
**Flood Risk Reduction Feasibility Study for:**

# Delta Legacy Communities of West Walnut Grove and Ryde, CA

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

**Submitted to:**
Sacramento County Department of Water Resources

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Visit the West Walnut Grove/Ryde Story Map for more details of the community, its history, and flood risk concerns: [West Walnut Grove/Ryde Story Map - Sacramento County Small Communities Flood Risk Reduction Program]

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# 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) |
| CVFPB | Central Valley Flood Protection Board |
| CVFPP | Central Valley Flood Protection Plan |
| CVP | Central Valley Project |
| CVRMP | Central Valley Riparian Mapping Project |
| DC | Delta ConservancyDCA Delta Conveyance Authority |
| Delta | Sacramento-San Joaquin Delta |
| District | Reclamation District |
| DLIS | Delta Levees Investment Strategy |
| DPC | Delta Protection Commission |
| DSC | Delta Stewardship Council |

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|---|---|
| DWR | California Department of Water Resources |
| EAD | Expected Annual Damage |
| 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 |
| 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 |
| 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 |
| NAVD 88 | North American Vertical Datum 1988 |
| NEPA | National Environmental Policy Act |
| NFIP | National Flood Insurance Program (developed by FEMA) |
| NOI | Notice of Intent |
| NRHP | National Register of Historic Places |

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|---|---|
| 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 |
| PL | Public Law |
| RD | Reclamation District |
| RFMP | Regional Flood Management Plan (component of CVFPP) |
| 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 |
| 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 |

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# Executive Summary

In 2017, Sacramento County received grants from the California Department of Water Resources (DWR) Small Communities Flood Risk Reduction Program (SCFRRP) 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 based on these potential elements, develop and prepare implementation costs for each of the management actions, identify a preferred suite of management actions 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 leveed system in the Sacramento River Corridor.

West Walnut Grove and Ryde are both located along the right bank of the Sacramento River near the southwest boundary of Sacramento County. Levees which protect the tract of land known as Grand Island where the Delta Legacy communities are located are maintained by Reclamation District 3 (RD 3). In total, Grand Island is protected by nearly 29 miles of levees which provide protection from flows in the Sacramento River on the east and Steamboat Slough to the west.

The levees surrounding Grand Island were initially constructed prior to 1906 by local interests and were generally built using materials dredged from the adjacent Sacramento River and Steamboat Slough. Over time various improvements have been made to the RD 3 Grand Island levees and they are now considered part of the State and federally authorized Sacramento River Flood Control Project and are now part of State Plan of Flood Control (SPFC) levees.

Sacramento County and its consultants developed this feasibility study in coordination with a planning committee comprised of residents living within the communities of West Walnut Grove and Ryde, including other landowners and business owners on Grand Island, including members of the Grand Island Reclamation District (RD 3). Other representative participating stakeholders with interest and knowledge in providing enhanced flood protection for the Delta Legacy Communities of West Walnut Grove and Ryde, including residents and landowners within West Walnut Grove and Ryde and agricultural landowners within the larger RD 3 basin, were also consulted. Several public stakeholder meetings were held to identify existing concerns and solicit feedback on the flood risk reduction efforts for the Delta Legacy Communities of West Walnut Grove/Ryde.

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#### Structural-based Management Actions

A suite of 10 potential structural-based management actions 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 management actions included repairing known erosion sites as identified by the District Engineer (MBK Engineers) for RD 3; repairing a known serious erosion site 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 Grand Island perimeter levee system; potentially constructing a cross levee along Highway 220; constructing a potential ring levee or an all-weather access road/flood-fight berm around West Walnut Grove including Clampett Tract and nearby residences just north of Clampett Tract; and securing 100-year Federal Emergency Management Agency (FEMA) 100-year accreditation for the communities of West Walnut Grove and Ryde.

These 10 structural-based management actions can be paired with a suite of non-structural management actions, including the potential implementation of a community-based private flood insurance program developed specifically for the two noted communities and/or additional Delta Legacy Communities via either a Homeowners Association (HOA), 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 Section 7.3 of this Feasibility Study Report.

The management actions were evaluated largely 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 management actions 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 management actions was further identified as follows:

- **Management Action 1**: Repair DWR FSRP Serious Erosion Site and Address Erosion Sites Identified by Local Maintaining Agency (LMA) Representatives
- **Management Action 2**: Repair and Strengthen-in-Place Sacramento River Right Bank SPFC Levee Reaches Directly Adjacent to Communities of West Walnut Grove and Ryde
- **Management Action 3**: All-Weather Access Road and Flood Fight Berm for West Walnut Grove – Clampett Tract

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- **Management Action 4**: Potential Ring Levee and FEMA Certification for West Walnut Grove – Clampett Tract was also recommended as an alternative to Management Action 3.

The estimated cost, net reduction in Expected Annual Damages (EAD) to the West Walnut Grove study area under existing conditions (without climate change adjustments), and the flood risk reduction payback period in years (excluding interest) associated with Management Actions 1, 2, 3, and 4 are summarized below. The cost for the recommended suite of relatively short-term Management Actions 1 to 3 is estimated at $20 to $38M in 2020 dollars. If Management Action 4 (ring levee & FEMA certification) is implemented in place of Management Action 3 (all-weather access road/flood fight berm), the total estimated capital cost is $56-$71 million (M) in 2020 dollars. Of the four management actions, Management Action 1 provides the largest incremental value to the community of West Walnut Grove/Clampett Tract and the larger study area. With the implementation of these management actions, the total net reduction in EAD for the West Walnut Grove study area is estimated at $8.4M under existing conditions, and as high as $42.4M under future conditions with climate change adjustments. Management Actions 3 and 4 result in a similar net reduction in EAD to the West Walnut Grove study area estimated at $1.3 to $1.4M, and as much as $8.4-$8.6M under future conditions with climate change adjustments. Note that while Management Action 2 as a standalone measure would not represent a substantial, incremental reduction in EAD within the study area, it would substantially reduce the potential for life loss if a levee breach were to occur along the right bank of the Sacramento River adjacent to either of the communities of West Walnut Grove or Ryde.

**Table ES1-1: Estimated Costs, Net Reduction in EAD Values, and Flood Risk Reduction Payback Period for Suite of Management Actions Under Existing Conditions**

| Management Action | Estimated Cost (millions) | Total Net Reduction in EAD to the West Walnut Grove Study Area under Existing Conditions (millions)[1] | Flood Risk Reduction Payback Period in Years (excluding interest)[2] |
|---|---|---|---|
| Repair DWR FSRP Site(s) and Address Erosion Sites Identified by the LMA Representatives (**MA 1**) | $4.5 | $8.4 | 0.5 years |
| Repair and Strengthen-in-Place Sacramento River Right Bank SPFC Levee Reaches Directly Adjacent to Communities of West Walnut Grove and Ryde (**MA 2**) | $9.9-$28.6 | N/A | N/A |
| All-Weather Access Road/Flood Fight Berm for the Community of West Walnut Grove/Clampett Tract (**MA 3**) | $5.4 | $1.3 | 4.1 years |
| Ring Levee and FEMA Certification for the Community of West Walnut Grove/Clampett Tract (MA **4**) | $22.7-$37.6 | $1.4 | 27.8 years |

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

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

A key long-term management action (Management Action 6) contains Statewide multi-benefits by repairing and strengthening-in-place the Sacramento River right bank levee of Grand Island (RD 3) between the confluence with Steamboat Slough and Georgiana Slough. The same geotechnical remedial actions could improve the resiliency and reliability of the same 5.9--mile length of the freshwater conveyance corridor along the Sacramento River between Steamboat Slough and Georgiana Slough, . The current river channel and levees 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 5.9 -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 (tunnels or canal) under consideration by the Delta Conveyance Authority. The 5.9 mile stretch of the Grand Island levee segment along the right bank of the Sacramento River between Steamboat Slough and Georgiana Slough near the Delta Cross Channel represents approximately 16 percent of the non-urban SPFC levee system along the freshwater conveyance corridor between the Delta Legacy Community of Freeport and the Delta Cross Channel; and nearly 10 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 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 $47M and $104M, which could gain the sizeable interest and cost-sharing contributions of the noted interests and beneficiaries Statewide and south of the Delta. Implementation recommendations for the multi-benefit project include West Walnut Grove and its neighboring Delta Legacy Communities meeting and working with Regional Flood Management Plan (RFMP) representatives, including Sacramento Area Flood Control Agency, West Sacramento Area Flood Control Agency, the Central Valley Flood Protection Board, and DWR Management Area 9 (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 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 management actions highlighted above, several non-structural measures were evaluated for their potential to reduce residual flood risk. These non-structural measures can be implemented independent of, or in combination with, the structural-

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based improvements. This study recommends the following preferred 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 West Walnut Grove/Ryde study area and adjoining RDs in the Lower-Sacramento – North Delta RFMP Region
- Implementation of a community-based flood-risk insurance program specific to the communities of West Walnut Grove and Ryde 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 West Walnut Grove/Ryde 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 management actions outlined above and non-structural measures outlined herein.
- Updating the Sacramento County Local Hazard Mitigation Plan and formalizing potential relief cut locations within RD 3
- Continued and improved public education and awareness
- Support continued actions to improve and maintain high NFIP Community Rating System score for Sacramento County/West Walnut Grove and Ryde
- Continued State support for refinements and Amendments to the NFIP via Agricultural Floodplain Ordinance Task Force and H.R. 3167
- Improved governance between RD 3, other regional RDs in the north Delta, and potentially establishing a HOA or GHAD for establishing a community-based flood insurance program and reducing flood risks within the communities on Grand Island, in particular the Delta Legacy Communities of West Walnut Grove and Ryde

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# 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 State Plan of Flood Control[1] (SPFC) 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.

[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 Sacramento River Flood Control Project (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 Central Valley Flood Protection Board) has provided assurances of nonfederal cooperation to the United States.

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. 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, as the local land-use planning entity, was awarded a DWR grant in 2017 on behalf of the communities of West Walnut Grove and Ryde, to prepare a feasibility study to identify and prioritize flood risk reduction management actions. For the purposes of this report, the communities of West Walnut Grove and Ryde refer to the densely populated communities of West Walnut Grove, also known as Clampett Tract, and Ryde. In addition to West Walnut Grove and Ryde 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 Delta Legacy Communities include Courtland, Hood, Locke, East Walnut Grove, Clarksburg, Rio Vista, and the City of Isleton.

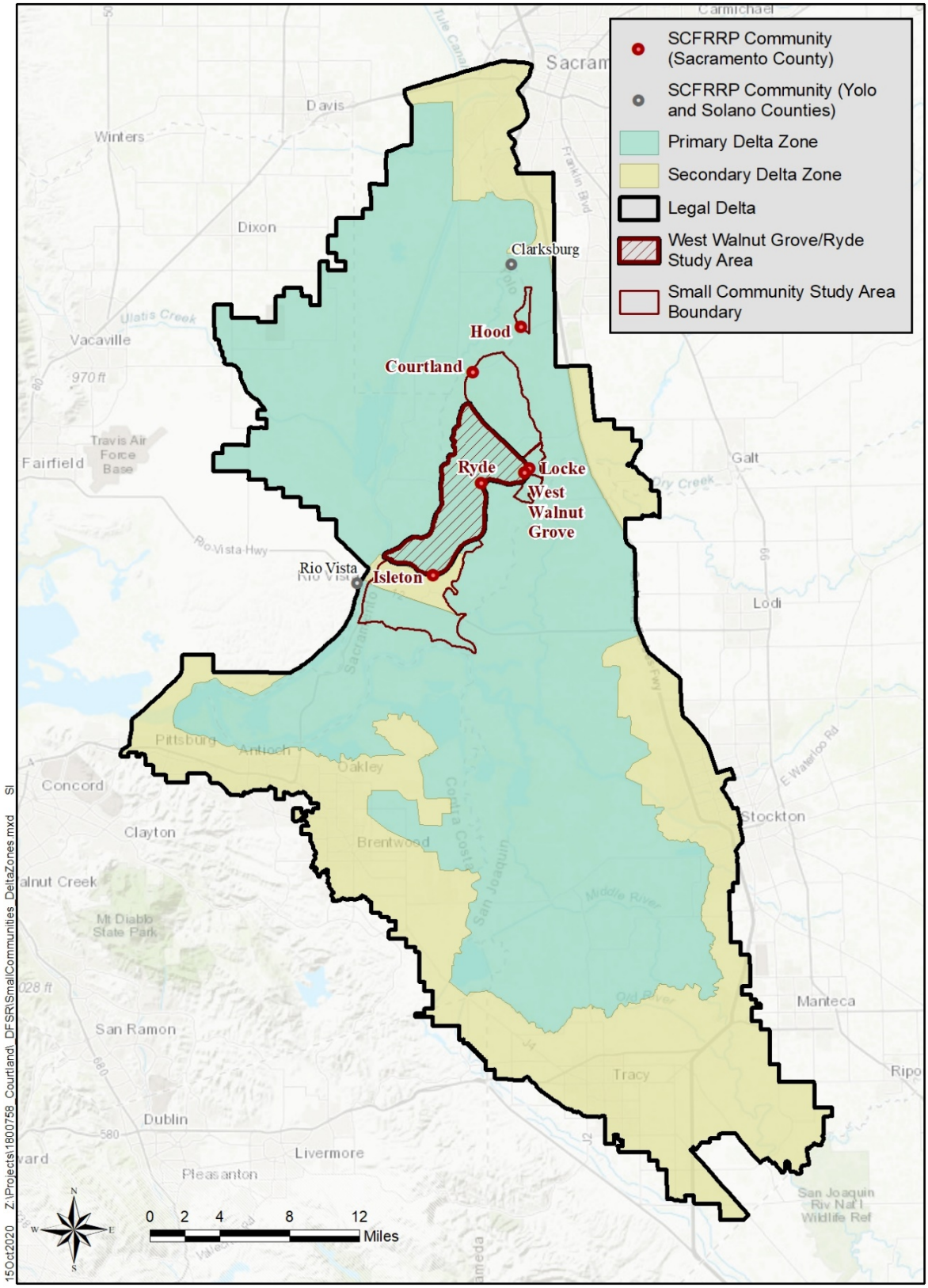



**Figure 1-1. Delta Legacy Communities Participating in the Small Communities Flood Risk Reduction Program**

## 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 West Walnut Grove/Ryde 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 West Walnut Grove/Ryde 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 West Walnut Grove/Ryde study area can collectively enhance the resiliency and reliability of through-Delta water conveyance upstream and immediately downstream 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 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 (*refer to* Figure 1-1) there are significant restrictions within the 2013 Delta Plan and subsequent updates 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 this study are not expected to induce development and/or result in increased flood risk within the West Walnut Grove/Ryde 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), the 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 3 million (M) acres of agricultural lands and a population of 25M.
- The entire volume of water conveyed by the SWP and CVP currently passes directly by West Walnut Grove via the SPFC-leveed channel of the Sacramento River.
- Approximately 5.9 miles of the 17.4 miles of SPFC levees managed by RD 3 protecting the West Walnut Grove/Ryde study area along the right/west bank of the Sacramento River 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.

- *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 West Walnut Grove/Ryde's Need for Improved Flood Protection

West Walnut Grove and Ryde are two of the eight Delta Legacy Communities located along the Lower Sacramento River Corridor in the North Delta participating in the SCFRRP (Figure 1-2). Note that Walnut Grove exists as a single community on the east side of the Sacramento River, but for this flood risk reduction study, the east and west sides of Walnut Grove are discussed and evaluated separately, since they have different levels of flood risk and are located within different RDs. The levees surrounding the communities of West Walnut Grove and Ryde on the right bank of the Sacramento River and the left bank of Steamboat Slough were initially constructed prior to 1906 by local interests and were generally built using materials dredged from the adjacent Sacramento River and Steamboat Slough. 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 RD 3 to learn if adequate documentation supported certification of the levees. In 2012, FEMA updated the flood insurance rate maps (FIRMs) and Grand Island, including the communities of West Walnut Grove and Ryde, were mapped as a Special Flood Hazard Area (SFHA) Zone AE.

The levees protecting the communities of West Walnut Grove and Ryde 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, 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 West Walnut Grove 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.

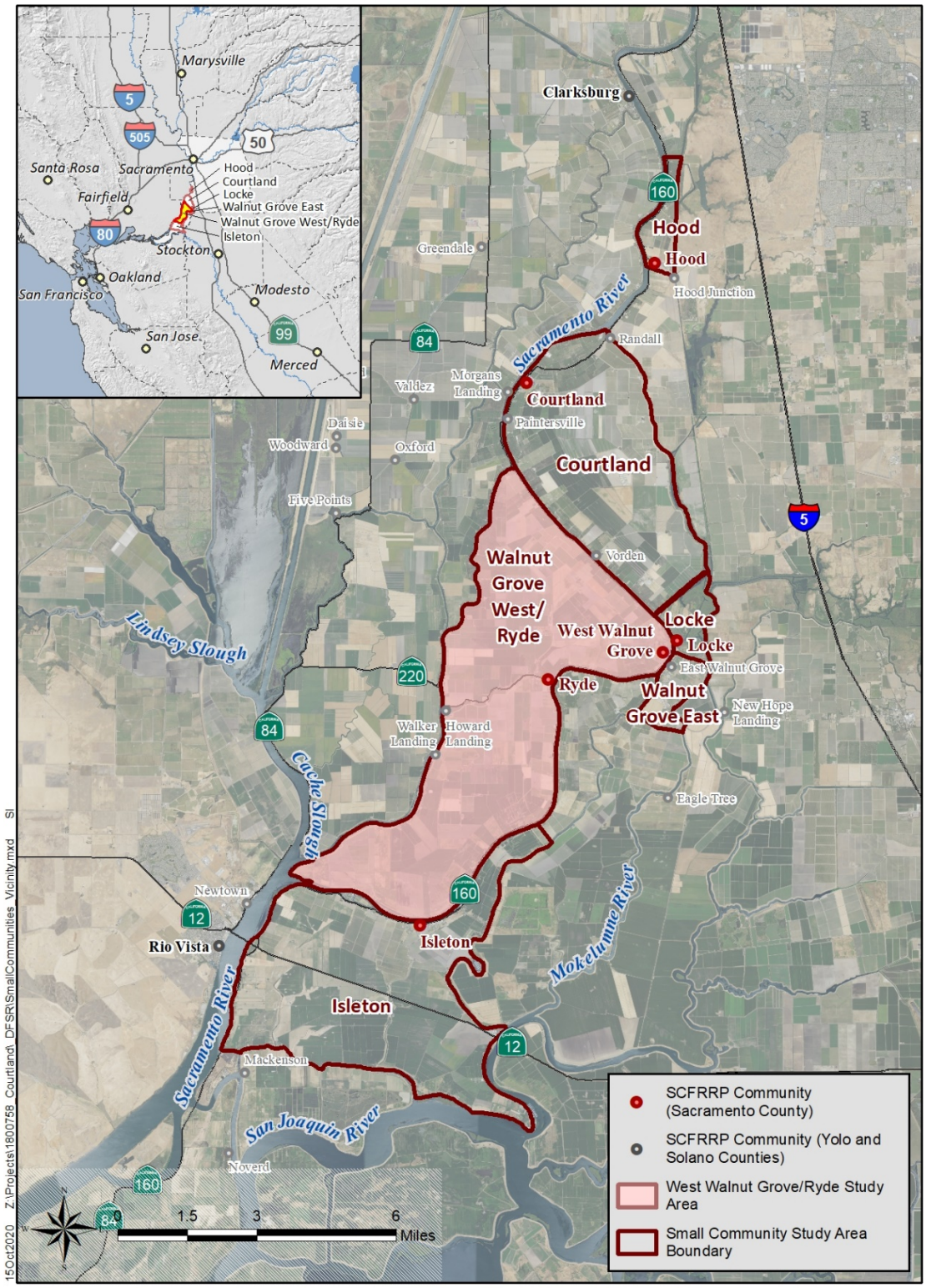



**Figure 1-2. Delta Legacy Communities Participating in the SCFRRP.**

## 1.5 Study Area and Location

The study area for this SCFRRP effort includes the communities of West Walnut Grove and Ryde and the larger 17,100-acre agricultural area which is protected by levees maintained by RD 3, also known as Grand Island (Figure 1-3).

The densely populated communities of West Walnut Grove and Ryde encompass approximately 125 acres. West Walnut Grove (Clampett Tract) sits at an elevation of 0 to 12 feet (North American Vertical Datum 1988 [NAVD 88]) along the west (right) bank of the Sacramento River, southwest and across the river from Locke. Ryde sits at an elevation of -4 to 0 feet NAVD 88 along the west (right) bank of the Sacramento River, approximately 2.6 miles southwest of West Walnut Grove. Elevations and flood depths provided herein are referenced to NAVD 88. RD 3 is the LMA responsible for levee maintenance on Grand Island and maintains 28.8 miles of levee, all of which are SPFC levees. Of these 28.8 miles, 17.4 miles are located along the Sacramento River from the northerly confluence with Steamboat Slough downstream of Courtland to the southerly confluence of the Sacramento River with Steamboat Slough and Cache Slough at the southern downstream end of Grand Island; and 11.4 miles extend along Steamboat Slough from the northerly intersection with the Sacramento River downstream of Courtland to the confluence with the Sacramento River and Cache Slough at the southern, downstream end of Grand Island[2]. The Grand Island – RD 3 levee system offers flood protection to the communities of West Walnut Grove and Ryde and the larger study area, that primarily consists of agricultural lands planted in permanent crops. A levee breach of the SPFC levees within RD 3 could very likely result in the inundation of significant portions of Grand Island and the communities of West Walnut Grove and Ryde.

[2] In addition to other flood management facilities, the SPFC includes "Project levees," which were constructed by the USACE as part of Federal-State flood control projects and were turned over to the State for operations and maintenance ("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.

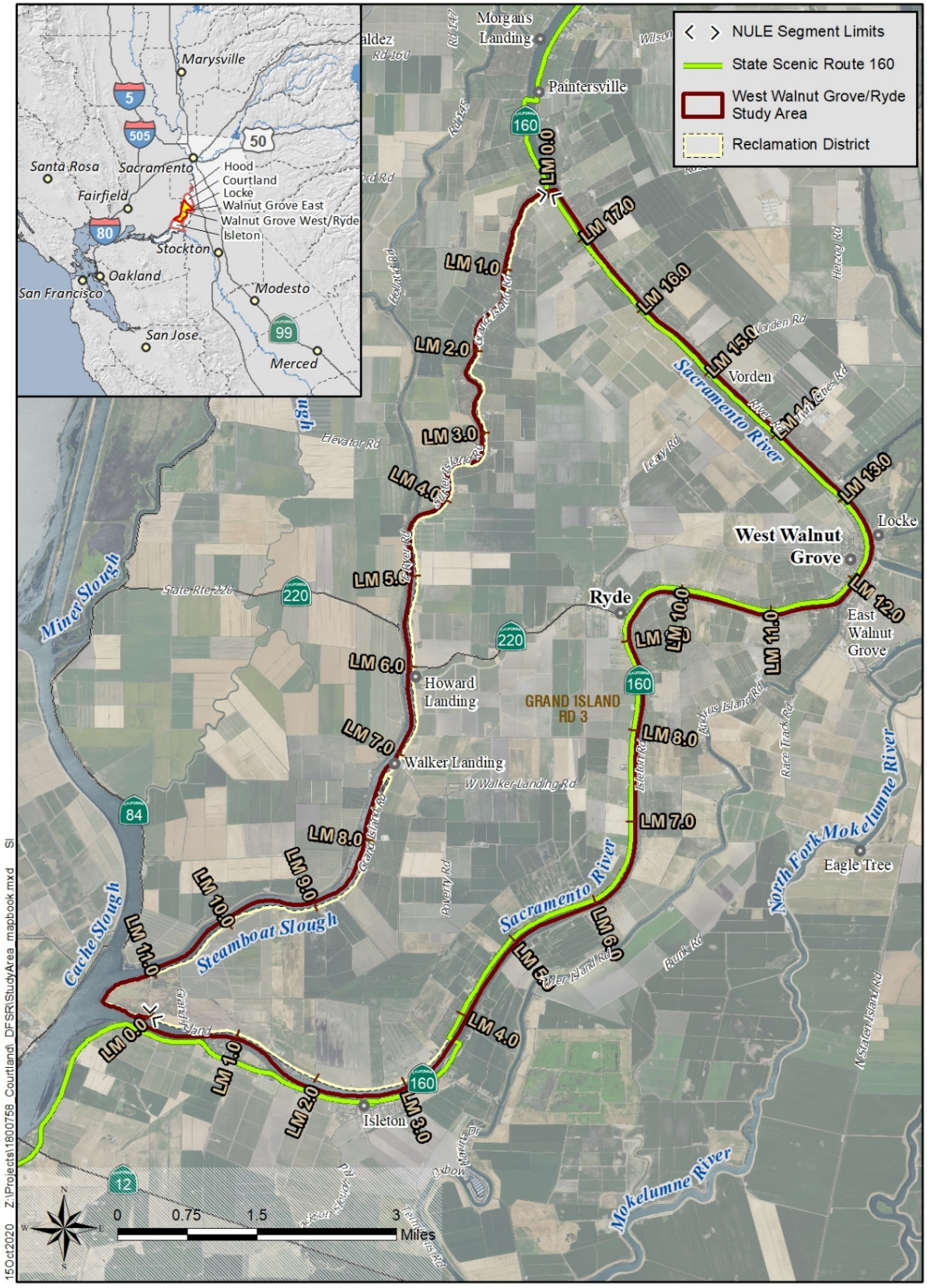



**Figure 1-3. West Walnut Grove/Ryde Study Area**

## 1.6 Public Outreach and Engagement

This feasibility study has been prepared in close coordination with the communities of West Walnut Grove and Ryde 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 West Walnut Grove/Ryde Story Map for more details: West Walnut Grove/Ryde Story Map - Sacramento County Small Communities Flood Risk Reduction Program.[3]

### *1.6.1 Stakeholder Identification and Outreach*

The residents and business owners of West Walnut Grove and Ryde have been invited and encouraged to participate in this planning effort that is intended to be develop from within the communities of West Walnut Grove and Ryde. This feasibility study has been prepared in coordination with representative stakeholders with interest and knowledge in providing enhanced flood protection for West Walnut Grove and Ryde. Stakeholders include representatives of RD 3; landowners and NFIP policy holders within RD 3-Grand Island and Sacramento County; the Sacramento County Department of Water Resources, including the county's floodplain administrator; and 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 West Walnut Grove and Ryde have been encouraged to stay engaged in this process through implementation of both structural-based management actions and non-structural measures.

### *1.6.2 Communications and Engagement*

The goal of this feasibility study is to have the flood risk reduction solutions be developed, promoted, and prioritized by the communities of West Walnut Grove and Ryde, including areas beyond the communities and within RD 3. The feasibility study began by developing a planning committee initially comprised of people that live within the communities and RD 3. The committee is comprised of the following members: Barbara McGowan, Robert Bromell, Dave Robinson, Joey Sanchez, and Mark Rogerson.

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/business owners within the RD. The study process began

[3] https://sacramentocounty.maps.arcgis.com/apps/MapJournal/index.html?appid=b2415f6ee34746bda8b8765782c3fa45

with the development of an interactive Story Map on Sacramento County's Storm Ready website http://sacdelta.stormready.org/ (published in September of 2018) that describes the communities, their importance to the region and current flood risk, and recommended solutions to reduce that risk.

An initial meeting with the planning committee as well as trustees from RD 3 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 difficulty in obtaining 100-year FEMA certification due to the large levee system and ongoing seepage areas along Steamboat Slough.

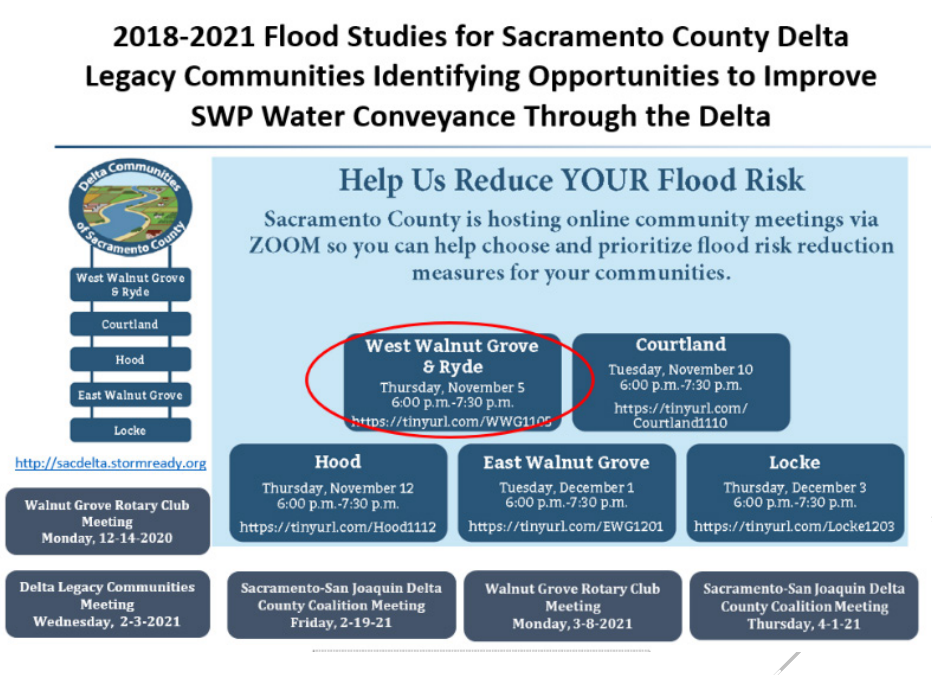
The opportunities identified during this meeting included: the multi-benefit opportunity of the levee system repairs / improvements to improve resiliency of through-Delta water conveyance and protecting deteriorated water quality from inundation of such a large island.

Structural management actions and non-structural measures were discussed. The group's highest priority structural management action was to fix the weakest links within the levee system. The group also expressed the desire to obtain FEMA 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 West Walnut Grove. The ring levee would isolate the community from flooding in the event a levee breach in RD 3 were to occur outside of the immediate community. The group expressed concerns that a potential ring levee could strand or isolate agricultural lands adjacent to West Walnut Grove/Ryde that support other nearby homes and businesses also considered to be part of the larger community within RD 3. 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.

Non-structural solutions were also discussed and included improvements to the emergency communication operations plan, development of relief cut locations, and working with FEMA and/or other providers to reduce NFIP 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 the meeting held in June of 2018, the Story Map for West Walnut Grove/Ryde was drafted and in August 2018, the Story Map at http://sacdelta.stormready.org/ was presented for review and to garner more input. was presented for review and to garner more input.

RD 3 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 RD 3 to perform geotechnical explorations. This included identification of Cone Penetration Tests (CPTs) locations in select areas around RD 3 to fill in data gaps and obtain an improved picture of levee hazard classifications and performance. Assurances were made to the District 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.




As the geotechnical data was analyzed and the suite of structural and non-structural management actions were developed, the study team again met with the community members to discuss initial findings from geotechnical evaluations as well as evaluate management actions in February 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 on RD 3; and (2) full levee modernization costs associated with bringing the SPFC levee system up to current, modern standards to meet FEMA 100-year accreditation standards pursuant to 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.[4]

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 levees protecting the communities of West Walnut Grove and Ryde, 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 RD 3 to provide existing levee data and known issues to

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

help inform and prioritize remediation actions. The planning committee as well as the public was provided a draft feasibility study report in October 2020 for their review which was followed by a virtual meeting in November 2020 to discuss the report and receive additional input. During the November 2020 meeting, stakeholders expressed interest in non-structural solutions to reducing flood risk in RD 3, including elevating structures and working with FEMA and/or other providers to reduce NFIP flood insurance premiums. There was no feedback on the structural solutions developed for the community of West Walnut Grove.

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 management actions 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.

A summary of outreach meetings held for the West Walnut Grove/Ryde study area is provided in Table 1-1.

**Table 1-1. Outreach Community Meetings for the West Walnut Grove/Ryde Study Area.**

| Date | Event/Location | Address | Host Organization | Attendance |
|---|---|---|---|---|
| 6/12/2018 | Kiononia Hall | 14120 Grand Ave, Walnut Grove | SCFRRP Study Team | 7 |
| 3/21/2019 | East Walnut Grove Fire Station | 14160 Grove St., Walnut Grove | SCFRRP Study Team | 15 |
| 2/19/2020 | Kiononia Hall | 14120 Grand Ave, Walnut Grove | SCFRRP Study Team and Public | 6 |
| 10/15/2020 | East Walnut Grove Fire Station | 14160 Grove St., Walnut Grove | RD 3 Board and SCFRRP Study Team | 12 |
| 11/05/2020 | Virtual Zoom Meeting | -- | SCFRRP Study Team | 9 |

### *1.6.3 Coordination with Key Agencies within the Delta*

This feasibility study has been prepared in coordination with the Delta stakeholders. They include representatives of RD 3; landowners and FEMA NFIP policy holders within RD 3; the 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.

#### 1.6.3.1 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/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.

#### 1.6.3.2 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/modifying the existing levee systems identified in this study for the communities of West Walnut Grove and Ryde, which may be subject to a consistency determination by the DSC.

#### 1.6.3.3 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 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.

## 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 West Walnut Grove/Ryde study area.

### *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 management actions 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 West Walnut Grove/Ryde 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 Sacrament 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.

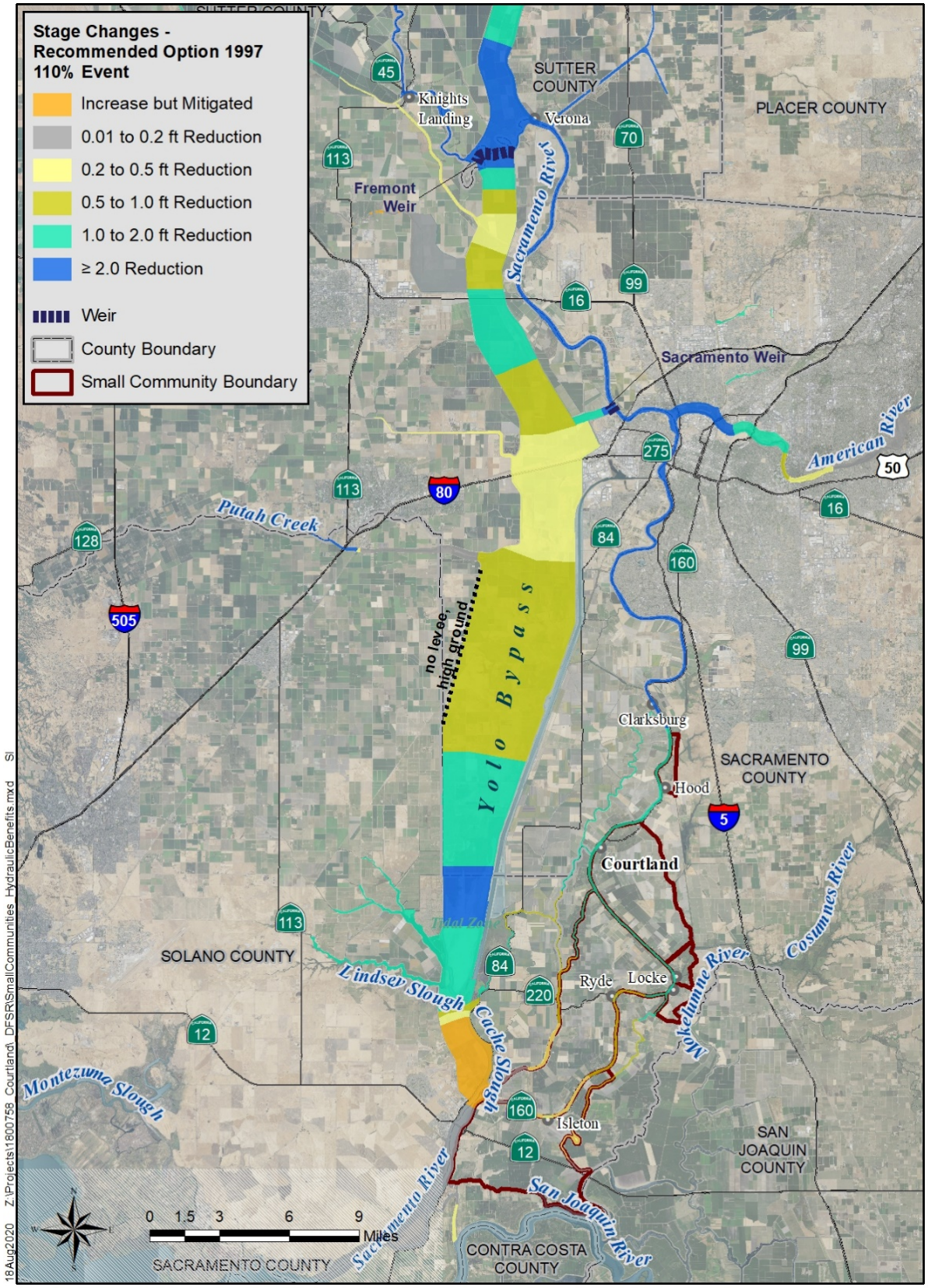



**Figure 1-4. Flood Stage Reductions as a Result of the BWFS Expansions and Modifications.**

### 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 also recommended further flood risk reduction feasibility studies for many small communities and Delta Legacy Communities, including West Walnut Grove/Ryde.

### 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 (EADs). Seventeen islands were identified as very-high priority and 36 islands and tracts were identified as high priority (DSC, 2017). The West Walnut Grove/Ryde study area was placed in the "Very High" category, and as such, is currently highly prioritized for State investments under the initial DLIS prioritization process (Figure 1-5).

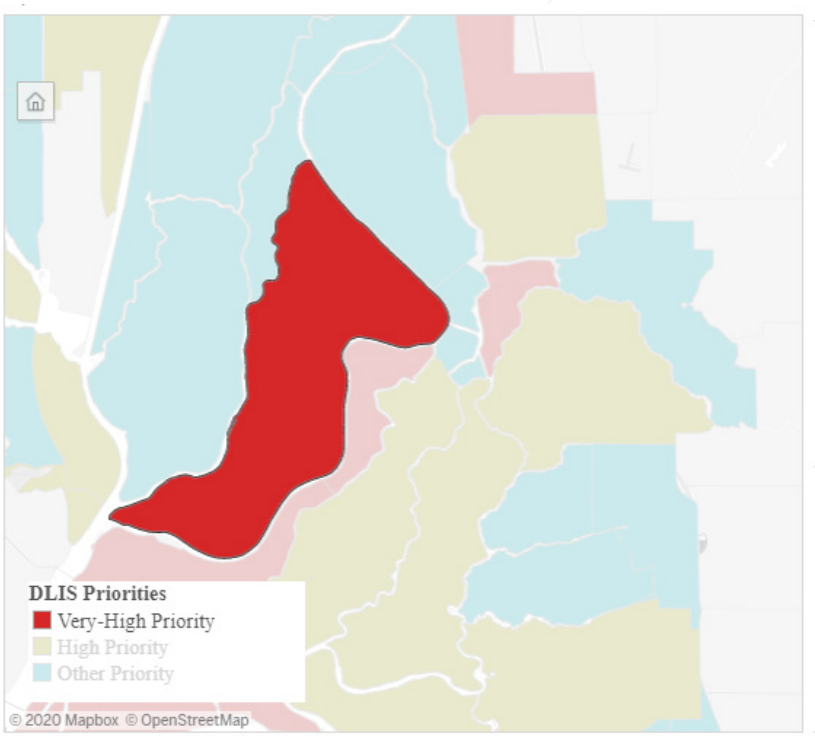



**Figure 1-5. DLIS Analysis – Overall Prioritization (Rand Corporation, 2020)**

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 West Walnut Grove/Ryde study area was initially estimated to have an annual probability of 2.2 percent to 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 3 levee system.

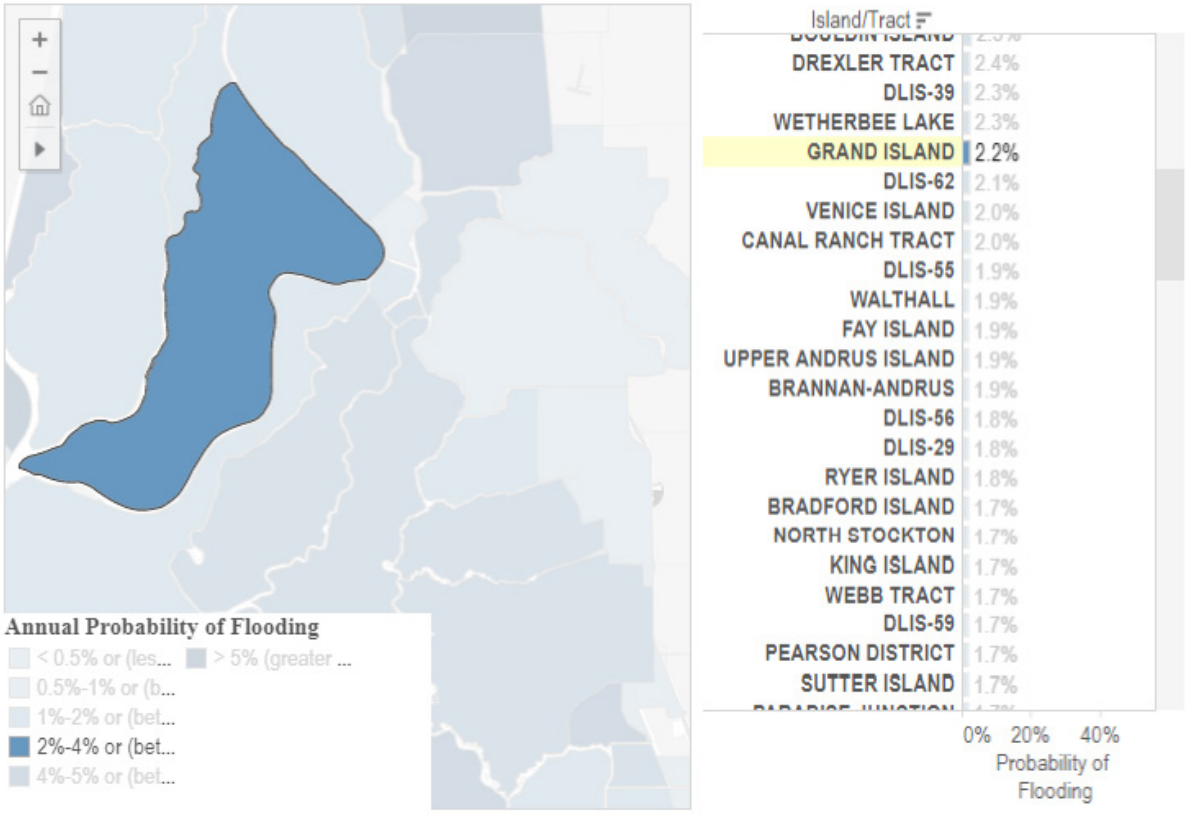



**Figure 1-6. DLIS Analysis - Hydrologic Event (Rand Corporation, 2020)**

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.[5]

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

### 1.7.5 Flood System Repair Project

The FSRP was funded by $150M of Proposition 1E funding and aims 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). Currently, there is one serious erosion site along the right, west bank of the Sacramento River within NULE Segment 384 which poses imminent flood threats to the communities of West Walnut Grove and Ryde, requiring priority attention. It is hoped that this feasibility study in combination with the DWR FSRP can assist RD 3 and the communities of West Walnut Grove and Ryde in prioritizing and implementing the remaining repair of the known and documented FSRP site by 2022-24.

