ATTACHMENT M

Draft Nonstructural Measures, Rio Oso Flood Risk Reduction Feasibility Project

Nonstructural Measures

Rio Oso Flood Risk Reduction Feasibility Project

Sutter County
April 2020

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2 Nonstructural Measures

The nonstructural measures evaluated to reduce residual risk in Rio Oso are presented in this attachment. Residual risk is defined as the product of (1) the chance of damage or other adverse consequence and (2) the amount of that damage or other adverse consequence, after flood management actions have been taken. Therefore, even after implementing the recommended alternative, Rio Oso would still face residual risk from flooding. Although it is not possible to completely eliminate residual risk, it can be mitigated with the implementation of nonstructural measures that improve flood system performance of existing facilities and/or reduce exposure, vulnerability, and consequences of flooding by adapting to the natural floodplain or inherent features of the floodplain. These nonstructural measures include: changes to the National Flood Insurance Program (NFIP), levee relief cuts, emergency flood fight plan, flood emergency evacuation plan, flood evacuation warning system, voluntary structure elevation, and agricultural conservation easements.

2.1 Changes to National Flood Insurance Program

2.1.1 2012 Central Valley Flood Protection Plan (CVFPP) & 2017 Update of the CVFPP

As proposed in the 2012 CVFPP and the 2017 update of the CVFPP, the State will work with FEMA's NFIP to determine opportunities to provide affordable flood insurance for low risk agricultural and farming structures within the floodplain and to promote a sustainable rural-agricultural economy. The State supports efforts to reform the NFIP under the condition that they result in more equitable implementation while reflecting corresponding flood risks. Consequently, the California Department of Water Resources (DWR) funded and participated in the Agricultural Floodplain Ordinance Task Force (Task Force that convened throughout 2016 to develop recommendations to FEMA for administrative refinements to the NFIP to help sustain agriculture in leveed Special Flood Hazard Areas (SFHA).

The 2017 CVFPP proposes evaluating implementation of a state-led flood insurance program to improve or replace the NFIP. A state-led flood insurance program could also serve as a new mechanism for funding projects such as levee improvements, land acquisitions, and easements in the long term. An assessment still needs to be performed to evaluate the feasibility and potential cost effectiveness of a state-led flood insurance program in comparison to the NFIP, especially in regards to mitigating losses to those affected by flooding and flood insurance (DWR, 2017).

2.1.2 Regional Flood Management Plan

The 2014 Feather River Regional Flood Management Plan (RFMP) presented possible nonstructural measures to be considered in the rural areas, including the small community of Rio Oso. The RFMP also considered similar nonstructural measures such as the modification of the area's status within the NFIP's administrative structure, elevating and flood-proofing structures, relocating structures, agricultural easements, and hazard mitigation.

2.1.3 Agricultural Floodplain Ordinance Task Force – Zone D with floodplain management ordinance and flood insurance instrument

The Task Force prepared a technical memorandum which presents recommendations for modifying FEMA's rules and practices under the NFIP to improve sustainability of agriculture in leveed SFHAs.

One of those recommendations included the implementation of a Zone D designation. It may be possible for Rio Oso to qualify for FEMA Zone D designation rather than Zone AE. Zone D designation is used in areas where there are undetermined, but possible, flood hazards and definitive analysis has yet to be conducted. Zone D designated areas are:

- Undeveloped and sparsely populated
- There are no federal restrictions on building new structures
- Flood insurance is not required but can be purchased through the NFIP at relatively high premiums.

