Appendix A: Historical Expenditures Support

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Appendix A: Historical Expenditures Support

Historical expenditures provide the baseline for comparing future expenditures. This appendix compiles the historical expenditures of State, federal, and local agencies that contribute to flood management in the Central Valley. The historical expenditure levels provide a baseline to evaluate the funding scenarios of the 2017 refined SSIA portfolio and give context to the future need for the Central Valley Flood Management Plan (CVFPP).

A.1 State Expenditures

State flood management expenditures in the Central Valley are primarily from the Division of Flood Management (DFM). The DFM's main revenue sources are the State General Fund and State General Obligation (GO) Bonds.

A.1.1 General Fund

To relate State General Fund expenditures on flood management to expenditures on other water resources management expenditures, Table A-1 shows the General Fund from the Governor's Budget for the California Department of Water Resources (DWR) and the Public Safety and Prevention of Damage program. The Public Safety and Prevention of Damage program area is one of a few budgeted program areas within the annual Governor's Budget assigned to DWR. The Public Safety and Prevention of Damage program area contains DFM as well as the Division of Dam Safety expenditures. This data informs Chapter 6 of the CVFPP investment strategy.

Table A-1. DWR State General Fund Expenditures by Year, Millions $[1]

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Average
DWR State General Fund Total	526.7	157.5	233.7	56.8	33.0	235.2	313.9	190.3	127.6	108.1	106.1	93.7	94.2	97.7	122.9	166.5
DWR Public Safety and Prevention of Damage[2]	150.8	56.3	178.1	38.6	16.8	150.3	238.3	120.6	111.7	92.7	92.1	80.9	82.2	82.5	84.1	105.1

Notes:

1. In 2015 dollars.
2. Governor's Budget detail: 3245-PUBLIC SAFETY AND PREVENTION OF DAMAGE. Legal Citations and Authority: Water Code Sections 6000-6470, 8350-8371, 8400-8415, 8590-8742, 12300-12318, 12570-12751, 12800-12875, 12878-12878.45, 12980-12995. 3245-PUBLIC SAFETY AND PREVENTION OF DAMAGE program area is one of a few budgeted program areas within the annual Governor's Budget assigned to DWR. Below is the program area description as stated in the Governor's Budget.

   This program supports the California Water Action Plan by protecting life and property from damage by floods, ensures proper construction and maintenance include assessing the State and regional investment needs to reduce risk, preventive floodplain management to discourage unwise use of areas subject to flooding, protection of floodplains, issuance of flood warnings, operation of flood control facilities, coordination and supervision of flood fight activities, and annual levee and flood channel maintenance and inspection in cooperation with other local, State, and federal partner agencies. This program also buys land, easements, and rights-of-way for federal flood control projects and supervises the design and construction of new dams and periodic inspection and reevaluation of all existing jurisdictional dams for proper operations and maintenance (O&M). Fiscal oversight and coordination activities associated with the Disaster Preparedness and Flood Prevention Bond Act of 2006 are administered under this program. The program also reviews federal dam projects in coordination with federal and other state agencies with regard to dam safety.

   Source: Governor's Budgets, 2001-2016

Table A-2 contains the DFM State General Fund expenditures for each of the flood management programs. The source data for this table contain both annual commitments and expenditures. Therefore, actual expenditures for any given year may differ from other data sources on State General Fund expenditures. This data informs Chapter 6 of the CVFPP investment strategy.

Table A-2. DFM State General Fund Expenditures by Year, Millions $[1]

Division of Flood Management Programs	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Average
Flood Emergency Response	6.48	11.90	13.89	13.16	13.34	17.03	15.14	14.62	14.65	16.18	13.64
Flood System Operations and Maintenance	10.98	19.07	22.07	18.92	19.20	15.60	13.69	13.15	14.03	13.58	16.03
Floodplain Risk Management	1.15	5.17	7.15	7.17	4.28	4.70	4.08	4.89	6.09	6.85	5.15
Flood Management Planning	3.42	10.73	11.24	4.09	0.17	0.75	0.62	0.61	1.28	1.18	3.41
Flood Risk Reduction Projects	0.69	5.01	9.39	0.89	0.00	0.02	4.40	0.00	0.00	0.03	2.04
Central Valley Total	**22.73**	**51.88**	**63.73**	**44.23**	**36.99**	**38.10**	**37.93**	**33.28**	**36.05**	**37.83**	**40.27**

Note:
1. In 2015 dollars.

Source: DWR, 2016

A.1.2 General Obligation Bonds

Table A-3 contains the DFM's State GO Bond expenditures for each flood management program. The source data for this table contain both annual commitments and expenditures. Therefore, actual expenditures for any given year may differ from other data sources on State GO Bond expenditures. This data informs Chapter 6 of the CVFPP investment strategy.

Table A-3. DFM GO Bond Expenditures by Year, Millions $[1]

Division of Flood Management Programs	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Average
Flood Emergency Response	0.00	0.26	13.24	7.47	11.09	10.62	9.92	16.38	15.83	11.96	9.68
Flood System Operations and Maintenance	0.00	0.00	1.47	0.18	0.50	0.60	3.30	3.80	5.18	8.83	2.39
Floodplain Risk Management	0.00	0.00	7.17	19.22	24.55	23.88	20.50	18.64	8.60	1.90	12.45
Flood Management Planning	0.00	10.75	41.01	31.73	42.40	39.45	37.56	51.22	49.97	32.08	33.62
Flood Risk Reduction Projects	49.95	22.14	127.58	169.64	195.88	160.77	81.71	133.22	164.91	107.71	121.35
Central Valley Total	**49.95**	**33.15**	**190.46**	**228.25**	**274.42**	**235.32**	**152.99**	**223.26**	**244.50**	**162.49**	**179.48**

Note:
1. In 2015 dollars.

Source: DWR, 2016

A.1.3 Combined General Fund and General Obligation Bonds Expenditures

Table A-4 contains the combined DFM State General Fund and State GO Bond expenditures for each flood management program. The source data for this table contain both annual commitments and expenditures. Therefore, the total expenditures for any given year may differ from other data sources on the same expenditures. This data informs Chapter 5 and 6 of the CVFPP investment strategy.

Table A-4. DFM Combined State General Fund and GO Bond Expenditures by Year, Millions $[1]

Division of Flood Management Programs	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Average
Flood Emergency Response	6.48	12.16	27.13	20.63	24.43	27.66	25.06	31.00	30.48	28.15	23.32
Flood System Operations and Maintenance	10.98	19.07	23.54	19.10	19.70	16.20	16.99	16.96	19.21	22.42	18.42
Floodplain Risk Management	1.15	5.17	14.31	26.39	28.83	28.58	24.57	23.53	14.69	8.75	17.60
Flood Management Planning	3.42	21.47	52.24	35.82	42.57	40.19	38.18	51.83	51.25	33.26	37.02
Flood Risk Reduction Projects	50.65	27.15	136.97	170.53	195.88	160.79	86.11	133.22	164.91	107.74	123.40
Central Valley Total	**72.68**	**85.02**	**254.20**	**272.48**	**311.41**	**273.42**	**190.92**	**256.53**	**280.55**	**200.31**	**219.75**

Note:
1. In 2015 dollars.

Source: DWR, 2016

A.1.4 Combined State and Local O&M SPFC Expenditures

Table A-4 contains the combined State and local O&M annual expenditures on State Plan of Flood Control (SPFC) facilities within the Central Valley. This data informs Chapter 5 and 6 of the CVFPP investment strategy.

Table A-5. Combined State and Local O&M SPFC Expenditures by Year, Millions $/year[1]

Year	Total Expenditures – Local Maintaining Agency (LMA)[4]	Total Expenditures – DWR [3] (Both Maintenance Yards)[5]	Total Annual O&M Expenditures
2008	$6.87	$10.21	$17.08
2009	$23.18	$9.66	$32.84
2010	$17.39	$9.21	$26.60
2011	$18.37	$9.73	$28.10
2012	$16.22	$9.53	$25.75
2013	$22.19	$9.13	$31.32
2014	$23.36	$12.17	$35.53
2015	$17.52	$11.71	$29.24
2016	$23.85	$11.50	$35.35
Average[2]	**$20.26**	**$10.00**	**$31.00**

Notes:
1. Nominal dollars due to inconsistent data reporting.
2. As official LMAs, DWR's Sacramento and Sutter maintenance yards were also required by Assembly Bill (AB) 156 to submit their expenses. 2008 was not included in the average due it being an incomplete reporting year.
3. Does not include administrative expenditures for DFM's Flood Maintenance Office or the Joint Operations Center in support of DWR's Maintenance Yards.
4. *Source: DWR, 2008-2016a*
5. *Source: DWR, 2008-2016b*

A.2 Federal Expenditures

The most significant federal contributions to Central Valley flood management are from the United States Army Corps of Engineers (USACE) and the Federal Emergency Management Agency (FEMA). Other federal agencies (e.g., U.S. Fish and Wildlife Service, U.S. Department of Agriculture, etc.) fund flood management activities, but are not evaluated in this appendix because their contributions are negligible.

A.2.1 United States Army Corps of Engineers

USACE is the primary source of federal funds for flood management investment in the Central Valley. USACE also supports investment of a wide range of water infrastructure projects, but in this appendix, only relevant flood management investments are presented. The source data for these tables are from USACE budgets. Therefore, the total expenditures for any given year may differ from actual expenditures in the respective year. The following three tables, Table-A-6, Table A-7, and Table A-8 present the same USACE budget information for the Central Valley in different ways. Table A-6 summarizes the annual budget for the three categories: Surveys, Feasibility, Preconstruction, Engineering and Design; Construction; and O&M for both SPFC and non-SPFC facilities in the Central Valley. Table A-7 summarizes the same budget information as in Table A-6, but isolates the budget of the Folsom Joint Federal Project. Table A-8 contains the individual flood control project budgets that contribute to the total

summaries in Table A-6 and Table A-7. The flood control projects listed in Table A-8 are not comprehensive of all USACE activities in the Central Valley. These projects are a subset that have had historical cost sharing with State or local agencies or are related to the SPFC. However, all of these tables include SPFC and non-SPFC facilities and is used as context for USACE expenditure capacity. This data informs Chapter 5 and 6 of the CVFPP investment strategy.

Table A-6. USACE Annual Budget for Flood Control in the Central Valley by Year, $[1,2]

Year	Surveys, Feasibility, Preconstruction Engineering and Design	Construction	O&M	Total Budget
2003	$3,327,000	$50,348,000	$12,359,000	$66,034,000
2004	$2,250,000	$16,200,000	$15,255,000	$33,705,000
2005	$1,720,000	$25,061,000	$11,471,000	$38,252,000
2006	$361,000	$36,812,000	$11,138,000	$48,311,000
2007	$339,000	$65,073,000	$8,132,038	$73,544,038
2008	$339,000	$66,528,000	$9,105,063	$75,972,063
2009	$807,000	$57,968,000	$6,901,515	$65,676,515
2010	$1,657,000	$94,455,000	$13,093,000	$109,205,000
2011	$1,657,000	$102,500,000	$12,904,000	$117,061,000
2012	$1,654,000	$64,548,000	$15,154,000	$81,356,000
2013	$2,053,000	$103,000,000	$15,991,000	$121,044,000
2014	$2,164,000	$76,850,000	$15,696,000	$94,710,000
2015	$2,325,000	$98,800,000	$15,373,000	$116,498,000
2016	$4,000,000	$88,026,000	$16,176,000	$108,202,000
Average	**$1,760,929**	**$67,583,500**	**$12,767,758**	**$82,112,187**

Note:
1. Expenditures not adjusted for inflation.
2. Expenditures include both SPFC and non-SPFC facilities. This budget is provided for context of USACE expenditure capacity in the Central Valley.

Source: USACE, 2002 - 2015

Table A-7 details the total USACE annual budget in the Central Valley with and without the Folsom Joint Federal Project. The Folsom Joint Federal Project is a large, one-time construction that, in certain years, increased the USACE annual budget in the Central Valley by more than double the historical levels. Chapter 6 of the CVFPP investment strategy used the annual USACE budget with and without the Folsom Joint Federal Project to demonstrate potential future revenue generating capacity.

Table A-7. USACE Total Budget for Flood Control Projects in the Central Valley by Year, $[1,2]

Year	Annual Budget Including the Folsom Joint Federal Project (JFP)	Folsom JFP Budget	Annual Budget Excluding the Folsom JFP
2003	$66,034,000		$66,034,000
2004	$33,705,000		$33,705,000
2005	$38,252,000		$38,252,000
2006	$48,311,000		$48,311,000
2007	$73,544,038		$73,544,038

Table A-7. USACE Total Budget for Flood Control Projects in the Central Valley by Year, $[1,2]

Year	Annual Budget Including the Folsom Joint Federal Project (JFP)	Folsom JFP Budget	Annual Budget Excluding the Folsom JFP
2008	$75,972,063		$75,972,063
2009	$65,676,515	$9,000,000	$56,676,515
2010	$108,355,000	$66,700,000	$41,655,000
2011	$116,211,000	$78,000,000	$38,211,000
2012	$81,356,000	$21,000,000	$60,356,000
2013	$121,294,000	$86,700,000	$34,594,000
2014	$96,210,000	$66,400,000	$29,810,000
2015	$116,148,000	$92,600,000	$23,548,000
2016	$108,202,000	$56,024,000	$52,178,000

Note:
1. Expenditures not adjusted for inflation.
2. Expenditures include both SPFC and non-SPFC facilities. This budget is provided for context of USACE expenditure capacity in the Central Valley.

Source: USACE, 2002-2015

Table A-8 details the individual USACE flood control projects relevant to the revenue generating capacity analysis in Chapter 6 of the CVFPP investment strategy. This list of flood control projects is not comprehensive of all USACE activities in the Central Valley. These projects are a subset that have had historical cost sharing with State or local agencies or are related to the SPFC.

Table A-8. USACE Budget for Individual Flood Control Project by Year, $[1,3]

Year	Surveys, Feasibility, Preconstruction Engineering and Design	Construction	O&M[2]	Sum of Total Expenditure
American River Watershed				
2003	$1,375,000	$27,180,000	$0	$28,555,000
2004	$50,000	$8,000,000	$0	$8,050,000
2005	$415,000	$11,175,000	$0	$11,590,000
2006	$0	$28,960,000	$0	$28,960,000
2007	$0	$46,800,000	$0	$46,800,000
2008	$0	$36,500,000	$0	$36,500,000
2009	$0	$13,000,000	$0	$13,000,000
2010	$0	$7,300,000	$0	$7,300,000
2011	$0	$4,700,000	$0	$4,700,000
2012	$0	$26,548,000	$0	$26,548,000
2013	$0	$11,500,000	$0	$11,500,000
2014	$0	$5,650,000	$0	$5,650,000

Table A-8. USACE Budget for Individual Flood Control Project by Year, $[1,3]

Year	Surveys, Feasibility, Preconstruction Engineering and Design	Construction	O&M[2]	Sum of Total Expenditure
2015	$675,000	$1,200,000	$0	$1,875,000
2016	$3,500,000	$18,641,000	$0	$22,141,000
American River Watershed (Folsom Dam JFP)				
2009	$0	$9,000,000	$0	$9,000,000
2010	$0	$66,700,000	$0	$66,700,000
2011	$0	$78,000,000	$0	$78,000,000
2012	$0	$21,000,000	$0	$21,000,000
2013	$0	$86,700,000	$0	$86,700,000
2014	$0	$66,400,000	$0	$66,400,000
2015	$0	$92,600,000	$0	$92,600,000
2016	$0	$56,024,000	$0	$56,024,000
Black Butte Lake				
2003	$0	$0	$2,034,000	$2,034,000
2004	$0	$0	$2,269,000	$2,269,000
2005	$0	$0	$1,882,000	$1,882,000
2006	$0	$0	$1,989,000	$1,989,000
2007	$0	$0	$1,452,202	$1,452,202
2008	$0	$0	$1,625,962	$1,625,962
2009	$0	$0	$1,232,458	$1,232,458
2010	$0	$0	$2,234,000	$2,234,000
2011	$0	$0	$2,367,000	$2,367,000
2012	$0	$0	$2,337,000	$2,337,000
2013	$0	$0	$2,259,000	$2,259,000
2014	$0	$0	$2,564,000	$2,564,000
2015	$0	$0	$2,233,000	$2,233,000
2016	$0	$0	$2,777,000	$2,777,000
Buchanan Dam, Eastman Lake				
2003	$0	$0	$1,796,000	$1,796,000
2004	$0	$0	$2,526,000	$2,526,000
2005	$0	$0	$1,958,000	$1,958,000
2006	$0	$0	$1,781,000	$1,781,000
2007	$0	$0	$1,300,337	$1,300,337
2008	$0	$0	$1,455,927	$1,455,927
2009	$0	$0	$1,103,573	$1,103,573
2010	$0	$0	$2,041,000	$2,041,000
2011	$0	$0	$2,119,000	$2,119,000
2012	$0	$0	$2,032,000	$2,032,000
2013	$0	$0	$1,919,000	$1,919,000

Table A-8. USACE Budget for Individual Flood Control Project by Year, $[1,3]

Year	Surveys, Feasibility, Preconstruction Engineering and Design	Construction	O&M[2]	Sum of Total Expenditure
2014	$0	$0	$2,052,000	$2,052,000
2015	$0	$0	$1,976,000	$1,976,000
2016	$0	$0	$2,001,000	$2,001,000
Farmington Dam				
2003	$0	$0	$308,000	$308,000
2004	$0	$0	$341,000	$341,000
2005	$0	$0	$526,000	$526,000
2006	$0	$0	$202,000	$202,000
2007	$0	$0	$147,484	$147,484
2008	$0	$0	$165,130	$165,130
2009	$0	$0	$125,167	$125,167
2010	$0	$0	$481,000	$481,000
2011	$0	$0	$0	$0
2012	$0	$0	$470,000	$470,000
2013	$0	$0	$450,000	$450,000
2014	$0	$0	$490,000	$490,000
2015	$0	$0	$558,000	$558,000
2016	$0	$0	$431,000	$431,000
Hidden Dam, Hensley Lake				
2003	$0	$0	$1,751,000	$1,751,000
2004	$0	$0	$2,621,000	$2,621,000
2005	$0	$0	$1,828,000	$1,828,000
2006	$0	$0	$2,090,000	$2,090,000
2007	$0	$0	$1,525,943	$1,525,943
2008	$0	$0	$1,708,528	$1,708,528
2009	$0	$0	$1,295,041	$1,295,041
2010	$0	$0	$2,170,000	$2,170,000
2011	$0	$0	$2,163,000	$2,163,000
2012	$0	$0	$2,272,000	$2,272,000
2013	$0	$0	$2,018,000	$2,018,000
2014	$0	$0	$2,067,000	$2,067,000
2015	$0	$0	$2,059,000	$2,059,000
2016	$0	$0	$2,180,000	$2,180,000
Marysville, Yuba City Levee Reconstruction				
2003	$0	$5,900,000	$0	$5,900,000
2004	$0	$500,000	$0	$500,000
2005	$0	$3,686,000	$0	$3,686,000

Table A-8. USACE Budget for Individual Flood Control Project by Year, $[1,3]

Year	Surveys, Feasibility, Preconstruction Engineering and Design	Construction	O&M[2]	Sum of Total Expenditure
Merced County Streams				
2003	$0	$500,000	$313,000	$813,000
2004	$0	$0	$280,000	$280,000
2005	$0	$0	$292,000	$292,000
2006	$0	$0	$251,000	$251,000
2007	$0	$0	$183,259	$183,259
2008	$0	$0	$205,187	$205,187
2009	$0	$0	$155,529	$155,529
2010	$0	$0	$451,000	$451,000
2011	$0	$0	$401,000	$401,000
2012	$0	$0	$399,000	$399,000
2013	$0	$0	$350,000	$350,000
2014	$0	$0	$400,000	$400,000
2015	$0	$0	$394,000	$394,000
2016	$0	$0	$387,000	$387,000
New Hogan Lake				
2003	$0	$0	$2,006,000	$2,006,000
2004	$0	$0	$2,789,000	$2,789,000
2005	$0	$0	$2,044,000	$2,044,000
2006	$0	$0	$1,994,000	$1,994,000
2007	$0	$0	$1,455,852	$1,455,852
2008	$0	$0	$1,630,050	$1,630,050
2009	$0	$0	$1,235,556	$1,235,556
2010	$0	$0	$2,515,000	$2,515,000
2011	$0	$0	$2,476,000	$2,476,000
2012	$0	$0	$2,456,000	$2,456,000
2013	$0	$0	$3,971,000	$3,971,000
2014	$0	$0	$2,593,000	$2,593,000
2015	$0	$0	$2,639,000	$2,639,000
2016	$0	$0	$2,993,000	$2,993,000
New Melones Lake				
2003	$0	$0	$1,651,000	$1,651,000
2004	$0	$0	$1,697,000	$1,697,000
2012	$0	$0	$1,897,000	$1,897,000
2013	$0	$0	$1,806,000	$1,806,000
2014	$0	$0	$1,937,000	$1,937,000
2015	$0	$0	$2,255,000	$2,255,000
2016	$0	$0	$1,998,000	$1,998,000

Table A-8. USACE Budget for Individual Flood Control Project by Year, $[1,3]

Year	Surveys, Feasibility, Preconstruction Engineering and Design	Construction	O&M[2]	Sum of Total Expenditure
Pine Flat Lake				
2003	$0	$0	$2,500,000	$2,500,000
2004	$0	$0	$2,732,000	$2,732,000
2005	$0	$0	$2,941,000	$2,941,000
2006	$0	$0	$2,831,000	$2,831,000
2007	$0	$0	$2,066,960	$2,066,960
2008	$0	$0	$2,314,278	$2,314,278
2009	$0	$0	$1,754,192	$1,754,192
2010	$0	$0	$3,201,000	$3,201,000
2011	$0	$0	$3,378,000	$3,378,000
2012	$0	$0	$3,291,000	$3,291,000
2013	$0	$0	$3,218,000	$3,218,000
2014	$0	$0	$3,593,000	$3,593,000
2015	$0	$0	$3,259,000	$3,259,000
2016	$0	$0	$3,409,000	$3,409,000
Sacramento and San Joaquin Basin Study (Central Valley Integrated Flood Management Study)				
2010	$850,000	$0	$0	$850,000
2011	$850,000	$0	$0	$850,000
2012	$300,000	$0	$0	$300,000
2013	$50,000	$0	$0	$50,000
2014	$466,000	$0	$0	$466,000
2015	$350,000	$0	$0	$350,000
2016	$0	$0	$0	$0
Sacramento River Bank Protection				
2003	$0	$6,916,000	$0	$6,916,000
2004	$0	$3,000,000	$0	$3,000,000
2005	$0	$3,400,000	$0	$3,400,000
2006	$0	$0	$0	$0
2007	$0	$10,960,000	$0	$10,960,000
2008	$0	$22,028,000	$0	$22,028,000
2009	$0	$23,968,000	$0	$23,968,000
2010	$0	$17,955,000	$0	$17,955,000
2011	$0	$15,000,000	$0	$15,000,000
2012	$0	$10,000,000	$0	$10,000,000
2013	$0	$3,000,000	$0	$3,000,000
2014	$500,000	$3,000,000	$0	$3,500,000
2015	$500,000	$1,000,000	$0	$1,500,000
2016	$500,000	$6,000,000	$0	$6,500,000

Table A-8. USACE Budget for Individual Flood Control Project by Year, $[1,3]

Year	Surveys, Feasibility, Preconstruction Engineering and Design	Construction	O&M[2]	Sum of Total Expenditure
Sac-San Joaquin Delta Islands and Levees				
2003	$100,000	$0	$0	$100,000
2004	$1,100,000	$0	$0	$1,100,000
2009	$468,000	$0	$0	$468,000
2010	$468,000	$0	$0	$468,000
2011	$468,000	$0	$0	$468,000
2012	$1,015,000	$0	$0	$1,015,000
2013	$1,015,000	$0	$0	$1,015,000
2014	$447,000	$0	$0	$447,000
San Joaquin River Basin				
2003	$600,000	$0	$0	$600,000
2004	$800,000	$0	$0	$800,000
2005	$530,000	$0	$0	$530,000
2014	$751,000	$0	$0	$751,000
South Sacramento County Streams				
2003	$0	$3,680,000	$0	$3,680,000
2004	$0	$2,100,000	$0	$2,100,000
2005	$0	$1,000,000	$0	$1,000,000
2006	$0	$2,852,000	$0	$2,852,000
2007	$0	$7,313,000	$0	$7,313,000
2008	$0	$8,000,000	$0	$8,000,000
2009	$0	$12,000,000	$0	$12,000,000
2010	$0	$2,500,000	$0	$2,500,000
2011	$0	$4,800,000	$0	$4,800,000
2012	$0	$5,000,000	$0	$5,000,000
Sutter County				
2003	$677,000	$0	$0	$677,000
2004	$200,000	$0	$0	$200,000
2005	$275,000	$0	$0	$275,000
2006	$361,000	$0	$0	$361,000
2007	$339,000	$0	$0	$339,000
2008	$339,000	$0	$0	$339,000
2009	$339,000	$0	$0	$339,000
2010	$339,000	$0	$0	$339,000
2011	$339,000	$0	$0	$339,000
2012	$339,000	$0	$0	$339,000
2013	$988,000	$0	$0	$988,000

Table A-8. USACE Budget for Individual Flood Control Project by Year, $[1,3]

Year	Surveys, Feasibility, Preconstruction Engineering and Design	Construction	O&M[2]	Sum of Total Expenditure
Yuba River Basin				
2003	$250,000	$0	$0	$250,000
2005	$100,000	$0	$0	$100,000
2012	$0	$2,000,000	$0	$2,000,000
2013	$0	$1,800,000	$0	$1,800,000
2014	$0	$1,800,000	$0	$1,800,000
2015	$0	$4,000,000	$0	$4,000,000
2016	$0	$7,361,000	$0	$7,361,000
Other				
2003	$325,000	$6,172,000	$0	$6,497,000
2004	$100,000	$2,600,000	$0	$2,700,000
2005	$400,000	$5,800,000	$0	$6,200,000
2006	$0	$5,000,000	$0	$5,000,000
2015	$800,000	$0	$0	$800,000

Notes:

1. Expenditures not adjusted for inflation.
2. The reported expenditures include O&M activities on USACE facilities or the USACE share of joint facilities. These expenditures do not contribute to the 2017 refined State Systemwide Investment Approach (SSIA) portfolio due to the original assurances provided to USACE by the State for O&M of the SPFC.
3. Expenditures include both SPFC and non-SPFC facilities. This budget is provided for context of USACE expenditure capacity in the Central Valley.

Source: USACE, 2002-2015

A.2.2 Federal Emergency Management Agency

FEMA provides local and state governments with funding for emergency preparedness programs, as well as emergency response funding following an emergency. Table A-9 details three grant programs that contribute to flood management in the Central Valley. The Flood Mitigation Assistance, Pre-Disaster Mitigation, and Hazard Mitigation Grants Programs provide funding to various agencies for projects and planning that reduce the risk of flood damage and life loss. This data informs Chapter 6 of the CVFPP investment strategy.

Table A-9. FEMA Hazard Mitigation Assistance Expenditures in the Central Valley by Year, Millions $[1]

FEMA HMA Programs	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Average
GF Expenses by Year																
Flood Mitigation Assistance	0.2	0.9	1.2	1.1	0.6	0.7	0.1	1.1	1.1	0.3	0.7	1.1	1.4	0.8	1.7	0.9
Pre-Disaster Mitigation	0.0	0.0	0.4	0.8	0.5	0.0	0.0	16.1	19.2	4.4	6.7	3.4	1.2	2.0	3.8	3.9
Hazard Mitigation Grants Program	151.5	173.8	120.9	48.9	0.1	0.0	0.0	36.1	15.0	33.9	14.0	15.9	11.2	0.8	10.2	42.2
Total	**151.7**	**174.7**	**122.6**	**50.8**	**1.2**	**0.7**	**0.1**	**53.3**	**35.2**	**38.6**	**21.4**	**20.4**	**13.8**	**3.6**	**15.7**	**46.9**

Note:
1. In 2015 dollars

Source: California State Auditor, 2002-2016

Table A-10 contains FEMA funding given to State and local agencies to update or develop new floodplain maps in California. This data informs Chapter 6 of the CVFPP investment strategy. Negative values in 2012 may reflect accounting adjustments from previous years, project closeout, or reallocation of funds from a different year.

Table A-10. Funds Given to California through FEMA Program by Year, Thousands $[1]

	2005	2006	2007	2008	2009	2010	2011	2012[2]	2013	2014	2015	Average
Cooperating Technical Partner (CTP)	230	67				352	152	-270	1,065	508	692	350
Map Modification	20	706	70	136	225	72	157	-2				173
Total	**250**	**773**	**70**	**136**	**225**	**424**	**309**	**-272**	**1,065**	**580**	**692**	**387**

Notes:
1. Nominal dollars due to inconsistent data reporting.
2. Negative values may reflect accounting adjustments from previous years, project closeout, or reallocation of funds from a different year.

Source: California State Auditor, 2006-2016

Table A-11 contains direct FEMA expenditures on updates or developments of new floodplain maps in the California. This data informs Chapter 5 and 6 of the CVFPP investment strategy.

Table A-11. FEMA Flood Hazard Mapping Expenditures in California, Thousands $[1]

Mapping Expenditure	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Map Modification – State Total	32,000					No data					
Risk Map – State Total	No data				13,500	16,000	No data				
Map Modification – Central Valley Flood Protection Plan (CVFPP) Counties[2]	6,150					No data					
Risk Map – CVFPP Counties	4,500					No data					

Notes:
1. Nominal dollars due to inconsistent data reporting.
2. FEMA provided an average of $2 million per year (total $10,650) between 2005 and 2009 for map modifications and risk mapping in CVFPP counties.

Source: FEMA, 2010

A.3 Local Expenditures

Cities, counties, and special districts are local agencies that can have flood management responsibilities in the Central Valley. Historical expenditure data were collected from the California State Controller's Office. The local expenditures presented have State and federal assistance removed to avoid double counting.

A.3.1 City Flood Management Expenditures

Cities with flood management responsibilities capture their flood expenditures primarily under Streets, Highways, and Storm Drain and Disaster Preparedness budgets. This data informs Chapters 5 and 6 of the CVFPP investment strategy.

Table A-12. Estimated City Expenditures on Flood Management, Central Valley Region, FYs 2003-2014

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Average
Streets, Highways, and Storm Drains ($ million)[1]													
Operating Expenditures	13	14	16	14	16	15	13	13	13	12	12	14	14
Capital Outlay	14	15	20	17	20	26	17	17	19	18	15	13	18
Total	27	29	36	31	36	41	30	30	32	30	27	27	31
Percentage of Total	99%	97%	100%	99%	100%	101%	98%	99%	100%	100%	99%	97%	99%
Disaster Preparedness ($ million)[1]													
Operating Expenditures	0.13	0.01	0.03	0.12	0.05	0.03	0.03	0.02	0.02	0.00	0.00	0.01	0.04
Capital Outlay	0.00	0.03	0.02	0.02	0.02	0.01	0.01	0.00	0.00	0.00	0.00	0.02	0.01
Total	0.13	0.04	0.05	0.14	0.07	0.04	0.04	0.02	0.02	0	0	0.03	0.05
Percentage of Total	0.48%	0.13%	0.14%	0.45%	0.19%	0.10%	0.13%	0.07%	0.06%	0.00%	0.00%	0.11%	0.15%
Grand Total	**27.31**	**29.9**	**35.95**	**31.4**	**36.14**	**40.74**	**30.62**	**30.22**	**32.04**	**29.99**	**27.22**	**27.71**	**31.60**

Note:
1. In 2015 dollars

Source: State Controller's Office (SCO), 2016a

A.3.2 County Flood Management Expenditures

Counties with flood management responsibilities capture their flood expenditures primarily under Flood Control, Soil, and Water Conservation budgets. This data informs Chapters 5 and 6 of the CVFPP investment strategy.

Table A-13. County Expenditures on Flood Management, Central Valley Region, FYs 2003-2014

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Average
Flood Control, Soil, and Water Conservation ($ million)[1]													
Operation Expenditures	2.0	2.3	2.1	1.3	1.4	2.8	2.7	2.6	2.6	2.7	2.6	0.9	2.2
Capital Outlay	0.3	0.4	0.4	0.2	0.2	0.5	0.5	0.5	0.5	0.5	0.5	0.2	0.4
Total	2.3	2.7	2.5	1.5	1.6	3.3	3.2	3.1	3.1	3.2	3.1	1.1	2.6

Note:
1. In 2015 dollars
Source: SCO (2016b)

A.3.3 Special District Flood Management Expenditures

Special districts are a form of local government created by a community to perform one or more specific activities. Special districts that report expenditures related to flood management activities include the following: Flood Control and Water Conservation Districts; Drainage and Drainage Maintenance Districts; and Land Reclamation and Levee Maintenance Districts. Many special districts receive State and federal assistance; this funding has been removed to avoid double counting. This data informs Chapter 6 of the CVFPP investment strategy.

Table A-14. Estimated Special District Expenditures on Flood Management, Central Valley Region, FYs 2003-2014

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Average
Flood Control and Water Conservation ($ million)[1,2]													
Ongoing	33.0	35.0	33.0	34.3	59.1	44.6	43.7	41.6	41.6	38.1	41.1	41.7	40.6
Debt Service	7.9	8.7	8.8	49.0	8.9	8.1	13.6	22.8	20.2	20.3	21.8	24.5	17.9
Fixed Assets	17.8	18.4	16.7	13.1	22.7	15.1	18.9	32.7	21.2	36.0	25.4	66.8	25.4
Other	11.2	16.7	7.3	9.3	3.6	53.0	3.7	106.4	99.0	102.1	69.1	45.5	43.9
Total	69.9	78.8	65.8	105.7	94.3	120.8	79.9	203.5	182.0	196.5	157.4	178.5	127.8
Drainage and Drainage Maintenance ($ million)[1,2]													
Ongoing	67.1	57.5	73.5	82.4	35.0	37.5	39.6	37.2	43.5	47.3	43.8	44.6	50.8
Debt Service	4.7	4.2	6.6	4.8	0.5	0.8	0.8	0.7	0.7	0.9	5.2	0.9	2.6
Fixed Assets	1.2	0.8	3.6	0.3	5.5	16.3	1.1	0.1	6.9	5.0	11.6	8.0	5.0
Other	26.9	39.7	35.4	53.6	13.9	17.7	17.1	17.2	10.1	7.7	4.0	3.5	20.6
Total	99.9	102.2	119.1	141.1	54.9	72.3	58.6	55.2	61.2	60.9	64.6	57.0	78.9
Land Reclamation and Levee Maintenance ($ million)[1,2]													
Ongoing	26.7	31.7	33.4	39.2	43.7	64.5	137.5	106.2	68.3	81.3	64.8	61.0	63.2
Debt Service	3.0	3.5	2.3	2.9	2.2	3.9	4.5	11.3	7.2	8.9	7.4	5.4	5.2
Fixed Assets	3.4	1.4	1.1	2.5	98.1	18.2	7.6	5.7	6.6	3.7	4.5	0.9	12.8
Other	4.0	2.9	0.2	0.2	0.4	2.0	0.1	0.1	0.1	1.2	9.2	1.9	1.9
Total	37.1	39.5	37.0	44.8	144.4	88.6	149.7	123.3	82.2	95.1	85.9	69.2	83.1
Grand Total	**206.9**	**220.5**	**221.9**	**291.6**	**293.6**	**281.7**	**288.2**	**382.0**	**325.4**	**352.5**	**307.9**	**304.7**	**289.74**

Note:
1. In 2015 dollars

Table A-14. Estimated Special District Expenditures on Flood Management, Central Valley Region, FYs 2003-2014

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Average

2. For reporting purposes, special districts are required to file financial transactions reports by activity. The activity designates a specific function or service provided by a special district. A special district may perform one or more activities (SCO, 2016c). The activity names are designated in the State Controller's Office Special District Report and may differ from the commonly used names of the special districts.

Source: SCO, 2016c

A.3.4 Special District Flood Management Revenues

Table A-15 reports annual special district revenues that accompany the annual expenditures reported in Table A-14. Differences in total revenues and expenditures are due to borrowing, grants, or other assistance programs. For this reason, revenues may be a better measure of revenue generating potential for special districts. This information informs Chapter 6 of the CVFPP investment strategy.

Table A-15. Estimated Special District Revenues for Flood Management, Central Valley Region, FYs 2003-2014, Millions $[1]

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Average
Total Revenues	205.4	221.3	215.2	223.8	200.5	184.6	220.9	174.8	185.7	195.7	182.7	180.6	199.3

Note:
1. In 2015 dollars

Source: SCO, 2016c

A.3.5 Combined Local Sources for Flood Management

Table A-16 summarizes average estimated city expenditures, average estimated county expenditures, and average estimated special district revenues for flood management as presented in Table A-12, Table A-13, and Table A-15, respectively. This data informs Chapter 6 of the CVFPP investment strategy, and are the average annual historical local expenditures in Chapter 7 scenarios of the CVFPP investment strategy.

Table A-16. Combined Local Sources for Flood Management, Central Valley Region, FYs 2003-2014, Millions $[1]

Local Source	Average
City Expenditures[2]	31.60
County Expenditures[3]	2.60
Special District Revenues[4]	199.30
Grand Total	**233.50**

Notes:
1. In 2015 dollars
2. Source: SCO, 2016a
3. Source: SCO, 2016b
4. Source: SCO, 2016c
5. The annual average local revenue capacity available assumed in Chapter 7 scenario development is approximately $215. This downward adjustment is from rounding and a $20 million annual expenditure on certain ongoing management actions such as routine maintenance.

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Appendix B: Management Action Support

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Appendix B: Management Action Support

Table B-1. Flood Management Actions and Types

Management Action Type	Management Action
Flood Infrastructure	Flood infrastructure varies significantly based on the type of flooding. Flood infrastructure can include the following:
	Levees and Floodwalls. Levees and floodwalls are designed to confine flood flows by containing waters of a stream or lake.
	Levee Setback. Setbacks improve channel conveyance, improve the level of safety, and minimize disruptions to vital riparian corridors.
	Channels. Channels convey flood waters to reduce the risk of slow-rise, flash, and debris-flow flooding.
	Bypasses. Bypasses redirect and convey flood waters to reduce the risk of slow-rise, flash, and debris-flow flooding.
	Retention and Detention Basins. Retention and detention basins are used to collect stormwater runoff and slowly release it at a controlled rate so that vulnerable areas are not flooded or eroded.
	Culverts and Pipes. Culverts and pipes are closed conduits used to drain stormwater runoff.
	Coastal Armoring Structures, Shoreline Stabilization, and Streambank Stabilization. Coastal armoring structures and shoreline stabilization reduce risk to low-lying coastal areas from flooding.
	Debris Mitigation Structures. Debris mitigation structures such as sabo dams, debris fences, and debris basins separate large debris material from debris flows, or they contain debris flows above a protected area when debris and alluvial flooding occur.
	Hydraulic Structures. Hydraulic structures include gates, weirs, and inlet/outlet structures.

Table B-1. Flood Management Actions and Types

Management Action Type	Management Action
Reservoir and Floodplain Storage and Operations	Reservoir and floodplain storage and operations include the following:
	Reservoir and Floodplain Storage. Reservoir and floodplain storage can regulate flood flows by reducing the magnitude of flood peaks occurring downstream.
	Storage Operations. Storage operations optimize the magnitude and timing of reservoir releases. This can reduce downstream flooding by optimizing the magnitude or timing of reservoir releases or through greater coordination of storage operations.
Operations, Maintenance, Repair, Rehabilitation, and Replacement	Consistent facility maintenance (and necessary repairs) is fundamental to proper system function. Many flood facilities were constructed in the early to mid-twentieth century and are near or have exceeded their expected service lives. Within the SPFC and other systems, some facilities were built much earlier and incorporated into the systems in an as-built condition. In both cases, the challenge of maintaining these facilities can be increased by what are considered design deficiencies by today's engineering standards and land use needs. Proper operation and maintenance (O&M) of functioning facilities can avoid the need for major repairs, new capital projects associated with deferred maintenance and keep costs low. Inadequate O&M (deferred maintenance) can result in very high repair, rehabilitation, or replacement costs (which can include mitigation for removing the vegetation that has been allowed to grow and is now considered habitat). Deferred maintenance also leads to increased financial and public safety risk exposure. Operation and maintenance, repair, replacement and rehabilitation (OMRR&R) actions include:
	Inspections and Assessment. Inspection of facilities is important to identify potential weaknesses in the system from encroachments and penetrations through levees as well as the condition of dams and other facilities. In addition, levee condition is routinely inspected by local agencies as well as California Department of Water Resources (DWR) and U.S. Army Corps of Engineers (USACE) on State or federal sponsored projects.
	Operation and Maintenance. Routine or periodic O&M includes activities that have to be performed at a minimum on an annual or semiannual basis. This includes management of vegetation (such as invasive species and channel snags), sediment removal, rodent and burrowing vector control to maintain levee integrity, minor erosion, levee crown repairs, and bank stabilization. O&M of pumping plants, gates and closure structures, weirs and overflow structures, as well as other flood control facilities are also included.
	Repair and Rehabilitation. As flood systems and infrastructure ages it requires repair and rehabilitation to continue to function. The age and condition of current systems and inadequate O&M funding over the last several decades has resulted in substantial facility repair and rehabilitation needs. Repair and rehabilitation of portions of levees, channels, and other infrastructure is required and is exacerbated by significant storm events. Some facilities were not designed or constructed to accommodate current conditions. Once facilities are rehabilitated to proper condition, consistent O&M supports avoidance of future major repairs, although minor repairs including erosion, patrol roads, pumps, upgrades to supervisory control and data acquisition (SCADA) and mechanical/electrical systems, and other facility wear and tear will always be required.
	Replacement. Some flood management structures and systems are aging and approaching the end of their designed useful life. If not rehabilitated or repaired, some structures may fail or become functionally obsolete. Replacement of such facilities (by either a functionally equivalent or upgraded structure) is necessary where repair or rehabilitation is not an option.

Table B-1. Flood Management Actions and Types

Management Action Type	Management Action
Watershed and Floodplain Management	Watershed and floodplain management generally refers to actions that consider human and ecological needs and work to balance risk and reward within the floodplain. Watershed and floodplain management actions can include:
	Floodplain Mapping. Floodplain mapping allows for more reliable risk assessment and mitigation. Risk assessments provide better results if done on a large scale to include all of the watershed or river basin.
	Building Codes and Floodproofing. Building codes and floodproofing include specific measures that reduce flood damage and preserve egress routes during high-water events.
	Flood Insurance. Flood insurance is provided by the federal government via the National Flood Insurance Program (NFIP) to communities that adopt and enforce an approved floodplain management ordinance to reduce future flood risk. Annual premiums are based on the level of risk. Premiums are high for frequently flooded communities and can increase over time depending on claims and frequency of flood events.
	Land Acquisitions and Easements. Land acquisitions and easements can be used to restore or preserve natural floodplain lands and to reduce the damages from flooding by preventing urban development.
	Retreat. Retreat is the permanent relocation, abandonment, or demolition of buildings and other structures.
	Flood Risk Awareness. Flood risk awareness can be raised through information and education efforts.
	Land Use Planning. Policies, ordinances, regulations, and practices can be used to limit development in flood-prone areas and encourage land uses compatible with existing water resources and floodplain functions. This can include policies and practices that restrict or prohibit development within floodplains, restrict size and placement of structures, prevent new development from incorporating adverse flood impacts to existing structures, encourage reduction of impervious areas, require floodproofing of buildings, encourage efficient use of water, protect sensitive ecosystems, and encourage long-term restoration of streams and floodplains.
	Studies and Analysis. Studies and analysis allow for more reliable risk assessment and a better understanding of the watershed or river basin.
	Performance Tracking and Technical Support. Performance tracking and technical support increase public agencies' capacity to monitor and synthesize information about the effectiveness of investments. Technical support includes monitoring, metric and tool development, resource capabilities, and scientific research.

Table B-1. Flood Management Actions and Types

Management Action Type	Management Action
Natural Floodplain and Ecosystem Functions	Natural floodplain and ecosystem functions can be a preferred alternative to restricting flood flows to an existing channel. Actions that support these include the following:
	Restoration of Riverine and Floodplain Habitats. Targeted habitats include shaded riverine aquatic (SRA) cover, riparian, marsh, and other wetland habitats, as well as wildlife-friendly floodplain agriculture; and specific actions include protecting and restoring quantity, quality, and connectivity of these habitats. Implementing these improvements along a river corridor may have a positive impact on the overall hydraulic function of a drainage system, and contribute to meeting permitting and mitigation requirements.
	Floodplain Reconnection. Ecosystem processes that sustain both riverine and riparian ecosystems occur during floodplain inundation events. Implementing this management action provides opportunities to reduce costly maintenance to flood infrastructure (e.g., repetitive erosion issues), leverage non-traditional funding sources, and provide species benefits that may contribute to meeting permitting and mitigation requirements, as well as a reduction in permitting burden through delisting of endangered species.
	Reduce Stressors. Stressors to natural floodplain and ecosystem functions include invasive species, revetment along channel banks, and barriers to fish passage.
	Invasive species eradication and maintenance addresses problems for both water management and ecosystems because those species can decrease channel capacity, increase the rate of sedimentation, and increase maintenance costs.
	Revetment can affect the hydraulics of river channels, constraining dynamic natural fluvial geomorphologic processes of erosion, deposition, and channel meander that contribute to healthy and sustainable ecosystems.
	Barriers to fish passage have caused delays to fish migration, and in some cases have made historical spawning and rearing habitats inaccessible.
Emergency Management	Emergency management includes the following:
	Emergency Preparedness. Emergency preparedness is the development of plans and procedures on how to respond to an emergency in advance of an event, including emergency response plans, evacuation procedures, and exercises to assess readiness.
	Emergency Response. Emergency response is the aggregate of all those actions taken by responsible parties at the time of an emergency, including early warning of events, response, and emergency sheltering.
	Recovery Programs and Actions. Recovery programs and actions include restoring utility services and public facilities, repairing damaged facilities, draining flooded areas, removing debris, and assisting individuals, businesses, and communities to protect lives and property.

