NFIP insurance premium rates, vulnerability of levees protecting through-Delta water conveyance, compliance with current FEMA accreditation standards, agricultural sustainability, threatened ecosystems, and threats from climate change and sea level rise.

3.1.1 Flood Risk

In the 2012 CVFPP, flood threats to small communities were characterized using attributes related to flood frequency, potential flood depth, and proximity to the nearest river. These characterizations were then used to prioritize the small communities into four categories (DWR, 2012b):

- **Group A (Flood Threat Level: High Hazard)**: Communities subject to high flooding frequency (greater than 1% per year) and also subject to deep flooding conditions (potential flood depths exceeding 3 ft. on average).
- **Group B (Flood Threat Level: Moderate to High Hazard)**: Communities subject to high flooding frequency (greater than 1% per year), subject to sheet flooding conditions (potential flood depths of less than 3 ft. on average), and less than 2 miles from a major flooding source.
- **Group C (Flood Threat Level: Low to Moderate Hazard)**: Communities subject to high flooding frequency (greater than 1% per year), subject to sheet flooding conditions (potential flood depths of less than 3 ft. on average), and more than 2 miles from a major flooding source.
- **Group D (Flood Threat Level: Low Hazard)**: Communities that are not subject to high flooding frequency (less than 1% per year).

Of those small communities protected by SPFC levees throughout the entire Central Valley, a total of eight were prioritized as **High Hazard**, including the communities of Courtland, Hood, Locke, East Walnut Grove, West Walnut Grove, and Ryde. Consequently, flood risk to these communities, including Courtland, is the highest relative to flood threats in the larger Central Valley, warranting improved flood protection in these areas.

DRAFT

Within the context of this feasibility study, flood risk is the largest issue facing the Courtland study area. In the event of a levee failure, particularly on the levee immediately fronting and upstream of the community, Courtland and the larger study area could see both life loss and significant property damage.

Flood risk is used as a basis to develop and prioritize flood risk reduction MAs for the purposes of this feasibility study. Flood risk is defined as:

Flood Risk = Probability of a Levee Failure x Consequences of a Levee Failure

Probability of levee failure within the Courtland study area has been historically evaluated by the DSC in the DLIS, and by DWR in the FSRP, 2017 CVFPP Update, and through the NULE program. These estimates are provided below, in Section 3.1.1.2.

Within the context of this study, consequences of levee failure are defined in terms of life loss and property damage. Life loss and property damage as a result of flooding within the Courtland study area have historically been evaluated by DWR as part of the 2012 CVFPP and the 2017 CVFPP Update and are being re-evaluated as part of the 2022 CVFPP Update. Current life loss estimates for the Courtland study area are provided in Section 3.1.1.3, and an inventory of property at risk of flooding is provided in Section 3.1.1.4.

The number of lives lost and the extent of property damage as a result of a levee failure also depend on several factors, including depth of flooding, inundation time, and floodwater velocity. Expected flood depths and inundation time within the study area have been estimated as part of the preparation of the Delta Flood Emergency Safety Plan (ESP) for the RDs and are summarized in Sections 3.1.1.5 and 3.1.1.6.

3.1.1.1 History

RD 551 experienced a major flood event in 1907 due to a break along Snodgrass Slough. At that time the District resolved that it would never experience a flood again and built the Snodgrass Slough levee larger than current geometry standards. As a result, RD 551 associates a low probability of levee failure to the levee along Snodgrass Slough. Since then, the District has experienced erosion due to high flood stages on the Sacramento River levee, but there is no record of direct flooding from the Sacramento River or Snodgrass Slough impacting District land and the community of Courtland since that time.

3.1.1.2 Probability of Levee Failure

As previously discussed, probability of levee failure within the study area has been historically evaluated by DWR as part of the FSRP, the NULE program, and the 2017 CVFPP Update, and by the DSC as part of the DLIS. The collective CVFPP and FSRP analyses aggregated the level of flood protection by impact area. The levels of flood protection offered by the current levee system(s) as detailed in the 2017 CVFPP Update were updated with new geotechnical information during the course of this study. Levee performance curves were collectively updated

DRAFT

by DWR and Sacramento County for each of the project levee segments in the study area and are provided in Appendix E. With updates to these levee performance curves, the SAC 47 (RD 551, including RD 755) and SAC 48 (Courtland) impact areas are conservatively estimated to have only a 7-year level of flood protection at the USACE 1957 Assessment Water Surface Elevation (AWSE), largely due to the presence of known FSRP critical and serious sites within RD 755 along the SPFC left bank levee of the Sacramento River.

DLIS analyses suggest that the level of flood protection for the study area ranges from 36 (SAC 48) to 60 years (SAC 47). Based upon empirical data and history provided above, the latter estimate of a 35- to 60-year level of flood protection is more applicable, particularly when comparing to the current, modern standard of obtaining a 100-year level of flood protection in accordance with FEMA's accreditation standards, pursuant to 44 CFR §65.10.

DWR's NULE Geotechnical Assessment Report (GAR) qualitatively evaluated probability of failure for the Courtland study area (Table 3-1). These same values are currently being updated by DWR and Sacramento County during the course of this feasibility study. For each NULE segment, four potential failure mechanisms (underseepage, slope stability, through seepage, and erosion) were evaluated and the segment was categorized based on its overall vulnerability to the various failure mechanisms. Segments were categorized as low, moderate, or high, based on the likelihood of either levee failure or the need to flood fight to prevent levee failure at the USACE 1957 design water surface elevation (WSEL). These analyses found NULE Segment 131 along the Sacramento River within RD 755 – Randall Island and upstream of Courtland to have a *high* likelihood of either levee failure or the need to flood fight to prevent levee failure at the USACE 1957 design WSEL based on the potential vulnerability to underseepage. NULE Segment 126 along the Sacramento River within RD 551 – Pearson District was found to have a *moderate* likelihood of either levee failure or the need to flood fight to prevent levee failure at the USACE 1957 design WSEL based on potential vulnerability to underseepage and erosion. The non-SPFC levees along Snodgrass Slough (NULE Segment 1041) and Meadows Slough (NULE Segment 1040) were identified as having *moderate* to *high* likelihood of levee failure at the assessed WSEL or AWSE based on potential vulnerability to underseepage and stability. These same values are currently being updated by DWR during the course of this feasibility study.

DRAFT

Table 3-1. Summary of NULE GAR Assessment Results for the Courtland Study Area (URS, 2011a)

Levee Segment Location	NULE Segment	Overall Segment Characterization	Results by Individual Failure Mechanism			
			Under-seepage	Slope Stability	Through Seepage	Erosion
Left Bank Sacramento River - RD 755 (SPFC levee)	131	High	High	Low	Lacking Sufficient Data	Moderate
Left Bank Sacramento River - RD 551 (SPFC levee)	126	Moderate	Moderate	Low	Low	Moderate
Right Bank Delta Meadows Slough RD 551 (Non-SPFC levee)	1040	Moderate	Moderate	Lacking Sufficient Data (Low to Moderate)	Low	Low
Right Bank Snodgrass Slough RD 551 (Non-SPFC levee)	1041	Moderate to High	Moderate	Lacking Sufficient Data (Moderate to High)	Low	Low

3.1.1.3 Life Loss

The 2017 CVFPP Update estimated potential life loss on an annualized basis for the subject impact areas: SAC 47 (RD 551, including RD 755) and SAC 48 (Courtland). Life loss on an annualized basis was analyzed in the 2017 CVFPP Update for a series of scenarios over a 60-year period of 2007 to 2067. The baseline scenario included an approximation of system performance prior to 2007, before implementation of system improvements in the Sacramento Basin. Four other scenarios were also analyzed which considered, to varying degrees: (1) the impact of implementation of DWR flood control projects; (2) non-structural systemwide actions including enhancement of flood preparedness and warning notifications; (3) larger-scale actions such as widening the Sacramento weir and Yolo Bypass system(s); (4) climate change; (4) sea level rise; (5) and population and land use changes. For all five scenarios, no life loss was estimated on an annualized basis for either impact area, including for the 2007 baseline case (DWR, 2017d).

Life loss on an annualized basis was also estimated as part of the DLIS. From this analysis, expected annual fatalities for RD 755 were estimated to be zero, with less than 0.2 annual fatalities predicted for RD 551 (DSC, 2017).

A breach immediately upstream or fronting the community of Courtland could result in floodwater depths in Courtland in excess of 10 feet combined with floodwater velocities in excess of 5 feet per second (fps). Combined floodwater depths and velocities in this scenario

DRAFT

would result in little to no warning time for evacuation, which poses imminent flood threats to the community of Courtland and would very likely result in life loss.

Instantaneous flooding with combined high flood depths and velocities into homes is a messy, dangerous situation likely resulting in loss of lives and costly cleanup expenses.

3.1.1.4 Property Damage

Structure counts, agricultural acreage, vehicle counts, and total miles of highways and streets, along with their associated values, were quantified as part of the 2017 CVFPP Update. These inventories and their associated values were updated as part of the 2022 CVFPP Update efforts during the course of this study. Within the study area, the value of structures, agricultural crops, vehicles, and highways and streets total over $410M in 2020 dollars:

- Total estimated depreciated replacement value of the 468 structures in the Courtland study area (RDs 551 and 755): $366.2M
- Total estimated value of agricultural crops: $25.1M
- Total estimated vehicle value: $12.1M
- Total estimated value of highways and streets: $6.5M

Structures at risk of flooding are summarized in Table 3-2. The Courtland study area contains approximately 468 structures, with the majority of these located within the community. As part of the 2017 update to the CVFPP, depreciated replacement values for these structures and contents were defined for the two impact areas within the Courtland study area, which are being updated as part of the 2022 CVFPP Update. As shown in

DRAFT

Table 3-3, the total depreciated replacement value for the Courtland study area escalated to 2020 dollars is nearly $366.2M, with about a fifth of this value ($67.2M) located within the community of Courtland.

Table 3-2. Structures within the Courtland Study Area (HDR, 2021).

CVFPP Impact Area (area in acres)	Total Structures Count				
	Residential	Commercial	Industrial	Public	Total
SAC 47: RD 755 and RD 551, less SAC 48: (9,642 acres)	164	0	156	0	320
SAC 48: Courtland (146 acres)	98	10	25	15	148
Total Courtland Study Area (9,788 acres)	262	10	181	15	468

DRAFT

Table 3-3. 2022 CVFPP Depreciated Replacement Value for Courtland Study Impact Areas SAC 47 and SAC 48 (HDR, 2021).

CVFPP Impact Area (area in acres)	Depreciated Replacement Value				
	Residential	Commercial	Industrial	Public	Total
SAC 47: RD 755 and RD 551, less SAC 48: (9,642 acres)	$65,419,000	$0	$233,571,000	$0	$298,990,000
SAC 48: Courtland (146 acres)	$29,471,000	$5,078,000	$21,036,000	$11,649,000	$67,234,000
Total Courtland Study Area (9,788 acres)	$94,890,000	$5,078,000	$254,607,000	$11,649,000	$366,224,000
Average Depreciated Value of Structures	$362,000	$508,000	$1,407,000	$777,000	$783,000

Note: Costs are reported in Quarter 1, 2020 dollars

Acreage of agricultural crops and their estimated worth, along with the total amount of vehicles and their estimated value, are summarized for each impact area and the collective study area in Table 3-4 and Table 3-5 below. In summary, crops within the study area are valued at $25.1M in 2020 dollars, with the majority of this value located outside the community of Courtland. The total vehicle value (excluding agricultural equipment) within the study area is nearly $12.1M in 2020 dollars, with vehicles in the community of Courtland valued at nearly $3.5M.

Table 3-4. Crop Acreage and Total Value for the Study Area (HDR, 2021).

CVFPP Impact Area (area in acres)	2020 Agricultural Acreage (acres)									Total Value
	Citrus	Deciduous	Field	Grain	Pasture	Rice	Truck	Vineyard	Total	
SAC 47: RD 755 and RD 551, less SAC 48: (9,642 acres)	0	1,588	2,657	615	550	0	724	1,818	7,952	$25,089,000
SAC 48: Courtland (146 acres)	0	1	1	3	0	0	0	0	5	$11,000
Total Courtland Study Area (9,788 acres)	0	1,589	2,658	618	550	0	724	1,818	7,957	$25,100,000

Note: Costs are reported in Quarter 1, 2020 dollars

DRAFT

Table 3-5. Vehicle Count and Value for the Study Area (HDR, 2021).

CVFPP Impact Area (area in acres)	Total Vehicle Count	Total Vehicle Value
SAC 47: RD 755 and RD 551, less SAC 48: (9,642 acres)	956	$8,604,000
SAC 48: Courtland (146 acres)	386	$3,474,000
Total Courtland Study Area (9,788 acres)	1,342	$12,078,000

Note: Costs are reported in Quarter 1, 2020 dollars

The total miles of highways and streets are summarized for each impact area and the collective study area in Table 3-6 below. The portion of SR 160 which runs through the study area is valued at nearly $1.9M. Streets within the greater RD 551/RD 755 basins outside the community of Courtland are valued at $4.4M, and the collective 1.3 miles of streets in Courtland are valued at $228,000.

Table 3-6. Total Miles of Highways and Streets and Value for the Study Area (HDR, 2021).

CVFPP Impact Area (area in acres)	Highways Miles	Total Highways Value	Streets Miles	Total Streets Value	Total Value of Highways and Streets
SAC 47: RD 755 and RD 551, less SAC 48: (9,642 acres)	2.7	$1,501,000	24.5	$4,433,000	$5,934,000
SAC 48: Courtland (146 acres)	0.6	$350,000	1.3	$228,000	$578,000
Total Courtland Study Area (9,788 acres)	3.3	$1,851,000	25.8	$4,661,000	$6,512,000

Note: Costs are reported in Quarter 1, 2020 dollars

Baseline (or without project) EAD estimates for the two impact areas within the Courtland study area have also developed as part of the 2022 CVFPP Update efforts (Table 3-7). As previously discussed, EAD is a common metric used to estimate risk within the Delta and other components of the Sacramento River Flood Control Project (SRFCP). EAD is calculated on an annualized basis and represents the annual average expected damages through the consideration of potential flooding conditions. Baseline EAD estimates incorporate updated levee performance curves and are provided for existing conditions and future conditions. Baseline EAD values under existing conditions include the existing conditions of the flood management system(s) in the Central Valley and includes projects that have been authorized and have funding, or that have started construction or implementation under the 2022 CVFPP. Baseline EAD values under future conditions have the same features as the existing conditions, with the addition of the effects of inland climate change projections and sea level rise. As shown below in Table 3-7, the total baseline EAD for the Courtland study area under existing conditions is estimated at nearly $45M in 2020 dollars. With the effects of climate change and sea level rise, baseline EAD for the Courtland study area under future conditions is estimated at over $95M in 2020 dollars. It should be noted that the EAD analyses utilized the hydrologic and hydraulic (H&H) models developed

DRAFT

specifically for the CVFPP 2017-2022 updates by DWR's consultant team, and not the H&H models prepared by the GEI Consultant Team in Appendix I.

Table 3-7. 2022 CVFPP EAD Values for SAC 47 and SAC 48 (HDR, 2021)

Impact Area	EAD[1], Existing Conditions	EAD[2], Future Conditions with Climate Change Adjustments
SAC 47: RD 755 and RD 551, less SAC 48: (9,642 acres)	$38,544,000	$81,118,000
SAC 48: Courtland (146 acres)	$6,366,000	$14,126,000
Total Courtland Study Area (9,788 acres)	$44,910,000	$95,244,000

Notes: [1] EAD as defined by the 2022 Without-Project Scenario from the 2022 CVFPP
[2] EAD as defined by the Future Without-Project Scenario from the 2022 CVFPP

3.1.1.5 Floodwater Depths and Velocities

Inundation mapping was conducted in May 2017 for RD 551 and RD 755 as part of Sacramento County's Flood ESPs for the RDs collectively located in the North Delta and in the county. Hypothetical levee breaches were modeled at three locations: (1) upstream of the community of Courtland (along the Sacramento River NULE Segment 131 in RD 755); (2) downstream from the community of Courtland (along the Sacramento River NULE Segment 126); and (3) east of Courtland along Snodgrass Slough (along NULE Segment 1041).

Based on these analyses, flood depths and corresponding velocities are greatest in the community of Courtland and in RDs 551 and 755 when there is a breach along the Sacramento River upstream of the community of Courtland, along NULE Segment 131 in RD 755. In this scenario, RD 551 is predicted to experience flood depths from 10 to 35 feet, and flow velocities in excess of 10 fps at any given breach location. Under this same scenario maximum flood depths within the densely populated community of Courtland are likely to reach 10 feet, and the maximum velocities could exceed 5 fps.

Potential flood depths in RD 755 could exceed 15 feet near the center of the RD in the event of a breach along the Sacramento River upstream of the community of Courtland within RD 755 (Figure 3-1). As shown in Figure 3-1, denoted by the arrows extending from the hypothetical breach location in RD 755, these flood depths could also be observed in the event of a levee failure both further upstream along NULE Segment 131 in RD 755, or further downstream along NULE Segment 126 in RD 551. Figure 3-1 depicts worse case flood depths that could occur in RDs 755 and 551 with a levee breach along the Sacramento River in the project study area at or upstream of the community of Courtland. Flood depths could actually be reduced by 5 to 6 feet or more as shown in Figure 3-1down to the Base Flood Elevation (BFE) of 16 feet NAVD 88 indicated if a downstream relief cut could be implemented in the lower reaches of RD 551 into Snodgrass Slough or the Lower Sacramento River (*see* Section 5.2.9, for more information).

DRAFT

In the event of a breach along the Sacramento River downstream from the community of Courtland, flood depths in the community of Courtland are predicted to reach between 5 to 10 feet with floodwater velocities within Courtland likely less than 5 fps. Flood depths in RDs 551 and 755 are expected to reach up to 30 feet and 15 feet, respectively.

Lowest floodwater depths and velocities are predicted when there is a breach along Snodgrass Slough (NULE Segment 1041). In this case, floodwater depths in the community of Courtland are predicted to be between 0 and 5 feet and floodwater ponding velocities likely less than 2 fps. Under a Snodgrass Slough breach scenario, the floodwater depths in RD 551 could reach 25 feet Potential flood ponding depths in RD 755 could reach close to 15 feet

The results of this inundation mapping demonstrate that, of the three breach locations investigated, a breach in the levee upstream or adjacent to the community of Courtland located within RD 755 (NULE Segment 131) produces the greatest floodwater depths and velocities within the study area, collectively posing the greatest risk to loss of life and property damage.

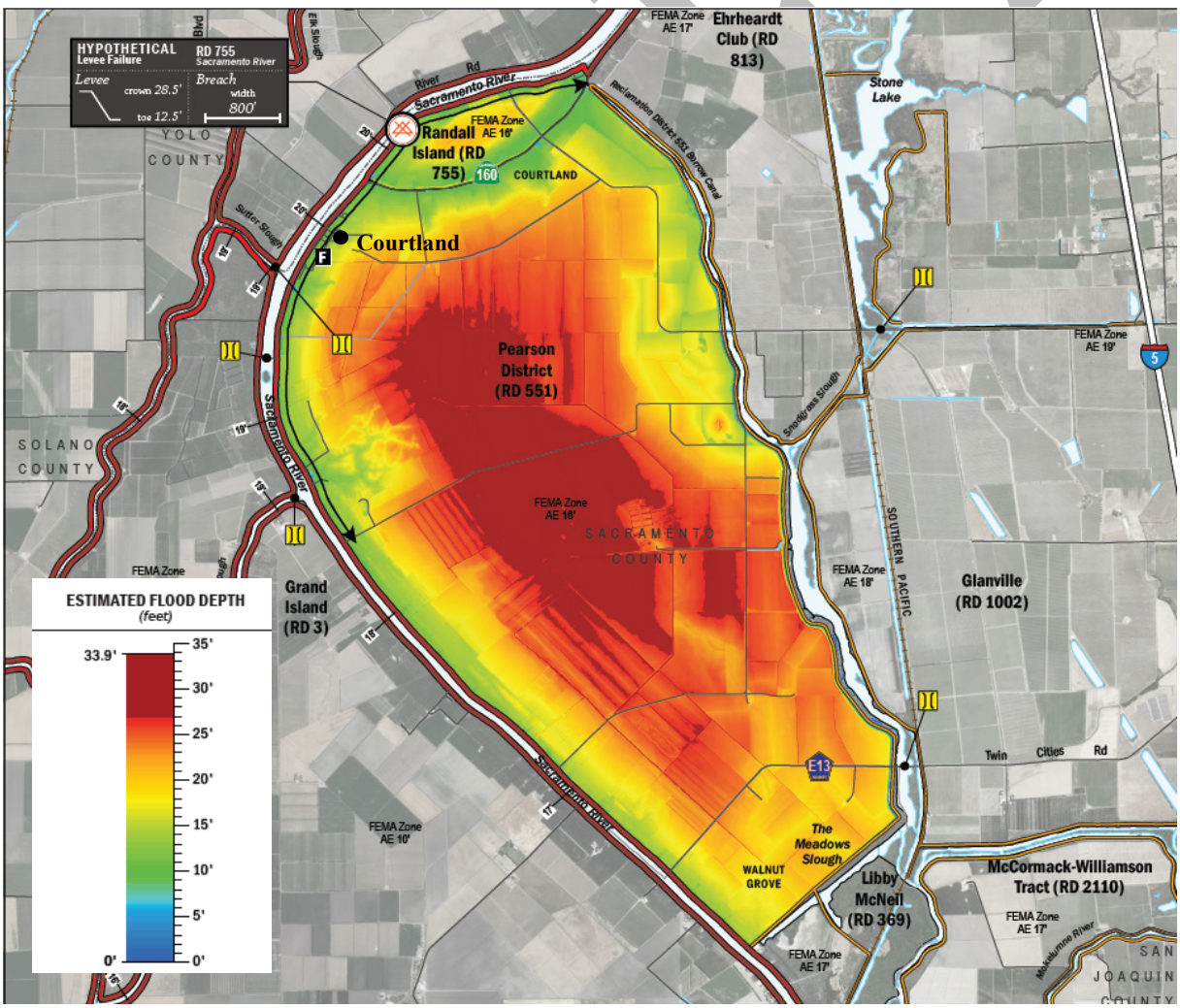


Figure 3-1. Study Area Maximum Flood Depths (Dynamic Planning + Science, 2017 for County of Sacramento).

3.1.1.6 Inundation Time

Using the same breach locations discussed in the preceding Section 3.1.1.5, the time to 1 foot of inundation in the Courtland study area was estimated as part of the inundation mapping performed for RDs 551 and 755 Delta Flood ESPs. The time to 1 foot of inundation is shortest for the community of Courtland and RDs 551 and 755, assuming a levee breach upstream within RD 755 (NULE Segment 131). In this scenario, RD 755 is inundated to 1 foot in 0 to 2 hours, with the community of Courtland inundated to 1 foot in 22 hours and RD 551 inundated as soon as 4 hours after the levee breach. The duration of time prior to reaching a 1-foot depth of flooding within the community of Courtland is longer based on a levee breach along Snodgrass Slough or downstream from Courtland (24-56 hours, respectively).

Although the given inundation times are representative of a levee breach both upstream and downstream of the hypothetical breach location in RD 755, it is expected that a breach on the levee immediately fronting the community of Courtland would result in nearly instantaneous inundation within the community with high velocities potentially exceeding 10 fps.

For more information on flood risk and to view a hypothetical flood simulation of the Courtland study area, visit the Courtland Story Map developed by Sacramento County located here: Courtland Story Map - Sacramento County Small Communities Flood Risk Reduction Program.[2]

3.1.2 Escalating NFIP Insurance Premium Rates

Delta legacy communities are subject to deep flooding behind a combination of federal/State authorized (SPFC) levees and non-SPFC, private levees. However, most all Delta legacy communities have **not** flooded in the last 100 years due to oversized levees with surplus freeboard and low to moderate risk of levee failure.

Flood risk can be determined using information from FEMA's Flood Insurance Study (FIS) in conjunction with FIRMs. FIRMs delineate SFHAs, which are defined as areas that will be inundated by the 100-year flood event. These areas include lands and improvements behind levees that are not fully accredited by FEMA in accordance with 44 CFR §65.10. The current FIS for Sacramento County is dated August 16, 2012 (FEMA, 2012). The community of Courtland, as shown in Figure 3-2, is located within Zone AE, which is defined by FEMA as being "subject to inundation by the 1 percent-annual-chance flood event determined by detailed methods." According to Figure 3-2, excerpted from the FEMA FIRM, the Courtland study area is subject to flooding in Zone AE to a BFE of 16.0 feet NAVD 88. It should be noted that the BFE of 16.0 feet NAVD 88 assumes that a relief cut can be deployed at the downstream, lower gradient of the subject study area; whereas if a relief cut is not deployed maximum flood elevations could possibly exceed 18.0 feet NAVD 88.

[2] https://waterresources.saccounty.net/DeltaSmallCommunities/Pages/default.aspx

DRAFT

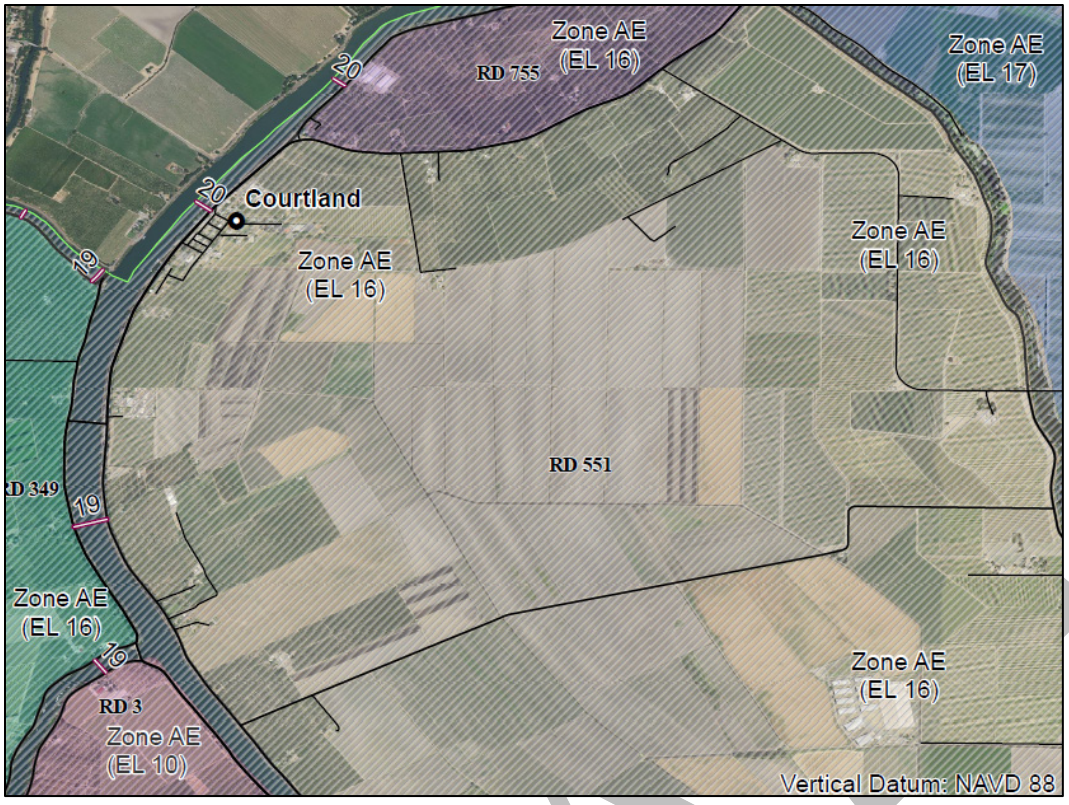


Figure 3-2. Courtland's 100-Year BFE Floodplain Recognized by FEMA.

Flood insurance through the NFIP is mandatory for buildings with a federally backed mortgage located in a SFHA. These premiums have been steadily on the rise since the passage of flood insurance reform laws including BW-12 and the Homeowner Flood Insurance Affordability Act (HFIAA) of 2014. Under HFIAA, policyholders can expect to see gradual increases in annual premiums until they reach a rate that the NFIP deems to be actuarially based. Effective April 1, 2018, NFIP annual premiums increased by 8 percent from $866 per policy to $935 per policy, not including HFIAA surcharges or other fees (FEMA, 2017). In October 2019, FEMA announced that beginning on April 1, 2020, annual renewal premiums would increase by 11.3 percent (FEMA, 2019a). This rate restructuring has been postponed to October 2021 according to FEMA as of November 7, 2019 (FEMA, 2019b).

For those who do not already have a current NFIP policy, they will be rated by FEMA based on the elevation of the living quarters of their structure(s) relative to Courtland's BFE of 16 feet NAVD 88. Sacramento County currently enjoys up to 40 percent discount on flood insurance costs due to the county's high CRS score, which is one of the top five CRS scores in the entire nation. Still, the rates are rising rapidly. Many NFIP policies in Courtland are grandfathered in at low rates that increase each year until reaching the rate based on an elevation certificate. *For example: if the floor of a house is 4 feet below the FEMA BFE of 16 feet in Courtland, with a cost of $200,000 per dwelling structure and $40,000 for structure contents, the new (non-grandfathered) NFIP premium would be $6,804 per year plus fees (this includes the county's favorable 40% discount with its high CRS score).*

DRAFT

As NFIP flood insurance rates increase the number of insured homes decrease. As a result, the Courtland community is increasingly and significantly under insured. While there are an estimated 468 structures in the Courtland study area valued with an estimated replacement value of $366.2M,[3] there are only 112 NFIP polices polices (valued at $350,000 maximum per policy including structure contents, presently capped at $250,000/structure and $100,000 for structure contents) providing $39M[4] in coverage.

To remove the entire project study area from the current FEMA BFE of 16 feet NAVD 88, the entire combined perimeter levee systems of RDs 551 and 755 would require reparing and strengthening in-place to current, modern engineering standards, consistent with the FEMA 100-year accreditation standards contained in 44 CFR §65.10. Click here to learn more about achieving a 100-year level of flood protection pursuant to the current FEMA accreditation standards.[5]

Levees protecting the Delta legacy communities fall well short of meeting current seepage and stability criteria pursuant to 44 CFR §65.10

The current cost estimate of such levee repairs/improvements for strengthening in place to achieve FEMA accreditation for just the community of Courtland (with a ring levee system) and the entire study area are provided in Sections 6.2.5 and 6.2.8, respectively.

3.1.3 Vulnerability of Levees Providing Through-Delta Water Conveyance

There are more than 1,100 combined miles of SPFC and non-SPFC levees in the Delta which convey water to 750,000 acres of farmland within the Delta for irrigation. Some, but not all of these levees in concert with the adjoining river channels also convey water toward the Clifton Forebay, which pumps the water south of the Delta to serve approximately 3M acres of agricultural lands and a population of 25M. Some of these same levees serve to protect the community of Courtland, which relies on this critical infrastructure to sustain the local agriculture economy, thus preserving the community's rich agricultural heritage. According to NULE evaluations performed in 2015, over 50 percent of SPFC non-urban levees and 40 percent of non-SPFC non-urban levees do not meet acceptable criteria for underseepage, through seepage, structural stability, and/or erosion (DWR, 2017b).

Maintenance and improvement of the current in-channel river conveyance system for the CVP and SWP water supply system(s) is a vastly better solution than a single-purpose tunnel as presently proposed by the Delta Conveyance Authority

Within the Courtland study area, the majority of the SPFC levees do not meet acceptable criteria for through seepage, underseepage, and erosion. The majority of the non-SPFC levees within the

[3] The FEMA open-source data is aggregated by zip code. These estimates represent the summation of SAC 47 and SAC 48 from the draft 2017 CVFPP Update – Technical Analyses Summary Expanded Report, 2017, and have been escalated to July 2020 dollars

[4] These estimates are sourced from the FEMA Open Source policy database

[5] https://www.fema.gov/sites/default/files/documents/fema_levee-guidance.pdf

DRAFT

study area also do not meet acceptable criteria for through seepage, with about one-third of the non-SPFC levees also being deficient for underseepage. The vulnerability of these levees is further compounded by climate change, which can intensify rain events and heighten flood risk and the risk of a seismic event in the future, which could cause the levees to fail. Additionally, as previously discussed, levees which are vulnerable to through seepage and underseepage can be particularly costly to remediate, making FEMA certification and 100-year flood protection infeasible to attain without significant cost-share from the State or others.

Maintenance and improvement of the current in-channel river conveyance system for the CVP and SWP water supply system(s) is a vastly better solution than a tunnel as presently proposed by the Delta Conveyance Authority (DCA). It costs less, is ecologically friendly, protects the "Delta as a Place," and it reduces flood risk to the Delta Legacy Communities, including Courtland, located upstream of the Delta Cross Channel. With or without the DCA as presently proposed, through-Delta conveyance will continue to rely on the freshwater corridor established both upstream and downstream of the Delta Cross Channel. Presently there are 37 miles of non-urban SPFC levees upstream and 25 miles downstream of the Delta Cross Channel in the North Delta that help convey water through the Delta (a total of 62 miles of SPFC levees which comprise significant portions of the Delta's freshwater corridor) (Figure 3-3). Improving 8.6 miles of SPFC levees to current, modern standards consistent with FEMA's 100-year accreditation standards within the RD 551/RD 755 project boundary of Courtland would constitute improving 23 percent of the non-urban SPFC levees upstream of the Delta Cross Channel and nearly 14 percent of the total non-urban SPFC levees in the Delta's freshwater conveyance corridor.

DRAFT

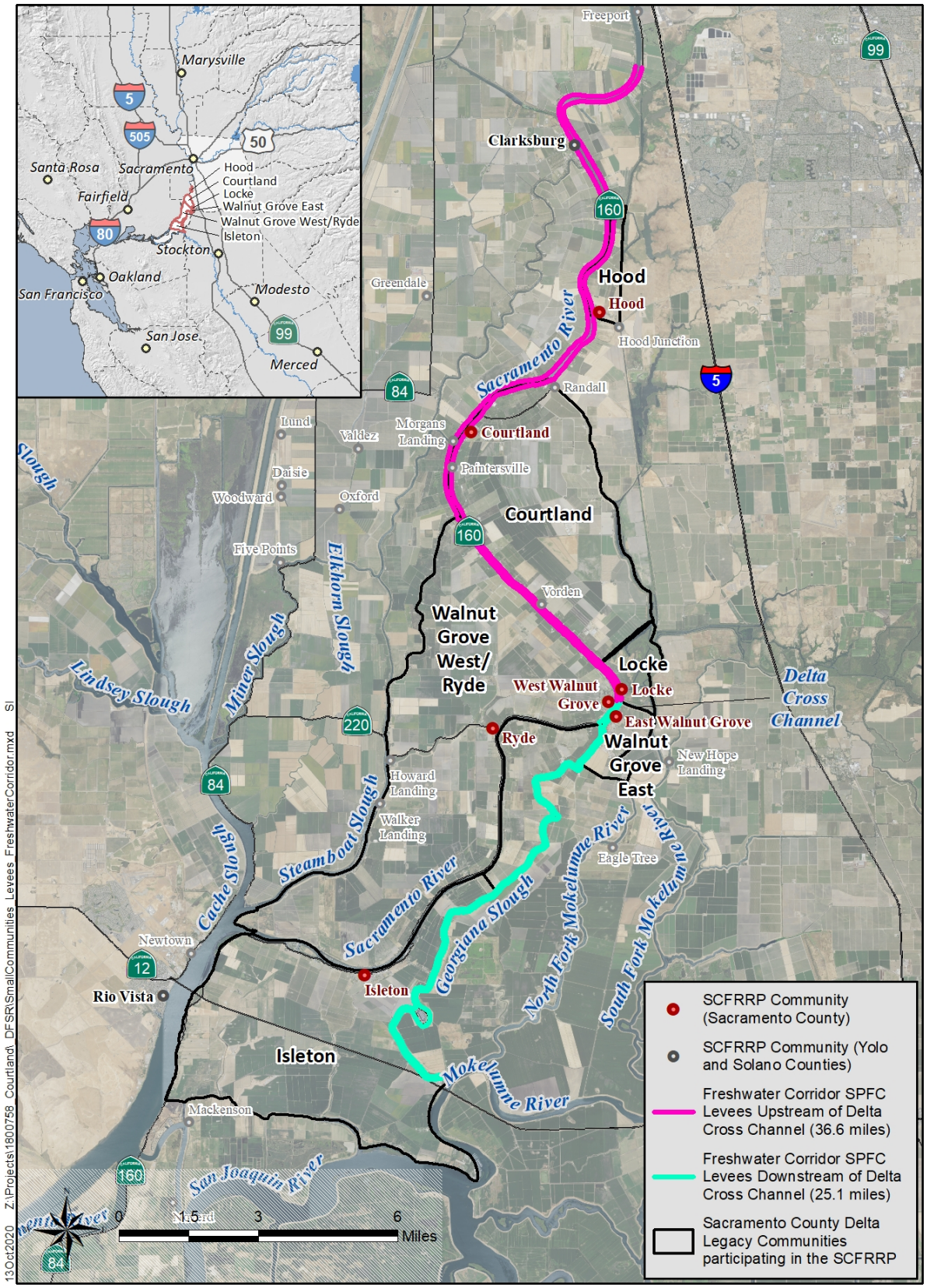


Figure 3-3. SPFC Levees which Comprise the North Delta's Freshwater Corridor.

3.1.4 Agricultural Sustainability

Agricultural lands within the Delta and in the immediate project study area are a key element of sustaining the economic health for the community of Courtland. In 2001, FEMA began updating FIRMs, and as a result, many small communities, including Courtland in 2012 were subsequently mapped into SFHAs. As a result, these communities are subject to regulations set forth by the NFIP, including land use requirements for elevating or floodproofing new and substantially improved structures and the requirement to purchase a flood insurance policy through the NFIP for each structure with a federally backed mortgage (mandatory insurance purchase requirement). These requirements do not provide the flexibility needed to sustain agriculture within the community and can make reinvestments that are needed in support of the agricultural economy infeasible or unattainable.

3.1.5 Threatened Ecosystems

Many of the historic tidal wetland areas of the Delta have been lost to development and placement of levees with a configuration that does not support tidal inundation of areas to sustain viable habitat. Vulnerability to flow and temperature changes associated with Delta water supply conveyance (and naturally occurring drought) and predation of migrating fish species from invasive species is also an issue in certain areas of the Delta.

3.1.6 Threats from Climate Change and Sea Level Rise

Climate change and sea level rise have the potential to increase peak flows and flood stages in the Lower Sacramento River and Mokelumne/Cosumnes River systems, including Snodgrass Slough. As discussed in Appendix I, peak flows in the Sacramento River could increase by 4 percent for the 100-year flood and 2.3 percent for the 200-year flood as a result of climate change. Additionally, sea level rise is expected to increase the 100-year flood stage in the Sacramento River between Elk Slough and Georgiana Slough by nearly 1.12 feet. The 200-year flood stage along the same extent is estimated to increase by 0.65 feet Increased flows and flood stages can not only result in more frequent flooding, which can lead to levee failure through greater hydro-dynamic pressures (and potential overtopping) but can also result in greater stresses to the levee system as levees are loaded with water for longer durations of time and *via* other mechanisms resulting from increased flow/flood stages (e.g., erosion). Note, however, that within the Courtland study area, the effects of climate change and sea level rise are less pronounced along the mainstem of the Sacramento River, as a result of planned improvements in the upstream and adjacent bypass systems, than they are for the more isolated, localized drainage of Snodgrass Slough.

It should be noted that the effects of climate change and sea level rise are partially neutralized along the Lower Sacramento River near the Courtland study area due to the planned system-wide improvements of widening both the Sacramento and Yolo Bypasses and their associated weirs. The said enhancements to the weir and bypass systems will shunt or divert greater amounts of

DRAFT

water from entering the Lower Sacramento River downstream of the American River during high water stage conditions. The value of reducing flood stages in the Lower Sacramento River system by widening the Sacramento Yolo Bypass system(s) is briefly discussed above in Section 1.7.2 and shown in Figure 1-4..

Unfortunately, there are no bypass systems to accommodate increases in floodwater flows and stages in Snodgrass Slough and the Franklin Pond area that are heavily influenced by Morrison Creek and the larger downstream confluence flows and stages of the Cosumnes and Mokelumne rivers. Thus, for Courtland, there is a greater concern of climate change impacts to flood stages along Snodgrass Slough in relation to the Lower Sacramento River.

3.2 Opportunities

Opportunities to address the problems discussed above are summarized below.

3.2.1 Reduce Flood Risks

The levees protecting the Courtland study area do not meet FEMA accreditation and current engineering standards to achieve a 100-year level of flood protection. When a levee is accredited by FEMA, the levee system is certified to meet current engineering standards contained in 44 CFR §65.10. These standards include criteria for through- and underseepage, freeboard, stability, settlement, encroachments, interior drainage, and other operations and maintenance criteria. These standards and criteria help to reduce the overall probability of levee failure and to ensure that communities and areas located behind the accredited levee(s) are protected during high water events. Since flood risk is partially characterized by the probability of levee failure, improving levees up to FEMA standards can help to reduce flood risk, thereby reducing the potential for life loss and property damage. A discussion surrounding the potential for life loss within the Courtland study area is provided above in Section 3.1.1.3. The potential for property damage within the Courtland study area was evaluated as part of this study using updated inventories of structures, vehicles, agricultural crops, highways, and streets from the forthcoming 2022 CVFPP Update. These inventories were used in a flood damage analysis to quantify EAD for the Courtland study area under existing and future conditions. These updated inventories are provided in Section 3.1.1.4, and results from the flood damage analysis are presented in Section 6.3.1.2 and further detailed in Appendix E.