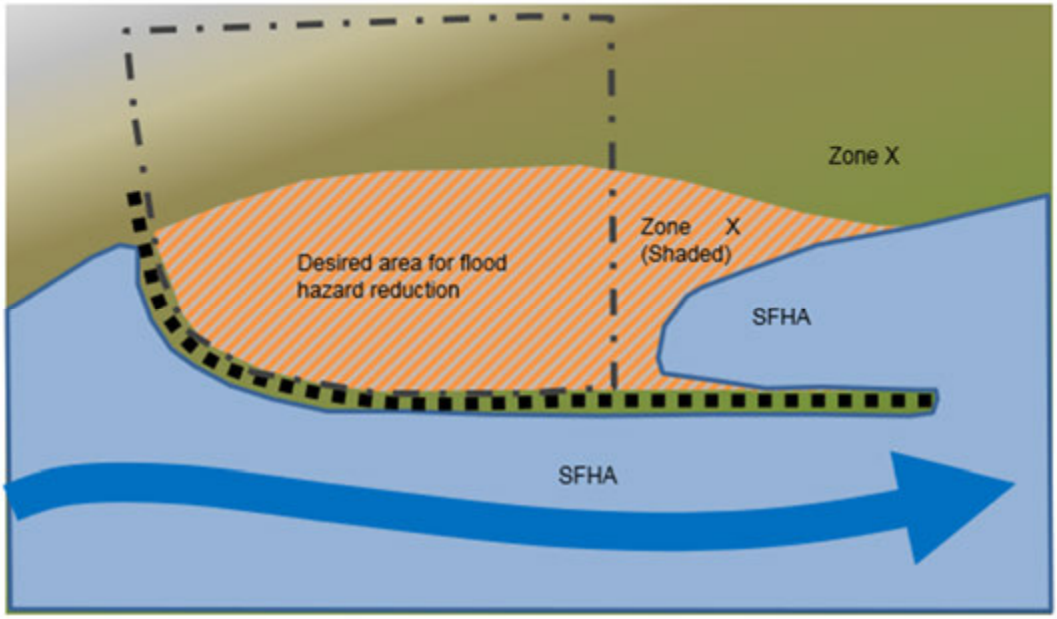
Past performance events on the levees protecting Rio Oso have included include levee breaks, underseepage, through seepage, erosion, overtopping, and slope instability. The levee systems affected may meet NFIP freeboard requirements but may fail to meet levee seepage, stability, and erosion standards. Changing designation is not recommended because it could lead to residents having a false sense security, even though the flood risk in the community would still remain.

While application of Zone D for rural areas was recommended by the Task Force, FEMA has not formally responded to the Task Force recommendations. Based on informal discussions with FEMA, it appears unlikely that FEMA would change the designation of an area already mapped as a SFHA, such as the Rio Oso area, to Zone D.

2.1.4 Agricultural Floodplain Ordinance Task Force – Zone X (Shaded) for certified levee reaches

The Agricultural Floodplain Ordinance Task Force recommended FEMA to revise Operating Guidance 12-13 to designate areas behind a certified reach of levee as Zone X (Shaded) instead of Zone D

FEMA's Operating Guidance 12-13 does not allow accreditation of a reach of levee unless the entire levee system is certified and accredited. Due to this, unshaded Zone X designation is used on the FIRM behind reaches of levees that meet all requirements for accreditation. In February 2018, FEMA issued updated guidance (Guidance Document 95) that states Zone X (Shaded) certification may be allowed behind an accredited reach of levee if it connects to a non-accredited reach of levee and would not unravel if a breach occurred where they connect (Figure 1).



Source: FEMA Guidance Document 95 (February 2018)

Figure 1. Levee System Designed to End in the Absence of High Ground

Initial outreach to FEMA on this issue has not confirmed whether this new approach can be used for Zone X (Shaded) designation behind a certified reach of levee. According to FEMA Title 44 Code of Federal Regulations Part 65.10 (Mapping of areas protected by levee systems), FEMA is required to apply the regulatory certification criteria to a levee system, not a levee reach. In informal discussions with FEMA, FEMA has suggested a change to CFR 65.10 may be required to implement this recommendation. However, this recommendation by the Agricultural Floodplain Ordinance Task Force does not actually appear to violate the requirements of 44CFR 65.10 since FEMA defines a levee system as “a flood protection system that consists of a levee, or levees, and associated structures, such as closure and drainage devices, which are constructed and operated in accordance with sound engineering practices.”

In the case of Rio Oso, even if these changes are made, this option only appears feasible if:

(1) the recommended alternative is implemented;
(2) additional levee evaluations/improvements dictated by additional hydraulic studies are implemented; and
(3) the levee reaches required for identifying a Zone X (Shaded), are certified by an engineer and accredited by FEMA.

The community may choose to pursue levee certification after the recommended alternative is implemented, and because the levee design water surface elevation is greater than the FEMA base flood elevation (BFE), the levee may be robust enough so as to not require much additional construction or geotechnical work. For Rio Oso, more analysis needs to be done before pursuing this measure.

2.1.5 Agricultural Floodplain Ordinance Task Force – Insurance rates for non-accredited levees

The Task Force also recommended setting insurance rates for structures protected by non-accredited levees with respect to the level of risk. The non-accredited levees of Rio Oso provide substantial risk reduction but not enough for accreditation. Insurance rates for structures protected by non-accredited levees are currently set as if the levees do not exist. FEMA would need to develop a methodology for rating a levee's level of flood protection.

The Task Force report (HDR, 2016) provided a methodology for FEMA to consider. A civil engineer would need to certify the level of flood protection. Justification for higher levels of flood protection would require more data and analysis than justification for lower levels of flood protection. Land use requirements, such as elevation requirements for new structures, would not be affected.