Table B-1. Flood Management Actions and Types

Management Action Type	Management Action
Programmatic, or Project-Specific Permitting	Permitting includes the following:
	Project- or Program-Specific Permitting. Permitting on a project-by-project basis can increase administrative costs, permitting and mitigation costs, and construction costs as well as increase schedule delays.
	Regional and Programmatic Permitting. Regional and programmatic permitting methods can increase efficiency of delivery of flood or water management activities, including operations, maintenance, repair, habitat enhancement and restoration, and minor infrastructure improvement or construction projects. Regional and programmatic permitting methods can be used to collectively manage permitting needs for multiple projects, over longer planning horizons, while consolidating mitigation and conservation efforts into larger, more viable conservation areas. A regional approach can accelerate permitting of system projects and lower per-unit costs versus project-by-project mitigation. Regional and programmatic permitting methods include regional Habitat Conservation Plans, Natural Community Conservation Plans, programmatic (i.e., federal) Endangered Species Act Section 7 consultations, and regional general permits. The process may take 3 to 10 years.
Policy and Regulations	*Policy and Regulations.* These actions can clarify flood management roles and responsibilities for local, regional, State, and federal agencies to improve coordination across the large number of agencies and entities involved in flood management. Multiple jurisdictional and regional partnerships can facilitate emergency planning and emergency management activities, including permitting, financing, operation and maintenance, repair, and restoration. Policies and regulations can include investment in human and technological resources to encourage a river basin scale approach to water and flood management.
Finance and Revenue	*Finance and Revenue.* These strategies can increase the ability to fund water management projects. Aligning flood management projects with other existing or planned projects (such as roads or highways) leverages funding from different agencies and jurisdictions to help accomplish objectives. Consolidating projects on a regional or watershed level can also improve cost effectiveness and financial feasibility by pooling resources. The initial cost of collaborating on projects or programs can be significant to an agency. However, it can make building and maintaining water management systems affordable and sustainable. Also, identifying new or revising existing finance/revenue mechanisms can improve public agencies' ability to fund capital and O&M needs and provide avenues to work together within river-basin geographies.

Table B-2. Capital Management Action Types and Data Sources of the 2017 Refined State Systemwide Investment Approach (SSIA) Portfolio

Management Action Category and Area of Interest	Relevant Management Action Types and Management Actions	Data Source	Detailed Data Source
Systemwide			
Yolo Bypass multi-benefit improvements	▪ **Flood Infrastructure:** Levees and floodwalls, levee setback, channels, bypasses, culverts and pipes, hydraulic structures ▪ **OMRR&R:** Repair and rehabilitation, replacement ▪ **Natural Floodplain and Ecosystem Functions:** Restoration of riverine and floodplain habitats	Basin-Wide Feasibility Studies (BWFSs)	▪ **BWFSs:** Yolo Bypass State-preferred option from the Sacramento River BWFS July 2017. Multiple projects entries for levee improvements, levee setbacks, habitat enhancements etc.
Feather River–Sutter Bypass multi-benefit improvements	▪ **N/A** – Single line project entry for Feather River-Sutter Bypass multi-benefit improvements	BWFSs	▪ **BWFSs:** Feather River-Sutter Bypass multi-benefit improvements State-preferred option from the Sacramento River BWFS July 2017.
Paradise Cut multi-benefit improvements	▪ **Flood Infrastructure:** Bypasses ▪ **Watershed and Floodplain Management:** Land acquisitions and easements	BWFSs	▪ **BWFSs:** Paradise Cut State preferred Option M – Agricultural focused from the San Joaquin River BWFS March 2017. Land acquisition cost separate project entry.
Reservoir and floodplain storage	▪ **Flood Infrastructure:** Retention and detention basins ▪ **Reservoir and Floodplain Storage and Operations:** Reservoir and floodplain storage ▪ **Watershed and Floodplain Management:** Land acquisitions and easements ▪ **Natural Floodplain and Ecosystem Functions:** Floodplain reconnection	BWFSs and RFMPs	▪ **BWFSs:** Dos Rios/Hidden Valley Ranch Transitory Storage, Three Amigos Transitory Storage, Upstream Reservoir Enlargements, Western Madera and Merced County Subsidence Solution, Land Acquisitions for Dos Rios and Flowage Easements from San Joaquin River BWFS March 2017. ▪ **Regional Flood Management Plans (RFMPs):** Bullards Bar Outlet Modification, Upper San Joaquin River Upstream Reservoir Enlargements.
Urban			
Levee improvements	▪ **Flood Infrastructure:** Levees and floodwalls	USACE	▪ **USACE:** USACE-led improvements for urban areas: Natomas, Chico, Marysville, Yuba City, Sacramento, West Sacramento, American River Watershed, Stockton, and Merced.

Table B-2. Capital Management Action Types and Data Sources of the 2017 Refined State Systemwide Investment Approach (SSIA) Portfolio

Management Action Category and Area of Interest	Relevant Management Action Types and Management Actions	Data Source	Detailed Data Source
Other infrastructure and multi-benefit improvements	▪ **Flood Infrastructure:** Levee setback, channels, bypasses, retention and detention basins, culverts and pipes, hydraulic structures ▪ **Reservoir and Floodplain Storage and Operations**: Reservoir and floodplain storage ▪ **Watershed and Floodplain Management:** Land Acquisitions and easements ▪ **Natural Floodplain and Ecosystem Functions:** Restoration of riverine and floodplain habitats, floodplain reconnection	BWFSs and RFMPs	▪ **BWFSs:** Mormon Channel Bypass, RD 17 Multi-benefit improvements and RM 52 levee setback from San Joaquin River BWFS March 2017. ▪ **RFMPs:** Miscellaneous levee setbacks, bypasses, retention and detention basins, channel improvements, hydraulic structures, reservoir and floodplain storage. Deferred repair, rehabilitation, and replacement for levees, channels, major and minor structures.
Rural			
Levee repair and infrastructure improvements	▪ **Flood Infrastructure:** Levees and floodwalls, channels, retention and detention basins, culverts and pipes, hydraulic structures	BWFSs and RFMPs	▪ **BWFSs:** Raise Levees (Baseline, SJRRP Reach 4B1, Bypass Alternative) in Subsidence Area, Chowchilla Bypass Bifurcation Structure Rehabilitation from the Sacramento River BWFS July 2017. ▪ **RFMPs:** Miscellaneous levees, floodwalls, channels, culverts and pipes, hydraulic structures, retention and detention basins. Deferred repair, rehabilitation, and replacement.
Small-scale levee setbacks and floodplain storage	▪ **Flood Infrastructure:** Levees setbacks, bypasses ▪ **Reservoir and Floodplain Storage and Operations**: Reservoir and floodplain storage	BWFSs and RFMPs	▪ **BWFSs:** Levee setback RM 60-65 from the Sacramento River BWFS July 2017. ▪ **RFMPs:** Miscellaneous levee setbacks, bypass, reservoir and floodplain storage project entries.
Land acquisitions and easements	▪ **Watershed and Floodplain Management:** Land acquisitions and easements	RFMPs and floodplain management effort	▪ **RFMPs:** Miscellaneous agricultural easements or access easements. ▪ **Floodplain Management Effort:** Land acquisition buffer for densely populated areas.
Habitat restoration/reconnection	▪ **Natural Floodplain and Ecosystem Functions:** Restoration of riverine and floodplain habitats, floodplain reconnection	RFMPs	▪ **RFMPs:** Miscellaneous restoration of riverine and floodplain habitats and floodplain reconnection project entries.

Table B-2. Capital Management Action Types and Data Sources of the 2017 Refined State Systemwide Investment Approach (SSIA) Portfolio

Management Action Category and Area of Interest	Relevant Management Action Types and Management Actions	Data Source	Detailed Data Source
Small Community			
Levee repair and infrastructure improvements	▪ **Flood Infrastructure:** Levees and floodwalls, channels, retention and detention basins, culverts and pipes, hydraulic structures	BWFSs and RFMPs	▪ **BWFSs:** Rio Vista improvements and Firebaugh improvements Option C from the Sacramento River BWFS July 2017. ▪ **RFMPs:** Miscellaneous levees, floodwalls, channels, culverts and pipes, hydraulic structures, retention and detention basins. Deferred repair, rehabilitation, and replacement.
Levee setbacks, land acquisitions, and habitat restoration	▪ **Flood Infrastructure:** Levees setbacks, bypasses ▪ **Reservoir and Floodplain Storage and Operations:** Reservoir and floodplain storage ▪ **Natural Floodplain and Ecosystem Functions:** Restoration of riverine and floodplain habitats, floodplain reconnection ▪ **Watershed and Floodplain Management:** Land acquisitions and easements	RFMPs and floodplain management effort	▪ **RFMPs:** Miscellaneous levee setbacks, bypass, reservoir and floodplain storage project entries. ▪ **Floodplain Management Effort:** Land/property acquisitions.

Table B-3. Ongoing Management Action Types and Data Sources of the 2017 Refined SSIA Portfolio

Management Action Category and Area of Interest	Relevant Management Action Types and Management Actions	Data Source	Detailed Data Source
Systemwide			
State Operations, planning and performance tracking	▪ **Watershed and Floodplain Management:** Floodplain mapping, building codes and floodproofing, flood risk awareness, land use planning, studies and analysis, performance tracking and technical support ▪ **Programmatic, or Project-Specific Permitting:** Programmatic, or project-specific permitting, ▪ **Policy and Regulations:** Policy and regulation ▪ **Finance and Revenue:** Finance and revenue	RFMPs and State operations/planning effort	▪ **RFMPs:** Miscellaneous policy, management and regulations, finance and revenue project entries. ▪ **State operations/planning effort:** State operation in support of 30-year implementation, activities associated with State policy, planning and performance tracking.
Emergency management	▪ **Emergency Management:** Emergency preparedness, emergency response and recovery programs and actions	RFMPs and emergency management effort	▪ **RFMPs:** Miscellaneous emergency preparedness project entries. ▪ **Emergency management effort:** Local/operational and State flood emergency planning and preparedness.
Reservoir operations	▪ **Reservoir and Floodplain Storage and Operations:** Storage operations	BWFSs	▪ **BWFSs:** Increase objective release from New Don Pedro in the Tuolumne River Watershed from San Joaquin BWFS March 2017. Forecast-coordinated operations (F-CO) for Yuba and Feather Rivers, forecast-integrated operations (F-IO) for Oroville, coordinated reservoir operations for Lower San Joaquin local maintaining agencies (LMAs).
Routine maintenance	▪ **OMRR&R:** Inspections and assessment, operation and maintenance, repair and rehabilitation, replacement	OMRR&R Workgroup	▪ **OMRR&R Workgroup:** Routine maintenance of levees, channels, major and minor structures including rodent control, channel dredging, vegetation and invasive species management, and sediment management in bypass systems. Repair, rehabilitation, and replacement of levees, channels, major and minor structures including pipe penetrations and chronic giant reed removal.

Table B-3. Ongoing Management Action Types and Data Sources of the 2017 Refined SSIA Portfolio

Management Action Category and Area of Interest	Relevant Management Action Types and Management Actions	Data Source	Detailed Data Source
Urban			
Risk awareness, floodproofing and land use planning	▪ **Watershed and Floodplain Management:** Floodplain mapping, building codes and floodproofing, flood risk awareness, land use planning, performance tracking and technical support	RFMPs and floodplain management effort	▪ **RFMPs:** Miscellaneous floodplain mapping, building codes and floodproofing, flood risk awareness, land use planning, performance tracking and technical support project entries. ▪ **Floodplain management effort:** mapping, risk awareness and land use planning, elevating and floodproofing structures, nonstructural berms and interior drainage.
Studies and analysis	▪ **Watershed and Floodplain Management:** Studies and analysis	RFMPs and USACE	▪ **RFMPs:** Miscellaneous studies and analysis project entries for 200-year level of protection and local system performance.
Rural			
Risk awareness, floodproofing and land use planning	▪ **Watershed and Floodplain Management:** Floodplain mapping, building codes and floodproofing, flood risk awareness, land use planning, performance tracking and technical support	RFMPs and floodplain management effort	▪ **RFMPs:** Miscellaneous floodplain mapping, building codes and floodproofing, flood risk awareness, land use planning, performance tracking and technical support project entries. ▪ **Floodplain management effort:** mapping, risk awareness and land use planning, elevating and floodproofing structures, nonstructural berms and interior drainage.
Studies and analysis	▪ **Watershed and Floodplain Management:** Studies and analysis	RFMPs	▪ **RFMPs:** Miscellaneous studies and analysis project entries for 100-year level of protection and local system performance.
Small Community			
Risk awareness, floodproofing and land use planning	▪ **Watershed and Floodplain Management:** Floodplain mapping, building codes and floodproofing, flood risk awareness, land use planning, performance tracking and technical support	RFMPs and floodplain management effort	▪ **RFMPs:** Miscellaneous floodplain mapping, building codes and floodproofing, flood risk awareness, land use planning, performance tracking and technical support project entries. ▪ **Floodplain management effort:** mapping, risk awareness and land use planning, elevating and floodproofing structures, nonstructural berms and interior drainage.
Studies and analysis	▪ **Watershed and Floodplain Management:** Studies and analysis	RFMPs and Small Communities Program	▪ **RFMPs and Small Communities Program:** Miscellaneous studies and analysis project entries for 100-year level of protection and local system performance.

Table B-4. Sacramento Basin Management Actions Included within the 2017 Refined SSIA Portfolio

#	Lead Agency	Project Name	Project Description	Estimated Cost - Provided by Source	Adjusted Estimated Cost - Present Value ($)	Adjusted Estimated Cost - Annualized ($/year)	Investment Type	Area of Interest and Management Action Category	Management Action Type
1	Wheatland	100 year alternatives for Dry Creek Levee and Bear River	This is a feasibility study to evaluate 100 year alternatives for repairs on the southern portion of the Dry Creek Levee and Bear River in RD 817 protecting the city of Wheatland.This project constitutes Phase 2 of RD 2103's goal of providing up to 200 year protection. Phase 1 included the design and repair of 5 miles on the Bear River North Levee south of Wheatland and was partially funded by DWR.	$ 797,000	$ 797,000	$ 40,662	Ongoing	Small Community - Studies and analysis	Watershed and Floodplain Management
2	California Department of Water Resources	100-year/200-year WS Profiles for Sacramento River and Butte Basin	Develop 100-year/200year WS Profiles for Sacramento River and Butte Basin	$ 500,000	$ 500,000	$ 25,510	Ongoing	Rural - Studies and analysis	Watershed and Floodplain Management
3	Sutter Butte Flood Control Agency	Additional levee improvement projects to achieve 100-year flood protection for the southern portions of the basin	Despite the ongoing improvements to the Feather River west levee, the Southern Sub-basin, with a population of 3,000 and valuable agricultural infrastructure, will continue to be imperiled by the low level of flood protection provided by the remaining levees surrounding the basin. These levees, including the lower Feather River west levee, the Sutter Bypass east levee and Wadsworth Canal levees are estimated to currently provide 10-year level of flood protection. While pursuing the long term goal of 100-year flood protection for the southern sub-basin that achieves the dual goals of reducing flood risk and regulatory/financial burden in the FEMA floodplain, SBFCA will concurrently pursue a two-track approach. First, SBFCA will prioritize limited improvements of critically deficient levees that provide the greatest risk reduction at least cost. Second, SBFCA and its partners will seek appropriate FEMA regulatory relief for the agricultural floodplain.	$ 191,277,000	$ 191,277,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
4	Reclamation District 1001, Nicolaus	Address specific seepage, under seepage, erosion, and stability concerns for the Feather River levee	Address specific seepage, under seepage, erosion, and stability concerns for the Feather River levee, from the Natomas Cross Canal to the River Oaks Golf Course. This would include filling the land side scour hole created when this levee was breached near Verona to drain flood waters in December 1955. 50% of 8.2 miles of seepage berm; seepage berm 80' X 4' w/collection pipe levee from the Natomas Cross Canal to the River Oaks Golf Course (Levee Unit 4, Levee Miles 5.2 to 13.4) and repairs to the Natomas Cross Canal downstream of Highway 99.	$ 5,400,000	$ -	$ -	Capital	Small Community - Levee repair and infrastructure improvements	Operation and Maintenance
5	N/A	Advanced Regional Mitigation Banks	Advanced mitigation of flood management improvements provides a means of making flood maintenance less expensive and timelier.	$ 10,000,000	$ 10,000,000	$ 510,193	Ongoing	Systemwide - State operations, planning and performance tracking	Policy and Regulations
6	California Department of Water Resources	Agricultural Land Easements: Small Community 1/2 mile Buffer	Small Community 1/2 Mile Buffer for Agricultural Land Acquisition. Acquisitions include property for permanent and non-permanent crops within the 100-year floodplain only.	$ 183,270,000	$ 183,270,000	$ -	Capital	Rural - Land acquisitions and easements	Watershed and Floodplain Management
7	California Department of Water Resources	Agricultural Land Easements: Small Community 1/2 mile Buffer	Small Community 1/2 Mile Buffer for Agricultural Land Acquisition. Acquisitions include property for permanent and non-permanent crops within the 100-year floodplain only.	$ 69,320,000	$ 69,320,000	$ -	Capital	Rural - Land acquisitions and easements	Watershed and Floodplain Management
8	California Department of Water Resources	Agricultural Land Easements: Small Community 1/2 mile Buffer	Small Community 1/2 Mile Buffer for Agricultural Land Acquisition. Acquisitions include property for permanent and non-permanent crops within the 100-year floodplain only.	$ 79,450,000	$ 79,450,000	$ -	Capital	Rural - Land acquisitions and easements	Watershed and Floodplain Management
9	California Department of Water Resources	Agricultural Land Easements: Urban 2-mile Buffer	Urban 2 Mile Buffer for Agricultural Land Acquisition. Acquisitions include property for permanent and non-permanent crops within the 100-year floodplain only.	$ 147,250,000	$ 147,250,000	$ -	Capital	Rural - Land acquisitions and easements	Watershed and Floodplain Management
10	California Department of Water Resources	Agricultural Land Easements: Urban 2-mile Buffer	Urban 2 Mile Buffer for Agricultural Land Acquisition. Acquisitions include property for permanent and non-permanent crops within the 100-year floodplain only.	$ 49,050,000	$ 49,050,000	$ -	Capital	Rural - Land acquisitions and easements	Watershed and Floodplain Management
11	California Department of Water Resources	Agricultural Land Easements: Urban 2-mile Buffer	Urban 2 Mile Buffer for Agricultural Land Acquisition. Acquisitions include property for permanent and non-permanent crops within the 100-year floodplain only.	$ -	$ -	$ -	Capital	Rural - Land acquisitions and easements	Watershed and Floodplain Management
12	City of Rio Vista	Airport Drive Drainage Improvements	Inadequate drainage during heavy storms at Church and Airport Road intersection. City would like to increase size of culverts and realign drainage ditches. Similar project estimated costs: Seven Mile Slough French Drain $413,000, Georgiana Slough French Drain $2,067,000, Mokelumne River French Drain $258,000. Average of three projects: $912,667	$ 912,667	$ 912,667	$ -	Capital	Small Community - Levee repair and infrastructure improvements	Flood Infrastructure
13	Marysville Levee District	All-weather patrol road improvements	Project for improvements in the levee patrol road surface to assure all weather access during high water events.	$ 50,000	$ 50,000	$ 2,551	Ongoing	Systemwide - Emergency management	Emergency Management
14	Reclamation District 10, Honcut	All-weather patrol road improvements - RD 10	Project for ensuring the integrity of the all-weather patrol road on the levee crown.	$ 1,380,000	$ 1,380,000	$ 70,407	Ongoing	Systemwide - Emergency management	Emergency Management
15	Sacramento Area Flood Control Agency, United States Army Corp of Engineers	American River Levee Improvements	Anticipatory erosion control program to protect the improved levees from failure due to erosion induced by sustained high flows in the river channel. Completed by 2030.	$ 32,000,000	$ -	$ -	Capital	Urban - Levee improvements	Flood Infrastructure
16	Sacramento Area Flood Control Agency, United States Army Corp of Engineers	American River Levee Improvements (Erosion Control Component)		$ 350,000,000	$ -	$ -	Capital	Urban - Levee improvements	Flood Infrastructure
17	Reclamation District 2098, Cache Haas Area	Back Levee Erosion Repair Project - RD 2098	A portion of the levees comprising the western boundary of RD-2098 have a history of waterside levee slope and toe erosion primarily associated with the close proximity of a water supply canal. The reach from approximately LM 9.7 to 12.2 experiences minor but constant erosion from continuous water deliveries through the canal for a significant portion of every year. An erosion protection feature is required to ensure waterside levee toe stability and avoid recurring waterside slope and toe repairs. The water supply canal through this reach was constructed and operational prior to construction of the levee. Rock armoring needs to be applied all along the toe of the irrigation canal side of the back levee. Similar project estimated costs: rock slope protection lisbon $4,216,000, rock slope protection ryer $7,337,000, rock slope protection tyler $841,000. Average of three projects: $4,131,333.	$ 4,131,333	$ 4,131,333	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance

Table B-4. Sacramento Basin Management Actions Included within the 2017 Refined SSIA Portfolio

#	Lead Agency	Project Name	Project Description	Estimated Cost - Provided by Source	Adjusted Estimated Cost - Present Value ($)	Adjusted Estimated Cost - Annualized ($/year)	Investment Type	Area of Interest and Management Action Category	Management Action Type
18	Reclamation District 2068, Yolano	Back Levee Erosion Repair Project - Yolano	A portion of the levees comprising the western boundary of RD-2068 have a history of waterside levee slope and toe erosion primarily associated with the close proximity of a water supply canal. The reach from approximately LM 0.0 to 2.0 experiences minor but constant erosion from continuous water deliveries through the canal for a significant portion of every year. An erosion protection feature is required to ensure waterside levee toe stability and avoid recurring waterside slope and toe repairs. The water supply canal, through this reach, was constructed and operational prior to construction of the levee. Rock armoring needs to be applied all along the toe of the irrigation canal side of the back levee. Similar project estimated costs: rock slope protection lisbon $4,216,000, rock slope protection ryer $7,337,000, rock slope protection tyler $841,000. Average of three projects: $4,131,333.	$ 4,131,333	$ 4,131,333	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
19	Reclamation District 1001, Nicolaus	Bear River south bank, Pleasant Grove Road to high ground	Phased improvements to the RD1001 levee system, Segment 246, to achieve 100-year FEMA levee protection. Reference: Non-Urban Levee Evaluations Project Remedial Alternatives and Cost Estimates Report (NULE RACER).	$ 109,742,000	$ 109,742,000	$ -	Capital	Small Community - Levee repair and infrastructure improvements	Flood Infrastructure
20	Reclamation District 1001, Nicolaus	Bear River south bank, Yankee Slough to Pleasant Grove Road	Phased improvements to the RD1001 levee system, Segment 283, to achieve 100-year FEMA levee protection. Reference: Non-Urban Levee Evaluations Project Remedial Alternatives and Cost Estimates Report (NULE RACER).	$ 75,148,000	$ 75,148,000	$ -	Capital	Small Community - Levee repair and infrastructure improvements	Flood Infrastructure
21	Butte County, City of Chico	Big Chico Creek, Little Chico Creek, and Comanche Creek Flood Reduction Improvements	Evaluate flood carrying capacity of Big Chico Creek, Little Chico Creek, and Comanche Creek in light of increased flows due to urbanization of surrounding areas.	$ 100,000	$ 100,000	$ -	Capital	Urban - Levee improvements	Flood Infrastructure
22	California Department of Water Resources	Bryte Landfill Remediation	The old Bryte Landfill, now closed, lies adjacent to the existing north levee of the Sacramento Bypass near its junction with the Yolo Bypass east levee. The alignment of the new Yolo Bypass and Sacramento Bypass levees could potentially leave this landfill site within the floodway, which could result in dispersal of its toxic materials. Reasonable methods for preventing such dispersal could include full avoidance or excavating the contaminated material and hauling it to an appropriate licensed landfill site (depending upon the toxicity of contaminants), moving the material to create an elevated staging area in the northwest corner of the new junction of the two bypass levees (with appropriate contamination barriers, drainage, and monitoring), or combinations of these actions.	$ -	$ 5,000,000	$ -	Capital	Systemwide - Yolo Bypass multi-benefit improvements	Flood Infrastructure
23	California Department of Water Resources	Build Prospect Island Cross Levee	Prospect Island, currently flooded and under development as improved fisheries and wildlife habitat by DWR, could provide incremental flood storage and conveyance improvements in the lower Yolo Bypass by breaching about 30 % of the DWSC east levee (Figure 5-19). This would expand the lower Yolo Bypass active floodplain by 1,200 acres.	$ 7,000,000	$ 7,000,000	$ -	Capital	Systemwide - Yolo Bypass multi-benefit improvements	Flood Infrastructure
24	Yuba County Water Agency	Bullard's Bar Outlets Modification	Project to increase flood capacity by adding a second gated spillway tunnel to the outlet works at New Bullard's Bar Dam. The additional spillway which was analyzed in the operation consisted of three 15.5-foot wide by 26-foot high gated openings set at an invert elevation of 1,893 feet. The sill of the additional gates would be about nine feet lower than the invert of the existing gates, which would increase the reservoir release capacity by 20,000 CFS when the reservoir flood pool is not encroached.	$ 140,000,000	$ 140,000,000	$ -	Capital	Systemwide - Reservoir and floodplain storage	Reservoir and Floodplain Storage and Operation
25	Westervelt	Bullock Bend Mitigation Bank	Create a mitigation bank for salmonids	$ 10,000,000	$ 10,000,000	$ 510,193	Ongoing	Systemwide - State operations, planning and performance tracking	Policy and Regulations
26	California Department of Water Resources	Butte Basin Overflow Weir Maintenance	Improved maintenance by DWR is needed following flood events (cleaning debris, repairing washout damage, etc.) at Goose Lake and M&T weirs.	$ 100,000	$ -	$ -	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
27	N/A	Butte City 100-Year Level of Protection	Provide Butte City with a 100-Year level of protection	$ -	$ -	$ -	Ongoing	Small Community - Studies and analysis	Watershed and Floodplain Management
28	California Department of Water Resources	Butte Slough Outfall Gates Replacement	Replacement of the Butte Slough outfall gates to improve O&M and fish passage.	$ 5,000,000	$ 5,000,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
29	California Department of Water Resources	Cache Creek Erosion/Bank Protection Project	DWR Maintenance Yard Rehabilitation of 4 critical erosion sites on Cache Creek, LM 2.54 to 5.58, 2.8 to 2.84, 3.86 to 3.95 and 4.13 to 4.27, about 1,600 LF.	$ 1,814,000	$ 1,814,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
30	California Department of Water Resources	Cache Creek Settling Basin	Includes measures to extend the functional life of CCSB. CCSB is nearing the end of its current design life. Sediment within the basin has elevated levels of mercury and CCSB has been identified as a source of MeHg, with environmental implications for the Yolo Bypass and the Delta. DWR is developing alternatives that will extend the functional life of CCSB by at least 50 years while being responsive to the RWQCB, CVR directives of reducing Hg and MeHg TMDLs by 14 and 50 percent, respectively.	$ -	$ 51,000,000	$ -	Capital	Systemwide - Yolo Bypass multi-benefit improvements	Flood Infrastructure
31	California Department of Water Resources	Cache Creek Settling Basin General Reevaluation Report	State-Federal Feasibility Study projects that DWR could partner in.	$ 4,000,000	$ 4,000,000	$ 204,077	Ongoing	Urban - Studies and analysis	Watershed and Floodplain Management
32	Reclamation District 2060, Hastings Tract	Cache Slough Bank Protection Project – Hastings	Waterside Bank protection and Rehabilitation project 2420 LF along Cache Slough at a serious erosion site, LM 1.3 to 2.23. Enhanced lower waterside slope habitat area with possible Riparian Forest, Scrub-Shrub, and emergent/freshwater marsh to mitigate or enhance the habitat value.	$ 2,744,000	$ 2,744,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
33	Reclamation District 2098, Cache Haas Area	Cache Slough Freeboard Project	Freeboard deficiency due to subsidence. 100 LF crown repair along Cache Slough at LM 7.41	$ 29,000	$ 29,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
34	Reclamation District 2098, Cache Haas Area	Cache Slough Stability Project	Construct a 60 LF stability protection project along Cache Slough at LM 5.9.	$ 35,000	$ 35,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
35	Reclamation District 108	Canal 14A Habitat Corridor	Create a terrestrial habitat corridor linking the Sacramento River to the Colusa Basin.	$ 5,000,000	$ 5,000,000	$ -	Capital	Rural - Habitat restoration/reconnection	Natural Floodplain and Ecosystem Functions
36	California Department of Water Resources	Central Valley Integrated Flood Management Study (CVIFMS), Phase 2	State-Federal Feasibility Study projects that DWR could partner in.	$ 4,000,000	$ 4,000,000	$ 204,077	Ongoing	Urban - Studies and analysis	Watershed and Floodplain Management

Table B-4. Sacramento Basin Management Actions Included within the 2017 Refined SSIA Portfolio

#	Lead Agency	Project Name	Project Description	Estimated Cost - Provided by Source	Adjusted Estimated Cost - Present Value ($)	Adjusted Estimated Cost - Annualized ($/year)	Investment Type	Area of Interest and Management Action Category	Management Action Type
37	Butte County	Cherokee Canal Bridge Crossing Improvement	Bridge crossings pose flood conveyance problems due to capacity constraints and floating debris accumulation. From upstream to downstream, the main bridge crossings include: 1. Nelson Road Bridge 2. Nelson-Shippee Road Bridge 3. Richvale Road Bridge 4. UPRR Bridge 5. Highway 162 Bridge This Plan recommends that these road crossings be improved to eliminate flow constrictions and debris buildup during high water events, beginning with the UPRR railroad crossing and Richvale Highway Bridge.	$ -	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
38	California Department of Water Resources	Cherokee Canal Corridor Management	Phase 1 Sediment Removal within Cherokee Canal is proposed to rehabilitate the channel to its 25 year flood design capacity. The design flood carrying capacity is not being met from Cottonwood Creek to the Union Pacific RR crossing. Segment between the Richvale Hwy and the RR crossing can pass only approximately 2/3 of the 25 year design flow of 11,500 cfs without encroaching on the design freeboard. DWR is proposing to remove sediment and address erosion issues in 4 mile section of Cherokee canal. Approximately 750,000 cu yds. of sediment may be removed to store creek to 25 year capacity.	$ -	$ -	$ -	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
39	California Department of Water Resources	Cherokee Canal Improvements	Restore Cherokee Canal to authorized protection level.	$ 50,000,000	$ -	$ -	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
40	California Department of Water Resources	Cherokee Canal Levee Improvements - Right Bank near Richvale		$ -	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Flood Infrastructure
41	California Department of Water Resources	Cherokee Canal Relief Weir, Left bank upstream of Richvale	Construct an overflow relief weir along left bank levee to limit water stages within the canal during times of high flow and secure flood flowage easements on local agricultural areas which become inundated as a result. Preliminary review of existing studies indicates that overflows escaping outside of the channel would flow somewhat adjacent to the existing canal and eventually end up in the Butte Sink. This option could direct flood impacts away from existing infrastructure, however, it should only be implemented with the willing consent of impacted local landowners.	$ -	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Flood Infrastructure
42	California Department of Water Resources	Cherokee Canal Sedimentation Basin(s)	DWR has proposed to remove up to 750,000 cu yds. of sediment up to the Cottonwood Creek confluence, with an undetermined amount of sediment to be removed between Cottonwood Creek and State Highway 99, to restore channel capacity, to improve habitat conditions for a variety of species, including the giant garter snake, and to reduce ongoing channel maintenance needs. In addition to these actions, additional habitat restoration actions could be implemented downstream of the RID siphon, in reaches that have excess channel capacity where riparian vegetation could be planted without adversely affecting floodwater conveyance. Planting of riparian vegetation throughout Cherokee Canal would create a continuous corridor of riparian habitat from the foothills to the Butte Sink that would provide a valuable migration corridor for wildlife from the Central Valley to the foothills and Cascade/Sierra Nevada Mountains.	$ -	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Flood Infrastructure
43	Butte County, City of Chico	City of Chico 200-Year Level of Protection	Provide the City of Chico with a 200-Year level of protection	$ 100,000,000	$ -	$ -	Capital	Urban - Levee improvements	Flood Infrastructure
44	City of Colusa	City of Colusa 100-Year Level of Protection	Provide City of Colusa with a 100-Year level of protection	$ 50,000,000	$ 50,000,000	$ 2,550,963	Ongoing	Small Community - Studies and analysis	Watershed and Floodplain Management
45	N/A	City of Durham 100-Year Level of protection.	Evaluate feasibility of bringing the Butte Creek levees which protect Durham up to 100-yr FEMA standard.	$ -	$ -	$ -	Ongoing	Small Community - Studies and analysis	Watershed and Floodplain Management
46	N/A	City of Williams Flood Hazard Mitigation Project	Implement alternative methods of reducing flood damages to the City of Willows and surrounding agricultural lands while increasing ecological value within the South Fork Willow Creek, North Fork Willow Creek, and Wilson Creek Sub-basins in Glenn County.	$ 1,000,000	$ 1,000,000	$ 51,019	Ongoing	Systemwide - State operations, planning and performance tracking	Policy and Regulations
47	City of Woodland	City of Woodland Feasibility Study Alternatives Analysis	Feasibility Study for identifying alternatives for flood risk reduction relating to levee construction.	$ 500,000	$ 500,000	$ 25,510	Ongoing	Urban - Studies and analysis	Watershed and Floodplain Management
48	Clarksburg Local Maintaining Agency	Clarksburg Improvements Feasibility Study	The RFMP is pre-feasibility, and thus a feasibility study is a recommended course of action for the area. Potential solutions to be explored include non-structural structure raising ($10.4M), a ring levee ($34.7M), fix-in-place of existing perimeter levees ($529M), and FEMA Zone D designation ($N/A) or a combination of those solutions.	$ 500,000	$ 500,000	$ 25,510	Ongoing	Small Community - Studies and analysis	Watershed and Floodplain Management
49	Lake County Watershed Protection District	Clover Creek Diversion Modifications	Regrade Clover Diversion Channel and possibly Clover Creek to improve conveyance and potentially improve spawning habitat for the Clear Lake ditch. Remove Clover Diversion Structure as is non functional and potential weak point in levee system. Project will improve level of flood protection to Upper Lake and State Highway 20.	$ 10,000,000	$ 10,000,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
50	Yuba County Water Agency	Colgate Tailwater Suppression	Tailwater suppression to result from coupling of Outlets Modification and Forecast-Based Operations. The peak downstream flow for the Yuba River at Marysville would be reduced from about 240,000 CFS to 200,000 CFS with these improvements.	$ 4,900,000	$ 4,900,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Flood Infrastructure
51	Colusa County Resource Conservation District	Colusa Basin WMP	Action items of the Water Management Plan including: 1) Assess the status and functionality of flood control infrastructure (e.g., drainage canals, ditches, canal banks, levees) and identify areas of risk, work with other agencies, coordinate efforts, support maintenance of flood control infrastructure and levees, 2) Manage flood water for short term retention and groundwater recharge where appropriate and promote recharge infrastructure, 3) Develop and implement measures to control runoff in foothills and on agricultural lands. Utilize vegetation to increase infiltration and create "sponge effect" in foothills. Create natural floodplains and detention ponds where appropriate.	$ 1,000,000	$ 1,000,000	$ -	Capital	Rural - Small-scale levee setbacks and floodplain storage	Reservoir and Floodplain Storage and Operation
52	Colusa County Office of Emergency Services, Cities of Colusa and Williams	Colusa County Local Hazard Mitigation Plan (LHMP)	Implement County Local Hazard Mitigation Plan	$ 500,000	$ 500,000	$ 25,510	Ongoing	Systemwide - Emergency management	Emergency Management

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#	Lead Agency	Project Name	Project Description	Estimated Cost - Provided by Source	Adjusted Estimated Cost - Present Value ($)	Adjusted Estimated Cost - Annualized ($/year)	Investment Type	Area of Interest and Management Action Category	Management Action Type
53	N/A	Comprehensive Bypass Management Plan	Develop a Comprehensive Bypass Management Plan for Sutter Bypass, Tisdale Bypass, and Cherokee Canal.	$ 500,000	$ 500,000	$ 25,510	Ongoing	Systemwide - State operations, planning and performance tracking	Policy and Regulations
54		Confluence of Sutter Bypass and Sacramento River	Improvements could include excavating a floodplain bench along the channel margins and oxbow to accommodate planting with riparian species. Riparian forest should propagate naturally with increased flooding. Because it is a backwater area, changes in roughness would likely not affect flood stages. Additionally, the disconnected oxbow channel could be lowered to increase connectivity to mainstem river flows and reduce stranding risks.	$ 22,000,000	$ 22,000,000	$ -	Capital	Rural - Habitat restoration/reconnection	Natural Floodplain and Ecosystem Functions
55	Reclamation District 827, Elkhorn	Consolidation for Maintaining Agencies	The Sac-Yolo North levee system is currently maintained and operated by four separate agencies. Consolidation of LMAs could result in greater efficiencies and consistency in how the system is maintained and operated. Project cost estimate: $50,000 for study to develop consolidation plan.	$ 50,000	$ 50,000	$ 2,551	Ongoing	Rural - Studies and analysis	Watershed and Floodplain Management
56	Reclamation District 1001, Nicolaus	Coon Creek Group Interceptor Canal Levee, Natomas Cross Canal to high ground	Phased improvements to the RD1001 levee system, Segment 285, to achieve 100-year FEMA levee protection. Reference: Non-Urban Levee Evaluations Project Remedial Alternatives and Cost Estimates Report (NULE RACER).	$ 13,503,000	$ 13,503,000	$ -	Capital	Small Community - Levee repair and infrastructure improvements	Flood Infrastructure
57		Cordova Creek Naturalization Project	The objectives of the Naturalization Project are to create a functioning, living stream, to improve the creek habitat, and to create a place for people to gather, learn, and enjoy nature. The project includes replacing the existing Clifton's Drain with a naturalized channel that will restore natural function to the stream. The channel design includes installing a low flow channel with inset floodplain terraces of gently varying width on both the left and right sides. Habitat restoration would take place along the channel boundary and within the floodplain terraces. Preliminary 15% designs have been completed for this project. Project cost range: $1,500,000-$2,400,000.	$ 2,400,000	$ 2,400,000	$ -	Capital	Urban - Other infrastructure and multi-benefit improvements	Natural Floodplain and Ecosystem Functions
58	California Department of Water Resources	Corridor Management Plan - Nelson Weir	4 million CY of sediment removal Downstream of Nelson Weir (Corridor Management Plan)	$ 40,000,000	$ -	$ -	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
59	N/A	Corridor Management Strategy	The Corridor Management Strategy (CMS) approach is a concept for improving flood management and ecological conditions through developing a vision, strategy, and plan (CMP) for managing a corridor that integrates flood risk management, improved ecosystem function and integrated water management over a long-term (greater than 30 years) planning horizon.	$ 1,000,000	$ 1,000,000	$ 51,019	Ongoing	Systemwide - State operations, planning and performance tracking	Policy and Regulations
60	Courtland Local Maintaining Agency	Courtland Improvements Feasibility Study	The RFMP is pre-feasibility, and thus a feasibility study is a recommended course of action for the area. Potential solutions to be explored include non-structural structure raising ($14M), a ring levee ($14M), fix-in-place of existing perimeter levees ($179.5M), and FEMA Zone D designation ($N/A) or a combination of those solutions.	$ 500,000	$ 500,000	$ 25,510	Ongoing	Small Community - Studies and analysis	Watershed and Floodplain Management
61	California Department of Water Resources	Critical Levee Repairs - Replaced RFMP Estimates	Critical levee repair sites provided by the Flood System Repair Program (FSRP) for seepage, erosion, and stability. Estimate of $4M per site, 30 sites identified by FSRP.	$ 120,000,000	$ 120,000,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
62	California Department of Water Resources	Critical Levee Repairs - Replaced RFMP Estimates	Critical levee repair sites provided by the Flood System Repair Program (FSRP) for seepage, erosion, and stability. Estimate of $4M per site, 13 sites identified by FSRP.	$ 52,000,000	$ 52,000,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
63	California Department of Water Resources	Critical Levee Repairs - Replaced RFMP Estimates	Critical levee repair sites provided by the Flood System Repair Program (FSRP) for seepage, erosion, and stability. Estimate of $4M per site, 23 sites identified by FSRP.	$ 92,000,000	$ 92,000,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
64	Reclamation District 900, West Sacramento	Critical Levee Seepage Repair Site	The West Sacramento GRR identified a critical seepage site along the east levee of the Yolo Bypass in RD-900. This site was associated with an Annual Exceedance Probability (AEP) of 0.089 (1 in 11). It is approximately 3,600-feet long and would be repaired through the installation of a seepage cutoff wall. The repair is estimated to cost less than $5M and is eligible for Federal credit through the West Sacramento GRR.	$ 5,000,000	$ -	$ -	Capital	Urban - Levee improvements	Flood Infrastructure
65	Reclamation District 537, Lovdal	Critical Levee Seepage Repair Site	The West Sacramento GRR identified a critical seepage site along the east levee of the Yolo Bypass in RD-537. This site was associated with an Annual Exceedance Probability (AEP) of 0.089 (1 in 11). It is approximately 2,000-feet long and would be repaired through the installation of a seepage cutoff wall. The repair is estimated to cost less than $5M and is eligible for Federal credit through the West Sacramento GRR.	$ 5,000,000	$ -	$ -	Capital	Urban - Levee improvements	Flood Infrastructure
66		CVP/SWP Fish Passage BiOp-locally preferred plan	Develop a locally preferred plan consistent with the CMP for addressing habitat, flood management, water supply, recreation, and drainage infrastructure issues in the YB–CS Complex that includes locally–identified drainage and infrastructure projects within the Complex (e.g., the projects identified in the Yolo Bypass Drainage and Water Infrastructure Improvement Study, April 2014). Costs are TBD when the NMFS BiOp has identified a preferred alternative.	$ -	$ -	$ -	Ongoing	Systemwide - State operations, planning and performance tracking	Watershed and Floodplain Management
67	City of West Sacramento	Deep Water Ship Channel East Levee	Slope flattening, installation of cutoff wall and stabilization with revetment at each existing pump station location.	$ 6,141,000	$ -	$ -	Capital	Urban - Levee improvements	Flood Infrastructure
68	Reclamation District 999, Netherlands	Deep Water Ship Channel Stability Project – Netherlands	2,640 LF Stability site LM 0.5 to 1.0 along the Deep Water Ship Channel and 500 LF Stability site from LM 1.8 to 1.9.	$ 1,822,000	$ 1,822,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
69	City of West Sacramento	Deep Water Ship Channel West Levee	11 miles of revetment, levee raise, slope flattening.	$ 144,814,000	$ -	$ -	Capital	Urban - Levee improvements	Flood Infrastructure
70	California Department of Water Resources	Degrade Levees near Prospect Island	Prospect Island, currently flooded and under development as improved fisheries and wildlife habitat by DWR, could provide incremental flood storage and conveyance improvements in the lower Yolo Bypass by breaching about 30 % of the DWSC east levee (Figure 5-19). This would expand the lower Yolo Bypass active floodplain by 1,200 acres.	$ 10,000,000	$ 17,000,000	$ -	Capital	Systemwide - Yolo Bypass multi-benefit improvements	Flood Infrastructure
71	California Department of Water Resources	Degrade Lower Egbert	Degrade portions of the Lower Egbert Tract (RD 2084) levees. A portion of the northwestern levee and southeastern levee of Lower Egbert Tract (RD 2084) would be degraded to a crown elevation of approximately 7 feet (NAVD 88) and armored to facilitate more efficient overflow during flood events (Figure 5-18). The lower Yolo Bypass is constricted by high ground on the west at its lower end, so improving conveyance in this region area is critical to reducing localized increases in stage to the extent possible.	$ 6,000,000	$ 6,000,000	$ -	Capital	Systemwide - Yolo Bypass multi-benefit improvements	Flood Infrastructure
72	California Department of Water Resources	Degrade Step Levees	Degrading remaining step levee segments in the lower bypass.	$ 2,000,000	$ 2,000,000	$ -	Capital	Systemwide - Yolo Bypass multi-benefit improvements	Flood Infrastructure