Securing levee improvements to FEMA accreditation standards can also enhance the resiliency and reliability of the through-Delta water conveyance system and help to ensure that water is conveyed as needed to agricultural farmland within the Delta and through the Delta to the SWP and CVP export pumps in the south Delta. Once a levee is accredited, the designation is shown on FIRM maps and can result in areas being mapped out of SFHAs. This can subsequently result in lower NFIP insurance premium rates. FEMA accreditation could also substantially reduce premiums for a community, flood-risk based insurance program that may be applicable for the

DRAFT

community of Courtland and possibly the adjoining larger project area of RDs 551 and 755 and other nearby Delta Legacy Communities.

3.2.2 Agricultural Sustainability

Efforts to improve agricultural sustainability within the Delta, including the Courtland study area, are outlined in the DPC's LURMP. The LURMP identifies methods for supporting the long-term viability of agriculture within the Delta region while being responsive to enhancing natural habitats and ecosystem restoration efforts by:

- Supporting the continued capability for agricultural operations to diversify and remain flexible to meet changing market demands and crop production technology
- Promoting the ability for agriculture operations to change the crops or commodities produced to whatever is most economically viable at the time
- Supporting the use of new crop production technologies that keep Delta agricultural operations competitive and economically sustainable

The DSC's Delta Plan also identifies policies and recommendations which seek to maintain Delta agriculture as a primary land use, food source, key economic sector, and as a way of life for the community of Courtland and for the Delta as a whole. The purpose of the policies and recommendations is to address the impacts to local agriculture from changing markets, water conveyance facilities, and changing water quality. A subset of these policies and recommendations include:

- Floodproofing the Delta, as far as feasible, by mainly improving existing levees
- Restricting urban development, while supporting farming and recreation
- Encouraging agritourism in and around legacy communities
- Promoting value-added crop processing

In addition to the above measures it is preferable to repair and strengthen-in-place levees systems with vertical cut-off walls over wider, seepage/stability berms on the land side of the levees that can displace valuable, high-productive agricultural lands.

3.2.2.1 Agricultural Floodplain Ordinance Task Force

The AFOTF is comprised of officials from FEMA, DWR, the CVFPB, RDs, levee districts, flood control agencies, counties, engineers, farmers, and non-governmental organizations. After forming in 2015, the AFOTF's goal was to develop administrative options of the FEMA NFIP to address sustainability of modern agriculture in deep floodplains. Administrative options were considered as they could be potentially implemented without changing laws or regulations.

Administrative options to improve agricultural sustainability within the Sacramento Valley were summarized in a technical memorandum prepared in 2016. In total, the memorandum

DRAFT

summarized nine recommendations which addressed how rules and practices could be modified to, "…(1) reduce or remove elevation and floodproofing requirements for new and substantially improved agricultural structures, and (2) reduce the cost of NFIP insurance premiums for agricultural structures with a federally backed mortgage to a more appropriate portion of the financial risk in the NFIP" (AFOTF, 2016). Further details and recommendations developed by the AFOTF are highlighted as item No. 9 in supporting Appendix H.

3.2.3 Potential Ecosystem Restoration Opportunities

Restoration opportunities adjacent to the Courtland study area, some of which were previously identified in the Lower Sacramento-North Delta RFMP potentially include:

1) Enhancing backwater habitat along Snodgrass Slough/RD 551 borrow canal and possibly enhancing the existing freshwater corridor of Snodgrass Slough
2) Advancing the nearby Zacharias Island/Snodgrass Slough Enhancement Project (includes breaching the western levee to allow a connection to Snodgrass Slough)
3) Enhancing the combination of wildlife habitat and recreation opportunities within the Delta Meadows State Park adjacent to the communities of Locke and East Walnut Grove
4) Enhancing or creating additional Shaded Riverine Aquatic (SRA) habitat along the Sacramento River or Snodgrass Slough in connection with addressing erosion concerns and/or replenishing rocks slope protection at known erosion sites
5) If potential borrow material is need for improving the Courtland project area levee systems consider borrowing material from the Stone Lakes Wildlife Area(s) (south and north of Hood-Franklin Road) that may create opportunities for enhancing tidal-influenced Delta habitat while also marginally reducing flood stages in the Franklin Pond areas east of Snodgrass Slough

See Appendix D for additional information on ecosystem opportunities within or adjoining the study area.

3.2.4 Enhance Resiliency and Reliability of Through-Delta Conveyance

Levees within the study area are vulnerable to earthquakes, climate change, and sea level rise, and most levee reaches do not meet current 100-year FEMA accreditation standards. These levees are used to protect both people and property and help convey water used to support the agricultural economy within the community of Courtland and beyond, including south of Delta interests. SPFC levees in the North Delta are particularly critical since they assist with the conveyance of water to and downstream of the Delta Cross Channel, which augments the flow of the Sacramento River water through the Delta to the collective SWP and CVP export pumps in the south Delta near Tracy. In the event of a levee failure, sea water intrusion from the San Francisco Bay could enter areas that are critical to the distribution of fresh water, threatening water supply.

DRAFT

Over time, through the DWR Delta Levee Subventions local-State cost share program, the levees have been maintained throughout the Delta, and some have been enlarged or geometrically improved to various Delta standard levels. Although not improving the Delta levees to modern 100-year FEMA accreditation criteria, continuing to maintain and improve levees within the Delta not only enhances flood protection for those people and properties within the study area and the Delta, but enhances the resiliency and reliability of through-Delta water conveyance. To promote this resiliency and reliability, levees both upstream and adjacent to the Delta Cross Channel along the Delta's freshwater corridor should be modernized to at least current 44 CFR §65.10 levee standards but also ultimately to a seismic standard to guard against earthquakes.

3.3 Constraints

3.3.1 Limited Local Funding Sources

LMAs partner with the State through the Delta Levee Subventions program to fund maintenance and repair of their flood control systems. However, the landscape by which levees are maintained by LMAs has drastically changed since levees were first constructed. Today, engineering design standards are more rigorous and environmental regulations are more stringent. In concert with deferred maintenance, these new requirements have increased costs to maintain the levee systems and lack of funding is a common problem facing many LMAs. This is particularly notable in small communities with limited resources and reduced tax base. LMAs derive assessment valuation per acre for each parcel in proportion to benefits derived from reclamation operation. Notably, improvements on parcels including buildings are not included in the assessment calculation per provisions of the California Water Code. With residential properties often falling below an acre, there is thus a limitation on how much properties within these communities can be assessed (California Water Code § 50000 et seq.).

3.3.2 Proposition 218 Assessments and Other Funding Issues

Performing levee upgrades or improvements often requires a cost sharing between local and State agencies. State funding for investments in flood management systems has largely been supported by general obligation bonds (DWR, 2017a). Multiple State programs with the purpose of rehabilitating levees within the Delta have been established as a result of these bond funds, including the SCFRRP, the Delta Subventions Program, and the Delta Levees Special Projects Program.

At the local level, LMAs rely primarily on taxes or special assessments on an acreage basis to make up their share of the funding for flood control projects. In 1996, California voters passed Proposition 218, the so-called "Right to Vote on Taxes Act." Proposition 218 amended the California Constitution by adding procedural and substantive requirements that must be met prior to levying new assessments (California Special Districts Association, 2013). As a result, all new assessments that are used for flood management must be voter approved. This directly impacts a

DRAFT

LMA's ability to raise funding for local flood management projects, and without a local funding source, LMAs are unable to partner in cost-sharing programs through the State.

Direct reclamation district assessments to homeowners are constrained by the California Water Code, and are approximately $25 per home, annually, in the community of Courtland. This is an order of magnitude lower than average assessments for flood protection in nearby urban areas (for comparison, Sacramento Area Flood Control Agency's assessment for a residential property located behind levees in Sacramento is over $200 annually, excluding costs for applicable flood insurance).

Existing assessment to agricultural landowners is very complex in the study area, since they are tied to the elevation and drainage needs of the assessed land. Currently, the average assessment per acre is $20.57, for a total of $181,029 for O&M for RD 551. These assessments also cover non-levee expenses: drainage costs including ditch maintenance, pumping operational costs, administrative costs, and LMA associations. Most of agricultural land assessment fees go to providing drainage to these lands and not to flood protection. Additionally, unlike other parts of the Central Valley, there are many homes and associated encroachments that pre-date the presence of federal and State oversight regarding levee repair and flood safety. These homes and encroachments are "grandfathered in", pay the same assessment as other homes, and the system must currently be maintained around them. Approximately 400 acres are protected per levee mile in Pearson District.

For large repair or improvement projects, like what may be proposed in this feasibility study, LMAs must access a line of credit to implement repairs, but then substantial time may pass before cost-share reimbursements or assessment funds are available for repayment. Thus, large cash reserves are often needed in advance of securing project funds for the State or other entities.

Another difficulty in funding repairs is that LMAs are responsible for mitigation costs associated with repairs and maintenance. These cost increase over time, especially as offsite mitigation opportunities become limited and are a requirement under State cost-share programs.

In addition to assessing properties within the Courtland study area for levee remediation repairs and improvements, the improvements and additional infrastructure may require additional O&M funds, and thus additional Proposition 218 Assessments may be required to address the incremental increases in O&M costs for new infrastructure such as a new ring levee.

3.3.3 Existing Delta Levee Standards

There are three agricultural levee standards that are widely used within the Delta: Hazard Mitigation Plan (HMP), PL 84-99, and the DWR Bulletin 192-82. These standards are summarized below in Figure 3-4 (DWR, 2019). The HMP levee configuration is widely used in the Delta on non-SPFC levees and is regarded as providing the minimal level of flood protection that is required for federal disaster assistance eligibility.

DRAFT

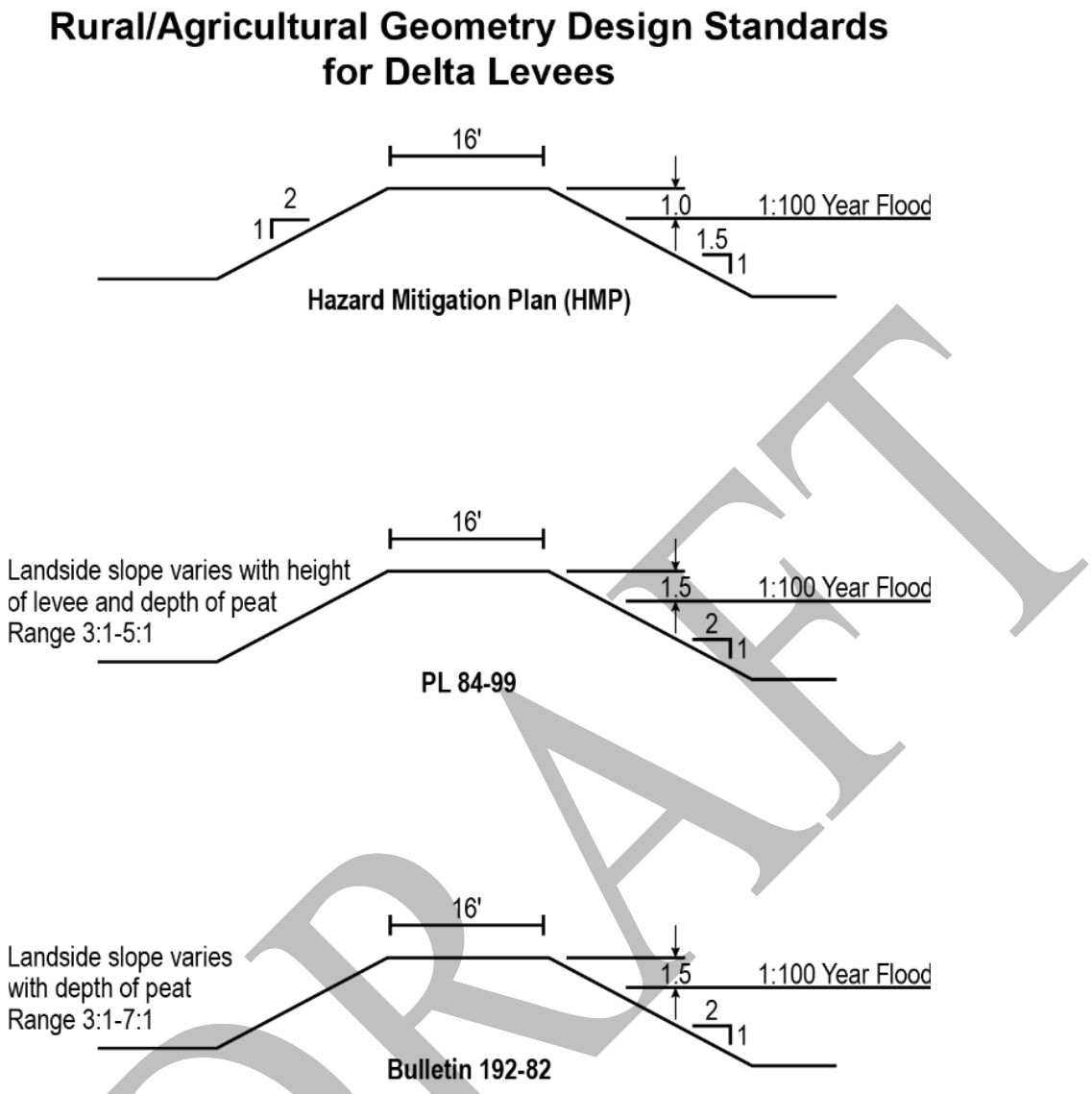


Figure 3-4. Rural/Agricultural Geometry Design Standards for Delta Levees

PL 84-99 guidance provides for somewhat better flood protection than the HMP standard, however it does not provide adequate protection from more extreme floods and earthquakes and does not provide a basis for adaption should sea level rise at an enhanced rate. The DWR Bulletin 192-82 standard is similar to the PL 84-99 criteria, except that it is designed relative to a one in 300-year flood event (0.33% annual chance of flooding).

The three Delta levee standards mentioned above are focused on protecting agricultural portions of the Delta and fall substantially short of the FEMA accreditation standards for meeting a 100-year level of flood protection pursuant to in 44 CFR §65.10 generally used for urban levees (Figure 3-5) (DWR, 2019). The economic sustainability of the Delta Legacy Communities cannot be assured when applying the lower agricultural levee standards previously established for the Delta.

DRAFT

Urban Geometry Design Standards for Delta Levees

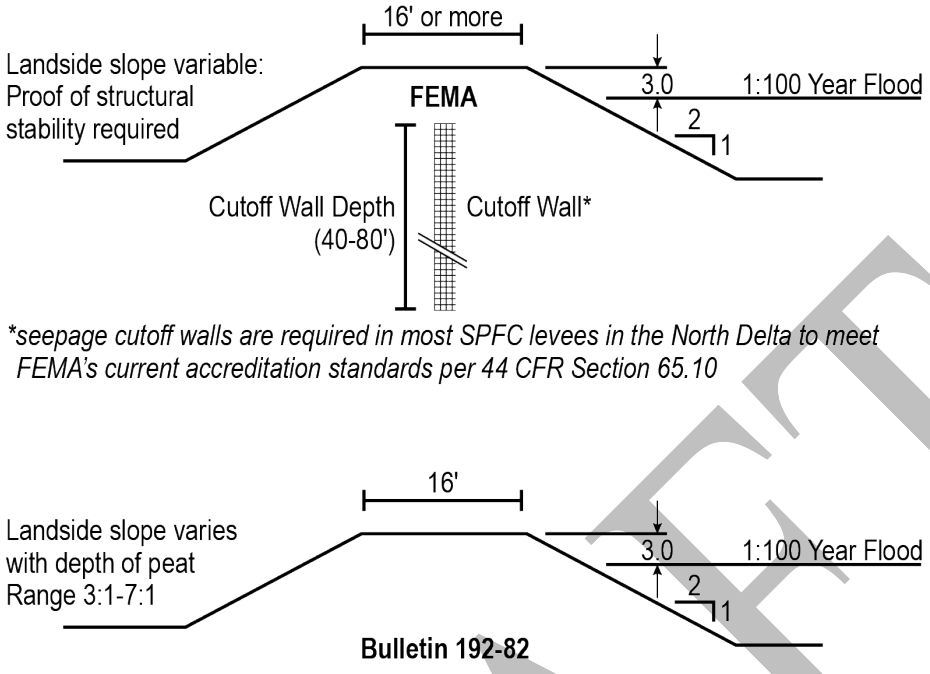


Figure 3-5. Urban Geometry Design Standards for Delta Levees

Agricultural levees within the Delta and those offering protection to the Courtland study area are largely improved to the PL 84-99 or Bulletin 192-82 geometry standards. However, FEMA accreditation requires levees to also meet USACE criteria contained in 44 CFR §65.10 generally used for urban levees, which goes beyond simple geometry standards. As previously discussed, this includes criteria for through and underseepage, stability, settlement, erosion, and other O&M criteria. Currently, very few Delta levees outside of urban areas meet the USACE criteria required for FEMA accreditation.

If Courtland hopes to be mapped by FEMA as Zone X (as they were before 2012 outside of the floodplain), the entire 16-mile perimeter levee system of the Courtland study area may require certification or smaller segments, such as one fronting the community paired with a certifiable ring levee, must be collectively improved to obtain a 100-year level of flood protection pursuant to 44 CFR §65.10.

3.3.4 Delta Plan Land Use Constraints

As previously discussed in Section 2.1.3, the Delta Plan prescribes requirements for land use and floodproofing. However, there are a number of other requirements in the Delta Plan aimed at protecting, restoring, and enhancing the Delta which constrain development within the Delta Legacy Communities located in the Primary Zone of the Delta. Levee improvements made within the study area must be consistent with the Delta Plan requirements, in addition to local ordinances or regulations. By prioritizing protection and enhancement of the Delta, the Delta Plan effectively restricts the loss of agricultural lands and/or the displacement of Delta Legacy

DRAFT

Communities. This can limit structural levee remediations to more costly alternatives, such as cutoff walls, over less costly alternatives, such as seepage and stability berms, since these berms are constructed on the landside toe of the levee and often require a displacement of agricultural lands or structures with a setback of anywhere from 150 to 350 feet

Additionally, the Delta Reform Act established a certification process for projects within and affecting the Delta. This requires any State or local agency proposing to undertake a "covered action" to submit to the DSC a written certification of consistency with detailed findings as to whether the covered action is consistent with the Delta Plan (California Water Code, § 85225). The project must not have significant adverse impacts on the achievement of the coequal goals or affect implementation of government-sponsored flood control programs to reduce risks to people and property in the Delta. Development of a consistency determination is usually prepared concurrently and alongside the regulatory documentation for a project, and thus represents a variable cost.

3.3.5 Biological Constraints

As described in Section 2.1.7, the study area contains sensitive vegetation communities and habitat for several special-status species. Project activities that have the potential to affect these sensitive resources will require additional studies and environmental permits prior to project implementation.

Major biological constraints to projects in the study area include very limited work windows in the 3-month period of August 1 – October 31) to perform any in-water work below the ordinary high-water line due to restrictions tied to the presence of several special status and endangered species within the Delta. Repairs of waterside erosion sites have been deferred around Courtland due to the permitting difficulty of completing these projects. There is also significant difficulty in obtaining space for mitigation for any impacts to existing vegetation along the levees. Many past projects in the study area attempted to be "self-mitigating" but this can only occur where the space and opportunity exist on a project site. There are limited (or no) mitigation credits remaining to purchase for SRA impacts in the area.

Specifically, the levee along Snodgrass Slough is oversized and has never needed riprap to address any issues. Thus, the vegetation along this portion of the study area has never been managed and comprises a large area of riparian habitat, and environmental impacts and associated mitigation for habitat removal could be prohibitive. Any levee improvement project will need to consider biological impacts and resulting mitigation measures. *See* Appendix B for additional information on biological resources within the study area. It is hoped that a programmatic biological mitigation program can be established leading to a practical and effective program to repair and strengthen the levees surrounding the community of Courtland, and possibly other neighboring Delta Legacy Communities as well.

DRAFT

3.3.6 Cultural Resources Constraints

As described in Section 2.1.8, a total of 27 cultural resources were identified during the records search and from information provided by Sacramento County, but only two have been formally evaluated for their eligibility for listing in either the NRHP or CRHR. Based on existing information, two additional resources may be eligible for listing. However, before implementation of any project activities, a smaller area of potential effect (APE) would need to be defined and any resources within the APE would be formally evaluated for their cultural or historical significance during the project's California Environmental Quality Act (CEQA) / National Environmental Protection Act (NEPA) permitting process. This evaluation involves consultation with interested Tribes and tribal organizations and consultation under Section 106 of the Historic Preservation Act (with a concurrence from the State Office of Historic Preservation).

If any significant resources are determined to likely be affected by project construction, then proper treatment of the resource would be determined. Since one form of treatment for cultural resources is avoidance, this could represent a constraint for implementation of a project element. Even if resources are not avoided and the project moves forward for construction, a cost would be incurred during excavation, archiving, or development of interpretive facilities and information, required to mitigate effects to the cultural resource.

See : Cultural Resources Records Search Results for Courtland, California for additional information regarding known and potential cultural resources within the project study area of Courtland and how they need to be addressed prior to any ground disturbing activities. : Cultural Resources Records Search Results for Courtland, California also further describes the National Heritage Designation Area within the study area and greater Delta.

3.3.7 Additional Regulatory Considerations

A permit under Section 14 of the Rivers and Harbors Appropriation Act of 1899, as amended, and codified in 33 U.S. Code 408 (Section 408 Permission) is required for permanent or temporary alteration or use of facilities that were built as part of a USACE civil works project (the Sacramento-San Joaquin Flood Control Project, along the Sacramento River portion of the study area). A 408 permission is generally needed for any work on SPFC levees and within easements, unless the work is classified as maintenance. However, maintenance and repair activities conducted by LMAs on SPFC levees for which they have O&M responsibilities that do not require Section 408 permission may still require coordination or concurrence from the USACE Sacramento District.

Additionally, a permit under Section 10 of the Rivers and Harbors Act of 1899 (applicable to construction of any structure in or over any navigable Water of the U.S.) may be needed for work along the Sacramento River and portions of Snodgrass Slough adjacent to RDs 551 and 755, depending on the nature of project implementation. The law applies to any dredging or

DRAFT

disposal of dredged materials, excavation, filling, rechannelization, or any other modification of Navigable Waters of the U.S., particularly any navigable waters in the North Delta.

DRAFT

4. Plan Formulation

The problems and opportunities described above led to the formulation of the study goals (Section 1) and planning objectives, detailed in this Section. These goals and objectives provide solutions for Courtland while capitalizing on opportunities to maximize multi-benefit projects and investment efficiency. Additionally, these goals and objectives, as well as stakeholder input, are utilized to measure how well plan flood risk reduction MAs meet the objectives of this study.

4.1 Planning Objectives

To achieve the study goal of modernizing SPFC levees to meet FEMA 100-year certification criteria, several broad objectives were identified as a framework for developing the preliminary suite of flood risk reduction elements and ultimately the final array of flood risk reduction MAs for Courtland. In prioritized order, these include:

- Reducing risk to life
- Reducing risk to property damage
- Reducing probability of levee failure
- Limitation of high insurance premiums
- Improved flood preparedness and response
- Enhance resiliency and reliability of through-Delta water conveyance
- Foster environmental stewardship

These objectives help to address the problems described in the preceding Section and are aligned with the State's interest as expressed within the framework of the CVFPP, the 2014 RFMP, SCFRRP, and the goals of other Delta agencies, where possible.

4.1.1 Reducing Risk to Life

Reducing risk to life is the first objective used to meet the goal of achieving 100-year flood protection for the Courtland study area. Life loss is the most devastating consequence of flooding. Since the mid-1800s, catastrophic flooding and life loss has been documented in California, particularly in the Central Valley. Deficiencies in the flood control system, fast-moving floodwaters, deep floodplains, and lack of preparedness and emergency response procedures have all contributed to this life loss. Most of these are of similar concern to the Courtland study area.

The risk of life loss is of greatest concern for the Courtland study area within the densely populated community of Courtland. Should a levee breach occur along the Sacramento River

DRAFT

immediately upstream and fronting the community, floodwaters would likely inundate the community at high velocities and depths, leaving little time to respond or evacuate, resulting in substantial life loss. Section 3.1.1.5, including Figure 3-1, provide in detail how and where the greatest risk of life loss exists to the community of Courtland and the greater study area encompassed by RDs 551 and 755.

Reducing risk to life is achieved by reducing flood risk. As described earlier, flood risk within the community and the larger study area is of concern and is based on the probability of flooding and the consequences of levee failure. By implementing flood risk reduction measures which reduce overall flood risk, either by reducing the probability of flooding or reducing the consequences of levee failure, risk of life loss is similarly reduced.

4.1.2 Reducing Risk to Property Damage

Property damage is another significant consequence of flooding. According to the USACE, as documented in the 2017 CVFPP Update, flooding in 1986 and 1997 together caused over $1 billion in damage to the areas protected by the SRFCP. Within the Courtland study area, the value of land and structural improvements, agricultural crops, vehicles, and highways and streets as updated during the course of this study as part of the 2022 CVFPP Update are valued at nearly $410M. These inventories and their associated values for the Courtland study area are provided in Section 3.1.1.4, including baseline values of EAD under existing conditions and future conditions with climate change adjustments (Table 3-7). A levee failure could result in substantial property damage in Courtland and the larger study area, particularly in the event of a breach on the levee immediately fronting the community. Additionally, damage to property as a result of flooding could also have a ripple effect within the community, with economic impacts sustained due to damages to businesses, homes, agricultural operations, and disruption to the transportation corridor of SR160. This study prioritizes flood risk reduction MAs which reduce the risk to property damage and to achieve the goal of 100-year flood protection for the study area. The net reductions in EAD values for several structural-based MAs developed specifically for the subject Courtland study area are provided in Section 6.3.1.2, with Table 6-5 and Table 6-6 providing a summary comparison of net EAD reductions for current baseline conditions and future conditions with climate change adjustments.

4.1.3 Reducing Probability of Levee Failure

Since flood risk is defined as the product of probability of levee failure and the consequences of levee failure, reducing the probability of levee failure is integral to reducing flood risk and thus achieving the goal of 100-year flood protection.

Reducing the probability of levee failure for the Courtland study area can be accomplished by implementing a number of measures:

- Repairing known deficiencies in the levee system, including but not limited to repairing known FSRP critical and serious sites within RD 755

DRAFT

- Addressing/repairing 26 collective known erosion sites on the Sacramento River levee system previously identified within RDs 551 and 755 by MBK Engineers and addressing potential erosion concerns identified by GEI Consultants along Snodgrass and Delta Meadows Sloughs
- While repairing known deficiencies also strengthen in-place the existing perimeter levee system(s) to offer improved levels of protection to the community
- Conduct annual inspections of the levee system and correct any known deficiencies including non-compliant encroachments that may pose a threat to the structural integrity of the levee system
- Enhance existing flood warning, preparedness, flood-fight and response systems and practices as identified in the Flood ESPs developed by Sacramento County
- Secure 100-year FEMA Certification for the community of Courtland and possibly for the entire Courtland project study area pursuant to 44 CFR §65.10

4.1.4 Limit of High Insurance Premiums

As previously noted in Section 3.1.2, of the estimated 468 structures in the Courtland study area valued at an estimated $366.2M, there are only 112 NFIP polices (valued at $350,000 maximum per policy including structure contents, presently capped at $250,000/structure and $100,000 for structure contents) providing only $39M[6] in flood insurance coverage. Rising insurance premiums over the last decade are a contributing factor to this differential and are an increasing problem within the study area. Lowering flood risks, and thus increasing flood protection, is a key action that can be taken to reduce flood insurance costs each year under the existing NFIP or under a new community-based flood insurance program.

4.1.5 Improved Flood Preparedness and Response

Improved flood preparedness and response is another objective used to complement the goal of 100-year flood protection. Improved preparedness and emergency response can limit the loss of life and property damage as a result of flooding by developing the framework needed to enhance the understanding of local flood risks, foster communication, and to promote public awareness of flood risks, thus reducing flood risk.

4.1.6 Enhancing Resiliency and Reliability of Through-Delta Water Conveyance

As previously noted, the vulnerability of levees protecting through-Delta water conveyance is a problem within the study area. Levees within the study area are vulnerable to through seepage and underseepage, earthquakes, climate change and sea level rise, and in many places do not

[6] These estimates are sourced from the FEMA Open Source policy database: https://www.fema.gov/about/openfema/data-sets

DRAFT

meet current engineering and FEMA accreditation standards. These levees are used to protect both people and property and support the agricultural economy within the community of Courtland and the adjoining project study area. SPFC levees in the North Delta are particularly critical since they also help convey water to the Delta Cross Channel, which augments the flow of the Sacramento River water through the Delta to the collective SWP and CVP export pumps in the south Delta near Tracy. In the event of a levee failure, sea water intrusion from the San Francisco Bay could enter areas of the freshwater corridor that are critical to the distribution of fresh water, threatening water supply to areas south of the Delta.

Continuing to improve levees within the Delta along the freshwater corridor not only enhances flood protection for those people and properties within the study area and the Delta, but it also contains the multi-benefit of enhancing the resiliency and reliability of through-Delta water conveyance. The existing through-Delta water conveyance system conveying water to the collective SWP and CVP export pumps in the south Delta provides water to over 3M acres of agricultural lands and to over 25M residences south of the Delta.

4.1.7 Environmental Stewardship and Multi-Benefits

In 2010, DWR formally adopted an Environmental Stewardship Policy to advance a department-wide "Total Resource Management" approach to planning and design of projects. By building environmental benefits into projects on a meaningful scale, DWR supports sustainability from an engineering, economic, social, and environmental perspective. The CVFPP includes the supporting goal of integrating recovery and restoration of key physical processes, self-sustaining ecological functions, native habitats, and species into flood management improvements (DWR, 2017c). Additionally, the SCFRRP increases the State cost-share for projects which advance multi-benefit flood protection for small communities (protection of State facilities, contribution to the State's sustainability objectives, water supply, and open space and recreation).

Waterside levee repairs such as known erosion sites can provide opportunities to introduce more SRA habitat valuable to fisheries and other aquatic species.

4.2 Future Baseline Conditions

The future baseline conditions provide the basis to formulating flood risk reduction MAs and assessing their benefits and impacts. Since impact assessment is the basis for plan evaluation, comparison, and selection, clear definition and full documentation of future baseline conditions are essential (DWR, 2014). These conditions are influenced by climate change, sea level rise, development, and land subsidence and are summarized as the future without project condition. Future baseline conditions in the Lower Sacramento River also consider system-wide benefits that are being implemented upstream in the Sacramento and Yolo Bypass/weirs that have the added benefit of diverting more flood waters into the bypasses and lowering flood stages in the Lower Sacramento River in the North Delta downstream of Sacramento.

DRAFT

By incorporating EAD assessments for existing baseline conditions (consistent with the values and methodologies utilized by DWR for the 2022 CVFPP update) and comparing them to future baseline conditions (consistent with the adjustments for climate change and sea level rise utilized by DWR for the 2017 CVFPP update) this feasibility study was able to compare net reductions in EAD values for various MAs under existing and future conditions. Appendix E provides more details on the EAD methodologies, net reductions in EAD values for various levels of flood risk reductions measures, and findings based on existing conditions and future conditions that include adjustments for climate change and sea level rise.

4.2.1 Climate Change and Sea Level Rise

Climate change is expected to significantly affect California's water resources in the form of changes to the hydrologic regime, sea level rise, and warmer temperatures. Although sea level rise is a minor issue in the North Delta, Californians will face a higher flood risk due to more rain and decreasing snowfall. Snow will melt faster and earlier in the season meaning more frequent flooding and less opportunity for natural storage in the mountains and will result in higher flood flows in the Delta. Reservoirs may fill earlier due to changing runoff patterns and operators will need to release water earlier in the season to make space for flood storage.

As previously discussed in Section 3.1.6, climate change and sea level rise have the potential to increase peak flows and flood stages in the Sacramento River, which would have some effects on the Courtland study area. Peak flows in the Sacramento River could increase by 4 percent for the 100-year flood and 2.3 percent for the 200-year flood as a result of climate change, and sea level rise is expected to increase the 100-year flood stage in the Sacramento River between Elk Slough and Georgiana Slough by nearly 1.12 feet on average. The 200-year flood stage along the same extent is estimated to increase by 0.65 feet on average. With respect to the Courtland study area, the effects of climate change rise are more pronounced along the more isolated, and largely unregulated, Snodgrass Slough as opposed to the mainstem of the Sacramento River as a result of planned improvements to the bypass systems upstream of and adjacent to the Sacramento River.

Climate change and sea level rise also have the potential to impact the estimates of flood damage, or EAD, under future conditions within the Courtland study area. The effects of inland climate change projections and sea level rise were incorporated into the EAD analyses performed as part of this study using a median estimate consistent with the methods and results of the 2017 CVFPP Update. These effects are described in greater detail in Section 6.3.1.2, and a full inventory of potential EAD values for the Courtland study area under future conditions is provided in Appendix E.

4.2.2 Development in the Floodplain

Improvement of levees can induce population growth and encourage development within the floodplain. This is true for all areas within the Central Valley, except for those areas within the

DRAFT

primary zone of the Legal Delta. As noted in previous Sections, development within the primary zone of the Delta, including the Courtland study area, is constrained by the Delta Plan and SPA ordinances which limit new residential, commercial, and industrial development. As such, future development within the study area is not expected to be substantial as a result of either removing the entire community of Courtland and/or large parts of the Courtland Study Area from the current (2012) FEMA 100-year floodplain with a BFE of 16.0 NAVD 88.

4.2.3 Land Subsidence in the Delta

While land subsidence is prevalent throughout large portions of the Delta due to underlying peat soils and land use practices, the effects are most pronounced within the central Delta and are least pronounced along the perimeter of the legal Delta. As such, the Courtland study area is not subject to notable subsidence, except for the center area of RD 551 some distance from its perimeter levee system and along an isolated segment of the Snodgrass Slough (NULE segment 1041), where underlying soil conditions indicate that subsidence could occur.

Substantial land subsidence in the study area, particularly along the alignment of the SPFC levee system along the left bank of the Sacramento River has not occurred is not expected in the future.

4.3 Alignment with Goals and Policies of Delta Agencies

Actions required to meet the objectives outlined above need to be in alignment with goals and policies of other requirements. Projects and MAs should be qualitatively measured against the requirements of various Delta planning and regulatory agencies. A multitude of broad policies and goals are described in various planning documents drafted by the DPC, DSC, and Conservancy, and an exhaustive matrix of potentially relevant Delta goals and policies is included as Appendix G.

4.3.1.1 Delta Protection Commission

DPC's LURMP includes several broad goals regarding land use and sustainability in the Delta. Specific to the study area is a goal to direct new non-agriculturally oriented non-farmworker residential development within the existing unincorporated Delta communities (Walnut Grove, Clarksburg, *Courtland*, Hood, Locke, and Ryde), to help encourage a critical mass of farms, agriculturally-related businesses and supporting infrastructure to ensure the economic vitality of agriculture within the Delta. Improved flood protection would indirectly contribute to this goal. Further LURMP goals are detailed in Appendix G.

DPC's Economic Sustainability Plan does not include a detailed evaluation of Courtland. However, the report mentions that all Delta levees should be brought to the HMP standard, if not to the more stringent PL 84-99 Standard. Many broad policies generally applicable to the study area are summarized in Appendix G.

DRAFT

4.3.1.2 Delta Stewardship Council

The Delta Reform Act (California Water Code §85306) requires that the DSC, in consultation with the CVFPB, recommend Delta Plan priorities for State investments in levee O&M and levee improvements in the Delta, including project levees that are part of the SPFC and non-SPFC levees that are constructed and maintained by LMAs.

The Delta Plan outlines a process to prioritize State O&M investments in Delta levees, O&M and levee improvements, and sets interim priorities to guide budget and funding for levee improvements, as detailed in Table 4-1. Levee improvements in the Delta should attempt to be responsive to the 3 x 3 goals established by the DSC in the Delta Plan outlined below in Table 4-1.

Table 4-1. 3x3 Goals of the DSC for State Investment in Delta Integrated Flood Management.

Goals	Localized Network	Levee Network	Ecosystem Conservation
1	Protect existing urban and adjacent areas by providing 200-year flood protection.	Protect water quality and water supply conveyance in the Delta, especially levees that protect freshwater aqueducts and the primary channels that carry fresh water through the Delta.	Protect existing and provide for a net increase in channel-margin habitat.
2	Protect small communities and critical infrastructure of statewide importance (located outside of urban areas).	Protect floodwater conveyance in and through the Delta to a level consistent with the SPFC for project levees.	Protect existing and provide for net enhancement of the floodplain habitat.
3	Protect agriculture and local working landscapes.	Protect cultural, historic, aesthetic, and recreational resources (Delta as Place).	Protect existing and provide for net enhancement of wetlands.

As described previously, the DSC also developed an overall DLIS, that: 1) quantifies flood risk, by considering the threats to Delta levees and the assets protected by these levees, and 2) prioritizes investments for levee repairs, improvements, and rehabilitation as Very High, High, or Other Priority. Generally, the priorities address the relationship between the flood risk of each island or tract and the number of State interests that island's or tract's assets encompass (people, property, ecosystem, water supply, and Delta as place). The entirety of the Courtland study area is currently designated as "Other Priority" under the DLIS prioritization. However, this prioritization is largely based upon levee geometry and availability of freeboard to the noted project area in comparison to other tracts within the Delta. Geotechnical evaluations by DWR under the NULE program and FSRP, including recent explorations conducted in 2019 specifically for this study, collectively confirm there are significant deficiencies, with known seepage concerns that are considered critical and serious. The noted deficiencies warrant

DRAFT

immediate attention and repair to reduce the risk of flooding to the Delta Legacy Community of Courtland.

The Delta Plan includes many performance measures (including net reductions in EAD values) focused on reducing flood damages and loss of life, multi-hazard coordination, levee improvements, water supply reliability, sustainability, and recreation and economic opportunities associated with the Delta Legacy Communities. Additional Delta Plan goals generally applicable to the study area are summarized in Appendix G.

4.3.1.3 Delta Conservancy

The Conservancy's Delta Public Lands Strategy includes integrated conservation for publicly funded lands in the Delta and identifies small areas in and adjacent to the study area for implementation of tidal marsh, dryland habitat, and "urban greening" around Courtland. Additional Conservancy goals generally applicable to the study area are also summarized in Appendix G.

DRAFT

5. Preliminary Suite of Flood Risk Reduction Elements

The following Section details the structural and non-structural preliminary suite of flood risk reduction elements considered as part of this feasibility study. These elements will be used to form MAs which can be implemented by the community of Courtland as funding sources are identified and become available. Potential multi-objective components which could be incorporated as part of the structural elements and non-structural measures are also discussed.

5.1 Structural Elements

Structural elements are those that repair or improve the existing levee/flood control system as it exists today. Structural elements considered in this feasibility study include repair-in-place levee repairs, prioritization of DWR FSRP critical and serious sites, and strengthening the existing levee system to meet the objectives outlined in Planning Objectives.

Structural elements discussed in this Section propose various remediations, such as cutoff walls, seepage berms, stability berms, combination seepage and stability berms, and rock slope protection (RSP) to address levee vulnerabilities within the study area. A brief discussion of these remediations is provided below. The proposed remediations are feasibility level, developed using limited available data, and new, but limited geotechnical data and analyses. Additional geotechnical explorations and analysis are recommended to refine these remediations and to ensure they are designed to FEMA criteria in an effort to secure FEMA accreditation for the community of Courtland and the larger study area in the future.

Cutoff Wall: A cutoff wall is a vertical trench in the levee filled with a slurry material that becomes nearly impermeable. It is used to reduce permeability through and under levee systems that may be susceptible to seepage. Cutoff walls are designed and installed to depths necessary to minimize through seepage and underseepage vulnerabilities. One advantage to this method is that it stabilizes the levee by constructing a barrier at either the levee centerline or near the levee waterside hinge-point and does not require the displacement and reclamation of land on the landside toe, as required by other methods to address seepage as described below. A typical cutoff wall is shown in Figure 5-1.

DRAFT

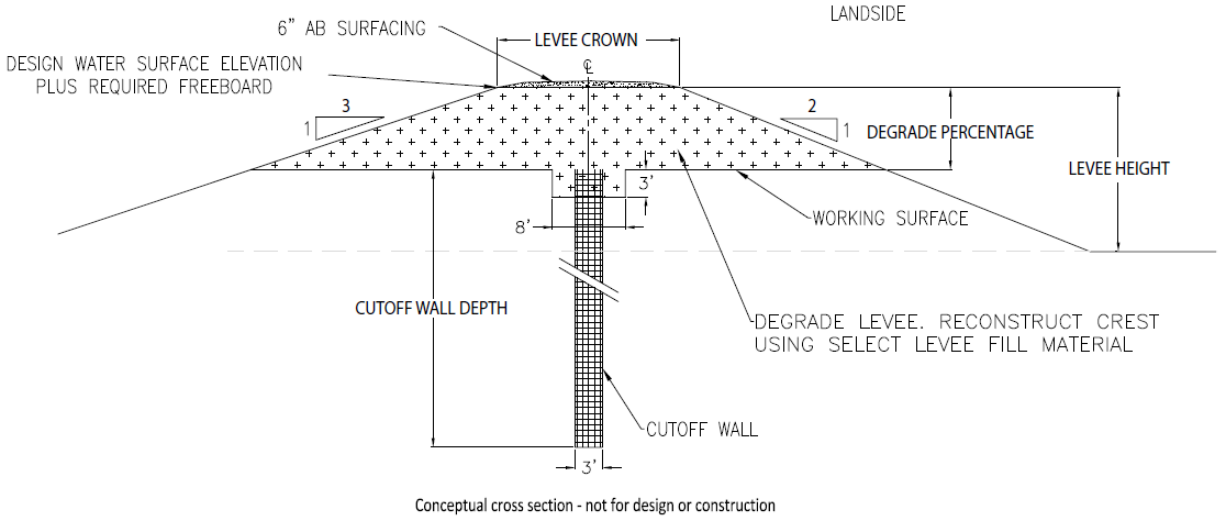


Figure 5-1. Typical Cutoff Wall.