2.1.6 NFIP premiums increases

FEMA recently made changes to the NFIP that apply to new businesses and renewals, effective April 1, 2019. These changes include premium increases, changes to primary residence determination, introduction of a Severe Repetitive Loss (SRL) Premium, and clear communication of these changes to policy holders. Premium increases comply with all the requirements of Biggert-Waters Flood Insurance Reform Act of 2012 and the Homeowners Flood Insurance Affordability Act (HFIAA) of 2014. Premiums will increase an average of 8.2%, the Federal Policy Fee or the HFIAA surcharge are not included (FEMA 2018). Including the HFIAA and Federal Policy Fee, the total amount billed will increase an average of 7.3% (FEMA 2018). No changes were made to the Deductible Factor, Federal Policy Fee, Reserve Fund Assessment, HFIAA Surcharge, or Probation Surcharge. ICC Fee will increase 3% for all policies except Preferred Risk and Newly Mapped rated policies (FEMA 2018).

FEMA is updating the Primary Residence Determination Guidance to allow a 2-4 family building to be a primary residence for the purpose of assessing the HFIAA Surcharge for policies effective on or after April 1, 2019. FEMA will introduce a SRL Premium of 5% for all policies covering properties with an SRL designation. FEMA is requiring that the Policy Declaration page display the following message; "Refer to www.fema.gov/cost-of-flood for more information about flood risk and policy rating." This page provides information regarding flood risk and policy rating to NFIP stakeholders.

2.1.7 Community Rating System

The NFIP Community Rating System (CRS) is a voluntary incentive program that recognizes and encourages community floodplain management activities that exceed the minimum NFIP requirements. The completion of the Local Hazard Mitigation Plan (LHMP) for Sutter County earns credits for the NFIP's CRS which provides for lower flood insurance premiums in CRS communities. The "benefit of mitigation planning is that it can help lessen the cost of flood insurance in Sutter County and the Cities of Live Oak and Yuba City" through NFIP CRS.

Flood insurance premium rates are discounted to reflect the reduced flood risk resulting from the community actions meeting the goals of the CRS program. The reduction in premium rates is provided according to a community's CRS classification. Sutter County joined the CRS in 2008 and is currently a CRS Class 6, with a 20 percent discount on flood insurance for those located within the SFHA and a 10 percent discount for those located in non-SFHA areas. More information on the NFIP CRS is located in the Sutter County LHMP.

Sutter County developed the LHMP update so that the County would be eligible for the FEMA Pre-Disaster Mitigation and Hazard Mitigation Grant Programs. More information on the Flood Mitigation Assistance Grant Program is located in section 1.6.3 of this attachment.

2.2 Levee Relief Cuts

A technical memorandum (TM) for evaluating potential flood risk for the communities of Rio Oso and Nicolaus analyzing the benefits of a potential levee relief cut in the RD 1001 basin was developed by MBK. Hydraulic analysis were performed as part of this feasibility study to evaluate the stage reduction benefits of the proposed relief cuts based on a breach on the Feather River levees at Highway 99. Based on the evaluation done by MBK, in the case of a breach on the Feather River levees at Highway 99, the relief cut is not a feasible flood contingency option for Rio Oso because the flood stage reduction is constrained by outflow as the inflow from the breach at Highway 99 exceeds outflow capacity at the site of the relief cut.

The proposed site of the relief cut is on the Feather River near Verona, as shown in Figure 5 of the *Small Communities Flood Risk Reduction Program – Hydraulic Analysis for the Communities of Rio Oso and Nicolaus TM*. The depth of the relief cut proposed is 10 feet because in the Highway 99 breach analysis the stage reached approximately 40 feet on the water side of the relief cut location and the top-of-levee elevation at this location is approximately 50 feet. Three potential relief cuts were explored in the hydraulic analysis with varying widths. The three different widths of the potential relief cuts are 100 feet, 500 feet, and 1,000 feet. The final crest elevation for all the relief cuts is 40 feet (NAVD 88). The approximate time available to construct the relief cut after breach occurs is 24 hours for all the potential relief cuts.

The breach parameters of a breach on the Feather River levees at Highway 99 are the following:

- The levee breach was assumed to occur once the water surface elevation (WSE) exceeds the Federal/State project levee design criteria of 45 feet (NAVD 88).
- The levee structure is assumed to completely wash out the levee towards the dry-side toe elevation of 33 feet (NAVD 88).
- The assumed width of the breach is 600 feet.
- Assumed formation time is 2 hours.