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#	Lead Agency	Project Name	Project Description	Estimated Cost - Provided by Source	Adjusted Estimated Cost - Present Value ($)	Adjusted Estimated Cost - Annualized ($/year)	Investment Type	Area of Interest and Management Action Category	Management Action Type
73		Delta Smelt BiOp-locally preferred plan	Develop a locally preferred plan that addresses habitat, flood management, water supply, recreation, and drainage infrastructure issues in the YB–CS Complex and that includes locally–identified drainage and infrastructure projects within the Complex. Work with relevant state and federal agencies, and other organizations to meet fish habitat requirements in the Cache Slough Complex consistent with the CMP.	$ 600,000	$ 600,000	$ 30,612	Ongoing	Systemwide - State operations, planning and performance tracking	Watershed and Floodplain Management
74	Wheatland	Develop more accurate FEMA 100-year maps for the existing developed area around Dry Creek	Preliminary, Planning Level project. Detailed project description not available at this time.	$ 40,000	$ 40,000	$ 2,041	Ongoing	Small Community - Risk awareness, floodproofing and land use planning	Watershed and Floodplain Management
75	Brannan-Andrus Levee Maintenance District	Dredge Material Rehandling Site Habitat Bank Development	Develop tidal marsh, shrub upland, and tree upland habitat in a portion of a dredge disposal site for mitigation for current and future projects and allow for future habitat expansion.	$ 750,000	$ 750,000	$ -	Capital	Rural - Habitat restoration/reconnection	Natural Floodplain and Ecosystem Functions
76	Wheatland	Dry Creek develop new hydrology	Project will be evaluating what additional steps may need to be taken to ensure 100- and 200-year flood protection from Dry Creek flood flows.	$ 75,000	$ 75,000	$ 3,826	Ongoing	Small Community - Studies and analysis	Watershed and Floodplain Management
77		Dry Creek Floodplain Grazing Unit Restoration Projects	The project consists of several restoration concepts. These include: • Dry Creek: Install a cattle exclusion fence along Dry Creek and plant with riparian vegetation. Grade the channel at several locations to create more inset floodplain and promote riparian habitat. Enhance the riparian corridor of the secondary channel with native riparian planting. • Robla Creek: Enhance connectivity to Steelhead Creek at outlet to allow proper drainage. Remove non–native vegetation and plant native riparian species. • Enhance upland areas on Hansen and Coyle ranch by restoring native grasses (while avoiding vernal pools). • Remove berms and fill ditches throughout the properties.	$ 21,000,000	$ 21,000,000	$ -	Capital	Urban - Other infrastructure and multi-benefit improvements	Natural Floodplain and Ecosystem Functions
78	Wheatland	Dry Creek south levee and San Joaquin ditch (3.9 mi) improvements feasibility study	Project will be evaluating what additional steps may need to be taken to ensure 100- and 200-year flood protection from Dry Creek flood flows and includes feasibility study and environmental documents.	$ 760,000	$ 760,000	$ 38,775	Ongoing	Small Community - Studies and analysis	Watershed and Floodplain Management
79	Solano County Public Works	Eastern Solano Regional Drainage and Flood Improvement Projects	Develop and implement the City of Dixon's regional watershed drainage project improvements and drainage water reuse for both levee protected lands and other lands dependent on drainage discharges into the YB–CS Complex.	$ 3,500,000	$ 3,500,000	$ -	Capital	Urban - Other infrastructure and multi-benefit improvements	Operation and Maintenance
80	City of Rio Vista	Edgewater Drive Improvements	Construction of a permanent floodwall pump station to reduce flooding along Edgewater Drive. However, limited room and private property issues complicate matters. Similar project cost estimate: Pump Station #5 Modernization $3,000,000.	$ 3,000,000	$ 3,000,000	$ -	Capital	Small Community - Levee repair and infrastructure improvements	Flood Infrastructure
81	Tehama County Flood Control and Water Conservation District	Elder Creek Flood Management, Restoration, and Invasive Species Removal	Undertake flood management, restoration and invasive species removal actions.	$ 500,000	$ -	$ -	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
82	California Department of Water Resources	Elevating & Floodproofing Structures		$ 10,038,080	$ 16,520,000	$ 842,838	Ongoing	Small Community - Risk awareness, floodproofing and land use planning	Watershed and Floodplain Management
83	California Department of Water Resources	Elevating & Floodproofing Structures		$ 5,019,040	$ 8,260,000	$ 421,419	Ongoing	Small Community - Risk awareness, floodproofing and land use planning	Watershed and Floodplain Management
84	California Department of Water Resources	Elevating & Floodproofing Structures		$ 10,038,080	$ 16,520,000	$ 842,838	Ongoing	Small Community - Risk awareness, floodproofing and land use planning	Watershed and Floodplain Management
85	Reclamation District 150, Merritt Island	Elk Slough Bank Protection Project – Merritt Island	Waterside Bank Protection and Rehabilitation project at four areas of Elk Slough. Enhanced lower waterside slope habitat area with possible Riparian Forest, Scrub-Shrub, and emergent/freshwater marsh to mitigate or enhance the habitat value. Estimated 120,000 to 160,000 tons of rip rap quarry stone and 50,000 tons of imported fill will be used. 3 year completion time.	$ 4,960,000	$ 4,960,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
86	Reclamation District 999, Netherlands	Elk Slough Feasibility Study – Netherlands	Evaluate existing levee conditions and habitat types and evaluate alternatives for improvements and sustainability. Large habitat corridor with valuable Riparian Forest and Shaded Riverine Aquatic habitat. 4 year completion time.	$ 775,000	$ 775,000	$ 39,540	Ongoing	Rural - Studies and analysis	Watershed and Floodplain Management
87	Reclamation District 150, Merritt Island	Elk Sough Bank Feasibility Study – Merritt Island	Evaluate Elk Slough channel and adjacent levee features to define the geometry of the system, catalog all features, and assess possible alternatives that can sustain, enhance, and protect both the flood protection and ecosystem values. 3 year completion time.	$ 775,000	$ 775,000	$ 39,540	Ongoing	Rural - Studies and analysis	Watershed and Floodplain Management
88	Reclamation District 0070, Reclamation District 1660, Meridian, Reclamation District 1500	Emergency Response Flood Safety Plan	RD 70/RD 1660 Emergency Response Plan: Prepare Emergency Response Plan that contains contact information for every resident within the basin. Pre-design of a future Meridian emergency berm is needed (alignment agreements, interior drainage, top of berm elevations, etc.) Improve coordination with E.R. responders in order to allow District staff access to the levees during an emergency.	$ 100,000	$ 100,000	$ 5,102	Ongoing	Systemwide - Emergency management	Emergency Management
89	N/A	Emergency Response Planning	Prepare Emergency Response Plans & Improve coordination with Emergency Response responders.	$ 1,000,000	$ 1,000,000	$ 51,019	Ongoing	Systemwide - Emergency management	Emergency Management
90	N/A	Emergency Responses Training	Training for Emergency Response Responders	$ 1,000,000	$ 1,000,000	$ 51,019	Ongoing	Systemwide - Emergency management	Emergency Management
91	Reclamation District 3, Grand Island	Encroachment Modification Project – Grand Island	Encroachment modification just north of the Ryde Hotel where the main pumping plant connects to the drainage canal along Highway 220. Project will consist of Environmental documentation, permitting, design, mitigation, construction, and enhancement components and est. 200 tons of riprap quarry stone, 500 tons of gravel and 10,000 tons of fill.	$ 2,635,000	$ 2,635,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance

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#	Lead Agency	Project Name	Project Description	Estimated Cost - Provided by Source	Adjusted Estimated Cost - Present Value ($)	Adjusted Estimated Cost - Annualized ($/year)	Investment Type	Area of Interest and Management Action Category	Management Action Type
92	Reclamation District 2068, Yolano	Encroachment Removal and Enforcement	Monitoring and enforcement by CVFPB to remove or bring into compliance encroachments.	$ 100,000	$ 100,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
93	Sacramento Area Flood Control Agency, United States Army Corp of Engineers	Environmental Enhancements	SAFCA flood risk reduction program also includes congressionally authorized environmental enhancements along the American River Parkway and at Folsom Dam. These projects reflect SAFCA's statutory mandate to carry out the Agency's flood control responsibilities in a manner that provides optimum protection to the environment.	$ 45,000,000	$ -	$ -	Capital	Urban - Other infrastructure and multi-benefit improvements	Natural Floodplain and Ecosystem Functions
94	Reclamation District 10, Honcut	Erosion protection at identified sites vulnerable sites	Preliminary, Planning Level project. Detailed project description not available at this time.	$ 1,006,236	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
95	Reclamation District 3, Grand Island	Erosion/Bank Protection Project – Grand Island	Rehabilitation of three sites on Steamboat Slough and two sites on the Sacramento River. Approx. 1,500 LF of eroding levee on the waterside of Steamboat Slough at LM 0.18 to 0.25, 0.92 to 0.97 and 1.04 to 1.08 and approx. 600 LF on the Sacramento River at LM 11.3 to 11.4 and 16.8 to 16.9. Imported fill and quarry stone est. at 5-10 tons per LF for the four large scour locations and 1-2 tons per LF for the last site. All sites that have vegetation impacts and in-water work will have on-site mitigation considered as the primary mitigation component for the repair. Completion time of 2-years.	$ 1,550,000	$ 1,550,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
96	Reclamation District 3, Grand Island	Erosion/Bank Protection Project 2 – Grand Island	Bank protection project on the Sacramento River and Steamboat Slough based on the District Trustees and engineer's knowledge of how the levee has performed and the District's knowledge of existing conditions at the southern end of the District.	$ 1,498,000	$ 1,498,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
97	N/A	Establish Flood Structure Protection Area Zones	Creation of "Flood Structure Protection Areas" directly adjacent to levees and other flood control structures would provide LMAs an opportunity for input on land-use decisions occurring in the vicinity of their facilities. These areas would be identified in county and city floodplain management ordinances and/or general plans as zones in which input is required from LMAs before land-use decisions are finalized.	$ 1,000,000	$ 1,000,000	$ 51,019	Ongoing	Rural - Risk awareness, floodproofing and land use planning	Watershed and Floodplain Management
98	Yuba City	Expand Willow Island Recreation Area, Yuba City	Expand the 172 acre park in the Feather River floodway to remove overgrown vegetation, provide ecosystem restoration improvements including plantings and wat along the old river channelerways, and improve recreational amenities in the park. The project will improve flood flows by removing non-native and invasive vegetation and will improve maintenance by forming a financially self-supported and actively managed recreational area to reduce channel maintenance obligations to DWR.	$ -	$ 150,000	$ 7,653	Ongoing	Urban - Risk awareness, floodproofing and land use planning	Watershed and Floodplain Management
99	Three Rivers Levee Improvement Authority	Feather Restoration Site - Phase 1 Design & Construction		$ 5,360,000	$ 5,360,000	$ -	Capital	Rural - Habitat restoration/reconnection	Natural Floodplain and Ecosystem Functions
100	Three Rivers Levee Improvement Authority	Feather Restoration Site - Phase 2 Design & Construction		$ 18,200,000	$ 18,200,000	$ -	Capital	Rural - Habitat restoration/reconnection	Natural Floodplain and Ecosystem Functions
101	California Department of Water Resources	Feather River - Channel RR&R - Arrundo Removal	Sources included meetings with regional representatives and information from DWR. No LMAs reported costs. Giant reed removal estimated cost range is from $7,000/acre to $10,000/acre based on DWR input. Upper end of was range chosen for unit cost given other regions identified costs as high as $25,000/acre.	$ 3,332,075	$ 3,332,075	$ 170,000	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
102	California Department of Water Resources	Feather River - Channel Sediment Removal	Channel maintenance activities including sediment, vegetation, and debris removal are conducted by DWR with respect to the Sacramento River Flood Control Project and generally by LMAs in the San Joaquin Valley. Estimated costs for the Sacramento Basin were developed by using historical projects overseen by DWR, which have occurred as funding has been available, as well as input from regional experts. Estimated costs for the San Joaquin Basin were based on direct interviews with LMAs and staff.	$ 4,900,110	$ 4,900,110	$ 250,000	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
103	California Department of Water Resources	Feather River - Channel Vegetation and Debris Removal	Channel maintenance activities including sediment, vegetation, and debris removal are conducted by DWR with respect to the Sacramento River Flood Control Project and generally by LMAs in the San Joaquin Valley. Estimated costs for the Sacramento Basin were developed by using historical projects overseen by DWR, which have occurred as funding has been available, as well as input from regional experts. Estimated costs for the San Joaquin Basin were based on direct interviews with LMAs and staff.	$ 29,400,662	$ 29,400,662	$ 1,500,000	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
104	California Department of Water Resources	Feather River - Large Structure O&M	Major structures involve those facilities described in CWC Section 8361 and administered by DWR, and include weirs, bypass outflow control structures, outfall gate facilities, and large regional pumping plants.	$ -	$ -	$ -	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
105	California Department of Water Resources	Feather River - Large Structures RR&R	Based on discussions with DWR and LMA staff, major structures have historically been repaired and well maintained, and there is not an immediate need to repair, replace, or rehabilitate these facilities. As such, RR&R costs were not identified for this TM given major structures were assumed not to require significant repairs over the next 50 years. However, it is recommended that funding reserves be established to ensure adequate funding is available in the future to continue needed repairs or to replace aged facilities.	$ -	$ -	$ -	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
106	California Department of Water Resources	Feather River - Non-urban Levee O&M (Rural)	Levee O&M costs were separated between urban and rural LMAs to capture the additional costs associated with urban area LMAs. Levee O&M included the following activities: vegetation maintenance, rodent control, encroachment and pipe maintenance, minor repairs (erosion, levee crown repairs etc.)	$ 86,041,625	$ 86,041,625	$ 4,389,780	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
107	California Department of Water Resources	Feather River - Non-urban Levee RR&R (Rural)	Levee-related RR&R costs have generally been driven by necessary flood-event repairs and known erosion or levee stability issues. The OMRR&R Work Group determined the Delta Subventions Program data set is the most robust data set for estimating RR&R cost on SPFC levees because the existence of the funding program has encouraged more regular analysis and repair of levees. Although urban levees are being improved to a higher standard to meet urban level of protection standards, the OMRR&R Work Group determined that repair and rehabilitation costs for urban and non-urban levees would not differ substantially, and the cost for ULDC compliance would be the only significant differentiating factor for RR&R of urban SPFC levees.	$ 24,316,112	$ 24,316,112	$ 1,240,590	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
108	California Department of Water Resources	Feather River - Small Community Levee O&M	Levee O&M costs were separated between urban and rural LMAs to capture the additional costs associated with urban area LMAs. Levee O&M included the following activities: vegetation maintenance, rodent control, encroachment and pipe maintenance, minor repairs (erosion, levee crown repairs etc.)	$ 115,589,291	$ 115,589,291	$ 5,897,280	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance

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#	Lead Agency	Project Name	Project Description	Estimated Cost - Provided by Source	Adjusted Estimated Cost - Present Value ($)	Adjusted Estimated Cost - Annualized ($/year)	Investment Type	Area of Interest and Management Action Category	Management Action Type
109	California Department of Water Resources	Feather River - Small Community Levee RR&R	Levee-related RR&R costs have generally been driven by necessary flood-event repairs and known erosion or levee stability issues. The OMRR&R Work Group determined the Delta Subventions Program data set is the most robust data set for estimating RR&R cost on SPFC levees because the existence of the funding program has encouraged more regular analysis and repair of levees. Although urban levees are being improved to a higher standard to meet urban level of protection standards, the OMRR&R Work Group determined that repair and rehabilitation costs for urban and non-urban levees would not differ substantially, and the cost for ULDC compliance would be the only significant differentiating factor for RR&R of urban SPFC levees.	$ 34,172,782	$ 34,172,782	$ 1,743,470	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
110	California Department of Water Resources	Feather River - Small Structures O&M	Minor structures include stop log or gated closure structures, pumping plants, monitoring wells and piezometers, retaining walls and floodwalls, pipe penetrations, and encroachments. Routine O&M of these types of structures is critical, but often overlooked for budgeting purposes. As became evident in the LMA data received, LMAs typically only account for routine power costs for pumping plants and do not separately account for other activities associated with minor structures such as video inspections of pipes, lubrication and minor repairs of pipe closure valves, routine inspection and maintenance of closure structure gates or stop logs, and inspection and minor repairs of floodwalls. The OMRR&R Work Group determined that costs for minor-structure O&M are likely included in the general overhead expenses for the LMAs who have structures, and no further estimates were developed. However, it is anticipated that video inspections of pipes will be required in the future (once every 5 years) for pipes crossing SPFC levees and as such these projected costs were included in the overall estimates.	$ 1,348,510	$ 1,348,510	$ 68,800	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
111	California Department of Water Resources	Feather River - Small Structures RR&R	Small structures such as stop logs or gated closure structures, monitoring wells and piezometers, retaining walls and floodwalls, pipes, and encroachments are typically accounted for in levee RR&R costs, except for pipes. Many of these pipes were installed before or during original project construction prior to the 1950s, but no plans were implemented to assure these facilities could be replaced when they exceed their useful life. As a result, many pipes have reached their useful life with many of these structures in need of repair, replacement, or proper pipe abandonment.	$ 39,671,293	$ 39,671,293	$ 2,024,000	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
112	California Department of Water Resources	Feather River - Urban Levee O&M	Levee O&M costs were separated between urban and rural LMAs to capture the additional costs associated with urban area LMAs. Levee O&M included the following activities: vegetation maintenance, rodent control, encroachment and pipe maintenance, minor repairs (erosion, levee crown repairs etc.)	$ 61,309,005	$ 61,309,005	$ 3,127,940	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
113	California Department of Water Resources	Feather River - Urban Levee RR&R	Levee-related RR&R costs have generally been driven by necessary flood-event repairs and known erosion or levee stability issues. The OMRR&R Work Group determined the Delta Subventions Program data set is the most robust data set for estimating RR&R cost on SPFC levees because the existence of the funding program has encouraged more regular analysis and repair of levees. Although urban levees are being improved to a higher standard to meet urban level of protection standards, the OMRR&R Work Group determined that repair and rehabilitation costs for urban and non-urban levees would not differ substantially, and the cost for ULDC compliance would be the only significant differentiating factor for RR&R of urban SPFC levees.	$ 19,026,932	$ 19,026,932	$ 970,740	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
114	Reclamation District 1001, Nicolaus	Feather River east levee, Cross Canal to River Oaks Golf Course	Phased improvements to the RD1001 levee system, Segment 247, to achieve 100-year FEMA levee protection. Reference: Non-Urban Levee Evaluations Project Remedial Alternatives and Cost Estimates Report (NULE RACER).	$ 349,758,000	$ 349,758,000	$ -	Capital	Small Community - Levee repair and infrastructure improvements	Flood Infrastructure
115	Sutter Butte Flood Control Agency	Feather River West Levee Project (FRWLPI), Thermalito to Laurel Avenue	A nearly 41-mile levee improvement project from Thermalito Afterbay to approximately Laurel Avenue. The goals of the project are to reduce flood risk and remove more than 34,000 properties from FEMA Special Flood Hazard Areas. This includes increasing public safety by providing 200-year flood protection to Biggs, Gridley, Live Oak, and Yuba City, and providing 100-year flood protection for the less populated areas south of Yuba City	$ 290,000,000	$ -	$ -	Capital	Small Community - Levee repair and infrastructure improvements	Flood Infrastructure
116	California Department of Fish and Wildlife, Sutter Butte Flood Control Agency	Feather River Wildlife Area – Abbot Lake Unit	The Feather River Wildlife Area -Abbott Lake Unit is a 439-acre CDFW-managed property. The wildlife area is managed to provide riparian habitat for migratory birds and special-status species and public opportunities for wildlife-oriented recreation. A variety of ecosystem restoration actions have been planned for the Abbot Lake Unit (e.g., River Partners 2010). These actions include strategically lowering the banks of the Feather River and creating side channels within the Abbot Lake Unit that would become inundated during frequent high-flow events, providing spawning habitat and high-water refugia for anadromous fish. These side channels would also improve floodwater conveyance. Along with the side channels, strategic grading could create benches and shelves that would provide additional frequently inundated floodplain habitat. Aside from these grading and excavation activities, ecosystem restoration actions for the Abbot Lake Unit could include the expansion of Abbot Lake to create additional marsh habitats. Much of the Abbot Lake Unit away from Abbott Lake is characterized by open grassland habitat. The wildlife habitat values of this area could be further enhanced by planting trees and shrubs to create riparian and SRA habitat in locations where additional woody vegetation would not adversely affect flood water conveyance.	$ 944,480	$ 944,480	$ -	Capital	Rural - Habitat restoration/reconnection	Natural Floodplain and Ecosystem Functions
117	California Department of Fish and Wildlife	Feather River Wildlife Area – Nelson Slough Unit	Ecosystem restoration actions for the Nelson Slough Unit would primarily rely on the rehabilitation of the weir and lowering of the floodway to create a variety of flood surface elevations that would support a diversity of habitats, including riparian woodland and scrub, marsh, native grassland, and frequently inundated floodplain while also providing additional flood conveyance through the removal of accumulated sediment. Additionally, side channels could be excavated to provide spawning areas for anadromous fish and to limit fish stranding after flood events. Along with side channels, benches, and shelves could be graded from the floodplain to reconnect the flows or re-engineer the floodplain. Because the Nelson Slough Unit occurs at the junction of the Feather River with the Sutter Bypass, large volumes of sediment are deposited in the area during flood events. Thus, ongoing maintenance of the area would likely be required to maintain the ecosystem functions and services of any habitats that were created within the Nelson Slough Unit.	$ 10,000,000	$ 10,000,000	$ -	Capital	Rural - Habitat restoration/reconnection	Natural Floodplain and Ecosystem Functions
118	California Department of Water Resources	Feather River-Sutter Bypass Improvements	Study of the Feather River-Sutter Bypass future options.	$ 2,300,000,000	$ 2,300,000,000	$ -	Capital	Systemwide - Feather River-Sutter Bypass multi-benefit improvements	Flood Infrastructure

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#	Lead Agency	Project Name	Project Description	Estimated Cost - Provided by Source	Adjusted Estimated Cost - Present Value ($)	Adjusted Estimated Cost - Annualized ($/year)	Investment Type	Area of Interest and Management Action Category	Management Action Type
119		FEMA NFIP Relief for Rural Areas	Facilitate a working group to explore alternative approaches to regulating the floodplain in agricultural areas that provides relief to rural communities where a structural solution to reduce flood risk is not practical or affordable.	$ 50,000	$ 50,000	$ 2,551	Ongoing	Rural - Risk awareness, floodproofing and land use planning	Watershed and Floodplain Management
120	California Department of Water Resources, Three Rivers Levee Improvement	FESSRO/TRLIA Advance Mitigation Site Restoration		$ 4,400,000	$ 4,400,000	$ -	Capital	Rural - Habitat restoration/reconnection	Natural Floodplain and Ecosystem Functions
121	Reclamation District 554, Walnut Grove	Fill of Former Tyler Island Slough along Old Walnut Grove Road – Walnut Grove	Two crucial long term goals maintain levee height and improve stability. Proposed projects include fill of the former Tyler Island Slough along Old Walnut Grove Road.	$ 275,000	$ 275,000	$ -	Capital	Small Community - Levee repair and infrastructure improvements	Operation and Maintenance
122	Three Rivers Levee Improvement Authority	Flood Control O&M Consolidation Study		$ 200,000	$ 200,000	$ 10,204	Ongoing	Rural - Studies and analysis	Watershed and Floodplain Management
123	Tehama County Flood Control and Water Conservation District	Flood Detention Basin FS	A Feasibility Study for constructing flood detention basins on foothill streams.	$ 500,000	$ 500,000	$ 25,510	Ongoing	Rural - Studies and analysis	Watershed and Floodplain Management
124	California Department of Water Resources	Flood ER Planning - Local/Operational Area and State Level	Includes local flood information and flood risk mapping activities, local flood forecasting and dissemination, local stream gage network enhancement, flood evacuation maps, flood ER plans, and levee safety plans. Includes State flood information and flood risk mapping, state flood forecasting and dissemination, levee advanced warning systems, and Flood ER Information Mgmt Systems.	$ 64,800,000	$ 64,800,000	$ 3,306,048	Ongoing	Systemwide - Emergency management	Emergency Management
125	California Department of Water Resources	Flood ER Planning - Local/Operational Area and State Level	Includes local flood information and flood risk mapping activities, local flood forecasting and dissemination, local stream gage network enhancement, flood evacuation maps, flood ER plans, and levee safety plans. Includes State flood information and flood risk mapping, state flood forecasting and dissemination, levee advanced warning systems, and Flood ER Information Mgmt Systems.	$ 63,700,000	$ 63,700,000	$ 3,249,927	Ongoing	Systemwide - Emergency management	Emergency Management
126	California Department of Water Resources	Flood ER Planning - Local/Operational Area and State Level	Includes local flood information and flood risk mapping activities, local flood forecasting and dissemination, local stream gage network enhancement, flood evacuation maps, flood ER plans, and levee safety plans. Includes State flood information and flood risk mapping, state flood forecasting and dissemination, levee advanced warning systems, and Flood ER Information Mgmt Systems.	$ 63,700,000	$ 63,700,000	$ 3,249,927	Ongoing	Systemwide - Emergency management	Emergency Management
127	California Department of Water Resources	Flood ER Preparedness - Local/Operational Level and State Level	Includes flood alert and warning systems, er training and exercising, local flood er materials, equipment and facilities, and all weather roads on levee crowns. Includes ER Training and drills, tabletop and functional exercises, full-scale exercises, and flood fight methods training. Also includes State flood fight materials and storage facilities, and funding for the State Flood Ops Center.	$ 50,400,000	$ 50,400,000	$ 2,571,371	Ongoing	Systemwide - Emergency management	Emergency Management
128	California Department of Water Resources	Flood ER Preparedness - Local/Operational Level and State Level	Includes flood alert and warning systems, er training and exercising, local flood er materials, equipment and facilities, and all weather roads on levee crowns. Includes ER Training and drills, tabletop and functional exercises, full-scale exercises, and flood fight methods training. Also includes State flood fight materials and storage facilities, and funding for the State Flood Ops Center.	$ 52,000,000	$ 52,000,000	$ 2,653,001	Ongoing	Systemwide - Emergency management	Emergency Management
129	California Department of Water Resources	Flood ER Preparedness - Local/Operational Level and State Level	Includes flood alert and warning systems, er training and exercising, local flood er materials, equipment and facilities, and all weather roads on levee crowns. Includes ER Training and drills, tabletop and functional exercises, full-scale exercises, and flood fight methods training. Also includes State flood fight materials and storage facilities, and funding for the State Flood Ops Center.	$ 52,900,000	$ 52,900,000	$ 2,698,919	Ongoing	Systemwide - Emergency management	Emergency Management
130	Richvale Sanitation District	Flood Protection for Richvale WWTP	Develop and implement flood protection improvements for Richvale Sanitation District's wastewater treatment plant and associated 18-acre pond system.	$ 500,000	$ 500,000	$ 25,510	Ongoing	Small Community - Risk awareness, floodproofing and land use planning	Watershed and Floodplain Management
131	N/A	Floodplain Delineations	Develop more detailed 100-year/200-year/500-year floodplain delineations and base flood elevations for the region to aid with will floodplain management policy and decision making.	$ 500,000	$ 500,000	$ 25,510	Ongoing	Rural - Risk awareness, floodproofing and land use planning	Watershed and Floodplain Management
132	Reclamation District 1001, Nicolaus	Floodproofing the Main Drain Pumping Plant	The RD 1001 Main Drain Pumping Plant is an SPFC facility along the Natomas Cross Canal right bank. The levee and pumping plant are below the Design Water Surface Elevation and requires sandbagging to avoid overtopping. Project would make improvements to raise the doors and windows above the DWSE. The pumping plant is an SPFC facility installed when the NCC cutoff natural drainage to the Feather River.	$ 500,000	$ 500,000	$ 25,510	Ongoing	Rural - Risk awareness, floodproofing and land use planning	Watershed and Floodplain Management
133	Sacramento Area Flood Control Agency, United States Army Corp of Engineers	Folsom Dam Flood Control Manual Update Project	Congress has directed USACE to update the 1987 flood control manual so as to reflect the operation capacities created by Folsom Dam JFP and Folsom Dam Raise and to take advantage of the National Weather Service's improving ability to forecast extreme precipitation and runoff in the American River watershed. USACE is currently working with Reclamation, SAFCA, DWR and the CVFPB to prepare an updated flood control manual by the winter of 2017. http://www.spk.usace.army.mil/Missions/CivilWorks/FolsomDamAuxiliarySpillway.aspx.	$ 900,000,000	$ -	$ -	Ongoing	Systemwide - Reservoir operations	Reservoir and Floodplain Storage and Operation
134	Sacramento Area Flood Control Agency, United States Army Corp of Engineers	Folsom Dam Joint Federal Project	2007 Federally Authorized project consists of physical modifications to Folsom Dam and Reservoir that would improve efficiency and effectiveness of flood control operations and fed safety requirements. New Gated auX. spillway on a natural ridge east of the main dam. Includes concrete lined approach channel, discharge chute in the left abutment and enlargement of existing stilling basin, and installation of six submerged tainter gates. Initiated in 2010 and expected to be completed in spring of 2017.	$ 161,000,000	$ -	$ -	Capital	Systemwide - Reservoir and floodplain storage	Reservoir and Floodplain Storage and Operation
135	Sacramento Area Flood Control Agency, United States Army Corp of Engineers	Folsom Dam Raise	2007 Federally Authorized project, consists of raising Folsom Dam's earthen dikes and wing dams by 3.5 FT so as to equal the height of the Folsom's main dam and modifying the dam's five main spillway gates and three emergency spillway gates so as to allow dam operators to add approx. 40,000 acre-feet of additional surcharge storage. This is expected to being by USACE in 2018 and completed by 2022.	$ 150,000,000	$ -	$ -	Capital	Systemwide - Reservoir and floodplain storage	Reservoir and Floodplain Storage and Operation

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136	Colusa County Resource Conservation District	Foothill Stream Restoration and Recharge Enhancement	Ten acre foothill stream corridor restoration project that will achieve multiple resource objectives including: Remove and/or control invasive vegetation; Reestablish riparian vegetation and improve connectivity; Reduce existing and potential bank erosion; Reestablish flood plain(s) to facilitate groundwater recharge, retain floodwater and provide habitat; Utilize the project as a demonstration site to facilitate education and outreach through workshops and field days, and studies to evaluate project effectiveness.	$ 1,000,000	$ 1,000,000	$ -	Capital	Rural - Habitat restoration/reconnection	Natural Floodplain and Ecosystem Functions
137	California Department of Water Resources, Yuba County Water Agency	Forecast-Based Operations (F-BO)	Project includes the concept of F-BO, as applied to operation of Oroville Dam and Reservoir, with a 200-year flood and an assumed forecast lead time of 72 hours. Previous studies suggest that F-BO can provide modest, but significant reductions in downstream peak flood flows.	$ 20,000,000	$ 20,000,000	$ 1,020,385	Ongoing	Systemwide - Reservoir operations	Reservoir and Floodplain Storage and Operation
138	California Department of Water Resources, Yuba County Water Agency	Forecast-Coordinated Operations for Yuba and Feather Rivers (F-CO)	F-CO has been an ongoing effort, intensified since 2005, to jointly operate Oroville and New Bullard's Bar reservoirs to meet downstream flow objectives and minimize the risk of flooding. Continuing improvements in flood modeling tools, risk evaluation tools, real-time information, and flood forecasts would be implemented under F-CO.	$ 2,000,000	$ 2,000,000	$ 102,039	Ongoing	Systemwide - Reservoir operations	Reservoir and Floodplain Storage and Operation
139	California Department of Water Resources	Fremont Weir Expansion	1.0 mile expansion of the Fremont Weir	$ 120,000,000	$ 120,000,000	$ -	Capital	Systemwide - Yolo Bypass multi-benefit improvements	Flood Infrastructure
140	Wheatland	FSRP Identified Critical Repairs, Bear River north levee, RD 817 [setback levee]	Project to ensure 200-year flood protection for Wheatland's urban and urbanizing areas from Bear River flooding, preliminarily identified a critical reach of Bear River levee in RD 817 just downstream of Oakley Lane that will need to be protected from erosion or set back to meet current criteria. Included design and construction of a setback levee, project ID L1.	$ 8,500,000	$ 8,500,000	$ -	Capital	Rural - Small-scale levee setbacks and floodplain storage	Flood Infrastructure
141	Brannan-Andrus Levee Maintenance District	Georgiana Slough Bank Protection	Bank protection project on Sta. 17+00 to Sta. 24+00, rehabilitated length of 700 LF.	$ 794,000	$ 794,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
142	Brannan-Andrus Levee Maintenance District	Georgiana Slough French Drain	The existing toe ditch will be filled with gravel and an 8" diameter drain line placed in the lowered existing ditch and a drainage blanket will be constructed on the levee slope. If necessary, a new irrigation ditch will be placed away from the toe to separate functions.	$ 2,067,000	$ 2,067,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
143	Reclamation District 556, Upper Andrus Island	Georgiana Slough Stability Project – Upper Andrus	4 stability sites that would be repaired through the construction of a stability protection project along Georgiana Slough roughly 1720 LF, LM 1.8 to 4.9.	$ 998,000	$ 998,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
144	California Department of Water Resources	Geotechnical Levee Improvements	Fix any remaining geotechnical inadequacies for urban areas unaddressed in the future baseline condition and fix known critical geotechnical deficiencies for rural and small communities.	$ 22,000,000	$ 33,000,000	$ -	Capital	Systemwide - Yolo Bypass multi-benefit improvements	Flood Infrastructure
145	N/A	Glenn 100-Year Level of Protection	Provide Glenn with a 100-Year level of protection	$ -	$ -	$ -	Ongoing	Small Community - Studies and analysis	Watershed and Floodplain Management
146	Sutter Butte Flood Control Agency	Gridley Bridge Bank Erosion Repair Design, Permitting & Construction		$ 5,460,000	$ 5,460,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
147	Sutter Butte Flood Control Agency	Gridley Open Space Restoration		$ -	$ -	$ -	Capital	Small Community - Levee setbacks, land acquisitions and habitat restoration	Natural Floodplain and Ecosystem Functions
148	N/A	Grimes 100-Year Level of Protection	Provide Grimes with a 100-Year level of protection	$ -	$ -	$ -	Ongoing	Small Community - Studies and analysis	Watershed and Floodplain Management
149		Habitat Enhancement in the Yolo Bypass	The U.S. Army Corps of Engineers, in partnership with the State of California and the Sacramento Area flood Control Agency, have been evaluating the potential flood control benefits of widening the Sacramento Weir and Bypass. The widening being contemplated would expand the Bypass to the north, replacing what is currently agricultural land. If this widening occurred, habitat restoration could be implemented within the expanded Bypass footprint. Low–flow sluice gates could be constructed at the Sacramento Weir and a terraced low–flow channel (or swale) could be excavated to allow more frequent flow exchange between the Sacramento River and the Sacramento and Yolo Bypass areas, particularly the Tule Canal/Toe Drain. Creation of this low flow swale would allow increased connectivity for anadromous fish passage between the Tule Canal/Toe Drain and the Sacramento River. Currently there is no anadromous fish passage through the Sacramento Bypass until the 27.5–foot elevation in the Sacramento River is topped. Seasonal wetland areas would be constructed, and if it could be implemented in a way that is flood neutral, riparian vegetation would be established along the wetlands and low–flow channel margins.	$ 27,000,000	$ -	$ -	Capital	Systemwide - Yolo Bypass multi-benefit improvements	Natural Floodplain and Ecosystem Functions
150	N/A	Hamilton City 100-Year Level of Protection	Provide Hamilton City with a 100-Year level of protection	$ 50,000,000	$ 50,000,000	$ 2,550,963	Ongoing	Small Community - Studies and analysis	Watershed and Floodplain Management
151	Sutter Butte Flood Control Agency	Hamilton Slough	A previously constructed weir is no longer needed and presents an unnecessary encroachment into the Feather River floodway. Along with removing the non-functioning weir and planting riparian vegetation in its place, restoration actions in this area could include planting of additional riparian vegetation along the Feather River and in selected locations within Hamilton Slough to provide additional habitat for terrestrial species and shaded riverine aquatic habitat that would benefit anadromous fish.	$ 5,000,000	$ 5,000,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Flood Infrastructure
152	Reclamation District 563	Hazard Mitigation Plan (HMP) Levee Improvement Project – Tyler Island	Bring portions of the levee currently below the HMP Criteria to six inches above the PL 84-99 Standards. Will include portions of the levee that meet the HMP Criteria, but do not meet the design template for this project that are in close proximity to stretches that do not meet the HMP Standards. Total length of improvements is 6,507 LF. Completion time of 1-year.	$ 728,000	$ 728,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Flood Infrastructure

Table B-4. Sacramento Basin Management Actions Included within the 2017 Refined SSIA Portfolio

#	Lead Agency	Project Name	Project Description	Estimated Cost - Provided by Source	Adjusted Estimated Cost - Present Value ($)	Adjusted Estimated Cost - Annualized ($/year)	Investment Type	Area of Interest and Management Action Category	Management Action Type
153	Caltrans	Highway 84 Closure Structure	The floodwall, however, could still be outflanked by high water from the Yolo Bypass. Highway 84, which is owned and maintained by Caltrans, runs along the Sacramento River and the downstream end of the Yolo Bypass floods in high water. A levee or seawall is needed along Highway 84, from the Rio Vista Bridge to the Mellin Levee, to protect the City's Industrial area along the river and to prevent flood water from entering the downtown area through the bridge underpass. There will need to be a gate across Highway 84 at the Mellin Levee to prevent flood water from rushing in through the gap and flooding the industrial area. Any flood protection solution along Highway 84 will need to be coordinated with Caltrans. A solution could be addressed as part of the realignment of the Rio Vista Bridge. Additional alternatives would be to raise Highway 84 or construct a floodwall along the Sacramento River. Comparison between Highway 12 underpass stop logs or closure structure or a re- alignment/relocation of the Highway 12 crossing of the Sacramento River to prevent flood flows from flooding Highway 84.	$ 500,000	$ 500,000	$ -	Capital	Small Community - Levee repair and infrastructure improvements	Flood Infrastructure
154	Hood Local Maintaining Agency	Hood Improvements Feasibility Study	The RFMP is pre-feasibility, and thus a feasibility study is a recommended course of action for the area. Potential solutions to be explored include non-structural structure raising ($10.4M), a ring levee ($31.2M), fix-in-place of existing perimeter levees ($161M), and FEMA Zone D designation ($N/A) or a combination of those solutions.	$ 500,000	$ 500,000	$ 25,510	Ongoing	Small Community - Studies and analysis	Watershed and Floodplain Management
155	California Department of Water Resources	Hydraulic Mitigation		$ 76,000,000	$ 76,000,000	$ -	Capital	Systemwide - Yolo Bypass multi-benefit improvements	Flood Infrastructure
156	Butte County Department of Water and Resource Conservation	Identification and Evaluation of Groundwater Recharge	To provide a more comprehensive, defensible characterization of this important asset, Butte County is proposing a Project that will characterize countywide groundwater recharge areas, identify potential areas for active recharge projects, and investigate possible groundwater recharge processes at one location. The first task involves preparing a countywide map identifying areas based on their potential to recharge groundwater. The purpose of the map will be to provide technical assistance to local land managers and planners to fulfill obligations to protect groundwater recharge areas. The second task will further identify specific areas in the county where groundwater recharge projects (e.g., flood detention basins, storm water or similar facilities) could provide benefits and may be viable. A third task will involve an investigation of groundwater recharge processes in a defined study area. The location will be chosen based on results from task one and two, availability of existing data, and site accessibility. Although data exists to reasonably characterize recharge conditions in some areas of Butte County, uncertainty exists in specific locations due to complex hydrology and geology. Therefore, the site investigation will use a suite of data types and analyses, including a geophysical investigation to better characterize the subsurface and possibly quantify recharge. Qualitifier: This does have ties to SPFC and to the upcoming Small Community Feasibility Studies. For example, this could be part of a multi-benefit solution for Cherokee Canal or Butte Creek. See Attachment 8 - Groundwater Analysis, funding may be more appropriate from SGMA implementation but will include as long as the study includes use of flood peak water, could be a refinement in 2022 for future BWFS elements.	$ 100,000	$ 100,000	$ 5,102	Ongoing	Rural - Studies and analysis	Watershed and Floodplain Management
157	Reclamation District 10, Honcut	Improve drainage along levee landside toe to improve visibility, flood fight access, and levee stability	Preliminary, Planning Level project. Detailed project description not available at this time.	$ 742,500	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
158	Reclamation District 1001, Nicolaus	Improve erosion protection along the Bear River south levee	Project to improve erosion protection along the Bear River south levee for 12.6 mi. total. Project would provide 50% erosion protection with 2' thick protection measures.	$ 2,561,328	$ -	$ -	Capital	Small Community - Levee repair and infrastructure improvements	Operation and Maintenance
159	N/A	Improve Flood Reservoir Operations	Implement Flood-Coordinated Operations for Shasta Dam and Black Butte Dam	$ -	$ -	$ -	Ongoing	Systemwide - Reservoir operations	Reservoir and Floodplain Storage and Operation
160	California Department of Water Resources	Improved Flood Protection for Rio Vista and Highway 84	The Rio Vista waterfront is vulnerable to flooding along a 2.4-mile reach that extends along the waterfront from downtown near California Street to the Mellin Levee and northward along the Mellin Levee to high ground. Rio Vista has proposed a combination of floodwalls, closure structures, and levee improvements to protect the city from 200-year flooding and higher sea level rise due to climate change. In the event that changes in the Yolo Bypass contribute to stage increases in the vicinity of Rio Vista, the State could potentially participate in the implementation of the local 200-year flood protection project as mitigation for such effects.	$ -	$ 16,000,000	$ -	Capital	Small Community - Levee repair and infrastructure improvements	Flood Infrastructure
161	Three Rivers Levee Improvement Authority	Incorporate Oliverhurst Detention Basin into the SPFC to adequately tie the project levee into high ground.	The Olivehurst Detention basin and Ring levee were constructed in 2006 to mitigate the fact that the SRFCP levee on the right (west) bank of the WPIC terminated into a railroad embankment, not in to high ground. As a result, the SRFCP induced flooding in South Olivehurst. TRLIA, as part of its program to improve the levees in RD 784 to provide 200-year protection, constructed the ring levee and detention basin to mitigate this flooding, provide GGS habitat, and alleviate this system deficiency. The ODB project needs to be incorporated into the SPFC and consideration should be given to incorporating these features into the Federally Authorized project. In this way the federal and State authorizations will appropriately reflect the functional system, as it now exists.	$ 50,000	$ 50,000	$ 2,551	Ongoing	Systemwide - State operations, planning and performance tracking	Policy and Regulations
162	Isleton Local Maintaining Agency	Isleton Improvements Feasibility Study	The RFMP is pre-feasibility, and thus a feasibility study is a recommended course of action for the area. Potential solutions to be explored include Non-structural structure raising ($69.2M), a ring levee ($47.4M), fix-in-place of existing perimeter levees ($253M) and FEMA Zone D ($N/A) designation or a combination of those solutions.	$ 500,000	$ 500,000	$ 25,510	Ongoing	Small Community - Studies and analysis	Watershed and Floodplain Management
163	Knights Landing Drainage District	Knights Landing Feasibility Study	The RFMP is pre-feasibility, and thus a feasibility study is a recommended course of action for the area. Potential solutions to be explored include Non-structural structure raising ($32.8M), a ring levee ($N/A), fix-in-place of existing perimeter levees ($184.7M), and FEMA Zone D designation ($N/A) or a combination of those solutions.	$ 500,000	$ 500,000	$ 25,510	Ongoing	Small Community - Studies and analysis	Watershed and Floodplain Management
164	Knights Landing Drainage District	Knights Landing Ridge Cut Repair	The project is the repair of three non-urban levee sites along the Knights Landing Ridge Cut. The repair of these three sites would complete the levee rehabilitation identified as necessary to restore the District levee to their authorized level of flood protection.	$ 7,242,000	$ 7,242,000	$ -	Capital	Small Community - Levee repair and infrastructure improvements	Operation and Maintenance