Stability Berm: Stability berms are earthen berms constructed on the levee landside slope to address through seepage and stability vulnerabilities. When a levee is only vulnerable to through seepage, a stability berm can be a more cost-effective alternative to a cutoff wall. However, this remediation requires construction on the levee landside and results in a loss of usable land. The overall width and depth of the stability berm depends upon the degree to which the levee is vulnerable to stability. A typical stability berm is shown in Figure 5-2.

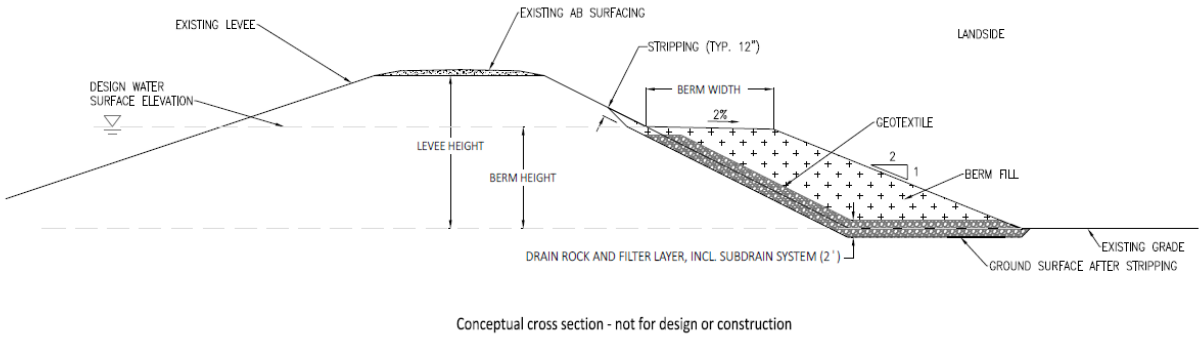


Figure 5-2. Typical Stability Berm.

Seepage Berm: Seepage berms are earthen berms constructed on the levee landside to address underseepage. These berms are constructed on the levee landside toe and extend outwards away from the levee anywhere from 150 to 350 feet in width in order to lengthen the seepage path. As a result, construction of seepage berms requires more land than construction of stability berms. A typical seepage berm is provided below in Figure 5-3.

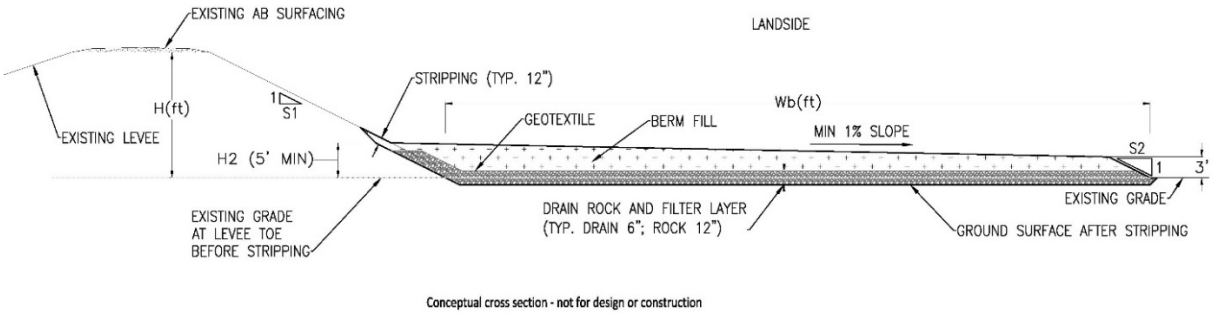


Figure 5-3. Typical Seepage Berm.

Combination Seepage and Stability Berm: Combination seepage and stability berms are constructed to address levees which have both underseepage and through seepage vulnerabilities. A typical combination seepage and stability berm is shown in Figure 5-4.

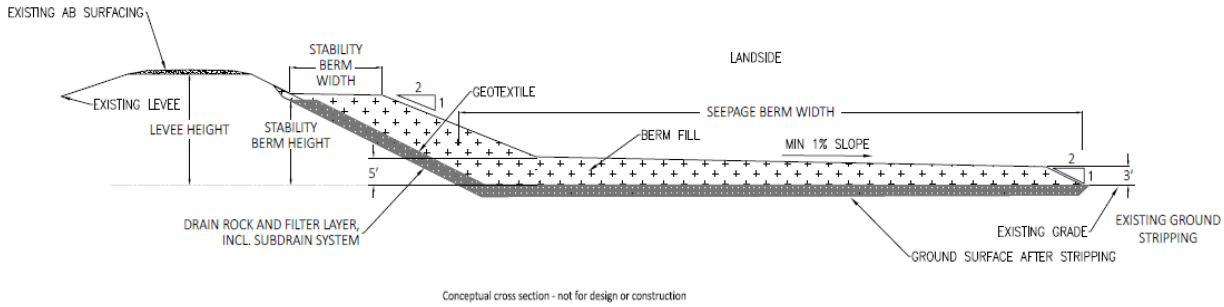


Figure 5-4. Typical Combination Seepage and Stability Berm.

Rock Slope Protection: RSP is used to address erosion through the placement of riprap on the waterside slope of the levee. Typical details for the SPFC and non-SPFC levees are provided in Sections 5.1.1.2, and 5.1.2.1, respectively.

5.1.1 Previously Identified Repair Needs

A number of studies and evaluations have identified various issues within the study area associated with through seepage, underseepage, stability, and erosion. The following is a summary of these studies and evaluations.

5.1.1.1 Repair DWR FSRP Critical and Serious Sites

DWR FSRP critical and serious sites are thought to pose the greatest risk to the community of Courtland. This flood risk reduction element repairs and enhances these critical and serious sites as documented in the DWR FSRP to current FEMA standards.

Within the context of the FSRP, critical and serious sites are generally defined as follows (URS, 2013a):

Critical Site: If not repaired, the site presents a significant risk of failure or would impede flood control function or flood fight activities during the next high-water event.

Serious Site: If not repaired in a timely manner, the site has the potential to become critical during the next high-water event.

As shown in Figure 5-5, there is one critical and one serious seepage site within RD 755 along NULE Segment 131, upstream from the community of Courtland. These sites are further characterized in Table 5-1 below. The critical seepage site extends from levee mile 0.1 to 0.2 and is approximately 500 feet in length. Supporting evidence for this site includes boils on the landside toe observed in 1986 and 1997 and observed seepage over a 250-foot-long stretch at the landside toe during a high-water event as observed by RD 755. The serious seepage site extends from levee mile 0.2 to 0.9 and is approximately 3,500 feet in length. Supporting evidence for this site includes the observation of boils and hydrophytic vegetation.

DRAFT

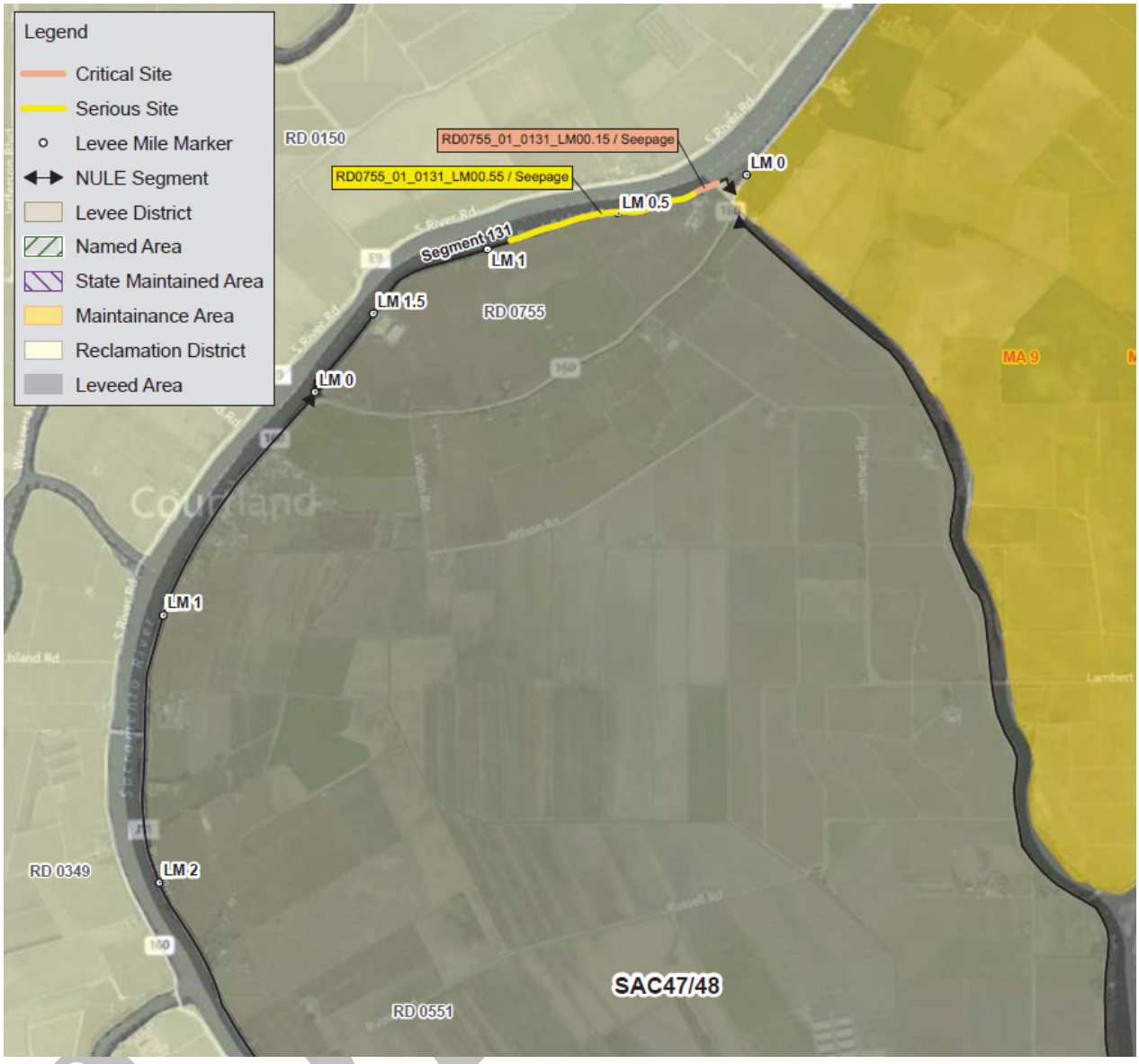


Figure 5-5. FSRP Critical and Serious Seepage Sites within RD 755 (URS, 2013b)

Table 5-1. FSRP Critical and Serious Seepage Sites and Proposed Solutions (URS, 2013b)

Segment Location	NULE Segment	Failure Mode	Site Status	Approximate Levee Mile Location	Length (ft.)	Supporting Evidence	Proposed Solution
Left Bank Sacramento River - RD 755 (SPFC levee)	131	Seepage	Critical	0.1 to 0.2	500	Boil on landside was documented in 1986; boil was sandbagged. Boil 1,000 ft. from landside toe documented in 1997. Seepage observed during high water at landside toe for 250 ft. stretch.	80-ft.-deep cutoff wall[1]
	131	Seepage	Serious	0.2 to 0.9	3,500	Seepage at landside toe and boil about 1,000 ft. from landside toe. Boils have been observed in previous years, but at different locations; not carrying material, but has a high flow rate. Hydrophilic vegetation observed on the landside berm.	80-ft.-deep cutoff wall or 75-ft.-wide, 8-ft.-tall combo seepage / stability berm[2]

Notes:

[1] As proposed by DWR in the 2013 FSRP Pre-Feasibility Report for Leveed Area SAC47/48: RD551 and Courtland

[2] As identified by GEI Consultants in 2020

This element addresses the critical site along NULE Segment 131 with a cutoff wall as proposed in the 2013 FSRP Pre-Feasibility Report for Leveed Area SAC47/48: RD551 and Courtland (2013 FSRP Pre-Feasibility Report) (URS, 2013b). As detailed in the 2013 FSRP Pre-Feasibility Report, a cutoff wall with a length and depth of 1,000 and 80 feet, respectively, is proposed to address the critical seepage site along NULE Segment 131.

Remediation for the serious site on NULE Segment 131 was developed as part of the scope of this feasibility study, since the 2013 FSRP Pre-Feasibility Report did not propose a remediation for this site. Two remediation alternatives are proposed for the repair of the FSRP serious site on NULE Segment 131, including an 80-foot-deep cutoff wall or a 75-foot-wide, 8-foot-tall combination seepage and stability berm.

DRAFT

5.1.1.2 Address Erosion Sites Identified by LMA Representatives – SPFC Levees

MBK Engineers, the District Engineer for RDs 551 and 755, has identified a total of 33 erosion sites for repair along the left bank of the Sacramento River levee in RDs 551 and 755 as a result of recent flood damages in 2017 and 2019 (Figure 5-6). Of these 33 sites, 30 are located in RD 551 and three are located in RD 755. Of the 30 sites in RD 551, 25 were identified in 2017 and another five were identified following flood damages in 2019. In both years, erosion sites were assessed by boat, and lengths and severity were estimated and documented with photos. During the assessments, MBK accounted for multiple variables that effect the likelihood of levee failure, the ability to flood fight successfully, and the consequences of levee failure. Sites were classified as critical, serious, or as areas of concern based on the site's likelihood of causing a levee breach. Critical sites include those areas where erosion significantly encroaches into the levee embankment or occurs above the midpoint of the levee to the crest. Serious sites show erosion near the levee toe up to the midpoint but do not significantly encroach on the levee template. Areas of concern are typically localized erosion sites with limited progression into the levee. Length along the levee and width into the levee were also factored into the assessment (MBK, 2017). A summary of how the 30 sites within RD 551 were characterized is provided below. Note that none of the sites identified in 2019 (5 in total) have been characterized by RD 551.

- Critical: 1 site
- Serious: 7 sites
- Area of Concern: 17 sites
- Not Characterized: 5 sites

Total: 30 sites

Following high water events in 2017, DWR performed a similar assessment to identify erosion sites for repair within RD 551. A total of 21 erosion sites were identified during the assessment by DWR:

- Critical: 0 sites
- Serious: 2 sites
- Area of Concern: 19 sites

Total: 21 Sites

DRAFT

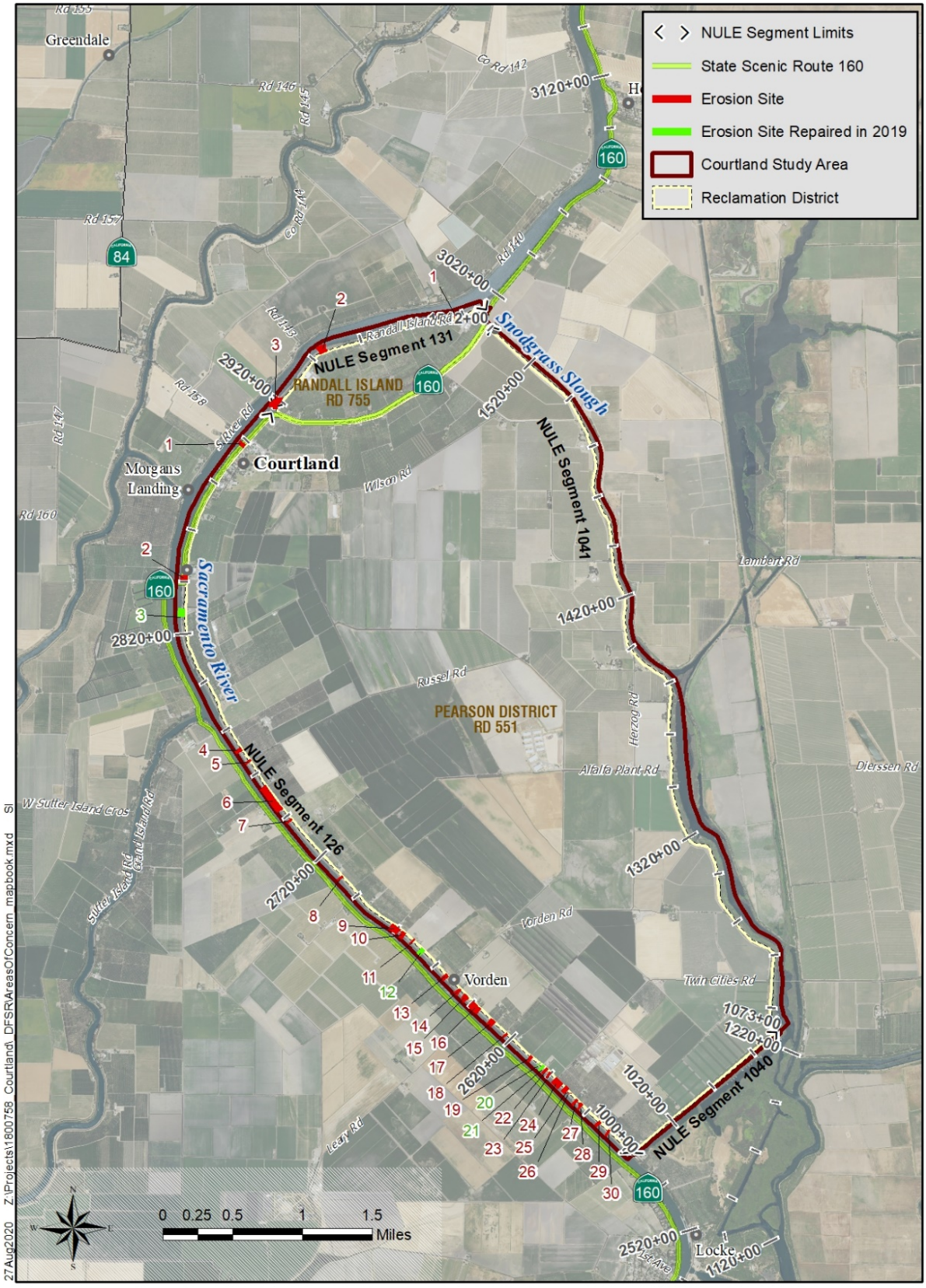


Figure 5-6. RD 551 and RD 755 SPFC Erosion Sites (MBK, 2019a).

The sites identified by MBK Engineers in 2017 were prioritized for repair based on the site's categorization and feedback from the LMA (

Table 5-2). Sites as observed in 2019 were also prioritized, though these sites were not formally categorized. In total, 11 sites were assigned the highest priority for repair and four of these sites were repaired by RD 551 in 2019. The remaining seven high priority sites, with three exceptions, were categorized more severely by RD 551 than by DWR, and as a result, only two of these sites are planned for repair by DWR in 2021.

The three sites in RD 755 have not been characterized or prioritized for repair. However, one site is planned for repair by DWR in 2021.

Note that non-SPFC levees along Delta Meadows Slough and Snodgrass Slough (NULE Segments 1040 and 1041, respectively) were not inspected in 2017 or 2019 due to lack of visibility from the amount of vegetation, and this element does not characterize these levees in terms of erosion nor propose any associated remediations.

This element addresses all of the remaining 26 SPFC erosion sites identified by MBK Engineers that were not repaired in 2019 and are not planned for repair by DWR in 2020 or 2021. Levee erosion repairs would be made to address erosion through the addition of 18-inch minus riprap by creating a 2-foot-wide berm across the entirety of the slope repair length perpendicular to the levee slope, above mean high water and up to the 100-year flood elevation of 20.0 feet NAVD 88 (Figure 5-7) (MBK, 2019b).

DRAFT

Table 5-2. SPFC Erosion Sites as Identified and Prioritized by MBK Engineers (MBK, 2020b)

RD	Site Number	Repair Priority	Begin Site	End Site	Length (ft.)	DWR Classification	RD Classification	Year Repaired	DWR Authorized Year for Repair
			Station	Station					
551	3	1	84+15	87+60	345	Area of Concern (A)	Serious (S)	2019	
	9	1	231+12	235+26	414	A	S		
	10	1	235+90	237+83	193	A	S		
	12	1	245+47	247+26	179	A	Critical	2019	
	13	1	258+80	260+40	160	A	S		
	16	1	273+82	278+08	426	S	S		2021
	20	1	307+90	308+49	59	A	A	2019	
	21	1	309+33	310+53	120	A	A	2019	
	23	1	313+15	314+15	100	A	A		
	24	1	316+24	320+12	388	A	S		
	27	1	327+45	328+45	100	Serious	S		2021
	1	2	15+43	17+09	166	A	A		
	2	2	71+75	73+50	175	--	--		
	5	2	148+00	149+00	100	--	--		
	6	2	159+69	170+73	1104	A	A		
	8	2	204+35	205+16	81	--	A		
	11	2	241+00	241+75	75	--	--		
	15	2	269+37	271+66	229	A	A		
	17	2	283+08	285+49	241	A	A		
	18	2	290+80	291+85	105	A	A		
	19	2	303+60	304+75	115	A	A		
	22	2	311+08	312+06	98	--	A		
	25	2	321+25	323+00	175	--	--		
	26	2	323+75	324+00	25	--	--		
	4	3	142+31	143+80	149	A	A		
	7	3	175+36	176+30	94	A	A		
	14	3	266+16	267+71	155	A	A		
	28	3	330+19	330+99	80	A	A		
	29	3	339+20	340+51	131	--	A		

DRAFT

RD	Site Number	Repair Priority	Begin Site	End Site	Length (ft.)	DWR Classification	RD Classification	Year Repaired	DWR Authorized Year for Repair
			Station	Station					
	30	3	344+58	345+51	93	--	A		
755	1	--	13+65	13+92	27	--	--		
	2	--	64+15	67+37	320	--	--		
	3	--	90+54	94+78	424	--	--		2021

DRAFT

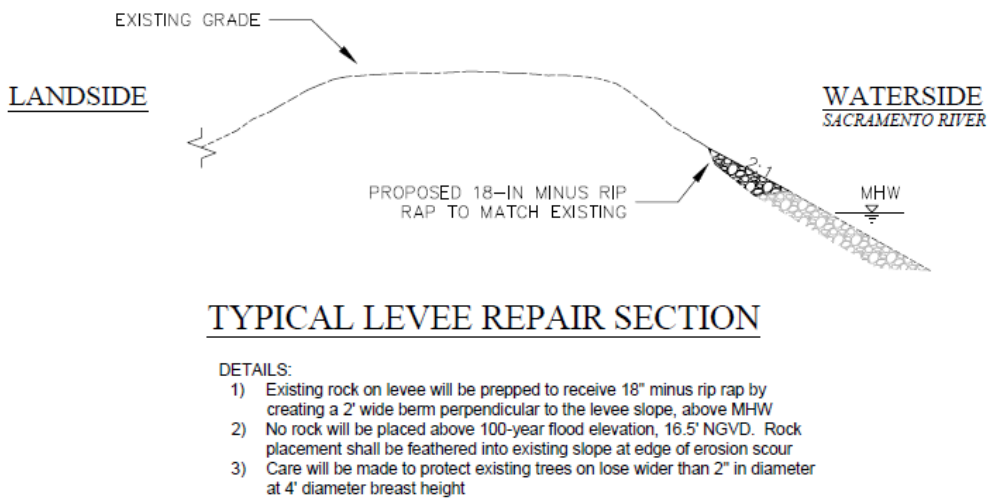


Figure 5-7. Conceptual Cross Section for the Proposed RSP to Remediate Erosion along the Left Bank of the Sacramento River (MBK, 2019b)

5.1.1.3 Repair and Strengthen-in-Place SPFC Levee Adjacent to Courtland

As previously discussed, a breach on the levee immediately fronting the community poses great risk to Courtland and the larger study area since a failure would likely result in significant property damage and life loss as a result of high floodwater depths and velocities and little time to evacuate. This flood risk reduction element repairs and strengthens the 0.73-mile-long portion of levee immediately adjacent to the community of Courtland along the left bank of the Sacramento River.

Improvement of this portion of levee was investigated as part of the NULE Phase 1 study, as documented in the NULE GAR and in the 2014 RFMP. This feasibility study leverages data from the NULE Phase 1 study along with additional data from CPTs collected in 2019 to develop two remedial alternatives for this segment of levee.

Remediations for this element, and those discussed in Sections 5.1.2.2 and 5.1.2.3, were developed considering through seepage, underseepage, slope stability, and freeboard. Additional information regarding the data used to develop these remediations and how levee vulnerabilities were identified can be found in 0. Based on the available data, remediations were developed to primarily address vulnerabilities for through seepage. As depicted in Figure 5-8, this element includes two remedial alternatives: a 20-foot-deep cutoff wall (Remediation Alternative 1) or an 8-foot-tall, 15-foot-wide stability berm (Remediation Alternative 2). *Note* that any erosion deficiencies on the segment of levee fronting Courtland are remediated as part of the element described above in Section 5.1.1.2 and are not remediated as part of this element. Further geotechnical investigations in connection with obtaining FEMA accreditation are warranted to confirm the levee fronting the community may or may not be vulnerable to underseepage and stability, in addition to the known vulnerability to through seepage.

DRAFT

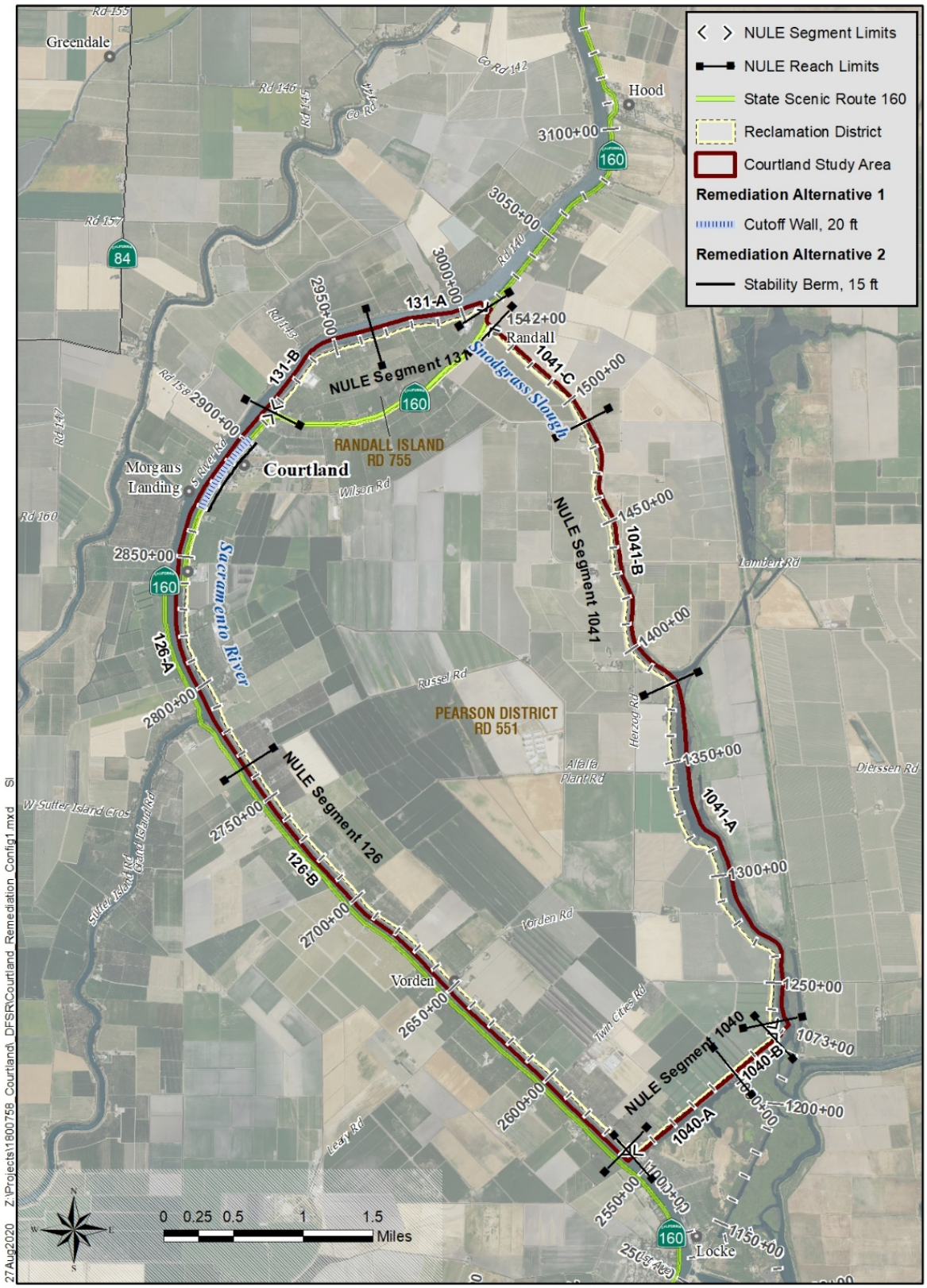


Figure 5-8. Remedial Alternatives to Address Through Seepage on the Levee Immediately Fronting the Community of Courtland

5.1.2 Additional Remediations and Improvements

Additional remediations to improve flood protection for the community of Courtland and the larger study area were investigated as part of this feasibility study and are provided below.

5.1.2.1 Address Potential Erosion Concerns – Non-SPFC Levees

This element addresses potential erosion concerns on the non-SPFC levees located along Delta Meadows Slough (NULE Segment 1040) using rock slope protection. Erosion concerns were identified based on embankment material and waterside slopes, with remediation slope lengths taken from the DWR NULE Phase 1 study (Table 5-3). A typical rock slope protection detail which is representative of erosion repairs currently being performed along the left bank of the Sacramento River in RD 755 is provided in Figure 5-9. Additional information on how erosion concerns are characterized and remediations are proposed can be found in Appendix A.

Table 5-3. Non-SPFC Erosion Concerns and Remediations.

Levee Segment Location	NULE Segment	Reach	Start Station	End Station	Reach Length (ft.)	Remediation
Right Bank Delta Meadows Slough – RD 551	1040	1040-A	1000+00	1050+00	5,000	145 ft. RSP (3,000 ft.)
	1040	1040-B	1050+00	1073+00	2,300	--
Right Bank Snodgrass Slough – RD 551	1041	1041-A	1231+00	1380+00	14,900	--
	1041	1041-B	1380+00	1490+00	11,000	--
	1041	1041-C	1490+00	1543+00	5,300	--

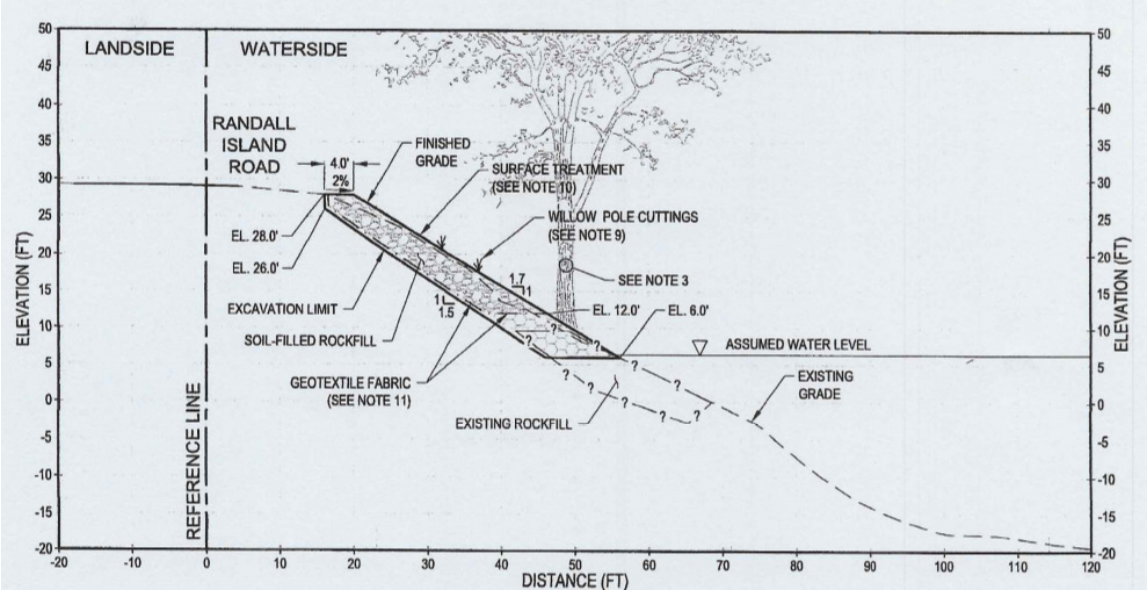


Figure 5-9. Typical RSP Detail for Remediation of Erosion in RD 755 (AECOM, 2020).

DRAFT

5.1.2.2 Repair and Strengthen-in-Place Sacramento River – SPFC Levees Only

This element repairs and strengthens the entirety of the 8.6 miles of SPFC levees (NULE Segment 126 in RD 551 and NULE Segment 131 in RD 755) located along the left bank of the Sacramento River. As discussed in Section 5.1.1.3 data from the DWR NULE Phase 1 study and additional CPTs were used to develop potential remediations for this element, which are summarized by reach according to the vulnerabilities present in the levee. As shown in Figure 5-10 and summarized in Table 5-4, this element primarily addresses through seepage and underseepage by reach using available data for the entirety of the SPFC levee system. Two remedial alternatives are provided to address the through seepage and underseepage vulnerabilities associated with each reach. Note that any erosion deficiencies on the SPFC levees are remediated as part of the element described in Section 5.1.1.2 and are not remediated as part of this element. Further geotechnical investigations in connection with obtaining FEMA accreditation may be needed to confirm the SPFC levees within the study area are not vulnerable to stability. Additional information regarding the data that was used to develop these remediations and how levee vulnerabilities were identified can be found in Appendix A.

DRAFT

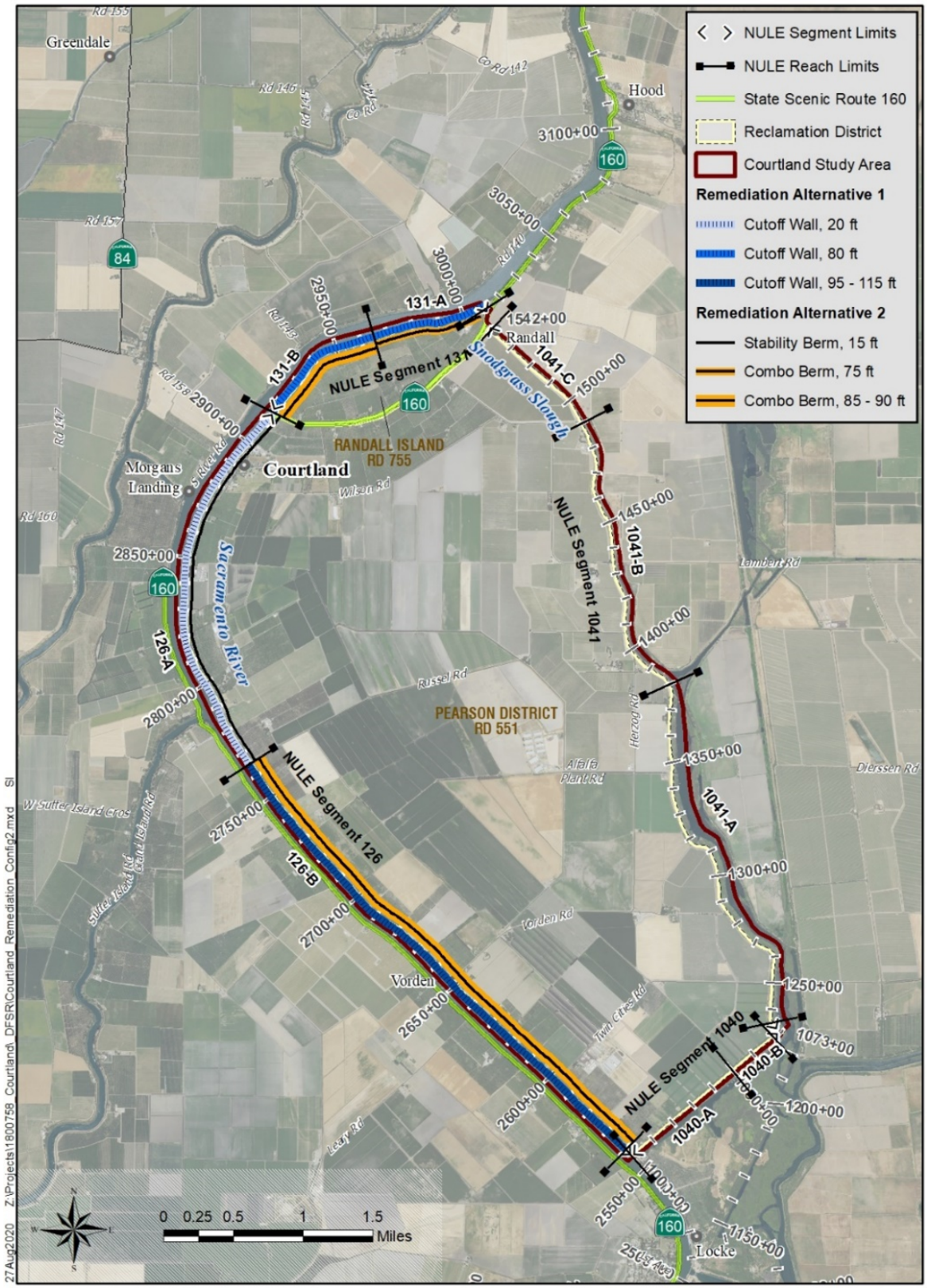


Figure 5-10. Remedial Alternatives to Repair and Strengthen the SPFC Levee System along the left bank of the Sacramento River

Table 5-4. Summary of Remedial Alternatives to Repair and Strengthen the SPFC Levee System along the left bank of the Sacramento River

Levee Segment Location	NULE Segment	Reach	Start Station	End Station	Reach Length (ft.)[1]	Remediation Alternative 1	Remediation Alternative 2	Vulnerability	
								Under-Seepage	Through-Seepage
Left Bank Sacramento River – RD 551	126	126-A	2765+00	2915+00	15,000	20-ft.-deep cutoff wall	15-ft.-wide, 8-ft.-tall stability berm	-	X
	126	126-B	2556+53	2765+00	20,800	115-ft.-deep cutoff wall	85-ft-wide, 9-ft.-tall combination seepage and stability berm	X	X
Left Bank Sacramento River – RD 755	131	131-A	2965+00	3012+00	4,700	80-ft.-deep cutoff wall	75-ft.-wide, 8-ft.-tall combination seepage and stability berm	X	X
	131	131-B	2915+00	2965+00	5,000	80-ft.-deep cutoff wall	85-ft.-wide, 9-ft.-tall combination seepage and stability berm	X	X

Note: [1] Reach lengths rounded to the nearest 100 feet

5.1.2.3 Repair and Strengthen-in-Place Snodgrass Slough & Delta Meadows Levees – Non-SPFC Levees Only

This element repairs and strengthens the entirety of the 7.3 miles of non-SPFC levees (NULE Segments 1040 and 1041) located along Snodgrass Slough to the east, and the Delta Meadows Slough levee common with portions of RD 369 to the south. Data from the DWR NULE Phase 1 study and additional CPTs collected in 2019 were used to develop remediations for this element.

As shown in Figure 5-11 and summarized in Table 5-5, this element addresses through seepage and underseepage by reach for the entirety of the non-SPFC levee system. Note that any erosion deficiencies or concerns on the non-SPFC levees are remediated as part of the element described in Section 5.1.2.1 and are not remediated as part of this element. Two remedial alternatives are provided to address the through seepage and underseepage vulnerabilities associated with each reach. Note that any erosion deficiencies on the SPFC levees are remediated as part of the element described in Section 5.1.1.2 and are not remediated as part of this element. Further geotechnical investigations in connection with obtaining FEMA accreditation may be needed to confirm the non-SPFC levees within the study area are not vulnerable to stability. Additional information regarding the data that was used to develop these remediations and how levee vulnerabilities were identified can be found in Appendix A.