The results of the hydraulic analysis indicate the maximum flood stage reduction due to a relief cut is about 0.1 feet to 0.6 feet. While relief cuts in the lower portions of the RD 1001 basin are constrained by outflow, there are potential reductions in up to 2,779 acres that are inundated during a breach on the Feather River levees at Highway 99. As seen in Figure 5 of the *Small Communities Flood Risk Reduction Program – Hydraulic Analysis for the Communities of Rio Oso and Nicolaus TM (Appendix B)*, Rio Oso would experience the majority of the reduction in inundated land.

2.3 Emergency Flood Fight Plan

Sutter County developed a LHMP update to make the County and its residents less vulnerable to future hazard events. The purpose of hazard mitigation is to reduce or eliminate long-term risk to people and property from hazards. According to the Sutter County LHMP update in 2013, one of the mitigation actions for RD 1001 includes a flood emergency response project. This project includes developing a training video, coordinate SIMS/NIMS/ICS training, establish a flood safe location for the Yuba Sutter Coalition, and purchase emergency equipment and supplies. In 2018 Sutter County

received a grant from DWR to update the Emergency Operations Plan. The Sutter County Board of Supervisors approved a resolution to begin the update process in the summer of 2019. Sutter County is planning futures updates to Evacuation Annex, South Area Flood Plan, Sutter County Flood Annex, and a plan specific to Rio Oso.

2.4 Flood Emergency Evacuation Plan

2.4.1 Sutter County

The *Sutter County Emergency Operations Plan – Annex 9 Evacuation and Mass Care/Shelter* details the flood emergency evacuation plan throughout the County. The Emergency Operations Plan for Sutter County was most recently updated in January of 2015. In the event of an emergency this plan will be implemented by the County Administrative Officer, Sheriff, County Fire Chief, or Incident Commander as appropriate. Many factors need to be considered during evacuations such as magnitude of the hazard, intensity, and duration. These factors are essential for determining the scope and timeframe for evacuation needed to ensure the safety of all the residents.

According to the Sutter County evacuation plan, the Operational Area Emergency Operations Center (OA EOC) will monitor hazardous situations as they develop. The OA EOC will determine the area's most likely to be impacted and notify the Regional Emergency Operations Center (REOC). The OA EOC will monitor the progress of the evacuation and exchange information with the REOC. The State and OA EOC will coordinate the deployment of resources as needed, available evacuee shelter capacity, and address modifications to evacuation routes if necessary.

The OA EOC may issue two types of evacuations; advisory and mandatory evacuations.

Advisory Evacuation: When conditions exist which indicate a mandatory evacuation order may be given in the near future. An advisory evacuation indicates:

- No imminent threat to lives.
- The public is advised to prepare for the issue of a Mandatory Evacuation order.
- Residents are advised to leave the area.
- Businesses are advised to take whatever precautions they deem necessary for protecting equipment and/or inventory.
- Access to the area under an Advisory Evacuation is unrestricted.
- May also be issued when a Mandatory Evacuation order has been lifted in an area but the conditions in the area remain subject to rapid change and could again become serious.

Mandatory Evacuation: When conditions exist that seriously endanger the lives of those in a defined area. A mandatory evacuation indicates:

- The danger is imminent.
- All non-essential persons are ordered to immediately leave the area via the described evacuation routes.
- Once out of the area, people (including residents) will not be permitted to return until conditions permit.
- Any non-essential persons found by officials traveling through the area will be escorted out and not permitted to re-enter the area.

The anticipated primary evacuation mode will most likely be private vehicles. Evacuation movement efforts will be conducted by the law enforcement agencies involved. Evacuation instructions will be

part of the warning and public information releases. Two-way traffic will be maintained if possible on all evacuation routes to allow access for emergency vehicles. Public Works will provide traffic control devices such as signs and barricades.

The Emergency Operations Director/Incident Commander will make the re-entry order after the threat has passed and Fire, Law Enforcement, Public Works, and/or Building Division personnel have inspected the evacuated area.

2.5 Flood Evacuation Warning System

Flood evacuation warning system information is detailed in the *Sutter County Emergency Operations Plan – Annex 5 Floods and Dam Failure* and the *Sutter County Emergency Operations Plan – Annex 9 Evacuation and Mass Care/Shelter*. There are three types of flooding that may occur in the Sutter County Operational Area. The first type is localized flooding due to severe rainfall and flash flooding. The second is slow rise flooding due to rising river levels caused by continued and heavy precipitation. The last type is flooding caused by catastrophic dam failure.

The following information is provided as guidelines for the Emergency Operations Team to be used within the procedural structure of SEMS and ICS and not intended to be a substitute for the decisions of the Emergency Operations Director. The information presented here is based on information provided by Local, State, and Federal Agencies as well as experiences and lessons learned from previous events/emergencies.