### 1.7.6 Non-Urban Levee Evaluations

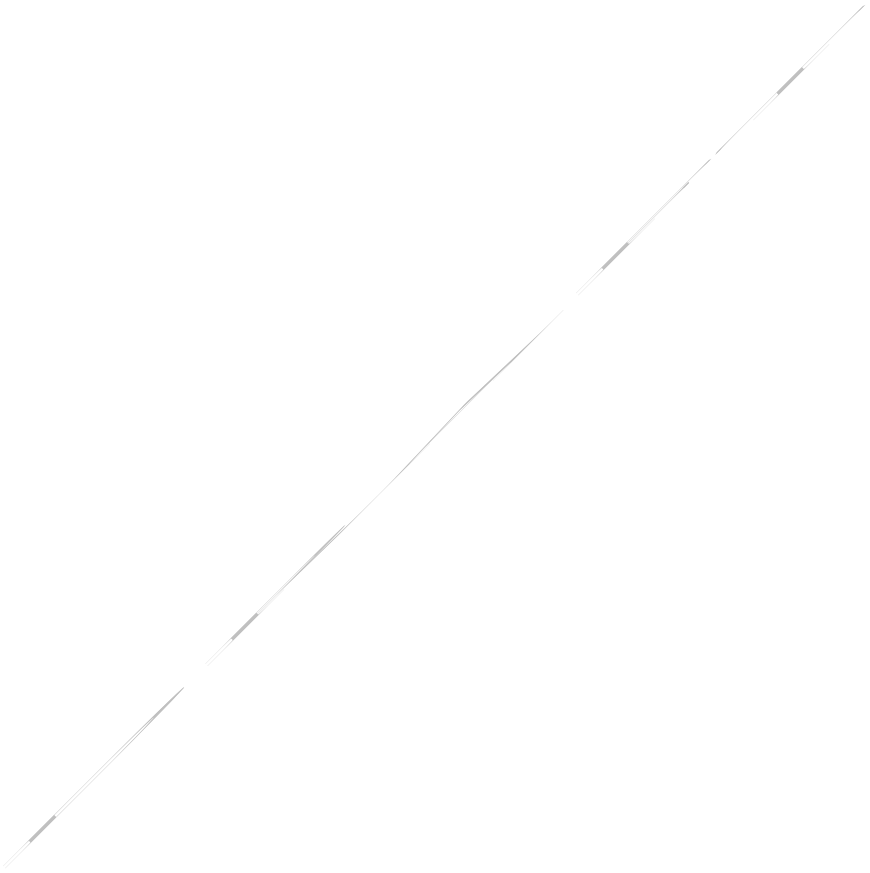
DWR's NULE program evaluated non-urban levees against geotechnical criteria likely to impact levee performance, including stability, through seepage, underseepage, and erosion. In general, the program was administered using a phased approach in communities with less than 10,000 residents and included 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 Appendix A and in Section 2.1.1, Topography and Levees. However, the West Walnut Grove/Ryde 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* Appendix A for additional information).

### 1.7.7 Levee System-Wide Improvement Framework

As of June 2021, RD 3 has an approved System-Wide Improvement Framework (SWIF) plan. The SWIF was 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. RD 3 will be making repairs that address system-wide issues and correct unacceptable inspection items in a prioritized manner to optimize flood risk reduction. The USACE's approval of the SWIF allows the noted LMA to remain active in the Public Law (PL) 84-99 rehabilitation program while the SWIF is being

implemented. 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.



# 2. Existing Conditions

## 2.1 Existing Conditions

### *2.1.1 Topography and Levees*

Ground elevation for the West Walnut Grove and Ryde study area is highest immediately adjacent to the levees (up to 8-12 ft., NAVD 88, along the right bank of the Sacramento River between Steamboat Slough and Ryde) and slopes toward the center of the study area (-12 to -8 ft., NAVD 88) (Figure 2-1). Top of levee elevations vary from approximately 22 to 26 feet NAVD 88 within the study area. The community of West Walnut Grove generally sits at an elevation of 0 to 12 feet NAVD 88 near the west (right) bank of the Sacramento River levee and the community of Ryde sits at an elevation of -4 to 0 feet NAVD 88 along the west (right) bank of the Sacramento River, in comparison to the larger study area that largely sits at an elevation of -4 to -12 feet NAVD 88.

The study area consists of 28.8 miles of levees, all of which are SPFC levees (Figure 2-1). Of these, approximately 17.4 miles are located along the west/right bank of the Sacramento River (NULE Segment 384) and 11.4 miles are located along the east/left bank of Steamboat Slough (NULE Segment 113) (URS, 2011a).

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 West Walnut Grove/Ryde study area was aggregated into one impact area (SAC 50 [Grand Island]) and two index points: SAC 50 (Grand Island, RD 3 – Steamboat Slough) and SAC 50a (Grand Island, RD 3 – Sacramento River).

Levee performance curves were collectively updated by DWR and Sacramento County for each of the project levee segments in the study area during the course of this study as a result of geotechnical explorations performed in 2016. The new levee performance curves are included in Appendix E. For the purposes of this study, the existing SAC 50 impact area was divided into two new impact areas: SAC 50 – Urban, which is representative of the community of West Walnut Grove/Clampett Tract, and SAC 50 – N1, which represents the remainder of Grand Island (Figure 2-2).

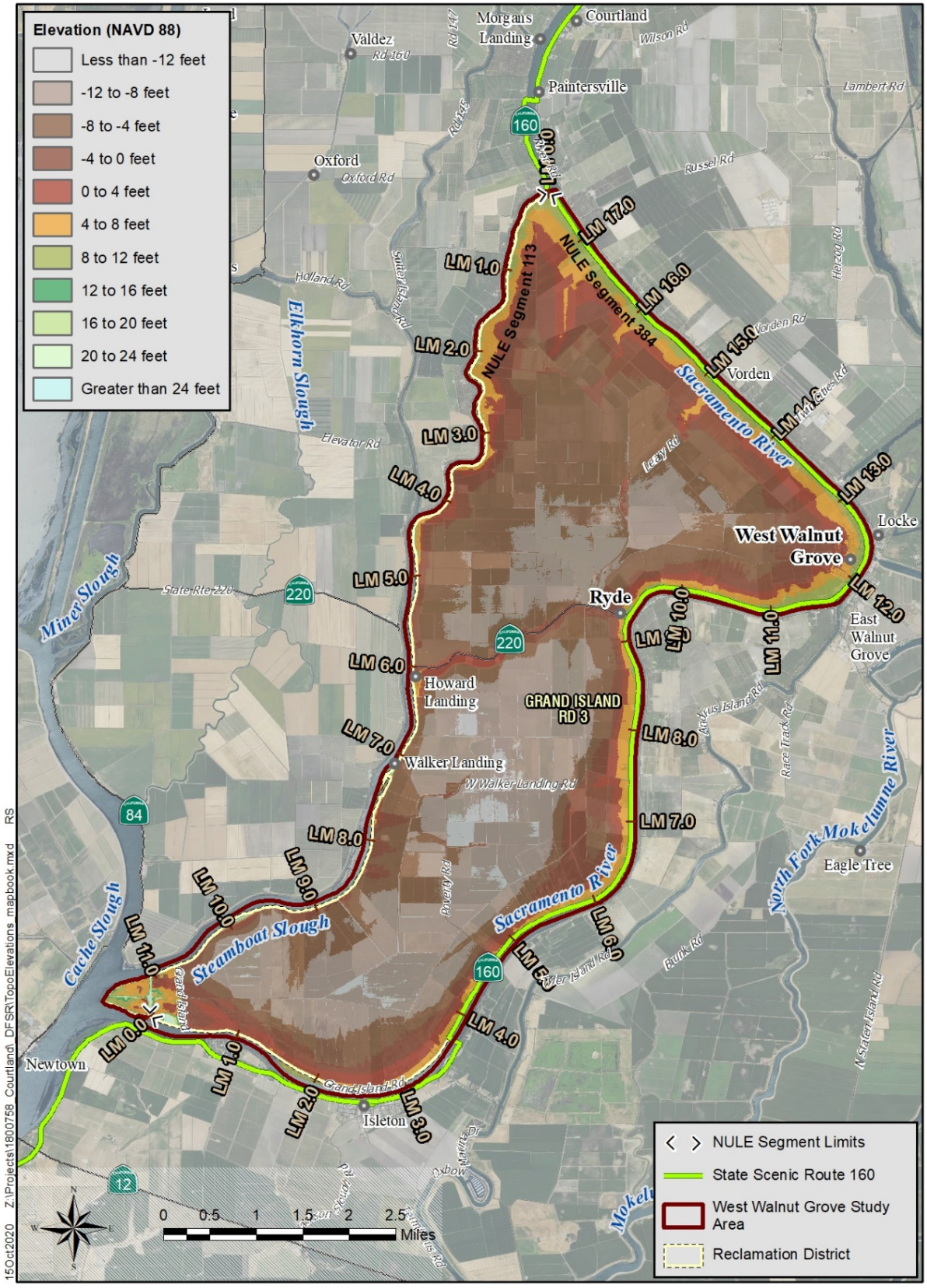



**Figure 2-1. Study Area Ground Elevations and DWR NULE Levee Segments**

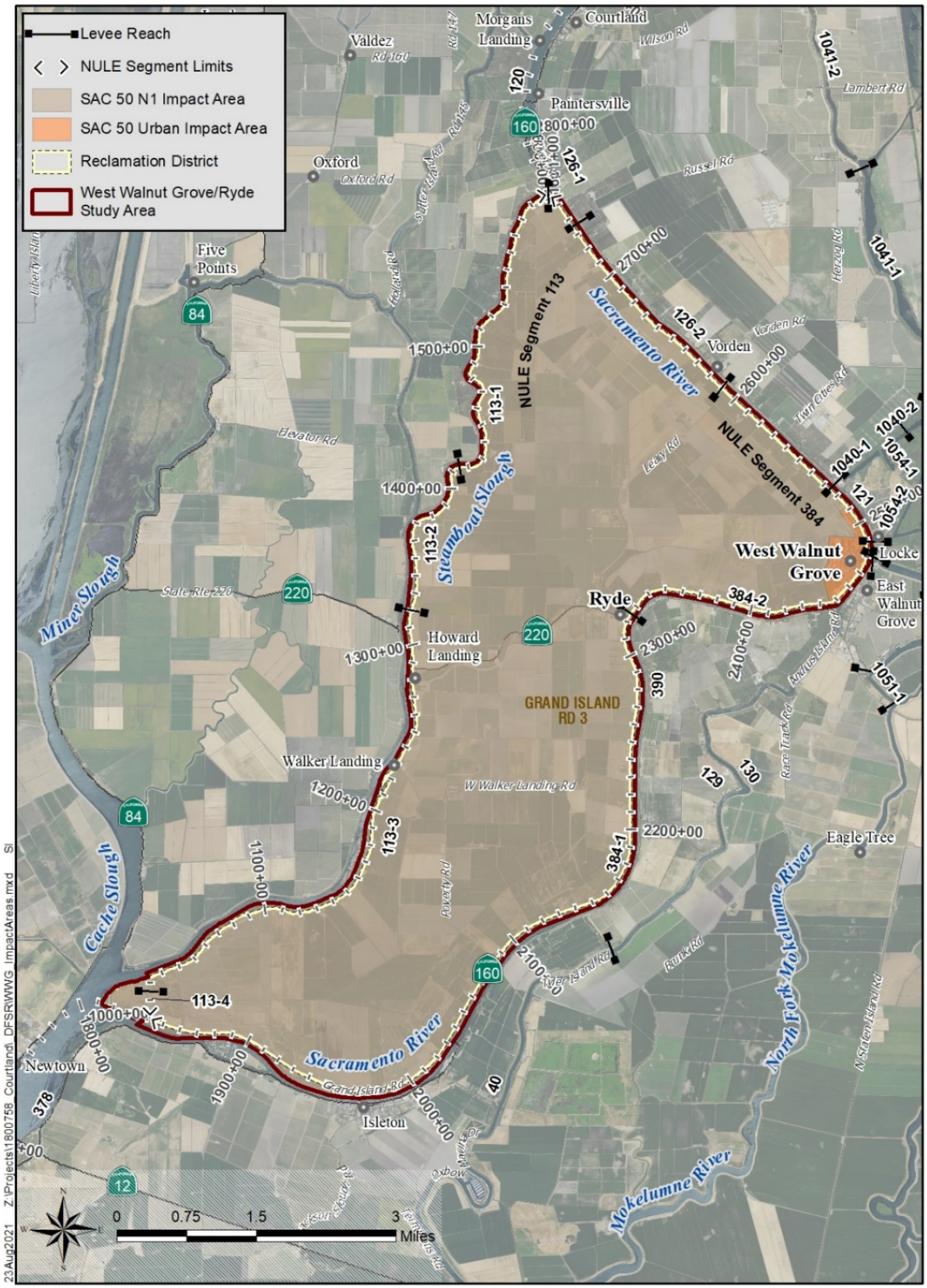



**Figure 2-2: West Walnut Grove Study Area Impact Areas**

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 2-1.

**Table 2-1. Summary of Levee Geometry (URS, 2011a)**

| Levee Segment Location | NULE Segment | Reach | Approximate Levee Height | Approximate Crown Width | Approximate Landside Slopes | Approximate Waterside Slopes |
|---|---|---|---|---|---|---|
| Right Bank Sacramento River – RD 3 (SPFC levee) | 384 | Reach 1 LM 0 to 1.1 | LM 0 to LM 2.4: 19 to 26 ft. above the landside toe | 20 to 40 ft. | 1.3H:1V to 4H:1V | 1.4H:1V to 4H:1V |
| | | Reach 2 LM 1.1 to 17.4 | LM 2.4 to LM 17.4: 14 to 20 ft. above the landslide toe | | | |
| Left Bank Steamboat Slough – RD 3 (SPFC levee) | 113 | Reach 1 LM 0 to 4.35 | 15 to 25 ft. above the landside toe | 20 to 35 ft. | 2H:1V to 4H:1V | 1.5H:1V to 3.5H:1V |
| | | Reach 2 LM 4.35 to 11.4 | 16 to 28 ft. above the landslide toe | 20 to 40 ft. | 2H:1V to 5H:1V | 1.5H:1V to 3.4H:1V |

### *2.1.2 Geomorphology*

Geomorphology (bed and bank erosion and sediment deposition) mapping developed for the DWR NULE project indicates the RD 3 levees along the Sacramento River and Steamboat Slough primarily overlie historical overbank deposits (Rob) likely consisting of interbedded sand, silt, and clay deposited during high-stage flow, overtopping channel banks (Figure 2-3). Localized areas of historical crevasse splay deposits (Rcs), historical slough deposits (Rsl), and historical distributary channel deposits (Rdc) are also present. The crevasse splay deposits (Rcs) are likely to consist of fine to coarse sand with minor lenses of gravel deposited from breaching of natural levees. The slough deposits (Rsl) likely consist of silt, clay, and trace sand, fining upward from low-energy channel deposits. The distributary channel deposits (Rdc) are likely to contain sand, silt, and clay from channelized flow conducting sediment to the floodplain. There are also two locations of overflow channel deposits (Rofc) along the Sacramento River levee (NULE Segment 384), likely consisting of vertically stratified sand, silt, and clay deposited when high stage water overtops channel banks and returns to the river.

Different conditions are present at the downstream end of the Sacramento River levee (NULE Segment 384). The southern approximately 1-mile of levee are mapped to overlie Holocene peat and mud (Hpm) with a few locations of historical overbank deposits (Rob). Holocene peat and mud (Hpm) likely consist of interbedded peat and organic-rich silt and clay from former tidal marsh deposits, now drained and farmed. A localized area of a Holocene channel deposits (Hch) is mapped near LM 1 to LM 1.4 and likely contains poorly graded sand and trace fine gravel. *See* Appendix A for additional information on existing geotechnical conditions within the study area, which includes the collection and evaluation of nine 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]

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

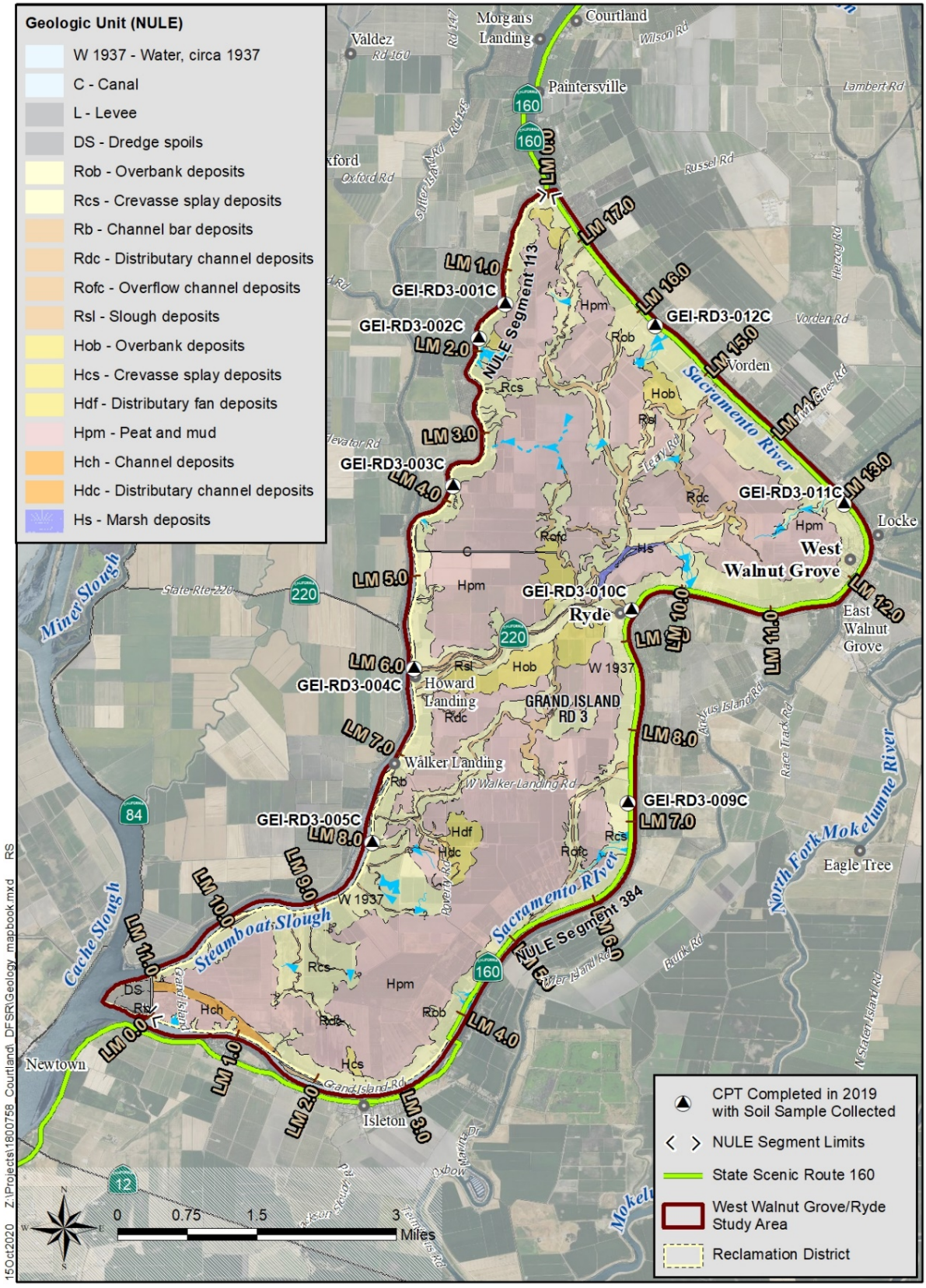



**Figure 2-3: Geomorphology within the Study Area.**

### 2.1.3 Population, Communities, and Land Use

According to the 2017 CVFPP Update and based on 2010 census data, the total population of the SAC 50 impact area (Grand Island), including West Walnut Grove, Ryde, and the larger agricultural area, is 1,465 (DWR, 2017d). Income information for West Walnut Grove and Ryde is not available; however, according to an annual American Community Survey conducted in 2016 and 2018, the median household income for the nearest census designated place (including East Walnut Grove and Locke) declined from $53,634 to $47,400 (United States Census Bureau, 2010). West Walnut Grove and Ryde are not considered disadvantaged communities as defined by the State of California.

**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."

West Walnut Grove and Ryde are within the Primary Zone of the Legal Delta which means that local and county general plans and land use decisions must be consistent with the Delta Plan. However, limited development within West Walnut Grove/Ryde along with several other communities in the Delta (Hood, Courtland, East 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 and Figure 2-5). Section 5010 of the Delta Plan requires new residential, commercial and industrial development 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 Special Planning Area (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.

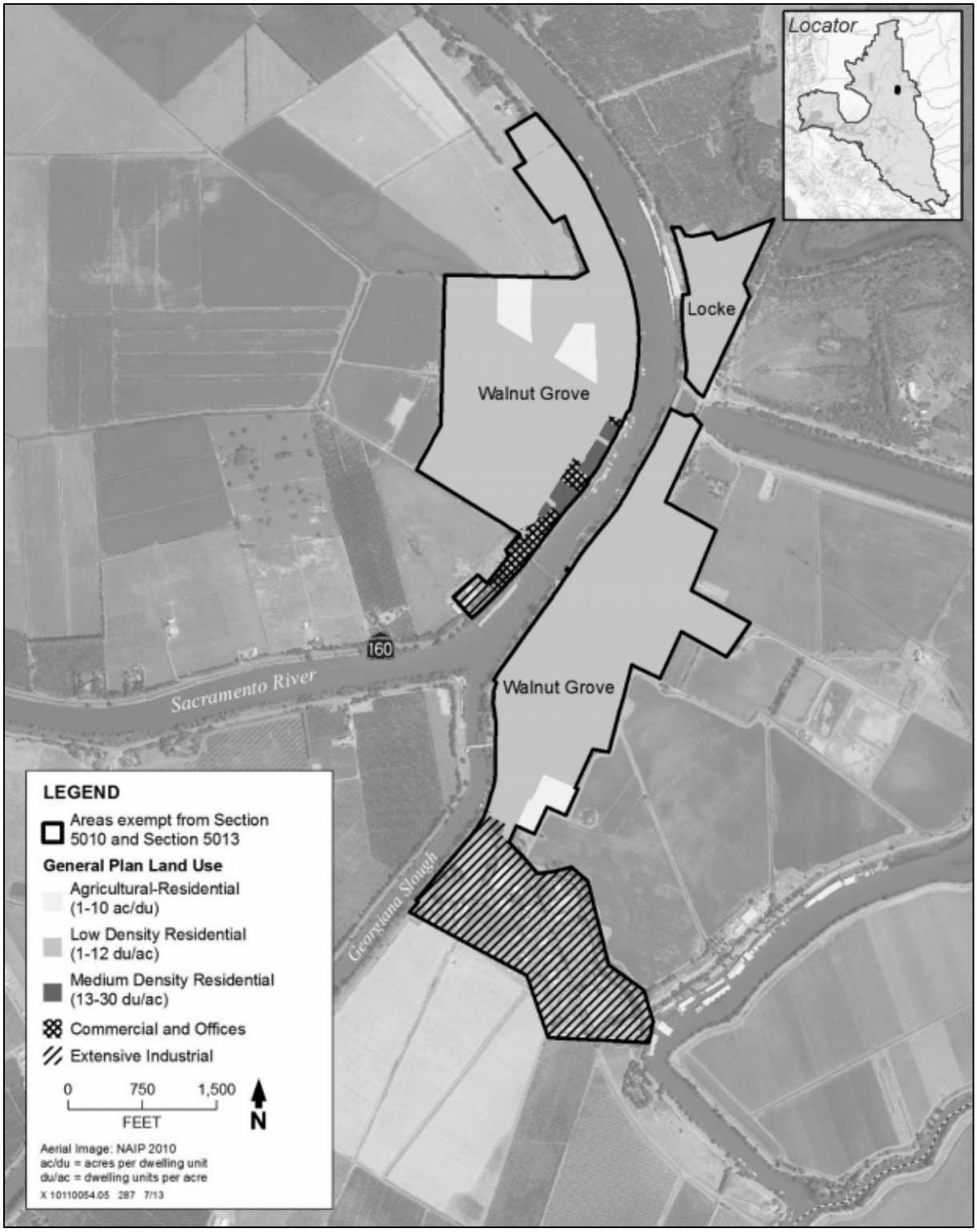



**Figure 2-4: West Walnut Grove Land Use under the Delta Plan (DSC, 2013)**

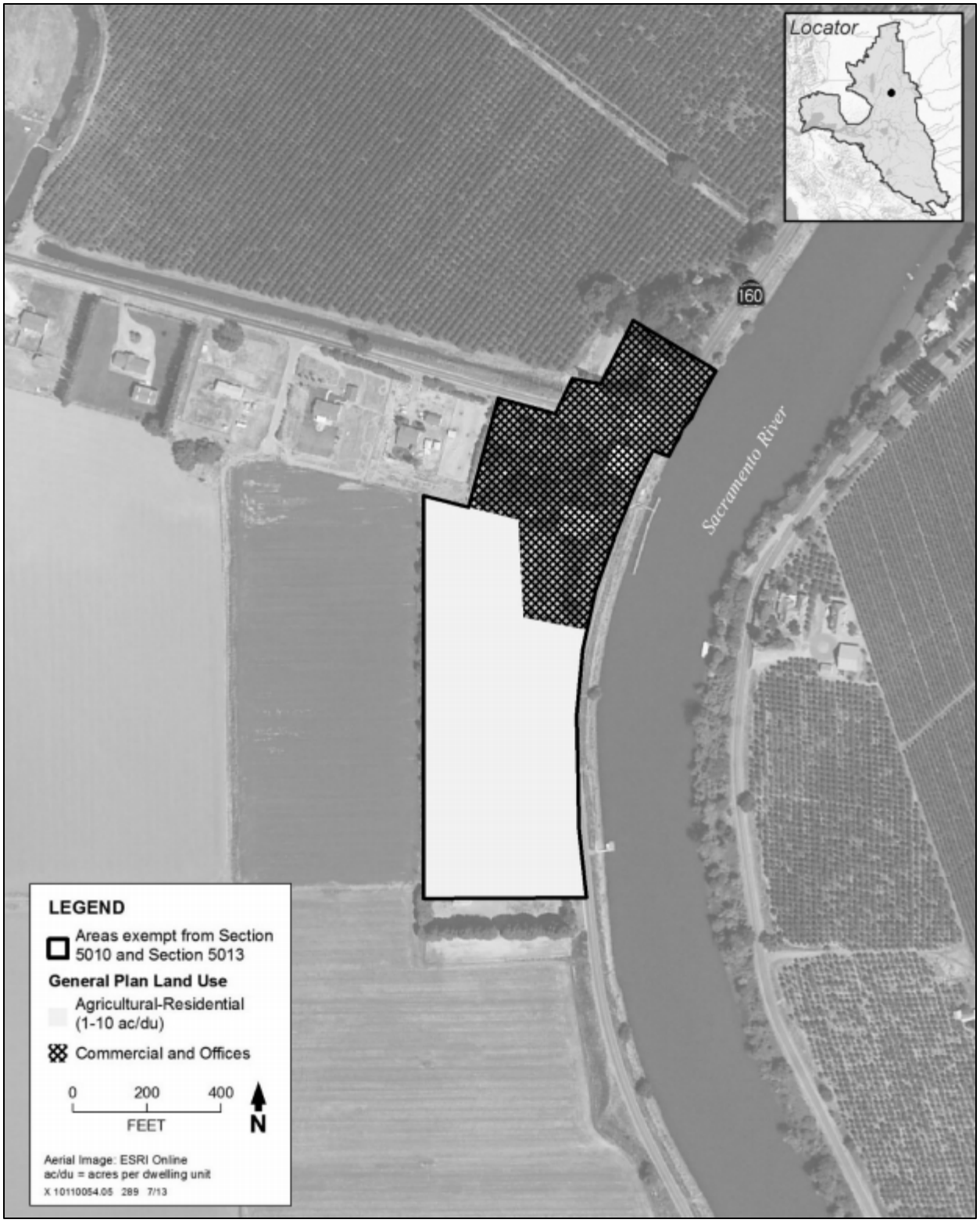



**Figure 2-5: Ryde Land Use under the Delta Plan (DSC, 2013)**

### 2.1.4 Hydrology and Hydraulics

The West Walnut Grove and Ryde study area is bounded by the Lower Sacramento River and Steamboat Slough 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 percent) away from the Lower Sacramento River and Steamboat Slough immediately adjacent to Grand Island, including the communities of West Walnut Grove and Ryde. Figure 1-4 indicates a stage reduction of approximately 1 to 2 feet at West Walnut Grove due to the planned enlargements of the upstream bypasses and weirs.

Estimated existing 100-year peak 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 for the West Walnut Grove/Ryde study area in Table 2-2. 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 Steamboat Slough to Georgiana Slough is approximately 66,300 cubic feet per second (cfs). Between Georgiana Slough and Cache Slough, Sacramento River flows are reduced to near 45,200 cfs due to distributary flows out of the Sacramento River main stem at Georgiana Slough and downstream tidal conditions. In Steamboat Slough between the junction with the Sacramento River and Sutter Slough, the 100-year peak flow is 25,000 cfs. Further downstream on Steamboat Slough between Sutter Slough and Cache Slough, the 100-year peak flow is increased by nearly 50 percent to 36,100 cfs. 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 2-2. Sacramento River and Steamboat Slough Existing and Future 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, Steamboat Slough to Georgiana Slough | 66,300 | 59,200 | 56,500 |
| Sacramento River, Georgiana Slough to Cache Slough (Yolo Bypass Junction) | 45,200 | 39,100 | 35,900 |
| Steamboat Slough, Sacramento River to Sutter Slough | 25,000 | 21,900 | 28,000 |
| Steamboat Slough, Sutter Slough to Cache Slough | 36,100 | 32,400 | 43,500 |

It should also 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 adjustments and downstream sea level rise adjustments) is 1 to 2 feet higher than the USACE 1957 profile grade. The USACE 1957 profile is used as a guide for the operations and maintenance of the Grand Island – RD 3 perimeter levee system. *See* Appendix I for further details on the water surface elevations, current and future, that are anticipated for the Sacramento River and Steamboat Slough surrounding Grand Island – RD 3.

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 West Walnut Grove/Ryde 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.

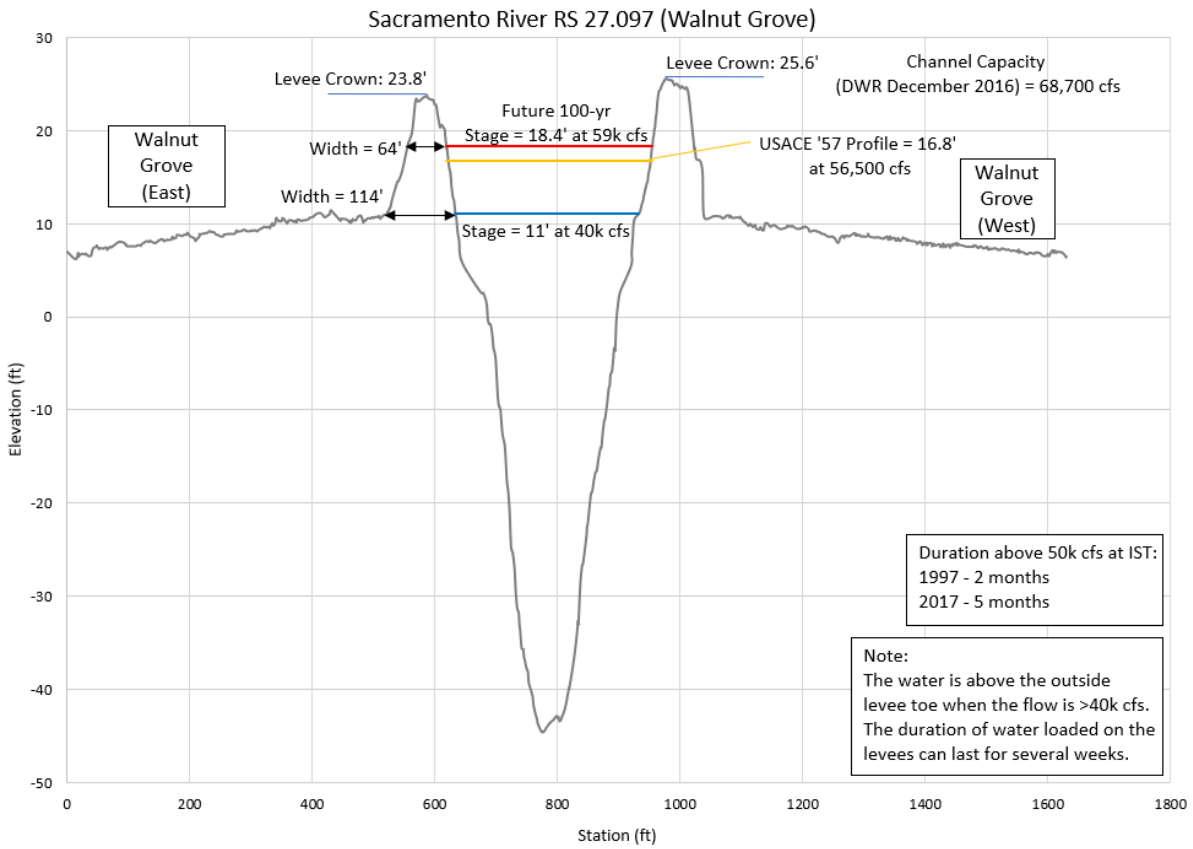



**Figure 2-6: Cross Section at Sacramento River Station 27.097 at West Walnut Grove Viewing Downstream**

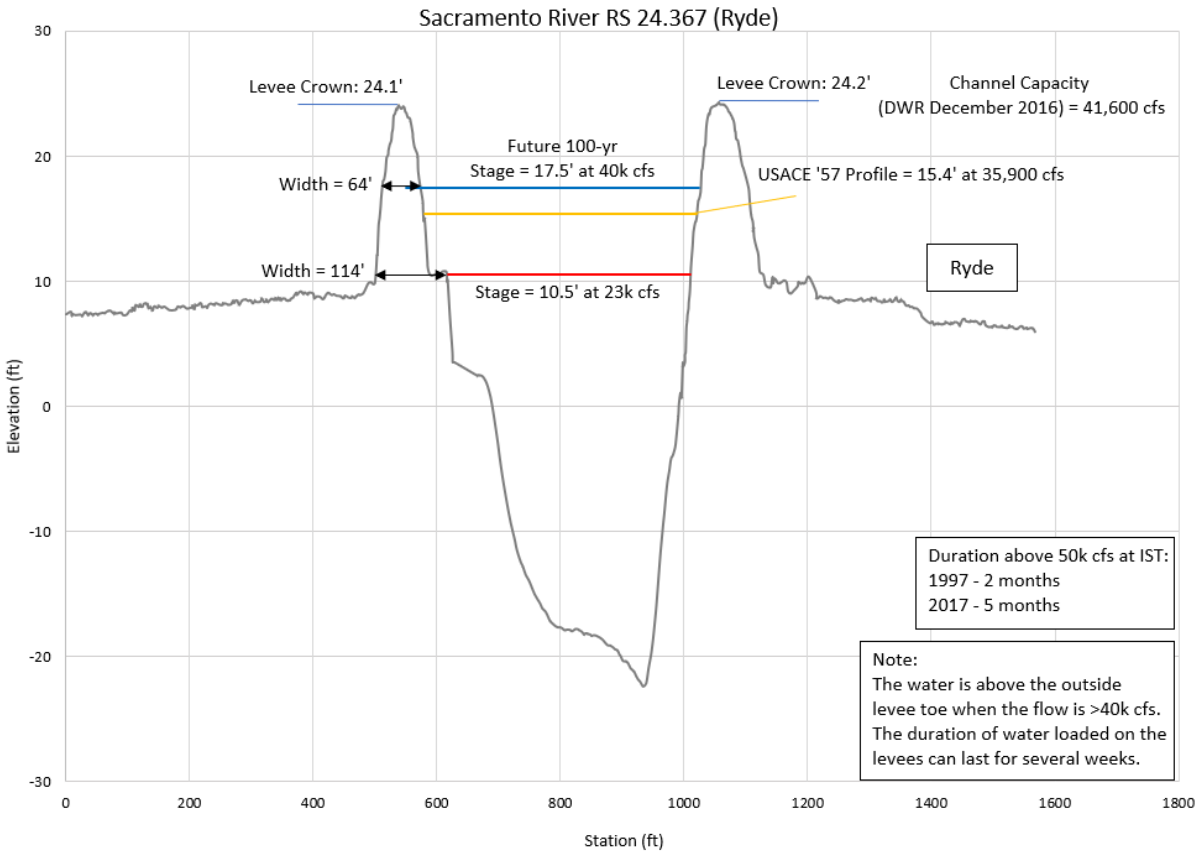



**Figure 2-7: Cross Section at Sacramento River Station 24.367 at Ryde Viewing Downstream**

### *2.1.5 Water Resources and Water Conveyance*

Delta waterways are important to North Delta communities and the State's water supply system. West Walnut Grove and Ryde lie along the Sacramento River near the Delta Cross Channel. 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.

### *2.1.6 Existing Infrastructure*

The community of West Walnut Grove is served by the Sacramento Regional County Sanitation District, whose regional wastewater treatment plant is located on the north side of Elk Grove, approximately 15 miles northeast of West Walnut Grove.

Critical infrastructure within the study area is shown in Figure 2-8. Critical infrastructure includes State Route (SR) 160, SR 220, county maintained paved roads, a ferry, local bridges, schools, RD 3 drainages and pumping stations, a fire station, gaging stations, water wells, oil/gas wells, a cell tower, a solid waste Facility, an oil/gas pipeline, and a PG&E substation near the center of Grand Island.

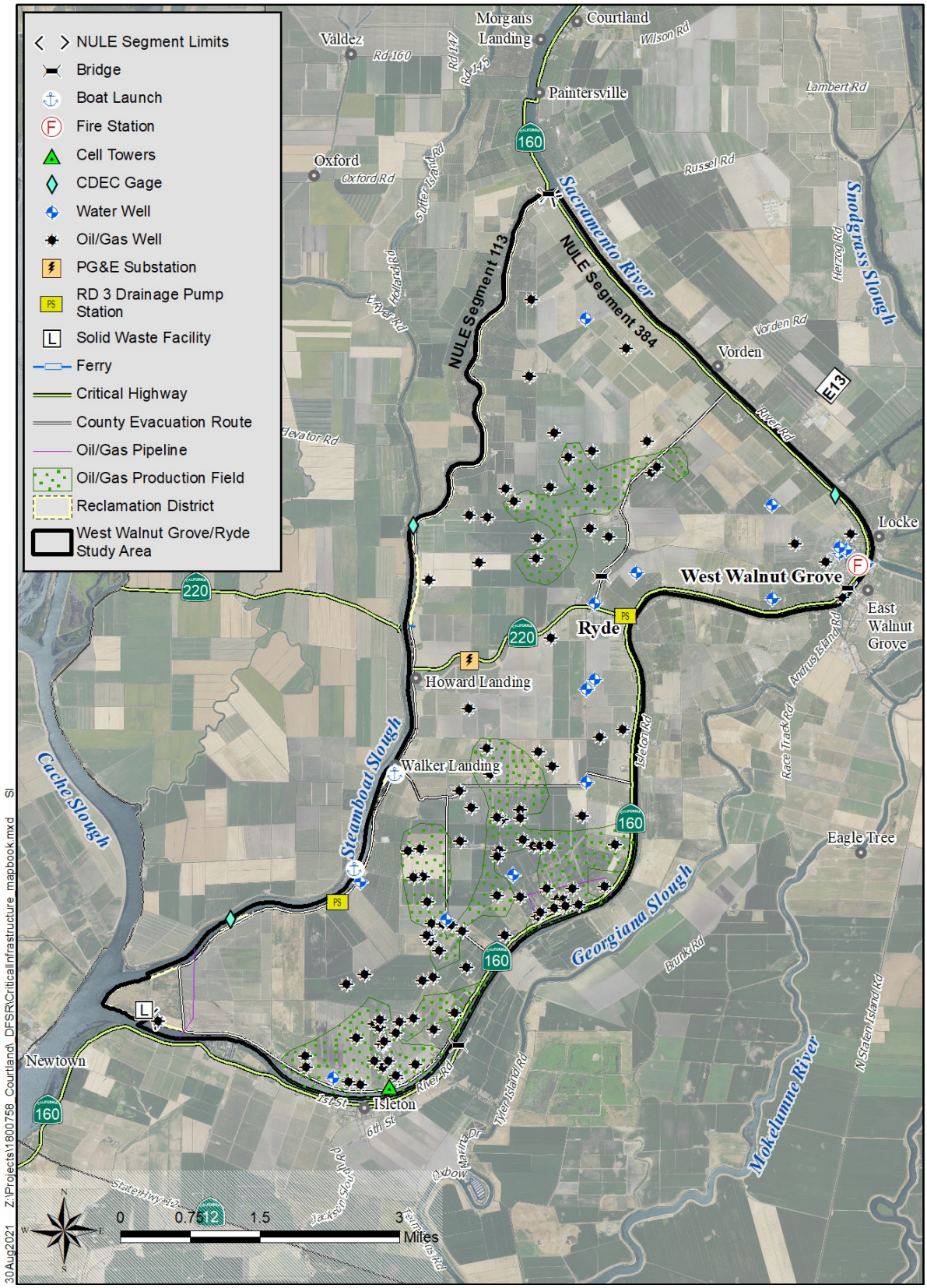



**Figure 2-8: West Walnut Grove/Ryde Critical Infrastructure within Grand Island Study Area**

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 West Walnut Grove study area to evaluate the annualized EAD for the West Walnut Grove 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, freshwater emergent wetland, and palustrine farmed features are found in the study area. The Sacramento River is located adjacent to the eastern boundary of the study area and converges with Steamboat Slough and Cache Slough at the southwestern most tip of the study area. Steamboat Slough is situated on the entire western boundary of the study area. Irrigation ditches throughout the interior of the study area, among parcels of agricultural land, provide drainage to the property owners, but the water is removed at pumping plants before entering waterways.