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165	Tehama County, City of Corning, The Nature Conservancy, California State Parks, California Department of Water Resources, Sacramento River Conservation Area Forum	Kopta Slough	The Kopta project is within the SPFC and modifies a SPFC facility (the revetment is part of the Chico Landing to Red Bluff Project). While technically not a reauthorization, the project would modify the federal project by either 408 permit or 1135 program. In addition, the project has the potential to reduce erosion damage to a State park and ultimately to the county bridge. The bridge is critical infrastructure. Tehama County is bisected by the Sacramento River and this bridge is critical for emergency services. The revetment removal (along with an associated berm removal) will restore natural hydraulic processes. It would increase natural bank and meander potential, as well as increase the frequency, depth, and duration of overbank flooding on the floodplain. • Remove revetment along 5,600 feet of the riverbank at the Kopta Slough property to restore fluvial and floodplain processes and mitigate for the loss of SRA habitat from DWR Flood Control Projects • Facilitate reestablishment of the river's historical channel alignment through Kopta Slough. • Establish erosion protection for the west abutment of Woodson Bridge and the City of Corning sewer outfall. • Restore 176 acres of mixed riparian forest habitat on the Kopta Slough property as mitigation for DWR flood control Projects, • Transfer the 708- acre Kopta Slough property from the California State Controller's Environmental Trust to a resource agency for long-term management. This element may include expansion of the Woodson Bridge SRA to the west side of the Sacramento River, with consideration for increasing public recreational opportunities.	$ 10,000,000	$ 10,000,000	$ -	Capital	Rural - Habitat restoration/reconnection	Natural Floodplain and Ecosystem Functions
166	United States Fish and Wildlife Service	Laurel Avenue Levee Setback	A multi-benefit project at this location would expand the floodway to increase floodwater conveyance capacity, and it would provide additional opportunities for compatible ecosystem restoration actions, similar to those planned for the TRLIA Feather River Levee Setback, as well as implementation of wildlife-friendly farming practices.	$ 70,000,000	$ 70,000,000	$ -	Capital	Rural - Small-scale levee setbacks and floodplain storage	Flood Infrastructure
167	Sutter Butte Flood Control Agency	Laurel to Cypress Critical Repair	Strengthen the existing levee by constructing deep cut-off walls, seepage-berms and other measures	$ 13,500,000	$ 13,500,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
168	Sutter Butte Flood Control Agency, Levee District 1	LD1 Star Bend Levee Setback Ecosystem enhancement	Levee District 1 (LD 1) constructed an approximately 3,400-ft-long setback levee on the right bank of the Feather River at Star Bend. In addition to providing 200-yr flood protection, construction of the setback area created opportunities for restoration of approximately 45 acres of riparian habitat to benefit terrestrial wildlife and to provide SRA habitat that would enhance fish habitat in the Feather River. LD 1 has already planted approximately 20 acres of riparian habitat as mitigation for construction of the setback levee. SBFCA recently initiated a project to plant another 20 acres in accord with FRWLP mitigation requirements and CVFPP goals.	$ 650,000	$ 650,000	$ -	Capital	Rural - Habitat restoration/reconnection	Natural Floodplain and Ecosystem Functions
169	N/A	Levee Easement and Property Line Survey	Research and survey the existing levee easements and adjacent property lines. There is no existing clear definition regarding the locations of LMA's legal boundaries. Qualifier: please coordinate with the CVFPB for official surveys.	$ 1,000,000	$ 1,000,000	$ 51,019	Ongoing	Systemwide - State operations, planning and performance tracking	Policy and Regulations
170	N/A	Levee Maintenance Issues	Develop a Regional Roundtable including LMA, Resource Agencies, State, and USACE representatives to develop strategies, programs, and projects to address the O&M issues discussed in Chapter 4 of the MUSR RFMP.	$ 100,000	$ 100,000	$ 5,102	Ongoing	Systemwide - State operations, planning and performance tracking	Policy and Regulations
171	Reclamation District 2098, Cache Haas Area	Levee Penetration Removals & Replacements	The RD-2098 levees along Cache and Haas Slough include a number of dilapidated levee penetrations installed during construction of the SRFCP levees. The primary penetrations at Lookout, Sycamore, and Duck Sloughs allow for both water supply and drainage. Project would include the prioritized removal or replacement of levee penetrations to reduce the flood risk associated with unreliable performance of the conduits during high water.	$ 2,000,000	$ 2,000,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
172	California Department of Water Resources	Levee Setback near Putah Creek	5,000-feet levee setbacks on the west side of the bypass north of Putah Creek.	$ -	$ 80,000,000	$ -	Capital	Systemwide - Yolo Bypass multi-benefit improvements	Flood Infrastructure
173	California Department of Water Resources	Levee Setback near Putah Creek - Ecosystem Assessments and Implementation	Ecosystem Assessments and Implementation I-80 to Putah Creek. Expand riparian corridor, enhance existing canals, preserve levee remnants for upland refugia, and maintain existing seasonal wetlands to enhance habitat connectivity for target species. Expand and enhance the riparian corridor and existing canals to improve habitat connectivity to west side of Yolo Bypass.	$ -	$ 3,810,000	$ -	Capital	Systemwide - Yolo Bypass multi-benefit improvements	Natural Floodplain and Ecosystem Functions
174	California Department of Water Resources	Levee Setback near Willow Slough Bypass	4,000-feet levee setbacks on the west side of the bypass north of Willow Slough and south of I-80.	$ 225,000,000	$ 125,000,000	$ -	Capital	Systemwide - Yolo Bypass multi-benefit improvements	Flood Infrastructure
175	California Department of Water Resources	Levee Setback near Willow Slough Bypass - Ecosystem Assessments and Implementation	Ecosystem Assessments and Implementation for North of Willow Slough Setback, and I-80. Expand riparian corridor, enhance existing canals, preserve levee remnants for upland refugia, and maintain existing seasonal wetlands to enhance habitat connectivity for target species. Expand and enhance the riparian corridor and existing canals to improve habitat connectivity to west side of Yolo Bypass.	$ -	$ 2,481,600	$ -	Capital	Systemwide - Yolo Bypass multi-benefit improvements	Natural Floodplain and Ecosystem Functions
176	Reclamation District 2060, Hastings Tract	Lindsey and Cache Slough Bank Protection Project – Hastings	Repair/Rehabilitation of multiple sites along 12,000 LF of lower sections closest to Yolo Bypass flows of Cache Slough and Lindsey Slough. Project components could include: Rehabilitation of waterside bank to withstand flood flows, and incorporate an enhanced lower waterside slope habitat area with possible riparian forest, scrub shrub, emergent/freshwater marsh to mitigate and enhance habitat values.	$ 2,067,000	$ 2,067,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
177	Reclamation District 536, Egbert Track	Lindsey Slough Bank Protection Project – Egbert	Waterside Bank protection and Rehabilitation project 460 LF along the Lindsey Slough, LM 4.83 to 5.03.	$ 522,000	$ 522,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
178	Reclamation District 2060, Hastings Tract	Lindsey Slough Bank Protection Project – Hastings	Waterside Bank Protection and Rehabilitation project 750 LF between LM 2.43 to 2.45 and 4.29. Enhanced lower waterside slope habitat area with possible Riparian Forest, Scrub- Shrub, and emergent/freshwater marsh to mitigate or enhance the habitat value.	$ 850,000	$ 850,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
179	Reclamation District 536, Egbert Track	Lindsey Slough Seepage Repair Project – Egbert	Seepage protection project 300 LF along the Lindsey Slough, LM 3.3 to 3.35. Project would consist of rock and fill.	$ 194,000	$ 194,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
180	Reclamation District 536, Egbert Track	Lindsey Slough Stability Project – Egbert	Levee Stability protection project 1,600 LF along the Lindsey Slough, LM 0.52 to 0.88.	$ 1,102,000	$ 1,102,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
181	DWR Maintenance Area 05	Little Chico Creek Diversion to Butte Creek	Evaluate flood carrying capacity of Little Chico Creek diversion to Butte Creek.	$ 100,000	$ 100,000	$ 5,102	Ongoing	Rural - Studies and analysis	Watershed and Floodplain Management

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182	Sutter County	Live Oak Park	Restoration actions could include planting riparian vegetation downstream from the boat ramp to create a wider strip of habitat and replacing some or all turf grass and other non-native species with appropriate native plants to increase wildlife habitat values.	$ 750,000	$ 750,000	$ -	Capital	Small Community Levee setbacks, land acquisitions and habitat restoration	Natural Floodplain and Ecosystem Functions
183	California Department of Water Resources	Lower Elkhorn Ecosystem Assessment and Implementation	Improve fish passage and habitat connectivity along the Tule Canal by removing barriers to fish passage, providing a seasonally inundated low-flow channel, and improving riparian and wetland habitat. Additionally, a low-flow channel would be created, and riparian areas would be enhanced and expanded. Providing a more functional Tule Canal with a seasonally inundated low-flow channel, bordered by a wetland terrace, would improve water quality and provide expanded wetland and inundated floodplain habitat for target fish species. A wider riparian corridor would benefit Draft CS target species including Least Bell's vireo and Swainson's hawk. Additionally, existing canals would be extended and sections of the existing levees would be retained as habitat and refugia for giant garter snake (GGS), respectively.	$ 18,000,000	$ 7,507,100	$ -	Capital	Systemwide - Yolo Bypass multi-benefit improvements	Natural Floodplain and Ecosystem Functions
184	California Department of Water Resources	Lower Elkhorn Levee Setback Assessment and Implementation	A 3,500-feet levee setback along the Lower Elkhorn basin and associated ecosystem restoration actions eastward from the existing alignment for a distance of about 5.5 miles to the new Sacramento Bypass levee, adding 2,300 acres to the Yolo Bypass floodway.	$ 158,000,000	$ 161,492,900	$ -	Capital	Systemwide - Yolo Bypass multi-benefit improvements	Flood Infrastructure
185	California Department of Water Resources	Lower Sacramento/Delta North - Channel RR&R - Arrundo Removal	Sources included meetings with regional representatives and information from DWR. No LMAs reported costs.	$ 2,352,053	$ 2,352,053	$ 120,000	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
186	California Department of Water Resources	Lower Sacramento/Delta North - Channel Sediment Removal	Channel maintenance activities including sediment, vegetation, and debris removal are conducted by DWR with respect to the Sacramento River Flood Control Project and generally by LMAs in the San Joaquin Valley. Estimated costs for the Sacramento Basin were developed by using historical projects overseen by DWR, which have occurred as funding has been available, as well as input from regional experts. Estimated costs for the San Joaquin Basin were based on direct interviews with LMAs and staff.	$ 29,400,662	$ 29,400,662	$ 1,500,000	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
187	California Department of Water Resources	Lower Sacramento/Delta North - Channel Vegetation and Debris Removal	Channel maintenance activities including sediment, vegetation, and debris removal are conducted by DWR with respect to the Sacramento River Flood Control Project and generally by LMAs in the San Joaquin Valley. Estimated costs for the Sacramento Basin were developed by using historical projects overseen by DWR, which have occurred as funding has been available, as well as input from regional experts. Estimated costs for the San Joaquin Basin were based on direct interviews with LMAs and staff.	$ 29,400,662	$ 29,400,662	$ 1,500,000	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
188	California Department of Water Resources	Lower Sacramento/Delta North - Large Structure O&M	Major structures involve those facilities described in CWC Section 8361 and administered by DWR, and include weirs, bypass outflow control structures, outfall gate facilities, and large regional pumping plants.	$ -	$ -	$ -	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
189	California Department of Water Resources	Lower Sacramento/Delta North - Large Structures RR&R	Based on discussions with DWR and LMA staff, major structures have historically been repaired and well maintained, and there is not an immediate need to repair, replace, or rehabilitate these facilities. As such, RR&R costs were not identified for this TM given major structures were assumed not to require significant repairs over the next 50 years. However, it is recommended that funding reserves be established to ensure adequate funding is available in the future to continue needed repairs or to replace aged facilities.	$ -	$ -	$ -	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
190	California Department of Water Resources	Lower Sacramento/Delta North - Non-urban Levee O&M (Rural)	Levee O&M costs were separated between urban and rural LMAs to capture the additional costs associated with urban area LMAs. Levee O&M included the following activities: vegetation maintenance, rodent control, encroachment and pipe maintenance, minor repairs (erosion, levee crown repairs etc.)	$ 255,041,335	$ 255,041,335	$ 13,012,020	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
191	California Department of Water Resources	Lower Sacramento/Delta North - Non-urban Levee RR&R (Rural)	Levee-related RR&R costs have generally been driven by necessary flood-event repairs and known erosion or levee stability issues. The OMRR&R Work Group determined the Delta Subventions Program data set is the most robust data set for estimating RR&R cost on SPFC levees because the existence of the funding program has encouraged more regular analysis and repair of levees. Although urban levees are being improved to a higher standard to meet urban level of protection standards, the OMRR&R Work Group determined that repair and rehabilitation costs for urban and non-urban levees would not differ substantially, and the cost for ULDC compliance would be the only significant differentiating factor for RR&R of urban SPFC levees.	$ 72,076,899	$ 72,076,899	$ 3,677,310	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
192	California Department of Water Resources	Lower Sacramento/Delta North - Small Community Levee O&M	Levee O&M costs were separated between urban and rural LMAs to capture the additional costs associated with urban area LMAs. Levee O&M included the following activities: vegetation maintenance, rodent control, encroachment and pipe maintenance, minor repairs (erosion, levee crown repairs etc.)	$ 43,304,823	$ 43,304,823	$ 2,209,380	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
193	California Department of Water Resources	Lower Sacramento/Delta North - Small Community Levee RR&R	Levee-related RR&R costs have generally been driven by necessary flood-event repairs and known erosion or levee stability issues. The OMRR&R Work Group determined the Delta Subventions Program data set is the most robust data set for estimating RR&R cost on SPFC levees because the existence of the funding program has encouraged more regular analysis and repair of levees. Although urban levees are being improved to a higher standard to meet urban level of protection standards, the OMRR&R Work Group determined that repair and rehabilitation costs for urban and non-urban levees would not differ substantially, and the cost for ULDC compliance would be the only significant differentiating factor for RR&R of urban SPFC levees.	$ 12,238,320	$ 12,238,320	$ 624,390	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
194	California Department of Water Resources	Lower Sacramento/Delta North - Small Structures O&M	Minor structures include stop log or gated closure structures, pumping plants, monitoring wells and piezometers, retaining walls and floodwalls, pipe penetrations, and encroachments. Routine O&M of these types of structures is critical, but often overlooked for budgeting purposes. As became evident in the LMA data received, LMAs typically only account for routine power costs for pumping plants and do not separately account for other activities associated with minor structures such as video inspections of pipes, lubrication and minor repairs of pipe closure valves, routine inspection and maintenance of closure structure gates or stop logs, and inspection and minor repairs of floodwalls. The OMRR&R Work Group determined that costs for minor-structure O&M are likely included in the general overhead expenses for the LMAs who have structures, and no further estimates were developed. However, it is anticipated that video inspections of pipes will be required in the future (once every 5 years) for pipes crossing SPFC levees and as such these projected costs were included in the overall estimates.	$ 1,709,158	$ 1,709,158	$ 87,200	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance

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195	California Department of Water Resources	Lower Sacramento/Delta North - Small Structures RR&R	Small structures such as stop logs or gated closure structures, monitoring wells and piezometers, retaining walls and floodwalls, pipes, and encroachments are typically accounted for in levee RR&R costs, except for pipes. Many of these pipes were installed before or during original project construction prior to the 1950s, but no plans were implemented to assure these facilities could be replaced when they exceed their useful life. As a result, many pipes have reached their useful life with many of these structures in need of repair, replacement, or proper pipe abandonment.	$ 91,102,851	$ 91,102,851	$ 4,648,000	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
196	California Department of Water Resources	Lower Sacramento/Delta North - Urban Levee O&M	Levee O&M costs were separated between urban and rural LMAs to capture the additional costs associated with urban area LMAs. Levee O&M included the following activities: vegetation maintenance, rodent control, encroachment and pipe maintenance, minor repairs (erosion, levee crown repairs etc.)	$ 168,250,188	$ 168,250,188	$ 8,584,000	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
197	California Department of Water Resources	Lower Sacramento/Delta North - Urban Levee RR&R	Levee-related RR&R costs have generally been driven by necessary flood-event repairs and known erosion or levee stability issues. The OMRR&R Work Group determined the Delta Subventions Program data set is the most robust data set for estimating RR&R cost on SPFC levees because the existence of the funding program has encouraged more regular analysis and repair of levees. Although urban levees are being improved to a higher standard to meet urban level of protection standards, the OMRR&R Work Group determined that repair and rehabilitation costs for urban and non-urban levees would not differ substantially, and the cost for ULDC compliance would be the only significant differentiating factor for RR&R of urban SPFC levees.	$ 52,215,576	$ 52,215,576	$ 2,664,000	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
198	California Department of Water Resources	Lower Yolo Bypass - West Setback - Ecosystem Assessment and Implementation	Restore tidal and subtidal marsh ecosystems via strategic levee breaches and channel grading. Preserve levee remnants for upland refugia for target species.	$ 20,000,000	$ 11,019,900	$ -	Capital	Systemwide - Yolo Bypass multi-benefit improvements	Natural Floodplain and Ecosystem Functions
199	California Department of Water Resources	Lower Yolo Bypass Assessment and Implementation	A levee setback south of RD 2068 to Rio Vista, and associated ecosystem restoration actions.	$ 185,000,000	$ 184,980,100	$ -	Capital	Systemwide - Yolo Bypass multi-benefit improvements	Flood Infrastructure
200	Yuba County Water Agency	Lower Yuba River Native Fish Habitat Enhancement	The Lower Yuba River Accord River Management Team Planning Group (RMT) implements the Lower Yuba River Accord, which is an agreement between 17 stakeholders, which enables the Yuba County Water Agency to successfully operate the Yuba River Development Project. Apart from management of flows to benefit native salmon and steelhead, habitat enhancement is part of the relicensing agreement for the Project. Actions to benefit Feather and Yuba River native fish should be coordinated with the RMT, and opportunities may exist to pursue projects to benefit Yuba River native fish that would also benefit flood management. The RMT is conducting extensive studies, monitoring and evaluations that could be of great benefit for the development of ecosystem enhancement and restoration actions on the Yuba River.	$ -	$ -	$ -	Capital	Rural - Habitat restoration/reconnection	Natural Floodplain and Ecosystem Functions
201	Deer Creek Watershed Conservancy, Tehama County Flood Control and Water Conservation District, California Department of Fish and Wildlife Northern Region (Region 1)	Lwr Deer Creek Levee Improvements & Habitat Restoration	All phases are needed to meet project conveyance and ecosystem restoration. Phase 2 only included design for the DCID dam replacement with implementation deferred to other funding sources as written for the Flood Corridor Grant Project. The design capacity needs both DCID dam and Red Bridge replacement to met design capacity, manage sediment, and restore ecosystem function. All components together help to make this a multi-objective project. - Phase 1 will conduct an overall evaluation of the project as described in the 2011 feasibility study. - Phase 2 will evaluate options to improve the existing SVRIC Diversion Dam and fish ladders. - Phase 3 will be the final design and construction of a new 4,620 LF levee. The new levee will be setback will create approximately 40 acres of new floodway with floodway and migration easements, which will be contoured to greatly assist fish passage (e.g. Salmon). - Phase 4 will consist of rebuilding Leininger Road Bridge (Red Bridge) with a conveyance width of about 450 feet. The section of the north bank levee upstream of Red Bridge (PL2) would be removed, and the spoils would be used to raise the north bank road abutment, thus maintaining the flooding use of the flood easement on the Leininger property. Additional engineering of the north bank road abutment is likely. - Phase 5 will consist of miscellaneous improvements to non project levees, and removal of rock revetment and spurs will further enhance the flood benefits and habitat restoration efforts for the reach.	$ 34,000,000	$ 34,000,000	$ -	Capital	Rural - Small-scale levee setbacks and floodplain storage	Flood Infrastructure
202	California Department of Water Resources	Mapping, Risk Awareness and Land Use Planning (Rural)	Covers the State's floodplain risk mgmt programs, information mgmt systems, channel capacity updates, land use planning, mitigation planning, etc	$ 787,800	$ 15,441,228	$ 787,800	Ongoing	Rural - Risk awareness, floodproofing and land use planning	Watershed and Floodplain Management
203	California Department of Water Resources	Mapping, Risk Awareness and Land Use Planning (Small Comm)	Covers the State's floodplain risk mgmt programs, information mgmt systems, channel capacity updates, land use planning, mitigation planning, etc	$ 3,151,200	$ 61,764,911	$ 3,151,200	Ongoing	Small Community - Risk awareness, floodproofing and land use planning	Watershed and Floodplain Management
204	California Department of Water Resources	Mapping, Risk Awareness and Land Use Planning (Urban)	Covers the State's floodplain risk mgmt programs, information mgmt systems, channel capacity updates, land use planning, mitigation planning, etc	$ 3,939,000	$ 77,206,138	$ 3,939,000	Ongoing	Urban - Risk awareness, floodproofing and land use planning	Watershed and Floodplain Management
205	Marysville Levee District	Marysville Ring Levee Phase 2B Design & Construction	Strengthen the existing levee by constructing deep cut-off walls, seepage-berms and other measures	$ 19,000,000	$ -	$ -	Capital	Urban - Levee improvements	Flood Infrastructure
206	Marysville Levee District	Marysville Ring Levee Phase 2C Design & Construction	Strengthen the existing levee by constructing deep cut-off walls, seepage-berms and other measures	$ 13,000,000	$ -	$ -	Capital	Urban - Levee improvements	Flood Infrastructure
207	Marysville Levee District	Marysville Ring Levee Phase 3 Design & Construction	Strengthen the existing levee by constructing deep cut-off walls, seepage-berms and other measures	$ 21,200,000	$ -	$ -	Capital	Urban - Levee improvements	Flood Infrastructure
208	Solano County Public Works	Mellin Levee Vegetation Control	Levee vegetation management and DWR to determine if Mellin Levee is actually an SPFC levee. Similar project estimated costs: Lisbon $378,000, Ryer $3,927,000, Tyler $1,481,000. Average of three projects: $1,928,667.	$ 1,928,667	$ -	$ -	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
209	N/A	Meridian 100-Year Level of Protection	Provide Meridian with a 100-Year level of protection	$ -	$ -	$ -	Ongoing	Small Community - Studies and analysis	Watershed and Floodplain Management

Table B-4. Sacramento Basin Management Actions Included within the 2017 Refined SSIA Portfolio

#	Lead Agency	Project Name	Project Description	Estimated Cost - Provided by Source	Adjusted Estimated Cost - Present Value ($)	Adjusted Estimated Cost - Annualized ($/year)	Investment Type	Area of Interest and Management Action Category	Management Action Type
210	United States Army Corp of Engineers	Middle Creek Flood Damage Reduction and Ecosystem Restoration Project	De-authorize and breach the lower east Middle Creek levees in multiple locations and restoring about 1,650 acres of floodplain. The project provides water quality benefits to Clear Lake (alleviates sediment inflow), and the depths of flooding within the Southern zone of benefit are estimated to be between 5' and 10' during the 100-year event. Restores lost wetland/riparian habitat and provides up to 6,500 ac-ft. new water supply.	$ 48,000,000	$ 48,000,000	$ -	Capital	Rural - Habitat restoration/reconnection	Natural Floodplain and Ecosystem Functions
211	California Department of Water Resources	Mid-Upper Sacramento - Channel RR&R - Arrundo Removal	Sources included meetings with regional representatives and information from DWR. No LMAs reported costs. Giant reed removal estimated cost range is from $7,000/acre to $10,000/acre based on DWR input. Upper end of was range chosen for unit cost given other regions identified costs as high as $25,000/acre.	$ 5,488,124	$ 5,488,124	$ 280,000	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
212	California Department of Water Resources	Mid-Upper Sacramento - Channel Sediment Removal	Channel maintenance activities including sediment, vegetation, and debris removal are conducted by DWR with respect to the Sacramento River Flood Control Project and generally by LMAs in the San Joaquin Valley. Estimated costs for the Sacramento Basin were developed by using historical projects overseen by DWR, which have occurred as funding has been available, as well as input from regional experts. Estimated costs for the San Joaquin Basin were based on direct interviews with LMAs and staff.	$ 73,501,655	$ 73,501,655	$ 3,750,000	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
213	California Department of Water Resources	Mid-Upper Sacramento - Channel Vegetation and Debris Removal	Channel maintenance activities including sediment, vegetation, and debris removal are conducted by DWR with respect to the Sacramento River Flood Control Project and generally by LMAs in the San Joaquin Valley. Estimated costs for the Sacramento Basin were developed by using historical projects overseen by DWR, which have occurred as funding has been available, as well as input from regional experts. Estimated costs for the San Joaquin Basin were based on direct interviews with LMAs and staff.	$ 29,400,662	$ 29,400,662	$ 1,500,000	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
214	California Department of Water Resources	Mid-Upper Sacramento - Large Structure O&M	Major structures involve those facilities described in CWC Section 8361 and administered by DWR, and include weirs, bypass outflow control structures, outfall gate facilities, and large regional pumping plants.	$ 10,388,234	$ 10,388,234	$ 530,000	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
215	California Department of Water Resources	Mid-Upper Sacramento - Large Structures RR&R	Based on discussions with DWR and LMA staff, major structures have historically been repaired and well maintained, and there is not an immediate need to repair, replace, or rehabilitate these facilities. As such, RR&R costs were not identified for this TM given major structures were assumed not to require significant repairs over the next 50 years. However, it is recommended that funding reserves be established to ensure adequate funding is available in the future to continue needed repairs or to replace aged facilities.	$ -	$ -	$ -	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
216	California Department of Water Resources	Mid-Upper Sacramento - Non-urban Levee O&M (Rural)	Levee O&M costs were separated between urban and rural LMAs to capture the additional costs associated with urban area LMAs. Levee O&M included the following activities: vegetation maintenance, rodent control, encroachment and pipe maintenance, minor repairs (erosion, levee crown repairs etc.)	$ 163,202,291	$ 163,202,291	$ 8,326,460	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
217	California Department of Water Resources	Mid-Upper Sacramento - Non-urban Levee RR&R (Rural)	Levee-related RR&R costs have generally been driven by necessary flood-event repairs and known erosion or levee stability issues. The OMRR&R Work Group determined the Delta Subventions Program data set is the most robust data set for estimating RR&R cost on SPFC levees because the existence of the funding program has encouraged more regular analysis and repair of levees. Although urban levees are being improved to a higher standard to meet urban level of protection standards, the OMRR&R Work Group determined that repair and rehabilitation costs for urban and non-urban levees would not differ substantially, and the cost for ULDC compliance would be the only significant differentiating factor for RR&R of urban SPFC levees.	$ 46,122,387	$ 46,122,387	$ 2,353,130	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
218	California Department of Water Resources	Mid-Upper Sacramento - Small Community Levee O&M	Levee O&M costs were separated between urban and rural LMAs to capture the additional costs associated with urban area LMAs. Levee O&M included the following activities: vegetation maintenance, rodent control, encroachment and pipe maintenance, minor repairs (erosion, levee crown repairs etc.)	$ 139,381,483	$ 139,381,483	$ 7,111,140	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
219	California Department of Water Resources	Mid-Upper Sacramento - Small Structures O&M	Minor structures include stop log or gated closure structures, pumping plants, monitoring wells and piezometers, retaining walls and floodwalls, pipe penetrations, and encroachments. Routine O&M of these types of structures is critical, but often overlooked for budgeting purposes. As became evident in the LMA data received, LMAs typically only account for routine power costs for pumping plants and do not separately account for other activities associated with minor structures such as video inspections of pipes, lubrication and minor repairs of pipe closure valves, routine inspection and maintenance of closure structure gates or stop logs, and inspection and minor repairs of floodwalls. The OMRR&R Work Group determined that costs for minor-structure O&M are likely included in the general overhead expenses for the LMAs who have structures, and no further estimates were developed. However, it is anticipated that video inspections of pipes will be required in the future (once every 5 years) for pipes crossing SPFC levees and as such these projected costs were included in the overall estimates.	$ 2,399,094	$ 2,399,094	$ 122,400	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
220	California Department of Water Resources	Mid-Upper Sacramento - Small Structures RR&R	Small structures such as stop logs or gated closure structures, monitoring wells and piezometers, retaining walls and floodwalls, pipes, and encroachments are typically accounted for in levee RR&R costs, except for pipes. Many of these pipes were installed before or during original project construction prior to the 1950s, but no plans were implemented to assure these facilities could be replaced when they exceed their useful life. As a result, many pipes have reached their useful life with many of these structures in need of repair, replacement, or proper pipe abandonment.	$ 58,958,128	$ 58,958,128	$ 3,008,000	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
221	California Department of Water Resources	Mid-Upper Sacramento - Urban Levee O&M	Levee O&M costs were separated between urban and rural LMAs to capture the additional costs associated with urban area LMAs. Levee O&M included the following activities: vegetation maintenance, rodent control, encroachment and pipe maintenance, minor repairs (erosion, levee crown repairs etc.)	$ 11,936,669	$ 11,936,669	$ 609,000	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
222	California Department of Water Resources	Mid-Upper Sacramento - Urban Levee RR&R	Levee-related RR&R costs have generally been driven by necessary flood-event repairs and known erosion or levee stability issues. The OMRR&R Work Group determined the Delta Subventions Program data set is the most robust data set for estimating RR&R cost on SPFC levees because the existence of the funding program has encouraged more regular analysis and repair of levees. Although urban levees are being improved to a higher standard to meet urban level of protection standards, the OMRR&R Work Group determined that repair and rehabilitation costs for urban and non-urban levees would not differ substantially, and the cost for ULDC compliance would be the only significant differentiating factor for RR&R of urban SPFC levees.	$ 3,704,483	$ 3,704,483	$ 189,000	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance

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223	California Department of Water Resources	Mid-Upper Sacramento -Small Community Levee RR&R	Levee-related RR&R costs have generally been driven by necessary flood-event repairs and known erosion or levee stability issues. The OMRR&R Work Group determined the Delta Subventions Program data set is the most robust data set for estimating RR&R cost on SPFC levees because the existence of the funding program has encouraged more regular analysis and repair of levees. Although urban levees are being improved to a higher standard to meet urban level of protection standards, the OMRR&R Work Group determined that repair and rehabilitation costs for urban and non-urban levees would not differ substantially, and the cost for ULDC compliance would be the only significant differentiating factor for RR&R of urban SPFC levees.	$ 39,390,419	$ 39,390,419	$ 2,009,670	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
224	Reclamation District 999, Netherlands	Miner Slough Bank Protection Control – Netherlands	Waterside Bank Protection and Rehabilitation project 400 LF LM 0.64. Enhanced lower waterside slope habitat area with possible Riparian Forest, Scrub-Shrub, and emergent/freshwater marsh to mitigate or enhance the habitat value.	$ 454,000	$ 454,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
225	Reclamation District 999, Netherlands	Miner Slough Seepage Repair Project – Netherlands	The construction of seepage control berms, drains or membranes along Miner Slough. Easement issues. Estimated 30,000 tons of gravel and 40,000 tons of imported fill. 3 year completion time.	$ 1,240,000	$ 1,240,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
226	Reclamation District 537, California Department of Water Resources, Yolo County	Monument Bend Maintenance	River side levee toe needs to be rebuilt along Old River Road and Monument Bend.	$ 1,000,000	$ 1,000,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
227		Natomas Cross Canal	Several multi–benefit design concepts could be adopted to improve habitat values at this site while still maintaining agricultural production including: • Maintaining existing rice fields while allowing seasonally inundation prior to spring planting, thus providing habitat value for waterfowl and simulated rearing habitat for salmonids. The installation of several egress areas for juvenile salmonids would be required within the rice fields to ensure the entrainment of salmonids does not occur. • Creating seasonal wetlands at the confluence of the East Side and Pleasant Grove • Creek Canals, while also potentially allowing concurrent rice production. • Installing seasonal wetland enhancements at the confluence of Pleasant Grove Creek and Pleasant Grove Creek Canal to add flood detention for Sankey Gap. • Installing floodplain benching and terracing and riparian enhancements along Pleasant Grove Creek. • feathering the edges of the Natomas Cross Canal in a way that is flood neutral to enhance shaded riverine aquatic (SRA) habitat. The site provides an opportunity for over 3,400 acres of multi–benefit use including providing habitat for salmonids, migratory birds and waterfowl while maintaining a proportion of the site in agricultural production.	$ 115,000,000	$ 115,000,000	$ -	Capital	Rural - Habitat restoration/reconnection	Natural Floodplain and Ecosystem Functions
228	Reclamation District 1001, Nicolaus	Natomas Cross Canal north levee	Phased improvements to the RD1001 levee system, Segment 284, to achieve 100-year FEMA levee protection. Reference: Non-Urban Levee Evaluations Project Remedial Alternatives and Cost Estimates Report (NULE RACER).	$ 123,878,000	$ -	$ -	Capital	Urban - Levee improvements	Flood Infrastructure
229	Sacramento Area Flood Control Agency, United States Army Corp of Engineers	Natomas Levees	Intended to address identified levee embankment and foundation stability issues as well as levee height deficiencies in the perimeter levee system protection the Natomas Basin east of the Sacramento River and north of the American River. Initiated by SAFCA in 2007 and to date roughly 50% of the project (approx. 18 miles) have been completed and it is anticipated that construction of the remainder will begin in 2016 and completed within 6 years. This includes 6 miles of the Sacramento River east levee, 2 miles of the American River north levee, 7 miles of the Natomas East Main Drainage Canal west levee and 3 miles of the Pleasant Grove Creek Canal west levee.	$ 700,000,000	$ -	$ -	Capital	Urban - Levee improvements	Flood Infrastructure
230	N/A	Nelson 100-Year Level of Protection	Provide Nelson with a 100-Year level of protection	$ 50,000,000	$ 50,000,000	$ 2,550,963	Ongoing	Small Community - Studies and analysis	Watershed and Floodplain Management
231	Reclamation District 1001, Nicolaus	Nelson Weir removal or modification to reduce erosion and improve habitat	Project consists of 2200 ' of rock weir being removed @ 5' tall (60 CY/ LF of weir) to reduce erosion and improve habitat.	$ 2,640,000	$ 2,640,000	$ -	Capital	Small Community - Levee repair and infrastructure improvements	Operation and Maintenance
232	N/A	Nelson/Richvale Small 100-Year Level of protection	Evaluate feasibility of providing 100-yr protection to Richvale and Nelson. Look at the feasibility of using existing agricultural lands as temporary detention basins to relieve high flows within Butte Creek.	$ 100,000	$ 100,000	$ 5,102	Ongoing	Small Community - Studies and analysis	Watershed and Floodplain Management
233	Reclamation District 827, Elkhorn	New East-West Cross Levee	The on-and off ramps to Interstate 5, at the northern end of the District, provide a critical route for basin ingress and egress. This access also provides a potential emergency evacuation route for West Sacramento. A levee failure upstream for RD 827 has the potential to inundate the Interstate 5 on-and off ramps. Constructing a new east-west cross levee north of Old River Road to redirect inundation flows back into the Yolo Bypass, would improve public safety for the region.	$ 8,000,000	$ 8,000,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Flood Infrastructure
234	California Department of Water Resources	Nonstructural Berms & Interior Drainage		$ 9,727,600	$ 18,768,000	$ 957,529	Ongoing	Small Community - Risk awareness, floodproofing and land use planning	Watershed and Floodplain Management
235	California Department of Water Resources	Nonstructural Berms & Interior Drainage		$ 4,863,800	$ 9,384,000	$ 478,765	Ongoing	Small Community - Risk awareness, floodproofing and land use planning	Watershed and Floodplain Management
236	California Department of Water Resources	Nonstructural Berms & Interior Drainage		$ 9,727,600	$ 18,768,000	$ 957,529	Ongoing	Small Community - Risk awareness, floodproofing and land use planning	Watershed and Floodplain Management
237	N/A	Nord 100-Year Level of Protection	Provide Nord with a 100-Year level of protection	$ 50,000,000	$ 50,000,000	$ 2,550,963	Ongoing	Small Community - Studies and analysis	Watershed and Floodplain Management

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238	Sacramento Area Flood Control Agency, United States Army Corp of Engineers	North Sacramento Streams	Located east of Natomas, contains several urbanized floodplains that are threatened by peak flood flows; Arcade Creek, Magpie Creek and the lower portion of the Natomas East Main Drainage Canal (NEMDC). Past improvements in the 1990's however recent preliminary embankment and foundation stability analyses indicate that up to four miles of additional improvement may be required along portions of the north and south levees of Arcade Creek and the east levee of NEMDC between Arcade Creek and Northgate Boulevard.	$ 150,000,000	$ -	$ -	Capital	Urban - Levee improvements	Flood Infrastructure
239	Northern California Regional Land Trust	Northern Sacramento Valley Regional Atlas	Development of a centralized GIS database and Digital Atlas for the Northern Sacramento Valley Region to build a comprehensive collection of water and resource management-related spatial information.	$ 100,000	$ 100,000	$ 5,102	Ongoing	Rural - Risk awareness, floodproofing and land use planning	Watershed and Floodplain Management
240		Northgate Culvert Replacement	The principal project would be to construct a bridge spanning 25 feet along the northern levee in the basin, replacing the existing undersized culvert. Additionally, a new culvert would be constructed under the bike trail in the southeast portion of the basin to increase circulation. The project would include basin grading to improve positive drainage and minimize stranding hazards, as well as native riparian vegetation planting.	$ 1,000,000	$ 1,000,000	$ -	Capital	Urban - Other infrastructure and multi-benefit improvements	Flood Infrastructure
241		Old Bryte Landfill Remediation	The relocation and/or remediation of an abandoned domestic landfill is required to setback the north levee of the Sacramento Bypass. Expansion of the Sacramento Bypass included setback of the north levee is included in the Common Features GRR recommended plan. The relocation and/or remediation of the landfill is estimated to cost less than $10M.	$ 10,000,000	$ -	$ -	Capital	Systemwide - Yolo Bypass multi-benefit improvements	Flood Infrastructure
242	N/A	Ord Bend 100-Year Level of Protection	Provide Ord Bend with a 100-Year level of protection	$ -	$ -	$ -	Ongoing	Small Community - Studies and analysis	Watershed and Floodplain Management
243	Sutter Butte Flood Control Agency	Oroville Wildlife Area Flood Stage Reduction Project Design, Permitting & Construction	Includes the design of weir improvements and ecosystem restoration to improve connectivity to historic floodway and reduce stages in main channel of the Feather River. The primary goal of the project is to divert water from the Feather River through the Oroville Wildlife Area to accommodate up to 80,000 cfs for a 200-year flood event. Project will fund project management, hydraulic modeling, feasibility, design, environmental documentation, and permitting. The site encompasses about 1,000 acres.	$ 5,853,800	$ 5,853,800	$ 298,657	Ongoing	Rural - Studies and analysis	Watershed and Floodplain Management
244	Sutter Butte Flood Control Agency	Oroville Wildlife Area Multi-Benefit Project	The Oroville Wildlife Area is managed by the CDFW and comprises approximately 11,000 acres west of Oroville that are managed for wildlife habitat and recreational activities. The FERC Agreement describes numerous multi-benefit habitat restoration actions that are required for this reach of the Feather River. These actions include excavation of the Feather River banks and lowering of adjacent, landside areas to re-connect the river with its disconnected floodplain. The FERC Agreement also requires the excavation of additional side channels that would provide important salmonid spawning habitat and refugia during high-water events as well as the restoration of riparian and wetland habitats to provide habitat for a variety of terrestrial species and shaded riverine aquatic habitat for fish.	$ 5,000,000	$ 5,000,000	$ -	Capital	Rural - Habitat restoration/reconnection	Natural Floodplain and Ecosystem Functions
245	Three Rivers Levee Improvement Authority	Phase IV—Complete WPRR levee improvements	Project for additional work that needed to be completed along the Western Pacific Railroad Canal levee to meet the State 200-year levee design criteria.	$ 15,228,000	$ -	$ -	Capital	Urban - Levee improvements	Flood Infrastructure
246	Reclamation District 563	PL 84-99 Levee Improvement Project – Tyler Island	After the entire levee meets or exceeds the HMP Criteria, the District will bring any remaining portions of levee below the PL 84-99 Standard to six inches above the PL 84-99 Standard. Divided into several phases as funding is available. Est. Total length of additional improvements of 64,054 LF. Completion time of 2 year.	$ 15,122,000	$ 15,122,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Flood Infrastructure
247	City of West Sacramento	Port North Levee	Improve with a floodwall approximately oriented at an offset, internally, to the property line of the Port. That alignment would maintain a minimum 25-ft offset from local railways and would require two closure structures at the east end of the property.	$ 37,650,000	$ -	$ -	Capital	Urban - Levee improvements	Flood Infrastructure
248	City of West Sacramento	Port South Levee	Improve with a combination of waterside slope flattening, a section of floodwall, and a section of cutoff wall.	$ 9,049,000	$ -	$ -	Capital	Urban - Levee improvements	Flood Infrastructure
249	N/A	Princeton 100-Year Level of Protection	Provide Princeton with a 100-Year level of protection	$ -	$ -	$ -	Ongoing	Small Community - Studies and analysis	Watershed and Floodplain Management
250	California Department of Water Resources	Property acquisition, demo & disposal - Phase 2		$ 229,360,000	$ 57,340,000	$ -	Capital	Small Community - Levee setbacks, land acquisitions and habitat restoration	Watershed and Floodplain Management
251	California Department of Water Resources	Property acquisition, demo & disposal - Phase 2		$ 114,680,000	$ 28,670,000	$ -	Capital	Small Community - Levee setbacks, land acquisitions and habitat restoration	Watershed and Floodplain Management
252	California Department of Water Resources	Property acquisition, demo & disposal - Phase 2		$ 229,360,000	$ 57,340,000	$ -	Capital	Small Community - Levee setbacks, land acquisitions and habitat restoration	Watershed and Floodplain Management
253	California Department of Water Resources	Property acquisition, demo & disposal - Phase 3		$ 229,360,000	$ 172,020,000	$ -	Capital	Small Community - Levee setbacks, land acquisitions and habitat restoration	Watershed and Floodplain Management
254	California Department of Water Resources	Property acquisition, demo & disposal - Phase 3		$ 114,680,000	$ 86,010,000	$ -	Capital	Small Community - Levee setbacks, land acquisitions and habitat restoration	Watershed and Floodplain Management
255	California Department of Water Resources	Property acquisition, demo & disposal - Phase 3		$ 229,360,000	$ 182,020,000	$ -	Capital	Small Community - Levee setbacks, land acquisitions and habitat restoration	Watershed and Floodplain Management
256	M&T Ranch	Protect M&T/Llano Seco Pumping Facilities	Develop a long term solution to address current meandering of the Sacramento River which is resulting in the need for dredging of the river to keep M&T/Llano Seco pump facilities operational.	$ 500,000	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance

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257	Reclamation District 2068, Yolano	Pump State #5 Modernization	Pump Station #5 is the only large capacity pump station capable of evacuating interior drainage from the Cache – Haas Area during large storm events. The pump house and discharge pipes are in need replacement. The modernization of this pump station on Shag Slough at LM 5.5 of Unit 1 is necessary to avoid flood damages. Pump station modernization is estimated to cost less than $3M.	$ 3,000,000	$ 3,000,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
258	TBD	Purchase of Agricultural Easements	Agricultural easements could be purchased from willing sellers on farmland along the landside of the Feather River levee. Agricultural easements would support ongoing agricultural activities and local communities while limiting urban development within the Feather River floodplain and providing opportunities for the implementation of wildlife-friendly farming practices and targeted habitat restoration actions. Compatible habitat restoration actions could include planting of native plant hedgerows along drainage canals and roadsides, construction or enhancement of ponds and other wetland habitats, and integration of native species, particularly native grasses, into agricultural areas where compatible with normal farming practices.	$ -	$ -	$ -	Capital	Rural - Land acquisitions and easements	Watershed and Floodplain Management
259	City of Davis	Putah Creek Capacity Study	Experience in 1997 shows that Putah Creek will flood, but the extent of possible flooding is not known. An existing capacity study of Putah Creek is recommended to determine if it meets design flow objectives in its current condition.	$ 500,000	$ 500,000	$ 25,510	Ongoing	Urban - Studies and analysis	Watershed and Floodplain Management
260	Reclamation District 10, Honcut	RD 10 Critical Seepage Repair		$ 310,000	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
261	Wheatland	RD 2103 Dry Creek Study, Design & Construction	Implement Dry Creek south levee 200-year ULDC levee improvements based on results of the feasibility study.	$ 56,767,000	$ 56,767,000	$ -	Capital	Small Community - Levee repair and infrastructure improvements	Flood Infrastructure
262	Wheatland	RD 2103 Flood System Repair Project All Weather Patrol Roads Construction		$ 240,000	$ 240,000	$ 12,245	Ongoing	Systemwide - Emergency management	Emergency Management
263	Wheatland	RD 2103 Levee Improvements	Evaluate, design, and construct levee improvements to achieve USACE project levee geometry and stability standards- prioritized based on risk remaining segments in RD 2103.	$ 4,252,000	$ 4,252,000	$ -	Capital	Small Community - Levee repair and infrastructure improvements	Flood Infrastructure
264	Three Rivers Levee Improvement Authority	RD 784 Site 7 Relief Well Rehabilitation Construction		$ 100,000	$ 100,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
265	Wheatland	RD 817 Flood System Repair Project All Weather Patrol Roads Construction		$ 270,000	$ 270,000	$ 13,775	Ongoing	Systemwide - Emergency management	Emergency Management
266	Wheatland	RD 817 Levee Improvements	Evaluate, design, and construct levee improvements to achieve USACE project levee geometry and stability standards- prioritized based on risk; remaining segments in RD 817.	$ 100,058,000	$ 100,058,000	$ -	Capital	Small Community - Levee repair and infrastructure improvements	Flood Infrastructure
267	Reclamation District 10, Honcut	Reclamation District 10 Rural levee Repair Project	Evaluate, design, and construct levee improvements in RD 10 to achieve USACE standards for this rural community	$ 175,657,000	$ 175,657,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Flood Infrastructure
268	N/A	Regional Programmatic Permitting	Develop regional program level permitting to streamline permit acquisition, similar to the DWR approach with the Small Erosion Repair Program (SERP). Actions to be considered for inclusion: • Programmatic EIR for series' of actions that can be characterized as one large project. • Master or Programmatic Streambed Alteration Agreements: obtained to cover a large, multi-phased project consisting of smaller specific projects for which detailed project plans are not available at the time the SAA is applied for. • USACE Regional General Permit (RGP): issued by a USACE district or division and authorizes a class of activities within a geographic region that are similar in nature and have minimal individual and cumulative environmental effects.	$ 500,000	$ 500,000	$ 25,510	Ongoing	Systemwide - State operations, planning and performance tracking	Programmatic, or Project-Specific Permitting
269	City of West Sacramento	Regional Trails Initiative	Develop a plan for a world class system of recreational corridors, greenways and bicycle-pedestrian trail connections in the greater Sacramento region portion of the Delta, which provides enriching experiences and ties into and enhances the existing flood protection system, providing not only recreational value, but also serving to promote agri-tourism, alternative commutes and other regional economic opportunities. Recreation, including bicycle and pedestrian access, is critical to agri-tourism and the long term viability of a sustainable ag economy.	$ 300,000	$ 300,000	$ 15,306	Ongoing	Systemwide - State operations, planning and performance tracking	Policy and Regulations
270	N/A	Repair Critical Erosion Site	A critical erosion site exists in the Phelan levee upstream of the M&T weir at R.M. 192.5. A breach at this site would result in major changes to the hydraulics of the Butte Basin.	$ 100,000	$ 100,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
271	Reclamation District 1001, Nicolaus	Repair, replace, or abandon existing drains and pipes through the levees	Project for replacement and repair expected to be completed by farmer. District would only abandon. Grouting 2/mile. 14" pipe 70' total length. Assumed 10' below WSE	$ 86,680	$ -	$ -	Capital	Small Community - Levee repair and infrastructure improvements	Operation and Maintenance
272	Reclamation District 1001, Nicolaus	Replace or improve Main Drain pumping plant	The RD 1001 Main Drain Pumping Plant is an SPFC facility along the Natomas Cross Canal right bank. The levee and pumping plant were constructed in 1917 and require significant (60KV dedicated) power to operate. This project would upgrade the pumps, power supply, and add redundancy and backup power to the facility. The pumping plant is an SPFC facility installed when the NCC cutoff natural drainage to the Feather River.	$ 8,000,000	$ 8,000,000	$ 408,154	Ongoing	Rural - Risk awareness, floodproofing and land use planning	Watershed and Floodplain Management
273	Reclamation District 1001, Nicolaus	Re-Rock levee crown patrol roads	Project to re-rock levee crown patrol roads – AB for 75% of levees in district	$ 943,811	$ 943,811	$ 48,153	Ongoing	Systemwide - Emergency management	Emergency Management
274	Three Rivers Levee Improvement Authority	Resolve ROW and encroachment issues for levees protecting urban areas	Project to resolve ROW and encroachment issues for levees protecting urban areas.	$ 10,000,000	$ 10,000,000	$ 510,193	Ongoing	Systemwide - State operations, planning and performance tracking	Policy and Regulations
275	N/A	Richvale 100-Year Level of Protection	Provide Richvale with a 100-Year level of protection	$ -	$ -	$ -	Ongoing	Small Community - Studies and analysis	Watershed and Floodplain Management