2.5.1 Public Notification

Public notification recommendations are detailed in the *Sutter County Emergency Operations Plan – Annex 9 Evacuation and Mass Care/Shelter*. Persons to be evacuated should be given as much warning time as possible.

1. *Pre-evacuation Warning:* On slow-moving events, pre-evacuation notice should be given to affected residents if it appears that hazardous conditions may warrant such action. Residents should be advised that they might have to evacuate on thirty minutes notice or less.

2. *Evacuation Warning:* Warnings should be given on a direct basis as well as through the media. This includes the following:

- Use of law enforcement and fire emergency vehicles moving through the affected area with sirens.
- Door-to-door notification
- Cable channel 19 broadcast
- “Stream Level” link on the Sutter County home web page (www.suttercounty.org)
- Sutter County’s Facebook page
- Wireless Emergency Alerts (www.calalerts.org)
- Flood information broadcasted on radio stations KUBA (1600 AM & 100.7 FM), KMJE (101.5 FM), and KKCY (103.1 FM).

3. *Emergency Public Information:* The Public Information Officer (PIO) will ensure that evacuation information is issued to the media on a timely basis. This information includes evacuation routes, location of temporary reception centers, and updates as information becomes available.

2.5.2 Responsible Agencies and Duties

This section presents the various duties and responsible agencies during a flood event or emergency.

Operational Structure: The County of Sutter will activate the appropriate SEMS functions based upon the level of the flood event/emergency.

Coordination of Disciplines: Sutter County will use multi-agency, multi-discipline coordination in its response to a flooding disaster or emergency.

Inclusion of Non-Profit Agencies/Organizations: Non-profit organizations, such as the American Red Cross will be involved in flood response planning. Sutter County will contact the appropriate non-profit organizations in the event of a potential threat.

Public Information: The PIO will be activated when necessary during an emergency. The PIO will coordinate with media for news releases.

Safety and Security: During actual emergency operations, heightened safety and security procedures will be followed by county personnel. Security and safety procedures will also be implemented for all command posts and other operational sites. The Sheriff's Department will serve as lead for security functions.

Information Sharing and Dissemination: During an actual emergency or disaster the release of information raises significant issues regarding information sharing and dissemination. Notification of an event or an emergency and any subsequent updates will be made verbally through the most secure landline available. Written confirmations of notification and updates will also be used. It is recommended that sensitive information not be communicated by cell phone or radio. Sutter County will have scheduled briefings for EOC staff to coordinate briefing times, reporting approaches, and news releases.

Sheriff's Office: The Sheriff, or designee, will determine and establish SOPs required for the operation and deployment of law enforcement assets controlled by his Department and as authorized by Local, State, and Federal Statutes/Regulations. The Sheriff Office will be the lead for the following actions:

- perimeter security
- access control
- traffic/crowd control
- evacuations
- notifications
- coordinate coroner issues
- assist with damage assessment
- fatalities management

Fire Services: The County Fire Chief, or designee, will determine and establish SOPs required for the operation and deployment of OA Fire assets controlled by the Division and as authorized by Local, State, and Federal Statutes/Regulations. Fire Services will be the lead for fire response, hazardous materials events, and medical/rescue operations. Fire Services will also provide support

as necessary to the Sheriff's Office for evacuation activities. Fire Services will assist with the following actions:

- perimeter and access control
- evacuation operations
- notifications
- damage assessment
- fatalities management
- addressing environmental needs
- fire and rescue mutual aid
- support to hazardous materials operations
- coordination with EMS and hospitals
- personnel protection issues
- coordination with public works and utilities

Public Works: Public Works will serve as lead for damage assessment and will be the representative for utilities concerns. Potential Public Works activities include:

- reconnaissance of public infrastructure (roads, bridges, facilities, and utilities)
- alternate route identification
- building access
- utility access re-routing
- temporary repairs
- access and crowd control
- fatalities management

2.5.3 Slow Rise Flood Threat Summary of Emergency Activation Stages

River stages are intended to be guides for declaring the response stages, which are also influenced by weather forecasts, dam releases and levee conditions. Table 1 shows the various response stages based on the Feather River gage at Nicolaus, which would impact Rio Oso.

When the Feather River is measured, at Nicolaus to be 39.5 feet the Emergency Management Team will enter into the Planning and Preparation Phase, Stage 1. The Emergency Management Team will take all factors into consideration when deciding to implement the following actions. The following Stages are intended to be guidelines for the Emergency Management Team and not intended to be a substitute for the decisions of the Emergency Operations Director.