The majority of the West Walnut Grove and Ryde study area is designated as prime farmland, with farmland of local importance located within or adjacent to the densely populated communities of West Walnut Grove and Ryde (Figure 2-9).

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 three-month construction period of August 1 through October 31 due to the presence of special-status and endangered fish species and supporting habitat.

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 eight vegetation communities within the study area (Figure 2-10). The majority of the study area is comprised of cropland and pasture, where alfalfa, grain, tomatoes, and other miscellaneous row crops are grown. Agricultural lands also include orchard and vineyard such as pear and grape. Other vegetation types within the study area include riparian forest, riparian scrub, and marsh.

Fourteen special-status plant species and 34 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.

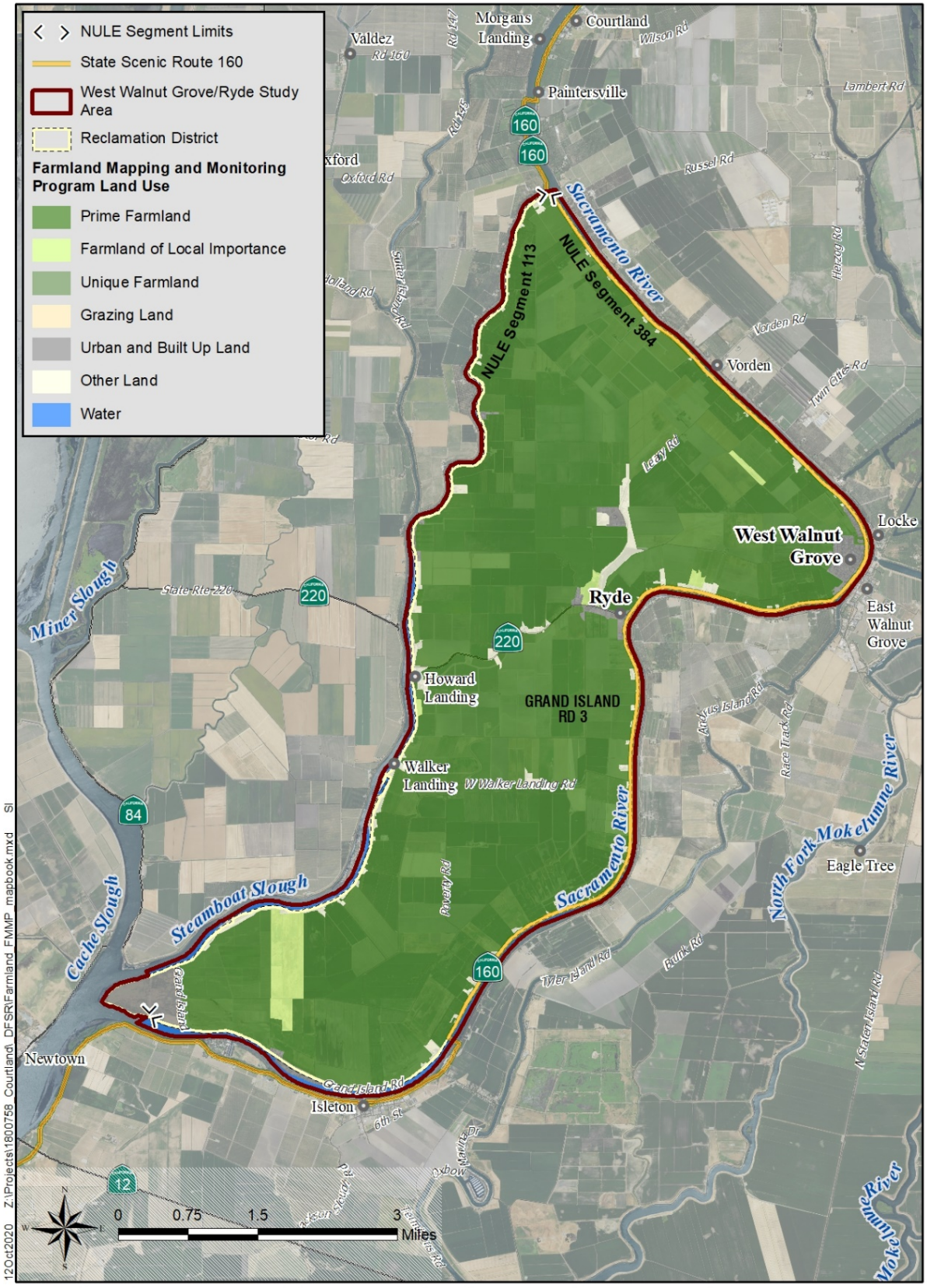



**Figure 2-9: Farmland Designations within the Study Area**

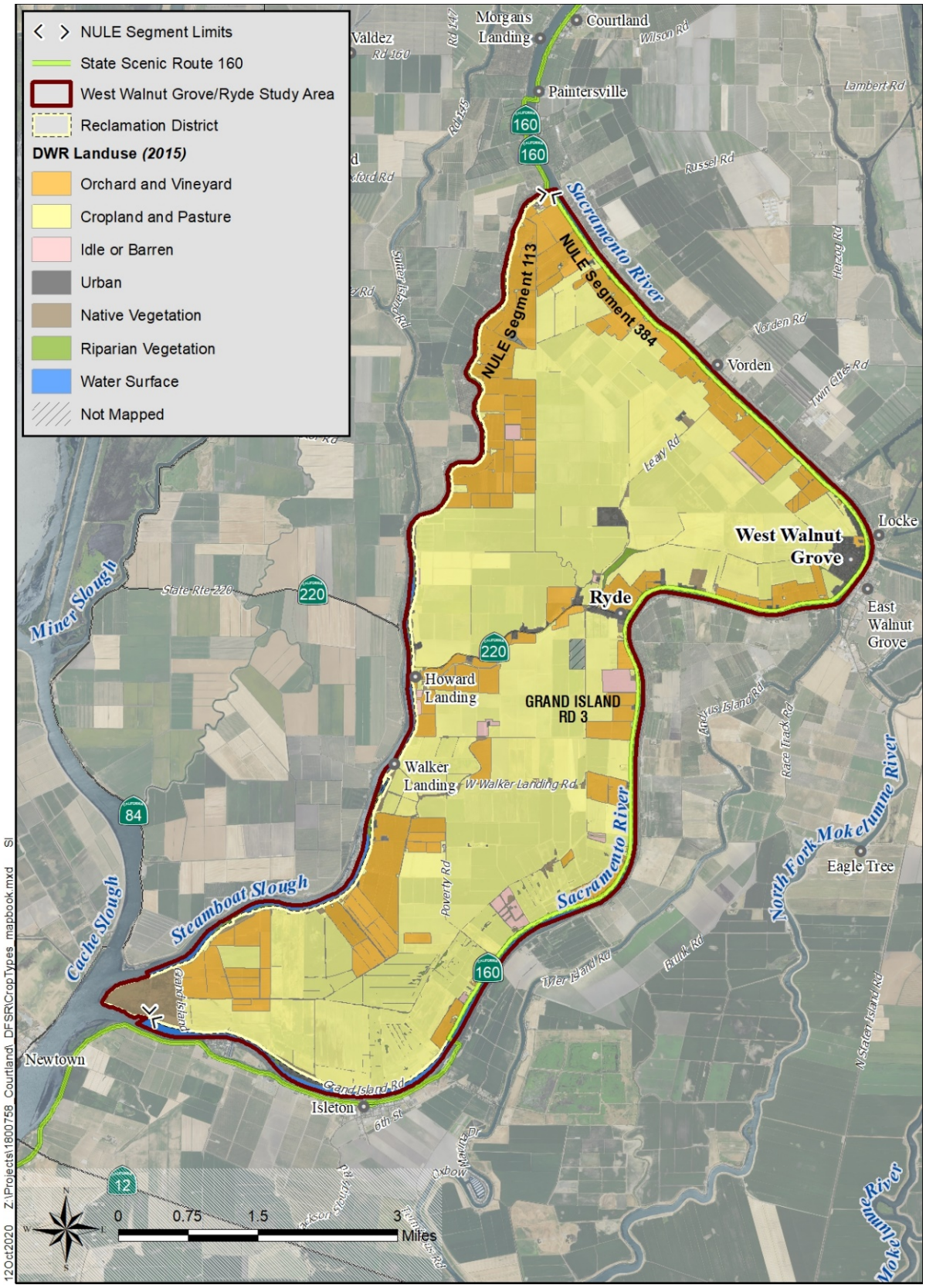



**Figure 2-10: Crop Types within the Study Area**

### 2.1.8 Cultural Resources

According to a records search conducted at the North Central Information Center, a total of 12 cultural resources are within the study area. Of those, one is a historical archaeological site and the remaining 11 are built environmental resources dating to the historic era. One of the built environment resources, the John Stanford Brown House (P-34-002377), has been determined eligible for listing in the National Register of Historic Properties (NRHP) and the California Register of Historical Resources (CRHR). None of the remaining 11 listed resources have formally been evaluated for their eligibility to be listed in the NRHP or CRHR. The built environment resources are located throughout the project area but are concentrated along SR 160; some of the resources do not have specific addresses (such as the levees).

Information provided by the county indicates there are no additional cultural resources within the study area.

In addition to the above resources, there are also historic resources located within the West Walnut Grove/Ryde study area, including the John Stanford Brown House (Figure 2-11).

In addition to the above resources located within the West Walnut Grove/Ryde study area, the entire study area is itself also 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.

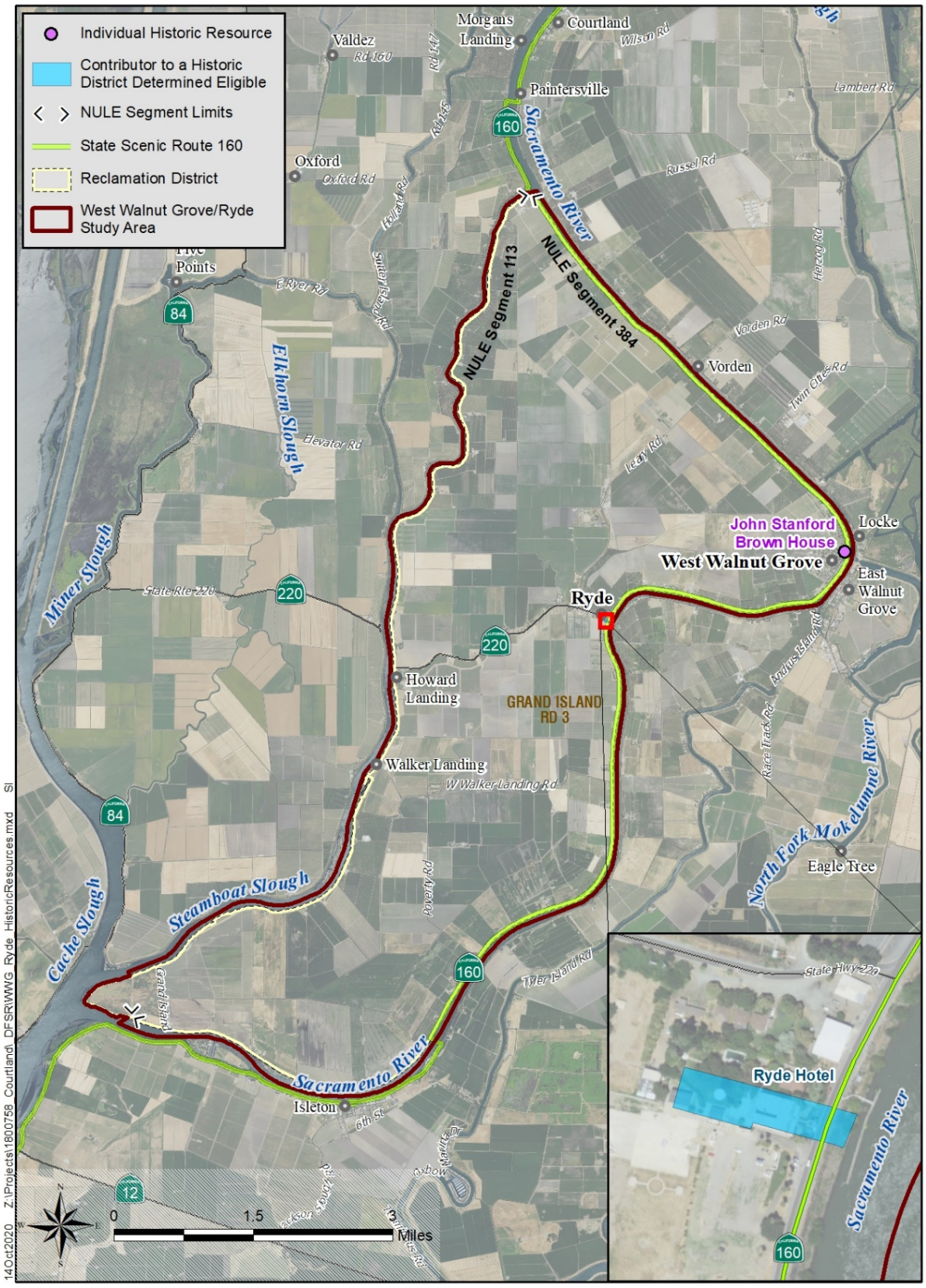



**Figure 2-11: Historic Resources within the Study Area.**

# 3. Problems, Opportunities and Constraints

## 3.1 Problems

In order for West Walnut Grove and Ryde to safely thrive into the future as the wonderful places that they are, we must deal with the issue of flood risk reduction. There are nearly 29 miles of levees surrounding the West Walnut Grove/Ryde study area and a breach anywhere could cause widespread flooding putting West Walnut Grove and Ryde at risk of significant damage, including the 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 two 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 West Walnut Grove, Ryde, East Walnut Grove, Courtland, Hood and Locke. Consequently, flood risk to these communities, including the communities of West Walnut Grove and Ryde, is the highest relative to flood threats in the larger Central Valley, warranting improved flood protection in these areas.

Within the context of this feasibility study, flood risk is the largest issue facing the West Walnut Grove/Ryde study area. In the event of a levee failure, particularly on the levee immediately fronting or upstream of each of the communities but also including the levee located along the western boundary of the study area, West Walnut Grove/Ryde 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 management actions 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 West Walnut Grove/Ryde 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 in Section 3.1.1.2.

Within the context of this study, consequences of levee failure is defined in terms of life loss and property damage Life loss and property damage as a result of flooding within the West Walnut Grove/Ryde study area has historically been evaluated by DWR as part of the 2012 CVFPP and 2017 CVFPP Update and are being re-evaluated as part of the 2022 CVFPP Update. Current life loss estimates for the West Walnut Grove 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 RD 3 and are summarized in Sections 3.1.1.5 and 3.1.1.6.

#### 3.1.1.1 History

RD 3 – Grand Island was flooded numerous times including 1871, 1876, 1878, 1879, and 1881. On February 21, 1878, a 10-foot levee section on Steamboat Slough was overtopped and eventually it was decided to breach the levee at four locations along the Sacramento River. The levee around Grand Island was completed in 1894; since then, the island has not flooded.

#### 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 index point. 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 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 50 (Grand

Island, RD 3 – Steamboat Slough) index point has a level of flood protection of less than 20 years, and the SAC 50a (Grand Island, RD 3 – Sacramento River) index point has a 50--year level of flood protection at the USACE 1957 Assessment Water Surface Elevation (AWSE).

The DLIS analyses prepared on behalf of the Delta Stewardship Council estimated the level of flood protection for RD 3 – Grand Island. The DLIS estimated that RD 3 – Grand Island has an estimated 26-year level of flood protection, which equates to a 4 percent annual probability of failure. Based upon empirical data and history provided above in Section 3.1.1.2, 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 West Walnut Grove/Ryde study area (Table 3-1). 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 (low, moderate, high) 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) or AWSE. Both RD 3 NULE segments were divided into reaches. The NULE Segment 384 reaches separated the downstream 1.1 miles of the Sacramento River levee as Reach 1 and the remaining 16.3 miles as Reach 2 based on differing geomorphology. The NULE GAR found NULE Segment 384 Reach 1 and 2 to both to have a *moderate* likelihood of levee failure at the 1955/57 design WSEL or AWSE based on potential vulnerability to underseepage and stability for Reach 1 and potential vulnerability to underseepage for Reach 2. Along the Steamboat Slough levee (NULE Segment 113) the NULE GAR reaches divided the segment at the confluence with Sutter Slough based on hydraulic flow conditions. NULE Segment 113 Reach 1, the upstream 4.35 miles of the segment, was assessed to have a *moderate* likelihood of levee failure at the 1955/57 design WSEL or AWSE based on the potential vulnerability to underseepage, through seepage, stability, and erosion. NULE Segment 113 Reach 2, the downstream 7.05 miles of the segment, was assessed to have a *high* likelihood of levee failure at the 1955/57 design WSEL or AWSE based on the potential vulnerability to underseepage, through seepage, stability, and erosion. These same values are currently being updated by DWR during the course of this feasibility study.

**Table 3-1. Summary of NULE GAR Assessment Results for the West Walnut Grove/Ryde Study Area (URS, 2011a)**

| Levee Segment Location | Reach | NULE Segment | Overall Segment Characterization | Results by Individual Failure Mechanism | | | |
|---|---|---|---|---|---|---|---|
| | | | | Underseepage | Slope Stability | Through Seepage | Erosion |
| Right Bank Sacramento River – RD 3 (SPFC levee) | Reach 1 LM 0 to 1.1 | 384 | Moderate | Moderate | Lacking Sufficient Data (Low to Moderate) | Low | Low |
| | Reach 2 LM 1.1 to 17.4 | | Moderate | Moderate | Low | Low | Low |
| Left Bank Steamboat Slough – RD 3 (SPFC levee) | Reach 1 LM 0 to 4.35 | 113 | Moderate | Moderate | Lacking Sufficient Data (Low to Moderate) | Moderate | Moderate |
| | Reach 2 LM 4.35 to 11.4 | | High | High | Lacking Sufficient Data | Lacking Sufficient Data | Moderate |

#### 3.1.1.3 Life Loss

The 2017 CVFPP Update estimated potential life loss on an annualized basis for the subject project study area of Grand Island, RD 3 SAC 50. 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. Annualized life loss for SAC 50 - Grand Island was estimated to range from one life for the 2017 baseline scenario and up to four lives for the 2067 scenario which includes the effects of climate change, sea level rise, and population/land use changes (DWR, 2017d).

Life loss on an annualized basis was also estimated as part of the DLIS. From this analysis, 0.2 expected annual fatalities were estimated for RD 3 – Grand Island (DSC, 2017).

A breach on the levee fronting either community is very likely to result in floodwater depths upwards of and in excess of 10 feet combined with floodwater velocities in excess of 10 feet per

second (fps). Combined floodwater depths and velocities in these scenarios would result in little to no warning time for evacuation, which poses imminent flood threats to the communities of West Walnut Grove and Ryde 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 $402.1M in 2020 dollars.

- Total estimated depreciated replacement value of the 680 structures in the West Walnut Grove/Ryde study area (including the entirety of RD 3): $333.6M
- Total estimated value of agricultural crops: $34.5M
- Total estimated vehicle value: $19.1M
- Total estimated value of highways and streets: $14.9M

Structures at risk of flooding are summarized in Table 3-2. The West Walnut Grove/Ryde study area contains approximately 680 structures. Approximately 234 structures are located within the densely populated community of West Walnut Grove – Clampett Tract, with the remaining 446 structures located throughout the greater RD 3 basin. As part of the 2017 CVFPP Update, depreciated replacement values for these structures and contents were defined for the two impact areas within the West Walnut Grove/Ryde study area, which are being updated as part of the 2022 CVFPP Update. As shown in Table 3-3, the total depreciated replacement value for the West Walnut Grove/Ryde study area escalated to 2020 dollars is over $333.6M, with structures in Clampett Tract comprising over one-third of this value ($108.6M). Residential and industrial structures outside the community are valued at over $220.8M.

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

| CVFPP Impact Area | Total Structures Count | | | | |
|---|---|---|---|---|---|
| | Residential | Commercial | Industrial | Public | Total |
| SAC 50 – N1 (RD 3, less the densely populated community of West Walnut Grove) | 294 | 4 | 148 | 0 | 446 |
| SAC 50 – Urban (West Walnut Grove) | 219 | 6 | 4 | 5 | 234 |
| *Total West Walnut Grove/Ryde Study Area* | 513 | 10 | 152 | 5 | 680 |

**Table 3-3. 2022 CVFPP Depreciated Replacement Value for West Walnut Grove Impact Area SAC 50 (HDR, 2021).**

| CVFPP Impact Area | Depreciated Replacement Value | | | | |
|---|---|---|---|---|---|
| | Residential | Commercial | Industrial | Public | Total |
| SAC 50 – N1 (RD 3, less the densely populated community of West Walnut Grove) | $118,032,000 | $4,155,000 | $102,811,000 | $0 | $224,998,000 |
| SAC 50 – Urban (West Walnut Grove) | $94,812,000 | $3,936,000 | $6,651,000 | $3,232,000 | $108,631,000 |
| *Total West Walnut Grove/Ryde Study Area* | $212,844,000 | $8,091,000 | $109,462,000 | $3,232,000 | $333,629,000 |
| *Average Depreciated Value of Structures* | $362,000 | $508,000 | $1,407,000 | $777,000 | $783,000 |

**Notes**: 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 in Table 3-4 and Table 3-5 below for the community of West Walnut Grove – Clampett Tract and the greater RD 3 basin. In summary, crops within the study area are valued at nearly $34.5M in 2020 dollars, and the total vehicle value (excluding agricultural equipment) within the study area is $19.1M in 2020 dollars.

**Table 3-4. Crop Acreage and Total Value for the West Walnut Grove/Ryde Study Area (HDR, 2021).**

| Impact Area | Agricultural Acreage (acres) | | | | | | | | | Total Value |
|---|---|---|---|---|---|---|---|---|---|---|
| | Citrus | Deciduous | Field | Grain | Pasture | Rice | Truck | Vineyard | Total | |
| SAC 50 – N1 (RD 3, less the densely populated community of West Walnut Grove) | 0 | 1,958 | 5,015 | 1,132 | 3,416 | 0 | 305 | 1,824 | 13,650 | $34,415,000 |
| SAC 50 – Urban (West Walnut Grove) | 0 | 0 | 28 | 0 | 8 | 0 | 0 | 4 | 40 | $55,000 |
| *Total West Walnut Grove/Ryde Study Area* | 0 | 1,958 | 5,043 | 1,132 | 3,424 | 0 | 305 | 1,828 | 13,690 | $34,470,000 |

**Notes**: Costs are reported in Quarter 1, 2020 dollars

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

| CVFPP Impact Area | Total Vehicle Count | Total Vehicle Value |
|---|---|---|
| SAC 50 – N1 (RD 3, less the densely populated community of West Walnut Grove) | 1,438 | $12,942,000 |
| SAC 50 – Urban (West Walnut Grove) | 686 | $6,174,000 |
| *Total West Walnut Grove/Ryde Study Area* | 2,124 | $19,116,000 |

**Notes:** Costs are reported in Quarter 1, 2020 dollars

The total miles of highways and streets along with their associated value are summarized for each impact area and the collective study area in Table 3-6 below. The portion of SR 220 which bisects the study area along with the portion of SR 160 along the right bank of the Sacramento River are valued at over $9.5M in 2020 dollars. Streets in the study area are valued at $5.3M.

**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 50 – N1 (RD 3, less the densely populated community of West Walnut Grove) | 15.8 | $8,858,000 | 27.3 | $4,937,000 | $13,795,000 |
| SAC 50 – Urban (West Walnut Grove) | 1.2 | $692,000 | 2.1 | $374,000 | $1,066,000 |
| *Total West Walnut Grove/Ryde Study Area* | 17.0 | $9,550,000 | 29.4 | $5,311,000 | $14,861,000 |

**Notes:** Costs are reported in Quarter 1, 2020 dollars

Baseline (or without project) EAD estimates for the two index points (SAC 50 and SAC50a) within the 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 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 West Walnut Grove study area under existing conditions is estimated at nearly $14M in 2020 dollars. With the effects of climate change and sea level rise, baseline EAD for the West Walnut Grove study area under future conditions is estimated at nearly $80M in 2020 dollars. It should be noted that the EAD analyses utilized the hydrologic and hydraulic (H&H) models developed 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 50 and SAC 50a (HDR, 2021).**

| Index Point | EAD[1], Existing Conditions | EAD[2], Future Conditions with Climate Change Adjustments |
|---|---|---|
| SAC 50 (Grand Island, RD 3 – Steamboat Slough) | $8,725,000 | $44,314,000 |
| SAC 50a (Grand Island, RD 3 – Sacramento River) | $5,235,000 | $35,385,000 |

[1] EAD as defined by the 2017 Without-Project Scenario from the 2017 CVFPP
[2] EAD as defined by the 2017 Without-Project Scenario from the 2017 CVFPP

#### 3.1.1.5 Floodwater Depths and Velocities

Inundation mapping was conducted in May 2017 for RD 3 as part of Sacramento County's Flood ESP for the RDs collectively located in the North Delta and in Sacramento County. For the West Walnut Grove/Ryde study area, three hypothetical levee breach locations were modeled to estimate potential flood depths and inundation times at two locations: (1) upstream and downstream of Sutter Slough (along the Steamboat Slough levee NULE Segment 113); and (2) downstream of the communities of West Walnut Grove and Ryde (along the right bank of the Sacramento River NULE Segment 384).

Based on these analyses, flood depths and corresponding velocities are generally greatest in the communities of West Walnut Grove and Ryde, and in the larger study area, when there is a breach along the Steamboat Slough levee (NULE Segment 113), upstream of Sutter Slough. As shown in Figure 3-1, denoted by the arrows extending from the hypothetical breach location, these flood depths are representative of a levee breach along NULE Segment 113 between the confluence with the Sacramento River and just north of SR 220. In this scenario, RD 3 is predicted to experience flood depths from 15 to 26 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 communities of West Walnut Grove and Ryde are likely to be on the order of 5 to 10 feet and upwards of 15 feet, respectively. A levee breach along the Steamboat Slough levee downstream of Sutter Slough produces similar effects in both communities; however, flood depths in the northern part of the basin generally remain below 20 feet.

Lowest floodwater depths and velocities are predicted when there is a breach along the Sacramento River (NULE Segment 384), downstream of the communities. In this case, portions of West Walnut Grove would not be inundated with floodwaters, with the remainder experiencing flood depths on the order of 5 feet and floodwater ponding velocities less than 2 fps. Ryde is estimated to experience flood depths on the order of 5 to 10 feet in this scenario, with the greater basin generally experiencing similar flood depths with the exception of portions of the southern part of the basin, where flood depths could reach upwards of 25 feet. *Note* that flood depths discussed above are also representative of a breach on the levee immediately fronting the community of Ryde.

The results of this inundation mapping demonstrate that, of the three breach locations investigated, a breach in the Steamboat Slough levee (NULE Segment 113) upstream of Sutter Slough 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 depicts worse case flood depths that could occur in RD 3 with a levee breach along Steamboat Slough assuming there is no relief cut implemented in the lower, downstream portion of Grand Island. Flood depths could actually be reduced by 5 to 6 feet or more as shown in Figure 3-1 down to the Base Flood Elevation (BFE) of 10 feet NAVD 88 indicated if a downstream relief cut could be implemented in the lower reaches of RD 3 (*see* Section 5.2.7 for more information).

Additionally, although not modeled as part of the inundation mapping effort associated with the RD 3 ESP, it is estimated that depth of flooding in West Walnut Grove or Ryde could reach that associated with the breach on NULE Segment 113 upstream of Sutter Slough or higher, in the event of a levee breach in front of either community.

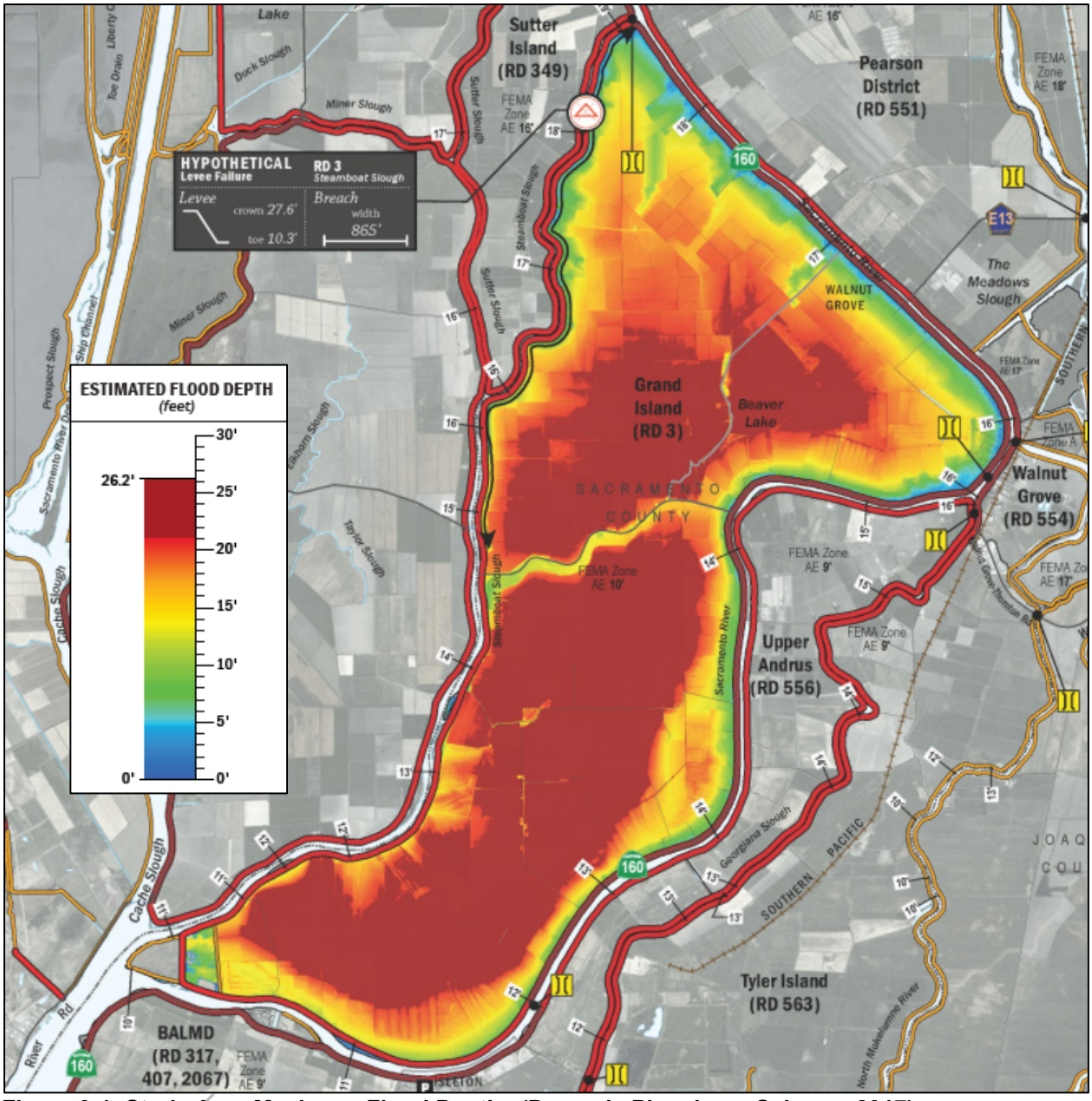



**Figure 3-1. Study Area Maximum Flood Depths (Dynamic Planning + Science, 2017).**

### 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 for the West Walnut Grove/Ryde study area was estimated as part of the inundation mapping performed for the RD 3 Delta Flood ESP. The time to 1 foot of inundation is shortest for the communities of West Walnut Grove and Ryde resulting from a levee breach on the Steamboat Slough levee (NULE Segment 113), downstream of Sutter Slough. In this scenario, West Walnut Grove is inundated to 1 foot generally between 48 to 56 hours, with some parts of the community inundated as soon as 24 to 32 hours after the levee breach. Ryde is estimated to be inundated to 1 foot within 8 to 16 hours after the levee breach in this scenario. The larger

agricultural area in RD 3 is estimated to be inundated to 1 foot between 0 to 24 hours after the levee breach. The duration of time prior to reaching a 1-foot-depth of flooding within the communities and the larger study area is greatest in the event of a levee failure along the Sacramento River (NULE Segment 384) downstream and south of SR 220, in which case most of West Walnut Grove is not inundated with floodwaters, and most of Ryde is inundated to 1foot on the order of 40 to 48 hours.

Similar to the preceding Section, although a breach on the levee immediately fronting the community of West Walnut Grove was not analyzed as part of the inundation mapping, it is expected that a breach at this location 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 West Walnut Grove/Ryde study area, visit the West Walnut Grove/Ryde Story Map developed by Sacramento County located here: West Walnut Grove/Ryde Story Map - Sacramento County Small Communities Flood Risk Reduction Program.[2]

### *3.1.2 Escalating NFIP Insurance Premium Rates*

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 West Walnut Grove, as shown in Figure 3-2, is located within Zone AE, which, as defined by FEMA, is "subject to inundation by the one-percent-annual-chance flood event determined by detailed methods." Ryde is also located within Zone AE. According to Figure 3-2 excerpted from the FEMA FIRM the West Walnut Grove/Ryde study area is subject to flooding in Zone AE to a BFE of 10 feet NAVD 88. It should be noted that the BFE of 10 feet NAVD 88 assumes that a relief cut can be deployed at the downstream, lower gradient of the subject study area.

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.

[2] https://sacramentocounty.maps.arcgis.com/apps/MapJournal/index.html?appid=b2415f6ee34746bda8b8765782c3fa45


**Figure 3-2. West Walnut Grove's 100-Year BFE Floodplain Recognized by FEMA (FEMA, 2020).**

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 the 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 West Walnut Grove/Ryde's BFE of 10 feet NAVD 88. Sacramento County currently enjoys up to a 40 percent discount on flood insurance costs due to the county's high Community Rating System (CRS) score, which is one of the top 5 CRS scores in the entire nation. Still, the rates are rising rapidly. Many NFIP policies in West Walnut Grove/Ryde 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 10 feet in West Walnut Grove/Ryde, 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 percent discount with its high CRS score).*

To remove the entire project study area from the current FEMA BFE of 10 feet NAVD 88, the entire combined perimeter levee systems of RD 3 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.[3]

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 West Walnut Grove (with a ring levee system) and the portion of the study area located north of SR 220 are provided in Section 6.2.4.

### 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 communities of West Walnut Grove and Ryde, which rely 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

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

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

acceptable criteria for underseepage, through seepage, structural stability, and/or erosion (DWR, 2017b).

Within the West Walnut Grove/Ryde study area, the majority of the SPFC levees do not meet acceptable criteria for underseepage, with portions of the levee system also vulnerable to through seepage, structural stability, and erosion. 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 the communities of West Walnut Grove and Ryde. A large portion of the West Walnut Grove/Ryde study area is located upstream of the Delta Cross Channel, along the right bank of the Sacramento River upstream of the communities of West Walnut Grove and Ryde. 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 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 5.3 miles of SPFC levees to current, modern standards consistent with FEMA's 100-year accreditation standards located north of the Delta Cross Channel would constitute improving 14 percent of the non-urban SPFC levees upstream of the Delta Cross Channel. Improving the 5.9 miles of SPFC levees within the study area which also coincide with the Delta's freshwater corridor would constitute improving nearly 10 percent of the total non-urban SPFC levees in the Delta's freshwater conveyance corridor.

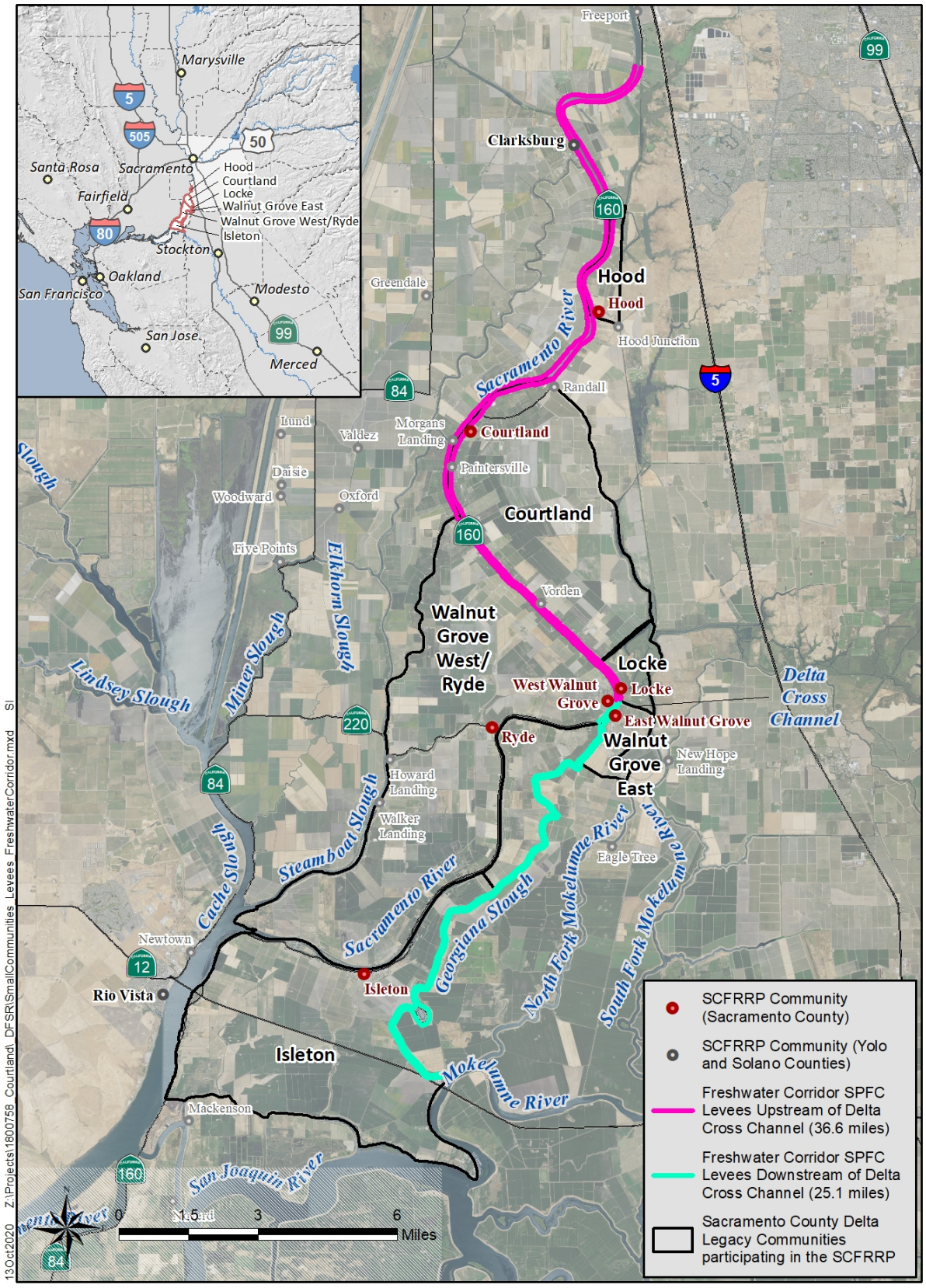



**Figure 3-3. SPFC Levees which Comprise the Delta's Freshwater Corridor.**

### 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 communities of West Walnut Grove and Ryde. In 2001, FEMA began updating FIRMs, and as a result, many small communities, including West Walnut Grove and Ryde 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. 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, climate change combined with sea level rise is expected to increase the 100-year flood stage in the Sacramento River between Steamboat Slough to Georgiana Slough by 1.12 feet, with 100-year flood stages between Georgiana Slough and Cache Slough also increasing by nearly 1.57 feet A 200-year flood stage along the same extents are estimated to increase by 0.71 and 1.08 feet, respectively. 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 West Walnut Grove/Ryde study area, the effects of climate change and sea level rise are less pronounced along the mainstem of the Sacramento River and Steamboat Slough as a result of planned improvements in the upstream/adjacent bypass systems.

## 3.2 Opportunities

Opportunities to address the problems discussed above are summarized below.

### *3.2.1 Reduce Flood Risks*

The levees protecting the West Walnut Grove/Ryde 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 West Walnut Grove/Ryde study area is provided above in Section 3.1.1.3. The potential for property damage within the West Walnut Grove/Ryde 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 West Walnut Grove/Ryde 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 communities of West Walnut Grove and Ryde, and possibly the adjoining larger project area and other nearby Delta Legacy Communities.

### *3.2.2 Agricultural Sustainability*

Efforts to improve agricultural sustainability within the Delta, including the West Walnut Grove and Ryde 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 communities of West Walnut Grove and Ryde and for the Delta as a whole. The purpose of these 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, mainly by 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 levee 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 Agricultural Floodplain Ordinance Task Force (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 FEMA's NFIP to address sustainability of modern agriculture in deep floodplains. Administrative options were considered as they could be potentially implemented without changing law or regulation.

Administrative options to improve agricultural sustainability within the Sacramento Valley were summarized in a technical memorandum prepared in 2016. In total, the memorandum 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 - Identification of Non-Structural Measures for the Communities of Hood, Courtland, Locke, East Walnut Grove, West walnut Grove/Ryde, and the City of Isleton.

### 3.2.3 Potential Ecosystem Restoration Opportunities

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

1) Construction of a setback levee on Grand Island and enlarging the existing river or slough channel(s) could potentially create up to 250 acres of subtidal open water, shallow subtidal, tidal marsh, riparian scrub, and riparian woodland habitats along the margin of all of part of the study area.
2) Constructing a relief cut at the southern end of Grand Island. This area of land owned by the federal government could be restored to tidal marsh. Restoration of this area would be consistent with local Delta stakeholder requests to conduct restoration activities first on public lands.
3) Enhancing or creating additional Shaded Riverine Aquatic (SRA) habitat along the Sacramento River (particularly River Miles 25-35) or Steamboat Slough in connection with addressing erosion concerns and/or replenishing rock slope protection (RSP) at known erosion sites. This enhancement along the left bank of the Sacramento River could be a potential extension and offer greater connectivity to the SRA opportunities outlined in the 2014 RFMP.

*See* 9.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 communities of West Walnut Grove and Ryde 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.

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 been largely 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 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 West Walnut Grove. This is an order of magnitude lower than average assessments for flood protection in nearby urban areas (for comparison, Sacramento Flood Control Agency's assessment for a residential

property located behind levees in Sacramento is over $250 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 $20.47, for a total of $350,000 for O&M for RD 3. 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," and pay the same assessment as other homes, and the system must currently be maintained around them.