Table B-4. Sacramento Basin Management Actions Included within the 2017 Refined SSIA Portfolio

#	Lead Agency	Project Name	Project Description	Estimated Cost - Provided by Source	Adjusted Estimated Cost - Present Value ($)	Adjusted Estimated Cost - Annualized ($/year)	Investment Type	Area of Interest and Management Action Category	Management Action Type
276	City of Rio Vista	Rio Vista Flood Risk Reduction	Develop and implement a 200–year flood protection program for the City of Rio Vista that also anticipates and accommodates any increased stages associated with upstream bypass expansion, sea level rise, or climate change. $500,000 for feasibility study.	$ 500,000	$ 500,000	$ 25,510	Ongoing	Small Community - Studies and analysis	Watershed and Floodplain Management
277	N/A	Robbins 100-Year Level of Protection	Provide Robbins with a 100-Year level of protection	$ -	$ -	$ -	Ongoing	Small Community - Studies and analysis	Watershed and Floodplain Management
278	Sutter County	Robbins Backup Power Supply	Install a new backup power supply at the Robbins' wastewater treatment plant. An alternative power source at the pump station is needed. During a high water situation in the Valley, if the pumps fail because the power goes out, the town of Robbins and the entire Sutter basin could flood.	$ 500,000	$ 500,000	$ 25,510	Ongoing	Small Community - Risk awareness, floodproofing and land use planning	Watershed and Floodplain Management
279	Reclamation District 307, Lisbon Island	Rock Slope Protection Project – Lisbon	RD 307 plans first to ensure the protection of the existing levee by adding supplementary quarry stone riprap above the existing riprap to any portions of the waterside slope of the levee requiring additional rock slope protection. This will prevent erosion and avoid ongoing repairs.	$ 4,216,000	$ 4,216,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
280	Reclamation District 501, Ryer Island	Rock Slope Protection Project – Ryer Island	RD 501 plans first to ensure the protection of the existing levee by adding supplementary quarry stone riprap above the existing riprap to any portions of the waterside slope of the levee requiring additional rock slope protection. This will prevent erosion and avoid ongoing repairs.	$ 7,337,000	$ 7,337,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
281	Reclamation District 563	Rock Slope Protection Project – Tyler Island	RD 563 plans first to ensure the protection of the existing levee by adding supplementary quarry stone riprap above the existing riprap to any portions of the waterside slope of the levee requiring additional rock slope protection. This will prevent erosion and avoid ongoing repairs.	$ 841,000	$ 841,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
282	Reclamation District 10, Honcut	Rodent Control - Reclamation District 10	Project for rodent control and burrow mitigation to address known seepage and structural levee issues.	$ 949,850	$ -	$ -	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
283	California Department of Water Resources	Sacramento BWFS Contingency on all Projects		$ -	$ 365,000,000	$ -	Capital	Systemwide - Yolo Bypass multi-benefit improvements	Flood Infrastructure
284	California Department of Water Resources	Sacramento Bypass Ecosystem Implementation	Improve fish passage, reduce stranding, preserve levee remnants for upland refugia, and preserve existing riparian, wetland and upland grassland areas.	$ 14,000,000	$ 4,437,800	$ -	Capital	Systemwide - Yolo Bypass multi-benefit improvements	Natural Floodplain and Ecosystem Functions
285	California Department of Water Resources	Sacramento Bypass Levee Setback	A corresponding 1,500-feet expansion of the Sacramento Bypass, and associated ecosystem restoration actions. The riparian corridor along the southern channel would be 330 feet wide.	$ 429,000,000	$ 430,562,200	$ -	Capital	Systemwide - Yolo Bypass multi-benefit improvements	Flood Infrastructure
286	Brannan-Andrus Levee Maintenance District	Sacramento River Bank Protection Project - LM 3 to LM 7	Bank protection project LM 3 to 7, Rehabilitated Length of 2,145 LF.	$ 2,432,000	$ 2,432,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
287	Reclamation District 150, Merritt Island	Sacramento River Bank Protection Project – Merritt Island	Waterside Bank Protection and Rehabilitation project at 4 sites, 1,200 LF, LM 2.04 to 2.16, 3.38, 3.48 and 4.58 to 4.65. Enhanced lower waterside slope habitat area with possible Riparian Forest, Scrub-Shrub, and emergent/freshwater marsh to mitigate or enhance the habitat value.	$ 1,361,000	$ 1,361,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
288	Reclamation District 341, Sherman Island	Sacramento River Bank Protection Project – Sherman Island	4 erosion sites along the Sacramento River that can be improved through the construction of a bank protection project along Cache Slough which will rehabilitate the waterside bank from levee mile 4.12 to 6.09, 1,994 LF.	$ 2,261,000	$ 2,261,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
289	Reclamation District 556, Upper Andrus Island	Sacramento River Bank Protection Project – Upper Andrus	2 erosion sites that would be improved through the construction of a bank protection project along that Sacramento River Slough, rehabilitated length of 1,700 LF, LM 0.31 to 3.25.	$ 1,928,000	$ 1,928,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
290	Reclamation District 999, Netherlands	Sacramento River Erosion Repair Project – Netherlands	1,600 LF erosion repair south of the Clarksburg Marina. At one point was listed 'high' on USACE Sac Bank Project, but has since been reduced on the list. Estimated 35,000 tons of gravel and 40,000 tons of imported fill will be used. 3 year completion time.	$ 2,067,000	$ 2,067,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
291	California Department of Water Resources	Sacramento River General Reevaluation Report	State-Federal Feasibility Study projects that DWR could partner in.	$ 4,000,000	$ 4,000,000	$ 204,077	Ongoing	Urban - Studies and analysis	Watershed and Floodplain Management
292	Knights Landing Drainage District	Sacramento River Levee (sites 9, 10, and 11)	Work on the Sacramento River levee would be conducted at sites 9, 10, and 11, between river miles 70 and 113 southeast of Knights Landing. These sites are located on the gravel maintenance road on top of the levee between the river and Yolo County Road 116B. - Site 9 starts approximately 1 mile east of Knights Landing at river mile (RM) 87.2 and extends 793 feet downstream to RM 87.1. - Site 10 starts approximately 1,584 feet downstream of site 9 at RM 86.8 and extends 878 feet downstream to RM 86.7. - Site 11 starts approximately 1.5 miles downstream of site 10 at RM 85.2 and extends 1.05 miles (5,555 feet) downstream to RM 84.1 along County Road 116B, just down river from sites 9 and 10. Remediation work at sites 9, 10, and 11 would consist of installing a soil/bentonite cutoff wall, of various lengths and depths, to reduce seepage. The work would involve (1) degrading the existing top of the levee down 4 to 5 feet to create a level working surface to install the cutoff wall and (2) excavating a trench 3 feet wide and at least 21 feet deep down through the crown of the levee, as follows: - Site 9 cutoff wall depth would vary from 26.27 feet to 31.08 feet deep. - Site 10 cutoff wall depth would vary from 23.04 feet to 26.38 feet deep. - Site 11 cutoff wall depth would vary from 21.00 feet to 116.75 feet deep, as follows: .900 feet (Stations 0+00 to 9+00) would be 21.00 feet to 27.04 feet deep. . 700 feet (Stations 9+00 to 16+00) would be 24.95 feet to 26.15 feet deep. . 800 feet (Stations 16+00 to 24+00) would be 23.52 to 25.3 feet deep. . 3155 feet (Stations 24+00 to 55+57) would be 113.48 feet to 116.75 feet deep.	$ 32,000,000	$ 32,000,000	$ -	Capital	Small Community - Levee repair and infrastructure improvements	Operation and Maintenance
293	Sacramento Area Flood Control Agency, United States Army Corp of Engineers	Sacramento River Levee Improvements	Sacramento River downstream of the mouth of the American River focus of substantial erosion control and seepage remediation efforts. Additional work will be needed to address levee embankment and foundation vulnerabilities which is likely to include construction of a combination of cutoff walls and relief wells over a distance of up to eight miles along various segments of the east levee between Freeport and Sutterville Road as well as remedial work to the floodwall between Interstate 50 and the Tower Bridge. $390M USACE, $147M DWR, $63M SAFCA	$ 600,000,000	$ -	$ -	Capital	Urban - Levee improvements	Flood Infrastructure

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294	Brannan-Andrus Levee Maintenance District	Sacramento River Revetment and Shaded Riverine Aquatic (SRA) Habitat Enhancement	Rebuild the slope and create a stable foundation for an eco-berm and a SRA habitat bench.	$ 2,584,000	$ 2,584,000	$ -	Capital	Rural - Habitat restoration/reconnection	Natural Floodplain and Ecosystem Functions
295		Sacramento River RT 35 to 46 Left and Right Bank Enhancements	The project involves the planting of small trees and shrubs along the shoreline of the cobble lined banks of the Sacramento River. Potential exists for the narrow but extensive creation of shallow cover for ¡juvenile fish along currently barren banks.	$ 2,600,000	$ 2,600,000	$ -	Capital	Urban - Other infrastructure and multi-benefit improvements	Natural Floodplain and Ecosystem Functions
296		Sacramento River RT 49.5 Left Bank Enhancements	The potential project involves planting riparian species in the unvegetated gaps along the left bank of the Sacramento River.	$ 1,900,000	$ 1,900,000	$ -	Capital	Urban - Other infrastructure and multi-benefit improvements	Natural Floodplain and Ecosystem Functions
297		Sacramento River RT 49.5 Right Bank Enhancements	The potential design concept includes creating a shallow water bench and planting riparian species in unvegetated gaps along the right bank downstream of the existing riparian forest at the Babel Slough confluence.	$ 1,900,000	$ 1,900,000	$ -	Capital	Urban - Other infrastructure and multi-benefit improvements	Natural Floodplain and Ecosystem Functions
298	Reclamation District 1600, Mull	Sacramento River Scour Hole Repair	8 Miles north of Road 117 and Old River, there are 3 large, deep scour holes, 8 ft. off the water side levee toe that would need to be repaired to increase the levee stability. Similar project cost estimate: Grand Island Erosion/Bank $1,550,000	$ 1,550,000	$ 1,550,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
299	Reclamation District 3, Grand Island	Sacramento River Seepage Control Project 2 – Grand Island	Critical seepage site located between LM 8.24 and 8.30 along the Sacramento River, with a total rehabilitated length of 300 LF which consists of rock and fill placement to control seepage.	$ 194,000	$ 194,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
300	California Department of Water Resources	Sacramento River Seepage Protection Project – Cache Creek	8,150 LF repair for multiple serious and critical seepage sites in Maintenance Area 9 that DWR plans to construct a seepage protection project along the Sacramento River to repair these locations. Project would consist of rock and fill to control the seepage. LM 10.7 to 18.1.	$ 5,264,000	$ 5,264,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
301	Reclamation District 150, Merritt Island	Sacramento River Seepage Protection Project – Merritt Island	275 LF Seepage protection project along the Sacramento River, from LM 5.9 to 5.95. Will consist of rock and fill to control seepage.	$ 178,000	$ 178,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
302	Reclamation District 755, Randall Island	Sacramento River Seepage Repair Project – Randall	4,000 LF repair for multiple seepage sites that can be repaired through construction of a seepage protection project along the Sacramento River which would consist of rock and fill to control the seepage. LM 0.1 to 0.9.	$ 2,583,000	$ 2,583,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
303	Reclamation District 556, Upper Andrus Island	Sacramento River Seepage Repair Project – Upper Andrus	Critical seepage site that would be repaired with the construction of a seepage protection project along the Sacramento River that would be 1950 LF from LM 3.58 to 3.95 that would consist of rock and fill to control seepage.	$ 1,259,000	$ 1,259,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
304		Sacramento River Tile 70 Right Floodplain Lowering and Backwater Slough Enhancement	The design concept is to excavate the existing floodplain to create more frequently activated floodplain (FAF) and enhance the existing backwater slough. This would require the removal of onsite vegetation, which includes a mix of mature riparian vegetation and non–native vegetation. Due to the vegetation density, the removal of some mature riparian vegetation would be inevitable and would require mitigation.	$ 1,000,000	$ 1,000,000	$ -	Capital	Rural - Habitat restoration/reconnection	Natural Floodplain and Ecosystem Functions
305	City of West Sacramento	Sacramento River West North Levee Balance of Reaches	Combination of cutoff walls (conventional and deep soil mixed) and raised levees, with waterside slope flattening.	$ 77,702,000	$ -	$ -	Capital	Urban - Levee improvements	Flood Infrastructure
306	City of West Sacramento	Sacramento River West South Levee (Southport Early Implementation Project)	3.6 mile combination of setback levee, adjacent levee, slope flattening, cutoff walls and landside seepage berms, with offset areas that are to be converted to floodplain and habitat restoration features.	$ 190,000,000	$ -	$ -	Capital	Urban - Other infrastructure and multi-benefit improvements	Flood Infrastructure
307		Sacramento Weir and Bypass	Support widening through authorization and implementation of the American River Watershed, Common Features, General Reevaluation Report (GRR) currently under development by the US Army Corps of Engineers (USACE).	$ 435,000,000	$ -	$ -	Capital	Systemwide - Yolo Bypass multi-benefit improvements	Flood Infrastructure
308	California Department of Water Resources	Sacramento Weir Expansion	A 1,500 feet expansion of Sacramento Weir.	$ -	$ -	$ -	Capital	Systemwide - Yolo Bypass multi-benefit improvements	Flood Infrastructure
309	Reclamation District 827, Elkhorn	Sac-Yolo North Systemwide Improvements Framework Plan	RD 827 levees are currently inactive in the NFIP and are ineligible for PL84-99 post flood assistance. RD 827 would like to work with its neighboring LMAs to prepare a Sac-Yolo North Systemwide Improvement Framework (SWIF) Plan so the system could regain PL84-99 eligibility. However, the LMAs currently lack the resources to develop a SWIF and would require grant funding assistance to do so.	$ 300,000	$ 300,000	$ 15,306	Ongoing	Rural - Studies and analysis	Watershed and Floodplain Management
310	N/A	Safe Harbor Agreements	A Safe Harbor Agreement is a voluntary agreement between any non-Federal property owner(s) and the USFWS or the National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (collectively, the Services) whereby performing actions that contribute to the recovery of listed species and fulfilling the conditions of the Safe Harbor Agreement, the property owner(s) will receive formal assurances from the Services that they will not require any additional or different management activities by the parties without their consent.	$ -	$ -	$ -	Ongoing	Systemwide - State operations, planning and performance tracking	Policy and Regulations
311	Reclamation District 10, Honcut	Seepage and under seepage site remediation	Preliminary, Planning Level project. Detailed project description not available at this time.	$ 1,623,050	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
312	Reclamation District 1601, Twitchell Island	Sevenmile Slough Crown Raising to Hazard Mitigation Plan (HMP) Project	Bring portions of the levee currently below the HMP Criteria above the PL 84-99 Standard. Would not likely be initiated until the San Joaquin River Levee Improvement Project is complete, which could take approximately 10 years.	$ 22,331,000	$ 22,331,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Flood Infrastructure
313	Yolo County	Small Community Flood Risk Reduction	Develop feasibility study to identify cost effective means to achieve protection against the base flood for the towns of Knights Landing and Yolo and implement the identified solution. Both towns appear to have viable levee improvement projects. $500,000 per Small Community.	$ 1,000,000	$ 1,000,000	$ 51,019	Ongoing	Small Community Studies and analysis	Watershed and Floodplain Management
314	Sutter Butte Flood Control Agency	Small Community Levee Reliability Study	Study to evaluate risk reduction alternatives for small communities of Sutter and Wilson in Sutter County. Small Community Study. Communities are protected by SPFC Facilities.	$ 995,000	$ 995,000	$ 50,764	Ongoing	Small Community Studies and analysis	Watershed and Floodplain Management
315	Tehama County Flood Control and Water Conservation District	Small Community of Gerber Feasibility Study	Feasibility Study for providing a 100-year level of protection to Gerber.	$ 500,000	$ 500,000	$ 25,510	Ongoing	Small Community Studies and analysis	Watershed and Floodplain Management

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316	Reclamation District 554, Walnut Grove	Snodgrass Slough Landside Fill and Minor Crown Raising – Walnut Grove	Two crucial long term goals maintain levee height and improve stability. Proposed projects include landside fill and minor crown-raising on the Snodgrass Slough levee.	$ 1,126,000	$ 1,126,000	$ -	Capital	Small Community - Levee repair and infrastructure improvements	Operation and Maintenance
317	Reclamation District 554, Walnut Grove	Snodgrass Slough Road and Old Walnut Grove Road Crown Raising – Walnut Grove	Two crucial long term goals maintain levee height and improve stability. Proposed projects include crown- raising on the Snodgrass Slough Road and Old Walnut Grove Road.	$ 103,000	$ 103,000	$ -	Capital	Small Community - Levee repair and infrastructure improvements	Operation and Maintenance
318	City of West Sacramento	South Cross Levee	Combination of slope flattening, short cutoff wall and an adjacent levee raise with an interior drainage system.	$ 11,684,000	$ -	$ -	Capital	Urban - Levee improvements	Flood Infrastructure
319	Sacramento Area Flood Control Agency, United States Army Corp of Engineers	South Sacramento Streams Group	Authorized by Congress in 1999, the project includes levee, channel, and flood wall improvements along Morrison Creek and its tributaries generally west of Franklin Boulevard. Work is now substantially complete with only a series of floodwall improvements and a detention basin along Florin Creek remaining and is expected to be carried out by the end of 2014. Improvements to the major levees included in the South Sacramento Streams Group (SSSG) Project have been underway for several years in order to provide increased flood protection to the southern portions of the City of Sacramento and relieve property owners in this area of the NFIP requirement to maintain high cost flood insurance. Floodwall improvements and a detention basin along Florin Creek are being constructed in 2014 and 2015 at a cost of approximately $15.0 million. This work will complete the project and raise total project expenditures to approximately $104.0 million.	$ 15,000,000	$ -	$ -	Capital	Urban - Levee improvements	Flood Infrastructure
320		Southport Early Implementation Project (EIP) Riparian Enhancement	The potential project involves enhancing the levee setback areas by planting native riparian species. The north setback area encompasses approximately 36 acres, the south setback area encompasses approximately 113 acres. These setback areas would be frequently inundated with implementation.	$ 7,200,000	$ 7,200,000	$ -	Capital	Urban - Other infrastructure and multi-benefit improvements	Natural Floodplain and Ecosystem Functions
321	Sutter Butte Flood Control Agency	Star Bend South Critical Repair		$ 8,800,000	$ 8,800,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
322	Sutter Butte Flood Control Agency	Star Bend to Laurel Avenue	Levee Improvements from Star Bend to Laurel Avenue.	$ 60,000,000	$ 60,000,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
323	California Department of Water Resources	State Operation in Support of 30-year Implementation	Activities and costs associated with State Operations for implementation of a 30 year program.	$ -	$ 180,000,000	$ 9,183,467	Ongoing	Systemwide - State operations, planning and performance tracking	Policy and Regulations
324	California Department of Water Resources	State Policy, Planning, and Performance Tracking	Activities and costs associated with State Policy, Planning and Performance tracking.	$ 250,000,000	$ 250,000,000	$ 12,754,815	Ongoing	Systemwide - State operations, planning and performance tracking	Policy and Regulations
325	Reclamation District 349, Sutter Island	Steamboat Slough Bank Protection Project – Sutter Island	Two erosion sites along Steamboat Slough that can be improved through the construction of a bank protection project along Cache Slough which will rehabilitate 300 LF of the waterside bank from LM 1.3 to 1.4 and 2.5.	$ 340,000	$ 340,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
326	Reclamation District 3, Grand Island	Steamboat Slough Seepage Control Project – Grand Island	Seepage control project on Steamboat Slough, between Stations 280+00 to 290+00. The project would consist of rock and fill to control the flow to the drainage pipes that will capture seepage and discharge in the lateral, and eventually into a district canal. Est. 40,000 tons of fill and 35,000 tons of gravel. Completion time of 3-years.	$ 1,757,000	$ 1,757,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
327	California Department of Fish and Wildlife, Federal Energy Regulatory Commission	Sunset Weir	Sunset Weir forms a forebay for Sunset Pumping Plant on the Feather River near Live Oak. The rock weir is the number one fish barrier on the Feather River to migrating salmonids and other species. It also impedes flood flows and is a recreation barrier. Removal would provide benefits to flood conveyance, fish passage, recreation, and channel maintenance. Project provides multiple benefits along the Feather River right bank levee near the City of Live Oak.	$ 2,000,000	$ 2,000,000	$ -	Capital	Rural - Habitat restoration/reconnection	Natural Floodplain and Ecosystem Functions
328	United States Fish and Wildlife Service	Sutter Bypass Sediment Removal	Remove sediment from the bypass to improve flood conveyance and reduce impediments to fish passage	$ 50,000,000	$ -	$ -	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
329	California Department of Fish and Wildlife	Sutter Bypass Wildlife Area	Opportunities to improve aquatic habitat, restore riparian woodland, or create other habitats are limited by the narrow strips of State-owned land that characterize much of the wildlife area. However, selective planting of riparian vegetation could occur in locations that currently lack riparian habitat to provide a continuous corridor of habitat along the Sutter Bypass levees, so long as the vegetation does not reduce the conveyance capacity of the bypass. Additionally, there are significant opportunities to encourage wildlife-friendly farming practices within the Sutter Bypass since the majority of the Bypass is privately-owned and actively farmed.	$ 3,000,000	$ 3,000,000	$ -	Capital	Rural - Habitat restoration/reconnection	Natural Floodplain and Ecosystem Functions
330	Sutter Butte Flood Control Agency	Sutter Bypass/Wadsworth Critical Repairs		$ 460,000	$ 460,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
331	Sutter Butte Flood Control Agency, Yuba County Water Agency, Three Rivers Levee Improvement Authority	Sutter Main Canal relocation to enhance salmonid temperature control and improve maintenance efficiency (FERC Process)	Project to relocate of the this canal along the Feather River right bank levee that poses seepage risk, causes frequent levee sloughing, and impedes maintenance and flood fighting activities. In addition to flood benefits, relocation of the Sutter Canal as proposed by DWR would move the intake to Thermalito therefore eliminating the need for an intake on the river which would also result in improvements to fish passage and recreation due to the elimination of the existing weir diversion. Project provides multiple benefits along the Feather River right bank levee near the City of Live Oak.	$ -	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
332	United States Fish and Wildlife Service	Sutter National Wildlife Refuge	Ducks Unlimited and California Waterfowl have completed some improvements to the canal system, but additional improvements to the water supply system would be beneficial. Habitat restoration actions could include targeted treatment of invasive species, particularly Bermuda grass (Cynodon dactylon), to improve the habitat values of existing wetlands and the targeted restoration of riparian habitat where needed to create a continuous corridor of riparian vegetation throughout the Sutter Bypass and where the planting of riparian vegetation would not adversely affect the Sutter Bypass' ability to convey water during flood events. Finally, there are also extensive opportunities to introduce and encourage wildlife friendly farming practices on private lands within the Sutter Bypass.	$ 1,500,000	$ 1,500,000	$ -	Capital	Rural - Habitat restoration/reconnection	Natural Floodplain and Ecosystem Functions

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333	Reclamation District 999, Netherlands	Sutter Slough Erosion Repair Project – Netherlands	The Sutter Slough erosion repairs are along multiple sites that have developed over many years. The primary concern with repairing these sites is the heavy vegetation which could require expensive mitigation. This Plan recommends that the vegetation be avoided or, where not able to be avoided, the loss be mitigated. Prior to initiating the planning phase, the sites along Sutter Slough will be surveyed or evaluated. The unknown depths of the erosion scour at these sites are a major concern to the District. The cost of the construction of the project includes: the environmental documentation, permitting, design, mitigation, construction, and enhancement components. It is anticipated that approximately 10,000 tons of riprap quarry stone and 2,500 tons of imported fill will be used. Assuming the financing is secured, the project will take approximately two years to complete.	$ 775,000	$ 775,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
334	Reclamation District 349, Sutter Island	Sutter Slough Seepage Repair Project - Sutter Island	There are two critical seepage sites in RD 349 identified in the FSRP. The sites would be repaired with the construction of a seepage protection project along Sutter Slough. The seepage protection project would be 1,000 feet long from approximately levee mile 0.04 and 3.01 to 3.05. The seepage control project would consist of multiple gradations of rock and fill to control the seepage.	$ 646,000	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
335	Sacramento Area Flood Control Agency, United States Army Corp of Engineers	System Operation and Maintenance	Long-term operation and maintenance risk based program that will address levee vegetation and access issues consistent with the requirements of the NFIP and DWR's urban levee design criteria. Lower risk veg and encroachments will be monitored and addressed as part of long term System Wide Improvement Frameworks (SWIF's) developed by the local maintaining agencies. Estimated cost: $4,800,000 per year, present value for 30 years at 3% $94,082,118.	$ 94,082,118	$ -	$ -	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
336	Reclamation District 827, Elkhorn	Systemwide Beneficiaries O&M Subvention Program	The levees maintained by RD 827 provide systemwide, regional benefits, and are integral to the overall region's flood safety. RD 827 would like to evaluate the potential development of an O&M subventions-type program to augment the District's funding of O&M for systemwide facilities.	$ 100,000	$ 100,000	$ 5,102	Ongoing	Systemwide - State operations, planning and performance tracking	Policy and Regulations
337	N/A	Systemwide Improvement Framework	Prepare System Wide Improvement Frameworks for project levee systems to restore PL84-99 eligibility	$ 1,000,000	$ 1,000,000	$ 51,019	Ongoing	Rural - Studies and analysis	Watershed and Floodplain Management
338	Knights Landing Drainage District	Systemwide Improvement Framework (SWIF)	This project is one of Knights Landing's recommendation alternatives to accompany the feasibility study that will address the community's levee embankment and foundation stability problems.	$ 150,000	$ 150,000	$ 7,653	Ongoing	Small Community - Studies and analysis	Watershed and Floodplain Management
339	Tehama County Flood Control and Water Conservation District, Tehama County	Tehama Flood Mitigation Plan (FMP) Projects	Implement Flood Mitigation Plan	$ 1,000,000	$ 1,000,000	$ 51,019	Ongoing	Systemwide - State operations, planning and performance tracking	Policy and Regulations
340	Tehama County Public Works, Tehama County	Tehama Hazard Mitigation Plan (HMP) City of Tehama Projects	Implement a plan to keep brush & debris clear from Tehama Simpson Slough. Analyze solutions to Gyle Rd flooding & funding sources. Improve barricading of Gyle Rd during flooding, & repair culvert on Gyle Rd for drainage of Oak Creek, Elevate or move City Hall to a structure with lower risk for flooding,	$ 1,000,000	$ -	$ -	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
341	Tehama County Public Works, Tehama County	Tehama Hazard Mitigation Plan (HMP) County Wide Projects	Implement HMP measures	$ 500,000	$ 500,000	$ 25,510	Ongoing	Systemwide - Emergency management	Emergency Management
342	Tehama County Public Works, Tehama County	Tehama Hazard Mitigation Plan (HMP) Unincorporated County Projects	Identify and implement a feasible risk reduction solution to the flooding problems around Corning along the Jewett and Burch Creek flood plain.	$ 1,000,000	$ 1,000,000	$ 51,019	Ongoing	Rural - Studies and analysis	Watershed and Floodplain Management
343	California Department of Water Resources	The 3B's Weir Improvements	Restore 3B's Weir elevation so overflows into Butte Basin when the Sacramento River do not occur below flood stage. Improvements are needed to raise the weir and then harden it so that the weir does not degrade in the future. Premature overflows from the 3B's weir result in damages to agricultural lands and infrastructure, and result in numerous road and bridge closures such as Hwy 162 and Ord Ferry (in 1995, Hwy 162 east of Butte City was closed for 26 days).	$ 1,000,000	$ 1,000,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
344	Reclamation District 1601, Twitchell Island	Three-mile Slough Bank Protection Project	There are additional critical and serious erosion and seepage sites in RD 1601 from the FSRP that are not addressed by improvements from its 5 year plan. RD 1601 plans to construct a large bank protection project along Threemile Slough to protect erosion and seepage sites. The project will rehabilitate the waterside bank and incorporate an enhanced lower waterside slope habitat area with possible riparian forest, scrub-shrub, and emergent/freshwater marsh features to mitigate for loss of habitat and enhance the habitat value along the slough. The erosion protection will be approximately 1,320 feet from levee mile 1.09 to 1.1, and the seepage protection will be approximately 2,500 feet from levee mile 1.5 to 1.95.	$ 4,332,000	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
345	California Department of Water Resources	Tie in to Deep Water Ship Channel	A gated weir to tie into the DWSC (Central or South tie-in). With appropriate agreements with USACE, local land use agencies, and Port of West Sacramento operators, a 1,000-foot gated weir structure would be constructed in the navigation levee on the west side of the DWSC to allow more than 60,000 cfs of flood waters to spill into it during a major flood event. This would restore the flow capacity of the Yolo Bypass that existed before the DWSC was completed in 1963. The Weir would be located immediately downstream of the South Cross Levee, which defines the southern boundary of RD 900.	$ 240,000,000	$ 240,000,000	$ -	Capital	Systemwide - Yolo Bypass multi-benefit improvements	Flood Infrastructure
346	Three Rivers Levee Improvement Authority	Toe Access Corridor - Upper Bear River	Acquire toes access corridor along urban levee to meet ULDC criteria	$ 20,000	$ 20,000	$ -	Capital	Rural - Land acquisitions and easements	Watershed and Floodplain Management
347	Three Rivers Levee Improvement Authority	Toe Access Corridor - Yuba River at Silver Wood	Acquire toes access corridor along urban levee to meet ULDC criteria	$ 10,000,000	$ 10,000,000	$ -	Capital	Rural - Land acquisitions and easements	Watershed and Floodplain Management
348	Three Rivers Levee Improvement Authority	Toe Access Corridor - Yuba River from Silver Wood to Simpson Ln	Acquire toes access corridor along urban levee to meet ULDC criteria	$ 500,000	$ 500,000	$ -	Capital	Rural - Land acquisitions and easements	Watershed and Floodplain Management

Table B-4. Sacramento Basin Management Actions Included within the 2017 Refined SSIA Portfolio

#	Lead Agency	Project Name	Project Description	Estimated Cost - Provided by Source	Adjusted Estimated Cost - Present Value ($)	Adjusted Estimated Cost - Annualized ($/year)	Investment Type	Area of Interest and Management Action Category	Management Action Type
349	Three Rivers Levee Improvement Authority	Toe Access Corridor - Yuba River from UPRR to Silver Wood	Acquire toes access corridor along urban levee to meet ULDC criteria	$ 500,000	$ 500,000	$ -	Capital	Rural - Land acquisitions and easements	Watershed and Floodplain Management
350	Three Rivers Levee Improvement Authority	TRLIA Feather River Levee Setback Ecosystem enhancement	The new levee created 200-year flood protection for surrounding communities by setting back approximately 4 miles of the existing levee on the left bank of the Feather River opposite Star Bend upstream toward Yuba City. The new levee also created opportunities to restore approximately 1,600 acres of riparian and wetland habitat on former agricultural lands that became part of the Feather River floodway with construction of the setback levee. Planning habitat restoration plans have been developed for the area (PWA 2008, River Partners 2009), and DWR's Flood Safe Environmental Sustainability and Statewide Resources Office (FESSRO) recently awarded approximately $4.4 million to TRLIA to pay for a portion of the estimated $9.1 million restoration project.	$ 9,100,000	$ 9,100,000	$ -	Capital	Rural - Habitat restoration/reconnection	Natural Floodplain and Ecosystem Functions
351	California Department of Water Resources	Tule Canal Improvements	Eliminate fish stranding and barriers and improve connectivity to Tule Canal and the Sacramento River for fish species in the Sacramento weir and bypass and Lower Elkhorn setbacks.	$ -	$ 12,000,000	$ -	Capital	Systemwide - Yolo Bypass multi-benefit improvements	Natural Floodplain and Ecosystem Functions
352	California Department of Water Resources	Upper Elkhorn Setback	A new setback levee, aligned north to south, would approximately bisect the existing Upper Elkhorn basin. The new setback levee would extend from the Sacramento River northwest of Verona southward for about six miles where it would tie into the Sacramento River levee just north of I-5. The setback levee would expand the Yolo Bypass by 2,695 acres (including the 500 acres north of the weir), most of which would continue to be farmed with a shift in cropping patterns consistent with periodic inundation. The new setback levee would connect with the existing Elkhorn west levee north of the Sierra Northern railway.	$ 210,000,000	$ 237,000,000	$ -	Capital	Systemwide - Yolo Bypass multi-benefit improvements	Flood Infrastructure
353	California Department of Water Resources	Upper Elkhorn Setback Ecosystem Implementation	Improve habitat connectivity between the Sacramento River, Tule Canal and Yolo Bypass via channel grading to reduce stranding, and construction of a low-flow channel and riparian corridor within new setback area to improve fish passage from Fremont Weir. Water levels would be optimized within setback area to improve fish rearing habitat and agricultural water supply. Tule Canal riparian habitat and fish passage would be enhanced and SRA habitat would be preserved and enhanced.	$ 40,000,000	$ 17,651,200	$ -	Capital	Systemwide - Yolo Bypass multi-benefit improvements	Natural Floodplain and Ecosystem Functions
354	Lake County Watershed Protection District	Upper Lake 100-year Feasibility Study	Conduct Feasibility Study for achieving 100-year protection for Upper Lake	$ 500,000	$ 500,000	$ 25,510	Ongoing	Small Community Studies and analysis	Watershed and Floodplain Management
355	California Department of Water Resources	Urban Levee Improvements	All urban levee improvements and associated cost estimates provided by USACE.	$ -	$ 3,380,000,000	$ -	Capital	Urban - Levee improvements	Flood Infrastructure
356		Urrutia Pit Reclamation and Enhancement	The potential project includes regrading approximately 10 acres of the property between the river and pond to allow more frequent inundation and development of shaded riparian aquatic habitat (SRA). The shoreline, which is currently at approximately a 10–year floodplain elevation, would be re–contoured to three terrace elevations to create topographic heterogeneity. The cut material would be used to construct a berm along the southern pond margin to minimize connectivity between the river and the pond, and to fill the southeast portion of the pond. Riparian enhancement along the pond margins would be completed, and access to the pond for fish from the Natomas East Main Drain Canal (NEMDC) Steelhead Creek, which runs along the northern boundary of the site just south of the Garden Highway, would be minimized. Project cost range: $5,200,000-$6,400,000.	$ 6,400,000	$ 6,400,000	$ -	Capital	Urban - Other infrastructure and multi-benefit improvements	Natural Floodplain and Ecosystem Functions
357	River Partners	USFWS Riparian Sanctuary project	Riparian Sanctuary project. This project is on hold while information is gathered for CVFPB so they can issue permits for rock removal. This project is riparian restoration on the Llano Seco Riparian Sanctuary Unit (USFWS) and to protect alignment of the Sac River at the Princeton-Codora-Glenn-Provident Irrigation District. Environmental Documentation has been complete, but the project has stalled in the permitting process.	$ 5,000,000	$ 5,000,000	$ -	Capital	Rural - Habitat restoration/reconnection	Natural Floodplain and Ecosystem Functions
358	Butte County Public Works Department	Various Locations	Levee Repairs and Rehabilitation. Mud Creek and Big Chico Creek.	$ 37,723,000	$ -	$ -	Capital	Urban - Other infrastructure and multi-benefit improvements	Operation and Maintenance
359	DWR Maintenance Area 01	Various Locations	Levee Repairs & Rehabilitation	$ 97,100,000	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
360	Sacramento River West Side Levee District	Various Locations	Levee Repairs & Rehabilitation	$ 244,646,000	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
361	Lake County Watershed Protection District	Various Locations	Levee Repairs & Rehabilitation	$ 85,541,000	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
362	Reclamation District 0070	Various Locations	Levee Repairs & Rehabilitation	$ 196,764,000	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
363	Reclamation District 1500	Various Locations	Levee Repairs & Rehabilitation	$ 993,761,000	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
364	Levee District 02	Various Locations	Levee Repairs & Rehabilitation	$ 52,998,000	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
365	Levee District 03	Various Locations	Levee Repairs & Rehabilitation	$ 72,836,000	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
366	Tehama County Flood Control and Water Conservation District	Various Locations	Levee Repairs & Rehabilitation	$ 97,529,000	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
367	State Maintenance Area 03	Various Locations	Levee Repairs and Rehabilitation	$ 127,627,000	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance

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368	Reclamation District 787	Various Locations	Levee Repairs & Rehabilitation	$ 62,105,000	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
369	DWR Maintenance Area 05, Butte Creek	Various Locations	Levee Repairs and Rehabilitation	$ 256,306,000	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
370	DWR Maintenance Area 12	Various Locations	Levee Repairs & Rehabilitation	$ 20,284	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
371	Reclamation District 0108	Various Locations	Levee Repairs & Rehabilitation	$ 179,264,000	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
372	Levee District 01G	Various Locations	Levee Repairs & Rehabilitation	$ 94,718,000	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
373	Reclamation District 1660	Various Locations	Levee Repairs & Rehabilitation	$ 285,228,000	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
374	State Maintenance Area 09	Various Locations	Levee Repairs & Rehabilitation	$ 99,781,000	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
375	Reclamation District 827, Elkhorn	Vegetation Control Program	The December 2013 USACE Period Inspection identified the current level of vegetation as being "unacceptable" for ELK 1 and ELK 2. RD 827 would like to develop a project to remove vegetation from the levee slope and 15 feet from the levee toe. This would also include the removal of invasive species, which currently impede visibility, thinning and trimming of existing trees; and removal of tree stumps if deemed necessary. The goal of this work would be to meet, at a minimum, the Central Valley Flood Protection Plan Levee Vegetation Management Strategy criteria. Similar project estimated costs: Lisbon $378,000, Ryer $3,927,000, Tyler $1,481,000. Average of three projects: $1,928,667.	$ 1,928,667	$ -	$ -	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
376	Reclamation District 307, Lisbon Island	Vegetation Control Project – Lisbon	Vegetation removal/thinning/trimming and mitigation from the levee slope and 15 feet from the levee toe. The goal of this project is to meet the Central Valley Flood Protection Plan Levee Vegetation Management Strategy criteria. 2 year completion time.	$ 378,000	$ -	$ -	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
377	Reclamation District 501, Ryer Island	Vegetation Control Project – Ryer Island	Vegetation removal/thinning/trimming and mitigation from the levee slope and 15 feet from the levee toe. The goal of this project is to meet the Central Valley Flood Protection Plan Levee Vegetation Management Strategy criteria. 2 year completion time.	$ 3,927,000	$ -	$ -	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
378	Reclamation District 563	Vegetation Maintenance and Removal Project – Tyler Island	Vegetation removal/thinning/trimming and mitigation from the levee slope and 15 feet from the levee toe. The goal of this project is to meet the Central Valley Flood Protection Plan Levee Vegetation Management Strategy criteria. 1-year completion time.	$ 1,481,000	$ -	$ -	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
379	Reclamation District 1600, Mull	Vegetation Mitigation Management	DWR has 3 mitigation sites along the Sac. River on the waterside of the levees that require vegetation maintenance and gravel for the access road. Similar project estimated costs: Lisbon $378,000, Ryer $3,927,000, Tyler $1,481,000. Average of three projects: $1,928,667.	$ 1,928,667	$ -	$ -	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
380	Tehama County Flood Control and Water Conservation District	Veterans/Cottonwood Lake No- Pump Off-Stream Surface Storage	Veterans Lake (up to 1 million AF) and Cottonwood Lake (up to 1.4 million AF) no-pump off-stream surface storage reservoirs would be constructed on minor tributaries of Cottonwood Creek that do not support/impact anadromous fish and will not impact sediment flow/gravel migration. Water Sources: A portion of Trinity River water already headed to the Sacramento River could be diverted via Whiskeytown w/new 13 mile tunnel. Increased releases from Shasta Lake would replace flows diverted to Veterans/Cottonwood. In addition, fish/sediment/gravel friendly diversions within the Cottonwood Creek watershed could also be used. Water Releases: Releases in the Cottonwood Creek watershed can be limited to just the amount needed to enhance anadromous fish spawning, with the remainder sent back through Whiskeytown/Keswick. Fishery Enhancement: A DWR study outlines spectacular increases in spawning salmon within the Cottonwood watershed with managed releases w/ similar benefits for steelhead expected.	$ -	$ -	$ -	Capital	Systemwide - Reservoir and floodplain storage	Reservoir and Floodplain Storage and Operation
381	Walnut Grove Local Maintaining Agency	Walnut Grove Improvements Study	The RFMP is pre-feasibility, and thus a feasibility study is a recommended course of action for the area. Potential solutions to be explored include non-structural structure raising ($301M), a ring levee ($71.5M), fix-in-place of existing perimeter levees ($642.9M), and FEMA Zone D designation ($N/A) or a combination of those solutions.	$ 500,000	$ 500,000	$ 25,510	Ongoing	Small Community - Studies and analysis	Watershed and Floodplain Management
382	City of Davis	Wastewater Treatment Plant Flood Protection Measures	100-year flood protection measures during the upgrade of the WWTP to comply with NPDES permit requirements. Measures include floodwall or levee around the key facilities and the Willow Slough Bypass north levee would need to be raised along the project area. Key facilities are not entirely clear in permit and it may be possible to negotiate with the RWQCB to which facilities do or do not need protection.	$ 9,966,000	$ -	$ -	Capital	Urban - Levee improvements	Flood Infrastructure
383	City of Rio Vista	Waterfront Floodwall and Public Access Project	Highest priority improvement for the City is the development of the Waterfront Floodwall and Public Access Project. 2,500 LF concrete floodwall along the current shoreline of the Sac River and would also include construction of a promenade in the same area for public access.	$ 7,793,000	$ -	$ -	Capital	Small Community - Levee repair and infrastructure improvements	Flood Infrastructure
384	California Department of Water Resources	West Sacramento River General Reevaluation Report	State-Federal Feasibility Study projects that DWR could partner in.	$ 4,000,000	$ 4,000,000	$ 204,077	Ongoing	Urban - Studies and analysis	Watershed and Floodplain Management
385	N/A	Wildlife Area improvements- Princeton SE	Wildlife Area improvements- Princeton SE restoration of 50 acres and addition of a parking lot, Invasive removal and restoration on 8 acres at the Stegman Unit.	$ 1,000,000	$ 1,000,000	$ -	Capital	Rural - Habitat restoration/reconnection	Natural Floodplain and Ecosystem Functions
386	Reclamation District 2035, Conaway Tract	Willow Slough Bypass Stability Project	Serious stability site along Willow Slough Bypass about 100 LF that requires the construction of stability protection.	$ 58,000	$ 58,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
387		Woodlake	The potential concepts for this site are organized into three priority levels and/or phases: • Excavate floodplain terrace and lower high ground adjacent to the river along the right bank to introduce higher inundation frequency. • Enhance shaded riverine aquatic (SRA) habitat along the right bank and secondary channel. Restore recently burned perennial native grassland, oak savanna, and riparian woodland habitats. • Lower 10–year floodplain elevation in eastern portion of the project site.	$ 43,000,000	$ 43,000,000	$ -	Capital	Urban - Other infrastructure and multi-benefit improvements	Natural Floodplain and Ecosystem Functions