Table 1. Response stages based on the Feather River gage at Nicolaus (NIC).

Stage 1 Planning and Preparation Phase (< 42.6')*		**Stage 2 Ready for Action Phase (≥ 42.6')***		**Stage 3 Emergency Phase (> 46.4')***
39.5' and Forecast to Rise	40' and Forecast to Rise	42.6' and Forecast to Rise	44' and Forecast to Rise	46.4' and Forecast to Rise
Emergency Operations Manager notifies members of the Management Team. Identification of On-Call Duty Officer for Emergency Operations Level 1 activation of the EOC, at 1130 Civic Center Blvd. during working hours Emergency Operations staff closely monitors river forecasts and river levels Emergency Operations Manager notifies REOC of plan activation and status (Duty Officer and/or Level 1 Activation of the EOC)	Level 2 activation of the EOC, if deemed necessary, location determined by Emergency Operations Director Emergency Operations notifies REOC of plan activation and status (Duty Officer and/or Level 2 Activation of the EOC) Begin written log. Human Services Director initiates preliminary planning for mass care centers. Notification of key personnel involved in emergency organization. Management Team meets as soon as practical. Assess conditions for Advisory Evacuation and evacuation of medical facilities, rest homes, and other special needs populations. County Health Officer requests (U.S. Department of Health and Human Services) DHHS assistance with planning for persons with medical needs. Assess need to fully activate (Level 3) the EOC, and to request DWR and National Guard Liaison. Request Incident Management Team from California Office of Emergency Services (CalOES) if the developing situation is predicted to reach Stage 3. PIO begins to make regular press releases. Assess need for disaster declaration. Vital records identified and tagged. Essential vehicles moved to pre-designated staging areas. Non-emergency equipment and vehicles made ready for move out of danger area. All Levee Districts and Reclamation Districts contacted every 24 hours (or more often) for situation update. Consider evacuation of schools in threatened areas EOC facility in Sutter set up (not activated). Emergency personnel ensure safety of families and prepare to return to duty. Incident Action Plan developed. Alert Beale Air Force Base Command Post or Disaster Preparedness Office	Activate Level 3 EOC, and relocate personnel, if not done previously. County Administrative Officer (Emergency Operations Director), Emergency Operations Manager, and PIO coordinate notification of change of status to all agencies and emergency organizations. Incident Action Plan developed for each operational period. Management Team meets every 12 hours. Assessment of conditions for advisory or mandatory evacuation. Request Incident Management Team from CalOES if the developing situation is predicted to reach Stage 3.	Assessment of conditions for advisory or mandatory evacuation. If all local resources are anticipated to be exhausted, County Administrative Officer and/or Board of Supervisors Chair, in cooperation with the City Administrator and Mayor of Yuba City and/or Live Oak, may proclaim the existence of a disaster and request the Governor to declare the county a disaster area. Cal Fire Incident Management Team requested if not already done.	Management Team meets every 12 hours or more often as necessary. Assess need for mandatory evacuation. Request Sheriff to coordinate with Yuba City Police to secure evacuated areas from possible looting.

Notes: Refer to the Basic Emergency Operations Plan and Annex 2 for additional information regarding EOC operations, recovery and mitigation operations/procedures, and/or disaster assistance.

*Southeast County Basins – Feather River @ Nicolaus (NIC)

Information summarized from the Sutter County Emergency Operations Plan – Annex 5 Floods and Dam Failure.

2.5.4 Dam Failure Plan and Response

Another potential hazard in the Rio Oso area is a potential dam failure. The estimated flood arrival time for an Oroville Dam failure reported by DWR is 13.2 hours with a 34 hour total inundation time, a New Bullards Bar Dam failure reported by Yuba Water Agency would have a 2.5 hour arrival time with a 4 hour total inundation time, and a Camp Far West Dam failure reported by South Sutter Water District would have 2.17 hour arrival time with a 2.75 hour total inundation time. The *Sutter County Emergency Operations Plan – Annex 5 Floods and Dam Failure* includes detailed information if hazardous situation is developing at any of these locations and if the situations escalate and failure is imminent or has occurred.

2.6 Voluntary Structure Elevation & Floodproofing

2.6.1 2012 CVFPP

The 2012 CVFPP proposed elevation and floodproofing of structures in small communities that would not be protected through structural improvements such as improved levees and/or ring levees to achieve 100-year level flood protection.