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 West Walnut Grove/Ryde study area for levee remediation repairs and improvements, said 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

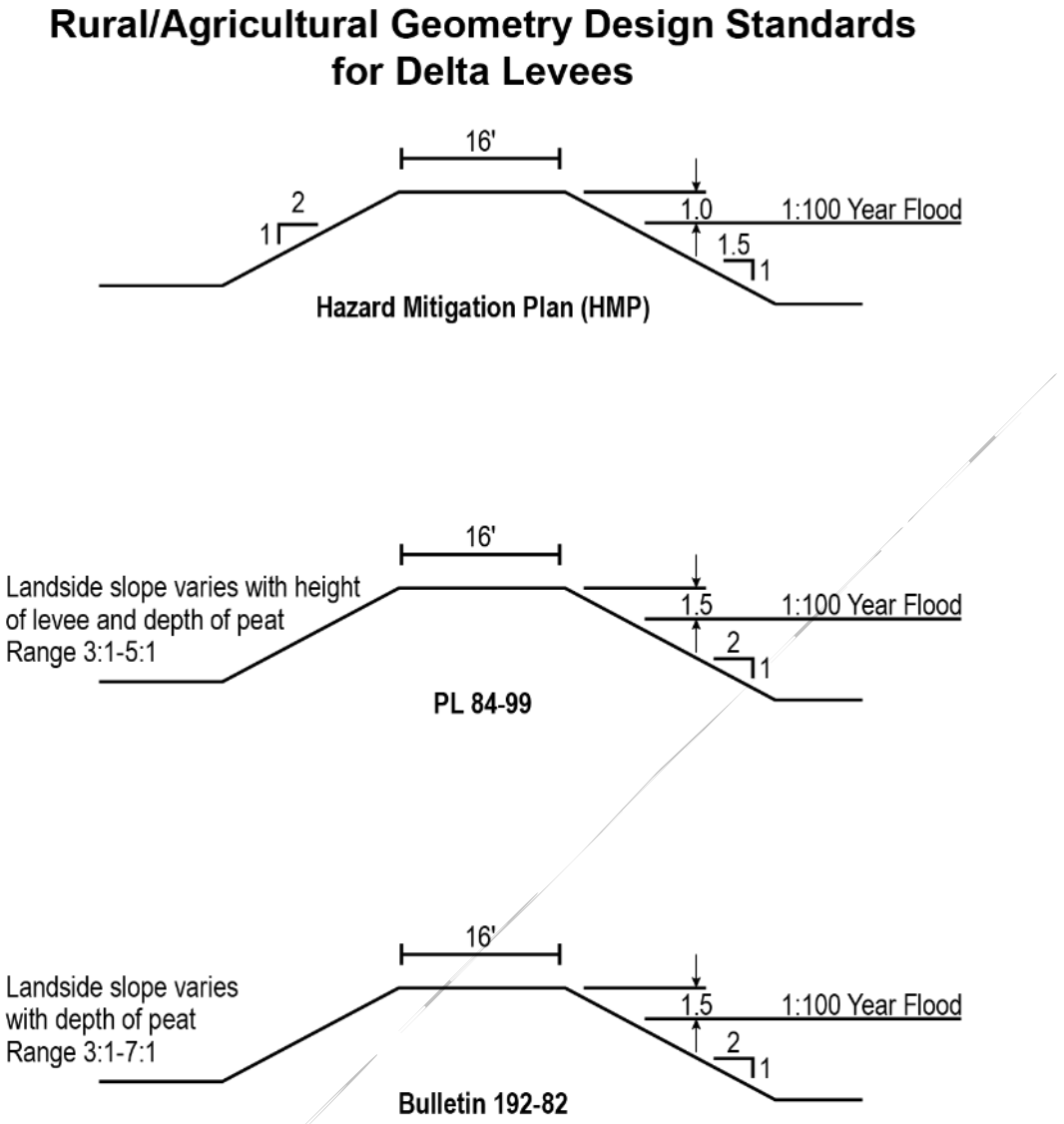



**Figure 3-4. Rural/Agricultural Geometry Design Standards for Delta Levees**

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.

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 three-hundred-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.

### Urban Geometry Design Standards for Delta Levees

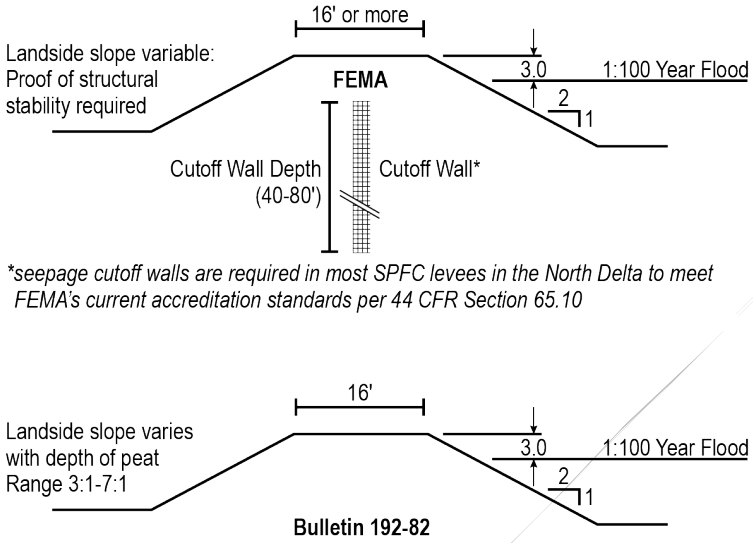



**Figure 3-5. Urban Geometry Design Standards for Delta Levees**

Agricultural levees within the Delta and those offering protection to the West Walnut Grove/Ryde 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 operations and maintenance criteria. Currently, very few Delta levees outside of urban areas meet the USACE criteria required for FEMA accreditation.

If West Walnut Grove and Ryde hope to be mapped by FEMA as Zone X (as they were before 2012), the entire 29-mile perimeter levee system of the West Walnut Grove/Ryde study area may require certification, or smaller segments, such as one fronting the community paired with a certifiable ring levee (for West Walnut Grove only), 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 these 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 Communities. This can limit structural levee remediations to more costly alternatives, such as cutoff walls, over less costly alternatives, such as seepage/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 fish and wildlife 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 three-month period of August 1 through 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 the study area due to the permitting difficulty of completing these types of 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 project vicinity have attempted to be "self-mitigating" but this can only occur where the space and opportunity exist on a project site. Without the space or conditions to provide onsite mitigation for projects, LMAs must look to mitigation banks where credits can be purchased; this can add considerable expense, depending on the habitat in need of mitigation. There are limited (or no) mitigation credits remaining to

purchase for SRA impacts in the greater Delta area and SRA impacts are most likely to occur with erosion repairs.

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 communities of West Walnut Grove and Ryde, and possibly other neighboring Delta Legacy Communities as well.

### *3.3.6 Cultural Resources Constraints*

As described in Section 2.1.8, a total of 12 cultural resources were identified during the records search and from information provided by the county of Sacramento but only one has been formally evaluated for eligibility for listing in either the NRHP or CRHR. 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/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.

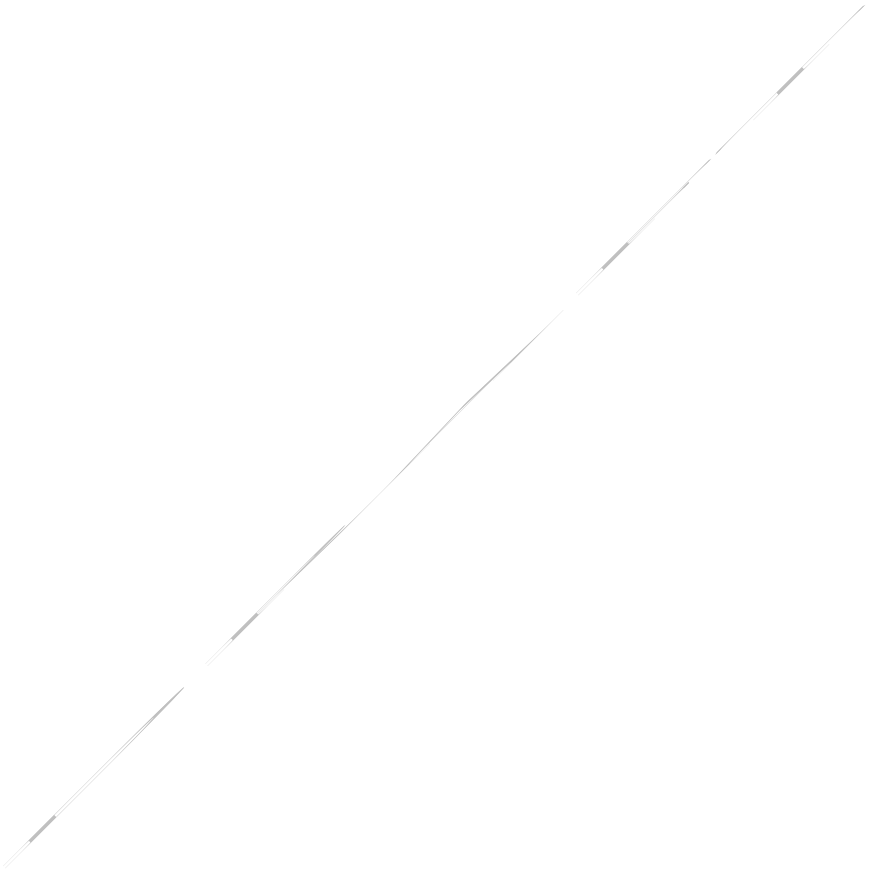
*See* Appendix C for additional information regarding known and potential cultural resources within the project study area of West Walnut Grove/Ryde and how they need to be addressed prior to any ground disturbing activities. Appendix C also further describes the National Heritage Designation Area within 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 or Steamboat Slough, depending on the nature of project implementation. The law applies to any dredging or 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.



# 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 West Walnut Grove/Ryde 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 management actions 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 management actions for West Walnut Grove and Ryde. 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, the 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 West Walnut Grove/Ryde 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 West Walnut Grove/Ryde study area.

The risk of life loss is of greatest concern for the West Walnut Grove/Ryde study area within the densely populated communities of West Walnut Grove and Ryde. Should a levee breach occur along the Sacramento River immediately upstream and fronting either of the communities, floodwaters would likely inundate the communities 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 West Walnut Grove and the greater study area encompassed by RD 3.

Reducing risk to life is achieved by reducing flood risk. As described earlier, flood risk within the communities 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 West Walnut Grove/Ryde study area, as previously discussed in Section 3, the value of land and structural improvements, agricultural crops, vehicles, and highways and streets are valued at nearly $402.1M. These inventories and their associated values for the West Walnut Grove/Ryde 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 the communities of West Walnut Grove and Ryde, as well as the larger study area, particularly in the event of a breach on the levee immediately fronting the communities. 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 corridors of SR 160 and SR 220. This study prioritizes flood risk reduction management actions 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 management actions developed specifically for the subject West Walnut Grove/Ryde study area are provided in Section 6.3.1.2, Table 6-6 and Table 6-7 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 West Walnut Grove/Ryde 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
- Addressing/repairing 13 collective known erosion sites on the left bank of Steamboat Slough and on the right bank of the Sacramento River previously identified within RD 3 by MBK Engineers
- 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 Delta Flood ESPs developed by Sacramento County
- Secure 100-year FEMA Certification for the community of West Walnut Grove and possibly for the entire portion of the study area north of SR 220 pursuant to 44 CFR §65.10

### 4.1.4 Limit of High Insurance Premiums

Of the estimated 680 structures in the West Walnut Grove/Ryde study area valued at an estimated $333.6M, there are only 272 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 $95M[4] in 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 risk, 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] These estimates are sourced from the FEMA Open Source policy database: https://www.fema.gov/about/openfema/data-sets

### 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 meet current engineering and FEMA accreditation standards. These levees are used to protect both people and property and support the agricultural economy within the communities of West Walnut Grove and Ryde, and the adjoining project study area. SPFC levees in the North Delta are particularly critical since they also 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 management actions 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.

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 management actions 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 discussed previously 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 West Walnut Grove/Ryde 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. Additionally, sea level rise is expected to increase the 100-year flood stage in the Sacramento River between Steamboat Slough to Georgiana Slough by 1.12 feet on average, with 100-year flood stages between Georgiana Slough and Cache Slough also increasing by nearly 1.57 feet on average. The 200-year flood stages along the same extents are estimated to increase by 0.71 and 1.08 feet on average, respectively. Increased flows and flood stages can not only result in more frequent flooding, which can lead to levee failure through overtopping, but can also result in greater stresses to the levee system as levees are loaded with water for longer periods of time and via other mechanisms resulting from increased flow/flood stages (e.g., erosion). Note, however, that within the West Walnut Grove/Ryde study area, the effects of climate change rise are less pronounced along the mainstem of the Sacramento River and Steamboat Slough as a result of improvements in the upstream/adjacent bypass systems.

Climate change and sea level rise also have the potential to impact the estimates of flood damage, or EAD, under future conditions within the West Walnut Grove/Ryde 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 West Walnut Grove/Ryde 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 Primary Zone of the Legal Delta. As noted in previous Sections, development within the Primary Zone of the Delta, including the West Walnut Grove/Ryde 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 communities of West Walnut Grove/Ryde and/or large parts of the West Walnut Grove/Ryde Study Area from the current (2012) FEMA 100-year floodplain with a BFE of 10 feet 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 West Walnut Grove/Ryde study area, particularly underlying and adjacent to most of its perimeter levee system is not subject to notable subsidence.

Substantial land subsidence in the study area, particularly along the alignment of the SPFC levee system along the right bank of Georgiana Slough and the left bank of Steamboat Slough, 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 management actions 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 includes a detailed evaluation of the larger Walnut Grove area (which includes the West Walnut Grove/Ryde study area) as part of their Walnut Grove Vision and Opportunity Sites evaluation (discussed further in Section 5.3.3). Many broad policies generally applicable to the study area are summarized in Appendix G.

#### 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 operations, maintenance, and 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 O&M State 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 3x3 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 State Plan of Flood Control 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 West Walnut Grove/Ryde study area is currently designated as "Very High" under the DLIS prioritization. This prioritization supports geotechnical evaluations by DWR under the NULE program FSRP, and recent explorations conducted in 2019 specifically for this study, which confirm that there are significant deficiencies, with known seepage concerns that are considered critical and serious. The noted deficiencies warrant immediate attention and repair to reduce the risk of flooding to the Delta Legacy Communities of West Walnut Grove and Ryde.

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 the study area for implementation of tidal marsh, dryland habitat, and "urban greening" around the developed areas of West Walnut Grove and Ryde. Additional Conservancy goals generally applicable to the study area are also summarized in Appendix G.

# 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 management actions which can be implemented by the communities of West Walnut Grove and Ryde 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 levee system to meet the objectives outlined in Section 4.1.

Structural elements discussed in this Section propose various remediations, such as cutoff walls, stability berms, combination seepage/stability berms, and RSP, to address levee vulnerabilities within the study area. A potential cross levee and ring levee system are also presented as measures to improve the flood control system in the West Walnut Grove/Ryde 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 communities of West Walnut Grove 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/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.

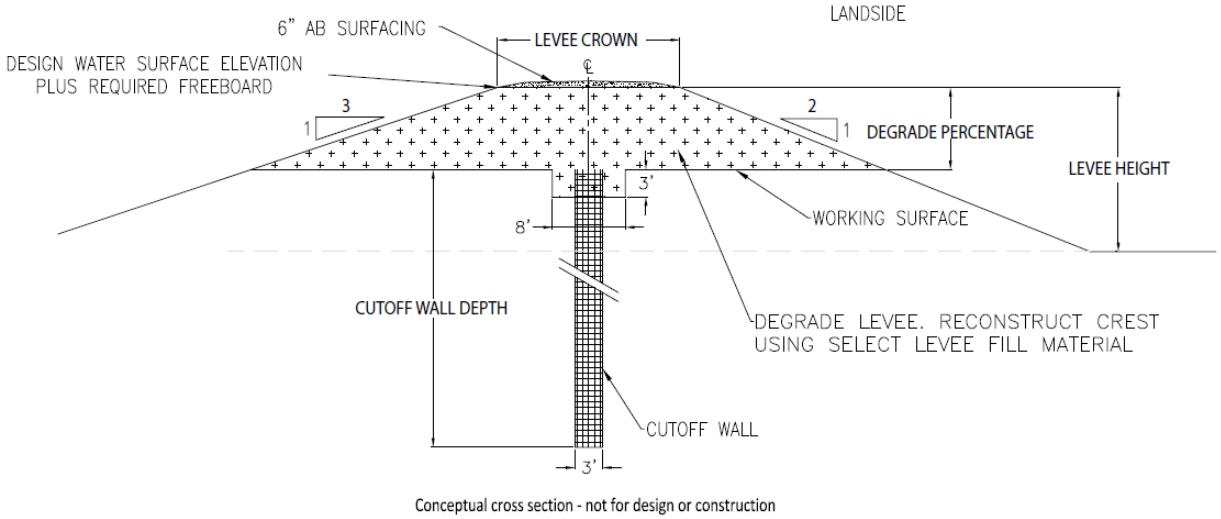



**Figure 5-1. Typical Cutoff Wall.**

**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.

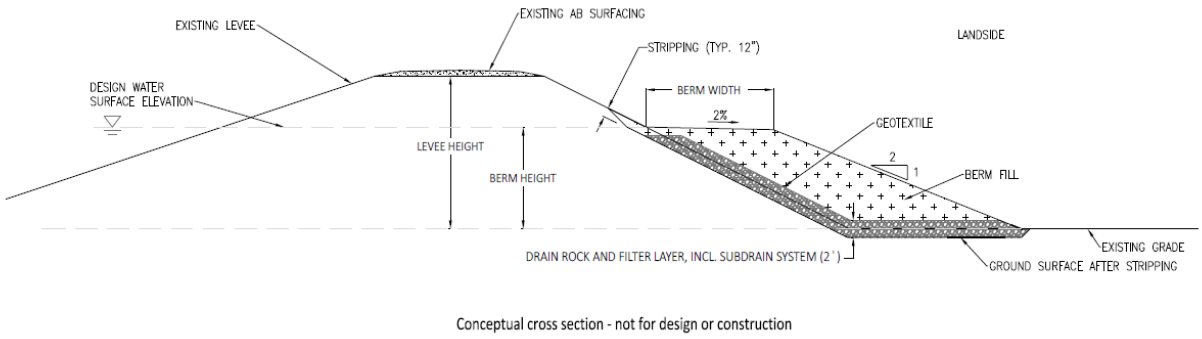



**Figure 5-2. Typical Stability Berm.**

**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 5-3.

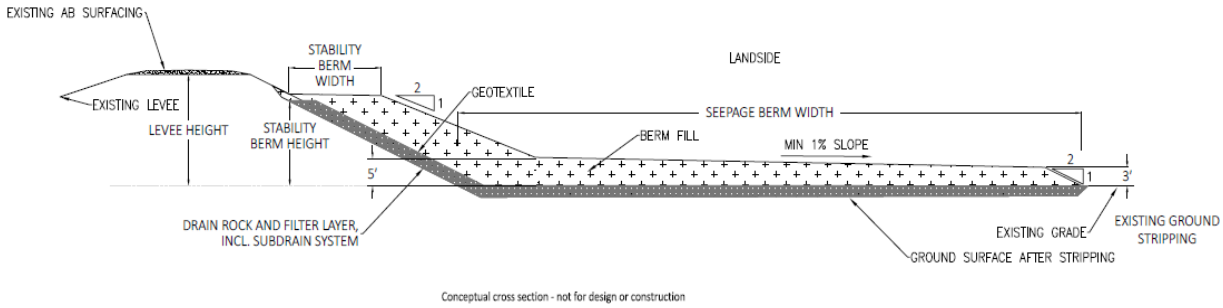



**Figure 5-3. Typical Combination Seepage and Stability Berm.**

**Rock Slope Protection:** RSP is used to address erosion through the placement of riprap on the waterside slope of the levee. A typical RSP detail is provided in Section 5.1.1.2.

## *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 communities of West Walnut Grove and Ryde. 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 5-4, DWR identified a total of five critical and serious sites on RD 3 (3 critical seepage sites, 1 critical erosion sites, and 1 serious erosion site). Two of the critical seepage sites and the critical erosion site are located along the Steamboat Slough levee (NULE Segment 113), and the remaining critical seepage site and serious erosion site are located along the west bank of the Sacramento River (NULE Segment 384). These sites are further characterized in Table 5-1 below.

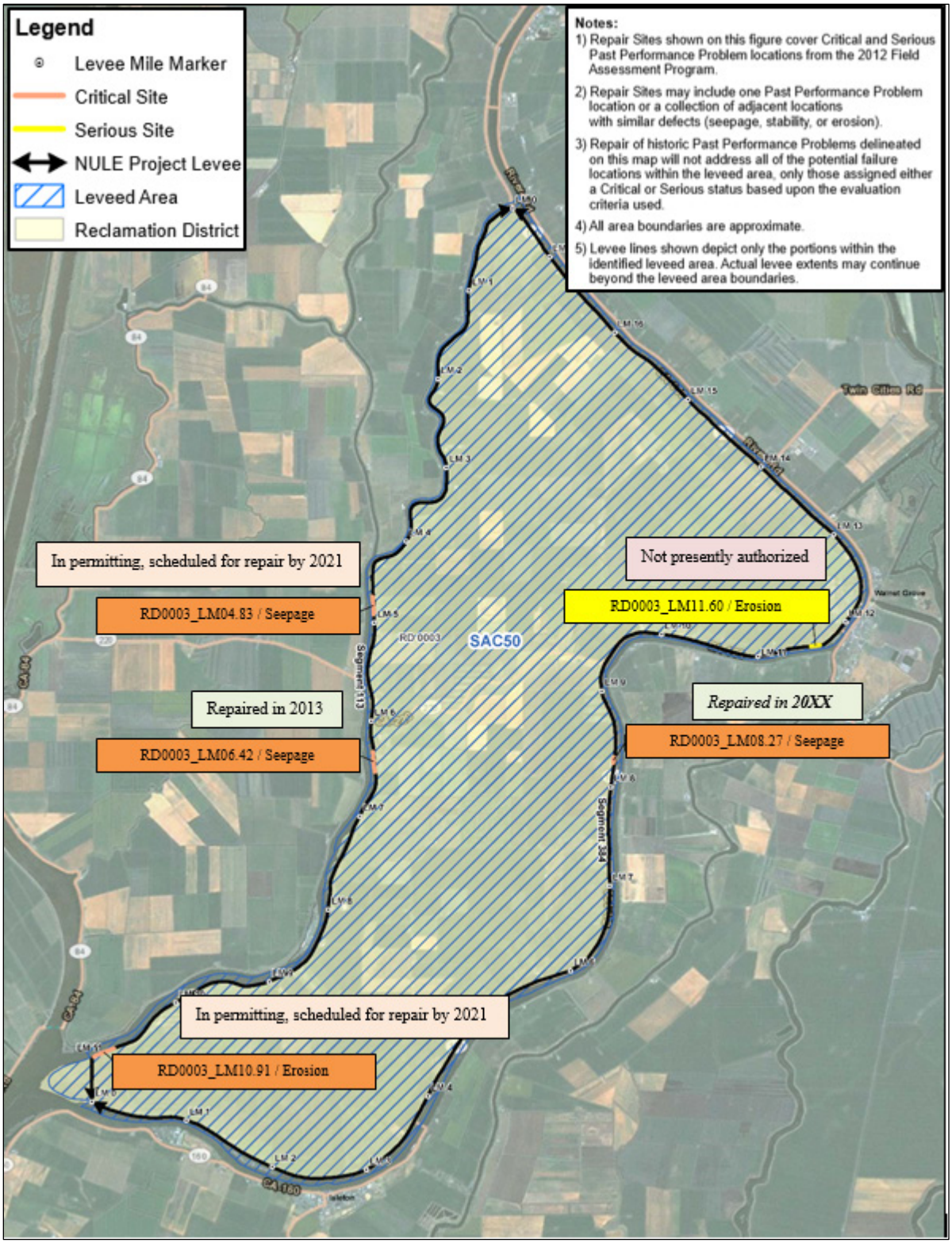



**Figure 5-4. Critical and Serious Seepage Sites within RD 3 (URS, 2013b), updated in 2020 by Sacramento County**

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

| Segment Location | Failure Mode | Site Status | Approximate Levee Mile Location | Length (ft.) | Supporting Evidence | Proposed Solution | Status |
|---|---|---|---|---|---|---|---|
| Right Bank of the Sacramento River (NULE Segment 384) | Erosion | Serious | 11.47 to 11.67 | 1,000 | Erosion observed along waterside toe and several leaning trees. Entire tree root system exposed with ~50-ft.-long scarp cuts 10-15 ft. into levee embankment and 8-ft.-deep. | Rock revetment[1] | Not presently authorized |
| | Seepage | Critical | 8.20 to 8.35 | 800 | 18-inch diameter boil observed roughly 350 ft. from the levee in 1997. LMA has noted a site near LM 8.24 where seepage occasionally occurs during highwater. | 80 ft. deep cutoff wall[1] | ***Repaired*** |
| Left Bank of Steamboat Slough (NULE Segment 113) | Seepage | Critical | 4.72 to 4.96 | 1,250 | Free flowing seepage that occasionally carries material located at the upstream end of the site. Actively flowing at time of inspection (15-20 gallons per minute) located 230 ft. from landside toe in irrigation ditch. Sinkholes observed at the downstream end. | 55 ft. deep cutoff wall | In permitting, scheduled for repair by 2022 |
| | Erosion | Critical | 10.78 to 11.02 | 1,400 | Observations indicate slope caving and sloughing above rock revetment from LM 10.8 to 11.02. 3-4 ft. near vertical erosion observed above riprap typical with 16 ft. erosion up to crown observed at several sites within 200 to 250 ft. of each other. | Widened levee | In permitting, scheduled for repair by 2022 |
| | Seepage | Critical | 6.34 to 6.50 | 800 | Seepage and boils in the toe ditch and adjacent field from LM 6.39 to 6.52. A 75 ft. wide, 250 ft. long Tule patch visible on the other side of the fence at landside toe. 4-inch artesian flow was observed within the Tule patch. | 250 ft. wide seepage berm | Repaired in 2013 |

**Note:** [1]As proposed by DWR in the 2013 FSRP Pre-Feasibility Report for Leveed Area SAC 50: Grand Island

As shown in Table 5-1, the critical sites on the Sacramento River and Steamboat Slough have been repaired or are currently in permitting and are scheduled for repair by 2022. This element addresses the remaining serious erosion site along the right bank of the Sacramento River (NULE Segment 384) with the remediation proposed in the 2013 FSRP Pre-Feasibility Report for Leveed Area SAC50: Grand Island (2013 DWR FSRP Pre-Feasibility Report) (URS, 2013b). As detailed in the 2013 FSRP Pre-Feasibility Report, rock revetment is proposed to address the serious erosion site along the right bank of the Sacramento River.

#### 5.1.1.2 Address Erosion Sites Identified by LMA Representatives

MBK Engineers, the District Engineer for RD 3, has identified a total of 13 erosion sites for repair along the Steamboat Slough levee (NULE Segment 113) and along the right bank of the Sacramento River levee (NULE Segment 384) (Figure 5-5). Of these 13 sites, 12 are a result of recent flood damages in 2017, and one is a legacy erosion site that RD 3 intends to repair. 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 Engineers, 2017). A summary of how the 13 sites within RD 3 were characterized is provided below.

- Critical: 4 sites
- Serious: 4 sites
- Area of Concern: 4 sites
- Not Characterized (legacy site): 1 site

  Total: 13 sites

Following high water events in 2017, DWR performed a similar assessment to identify erosion sites for repair within RD 3. A total of 12 erosion sites were identified during the assessment by DWR:

- Critical: 0 sites
- Serious: 2 sites
- Area of Concern: 10 sites

  Total: 12 sites

A comparison of these assessments and an overall summary of these sites is provided in Table 5-2.

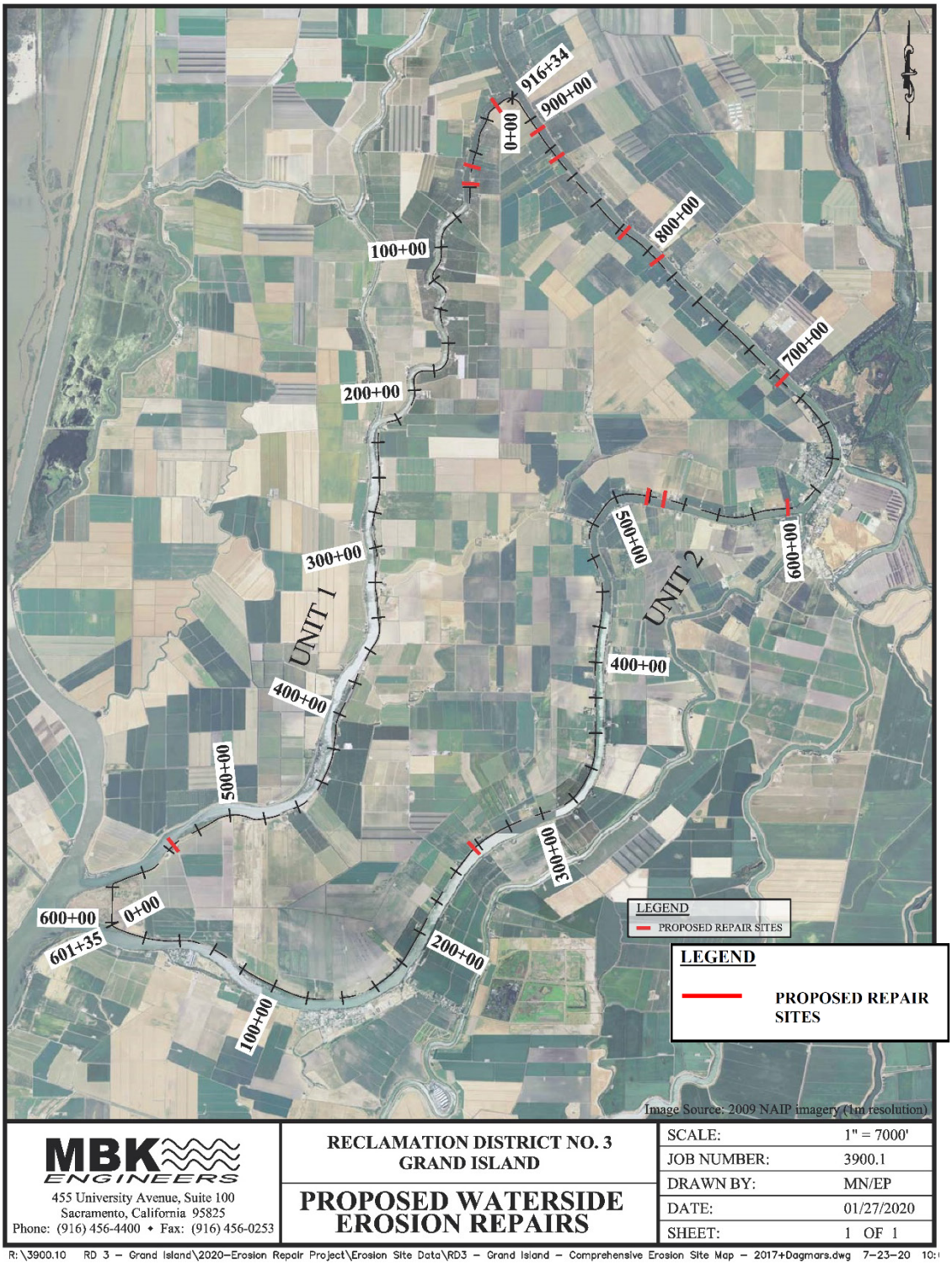



**Figure 5-5. RD 3 Erosion Sites (MBK Engineers, 2020c).**

**Table 5-2. RD 3 Erosion Sites as Identified by MBK Engineers (MBK, 2020b)**

| Site Number | Begin Site RD 3 Station | End Site RD 3 Station | Length (ft.) | NULE Reach | DWR Classification | RD Classification | DWR Authorized Year for Repair |
|---|---|---|---|---|---|---|---|
| 1 | 9+63 | 10+85 | 122 | 113-J | Serious (S) | Critical (C) | 2021 |
| 2 | 48+20 | 51+06 | 286 | 113-I | S | C | 2021 |
| 3 | 57+57 | 57+98 | 41 | 113-I | Area of Concern (A) | S | |
| 4 | 536+35 | 539+47 | 312 | 113-B | A | S | |
| 5 | 256+60 | 257+96 | 136 | 384-A | A | A | |
| 6 | 518+55 | 519+81 | 126 | 384-E | A | A | |
| 7 | 528+97 | 529+58 | 61 | 384-E | A | A | |
| 8 | 598+22 | 602+45 | 422 | 384-E | -- | -- | |
| 9 | 694+80 | 695+69 | 89 | 384-F | A | S | |
| 10 | 792+44 | 795+74 | 330 | 384-G | A | C | |
| 11 | 816+64 | 816+97 | 33 | 384-G | A | S | |
| 12 | 873+61 | 874+83 | 122 | 384-H | A | C | |
| 13 | 892+36 | 892+70 | 34 | 384-H | A | A | |

Sites identified as serious by DWR are planned for repair by the State in 2022. The remaining 11 sites would be addressed as part of this element. 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 10 feet NAVD 88 (Figure 5-6) (MBK, 2019).

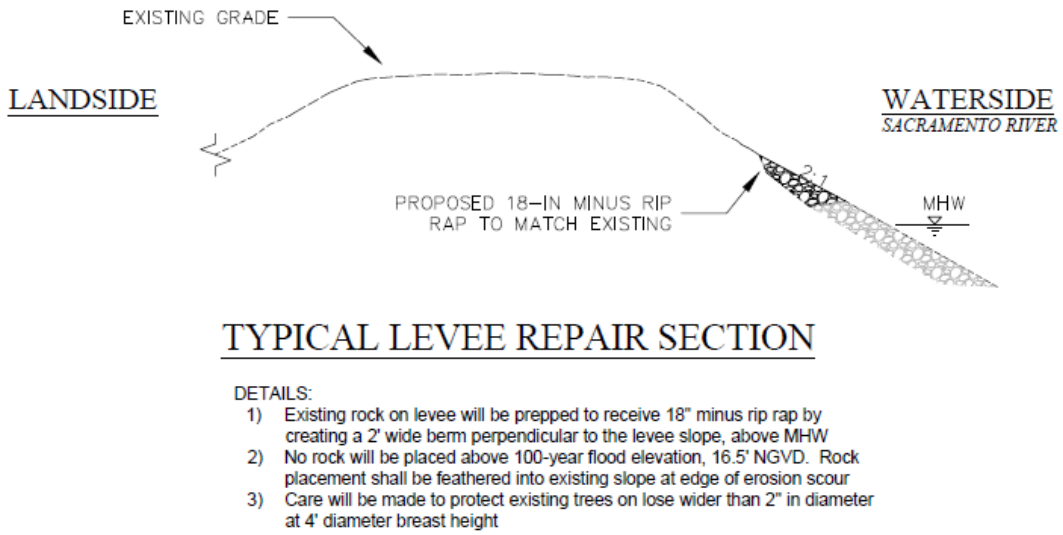



**Figure 5-6. Conceptual Cross Section for the Proposed RSP to Remediate Erosion within RD 3 (MBK, 2019)**

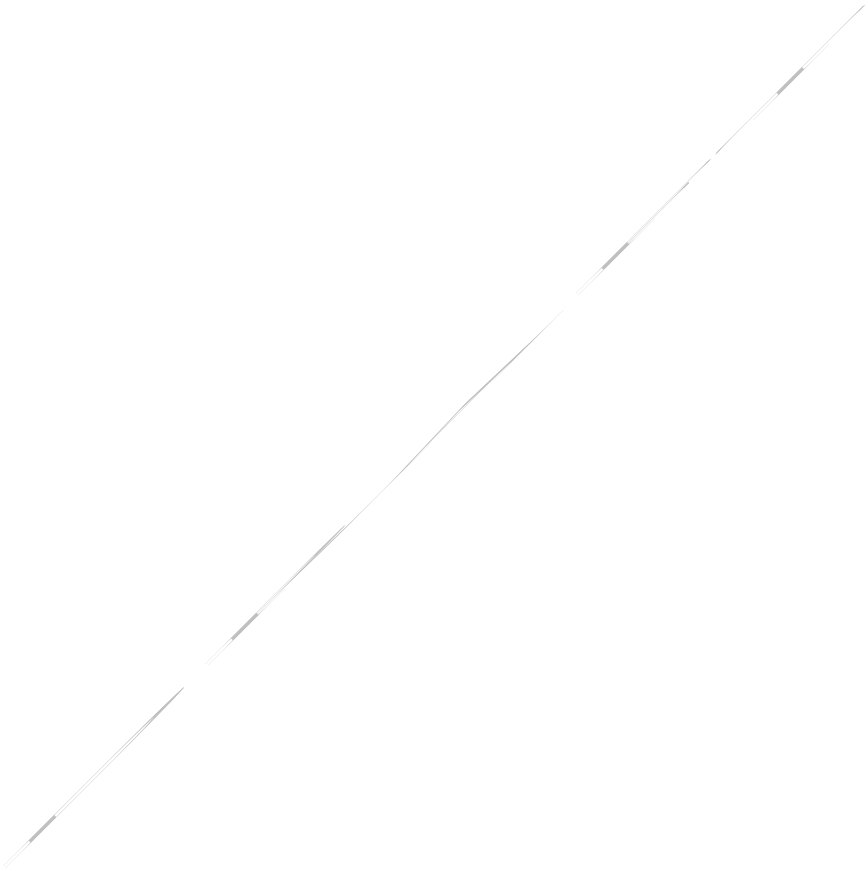
#### 5.1.1.3 Repair and Strengthen-in-Place Sacramento River Right Bank SPFC Levee Adjacent to the two Communities of West Walnut Grove and Ryde

As previously discussed, a breach on the Sacramento River levee immediately fronting the community of West Walnut Grove poses great risk to both West Walnut Grove and Ryde, 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 1.38-mile-long portion of Sacramento River right bank levee immediately adjacent to the community of West Walnut Grove, and a 0.44-mile-long portion adjacent to the community of Ryde for a total combined length of 1.82 miles.

Improvement of these portions of levee system 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 5.1.2.1 through 5.1.2.5, 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 Appendix A. Based on the available data, remediations were

developed to primarily address vulnerabilities for through seepage. As depicted in Figure 5-7, this element includes two remedial alternatives to primarily address through seepage vulnerabilities: a 15-25-foot-deep cutoff wall (Remedial Alternative 1) or a 7- to 8-foot-tall, 15-foot-wide stability berm (Remediation Alternative 2). Note that any erosion deficiencies on the segment of levee fronting West Walnut Grove and Ryde 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 are warranted to confirm the levee fronting the communities may or may not be vulnerable to underseepage and slope stability, in addition to the known vulnerability to through seepage.



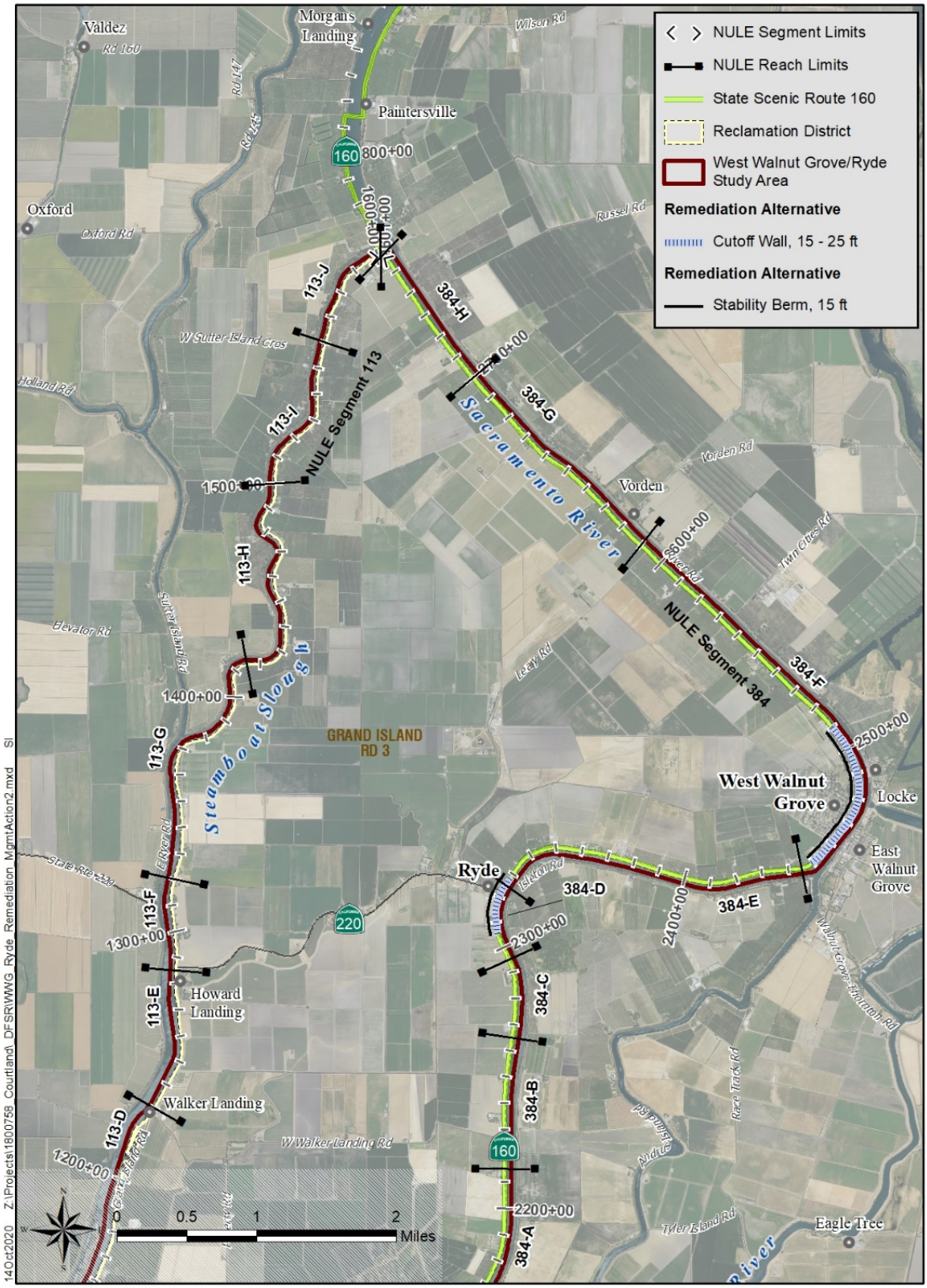



**Figure 5-7. Remedial Alternatives to Address Vulnerabilities on the SPFC Levee Immediately Fronting the two Communities of West Walnut Grove and Ryde**

### *5.1.2 Additional Remediations and Improvements*

Additional remediations to improve flood protection for the communities of West Walnut Grove and Ryde were investigated as part of this feasibility study and are provided below.