DRAFT

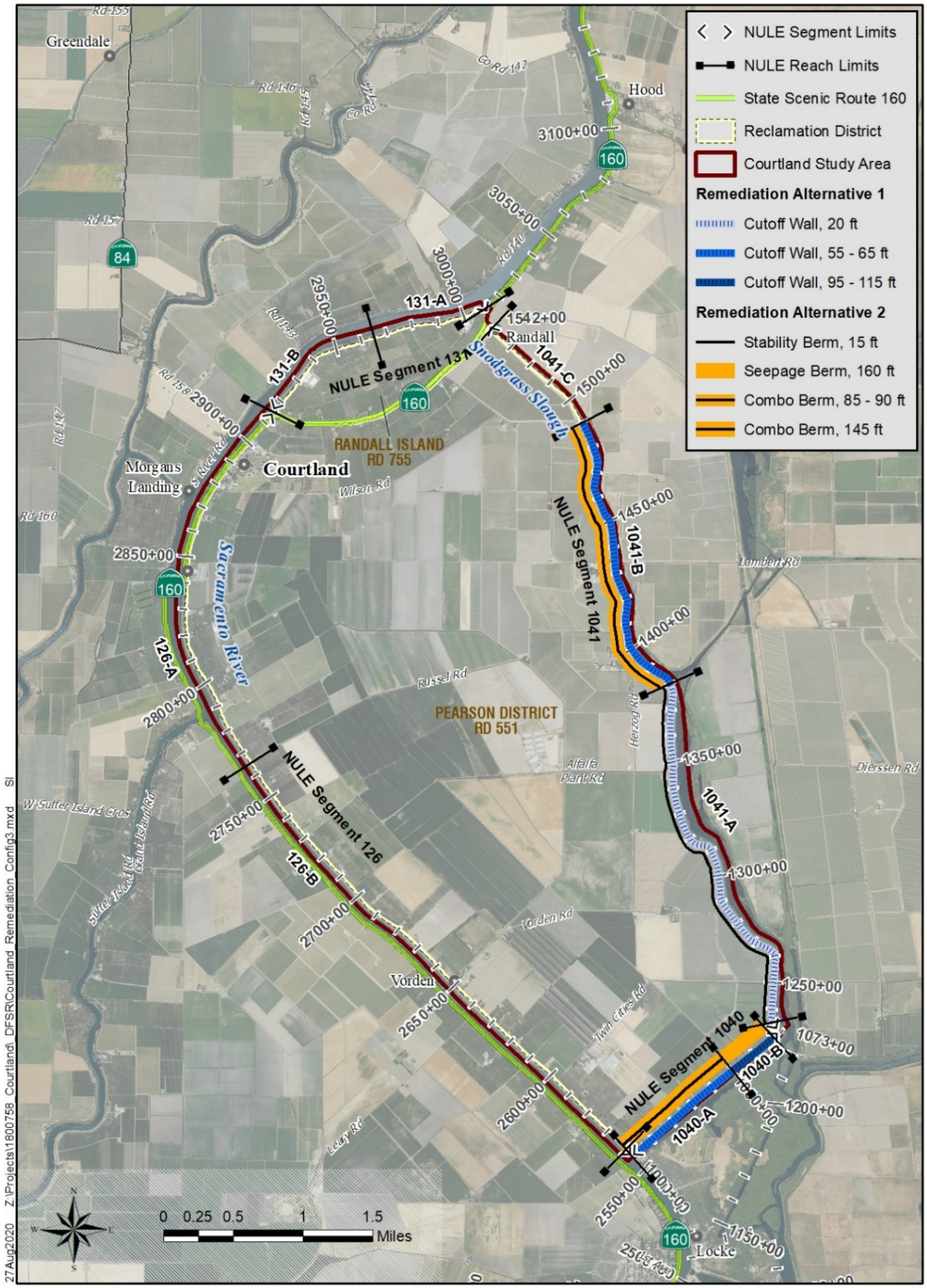


Figure 5-11. Remedial Alternatives to Improve the non-SPFC Levee System along Snodgrass and Meadows Sloughs.

Table 5-5. Summary of Remedial Alternatives to Improve the non-SPFC Levee System along Snodgrass and Meadows Sloughs

Levee Segment Location	NULE Segment	Reach	Start Station	End Station	Reach Length (ft.)	Remediation Alternative 1	Remediation Alternative 2	Vulnerability	
								Under-Seepage	Through-Seepage
Right Bank Delta Meadows Slough – RD 551	1040	1040-A	1000+00	1050+00	5,000	65 ft. deep cutoff wall	145-ft.-wide 20-ft.-tall combination seepage and stability berm	X	X
	1040	1040-B	1050+00	1073+00	2,300	95 ft. deep cutoff wall	160-ft.-wide seepage berm	X	-
Right Bank Snodgrass Slough – RD 551	1041	1041-A	1231+00	1380+00	14,900	20 ft. deep cutoff wall	15-ft.-wide 13-ft.-tall stability berm	-	X
	1041	1041-B	1380+00	1490+00	11,000	55 ft. deep cutoff wall	90-ft.-wide seepage berm	X	X
	1041	1041-C	1490+00	1543+00	5,300	N/A	N/A	-	-

5.1.2.4 Secure 100-Year FEMA Certification for Community of Courtland or for Entire Courtland Study Area, including all of RDs 551 and 755

This element builds on the previous collection of elements by improving all levee segments (SPFC and non-SPFC) within the study area in accordance with FEMA standards for freeboard, seepage, erosion, and stability and settlement concerns pursuant to 44 CFR §65.10. In addition to the proposed structural remediations depicted in Figure 5-10 and Figure 5-11 and erosion remediation measures discussed in Sections 5.1.1.2 and 5.1.2.1, certain FEMA design criteria, O&M requirements, and documentation requirements specified in 44 CFR §65.10 are also addressed. These FEMA accreditation requirements are discussed briefly below.

Freeboard: Riverine levees must provide a minimum freeboard of 3 feet above the 100-year water-surface level, preferably that addresses both climate change and sea level rise. An additional 1 foot above the minimum is required within 100 feet on either side of structures (such as bridges) riverward of the levee or wherever the flow is constricted.

Embankment Protection: Engineering analyses must be submitted that demonstrate no appreciable erosion of the levee embankment can be expected during the base flood, as a result of either currents or waves, and that anticipated erosion will not result in failure of the levee embankment or foundation directly or indirectly through reduction of the seepage path and

DRAFT

subsequent instability. The factors to be addressed in such analyses include but are not limited to: Expected flow velocities (especially in constricted areas); expected wind and wave action; ice loading; impact of debris; slope protection techniques; duration of flooding at various stages and velocities; embankment and foundation materials; levee alignment, bends, and transitions; and levee side slopes.

Embankment and Foundation Stability (Including Through Seepage and Underseepage): Engineering analyses that evaluate levee embankment stability must be submitted. The analyses provided shall evaluate expected seepage during loading conditions associated with the base flood and shall demonstrate that seepage into or through the levee foundation and embankment will not jeopardize embankment or foundation stability. An alternative analysis demonstrating that the levee is designed and constructed for stability against loading conditions for Case IV as defined in the USACE manual, "Design and Construction of Levees" (EM 1110-2-1913, Chapter 6, Section II), may be used. The factors that shall be addressed in the analyses include, Depth of flooding, duration of flooding, embankment geometry and length of seepage path at critical locations, embankment and foundation materials, embankment compaction, penetrations, other design factors affecting seepage (such as drainage layers), and other design factors affecting embankment and foundation stability (such as berms).

Settlement: Engineering analyses must be submitted that assess the potential and magnitude of future losses of freeboard as a result of levee settlement and demonstrate that freeboard will be maintained within the minimum standards set forth in paragraph (b)(1) of this section. This analysis must address embankment loads, compressibility of embankment soils, compressibility of foundation soils, age of the levee system, and construction compaction methods. In addition, detailed settlement analysis using procedures such as those described in the USACE manual, "Soil Mechanics Design – Settlement Analysis" (EM 1100-2-1904) must be submitted.

Design Criteria

Closures/Encroachments: All openings must be provided with closure devices that are structural parts of the system during operation and design according to sound engineering practice.
Interior Drainage: An analysis must be submitted that identifies the source(s) of such flooding, the extent of the flooded area, and, if the average depth is greater than 1 ft., the water-surface elevation(s) of the base flood. This analysis must be based on the joint probability of interior and exterior flooding and the capacity of facilities (such as drainage lines and pumps) for evacuating interior floodwaters.
Other Design Criteria: In unique situations, such as those where the levee system has relatively high vulnerability, FEMA may require that other design criteria and analyses be submitted to show that the levees provide adequate protection. In such situations, sound engineering practice will be the standard on which FEMA will base its determinations. FEMA will also provide the rationale for requiring this additional information.

Operations Plans and Criteria

Closures: Operation plans for closures must include the following: • Documentation of the flood warning system, under the jurisdiction of federal, State, or community officials, that will be used to trigger emergency operation activities and demonstration that sufficient flood warning time exists for the completed operation of all closure structures, including necessary sealing, before floodwaters reach the base of the closure.

DRAFT

- A formal plan of operation including specific actions and assignments of responsibility by individual name or title.
- Provisions for periodic operation, at not less than 1-year intervals, of the closure structure for testing and training purposes.

Interior Drainage Systems: Interior drainage systems associated with levee systems usually include storage areas, gravity outlets, pumping stations, or a combination thereof. These drainage systems will be recognized by FEMA on NFIP maps for flood protection purposes only if the following minimum criteria are included in the operation plan:

- Documentation of the flood warning system, under the jurisdiction of federal, State, or community officials, that will be used to trigger emergency operation activities and demonstration that sufficient flood warning time exists to permit activation of mechanized portions of the drainage system.
- A formal plan of operation including specific actions and assignments of responsibility by individual name or title.
- Provision for manual backup for the activation of automatic systems.
- Provisions for periodic inspection of interior drainage systems and periodic operation of any mechanized portions for testing and training purposes. No more than 1-year shall elapse between either the inspections or the operations.

Other Operations Plans and Criteria: Other operating plans and criteria may be required by FEMA to ensure that adequate protection is provided in specific situations. In such cases, sound emergency management practice will be the standard upon which FEMA determinations will be based.

Maintenance Plans and Criteria

Levee systems must be maintained in accordance with an officially adopted maintenance plan, and a copy of this plan must be provided to FEMA by the owner of the levee system when recognition is being sought or when the plan for a previously recognized system is revised in any manner. All maintenance activities must be under the jurisdiction of a federal or State agency, an agency created by federal or State law, or an agency of a community participating in the NFIP that must assume ultimate responsibility for maintenance. This plan must document the formal procedure that ensures that the stability, height, and overall integrity of the levee and its associated structures and systems are maintained. At a minimum, maintenance plans shall specify the maintenance activities to be performed, the frequency of their performance, and the person by name or title responsible for their performance.

5.2 Non-Structural Measures

Non-structural measures improve flood system performance and reduce exposure, vulnerability, and consequences of flooding. The suite of non-structural measures can be implemented in most cases with or without modifying the existing levee and flood control system. The full suite of non-structural measures considered in this feasibility study for the community of Courtland and the adjoining North Delta Legacy Communities within Sacramento County are described in detail in Appendix H and summarized below:

1. Flood Fight Berm or a Ring Levee System
2. Voluntary Elevations of Structures
3. Wet or Dry Floodproofing
4. Acquisition and Relocation

DRAFT

5. Flood ESPs
6. Sacramento County Office of Emergency Services (OES) Decision Support Tool
7. Local Hazard Mitigation Plan (LHMP) and Relief Cuts
8. Alternatives to FEMA NFIP – Private, Community-Based Flood Insurance
9. NFIP Flood Insurance Enhancements *via* AFOTF
10. Mokelumne River Conveyance Improvements & State Island Overflow Area
11. Improve FEMA CRS Score for Sacramento County/Isleton
12. Land Use Regulations and Limitations
13. Improved Governance Between Neighboring LMAs/RDs
14. SWIFs & Periodic Inspections with USACE
15. Public Education/Public Awareness

The key non-structural measures identified above and within : Identification of Non-Structural Elements for the Communities of Hood, Courtland, Locke, East Walnut Grove, and West Walnut Grove & Ryde Flood Risk Reduction Feasibility Studies, that are community- specific to the Courtland Study Area and warrant further discussions and descriptions are described in more detail below. All of the above non-structural measures identified above were presented to the Courtland Study Area planning committee with most measures deemed acceptable, as summarized in Section 7.3. Appendix H also provides a description of why some measures may be more applicable to neighboring Delta Legacy Communities or why they may not be applicable to each specific Delta Legacy Community.

5.2.1 All-Weather Access Road/Flood-Fight Berm

This measure includes construction of an all-weather access road and flood fight berm to reduce flood risk within the community of Courtland (Figure 5-12). Similar to a ring levee, an access road and flood fight berm would encircle the densely populated portion of the existing community of Courtland and isolate the community from potential flood waters that could occur due to levee breaches occurring anywhere outside of the immediate community but within the larger agricultural basins within RDs 551 and 755. An all-weather access road and flood fight berm is essentially a slightly elevated all-weather roadway to accommodate the temporary placement of interlocking Muscle Wall during flood fight conditions in either RD 551 or RD 755. The noted access road would accommodate the temporary flood fight installation of a 4- to 8-foot-high Muscle Wall. The access road/flood fight berm would follow a similar, but shorter alignment as a potential ring levee depicted in Figure 5-13, totaling around 1.2 miles in length, with an 18-foot-wide road width, 3H:1V landside and waterside slopes, and a maximum road crown elevation of 13 feet, assuming a downstream design WSEL of 16 feet NAVD 88 and 1 foot of freeboard. Note that the maximum crown elevation of 16 feet was developed assuming a relief cut could be executed within the basin. The maximum crown elevation would need to be 5 to 6 feet higher if a relief cut were not deployed in the downstream portion of the basin. The

DRAFT

flood fight Muscle Wall (similar to a plastic Jersey barrier containing a 4- to 8-foot minimum wide base) would be stored nearby within the Delta by either the community, the local RDs, the county, and/or by DWR and could be transported, handled, and assembled expeditiously to fend off rising flood waters that may occur in the larger agricultural basins of RDs 551 and 755. A storage site for the Muscle Wall and other flood-fight materials in the North Delta has been established by Sacramento County OES and others near Walnut Grove Elementary School and the Fire Station in Walnut Grove East (within RD 544).

Figure 5-12 below notes the anticipated height of Muscle Wall needed along the alignment of the access road/flood fight berm, along with the estimated total length of 4, 6, and 8 feet high Muscle Wall needed, and the estimated height of the access road/flood fight berm every 500 feet. In general, the height of the access road/flood fight berm is highest southeast and southwest of the Bates Elementary School in Courtland, with an average height of 5.5 feet. Along this segment of the access road/flood fight berm, the existing ground elevation is lowest, and would require an 8-foot-high Muscle Wall assuming a design WSEL of 16 feet NAVD 88 and 1 foot of freeboard. The height of the access road/flood fight berm is estimated to be the lowest, ranging between 1 and 3 feet, at both terminating points along landward toe of the Sacramento River levee and extending easterly, where existing ground elevations are highest. These segments of the access road/flood fight berm closest to the levee would require the shortest Muscle Wall (4 ft.).

DRAFT

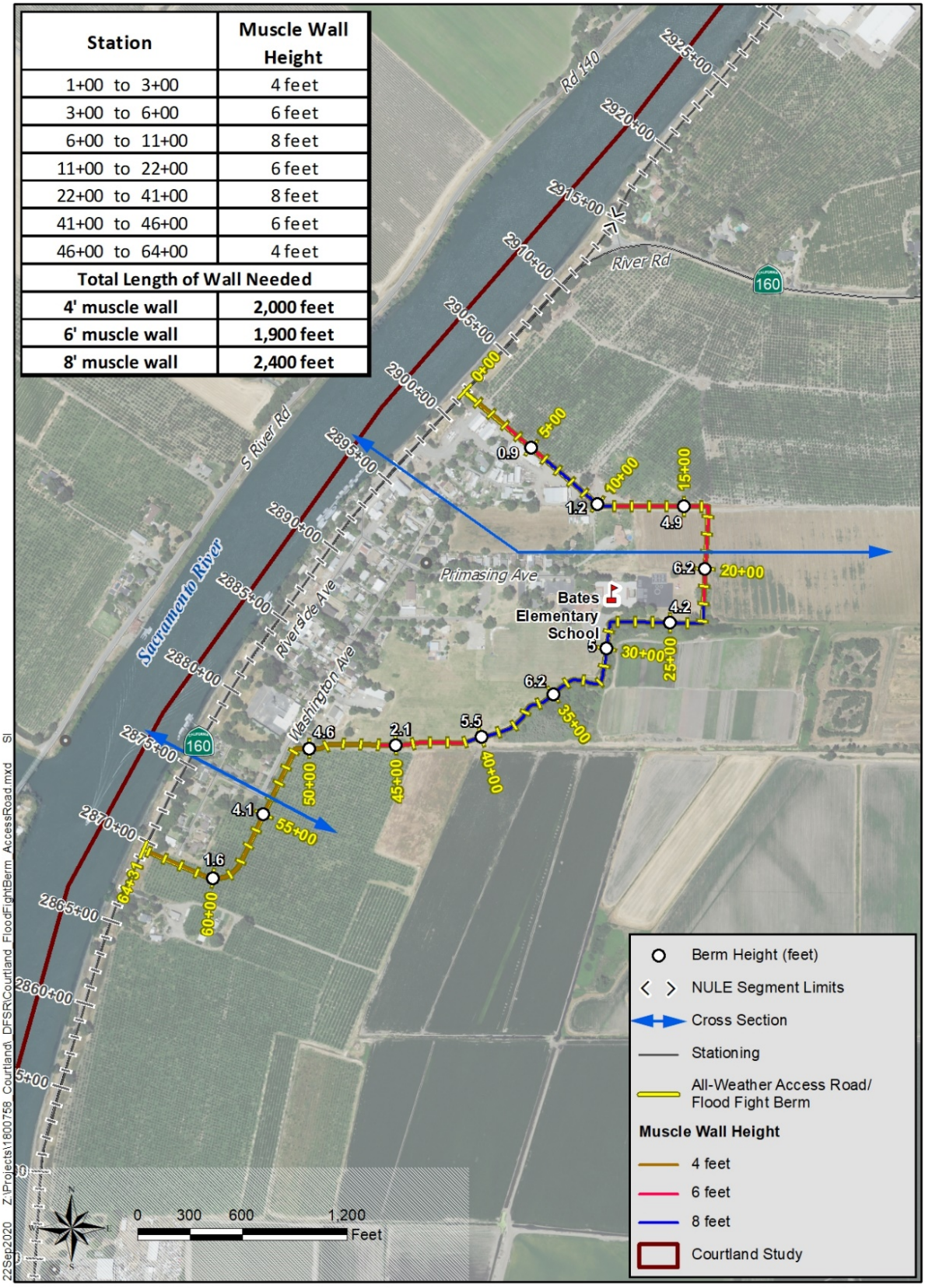


Figure 5-12. Conceptual All-Weather Access Road/Flood Fight Berm for the Community of Courtland.

5.2.2 Construction of a Potential Ring Levee

A ring levee is a permanent flood control structure and would be higher in height than an all-weather access road/flood fight berm, but slightly lower in height than the existing levees adjacent to the Sacramento River. The purpose of considering a ring levee is to mitigate the highest potential consequence of failure in terms of life loss and property damage if repairing the entire perimeter levee system becomes impractical due to funding or other issues. A ring levee, similar to an all-weather access road/flood fight berm, would encircle the densely populated portion of the existing community of Courtland and isolate the community from potential flood waters that could occur due to levee breaches occurring anywhere outside of the immediate community but within the larger tracts of lands comprised within the collection of RDs 551 and 755. In an effort to secure FEMA accreditation, the ring levee would be constructed in concert with improving and strengthening the levee fronting the community along the left bank of the Sacramento River.

The proposed ring levee configuration for Courtland as detailed in the 2012 CVFPP and 2014 RFMP assumed that the levee would extend eastward near the southeast corner of the Bates Elementary School parcel line and around the former sanitary sewer settling ponds (no longer in service due to Courtland's interceptor pipeline connection into the Sacramento Regional Sanitation Treatment plant located near Elk Grove). As shown in Figure 2-3, development in this area is restricted under the county SPA and the Delta Plan. As such, a new configuration is presented as part of this feasibility study (Figure 5-13). This new configuration or alignment would closely adhere to the boundaries as dictated by the county SPA and Delta Plan and would total approximately 1.43 miles in length, with a 20-foot crown width, 3H:1V landside and waterside slopes, and levee crest elevation of 19 feet, assuming a design WSEL of 16 feet NAVD 88 and 3 feet of freeboard. Note that the levee crest elevation of 19 feet was developed assuming a relief cut would be executed within the basin. The maximum crown elevation would need to be 5 to 6 feet higher if a relief cut were not deployed in the downstream portion of the basin.

DRAFT

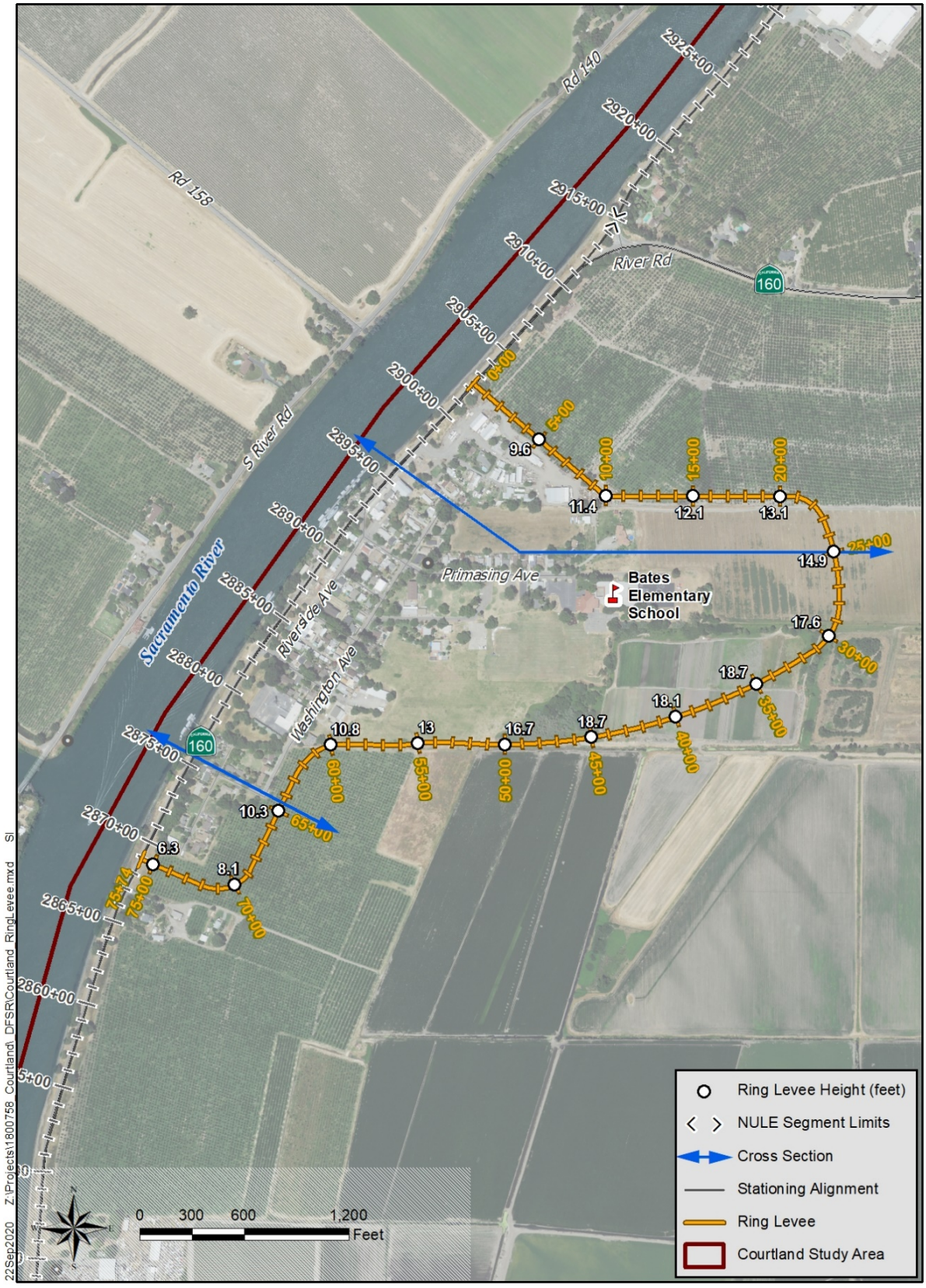


Figure 5-13. Conceptual Ring Levee for the Community of Courtland.

Accompanying cross sections at stations 2896+00, near the north part of Courtland, and 2876+00, near the southwest part of Courtland, as shown in Figure 5-12 and Figure 5-13 are provided in Figure 5-14 and Figure 5-15 below. At station 2896+00, the proposed access road/flood fight berm would be closer to the Bates Elementary School than the proposed ring levee, which would be located approximately 700 feet further east. Ground elevations along this cross section would require the ring levee to be an estimated 15.5 feet tall, with an estimated height of 6 feet for the access road/flood fight berm. At station 2876+00, the access road/flood fight berm and ring levee are proposed to follow the same alignment, however due to ground elevations along this cross section being an estimated 4 feet higher on average than at station 2896+00, the height of the ring levee is estimated to be 5 feet shorter than at station 2896+00, with the access road/flood fight berm estimated to be 1.5 feet shorter than at station 2896+00.

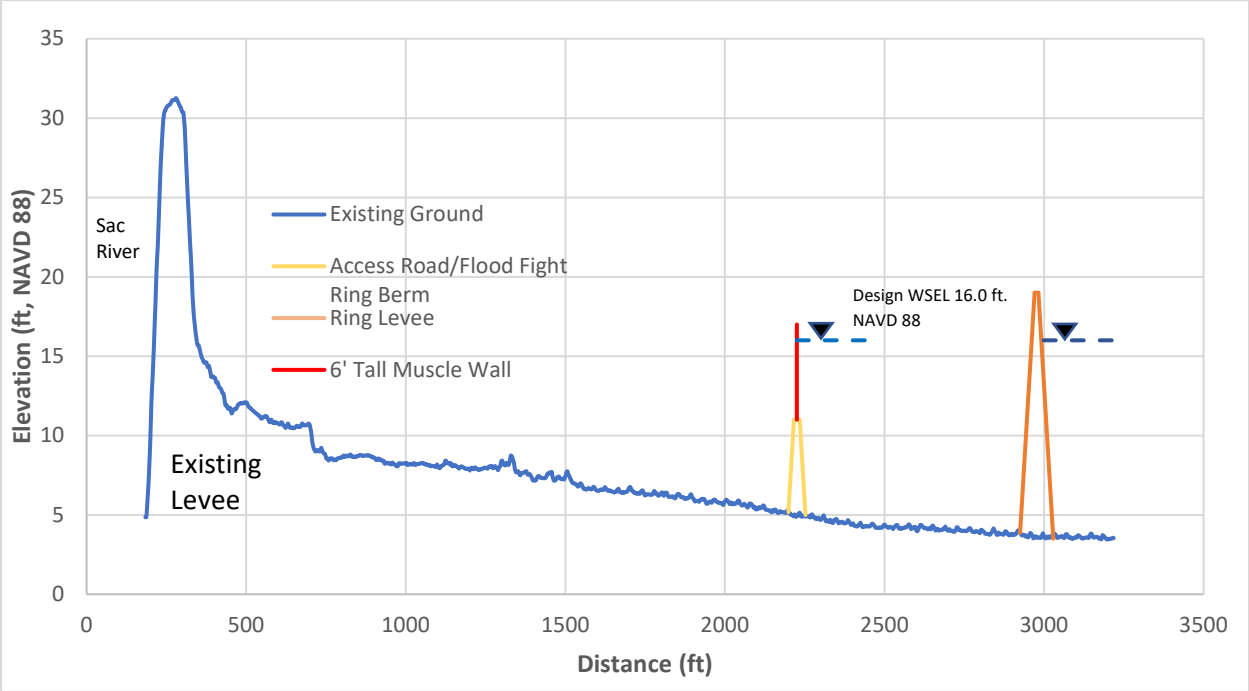


Figure 5-14. Cross Section 2896+00 of Potential Flood Fight Berm and Ring Levee Systems

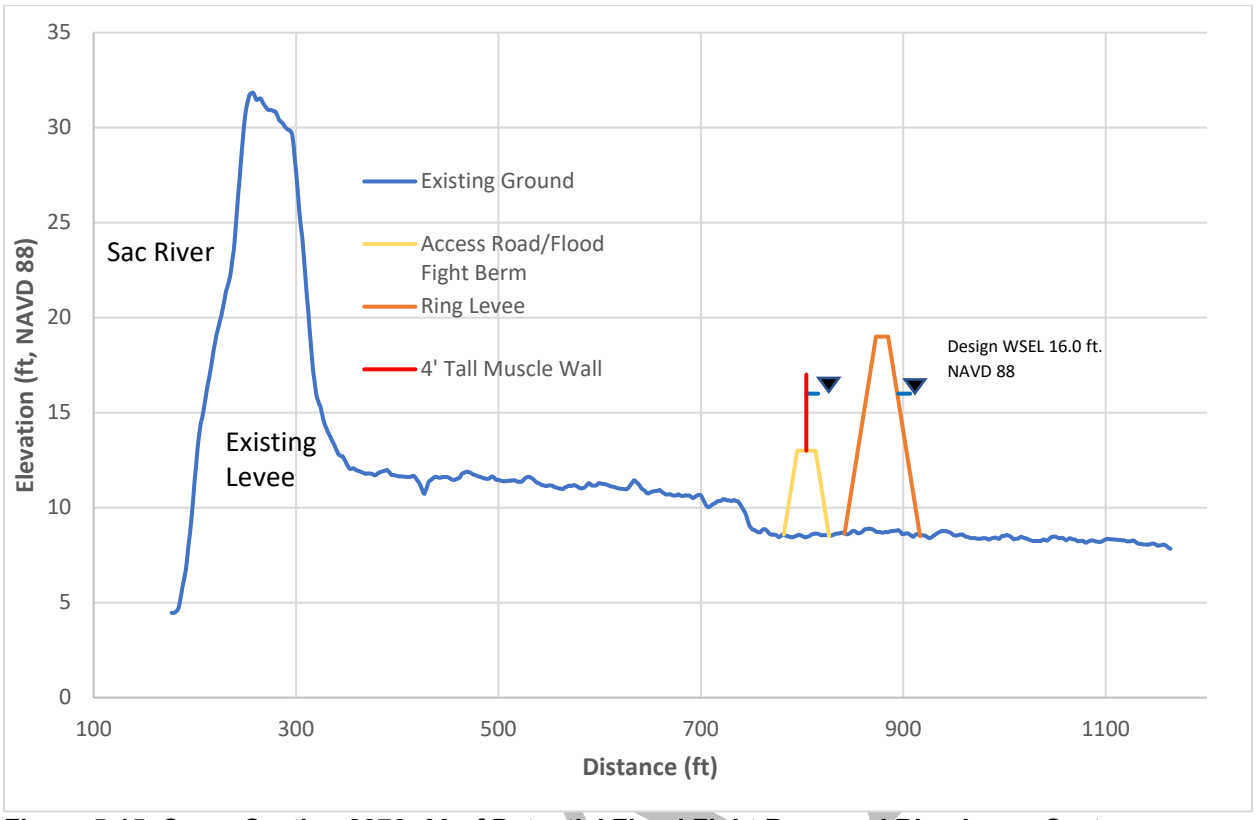


Figure 5-15. Cross Section 2876+00 of Potential Flood Fight Berm and Ring Levee Systems

5.2.3 Voluntary Elevation of Structures

The voluntary structural elevation program collectively administered by FEMA and Sacramento County (and possibly others) is a flood risk reduction measure that involves physically raising existing structures to an elevation 1.5 feet or greater above the FEMA BFE resulting from natural overland flows and/or a levee breach. For the Courtland study area, the current BFE is currently set at 16 feet NAVD 88. This is a common and effective way to minimize damage from flooding and is a key flood protection provision of the NFIP.

Hydraulics and hydrologic modeling of the Lower Sacramento River system indicates that the structures in the study area would require raising between 5 and 10 feet to be elevated to or above the maximum floodplain. Elevations of this height may require additional seismic (and other practical) considerations to ensure stability and continued utility of the structures in question.

Below is a summary table that indicates the number and types of structures located within the community of Courtland (SAC 48), and within the greater Courtland Study Area within RDs 551 and 755 (SAC 47). The table also indicates the likely minimum cost of raising each of the noted structures, acknowledging that commercial and industrial structures will undoubtedly be more than the current estimate of $170,000/ea. to raise residential structures.

DRAFT

Table 5-6. Total Count and Cost to Elevate Structures in Courtland Study Area

Community and Study Area	CVFPP Impact Area	Total Structure Count and Cost to Elevate @ $170,000/Structure				
		Residential	Commercial	Industrial	Public	Total
Courtland Community	SAC 48	98	10	25	15	148
		$16,660,000	$ 1,700,000	$4,250,000	$2,550,000	$25,160,000
Courtland Study Area	SAC 47 & 48	262	10	181	15	468
		$ 44,540,000	$1,700,000	$30,770,000	$2,550,000	$79,560,000

5.2.4 Wet or Dry Floodproofing

Damages to structures behind levees can be greatly reduced through effective floodproofing. Floodproofing can be cost effective for most structures where maximum depths of potential flooding are not expected to exceed 5 feet However, agricultural-related structures have been known to be flood-proofed for flood depths far exceeding 5 feet. If the flood depth at a site is above the practical height limits of available floodproofing barriers, an alternate mitigation method, such as raising of structures should be considered.

Though the base flood depth in the Courtland study area is 16 feet NAVD 88, wet or dry floodproofing could be implemented for select structures in the study area where maximum potential flood depths are not expected to exceed 5 feet

5.2.5 Acquisitions or Relocations

This flood risk reduction element involves acquiring land or relocating dwelling units, businesses, or agricultural structures to reduce flood risk. This element is included for comparison purposes, but it is not a preferred action for the subject Delta Legacy Community of Courtland due to relocations of homes and businesses being disruptive to residents and the overall community. DWR and others have suggested select communities subject to either deep or repetitive flooding should consider relocation to higher ground that is not subject to flooding. Relocating entire communities within the Delta, particularly Delta Legacy Communities, is inconsistent with the goals and objectives of both the Delta Plan and the SSJDNHA designation.

5.2.6 Local Hazard Mitigation Plan and Relief Cuts

The Sacramento County LHMP is a multi-jurisdictional plan that geographically covers the entire area within Sacramento County's jurisdictional boundaries (planning area), including RD 551. The LHMP identifies hazards within the county, including those from floods and levee failure, assesses the vulnerability of the planning area to these hazards, and identifies mitigations to reduce or eliminate long-term risk to life loss and property damage from these hazards. The

DRAFT

county developed the initial LHMP in 2005 and was last updated in 2016. The county LHMP is updated every 5 years and is currently scheduled for a new update in 2021 that will likely include a greater discussion regarding potential relief cuts in RD 551.

As a mitigation measure which can be used to reduce risk to life loss and property damage as a result of flooding or levee failure, potential locations of relief cuts could be formalized within the LHMP. The levee system protecting the Courtland study area acts somewhat as a bowl with the water filling up to the top of the lowest downstream levee, typically at the lowest elevations within RD 551, near its large drainage pumping facility into Snodgrass Slough. However, a carefully planned relief cut excavated into the levee at the lower downstream end of RD 551 during or immediately following a breach event in the northerly portion of the basin would allow the water to escape or drain out of the RD before filling up the entire basin. For example, if there is 5 feet of freeboard at the lower downstream end of the RD, the relief cut could potentially reduce flood depths by as much as 5 feet over the entirety of the RD, while waiting for the lower, downstream levee reach to overtop (Figure 5-16 as compared against Figure 3-1). Personnel from RDs 551 and 755 and adjoining downstream Districts will determine if a relief cut will be necessary should flooding occur; however, in most cases there is no written description nor agreement for a planned relief cut. Potential relief cut locations should be identified, further evaluated, and formalized while updating the LHMP which addresses RD 551.

DRAFT

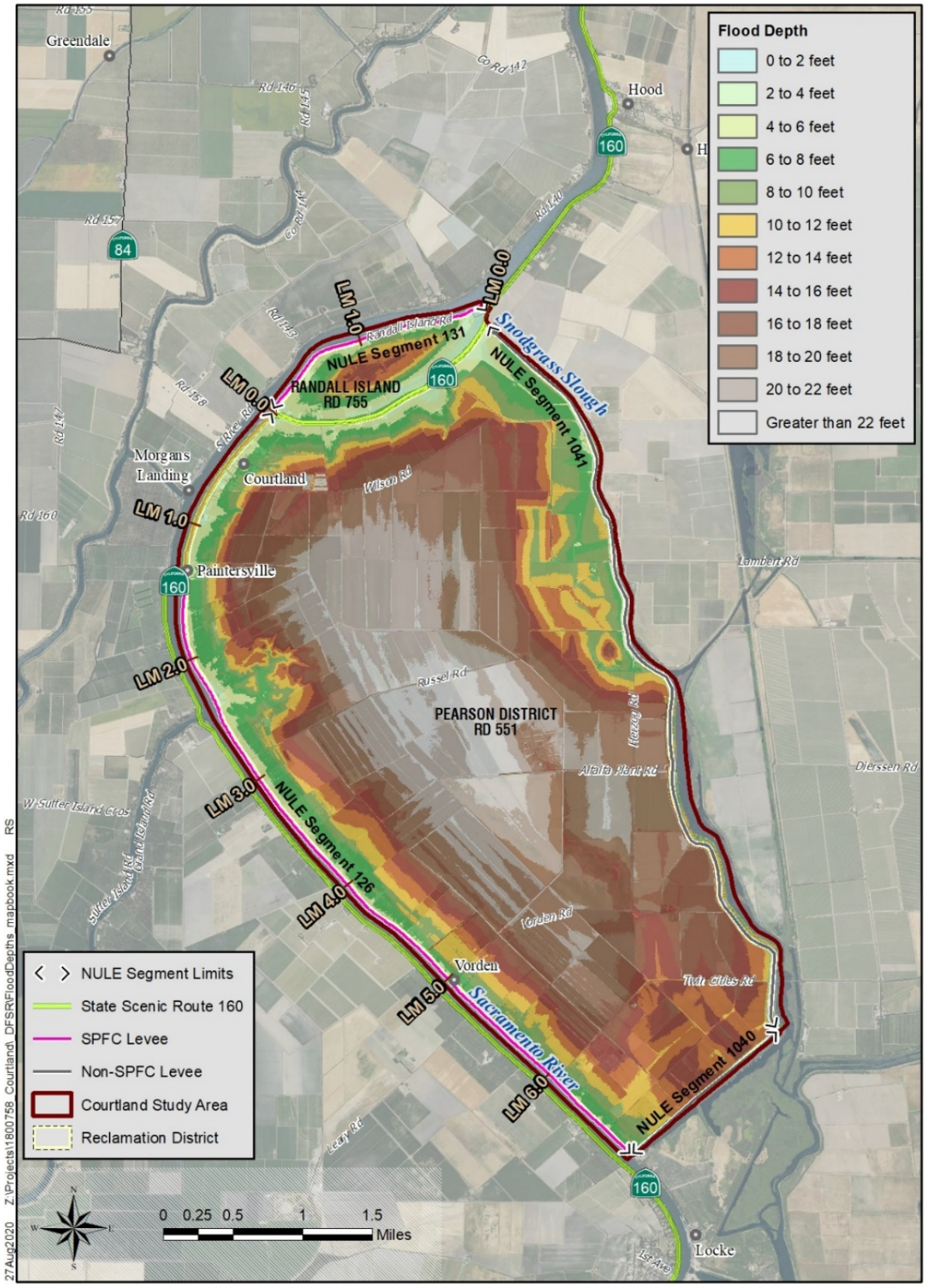


Figure 5-16. Maximum Flood Depths Following a Relief Cut.

5.2.7 Improved Emergency Response – Flood Emergency Safety Plans and County OES Decision Support Tool

Flood ESPs are one tool aimed at improving emergency response within Sacramento County. Public information, posted at the county's webpage, includes the following for individual RD ESPs: a Delta Area Flood Map, flood depth maps, how long it will take to flood the individual RDs, evacuation routes, and time tables indicating the duration of time in hours, days, weeks, or months to pump-out and entirely drain the individual RDs, depending upon the rate of pumping capacity.

The Flood Operation Decision Support System (FODSS) tool is another effort aimed at improving emergency response within Sacramento County. Funded by DWR and sponsored by the County of Sacramento, Governor's OES, the FODSS tool aims to improve emergency response, emergency management and coordination during high water and flood emergencies within the county.

5.2.8 Alternatives to NFIP – Community- and Flood-Risk Based Insurance Programs

The NFIP is managed by the FEMA, through its subcomponent, known as the Federal Insurance and Mitigation Administration. It is currently the only federally backed flood insurance program, so the introduction of alternative flood insuring options for homeowners (such as private community-based flood insurance) carries the advantage of offering potentially more favorable terms to residents within any of the noted Delta Legacy Communities of Sacramento County, including the city of Isleton.

Potential Benefits of a Community-Based Flood Insurance Program

- Potential source for project finance to reduce risk to community and assets
- Improved understanding of underlying risks and resilience opportunities
- Communities could renegotiate contracts every 5 to 7 years and decide how much risk to retain and how much to transfer. Project financing would not be accounted for as debt on the community's balance sheet, providing added flexibility to the community
- Insurance could cover additional items such as funding for continuity of services, community equipment, and other items that are currently self-insured
- *See* : Community-Based Flood Insurance Technical Memorandum, for further details for a community-based flood insurance program for Courtland and other nearby Delta Legacy Communities

A review of FEMA's current and planned mapping procedures, insurance, requirements, insurance rates, and policies indicates that agricultural facilities in leveed areas of the Sacramento Valley, including the Courtland, have been bearing a disproportionately large share of the financial burden of the NFIP. Private sector involvement in the flood insurance industry could protect this area's flood insurance premiums by matching rates to risk through an emerging market for private community-based flood insurance policies.

DRAFT

As NFIP premiums continue to increase for residents in Courtland, private insurers are entering the market. They are taking advantage of better flood mapping, modeling, the accessibility of increasingly high-resolution national data sets, innovations in statistical analysis, and sophisticated global financial markets to fill the affordability gap. In 2019, over 10,000 private insurance policies were written in California (Wholesale & Specialty Insurance Association, 2019).

Private insurers use their own models to establish the price of a policy. For example, the nonprofit First Street Foundation (2020) recently released a nationwide flood model accessible from any mobile device similar to many used by private insurers. It is an easily understood, easily accessible nationwide tool for presenting flood risk information. By visiting FloodFactor.com a resident in Courtland can easily get a general picture of their flood risk.[1] Flood risk is specified by assigning a risk score from 1 to 10. The score is based on cumulative likelihood of flooding at different flood depths based on riverine analyses which indicate flood depths can exceed 10 feet in certain North Delta Communities.

Flood risk information obtained from sites like FloodFactor.com will be different than flood information produced by DWR or FEMA because the methods to assess risk are different.[2]

An alternative to individual homeowner policies is a community-based flood insurance program. A community-based flood insurance program would have the opportunity to lower flood insurance costs by working with an insurer to provide better risk information and by actively implementing agreed upon mitigation measures. A community might choose to: (1) sell their risk to an insurer; (2) finance the risk through capital markets; or (3) by actively managing the flood risk, the community flood risk program would provide the opportunity to both reduce flood insurance premiums and finance levee improvements and/or implement non-structural measures identified herein Non-Structural Measures, and 7.3.