According to the 2012 CVFPP, State investments in small community protection will be prioritized based on relative community flood threat levels, considering factors such as:

- Population
- Likelihood of flooding
- Proximity to flooding source
- Depth of flooding
- Financial feasibility
- Achievement of the CVFPP Goals with respect to integrating multiple benefits

In general, the State will consider the following nonstructural options for protecting small communities in the SPFC Planning Area from a 100-year flood:

- Raising/elevating structures
- Floodproofing
- Willing seller purchases
- Relocating structures

For planning purposes, DWR used a preliminary cost threshold of $100,000 per house protected for elevating or floodproofing a house. When estimated costs exceed the threshold, other nonstructural means for flood protection will be considered.

Based on planning level estimates:

- 15 small communities would receive 100-year flood protection from about 80 miles of levee improvements or new levee construction.
- Another five small communities would receive 100-year flood protection, at minimum, through implementation of urban and system improvements included in the State Systemwide Investment Approach (SSIA).
- Seven small communities would receive flood protection through floodplain management actions such as floodproofing or raising structures.

The Flood Risk Reduction Projects Program develops projects that support the CVFPP Goals. In addition to new projects and improvement of existing facilities, some existing flood protection facilities may be modified or removed if the facilities no longer support system performance. State investments in system improvements may be through grant programs or direct investments in improved or new facilities. System improvements may be implemented through a partnership program and cost-sharing among DWR, local agencies, the Board, and USACE. The implementation program for the Flood Risk Reduction Projects Program applicable to Rio Oso is the Small Community Flood Risk Reduction Program. This program aims to coordinate efforts to develop local flood damage reduction projects for small communities to assist them with achieving 100-year level flood protection through ring levees and improving existing levees. On top of feasible structural improvements, nonstructural improvements may be considered in flood risk reduction in small communities.

It is recommended that Rio Oso pursue these CVFPP programs in the future should funding ever become available.

2.6.2 2017 CVFPP

The 2017 CVFPP continued to target 100-yr flood protection to small communities. A near-term milestone was established to “seek resources to establish floodplain management programs to implement key activities such as expanded agricultural easements, environmental conservation, flood risk awareness campaigns, floodproofing, and similar activities that promote land uses compatible with periodic flooding” (DWR 2017). Near-term Milestones are brief statements of progress that might be achieved by the 2022 CVFPP update if sufficient resources are available.

Small communities are encouraged to consider a wide range of actions to reduce flood risk. Along with structural improvements, nonstructural alternatives, such as raising/elevating structures and floodproofing should be considered.

Currently, DWR has not developed a program for funding structure raising or floodproofing.

2.6.3 FEMA Programs

FEMA has grant programs to assist state, local, tribal, and territorial governments following emergency situations and provides preparedness grants to reduce risk for future hazards. Potential options for Rio Oso to pursue include the Pre-Disaster Mitigation (PDM) Grant Program, the Flood Mitigation Assistance (FMA) Program, and the Hazard Mitigation Grant Program.

The PDM Grant Program is designed to assist states in implementing a sustained pre-disaster natural hazard mitigation program. This grant programs aims to reduce overall risk to the population and structures from future hazard events, while reducing reliance of Federal funding in future disasters. PDM grants are funded annually by Congressional appropriations.

The purpose of the FMA program is to reduce or eliminate claims under the NFIP by providing funding for projects that reduce or eliminate long-term flood risk to structures insured under the NFIP. FEMA requires states and local governments develop and adopt hazard mitigation plans in order to receive certain non-emergency disaster assistance. Sutter County developed the Local Hazard Mitigation Plan (LHMP) update so that the County would be eligible for the FEMA Pre-Disaster Mitigation and Hazard Mitigation Grant Programs. With the Sutter County LHMP, the FMA Grant Program is a recommended avenue to pursue funding.

The purpose of the Hazard Mitigation Grant Program is to help communities implement hazard mitigation measures following a Presidential Major Disaster Declaration in the areas of the state requested by the Governor. This grant program aims to reduce the risk of loss of life and property from future disaster through mitigation measures and could become applicable to Rio Oso following a catastrophic flood.

2.6.4 Potential Floodproofing in Rio Oso

A GIS analysis was performed to assess structures that are potential candidates for floodproofing. The structure data was from the 2012 CVFPP structure inventory database from ParcelQuest. Structures may have changed in the years since the last update to the structure inventory but are applicable for this exercise. The data associated with these points includes structure category, ground elevation, and foundation height. The structure inventory data points were then compared to a composite of maximum water depths from a breaches on the Feather River levee at Highway 99 and Highway 70 from the *Small Communities Flood Risk Reduction Program – Hydraulic Analysis for the Communities of Rio Oso and Nicolaus TM*. The maximum flood depths for structures were then calculated while taking into account foundation height.