#### 5.1.2.1 Repair and Strengthen-in-Place Steamboat Slough Left Bank SPFC Levee (North of SR 220)

This element repairs and strengthens the entirety of the approximately 5.3 miles of SPFC levees located along the left bank of Steamboat Slough (NULE Segment 113), north of SR 220. 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 5-8 and summarized in Table 5-3, this element primarily addresses through seepage and underseepage by reach using available data for the SPFC levees along Steamboat Slough, north of SR 220. Two remedial alternatives are provided to address the through seepage and underseepage vulnerabilities associated with each reach. Freeboard and slope stability were not addressed as part of this element as the levee was not found to be vulnerable to these failure modes using the available data. Note that any erosion deficiencies on this segment of levee are remediated as part of the element described in Section 5.1.1.2 and are not remediated as part of this element. Additional information regarding the data that was used to develop these remediations and how levee vulnerabilities were identified can be found in Appendix A.

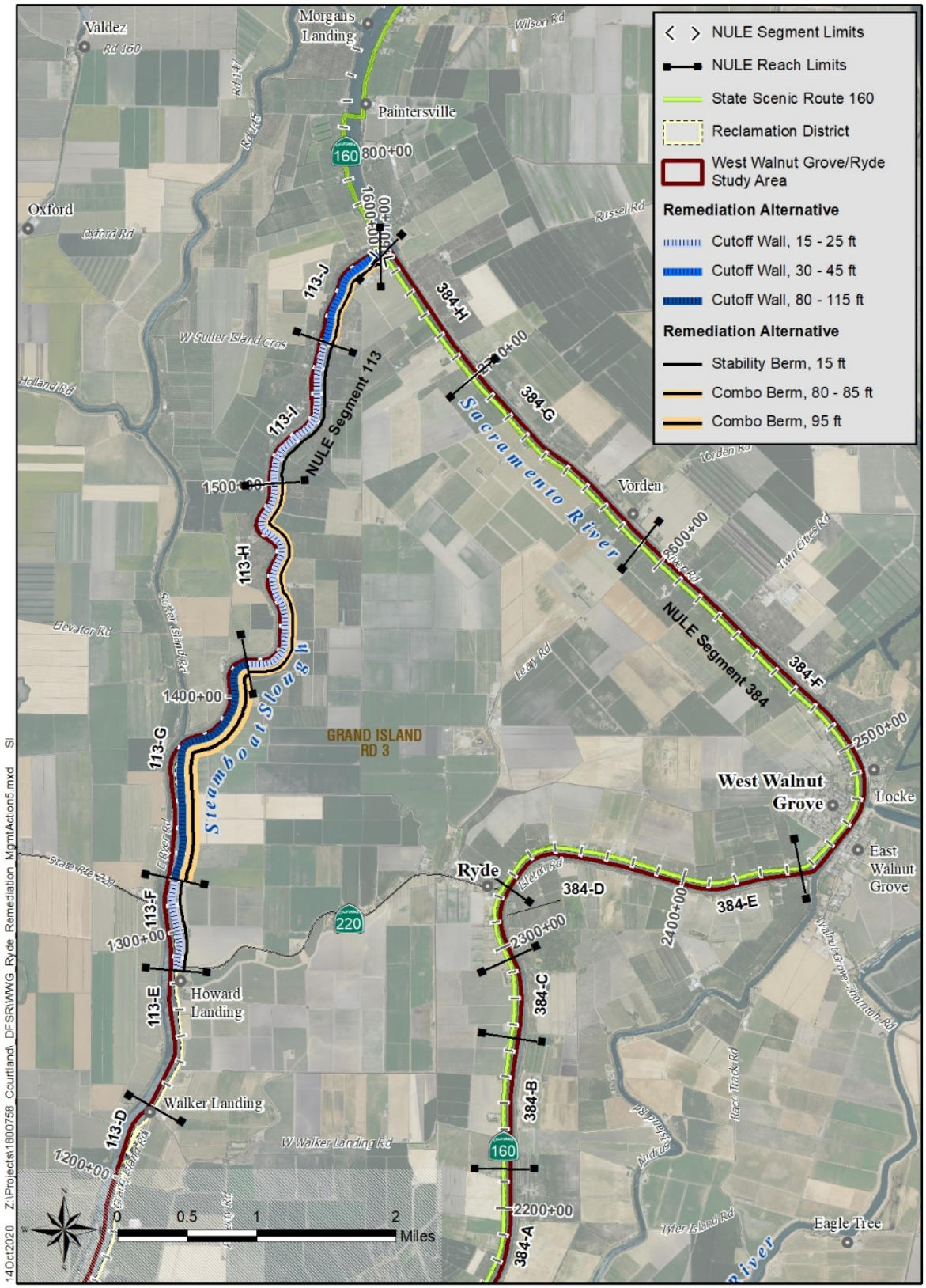



**Figure 5-8. Remedial Alternatives to Repair and Strengthen the SPFC Levees Along Steamboat Slough, north of SR 220**

**Table 5-3. Summary of Remedial Alternatives to Repair and Strengthen the SPFC Levees Along Steamboat Slough, north of SR 220**

| 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 |
| Steamboat Slough, North of SR 220 | 113 | 113-F | 1285+00 | 1320+00 | 3,500 | 20-ft.-deep cutoff wall | 15-ft.-tall, 15-ft.-wide stability berm | - | X |
| | | 113-G | 1320+00 | 1415+00 | 9,500 | 90-ft.-deep cutoff wall | 95-ft.-wide, 11-ft.-tall combination seepage and stability berm | X | X |
| | | 113-H | 1415+00 | 1500+00 | 8,500 | 25-ft.-deep cutoff wall | 85-ft.-wide, 8.5-ft.-tall combination seepage and stability berm | X | X |
| | | 113-I | 1500+00 | 1560+00 | 6,000 | 15-ft.-deep cutoff wall | 10-ft.-tall, 15-ft.-wide stability berm | - | X |
| | | 113-J | 1560+00 | 1601+40 | 4,100 | 35-ft.-deep cutoff wall | 80-ft.-wide, 9-ft.-tall combination seepage and stability berm | X | X |

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

#### 5.1.2.2 Repair and Strengthen-in-Place Steamboat Slough Right Bank SPFC Levee (South of SR 220)

This element repairs and strengthens the entirety of the approximately 6.1 miles of SPFC levees located along Steamboat Slough (NULE Segment 113), south of SR 220. 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 5-9 and summarized in Table 5-4, this element primarily addresses through seepage and underseepage by reach using available data for the SPFC levees along Steamboat Slough, south of SR 220. Two remedial alternatives are provided to address the through seepage and underseepage vulnerabilities associated with each reach. Freeboard and slope stability were not addressed as part of this element as the levee was not found to be vulnerable to these failure modes using the available data. Note that any erosion deficiencies on this segment of levee are remediated as part of the element described in Section 5.1.1.2 and are not remediated as part of this element. Additional information regarding the data that was used to develop these remediations and how levee vulnerabilities were identified can be found in Appendix A.

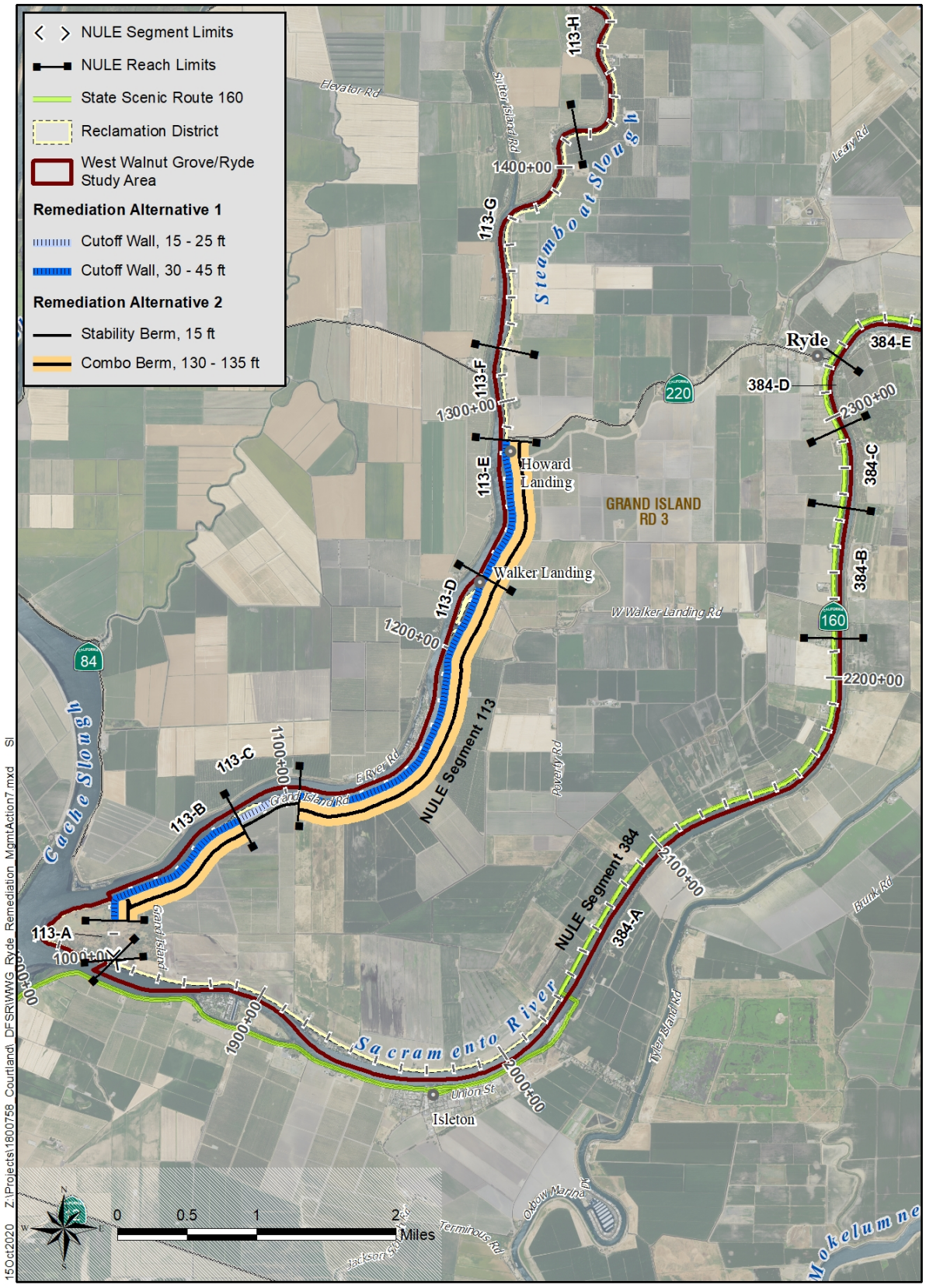



**Figure 5-9. Remedial Alternatives to Repair and Strengthen the SPFC Levees Along Steamboat Slough, South of SR 220**

**Table 5-4. Summary of Remedial Alternatives to Repair and Strengthen the SPFC Levees Along Steamboat Slough, south of SR 220**

| Levee Segment Location | NULE Segment | Reach | Start Station | End Station | Reach Length (ft.) | Remediation Alternative 1 | Remediation Alternative 2 | Vulnerability | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Under-Seepage | Through-Seepage |
| Steamboat Slough, South of SR 220 | 113 | 113-A | 1000+00 | 1015+00 | 1,500 | N/A | N/A | - | - |
| | | 113-B | 1015+00 | 1080+00 | 6,500 | 30-ft.-deep cutoff wall | 135-ft.-wide, 11-ft.-tall combination seepage and stability berm | X | X |
| | | 113-C | 1080+00 | 1105+00 | 2,500 | 20-ft.-deep cutoff wall | 15-ft.-tall, 15-ft.-wide stability berm | - | X |
| | | 113-D | 1105+00 | 1230+00 | 12,500 | 30-ft.-deep cutoff wall | 130-ft.-wide, 14-ft.-tall combination seepage and stability berm | X | X |
| | | 113-E | 1230+00 | 1285+00 | 5,500 | 45-ft.-deep cutoff wall | 130-ft.-wide, 13-ft.-tall combination seepage and stability berm | X | X |

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#### 5.1.2.3 Repair and Strengthen-in-Place Sacramento River Right Bank SPFC Levee (Between the Confluence with Steamboat Slough and Georgiana Slough)

This element repairs and strengthens the 5.9 miles of SPFC levees located along the right bank of the Sacramento River (NULE Segment 384), between the confluence with Steamboat Slough and Georgiana Slough. 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 5-5, this element primarily addresses through seepage and underseepage by reach using available data for the SPFC levees along the right bank of the Sacramento River between the confluence with Steamboat Slough and Georgiana Slough. Two remedial alternatives are provided to address the through seepage and underseepage vulnerabilities associated with each reach. Freeboard and slope stability were not addressed as part of this element as the levee was not found to be vulnerable to these failure modes using the available data. Note that any erosion deficiencies on this segment of levee are remediated as part of the element described in Section 5.1.1.2 and are not remediated as part of this element. Additional information regarding the data that was used to develop these remediations and how levee vulnerabilities were identified can be found in Appendix A.

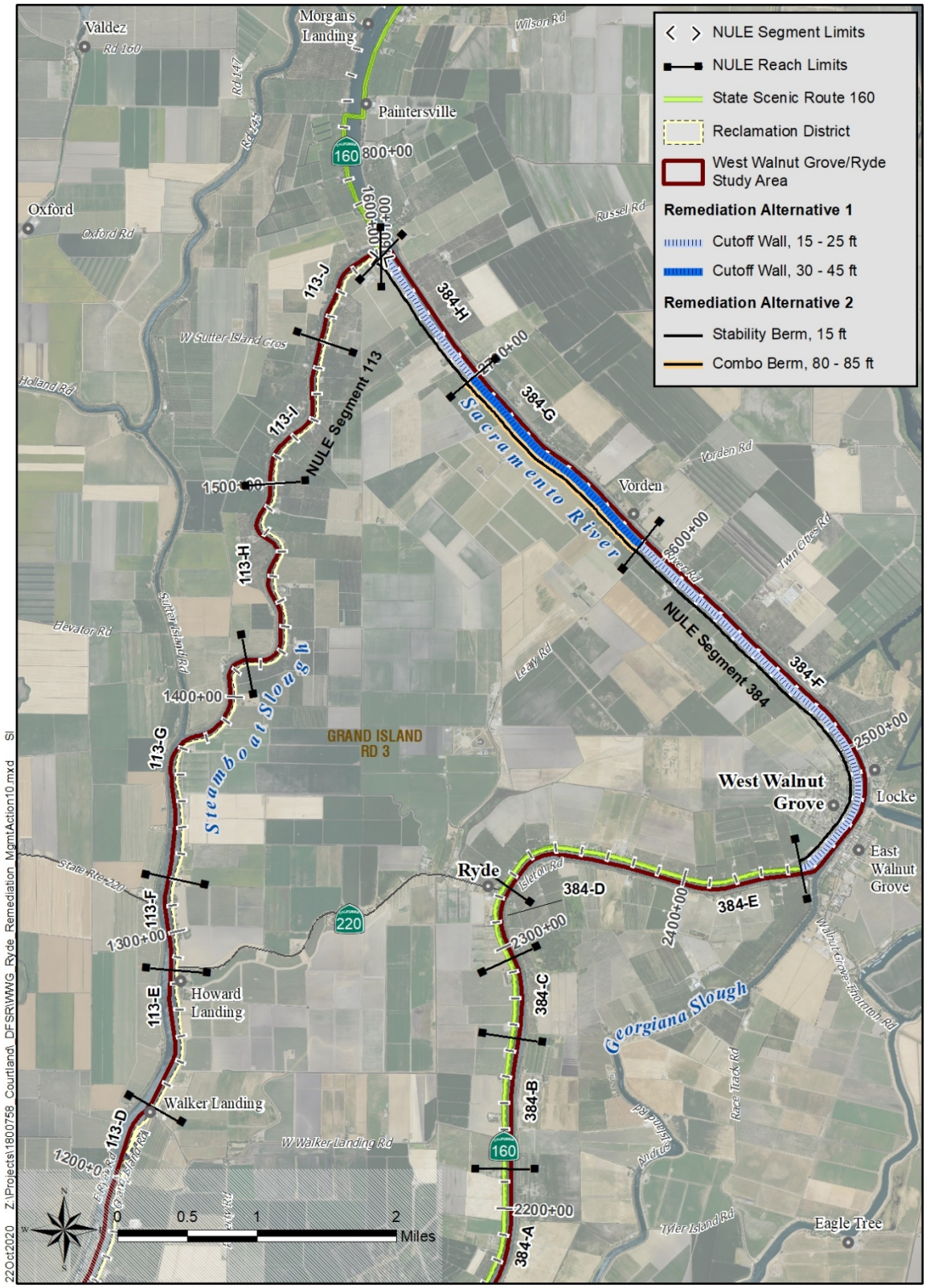


**Figure 5-10. Remedial Alternatives to Repair and Strengthen the SPFC Levees Along the Right Bank of the Sacramento River Between the Confluence with Steamboat Slough and Georgiana Slough**

**Table 5-5. Remedial Alternatives to Repair and Strengthen the SPFC Levees Along the Right Bank of the Sacramento River Between the Confluences with Steamboat Slough and Georgiana Slough**

| 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 |
| Right Bank of the Sacramento River, North of SR 220 | 384 | 384-F | 2445+00 | 2610+00 | 16,500 | 15-ft.-deep cutoff wall | 7-ft.-tall, 15-ft.-wide stability berm | - | X |
| | | 384-G | 2610+00 | 2700+00 | 9,000 | 35-ft.-deep cutoff wall | 80-ft.-wide, 8 ft.-tall combination seepage and stability berm | X | X |
| | | 384-H | 2700+00 | 2757+91 | 5,800 | 15-ft.-deep cutoff wall | 9 ft.-tall, 15-ft.-wide stability berm | - | X |

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

#### 5.1.2.4 Repair and Strengthen-in-Place Sacramento River Right Bank SPFC Levee (Between the Confluence with Steamboat Slough and 0.33 Miles South of SR 220)

This element repairs and strengthens the entirety of the approximately 8.48 miles of SPFC levees located along the right bank of the Sacramento River (NULE Segment 384), between the confluence with Steamboat Slough and approximately 0.33 miles south of SR 220. 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 5-11 and summarized in Table 5-6, this element primarily addresses through seepage and underseepage by reach using available data for the SPFC levees along the right bank of the Sacramento River, north of SR 220, plus a portion of Reach 384-D located just north and south of SR 220. Two remedial alternatives are provided to address the through seepage and underseepage vulnerabilities associated with each reach. Freeboard and slope stability were not addressed as part of this element as the levee was not found to be vulnerable to these failure modes using the available data. Note that any erosion deficiencies on this segment of levee are remediated as part of the element described in Section 5.1.1.2 and are not remediated as part of this element. Additional information regarding the data that was used to develop these remediations and how levee vulnerabilities were identified can be found in Appendix A.

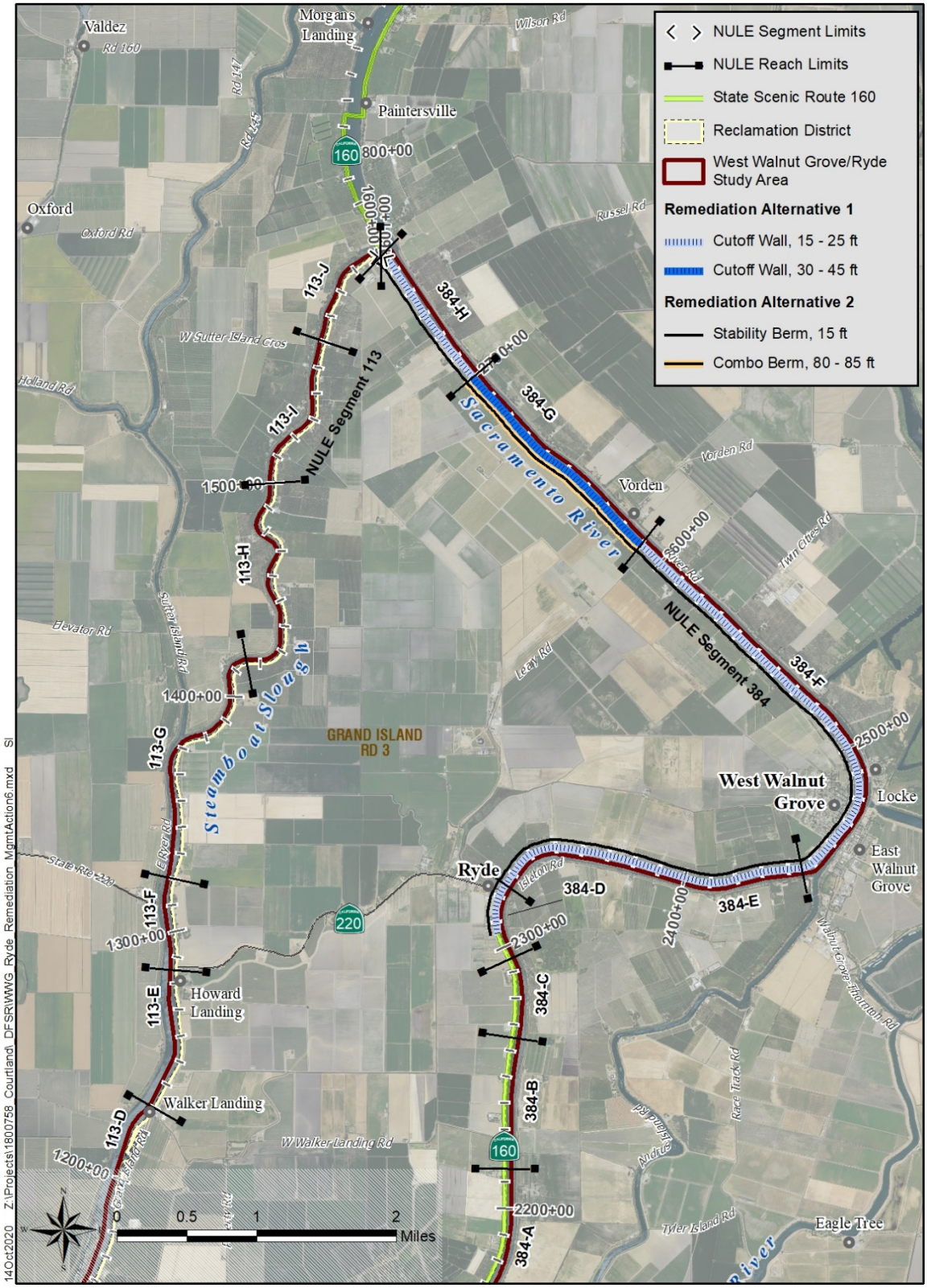


**Figure 5-11. Remedial Alternatives to Repair and Strengthen the SPFC Levees Along the Right Bank of the Sacramento River Between the Confluence with Steamboat Slough and 0.33 Miles South of SR 220**

**Table 5-6. Remedial Alternatives to Repair and Strengthen the SPFC Levees Along the Right Bank of the Sacramento River Between the Confluence with Steamboat Slough and 0.33 Miles South of SR 220**

| 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 |
| Right Bank of the Sacramento River, North of SR 220 | 384 | 384-D | 2305+17 | 2325+00 | 2,000 | 15-ft.-deep cutoff wall | 8 ft.-tall, 15-ft.-wide stability berm | - | X |
| | | 384-E | 2325+00 | 2445+00 | 12,000 | 25-ft.-deep cutoff wall | 7-ft.-tall, 15-ft.-wide stability berm | X | X |
| | | 384-F | 2445+00 | 2610+00 | 16,500 | 15-ft.-deep cutoff wall | 7-ft.-tall, 15-ft.-wide stability berm | - | X |
| | | 384-G | 2610+00 | 2700+00 | 9,000 | 35-ft.-deep cutoff wall | 80-ft.-wide, 8-ft.-tall combination seepage and stability berm | X | X |
| | | 384-H | 2700+00 | 2757+91 | 5,800 | 15-ft.-deep cutoff wall | 9-ft.-tall, 15-ft.-wide stability berm | - | X |

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

#### 5.1.2.5 Repair and Strengthen-in-Place Sacramento River Right Bank SPFC (South of Ryde/SR 220)

This element repairs and strengthens approximately 8.9 miles of SPFC levees (NULE Segment 384) located along the right bank of the Sacramento River, south of SR 220, omitting the 0.38-mile portion of levee fronting and just south of the community of Ryde which is repaired as part of the structural element described in the previous Section 5.1.1.3. 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 5-12 and summarized in Table 5-7, this element primarily addresses through seepage and underseepage by reach using available data for the SPFC levees along the right bank of the Sacramento River, south of SR 220. Two remedial alternatives are provided to address the through seepage and underseepage vulnerabilities associated with each reach. Freeboard and slope stability were not addressed as part of this element as the levee was not found to be vulnerable to these failure modes using the available data. Note that any erosion deficiencies on this segment of levee are remediated as part of the element described in Section 5.1.1.2 and are not remediated as part of this element. Additional information regarding the data that was used to develop these remediations and how levee vulnerabilities were identified can be found in Appendix A.

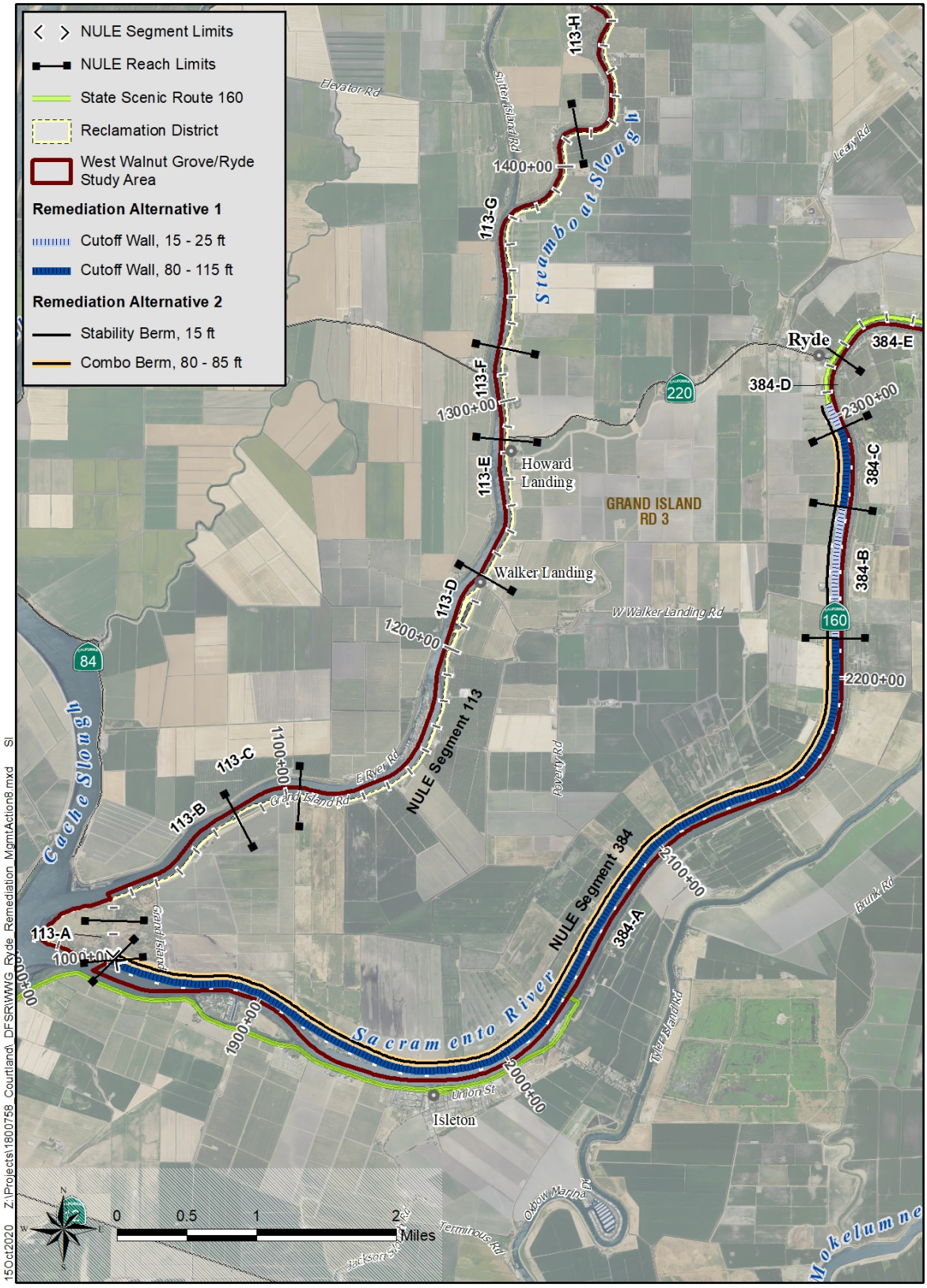


**Figure 5-12. Remedial Alternatives to Repair and Strengthen the SPFC Levees Along the Right Bank of the Sacramento River, south of SR 220**

**Table 5-7. Summary of Remedial Alternatives to Repair and Strengthen the SPFC Levees Along the Right Bank of the Sacramento River, south of SR 220**

| 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 |
| Right Bank of the Sacramento River, South of SR 220 | 384 | 384-A | 1841+71 | 2215+00 | 37,300 | 80-ft.-deep cutoff wall | 85-ft.-wide, 7-ft.-tall combination seepage and stability berm | X | X |
| | | 384-B | 2215+00 | 2265+00 | 5,000 | 15-ft. deep cutoff wall | 7-ft.-tall, 15-ft.-wide stability berm | - | X |
| | | 384-C | 2265+00 | 2295+00 | 3,000 | 115-ft.-deep cutoff wall | 80-ft.-wide, 7-ft.-tall combination seepage and stability berm | X | X |
| | | 384-D | 2295+00 | 2305+17 | 1,000 | 15-ft.-deep cutoff wall | 8-ft.-tall, 15-ft.-wide stability berm | - | X |

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

#### 5.1.2.6 SR 220 Cross Levee

This flood risk reduction element constructs a new 2.7-mile-long cross levee along the portion of SR 220 which bisects RD 3. This cross levee could be constructed and joined with levee repairs and improvements along the left bank of Steamboat Slough and the right bank of the Sacramento River to form a complete levee system which could be certified by FEMA to secure 100-year flood protection for the communities of West Walnut Grove, Ryde, and the northern portion of the study area. The new cross levee would be a multi-benefit project that would include raising and widening SR 220 and the combined road levee embankment section would be constructed with a 30- to 40-foot-crown width, 3H:1V landside and waterside slopes, and levee crest elevation of 14 feet, assuming a downstream design WSEL of 11 feet NAVD 88 and 3 feet of freeboard.

#### 5.1.2.7 Secure 100-Year FEMA Certification for Communities and/or Larger Portions of Grand Island – RD 3

This element builds on the previous collection of elements by improving all SPFC levee segments 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 the preceding sections and erosion remediation measures discussed in Section 5.1.1.2, 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 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 foot, 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:<br>• 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.<br>• A formal plan of operation including specific actions and assignments of responsibility by individual name or title.<br>• 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:<br>• 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 communities of West Walnut Grove and Ryde and the adjoining North Delta Legacy Communities within Sacramento County are described in detail in Appendix H and summarized below:

1. Flood Fight Berms or a Ring Levee System
2. Voluntary Elevation of Structures
3. Wet or Dry Floodproofing
4. Acquisition and Relocation
5. Flood Emergency Safety Plans (ESPs)
6. Sacramento County Office of Emergency Services (OES) Decision Support Tool
7. Local Hazard Mitigation Plan and Relief Cuts
8. Alternatives to FEMA's NFIP – Private, Community-Based Flood Insurance
9. NFIP Flood Insurance Enhancements *via* AFOTF

10. Mokelumne River Conveyance Improvements & Staten Island Overflow Area
11. Improve FEMA's 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 Appendix H that are community-specific to the West Walnut Grove/Ryde 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 West Walnut Grove/Ryde 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 for the Community of West Walnut Grove/Clampett Tract*

This measure includes construction of a 1.4-mile-long all-weather access road and flood fight berm to reduce flood risk within the community of West Walnut Grove (Figure 5-13). Similar to a ring levee, an access road and flood fight berm would encircle the densely populated portion of the existing community of West Walnut Grove (Clampett Tract and nearby residences north and upstream of Clampett Tract) 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 basin of Grand Island – RD 3. 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. 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 alignment as the potential ring levee described below in Section 5.2.2, with a 20-foot-wide road width, 3H:1V landside and waterside slopes, and maximum road crown elevation of 11 feet, assuming a downstream design WSEL of 10 feet NAVD 88 and 1 foot of freeboard. Note that the maximum crown elevation of 11 feet was developed assuming a relief cut would be executed within the lower, downstream portion of Grand Island. The maximum crown elevation would need to be 5 to 6 feet higher if a relief cut were not planned or implemented in the lower, downstream portion of Grand Island. The flood fight Muscle Wall (similar to a plastic Jersey barrier containing a 4-8 ft. 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 basin of Grand Island – RD 3. 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 5-13 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-foot-high Muscle Wall needed, and the estimated height of the access road/flood fight berm at every 500-foot-interval. In general, the height of the access road/flood fight berm is highest between station 37+00 to 50+00 west of Island View Way, with an average height of 4 feet Along this segment of the access road/flood fight berm, existing ground elevation is lowest, and would require 8-foot-high Muscle Wall assuming a design WSEL of 10 feet NAVD 88 and 1 foot of freeboard. The height of the access road/flood fight berm is estimated to be at grade (0 ft.) at both terminating points along the landward toe of the Sacramento River where existing ground elevations are highest and extending westerly. These segments of the access road/flood fight berm closest to the levee and both north and south of Clampett Tract would require the shortest Muscle Wall (4 ft.).

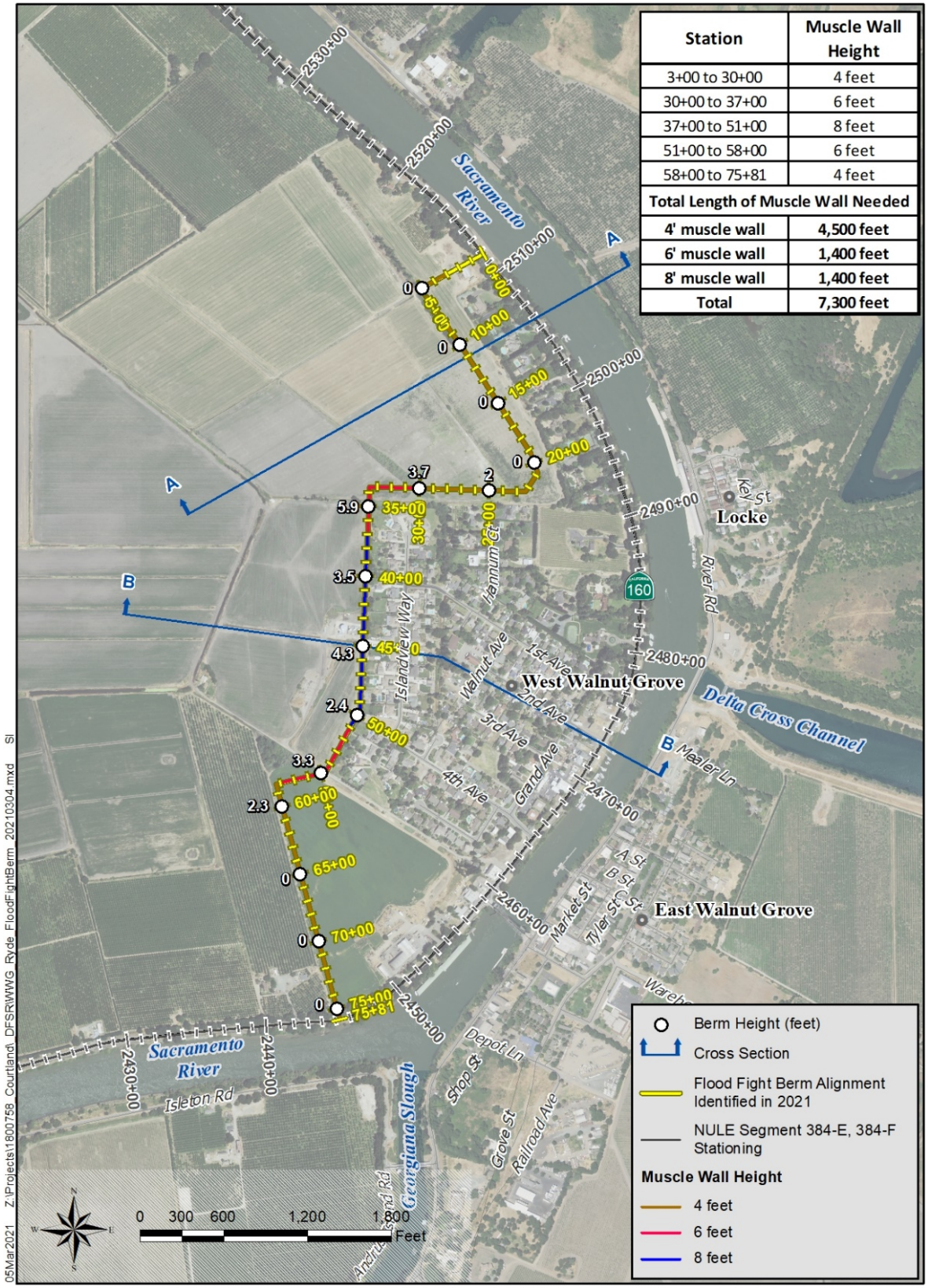


**Figure 5-13. Potential Flood Fight Berm Alignment for the Community of West Walnut Grove**

### 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 West Walnut Grove (including developed areas immediately north and south Clampett Tract) 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 RD 3. 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 right bank of the Sacramento River.

The proposed 1.8-mile ring levee configuration for West Walnut Grove as detailed in the 2012 CVFPP and 2014 RFMP assumed that the levee would extend well beyond the developed limits of West Walnut Grove/Clampett Tract, which would require repair of an additional 1.1 miles of levee along the Sacramento River and a higher embankment due to the lower ground elevations further west of the community. As such, a new configuration is presented as part of this feasibility study (Figure 5-14). This new configuration or alignment would closely adhere to the boundaries as dictated by the Delta Plan and would total approximately 1.4 miles in length, with a 20-foot minimum crown width, 3H:1V landside and waterside slopes, and levee crest elevation of 14 feet, assuming design WSEL of 11 feet NAVD 88 (due to climate change and sea level rise) and 3 feet of freeboard. Note that the levee crest elevation of 14 feet was developed assuming a relief cut would be executed within the lower, downstream portion of Grand Island. The maximum crown elevation would need to be 5 to 6 feet higher if a relief cut were not deployed in the southerly, downstream portion of Grand Island.

Accompanying the plan view of potential ring levee alignments shown below in Figure 5-14 are cross sections are provided in Figures 5-15 and 5-16 below to indicate the heights of the ring levee in relation to a shorter access road/flood fight berm. With respect to the ring levee, ground elevations along cross section A-A are marginally lower than along cross section B-B, requiring the ring levee to be an estimated 1.5 feet taller at cross section A-A than cross section B-B.