One way that a community might choose to implement a community-based flood insurance program is through the establishment of a Homeowners Association (HOA) or a Geologic Hazard Abatement District (GHAD). A GHAD is a State-level public agency for the purpose of providing prevention, rapid response, and funding to address hazardous geologic conditions. They were established in 1979 by the Beverly Act to allow local residents to develop self-funding mechanisms that address the long-term abatement and maintenance of structures that protect real property from geologic hazards.

The city of Isleton has already taken the initial steps in June to July of 2021 to formalize a path for property owners within its city limits to aggregate their resources and establish a community-based flood insurance program that can be used to augment and/or replace the current set of NFIP policies held within the City of Isleton. The County is also encouraging the unincorporated North Delta Legacy of Courtland to consider alternatives to the current NFIP, including a

[1] http://www.floodfactor.com/
[2] http://www.floodfactor.com/

DRAFT

community-based flood insurance program that could be administered with or without developing a GHAD. A similar community-based flood insurance program is being considered for the San Francisquito Creek JPA, located in the south Bay Area. (*See* Appendix J regarding considerations for developing a community-based flood insurance program to either augment or replace NFIP policies within the Delta Legacy Communities, prepared by Kathleen Schaefer, P.E., CFM, former FEMA regional administrator of NFIP.)

5.2.9 NFIP Flood Insurance Enhancements via AFOTF

The AFOTF *via* its Technical Memorandum of December 28, 2016, has recommended as many as seven administrative refinements of the NFIP to sustain agriculture as a wise use of the floodplain in leveed SFHAs. The NFIP administrative refinements (and amendments proposed by H.R. 830) are focused on improving agricultural sustainability while collectively reducing flood risks. The recommendations address how rules and practices could be modified to: (1) reduce or remove elevation and floodproofing requirements for new and substantially improved agricultural structures, and (2) reduce the cost of flood insurance for agricultural structures with a federally backed mortgage to a more appropriate risk-based portion of the financial risk in the NFIP. The key elements include the following, of which most are applicable to the Courtland study area:

a) Levee relief cuts with emergency operation plans and floodplain management ordinance
b) Zone X for certified levee reaches: The partial accreditation of a basin or levee reach could potentially lead to lower NFIP insurance rates as portions of levee systems are approved
c) Wet floodproofing rules for agricultural structures
d) Insurance rates for nonaccredited levees: The AFOTF recommends that FEMA use sound actuarial science to amend its insurance rates to reflect flood protection provided by a non-accredited levee as documented by a civil engineer
e) Insurance rates for agricultural structures
f) Insurance rates for wet floodproofed structures
g) Add levee risk management activities to FEMA CRS

5.2.10 Mokelumne River Conveyance Improvements/Flood Easements

In October 2010, a Final Environmental Impact Report (EIR) was published by DWR for the North Delta Flood Control and Ecosystem Restoration Project. The purpose of this project was to implement flood control improvements in a manner that benefits aquatic and terrestrial habitats, species, and ecological processes. Specifically, improvements were sought which were expected to reduce damage to land uses, infrastructure, and the Bay-Delta ecosystem resulting from overflows caused by insufficient channel capacities and catastrophic levee failures in the North Delta study area. One option analyzed and presented in this EIR included dredging components

DRAFT

of the channel along the North and South Forks of the Mokelumne River. Dredging is expected to directly reduce flood stages in the Mokelumne River and Snodgrass Slough providing a flood risk reduction benefit to the adjoining nearby communities, including Courtland. Another option yielding similar results involves raising levee segments along these reaches. The implementation of these screened alternatives has the potential to directly reduce flood risk for the Courtland study area which is impacted by high water stages in the Snodgrass Slough.

Another option specific to this area which could reduce flood risks to the study area involves allowing flood stages along the North and South Forks of the Mokelumne River to overtop into Staten Island, or portions thereof, and serve as a flood relief overflow area. This option's feasibility stems largely from the fact that this area is sparsely populated, and its use for a flood easement would allow for significant lowering of water stages in the North Delta Region adjoining and upstream of the North and South Forks of the Mokelumne River.

In addition to the 2010 Final EIR published by DWR for the North Delta Flood Control and Ecosystem Restoration Project there have been a series of other documents developed by DWR and the California Federal Bay Delta Program to reduce flood risks and improve water conveyance through the North Delta following the flooding of the RD 563 portion of Walnut Grove (East) and Thornton within the New Hope Tract during February of 1986. These documents are described in more detail in Appendix H. The documents suggest improving channel capacity in the Mokelumne River on either side of Staten Island and/or securing flood easements on Staten Island to accept excess flood waters would significantly reduce flood stages upstream in Snodgrass Sough for the nearby communities of East Walnut Grove, Locke and possibly as far upstream as Courtland and Hood.

5.2.11 Improve FEMA Community Rating System for Sacramento County

Sacramento County, *via* its floodplain administrator program, is a very active participant of the NFIP, and through its county-wide Flood Protection Ordinance the county strives to reduce flood risks throughout the unincorporated areas of Sacramento County while also attempting to reduce NFIP premium policy rates. Through different flood mitigation activities outlined within the NFIP, Sacramento County has been able to reduce flood insurance through the FEMA CRS. Since 1992, Sacramento County has steadily improved its CRS score and as of May 2017, Sacramento County has maintained a Class 2 designation, which has yielded a 40 percent reduction of NFIP insurance premiums for SFHAs (an average reduction of $547 in annual NFIP premiums), within Sacramento County, including the entire Courtland study area. The county currently has the opportunity to improve their CRS score to achieve the highest possible Class 1 designation by implementing and participating in Emergency Action Plans (EAPs) and associated Table Top Exercises for nearby, upstream dams/reservoirs (namely Folsom Reservoir, and possibly others) that could have a sizeable impact on flooding portions of Sacramento County if said reservoir(s) were to fail and cause flooding. This last jump from a CRS Class 2 to Class l designation would result in the last available 5 percent decrease in NFIP premiums and

DRAFT

would place Sacramento County as the 2nd highest ranked CRS community in the entire Country behind Placer County.

5.2.12 Improved Governance between Neighboring LMAs and RDs and Community

The RDs in the North Delta are protected by a system of leveed channels, multipurpose reservoirs, and other structures that now comprise the SRFCP. The goal of the SRFCP is to reduce the chance of flooding for the communities in Sacramento County. Under the Standardized Emergency Management System (SEMS), Sacramento County establishes an Operational Area (OA). Traditionally, LMAs have not been included in planning or exercises. LMAs have relied mainly on DWR as their primary flood fight trainer, resources provider, and the next link in the SEMS chain of command rather than the local OA management structure. The Sacramento County Delta Flood ESP, written in June 2017, is an effort to improve communication between Sacramento County and the Delta LMAs by providing a better understanding of the river system, providing rescue and evacuation mapping, laying out the flood emergency response process, formulating detailed hazard information for LMAs, and providing flood response trainings.

To improve economies of scale between the two adjoining RDs, namely RD 551 – Pearson District and RD 755 – Randall Island, the two Districts are contemplating merging their forces together (personnel, consultants, and equipment) to streamline costs and collaborate on reducing flood risks within the adjoining basins, including joining forces to work with DWR in repairing the known critical and serious sites identified within RD 755 under DWR's FSRP. The two noted Districts have also joined forces with other neighboring Districts in LOI to file a SWIF application with the CVFPB and the USACE. The SWIF assesses deficiencies and prioritizes levee repairs along the left bank of the Sacramento River, including the SPFC levee segments that provide protection to the communities of Courtland, Locke and East Walnut Grove.

Due to assessment limitations imposed by the California Water Code, RD 551 and other similar RDs are limited to assessing properties within their District(s) by acreage and not by property improvements. Thus, it may be advantageous for the RDs and the CTA to work closer together in potentially developing an improved assessment or a GHAD for implementing flood risk reduction measures specific to the community. Framework exists for community-specific assessments similar to the county assessments that are in place for regional sanitation services, water supply and storm drainage services that are provided by the county and/or others beyond those provided by RDs 551 and 755.

5.2.13 Public Education and Awareness

There are currently three programs within the Delta that provide public education, awareness, and notifications about flood risk. One is the Delta Flood Preparedness Week hosted annually by the DPC. As part of this effort the DPC provides calendars that consolidate important flood-

DRAFT

related information specific to the Delta including emergency phone numbers and websites with flood education as well as safety information.

A second is the Sacramento County Program for Public Information that aims to increase awareness through informational materials (such as the Storm Ready Booklets) and multiple levels of outreach, ranging from radio spots to specific stakeholder engagement. This program can act as a conduit of flood risk information and coordination directly with the community members of Courtland.

The third program is the DWR Flood Risk Notification Program that includes sending annual notices in advance of the flood season to every property owner who is located behind a SPFC levee within the Delta. The individual notices include the property owner's address and informs the owners their property may be exposed to potential flood risk from the failure of the levee system. The notice also suggests each property owner visit DWR's Flood Risk Notification and enter their address to get the most information on State-federal levees in their area.[3]

5.3 Multi-Objective Components

There are several opportunities for including multi-objective components during construction of structural elements and implementation of select non-structural measures. Multi-objective options could offer benefits outside of the Courtland Legacy Community boundary and benefit the broader community within and beyond the larger study area.

5.3.1 Water Quality and Water Supply, including Through-Delta Conveyance Reliability and Operational Flexibility

The Delta Cross Channel, built in 1951 and used seasonally, assists operators of the CVP and the SWP in managing salinity and water levels, ensuring irrigation supplies to CVP pumps, and helps to protect sensitive Delta fish species. The possibility exists to make similar modifications to the upper portions of Snodgrass Slough *via* the old RD 551 borrow canal adjoining Snodgrass Slough to create a connection to the Sacramento River, which could offer even more flexibility in managing water supply and quality by creating an additional freshwater corridor in the North Delta. Snodgrass Slough modifications could be combined with structural elements proposed for this area but are currently developed only to a rough conceptual level and more research into this possible multi-benefit elements is needed.

Repairing and strengthening the SPFC levee reaches along the east, left bank of the Sacramento River upstream of the Delta Cross Channel in the north Delta (MA9, RD 755 – Randall Island, RD 551 – Pearson District, RD 369 – Libby McNeil/Locke, and RD 554 – East Walnut Grove) would also improve the reliability and resiliency of conveying through-Delta CVP and SWP water in the Lower Sacramento River to the Delta Cross Channel. Improving 8.6 miles of SPFC levees to current, modern levee standards consistent with FEMA's 100-year accreditation

[3] http://water.ca.gov/myfloodrisk

DRAFT

standards within the RD 551/RD 755 project boundary of Courtland would constitute improving 23 percent of the non-urban SPFC levees upstream of the Delta Cross Channel and nearly 14 percent of the total non-urban SPFC levees in the Delta's freshwater conveyance corridor.

5.3.2 Ecosystem Restoration/Enhancement

Ecosystem restoration opportunities must be balanced with flood management requirements and in support of continued agricultural land uses in the Delta. Restoration opportunities adjacent to Courtland include:

1) Enhancing backwater habitat along Snodgrass Slough/RD 551 borrow canal and possibly enhancing the existing freshwater corridor of Snodgrass Slough.
2) Advancing the nearby Zacharias Island/Snodgrass Slough Enhancement Project (includes breaching the western levee of Zacharias Island to allow a connection to Snodgrass Slough).
3) Enhancing the combination of wildlife habitat and recreation opportunities within the Delta Meadows State Park adjacent to the communities of Locke and East Walnut Grove.
4) Enhancing or creating additional SRA habitat along the Sacramento River or Snodgrass Slough in connection with addressing erosion concerns and/or replenishing RSP at known erosion sites.
5) If potential borrow material is needed for improving the Courtland study area levee system, consider borrowing material from the Stone Lakes Wildlife Area(s) (south and north of Hood-Franklin Road) that may create opportunities for enhancing tidal-influenced Delta habitat while also marginally reducing flood stages in the Franklin Pond areas east of Snodgrass Slough.

The opportunity for SRA habitat enhancement of the right bank of the Sacramento River could be a potential extension and offer greater connectivity to the SRA opportunities outlined in the 2014 RFMP between Sacramento RM 35 and RM 46 within MA 9 between Freeport and Courtland. *See* Appendix D for a detailed discussion of ecosystem opportunities.

5.3.3 Public Recreation and Education Multi-Benefit Opportunities

The Delta Legacy Communities and encompassing study areas provide a unique mix of modern working agricultural lands, wildlife habitat and viewing opportunities, pastoral landscapes, and a glimpse into history. This provides an opportunity to encourage public education and recreation opportunities for community residents and visitors from outside the Delta and to provide economic stimulus from Delta-centric tourism.

All-Weather Access Road/Flood-Fight Berm Trail

The previously proposed non-structural access road/flood fight berm could be modified slightly to act as a community trail for walking or biking. Approximately 30 percent of the access

DRAFT

road/flood berm is adjacent to public property (school grounds) which reduces affects to nearby residents and ongoing agricultural activities, primarily pear orchards. Modifications to the road/berm could also include restricted access for portions of the alignment adjacent to residences and sensitive orchard operations on the extreme north and south ends of the alignment.

The modified access road/berm could also include signage and interpretive information for users regarding the rich history of the area and connect to the north side of Courtland, which historically included the northernmost Chinese settlement in the Delta. Courtland was a center for Chinese-American politics, and even hosted late Chinese President Sun Yat-sen, who was from the Chungshan district of China, where many Chinese Delta residents originated.

The last Chinese business/building, the Wo Chong store, still stands, although the store closed in 1974. Although Courtland's "Chinatown" no longer exists due to many fires and relocations, visitors could experience Courtland and learn more of its history if a community trail concept were included in the access road/flood berm non-structural measure.

Regional Connection Trail

Improvements to perimeter levees along Snodgrass Slough could include installation of an all-weather surface along the existing crown road, parking, and signage. A trail leading around the perimeter of the study area could be usable for local residents and out-of-Delta visitors, provided protection measures were put in place to not interfere with year-round and seasonal agricultural operations adjacent to the levee crowns. Several of the levee slopes on the non-SPFC levees consist of ongoing agricultural operations including vineyards and orchards that may not be most conducive to readily allowing public access onto the levee crowns.

Potential trailhead locations include areas where Lambert Road and Twin Cities Road intersect Snodgrass Slough and where the historic borrow area for the levee along Delta Meadows Slough intersects River Road at the far southern end of the study area near Locke. A perimeter trail could offer a connection to other Delta Legacy Communities, north to Stone Lakes National Wildlife Refuge, and to the adjacent Delta Meadows State Park (with facility improvements in partnership with State Parks). This concept could also be combined with improvements proposed for the adjacent communities of Locke and Walnut Grove (East) due to shared levees and nearby abandoned railroad spur alignments to connect Delta Legacy Communities with each other and the larger region.

These concepts must be balanced with maintaining the quality of life for residents and agricultural practices of the greater Courtland community and require further refinement and discussion with landowners, stakeholders, including the CTA and Planning Committee and Sacramento County. However, Courtland has much to share with visitors, as detailed on the

DRAFT

Story Map for the community, accessible here: Courtland Story Map - Sacramento County Small Communities Flood Risk Reduction Program.[4]

DRAFT

[4] https://sacramentocounty.maps.arcgis.com/apps/MapJournal/index.html?appid=0471b70d12d6444c8b65e27de4c8aaea

6. Identification and Trade-Off Analysis of Flood Risk Reduction Management Actions

This Section uses the structural elements and non-structural measures previously described in Preliminary Suite of Flood Risk Reduction Elements, to develop and prioritize MAs based on risk reduction and responsiveness to planning objectives, as well as constraints regarding funding, implementation, and capital costs. These MAs are recommended to be implemented in a successive fashion as funding is collectively identified and secured. This Section also provides the capital costs associated with each MA, as well as a trade-off analysis using the planning objectives identified above in Planning Objectives.

The structural elements and non-structural measures identified in Preliminary Suite of Flood Risk Reduction Elements were prioritized into eight MAs based on the most efficient approaches to reducing risk and achieving the previously identified objectives of:

- Reducing risk to life
- Reducing risk to property damage
- Reducing probability of levee failure
- Limitation of high insurance premiums
- Improved preparedness and response
- Enhancing resiliency and reliability of through-Delta water conveyance
- Prioritizing environmental stewardship and multi-benefit projects

As previously discussed, risk reduction is defined as the product of the probability of levee failure and the consequences of failure. The consequences of levee failure are defined in this study in terms of life loss and property damage. Of the eight MAs, those which resulted in the greatest risk reduction by reducing the probability of levee failure of the weakest levee segments and reducing the consequences of levee failure through reduced life loss and property damage were given priority. However, funding, implementation, and capital cost are also considered during the prioritization process.

The eight structural based MAs are summarized below. These MAs are compared against the no action, future without project condition to quantify and qualify how well each MA addresses the objectives of this study using the planning objectives identified above in Planning Objectives.

DRAFT

6.1 Identification of Flood Risk Reduction Management Actions

6.1.1 No Action, Future Without Project

Future without project conditions represent the current level of flood protection within the study area, does not incorporate any structural or non-structural flood risk reduction elements, and incorporates expected changes to the study area from climate change, sea level rise, and future land uses. These conditions do not include any flood management improvements that have been authorized and have funding, or that have started construction or implementation.

Without any changes to the flood management system or implementation of non-structural measures:

- The study area remains at a high risk of flooding. As previously discussed, according to ongoing and previous studies conducted by DWR and the DSC DLIS, it is estimated that the community of Courtland has an estimated 7- to 36-year level of flood protection. The greater study area, including RDs 551 and 755 excluding the community of Courtland, has an estimated 7- to 60-year level of flood protection.
- There is a high risk of life loss for the densely populated community of Courtland. Currently, the levee fronting the community of Courtland, as documented by DWR in the NULE GAR, is estimated to have a moderate risk of levee failure or the need to flood fight based on the potential vulnerability to underseepage and erosion. In the event of a levee failure at this location, significant life loss is likely as a result of high floodwater stages and velocities which would leave little time to evacuate.
- There is also a high risk of property damage for the community of Courtland. As documented by DWR in the NULE GAR, the levee immediately upstream from the community in RD 755 – Randall Island is estimated to have a high risk of levee failure or the need to flood fight based on the potential vulnerability to underseepage. This is further evident by the DWR FSRP sites along NULE Segment 131, which have not been fully repaired to date. A levee breach upstream of Courtland in RD 755 along this segment of levee could result in significant property damage to the community. The total value of structures and their contents, highways and streets, agricultural crops, and vehicles (excluding agricultural equipment) within the community of Courtland totals $71.3M. With the current level of flood protection noted above this equates to an EAD for Courtland (SAC 48 impact area) of $6.4M under existing conditions and up to $14M under future conditions with the effects of inland climate change and sea level rise.
- The larger study area remains susceptible to high NFIP annual premium increases, which could result in a net reduction of insured homes, further increasing flood risk.
- Levees within the Delta remain at risk of failure, which could significantly impact the agricultural economy within and adjacent to the community of Courtland and the conveyance of water to SWP and CVP water contractors south of the Delta.

DRAFT

6.1.2 Management Action 1: Repair DWR FSRP Critical and Serious Sites in RD 755

The two combined critical and serious seepage FSRP sites in RD 755 upstream from the community of Courtland on the left bank of the Sacramento River along NULE Segment 126 pose imminent flood threats to the community of Courtland and the larger study area. These sites were identified under the DWR FSRP in 2013 and remain unrepaired. As previously discussed, a levee failure at either of these locations could result in life loss in the Courtland study area *via* high floodwater depths and velocities. Property damage is also of concern in the Courtland study area as a result of deep flooding. Repairing these previously identified FSRP sites would not only reduce the probability of levee failure, but also reduce the risk of life loss and property damage (both within Courtland and the larger study area), resulting in a net reduction in flood risk.

When considering capital cost, implementation, funding, and stakeholder input, repair of the DWR FSRP critical and serious sites was selected as the most efficient, and no regrets means to reducing flood risk to the community of Courtland and the larger study area and was thus prioritized as MA 1. MA 1 is comprised of the following prioritized flood risk reduction elements, with 1A presenting the greatest risks to the community of Courtland:

- 1A: Repair DWR FSRP Critical Site in RD 755
- 1B: Repair DWR FSRP Serious Site in RD 755

These elements are depicted in Figure 6-1 and the proposed remediations for each are discussed in Section 5.1.1.1 (1A, 1B).

DRAFT

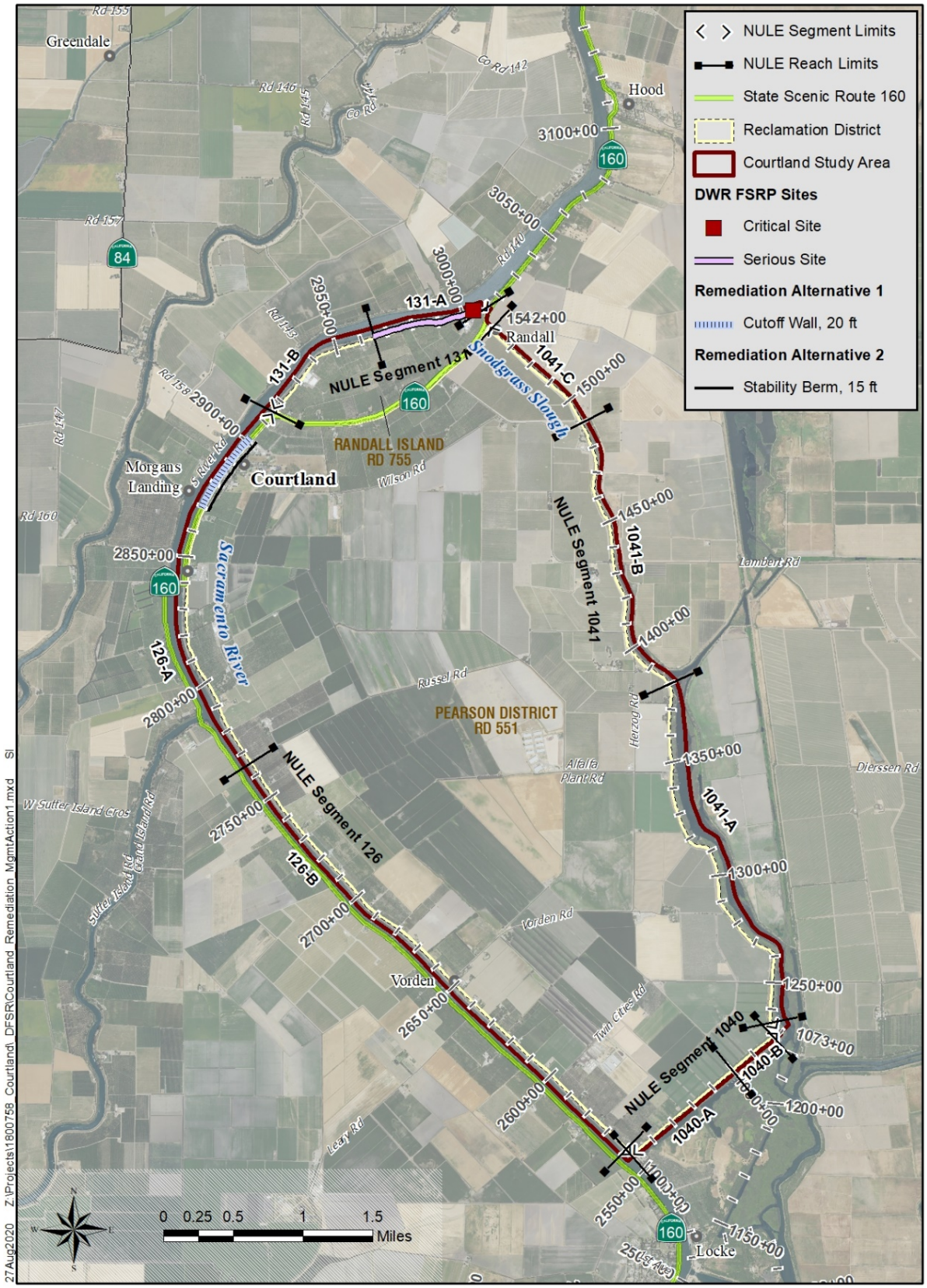


Figure 6-1. Management Action 1 – Repair of DWR FSRP Critical and Serious Sites

6.1.3 Management Action 2: Address Erosion Sites and Erosion Concerns on SPFC and Non-SPFC Levees

High velocity flows on the Sacramento River in conjunction with the highly erodible and loose sands which comprise the SPFC levees have resulted in 30 erosion sites of concern as identified by the LMA representatives in RD 551 and three erosion sites in RD 755, as detailed in Section 5.1.1.2. Of these 33 sites, seven have been repaired or are planned for repair leaving 26 sites (24 sites in RD 551 and two sites in RD 755) that require attention. Over time, these sites can gradually worsen and lead to levee failures. Of particular concern due to the levee material and the high velocity flows on the Sacramento River are the four remaining serious sites in RD 551 which have not been repaired and are not planned for immediate repair by the RD or by DWR. The risk of flooding at these locations is high. Serious sites have the capability of worsening into more critical sites during a flood event, which could lead to levee failures. As a result, the probability of levee failure for these sites is high. Additionally, the risk of property damage should a levee failure occur as a result of these erosion sites is also high. Two of these sites are located downstream from the community, which in the event of a levee failure could result in flood depths ranging from 5 to 10 feet in the community of Courtland, 15 feet in RD 755, and nearly 30 feet in some parts of RD 551. The two remaining sites in RD 755 are also of concern, as the levee segment in RD 755 is estimated to have a high likelihood of either levee failure or the need to flood fight (which could be exacerbated by these erosion sites), and a failure along the levee could result in flood depths up to 10 feet in the community of Courtland, up to 20 feet in RD 755, and nearly 35 feet in parts of RD 551. In either scenario, levee failure would result in significant property damage to the community of Courtland and the larger study area.

Potential erosion concerns on the non-SPFC levees present similar flood risk to the community of Courtland and the larger study area. Levees with erosion concerns are currently estimated to have a moderate likelihood of failure or the need to flood fight and repairing these erosion concerns would help reduce the likelihood of failure, thereby reducing the overall flood risk to the community and the study area.

Repair of the LMA identified erosion sites on the SPFC levees and addressing potential erosion concerns on the non-SPFC levees were thus selected as the next most efficient means to reducing flood risk to the community of Courtland and the larger study area. MA 2 is comprised of the following prioritized flood risk reduction elements, with 2A presenting the greatest risks to the community of Courtland:

- 2A: Address Erosion Sites Identified by LMA Representatives – SPFC Levees
- 2B: Address Potential Erosion Concerns – Non-SPFC Levees

MA 2A includes repair of four serious sites, 15 areas of concern, and five other sites that have not been categorized by the RD in RD 551, along with two erosion sites in RD 755. MA 2B includes addressing potential erosion concerns on the right bank Delta Meadows Slough levee

DRAFT

adjoining RD 369. The erosion locations and proposed remediations for MAs 2A and 2B are discussed in Sections 5.1.1.2 and 5.1.2.1.

6.1.4 Management Action 3: Repair and Strengthen-in-Place SPFC Reach Immediately Adjacent to Courtland to Largely Address Through-Seepage Concerns

As previously discussed, the risk of life loss is of greatest concern within the densely populated community of Courtland since a levee breach along the Sacramento River east levee directly adjacent to the community could likely result in high floodwater velocities, leaving little time to evacuate. A levee breach along the community of Courtland could result in significant property damage in the community and in RDs 551 and 755 as a result of deep flooding. Since flood risk is defined in terms of probability of levee failure and risk of life loss and property damage, and the levee fronting the community of Courtland is estimated to have a moderate likelihood of failure, this segment of levee poses great risk to the community of Courtland and the larger study area.

Although this segment of levee poses the greatest risk of life loss to the community of Courtland, remediating this levee was prioritized as MA 3 based on stakeholder input. The proposed remediations are discussed in Section 5.1.1.3.

6.1.5 Management Action 4: All-Weather Access Road/Flood-Fight Berm for the Community of Courtland

Construction of an all-weather access road/flood-fight berm would not result in reduced probability of levee failure, or reduced risk to the larger study area of RD 755 and RD 551; however, constructing an all-weather access road/flood fight berm would prevent floodwaters originating upstream or downstream within the RDs 755 and 551 basins from entering the community. In addition to preventing floodwaters from entering the community, the access road/flood-fight berm could allow additional time for evacuation, thus further reducing life loss and property damage, and ultimately reducing flood risk for the community. An all-weather access road/flood-fight berm could also lend multi-benefit opportunities for public recreation and education along the perimeter limits of the community. While this flood risk reduction element would likely result in a greater reduction in life loss than repair of the SPFC and non-SPFC erosion sites, the all-weather access road/flood-fight berm will not reduce risk to the larger agricultural basin. As a result, the access road/flood-fight berm was prioritized as MA 4.

6.1.6 Management Action 5: Ring Levee & FEMA Certification for the Town of Courtland

Construction of a ring levee in addition to repairing and strengthening-in-place of the levee immediately fronting the community of Courtland was selected as the next most efficient means of reducing risk, including reduction of potential life loss within the community. Similar to

DRAFT

MA 4, MA 5 does not result in reduced risk to the larger agricultural basin containing RD 551 and RD 755. However, construction of a ring levee and repairing and strengthening-in-place the levee fronting the community would reduce flood risk for Courtland by protecting the people, lives, and property inside of the community in the event of a flood. FEMA accreditation of the ring levee would also result in 100-year flood protection for the populated Town of Courtland, which would limit high insurance premiums and also partially enhance the resiliency and reliability of through-Delta water conveyance. The ring levee as part of MA 5 would be constructed as described in Section 5.2.2, Figure 5-13, and the repair/strengthen-in-place of the levee along the community would be performed as described in Section 5.1.1.3.

6.1.7 Management Action 6: Repair and Strengthen-in-Place Sacramento River – SPFC Levees Only (Multi-Benefit Component to Improve Reliability and Resiliency of Through-Delta Conveyance)

Repair and strengthen-in-place of all the 8.6 miles of SPFC levees in RDs 551 and 755 would greatly reduce the probability of levee failure along the entire left bank of the Sacramento River and protect lives and property within both the community of Courtland and within both RDs. MA 6 also provides the multi-benefit of improving the resiliency and reliability of through-Delta water conveyance by improving 23 percent of the non-urban SPFC levees located between Freeport and the Delta Cross Channel (total of 37 miles), and nearly 14 percent of the total non-urban SPFC levees downstream of Freeport (total of 62 miles) which comprise the freshwater corridor in the North Delta. Repairing and strengthening the SPFC levees in the Courtland study area would greatly reduce flood risk and improve the resiliency and reliability of through-Delta conveyance of SWP and CVP water. Capital cost, funding, and implementation considerations resulted in prioritization of this flood risk reduction element as MA 6. The proposed remediations for MA 6 are described in Section 5.1.2.2.

See Appendix K for further details in support of the multi-benefit opportunities identified by the Sacramento County Delta Legacy Communities associated with reducing flood risks combined with improving SWP water conveyance through the Delta.

6.1.8 Management Action 7: Repair and Strengthen-in-Place Snodgrass Slough & Delta Meadows Levees – Non-SPFC Levees Only

Similar to MA 6, repairing and strengthening-in-place 7.3 miles of non-SPFC levees would greatly reduce the probability of levee failure along Snodgrass Slough and Delta Meadows Slough, which would result in reduced life loss and property damage. The levees along the Sacramento River are of greater concern when it comes to protecting people and property. As a result, this flood risk reduction element was prioritized after the repair and strengthen-in-place of the SPFC levees along the Sacramento River. MA 7 repairs and strengthens the entirety of the non-SPFC levees (NULE Segments 1040 and 1041) located along Snodgrass Slough to the east and RD 369 and Delta Meadows Slough to the south consistent with the proposed remediations described in Section 5.1.2.3.

DRAFT

6.1.9 Management Action 8: Secure 100-Year FEMA Certification for Entire Study Area including Courtland and RD 551/755 Basins

FEMA certification of the perimeter levee system ensures 100-year flood protection for the community of Courtland and the larger study area containing the combined basins of RDs 551 and 755. FEMA certification helps to limit high insurance premiums and enhances the resiliency and the reliability of through-Delta water conveyance by improving nearly 14 percent of the total non-urban SPFC levees downstream of Freeport (62 miles) which comprise the freshwater corridor in the Delta, and 23 percent of the total non-urban SPFC levees located between Freeport and the Delta Cross Channel (total of 37 miles). However, FEMA certification of the entire perimeter levee system may be cost-prohibitive without support from through- and south-of-Delta water conveyance interests associated with the CVP and SWP. As a result, securing 100-year FEMA certification for the entire perimeter levee system was prioritized as MA 8. FEMA accreditation could be obtained once the perimeter levee system is remediated and improved to FEMA criteria for erosion, through seepage, underseepage, slope stability, and freeboard. All design criteria, O&M requirements, and documentation requirements included in 44 CFR §65.10 would also need to be addressed to secure 100-year FEMA certification for the entire study area within RDs 551 and 755.

6.2 Capital Costs

Cost estimates were developed for each of the structural elements identified in Section 5.1 and for the construction of a ring levee and an all-weather access road/flood fight berm around the community of Courtland. Where possible, these cost estimates were developed in concert with previous estimates prepared by DWR and MBK Engineers. Table 6-1 provides a range of capital cost estimates by levee reach (excluding erosion) using the previously identified remediation alternatives. These estimates are used as the basis to develop the range of costs for each of the repair and strengthen-in-place structural elements, as well as the repair of the DWR FSRP serious site. Capital cost estimates to address erosion sites and concerns on the SPFC and non-SPFC levees are presented separately below in Section 0 and cost estimates for the ring levee and access road/flood fight berm are provided in Sections 6.2.5 and 6.2.4, respectively. Costs presented in this Section are intended to be Class 4 (Feasibility Level) estimates as defined by the Association for Advancement of Cost Engineering International, and additional geotechnical explorations and analysis are recommended to further refine these cost estimates. Costs for all approaches are escalated to a cost basis of July 2020 using the 20 cities average from the Engineering News-Record Construction Cost Index. Further description of the development of the capital costs can be found in Appendix F.

6.2.1 Repair DWR FSRP Critical and Serious Sites (Management Action 1)

MA 1 is comprised of the following prioritized flood risk reduction elements:

DRAFT

- 1A: Repair DWR FSRP Critical Site in RD 755
- 1B: Repair DWR FSRP Serious Site in RD 755

The range of cost estimates to repair the critical site located along NULE Segment 131 in RD 755 (MA 1A) was developed using the costs provided for reach 131-A in Table 6-1 and using past costs developed by DWR as documented in the 2013 FSRP Pre-Feasibility Report. The estimated cost to repair the FSRP critical site using the berm remediation developed for reach 131-A, assuming the berm would be implemented across 500 feet of levee, is $1,267,000. The estimated cost to repair the FSRP critical site using an 80 feet deep cutoff wall as documented in the 2013 FSRP Pre-Feasibility Report, escalated to July 2020 dollars, is $3,750,000. The cost to remediate the critical site thus ranges from $1,267,000 (75-ft.-wide, 8-ft.-tall combination seepage/stability berm) to $3,750,000 (80 ft. deep cutoff wall, as developed by DWR).

The range of cost estimates to repair the serious site located along NULE Segment 131 in RD 755 was developed using the costs provided for reach 131-A in Table 6-1. Assuming that each remediation alternative would be implemented across 3,500 feet of levee, the cost to remediate the serious site ranges from $8,870,000 (75-ft.-wide, 8-ft.-tall combination seepage/stability berm) to $26,588,000 (80-ft.-deep cutoff wall).

The total cost for this element ranges from $10,137,000 (assuming berms are implemented for each reach) to $30,338,000 (assuming cutoff walls are implemented for each reach).

DRAFT

Table 6-1. Repair and Strengthen-in-Place Cost Estimates by Levee Reach for Courtland Study Area, Excluding Erosion Repairs

Levee Segment Location	NULE Segment / Reach	Start Station	End Station	Length (ft)[1]	Remediation Alternative 1	Remediation Alternative 1 Cost Estimate	Remediation Alternative 2	Remediation Alternative 2 Cost Estimate
Left Bank SPFC Sacramento River - RD 551	126-A	2765+00	2915+00	15,000	20-ft.-deep cutoff wall	$52,337,000	15-ft.-wide, 8-ft.-tall stability berm	$16,115,000
	126-B	2556+53	2765+00	20,800	115-ft.-deep cutoff wall	$274,773,000	85-ft. wide, 9-ft.-tall combination seepage and stability berm	$61,993,000
Left Bank SPFC Sacramento River - RD 755	131-A	2965+00	3012+00	4,700	80-ft.-deep cutoff wall	$35,704,000	75-ft.-wide, 8 ft.-tall combination seepage and stability berm	$11,911,000
	131-B	2915+00	2965+00	5,000	80-ft.-deep cutoff wall	$38,458,000	85-ft. wide, 9-ft.-tall combination seepage/stability berm	$14,402,000
Totals for SPFC Levees				**45,500 ft., 8.62 Mi.**		**$401,272,000 ($47M/mile)**		**$104,421,000 ($12M/mile)**
Right Bank Non-SPFC Delta Meadows Slough - RD 551	1040-A	1000+00	1050+00	5,000	65-ft.-deep cutoff wall	$24,268,000	145-ft.-wide, 20-ft.-tall combination seepage and stability berm	$23,845,000
	1040-B	1050+00	1073+00	2,300	95-ft.-deep cutoff wall	$30,507,000	160-ft.-wide seepage berm	$8,507,000

DRAFT

Levee Segment Location	NULE Segment / Reach	Start Station	End Station	Length (ft)[1]	Remediation Alternative 1	Remediation Alternative 1 Cost Estimate	Remediation Alternative 2	Remediation Alternative 2 Cost Estimate
Right Bank Non-SPFC Snodgrass Slough - RD 551	1041-A	1231+00	1380+00	14,900	20-ft.-deep cutoff wall	$55,994,000	15-ft.-wide, 13-ft.-tall stability berm	$16,030,000
	1041-B	1380+00	1490+00	11,000	55-ft.-deep cutoff wall	$48,025,000	90-ft.-wide seepage berm	$23,894,000
	1041-C	1490+00	1543+00	5,300	N/A	$0	N/A	$0
Total for Non-SPFC Levees				**38,500 ft., 7.29 Mi.**		**$158,794,000 ($22M/mile)**		**$72,276,000 ($10M/mile)**
Total Perimeter Levee System for Courtland Study Area				**84,000 ft., 15.91 Mi.**		**$560,066,000 ($35M/mile)**		**$176,697,000 ($11M/mile)**

Note: [1] Reach lengths rounded to the nearest 100 feet

DRAFT

6.2.2 Address Erosion Sites and Erosion Concerns on SPFC and Non-SPFC Levees (Management Action 2)

MA 2 is comprised of the following prioritized flood risk reduction elements:

- 2A: Address Erosion Sites Identified by LMA Representatives – SPFC Levees
- 2B: Address Potential Erosion Concerns – Non-SPFC Levees

Previous costs to repair the four RD 551 erosion sites in 2019 were used to develop costs to repair the remaining 26 erosion sites located on the SPFC levees along the left bank of the Sacramento River in RDs 551 and 755 (MA 2A). The total cost estimate for MA 2A is $2,878,000.

Using the remediation slope lengths taken from the DWR NULE Phase 1 study in concert with the proposed remediations described in Section 5.1.2.1, the cost estimate to repair potential erosion concerns along the non-SPFC levees located Delta Meadows Slough (MA 2B) could potentially as approach as much as $6,749,000.

Further description of the development of these cost estimates can be found in Appendix F.

6.2.3 Repair and Strengthen-in-Place SPFC Levee Adjacent to Courtland (Management Action 3)

The range of cost estimates to repair and strengthen the levee immediately fronting the community of Courtland were developed using the costs provided for reach 126-A in Table 6-1. Assuming that the levee fronting the community totals 0.73 miles in length (including an additional 300 feet on either end to accommodate the transition of a potential access road/flood fight berm or ring levee), the cost to repair this segment of levee ranges from $4,190,000 (15-ft.-wide, 8-ft.-tall stability berm) to $13,608,000 (20-ft.-deep cutoff wall). However, it is expected that a cutoff wall would be implemented along this segment of levee to reduce physical impacts associated with a stability berm that would displace structures within the community that are located on and/or directly adjacent to the landward toe of the existing levee system.

In comparison, as detailed in the 2011 Remedial Alternatives and Cost Estimates Report (RACER) for the North NULE study area, DWR estimated a total cost of $46,820,000 to remediate the entirety of NULE Segment 126 (6.8 miles) in the Courtland study area, which equates to $59,051,000 when escalated to July 2020 dollars. With an estimated length of 0.73 miles, DWR's estimated cost to remediate the levee fronting the community of Courtland is $6,339,000.

DRAFT

6.2.4 All-Weather Access Road/Flood-Fight Berm for the Community of Courtland (Management Action 4)

The estimated cost to construct the all-weather access road/flood-fight berm described in Section 5.2.1 is $5,348,000 and is further detailed in Appendix F.

6.2.5 Construction and FEMA Certification of a Ring Levee around the Community of Courtland (Management Action 5)

The estimated cost to construct the ring levee described in Section 5.2.2 and to secure FEMA accreditation for the community includes cost components for construction of the ring levee, repairing and strengthening-in-place the levee immediately fronting the community of Courtland, and FEMA certification. These cost components and the total estimated cost for this element are summarized in Table 6-2 below. A range of costs is provided, as the strengthen-in-place repairs to the levee fronting the community of Courtland can be remediated through a cutoff wall or a stability berm, which results in a range of costs for this repair and strengthen-in-place element. However, it is expected that a cutoff wall would be implemented along this segment of levee to reduce physical impacts associated with a stability berm that would displace structures within the community that are located on and/or directly adjacent to the landward toe of the existing levee system. Note that the estimated costs to improve the levee fronting the community of Courtland includes an additional 300 feet on either end to accommodate the transition of the ring levee. Additionally, to attain FEMA accreditation, erosion site 1 identified by the LMA representatives will likely need to be addressed in addition to the repairs and strengthening-in-place of the levee fronting the community and construction of the new ring levee. These erosion repairs costs have not been included in the range of costs below.