Table 2 below summarizes the maximum flood depths for Rio Oso. Table 3 summarizes the total numbers of structures in this analysis by category. Note that this information is based on the max flood depths of breaches on the Feather River levee at Highway 99 and at Highway 70, actual flood depths may vary based on the location of the levee breach. For a particular breach that might actually occur, the flood depth may be lower, increasing the number of structures exposed to only shallow flooding. The structures in this analysis are located in Rio Oso.

Table 2. Structure inventory and maximum flood depths for Rio Oso

	Max Flood Depths	
	< 3 feet	**> 3 feet**
Residential	47	8
Industrial	1	0
Commercial	0	1
Public	0	1
Total	**48**	**10**

Table 3. Total number of structures by category

Category	Number of Structures
Residential	55
Industrial	1
Commercial	1
Public	1
Total	**58**

Normally, dry floodproofing requires a structure-specific evaluation by a civil engineer specializing in hydraulic loading of structures. It may be advantages for the community to identify structures which meet the flood depth criteria for dry floodproofing. These structures should be tested to see if they meet structural criteria prior to dry floodproofing. Residential structures that experience flooding of less than three feet could potentially be considered for dry floodproofing and reduce their flood risk. Dry floodproofing is a more viable option for structures with slab foundations than with raised

foundations. Additionally, structures with more than three feet of flooding would benefit from structure elevation. Structure elevation is generally less costly for structures with raised foundations than structures on slab foundations.

2.6.5 Remodeling Benefits

Concerns were raised by local stakeholders that structure elevations and floodproofing may divert funds from levee improvements. If this is a concern, structure elevations may still be accomplished by interested residents. A secondary benefit of this option is that this may allow the interested resident to remodel their homes and while elevating the structure. This could potentially reduce flood risk without diverting funds for structure elevations. The County could assist residents in acquiring all the proper building permits to elevate their homes and obtain the flood risk reduction benefit.

2.6.6 Public Outreach

It could serve to benefit those in the community if they are made aware to their flood risk and make them aware of the possibility of elevating their residence assuming the proposed remodeling option were to become available to them. Structure elevations through remodeling would be on a volunteer basis. Additional more detailed analysis would need to be done to determine specific structures that fall within the criteria for dry floodproofing and structure elevation.

2.7 Agricultural Conservation Easements

2.7.1 2012 CVFPP

The 2012 CVFPP initially proposed DWR's interest in acquiring agricultural conservation easements to limit rural development in areas protected by the SPFC. The idea is to acquire easements that preclude development from farmers on a volunteer basis.

According to the 2012 CVFPP, the State supports "investing in "no-regrets" programs and actions that clearly enhance system resiliency, integrate programs and resources, and preserve flexibility for future generations." Acquisition of agricultural conservation easements falls into this plan.

The Flood Risk Reduction Projects Program System Improvements implementation program aims to provide resiliency during major flood events by lowering peak stages, diverting devastating flows from urban areas, creating open spaces, and ecosystem enhancements. Specific actions under this program include acquiring land and establishing easements. Participation and partnership in this program by USACE will be critical for implementing large-scale systemwide projects. The State and local project sponsors would be responsible for any lands, easements, rights-of-way, and relocations.

2.7.2 2017 CVFPP

The 2017 update of the CVFPP continues DWR's interest in acquiring agricultural conservation easements. A near term milestone was established to "seek resources to establish floodplain management programs to implement key activities such as expanded agricultural easements, environmental conservation, flood risk awareness campaigns, floodproofing, and similar activities that promote land uses compatible with periodic flooding."

2.7.3 Summary

Currently, DWR has not developed a program for acquiring agricultural easements. No model agreement has been developed and funding has not been acquired. If and when DWR acquires

funding and develops a program, the community of Rio Oso should carefully evaluate the pros and cons of the program as it would apply in the Rio Oso area. Although participation would likely be on a voluntary basis with only willing sellers, the community itself would have an interest in how the program is applied in the Rio Oso area. Considering that the Rio Oso area comprises only a small portion of the lands protected by the State Plan of Flood Control and it is currently mapped by FEMA as a SFHA, DWR's funding for agricultural conservation easements in the Rio Oso area may be very limited.

2.8 Nonstructural Measures Ranked

For this study, several nonstructural measures were considered and evaluated for future consideration by Rio Oso. The measures are presented in order of feasibility and potential benefit to Rio Oso:

- Flood Emergency Evacuation Plan
- Flood Evacuation Warning System
- Emergency Flood Fight Plan
- Levee Relief Cuts
- Voluntary Structure Elevation & Floodproofing
- Changes to National Flood Insurance Program (NFIP)
- Agricultural Conservation Easements

3 References

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