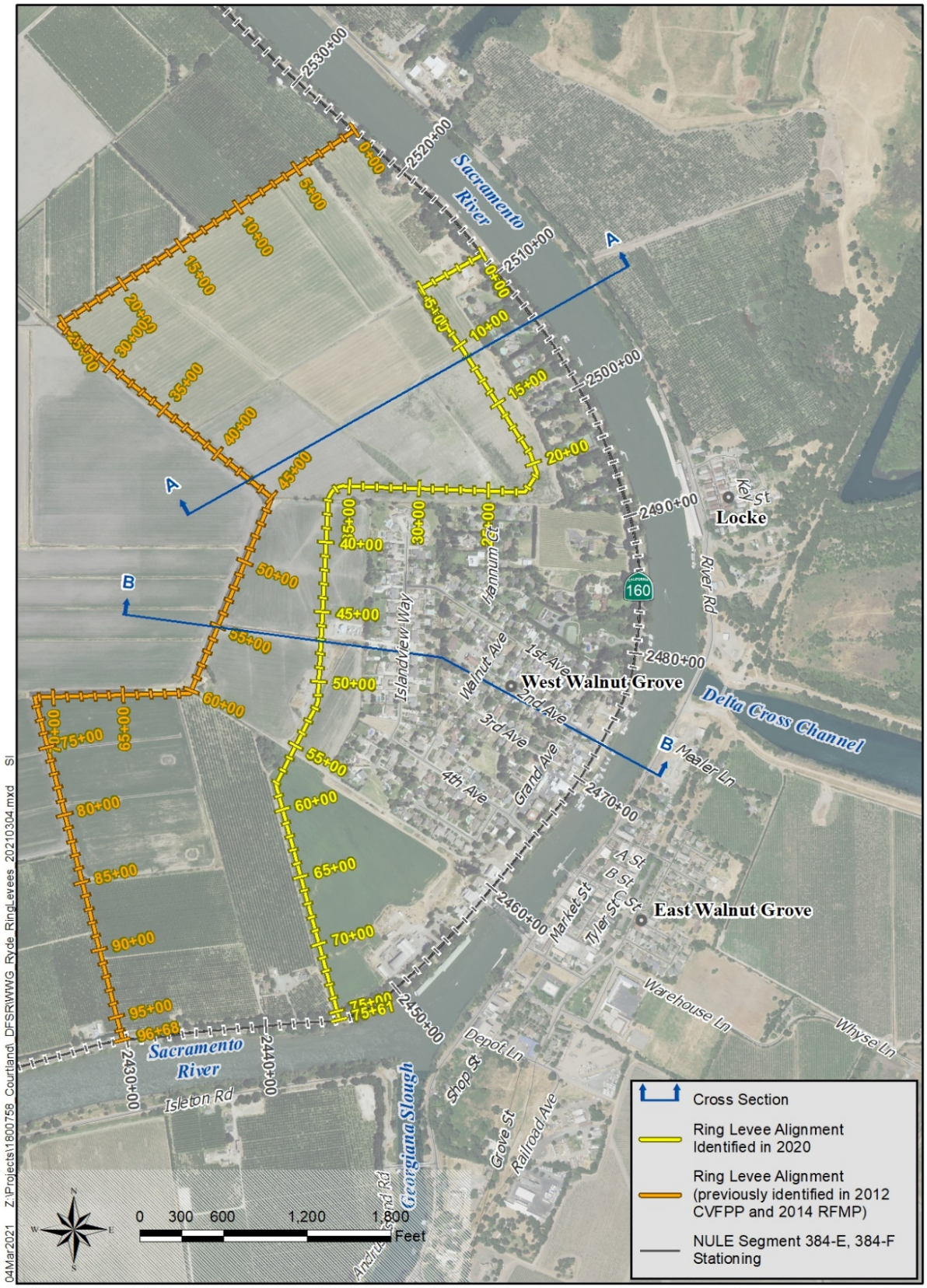


**Figure 5-14: Potential Ring Levee Alignments for the Community of West Walnut Grove**

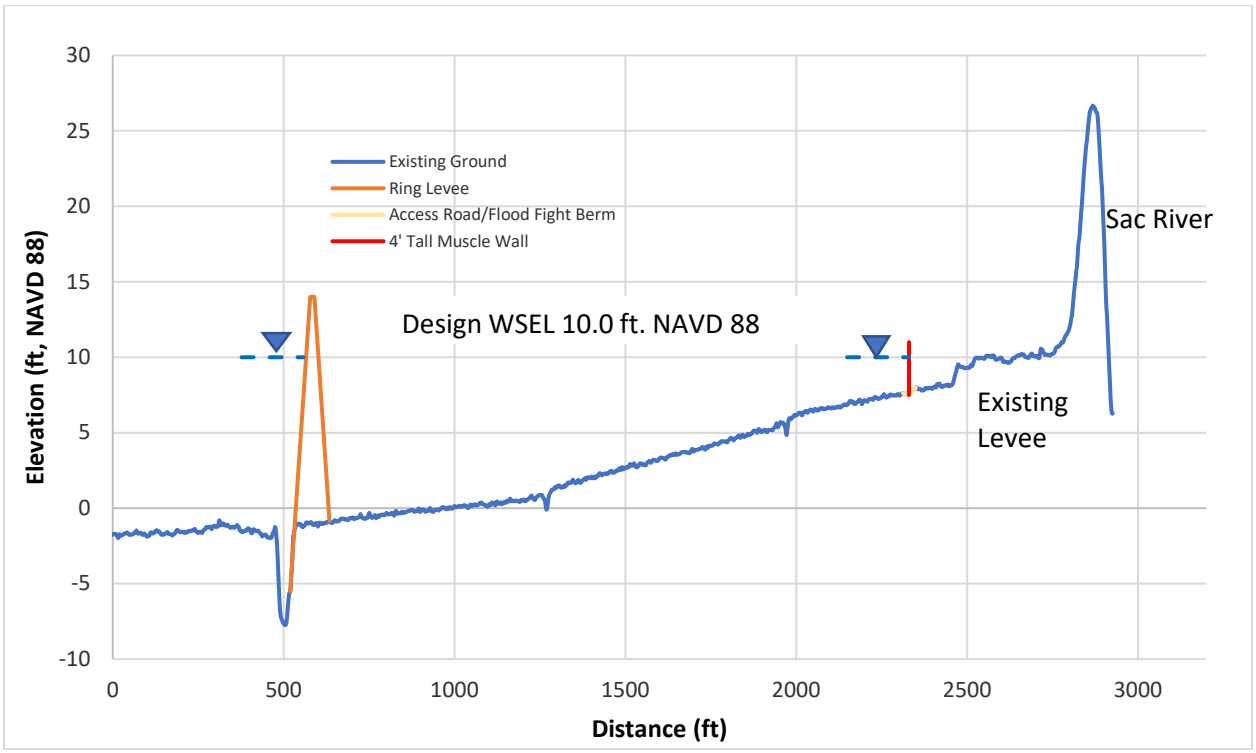


**Figure 5-15. "A-A" Cross Section of Potential Flood Fight Berm and Ring Levee Systems**

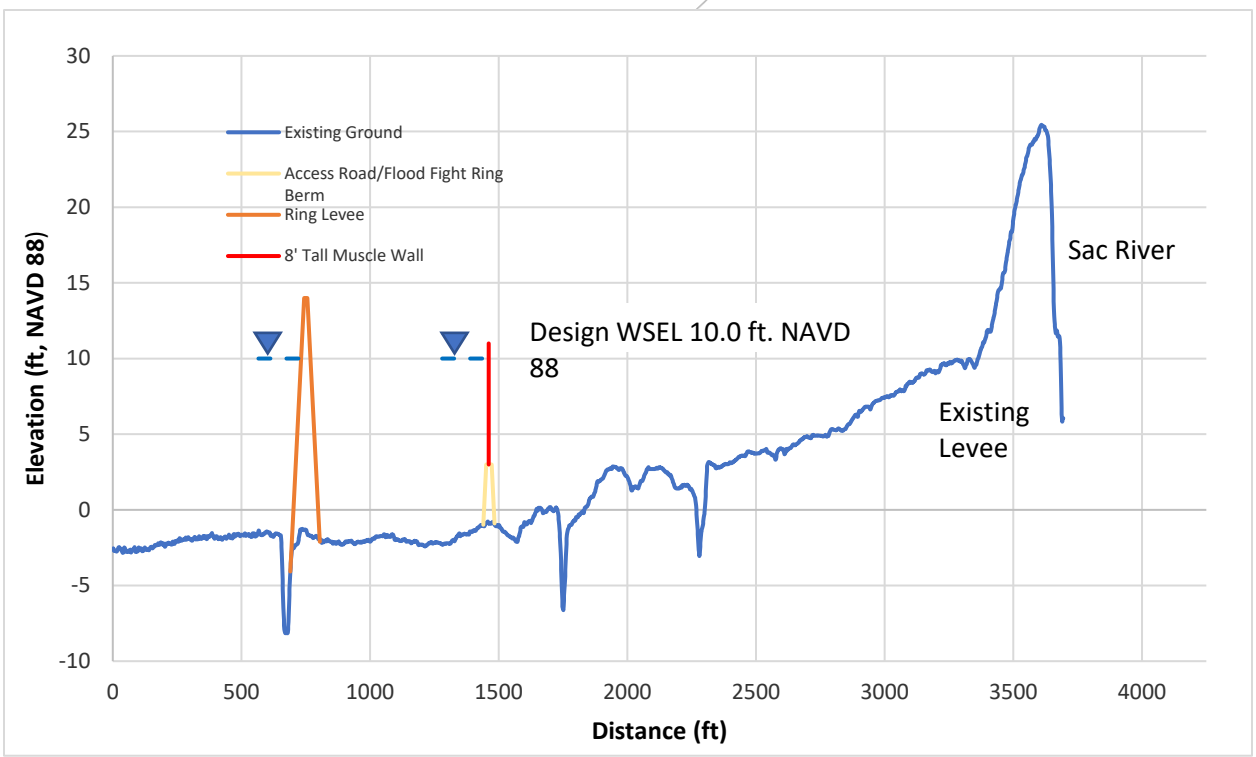


**Figure 5-16. "B-B" Cross Section of Potential Flood Fight Berm and Ring Levee Systems**

### 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 element 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 West Walnut Grove/Ryde study area, the current BFE is currently set at 10 feet NAVD 88 that assumes a relief cut could be deployed in the southerly, downstream portion of Grand Island. 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 (excerpted from Appendix H) that indicates the number and types of structures located within the community of West Walnut Grove (SAC 50-URB), and within the greater West Walnut Grove Study Area (SAC 50). 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.

**Table 5-8: Total Count and Cost to Elevate Structures in the 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 |
| West Walnut Grove | SAC 50-URB | 219 | 6 | 4 | 5 | 234 |
| (Clampett Tract) | | $37,230,000 | $1,020,000 | $680,000 | $850,000 | $39,780,000 |
| West Walnut Grove Study Area | SAC 50 | 513 | 10 | 152 | 5 | 680 |
| (Grand Island) | | $87,210,000 | $1,700,000 | $25,840,000 | $850,000 | $115,600,000 |

### 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 West Walnut Grove/Ryde study area is 10 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 Communities of West Walnut Grove/Ryde 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 with inconsistent with the goals and objectives of both the Delta Plan and the SSJDNHA.

### 5.2.6 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.

### 5.2.7 Local Hazard Mitigation Plan and Relief Cuts

The Sacramento County Local Hazard Mitigation Plan (LHMP) is a multi-jurisdictional plan that geographically covers the entire area within Sacramento County's jurisdictional boundaries (planning area), including RD 3. The LHMP identifies hazards within Sacramento 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 county developed the initial LHMP in 2005 and was last updated in 2016. The Sacramento 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 3.

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 West Walnut Grove/Ryde 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 3, near the southwest corner of the island. However, a carefully planned relief cut excavated into the levee at the lower downstream end of Grand Island during or immediately following a breach event in the northerly portion of the island would allow the water to escape or drain out of Grand Island before filling up the entire basin. For example, if there is 5 feet of freeboard at the lower downstream end of the island, the relief cut could potentially reduce flood depths by as much as 5 feet over the entirety of the island, while waiting for the lower, downstream levee reach to overtop (as compared to Figure 3-1). The RD personnel 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 in RD 3 should be identified and further evaluated while updating the LHMP.

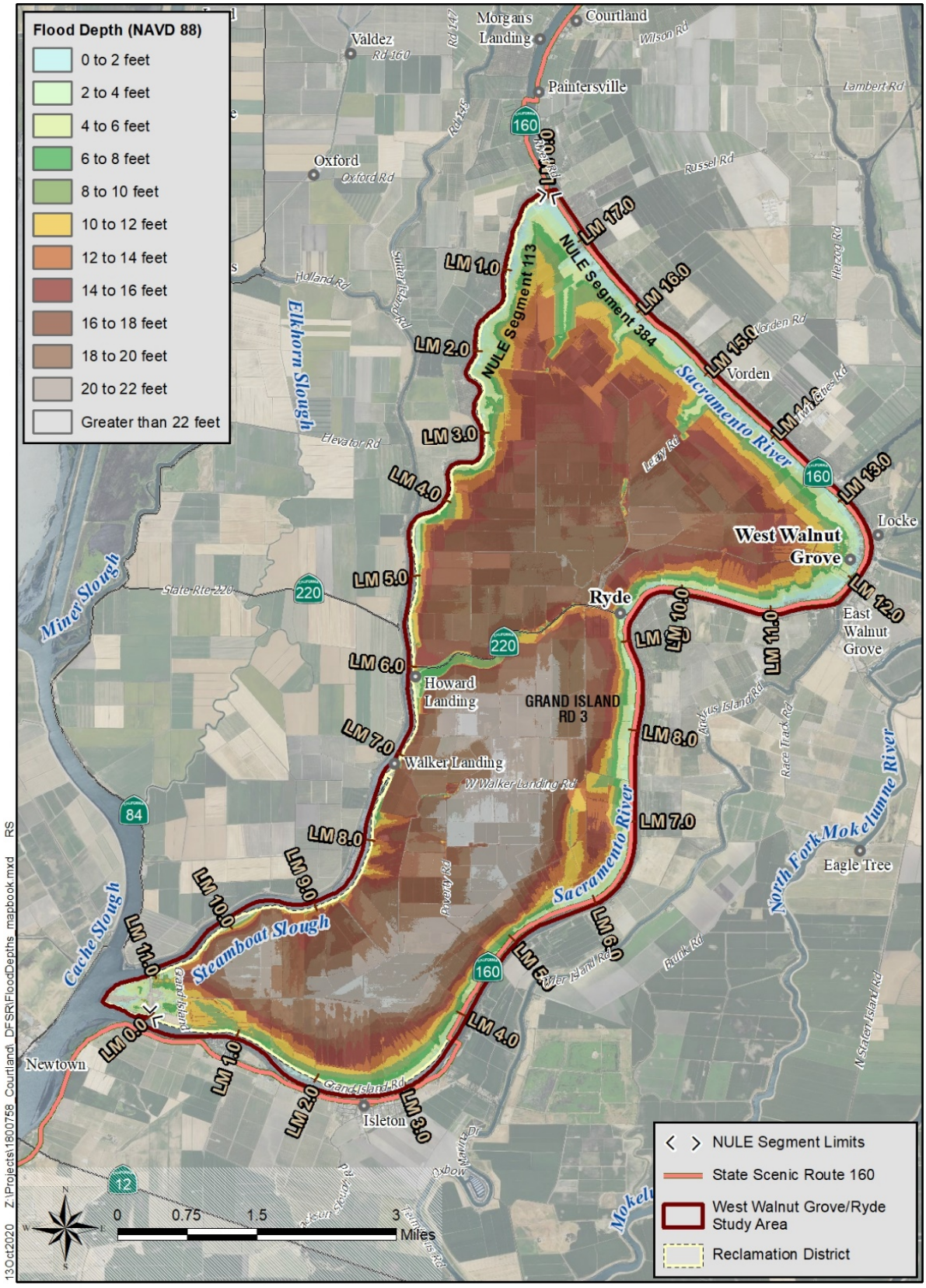


**Figure 5-17. Maximum Flood Depths Following a Relief Cut.**

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

The NFIP is managed by 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.

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 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. As NFIP premiums continue to increase for residents in West Walnut Grove, 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).

**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 Appendix J for further details for a Community-Based Flood Insurance Program for West Walnut Grove/Ryde and other nearby Delta Legacy Communities

Private insurers use their own models to establish the price of a policy. For example, the nonprofit First Street Foundation 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 West Walnut Grove 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

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

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.

An alternative to individual NFIP 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 a 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 Section 5.2, and in Section 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-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 West Walnut Grove to consider alternatives to the current NFIP, including a 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, largely 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 West Walnut Grove/Ryde study area:

a) Levee relief cuts with Emergency Operation Plan's (EOPs) 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's 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 involved dredging along the North and South Forks of the Mokelumne River to reduce flood stages in the Mokelumne River and Snodgrass Slough, which would provide a flood risk reduction benefit to adjoining nearby communities. Another option included allowing flood stages along the North and South Forks of the Mokelumne River to overtop into Staten Island, or portions thereof, which would serve as a flood relief overflow area.

This element is included for comparison purposes, but it is not expected to result in flood risk reduction benefits for the Delta Legacy communities of West Walnut Grove and Ryde. West Walnut Grove and Ryde are somewhat isolated from the high-water conditions within the unregulated watersheds associated with the Cosumnes River, Dry Creek and Snodgrass Slough that drain into the capacity constrained Mokelumne River system adjoining and upstream of State Island.

### *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's 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 $547 in annual NFIP premiums), within the county, including the entire West Walnut Grove/Ryde study area. The county currently has the opportunity to improve their CRS score to achieve the highest possible Class 1 designation by implementing and participating in Emergency Action Plans (EAPs) and associated Table Top Exercises for nearby, upstream dams/reservoirs (namely Folsom Reservoir, and possibly others) that could have a sizeable impact on flooding portions of Sacramento County if said reservoir(s) were to fail and cause flooding. This last jump from a CRS Class 2 to Class l designation would result in the last available 5 percent decrease in NFIP premiums and would place Sacramento County as the 2$^{nd}$ 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.

Due to assessment limitations imposed by the California Water Code, RD 3 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 RD to work closer together in potentially developing an improved assessment and/or GHAD for implementing flood risk reduction measures specific to the communities. 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 RD 3.

### 5.2.13 SWIFs and Periodic Inspections with USACE

RD 3 has an approved SWIF plan. As outlined in the SWIF, RD 3 will be making repairs that address system-wide issues in a prioritized manner to optimize flood risk reduction. The USACE's approval of the SWIF allows RD 3 to remain active in the PL 84-99 rehabilitation program while the SWIF is being implemented. This is important since, in order to be eligible for rehabilitation assistance under PL 84-99, the project must be considered "Active" at the time of damage.

Furthermore, the USACE conducts periodic inspections once every five years on federally authorized levees in the USACE Levee Safety Program. Findings from these reports can jeopardize PL 84-99 eligibility. As part of their SWIF, RD 3 will also be correcting any unacceptable items identified by the USACE, or DWR as part of their semiannual inspections, to help increase the level of flood protection for Grand Island.

### 5.2.14 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-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 West Walnut Grove and Ryde.

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 that 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 website and enter their address to get the most information on State-federal levees in their area.[2]

## 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 West Walnut Grove and Ryde Legacy Community boundaries 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

Repairing and improving the SPFC levee reaches along the Sacramento River between Freeport and the Delta Cross Channel (which includes Maintenance Area 9, RD 755 – Randall Island, RD 551 – Pearson District, RD 369 – Libby McNeil/Locke, RD 554 – East Walnut Grove, and RD 3 – West Walnut Grove/Ryde) 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 the 5.9-mile stretch of SPFC levees located along the right bank of the Sacramento River between the confluence with Steamboat Slough and Georgiana Slough would improve nearly 10 percent of the SPFC levees which comprise the freshwater corridor within the Delta (total of 62 miles). Similarly, improving the 5.9 miles of SPFC levees located along the right bank of the Sacramento River between the confluence with Steamboat Slough and the Delta

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

Cross Channel would improve approximately 16 percent of the SPFC levees located upstream of the Delta Cross Channel (total of 37 miles).

### 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 West Walnut Grove and Ryde include:

1) Construction of a setback levee on Grand Island and enlarging the existing river or slough channel(s) could potentially create up to 250 acres of subtidal open water, shallow subtidal, tidal marsh, riparian scrub, and riparian woodland habitats along the margin of all of part of the study area
2) Enhancing or creating additional SRA habitat along the Sacramento River (particularly River Miles 25-35) or Steamboat Slough in connection with addressing erosion concerns and/or replenishing RSP at known erosion sites. This enhancement along 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.
3) Constructing a relief cut at the southern tip of Grand Island. This area of land owned by the federal government could be restored to tidal marsh. Restoration of this area would be consistent with local Delta stakeholder requests to conduct restoration activities first on public lands. RD 3 is currently evaluating the best locations of relief cuts at the southerly downstream end of Grand Island and should consider the subject location that could be occupied and publicly owned federal property.

*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 Cross Levee Trail, Ring Levee Trail and Regional Connection Trail*

The potential cross levee along SR 220 could serve as community or regional trail system of Grand Island; and the ring levee around West Walnut Grove could be modified slightly to act as a community trail for walking or biking the outer perimeter of Clampett Tract. Refinements to the cross levee and ring levee features could also include restricted access for portions of the alignment adjacent to residences. Preliminary trailhead locations include open land adjacent to

the Ryde Hotel and the intersection of SR 220 and Grand Island Road, near the J-Mack Ferry crossing on the west side of RD 3 near Howard Landing.

The modified cross levee near Ryde could also include signage and interpretive information for users regarding the rich history of the area, including the exciting history of the Ryde Hotel, and by connecting to SR 160, would offer users a link to West Walnut Grove to the north, where users could connect to the ring levee trail.

Users could also connect over to East Walnut Grove, by crossing the river. Because the larger community of Walnut Grove has commercial zones on both sides of the river, the Sacramento River bridge is an important linkage between West and East Walnut Grove. There is an opportunity to enhance the commercial area of West Walnut Grove, particularly with an improved pedestrian and bicycle access along the levee and improved crossings for walkers and bikers at the existing bridge.

Improvements to perimeter levees along the Sacramento River or Steamboat Slough could also include installation of an all-weather surface along the existing crown road, parking, and signage. The trail could link cultural sites in the study area, including the historic Grand Island Mansion. A trail leading around the perimeter of the study area could be usable for local residents and out-of-Delta visitors.

Any trail placement in the study area would expand the possibility for connections to other Delta Legacy Communities, north to Stone Lakes National Wildlife Refuge, and to the nearby Delta Meadows State Park (with facility improvements in partnership with State Parks). The trail concepts described above 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 West Walnut Grove and Ryde communities and require further refinement and discussion with landowners, stakeholders, and Sacramento County. However, West Walnut Grove and Ryde have much to share with visitors, as detailed on the Story Map for the communities, accessible here: West Walnut Grove/Ryde Story Map - Sacramento County Small Communities Flood Risk Reduction Program.[3]

[3] https://sacramentocounty.maps.arcgis.com/apps/MapJournal/index.html?appid=b2415f6ee34746bda8b8765782c3fa45

# 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 Section 5 to develop and prioritize management actions based on risk reduction and responsiveness to planning objectives, as well as constraints regarding funding, implementation, and capital costs. These management actions 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 management action, as well as a trade-off analysis using the planning objectives identified above in 4.1.

The structural elements and non-structural measures identified in Section 5 were prioritized into ten management actions 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 ten management actions, 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 were also considered during the prioritization process.

## 6.1 Identification of Flood Risk Reduction Management Actions

The ten structural based management actions are summarized below. These management actions are compared against the no action, future without project condition to quantify how well each management action addresses the objectives of this study using the planning objectives identified above in 4.1.

### 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 previous studies conducted by DWR and the DSC DLIS, it is estimated that the study area has an estimated 20- to 50-year level of flood protection.
- There is a high risk of life loss for the densely populated communities of West Walnut Grove and Ryde. Currently, the levee fronting each of the communities, 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 potential vulnerability to through and possibly underseepage. 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 communities of West Walnut Grove and Ryde. As documented by DWR in the NULE GAR, the SPFC levees in the study area are estimated to have a moderate to high risk of levee failure or the need to flood fight, primarily based on the potential vulnerability to through- and underseepage. A levee breach in RD 3 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 RD 3 totals $402M. With the current level of flood protection noted above, this equates to an EAD for the West Walnut Grove study area of up to $8.7M under existing conditions and up to $44M under future conditions with the effects of 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 communities of West Walnut Grove and Ryde and the conveyance of water to SWP/CVP water contractors south of the Delta.

### 6.1.2 Management Action 1: Repair DWR FSRP Serious Erosion Site and Address Erosion Sites Identified by LMA Representatives

The DWR FSRP serious erosion site on the right bank of the Sacramento River along NULE Segment 384 located upstream from Ryde and adjacent to West Walnut Grove poses imminent flood threats to both communities (Figure 5-4). This site was identified under the FSRP in 2013 and remains unrepaired. A levee failure at this location could result in life loss via high floodwater depths and velocities. Property damage is also of concern in the event of a levee failure as a result of deep flooding. As the serious erosion site is located along the right bank of the Sacramento River (NULE Segment 384), which is currently estimated to have a moderate risk of levee failure, repairing this site would not only reduce the probability of levee failure, but also reduce the risk of life loss and property damage, resulting in a net reduction in flood risk.

High velocity flows on the Sacramento River in conjunction with the highly erodible and loose sands which comprise the SPFC levees have resulted in 13 erosion sites of concern as identified by the LMA representatives in RD 3, as detailed in Section 5.1.1.2. Of these 13 sites, two are planned for repair by DWR leaving 11 sites that require attention. The risk of flooding at these locations is high. 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 two remaining critical sites along the west bank of the Sacramento River, located upstream from both communities. The four remaining serious sites, two of which are located upstream of the communities, and two of which are located along Steamboat Slough, are also of concern since serious sites have the capability of worsening into more critical sites during a flood event, which could lead to levee failures. Further, levees in the study area are estimated to have a moderate to high likelihood of failure as a result of vulnerabilities to through seepage and under seepage, which further compounds flood risk at these erosion locations. Additionally, nearly all of the erosion sites pose a high risk of property damage should a levee failure occur as a result of said erosion. With the exception of one site located downstream from both of the communities, levee failures at these sites could result in flood depths ranging from 5 to 10 feet in West Walnut Grove, upwards of 15 feet in Ryde, and up to 26 feet in parts of the RD 3 basin (or possibly higher in the event of a levee failure along the west bank of the Sacramento River, upstream of the communities, which was not modeled as part of the RD 3 Delta ESP).

Considering capital cost, implementation, and funding, repair of the DWR FSRP serious erosion site and LMA identified erosion sites was selected as the most efficient, and no regrets means to reducing flood risk to the communities of West Walnut Grove and Ryde and the larger study area. Together, these flood risk reduction elements comprise Management Action 1, which includes repair of the DWR FSRP serious erosion site along the right bank of the Sacramento River, as well as repair of the LMA identified erosion sites, including two critical erosion sites, four serious erosion sites, four erosion areas of concern, and one legacy erosion site that has not been categorized by the RD. The proposed remediations for the DWR FSRP sites is described in Section 5.1.1.1, and the erosion locations and proposed remediations are provided in Section 5.1.1.2.

### 6.1.3 Management Action 2: Repair and Strengthen-in-Place Sacramento River Right Bank SPFC Levee Reaches Directly Adjacent to Communities of West Walnut Grove and Ryde

As previously discussed, the risk of life loss is of greatest concern from a levee breach directly within the densely populated communities of both West Walnut Grove and Ryde. A levee breach along the west bank of the Sacramento River directly adjacent to either community (NULE Segment 384) would likely result in high floodwater depths and velocities, leaving little time to evacuate. Property damage is also of concern in the event of a levee breach along either of the communities as a result of high flood depths. As discussed above, the levees on the west bank of the Sacramento River are estimated to have a moderate likelihood of failure. Repairing and strengthening the 1.8 combined miles of levee immediately fronting each of the communities is likely to result in the greatest reduction in flood risk to the communities. However, these flood risk reduction elements were prioritized as Management Action 2 due to capital cost, implementation, and funding considerations. Management Action 2 is depicted in Figure 6-1 and the proposed remediations for each are discussed in Sections 5.1.1.3 and 5.1.1.2.

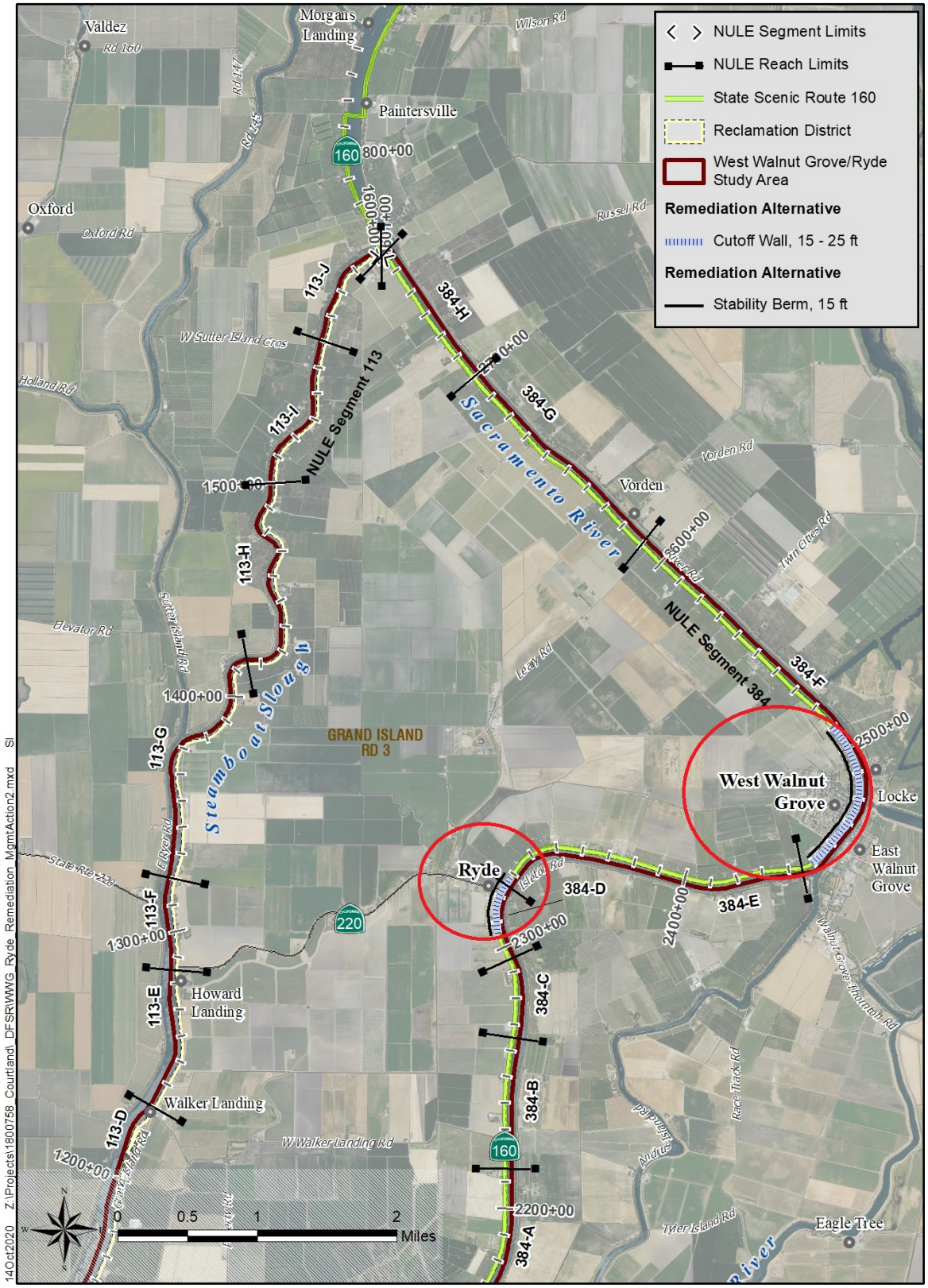


**Figure 6-1. Management Action 2 - Levee Cut-off Walls Immediately Adjacent to West Walnut Grove and Ryde**

### 6.1.4 Management Action 3: All-Weather Access Road/Flood Fight Berm for West Walnut Grove – Clampett Tract

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 3; however, constructing an all-weather access road/flood fight berm would prevent floodwaters originating upstream or downstream within the RD 3 – Grand Island basin 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 of West Walnut Grove. An all-weather access road/flood fight berm could also lend multi-benefit opportunities for public recreation and education. As a result, the access road/flood fight berm was prioritized as Management Action 3. The all-weather access road/flood fight berm could be constructed as described in Section 5.2.1

### 6.1.5 Management Action 4: Ring Levee and FEMA Certification for West Walnut Grove – Clampett Tract

Construction of a ring levee in addition to repairing and strengthening-in-place the Sacramento River right bank levee immediately fronting the community of West Walnut Grove was selected as the next most efficient means of reducing risk, including reduction of potential life loss within the community. Similar to Management Action 3, Management Action 4 does not result in reduced risk to the larger agricultural basin. However, construction of a ring levee and repairing and strengthening-in-place of the levee fronting the community would reduce flood risk for West Walnut Grove by protecting the people, lives, and property inside of the community and residences immediately north of Clampett Tract 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 West Walnut Grove, 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 Management Action 4 would be constructed as described in Section 5.2.2, and the repair/strengthen-in-place of the levee along the community would be performed as described in Section 5.1.1.3.

### 6.1.6 Management Action 5: Repair and Strengthen-in-Place Steamboat Slough Left Bank SPFC Levee (North of SR 220)

Repairing and strengthening-in-place of the 5.3 miles of SPFC levees along the left bank of Steamboat Slough north of SR 220 would greatly reduce the probability of levee failure along Steamboat Slough, which is currently estimated to have a moderate to high likelihood of failure primarily due to seepage and erosion vulnerabilities. As previously discussed, a breach along this segment of levee could result in flood depths up to 10 feet in West Walnut Grove, 15 feet in Ryde, and upwards of 26 feet in the larger RD 3 – Grand Island basin, which results in a high risk of property damage. Life loss is also of concern should this segment of levee fail, since

select portions of the basin which could be inhabited could be inundated to 1 foot within hours; however, most of the populated portions of the community are expected to have sufficient time for evacuation should a levee breach occur along Steamboat Slough north of Sutter Slough. Repairing and strengthening the levee along Steamboat Slough north of SR 220 would greatly reduce flood risk via reduction in probability of levee failure and reduction in risk to property damage. Capital cost, funding, and implementation considerations resulted in prioritization of this flood risk reduction element as Management Action 5. The proposed remediations for Management Action 5 are described in Section 5.1.2.1.

### *6.1.7 Management Action 6: Repair and Strengthen-in-Place Sacramento River Right Bank SPFC Levee Between the Confluences with Steamboat Slough and Georgiana Slough – (Multi-Benefit Component to Improve Reliability and Resiliency of Through-Delta Conveyance)*

Repair and strengthen-in-place of the 5.9 miles of SPFC levees along the Sacramento River between the confluence with Steamboat Slough and Georgiana Slough would greatly reduce the probability of levee failure along the west or right bank of the Sacramento River and protect lives and property within West Walnut Grove and RD 3. This flood risk reduction element was prioritized as Management Action 6 since the Sacramento River levees pose less of a flood risk to the communities and the larger study area than the Steamboat Slough levees. Management Action 6 would also improve the resiliency and reliability of through-Delta water conveyance by improving 16 percent of the SPFC levees located between Freeport and the Delta Cross Channel (total of 37 miles), and nearly 10 percent of the total SPFC levees downstream of Freeport (62 miles) which comprise the freshwater corridor in the North Delta. Management Action 6 repairs and strengthens the levees located along the west/right bank of the Sacramento River pursuant to the proposed remediations described in Section 5.1.2.3.

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 Sacramento River Right Bank SPFC Levee (Between the Confluence with Steamboat Slough and 0.33 miles South of SR 220)*

Similar to Management Action 6, repairing and strengthening-in-place approximately 8.48 miles of SPFC levees along the west or right bank of the Sacramento River between the confluence with Steamboat Slough and approximately 0.33 miles south of SR 220 would greatly reduce the probability of levee failure along the west or right bank of the Sacramento River and protect lives and property within both communities and RD 3. This flood risk reduction element was prioritized as Management Action 7 after Management Action 6 due to capital cost considerations. Similar to Management Action 6, Management Action 7 would improve the

resiliency and reliability of through-Delta water conveyance by improving 16 percent of the SPFC levees in the Delta located between Freeport and the Delta Cross Channel (total of 37 miles) and over 10 percent of the total SPFC levees downstream of Freeport (62 miles) which comprise the freshwater corridor in the North Delta. Management Action 7 repairs and strengthens the levees located along the west/right bank of the Sacramento River pursuant to the proposed remediations described in Section 5.1.2.4.

### 6.1.9 Management Action 8: Repair and Strengthen-in-Place Steamboat Slough Left Bank SPFC Levees (South of SR 220)

Repair and strengthen-in-place of the 6.1 miles of SPFC levees located along the east or left bank of Steamboat Slough south of SR 220 was prioritized as Management Action 8 since the associated flood risk in terms of probability of levee failure, and risk to life loss and property damage as a result of high flood depths, is greater for these levees than the Sacramento River levees south of SR 220. Additionally, the levees located south of SR 220 collectively pose less of a flood risk to the communities of West Walnut Grove and Ryde since they are located downstream from the communities. Management Action 8 repairs and strengthens the SPFC levees located along Steamboat Slough south of SR 220 pursuant to the proposed remediations described in Section 5.1.2.2.

### 6.1.10 Management Action 9: Repair and Strengthen-in-Place Sacramento River Right Bank SPFC Levee (South of SR 220)

Repair and strengthen-in-place of the 8.9 miles of SPFC levees located along the west or right bank of the Sacramento River south of SR 220 (omitting the 0.33-mile portion of levee fronting the community of Ryde which is repaired as part of Management Action 7) was prioritized as Management Action 9 since this segment of levee poses the least flood risk of the four levee reaches associated with Steamboat Slough and the Sacramento River, north and south of SR 220. Management Action 9 repairs and strengthens the SPFC levees located along the west bank of the Sacramento River south of SR 220 pursuant to the proposed remediations described in Section 5.1.2.5.

### 6.1.11 Management Action 10: Secure 100-Year FEMA Certification for Sacramento River and Steamboat Slough Levees North of SR 220 Paired with a SR 220 Cross Levee

Management Action 10 repairs and strengthens 5.3 miles of Steamboat Slough levees north of SR 220 and 8.48 miles of Sacramento River levees between the confluence with Steamboat Slough and 0.33 miles south of SR 220 in concert with a 2.7-mile-long cross levee along the portion of SR 220 which bisects RD 3 to form a complete, certifiable levee system. FEMA certification of the combined 13.8 miles of SPFC levees located along the left bank of Steamboat Slough and the right bank of the Sacramento River north of SR 220 along with the 2.7 mile connecting cross levee along SR 220 would ensure 100-year flood protection for the

communities of West Walnut Grove and portions of Ryde. This would greatly reduce flood risks and would help to limit high insurance premiums within the communities and enhances the resiliency and the reliability of through-Delta water conveyance by improving 16 percent of the SPFC levees located within the Delta between Freeport and the Delta Cross Channel (total of 37 miles) and over 10 percent of the total SPFC levees downstream of Freeport (62 miles) which comprise the freshwater corridor in the North Delta. Management Action 10 also provides multi-benefit opportunities as previously discussed. However, FEMA certification of this cross 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 this levee system was prioritized as Management Action 10. FEMA accreditation could be attained once the perimeter levee system inclusive and north of SR 220 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.

Note that FEMA certification for the entire perimeter levee system which is comprised of 28.8 miles of levees encompassing all of Grand Island was not considered as part of this feasibility study due to cost and implementation considerations.

## 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 town of West Walnut Grove. 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, which are summarized in Sections 6.2.2 and 6.2.5 through 6.2.10 below. Capital cost estimates to address the DWR FSRP critical and serious sites and erosion sites are presented separately in Section 6.2.1 below, and cost estimates for the SR 220 cross levee, ring levee and access road/flood fight berm are provided in Sections 6.2.10, 6.2.4, and 6.2.3, 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.

**Table 6-1. Repair/Strengthen-in-Place Cost Estimates by Levee Reach for the West Walnut Grove/Ryde Study Area, Excluding Erosion Repairs**

| SPFC Levee Segment Location | Reach | Start Station | End Station | Length (ft)[1] | Remediation Alternative 1 | Remediation Alt. 1 Cost Estimate | Remediation Alternative 2 | Remediation Alternative 2 Cost Estimate |
|---|---|---|---|---|---|---|---|---|
| Steamboat Slough, south of SR 220 | 113-A | 1000+00 | 1015+00 | 1,500 | -- | -- | -- | -- |
| | 113-B | 1015+00 | 1080+00 | 6,500 | 30-ft.-deep cutoff wall | $28,292,000 | 135-ft.-wide, 11-ft.-tall combination seepage and stability berm | $29,514,000 |
| | 113-C | 1080+00 | 1105+00 | 2,500 | 20-ft.-deep cutoff wall | $11,430,000 | 15-ft.-tall, 15-ft.-wide stability berm | $2,521,000 |
| | 113-D | 1105+00 | 1230+00 | 12,500 | 30-ft.-deep cutoff wall | $54,932,000 | 130-ft- wide, 14-ft.-tall combination seepage and stability berm | $59,054,000 |
| | 113-E | 1230+00 | 1285+00 | 5,500 | 45-ft.-deep cutoff wall | $30,328,000 | 130-ft.-wide, 13-ft.-tall combination seepage and stability berm | $25,308,000 |
| Steamboat Slough, north of SR 220 | 113-F | 1285+00 | 1320+00 | 3,500 | 20-ft.-deep cutoff wall | $12,931,000 | 15-ft.-tall, 15-ft.-wide stability berm | $4,761,000 |
| | 113-G | 1320+00 | 1415+00 | 9,500 | 90-ft.-deep cutoff wall | $96,770,000 | 95-ft.-wide, 11-ft.-tall combination seepage and stability berm | $37,950,000 |
| | 113-H | 1415+00 | 1500+00 | 8,500 | 25-ft.-deep cutoff wall | $29,627,000 | 85-ft.-wide, 8.5-ft.-tall combination seepage and stability berm | $26,114,000 |
| | 113-I | 1500+00 | 1560+00 | 6,000 | 15-ft.-deep cutoff wall | $16,134,000 | 10-ft.-tall, 15-ft.-wide stability berm | $8,344,000 |
| | 113-J | 1560+00 | 1601+40 | 4,100 | 35-ft.-deep cutoff wall | $16,849,000 | 80-ft.-wide, 9-ft.-tall combination seepage and stability berm | $11,450,000 |
| **Totals for Steamboat Slough Levees** | | | | **60,100 ft., 11.4 Mi.** | | **$297,293,000 ($26M/mile)** | | **$205,016,000 ($18M/mile)** |

| SPFC Levee Segment Location | Reach | Start Station | End Station | Length (ft)[1] | Remediation Alternative 1 | Remediation Alt. 1 Cost Estimate | Remediation Alternative 2 | Remediation Alternative 2 Cost Estimate |
|---|---|---|---|---|---|---|---|---|
| Right Bank of the Sacramento River, south of SR 220 | 384-A | 1841+71 | 2215+00 | 37,300 | 80-ft.-deep cutoff wall | $279,228,000 | 85-ft.-wide, 7-ft.-tall combination seepage and stability berm | $98,474,000 |
| | 384-B | 2215+00 | 2265+00 | 5,000 | 15-ft.-deep cutoff wall | $14,960,000 | 7-ft.-tall, 15-ft.-wide stability berm | $6,092,000 |
| | 384-C | 2265+00 | 2295+00 | 3,000 | 115-ft.-deep cutoff wall | $37,695,000 | 80 ft. wide, 7 ft. tall combination seepage and stability berm | $7,122,000 |
| | 384-D | 2295+00 | 2325+00 | 3,000 | 15-ft.-deep cutoff wall | $8,744,000 | 8 ft. tall, 15 ft. wide stability berm | $3,295,000 |
| Right Bank of the Sacramento River, north of SR 220 | 384-E | 2325+00 | 2445+00 | 12,000 | 25-ft.-deep cutoff wall | $43,570,000 | 7 ft. tall, 15 ft. wide stability berm | $9,954,000 |
| | 384-F | 2445+00 | 2610+00 | 16,500 | 15-ft.-deep cutoff wall | $47,960,000 | 7 ft. tall, 15 ft. wide stability berm | $16,505,000 |
| | 384-G | 2610+00 | 2700+00 | 9,000 | 35-ft.-deep cutoff wall | $39,014,000 | 80 ft. wide, 8 ft. tall combination seepage and stability berm | $25,016,000 |
| | 384-H | 2700+00 | 2757+91 | 5,800 | 15-ft.-deep cutoff wall | $17,240,000 | 9 ft. tall, 15 ft. wide stability berm | $5,441,000 |
| **Totals for Sacramento River Levees** | | | | **91,600 ft., 17.4 Mi** | | **$488,411,000 ($28M/mile)** | | **$171,899,000 ($10M/mile)** |
| **Totals for Grand Island Perimeter Levee System** | **Perimeter Levees North of Hwy 220** | | | **14.2** | **Cutoff walls** | **$320,095,000** | **Seepage/Stability Berms** | **$145,535,000** |
| | **Perimeter Levees South of Hwy 220** | | | **14.6** | **Cutoff Walls** | **$465,609,000** | **Seepage/Stability Berms** | **$231,380,000** |
| | **Entire Perimeter Levee System of Grand Island** | | | **28.8** | **Cutoff Walls** | **$785,704,000** | **Seepage/Stability Berms** | **$376,915,000** |

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

### 6.2.1 Repair DWR FSRP Serious Erosion Site (Management Action 1)

Management Action 1 includes repair of the DWR FSRP serious erosion site along the right bank of the Sacramento River, as well as repair of the 11 LMA identified erosion sites, including two critical erosion sites, four serious erosion sites, four erosion areas of concern, and one legacy erosion site that has not been categorized by the RD.

The estimated cost to repair the DWR FSRP serious erosion site along the west bank of the Sacramento River as documented in the 2013 FSRP Pre-Feasibility Report, escalated to July 2020 dollars, and with a 10 percent markup included for environmental documentation and permitting, is $3,559,000.