Table 6-2. Estimated Range of Costs for Construction of a Ring Levee System to FEMA Certification.

Cost Component	Estimated Cost
1. Construction of a new Ring Levee	$19,787,000
2. Repair and Strengthen-in-Place SPFC Levee Immediately Fronting the Community of Courtland	$4,190,000 - $13,608,000
3. FEMA Certification (5% of items 1-2 above)	$1,199,000 - $1,670,000
Total	**$25,176,000 - $35,064,000**

In comparison, as detailed in the 2012 CVFPP, DWR estimated a total cost of $13,573,000 to construct a new ring levee and to perform fix-in-place repairs to the levee fronting the community, which equates to $16,680,000 when escalated to July 2020 dollars.

DRAFT

6.2.6 Repair and Strengthen-in-Place Sacramento River – SPFC Levees (Multi-Benefit Component to Improve Reliability and Resiliency of Through-Delta Conveyance) (Management Action 6)

The range of cost estimates to repair and strengthen the SPFC levee segments located along the left bank of the Sacramento River were developed using the costs provided for reaches 126-A, 126-B, 131-A, and 131-B in Table 6-1, and the cost to repair the erosion sites as provided in Section 0. The cost estimate for this element ranges from $107,299,000 (assuming berms are implemented for each reach) to $404,150,000 (assuming cutoff walls are implemented for each reach).

In comparison, as detailed in the 2011 DWR RACER for the North NULE study area, DWR estimated a total cost of $70,976,000 to remediate the entirety of NULE Segment 126 (6.8 miles) and NULE Segment 131 (1.8 miles) in the Courtland study area, which equates to $89,517,000 when escalated to July 2020 dollars.

6.2.7 Repair and Strengthen-in-Place Snodgrass Slough & Delta Meadows Levees – Non-SPFC Levees (Management Action 7)

The range of cost estimates to repair and strengthen the non-SPFC levee segments located along Snodgrass and Meadows Slough were developed using the costs provided for reaches 1040-A, 1040-B, 1041-A, 1041-B, and 1041-C, and the estimated cost to address potential erosion concerns on the non-SPFC levees as provided in Section 6.2.2. The cost estimate for this element ranges from $79,025,000 (assuming berms are implemented for each reach requiring remediation/and/or improvements) to $165,543,000 (assuming cutoff walls are implemented for each reach).In comparison, as detailed in the 2011 RACER for the North NULE study area, DWR estimated a total cost of $98,370,000 to remediate the entirety of NULE Segment 1040 (1.4 miles) and NULE Segment 1041 (5.9 miles) in the Courtland study area, which equates to $124,067,000 when escalated to July 2020 dollars.

6.2.8 Secure 100-Year FEMA Certification for Entire Study Area Including Courtland and RDs 551/755 Basins (Management Action 8)

The cost of securing 100-year FEMA certification for the entire study area, including the community of Courtland, is the summation of all the costs associated with: (1) repairing and strengthening the entirety of the perimeter levees (SPFC and non-SPFC levees) to current FEMA standards identified above in Sections 6.2.6 and 6.2.7 and collectively identified above in Table 6-1; (2) addressing erosion sites identified by LMA representatives on the SPFC levees and erosion concerns on the non-SPFC levees; (3) addressing any reaches that contain an immediate freeboard issue (currently none) or long-term settlement issues (unknown) as noted above in Section 5.1.2.4; (4) correcting all encroachments (closures, pipelines, and structures) within and/or adjacent to the entirety of the perimeter levee system that pose a threat to the structural and/or operational integrity of the levee system pursuant to 44 CFR §65.10, as noted above in

DRAFT

Section 5.1.2.4; (5) conducting the applicable interior drainage studies and operational plans as noted above in Section 5.1.2.4; and (6) updating applicable operation and maintenance plans following all repairs and improvements and modifications to ensure the entirety of the perimeter levee system is operated and maintained by RDs 551 and 755 in accordance with FEMA, USACE, and CVFPB standards. For cost estimating purposes, FEMA certification items (3) through (6) noted herein and described in more detail within Section 5.1.2.4, are estimated at 5 percent of items (1) and (2) herein associated with repairing and strengthening the entirety of the perimeter levee system and addressing erosion sites identified by LMA representatives and other erosion concerns on the non-SPFC levees. The estimated cost to secure 100-year FEMA certification for the community of Courtland and the larger study area ranges from $226,762,000 (assuming berms are implemented to repair the entire perimeter levee system) to $615,529,000 (assuming cutoff walls are implemented to repair the entire perimeter levee system) (Table 6-3).

Table 6-3. Estimated Range of Costs for 100-Year FEMA Certification for Entire Study Area Including Courtland and RDs 551/755 Basins

Cost Component	Estimated Cost
Remediation and Improvement Alternative 1 (Cutoff Walls) Implemented for Entire Perimeter Levee System of Courtland Study Area (15.9 miles)	
1. Repair and Strengthen-in-Place Repairs to the Entire Perimeter Levee System: Remediation Alternative 1 (Cutoff Walls)	$560,066,000
2. Address LMA Identified Erosion Sites on the SPFC Levees and Erosion Concerns on the Non-SPFC Levees	$9,628,000
3. FEMA Certification (5% of items 1-2, above)	$28,485,000
Total	**$598,178,000 ($38M/mile)**
Remediation and Improvement Alternative 2 (Berms) Implemented for Entire Perimeter Levee System of Courtland Study Area (15.9 miles)	
1. Repair and Strengthen-in-Place Repairs to the Entire Perimeter Levee System: Remediation Alternative 2 (Berms)	$176,697,000
2. Address LMA Identified Erosion Sites on the SPFC Levees and Erosion Concerns on the Non-SPFC Levees	$9,628,000
3. FEMA Certification (5% of items 1-2, above)	$9,316,000
Total	**$195,641,000 ($12M/mile)**

6.2.9 Capital Cost Summary

A summary of capital costs for MAs 1 through 8 is provided in Table 6-4 below.

DRAFT

Table 6-4: Estimated Range of Costs for Management Actions 1-8 Including FEMA Certification for Community of Courtland and Entire Study Basins of RDs 551 and 755

Management Action (MA)	Cutoff Walls	Berms	Ring Levee or All-Weather Access Road/Flood Fight Berm	RSP	FEMA Certification	Total
1A: Repair DWR FSRP Critical Site in RD 755	$3,750,000	$1,267,000	$0	$0	$0	$1,267,000 - $3,750,000
1B: Repair DWR FSRP Serious Site in RD 755	$26,588,000	$8,870,000	$0	$0	$0	$8,870,000 - $26,588,000
Total for MA 1: Repair DWR FSRP Critical and Serious Sites in RD 755	$30,338,000	$10,137,000	$0	$0	$0	$10,137,000 - $30,338,000
2A: Address Erosion Sites Identified by the LMA Representatives – SPFC Levees	$0	$0	$0	$2,878,000	$0	$2,878,000
2B: Address Erosion Concerns – Non-SPFC Levees	$0	$0	$0	$6,749,000	$0	$6,749,000
Total for MA 2: Address Erosion Sites and Erosion Concerns on SPFC and Non-SPFC Levees	$0	$0	$0	$9,627,000	$0	$9,627,000
3: Repair and Strengthen in-Place SPFC Reach Immediately Adjacent to Courtland to Largely Address Through-Seepage Concerns	$13,608,000	$4,190,000	$0	$0	$0	$4,190,000 - $13,608,000
4: All-Weather Access Road/Flood Fight Berm for Courtland	$0	$0	$5,348,000	$0	$0	$5,348,000
5: Ring Levee System for Courtland & FEMA Certification	$13,608,000	$4,190,000	$19,787,000	$0	$1,199,000 - $1,670,000	$25,176,000 - $35,064,000
6: Repair and Strengthen-in-Place Sacramento River – SPFC Levees (Multi-Benefit	$401,272,000	$104,461,000	$0	$2,878,000	$0	$107,229,000 - $404,150,000

DRAFT

Management Action (MA)	Cutoff Walls	Berms	Ring Levee or All-Weather Access Road/Flood Fight Berm	RSP	FEMA Certification	Total
Component to Improve Through-Delta Conveyance) – 8.6 miles						
					Total Cost per Mile for MA 6	$12M-$47M
7: Repair and Strengthen-in-Place Snodgrass Slough & Delta Meadows – Non-SPFC Levees – 7.3 miles	$158,794,000	$72,276,000	$0	$6,749,000	$0	$79,025,000 - $165,543,000
					Total Cost per Mile for Management Action 7	$11M-$23M
8: Secure 100-Year FEMA Certification for Entire Study Area Including Courtland and RD 551/755 Basins – 15.9 miles	$560,066,000	$176,697,000	$0	$9,628,000	$9,316,000 - $28,485,000	$195,641,000 - $598,178,000
					Total Cost per Mile for Management Action 8	$12M-$38M

DRAFT

6.3 Trade-Off Analysis of Flood Risk Reduction Management Actions

MAs were compared in a trade-off analysis against the study goal of obtaining 100-year flood protection for the Courtland study area and against the objectives described in Section 4.1. Other considerations, such as agricultural sustainability, local support, cost, cultural resources, ecosystem, and consistency with existing Delta regulations and policies were also used to compare each of the MAs. The trade-off analyses also incorporate the net reduction in EAD values determined for most structural-based MAs, including net EAD reductions for implementing either the access road/flood-fight berm or a certified ring levee system.

6.3.1 Planning Objectives

6.3.1.1 Reducing Risk to Life

A breach within the levee fronting the community could contain high instantaneous floodwater velocities and depths of imminent danger within the community that would most likely result in life loss in Courtland. MAs 3, 5, 6, and 8 are the only MAs which fortify the levee to current FEMA accreditation standards fronting the community. As a result, these four MAs would result in the greatest measurable reduction in life loss. A levee breach along the Sacramento River upstream of the community of Courtland also has the potential to result in life loss; thus, those MAs which fortify this segment of levee or protect the community against floodwaters resulting from a levee breach along this segment of levee result in the next greatest measurable reduction in life loss (MAs 1, 2A, 4). Considering the no action condition, a levee failure along Snodgrass Slough or Meadows Slough is not likely to result in significant life loss to the community since the inundation time to 1 foot in the community of Courtland, as a result of a levee failure on Snodgrass Slough, is estimated to be 24 hours. While fortifying the non-SPFC levees would reduce the probability of flooding, it is expected that inundation to 1 foot in 24 hours is sufficient to avoid life loss in the community and a net reduction in life loss is not expected. Thus, MAs 2B and 7 are not likely to result in a reduction in life loss.

6.3.1.2 Reducing Risk to Property Damage

As previously discussed, EAD represents the annualized expected damages through the consideration of potential flooding conditions and is one of the primary drivers for flood management funding within the Delta. EAD includes potential flood damages to structures, structure contents, land improvements, adjoining crops, regional infrastructure, and vehicles. Reduction in EAD is a common metric used to evaluate flood risk reduction measures and is used in this feasibility study to evaluate how well each MA meets the objective of reducing risk to property damage. Further details on the EAD analysis performed as part of this study are provided in : Expected Annual Damages Technical Memorandum

DRAFT

As shown previously in Table 3-7, baseline (or without project) EAD for the Courtland study area under existing and future conditions (with climate change adjustments) is nearly $45M and $95M, respectively. Existing without project conditions represent the current level of flood protection within the study area and does not incorporate any new structural or any new proposed non-structural flood risk reduction elements. Future without project conditions represent the current level of flood protection within the study area, does not incorporate any structural or non-structural flood risk reduction elements, and incorporates expected changes to the study area from climate change, sea level rise, and future land uses. These baseline conditions do not include any flood management improvements in the study area that have been authorized and have funding, or that have started construction or implementation.

Table 6-5 and Table 6-6 below provide the estimated net reduction in EAD to the Courtland study area under existing and future conditions as a result of implementing MAs 1, 2, 4, 5, and 8. The net reduction in EAD in each table is formulated by subtracting the estimated EAD value for each impact area, which is estimated assuming a fractional, partial, or full improvement, from the baseline (or without project) EAD. The pay-back period in years (excluding interest) is then calculated using the estimated cost of each MA.

Overall, the greatest reduction in EAD for the Courtland study area is provided by MA 8 (FEMA certification of the entire perimeter levee system). As shown in Table 6-5, implementing MA 8 would reduce EAD for the study area by over $44M under existing conditions. On an annualized basis, this represents an EAD of $318,000 for the RD 551/755 basin (less the community of Courtland) and an EAD of $54,000 for the community of Courtland. However, at a cost of up to nearly $600M, the flood risk reduction payback period is over 13 years (excluding interest).

Repairing the FSRP critical and serious seepage sites in RD 755 along with the erosion sites identified by LMA representatives on the SPFC levees and erosion concerns on the non-SPFC levees (collectively MAs 1 and 2) results in a similar net reduction to the Courtland study area. By repairing these sites, EAD in the community of Courtland is estimated at $265,000 under existing conditions, with EAD for the larger RD 551/755 basin estimated at $1.6M under existing conditions, presenting a total net reduction to the study area of $43M. With an estimated cost of up to $40M, the flood risk reduction pay-back period is less than one year. Repairing just the critical FSRP critical seepage site in RD 755 (MA 1A) also provides value to the community of Courtland and the larger study area, with a total net reduction in EAD of nearly $13M under existing conditions. At an estimated cost of just nearly $4M, the pay-back period for this MA is less than four months.

The proposed all-weather access road/flood fight berm (MA 4) and ring levee (MA 5) also provide direct measurable value to the community of Courtland. MA 4 is estimated to result in a net reduction in EAD to the community of Courtland of over $6M under existing conditions, with an estimated pay-back period of less than one year. The estimated net reduction in EAD for the community of Courtland under MA 5 is around $200,000 more, at just over $6.3M under

DRAFT

existing conditions; however, at a cost of up to $35M, the payback period for MA 5 is higher at almost 6 years.

The discussion above also applies under future conditions as shown in Table 6-6. As shown in Table 6-6, the effects of climate change and sea level rise result in both an increase in the baseline EAD for the Courtland study area ($95M increased from nearly $45M under existing conditions), and a greater benefit from each of the MAs as seen by the higher net reductions in EAD.

In general, when considering the estimated capital cost to construct or implement each MA, repairing the DWR FSRP critical and serious sites combined with repairing and addressing all of the erosion sites and potential concerns on the SPFC and non-SPFC levees (MAs 1 and 2) provides the largest incremental value to the community of Courtland and the larger study area. With the implementation of these MAs, the total net reduction in EAD for the Courtland study area is estimated at $43M under existing conditions and over $91M under future conditions. Repairing just the FSRP critical site in RD 755 (MA 1A) provides the next largest incremental value to the community and the larger study area, with a total net reduction of nearly $13M under existing conditions and over $22M under future conditions. Notably, as shown in Table 6-5 and Table 6-6, the all-weather access road/flood-fight berm (at an estimated cost of $5M) provides the same value to the community of Courtland as repairing all of the DWR FSRP critical and serious sites and all of the erosion sites and potential erosion concerns (at an estimated cost of $40M). In both cases, EAD in the community of Courtland is reduced to $563,000 under future conditions and $265,000 under existing conditions. A ring levee around the community of Courtland (at an estimated cost of $35M) is also estimated to provide the same value to the community of Courtland as certifying the entire Courtland study area perimeter levee system (at an estimated cost of $598M). In these cases, EAD is reduced to between $54,000 (existing conditions) and $136,000 (future conditions).

DRAFT

Table 6-5: Courtland Study Area EAD Values for Existing Conditions Consistent with the 2022 CVFPP Update

Scenarios for Select Structural-Based Management Actions (MAs)	Estimated Cost	Courtland SAC 47 EAD	RDs 551 & 755 less Courtland SAC 48 EAD	Total Net Reduction to Courtland Study Area	Flood Risk Reduction Pay Back Period in Years (excluding interest)
Baseline EAD, SAC 48 (Courtland): **$6,366,000** [(1)] Baseline EAD, SAC 47 – RDs 551 & 755 (less the community of Courtland): **$38,544,000** [(1)] Total Baseline EAD for the Courtland Study Area (SAC 47 & SAC 48): **$44,910,000** [(1)]					
Repair of the FSRP Critical Seepage Site in RD 755 **(MA 1A)**[(2)]	$1,267,000-$3,750,000	$27,557,000	$4,553,000	$44,910,000 - $27,557,000 - $4,553 = $12,800,000	$3,750,000 /$12,800,000 = 0.3 years
Repair of the FSRP Critical and Serious Seepage Sites in RD 755 and Erosion Sites and Potential Erosion Concerns **(MA 1, 2)**[(3)]	**Combined Total Cost of MA 1, MA 2:** $19,764,000-$39,966,000	$1,602,000	$265,000	$44,910,000 - $1,602,000 - $265,000 = $43,043,000	$39,966,000 /$43,043,000 = 0.9 years
All-Weather Access Road/Flood Fight Berm for Courtland **(MA 4)**[(3)]	$5,348,000	N/A	$265,000	$6,366,000 - $265,000 = $6,101,000	$5,348,000 /$6,101,000 = 0.9 years
Ring Levee System for Courtland & FEMA Certification **(MA 5)**[(4)]	$25,176,000-$35,064,000	N/A	$54,000	$6,366,000 - $54,000 = $6,312,000	$35,064,000 /$6,312,000 = 5.6 years
FEMA Certification of the Entire Courtland Study Area Perimeter Levee System **(MA 8)**[(4)]	$195,640,000-$598,178,000	$318,000	$54,000	$44,910,000 - $318,000 - $54,000 = $44,538,000	$598,178,000 /$44,538,000 = 13.4 years

Notes: Levee Performance Data Curve for EAD Values: [(1)] Baseline without Improvement [(2)] Fractional Improvement [(3)] Partial Improvement [(4)] Full Improvement

DRAFT

Table 6-6: Courtland Study Area EAD Values for Future Conditions Consistent with the 2022 CVFPP Update

Scenarios for Select Structural-Based Management Actions (MAs)	Estimated Cost	Courtland SAC 47 EAD	RDS 551 & 755 less Courtland SAC 48 EAD	Total Net Reduction to Courtland Study Area	Flood Risk Reduction Pay Back Period in Years (excluding interest)
Future conditions Baseline EAD, SAC 48 (Courtland): **$14,126,000**[(1)] Future Conditions Baseline EAD, SAC 47 – RDs 551 & 755 (less the community of Courtland): **$81,118,000**[(1)] Future Conditions Total Baseline EAD for the Courtland Study Area (SAC 47 & SAC 48): **$95,244,000**[(1)]					
Repair of the FSRP Critical Seepage Site in RD 755 **(MA 1A)** [(2)]	$1,267,000-$3,750,000	$62,287,000	$10,861,000	$95,244,000 - $62,287,000 - $10,861,000 = $22,096,000	$3,750,000/$22,096,000 = 0.2 years
Repair of the FSRP Critical and Serious Seepage Sites in RD 755 and Erosion Sites in RD 551 **(MA 1, 2)** [(3)]	**Combined Total Cost of MA 1, MA 2:** $19,764,000-$39,966,000	$3,233,000	$563,000	$95,244,000 - $3,233,000 - $563,000 = $91,449,000	$39,966,000/$91,448,000 = 0.4 years
All-Weather Access Road/Flood Fight Berm for Courtland **(MA 4)** [(3)]	$5,348,000	N/A	$563,000	$14,126,000 - $563,000 = $13,563,000	$5,348,000/$13,563,000 = 0.4 years
Ring Levee System for Courtland & FEMA Certification **(MA 5)** [(4)]	$25,176,000-$35,064,000	N/A	$136,000	$14,126,000 - $136,000 = $13,990,000	$35,064,000/$13,990,000 = 2.5 years
FEMA Certification of the Courtland Study Area Perimeter Levee System **(MA 8)** [(4)]	$195,640,000-$598,178,000	$775,000	$136,000	$95,244,000 - $775,000 - $136,000 = $94,333,000	$598,178,000/$94,333,000 = 6.3 years

Notes: Levee Performance Data Curve for EAD Values: [(1)] Baseline without Improvement [(2)] Fractional Improvement [(3)] Partial Improvement [(4)] Full Improvement

DRAFT

6.3.1.3 Reducing Probability of Levee Failure

MA 1 results in a high reduction in the probability of levee failure through the repair of the DWR FSRP critical and serious sites upstream of the community in RD 755. Repair of the DWR FSRP critical and serious seepage sites would significantly reduce the probability of levee failure along the segment of levee in RD 755 (NULE Segment 131) since this levee segment is estimated to have a high likelihood of failure due to underseepage vulnerabilities. As documented in the FSRP, it is estimated that repair of the critical and serious sites within RD 755 would reduce the recurrence interval associated with NULE Segment 131 from 3- to 50-years.

MA 2A includes repair of four serious erosion sites, 15 areas of erosion concern, and seven other erosion sites that have not been categorized, all of which are on the SPFC levees located along the left bank of the Sacramento River. Repair of these 26 erosion sites would reinforce those segments of levee which have sustained serious damage, as well as other areas of concern which can progress into critical or serious sites during a flood event. As a result, MA 2A results in a moderate reduction in the probability of levee failure

MA 2B repairs erosion concerns on the non-SPFC levees. Levees located along Delta Meadows Slough are estimated to have a low likelihood of failure as a result of erosion vulnerabilities, as documented in the NULE GAR for the north NULE study area. As a result, MA 2B results in a low reduction in the probability of levee failure.

MA 3 includes repairing and strengthening-in-place the levee immediately fronting the community of Courtland, which is currently estimated to have a moderate likelihood of failure. Repairing and strengthening-in-place the levee immediately fronting Courtland would likely eliminate the probability of an instantaneous levee failure immediately adjacent to the community. As a result, MA 3 results in a moderate reduction in the probability of levee failure.

MA 4 integrates an all-weather access road/flood-fight berm and is a non-structural measure which does not modify or improve the existing levee/flood control system. As a result, this MA does not result in a net reduction in the probability of levee failure but does reduce the risk to flooding in the community of Courtland.

MA 5 integrates a ring levee with repairing and strengthening-in-place the levee immediately fronting the community of Courtland. Though the ring levee itself would not result in a net reduction in the probability of levee failure, MA 5 would result in a high reduction in the probability of levee failure since repairing and strengthening-in-place the levee reach immediately adjacent to the community being a component of the ring levee system would likely eliminate the probability of an instantaneous levee failure immediately adjacent to the community.

MA 6 repairs and strengthens-in-place the SPFC levees along the left bank of the Sacramento River. Improving these levee segments (NULE Segments 126 and 131) would likely eliminate the potential of a levee failure, both immediately adjacent to the community and along the

DRAFT

entirety of both NULE Segments. As a result, MA 6 results in a high reduction in the probability of levee failure.

MA 7 repairs and strengthens the non-SPFC levees located along Snodgrass Slough and Meadows Slough. Similar to MA 6, improving these levee segments would likely eliminate the potential of a levee failure along the NULE Segments which comprise these levees, and as a result, MA 7 results in a high reduction in the probability of levee failure.

MA 8 includes repairing and strengthening all of the SPFC and non-SPFC levee reaches surrounding the community and entire study area and includes certification of the entire perimeter levee system to FEMA standards. The collection of improving the entire perimeter levee system and certifying said perimeter levee system would result in the highest reduction in the probability of levee failure of all MAs under consideration.

6.3.1.4 Reduction of High Insurance Premiums

Those MAs which result in 100-year FEMA certification could result in a net reduction in NFIP insurance premiums. MAs 5 and 8 are the only solutions which result in 100-year FEMA certification. However, implementation of the structural and non-structural elements as part of MAs 1 through 4, 6, and 7, in concert with a community- or risk-based insurance program, could also result in a net reduction in flood insurance premiums for the community. *See* Section 5.2.8 and Appendix J, for greater discussions and potential options for Courtland and other nearby Delta Legacy Communities to pursue community-based flood insurance programs.

6.3.1.5 Enhancing Resiliency and Reliability of Through-Delta Water Conveyance

MAs 6 and 8 would provide the greatest multi-benefit enhancement of the resiliency and reliability of through-Delta water conveyance by improving the entire 8.6 mile SPFC levee system located along the Sacramento River within the study area, which equates to 23 percent of the non-urban SPFC levees located between Freeport and the Delta Cross Channel (total of 37 miles) and nearly 14 percent of the total 62 miles of non-urban SPFC levees downstream of Freeport which comprise the freshwater corridor in the North Delta (*see* Figure 3-3). MAs 1, 2A, 3, and 5 which fortify various segments of the SPFC levee system within the study area also enhance through-Delta water conveyance to a lesser degree. MAs 2B, 4, and 7 do not improve through-Delta water conveyance. However, a levee breach along Snodgrass Slough could possibly pose a temporary disruption to water quality in the Delta, potentially resulting in an interruption of through-Delta CVP/SWP deliveries routed through the Delta Cross Channel.

6.3.1.6 Environmental Stewardship and Multi-Benefits

Under MAs 1, 2A, 3, and 5, ecosystem restoration and enhancement, conducted in concert with improvements proposed for the Courtland study area as detailed in the 2014 RFMP, could be implemented along with any structural MAs proposed for that reach. Under MAs 6 and 7, the following enhancement concepts could be implemented: 1) backwater habitat provided by the

DRAFT

Snodgrass Slough/RD 551 Borrow canal freshwater corridor (which would benefit water supply reliability and sensitive species, 2) the nearby Zacharias Island and Snodgrass Slough Enhancement Project (includes breaching the western levee to allow a connection to Snodgrass Slough), 3) enhancing or creating additional SRA habitat along the Sacramento River or Snodgrass Slough in connection with addressing erosion concerns and/or replenishing RSP at known erosion sites, and 4) if potential borrow material is needed for improving the Courtland project area levee systems consider borrowing material from the Stone Lakes Wildlife Area(s) (south and north of Hood-Franklin Road) that may create opportunities for enhancing tidal-influenced Delta habitat while also marginally reducing flood stages in the Franklin Pond areas east of Snodgrass Slough.

Under MAs 4 and 5, a recreation component could be implemented along with construction of the all-weather access road/flood-fight berm or ring levee, in the form of a multi-use trail that would include signage and interpretive information for users regarding the rich history of the area and connect to the north side of Courtland, which historically included the northernmost Chinese settlement in the Delta. This is not an option under the other MAs, which do not include the access road component. MAs 6, 7, and 8, with their focus on Snodgrass Slough and perimeter levees, could include installation of an all-weather surface road along the existing crown road, parking, and signage. A perimeter trail could offer a connection to other Delta Legacy Communities, north to Stone Lakes National Wildlife Refuge, and to the adjacent Delta Meadows State Park (with facility improvements in partnership with State Parks). This concept could also be combined with improvements proposed for the adjacent communities.

6.3.2 Other Considerations

6.3.2.1 Agricultural Sustainability

Under MAs 2A and 2B, agricultural sustainability would not be affected since riprap or RSP would be placed on the existing waterward slopes of the levee system. Thus, adjacent land would not be affected, except possibly for a short time during construction. However, under MA 4, an estimated 10 acres of agricultural land and open space would be affected by construction of the all-weather access road/flood-fight berm to accommodate the footprint of the access road/flood-fight berm and any necessary easements adjacent to the access road. MA 5 consisting of a ring levee and repairing and strengthening the levee immediately fronting the community of Courtland would result in similar, but larger impacts (estimated 24 acres) largely due to a higher levee footprint as a result of higher levee heights along the alignment of the ring levee, relative to levee heights of the proposed all-weather access road/flood fight berm (Table 6-7). Of these 24 acres, 21 acres would be displaced as a result of construction of the ring levee, with the remaining 3 acres attributed to construction of a cutoff wall or stability berm to remediate the levee immediately fronting the community of Courtland (though it is assumed that a cutoff wall would be implemented on this levee reach to reduce physical impacts associated with a stability berm that would displace structures within the community).

DRAFT

Under MAs 1, 3, 6, 7, and 8, agricultural sustainability could be affected if the repair and strengthen-in-place *via* cutoff walls (Remediation Alternative 1) are not implemented, since the proposed seepage, stability, or combination berms (proposed as Remediation Alternative 2) could range from 15 to 145 feet wide, resulting in displacement of productive permanent crops (orchards and vineyards) and seasonal row or field crops. The estimated displacement of acreage associated with implementing cutoff walls *versus* seepage, stability, or combination berms as part of MAs 1, 3, 6, 7, and 8 is summarized below in Table 6-5. If the community and RDs were to implement seepage, stability, or combination berms for the entire levee system as part of MA 8, an estimated 200 acres of productive permanent crops and seasonal row or field crops would be displaced. Implementing combination or stability berms on the SPFC levees located on the Sacramento River as part of MA 6 would displace an estimated 133 acres of permanent and seasonal crops, and implementing the proposed seepage, stability, or combination berms on the non-SPFC levees located on Snodgrass Slough and Meadows Slough would displace an estimated 71 acres of permanent and seasonal crops. Under MA 1, implementing stability berms to repair the DWR FSRP serious site would result in an estimated 13 acres of displaced permanent and seasonal crops. Implementing stability or combination berms to repair and strengthen the levee immediately fronting the community of Courtland as part of MA 3 would result in 2 acres of displaced permanent and seasonal crops (though it is assumed that a cutoff wall would be implemented on this levee reach to reduce physical impacts associated with a stability berm that would displace structures within the community). As shown in Table 6-7, overall impacts are reduced when implementing cutoff walls for each of the proposed MAs.

DRAFT

Table 6-7. Estimated Displaced Agricultural Acreage when Implementing Management Actions 1 and 3-8

Management Action (MA)	Estimated Displaced Agricultural Acreage: Remediation Alternative 1 (Cutoff Walls)	Estimated Displaced Agricultural Acreage: Remediation Alternative 2 (Seepage, Stability, or Combination Berms)
MA 1: Repair DWR FSRP Critical and Serious Sites in RD 755	3	13
MA 3: Repair and Strengthen-in-Place SPFC Reach Immediately Adjacent to Courtland	2	2
MA 4: All-Weather Access Road and Flood Fight Berm for the Town of Courtland	10	
MA 5: Ring Levee & FEMA Certification for the Community of Courtland	24	24
MA 6: Repair and Strengthen-in-Place through Geotechnical Remediation, Sacramento River – SPFC Levees	29	133
MA 7: Repair and Strengthen-in-Place through Geotechnical Remediation, Snodgrass Slough & Delta Meadows Levees – Non-SPFC Levees	2	71
MA 8: Secure 100-Year FEMA Certification for Community/RDs	31	204

6.3.2.2 Local Support

Those MAs which result in the least impacts to agricultural sustainability garner the most local support. Consequently, under MAs 1, 3, 6, and 7, local support is given to vertical remediations (cutoff walls) over horizontal remediations (seepage, stability or combination berms) since a cutoff wall would be installed entirely within the existing levee prism and would not result in a net reduction in agricultural land. Additionally, between MAs 2A and 2B, local support is greater for MA 2A, since the non-SPFC levees on Snodgrass Slough are overbuilt, and the RDs associate a lower probability of levee failure to this segment of levee relative to the Sacramento River SPFC levee segments. Finally, between MAs 4 and 5, local support is greater for MA 4, since an all-weather access road/flood fight berm would be constructed so that the top of the berm can be 6 to 10 feet lower than that of a ring levee crown and would result in less viewshed impacts to the community of Courtland, and less right-of-way acquisition coupled with potentially less displacement of permanent orchards immediately adjacent to the community.

DRAFT

6.3.2.3 Cost

MA 2A (repair of the LMA identified erosion sites on the SPFC levees), MA 2B (repair of the non-SPFC erosion concerns), and MA 4 (all-weather access road/flood-fight berm) are the lowest cost solutions to reducing flood risk in the study area at just over $2.8M, $6.7M, and nearly $5.4M, respectively. MA 5 (ring levee around the community of Courtland and FEMA certification) is the next lowest cost solution at just over $35M. MA 3 (repairing and strengthening-in-place of the levee fronting the community of Courtland) is the next lowest cost solution ranging in cost from $4.2M to $13.6M, and MA 1 (repair of the DWR FSRP critical and serious sites) ranges in cost from $10.1M to $30.3M. MA 5 (ring levee around the community of Courtland) ranges in cost from $25.2 to $35.1M. The remaining MAs 6 to 8 are the highest cost solutions to reducing flood risk to the Courtland study area. These solutions range in cost between $79M to over $598M, depending on whether seepage/stability/combination berms or cutoff walls are implemented to address the vulnerabilities on each reach of levee. The highest cost solution to reducing flood risks in the study area, ranging between nearly $196M and $598M, is MA 8. This MA repairs and strengthens-in-place the entire perimeter levee system and secures FEMA accreditation for the study area, including Courtland.

6.3.2.4 Cultural Resource Considerations

Under MAs 1, 2A, 2B, and 3, cultural resources could be affected, since installation of a cutoff wall and/or placement of riprap could disturb previously unknown archeological resources. However, built-environmental resources, such as historic buildings, on adjacent land would not be permanently affected. Additionally, under MA 4 and 5, cultural resources could be affected by construction of the foundation of the all-weather access road/flood fight berm and ring levee. Under MAs 6 and 7 cultural resources could be affected by repair/strengthen-in-place remediations if the cutoff wall alternative (1) is not implemented, since the proposed seepage, stability, or combination berm could range from 15- to 145-foot wide and may require grading or foundational work before the berm is constructed.

6.3.2.5 Ecosystem Considerations

Under MAs 1 and 3, it is unlikely that biological resources would be affected, since a cutoff wall would be installed entirely within the existing levee prism and riprap would be placed on the existing levee, which is fairly clear of vegetation except for some large trees. It is likely these repairs could be implemented if appropriate work window restrictions, monitoring, and species and habitat avoidance and mitigation measures are in place. However, under MA 4 and 5, a small amount of open space would be affected by construction of the all-weather access road/flood fight berm or ring levee to accommodate the road footprint (up to 20 ft. wide) and any necessary easements adjacent to the access road or ring levee. Biological resources in this area could be affected if any sensitive habitat along the alignment cannot be avoided. MAs 2A and 2B could also result in impacts to SRA habitat valuable to fisheries and other aquatic species if appropriate work window restrictions, monitoring, and species and habitat avoidance and mitigation

DRAFT

measures are not in place. Under MAs 6 and 7 biological resources could likely be avoided/minimized by fix-in-place remediation activities. However, as discussed previously, the extensive habitat along Snodgrass Slough would likely preclude any waterside repairs or remediation. However, cut-off walls or landside repairs are more likely than water side repairs and improvements.

The restoration activities possible in the study area would be consistent with Delta Plan Strategy 4.2 "Restore Habitat" and Strategy 4.4 "Prevent Introduction of and Management of nonnative Species Impacts". These actions would provide benefits to the following species: Sacramento splittail and Delta smelt, western pond turtle, multiple waterbird guilds (waders, dabblers, and divers), tricolored blackbird, other songbird species. The actions described at a conceptual level, above, would also provide improved patch size for riparian habitat, and critical habitat connectivity between Cosumnes River Preserve, Delta Meadows, Staten Island, and Stone Lakes National Wildlife Refuge.

6.3.2.6 Consistency with Existing Delta Regulations and Policies

As mentioned previously, there are several agencies with regulatory, flood management, and/or land use authority over projects in the Delta, including the subject Sacramento County Delta Legacy Community of Courtland that is located in the Primary Zone of the Delta. Due to the large number of broad policies and goals contained in the many DPC, DSC, and Conservancy planning documents applicable to the study area, an exhaustive matrix comparing the various proposed flood management elements against the many broad goals and policies of Delta agencies is contained in Appendix G.

Generally, all of the proposed MAs indirectly support the various Delta agencies plans and policies regarding sustainability and viability of the Delta agricultural economy, preservation of the Legacy Community's unique history and sense of place, and opportunities for public recreation and ecosystem enhancement (where feasible). The only MA components that could conflict with existing regulations could be those that propose seepage/stability berms and possibly the access road/flood fight berm, if their final configuration would affect a substantial acreage of important farmland of regional and statewide significance within the study area. Although most restrictions regarding agricultural land conversion address conversion to urban uses, the concept of taking agricultural land out of production due to flood management facilities would need to be explored further before implementation of any MA.

Historically, levee repairs can induce population growth and encourage development within the floodplain. Although levee repairs are proposed under all of the various MAs, development within the Delta is constrained by the Delta Plan and SPA ordinances which limit new residential, commercial, and industrial development within the Primary Zone of the Delta. As such, future floodplain development within the study area is not expected to be substantial. By protecting Courtland and adjacent working agricultural lands with better flood protection, and

DRAFT

providing multi-benefit opportunities when possible, Courtland can reasonably thrive as a community within the confines of existing regulations.

6.3.3 Trade-Off Analysis Summary

A summary of the trade-off analysis is provided in Table 6-8 below.

DRAFT

Table 6-8. Trade-Off Analysis Summary

Management Action	Flood Risk Reduction				Limitation of High Insurance Premiums	Estimated Displacement of Agricultural Acreage (Cutoff Walls/Berms)	Enhancing Resiliency and Reliability of through-Delta Water Conveyance	Local Support	Multi-Benefit, Eco-System Enhancements	Cost
	Reducing Risk to Life	Reducing Risk to Property Damage (EAD Reduction)	Reduced Probability of Levee Failure	Net Reduction in EAD to Courtland Study Area (Existing Conditions/Future Conditions) ($)						
1	High	High	High	$12,800,000 - $22,096,000 (MA 1A only)	No	3/13	Yes	High	Low	Medium
2A	Low	High	Medium	$43,043,000 - $91,449,000 (when combined with MA 1A, 1B)	No	0	Yes	High	High	Low
2B	Low	High	Low		No	0	No	High	High	Low
3	High	High	Medium	N/A	No	2/2	Yes	Medium	Medium	Medium
4	Low	Medium	None	$6,101,000 -$13,563,000	No	10	No	Medium	Low	Low
5	High	Medium	High	$6,312,000 -$13,990,000	Yes	24/24	Yes	Low	Low	Medium
6	High	High	High	N/A	No	29/133	Yes	High	Low	High
7	Low	High	High	N/A	No	2/71	No	Medium	Medium	High
8	High	High	High	$44,538,000-$94,333,000	Yes	31/204	Yes	High	Medium	High

DRAFT

[This page left intentionally blank]

DRAFT

7. Recommendations

Section 7 details the suite of MAs recommended for implementation. Stakeholder and public input on these MAs is also provided, along with other non-structural measures that are recommended for implementation. Following these recommendations, right-of-way and easements considerations, as well as considerations for operation, maintenance, repair, replacement and rehabilitation (OMRR&R) are discussed, as well as regulatory requirements, financial feasibility, and stakeholder support.

7.1 Recommended Suite of Structural-Based Management Actions

Of the eight MAs previously identified, MAs 1 through 4 are recommended for timely, near-term implementation. This includes:

- **Management Action 1:** Repair DWR FSRP Critical and Serious Sites (sequentially 1A thru 1B, with 1A presenting the greatest risk to Courtland)
    - 1A: Repair DWR FSRP Critical Site in RD 755
    - 1B: Repair DWR FSRP Serious Site in RD 755
- **Management Action 2:**
    - 2A: Address Erosion Sites Identified by LMA Representatives – SPFC Levees
    - 2B: Address Potential Erosion Concerns – Non-SPFC Levees
- **Management Action 3:** Repair and Strengthen in-Place SPFC Reach Immediately Adjacent to Courtland to Largely Address Through-Seepage Concerns
- **Management Action 4:** Access Road/Flood-Fight Berm for the Town of Courtland

Two additional Management Actions for long-term consideration:

- **Management Action 5:** Ring Levee & FEMA Certification for the Town of Courtland is also recommended as an alternative to MA 4.
- **Multi-Benefit Management Action 6:** Repair and Strengthen-in-Place a total of 8.6 miles SPFC levee segments in RD 775 (NULE Segment 131) and RD 551 (NULE Segment 126) as a multi-benefit project to improve through-Delta water conveyance reliability and resilience upstream of the Delta Cross Channel, with or without current DCA proposal of single tunnel. See Appendix K for further details in support of the multi-benefit opportunities identified by the Sacramento County Delta Legacy Communities associated with reducing flood risks combined with improving SWP water conveyance through the Delta.

DRAFT

Long-term MAs include the long-term goal of securing a 100-year level of flood protection for the entire study area (**MA 8**) by repairing and improving both the SPFC levees along the Sacramento River and the non-SPFC levees along Snodgrass and Delta Meadows Sloughs, particularly if MA 5 consisting of a ring levee is not implemented.