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388	California Department of Water Resources	Woodland Lower Cache Creek Feasibility Study	State-Federal Feasibility Study projects that DWR could partner in.	$ 4,000,000	$ 4,000,000	$ 204,077	Ongoing	Urban - Studies and analysis	Watershed and Floodplain Management
389	City of Woodland	Woodland's Flood Risk Reduction and Railroad Relocation	Feasibility study to develop and implement a 200–year flood protection program for the City of Woodland that incorporates the relocation of rail facilities that impact regional flood protection infrastructure and includes conversion of the Sierra Northern Rail line between West Sacramento and Woodland into a regional trail for enriching experiences.	$ 200,000,000	$ 200,000,000	$ -	Capital	Urban - Levee improvements	Flood Infrastructure
390	N/A	Working Landscapes	Encourage farmers to invest in habitat on farmland in a manner that is mutually beneficial to production agriculture and the ecosystem	$ 100,000	$ 100,000	$ 5,102	Ongoing	Systemwide - State operations, planning and performance tracking	Policy and Regulations
391	Three Rivers Levee Improvement Authority	WPIC ULDC Remediation Design & Construction	Improvements to the Western Pacific Interceptor Canal levee in RD 784 to meet ULDC criteria. This project is a follow on to the EIP Western Pacific Interceptor Canal project.	$ 15,150,000	$ 15,150,000	$ -	Capital	Urban - Other infrastructure and multi-benefit improvements	Operation and Maintenance
392	Reclamation District 2060, Hastings Tract	Wright Cut Bank Protection Project – Hastings	Rehabilitation of 3,500 LF of waterside bank to withstand Yolo Bypass flood flows, and incorporate an enhanced lower waterside slope habitat area with possible riparian forest, scrub shrub, emergent/freshwater marsh to mitigate and enhance habitat values.	$ 3,100,000	$ 3,100,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
393	Reclamation District 1001, Nicolaus	Yankee Slough north and south bank, from confluence to Pleasant Grove Road	Phased improvements to the RD1001 levee system, Segment 144 & 145, to achieve 100-year FEMA levee protection. Reference: Non-Urban Levee Evaluations Project Remedial Alternatives and Cost Estimates Report (NULE RACER).	$ 57,547,000	$ 57,547,000	$ -	Capital	Small Community - Levee repair and infrastructure improvements	Flood Infrastructure
394		YB-CS Complex Management Plan	CMP will focus on addressing policy issues associated with the implementation of any project in the existing YB–CS Complex. Development of the CMP will be led by a team of local agencies with participation from key state and federal government agencies.	$ 200,000	$ 200,000	$ 10,204	Ongoing	Systemwide - State operations, planning and performance tracking	Policy and Regulations
395	Reclamation District 1600, Mull	Yolo Bypass Bank Protection	On the Yolo bypass levee (Levee Segment 295), 3 miles south of the Freemont Weir 6,800 LF needs repair of erosion; requires gravel to improve access and repair 3:1 slope.	$ 7,679,000	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
396	Reclamation District 785, Driver	Yolo Bypass Bank Protection Project	Bank protection project to repair a serious erosion site along the Yolo Bypass at LM 2.2 about 200 LF.	$ 227,000	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
397	California Department of Water Resources	Yolo Bypass Freeboard Raise	Six feet of freeboard over the estimated 1997 110 % water surface profile for urban areas.	$ 28,000,000	$ 73,000,000	$ -	Capital	Systemwide - Yolo Bypass multi-benefit improvements	Flood Infrastructure
398	Reclamation District 827, Elkhorn	Yolo Bypass Freeboard Restoration	The existing bypass levee does not, currently, have the recommended six foot of freeboard above the 1957 Design Water Surface Profile prescribed in the USACE O&M manual. With this project the levee crown elevation should be restored to the authorized elevation.	$ 6,000,000	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Flood Infrastructure
399	City of West Sacramento	Yolo Bypass Levee	Stability berm and 2 miles of cutoff wall. Future Closure structure will be required for the I-80 crossing.	$ 51,531,000	$ -	$ -	Capital	Urban - Levee improvements	Flood Infrastructure
400	Reclamation District 1600, Mull	Yolo Bypass Levee Crown Repair	On the Yolo bypass levee, 2 miles south of the Fremont Weir and running for 2.3 miles the levee crown road needs an addition 5.-6 inches of base and gravel added to ensure safe driving during patrols in wet weather and high water events. Also landward side, the levee needs improved stability and additional soil to have a 3:1 slope.	$ 3,503,000	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Flood Infrastructure
401	Reclamation District 785, Driver	Yolo Bypass Levee Flattening Project	Project in coordination with RD 785. Details to be provided by RD 827. Similar project estimated costs: DWSC East $6,141,000, Port South $9,049,000, South Cross $11,684,000. Average of three projects: $8,958,000	$ 8,958,000	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
402	Reclamation District 785, Driver	Yolo Bypass Levee Improvements	2 miles of the Yolo Bypass levee need repairs including rip rap and rock placed on the crown to allow for winter patrol access and emergency access.	$ 3,046,000	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Flood Infrastructure
403	Reclamation District 827, Elkhorn	Yolo Bypass Levee Relocation	Relocation of the Yolo Bypass levee is currently being evaluated as part of Sacramento Weir and Bypass Project, described in Section 5.6.1 of the FloodProtect plan. RD 827 is supportive of the relocation evaluation and looks forward to further discussions regarding this potential project.	$ 200,000,000	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
404	Reclamation District 2068, Yolano	Yolo Bypass Outflanking	Approx. 0.5-miles of the RD-2068 Unit 1 levee from King Road north to Yolano Mills Road was never constructed as part of the Sacramento River Flood Control Project (SRFCP). Flood fighting was required in 1986 and 1997 to prevent outflanking of the existing Yolo Bypass levee. Project would include the construction of approx. 0.5 miles of levee coincident with County Road 104. $2300/linear foot for new levee.	$ 6,000,000	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Flood Infrastructure
405	Reclamation District 2068, Yolano	Yolo Bypass Seepage Repair Project – Yolano	Rock and fill repair for serious seepage site along the Yolo Bypass; roughly 700 ft. long.	$ 452,000	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
406	Reclamation District 827, Elkhorn	Yolo Bypass Stability Berm	Single site along the Yolo Bypass, LM 0.3 to 0.5 about 110 LF requires a stability berm and is considered to be a serious stability problem.	$ 64,000	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
407	Reclamation District 2068, Yolano	Yolo Bypass Waterside Enhancement Project – Yolano	Project would provide additional slope material (bypass side of levee) at a possible 10:1 or flatter slope. Providing protection from high water flood erosion, habitat friendly slopes, and includes a large enhancement and mitigation component. (Est. 1M tons of imported fill).	$ 6,821,000	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
408	Reclamation District 2098, Cache Haas Area	Yolo Bypass West Levee Erosion Repair - RD 2098	Repair of erosion caused by interior drainage from LM 0.0 to 3.5. Landside erosion protection features are needed to ensure toe stability and to avoid recurring landside slope and toe repairs. Similar project estimated costs: rock slope protection lisbon $4,216,000; rock slope protection ryer $7,337,000; rock slope protection tyler $841,000; Cache Creek Erosion $1,814,000. Average of three projects: $3,552,000	$ 3,552,000	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
409	Reclamation District 2068, Yolano	Yolo Bypass West Levee Erosion Repair Project – Yolano	Rock reinforcement at critical erosion site located between levee miles 3.2 and 5.5 on both sides of levee and at both bypass and landside toes. Similar project estimated costs: rock slope protection lisbon $4,216,000; rock slope protection ryer $7,337,000; rock slope protection tyler $841,000; Cache Creek Erosion $1,814,000. Average of three projects: $3,552,000	$ 3,552,000	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
410	Reclamation District 2068, Yolano	Yolo Bypass West Levee Improvement Project – Yolano	Freeboard deficiency results in overtopping during high water events in the bypass combined with high winds and resulting wave fetch. 5 to 6 feet of freeboard is needed to assure no overtopping.	$ 12,000,000	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Flood Infrastructure

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411	Reclamation District 2068, Yolano	Yolo Bypass West Levee Interior Erosion Repair Project	Repair of erosion caused by interior drainage from LM 3.2 to 5.5. Landside erosion protection features are needed to ensure toe stability and to avoid recurring landside slope and toe repairs. Similar project estimated costs: rock slope protection lisbon $4,216,000; rock slope protection ryer $7,337,000; rock slope protection tyler $841,000; Cache Creek Erosion $1,814,000. Average of three projects: $3,552,000	$ 3,552,000	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
412		Yolo County Park Gravel Pit Connection and Riparian Enhancement	The proposed project would involve construction of frequently inundated inflow and outflow channels between Sacramento River and the pit to provide off–channel habitat and minimize stranding hazards. Design considerations should include whether to passively or actively control connectivity and ensuring the project design does not increase the exposure of salmonids to warm water fish predators within the gravel pit. Riparian vegetation would be planted along the margins of the pond and inflow/outflow channels. The terrace to the east of the pond and adjacent to the river would be lowered to inundate more frequently and support riparian vegetation.	$ 7,200,000	$ 7,200,000	$ -	Capital	Urban - Other infrastructure and multi-benefit improvements	Natural Floodplain and Ecosystem Functions
413	Yolo County	Yolo Feasibility Study	The RFMP is pre-feasibility, and thus a feasibility study is a recommended course of action for the area. Potential solutions to be explored include Non-structural structure raising ($18.6M), a ring levee ($N/A), fix-in-place of existing perimeter levees ($45.4M), and FEMA Zone D designation ($N/A) or a combination of those solutions.	$ 500,000	$ 500,000	$ 25,510	Ongoing	Rural - Studies and analysis	Watershed and Floodplain Management
414	Three Rivers Levee Improvement Authority	Yuba 86 Break Site Berm Design & Construction	Project complete.	$ 1,500,000	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Flood Infrastructure
415	Three Rivers Levee Improvement Authority	Yuba Goldfields Design & Construction	Project to develop and implement plan to ensure and sustain 200-year protection. The first step was to work with mining interests to construct non-leveed embankments in 2011 to address the highest risk areas. Step 2 is to construct features that address moderate risk in 2014 that will meet FEMA standards. Step 3 is to construct features that will meet the State of California's 200-year requirements and will be completed prior to 2025. Step 4: Will implement the 200-year plan developed in Step 3.	$ 20,000,000	$ 20,000,000	$ -	Capital	Urban - Levee improvements	Flood Infrastructure
416	California Department of Water Resources	Yuba Goldfields Proposed Study	State-Federal Feasibility Study projects that DWR could partner in.	$ 4,000,000	$ 4,000,000	$ 204,077	Ongoing	Urban - Studies and analysis	Watershed and Floodplain Management
417	California Department of Water Resources	Yuba River General Reevaluation Report	State-Federal Feasibility Study projects that DWR could partner in.	$ 4,000,000	$ 4,000,000	$ 204,077	Ongoing	Urban - Studies and analysis	Watershed and Floodplain Management
418	Three Rivers Levee Improvement Authority	Yuba River South Levee ULDC Remediation	TRLIA is planning to perform additional explorations and implement a levee widening project to provide up to 200 year level of protection on a small section of the Yuba River South Levee. The proposed reach is a site of a 1986 levee break in which the USACE repaired using large rocks and unknown material. The proposed project will fund geotechnical explorations, design, construction, and management.	$ 1,500,000	$ 1,500,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Flood Infrastructure
419		Zacharias Island / Snodgrass Slough Enhancements	The concept design includes breaching the western levee to allow a connection to Snodgrass Slough. The existing farmland would be excavated and terraced to create backwater sloughs, SRA, riparian forest, and frequently inundated floodplain. Potential also exists for other beneficial uses of the property.	$ 3,800,000	$ 3,800,000	$ -	Capital	Rural - Habitat restoration/reconnection	Natural Floodplain and Ecosystem Functions

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#	Data Set Source	Lead Agency	Project Name	Project Description	Estimated Cost - Provided by Source	Adjusted Estimated Cost - Present Value ($)	Adjusted Estimated Cost - Annualized ($/year)	Investment Type	Area of Interest and Management Action Category	Management Action Type
1	RFMP	San Joaquin County, City of Stockton	200-year Floodplain Maps & Master Plan		$ 2,100,000	$ 2,100,000	$ 107,140	Ongoing	Rural - Risk awareness, floodproofing and land use planning	Watershed and Floodplain Management
2	USACE	San Joaquin County, City of Stockton	200-year ULDC Analysis	The goal for most of the Stockton Metropolitan area is to maintain 100-year protection in the near-term and seek 200-year level of protection in the long-term. The first critical step in developing a plan to comply with SB5 is to determine where a ULOP finding is required (i.e. where the 200-year floodplain, assuming levees fail, is greater than 3-feet). This will inform land use agencies on where findings will be required, and where findings are not required. For areas where ULOP findings are required, land use agencies will need to complete an evaluation of levees against ULDC criteria. Land use agencies may elect to pursue this evaluation in phases. For levee systems found to currently meet ULDC as-is, land use agencies may make ULOP findings for areas protected by these levee systems. For levee systems that do not currently meet ULDC criteria, a land use agency will have to make adequate progress toward improvements to make ULOP findings.	$ 5,000,000	$ 5,000,000	$ 255,096	Ongoing	Urban - Studies and analysis	Watershed and Floodplain Management
3	RFMP	Delta South Region	Additional Forecasting/Notification - Delta South Region	Regional project in the Delta South region to reduce residual risk through additional forecasting/notification.	$ 10,000,000	$ -	$ -	Ongoing	Systemwide - Emergency management	Emergency Management
4	RFMP	Lower San Joaquin River Region	Additional Forecasting/Notification - Lower San Joaquin Region	Regional project in the Lower San Joaquin region to reduce residual risk through additional forecasting/notification.	$ 10,000,000	$ -	$ -	Ongoing	Systemwide - Emergency management	Emergency Management
5	RFMP	Delta South Region	Additional Information Collection/Sharing - Delta South Region	Regional project in the Delta South region to reduce residual risk through additional information collection/sharing.	$ 11,300,000	$ -	$ -	Ongoing	Rural - Studies and analysis	Watershed and Floodplain Management
6	RFMP	Lower San Joaquin River Region	Additional Information Collection/Sharing - Lower San Joaquin Region	Regional project in the Lower San Joaquin region to reduce residual risk through additional information collection/sharing.	$ 15,000,000	$ -	$ -	Ongoing	Rural - Studies and analysis	Watershed and Floodplain Management
7	Other	California Department of Water Resources	Agricultural Land Easements: Small Community 1/2 mile Buffer	Small Community 1/2 Mile Buffer for Agricultural Land Acquisition. Acquisitions include property for permanent and non-permanent crops within the 100-year floodplain only.	$ -	$ -	$ -	Capital	Rural - Land acquisitions and easements	Watershed and Floodplain Management
8	Other	California Department of Water Resources	Agricultural Land Easements: Small Community 1/2 mile Buffer	Small Community 1/2 Mile Buffer for Agricultural Land Acquisition. Acquisitions include property for permanent and non-permanent crops within the 100-year floodplain only.	$ -	$ -	$ -	Capital	Rural - Land acquisitions and easements	Watershed and Floodplain Management
9	Other	California Department of Water Resources	Agricultural Land Easements: Small Community 1/2 mile Buffer	Small Community 1/2 Mile Buffer for Agricultural Land Acquisition. Acquisitions include property for permanent and non-permanent crops within the 100-year floodplain only.	$ 81,750,000	$ 81,750,000	$ -	Capital	Rural - Land acquisitions and easements	Watershed and Floodplain Management
10	Other	California Department of Water Resources	Agricultural Land Easements: Urban 2-mile Buffer	Urban 2 Mile Buffer for Agricultural Land Acquisition. Acquisitions include property for permanent and non-permanent crops within the 100-year floodplain only.	$ 208,420,000	$ 208,420,000	$ -	Capital	Rural - Land acquisitions and easements	Watershed and Floodplain Management
11	Other	California Department of Water Resources	Agricultural Land Easements: Urban 2-mile Buffer	Urban 2 Mile Buffer for Agricultural Land Acquisition. Acquisitions include property for permanent and non-permanent crops within the 100-year floodplain only.	$ 9,020,000	$ 9,020,000	$ -	Capital	Rural - Land acquisitions and easements	Watershed and Floodplain Management
12	Other	California Department of Water Resources	Agricultural Land Easements: Urban 2-mile Buffer	Urban 2 Mile Buffer for Agricultural Land Acquisition. Acquisitions include property for permanent and non-permanent crops within the 100-year floodplain only.	$ 12,520,000	$ 12,520,000	$ -	Capital	Rural - Land acquisitions and easements	Watershed and Floodplain Management
13	RFMP	Reclamation District 2058	All-weather Road Reclamation District 2058	The field data and inspections along Paradise Cut show that levee crown widths are narrower than HMP standards. The levee crown between Alder Avenue and Cedar Avenue poses vehicular access limitations due to narrow levee crown. This section is approximately 6,000 feet long and would require placing engineered fill on the landside of the levee to widen the crown by approximately 5-6 feet.	$ 100,000	$ 100,000	$ 5,102	Ongoing	Systemwide - Emergency management	Emergency Management
14	RFMP	Reclamation District 2064	All-Weather Road Reclamation District 2064	The project levee along the San Joaquin River and Stanislaus River is too narrow and lacks an all-weather access road. The levee crown should be widened and an all-weather road installed to ensure travel along the levee is possible during a flood fight.	$ 1,000,000	$ 1,000,000	$ 51,019	Ongoing	Systemwide - Emergency management	Emergency Management
15	RFMP	Reclamation District 2089	All-weather Road Reclamation District 2089	The SPFC levee along RD 2089 needs supplemental aggregate base to improve the all-weather road.	$ 600,000	$ 600,000	$ 30,612	Ongoing	Systemwide - Emergency management	Emergency Management
16	RFMP	San Joaquin River Restoration Program	Arroyo Canal Screening and Sack Dam Passage	The SJRRP and HMRD will be constructing the new Sack Dam and providing a fish screen at Arroyo Canal. The new Sack Dam could improve the operational ability to release water into Reach 4A during flood conditions.	$ 25,000,000	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Flood Infrastructure
17	RFMP	Madera County	Ash Slough Arundo and Channel Cleaning	Approximately 21 miles of channel clearing and arundo eradication and channel clearing within Ash Slough. arundo is an aggressive bamboo weed which requires continual herbicide treatment to fully eradicate. Due to the high cost and lack of funding, arundo has been allowed to grow unabated and is now constricting flood flows and reducing channel capacity. USACE has indicated that Ash Slough is no longer PL 84-99 eligible.	$ 1,500,000	$ -	$ -	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
18	RFMP	Merced Streams Group	Bear Creek Diversion Channel Feasibility Study	Based upon review of existing information, a diversion channel located upstream of Merced may significantly reduce flood risk within the City. The diversion channel would run in a south/southwest direction from Bear Creek. A feasibility study is needed to evaluate different options for the system improvement and define benefits and applicability.	$ 100,000	$ 100,000	$ 5,102	Ongoing	Rural - Studies and analysis	Watershed and Floodplain Management
19	RFMP	Lower San Joaquin Levee District	Bear Creek Diversion Structure	In 1963, the State Department of Water Resources (DWR) constructed the Bear Creek siphon and diversion structure (BCSDS) at the intersection of Bear Creek and the East Side Canal. The facility was intended to channel Bear Creek flows over the East Side Canal Siphon during the winter and to divert these flows into the East Side Canal during the irrigation season. The invert of the structure is higher than the upstream channel which constrains flood flows, causes upstream ponding and migration of flood flows around the system improvement levee unit, and results in landside flooding. The proposed system improvement will enlarge the BCSDS by building additional bays to extend the structure to the south. These bays would be used at times of unusual storm runoff when properties, both agricultural and residential, are threatened by rising flood waters in Bear Creek. Design would incorporate fish passage elements. The Bear Creek Diversion Structure system improvement could also be developed in conjunction with proposed improvements on the Sno-Bird Unit of the San Luis Nat'l Wildlife Refuge Complex, as described in projects 67 and 68 on this list, to enhance the ability of this project to provide multiple benefits.	$ 260,000	$ 260,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
20	USACE	San Joaquin County, City of Stockton	Bear Creek System PL 84-99 Improvements		$ 37,000,000	$ -	$ -	Capital	Urban - Levee improvements	Flood Infrastructure

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21	RFMP	Merced Streams Group	Bear Reservoir Enlargement and Downstream Levee and Channel Improvements	Bear Reservoir was constructed in the early 1950's as an element of the Merced Streams Group Project authorized by Congress's 1944 Flood Control Act. The Flood Control Act of 1970 called for three additional flood control reservoirs, enlargement of existing reservoirs, and 52 miles of levee and channel modifications. To date only one additional reservoir has been built (Castle Dam). The enlargement of Bear Reservoir and downstream levee and channel improvements would increase the level of flood protection to the most populated areas of Merced County. Bear Reservoir was originally constructed to provide protection for up to a 50-year storm event. The State of California has adopted legislation that calls for a minimum of 200-year flood protection for urbanized areas. This system improvement would meet the requirements of the new flood control legislation. As part of this project, opportunities for riparian and wetland habitat enhancements will be considered.	$ 202,940,000	$ 202,940,000	$ -	Capital	Systemwide - Reservoir and floodplain storage	Flood Infrastructure
22	RFMP	Madera Irrigation District	Berenda Creek Arundo Removal and Channel Clearing	Approximately 13 miles of channel clearing and arundo eradication and channel clearing within Berenda Creek. arundo is an aggressive bamboo weed which requires continual herbicide treatment to fully eradicate. Due to the high cost and lack of funding, arundo has been allowed to grow unabated and is now constricting flood flows and reducing channel capacity.	$ 500,000	$ -	$ -	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
23	RFMP	Madera County	Berenda Slough Arundo and Channel Clearing	Approximately 18 miles of channel clearing and arundo eradication and channel clearing within Berenda Slough. arundo is an aggressive bamboo weed which requires continual herbicide treatment to fully eradicate. Due to the high cost and lack of funding, arundo has been allowed to grow unabated and is now constricting flood flows and reducing channel capacity.	$ 1,300,000	$ -	$ -	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
24	RFMP	Merced County	Black Rascal Creek Flood Control Project	Construction of a regulating reservoir on the Black Rascal Creek Watershed. System improvement location is immediately north of Yosemite Avenue and Arboleda Drive in northeast Merced. System improvement will provide protection against a 200-year storm event and much needed flood control on the currently unprotected Black Rascal Creek Watershed. System improvement will benefit all downstream areas of watershed. The reservoir will maintain a deadpool for wildlife purposes. During flood season the reservoir would be used primarily as a flood retention basin. During irrigation season the reservoir would regulate irrigation flows and improve efficiency of Merced Irrigation District's water system without impacting power generation scheduling by the Independent System Operator (ISO) at New Exchequer Dam. Based upon initial review of existing information, reducing flood flows in Black Rascal Creek at the Yosemite Ave. diversion to less than about 3,000 cubic feet per second (cfs) by use of upstream detention will substantially reduce the flooding in the City of Merced. The completed system improvement could protect houses in the Franklin-Beachwood area, where over 80 homes were flooded during the 2006 flood. A flood control structure on Black Rascal Creek could also offer protection to other areas situated along Bear Creek. As part of this project, opportunities for riparian and wetland habitat enhancements will be considered.	$ 32,980,000	$ -	$ -	Capital	Urban - Other infrastructure and multi-benefit improvements	Flood Infrastructure
25	RFMP	Lower San Joaquin Levee District	Bridge Enlargement over Eastside Bypass at Sandy Mush Road	The Sandy Mush Road crossing of the Eastside Bypass Channel includes a bridge deck and piles with elevated road embankments at each end of the bridge. The flow area under the bridge and between the embankments is much less than the upstream flow area of the Bypass. This constricts flood flows and causes upstream freeboard encroachment. The elevated road embankments have been cut three times in the past to allow the flood flows to pass. Cutting the road is problematic for Merced County because the road is designated as an arterial evacuation route. The bridge needs to be lengthened to reduce the flow restriction. An alternative option could be to install culverts in the embankments to reduce the flow area. As part of this project, opportunities for riparian and wetland habitat enhancements will be considered.	$ 1,610,000	$ 1,610,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
26	RFMP	Merced Streams Group	Burns Reservoir Enlargement and Downstream Levee and Channel Improvement	Burns Reservoir was constructed in the early 1950's as an element of the Merced Streams Group Project authorized by Congress's 1944 Flood Control Act. The enlargement of Burns Reservoir and downstream levee and channel improvements would increase the level of flood protection to the most populated areas of Merced County. Burns Reservoir was originally constructed to provide protection for up to a 50-year storm event. The State of California has adopted legislation that calls for a minimum of 200-year flood protection for urbanized areas. This project could help to meet the requirements of the new flood control legislation while also providing increased flood protection to the most urbanized areas of Merced County. This project calls for design, environmental documents, and construction funding. Due to the length of time since the project was identified, a new feasibility study may need to be completed to deal with changes in legislation.	$ 39,180,000	$ 39,180,000	$ -	Capital	Systemwide - Reservoir and floodplain storage	Flood Infrastructure
27	BWFS	California Department of Water Resources	Calaveras River Upstream Flood Storage	This element of the San Joaquin BWFS includes additional 42 TAF dedicated flood storage in the Calaveras River watershed, which could be achieved by conjunctive use or FIO. BWFS analysis found that this amount of storage was found to mitigate for stage increases caused by climate change and reduce the need for some levee improvements.	$ 105,000,000	$ 105,000,000	$ -	Capital	Systemwide - Reservoir and floodplain storage	Reservoir and Floodplain Storage and Operation
28	USACE	San Joaquin County, City of Stockton	Calaveras System PL 84-99 Improvements		$ 24,000,000	$ -	$ -	Capital	Urban - Levee improvements	Flood Infrastructure
29	RFMP	Central California Irrigation District, San Luis Canal Company	Camp 13 Area Surface Storage	The Camp 13 Area surface storage project includes construction of a reservoir project west of Firebaugh between the CCID Outside Canal and Main Canal. A 2013 report evaluated about 5,200 acres of land for potential storage (San Luis & Delta Mendota Water Authority, 2013). The evaluation considered options for 500, 1,000, and 1,800 acre reservoir sites, at specific locations to be determined in the future. The project would receive surface water from the SJRECWA or flood flows off the SJR or Kings River. CCID facilities would be used to convey water to the project lands.	$ 44,000,000	$ 44,000,000	$ -	Capital	Small Community - Levee setbacks, land acquisitions and habitat restoration	Reservoir and Floodplain Storage and Operation
30	RFMP	Merced County	Channel Dredging and/or Vegetation Removal	Streams, creeks, and rivers within the Merced Region are periodically choked with vegetation causing channel capacities to be exceeded during major floods. Removing some of this vegetation and/or excavating the channel would increase the carrying capacity and decrease the flood risk for select areas. This option may benefit reaches of Bear Creek, Black Rascal Creek, and Black Rascal Slough where current channel capacities are well below the 100-year level. This option may be implemented as a capital improvement project, or implemented via current Operations and Maintenance activities.	$ 2,200,000	$ -	$ -	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance

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31	RFMP	3F Group (Trout Unlimited, Ducks Unlimited, and American Rivers)	Cinnamon Slough Study (Merced Wildlife Refuge)	This unit of the Merced National Wildlife Refuge, adjacent to the Eastside Bypass, has recently been restored for wetlands by Ducks Unlimited. The U.S. Fish and Wildlife Service staff at the refuge complex is very supportive of a system improvement that would connect the Bypass to the Unit and thereby provide additional irrigation for wetlands while also providing rearing opportunities for spring and fall-run Chinook salmon. Water is supplied by a low-lift pump on the northwest end of the site. Additional lands within the Refuge boundaries, adjacent to the Unit and inside the Bypass, could also serve as rearing habitat if the topography were slightly modified. This system improvement would provide flood attenuation, juvenile salmonid rearing, groundwater recharge, more stable wetlands, and recreation.	$ 100,000	$ 100,000	$ 5,102	Ongoing	Rural - Studies and analysis	Watershed and Floodplain Management
32	RFMP	Reclamation District 2092	Consolidation of O&M, RD 2092	Two or more Reclamation Districts form a formal partnership to share technical, financial and/or operational capacity to perform necessary O&M. As an initial step, investigate potential governance options and design and implement a pilot maintenance agreement project.	$ 200,000	$ 200,000	$ 10,204	Ongoing	Rural - Studies and analysis	Watershed and Floodplain Management
33	RFMP	Merced County	Construct Levees or Channel Widening Projects Along Creeks/Streams in the Region	Levees and/or channel widening projects would contain flood flows in existing channels for Bear Creek, Black Rascal Creek and Slough, Deadman Creek, Dry Creek, Fahrens Creek, and Mariposa Creek, which are subject to flooding. As part of this project, opportunities for riparian and wetland habitat enhancements will be considered.	$ -	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Flood Infrastructure
34	USACE	Merced County	Construct Ring Levees Around Flood Prone Areas	A ring levee is a levee that completely encircles an area subject to inundation from all directions. These can effectively protect structures or areas from shallow flooding. Ring levees are generally less than 5-feet tall, and have minor impacts to the floodplain outside the ring. Ring levees may be constructed around single facilities, or could encircle larger areas. For example, Marysville, CA is encircled by a ring levee. A recent residential subdivision on Hotchkiss Tract (RD799) included a ring levee to reduce the likelihood of flood damage to these structures. A key to the feasibility of ring levees, particularly on discrete facilities, is the availability of right-of-way and the acceptability of risk of remaining inside during a flood with evacuation routes cut off.	$ -	$ -	$ -	Capital	Urban - Levee improvements	Flood Infrastructure
35	RFMP	Lower San Joaquin River Region	Coordinated Reservoir Ops	Regional project for all LMAs in the Lower San Joaquin River region.	$ 6,000,000	$ 6,000,000	$ 306,116	Ongoing	Systemwide - Reservoir operations	Reservoir and Floodplain Storage and Operation
36	RFMP	California Department of Water Resources	Critical Levee Repairs - Replaced RFMP Cost	Critical levee repair sites provided by the Flood System Repair Program (FSRP) for seepage, erosion, and stability. Estimate of $4M per site, 33 sites identified by FSRP.	$ 132,000,000	$ 132,000,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
37	RFMP	California Department of Water Resources	Critical Levee Repairs - Replaced RFMP Cost	Critical levee repair sites provided by the Flood System Repair Program (FSRP) for seepage, erosion, and stability. Estimate of $4M per site, 17 sites identified by FSRP.	$ 68,000,000	$ 68,000,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
38	RFMP	California Department of Water Resources	Critical Levee Repairs - Replaced RFMP Cost	Critical levee repair sites provided by the Flood System Repair Program (FSRP) for seepage, erosion, and stability. Estimate of $4M per site, 18 sites identified by FSRP.	$ 72,000,000	$ 72,000,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
39	RFMP	Reclamation District 404	Cut-off Wall along French Camp Slough	The right bank of French Camp Slough is prone to seepage. The District has identified the need for a cutoff wall along the right bank of French Camp Slough, just downstream of Walker Slough. The proposed cutoff wall would extend along French Camp Slough for approximately 1,200 feet.	$ 1,100,000	$ 1,100,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Flood Infrastructure
40	RFMP	Merced County	Develop Emergency Response Plans	The objective of an emergency response plan is the prevent loss of life; reduce physical damage to public and private property (evacuation equipment, pre and post flood fight materials, etc.); plan for speedy recovery; and disaster management and communication. The development of emergency response plans are typically a low-cost/high benefit option for mitigating flood risk.	$ 100,000	$ 100,000	$ 5,102	Ongoing	Systemwide - Emergency management	Emergency Management
41	RFMP	Delta South Region	Develop Enhanced O&M - Delta South Region	Develop practices and procedures to implement enhanced O&M.	$ 15,000,000	$ 15,000,000	$ 765,289	Ongoing	Rural - Studies and analysis	Watershed and Floodplain Management
42	RFMP	Lower San Joaquin River Region	Develop Enhanced O&M - Lower San Joaquin Region	Develop practices and procedures to implement enhanced O&M.	$ 15,000,000	$ 15,000,000	$ 765,289	Ongoing	Rural - Studies and analysis	Watershed and Floodplain Management
43	RFMP		Develop Expedited Permitting Programs for Maintenance Actions	Coordinate with all permitting agencies to develop a permitting program that will reduce the time and cost required to permit routine maintenance actions.	$ -	$ -	$ -	Ongoing	Systemwide - State operations, planning and performance tracking	Policy and Regulations
44	RFMP	Merced County	Divert Flood Flows to Agricultural Lands	Diverting flood flows out of Bear Creek, east of City of Merced, onto nearby agricultural land could decrease peak flows within the channel. Depending on the topography, the types of crops, and the willingness of the landowners, agricultural land could be utilized as detention basins where excess flood flows would be temporarily stored until water percolates back into the ground. Agricultural lands would be temporarily flooded and the waters would be routed back into the channel after the high flows recede.	$ -	$ -	$ -	Capital	Rural - Small-scale levee setbacks and floodplain storage	Reservoir and Floodplain Storage and Operation
45	RFMP		Divert Flood Flows to Agricultural Lands (both in the Mid and the Upper San Joaquin River Regions)	Large areas exist along the San Joaquin River that could be used for temporary flood flow storage. With agriculture as the primary land use in the floodplains of the Mid and Upper San Joaquin River regions and the presence of large wildlife refuges along the river, a series of designated areas could be managed in a coordinated way to reduce peak flow and provide temporary storage during a flood event. In some places, this is essentially a "no-action" alternative since it already occurs. Depending on the topography, the types of crops, and the willingness of the landowners, agricultural properties and refuge lands could be utilized as detention basins where excess flood flows would be stored temporarily until water percolates back into the ground. Other agricultural lands would be temporarily flooded and the waters would be routed back into the channel after the high flows recede. The United States Army Corps of Engineers Reconnaissance Report, San Joaquin River, Mainstem (January 1993) describes this concept and identifies specific sites that could be used in a network of temporary flood storage areas.	$ -	$ -	$ -	Capital	Rural - Small-scale levee setbacks and floodplain storage	Reservoir and Floodplain Storage and Operation
46	RFMP	River Partners	Dos Rios Ranch Floodplain Expansion and Ecosystem Restoration Project and Hidden Valley Ranch Mitigation Project	Project to restore flooding and transient floodwater storage to approximately 1,000 acres of historic floodplain, restore riparian habitats, and promote river physical processes of scour and deposition along 6 river miles. Remove levee maintenance obligations from State Plan of Flood Control (SPFC) and modify USACE O&M manual to allow breaching and other modification to the existing levees. Provide 191 acres of habitat mitigation for future regional SPFC environmental impacts.	$ 5,100,000	$ -	$ -	Capital	Systemwide - Reservoir and floodplain storage	Reservoir and Floodplain Storage and Operation

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47	BWFS	California Department of Water Resources	Dos Rios/Hidden Valley Ranch Transitory Storage	DWR has partnered with other local, State and federal agencies and River Partners to fund the acquisition of Dos Rios Ranch, a 1,603-acre agricultural property west of Modesto. BWFS analysis showed this does not have system-scale hydraulic effects but provides significant ecosystem restoration benefit. The Levee Breaching Option of Dos Rios Transitory Storage was included in the State Recommended Plan because this element would provide an additional 700 acres of riparian and marsh habitat, and large recreational benefits, at low cost.	$ 34,000,000	$ 13,000,000	$ -	Capital	Systemwide - Reservoir and floodplain storage	Reservoir and Floodplain Storage and Operation
48	RFMP	Lower San Joaquin River LMAs	Dredge SJ River from Paradise Cut to Stanislaus River	Regional project for all LMAs in the Lower San Joaquin River region.	$ 60,000,000	$ -	$ -	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
49	RFMP	Madera Irrigation District	Dry Creek Arundo and Channel Clearing	Approximately 13 miles of channel clearing and invasive species removal within Dry Creek. Due to the high cost and lack of funding, vegetation has been allowed to grow unabated and is now constricting flood flows and reducing channel capacity.	$ 500,000	$ -	$ -	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
50	RFMP	Stanislaus County, City of Modesto	Dry Creek Watershed Detention Reconnaissance Study	Complete a reconnaissance study of potential options for reducing flood risks by detaining flood flows in the Dry Creek watershed, upstream of the City of Modesto. While the main purpose of this project is to reduce flood risk for lands in and around the City of Modesto, it would also have the effect of reducing flood flows entering the Tuolumne River and thence the San Joaquin River. To our knowledge, the effect of a hypothetical detention facility in the Dry Creek basin has not been quantitatively evaluated. According to the current FEMA Flood Insurance Study, the 100-year flow on Dry Creek at Modesto (192.3 sq.mi.) is 11,800 cfs; whereas the 100-year peak flow on the Tuolumne River at Modesto (1884 sq.mi.) is 70,000 cfs. In a 10-year event, the values are 4,730 cfs and 10,500 cfs, respectively. As a back-of-the-envelope assessment, a 30,000 AF storage facility could contain 24 hours of an average 15,000 cfs flow. This suggests that such a facility would have the capacity to detain most or all of Dry Creek's flood flows in a large event, perhaps creating a 2,000-8,000 cfs reduction in Dry Creek contributions to the Tuolumne River and on the San Joaquin River at the time of peak flows in those larger systems. This opportunity to reduce inflows to the San Joaquin River may be similar to, or larger than, the flow reduction resulting from managed detention on the San Joaquin River at the National Wildlife Refuge, which was evaluated at approximately 3,000 cfs in a 35,000 cfs event on the San Joaquin River (ESA, 2015).	$ 250,000	$ 250,000	$ 12,755	Ongoing	Rural - Studies and analysis	Watershed and Floodplain Management
51	RFMP	Madera County	Eastside Acres San Joaquin River Levee Project	The Community of Eastside Acres, a housing subdivision consisting of about 70 residences and one commercial business, is located east of the City of Firebaugh along the right bank of the San Joaquin River in Madera County. Eastside Acres is in the 100-year flood plain and sand bagging is required during routine flood events. The conceptual levee project layout consists of a ring levee system that would encircle the housing subdivision. The ring levee would be approximately 1.32 miles in length, and have an average height of 4.63 feet.	$ 1,210,000	$ 1,210,000	$ -	Capital	Small Community - Levee repair and infrastructure improvements	Flood Infrastructure
52	BWFS	California Department of Water Resources	Eastside Bypass Levee Improvements in Subsidence Area	The SJRRP Reach 4B, Eastside Bypass, and Mariposa Bypass Channel and Structural Improvements Project (Reach 4B Project) includes channel and structural improvements to ensure flows and fish passage through Reach 4B of the San Joaquin River, the Sand Slough Control Structure, the Reach 4B Headgate, and the Eastside and Mariposa bypasses. The passing for flood design flows through the Eastside Bypass may require a combination of levee setbacks, channel grading, and levee raises due to subsidence. Levee raises would restore the Eastside Bypass design capacity of 16,500 cfs and provide 4 feet of freeboard. Levee improvements could be potentially implemented in coordination with the Reach 4B Project. In coordination with DWR's efforts to support the SJRRP, costs of incremental levee improvements with and without the SJRRP Reach 4B project. SJRRP Reach 4B Project Alternative 2 assumed a 1,000-foot setback levee along one side of Middle Eastside Bypass and 500 feet of setback along the right side of the Mariposa Bypass. Alternative 1 assumed 4,500 cfs capacity in Reach 4B1. Potential levee improvements along the Mariposa Bypass to address subsidence were not included in the cost estimate. Costs include the levee improvement without the SJRRP Reach 4B Project.	$ 120,000,000	$ 100,000,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Flood Infrastructure
53	RFMP	Merced County	Ecosystem Restoration Along Waterways	An alternative similar to routing flood flows onto agricultural land (system improvement 33) would be to acquire riparian areas of agricultural land and restore natural floodplains. This type of flood control system improvement could be implemented as an ecosystem mitigation bank. A secondary benefit to this option would be the direct recharge of groundwater. This type of system improvement may be feasible for reaches of Bear Creek located upstream and downstream of City of Merced. Costs would vary on the number of parcels acquired, willingness of landowner to sell all or part of their property, and environmental impacts.	$ -	$ -	$ -	Capital	Rural - Habitat restoration/reconnection	Natural Floodplain and Ecosystem Functions
54	RFMP		Ecosystem Restoration Along Waterways (both in the Mid SJR and the Upper San Joaquin Regions)	Similar to routing flood flows onto agricultural land, an alternative approach would be to acquire agricultural properties along the San Joaquin River and allow for seasonal floodplain inundation to provide fish rearing habitat as well as the diversion of flood flows, and, in some areas, the direct recharge of groundwater. This type of project could be implemented as a conservation easement, part of the Central Valley Habitat Exchange, or an ecosystem mitigation bank.	$ -	$ -	$ -	Capital	Rural - Habitat restoration/reconnection	Natural Floodplain and Ecosystem Functions
55	Other	California Department of Water Resources	Elevating & Floodproofing Structures		$ 14,430,240	$ 23,664,000	$ 1,207,320	Ongoing	Small Community - Risk awareness, floodproofing and land use planning	Watershed and Floodplain Management
56	Other	California Department of Water Resources	Elevating & Floodproofing Structures		$ 7,215,120	$ 11,832,000	$ 603,660	Ongoing	Small Community - Risk awareness, floodproofing and land use planning	Watershed and Floodplain Management
57	Other	California Department of Water Resources	Elevating & Floodproofing Structures		$ 14,430,240	$ 23,664,000	$ 1,207,320	Ongoing	Small Community - Risk awareness, floodproofing and land use planning	Watershed and Floodplain Management
58	RFMP		Emergency Response Improvement	Implement the following measures to improve emergency response in the planning area: 1) develop local flood fight plans with support from larger agencies, such as Modesto and Stanislaus County; 2) develop public safety agency evacuation plans; 3) clarify and document the command structure for areas with flood risk; 4) better define operational area logistical support for flood fight operations; and 5) form a Stanislaus Operational Area flood response working group.	$ -	$ -	$ -	Ongoing	Systemwide - Emergency management	Emergency Management

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#	Data Set Source	Lead Agency	Project Name	Project Description	Estimated Cost - Provided by Source	Adjusted Estimated Cost - Present Value ($)	Adjusted Estimated Cost - Annualized ($/year)	Investment Type	Area of Interest and Management Action Category	Management Action Type
59	RFMP	Stanislaus County Office of Emergency Services	Emergency Response Plan – Debris Management	A debris management plan is needed to better prepare to restore public services and ensure public health and safety in the aftermath of a flood or earthquake and to better position the Mid SJR Region for emergency response funding from the State of California, Federal Emergency Management Agency (FEMA), and other participating entities. Stanislaus County Office of Emergency Services proposes the development of a comprehensive, countywide debris management plan.	$ 110,000	$ 110,000	$ 5,612	Ongoing	Systemwide - Emergency management	Emergency Management
60	RFMP	Stanislaus County Office of Emergency Services	Emergency Response Plan – Local Planning and Training	Planning and training are necessary to improve coordination between local agencies so that emergency response can be improved in the planning area. A program would be developed and implemented to address this need.	$ 110,000	$ 110,000	$ 5,612	Ongoing	Systemwide - Emergency management	Emergency Management
61	RFMP	Lower San Joaquin Levee District	Enlarge Chowchilla Canal Bypass Control Structure	The control structure at the head waters of the Chowchilla Canal Bypass should be enlarged with two additional gate bays to minimize upstream seepage and levee failure. This will increase the emergency flow capacity and operational flexibility of the structure. The bypass channel may need to be evaluated for increased channel capacity. System improvement will require geotechnical analyses and would include fish passage.	$ 3,380,000	$ 3,380,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Flood Infrastructure
62	RFMP	Reclamation District 404	Erosion Protection along Reclamation District 404 Levees	This project is aimed at addressing erosion issues along RD 404 levees. It will include the placement of approximately 7,000 feet of 18-inch minus riprap at various locations along the right bank of the San Joaquin River, French Camp Slough, and Walker Slough, all at elevations above USACE jurisdiction.	$ 600,000	$ 600,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
63	RFMP	Madera County	Erosion Repair Project	Perform erosion repairs in Fresno River and Berenda Slough.	$ 1,500,000	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
64	RFMP	San Joaquin River Restoration Program	Firebaugh Habitat Projects	SJRRP is appraising several properties that may be impacted by shallow groundwater seepage in Reach 3 of the San Joaquin River due to the SJRRP. Acquisition of these properties by SJRRP could result in multi-benefit projects for transitory flood storage near Firebaugh, floodplain habitat and associated flood benefits, and could be rented or leased back to growers (estimated farmable in 80% of years) to eliminate or minimize the amount of agricultural land taken out of production. Habitat work could be done by economically disadvantaged communities of Firebaugh and Mendota to provide flood benefits. This project should be coordinated with the City of Firebaugh levee improvement projects (44-46 on this list) to provide mitigation and multi-benefit system improvements for this area.	$ -	$ -	$ -	Capital	Rural - Land acquisitions and easements	Watershed and Floodplain Management
65	BWFS	California Department of Water Resources	Firebaugh Small Community Improvements (BWFS Option C)	This project would include multi-benefit levee improvements consistent with Firebaugh Option C of the San Joaquin BWFS. It would include a mix of fix-in-place levee improvements, levee raises, new levees, and strategic setback levees to provide 100 year LOP for Firebaugh and the adjacent Eastside Acres development. This element is included because it provides effective flood damage reduction for a disadvantaged small community, while also providing 623 acres of riparian and marsh habitat, and recreational benefits. A recreational trail system consistent with the Firebaugh General Plan is incorporated with the levee improvements. Option C was selected as the preferred option because it provided the most ecosystem, recreation, and open space benefits for only moderately increased cost, especially considering potential cost-share from the SJRRP.	$ 100,000,000	$ 105,600,000	$ -	Capital	Small Community - Levee repair and infrastructure improvements	Flood Infrastructure
66	RFMP	San Joaquin River Restoration Program	Fish passage improvement at flood control structures	Flood control structures in the Mariposa Bypass, Eastside Bypass, and the San Joaquin River including the Sand Slough Control Structure, Reach 4B headgates, and the Chowchilla Bifurcation Structure are partial barriers to fish passage at higher flows and may be complete barriers at lower flows. Some of these structures may be in need of repair or replacement by SJRRP in order to adequately serve their intended flood management purpose and meet fish passage requirements.	$ -	$ -	$ -	Ongoing	Systemwide - State operations, planning and performance tracking	Natural Floodplain and Ecosystem Functions
67	RFMP	Reclamation District 1	Flood Contingency Map Reclamation District 1	The current flood contingency map for RD 1 needs to be updated.	$ 20,000	$ -	$ -	Ongoing	Rural - Risk awareness, floodproofing and land use planning	Watershed and Floodplain Management
68	RFMP	Reclamation District 2089	Flood Contingency Map Reclamation District 2089	The current flood contingency map for RD 2089 needs to be updated.	$ 20,000	$ -	$ -	Ongoing	Rural - Risk awareness, floodproofing and land use planning	Watershed and Floodplain Management
69	RFMP	Reclamation District 2126	Flood Contingency Map Reclamation District 2126	A Flood Contingency Map (FCM) does not exist for RD 2126. A FCM should be prepared to improve emergency response and reduce damage to crops / farm equipment in the event of flood.	$ 20,000	$ -	$ -	Ongoing	Rural - Risk awareness, floodproofing and land use planning	Watershed and Floodplain Management
70	RFMP	Reclamation District 524	Flood Contingency Map Reclamation District 524	RD 524's Flood Contingency Map (FCM) is not up to date. The FCM should be updated to improve emergency response and reduce risk to people in the event of flood.	$ 20,000	$ -	$ -	Ongoing	Rural - Risk awareness, floodproofing and land use planning	Watershed and Floodplain Management
71	Other	California Department of Water Resources	Flood ER Planning - Local/Operational Area and State Level	Includes local flood information and flood risk mapping activities, local flood forecasting and dissemination, local stream gage network enhancement, flood evacuation maps, flood ER plans, and levee safety plans. Includes State flood information and flood risk mapping, state flood forecasting and dissemination, levee advanced warning systems, and Flood ER Information Mgmt Systems.	$ 52,100,000	$ 52,100,000	$ 2,658,103	Ongoing	Systemwide - Emergency management	Emergency Management
72	Other	California Department of Water Resources	Flood ER Planning - Local/Operational Area and State Level	Includes local flood information and flood risk mapping activities, local flood forecasting and dissemination, local stream gage network enhancement, flood evacuation maps, flood ER plans, and levee safety plans. Includes State flood information and flood risk mapping, state flood forecasting and dissemination, levee advanced warning systems, and Flood ER Information Mgmt Systems.	$ 52,300,000	$ 52,300,000	$ 2,668,307	Ongoing	Systemwide - Emergency management	Emergency Management
73	Other	California Department of Water Resources	Flood ER Planning - Local/Operational Area and State Level	Includes local flood information and flood risk mapping activities, local flood forecasting and dissemination, local stream gage network enhancement, flood evacuation maps, flood ER plans, and levee safety plans. Includes State flood information and flood risk mapping, state flood forecasting and dissemination, levee advanced warning systems, and Flood ER Information Mgmt Systems.	$ 128,300,000	$ 128,300,000	$ 6,545,771	Ongoing	Systemwide - Emergency management	Emergency Management
74	Other	California Department of Water Resources	Flood ER Preparedness - Local/Operational Level and State Level	Includes flood alert and warning systems, er training and exercising, local flood er materials, equipment and facilities, and all weather roads on levee crowns. Includes ER Training and drills, tabletop and functional exercises, full-scale exercises, and flood fight methods training. Also includes State flood fight materials and storage facilities, and funding for the State Flood Ops Center.	$ 35,500,000	$ 35,500,000	$ 1,811,184	Ongoing	Systemwide - Emergency management	Emergency Management
75	Other	California Department of Water Resources	Flood ER Preparedness - Local/Operational Level and State Level	Includes flood alert and warning systems, er training and exercising, local flood er materials, equipment and facilities, and all weather roads on levee crowns. Includes ER Training and drills, tabletop and functional exercises, full-scale exercises, and flood fight methods training. Also includes State flood fight materials and storage facilities, and funding for the State Flood Ops Center.	$ 37,800,000	$ 37,800,000	$ 1,928,528	Ongoing	Systemwide - Emergency management	Emergency Management