Previous costs to repair RD 3 erosion sites were used to develop costs to repair the 11 erosion sites located on the SPFC levees along the right bank of the Sacramento River and on Steamboat Slough. The total cost estimate for this element is $1,201,000. Further description of the development of this cost estimate can be found in Appendix F.

### 6.2.2 Repair and Strengthen-in-Place Sacramento River Right Bank SPFC Levee Reaches Directly Adjacent to the Communities of West Walnut Grove and Ryde (Management Action 2)

The range of cost estimates to repair and strengthen the levees immediately fronting the communities of West Walnut Grove and Ryde were developed using the costs provided for reaches 384-D, 384-E, and 384-F in Table 6-1. These cost components and the total estimated cost for this element are summarized in Table 6-2 below. Assuming that the levee fronting the community of West Walnut Grove totals 1.38 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 $7,427,000 (15-ft.-wide, 7-ft.-tall stability berm) to $21,553,000 (15- to 25-ft.-deep cutoff wall). Assuming that the levee fronting the community of Ryde totals 0.44 miles in length, the cost to repair this segment of levee ranges from $2,466,000 (15-ft.-wide, 7- to 8-ft.-tall stability berm) to $6,998,000 (15- to 25-ft.-deep cutoff wall). Thus, the total cost estimate for this element ranges from $9,893,000 (15-ft.-wide, 7- to 8-ft.-tall stability berm) to $28,551,000 (15- to 25-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 DWR Remedial Alternatives and Cost Estimates Report (RACER) for the North NULE study area, DWR estimated a total cost of $29,620,000 to remediate the most northerly 16.3 miles of NULE Segment 384, which equates to $37,357,000 in July 2020 dollars. With an estimated total length of 1.82 miles, DWR's estimated cost to remediate the levee fronting the communities of West Walnut Grove and Ryde is $4,171,000.

**Table 6-2. Estimated Range of Costs to Repair and Strengthen the Sacramento River Right Bank SPFC Levee Fronting the Communities of West Walnut Grove and Ryde**

| Cost Component | Estimated Cost |
|---|---|
| 1. Repair and Strengthen-in-Place SPFC Levee Immediately Fronting the Community of West Walnut Grove (1.32 miles) | $2,466,000 - $6,998,000 |
| 2. Repair and Strengthen-in-Place SPFC Levee Immediately Fronting the Community of Ryde (0.44 miles) | $7,427,000 - $21,553,000 |
| **Total** | $9,893,000 - $28,551,000 ($5.4-$15.7M/mile) |

### *6.2.3 All-Weather Access Road/Flood Fight Berm around the Town of West Walnut Grove (Management Action 3)*

The estimated cost to construct the all-weather access road/flood fight berm described in Section 5.2.1 is $5,380,000.

### *6.2.4 Construction and FEMA Certification of a Ring Levee Around the Community of West Walnut Grove – Clampett Tract (Management Action 4)*

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 repairs to the levee immediately fronting the community of West Walnut Grove, and FEMA certification. These cost components and the total estimated cost for this element is summarized in Table 6-3 below. A range of costs is provided, as the strengthen-in-place repairs to the levee fronting the community of West Walnut Grove 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 repair and strengthen the levee fronting the community of West Walnut Grove includes an additional 300 feet on either end to accommodate the transition of the ring levee. Additionally, to attain FEMA accreditation, erosion site 8 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 costs have not been included in the range of costs below.

**Table 6-3. Estimated Range of Costs for Construction of a Ring Levee and FEMA Certification for Community of West Walnut Grove – Clampett Tract**

| Cost Component | Estimated Cost |
|---|---|
| 1. Construction of a Ring Levee | $14,260,000 |
| 2. Repair and Strengthen-in-Place Sacramento River Right Bank SPFC Levee Immediately Fronting the Community of West Walnut Grove | $7,427,000 - $21,553,000 |
| 3. FEMA Certification (5 percent of items 1-2 above) | $1,084,000 - $1,791,000 |
| **Total** | $22,771,000 - $37,604,000 |

*Placeholder - comparison w/DWR estimate.*

### 6.2.5 Repair and Strengthen-in-Place Steamboat Slough Left Bank SPFC Levee (North of SR 220) (Management Action 5)

The range of cost estimates to repair and strengthen the Steamboat Slough levee north of SR 220 were developed using the costs provided for reaches 113-F, 113-G, 113-H, 113-I, and 113-J in Table 6-1. The total cost to repair this segment of levee ranges from $88,619,000 (assuming stability/combination berms are implemented for each reach) to $172,311,000 (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 $87,270,000 to remediate the Steamboat Slough levee north of SR 220.

### 6.2.6 Repair and Strengthen-in-Place Sacramento River Right Bank SPFC Levee Between the Confluence with Steamboat Slough and Georgiana Slough (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 west or right bank of the Sacramento River levee between the confluence with Steamboat Slough and Georgiana Slough were developed using the costs provided for reaches 384-F, 384-G, and 384-H in Table 6-1. The total cost to repair this segment of levee ranges from $46,692,000 (assuming stability/combination berms are implemented for each reach) to $104,214,000 (assuming cutoff walls are implemented for each reach). However, it is expected that a cutoff wall would be implemented along the segment of levee fronting the community of West Walnut Grove 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 RACER for the North NULE study area, DWR estimated a total cost of $29,620,000 to remediate the most northerly 16.3 miles of NULE Segment 384,

which equates to $37,357,000 in July 2020 dollars. With an estimated length of 5.9 miles, DWR's estimated cost to remediate the levee along the right bank of the Sacramento River between Steamboat Slough and Georgiana Slough is $13,522,000.

### 6.2.7 Repair and Strengthen-in-Place Sacramento River Right Bank SPFC Levee (Between the Confluence with Steamboat Slough and 0.33 miles South of SR 220) (Management Action 7)

The range of cost estimates to repair and strengthen the west or right bank of the Sacramento River levee between the confluence with Steamboat Slough and 0.33 miles south of SR 220 were developed using the costs provided for reaches 384-D, 384-E, 384-F, 384-G, and 384-H in Table 6-1. The total cost to repair this segment of levee ranges from $59,120,000 (assuming stability/combination berms are implemented for each reach) to $153,632,000 (assuming cutoff walls are implemented for each reach). However, it is expected that a cutoff wall would be implemented along the segment of levee fronting the communities of West Walnut Grove and Ryde 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 RACER for the North NULE study area, DWR estimated a total cost of $29,620,000 to remediate the most northerly 16.3 miles of NULE Segment 384, which equates to $37,357,000 in July 2020 dollars. With an estimated length of 8.5 miles, DWR's estimated cost to remediate the levee along the right bank of the Sacramento River between Steamboat Slough and 0.33 miles south of SR 220 is $19,435,000.

### 6.2.8 Repair and Strengthen-in-Place Steamboat Slough Left Bank SPFC Levee (South of SR 220) (Management Action 8)

The range of cost estimates to repair and strengthen the Steamboat Slough levee south of SR 220 were developed using the costs provided for reaches 113-A, 113-B, 113-C, 113-D, and 113-E in Table 6-1. The total cost to repair this segment of levee ranges from $116,397,000 (assuming stability/combination berms are implemented for each reach) to $124,982,000 (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 $100,876,000 to remediate the most southerly 7 miles of NULE Segment 113, which equates to $127,227,000 in July 2020 dollars. With an estimated length of 6.1 miles, DWR's estimated cost to remediate the Steamboat Slough levee south of SR 220 is $110,083,000.

### 6.2.9 Repair and Strengthen-in-Place Sacramento River Right Bank SPFC Levee (South of SR 220) (Management Action 9)

The range of cost estimates to repair and strengthen the 8.9 miles of levee along the west bank of the Sacramento River south of SR 220 (omitting the 0.33-mile portion of levee fronting the community of Ryde which is repaired as part of Management Action 7) were developed using the costs provided for reaches 384-A, 384-B, 384-C, and 384-D in Table 6-1. The total cost to repair this segment of levee ranges from $112,805,000 (assuming stability/combination berms are implemented for each reach) to $334,847,000 (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 $38,325,000 to remediate the right bank of the Sacramento River south of SR 220.

### 6.2.10 Secure 100-Year FEMA Certification for Sacramento River and Steamboat Slough Levees North of SR 220 Paired with a SR 220 Cross Levee (Management Action 10)

The cost of securing 100-year FEMA certification for the northerly half of Grand Island, including the community of West Walnut Grove, is the summation of all the costs associated with: (1) repairing and strengthening the west bank of the Sacramento River levee north of SR 220 to current FEMA standards identified above in Section 6.2.6 and Table 6-1; (2) repairing and strengthening the left bank of the Steamboat Slough levee north of SR 220 to current FEMA standards identified above in Section 6.2.5 and Table 6-1; (3) addressing erosion sites identified by LMA representatives; (4) constructing a new cross levee along SR 220; (5) addressing any reaches that contain an immediate freeboard issue (currently none) or long-term settlement issues (unknown) as noted above in Section 5.1.2.7; (6) 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 Section 5.1.2.7; (7) conducting the applicable interior drainage studies and operational plans as noted above in Section 5.1.2.7; and (8) updating applicable operation and maintenance plans following all repairs and improvements and modifications to ensure the segment of levee along the west bank of the Sacramento River is operated and maintained by RD 3 in accordance with FEMA, USACE, and CVFPB standards. For cost estimating purposes, FEMA certification items (5) through (8) noted herein and described in more detail within Section 5.1.2.7, are estimated at 5 percent of the total combined cost of items (1) through (4) herein associated with repairing and strengthening the segments of levee north of SR 220, addressing erosion sites identified by LMA representatives, and constructing a new cross levee along SR 220. The estimated cost to secure 100-year FEMA certification for the community of West Walnut Grove and the portion of Grand Island north of SR 220 ranges from $200,171,000 (assuming berms are implemented to repair the segment of levees north of SR 220) to $387,285,000 (assuming cutoff walls are implemented to repair the segment of levees north of SR 220) (Table 6-4).

**Table 6-4. Estimated Range of Costs for 100-Year FEMA Certification for Portion of Grand Island North of SR 220.**

| Cost Component | Estimated Cost |
|---|---|
| **Remediation and Improvement Alternative 1 (Cutoff Walls) Implemented for Repair of Levees North of SR 220** | |
| 1. Repair and Strengthen-in-Place Sacramento River Right Bank SPFC Levee North of SR 220: Remediation Alternative 1 (Cutoff Walls) | $153,632,000 |
| 2. Repair and Strengthen-in-Place Steamboat Slough Left Bank Levee North of SR 220: Remediation Alternative 1 (Cutoff Walls) | $172,311,000 |
| 3. Construct a New Cross Levee Along SR 220 | $38,380,000 |
| 4. Address Remaining Erosion Sites Identified by LMA Representatives and by the FSRP | $4,520,000 |
| 5. FEMA Certification (5% of items 1-4 above) | $18,442,000 |
| **Total** | $387,285,000 |
| **Remediation and Improvement Alternative 2 (Berms) Implemented for Repair of Levees North of SR 220** | |
| 1. Repair and Strengthen-in-Place Sacramento River Right Bank SPFC Levee North of SR 220: Remediation Alternative 2 (Berms) | $59,120,000 |
| 2. Repair and Strengthen-in-Place Steamboat Slough Left Bank SPFC Levee North of SR 220: Remediation Alternative 2 (Berms) | $88,619,000 |
| 3. Construct a New Cross Levee along SR 220 | $38,380,000 |
| 4. Address Remaining Erosion Sites Identified by LMA Representatives and by the FSRP | $4,520,000 |
| 5. FEMA Certification (5% of items 1-4 above) | $9,532,000 |
| **Total** | $200,171,000 |

### *6.2.11 Capital Cost Summary*

A summary of capital costs for Management Actions 1 through 10 is provided in Table 6-5 below.

**Table 6-5. Estimated Range of Costs for Management Actions 1-10 Including FEMA Certifications for the Community of West Walnut Grove and the Portion of Grand Island North of SR 220**

| Management Action | Cutoff walls | Berms | Ring Levee or All-Weather Access Road/Flood Fight Berm | RSP/Rock Revetment | FEMA Certification | Total $M |
|---|---|---|---|---|---|---|
| 1: Repair DWR FSRP Site(s) and Address Erosion Sites Identified by the LMA Representatives | $0 | $0 | $0 | $4,520,000 | $0 | $5M |
| 2: Repair and Strengthen-in-Place Sacramento River Right Bank Levee Adjacent to West Walnut Grove and Ryde | $28,551,000 | $9,893,000 | $0 | $0 | $0 | $10M- $29M |
| 3: All-Weather Access Road/Flood Fight Berm for the Community of West Walnut Grove/Clampett Tract | $0 | $0 | $5,380,000 | $0 | $0 | $5M |
| 4: Ring Levee and FEMA Certification for the Community of West Walnut Grove/Clampett Tract | $21,553,000 | $7,427,000 | $14,260,000 | $0 | $1,084,000 - $1,791,000 | $23M-$38M |
| 5: Repair and Strengthen-in-Place Steamboat Slough Left Bank SPFC Levee (north of SR 220 – 6.0 miles) | $172,311,000 | $88,619,000 | $0 | $0 | $0 | $89M-$172M |
| **Total Cost per Mile for Management Action 5** | | | | | | **$15M-$29M** |
| 6: Repair and Strengthen-in-Place Sacramento River Right Bank SPFC Levee (between the confluence with Steamboat Slough and Georgiana Slough – 5.9 miles) | $104,214,000 | $46,962,000 | $0 | $0 | $0 | $47M-$104M |
| **Total Cost per Mile for Management Action 6** | | | | | | **$8M-$18M** |
| 7: Repair and Strengthen-in-Place Sacramento River Right Bank SPFC Levee (north of SR 220 – 8.2 miles) | $153,632,000 | $59,120,000 | $0 | $0 | $0 | $59M-$154M |
| **Total Cost per Mile for Management Action 7** | | | | | | **$7M-$19M** |
| 8: Repair and Strengthen-in-Place Steamboat Slough Left Bank SPFC Levee (south of SR 220 – 5.4 miles) | $124,982,000 | $116,397,000 | $0 | $0 | $0 | $116M-$125M |
| **Total Cost per Mile for Management Action 8** | | | | | | **$22M-$23M** |
| 9: Repair and Strengthen-in-Place Sacramento River Right Bank SPFC Levee (south of SR 220 – 9.15 miles) | $334,847,000 | $112,805,000 | $0 | $0 | $0 | $113M-$335M |
| **Total Cost per Mile for Management Action 9** | | | | | | **$12M-$37M** |
| 10: Secure 100-Year FEMA Certification for Sacramento River and Steamboat Slough SPFC Levees North of SR 220 Paired with a SR 220 Cross Levee | $325,943,000 | $147,739,000 | $38,380,000 | $4,520,000 | $9,532,000 - $18,442,000 | $200M - $387M |

## 6.3 Trade-Off Analysis of Flood Risk Reduction Management Actions

Management actions were compared in a trade-off analysis against the study goal of obtaining 100-year flood protection for the West Walnut Grove/Ryde study area and against the objectives described in Section 4. 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 management actions. The trade-off analyses also incorporate the net reduction in EAD values determined for most structural-based management actions, including net EAD reductions for implementing an all-weather access road/flood fight berm.

### *6.3.1 Planning Objectives*

#### 6.3.1.1 Reducing Risk to Life

A breach within the levee fronting either of the communities could contain high instantaneous floodwater velocities and depths of imminent danger within the communities that would most likely result in life loss in West Walnut Grove or Ryde. Management Actions 2, 4, 6, 7, 9, and 10 are the only management actions which fortify the levees to current FEMA accreditation standards fronting the communities. As a result, these 6 management actions would result in the greatest measurable reduction in life loss. A levee breach along the right bank of the Sacramento River or along the left bank of Steamboat Slough north of SR 220, as well as along Steamboat Slough south of SR 220, also has the potential to result in life loss in these communities; thus, those Management Actions which fortify these segments of levee or protect the community against floodwaters resulting from a levee breach along these segments of levee result in the next greatest measurable reduction in life loss (Management Actions 1, 3, 5, 8).

#### 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 management action meets the objective of reducing risk to property damage. Further details on the EAD analysis performed as part of this study are provided in Appendix E.

As shown previously in Table 3-7, baseline (or without project) EAD for the West Walnut Grove/Ryde study area under existing and future conditions (with climate change adjustments) is up to $8.7M and $44.3M, 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 6-6 and Table 6-7 below provide the estimated net reduction in EAD to the West Walnut Grove/Ryde study area under existing and future conditions as a result of implementing Management Actions 1, 3, 4, 5, and 7 through 10. 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 management action.

Overall, the greatest reduction in EAD for the West Walnut Grove/Ryde study area is provided by Management Action 10 (Secure 100-Year FEMA Certification for SPFC Levees north of SR 220 Paired with an Elevated SR 220 Cross Levee). As shown in Table 6-6, implementing Management Action 8 would reduce EAD for the study area by over $8.6M under existing conditions. On an annualized basis, this represents an EAD of $22,000 for the RD 3 basin (less the community of West Walnut Grove) and an EAD of $54,000 for the community of West Walnut Grove. However, at a cost of up to nearly $400M, the flood risk reduction payback period is nearly 50 years (excluding interest). Securing FEMA certification for the entire RD 3 perimeter levee system results in a similar net reduction in EAD, however the payback period is over 90 years at an estimated cost of nearly $800M.

Repairing the FSRP serious erosion site along with the erosion sites identified by LMA representatives (Management Action) results in a similar net reduction to the West Walnut Grove/Ryde study area. By repairing these sites, EAD in the community of West Walnut Grove is estimated at $252,000 under existing conditions, with EAD for the larger RD 3 basin estimated at $50,000 under existing conditions, presenting a total net reduction to the study area of $8.4M. With an estimated cost of $4.5M, the flood risk reduction pay-back period is around 6 months.

The proposed all-weather access road/flood fight berm (Management Action 3) and ring levee (Management Action 4) also provide direct measurable value to the community of West Walnut Grove/Clampett Tract. Management Action 3 is estimated to result in a net reduction in EAD to the community of West Walnut Grove of over $1.3M under existing conditions. On an annualized basis, this represents an EAD of $50,000 for the community of West Walnut Grove. At an estimated cost of $5.3M, the flood risk reduction payback period for the proposed all-weather access road/flood fight berm is four years. Similarly, Management Action 4 is estimated to result in a net reduction in EAD to the community of West Walnut Grove of over $1.3M, representing an annualized EAD for the community of $22,000; however, at an estimated cost of

up to $37M, the flood risk reduction pay-back period for the proposed ring levee is nearly 30 years.

The discussion above also applies under future conditions as shown in Table 6-7. As shown in Table 6-7, the effects of climate change and sea level rise result in both an increase in the baseline EAD for the West Walnut Grove study area ($44M increased from nearly $9M under existing conditions), and a greater benefit from each of the management actions as seen by the higher net reductions in EAD.

In general, when considering the estimated capital cost to construct or implement each management action, repairing the DWR FSRP serious erosion site combined with repairing all of the known erosion sites (Management Action 1) provides the largest incremental value to the community of West Walnut Grove/Clampett Tract and the larger study area. With the implementation of these management actions, the total net reduction in EAD for the West Walnut Grove study area is estimated at $8.4M under existing conditions and over $42M under future conditions. Notably, as shown in Table 6-6 and Table 6-7, the all-weather access road/flood fight berm (at an estimated cost of $5.3M) provides the same value to the community of West Walnut Grove/Clampett Tract as Management Action 1. In both cases, EAD in the community of West Walnut Grove is reduced to $396,000 under future conditions and $50,000 under existing conditions. Additionally, a ring levee around the community of West Walnut Grove (at an estimated cost of $37M) is also estimated to provide the same value to the community of West Walnut Grove/Clampett Tract as securing 100-year FEMA certification for the community either through a SR 220 cross levee system (at an estimated cost of $387M) or repairing and strengthening-in-place the entire perimeter levee system (at an estimated cost of $785M). In these cases, EAD in the community of West Walnut Grove is reduced to between $22,000 (existing conditions) and $146,000 (future conditions).

**Table 6-6: West Walnut Grove/Ryde Study Area EAD Values for Existing Conditions Consistent with the 2022 CVFPP Update**

| Scenarios for Select Management Actions (MAs) | Estimated Cost | West Walnut Grove SAC 50-Urban EAD | Grand Island less WW Grove SAC 50-N1 EAD | Total Net Reduction to West Walnut Grove Study Area | Flood Risk Reduction Pay Back Period in Years (excluding interest) |
|---|---|---|---|---|---|
| Baseline EAD, SAC 50 - Urban (Community of West Walnut Grove/Clampett Tract): **$1,377,000**(1)<br>Baseline EAD, SAC 50-N1 (Grand Island less West Walnut Grove/Clampett Tract): **$7,346,000**(1)<br>Total Baseline EAD for the West Walnut Grove Study Area (SAC 50-Urban & SAC 50-N1): **$8,723,000**(1) | | | | | |
| Repair DWR FSRP Site(s) and Address Erosion Sites Identified by LMA Representatives **(MA 1)** (3) | $4,520,000 | $50,000 | $252,000 | $8,723,000 - $50,000 - $252,000 = $8,421,000 | $4,520,000/$8,421,000 = 0.5 years |
| All-Weather Access Road/Flood Fight Berm for the Community of West Walnut Grove/Clampett Tract **(MA 3)** (3) | $5,380,000 | $50,000 | N/A | $1,377,000 - $50,000 = $1,327,000 | $5,380,000/$1,327,000 = 4.1 years |
| Ring Levee and FEMA Certification for the Community of West Walnut Grove/Clampett Tract **(MA 4)** (4) | $22,771,000-$37,604,000 | $22,000 | N/A | $1,377,000 - $22,000 = $1,355,000 | $37,604,000/$1,355,000 = 27.8 years |
| Secure 100-Year FEMA Certification for the Entire West Walnut Grove Study Area **(MA 5, 7, 8, 9)** (4) | $376,941,000-$785,772,000 | $22,000 | $90,000 | $8,723,000 - $22,000 - $90,000 = $8,611,000 | $785,772,000/$8,611,000 = 91.3 years |
| Secure 100-Year FEMA Certification for Sacramento River and Steamboat Slough SPFC Levees North of Hwy 220 Paired with an Elevated Hwy 220 Cross Levee **(MA 10)** (4) | $200,171,000-$387,285,000 | $22,000 | $54,000* | $8,723,000 - $22,000 - $54,000* = $8,647,000 | $387,285,000/$8,647,000 = 44.8 years |

**Notes:** Levee Performance Data Curve for EAD Values: [1]Baseline w/o Improvements; [2]Fractional Improvements; [3]Partial Improvements; [4]Full FEMA Cert. Improvements

MA = Management Area

Values provided for SAC 50-Urban and SAC 50-N1 along with the total net reduction to the West Walnut Grove study area are representative of the maximum EAD values between the SAC 50 (Steamboat Slough) and SAC 50a (Sacramento River) index points,

* The area on Grand Island south of State Hwy 220 represents about 50% of Grand Island, but approximately 60% of the potential flood damages on Grand Island (outside of the West Walnut Grove Urban Area – SAC 50-Urban) would likely occur in the lower lying, down-gradient portion of Grand Island.

**Table 6-7: West Walnut Grove/Ryde Study Area EAD Values for Future Conditions Consistent with the 2017 CVFPP Update**

| Scenarios for Select Management Actions (MAs) | Estimated Cost | West Walnut Grove SAC 50-Urban EAD | Grand Island less WW Grove SAC 50-N1 EAD | Total Net Reduction to West Walnut Grove Study Area | Flood Risk Reduction Pay Back Period in Years (excluding interest) |
|---|---|---|---|---|---|
| Future conditions Baseline EAD, SAC 50-Urban (Community of West Walnut Grove/Clampett Tract): **$8,743,000**[(1)]<br>Future conditions Baseline EAD, SAC 50-N1 (Grand Island less West Walnut Grove/Clampett Tract): **$35,571,000**[(1)]<br>Future conditions Total Baseline EAD for the West Walnut Grove Study Area (SAC 50-Urban & SAC 50-N1): **$44,314,000**[(1)] | | | | | |
| Repair DWR FSRP Site(s) and Address Erosion Sites Identified by LMA Representatives **(MA 1)** [(3)] | $4,520,000 | $396,000 | $1,538,000 | $44,314,000 - $396,000 - $1,538,000 = $42,379,000 | $4,520,000/$42,379,000 = 0.11 |
| All-Weather Access Road/Flood Fight Berm for the Community of West Walnut Grove/Clampett Tract **(MA 3)** [(3)] | $5,380,000 | $396,000 | N/A | $8,743,000 - $396,000 = $8,347,000 | $5,380,000/$8,347,000 = 0.64 |
| Ring Levee and FEMA Certification for the Community of West Walnut Grove/Clampett Tract **(MA 4)** [(4)] | $22,771,000-$37,604,000 | $146,000 | N/A | $8,743,000 - $146,000 = $8,597,000 | $37,604,000/$8,597,000 = 4.37 |
| Secure 100-Year FEMA Certification for the Entire West Walnut Grove Study Area **(MA 5, 7, 8, 9)** [(4)] | $376,941,000-$785,772,000 | $146,000 | $528,000 | $44,314,000 - $146,000 - $528 = $43,641,000 | $785,772,000/$43,641,000 = 18.0 |
| Secure 100-Year FEMA Certification for Sacramento River and Steamboat Slough SPFC Levees North of SR 220 Paired with an Elevated Hwy 220 Cross Levee **(MA 10)** [(4)] | $200,171,000-$387,285,000 | $146,000 | $317,000* | $44,314,000 - $146,000 - $317,000 = $43,852,000* | $387,285,000/$43,852,000 = 8.83 |

**Notes:** Levee Performance Data Curve for EAD Values: [1]Baseline w/o Improvements; [2]Fractional Improvements; [3]Partial Improvements; [4]Full FEMA Cert. Improvements

MA = Management Area

Values provided for SAC 50-Urban and SAC 50-N1 along with the total net reduction to the West Walnut Grove study area are representative of the maximum EAD values between the SAC 50 (Steamboat Slough) and SAC 50a (Sacramento River) index points,

* The area on Grand Island south of State Hwy 220 represents about 50 percent of Grand Island, but approximately 60 percent of the potential flood damages on Grand Island (outside of the West Walnut Grove Urban Area – SAC 50-Urban) would likely occur in the lower lying, down-gradient portion of Grand Island.

#### 6.3.1.3 Reducing Probability of Levee Failure

Management Action 1 repairs the known weakest links in the levee system as identified by the FSRP and the LMA. As documented in the FSRP, it is estimated that repair of the DWR FSRP critical and serious sites on the right bank of the Sacramento River would reduce the levee recurrence interval associated with the SAC 50a index point. Similarly, repair of the 11 erosion sites, including 2 critical and 4 erosion sites, most of which are located upstream of either West Walnut Grove or Ryde, 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 erosion sites during a flood event. As a result, Management Action 1 results in a high reduction in the probability of levee failure.

Management Action 2 repairs and strengthens the levees fronting the communities of West Walnut Grove and Ryde. Repair and strengthening of these levees would likely eliminate the probability of an instantaneous levee failure immediately adjacent to each of the communities. As such, Management Action 2 results in a high reduction in the probability of levee failure.

Management Action 3 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 Management Action does not result in a net reduction in the probability of levee failure, but it reduces the risk to flooding in the community of West Walnut Grove, including Clampett Tract and nearby residences just north of Clampett Tract.

Management Action 4 integrates a ring levee with fixing and improving the levee immediately fronting the community of West Walnut Grove. Though the ring levee itself would not result in a net reduction in the probability of levee failure, Management Action 4 would result in a high reduction in the probability of levee failure since fixing and improving the levee reach immediately adjacent to the community would likely eliminate the probability of an instantaneous levee failure immediately adjacent to the community.

Management Actions 6, 7, and 9 repair and strengthen the SPFC levees along the right bank of the Sacramento River. Strengthening these levees would likely eliminate the potential of a levee failure, both immediately adjacent to both communities and along the entirety of the levee segment. As a result, Management Actions 6, 7, and 9 result in a high reduction in the probability of levee failure.

Management Actions 5 and 8 repair and strengthen the SPFC levees along the left bank of Steamboat Slough. Similar to Management Actions 6 and 8, improving these levee segments would likely eliminate the potential of a levee failure, and as a result, Management Actions 5 and 7 result in a high reduction in the probability of levee failure.

Management Action 10 includes repairing and strengthening all of the SPFC levee reaches north of SR 220 paired with a cross levee along SR 220 which includes certification of said perimeter levee system to FEMA standards. Improving and certifying this levee system would result in the

highest reduction in the probability of levee failure of all management actions under consideration.

#### 6.3.1.4 Reduction of High Insurance Premiums

Those management actions which result in 100-year FEMA certification could result in a net reduction in NFIP insurance premiums. Management Actions 4 and 10 are the only solutions which result in 100-year FEMA certification. However, implementation of the structural elements and non-structural measures as part of the remaining management actions, in concert with a community- or risk-based insurance program, could also result in a net reduction in flood insurance premiums for the community. *Refer to* 5.2.7 and Appendix J for greater discussions and potential options for West Walnut Grove 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

Management Actions 6, 7 and 10 would provide the greatest multi-benefit enhancement of the resiliency and reliability of through-Delta water conveyance. Improving the 5.9 mile stretch of SPFC levees located along the right bank of the Sacramento River between the confluence with Steamboat Slough and Georgiana Slough would improve nearly 10 percent of the SPFC levees which comprise the freshwater corridor within the Delta (total of 62 miles). Similarly, improving the same 5.9 miles of SPFC levees located along the right bank of the Sacramento River would improve 16 percent of the SPFC levees located in the Delta between Freeport and the Delta Cross Channel. Management Actions 1, 2, and 4 which fortify various segments of the SPFC levee system within the study area also enhance through-Delta water conveyance to a lesser degree. Management Actions 3, 5, 8, and 9 do not improve through-Delta water conveyance.

#### 6.3.1.6 Environmental Stewardship and Multi-Benefits

Under Management Actions 1, 2, and 5-9, ecosystem restoration and enhancement, conducted in concert with improvements proposed for the study area regarding erosion repair or levee strengthening along the Sacramento River or Steamboat Slough, could be implemented along with any structural management actions proposed for that reach and could include enhancements to SRA habitat.

Additionally, implementation of non-structural measures such as a relief cut could provide several hundred acres of tidal marsh habitat.

Under Management Actions 3, 4 and 10, a recreation component could be implemented along with construction of the cross levee 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 East Walnut Grove and the greater Delta. This is not an option under the other management actions, which do not include the cross levee or ring levee components. Management Actions 5, 6, 7, 8, and 9, with their focus on perimeter levees, could include

installation of an all-weather surface road along the existing crown road, parking, and signage. As described previously, a perimeter trail could offer a connection to other Delta Legacy Communities, 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 Management Action 1, agricultural sustainability would not be affected. To address the erosion sites as identified by LMA representatives and the DWR FSRP serious erosion site, 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 Management Action 3, 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 road footprint of the access road/flood fight berm and any necessary easements adjacent to the access road. Management Action 4 consisting of a ring levee and repairing and strengthening the levee immediately fronting the community of West Walnut Grove would result in similar, but larger impacts 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 6-8). With the proposed ring levee, an estimated 18 to 23 acres of agricultural land would be displaced as a result of construction of the ring levee, and repairs to the levee adjacent to the community, depending on whether a stability berm or cutoff wall is implemented to remediate the levee immediately fronting the community of West Walnut Grove (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).

Under Management Actions 2, 5, 6, 7, 8, 9, and 10, agricultural sustainability could be affected if the repair and strengthen-in-place via cutoff walls (Remediation Alternative 1) are not implemented, since the proposed stability or combination berms (proposed as Remediation Alternative 2) could range from 15 to 135 feet in width, 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 stability or combination berms as part of Management Actions 2, 5, 6, 7, 8, 9, and 10 is summarized below in Table 6-8. Under Management Action 2, implementing stability berms on the SPFC levees fronting the communities of West Walnut Grove and Ryde would displace an estimated 6 acres of permanent and seasonal crops (though it is assumed that a cutoff wall would be implemented on these levee reaches to reduce physical impacts associated with a stability berm that would displace structures within each of the communities). Implementing berms for Management Actions 5 and 9 is estimated to result in the displacement of nearly 90 acres of permanent and seasonal crops. Repairing and strengthening the Steamboat Slough levees south of SR 220 using

berms would result in the greatest displacement of permanent and seasonal crops at just over 140 acres. If the community and RDs were to implement stability or combination berms for the entire levee system north of SR 220 as part of Management Action 10, an estimated 120 acres of productive permanent crops and seasonal row or field crops would be displaced. Implementing berms for Management Actions 6 and 7 is estimated to result in the displacement of less than 40 acres of permanent and seasonal crops. As shown in Table 6-8, these impacts are reduced when implementing cutoff walls for each of the proposed management actions.

**Table 6-8. Estimated Displaced Acreage when Implementing Management Actions 2-10**

| Management Action | Estimated Displaced Agricultural Acreage: Remediation Alternative 1 (Cutoff Walls) | Estimated Displaced Agricultural Acreage: Remediation Alternative 2 (Stability or Combination Berms) |
|---|---|---|
| Management Action 2: Repair and Strengthen-in-Place Sacramento River Right Bank SPFC Levee Reaches Directly Adjacent to Communities of West Walnut Grove and Ryde | 0 | 6 |
| Management Action 3: All-Weather Access Road/Flood Fight Berm for West Walnut Grove – Clampett Tract | 10 | |
| Management Action 4: Ring Levee and FEMA Certification for West Walnut Grove – Clampett Tract | 18 | 23 |
| Management Action 5: Repair and Strengthen-in-Place Steamboat Slough Left Bank SPFC Levee (north of SR 220) | 21 | 87 |
| Management Action 6: Repair and Strengthen-in-Place Sacramento River Right Bank SPFC Levee (between the confluence with Steamboat Slough and Georgiana Slough) | 0 | 29 |
| Management Action 7: Repair and Strengthen-in-Place Sacramento River Right Bank SPFC Levee (north of SR 220) | 0 | 35 |
| Management Action 8: Repair and Strengthen-in-Place Steamboat Slough Left Bank SPFC Levee (south of SR 220) | 18 | 142 |
| Management Action 9: Repair and Strengthen-in-Place Sacramento River Right Bank SPFC Levee (south of SR 220) | 34 | 86 |
| Management Action 10: Secure 100-Year FEMA Certification for Sacramento River and Steamboat Slough Levees North of SR 220 Paired with SR 220 Cross Levee | 21 | 122 |

#### 6.3.2.2 Local Support

Those management actions which result in the least impacts to agricultural sustainability garner the most local support. Consequently, under Management Actions 1, 2, 4, 5, 6, 7, 8, 9, and 10, 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 Management Actions 3 and 4, local support is greater for Management Action 3, 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 West Walnut Grove, and less right-of-way acquisition coupled with potentially less displacement of permanent orchards immediately adjacent to the community.

#### 6.3.2.3 Cost

Management Action 1 (repair of the DWR FSRP serious erosion site and LMA identified erosion sites) and Management Action 3 (all-weather access road/flood fight berm) are the lowest cost solutions to reducing flood risk in the study area at $4.5M and $5.4M, respectively. Management Action 2 (repair and strengthen-in-place adjacent to the communities of West Walnut Grove and Ryde) and Management Action 4 (ring levee around the town of West Walnut Grove and FEMA certification) are the next lowest cost solutions, with estimated costs of $10M to $29M and $23M to $38M, respectively. Management Actions 5 through 10, which repair and strengthen-in-place various segments of levees along the Sacramento River or Steamboat Slough, are the highest cost solutions to reducing flood risk to the study area. These solutions range in cost between $47M to $387M, depending on whether stability/combination berms or cutoff walls are implemented to address the vulnerabilities on each reach of levee. The highest cost solution to reduce flood risks in the study area, ranging between $200M and $387M, is Management Action 10, which repairs and strengthens-in-place the levees on the Sacramento River and Steamboat Slough north of SR 220 paired with a new cross levee along SR 220.

#### 6.3.2.4 Cultural Resource Considerations

Under all management actions, cultural resources could be affected, since installation of a cutoff wall, placement of riprap, construction of a new cross levee or ring levee, or construction of seepage stability or combination berms (ranging from 15-ft- to 135-ft-wide) could require grading or excavation that could potentially disturb previously unknown archeological resources. However, built-environmental resources, such as historic buildings, on adjacent land would not be permanently affected. Additionally, under Management Actions 3 and 4, cultural resources could be affected by construction of the foundation of the cross-levee berm and ring levee.

#### 6.3.2.5 Ecosystem Considerations

Under Management Actions 1 and 2, 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 Management Actions 3, 4 and 10, a small amount of open space would be affected by construction of the cross levee, ring levee or all-weather access road/flood fight berm and any necessary easements required for maintenance. Biological resources in this area could be affected if any sensitive habitat along the alignment cannot be avoided. Under Management Actions 5, 6, 7, 8 and 9 biological resources could likely be avoided/minimized by fix-in-place remediation activities, since most areas along existing easements, where a stability or combination berm would be constructed, are generally kept clear of habitat for ease of levee inspection and maintenance by the LMAs.

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 critical regional 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 Communities of West Walnut Grove and Ryde that are 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 management actions 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 management action components that could conflict with existing regulations could be those that propose combination 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 management action.

Historically, levee repairs can induce population growth and encourage development within the floodplain. Although levee repairs are proposed under all of the various management actions, 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 West Walnut Grove/Ryde and adjacent working agricultural lands with better flood protection, and providing multi-benefit opportunities when possible, West Walnut Grove/Ryde can reasonably thrive communities within the confines of existing regulations.

### *6.3.3 Trade-Off Analysis Summary*

A summary of the trade-off analysis is provided in Table 6-9 below.

**Table 6-9. Trade-Off Analysis Summary Table**

| 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 West Walnut Grove Study Area (Existing Conditions/Future Conditions) ($) | | | | | | |
| **1** | High | High | High | $8,421,000 - $42,379,000 | No | 0/0 | No | High | **Low** | Low |
| **2** | High | High | High | N/A | No | 0/6 | No | Medium | | Medium |
| **3** | High | High | -- | $1,327,000 - $8,347,000 | No | 10 | No | Medium | | Low |
| **4** | High | High | None | $1,355,000 - $8,597,000 | Yes | 18/23 | No | Low | | Medium |
| **5** | High | High | High | $8,611,000 - $43,641,000 (MA 5, 7, 8, 9 combined) | No | 21/87 | No | Medium | | High |
| **6** | High | High | High | | No | 0/29 | Yes | High | | High |
| **7** | High | High | High | | No | 0/35 | Yes | High | | High |
| **8** | High | High | High | | No | 18/142 | No | Medium | | High |
| **9** | High | Medium | High | | No | 34/86 | No | Medium | | High |
| **10** | High | High | High | $8,647,000 - $43,852,000 | Yes | 21/122 | Yes | High | | High |

# 7. Recommendations

Section 7 details the suite of management actions recommended for implementation. Stakeholder and public input on these management actions 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 10 management actions previously identified, Management Actions 1-3 are recommended for timely, near-term implementation. This includes:

- **Management Action 1:** Repair DWR FSRP Serious Erosion Site and Address Erosion Sites Identified by the LMA Representatives
- **Management Action 2:** Repair and Strengthen in-Place Sacramento River SPFC Levee Reaches Directly Adjacent to the Communities West Walnut Grove and Ryde
- **Management Action 3:** All-Weather Access Road/Flood Fight Berm for West Walnut Grove – Clampett Tract

**Management Action 4**: Ring Levee and FEMA Certification for West Walnut Grove – Clampett Tract is also recommended as an alternative to Management Action 3.

One additional management action for long-term consideration:

**Multi-Benefit Management Action 6:** Repair and strengthen-in-place a total of 5.9 miles of SPFC levee segments 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.

Long term management actions include the long-term goal of securing a 100-year level of flood protection for the community of West Walnut Grove by repairing the SPFC levee reaches along the right bank of the Sacramento River and left bank of Steamboat Slough north of SR 220, paired with a cross levee along SR 220, particularly if Management Action 3 or 4 consisting of an all-weather access road/flood fight berm or ring levee are not implemented.

As previously mentioned above, repairing and improving the SPFC levee along the right, west bank of the Sacramento River north of SR 220 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 Management Action Items 6 through 10 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 management actions 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 management actions are provided below.

### *7.1.1 Management Action 1: Repair DWR FSRP Serious Erosion Site and Address Erosion Sites Identified by LMA Representatives*

#### 7.1.1.1 DWR FSRP Critical and Serious Sites

As previously discussed in Section 5.1.1.1, rock revetment is recommended to repair the FSRP serious erosion site located along the right bank of the Sacramento River, as documented in the 2013 FSRP Pre-Feasibility Report. A conceptual cross section is provided in Figure 7-1.

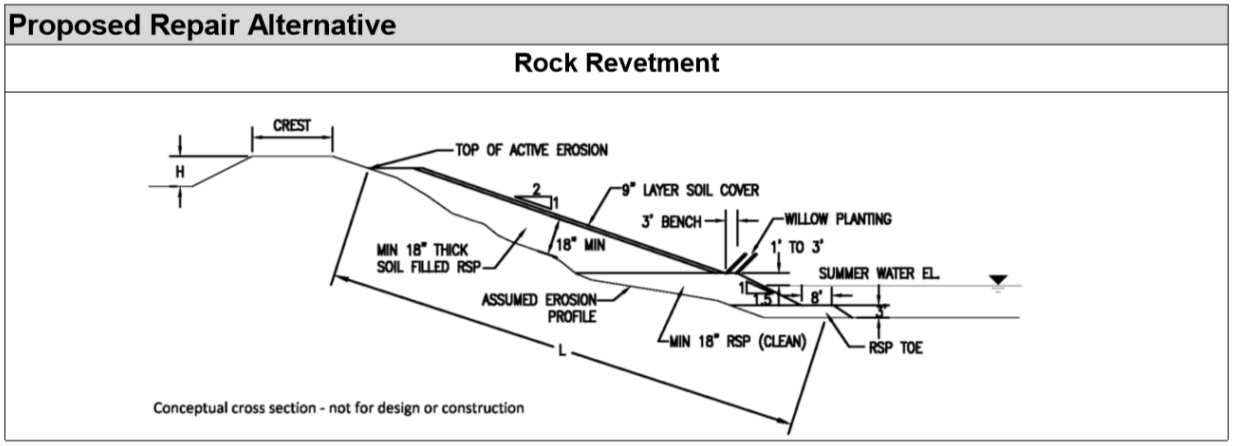


**Figure 7-1. Conceptual Cross Section for Repair of the Serious Erosion Site along the West Bank of the Sacramento River (URS, 2013b)**

#### 7.1.1.2 Address Erosion Sites from LMA Representatives

As described in Section 5.1.1.2, erosion sites 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 5-6.