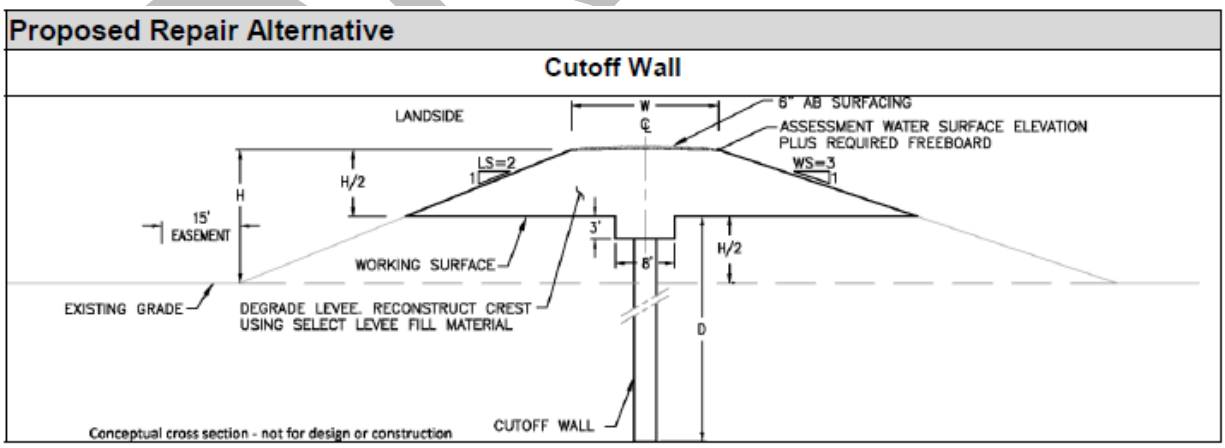
As previously discussed, repairing and strengthening the SPFC levee along the left, east bank of the Lower Sacramento River would also improve the resiliency and reliability of the through-Delta water conveyance system upstream of the Delta Cross Channel. Provided the community can also garner support from in-Delta and South of Delta water export interested parties, including but not limited to, the DCA, DWR, CVP, Metropolitan Water, and State Water Contractors, it is recommended that MA Items 6 through 8 be implemented over time to improve and modernize the perimeter levee systems that also serve to improve the resiliency and reliability of the through-Delta conveyance system as it currently exists today and into the future with conveyance of water through the Delta upstream of the Delta Cross Channel.

It is also recommended that all of the above recommended structural-based MAs be coupled with the noted suite of non-structural measures identified and prioritized in Section 7.3 below. The conceptual designs and estimated costs for this suite of MAs are provided below.

7.1.1 Management Action 1: Repair DWR FSRP Critical and Serious Sites in RD 755

7.1.1.1 Management Action 1A, 1B: DWR FSRP Critical and Serious Sites

As previously discussed in Section 5.1.1.1, a cutoff wall with a length and depth of 1,000 feet and 80 feet, respectively, is recommended to repair the FSRP critical site located along NULE Segment 131 in RD 755 (Figure 7-1).



H: 15.0 Feet		Levee Mile Start:	0.11
W: 29.0 Feet		Levee Mile End:	0.29
D: 80.0 Feet		Repair Length (ft):	1,000
H/2: 7.5 Feet			

DRAFT

Figure 7-1. Proposed Cutoff Wall Specifications for Repair of Critical Seepage Site within RD 755 (URS, 2013b)

Remedial alternatives to repair the FSRP serious site located along NULE Segment 131 in RD 755 include an 80-foot-deep cutoff wall or a 75-foot-wide combination seepage/stability berm. The cutoff wall was selected as the recommended remedial alternative to address the serious site in RD 755. The cutoff wall would be 3,500 feet long and a conceptual cross section is provided in Figure 5-1.

7.1.2 Management Action 2: Address Erosion Sites and Erosion Concerns on SPFC and Non-SPFC Levees

7.1.2.1 Management Action 2A: Address Erosion Sites Identified by LMA Representatives – SPFC Levees

As described in Section 5.1.1.2, erosion sites on the left bank of the Sacramento River (NULE Segments 126 and 131) identified by the LMA will be addressed through the addition of 18-inch minus riprap by creating a 2-foot-wide berm across the entirety of the slope repair length perpendicular to the levee slope above mean high water. A conceptual cross section for this remediation is provided in Figure 5-7.

7.1.2.2 Management Action 2B: Address Potential Erosion Concerns – Non-SPFC Levees

A conceptual cross section for this remediation is provided in Figure 5-9.

7.1.3 Management Action 3: Repair and Strengthen-in-Place Levee Adjacent to Courtland

As described in Section 5.1.1.3, remedial alternatives to repair and strengthen the levee along the Sacramento River immediately fronting the community of Courtland include a 20-foot-deep cutoff wall or an 8-foot-tall, 15-foot-wide stability berm. The 20-foot-deep cutoff wall was selected as the recommended remedial alternative to improve the segment of levee adjacent to the community in an effort to reduce physical impacts that would displace structures within the community. A conceptual cross section for this remediation is provided in Figure 5-2.

7.1.4 Management Action 4: All-Weather Access Road/Flood-Fight Berm for the Town of Courtland

As discussed in Section 5.2.1, the proposed all-weather access road/flood fight berm would follow the alignment depicted in Figure 5-12, with an 18-foot-wide crown width, 3H:1V landside and waterside slopes, and maximum road crown elevation of 13 feet, assuming design WSEL of 16 feet NAVD 88 and 1 foot of freeboard. Note that the maximum crown elevation of 13 feet was developed assuming a relief cut would be executed within the basin.

DRAFT

7.1.5 Management Action 5: Ring Levee & FEMA Certification for the Town of Courtland

As discussed in Section 5.2.2, the proposed ring levee would follow the alignment shown in Figure 5-13, with a 20 ft. crown width, 3H:1V landside and waterside slopes, and levee crest elevation of 19 feet, assuming design WSEL of 16 feet NAVD 88 and 3 feet of freeboard. Note that the levee crest elevation of 19 feet was developed assuming a relief cut would be executed within the basin. The maximum crown elevation would need to be 5 to 6 feet higher if a relief cut were not employed in the basin.

7.1.6 Management Action 6: Repair and Strengthen-in-Place SPFC Levees Only - Including Multi-Benefit of Improving Reliability and Resiliency of Through-Delta Water Conveyance System

As described in Section 5.1.2.2, remedial alternatives to repair and strengthen the entire 8.6 miles of SPFC levee along the left bank of the Sacramento River include cutoff walls ranging from 20 to 115 feet deep; or a set of stability- or combination seepage-stability berms ranging from 15 to 85 feet wide.

7.2 Stakeholder and Public Input on Structural-Based Management Actions and Non-Structural Flood Risk Reduction Measures

The recommended suite of six MAs was informed by stakeholder and public feedback received following preparation of the draft feasibility study report in November 2020. Stakeholders and the public expressed the greatest support for repairing the weakest links in the perimeter levee system(s) of the Courtland study area (MAs 1, 2, and 3) and repairing and strengthening the entire 8.6 miles of SPFC levees along the left bank of the Sacramento River (MA 6) due to the multi-benefit component of improving both the water conveyance system and the flood control system.

Of the remaining MAs consisting of a ring levee and an all-weather access road/flood fight berm, the all-weather access road is more favorable to locals. Though not a preferred alternative by RDs 551/755, this non-structural MA is relatively low in cost ($5.3M) in comparison to other recommended MAs and would protect the community of Courtland from potential flood waters originating outside of the community. As a result, this feasibility study recommends this MA (absent implementation of MA 6) for future implementation by the community of Courtland, though RD 551/755 have noted that they would not lead the efforts needed for design, construction, operation, and maintenance.

The ring levee (MA 5) is not a preferred MA for locals or other key stakeholders including RD 551/755. While not supported as a preferred MA, a ring levee around the community of Courtland paired with repairing and strengthening the levee fronting the community is ultimately recommended for future implementation (without MA 6) since it is a lower cost solution to

DRAFT

reducing the risk to life loss, property damage, and the probability of levee failure, and it would help limit high, escalating insurance premiums by securing FEMA accreditation for the community.

See Appendix K for further details in support of the multi-benefit opportunities associated with MA 6 identified by the Sacramento County Delta Legacy Communities associated with reducing flood risks combined with improving SWP water conveyance through the Delta.

7.3 Non-Structural Measures Recommended for Implementation

Out of the full suite of 15 non-structural measures described in detail in Appendix H, and further discussed in Section 5.2: Non-Structural Measures, an all-weather access road/flood fight-berm (or a ring levee as an alternative) is included as part of the recommended structural-related MAs discussed in the previous Section.

The following non-structural measures identified and numbered as follows in Appendix H, are recommended to be carried forward to reduce flood risks within the Courtland study area include the following:

1. Flood Fight Berm or a Ring Levee System
2. Voluntary Elevations of Structures
3. Wet or Dry Floodproofing
4. Flood Emergency Safety Plans
5. Sacramento County OES Decision Support Tool
6. LHMP and Relief Cuts
7. Alternatives to FEMA NFIP – Private, Community-Based Flood Insurance
8. NFIP Flood Insurance Enhancements *via* AFOTF
9. Mokelumne River Conveyance Improvements & Staten Island Overflow Area
10. Improve FEMA CRS Score for Sacramento County/Isleton
11. Land Use Regulations and Limitations
12. Improved Governance Between Neighboring LMAs/RDs
13. SWIFs & Period Inspections with USACE
14. Public Education/Public Awareness

The only Non-Structural Measure previously identified, but not carried forward is Acquisitions and Relocations (Item No. 4 in : Identification of Non-Structural Elements for the Communities of Hood, Courtland, Locke, East Walnut Grove, and West Walnut Grove & Ryde Flood Risk Reduction Feasibility Studies). This item was not carried forward at the request of the Courtland Planning Committee. Also, relocating entire communities within the Delta, particularly Delta

DRAFT

Legacy Communities such as Courtland, is inconsistent with the goals and objectives of both the Delta Plan and the SSJDNHA designation.

The recommended suite of the key non-structural measures and timeline status are summarized below. Of these, a portion are currently ongoing within the Courtland study area, with the remaining recommended for implementation in the near-term and long-term as summarized in

Table 7-1. Associated recommendations, as applicable, are summarized below Table 7-1.

Table 7-1. Recommended Timeline for Implementation of Non-Structural Measures

Non-Structural Measure	Ongoing	Recommended: Near Term	Recommended: Long Term
Voluntary Structural Elevation		X	X
Wet or Dry Floodproofing		X	X
Flood Emergency Safety Plans	X	X	X
Sacramento County OES Decision Support Tool	X	X	X
LHMP and Relief Cuts		X	X
Alternatives to NFIP – Community and Flood-Risk Based Insurance Program		X	X
NFIP Flood Insurance Enhancements *via* AFOTF		X	X
Mokelumne River Conveyance Improvements/Flood Easements			X
Improve FEMA CRS for Sacramento County	X	X	
Improved Governance between Neighboring LMAs/RDs & Community		X	X
SWIFs & Periodic Inspections with USACE		X	X
Public Education and Awareness	X	X	X

Below are brief descriptions of each of the non-structural measures that are proposed for implementation, most of which have been previously described in Appendix H, and above in Section 5.2.

7.3.1 Voluntary Elevation of Structures

It is recommended that voluntary raising of structures, on a case-by-case basis, be carried forward as a non-structural solution for reducing flood risks within the Courtland study area. The county should continue to encourage residential and business owners to participate in the voluntary raising of structures by offering potential cost-sharing incentives (50 percent or greater cost share reductions) available through federal and State cost-sharing programs.

DRAFT

As described previously, there are a total of 148 structures clustered in the community of Courtland, and an additional 320 structures located in the balance of RDs 755 and 551 for a total count of 468 structures in the entire study area of Courtland. As previously presented in Table 5-6 in Non-Structural Measures, this represents a cost of at least $25M to elevate all of the structures within the community of Courtland, and at least $80M to elevate all of the structures within the greater study are that is including all Courtland and RDs 551 and 755 combined. Note that this cost could be greater when assuming commercial, industrial, and public buildings may be more costly to elevate than single family residential structures.

The cost to raise all structures to these heights may be feasible with federal and State participation but may not be desirable for the entire community. However, elevating structures is encouraged on a case-by-case basis wherever feasible with federal and State assistance. This non-structural solution would need to be voluntary for residential structures as expressed during public outreach meetings, but it could be mandatory for essential, critical facilities in the event the preferred MAs are not fully implemented. This element is recommended for implementation, on a case-by-case basis, in the long term.

7.3.2 Wet or Dry Floodproofing

Please *refer to* Section 5.2: Non-Structural Measures for a more detailed description of this non-structural measure that would be voluntary in nature by individual homeowners and business owners, similar to voluntary elevation of structures. Similar to elevating structures, wet or dry floodproofing would be done a case-by-case-basis and could be implemented during the short- and long-term.

7.3.3 Improved Emergency Response

RDs 551 and 755 are currently utilizing the DWR Delta Flood Emergency Response Grant Round 2 funding to update their Delta Flood ESPs. RDs 551 and 755 are the grantees within the funding agreement which covers plan updates for several other RDs in Sacramento County.

The intent is for the ESPs to be consistent with AB 156, FEMA's Comprehensive Preparedness Guide 101, and regional formatting standards. This includes the development of supporting annexes, namely a flood-specific annex that details the RDs' field response operations. The written flood annex will be transferred to a Flood Contingency Map annex that is quick to access and easy to interpret during an emergency.

The ESPs will also be reviewed for consistency with SEMS and National Incident Management System standards such as appointing an incident commander, assigning specific response actions to objective conditions, and emergency spending authorities. The Emergency Operation Plan's (EOP) format will also be updated to be consistent with regional standards (San Joaquin, Yolo, and Solano County Flood ESPs).

DRAFT

Additional district specific enhancement will include: identifying the gauges listed in the already-developed EOPs that need datum conversions to NAVD 88 (in order to meet grant requirements); identifying any other critical infrastructure and elevations (pump stations, etc.); and evaluating the feasibility of a relief cut(s) where appropriate, with a brief technical memorandum summarizing the conditions in which a relief cut may be a feasible option (*see* Local Hazard Mitigation Plan and Relief Cuts, below for more information).

Coordination on the plan update began in September 2020 and the final plan update is scheduled for completion before the end of 2021.

It is recommended that the Delta Flood ESPs for RDs 551 and 755 be updated every 5 years and/or as needed.

7.3.4 Local Hazard Mitigation Plan and Relief Cuts

Sacramento County began public outreach to update the 2016 LHMP in 2020. The next 5-year update to the LHMP is planned to be complete by the end of 2021. As part of this update, Sacramento County has the opportunity to reevaluate the impacts of flooding and levee failure to the people and assets of the Sacramento County planning area, including RDs 551 and 755, and to establish updated goals and prioritize projects to reduce these impacts on people and property within RDs 551 and 755. It is recommended that Sacramento County continue to update the LHMP every 5 years.

Relief cuts properly executed in the study area could result in a reduction in flood depths in excess of 4 feet If the RDs are willing, as previously noted, the updated LHMP may be a place to formalize relief cuts. As discussed above, Sacramento County RDs will be updating their ESPs and are looking at incorporating a relief cut if feasible. Preliminary relief cut evaluations for the RD 551 and 755 basins has shown that a relief cut would be of greatest value if deployed within the non-SPFC levee segment closest to the RD 551 drainage pumping station, opposite Zacharias Island. However, a relief cut at or near this location would have to be carefully planned with water metered out at controlled rates to not adversely impact high stages that may co-exist in the Mokelumne River – Snodgrass Slough – Franklin Pond areas in concert with the Delta Cross Channel Gates being either closed or opened. A default relief cut already exists close to elevation 19.0 NAVD 88 where the Lambert Road depression exits through a depression in the RD 551 Borrow Cut levee just north of Snodgrass Slough. Another optional location for a relief cut may be near the downstream end of NULE Segment 126 along the Sacramento River, upstream of RD 551's cross levee adjacent to downstream RD 369 – Libby McNeil. However, a relief cut at this location may not be very beneficial if there is not a large gradient drop in the Sacramento River stages along the study area between Courtland and Locke.

DRAFT

7.3.5 Alternatives to NFIP – Community and Flood-Risk Based Insurance Program

Please *refer to* Section 5.2: Non-Structural Measures for a more detailed description of this non-structural measure of a community-based flood insurance program that has been recommended for implementation for the short- and long-term as a viable supplement and/or alternative to FEMA's current NFIP.

Courtland and other Delta legacy Communities might choose to implement a community-based flood insurance program through the establishment of a HOA or a GHAD. A GHAD is a State-level public agency for the purpose of providing prevention, rapid response, and funding to address hazardous geologic conditions. They were established in 1979 by the Beverly Act to allow local residents to develop self-funding mechanisms that address the long-term abatement and maintenance of structures that protect real property from geologic hazards.

The city of Isleton has already taken the initial steps in June-July of 2021 to formalize a path for property owners within its city limits to aggregate their resources and establish a community-based flood insurance program that can be used to augment and/or replace the current set of NFIP policies held within the city of Isleton. The county is also encouraging the unincorporated North Delta Legacy of Courtland to consider alternatives to the current NFIP, including a community-based flood insurance program that could be administered with or without developing a GHAD (for further details *see* : Community-Based Flood Insurance Technical Memorandum largely prepared by Kathleen Schaefer, P.E., CFM, former FEMA regional administrator of NFIP).

7.3.6 NFIP Flood Insurance Enhancements via AFOTF

Please *refer to* Section 5.2: Non-Structural Measures, for a more detailed description of this non-structural measure that is an ongoing, long-term non-structural measure that could be beneficial to all unincorporated, agriculturally-based areas within Sacramento County including the community of Courtland.

This non-structural measure developed by the Agricultural Floodplain Ordinance Task Force (AFOTF) *via* its Technical Memorandum of December 28, 2016, has recommended as many as seven administrative refinements of the NFIP to sustain agriculture as a wise use of the floodplain in leveed SFHAs. The seven administrative refinements listed below are consistent with other non-structural measures that have been recommended for implementation. The key elements include the following, of which are applicable to the agricultural-based community of Courtland and the surrounding study area within RDs 551 and 755:

a) Levee relief cuts with emergency operation plans and floodplain management ordinance

DRAFT

b) Zone X for certified levee reaches: The partial accreditation of a basin or levee reach could potentially lead to lower NFIP insurance rates as portions of levee systems are approved

c) Wet floodproofing rules for agricultural structures

d) Insurance rates for nonaccredited levees: The AFOTF recommends that FEMA use sound actuarial science to amend its insurance rates to reflect flood protection provided by a non-accredited levee as documented by a civil engineer

e) Insurance rates for agricultural structures

f) Insurance rates for wet floodproofed structures

g) Add levee risk management activities to FEMA CRS

7.3.7 Mokelumne River Conveyance Improvements and Flood Easements

Please *refer to* Section 5.2: Non-Structural Measures, for a more detailed description of this non-structural measure that is a long-term non-structural measure that may have flood stage reduction benefits to community of Courtland by potentially lowering flood stage levels along Snodgrass Slough located southeasterly of Courtland.

The documents referenced in Item 9 of : Identification of Non-Structural Elements for the Communities of Hood, Courtland, Locke, East Walnut Grove, and West Walnut Grove & Ryde Flood Risk Reduction Feasibility Studies strongly suggest improving channel capacity in the Mokelumne River on either side of Staten Island and/or securing flood easements on Staten Island to accept excess flood waters would significantly reduce flood stages upstream in Snodgrass Sough for the nearby communities of East Walnut Grove, Locke and possibly as far upstream as Courtland and Hood.

A regional solution for reducing flood stages in the North and South Forks of the Mokelumne River would be beneficial to lower flood stages in nearby Snodgrass Slough and the Franklin Pond, Point Pleasant area and the Cosumnes River, all of which are impacted by high flood stages downstream on the Mokelumne River on either side of Staten Island.

7.3.8 Improve FEMA Community Rating System Score

Please *refer to* Section 5.2: Non-Structural Measures for a more detailed description of this non-structural measure that is an ongoing, long-term non-structural measure that has been beneficial to all unincorporated areas within Sacramento County including the community of Courtland.

Sacramento County, *via* its floodplain administrator program, is a very active participant of the NFIP, and through its county-wide Flood Protection Ordinance the county strives to reduce flood risks throughout the unincorporated areas of Sacramento County while also attempting to reduce NFIP premium policy rates. Through different flood mitigation activities outlined within the NFIP, Sacramento County has been able to reduce flood insurance through the FEMA CRS. The

DRAFT

county currently has the opportunity to improve their CRS score to achieve the highest possible Class 1 designation by implementing and participating in Emergency Action Plans (EAPs) and associated Table Top Exercises for nearby, upstream dams/reservoirs (namely Folsom Reservoir, and possibly others) that could have a sizeable impact on flooding portions of Sacramento County if said reservoir(s) were to fail and cause flooding. This last jump from a CRS Class 2 to Class l designation would result in the last available 5 percent decrease (from 40 to 45%) in NFIP premiums and would place Sacramento County as the 2nd highest ranked CRS community in the entire United States behind Placer County.

7.3.9 Improved Governance between Neighboring LMAs/RDs and Community

Please *refer to* Section 5.2: Non-Structural Measures, for a more detailed description of this non-structural measure that is a long-term non-structural measure that could be beneficial to not only the community of Courtland, but also the combined Reclamation Districts, namely RD 551-Pearson District and RD 755 – Randall Island coming together and potentially working with the CTA).

To improve economies of scale between the two adjoining RDs, the two Districts are contemplating merging their forces together (personnel, consultants, and equipment) to streamline costs and collaborate on reducing flood risks within the adjoining basins, including joining forces to work with DWR in repairing the known critical and serious sites identified within RD 755 under DWR's FSRP. The two noted Districts have also joined forces with other neighboring Districts in developing a NOI to file a SWIF application with the CVFPB and the USACE. The SWIF assesses deficiencies and prioritizes levee repairs along the left bank of the Sacramento River, including the SPFC levee segments that provide protection to the communities of Courtland, Locke and East Walnut Grove.

Due to assessment limitations imposed by the California Water Code, RD 551 and other similar RDs are limited to assessing properties within their District(s) by acreage and not by property improvements. Thus, it may be advantageous for the RDs and the CTA to work closer together in potentially developing an improved assessment or a GHAD for implementing flood risk reduction measures specific to the community. Framework exists for community-specific assessments similar to the county assessments that are in place for regional sanitation services, water supply and storm drainage services that are provided by the county and/or others beyond those provided by RDs 551 and 755.

7.3.10 Public Education and Awareness

Please *refer to* Section 5.2: Non-Structural Measures and Appendix H for a more detailed description of this non-structural measure that includes three ongoing public education and awareness programs for the Delta Legacy Communities. The noted public education/awareness programs are administered by: (1) the DPC *via* their Delta Flood Preparedness Week hosted each

DRAFT

fall season prior to the beginning of each flood season; (2) the Sacramento County Program for Public Information increases flood awareness through informational materials (such as the Storm Ready Booklets) and multiple levels of outreach, ranging from radio spots to specific stakeholder engagement; and (3) the DWR Flood Risk Notification Program that includes sending annual notices in advance of the flood season to every property owner who is located behind a SPFC levee within the Delta. The individual notices include the property owner's address and informs the owners their property may be exposed to potential flood risk from the failure of the levee system. The DWR also suggests each property owner visit DWR's Flood Risk Notification and enter their address to get the most information on State-federal levees in their area.[1]

These programs all act as an ongoing, long-term conduit of flood risk information and coordination directly with the community members of Courtland and other nearby Delta Legacy Communities protected by a combination of SPFC and non-SPFC levees.

7.4 Right-of-Way and Easement Considerations/Recommendations

Local preference and planning guidelines in the Delta encourage retention of agricultural lands as much as possible; and the Delta Plan encourages preservation of agricultural land and uses *versus* displacement for commercial or residential uses. The structural-based MA components that could conflict with existing, regional regulations of preserving agricultural lands in the Delta could be those that include seepage/stability berms and possibly the access road/flood-fight berm and/or ring levee system as noted above in Section 6.3.2.1. Table 6-7 in Section 6.3.2.1 provides a summary of each structural-based MA and the corresponding acreage of agricultural lands that may be displaced with either a seepage/stability or combination berms, or with an access road/flood-fight berm or a ring levee system.

If the final configuration of structural-based MAs would displace or affect a substantial acreage of important farmland of regional and statewide significance within the study area it may be deemed inconsistent with the Delta Plan and policies as administered by the DSC and DPC. It should be noted any major construction activity within the Delta would be considered a "Covered Action" under the Delta Reform Act of 2009 within Delta and the CEQA lead agency would be required to submit a written certification of consistency with detailed findings as to whether the covered action is consistent with the Delta Plan. Any person who claims that a proposed "Covered Action" is inconsistent with the Delta Plan may appeal a certification of consistency to the Council. (Calif. Water Code, § 85225.10).

It should be noted that most landowners in the study area adjoining the existing SPFC and non-SPFC levee systems actually own fee-title land under the levee prism and up to the ordinary high water mark on the water-side of the levee to maintain their riparian water rights to the Sacramento River and adjoining sloughs. The State and the Sacramento-San Joaquin drainage district retain easements for the SPFC levees; and Caltrans and Sacramento County also retain

[1] http://water.ca.gov/myfloodrisk

DRAFT

easements in most locations (*vs*. fee title) where highway and or roadway are overlain on the top of the levee crowns.

Right-of-way (ROW) acquisition quantities were estimated for the multitude of structural-based MAs (*see* Appendix F). In addition to determining costs for acquiring fee title or dedicated easements for various MAs, estimates were also developed for any temporary roadways to divert traffic. ROW was estimated based on review of aerial photography of existing land use and visual ground-truthing to confirm some of the different agricultural uses. ROW acquisition costs as summarized below in Table 7-2 only accounts for the required alignment and doesn't include purchase of full parcels.

The impact of known utilities to be relocated is considered minimal to the larger scope of the project. Unidentified utility relocations are assumed part of the allowance for unlisted items costs. Costs do not include removal and relocation of any existing structure on the landside of the levee, including but not limited to pump stations, residences, etc. The impact of utility crossings on the stability of the levee foundation, embankments and refinements to associated costs for mitigation and / or relocation of these crossings will need to be considered during the project design phase.

Table 7-2: Permanent Right-of-Way Cost Estimates per Acre and Structure

Right-of-Way (fee title) & Structures	Unit	Unit Cost
Permanent Right-of Way (fee title) - Seasonal Agricultural Field/ Row Crops	AC	$25,000
Permanent Right-of Way (fee title) - Orchard/ Vineyard	AC	$40,000
Permanent Right-of Way (fee title) - Commercial/ Industrial	AC	$240,000
Permanent Right-of Way (fee title) - Residential	AC	$180,000
Residential structures	Ea	$250,000
Other structures	Ea	$75,000

7.5 OMRR&R Considerations

O&M is the traditional term used to describe the routine activities necessary for a functioning flood management system. OMRR&R is a more recently developed term used to describe and include the comprehensive set of non-routine activities that realistically need to occur for the system, and also includes rehabilitation, repair, and replacement.

LMA activities are guided, in part, by O&M manuals developed by the USACE in the mid-1950s and associated hydraulic design criteria. The original project assurances provided to the federal government in the 1950s make no mention of repair, rehabilitation, and replacement (RR&R). The term was first introduced in the Water Resources Development Act of 1986. Responsibility for the RR&R of SPFC facilities is not widely agreed upon across agencies. As the responsibility for portions of OMRR&R has shifted, funding issues have become more pronounced, requiring

DRAFT

additional interpretation of SPFC assurance agreements, O&M manuals, and governing codes and regulations. Accordingly, interpretations of responsibility and necessary funding can differ.

LMAs are not only faced with insufficient funding to conduct the activities needed to maintain and operate SPFC facilities, but they are also working under conditions, design standards, and environmental regulations that have changed since the flood infrastructure was constructed. These changes have complicated OMRR&R and affected the ability to perform necessary activities needed to ensure a fully functioning flood system. Historically, this was not a major issue because federal programs, including PL 84-99 administered by USACE, were relied on to fund necessary repairs associated with damages from significant flood events. However, federal funding is becoming more difficult to obtain and eligibility requirements for post-event assistance through PL 84-99 are becoming increasingly more difficult to meet.

As part of the 2017 CVFPP Update, DWR prepared an OMRR&R cost estimate to account for more stringent USACE O&M standards, additional USACE RR&R responsibilities, increasing mitigation costs, and correcting original system design deficiencies. In the technical memorandum, the State communicates that although the State may provide investment in levees, the responsibility for maintenance lies with LMAs. To support the continued increase in O&M and additional burden of RR&R responsibilities, an assessment will likely be necessary.

The most recent 5-year average of subventions claims that cover RD 551's O&M has been approximately $112,000 for the existing SPFCA and non-SPFC levee system(s) totaling approximately miles 14.1 miles for a significant portion of the Courtland study area (excluding RD 755). This will likely increase with implementation of the SWIF with the USACE.

OMRR&R costs in the Courtland Study Area will also increase in connection with the implementation and OMRR&R of an access road/flood-fight berm (MA 4) or a ring levee system around the Community (MA 5). These are MAs that RD 551 will not likely pursue unless there is large support and financial assistance from the community beneficiaries, namely the residences and business owners of the Courtland community. The community will need to conduct a benefit assessment for not only the implementation and construction of either perimeter system around the community but also for the long-term OMRR&R of any community perimeter flood defense system. The community beneficiaries of said perimeter system may not be the likely candidate to perform the OMRR&R, but they need to be prepared to compensate RD 551 (or another applicable O&M entity) for any incremental cost of OMRR&R over and above what RD 551 may incur without the added presence of either an access road/flood-fight berm or potential ring levee system.

No new substantial OMRR&R cost are anticipated by either RD 551 and 551 with the implementation of MAs 1 through 3 associated with repairing the known FSRP critical and serious sites, addressing known erosion sites and concerns within the RDs, and strengthening-in-place the existing levee system immediately adjacent to the community.

DRAFT

Repairing and strengthening-in place the entire 8.6-miles of the SPFC levee system in RDs 551 and 755, including addressing any non-compliant encroachments, along the left bank of the Sacramento River (MA 6 containing multiple benefits) will not likely increase OMRR&R costs for said RDs.

7.6 Regulatory Requirements

Environmental requirements associated with implementation of the preferred MA would include preparation of a CEQA/NEPA document, permits, endangered species consultations, Tribal consultation, and cultural resource assessments and consultations.

The level of CEQA/NEPA documentation required for the preferred structural-based MAs is dependent on many factors, including the project extent and severity of associated environmental impacts including biological and cultural resources, and air quality and greenhouse gas emissions. Under CEQA, if all impacts can be avoided or mitigated for, then a Mitigated Negative Declaration would suffice for the project. However, in areas where extensive habitat or air quality impacts are unavoidable, then an EIR would need to be prepared. More extensive CEQA documentation would result in a higher cost for analysis and preparation. The required level of NEPA documentation generally follows CEQA, but in certain instances, a less extensive analysis may be appropriate, depending on the lead federal agency.

Permits such as Clean Water Act Section 404 and 401 permits, approvals under the federal Endangered Species Act and California Endangered Species Act, and a Streambed Alteration Agreement from the CDFW (Section 1600 permit) will be needed, depending on what levee elevation is affected (if work is below Mean High Water or Ordinary High Water) and if upland work is conducted in sensitive areas. Prior to beginning the regulatory process for implementation of a proposed element, the following studies would be needed: a wetland delineation of the study area in accordance with the 1987 USACE Wetland Delineation Manual and Sacramento District standards, and focused habitat classification and assessments to determine the potential impacts of the project on special-status species. Conducting the delineation and focused surveys incurs a cost as may any avoidance or minimization measures that may need to be incorporated into project design. Additionally, mitigation for unavoidable effects to sensitive vegetation and wildlife would likely incur a cost associated with on-site or off-site mitigation.

RDs 551 and 755 currently conduct some maintenance activities (repairs affecting up to 100 ft. of levee) under a Routine Maintenance Agreement (RMA) with CDFW. The RMA covers maintenance activities for 5 years from the date of issuance, but can often be extended indefinitely, with periodic “touch-up” biological surveys. Depending on project activities, this agreement may be used or a separate 1600 may be required from CDFW. There are several CDFW staff familiar with project activities common to Delta levees maintenance and repairs covered under the Subventions program, and this helps with timely project permitting and implementation. Due to the presence of several threatened and endangered aquatic species in the

DRAFT

Delta it should be noted that most all waterside work on the levees in the Delta is largely limited to the short 90-day disturbance period of August 1 through October 31.

As described previously, a total of 27 resources were identified during the records search and from information provided by the county of Sacramento. The majority of these have not been formally evaluated for their eligibility for listing in either the NRHP or CRHR. Many of the identified resources are along the Sacramento River levee and within the community of Courtland, and therefore near to elements of the proposed MAs, including remediation of levees along the Sacramento River and the flood fight access road and berm. Further evaluation of these resources, including cultural and historical resources, would need to be conducted to inform final project design and implementation. *See* Appendix C for additional information on cultural resources within the study area.

In addition to complying with environmental regulations, any geotechnical investigations, and subsequent modifications on or within 15 feet landward of any SPFC levee system will require a USACE Section 408 permit approval initiated by the local sponsor through the CVFPB. The sponsor's application, must be developed by the local LMA or RD prior to submittal to the CVFPB. Upon receipt by the CVFPB it can take 90 to 120 days to receive approval and a mandatory endorsement by the CVFPB prior to their submittal to the USACE. Upon receipt of the Section 408 application by the USACE it can take at times up to 18 months or more to issue the Section 408 approval. Thus, it may take up to two years for the local sponsor to gain Section 408 approval after submitting an application to the CVFPB.

7.7 Federal, State and Local Funding Sources and Financial Strategies

The potential federal, State, and local funding sources for the flood risk reduction MAs and non-structural measures identified for the Delta Legacy of Courtland identified below in Sections 7.7.1 through 7.7.3 are largely excerpted and updated from the suite of funding sources previously identified in the 2014 Lower Sacramento/Delta North RFMP and the 2017 CVFPP Update. One new additional key federal funding source is FEMA's Building Resilient Infrastructure and Communities (BRIC) program that can channel competitive funds to the small Delta Legacy Communities through Cal OES for both structural and non-structural flood risk reduction measures.

7.7.1 Federal Funding Sources

The process for garnering federal funding for flood risk reduction projects requires that a federal interest in the project be identified. Federal interest has generally been identified and evaluated within feasibility studies prepared by the USACE, which evaluate various criteria and generally emphasize the flood damage-reduction benefits typically associated with larger urban area projects. Unfortunately, the small communities and rural areas generally lack the necessary flood risk reduction benefits alone to justify a significant federal interest, unless there are sizeable

DRAFT

multi-objectives/benefits that can also be attached to the smaller benefits normally associated with small, rural communities. One sizeable multi-benefit component that has been identified in most all of the Sacramento County Delta Legacy communities is repairing and strengthening-in-place the SPFC levee system along the Sacramento River. Courtland's structural-based MA 6 of improving the SPFC levee reaches for the entire Courtland study area will also improve the reliability and resiliency of the through-Delta conveyance of SWP and CVP water through the Delta.

Given the constrains of the current approach for evaluating and garnering federal investment for stand-alone flood risk reduction projects, coupled with constrained federal budgets, it may be difficult to secure significant federal investment in the region through the USACE. Furthermore, the evaluation, project identification and appropriation process for USACE projects can be protracted, expensive and can lead to higher project costs that may, in some cases, not be in the best economic interest of local project proponents.

Greater opportunities for federal funding may exist via FEMA's emerging BRIC program that can channel competitive funds to small communities through Cal OES. FEMA's BRIC program supports flood risk reduction programs and projects for small, rural communities with smaller, local cost-sharing requirements, particularly for disadvantaged communities. It also enables large multi-benefit infrastructure projects that could possibly be combined with reducing flood risks in the noted North Delta Legacy Communities, including the benefit of improving the long-term reliability and resiliency of through-Delta conveyance of SWP and CVP water through the Delta adjoining the communities. This is particularly applicable for the federal- and State-authorized SPFC levee system in the North Delta adjoining the chain of six Delta Communities, namely Hood, Courtland, Locke, Walnut Grove (East and West) directly adjacent to the Sacramento River SPFC levee system, and the city of Isleton adjacent to the Georgiana Slough SPFC levee system.

Table 7-3 provides a summary of potential federal funding sources to fund both structural-based management improvements and non-structural flood risk reduction measures. The table outlines the general uses of the funding source and the attributes and applicability of the mechanism for flood management.

DRAFT

Table 7-3: Potential Federal Funding Programs

Agency	Program Name (Acronym)	Program Summary	Status	Who is Eligible to Apply	Cost Share Range
FEMA	Building Resilient Infrastructure and Communities (BRIC)	The BRIC program supports hazard mitigation projects, reducing the risks faced from disasters and natural hazards. (Approximately $919M available for local projects spread across entire nation for fiscal year 2021)	Relatively New	Federally Recognized Native American Tribes, State governments; City or township governments, County governments via Cal OES	Varies 75%-90% Highest for small disadvantaged communities (DACs)
FEMA	Flood Mitigation Assistance (FMA)	The FMA grant program provides funding to reduce or eliminate the risk of repetitive flood damage to buildings and structures insurable under the National Flood Insurance Program (NFIP).	Ongoing	Federally Recognized Native American Tribes, State governments; City or township governments, County governments via Cal OES	Varies 75%-100%
FEMA	Pre-Disaster Mitigation (PDM)	The PDM Grant Program is designed to implement a sustained pre-disaster natural hazard mitigation program to reduce overall risk from future hazard events, while also reducing reliance on federal funding from future disasters.	Ongoing	Federally Recognized Native American Tribes, State governments; City or township governments, County governments via Cal OES	75% 90% for small disadvantaged communities (DACs)
USACE/State	USACE/CVFPB Feasibility Studies (USACE FS)	A feasibility report is developed to identify the recommended plan: project scope, economic benefit, and an accurate cost and schedule baseline identified with potential project risks.	Ongoing	CVFPB with a local Sponsor	50% USACE, 50% State and Locals Split
USACE/State	USACE/CVFPB Civil Works Projects (USACE CW)	Upon completion of a USACE feasibility study a Chief's Report is provided to congress. If the Chief's Report is authorized by Congress a local agency can advance a project with the USACE upon securing federal appropriations.	Ongoing	CVFPB with a local Sponsor, 25%	35% Split between CVFPB and local Sponsor
USACE	Sacramento River Bank Protection Project (SRBPP)	The Sacramento River Bank Protection Project is a long-term flood risk management project designed to enhance public safety and help protect property along the Sacramento River and its tributaries.	Phasing Out	Project Levees authorized in the SRFCP	0%

DRAFT

7.7.2 State Funding Sources

In the near term, the State plans to utilize the remaining Proposition 1E bonds authorized to fund projects consistent with the CVFPP last adopted in July 2017 and being updated at 5-year intervals with the next update scheduled for 2022. Within the latest 2017 CVFPP updates, the State identified remaining Proposition 1E and 84 bond funds were not sufficient to meet all of the flood protection goals and identified an ongoing need for flood risk reduction within the Central Valley. Additional bond authorizations and greater utilization of State general funds will be needed to meet the goals identified in the CVFPP, particularly for the SCFRRP flood risk reduction components. The SCFRRP component measures for the entire CVFPP study area were estimated between $1.5B to $1.9B in the 2017 CVFPP update for the Sacramento Basin alone compared to only $310M to $370M for the San Joaquin Basin. The State Legislature will need to play a significant role, with respect to how State and local funding can be generated particularly within the Delta region, as it considers legislation associated with planned updates to the CVFPP and the associated financing/funding plan recommendations.

Below is an abbreviated excerpt from Section 3.13.1 of California's Flood Future Report of November 2013 that suggests levee improvements in the Delta should be orchestrated with improving the conveyance of SWP and CVP water through the Delta to areas south of the Delta where water demands are significantly greater than available water supplies south of the Delta.

> "The Sacramento-San Joaquin Delta provides a major source of water supply to more than 60 percent of California residents and is a vital source of water supply for agriculture. The Delta is a unique place defined by its ecological value as the transitional ecosystem from fresh to salt water and by its extensive levee system *(including SPFC levees in the north Delta and several non-SPFC levees in the central and south Delta that convey water to the SWP and CVP pumps in the south Delta)*. The Delta consists of approximately 70 major islands and tracts encompassing approximately 700,000 acres located behind levees. Virtually all assets and attributes of the Delta are dependent upon this large levee system. The levees reduce flood risk to land areas near and below sea level and provide for a network of channels that direct movement of *(SWP and CVP)* water across the Delta. The State of California has significant interest in the benefits provided by Delta levees, which have been legislated in the California Water Code (§ 12981, for example).
>
> The Delta is unique, not only as a levee system but also as an influence on existing DWR flood management programs within the Delta. The Delta is a prime example of why Integrated Water Management (IWM) is important in California. Due to its location, importance for much of California's water supply, deteriorating ecosystem conditions, questions about levee integrity and feasibility for improvements, and other issues, flood management cannot be considered in isolation of other resource needs. The importance of the Delta and its levees to the State has been included many times in legislation and codes. In addition, multiple federal and State processes are underway to solve a variety of resource management problems in the Delta, and several include consideration of levee improvements or other flood management actions. These plans, *including the DCA's current efforts that consider a single-purpose isolated conveyance facility* and the Delta Stewardship Council (DSC) Delta Plan, *may* alter Delta conditions and will influence the future of IWM in the Delta. Implementation of these programs would alter ecosystem conditions and water

DRAFT

infrastructure, which would influence Delta flood risk; therefore, flood management in the Delta needs to be considered as part of these larger planning efforts."

Given the above perspective within California's Flood Future Report there should be a larger financial interest in reducing flood risks in Delta by the USACE, USBR, FEMA, DWR, CVFPB, and Delta water users south of the Delta. This holds true particularly for improving the SPFC levees in the subject north Delta Legacy Community study areas adjoining the SWP and CVP freshwater conveyance corridor along the Sacramento River upstream of the Delta Cross channel, and portions of both Snodgrass and Georgiana Sloughs immediately downstream of the Delta Cross Channel.

Other policy efforts that could potentially generate future State funding include the recommendations presented within the current Governor's Water Resiliency Portfolio Water Action Plan. These recommendations include providing support and expanding funding for Integrated Water Management Planning and Projects, creating incentives for multi-benefit projects, providing assistance to disadvantaged communities, and prioritizing funding to reduce flood risk and improve flood response. In addition to recommendations that could direct State funding to the region, the former Governor's Water Action Plan also identified recommendations that could make it easier to generate local funding including removing barriers to local and regional funding for water projects. One of the key concepts in the Water Action Plan called for the development of a water financing strategy that leverages various sources of water-related project funding and proposes options for eliminating funding barriers, including barriers to co-funding multi-benefit projects.