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76	Other	California Department of Water Resources	Flood ER Preparedness - Local/Operational Level and State Level	Includes flood alert and warning systems, er training and exercising, local flood er materials, equipment and facilities, and all weather roads on levee crowns. Includes ER Training and drills, tabletop and functional exercises, full-scale exercises, and flood fight methods training. Also includes State flood fight materials and storage facilities, and funding for the State Flood Ops Center.	$ 46,600,000	$ 46,600,000	$ 2,377,497	Ongoing	Systemwide - Emergency management	Emergency Management
77	RFMP	River Partners	Flood Risk Education	Develop and implement a regional flood risk management educational program to raise awareness of flood risks and elevate the level of public understanding with respect to flood risk management needs and the value of investments to address them. For the local maintaining agencies (LMAs), include education on their role in flood risk management and provide technical guidance/assistance on levee maintenance activities and permitting requirements.	$ 30,000	$ -	$ -	Ongoing	Rural - Risk awareness, floodproofing and land use planning	Watershed and Floodplain Management
78	RFMP	Gravelly Ford Water District	Flooding Existing Pasture Lands	This project would divert San Joaquin River flood waters from the Chowchilla Canal Bypass to reduce flood flows, provide water supply, recharge local groundwater, and help prevent local subsidence. The Madera IRWMP supports projects that reduce flooding and promote efficient water use and groundwater recharge. There are two blocks of existing pasture land located immediately north of Firebaugh Avenue which crosses the Chowchilla Canal Bypass channel about 7 miles east of Firebaugh. On the west side of the Bypass channel there is approximately 1400 acres of non-irrigated pasture that could be flooded. A new turnout from the Bypass channel and a pipeline across the Chowchilla Canal would be needed to deliver flood water to this land. On the east side of the Bypass channel there is approximately 1700 acres of pasture that could be flooded. About half of this acreage already has an existing flood irrigation system that could be used to distribute flood water. The system irrigates from east to west so approximately 2 miles of new pipeline would be needed to divert Bypass water to the east side of the property.	$ -	$ -	$ -	Capital	Rural - Small-scale levee setbacks and floodplain storage	Reservoir and Floodplain Storage and Operation
79	RFMP	Lower San Joaquin River LMAs	Floodplain at Dos Rios (transitory storage)	DWR has partnered with other local, State and federal agencies and River Partners to fund the acquisition of Dos Rios Ranch, a 1,603-acre agricultural property west of Modesto. Phase 1 finalized in mid-April 2013, the $21.8 million acquisition is part of a multi-phase project designed to improve flood protection, increase inundated floodplain, and restore wildlife habitat at the confluence of the San Joaquin and Tuolumne Rivers. Phase 2 will comprise three major components: restoration planning and permitting, habitat restoration, and levee breaching study. The project will restore flooding and transient floodwater storage to 948 acres of historic floodplain, restore riparian habitats, and promote river physical processes of scour and deposition along six river miles.	$ 8,500,000	$ -	$ -	Capital	Systemwide - Reservoir and floodplain storage	Reservoir and Floodplain Storage and Operation
80	BWFS	California Department of Water Resources	Flowage Easements in Subsidence Area	DWR performed hydraulic analysis to evaluate the anticipated impacts of subsidence on the hydraulic performance of the flood system. With the projected long-term subsidence the frequency of levee overtopping in some areas would increase, potentially increasing flood damages. Purchasing flowage easements for lands expected to experience increased flooding due to subsidence could reduce long-term flood damages. The flowage easement area was assumed to be the inundation area resulting from long-term subsidence at design capacity minus the inundation area under existing baseline conditions at design capacity. This increased inundation area is shown in Figure 5-12. Unlike the levee improvements analysis above, the inundation area was calculated for subsidence throughout the entire Eastside Bypass. This easement area totaled about 16,300 acres. Assuming $10,000 per acre for flowage easements, the total cost of flowage easements was estimated at approximately $163 million. Costs for flowage easements and levee improvements were similar to each other under this reconnaissance-level of analysis; especially considering levee improvements only addressed subsidence along the Middle Eastside Bypass.	$ 180,000,000	$ 163,000,000	$ -	Capital	Systemwide - Reservoir and floodplain storage	Watershed and Floodplain Management
81	BWFS	California Department of Water Resources	Forecast-Coordinated Operations	Forecast-Coordinated Operations (FCO), which would coordinate flood releases from multiple reservoirs located in various tributaries of a major river to optimize the use of downstream channel capacity, optimize the use of total available flood storage space in the system, and eventually reduce overall peak flood flows downstream from these reservoirs	$ -	$ -	$ -	Ongoing	Systemwide - Reservoir operations	Reservoir and Floodplain Storage and Operation
82	BWFS	California Department of Water Resources	Forecast-Informed Operations for Tuolumne River Watershed	This project of the San Joaquin BWFS would incorporate FIO pre-releases coupled with increasing objective release for Tuolumne River. This element was included in the State Recommended Plan because it provides large stage reduction along Tuolumne River and stage reduction along San Joaquin River near higher risk areas for a severely flood storage limited watershed for limited costs. FIO seeks to coordinate flood releases from multiple reservoirs located in various tributaries of a major river to optimize the use of downstream channel capacity, the use of total available flood storage space in the system, and eventually to reduce overall peak flood flows downstream from these reservoirs. While there could be an almost infinite number of FIO operational scenarios, this reconnaissance evaluation used a 46,000-cfs flow objective for San Joaquin River at Vernalis as an operational constraint, which is a key location for San Joaquin River flow conditions, to begin exploring FIO opportunities.	$ -	$ -	$ -	Ongoing	Systemwide - Reservoir operations	Reservoir and Floodplain Storage and Operation
83	RFMP	Reclamation District 1608, Lincoln Village West	Fourteen Mile Slough Sediment Removal Project	To ensure water side levee access along the entire reach of Fourteen Mile Slough for which RD1608 has flood control jurisdictional responsibility, RD 1608 has approved the design and construction of a Sediment Removal Project from Village Marina to the Feather River Drive Bridge. This project will allow for continuity of operations for levee maintenance, minor repair, major rehabilitation, and emergency flood fight activities in this reach. It will also resolve the very limited landside levee access issue along the SW Levee portion of this reach.	$ 2,500,000	$ -	$ -	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
84	RFMP	Fresno Slough Improvement Group	Fresno Slough Sediment Removal	Remove sediment from Fresno Slough both inside and outside the Wildlife Refuge. It is uncertain, but probable to obtain permits to do this work. It would be easier and less costly if the work could be done at the same time that the Mendota Pool is dewatered for maintenance.	$ 720,000	$ -	$ -	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
85	RFMP	Fresno Slough Improvement Group	Fresno Slough South Levee Repair and Floodplain Enhancement Project	Improve the south levee, which has open toe drains and inadequate freeboard. Improvements might include removing the toe drains, rebuilding the levees, and bringing the levees under the jurisdiction of a responsible stakeholder. Enhancements would involve the modification of existing levees surrounding a State-owned parcel of land. The levee modifications would improve flow over the land and reduce pressure on other nearby levees during flood events. The current configuration of levees and cuts concentrates channel flow and increases the pressure at a weak point of the nearby levees.	$ 1,340,000	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance

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86	RFMP	Gomes Lake Joint Powers Authority	Gomes Lake / Harding Drain Improvements	This project includes multiple components to enhance the function, reliability, flexibility and capacity of the Gomes Lake facility, which stores and drains stormwater and return flows, providing flood risk reduction behind the east bank levees of the San Joaquin River. DWR asked for clarification on which levee was subject to erosion hazards. It is the project levee adjacent to the Gomes Lake Bypass Channel, which enters Gomes Lake from the south. Flood fight operations are necessary for two distinct structures in this district; the project levee and the Gomes Lake dike. Failure of either structure could flood portions of the district damaging property and potentially critical assets. Failure of the Gomes Lake Dike could also create additional threats to the stability of the project levee. The emergency response organizational structure for coordinating these two operations is unclear as well as the process for resolving any conflicts between each operation that may arise. At least no written protocols or procedures addressing these issues were identified. A constriction in the Channel and periods of rapid drawdown of Gomes Lake can create a 300 cfs flow creating the potential for damage to the project levee.	$ 1,700,000	$ 1,700,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
87	RFMP	Gravelly Ford Water District	Gravelly Ford Madera Ranch Recharge Project	Gravelly Ford Water District is located north and east of the San Joaquin River in Madera County. The District has an existing diversion from the river located approximately 8 miles upstream of the Chowchilla bifurcation structures. The District's existing water delivery system includes open ditches, pipelines, control structures and pumps. The system runs west from the river diversion point then turns north. The proposed Madera Irrigation Water Bank land is located between Avenue 7, which is about 3 miles north of the turn, and Avenue 12. Gravelly Ford's system has the ability to convey water from the river to the water bank lands, but a number of improvements are needed to maximize capacity and improve the operating efficiency. The improvements would include replacement of existing road crossing culverts, modifications to control structures, water measurement improvements, and canal and pipeline enlargements. Flood water diverted to the land would be spread for groundwater recharge and then re-used for irrigation. The proposed improvements would allow the delivery system to operate in both directions to bring flood water in and then later distribute the recaptured groundwater for irrigation. With the proposed improvements the system could divert a maximum flow of 50 cubic-feet per second (cfs). A possible secondary benefit would be to make some of the banked water available to the Red Top area through transfers to help mitigate subsidence.	$ 1,970,000	$ 1,970,000	$ -	Capital	Rural - Small-scale levee setbacks and floodplain storage	Reservoir and Floodplain Storage and Operation
88	RFMP	Stanislaus County	Grayson Multi-benefit Flood Risk Reduction	The Grayson Multi-benefit Flood Risk Reduction Project is designed to reduce flood hazards in the community of Grayson that are associated with flood flows escaping into the San Joaquin River channel at the entrance to Laird Slough, the primary channel for conveying flows in this reach. In addition to reducing flood risk in Grayson, the project will provide habitat enhancement and public recreation benefits, and help to provide transportation and infrastructure benefits by reducing flooding of Grayson Road, a major east-west corridor across the San Joaquin River. Based on early modeling for the Basinwide Feasibility Study, it appears that the Grayson Road Bridge constitutes a significant local impediment to flood flows on the San Joaquin River. This project would wholly or partially address that issue. This project will provide flood risk management, ecosystem, recreation, transportation, and groundwater recharge benefits.	$ 15,000,000	$ 15,000,000	$ -	Capital	Small Community - Levee repair and infrastructure improvements	Operation and Maintenance
89	RFMP	Great Valley Grassland State Park, Lower San Joaquin Levee District	Great Valley Grassland State Park (GVGSP) Levee De-Authorization	In 2011, the California Department of Parks and Recreation assessed the feasibility of restoring floodplain connectivity and dependent habitats to approximately 330 acres within the GVGSP. The system improvement would provide a more natural floodplain process to help control exotic species and restore geomorphic and ecological conditions similar to the pre-levee conditions. The system improvement would reduce flood flow constraints below Highway 165 thereby improving upstream flood conditions in Stevinson Water District. The levee along the river would be deauthorized to allow flood water to flow into State Park lands. System improvement will include wetland creation and invasive species removal. Proposed improvements on GVGSP should be coordinated with adjacent system improvements proposed on San Luis Nat'l Wildlife Refuge units (projects 60-65 on this list) to optimize attainment of flood and ecosystem benefits in this area.	$ 4,930,000	$ 4,930,000	$ 251,525	Ongoing	Systemwide - State operations, planning and performance tracking	Policy and Regulations
90	RFMP	Stanislaus County Office of Emergency Services	Hydraulic and Channel Migration Studies	Two regional studies (mainstem San Joaquin River flood hydraulics and channel migration) and three focused hydraulic studies are needed to better inform flood management in the Mid SJR Region.	$ 200,000	$ 200,000	$ 10,204	Ongoing	Rural - Studies and analysis	Watershed and Floodplain Management
91	BWFS	California Department of Water Resources	Hydraulic Structure Upgrades	Upgrade of hydraulic structures in the Upper San Joaquin Region because of facility age or operational problems was identified on a site-specific basis in the 2012 CVFPP SSIA at Chowchilla Canal Bypass Control Structure, San Joaquin River Control Structure, Eastside Bypass Control Structure, Mariposa Bypass Control Structure, and Mariposa Drop Structure. The objective of this element is to proactively prevent catastrophic failure of the Chowchilla Canal Bypass Control Structure and San Joaquin River Control Structure during large flood events. These structures would receive critical structural rehabilitation. Catastrophic failure of these structures would severely reduce the ability of operators to control the flow split between the Chowchilla Bypass and San Joaquin River, resulting in increased flood damages. The hydraulic model currently represents these hydraulic structures as fully functioning; therefore, no additional hydraulic evaluations were conducted. Estimated costs for these upgrades totaled approximately $2 million.	$ -	$ 2,000,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
92	RFMP		Improve Upstream Reservoir Operations	Update and improve upstream reservoir operations through enhancements to coordination among operating entities; use of additional information, including forecasting; broader communications with others, including local communities; improved and accessible gaging; and updated flood control manuals. Analyze and implement actions to modify upstream reservoir operations to improve flood management; aquatic, riparian, and floodplain habitat; water quality; and recreation.	$ -	$ -	$ -	Ongoing	Systemwide - Reservoir operations	Reservoir and Floodplain Storage and Operation
93	BWFS	California Department of Water Resources	Increase Objective Release (from 9K cfs to 25K cfs) from New Don Pedro in the Tuolumne River Watershed	Operations component of the increased Objective Release (from 9K cfs to 25K cfs) from New Don Pedro at the Modesto Gage in the Tuolumne River Watershed.	$ -	$ 252,000,000	$ 12,856,853	Ongoing	Systemwide - Reservoir operations	Reservoir and Floodplain Storage and Operation

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#	Data Set Source	Lead Agency	Project Name	Project Description	Estimated Cost - Provided by Source	Adjusted Estimated Cost - Present Value ($)	Adjusted Estimated Cost - Annualized ($/year)	Investment Type	Area of Interest and Management Action Category	Management Action Type
94	RFMP	Merced County	Increase Public Awareness of Flooding	Increasing the public's knowledge about flood risk is another non-structural alternative for mitigating flood risk. In addition to improving safety during floods, the efforts can also enhance public support of flood control projects. Typical forms of outreach include press releases, individual mailer brochures, website development, posters, "flood awareness month", and social networking site involvement. Note that the public outreach efforts can often be completed in conjunction with other related projects in order to reduce costs. Merced and other communities are prone to flooding from the creeks in the region. Increasing public awareness of flood season, precautionary measures, and their location with respect to the floodplain may be effective in reducing flood damages.	$ 50,000	$ -	$ -	Ongoing	Rural - Risk awareness, floodproofing and land use planning	Watershed and Floodplain Management
95	RFMP	Central California Irrigation District, San Luis Canal Company	Ingomar Reservoir Surface Storage	This project would divert San Joaquin River and Kings River flood water at Mendota Pool to reduce flood flows, provide water supply, recharge local groundwater, and help prevent local subsidence. The project protects SPFC facilities along the San Joaquin River by diverting flood flows and the objectives are consistent with SSIA. The Ingomar Reservoir surface storage project includes expansion of the existing Ingomar Reservoir. The project is located east of the CCID Main Canal and north of Henry Miller Road. A 2013 report evaluated the expansion of the existing 41-acre site to about 650 acres (San Luis & Delta Mendota Water Authority, 2013). The project would receive surface water from the SJRECWA or flood flows off the SJR or Kings River. CCID facilities would be used to convey water to the project lands.	$ 18,300,000	$ 18,300,000	$ -	Capital	Systemwide - Reservoir and floodplain storage	Reservoir and Floodplain Storage and Operation
96	RFMP	Lower San Joaquin Levee District	Install New Gaging Stations	Gaging stations to anticipate flows into the Eastside Bypass.	$ 330,000	$ -	$ -	Ongoing	Rural - Risk awareness, floodproofing and land use planning	Watershed and Floodplain Management
97	RFMP	River Partners	Integrated Levee Vegetation Management – Flood Maintenance and Habitat	This project includes re-establishing appropriate vegetation on levee slopes to promote terrestrial wildlife survival during floods – either native sod on active levees or native brush vegetation on inactive levees (RDs 2099, 2100, 2102, and 2092 in the future).	$ 6,400,000	$ 6,400,000	$ -	Capital	Rural - Habitat restoration/reconnection	Natural Floodplain and Ecosystem Functions
98	RFMP	Delta South Region	Land Use and Floodplain Management - Delta South Region	Regional project in the Delta South region to reduce residual risk.	$ 10,000,000	$ 10,000,000	$ 510,193	Ongoing	Rural - Risk awareness, floodproofing and land use planning	Watershed and Floodplain Management
99	RFMP	Lower San Joaquin River Region	Land Use and Floodplain Management - Lower San Joaquin River	Regional project in the Lower San Joaquin River region to reduce residual risk.	$ 20,000,000	$ 20,000,000	$ 1,020,385	Ongoing	Rural - Risk awareness, floodproofing and land use planning	Watershed and Floodplain Management
100	RFMP	Merced Irrigation District	Le Grand Canal Flood Control Structure at Black Rascal Creek	Le Grand Canal is considered the official spillway to Lake Yosemite by the Division of Safety of Dams (DSOD). The canal commences at the lake and traverses southeasterly along the foothills toe contour toward the town of Planada. As a result , the canal intercepts or bypasses all creeks and ravines draining the foothills. The first major water way it crossed is Black Rascal Creek. The Canal crosses the creek with a double barrel reinforced concrete box. However, at the end of the irrigation season, Merced Irrigation District (MID) breaches the right bank of the canal and places a temporary dam, whereby all flood flows from Lake Yosemite are deposited to the creek. With the start of every irrigation season, the canal is repaired and flows could continue downstream. A control structure connected to Merced Irrigation District SCADA system would give Merced Irrigation District the flexibility to react timely and divert all or portion of flood flows as needed. As part of this project, opportunities for riparian and wetland habitat enhancements will be considered.	$ 490,000	$ 490,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Flood Infrastructure
101	RFMP	Merced Irrigation District	Le Grand /Planada Flood Control /Conjunctive Use Expansion Study	The Le Grand canal was originally constructed to convey irrigation flows from Lake Yosemite (LY) south to the Planada and Le Grand area. The canal crosses multiple ravines and waterways along its course, including Black Rascal Creek (BRC) and Bear Creek (BC). The canal is the official spillway for Lake Yosemite. During flood season, MID breaches its southerly bank to discharge conveyed flows from the lake to BRC and prevent the canal from overtopping downstream due to limited channel capacity downstream. This multi-purpose system improvement study is to redirect and route the flood waters from LY, BRC, BC and the watershed between them safely downstream through various conveyance systems for beneficial uses in the southern Merced region where groundwater is the main supply. A series of checks and diversion structures would be constructed along the canal to control and manage flood flows. Various reaches of Le Grand and Planada Canals must be enlarged as well to accommodate for higher flow. The system improvement is needed to provide protection against the overtopping of Lake Yosemite, especially in the case of storms occurring within the irrigation season. The system improvement would allow MID to move from an irrigation season mode to flood management mode and vice versa with minimal impact to the system, UC Merced, the City of Merced, and Merced County. Additionally, the system improvement is needed to prevent the Le Grand and Planada Canals from breaching during high flood flows. The controlled flood waters may be re-routed to provide additional water supply downstream for various uses such as environmental, recharge, and counter subsidence measures.	$ 240,000	$ 240,000	$ 12,245	Ongoing	Rural - Studies and analysis	Watershed and Floodplain Management
102	RFMP	Lower San Joaquin Levee District	Levee Breaches Unit 1, LM 9.90 ; Unit 5, LM 0.25	Levee breaches at Unit 1, levee mile (LM) 9.90 and Unit 5, LM 0.25 are the result of previous flood flow actions. Recent USACE inspection rated the levee units unacceptable to project standards (potential PL84-99). It is proposed to add structures with removable flash boards that would contain flood water in the river channel and permit landside flood water to drain into the river by removing the flash boards.	$ 535,000	$ 535,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
103	RFMP	San Joaquin River Restoration Program	Levee Improvements in Reach 2B, 3, 4B, Eastside Bypass, Mariposa Bypass, and Reach 5	The SJRRP is increasing channel capacity to 4,500 cfs in Reaches 2B and 4B through major projects. Levees in other reaches may also need improvements to increase capacity to 4,500 cubic feet per second (cfs). An initial hydraulic evaluation has been done and DWR has prioritized the next step in data collection and geotechnical evaluation. The result of the further evaluation will help the SJRRP identify future remediation needs for existing levees. Initial system improvement costs were developed assuming that all levees will need remediation; these costs will go down as geotechnical evaluations are complete. As a part of this project, inter-agency agreements, funding, and coordination will be formalized.	$ 235,000,000	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Flood Infrastructure
104	RFMP	Lower San Joaquin Levee District	Levee Improvements in Subsidence Area	Improve Eastside Bypass levees in areas of subsidence. As part of this project, opportunities for riparian and wetland habitat enhancements will be considered.	$ -	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance

Table B-5. San Joaquin Basin Management Actions Included within the 2017 Refined SSIA Portfolio

#	Data Set Source	Lead Agency	Project Name	Project Description	Estimated Cost - Provided by Source	Adjusted Estimated Cost - Present Value ($)	Adjusted Estimated Cost - Annualized ($/year)	Investment Type	Area of Interest and Management Action Category	Management Action Type
105	RFMP	Madera County	Levee Patrol Road Repair	Perform repair and place aggregated base for levee patrol roads on approximately 12 miles on the Fresno River, Berenda Slough and Ash Slough. Due to high cost and limited funding, repairs on levee patrol; roads have been delayed, and vegetation has been allowed to grow unabated. In addition, adjacent landowners have made modifications to levee patrol roads to access private properties.	$ 500,000	$ 500,000	$ 25,510	Ongoing	Systemwide - Emergency management	Emergency Management
106	RFMP	Delta South Region	Local ER Planning - Delta South Region	Regional project in the Delta South region to reduce residual risk.	$ 10,000,000	$ -	$ -	Ongoing	Rural - Studies and analysis	Watershed and Floodplain Management
107	RFMP	Lower San Joaquin River Region	Local ER Planning - Lower San Joaquin River Region	Regional project in the Lower San Joaquin River region to reduce residual risk.	$ 20,000,000	$ -	$ -	Ongoing	Rural - Studies and analysis	Watershed and Floodplain Management
108	RFMP	Central California Irrigation District	Los Banos Creek Recharge and Recovery	This project could divert San Joaquin River and Kings River flood water at Mendota Pool to reduce flood flows, provide water supply, recharge local groundwater, and help prevent local subsidence. The project protects SPFC facilities along the San Joaquin River by diverting flood flows and the objectives are consistent with SSIA. The Los Banos Creek Recharge & Recovery project includes construction of 103 acres of recharge ponds and 6 recovery wells along LBC between the California Aqueduct and the Central California Irrigation District's (CCID) Outside Canal. The project would receive surface water from LBC, the SJRECWA, San Luis Water District (SLWD), CCID Main and Outside Canals or through exchange from other contractors. The DMC and Outside Canal would be used to convey the water to the bank. Water wells will be piped to the DMC and CCID Outside canals.	$ 5,000,000	$ 5,000,000	$ -	Capital	Rural - Small-scale levee setbacks and floodplain storage	Reservoir and Floodplain Storage and Operation
109	Other	California Department of Water Resources	Lower San Joaquin Feasibility Study, Phase 2	State-Federal Feasibility Study projects that DWR could partner in.	$ 4,000,000	$ 4,000,000	$ 204,077	Ongoing	Urban - Studies and analysis	Watershed and Floodplain Management
110	Other	California Department of Water Resources	Lower San Joaquin River/Delta South - Channel RR&R - Arrundo Removal	Regional input indicated giant reed removal cost at $25,000/acre.	$ 1,960,044	$ 1,960,044	$ 100,000	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
111	Other	California Department of Water Resources	Lower San Joaquin River/Delta South - Channel Sediment Removal	Channel maintenance activities including sediment, vegetation, and debris removal are conducted by DWR with respect to the Sacramento River Flood Control Project and generally by LMAs in the San Joaquin Valley. Estimated costs for the Sacramento Basin were developed by using historical projects overseen by DWR, which have occurred as funding has been available, as well as input from regional experts. Estimated costs for the San Joaquin Basin were based on direct interviews with LMAs and staff.	$ 23,520,530	$ 23,520,530	$ 1,200,000	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
112	Other	California Department of Water Resources	Lower San Joaquin River/Delta South - Channel Vegetation and Debris Removal	Channel maintenance activities including sediment, vegetation, and debris removal are conducted by DWR with respect to the Sacramento River Flood Control Project and generally by LMAs in the San Joaquin Valley. Estimated costs for the Sacramento Basin were developed by using historical projects overseen by DWR, which have occurred as funding has been available, as well as input from regional experts. Estimated costs for the San Joaquin Basin were based on direct interviews with LMAs and staff.	$ 5,880,132	$ 5,880,132	$ 300,000	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
113	Other	California Department of Water Resources	Lower San Joaquin River/Delta South - Large Structure O&M	Major structures involve those facilities described in CWC Section 8361 and administered by DWR, and include weirs, bypass outflow control structures, outfall gate facilities, and large regional pumping plants.	$ 1,372,031	$ 1,372,031	$ 70,000	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
114	Other	California Department of Water Resources	Lower San Joaquin River/Delta South - Large Structures RR&R	Based on discussions with DWR and LMA staff, major structures have historically been repaired and well maintained, and there is not an immediate need to repair, replace, or rehabilitate these facilities. As such, RR&R costs were not identified for this TM given major structures were assumed not to require significant repairs over the next 50 years. However, it is recommended that funding reserves be established to ensure adequate funding is available in the future to continue needed repairs or to replace aged facilities.	$ -	$ -	$ -	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
115	Other	California Department of Water Resources	Lower San Joaquin River/Delta South - Non-urban Levee O&M (Rural)	Levee O&M costs were separated between urban and rural LMAs to capture the additional costs associated with urban area LMAs. Levee O&M included the following activities: vegetation maintenance, rodent control, encroachment and pipe maintenance, minor repairs (erosion, levee crown repairs etc.)	$ 70,438,106	$ 70,438,106	$ 3,593,700	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
116	Other	California Department of Water Resources	Lower San Joaquin River/Delta South - Non-urban Levee RR&R (Rural)	Levee-related RR&R costs have generally been driven by necessary flood-event repairs and known erosion or levee stability issues. The OMRR&R Work Group determined the Delta Subventions Program data set is the most robust data set for estimating RR&R cost on SPFC levees because the existence of the funding program has encouraged more regular analysis and repair of levees. Although urban levees are being improved to a higher standard to meet urban level of protection standards, the OMRR&R Work Group determined that repair and rehabilitation costs for urban and non-urban levees would not differ substantially, and the cost for ULDC compliance would be the only significant differentiating factor for RR&R of urban SPFC levees.	$ 27,748,345	$ 27,748,345	$ 1,415,700	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
117	Other	California Department of Water Resources	Lower San Joaquin River/Delta South - Small Community Levee O&M	Levee O&M costs were separated between urban and rural LMAs to capture the additional costs associated with urban area LMAs. Levee O&M included the following activities: vegetation maintenance, rodent control, encroachment and pipe maintenance, minor repairs (erosion, levee crown repairs etc.)	$ -	$ -	$ -	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
118	Other	California Department of Water Resources	Lower San Joaquin River/Delta South - Small Community Levee RR&R	Levee-related RR&R costs have generally been driven by necessary flood-event repairs and known erosion or levee stability issues. The OMRR&R Work Group determined the Delta Subventions Program data set is the most robust data set for estimating RR&R cost on SPFC levees because the existence of the funding program has encouraged more regular analysis and repair of levees. Although urban levees are being improved to a higher standard to meet urban level of protection standards, the OMRR&R Work Group determined that repair and rehabilitation costs for urban and non-urban levees would not differ substantially, and the cost for ULDC compliance would be the only significant differentiating factor for RR&R of urban SPFC levees.	$ -	$ -	$ -	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
119	Other	California Department of Water Resources	Lower San Joaquin River/Delta South - Small Structures O&M	Minor structures include stop log or gated closure structures, pumping plants, monitoring wells and piezometers, retaining walls and floodwalls, pipe penetrations, and encroachments. Routine O&M of these types of structures is critical, but often overlooked for budgeting purposes. As became evident in the LMA data received, LMAs typically only account for routine power costs for pumping plants and do not separately account for other activities associated with minor structures such as video inspections of pipes, lubrication and minor repairs of pipe closure valves, routine inspection and maintenance of closure structure gates or stop logs, and inspection and minor repairs of floodwalls. The OMRR&R Work Group determined that costs for minor-structure O&M are likely included in the general overhead expenses for the LMAs who have structures, and no further estimates were developed. However, it is anticipated that video inspections of pipes will be required in the future (once every 5 years) for pipes crossing SPFC levees and as such these projected costs were included in the overall estimates.	$ 3,230,153	$ 3,230,153	$ 164,800	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance

Table B-5. San Joaquin Basin Management Actions Included within the 2017 Refined SSIA Portfolio

#	Data Set Source	Lead Agency	Project Name	Project Description	Estimated Cost - Provided by Source	Adjusted Estimated Cost - Present Value ($)	Adjusted Estimated Cost - Annualized ($/year)	Investment Type	Area of Interest and Management Action Category	Management Action Type
120	Other	California Department of Water Resources	Lower San Joaquin River/Delta South - Small Structures RR&R	Small structures such as stop logs or gated closure structures, monitoring wells and piezometers, retaining walls and floodwalls, pipes, and encroachments are typically accounted for in levee RR&R costs, except for pipes. Many of these pipes were installed before or during original project construction prior to the 1950s, but no plans were implemented to assure these facilities could be replaced when they exceed their useful life. As a result, many pipes have reached their useful life with many of these structures in need of repair, replacement, or proper pipe abandonment.	$ 96,434,171	$ 96,434,171	$ 4,920,000	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
121	Other	California Department of Water Resources	Lower San Joaquin River/Delta South - Urban Levee O&M	Levee O&M costs were separated between urban and rural LMAs to capture the additional costs associated with urban area LMAs. Levee O&M included the following activities: vegetation maintenance, rodent control, encroachment and pipe maintenance, minor repairs (erosion, levee crown repairs etc.)	$ 71,639,613	$ 71,639,613	$ 3,655,000	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
122	Other	California Department of Water Resources	Lower San Joaquin River/Delta South - Urban Levee RR&R	Levee-related RR&R costs have generally been driven by necessary flood-event repairs and known erosion or levee stability issues. The OMRR&R Work Group determined the Delta Subventions Program data set is the most robust data set for estimating RR&R cost on SPFC levees because the existence of the funding program has encouraged more regular analysis and repair of levees. Although urban levees are being improved to a higher standard to meet urban level of protection standards, the OMRR&R Work Group determined that repair and rehabilitation costs for urban and non-urban levees would not differ substantially, and the cost for ULDC compliance would be the only significant differentiating factor for RR&R of urban SPFC levees.	$ 25,790,261	$ 25,790,261	$ 1,315,800	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
123	USACE	San Joaquin County, City of Stockton	LSJRFS NED Plan, (use as a master plan)	In 2009 the LSJRFS was initiated by USACE to study deficiencies in the flood control system for the lower San Joaquin River from the confluence with the Stanislaus River downstream to the Lodi wastewater treatment plant. The LSJRFS also includes the eastside tributaries to the lower San Joaquin River. The LSJRFS is anticipated to be complete in spring-2016 and may provide justification for federal cost sharing on selected project features that are in the federal interest. The LSJRFS considered numerous incremental improvement alternatives to provide protection to North Stockton and Central Stockton which reasonably maximize net benefits. The elements shown below are currently the collection of incremental improvements to be selected as the NED plan. The NED plan includes provision sea level rise by raising levees.	$ 1,027,000,000	$ -	$ -	Capital	Urban - Levee improvements	Flood Infrastructure
124	RFMP	Madera Irrigation District	Madera Irrigation District Water Bank Facility	Develop water bank facility to capture flood flows and perform groundwater recharge. The facility can be used to bank water for future use.	$ 124,000,000	$ -	$ -	Capital	Rural - Small-scale levee setbacks and floodplain storage	Reservoir and Floodplain Storage and Operation
125	RFMP	Madera Irrigation District	Madera Lake Regulating and Recharge Project	Regulating and recharge at Madera Lake. As part of this project, opportunities for riparian and wetland habitat enhancements will be considered.	$ 3,500,000	$ 3,500,000	$ -	Capital	Rural - Small-scale levee setbacks and floodplain storage	Reservoir and Floodplain Storage and Operation
126	BWFS	California Department of Water Resources	Madera Ranch Recharge Projects	The Upper San Joaquin RFMP identified a series of projects to implement groundwater banking in the Madera Ranch area, which is located north of the San Joaquin River in Madera County. The projects would occur in partnership between Gravelly Ford Water District and Madera Irrigation District for conveying flood flows diverted from an existing diversion point on the San Joaquin River to a new water banking facility. Madera Irrigation District is pursuing a project that would develop groundwater recharge and banking facilities within Madera Ranch. In 2011, Reclamation released an environmental impact statement for groundwater recharge in Madera Irrigation District (Reclamation, 2011). The Madera Irrigation District Water Supply Enhancement Project in the Madera Ranch area could be used to capture diverted flood flows by Gravelly Foard Water District in wet years, provide local water supplies through reuse of recharged groundwater in dry years, and potentially make water available to help mitigate subsidence near the Red Top area. As such, this project would provide enhanced water supply reliability and flexibility and improved conjunctive use, reduce current aquifer overdrafting, and increase groundwater quality in the area (Reclamation, 2011). The Madera Ranch recharge lands and banking facilities would cover approximately 13,600 acres with 323 acres of recharge basins (Provost and Pritchard, 2014). In addition, approximately 3,000 acres of existing pastureland within the Gravelly Ford Water District east and west of the Chowchilla Canal Bypass Channel could be flooded with diverted flood flows to help reduce peak flows and further recharge the groundwater basin for future water supply.	$ -	$ -	$ -	Capital	Systemwide - Reservoir and floodplain storage	Reservoir and Floodplain Storage and Operation
127	Other	California Department of Water Resources	Mapping, Risk Awareness and Land Use Planning (Rural)	Covers the State's floodplain risk mgmt programs, information mgmt systems, channel capacity updates, land use planning, mitigation planning, etc.	$ 787,800	$ 15,441,228	$ 787,800	Ongoing	Rural - Risk awareness, floodproofing and land use planning	Watershed and Floodplain Management
128	Other	California Department of Water Resources	Mapping, Risk Awareness and Land Use Planning (Small Comm)	Covers the State's floodplain risk mgmt programs, information mgmt systems, channel capacity updates, land use planning, mitigation planning, etc.	$ 3,151,200	$ 61,764,911	$ 3,151,200	Ongoing	Small Community - Risk awareness, floodproofing and land use planning	Watershed and Floodplain Management
129	Other	California Department of Water Resources	Mapping, Risk Awareness and Land Use Planning (Urban)	Covers the State's floodplain risk mgmt programs, information mgmt systems, channel capacity updates, land use planning, mitigation planning, etc.	$ 3,939,000	$ 77,206,139	$ 3,939,000	Ongoing	Urban - Risk awareness, floodproofing and land use planning	Watershed and Floodplain Management
130	RFMP	Merced Streams Group	Mariposa Reservoir Enlargement and Downstream Levee and Channel Improvements	Mariposa Reservoir was constructed in the early 1950's as an element of the Merced Streams Group Project authorized by Congress's 1944 Flood Control Act. The Flood Control Act of 1970 called for three additional flood control reservoirs, enlargement of existing reservoirs, and 52 miles of levee and channel modifications. To date only one additional reservoir has been built (Castle Dam). The enlargement of Mariposa Reservoir and downstream levee and channel improvements would increase the level of flood protection to Planada and Le Grand, both of which are DAC's in Merced County. Mariposa Reservoir was originally constructed to provide protection for up to a 50-year storm event. The State of California has adopted legislation that calls for a minimum of 200-year flood protection for urbanized areas. This system improvement would meet the requirements of the new flood control legislation. As part of this project, opportunities for riparian and wetland habitat enhancements will be considered.	$ 112,500,000	$ 112,500,000	$ -	Capital	Systemwide - Reservoir and floodplain storage	Flood Infrastructure
131	RFMP	San Joaquin County, Lower San Joaquin LMAs	Master Plan of San Joaquin River Corridor	Regional project for all LMAs in the Lower San Joaquin River region.	$ 2,000,000	$ 2,000,000	$ 102,039	Ongoing	Rural - Studies and analysis	Watershed and Floodplain Management

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132	RFMP	Merced Streams Group	Merced County Flood Control District	In the past decade, established flood control agencies have had great success in mitigating flood risk throughout California, due to their singular focus. Example's include the Sacramento Area Flood Control Agency (SAFCA), the Sutter Butte Flood Control Agency (SBFCA), the San Joaquin Area Flood Control Agency (SJAFCA), and the San Joaquin County Flood Control and Water Conservation District (SJCFC & WCD). This option would involve the creation of a flood control agency for the region, either as an adjunct of Merced County, or as a joint powers authority. The agency would be responsible for planning, coordinating, and managing flood control projects for the region. A central flood control agency could also perform O&M functions.	$ 100,000	$ 100,000	$ 5,102	Ongoing	Systemwide - State operations, planning and performance tracking	Policy and Regulations
133	Other	California Department of Water Resources	Merced County Streams General Reevaluation Report	State-Federal Feasibility Study projects that DWR could partner in.	$ 4,000,000	$ 4,000,000	$ 204,077	Ongoing	Urban - Studies and analysis	Watershed and Floodplain Management
134	RFMP	San Luis National Wildlife Refuge	Merced NWR - Modify water intake structures at selected refuge units	Existing pipes with flap-gates on flood control levee – further develop these sites to divert floodwaters onto refuge floodplain lands. There are numerous locations along the flood control levees at the Merced, Lonetree, and Sno-Bird units of Merced NWR where replacement of existing flap gates with new screw-gates and, where necessary, catwalks would allow controlled diversion of floodwaters onto refuge lands. In some locations water control structures and/or armoring of existing water conveyance facilities would be needed. This would allow controlled diversions onto refuge floodplain lands at approximately 15 locations, some of which are noted as follows: a) Merced Unit – there is potential for diverting water into Cinnamon Slough area. However there is a need to consider impacts to managed refuge wetlands adjacent to the north. b) Lonetree Unit – floodwater could be diverted to area outside levee. However there is a need to consider impacts to adjacent private farmlands to the east. c) Sno-Bird Unit – potential to divert waters into north, middle, and south subunits. However, there is a need to consider flood impacts to adjacent landowners. Control on volume and limits on amounts of water diverted at these locations would be necessary to prevent damage to refuge infrastructure, resource values, and adjacent private lands.	$ 580,000	$ 580,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Flood Infrastructure
135	RFMP	San Luis National Wildlife Refuge	Merced NWR Merced Unit - Enhance infrastructure to divert flood flows onto 1200 acres of existing wetlands and other refuge lands	There are numerous locations on the Merced Unit where pipes with flap-gates are present in the flood control levees of the Eastside Bypass, and are well situated to potentially divert floodwaters onto Refuge lands. However, there is no direct connection to move that water out into the Refuge water conveyance system. The refuge currently uses a pipeline to move water throughout the managed wetland units and other refuge lands. The pipeline is in close proximity to the flood control levee. Additionally there are refuge pumps in place which could be used to lift the water from the Bypass into the pipeline, but are currently not connected to the pipeline. At 2 locations along the levee existing pumps could be reconfigured and connected to the existing pipeline. The connection between the pumps and the pipeline would allow floodwater to be diverted from the Bypass into managed Refuge wetlands. Control on volume and limits on amounts of water diverted at these locations would be necessary to prevent damage to refuge infrastructure, resource values, and adjacent private lands.	$ 235,000	$ 235,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Flood Infrastructure
136	RFMP	San Luis National Wildlife Refuge	Merced NWR Sno-Bird Unit – Construct diversions off Eastside Canal	The Eastside Canal, which runs along the northern boundary of the Sno-Bird Unit is also impacted by flood events and can exceed its conveyance capacity and flood out downstream locations. There is an opportunity to divert excess floodwater from the canal onto Refuge floodplain lands. a) Remove sediment in the canal at the existing weir diversion structure and rehabilitate the first section of the existing canal downstream of the weir. Replace the weir boards and make minor repairs to the concrete structure. Install two canal gates where the refuge canal flows back into Bear Creek. One gate would be for an existing culvert and the other for a new culvert through the Bear Creek flood control levee. A new channel would be excavated inside the levee to connect the new culvert to the Bear Creek pilot channel. These improvements would allow floodwater to be spread in basins and swales in the north and middle subunits and then drain back into the Eastside Bypass. b) Install a new canal turnout structure in the Eastside Canal at the northwest corner of the Sno-Bird Unit. The site has been breached in the past to relieve pressure on the Eastside Canal and prevent downstream flooding. Controlled diversions could be spread out into basins and swales of the north subunit and then drain back into the Eastside Bypass.	$ 263,000	$ 263,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Flood Infrastructure
137	RFMP	Merced Streams Group	Merced Region Programmatic Environmental Impact Report for Stream Bed and Vegetation Control	Flood management continues to be increasingly important and difficult at the local level. Vegetation and stream bed/channel management is critical to decrease flood related impacts in Merced County. Recent interpretations and application of Fish and Game codes have nearly halted Stream Bed and Channel maintenance. CEQA analyses required for the Streambed Alteration permitting on each project is expensive and defers maintenance, creating complex unintended outcomes. The Merced IRWM region should explore the effectiveness and expense of preparing a local Programmatic Environmental Impact Report (PEIR) to potentially create low-cost and faster-tearing in subsequent CEQA reviews related to flood management. (MIRWMP, 2013c)	$ 300,000	$ 300,000	$ 15,306	Ongoing	Systemwide - State operations, planning and performance tracking	Programmatic, or Project-Specific Permitting
138	USACE	California Department of Water Resources	Merced Urban Improvements	The objective of this element is to achieve a 200 year urban LOP for City of Merced consistent with the 2012 CVFPP SSIA. USACE proposed several structural and nonstructural management actions for Merced during an earlier phase of the Merced County Streams Group Project, as described in the Draft Measures for Merced and General Design Memorandum, Phase II Merced County Streams, CA (USACE, 2001; USACE, 1981). A wide range of actions could potentially provide Merced with an urban LOP, many of which were identified in these previous studies. These actions include additional off stream storage, reservoir enlargement, diversion channels, levee improvements, and channel improvements that were identified in the Upper San Joaquin RFMP. Studies of these potential improvements are still in the early stages, and a package of actions to provide Merced with 200 year LOP has not yet been determined. Actions to provide 200-year LOP for Merced were not formulated and evaluated in this BWFS. Only a small portion of the city of Merced is protected by SPFC facilities. DWR hydraulic and economic models do not fully extend up to Merced, so Merced is not explicitly represented within BWFS systemwide modeling tools. However, consistent with the 2012 CVFPP, DWR supports development of the appropriate actions to achieve 200 year urban LOP for Merced.	$ -	$ -	$ -	Capital	Urban - Levee improvements	Flood Infrastructure

Table B-5. San Joaquin Basin Management Actions Included within the 2017 Refined SSIA Portfolio