### 7.1.2 Management Action 2: Repair and Strengthen-in-Place Sacramento River Right Bank SPFC Levee Reaches Directly Adjacent to Communities of West Walnut Grove and Ryde

As described in Section 5.1.1.3, remedial alternatives to repair and strengthen the levee along the right bank of the Sacramento River immediately fronting the community of West Walnut Grove include a 15-foot-deep cutoff wall or a 7-foot-tall, 15-foot-wide stability berm. The 15-foot-deep cutoff wall was selected as the recommended remedial alternative to repair and strengthen 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 5-1.

Similarly, remedial alternatives to repair and strengthen the levee along the right bank of the Sacramento River immediately fronting the community of Ryde include a 15-foot-deep cutoff wall or an 8-foot-tall, 15-foot-wide stability berm. The 15-foot-deep cutoff wall was selected as the recommended remedial alternative to repair and strengthen 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 5-1.

### 7.1.3 Management Action 3: All-Weather Access Road and Flood Fight Berm for West Walnut Grove – Clampett Tract

As discussed in Section 5.2.1, the all-weather access road/flood fight berm would follow the alignment depicted in Figure 5-13, with a 20-foot-wide crown width, 3H:1V landside and waterside slopes, and maximum road crown elevation of 11 feet, assuming design WSEL of 10 feet NAVD 88 and 1 foot of freeboard. Note that the maximum crown elevation of 11 feet was developed assuming a relief cut would be executed within the basin.

### 7.1.4 Management Action 4: Ring Levee and FEMA Certification for West Walnut Grove – Clampett Tract

As discussed in Section 5.2.2, the proposed ring levee would follow the alignment shown in Figure 5-14, with a 20-foot minimum crown width, 3H:1V landside and waterside slopes, and levee crest elevation of 14 feet, assuming design WSEL of 11 feet NAVD 88 (due to climate change and sea level rise) and 3 feet of freeboard. Note that the levee crest elevation of 14 feet was developed assuming a relief cut would be executed within the lower, downstream portion of Grand Island. The maximum crown elevation would need to be 5 to 6 feet higher if a relief cut were not deployed in the southerly, downstream portion of Grand Island.

### 7.1.5 Management Action 6: Repair and Strengthen-in-Place Sacramento River Right Bank SPFC Levee Between the Confluence with Steamboat Slough and Georgiana Slough - Including Multi-Benefit of Improving Reliability and Resiliency of Through-Delta Water Conveyance System

As described in Section 5.1.2.3, remedial alternatives to repair and strengthen the entire 5.9 miles of SPFC levee along the right bank of the Sacramento River between the confluence with Steamboat Slough and Georgiana Slough include cutoff walls ranging from 15- to 35-foot-deep; or a set of stability or combination seepage-stability berms ranging from 15- to 80-foot-wide.

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

The recommended suite of four management actions were informed by stakeholder and public feedback received following preparation of the draft feasibility study report in October 2020. Stakeholders and the public expressed the greatest support for repairing the weakest links in the perimeter levee system of the West Walnut Grove/Ryde study area (Management Action 1) and repairing and strengthening the entire 5.9 miles of SPFC levees along the right bank of the Sacramento River between Steamboat Slough and Georgiana Slough (Management Action 6) due to the multi-benefit component of improving both the water conveyance system and the flood control system.

Between Management Action 3 (all-weather access road/flood fight berm for West Walnut Grove – Clampett Tract) and Management Action 4 (ring levee and FEMA certification for West Walnut Grove – Clampett Tract), the all-weather access road is more favorable to locals. Though not a preferred alternative by RD 3, this non-structural management action is relatively low in cost ($5.4M) in comparison to other recommended management actions and would protect the community of West Walnut Grove from potential flood waters originating outside of the community. As a result, this feasibility study recommends this management action (absent implementation of Management Action 6) for future implementation by the community of West Walnut Grove, though RD 3 has noted that they would not lead the efforts needed for design, construction, operation, and maintenance.

The ring levee (Management Action 4) is not a preferred management action for locals or other key stakeholders including RD 3. While not supported as a preferred management action, a ring levee around the community of West Walnut Grove paired with repairing and strengthening the levee fronting the community is ultimately recommended for future implementation (without Management Action 6) since it is a lower cost solution to 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, an all-weather access road/flood fight-berm (or a ring levee as an alternative) is included as part of the recommended structural-related management actions discussed in the previous Section.

The following non-structural measures identified and numbered as follows in Appendix H – Non-Structural Measures are recommended to be carried forward to reduce flood risks within the West Walnut Grove/Ryde study area include the following:

1. Flood Fight Berm or a Ring Levee System
2. Voluntary Elevation of Structures
3. Wet or Dry Floodproofing
4. Flood Emergency Safety Plans
5. Sacramento County OES Decision Support Tool
6. Local Hazard Mitigation Plan and Relief Cuts
7. Alternatives to FEMA's NFIP – Private, Community-Based Flood Insurance
8. NFIP Flood Insurance Enhancements *via* AFOTF
9. Improve FEMA's CRS Score for Sacramento County/Isleton
10. Land Use Regulations and Limitations
11. Improved Governance Between Neighboring LMAs/RDs
12. SWIFs & Periodic Inspections with USACE
13. Public Education/Public Awareness

The only non-structural measures previously identified but not carried forward are acquisitions and relocations and Mokelumne River conveyance improvements.

Acquisitions and relocations were not carried forward at the request of the key stakeholders. Relocating entire communities within the Delta, particularly Delta Legacy Communities such as West Walnut Grove and Ryde, is inconsistent with the goals and objectives of both the Delta Plan and the Sacramento-San Joaquin Delta National Heritage Area designation.

The Mokelumne River conveyance improvements was not carried forward since it is not expected to result in sizeable flood risk reduction benefits for the Delta Legacy communities of West Walnut Grove and Ryde along the mainstem of the Sacramento River .

The recommended suite of the key non-structural measures and timeline status are summarized below. Of these, a portion are currently ongoing within the West Walnut Grove/Ryde study area, with the remaining recommended for implementation in the near term and long term as summarized in Table 7-1. Associated recommendations and costs, as applicable, are summarized below.

**Table 7-1. Recommended Timeline for Implementation of Other 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 |
| Local Hazard Mitigation Plan 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 Community Rating System Score 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 West Walnut Grove/Ryde 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% or greater cost share reductions) available through federal and State cost-sharing programs.

As described previously, there are a total of 680 structures in RD 3. As previously presented in Table 5-8 in Section 5.2.3, this represents a total cost of at least $40M to elevate all of the structures within the community of Hood, and at least $116M to elevate all of the structures in all of RD 3, including the communities of West Walnut Grove/Ryde. 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 management actions 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

For a more detailed description of this non-structural measure that would be voluntary in nature for individual homeowners and business owners, similar to voluntary elevation of structures, *refer to* Section 5.2.4. 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 – Flood Emergency Safety Plans and County OES Decision Support Tool

RD 3 is currently utilizing the DWR Delta Flood Emergency Response Grant Round 2 funding to update its Delta Flood ESP. RD 3 is the grantee within the funding agreement which covers plan updates for several other RDs in Sacramento County.

The intent is for the ESP 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 RD's 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 ESP 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 EOPs format will also be updated to be consistent with regional standards (San Joaquin, Yolo, and Solano County Flood ESPs).

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* Section 7.3.4 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 ESP for West Walnut Grove/Ryde 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 county planning area, including RD 3, and to establish updated goals and prioritize projects to reduce these impacts on people and property within RD 3. It is recommended that the 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 RD 3 is 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 3 basin has shown that a relief cut would be of greatest value if deployed somewhere near or on the southern tip of Grand Island, or near the southern downstream end of Steamboat Slough.

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

Please refer to Section 5.2.8 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.

West Walnut Grove/Ryde and other Delta legacy Communities might choose to implement a community-based flood insurance program through the establishment of an 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 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 Communities of West Walnut Grove and Ryde 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* Appendix J, prepared by Kathleen Schaefer, P.E., CFM, former FEMA regional administrator of NFIP).

### *7.3.6 NFIP Flood Insurance Enhancements via AFOTF*

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 communities of West Walnut Grove and Ryde, *refer to* Section 5.2.9.

This non-structural measure developed by 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. These 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 most are applicable to the agricultural-based communities of West Walnut Grove and Ryde and the surrounding study area within RD 3:

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's CRS

### 7.3.7 Improve FEMA Community Rating System Score for Sacramento County

Please refer to Section 5.2.11 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 communities of West Walnut Grove and Ryde.

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 the county while also attempting to reduce NFIP premium policy rates. Through different flood mitigation activities outlined within the NFIP, the county has been able to reduce flood insurance through the FEMA CRS. The county currently has the opportunity to improve their CRS score to achieve the highest possible Class 1 designation by implementing and participating in 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 the county as the 2nd highest ranked CRS community in the entire United States, behind Placer County.

### 7.3.8 Improved Governance between Neighboring LMAs/RDs and Community

For a more detailed description of this non-structural measure that is a long-term non-structural measure that could be beneficial to the communities of West Walnut Grove and Ryde as they come together to potentially work with RD 3, *refer to* Section 5.2.12.

### 7.3.9 SWIFs and Periodic Inspections with USACE

Please refer to Section 5.2.13 and Appendix H for a more detailed description of this non-structural measure that includes optimizing flood risk reduction through implementation of a SWIF.

### 7.3.10 Public Education and Awareness

Please refer to Section 5.2.14 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 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 up-to-date 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 West Walnut Grove, Ryde 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 management action 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: Agricultural Sustainability. Table 6-8 in Section 6.3.2.1 provides a summary of each structural-based management action 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 management actions 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 easements in most locations (vs. fee title) where highway and or roadway are overlain on the top of the levee crowns.

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

Right-of-way (ROW) acquisition quantities were estimated for the multitude of structural-based management actions (see Appendix F – Cost Estimate Development for Flood Risk Reduction Management Actions). In addition to determining costs for acquiring fee title or dedicated easements for various management actions, 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**

| Permanent Right-of Way (fee title & Structures) | 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 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

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 84-994 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 3's O&M has been approximately $255,000 for the existing SPFC levee system totaling approximately 29 miles. This will likely increase with implementation of the SWIF.

OMRR&R costs in the West Walnut Grove/Ryde study area will also increase in connection with the implementation and OMRR&R of an all-weather access road/flood fight berm (Management Action 3) or a ring levee system around the community (Management Action 4). These are management actions that RD 3 will not likely pursue unless there is large support and financial assistance from the community beneficiaries, namely the residences and business owners of the West Walnut Grove/Clampett Tract community. The community will need to conduct a benefit assessment for not only the implementation and construction of the 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 3 (or another applicable O&M entity) for any incremental cost of OMRR&R over and above what RD 3 may incur without the added presence of either an all-weather access road/flood fight berm or potential ring levee system.

No new substantial OMRR&R costs are anticipated by RD 3 with the implementation of Management Actions 1 and 2 associated with repairing the known FSRP critical and serious sites, addressing known erosion sites and concerns within the RD, and strengthening-in-place the existing levee system immediately adjacent to the community.

Repairing and strengthening-in place the entire 5.9 miles of SPFC levee between Steamboat Slough and Georgiana Slough (Management Action 6 containing multiple benefits), including addressing any non-compliant encroachments, will not likely increase OMRR&R costs for RD 3.

## 7.6 Regulatory Requirements

Environmental requirements associated with implementation of the preferred management action 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 management action 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 (is work 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.

The Districts 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 1,600 may be required from CDFW. The 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.

As described previously, a total of 12 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 or adjacent to the communities of West Walnut Grove and Ryde, and therefore near to elements of the potential management actions, including remediation of levees along the Sacramento River and the flood fight access road and berm. Further evaluation of these 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 management actions and non-structural measures identified for the Delta Legacy communities of West Walnut Grove and Ryde 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 multi-objectives/benefits that can also be attached to the smaller benefits normally associated with small, rural communities that exist in the North Delta. 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 for the entirety of the community's study area (West Walnut Grove's structural-based Management Action 6) 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.

**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.<br>(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<br>75%-90%<br>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<br>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%<br>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% |

### 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 SCFFRP 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 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.

**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 (DSP) | 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%<br>Up to 100% for Habitat Projects |
| State DWR | Delta Levees Subventions (DLS) | 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-<br>High Flood Threat Level. | 50 to 90% |
| State-California Natural Resource Agency | California River Parkways Program (CRPP) | 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%<br>Up to 100% for DACs |
| State DWR | Flood Maintenance Assistance Program (FMAP) | 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% |

### 7.7.3 Local Cost Share Financing 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. The acreage-based only assessment approach is in large part due to the assessment constrictions presented by Proposition 218 as further discussed above in Section 3.3.2. An exception to the acreage-only assessment in the North Delta is RD 563 - Tyler Island who 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 communities of West Walnut Grove and Ryde within the larger basin of RD 3, it is recommended that the communities of West Walnut Grove and Ryde assess themselves on a combined acreage- and structural-benefit basis, similar to RD 563. A benefit assessment study to support improvements that only benefit the community and not the balance of the larger study area will be likely be required; 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).

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 RD 3 where the communities of West Walnut Grove and Ryde are 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 administered by DWR and have minimum deductible cost 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 may need to assist with said RD levee improvements that provide direct and/or indirect flood risk reduction benefits to the community.

**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. |

## 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 6-6 for existing conditions without climate change adjustments, and Table 6-7 for future conditions that include adjustments for climate change.

The EAD values in Table 6-6 under existing conditions indicates there is a great net reduction in EAD values in the amount of $8.4M that could result from Management Action 1 alone by repairing the outstanding FSRP serious repair site and the LMA identified erosion sites in the amount of $4.5M, indicating a short payback period of less than one year. Management Action 3 consisting of an all-weather access road/flood fight berm around the community of West Walnut Grove/Clampett Tract in the amount of up to $5.4M will result in a net reduction in EAD in the amount of $1.3M for the entire study area, also indicating a short payback period of around four years. The challenge with implementing Management Actions 4-10 with longer payback periods well beyond 10 years is the benefit area(s) coming up with the local cost-share components from not only RD 3, but also from the limited amount of citizens and businesses residing in the community of West Walnut Grove/Clampett Tract who will benefit from said repairs or improvements.

### *7.8.2 Conceptual 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 3) with a payback period estimated at four years, 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 17,100-acre study area beyond just the immediate community area of West Walnut Grove/Clampett Tract encompassing only 170 acres. Assessments can only be levied where there is direct benefit received from anyone of the proposed management actions.

For management actions benefiting the entirety of the study area totaling approximately 17,100 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 RD 3, the community of West Walnut Grove, or some combination thereof for those management actions which reduce flood risk for the larger RD 3 basin. As described above in Section 7.7.3, this local cost share could be generated through a conventional acreage-based assessment deployed by RD 3, 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, 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 3 basin could generate up to $256,500 per year. Without any additional structural assessments and/or assessment developed separately by the community of West Walnut Grove, the total number of years for the RD to acquire cash and secure financing for a 5 percent cost share and pay back the financed amount to repair the DWR FSRP serious erosion site and the LMA identified erosion sites/concerns (Management Action 1) is estimated at less than one year. If a cost-share of 10 percent was required, the entire payback period could be doubled to 2 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 3) and the ring levee (Management Action 4) could be generated through a similar acreage assessment paired with a structural benefit assessment within the immediate community of West Walnut Grove. By assessing the total acreage (170 acres) just within the community of West Walnut Grove at $80 per acre, an estimated $13,600 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 $69,700 per year. With these assessments totaling $83,300 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 three years to pay back the financed amount. To finance a local cost-share for a certified ring levee system (Management Action 4) at an estimated cost of $23-$38M, it could take up to four-and-a-half years to acquire cash to secure local cost-share financing for the ring levee, and an estimated 22 years to pay back the financed amount. Again, all of these payback periods could be doubled if a 10 percent cost share 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 3 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 more basin-wide, comprehensive Management Actions 5-9. These assessments could generate up to $475,000 per year, of which a portion of the residential assessment would be borne by the community of West Walnut Grove and the remainder would be borne by RD 3 as shown below

in Table 7-6. At an estimated cost of $104M to repair and strengthen the entire 5.9 miles of SPFC levees along the Sacramento River between the confluence with Steamboat Slough and Georgiana Slough (Multi-Benefit Management Action 6), it could take just over two years to accumulate enough assessment to secure local cost-share financing and up to nine years to pay back the financed amount. This assumes there is only a small 5 percent cost share requirement, and the assessments remain as indicated in Table 7-6. To certify the entire perimeter levee system to FEMA's current 100-year levee accreditation standards for the entire West Walnut Grove/Ryde study area (collectively Management Actions 5, 7, 8, and 9) using only the assessments described above, it could take approximately 17 years to just acquire cash to the secure local cost-share financing. Similarly, securing 100-year FEMA certification by repairing and strengthening the levees along the left bank of Steamboat Slough and the right bank of the Sacramento River north of Highway 220 in concert with a cross levee along Highway 220 could require nearly 24 years to just acquire cash to secure local cost-share financing. Thus, there needs to be a long-range financial plan developed by the communities of West Walnut Grove and Ryde 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, but also for improving all of the collective 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.

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

| | | Management Action (MA) | | | | | |
|---|---|---|---|---|---|---|---|
| | | Repair DWR FSRP Site(s) and Address Erosion Sites Identified by LMA Representatives (**MA 1**) | All-Weather Access Road/Flood Fight Berm for the Community of West Walnut Grove/Clampett Tract (**MA 3**) | Ring Levee and FEMA Certification for the Community of West Walnut Grove/Clampett Tract (**MA 4**) | Repair and Strengthen-in-Place Sacramento River Right Bank SPFC Levee (between the confluence with Steamboat Slough and Georgiana Slough) (**MA 6**) | Secure 100-Year FEMA Certification for the Entire West Walnut Grove Study Area (**MA 5, 7, 8, 9**) | Secure 100-Year FEMA Certification for Sacramento River and Steamboat Slough SPFC Levees North of Highway 220 Paired with an Elevated Hwy 220 Cross Levee (**MA 10**) |
| Estimated Cost (Low) | | $4,520,000 | $5,380,000 | $22,771,000 | $46,962,000 | $376,941,000 | $200,171,000 |
| Estimated Cost (High) | | $4,520,000 | $5,380,000 | $37,604,000 | $104,214,000 | $785,772,000 | $387,285,000 |
| Net Reduction in EAD to West Walnut Grove/Ryde Study Area, Existing Conditions | | $8,421,000 | $1,327,000 | $1,355,000 | N/A | $8,611,000 | $8,647,000 |
| Net EAD Reduction in EAD to Walnut Grove/Ryde Study Area, Future Conditions | | $42,379,000 | $8,347,000 | $8,597,000 | N/A | $43,641,000 | $43,852,000 |
| Flood Risk Reduction Payback Period (in Years: Future – Existing Conditions) | | 0.1 o 0.5 years | 0.6 to 4.1 years | 4.4 to 27.8 years | N/A | 18.0 to 91.3 years | 8.8 to 44.8 years |
| Local Responsibility (Lead **Assessed**/Support) | | **RD 3** | **Community of West Walnut Grove**/RD 3 | **Community of West Walnut Grove**/RD 3 | **RD 3/Community of West Walnut Grove** | **RD 3/Community of West Walnut Grove** | **RD 3/Community of West Walnut Grove** |
| Local Cost Share | 5% of Total Cost | $226,000 | $269,000 | $1,880,000 | $5,211,000 | $39,289,000 | $19,364,000 |
| | 80% Local Financed (4% Total Cost of MA) | $180,800 | $215,200 | $1,504,000 | $4,168,800 | $31,431,200 | $15,491,200 |
| | 20% Local Cash Needed (1% Total Cost of MA) | $45,200 | $53,800 | $376,000 | $1,042,200 | $7,857,800 | $3,872,800 |

| | Management Action (MA) | | | | | |
|---|---|---|---|---|---|---|
| | Repair DWR FSRP Site(s) and Address Erosion Sites Identified by LMA Representatives (**MA 1**) | All-Weather Access Road/Flood Fight Berm for the Community of West Walnut Grove/Clampett Tract (**MA 3**) | Ring Levee and FEMA Certification for the Community of West Walnut Grove/Clampett Tract (**MA 4**) | Repair and Strengthen-in-Place Sacramento River Right Bank SPFC Levee (between the confluence with Steamboat Slough and Georgiana Slough) (**MA 6**) | Secure 100-Year FEMA Certification for the Entire West Walnut Grove Study Area (**MA 5, 7, 8, 9**) | Secure 100-Year FEMA Certification for Sacramento River and Steamboat Slough SPFC Levees North of Highway 220 Paired with an Elevated Hwy 220 Cross Levee (**MA 10**) |
| Acreage Assessment[1] | $256,500 | $13,600 | $13,600 | $256,500 | $256,500 | $102,600 |
| Residential Assessment[2] | -- | $65,700 | $65,700 | $65,700 (West Walnut Grove)<br>$88,200 (RD 3) | $65,700 (West Walnut Grove)<br>$88,200 (RD 3) | $35,280 |
| Commercial/Industrial Assessment[3] | -- | $4,000 | $4,000 | $4,000 (West Walnut Grove)<br>$60,800 (RD 3) | $4,000 (West Walnut Grove)<br>$60,800 (RD 3) | $24,320 |
| Total Annual Assessments | $256,500 | $83,300 | $83,300 | $475,200 | $475,200 | $162,200 |
| Number of Years to Acquire Cash to Secure 5% local Cost-Share Financing | 0.2 years | 0.7 years | 4.5 years | 2.2 years | 16.5 years | 23.9 years |
| Number of Years to Pay Back Financed Amount | 0.7 years | 3.1 years | 21.6 years | 8.8 years | 66.1 years | 95.5 years |
| Total Payback Years | 0.9 years | 3.8 years | 26.1 years | 11.0 years | 82.6 years | 120 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 RD 3 (17,100 acres); and $80/acre for community of West Walnut Grove (170 acres)

[2] Residential assessment utilizes the total number of residential structures located within the community of West Walnut Grove 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)

# 8. Implementation of Recommendations

## 8.1 Implementation Schedule including Roles and Responsibilities

The communities of West Walnut Grove/Clampett Tract and Ryde, acting through Sacramento County with support from RD 3, have the opportunity to significantly reduce flood risks to the communities and the larger study area including RD 3 – Grand Island. West Walnut Grove/Ryde, Sacramento County, and the noted RD intend to accomplish this by: (1) repairing and strengthening-in-place the greatest known and documented weaknesses in the perimeter SPFC levee system along the right bank of the Sacramento River and the left bank of Steamboat Slough protecting the West Walnut Grove/Ryde study area and, (2) potentially constructing an all-weather access road/flood-fight berm to further protect the community of West Walnut Grove/Clampett Tract 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 communities of West Walnut Grove/Clampett Tract and Ryde would prefer to see the well documented DWR FSRP serious erosion site repaired by DWR with support from the RD within the next few years, by 2024. Management Action 1 also includes addressing other known erosion sites. The repair of the DWR FSRP serious erosion site (estimated at $3.6M), when combined with addressing other known erosion sites (presently estimated at nearly $1M), will result in a net reduction in EAD of approximately $8.4M for the entire study area under existing conditions. The benefit of these projects is nearly five-fold under future conditions with an estimated net reduction in EAD for the entire study area of over $42M as a result of the effects of inland climate change and sea level rise.

Following remediation of the noted FSRP site and known erosion sites, the communities would prefer to see the 1.8 miles of SPFC levee immediately adjacent to the communities of West Walnut Grove/Clampett Tract and Ryde fortified within the next 5 to 10 years to meet current FEMA accreditation standards (Management Action 2) at a cost of approximately of $29M. 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 either of these locations.

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 resiliency of conveying SWP and CVP water 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 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 serious erosion site on Steamboat Slough and the LMA identified erosion sites throughout Grand Island (structural-based Management Action 1), RD 3 is funding and executing these projects based on their limited annual budgets for repairs either through Delta Levees Special Projects and/or Subventions.
2. Consistent with the approach outlined above for correcting the known FSRP site associated with Management Action 1, the RD should also earmark nominal funds, with the possible assistance from Sacramento County and the communities of West Walnut Grove and Ryde, to address the extent of erosion repairs on the SPFC levee system along the right bank of the Sacramento River and the left bank of Steamboat Slough. Funds should also be earmarked by the RD 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 communities of West Walnut Grove and Ryde, with support from Sacramento County and the RD, 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 basin and the West Walnut Grove/Ryde study area. The community-specific flood risk management actions that could significantly reduce life loss and potential damages in West Walnut Grove and Ryde due to flooding in the communities include strengthening-in-place the Sacramento River SPFC levee immediately fronting each of the communities (Management Action 2). These community-specific levee improvements could be paired, as recommended, with an accompanying all-weather access road/flood-fight berm (Management Action 3), which would require planning and financing beyond the current responsibilities of RD 3. 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 1.8 miles of the SPFC levee immediately fronting each of the communities, 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 communities, with the support of Sacramento County and others, work with RD 3 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 communities of West Walnut Grove and Ryde 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 3). 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 communities that is currently assessed by RD 3 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 portion of the SPFC levee system along the right bank of the Sacramento River between Steamboat Slough and Georgiana Slough (Management Action 6).

6. In connection with implementing the multiple-benefit project of improving the 5.9 miles of SPFC levee in the project area that will also improve the reliability and resiliency of conveying SWP and CVP water 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, and the Delta Legacy Communities have suggested improving the SPFC levee system, particularly upstream of the Delta Cross Channel is necessary with or without the proposed DCA. It is suggested that the communities of West Walnut Grove and Ryde, and their neighboring Delta Legacy Communities particularly in Yolo and Sacramento Counties, work with RFMP representatives, including Sacramento Area Flood Control Agency, the West Sacramento Flood Control Agency, the CVFPB and DWR Management Area 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 an independent isolated conveyance facility. 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. Concurrently with implementing the near- and long-term structural-based management actions the communities of West Walnut Grove/Ryde, with assistance from Sacramento County, RD 3, and others, can implement the following non-structural measures to further reduce residual flood in West Walnut Grove/Ryde study area. All of the non-structural measures for implementation are described in more detail in Sections 5.2 and 7.3. 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 Elevation of Structures
    3. Wet or Dry Floodproofing
    4. Flood Emergency Safety Plans
    5. Sacramento County OES Decision Support Tool
    6. Local Hazard Mitigation Plan and Relief Cuts
    7. Alternatives to FEMA's NFIP – Private, Community-Based Flood Insurance
    8. NFIP Flood Insurance Enhancements *via* AFOTF
    9. Improve FEMA's CRS Score for Sacramento County/Isleton
    10. Land Use Regulations and Limitations
    11. Improved Governance Between Neighboring LMAs/RDs
    12. SWIFs & Periodic Inspections with USACE
    13. Public Education/Public Awareness

## 8.2 Delta Regulatory Compliance, Delta Investment Priorities, and Additional Studies and 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 3x3 prioritization table for levee investments is presented in Section 4 and is highlighted below in Table 8-1. The 3x3 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 West walnut Grove are most responsive to the DSC's Prioritization of State Investments in Delta levees and risk reduction. West Walnut Grove's Management Action 6, consisting of the multi-benefit project of repairing and strengthening-in-place 5.9 miles of the SPFC levee between Steamboat and Georgianna Sloughs 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 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.

Although not fully exhausted through this current feasibility study effort, it is recommended that West walnut Grove 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***

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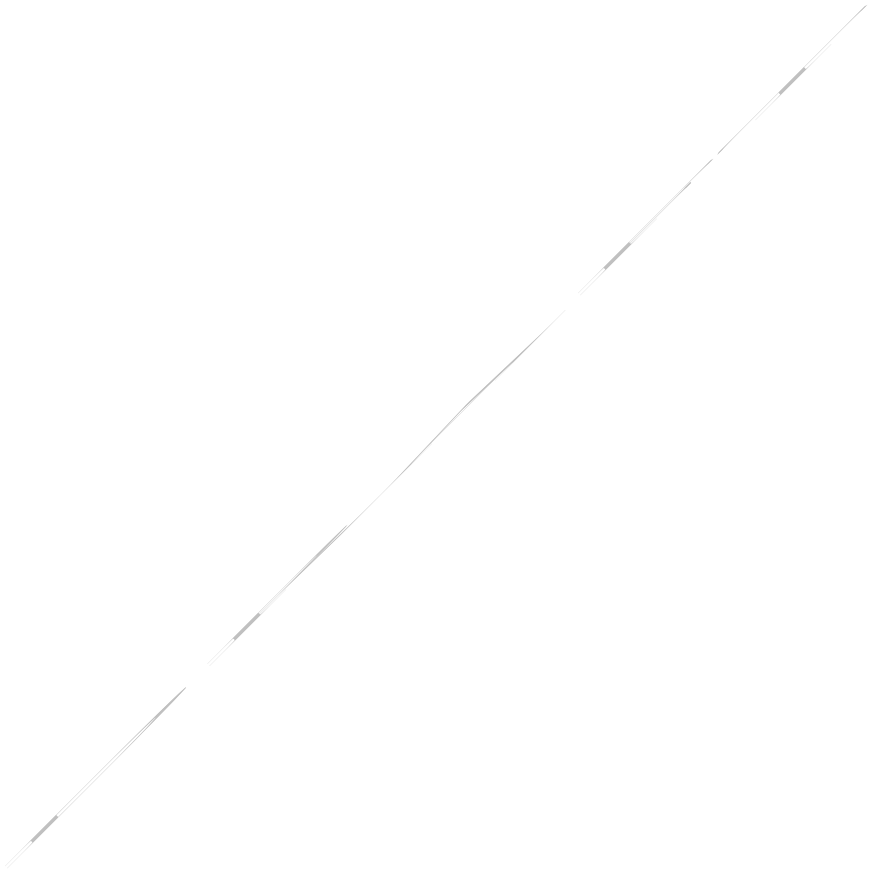
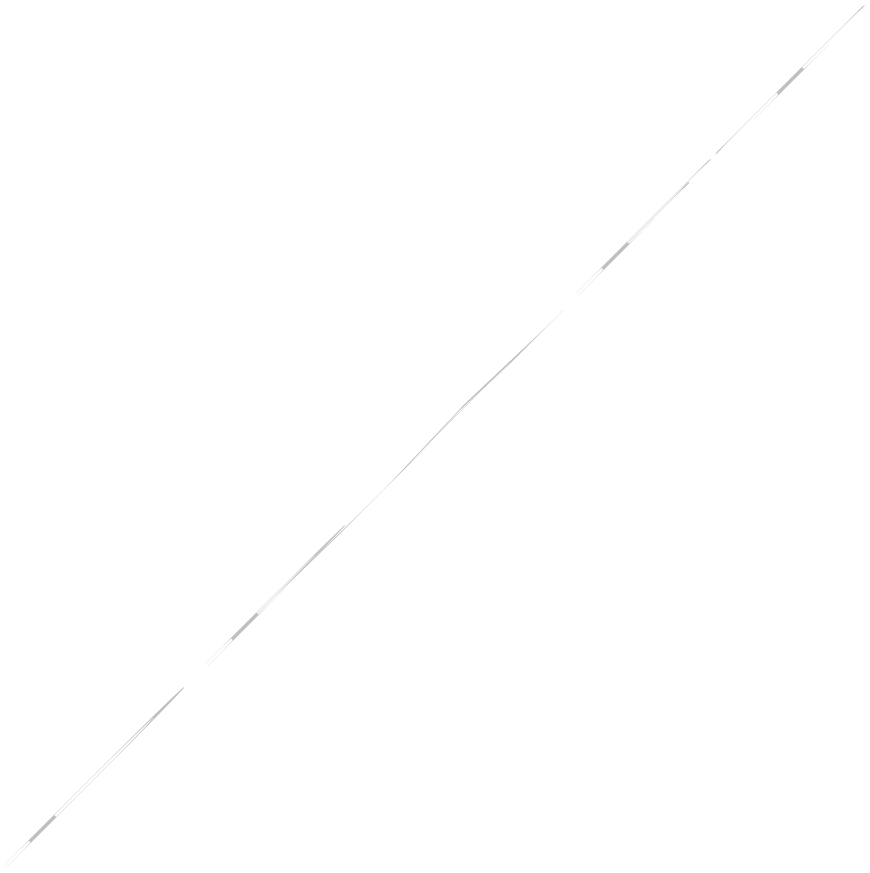
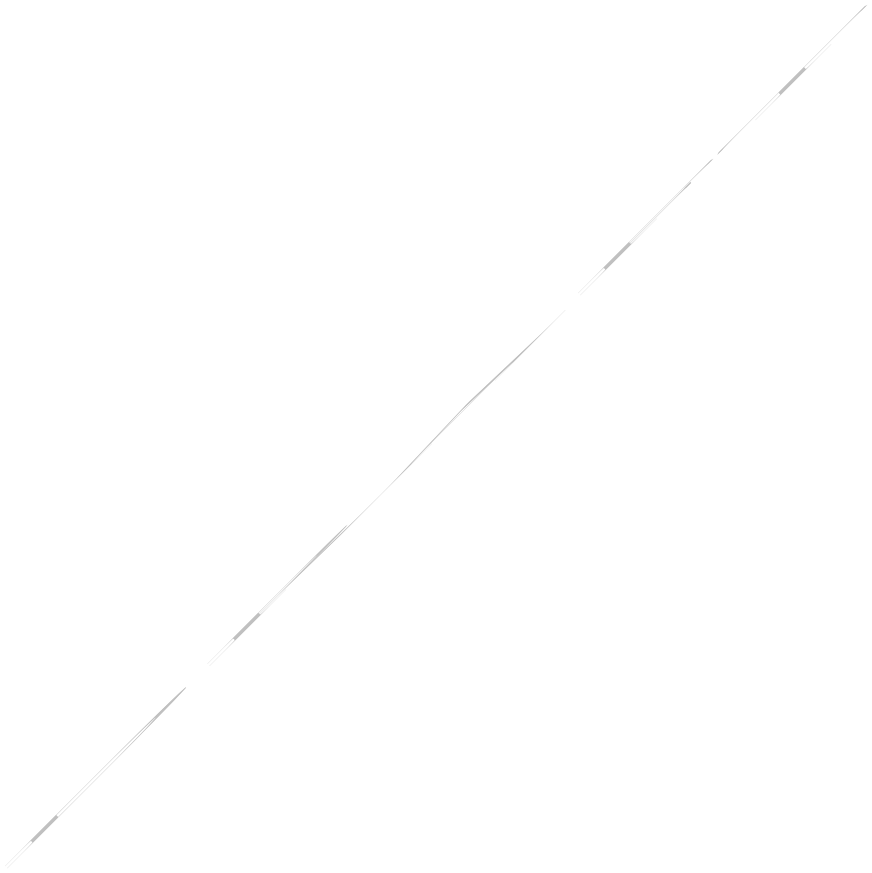
# Appendix A: Geotechnical Data and Assessment Report



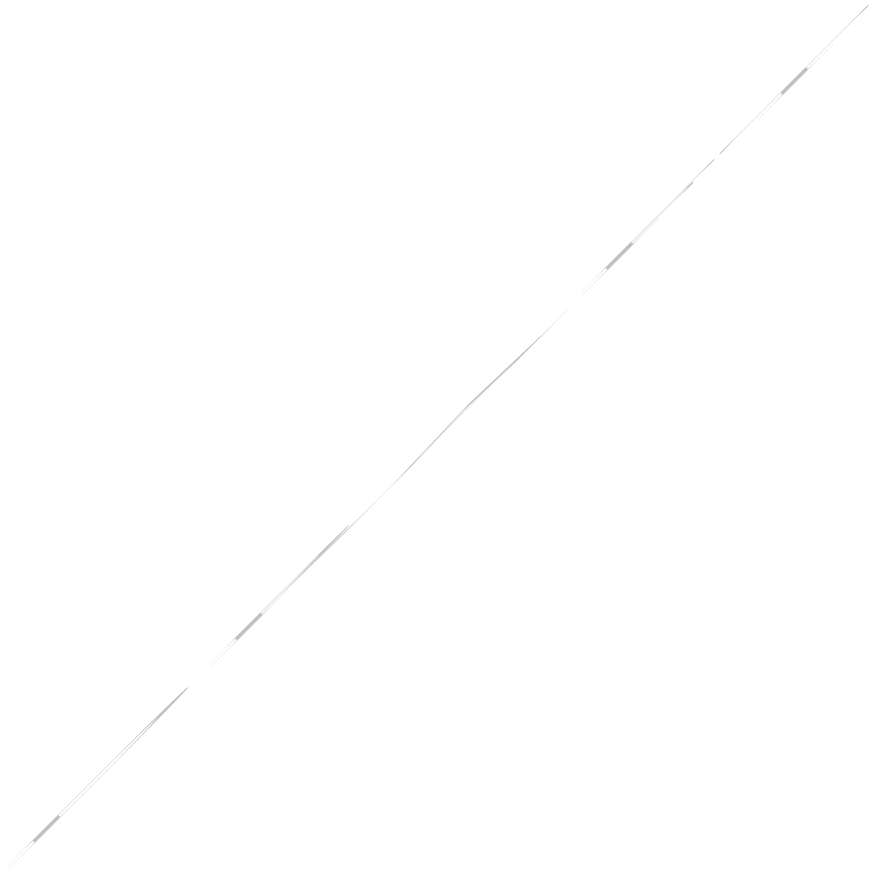
# Appendix B: Biological Resources Constraints Assessment for the Communities of West Walnut Grove and Ryde – Grand Island



# Appendix C: Cultural Resources Records Search Results for West Walnut Grove and Ryde, California

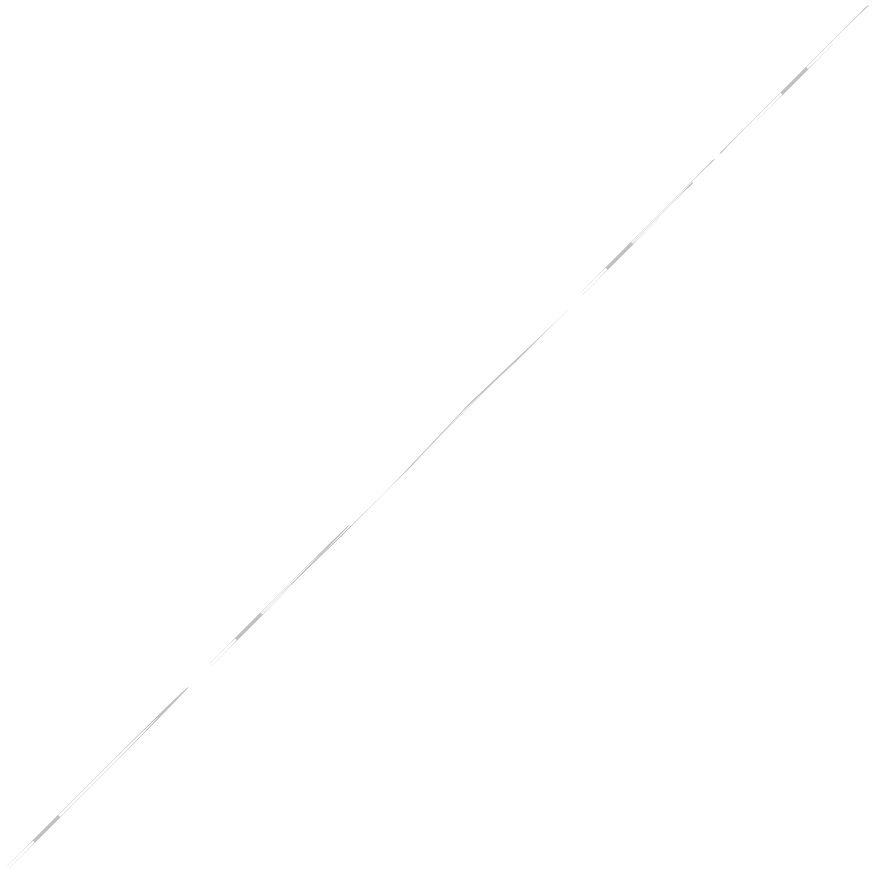


# Appendix D: Ecosystem Multi-benefit Opportunities for the Sacramento County Delta Legacy Communities Small Communities Flood Risk Reduction Feasibility Studies



# Appendix E: Expected Annual Damages Technical Memorandum for the Delta Legacy Communities of West Walnut Grove and Ryde

# Appendix F: Cost Estimate Development of Flood Risk Reduction Management Actions for the Flood Risk Reduction Feasibility Study for Delta Legacy Communities of West Walnut Grove and Ryde, CA

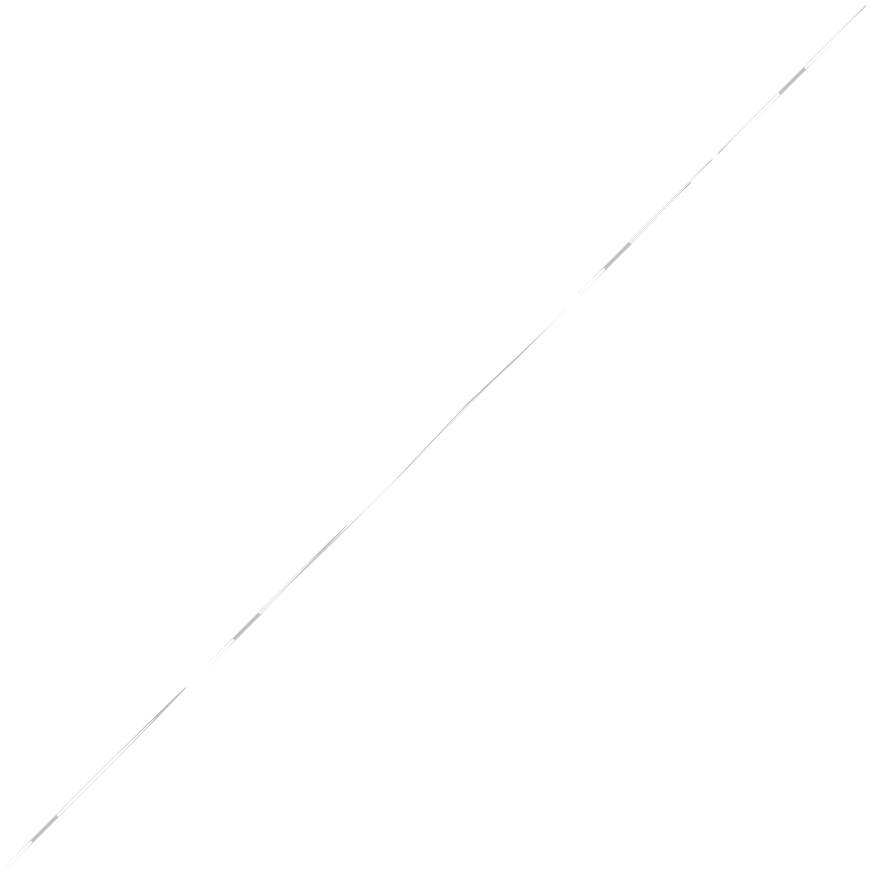


# Appendix G: DPC, DSC, and Delta Conservancy Master Comparison Matrix

# 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

# 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

# Appendix J: Community-Based Flood Insurance Program Technical Memorandum



# 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