Table 7-4 provides a summary of potential State funding sources applicable to Delta Legacy Communities protected by SPFC levees. The State funding programs can fund both structural-based management improvements and non-structural flood risk reduction measures. The table outlines the general uses of the funding source and the attributes and applicability of the mechanism for flood management.

DRAFT

Table 7-4: Potential State Funding Programs

Agency	Program Name (Acronym)	Program Summary	Status	Who is Eligible to Apply	Cost Share Range
State DWR	Delta Special Projects	Cost share grant program for levee maintaining agencies in the Delta to rehabilitate non-SPFC and eligible SPFC levees.	Ongoing	LMA's within the Primary and Secondary Zones of the Legal Delta and limited areas within the Suisun Marsh.	75 to 95% Up to 100% for Habitat Projects
State DWR	Delta Levees Subventions	Cost share program for the maintenance and rehabilitation of non-SPFC and eligible SPFC levees in the Delta.	Ongoing	LMA's within the Primary and Secondary Zones of the Legal Delta.	Up to 75%
State DWR	Flood System Repair Projects (FSRP)	Evaluate (feasibility), design, and construct repairs of non-urban SPFC Facility (levees, channels, structures, etc.) deficiencies	Phasing Out	Eligible applications are local public agencies or Joint Powers Authority	50 to 90%
State DWR	Small Community Flood Risk Reduction Program (SCFRRP)	Projects to reduce flood risk in small, rural, and agricultural communities in the Central Valley. Funds support non-routine O&M, O&M plan updates, evaluations, feasibility studies, design, and construction of proactive repairs to flood control facilities of the SPFC and appurtenant non-SPFC levees.	Current	Local agencies: evaluate SPFC facilities must protect small and rural communities in the Central Valley designated by the CVFPP to have a High or Moderate-High Flood Threat Level.	50 to 90%
State-California Natural Resource Agency	California River Parkways Program	The Proposition 50 California River Parkways Grant Program in the Resources Agency is a competitive grant program for river parkways projects.	Ongoing	Public Agencies and California Nonprofit Organizations	50 to 90%
State DWR	Proposition 68	Proposition 68 authorizes $4.1 billion for State and local parks, natural resources protection, climate adaptation, water quality, and flood protection.	Ongoing	Public agencies, non-profit organizations, public utilities, Native American Tribes, and mutual water companies	50% Up to 100% for DACs
State DWR	Flood Maintenance Assistance Program	Program that provides State funds for eligible maintenance activities to Local Maintaining Agencies and Maintenance Areas.	Ongoing	Local Maintaining Agencies	50 to 75%
State IRWM	Integrated Regional Water Management (IRWM)	Grant funds for development and revisions of IRWM Plans, and implementation of projects in IRWM Plans. Goals of Projects: to assist local public agencies to meet long- term water management needs of the State.	Ongoing	Applicant must be a local public agency or nonprofit representing an accepted IRWM Region. Other IRWM partners may access funds if their projects are identified in the Applicable IRWM Plan	Up to 75%

DRAFT

7.7.3 Local Cost Share Funding Sources and Assessment Strategies

The cities, counties, LMAs and the regional flood management agencies have played a significant part in funding the local share of flood management improvements and operations and maintenance. Funding by local agencies within the region is largely limited due to constitutional and statutory constraints to the way local governments can fund and finance capital improvements and services. As noted previously, Attachment I to California's Flood Future Report provides a detailed description of funding mechanisms available to local agencies to fund flood management improvements. In general, revenues for flood management within the North Delta are generated mostly by RDs or LMAs from property-based taxes, fees and assessments. In California, a local agency's ability to provide ongoing services and invest in its infrastructure is limited by voter-approved initiatives, such as Proposition 13 (1978) (limiting property tax increases) and Proposition 218 (1996) (requiring voter approval for new assessments) as previously discussed above in Constraints Sections 3.3.1 and 3.3.2.

Limited Availability of Local Funding Sources

Presently the RDs and LMAs in the North Delta largely assess O&M and repair of the levee systems on an agricultural acreage basis, and do not necessarily assess on a land improvement basis that accounts for residential, commercial, or industrial structures. An exception to the acreage-only assessment in the North Delta is RD 563 - Tyler Island that experienced flooding in 1986 and has had subsequent flood fights in 2007 and 2017. RD 563 (encompassing a portion of the East Walnut Grove study area) successfully executed a Proposition 218 benefit assessment in the early 2010's. Following their detailed Proposition 218 benefit assessment study RD 563 now assesses anywhere from $45 to $65/year for agricultural acreage, $550 to $600/year for residential structures, and anywhere from $1,000 to $1,500/year for commercial/industrial groupings of multiple structures, all dependent upon the benefit received from maintenance, repair and improving the levee system designed to eliminate or reduce variable flood depths within RD 563. To improve the local cost-sharing participation by the Delta Legacy Communities for smaller community-specific flood risk reduction measures such as a flood fight berm, a ring levee, or a cutoff levee system for the community of Courtland within the larger combined basin of RDs 551and 755, it is recommended that the community of Courtland assess themselves on a combined acreage- and structural-benefit basis, similar to RD 563. A benefit assessment study will be needed to support improvements that benefit the community and not the balance of the larger study area (RDs 551 and 755); and it may be advisable for the community to consider the development of a GHAD that could also incorporate a community-based flood insurance program. The community-based flood insurance program coupled with the suggested structural-improvement assessment approach can further enhance the community's ability to buy-down known flood risks (*see* Appendix J regarding a community-based flood insurance program for the Delta Legacy Communities in Sacramento County coupled with a community benefit assessment to generate local cost-share funds and assist with financing flood risk reduction measures.

DRAFT

Table 7-5 provides a summary of the local funding methods used by many agencies in California and the region to fund flood management improvements and services. The table describes the general uses of the funding source and the attributes and applicability of the mechanism for flood management. Included within these sources, many LMAs and RDs within the Delta, such as RDs 551 and 755 where the community of Courtland is located, fund ongoing O&M and repairs of levees via the Delta Levee Subventions program and/or the Delta Levees Special Projects, both of which are administered by DWR. These programs are reimbursement based and have minimum deductible costs per levee mile, and can include substantial local, up-front cost-share cashflow requirements. Thus, it is important to the communities within the existing RDs to know that they will need to help the RDs or LMAs pay for levee improvements that provide direct and/or indirect flood risk reduction benefits to the community. The communities should also expect to pay for or offset any additional, increased costs associated with the long-term OMRR&R for any new or ongoing community-specific flood infrastructure improvements.

DRAFT

Table 7-5: Potential Local Funding Programs and Assessment Strategies

Potential Local Funding Programs and Assessment Strategies						Pros, Cons, and Notes		
Item	**Use**	**Voter Approval**	**Bonds Allowed**	**Long/ Short Term**	**Entity**	**Pro**	**Con**	**Notes**
Geological Hazard Abatement Districts (GHAD)	O&M/ Capital Improvements	50% of Property Assessed	Yes	Long-Term	Independent District / Community	Broad scope of works, locally autonomous, Simple Majority Approval, Ongoing Funding Source. Some CEQA exemptions	Must prepare Plan of Control. Creates new responsible independent entity (similar to JPA), Prop 218 applies with respect to assessments levied.	Alternative to RD. Can fund reserves & Community-Based Insurance Program
Various Water Code Sections	O&M/ Capital Improvements	50% by Property Assessed	No	Long-Term	RDs & Community	Simple Majority Approval, Ongoing Funding Source	Applicability of Prop 218 - Must Show Benefit	Can fund maintenance or capital works. Can be used to finance improvements.
Benefit Assessment District Act of 1982	O&M/ Capital Improvements	50% of Property Assessed	No	Long-Term	Flexible	Simple Majority Approval, Ongoing Funding Source	Must Show Benefit Improvements/Services must be within the Boundary	Could provide some reimb. of Advance Funding
Municipal Imprvmt. District Act of 1913/1915	Capital Improvements	50% of Property Assessed	Yes	Long-Term	Flexible	Simple Majority Approval, Ongoing Funding Source	Must Show Benefit Improvements/Services must be within the Boundary	Could provide some reimb. of Advance Funding
Community Facilities Districts	O&M/ Capital Improvements	2/3's (See Note)	Yes	Long-Term	Flexible	Benefit not Needed, Flexible in Forming District, Improvements located anywhere	2/3 Approval Difficult to Obtain	Voting requirements change depending on presence of registered voters within boundary.
Advance Funding	Planning & Capital Improvements	NA	NA	Short-Term	N/A	Can cover upfront planning and operations costs	Limited/Uncertain Availability	Could be subject to reimb. from various sources over time.

DRAFT

7.8 Financial Feasibility and Local Cost Share Requirements for Key Management Actions

7.8.1 Financial Feasibility Summary Utilizing EAD Evaluations

The net reductions in EAD and financial feasibility values (in pay-back periods) for most of the key recommended short-term and long-term structural-based management actions are described above in Section 6.3.1.2. The evaluations, inventory values, and methodology are presented in Appendix E.

The summary of the EAD results indicating net reductions in EAD values and the return period(s) of investment (in years) for various structural based management actions are summarized in Table 6-5 for existing conditions without climate change adjustments, and Table 6-6 for future conditions that include adjustments for climate change.

The EAD values in Table 6-5 under existing conditions indicates there is a great net reduction in EAD values in the amount of $12.8M that could result from Management Action 1A alone by repairing the one outstanding FSRP critical repair site in the amount of $3.75M, indicating a short payback period of one year. Management Actions 1 and 2 consisting of repairing all known FSRP sites and addressing known erosion sites/concerns within RDs 551 and 755 in the collective amount of up to $40M will result in a net reduction in EAD in the amount of $43.0M for the entire study area, also indicating a short payback period of less than one year. The challenge with implementing Management Actions 5, 6, or 8 with longer payback periods is the benefit area(s) coming up with the local cost-share components from not only the combined RDs 551-Pearson District and RD 755-Randall Island, but also from the limited amount of citizens and businesses residing in the community of Courtland who will benefit from said repairs or improvements.

Long-term multi-benefit Management Action 6 (Multi-benefit project of repairing the entire 8.6 miles of SPFC levees within the study area) and Management Action 8 (FEMA certification of the entire Courtland study area) are estimated at up to $404M and $598M, respectively with payback periods well beyond 10 years.

7.8.2 Local Cost Share Financing and Assessment Strategies

Implementing any of the above management actions, including the flood risk reduction measure of implementing a simple access road/flood fight berm around the community (Management Action 4) with a payback period estimated at less than a year, will still require a local cost share of at least 5 to 10 percent. This could be a large challenge, particularly if said management actions do not provide a direct benefit to the balance of the larger 9,200-acre study area beyond just the immediate community area of Courtland encompassing only 140 acres. Assessments can only be levied where there is direct benefit received from anyone of the proposed management actions.

DRAFT

For management actions benefiting the entirety of the study area totaling approximately 9,200 acres there still is a challenge with developing the required local cost-share to participate in the noted federal and State grant programs identified above in Sections 7.7.1 and 7.7.2. Assuming that 80 percent of a local cost-share could be financed with the other 20 percent acquired in accumulated proceeds from an assessment, only one to two percent of the total cost of each management action will be required from the collective RDs 551/755, the community of Courtland, or some combination thereof for those management actions which reduce flood risk for the larger RD 551/755 basin. As described above in Section 7.7.3, this local cost share could be generated through a conventional acreage-based assessment commonly deployed by RDs 551 and 755, as well as a structural benefit basis, similar to what RD 563 accomplished on Tyler Island in the early 2010's with their Proposition 218 benefit assessment to fund substantial levee repairs/improvements.

Provided below in Table 7-6 is a conceptual analysis of local cost-share assessments and corresponding local pay-back periods for select management actions. A simple conventional agricultural assessment of $15 per acre over the entire RD 551/755 basin could generate up to $138,000 per year. Excluding any additional assessments developed separately by the community of Courtland, the total number of years for the RDs to acquire cash and secure financing for a 5 percent cost-share and pay back the financed amount to repair the single DWR FSRP critical seepage site (Management Action 1A) is estimated at less than 2 years. With this same assessment level of $15/acre over the two RDs, it could take up to three years to acquire cash to secure a local cost-share of 5 percent for financing the repair all of the DWR FSRP critical and seepage sites and all of the erosion sites/concerns (Management Actions 1 and 2), with approximately another 12 years to pay back the financed amount. This simple, conceptual financing scenario assumes a nominal local cost share requirement of only 5 percent. If a cost-share of 10 percent was required, the entire payback period could be doubled to 24 years utilizing the acreage-based only assessment. However, if there was a structural benefit assessment implemented the payback could be shortened.

The local cost share for the all-weather access road/flood fight-berm (Management Action 4) and the ring levee (Management Action 5) could be generated through a similar acreage assessment paired with a structural benefit assessment within the immediate community of Courtland. By assessing the total acreage (140 acres) just within the community of Courtland at $80 per acre, an estimated $11,200 per year could be generated. Similarly assessing residential, commercial, and industrial structures just within the community, at $300 per residential structure and $400 per commercial or industrial structure (to be refined in more detailed during a benefit assessment study), could generate up to $43,400 per year. With these assessments totaling $54,600 per year, it would take less than one year to acquire cash to secure local cost share financing for the all-weather access road/flood fight berm, and another four years to pay back the financed amount. To finance a local cost-share for a certified ring levee system (Management Action 5) at an estimated cost of $25-$35M, it could take up to six-and-a-half years to acquire cash to secure local cost-share financing for the ring levee, and an estimated 32 years to pay back the financed amount. Again, all of these payback periods could be doubled if a 10 percent cost-share

DRAFT

requirement is needed instead of the nominal 5 percent local cost-share scenario that is presented in Table 7-6.

Assessing all of the acreage in the RD 551/755 basin at $15 per acre along with all of the residential, commercial, and industrial structures in the basin (at $300 per residential structure and $400 per commercial or industrial structure) could be used to generate local cost-share for the basin-wide, comprehensive Management Actions 6 and 8. These assessments could generate up to nearly $300,000 per year, of which a portion of the residential assessment would be borne by the community of Courtland (SAC 48) and the remainder would be borne by SAC 47 (remainder of the RD 551/755 basin) as shown below in Table 7-6. At an estimated cost of $404M to repair and strengthen the entire 8.6 miles of SPFC levees in the study area (Multi-Benefit Management Action 6), it could take nearly 14 years to accumulate enough assessment to secure local cost-share financing and up to 55 years to pay back the financed amount. Again, this assumes there is only a small 5 percent cost-share requirement and the assessments remain as indicated in Table 7-6. Thus, there needs to be a long-range financial plan developed by the community of Courtland and the greater North Delta interests on how they can seek additional funds to partner with other benefiting agencies, particularly for the multi-benefit Management Action 6 associated with improving the resiliency and reliability of conveying SWP and CVP water adjacent to the SPFC levee system in the North Delta.

Similarly, to certify the entire perimeter levee system to FEMA's current 100-year levee accreditation standards for the entire Courtland study area (inclusive of RDs 551 and 755) using only the assessments described above, it could take approximately 20 years to just acquire cash to the secure local cost-share financing. Thus, there also needs to be a long-term regional finance plan developed for improving all of the collective Courtland study area SPFC and non-SPFC levee segments if it is ultimately desired to have the entire study area meet FEMA's current 100-year levee accreditation standards.

DRAFT

Table 7-6: Conceptual Analysis of Courtland Local Cost-Share Assessments and Local Pay-Back Periods for Select Management Actions

		Management Action (MA)					
		Repair of the FSRP Critical Seepage Site in RD 755 (**MA 1A**)	Repair of all FSRP Sites in RD 755 and Erosion Sites/ Concerns (**MA 1, 2**)	All-Weather Access Road/Flood Fight Berm for Courtland (**MA 4**)	Ring Levee System for Courtland & FEMA Certification (**MA 5**)	Repair and Strengthen-in-Place Sacramento River – SPFC Levees (Multi-Benefit Component) (**MA 6**)	FEMA Certification of the Entire Courtland Study Area Perimeter Levee System (**MA 8**)
Estimated Cost (Low)		$1,267,000	$19,764,000	$5,348,000	$25,176,000	$107,299,000	$195,640,000
Estimated Cost (High)		$3,750,000	$39,966,000	$5,348,000	$35,064,000	$404,150,000	$598,178,000
Net Reduction in EAD to Courtland Study Area, Existing Conditions		$12,800,000	$43,043,000	$6,101,000	$6,312,000	N/A	$44,538,000
Net Reduction in EAD to Courtland Study Area, Future Conditions		$22,096,000	$91,449,000	$13,563,000	$13,990,000	N/A	$94,333,000
Flood Risk Reduction Payback Periods (in Years: Future to Existing Conditions)		0.2 to 0.3 years	0.4 to 0.9 years	0.4 to 0.9 years	2.5 to 5.6 years	N/A	6.3 to 13.4 years
Local Responsibility (Lead **Assessed** / Support)		**RDs 551 & 755**	**RDs 551 & 755**	**Community of Courtland/** RDs 551 & 755	**Community of Courtland**/RDs 551 & 755	**RDs 551 & 755/ Community of Courtland**	**RDs 551 & 755/ Community of Courtland**
5% Local Cost Share Scenario	5% of Total Cost	$188,000	$1,998,000	$267,000	$1,753,000	$20,208,000	$29,909,000
	80% Local Financed (4% Total Cost of MA)	$150,400	$1,598,400	$213,600	$1,402,400	$16,166,400	$23,927,200
	20% Local Cash Needed (1% Total Cost of MA)	$37,600	$399,600	$53,400	$350,600	$4,041,600	$5,981,800

DRAFT

	Management Action (MA)					
	Repair of the FSRP Critical Seepage Site in RD 755 (**MA 1A**)	Repair of all FSRP Sites in RD 755 and Erosion Sites/ Concerns (**MA 1, 2**)	All-Weather Access Road/Flood Fight Berm for Courtland (**MA 4**)	Ring Levee System for Courtland & FEMA Certification (**MA 5**)	Repair and Strengthen-in-Place Sacramento River – SPFC Levees (Multi-Benefit Component) (**MA 6**)	FEMA Certification of the Entire Courtland Study Area Perimeter Levee System (**MA 8**)
Acreage Assessment[1]	$138,000	$138,000	$11,200	$11,200	$138,000	$138,000
Residential Assessment[2]	--	--	$29,400	$29,400	$49,200 (SAC 47)	$49,200 (SAC 47)
					$29,400 (SAC 48)	$29,400 (SAC 48)
Commercial/Industrial Assessment[3]	--	--	$14,000	$14,000	$62,400 (SAC 47)	$62,400 (SAC 47)
					$14,000 (SAC 48)	$14,000 (SAC 48)
Total Annual Assessments	$138,000	$138,000	$54,600	$54,600	$293,000	$293,000
Number of Years to Acquire Cash to Secure 5% local Cost-Share Financing	0.3 years	2.9 years	1.0 years	6.4 years	13.8 years	20.4 years
Number of Years to Pay Back Financed Amount	1.1 years	11.6 years	3.9 years	32.3 years	55.2 years	81.7 years
Total Payback Years for Existing Conditions	1.4 years	14.5 years	4.9 years	38.7 years	69.0 years	102.1 years

Notes: The assessed values indicated below are very preliminary in nature per acre and/or per the various structures. A full benefit assessment study will be needed to determine actual assessment values. Changing the acre-assessed values and and/or the structure benefit-assessed values will obviously impact the estimated pay back periods presented herein.

[1] Acreage assessment assessed at $15/acre for RDs 551 & 755 (9,060 to 9,200 acres); and $80/acre for community of Courtland (140 acres)

[2] Residential assessment utilizes the total number of residential structures located within the community of Courtland from the 2022 CVFPP Update, assessed at $300 per structure

[3] Commercial/industrial assessment utilizes the inventory of structures from the 2022 CVFPP Update, assessed at $400 per commercial and industrial structures (to be refined later based upon benefit values, that can be partially based upon sq. ft. and elevation of structures, and maximum potential depth of flooding)

(SAC 47) = RDs 551 & RD 755, less SAC48 (Courtland) = 9,060 Acres

(SAC 48) = Community of Hood (within boundaries of flood-fight berm or ring levee system) = 140 Acres

DRAFT

8. Implementation of Recommendations

8.1 Implementation Schedule including Roles and Responsibilities

The community of Courtland, acting through the Sacramento County with support from RDs 551 and 755, has the opportunity to significantly reduce flood risks to Courtland and its larger study area including RD 551 – Pearson District and RD – 755 Randall Island. Courtland, Sacramento County, and the noted RDs intend to accomplish this by repairing and strengthening-in-place the greatest known and documented weaknesses in the perimeter SPFC levee system along the left bank of the Sacramento River protecting the Courtland Study Area and potentially constructing an access road/flood-fight berm to further protect the community in the event a levee breach were to occur in the Study Area but outside of the Community.

As its highest priority (Management Action 1), the community of Courtland would prefer to see the well documented DWR FSRP critical and serious sites repaired in RD 755 by DWR with support from the RDs within the next few years, by 2024. The repair of the critical site (estimated at $3.8M) and the serious site (estimated at $26M), when combined with addressing known erosion sites/concerns (Management Action 2 presently estimated at $10M), will result in a net reduction in EAD of approximately $43M for the entire study area under existing conditions. The benefit of these projects is nearly twice as much under future conditions with an estimated net reduction in EAD for the entire study area of over $91M as a result of the effects of inland climate change and sea level rise.

Following remediation of the noted FSRP sites and known erosion sites/concerns, the community would prefer to see the nearly 0.75-mile-long portion of the SPFC levee immediately adjacent to Courtland fortified within the next 5 to 10 years to meet current FEMA accreditation standards (Management Action 3) at a cost of approximately of $14M. This action alone would not represent a substantial, incremental reduction in EAD values within the study area, but it would substantially reduce the potential for life loss if a levee breach were to occur at this location.

To achieve the noted reductions in flood risk the following recommendations include full development of the structural-based Management Actions, including improving the SPFC levee system to meet current, FEMA 100-year accreditation standards, advancing non-structural measures, and developing multi-benefits that will improve the reliability and residency of conveying SWP and CVP in the North Delta upstream of the Delta Cross Channel. They are outlined and planned to secure financial assistance and concurrence with DWR, the CVFPB, the USACE, and the Delta Conservancy and confirm consistency with Delta Plans administered by the DPC and the DSC to reduce known flood risks in the North Delta. The following recommendations can be sequenced or phased in the order as listed below or amended based upon variable funding sources. However, it is recommended the first two recommendations take

DRAFT

priority for initiating all short-term structural-based Management Actions, with all other recommendations not tied to any specific phasing or prioritization, with several non-structural measures already partially implemented.

1. In connection with executing repairs to the known FSRP critical and serious repair sites (structural-based Management Actions 1A and 1B) both RDs 551 and 755 notified DWR by letter on February 1, 2021, they have collective and combined interests in repairing and partially funding the known, no-regrets, critical FSRP repair site in RD 755, and they need timely financial assistance and participation from DWR. Short of DWR providing assistance and funding for the full repairs for just the critical site, DWR should consider providing assistance to the RDs (or within DWR) to fund the initial design and permitting for not only the critical FSRP site, but also the adjoining serious FSRP site. It may be more cost-effective to design, permit and construct these two known FSRP sites simultaneously or during back-to-back years, as the preferred repair solutions identified by Courtland and the RDs call for the installation of seepage/underseepage cutoff walls. With DWR funding most or all of the initial design, permitting, and CEQA/NEPA documentation it would allow more time for the RDs and the community of Courtland to develop its applicable cost-share funds that may be necessary to actually execute the repairs at the known FSRP sites.
2. Consistent with the approach outlined above for correcting the know FSRP sites associated with Management Action 1, the RDs should also earmark nominal funds, with the possible assistance from Sacramento County and the community of Courtland, to address the extent of erosion repairs on the SPFC levee system along the left bank of the Sacramento River and further evaluate the erosion concerns that may exist on the non-SPFC levee system along Delta Meadows Slough. Funds should also be earmarked by the RDs to fund the design, permitting and CEQA/NEPA documentation for the applicable repairs so the repairs are shovel-ready when larger funding sources become available either through Delta Levees Special Projects and/or Subventions in addition to other grant programs that may be available.
3. The community of Courtland, with support from Sacramento County and the RDs, should seek funds *via* community block grants funds or other sources to fund a Proposition 218 election that may be required to raise local cost-share funds for developing the applicable local cost share for flood risk reduction actions that have community-specific benefits over and above those that are more beneficial to the larger RD basins and the Courtland Study Area. The community-specific flood risk management actions that could significantly reduce life loss and potential damages in Courtland due to flooding in the community include strengthening-in-place the Sacramento River SPFC levee immediately fronting the community (Management Action 3). These community-specific levee improvements could be paired, as recommended, with either an accompanying access road/flood-fight berm (Management Action 4), or a less favorable ring levee system encompassing the community (Management Action 5), either of which would require planning and financing beyond the current responsibilities of RDs 551 and 755.

DRAFT

The local cost share of said community-specific flood risk reduction measures could also be partially funded *via* a community-based flood insurance program as another relatively near-term non-structural measure, as noted further below.

4. To implement Management Action 3 – repairing and strengthening-in-place nearly 0.75 mile of the SPFC levee immediately fronting the community, geotechnical explorations will be required in advance of preparing preliminary designs and advancing permits and supporting CEQA/NEPA documentation. It is recommended that that the community, with the support of Sacramento County and others, work with RD 551 to identify potential funding sources and advance said geotechnical explorations, remediation designs, and environmental documents so this management action is closer to shovel-ready when funds may become more readily available.

5. The community of Courtland should work closely in the near-term with other Delta Legacy Communities in Sacramento County, particularly other DWR SCFRRP participants, including the city of Isleton, to establish a GHAD or HOA to advance a private, community-based flood insurance program that would effectively provide relief from the ever-increasing high NFIP rates and possibly support the implementation of the access road/flood-fight berm (Management Action 4). The city of Isleton has taken the initial steps in developing a community-based flood insurance program, and it will be more cost effective (resulting in significantly lower insurance premiums than offered by the NFIP) if there were more nearby communities pooling their resources together and aggregating or spreading their potential flood losses over a larger pool of insureds. The timely development of said GHAD or HOA would not only serve to substantially reduce flood insurance rates, but it could serve as a vehicle to generate local cost-share funds to buy-down flood risks within the community that is currently assessed by RD 551 on an acreage only basis, *versus* a flood risk value tied to structure improvements and content values. The private, community-based flood insurance program could also fund regional programs or local cost-share requirements to buy-down risks at the regional level, including larger, long-term multi-objective components such as improving the entire SPFC levee reaches not only in the Courtland Project Study Area but also in the greater North Delta (Multi-Benefit Management Action 6).

6. In connection with implementing the multiple-benefit project of improving the 8.6 miles of SPFC levee in the project area that will also improve the reliability and resiliency of conveying SWP and CVP in the North Delta (Management Action 6) it is recommended that community representatives pool their resources together with other participating Delta Legacy Communities in the North Delta. Improving the SPFC levees to current, modern FEMA standards to address seepage, under seepage, and stability will also serve to improve the reliability and resiliency of conveying SWP and CVP water through the North Delta with or without the DCA's current tunnel and intakes proposal. The noted communities and regional stakeholders have been approached by the DCA regarding their Communities Benefits Program (CBP), and the Delta Legacy Communities have suggested improving the SPFC levee system, particularly upstream of the Delta Cross

DRAFT

Channel is necessary with or without the proposed DCA improvements. It is suggested that the community of Courtland and its neighboring Delta Legacy Communities, particularly in Yolo and Sacramento Counties, work with RFMP representatives, including the Sacramento Area Flood Control Agency, West Sacramento Flood Control Agency, CVFPB, and DWR MA 9 to share and ideally implement their preferred alternative of how improving the limited number of SPFC levee miles in the North Delta along the Sacramento River in the North Delta will also improve the reliability and resiliency of conveying SWP and CVP water through the entire Delta, with or without the DCA's independent, isolated conveyance facility. The multi-benefit attributes of improving and modernizing the SPFC levee system in tandem with improving water conveyance through the Delta should also be presented and shared with the DPC, DSC, and the Delta Conservancy. (See Appendix K for additional background information related to improving water conveyance through the Delta in tandem with reducing flood risks to the Delta Legacy Communities within Sacramento County.)

7. Concurrently with implementing the near- and long-term structural-based Management Actions the community of Courtland, with assistance from Sacramento County, the two RDs and others, can implement the following non-structural measures to further reduce residual flood in the Courtland Study Area. All of the non-structural measures for implementation are described in more detail in Section 5.2 and 7.3, and in Appendix H. The following non-structural solutions are highly recommended for implementation, some of which are already in the early stages of implementation:
    1. Flood Fight Berm or a Ring Levee System
    2. Voluntary Elevations of Structures
    3. Wet or Dry Floodproofing
    4. Flood ESPs
    5. Sacramento County OES Decision Support Tool
    6. LHMP and Relief Cuts
    7. Alternatives to FEMA NFIP – Private, Community-Based Flood Insurance
    8. NFIP Flood Insurance Enhancements *via* AFOTF
    9. Mokelumne River Conveyance Improvements & State Island Overflow Area
    10. Flood Fight Berm or a Ring Levee System
    11. Improve FEMA CRS Score for Sacramento County/Isleton
    12. Land Use Regulations and Limitations
    13. Improved Governance Between Neighboring LMAs/RDs
    14. SWIFs & Period Inspections with USACE
    15. Public Education/Public Awareness

DRAFT

8.2 Delta Regulatory Compliance, Delta Investment Priorities, and Additional Studies & Plans

8.2.1 DSC Consistency Determination Required with Delta Plan and Qualifying Covered Actions

The Sacramento-San Joaquin Delta Reform Act of 2009 (Delta Reform Act) established a certification process for demonstrating consistency with the Delta Plan. The Delta Reform Act requires any State or local agency proposing to undertake a qualifying action (covered action) must submit to the Delta Stewardship Council (DSC) a written certification of consistency with detailed findings as to whether the covered action is consistent with the Delta Plan (Wat. Code, § 85225). ***The certification of consistency needs to demonstrate the project or covered action is consistent with the Delta Plan's co-equals goals of providing a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem. The coequal goals are to be achieved in a manner that protects and enhances the unique cultural, recreational, natural resources and agricultural values of the Delta as an evolving place.***

As a component of demonstrating consistency of covered actions with the Delta Plan all levee projects must evaluate and where feasible incorporate alternatives, including the use of setback levees, to increase floodplains and riparian habitats. ***Evaluation of setback levees in the Delta shall be required along the Sacramento River between Freeport and Walnut Grove and other locations as shown in Appendix 8 of the Delta Plan.*** This Delta Plan policy considers construction of new levees or substantially rehabilitate or reconstruction of existing levee systems as covered actions. This policy language relative to expanding floodplains and riparian habitats in levee projects within the Delta was last amended by the DSC and included in the California Code of Regulations in 2019. Thus, prior to undertaking any substantial levee rehabilitation projects located between Freeport and Walnut Grove the project proponent, whether it is a local community, RD, LMA, or any other local/state entity, it should consult early with the DSC regarding the applicability of evaluating setback levee alternatives in tandem with substantial levee rehabilitation efforts as considered in this feasibility study report; and then the project proponent should be prepared to file a consistency determination upon completion and adoption of the applicable final CEQA/NEPA documents.

8.2.2 Alignment with DSC's 3x3 Prioritization of State Investments in Delta Levees and Flood Risk Reduction

As previously highlighted in Section 4.1, the Delta Legacy Communities and their cost-share partners investing in substantial levee repairs, improvements, and rehabilitation efforts, including increased OMRR&R expenditures, should be structured as outlined in this feasibility study report, to be most responsive to the DSC's 3x3 Prioritization of State Investments in Delta Levees and Risk Reduction. The DSC's prioritization table for levee investments is presented in Section 4 and is highlighted below in Table 8-1. The DSC's prioritization table is highlighted below in five of the nine cells indicating that most structural-based management actions and non-structural measures proposed for implementation for the community of Courtland are most

DRAFT

responsive to the DSC's Prioritization of State Investments in Delta levees and risk reduction. Courtland's Management Action 6, consisting of the multi-benefit project of repairing and strengthening-in-place 8.6 miles of SPFC levee also has the added benefit of improving the resiliency and reliability of the fresh water conveyance corridor aqueduct that conveys SWP and CVP water through the Delta. See Appendix K for further details in support of the multi-benefit opportunities identified by the Sacramento County Delta Legacy Communities associated with reducing flood risks combined with improving SWP water conveyance through the Delta.

Although not fully exhausted through this current feasibility study effort, it is recommended that Courtland and its cost-sharing partners further explore ecosystem conservation opportunities that may protect existing and provide net enhancements to floodplain habitat.

Table 8-1: 3x3 Goals of the DSC for State Investment in Delta Integrated Flood Management.

Goals	Localized Network	Levee Network	Ecosystem Conservation
1	Protect existing urban and adjacent areas by providing 200-year flood protection.	Protect water quality and water supply conveyance in the Delta, especially levees that protect freshwater aqueducts and the primary channels that carry fresh water through the Delta.	Protect existing and provide for a net increase in channel-margin habitat.
2	Protect small communities and critical infrastructure of statewide importance (located outside of urban areas).	Protect floodwater conveyance in and through the Delta to a level consistent with the SPFC for project levees.	Protect existing and provide for net enhancement of the floodplain habitat.
3	Protect agriculture and local working landscapes.	Protect cultural, historic, aesthetic, and recreational resources (Delta as Place).	Protect existing and provide for net enhancement of wetlands.

8.2.3 Additional Ongoing Studies and Plans

CVFPP and Lower Sacramento-Delta North Regional Flood Management Plan (RFMP) Updates

Relief Cut Updates via Local Hazard Mitigation Plans (LHMP)

Great California Delta Trail Plan by DPC

9. References

AECOM. 2020. 2020/2021 Levee Repairs (North). Butte Creek, Elder Creek, Elk Slough, Sacramento River, Yankee Slough. RD0755 U01 LM 1.77, Site 58 – LMA-156 (Sacramento River) Cross Sections.

Agricultural Floodplain Ordinance Task Force (AFOTF). 2016. Recommended Administrative Refinements of the National Flood Insurance Program to Sustain Agriculture as a Wise Use of the Floodplain in Leveed Special Flood Hazard Areas. Available at: http://frrfmp.com/wp-content/uploads/2017/05/AFOTFTech-Memo12.28.16.pdf

California Department of Water Resources (DWR). 2012a. 2012 Central Valley Flood Protection Plan. Available at: https://water.ca.gov/LegacyFiles/cvfmp/docs/2012%20CVFPP%20FINAL%20lowres.pdf

_____. 2012b. 2012 Central Valley Flood Protection Plan Attachment 8J: Cost Estimates. Appendix D – Protection of Small Communities.

_____. 2014. Guidance for Development of a State-Led Feasibility Study. https://water.ca.gov/LegacyFiles/floodmgmt/funding/docs/Final-Draft-Feasibility-Study-Guidance-wAppendices-2014.pdf

_____. 2017a. Flood System Long-Term Operations, Maintenance, Repair, Rehabilitation, and Replacement Cost Evaluation. Available at: https://water.ca.gov/LegacyFiles/cvfmp/docs/OMRRR_TM_Jan_2017.pdf

_____. 2017b. Flood System Status Report. Available at: https://cawaterlibrary.net/wp-content/uploads/2017/10/2017FSSR-Compiled-Aug2017-Excerpt.pdf

_____. 2017c. Central Valley Flood Protection Plan 2017 Update. Available at: https://water.ca.gov/LegacyFiles/cvfmp/docs/2017/2017CVFPPUpdate-Final-20170828.pdf

_____. 2017d. 2017 CVFPP Update – Scenario Technical Analyses Summary Expanded Report.

_____. 2019. Annual Report to the Delta Stewardship Council. State Funds Awarded for Delta Levee Improvement and Rehabilitation Projects. Available at: https://deltacouncil.ca.gov/pdf/council-meeting/meeting-materials/2019-11-21-item-9-attachment-1-dwr-annual-delta-funding-report-fy19.pdf

California Special Districts Association. 2013. Proposition 218 Guide for Special Districts. Available at:

DRAFT

https://www.waterboards.ca.gov/waterrights/water_issues/programs/drought/pricing/docs/csda_guide_proposition_218.pdf

County of Sacramento. 2017a. Courtland Special Planning Area. Available at: https://planning.saccounty.net/LandUseRegulationDocuments/Pages/SPAandNPAs.aspx

_____. 2017b. Local Hazard Mitigation Plan, Annex G Chapter 6 Reclamation District 551. Available at: https://waterresources.saccounty.net/Local%20Hazard%20Mitigation%20Plan%202017/Annex%20G%20Delta%20Chap%206%20Reclamation%20District%20551.pdf

Delta Protection Commission (DPC). 2012. Economic Sustainability Plan for the Sacramento-San Joaquin Delta. Available at: https://www.pacific.edu/documents/school-business/BFC/Econ%20Sustain%20Plan%20PDFs/Final%20ESP_2012.01.19.pdf

Delta Stewardship Council (DSC). 2013. Delta Plan. Available at: http://deltacouncil.ca.gov/pdf/delta-plan.pdf

_____. 2017. Delta Levees Investment Strategy. Available at: https://cawaterlibrary.net/wp-content/uploads/2018/01/DLIS-Final-Report_rev2_July-2017.pdf

Dynamic Planning + Science for County of Sacramento. 2017. RD 755 Delta Flood Emergency Safety Plan.

Federal Emergency Management Agency (FEMA). 2012. FEMA Flood Map Service Center. Available at: https://msc.fema.gov/portal/home#wcm-survey-target-id

_____. 2017. Bulletin W-17061. Available at: https://nfipservices.floodsmart.gov/2017/w-17061

_____. 2019a. Bulletin Week of October 7, 2019. Available at: https://content.govdelivery.com/accounts/USDHSFEMA/bulletins/264d15e#link_7

_____. 2019b. FEMA Defers the Implementation of Risk Rating 2.0. Available at: https://www.fema.gov/news-release/2019/11/07/fema-defers-implementation-risk-rating-20

First Street Foundation. 2020. Flood Factor Matrix. Available at: https://floodfactor.com/methodology

FloodProtect. 2014. Lower Sacramento River/Delta North Regional Flood Management Plan. Available at: https://www.yolocounty.org/home/showdocument?id=28753

HDR. 2021. Sacramento County Small Communities Expected Annual Damage Analysis.

DRAFT

MBK Engineers. 2012. Reclamation District No. 551 Pearson Island, Five Year Plan: Special Flood Control Project Planning. Sacramento, CA, June 2012.

_____. 2017. Central Valley Flood Protection Board September 28, 2017 Letter. Reclamation District 551, Justification for Site Classifications. DWR Emergency Rehabilitation, 2017 Storm Damages.

_____. 2019a. Reclamation District No. 551 Erosion Sites.

_____. 2019b. Reclamation District No. 551 Pearson District Levee Repair Project.

_____. 2020a. Comments on Notice of Preparation of Environmental Impact Report for the Delta Conveyance Project.

_____. 2020b. RD 551 Pearson District 2017/2019 Flood Damage Sites.

Rand Corporation. 2020. Decision Support Tool for the San Francisco Bay-Delta levee Investment Strategy. Available at: https://www.rand.org/pubs/tools/TL266/tool.html

URS. 2011a. Geotechnical Assessment Report, North NULE Project Study Area. Non-Urban Levee Evaluations project.

URS. 2011b. Remedial Alternatives and Cost Estimates Report (RACER), North NULE Study Area. Non-Urban Levee Evaluations project.

URS. 2013a. 2012 Levee Performance Problems Evaluation Report for Sacramento River Basin. Flood System Repair Project. Volume 1.

URS. 2013b. Pre-Feasibility Report for Leveed Area SAC47/48 RD 551 and Courtland. Flood System Repair Project.

United States Census Bureau. 2010. Available at: https://data.census.gov/cedsci/

Wholesale & Specialty Insurance Association. 2019. Surplus Lines Flood Insurance Market Data and Statistics. Available at: https://www.wsia.org/docs/PDF/Legislative/SurplusLinesMarketDataandStatistics2-28-19.pdf

DRAFT

Appendix A: Geotechnical Data and Assessment Report

DRAFT

Appendix B: Biological Resources Constraints Assessment for the Community of Courtland

DRAFT

Appendix C: Cultural Resources Records Search Results for Courtland, California

DRAFT

Appendix D: Ecosystem Multi-Benefit Opportunities for the Sacramento County Delta Legacy Communities Small Communities Flood Risk Reduction Feasibility Studies

DRAFT

DRAFT

Appendix E: Expected Annual Damages Technical Memorandum

DRAFT

Appendix F: Cost Estimate Development of Flood Risk Reduction Management Actions for the Flood Risk Reduction Feasibility Study for Delta Legacy Community of Courtland, CA

DRAFT

Appendix G: DPC, DSC and Delta Conservancy Master Comparison Matrix

DRAFT

Appendix H: Identification of Non-Structural Elements for the Communities of Hood, Courtland, Locke, East Walnut Grove, and West Walnut Grove & Ryde Flood Risk Reduction Feasibility Studies

DRAFT

Appendix I: Hydrology and Hydraulics Technical Memorandum for the North Delta Legacy Communities of Hood, Courtland, Locke, Walnut Grove (East), Ryde/Walnut Grove (West), and Isleton

DRAFT

Appendix J: Community-Based Flood Insurance Technical Memorandum

DRAFT

Appendix K: Multi-Benefit Project Opportunities Identified to Reduce Flood Risks and Improve SWP Water Conveyance Through the Delta by the Sacramento County Delta Legacy Communities

DRAFT