#	Data Set Source	Lead Agency	Project Name	Project Description	Estimated Cost - Provided by Source	Adjusted Estimated Cost - Present Value ($)	Adjusted Estimated Cost - Annualized ($/year)	Investment Type	Area of Interest and Management Action Category	Management Action Type
139	Other	California Department of Water Resources	Mid San Joaquin River - Large Structures RR&R	Based on discussions with DWR and LMA staff, major structures have historically been repaired and well maintained, and there is not an immediate need to repair, replace, or rehabilitate these facilities. As such, RR&R costs were not identified for this TM given major structures were assumed not to require significant repairs over the next 50 years. However, it is recommended that funding reserves be established to ensure adequate funding is available in the future to continue needed repairs or to replace aged facilities.	$ -	$ -	$ -	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
140	Other	California Department of Water Resources	Mid San Joaquin River - Non-urban Levee O&M (Rural)	Levee O&M costs were separated between urban and rural LMAs to capture the additional costs associated with urban area LMAs. Levee O&M included the following activities: vegetation maintenance, rodent control, encroachment and pipe maintenance, minor repairs (erosion, levee crown repairs etc.)	$ 28,492,182	$ 28,492,182	$ 1,453,650	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
141	Other	California Department of Water Resources	Mid San Joaquin River - Urban Levee O&M	Levee O&M costs were separated between urban and rural LMAs to capture the additional costs associated with urban area LMAs. Levee O&M included the following activities: vegetation maintenance, rodent control, encroachment and pipe maintenance, minor repairs (erosion, levee crown repairs etc.)	$ -	$ -	$ -	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
142	Other	California Department of Water Resources	Mid San Joaquin River - Channel RR&R - Arrundo Removal	Regional input indicated giant reed removal cost at $25,000/acre.	$ -	$ -	$ -	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
143	Other	California Department of Water Resources	Mid San Joaquin River - Channel Sediment Removal	Channel maintenance activities including sediment, vegetation, and debris removal are conducted by DWR with respect to the Sacramento River Flood Control Project and generally by LMAs in the San Joaquin Valley. Estimated costs for the Sacramento Basin were developed by using historical projects overseen by DWR, which have occurred as funding has been available, as well as input from regional experts. Estimated costs for the San Joaquin Basin were based on direct interviews with LMAs and staff.	$ 3,062,569	$ 3,062,569	$ 156,250	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
144	Other	California Department of Water Resources	Mid San Joaquin River - Channel Vegetation and Debris Removal	Channel maintenance activities including sediment, vegetation, and debris removal are conducted by DWR with respect to the Sacramento River Flood Control Project and generally by LMAs in the San Joaquin Valley. Estimated costs for the Sacramento Basin were developed by using historical projects overseen by DWR, which have occurred as funding has been available, as well as input from regional experts. Estimated costs for the San Joaquin Basin were based on direct interviews with LMAs and staff.	$ 5,880,132	$ 5,880,132	$ 300,000	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
145	Other	California Department of Water Resources	Mid San Joaquin River - Large Structure O&M	Major structures involve those facilities described in CWC Section 8361 and administered by DWR, and include weirs, bypass outflow control structures, outfall gate facilities, and large regional pumping plants.	$ -	$ -	$ -	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
146	Other	California Department of Water Resources	Mid San Joaquin River - Non-urban Levee RR&R (Rural)	Levee-related RR&R costs have generally been driven by necessary flood-event repairs and known erosion or levee stability issues. The OMRR&R Work Group determined the Delta Subventions Program data set is the most robust data set for estimating RR&R cost on SPFC levees because the existence of the funding program has encouraged more regular analysis and repair of levees. Although urban levees are being improved to a higher standard to meet urban level of protection standards, the OMRR&R Work Group determined that repair and rehabilitation costs for urban and non-urban levees would not differ substantially, and the cost for ULDC compliance would be the only significant differentiating factor for RR&R of urban SPFC levees.	$ 11,224,193	$ 11,224,193	$ 572,650	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
147	Other	California Department of Water Resources	Mid San Joaquin River - Small Community Levee O&M	Levee O&M costs were separated between urban and rural LMAs to capture the additional costs associated with urban area LMAs. Levee O&M included the following activities: vegetation maintenance, rodent control, encroachment and pipe maintenance, minor repairs (erosion, levee crown repairs etc.)	$ 5,206,857	$ 5,206,857	$ 265,650	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
148	Other	California Department of Water Resources	Mid San Joaquin River - Small Community Levee RR&R	Levee-related RR&R costs have generally been driven by necessary flood-event repairs and known erosion or levee stability issues. The OMRR&R Work Group determined the Delta Subventions Program data set is the most robust data set for estimating RR&R cost on SPFC levees because the existence of the funding program has encouraged more regular analysis and repair of levees. Although urban levees are being improved to a higher standard to meet urban level of protection standards, the OMRR&R Work Group determined that repair and rehabilitation costs for urban and non-urban levees would not differ substantially, and the cost for ULDC compliance would be the only significant differentiating factor for RR&R of urban SPFC levees.	$ 2,051,186	$ 2,051,186	$ 104,650	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
149	Other	California Department of Water Resources	Mid San Joaquin River - Small Structures O&M	Minor structures include stop log or gated closure structures, pumping plants, monitoring wells and piezometers, retaining walls and floodwalls, pipe penetrations, and encroachments. Routine O&M of these types of structures is critical, but often overlooked for budgeting purposes. As became evident in the LMA data received, LMAs typically only account for routine power costs for pumping plants and do not separately account for other activities associated with minor structures such as video inspections of pipes, lubrication and minor repairs of pipe closure valves, routine inspection and maintenance of closure structure gates or stop logs, and inspection and minor repairs of floodwalls. The OMRR&R Work Group determined that costs for minor-structure O&M are likely included in the general overhead expenses for the LMAs who have structures, and no further estimates were developed. However, it is anticipated that video inspections of pipes will be required in the future (once every 5 years) for pipes crossing SPFC levees and as such these projected costs were included in the overall estimates.	$ 627,214	$ 627,214	$ 32,000	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
150	Other	California Department of Water Resources	Mid San Joaquin River - Small Structures RR&R	Small structures such as stop logs or gated closure structures, monitoring wells and piezometers, retaining walls and floodwalls, pipes, and encroachments are typically accounted for in levee RR&R costs, except for pipes. Many of these pipes were installed before or during original project construction prior to the 1950s, but no plans were implemented to assure these facilities could be replaced when they exceed their useful life. As a result, many pipes have reached their useful life with many of these structures in need of repair, replacement, or proper pipe abandonment.	$ 14,739,532	$ 14,739,532	$ 752,000	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
151	Other	California Department of Water Resources	Mid San Joaquin River - Urban Levee RR&R	Levee-related RR&R costs have generally been driven by necessary flood-event repairs and known erosion or levee stability issues. The OMRR&R Work Group determined the Delta Subventions Program data set is the most robust data set for estimating RR&R cost on SPFC levees because the existence of the funding program has encouraged more regular analysis and repair of levees. Although urban levees are being improved to a higher standard to meet urban level of protection standards, the OMRR&R Work Group determined that repair and rehabilitation costs for urban and non-urban levees would not differ substantially, and the cost for ULDC compliance would be the only significant differentiating factor for RR&R of urban SPFC levees.	$ -	$ -	$ -	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
152	RFMP	Lower San Joaquin Levee District	Modernize Electrical Controls, Level Sensors & SCADA for Control Structures	The electrical controls and water level sensors for the primary control structures were installed in the 1960's with the original system improvement. They are antiquated and should be modernized for improved reliability and integration with a new SCADA system. System improvement location is at Chowchilla Canal Bypass Control Structure, San Joaquin River Control Structure, Eastside Bypass Control Structure, and Mariposa Bypass Control Structure.	$ 1,885,000	$ 1,885,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance

Table B-5. San Joaquin Basin Management Actions Included within the 2017 Refined SSIA Portfolio

#	Data Set Source	Lead Agency	Project Name	Project Description	Estimated Cost - Provided by Source	Adjusted Estimated Cost - Present Value ($)	Adjusted Estimated Cost - Annualized ($/year)	Investment Type	Area of Interest and Management Action Category	Management Action Type
153	RFMP	City of Modesto	Modesto WWTPs: Flood and Water Quality Risk Reduction	This project is focused on protecting Tuolumne and San Joaquin River water quality and reducing the risk of flooding for Modesto's Wastewater Treatment Plants. By relocating Primary Treatment, improving Flood Protection infrastructure, utilizing storage ponds, irrigating with captured water and incorporating vacated land into the Tuolumne River Regional Park Master Plan, we can reduce flood risk and protect the integrity of our rivers. This project is adjacent to another RFMP project site, the Tuolumne River Regional Parkway Carpenter Road Project, and would provide synergistic benefits to that project.	$ 80,000,000	$ 90,000,000	$ 4,591,733	Ongoing	Urban - Risk awareness, floodproofing and land use planning	Watershed and Floodplain Management
154	RFMP	Merced County	Modify Land Use Designations	Merced County currently imposes development restrictions for Special Flood Hazard Areas (Chapter 18.34 of the County Code) in accordance with FEMA and the NFIP. Merced County's Floodplain Land Use Ordinance also provides formal primary and secondary floodplain zones along streams and describes limitations on land uses in these zones. Modifications to the existing land use designations within the Merced Region could direct growth outside of the floodplain. New options include: imposing elevation requirements for new development within the 200-yr or 500-year floodplain, limiting or restricting new development within the 200-yr or 500-year floodplain in accordance with SB-5 requirements, or designating permanent agricultural zones. While this option may inhibit economic growth in floodplains, it may reduce flood risk and ultimately cost less than flood control system capital improvements.	$ -	$ -	$ -	Ongoing	Rural - Risk awareness, floodproofing and land use planning	Watershed and Floodplain Management
155	RFMP	San Luis National Wildlife Refuge	Modify water intake structures at selected refuge units	There are 40 locations on the East Bear Creek Unit, West Bear Creek Unit, and San Luis Unit where pipes with flap-gates are present in the flood control levees of the San Joaquin River and Eastside Bypass. Some of these locations are well situated to divert floodwaters onto National Wildlife Refuge (NWR) lands. Screw-gates could be installed where needed and catwalks to these screw-gates could be placed on existing pipes. In some locations water control structures and/or armoring of existing water conveyance facilities would be needed. This would allow multiple controlled diversions onto refuge floodplain lands. Control on volume and limits on amounts of water diverted at these locations would be necessary to prevent damage to refuge infrastructure, resource values, and adjacent private lands. A study would be needed to determine which of these possible diversion points for floodwater would benefit wildlife conservation and floodwater storage objectives the best. At some locations enhancement of existing channels likely would be necessary to achieve the desired outcome -placing water into already defined managed wetlands, managed riparian habitat or low elevation uplands which evolved under conditions which included low depth (sheet water) flooding. This system improvement would seek to further develop a subset of the 40 available sites.	$ 1,540,000	$ 1,540,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Flood Infrastructure
156	BWFS	California Department of Water Resources	Mormon Channel Bypass	The purpose of the Mormon Channel Bypass element is to reduce peak stages in the Stockton Diverting Canal and Old Calaveras River, provide terrestrial habitat, and provide recreation/open space benefits. This element includes a control structure and channel improvements to divert up to 1,200 cfs from the upstream end of the Stockton Diverting Canal to the Mormon Channel to provide additional resiliency from climate change by reducing flows in the Stockton Diverting Canal and Old Calaveras River. This element was included in the State Recommended Plan because it would provide stage reduction benefits along the urbanized reaches of the Calaveras River and Stockton Diverting Canal and provide potentially very significant recreational benefits at modest cost.	$ 39,000,000	$ 43,000,000	$ -	Capital	Urban - Other infrastructure and multi-benefit improvements	Flood Infrastructure
157	Other	California Department of Water Resources	Nonstructural Berms & Interior Drainage		$ 4,982,880	$ 11,784,000	$ 601,211	Ongoing	Small Community - Risk awareness, floodproofing and land use planning	Watershed and Floodplain Management
158	Other	California Department of Water Resources	Nonstructural Berms & Interior Drainage		$ 2,491,440	$ 5,892,000	$ 300,605	Ongoing	Small Community - Risk awareness, floodproofing and land use planning	Watershed and Floodplain Management
159	Other	California Department of Water Resources	Nonstructural Berms & Interior Drainage		$ 4,982,880	$ 11,784,000	$ 601,211	Ongoing	Small Community - Risk awareness, floodproofing and land use planning	Watershed and Floodplain Management
160	RFMP	Central California Irrigation District, San Luis Canal Company	Orestimba Creek Recharge and Recovery Project	This project would divert San Joaquin River and Kings River flood water at Mendota Pool to reduce flood flows, provide water supply, recharge local groundwater, and help prevent local subsidence. The Westside-San Joaquin IRWM recommends this project as it provides multiple benefits to the region. The project protects SPFC facilities along the San Joaquin River by diverting flood flows and the objectives are consistent with SSIA. The Orestimba Creek Recharge & Recovery Project includes construction of 85 acres of recharge ponds and 5 recovery wells along Orestimba Creek between the DMC and the Eastin Water District boundary. The project would receive surface water from Orestimba Creek, SJR flood system, CCID and/or Del Puerto Water District (DPWD). The DMC and/or CCID Main Canal could be used to convey the SJR flood water to the bank. Water wells will be piped to the DMC or CCID Main Canal.	$ 8,200,000	$ 8,200,000	$ -	Capital	Rural - Small-scale levee setbacks and floodplain storage	Reservoir and Floodplain Storage and Operation
161	RFMP	Merced Streams Group	Owens Reservoir Enlargement and Downstream Levee and Channel Improvements	Owens Reservoir was constructed in the early 1950's as an element of the Merced Streams Group Project authorized by Congress's 1944 Flood Control Act. The Flood Control Act of 1970 called for three additional flood control reservoirs, enlargement of existing reservoirs, and 52 miles of levee and channel modifications. To date only one additional reservoir has been built (Castle Dam). The enlargement of Owens Reservoir would increase the level of flood protection to Planada and Le Grand, both of which are DAC's in Merced County. Owens Reservoir was originally constructed to provide protection for up to a 50-year storm event. The State of California has adopted legislation that calls for a minimum of 200-year flood protection for urbanized areas. This system improvement would meet the requirements of the new flood control legislation. As part of this project, opportunities for riparian and wetland habitat enhancements will be considered.	$ 8,850,000	$ 8,850,000	$ -	Capital	Systemwide - Reservoir and floodplain storage	Flood Infrastructure
162	BWFS	California Department of Water Resources	Paradise Cut Bypass Expansion - Land Acquisition	Near term cost estimate for Paradise Cut land acquisitions.	$ 35,000,000	$ 35,000,000	$ -	Capital	Systemwide - Paradise Cut multi-benefit improvements	Flood Infrastructure

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163	BWFS	California Department of Water Resources	Paradise Cut Bypass Expansion (BWFS Option M-Ag-Focused):	Paradise Cut, located on the southwestern side of Steward Tract in Lathrop, is a federal flood control bypass that diverts flows from the San Joaquin River during high flows. A Paradise Cut bypass expansion was broadly defined in the 2012 CVFPP as an element to improve flood risk management and provide ecosystem benefits in the San Joaquin River Basin. This element of the San Joaquin BWFS includes Paradise Cut Bypass Expansion Option M Ag-Focused. This option would include a combination of new secondary upstream weir, 4,000 to 7,000 feet of left bank setback levees on Paradise Cut, downstream levee improvements, and the Base Case improvements. This element removes revetment and restores shaded riverine aquatic habitat along the degraded San Joaquin River levee and restores the southern portion of the current in-channel bar for floodplain rearing habitat. However, most of the land within the setback area would be kept in agricultural production. This option was selected because it provided balanced mix of more than 2.5 feet stage reduction along the San Joaquin River for large flood events, significant ecosystem benefits through riparian habitat restoration and increased shaded riverine aquatic cover, and agricultural stewardship. Over the long-term future, portions of the setback areas could be converted to habitat with willing landowners and in coordination with local land use agencies.	$ 250,000,000	$ 274,000,000	$ -	Capital	Systemwide - Paradise Cut multi-benefit improvements	Flood Infrastructure
164	RFMP	California Department of Water Resources, Delta South LMAs	Paradise Cut Expansion	The Paradise Cut Improvements consist of a "base case," "initial improvements," and five alts for an expansion of the Paradise Cut bypass. The initial improvements include these projects in addition to the base case: dredging of Salmon Slough/Doughty Cut, widening of Paradise Weir from 180 ft. to 400 ft., and performing a channel cut between Salmon Slough and Doughty Cut.	$ 355,000,000	$ -	$ -	Capital	Systemwide - Paradise Cut multi-benefit improvements	Flood Infrastructure
165	USACE	San Joaquin County, City of Stockton, City of Lathrop	Plan for Stockton 200-year ULOP	Senate Bill 5 (passed in 2007) requires a 200-year level of flood protection for urban and urbanizing areas within California's Central Valley. Under SB5, development in moderate or special flood hazard areas (500-year and 100-year floodplains, respectively) would only be allowed within the Central Valley if the city or county can find, based on substantial evidence in the record, that the development will be subject to less than 3 ft. of flooding during a 200-year flood event. Additionally, the ULDC and ULOP requirements developed pursuant to SB5 pose onerous "findings" requirements on local land use authorities, which can make achieving an in many developed areas difficult due to the required system improvements necessary to meet increased levels of flood protection. The first step in developing a plan to comply with SB5 is to determine an accurate 200-year floodplain. DWR prepared preliminary floodplain maps for the cities of Stockton and Lathrop in August 2013, but these floodplains were arbitrarily clipped at the respective spheres of influence of each city, did not consider non-project levees, and used conservative breach parameters. A refined 200-year floodplain map showing the extent and depth of flooding for San Joaquin County should be prepared to enable land use agencies to move forward with developing a long-term plan to comply with SB5.	$ 200,000	$ -	$ -	Capital	Urban - Levee improvements	Flood Infrastructure
166	Other	California Department of Water Resources	Property acquisition, demo & disposal - Phase 2		$ 28,800,000	$ 7,200,000	$ -	Capital	Small Community - Levee setbacks, land acquisitions and habitat restoration	Watershed and Floodplain Management
167	Other	California Department of Water Resources	Property acquisition, demo & disposal - Phase 2		$ 14,400,000	$ 3,600,000	$ -	Capital	Small Community - Levee setbacks, land acquisitions and habitat restoration	Watershed and Floodplain Management
168	Other	California Department of Water Resources	Property acquisition, demo & disposal - Phase 2		$ 28,800,000	$ 7,200,000	$ -	Capital	Small Community - Levee setbacks, land acquisitions and habitat restoration	Watershed and Floodplain Management
169	Other	California Department of Water Resources	Property acquisition, demo & disposal - Phase 3		$ 28,800,000	$ 21,600,000	$ -	Capital	Small Community - Levee setbacks, land acquisitions and habitat restoration	Watershed and Floodplain Management
170	Other	California Department of Water Resources	Property acquisition, demo & disposal - Phase 3		$ 14,400,000	$ 10,800,000	$ -	Capital	Small Community - Levee setbacks, land acquisitions and habitat restoration	Watershed and Floodplain Management
171	Other	California Department of Water Resources	Property acquisition, demo & disposal - Phase 3		$ 28,800,000	$ 26,600,000	$ -	Capital	Small Community - Levee setbacks, land acquisitions and habitat restoration	Watershed and Floodplain Management
172	USACE	Reclamation District 524, San Joaquin Office of Emergency Services, Reclamation District 404	Protect Stockton Wastewater Treatment Plant	The levees protecting the ponds are too low and have seepage issues. Increasing levee height and reducing seepage into the wastewater ponds was suggested as a potential project. This project is not a responsibility of the District.	$ 2,000,000	$ -	$ -	Capital	Urban - Levee improvements	Flood Infrastructure
173	RFMP	Reclamation District 524	Railroad Crossing Reinstallation	The Burlington Northern Santa Fe Railroad Company has railroad tracks that cross the San Joaquin River and impact the levee on the northeastern boundary of the District. These tracks also bisect the City of Stockton's Wastewater Treatment Ponds. Currently there is no road over the railroad which impairs levee inspections and patrols. This lack of access also obstructs emergency levee repairs. A railroad crossing over the BNSF tracks on the levee crown is needed so the District can fulfill its responsibilities effectively, especially during a high water event.	$ 400,000	$ 400,000	$ 20,408	Ongoing	Systemwide - Emergency management	Emergency Management
174	RFMP	San Joaquin County	Raise Little Johns Levees		$ 460,000	$ 460,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Flood Infrastructure
175	RFMP	Lower San Joaquin Levee District	Raise Part of Left Bank Levee Unit 6	Portions of the left bank levee Unit 6 which are opposite right bank levee Units 5, 7, 8, 9 & 10, were constructed as much as 2 feet lower than the right bank levees and need to be raised to provide the design freeboard. System improvement would require modeling of the system in the area to set levee elevation. Project levee was never accepted by LSJLD (governance issue)	$ 4,250,000	$ 4,250,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance

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176	RFMP	Delta South Region	Raise Structures	Raising and waterproofing structures and building berms.	$ 20,000,000	$ 20,000,000	$ 1,020,385	Ongoing	Rural - Risk awareness, floodproofing and land use planning	Watershed and Floodplain Management
177	RFMP	Patterson Westside Farms	RD 1602 SPFC Modification Project	The property owners within RD 1602 propose to remove state and federal OMRR&R obligations for their levees. The LMA identified as Reclamation District (RD) 1602 does not currently exist as a formal entity, but Patterson Westside Farms/Twin Oaks Irrigation District have organized meetings of the property owners within the RD to develop this concept. The property owners are interested in continuing to farm their lands and maintain the levee system, but not be constrained by the state and federal standards. The staff time and dollar cost of meeting those standards are greater than the value of continuing to be part of the state-federal flood project. A preferred approach to accomplishing this change has not yet been identified.	$ 4,700,000	$ 500,000	$ 25,510	Ongoing	Systemwide - State operations, planning and performance tracking	Policy and Regulations
178	USACE	California Department of Water Resources	RD 17 Levee Improvements (BWFS Option C)	DWR proposed the RD 17 cross levee option and a small setback levee near the Old River confluence (RM 52). The existing San Joaquin River levee would remain unchanged to protect rural-agricultural areas within deep floodplains of approximately 6 feet or higher, but the existing levee would not provide an urban level of protection. This option would include levee raises, geotechnical improvements, new levees, and 782 acres of additional ecosystem habitat. This option is included in the State Recommended Plan because it would effectively achieve 200-year level of protection for the existing urban populations within RD 17 while also promoting wise use of floodplains in the rural, deep floodplains of RD 17, and promote agricultural stewardship. The cross levee option also provides future flexibility in areas outside the cross levee. Land could be kept in agricultural production in perpetuity or some portions converted to habitat with willing landowners and in coordination with local land use agencies.	$ 455,000,000	$ -	$ -	Capital	Urban - Other infrastructure and multi-benefit improvements	Flood Infrastructure
179	RFMP	Reclamation District 2031, Elliott	RD 2031 Resilience	Complete the necessary repairs and upgrades to bring RD levee system back into “Active” status for PL84-99 eligibility.	$ 2,000,000	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
180	RFMP	Reclamation District 2063, Crows Landing	RD 2063 Resilience	Complete the necessary repairs and upgrades to bring RD levee system back into “Active” status for PL84-99 eligibility.	$ 3,500,000	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
181	RFMP	Reclamation District 2091, Chase	RD 2091 Resilience	Complete the necessary repairs and upgrades to bring RD levee system back into “Active” status for PL84-99 eligibility.	$ 400,000	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
182	RFMP	Reclamation District 2101, Blewett	RD 2101 Resilience	Complete the necessary repairs and upgrades to bring RD levee system back into “Active” status for PL84-99 eligibility, including addressing a major levee erosion site.	$ 2,500,000	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
183	RFMP	San Joaquin River Restoration Program	Reach 2B Project - San Mateo Road Crossing	Construct a crossing across the San Joaquin River at San Mateo Avenue and build levee setbacks as part of the project in Reach 2B.	$ 9,600,000	$ -	$ -	Capital	Rural - Small-scale levee setbacks and floodplain storage	Flood Infrastructure
184	RFMP	San Joaquin River Restoration Program	Reach 2B/Mendota Pool Bypass	Reach 2B levees will be setback by the SJRRP to provide floodplain habitat for fish and increase the capacity of Reach 2B to 4,500 cfs (from an estimated 1,300 cfs). Floodplain could be used as transitory storage and this system improvement will repair any levee stability issues in this reach by replacing them. This system improvement would increase flood protection to lands in the area and could increase operational flexibility to manage flood releases. Continued coordination with flood agencies could result in additional benefits. The SJRRP will be constructing a means for fish passage over Mendota Dam, either through the Mendota Pool Bypass or the Fresno Slough Dam. Fresno Slough Dam may have benefits to improving the ability of CCID to manage flood flows in Mendota Pool through a new dam. The Mendota Pool Bypass could provide flood benefits by an expanded river width / floodplain and an alternate channel around Mendota Pool. As a part of this project, inter-agency agreements, funding, and coordination will be formalized.	$ 295,000,000	$ -	$ -	Capital	Rural - Small-scale levee setbacks and floodplain storage	Flood Infrastructure
185	RFMP	San Joaquin River Restoration Program	Reach 4B Improvements	The SJRRP is required in the Settlement to increase the capacity of Reach 4B1 of the San Joaquin River to 475 cfs (from an estimated 20 cfs). In addition, the SJRRP will be determining whether to route fish and flows up to 4,500 cfs through Reach 4B1 of the San Joaquin River, or through the Eastside Bypass, or some combination. Setback levees would be built in either case. If flows are to be routed into the Eastside Bypass, Mariposa Bypass, and then to Reach 4B2, Mariposa Bypass setback levees may also be built. Setback levees maintain flood capacity, repair existing flood levees, and allow for habitat improvements such as vegetation growth within the channels. As a part of this project, inter-agency agreements, funding, and coordination will be formalized.	$ 234,199,000	$ -	$ -	Capital	Rural - Small-scale levee setbacks and floodplain storage	Flood Infrastructure
186	RFMP	Reclamation District 1	Reclamation District 1 Dryland Levee Improvements (Border RD 2089)	Improving these dryland levees to PL 84-99 standards would provide increased flood protection to RD 1 in the event neighboring Districts flood.	$ 1,250,000	$ 1,250,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Flood Infrastructure
187	RFMP	Reclamation District 1	Reclamation District 1 Seepage Repairs and Slope Stability Repairs	A serious seepage site has been identified by the FSRP on the south-eastern side of the District adjacent to RD 2062. The NULE program also identified needed seepage repairs along Middle River. Repair of both seepage sites is important to the District.	$ 43,396,000	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
188	RFMP	Reclamation District 1007	Reclamation District 1007 Geometry Improvements	Waterside slopes on the levees adjacent to Old River need to be flattened out, especially to hold erosion protection. The District engineer indicated that there is no immediate need for these improvements, but would need to be completed if Paradise Cut expansion is implemented. These improvements are expensive because of waterside habitat and land-side encroachments.	$ 30,375,000	$ 30,375,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Flood Infrastructure
189	RFMP	Reclamation District 1007	Reclamation District 1007 Restore Design Capacity to Old River/Paradise Cut	Sedimentation in Old River should be dredged to restore the design capacity of the waterways, especially if Paradise Cut expansion is implemented.	$ 10,000,000	$ -	$ -	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
190	RFMP	Reclamation District 2058	Reclamation District 2058 Conduct Endangered Species Habitat Mapping	The District needs to be aware of the location and extent of habitat that could contain riparian brush rabbit, giant garter snake, Elderberry, etc. A habitat survey could provide this information.	$ 50,000	$ 50,000	$ 2,551	Ongoing	Rural - Risk awareness, floodproofing and land use planning	Watershed and Floodplain Management
191	RFMP	Reclamation District 2058	Reclamation District 2058 Erosion Protection	A critical erosion protection site has been identified by the FSRP on the western side of the District (along Sugar Cut) adjacent to RD 1007. Rip rap or other erosion protection measures are needed in these areas.	$ 754,000	$ 754,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance

Table B-5. San Joaquin Basin Management Actions Included within the 2017 Refined SSIA Portfolio

#	Data Set Source	Lead Agency	Project Name	Project Description	Estimated Cost - Provided by Source	Adjusted Estimated Cost - Present Value ($)	Adjusted Estimated Cost - Annualized ($/year)	Investment Type	Area of Interest and Management Action Category	Management Action Type
192	RFMP	Reclamation District 2058	Reclamation District 2058 Seepage Repairs	Critical seepage sites have been identified by the FSRP on the north and eastern sides of the District adjacent to RD 2089 and RD 1007 respectively. A study on the necessary repair and subsequent implementation of the repair needs to be done. Decisions on repairing the levee reach along Paradise Cut may be influenced by the timing and/or results of the investigation for expansion of Paradise Cut.	$ 25,143,000	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
193	RFMP	Reclamation District 2058	Reclamation District 2058 Slope Stability Repairs	Serious slope stability sites have been identified by the FSRP along the northern side of the District. Identified stability concern sites are in need of repair. Decisions on repairing the levee reach along Paradise Cut may be influenced by the timing and/or results of the investigation for expansion of Paradise Cut.	$ 11,456,000	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
194	RFMP	Reclamation District 2062	Reclamation District 2062 Study Paradise Cut Expansion		$ 1,500,000	$ 1,500,000	$ 76,529	Ongoing	Rural - Studies and analysis	Watershed and Floodplain Management
195	RFMP	Reclamation District 2064	Reclamation District 2064 Address PL84-99 Deficiencies	The District (RD 2064) would like to bring upgrade deficient levees to the PL 84-99 standard.	$ 800,000	$ 800,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
196	RFMP	Reclamation District 2064	Reclamation District 2064 Erosion Protection	The District noted erosion repairs are an expensive on-going part of their annual O&M. A specific problem area is at the northern boundary of the District near RD 2075. These erosion sites are in need of repair. The District would also like to have the west face of the Ten Mile dryland levee protected with riprap but does not have the financial resources to undertake the project.	$ 5,400,000	$ -	$ -	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
197	RFMP	Reclamation District 2064	Reclamation District 2064 Seepage Repair	Critical seepage sites have been identified by DWR's FSRP along District levees. Seepage repairs need to be made at these sites along RD 2064 levees adjacent to both the San Joaquin and Stanislaus River.	$ 45,625,000	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
198	RFMP	Reclamation District 2074	Reclamation District 2074 Dryland Levee Improvements	Ten Mile Levee is a dry land levee that is part of the system of levees defending the Western portion of the City of Stockton from flooding from the West and protects State Plan of Flood Control levees along the Calaveras River in the event of the failure of levees on Wright-Elmwood Tract (RD 2119). The Project is to install a bentonite cut-off wall to protect against underseepage in a flood event.	$ 19,050,000	$ 19,050,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Flood Infrastructure
199	RFMP	Reclamation District 2074	Reclamation District 2074 Erosion Protection	The District would also like to have the west face of the Ten Mile dryland levee protected with riprap but does not have the financial resources to undertake the project.	$ 5,000,000	$ 5,000,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
200	RFMP	Reclamation District 2074	Reclamation District 2074 Seepage Repairs	The District would like to evaluate seepage along the Calaveras River and Fourteen Mile Slough and make repairs that are necessary to avoid future seepage occurrences.	$ 7,600,000	$ 7,600,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
201	RFMP	Reclamation District 2075	Reclamation District 2075 Erosion Protection	The District noted erosion repairs are an expensive on-going part of their annual O&M. Specific problem areas were not identified, as District staff believes that the whole levee along the San Joaquin River is in need of protective rock placement.	$ 4,500,000	$ -	$ -	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
202	RFMP	Reclamation District 2075	Reclamation District 2075 Geometry Improvements	The District would like to upgrade deficient levee segments to meet the PL 84-99 Standard.	$ 32,156,000	$ 32,156,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Flood Infrastructure
203	RFMP	Reclamation District 2075	Reclamation District 2075 Restore Design Capacity of the SJ River	The District needs this silt buildup in the San Joaquin River to be removed to restore the design capacity and reduce the hydraulic load on its levees. This is a regional project that would benefit several Rds.	$ -	$ -	$ -	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
204	RFMP	Reclamation District 2075	Reclamation District 2075 Seepage Repair	Critical seepage sites have been identified by the FSRP along District levees. Identified seepage concern sites are in need of repair.	$ 20,300,000	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
205	RFMP	Reclamation District 2085	Reclamation District 2085 Erosion Protection	Critical erosion sites have been identified by the FSRP along District levees. One site is reported to be about 12 feet vertical for several hundred feet. These erosion sites are in need of repair.	$ 300,000	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
206	RFMP	Reclamation District 2085	Reclamation District 2085 Restore Design Capacity of the San Joaquin River	According to the District, the San Joaquin River adjacent to RD 2085 has experienced siltation and sediment buildup that has significantly decreased the capacity of the river channel from its original design capacity. The District needs this silt to be removed to restore the design capacity and reduce the hydraulic load on its levees. This project is envisioned as a regional study to determine potential actions and tied to the study of Paradise Cut rather than a project for the RD 2085.	$ -	$ -	$ -	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
207	RFMP	Reclamation District 2085	Reclamation District 2085 Seepage Repairs	Critical seepage sites have been identified by the FSRP along District levees. These seepage sites are in need of repair.	$ 33,375,000	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
208	RFMP	Reclamation District 2089	Reclamation District 2089 Address PL84-99 Deficiencies	The District would like to improve their levees to meet PL84-99 Standards. This applies to about 3% of the total levee length, located on the south-eastern side of the District near the confluence of Paradise Cut and Old River.	$ 500,000	$ 500,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Flood Infrastructure
209	RFMP	Reclamation District 2089	Reclamation District 2089 Conduct a Study to Determine the Potential for Setback Levees	Conducting a study to determine the potential for setback levees will allow the District to understand how setback levees can help reduce flood risk within the District.	$ 100,000	$ 100,000	$ 5,102	Ongoing	Rural - Studies and analysis	Watershed and Floodplain Management
210	RFMP	Reclamation District 2089	Reclamation District 2089 Erosion Protection	Critical erosion sites have been identified by the FSRP along District levees. Other sites have been identified by stakeholders. Identified erosion sites are in need of repair. The District also plans to ensure the protection of the existing levee by adding supplementary riprap above the existing riprap to any portions of the waterside slope of the levee requiring additional rock slope protection. This will prevent erosion and minimize future erosion repairs. The erosion protection is estimated to cost about $1.5 million plus an additional $1 million for mitigation.	$ 2,500,000	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
211	RFMP	Reclamation District 2089	Reclamation District 2089 Restore Capacity to Salmon Slough	Salmon Slough is badly silted, and has does not convey flood flows efficiently. In the past, the slough was used to relieve pressure from flows in Paradise Cut, but now is a bottleneck. Dredging to allow original capacity will relieve pressure in Paradise Cut and reduce flood risk to the District.	$ 1,000,000	$ -	$ -	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
212	RFMP	Reclamation District 2089	Reclamation District 2089 Seepage and Slope Stability Repairs	Critical seepage sites have been identified by the FSRP along Old River and Salmon Slough. These sites are in need of repair. Critical slope stability concerns were identified by the FSRP throughout RD 2089 levees along Old River and Salmon Slough. These sites are in need of repair.	$ 29,400,000	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
213	RFMP	Reclamation District 2094	Reclamation District 2094 Geometry Improvements	The existing levee needs a larger cross section. The land-side slope of the levee along the San Joaquin River is currently steeper than 3:1. Levee geometry improvements would increase the stability of the levee, and bring it up to current standards.	$ 9,188,000	$ 9,188,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Flood Infrastructure

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214	RFMP	Reclamation District 2094	Reclamation District 2094 Improve Dryland Levees	The dryland Levee located on the south boundary of RD 2094 is lower and less reliable than the levees along the San Joaquin River and was overtopped in 1997 when RD 2075 flooded. This levee was originally constructed to protect RD 2075 in the event of a failure of a levee downstream (north) on the San Joaquin River. Furthermore, this cross levee is one of only two means of egress during a flood event. This project would improve this levee to protect RD 2094 from flooding in RD 2075, and would improve public safety.	$ 13,781,000	$ 13,781,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Flood Infrastructure
215	RFMP	Reclamation District 2094	Reclamation District 2094 Restore Design Capacity to San Joaquin River	RD 2075 needs this silt buildup in the San Joaquin River to be removed to restore the design capacity and reduce the hydraulic load on its levees. This is a regional project that would benefit several Rds.	$ -	$ -	$ -	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
216	RFMP	Reclamation District 2094	Reclamation District 2094 Slope Stability Repairs, and Seepage Repairs	A slope stability repair site has been identified by the FSRP on the western side of the District along the San Joaquin River. Identified stability concern sites are in need of repair. The levee along the San Joaquin River is shown to have a moderate likelihood of failure due to seepage. A study should be conducted along this levee to determine the most appropriate seepage repair method, followed by implementation of the recommended action.	$ 11,456,000	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
217	RFMP	Reclamation District 2095	Reclamation District 2095 Erosion Protection	Serious erosion protection sites have been identified by the FSRP along the San Joaquin River on the eastern side of the District. The following erosion sites are in need of repair: • Unit 1 LM 0.73-0.74 • Unit 1 LM 0.86-0.86 • Unit 2 LM 1.77-1.80 • Unit 2 LM 1.85-1.89 All are on the DWR Erosion Survey and are Minimally Acceptable in the DWR Spring 2014 Levee Inspection. The District would like to repair these sites before they become Unacceptable for flood protection.	$ 450,000	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
218	RFMP	Reclamation District 2095	Reclamation District 2095 Seepage and Slope Stability Repairs	Serious seepage repair sites have been identified by the FSRP along the San Joaquin River on the eastern side of the District. Identified seepage sites are in need of repair. Decisions on fixing additional smaller sites along Paradise Cut may be influenced by the timing and/or results of the investigation for expansion of Paradise Cut.	$ 22,812,000	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
219	RFMP	Reclamation District 2096	Reclamation District 2096 Geotechnical Assessment	The RFMP Team recommends a geotechnical assessment be done for the levees around this District.	$ 50,000	$ 50,000	$ 2,551	Ongoing	Urban - Studies and analysis	Watershed and Floodplain Management
220	RFMP	Reclamation District 2096	Reclamation District 2096 Raise/Flood Proof Homes & Protect Utilities	Discussions with District representatives indicate that they would be interested in raising/flood proofing about 60 permanent homes above flood level. The remainder of residences are mobile homes. District representatives indicate that the mobile homes could be moved when flood threat increases.	$ 7,000,000	$ 7,000,000	$ 357,135	Ongoing	Urban - Risk awareness, floodproofing and land use planning	Watershed and Floodplain Management
221	RFMP	Reclamation District 2107	Reclamation District 2107 PL84-99 Improvements	The District has no plans for projects in the near future. However, levee improvements to the PL 84-99 standard will eventually be completed.	$ 2,800,000	$ 2,800,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Flood Infrastructure
222	RFMP	Reclamation District 524	Reclamation District 524 Address Penetration Problems	Levee penetrations along the San Joaquin River need to be resolved. These are in the area of the Stockton WWTP facilities.	$ 5,000,000	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
223	RFMP	Reclamation District 524	Reclamation District 524 Erosion Protection	The District needs rip rap placement along the west bank of San Joaquin River. A serious erosion site adjacent to the WWTP ponds has been identified by DWR in the FSRP. These areas all need placement of erosion protection to ensure these levees continue to protect the District.	$ 3,700,000	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
224	RFMP	Reclamation District 524	Reclamation District 524 Seepage Repairs	A critical seepage site has been identified by the FSRP on the north-eastern side of the District adjacent to the WWTP ponds. Identified seepage sites are in need of repair.	$ 5,000,000	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
225	RFMP	Reclamation District 544	Reclamation District 544 Address Encroachments	The District identified encroachments along the west bank of the San Joaquin River. The District would like to identify all encroachments and address those that are not properly permitted.	$ 5,000,000	$ 5,000,000	$ 255,096	Ongoing	Rural - Studies and analysis	Watershed and Floodplain Management
226	RFMP	Reclamation District 544	Reclamation District 544 Erosion Protection	The District plans to ensure the protection of the existing levee by adding rock slope protection to portions of the waterside slope of the levees requiring additional rock slope protection.	$ 1,500,000	$ 1,500,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
227	RFMP	Reclamation District 544	Reclamation District 544 Seepage Repairs - Long reaches	Levees along the San Joaquin River and Old River have experienced seepage during previous high water events. Critical seepage sites have also been identified by the FSRP. The District would like to implement the necessary improvements to mitigate seepage deficiencies. Identified seepage concern sites are in need of repair.	$ 55,100,000	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
228	RFMP	Reclamation District 544	Reclamation District 544 Seepage Repairs - Short critical reaches	Levees along the San Joaquin River and Old River have experienced seepage during previous high water events. Critical seepage sites have also been identified by the FSRP. The District would like to implement the necessary improvements to mitigate seepage deficiencies. Identified seepage concern sites are in need of repair.	$ 10,000,000	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
229	RFMP	Reclamation District 544	Reclamation District 544 Slope Stability Repairs	Critical slope stability sites have been identified by the FSRP along District levees. Identified stability concern sites are in need of repair.	$ 5,000,000	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
230	RFMP	Reclamation District 773	Reclamation District 773 Geometry Improvements	The reach of levee adjacent to Fabian and Bell Canal currently contains segments of over-steepened landside slopes that require flattening in order to improve overall levee stability. The levee adjacent to Grant Line Canal was also noted as having land side slopes that are too steep. Necessary levee geometry improvements will be made to these levees to meet PL84-99 project standards discussed above. Additionally, the reach of levee adjacent to Fabian and Bell Canal contains segments of over-steepened waterside slopes. The District intends to set back the levee template thereby allowing the over-steepened waterside slopes to become sacrificial over time. These geometry improvements will be more critical if the expansion of Paradise Cut occurs.	$ 42,175,000	$ 42,175,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Flood Infrastructure
231	RFMP	Lower San Joaquin Levee District	Rehabilitation of San Joaquin River Control Structure	Settlement has occurred at the San Joaquin River Control Structure, resulting in the wing walls separating from the structure. The wing wall backfill could be excavated and voids grouted under the spread footings, or spread footings could be added or enlarged to minimize further settlement. Depending on phasing and/or timing, the design could be coordinated with the SJRRP 2B project to allow incorporation of fish passage and/or habitat restoration elements within the project footprint. However, it is also possible that any improvements to the SJR Control Structure resulting from implementation of 2B would occur as a separate project	$ 340,000	$ 340,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
232	RFMP	San Joaquin County, City of Stockton	Repair Mormon Slough Bank	Mormon Slough has experienced bank erosion from several past flood events. Bank erosion in the vicinity of Escalon-Bellota Road remains a problem reach. This project aims to repair this reach of Mormon Slough along with preventative measures to mitigate future bank erosion throughout the Mormon Slough.	$ 13,500,000	$ 13,500,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance

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233	RFMP	Reclamation District 404	Resolve Levee Penetration Issues	Many levee penetrations need remediation, especially in areas north of Highway 4.	$ 2,000,000	$ -	$ -	Capital	Urban - Other infrastructure and multi-benefit improvements	Operation and Maintenance
234	RFMP	San Joaquin Area Flood Control Agency, San Joaquin County	Restore Mormon Channel	This project would divert up to 1,500 cfs to Mormon Channel via a weir at the head of the Stockton Diverting Canal, thereby reducing the flood flow in the Stockton Diverting Canal and the Lower Calaveras River below the Diverting Canal. This would reduce flooding potential of these systems and provide some resiliency to accommodate future climate change.	$ 50,000,000	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Flood Infrastructure
235	RFMP	City of Patterson	Riverfront Park Project	Creation of a riverfront park, recreational trail, and enhanced habitat along the western bank of the San Joaquin River between Old Las Palmas Avenue and Eucalyptus Avenue.	$ 2,500,000	$ -	$ -	Capital	Urban - Other infrastructure and multi-benefit improvements	Natural Floodplain and Ecosystem Functions
236	BWFS	California Department of Water Resources	RM 52 Setback levee	In conjunction with the RD 17 element, DWR also studied a setback levee at San Joaquin RM 52 (at the confluence of the San Joaquin and Old rivers). The confluence of San Joaquin and Old rivers is a valuable ecological area, and the inclusion of a setback levee would provide wetland, riparian and SRA habitat, including 65 acres of inundated floodplain habitat. A setback levee at this location would also be less costly than a fix-in-place improvement of the existing levee at the same location. The existing south levee would be left intact to maintain the flow split between the San Joaquin River and Old River. • 0.6 mile of setback • 130 acres riparian and marsh habitat • 40 acres of inundated floodplain habitat	$ 6,000,000	$ 12,000,000	$ -	Capital	Urban - Other infrastructure and multi-benefit improvements	Flood Infrastructure
237	BWFS	California Department of Water Resources	RM 60-65 Setback Levee	This element of the San Joaquin BWFS would include an approximately 800 acre right bank San Joaquin River setback levee to achieve 50 year LOP and to address known levee seepage, stability, and geometry problems. Land in the setback area would stay in agricultural production but would be inundated more frequently through the purchase of flowage easements. This element was included in the State Recommended Plan because it would increase the LOP from 30 year to 50 year, provide limited stage reduction, reduce levee length and associated O&M and repair costs, provide ecosystem restoration benefits, and promote agricultural stewardship for similar costs to fix-in-place levee improvements.	$ 62,000,000	$ 62,600,000	$ -	Capital	Rural - Small-scale levee setbacks and floodplain storage	Flood Infrastructure
238	RFMP	San Joaquin River Restoration Program	Salt Slough Barrier and Mud Slough Barrier	Construct fish screens / barriers at the Salt and Mud Sloughs to prevent fish straying.	$ -	$ -	$ -	Ongoing	Systemwide - State operations, planning and performance tracking	Natural Floodplain and Ecosystem Functions
239	RFMP	City of Firebaugh	San Joaquin River Bank Stabilization at Firebaugh	Just north of 13th Street (Firebaugh Blvd.) the San Joaquin River turns due west toward downtown Firebaugh. It then makes a sharp turn to the northwest and parallels the downtown area. In recent years a bank stabilization project was constructed at this turn that included sheet piling and rock filled wire cages. About 1/4-mile downstream of this project the river makes another sharp turn to the northeast near the intersection of 9th and Q Streets. The west bank at this turn is steep, unstable, and less than 50-feet away from several residences. A second bank stabilization system improvement with a similar configuration to the first is needed at this location. This project could include recreation and environmental enhancement components.	$ 1,800,000	$ 1,800,000	$ -	Capital	Small Community - Levee repair and infrastructure improvements	Operation and Maintenance
240	RFMP		San Joaquin River Basin Sediment Status and Dynamics Study	For the entire San Joaquin River basin, 1) conduct a multi-year monitoring program, 2) develop a reach-based sediment budget and conceptual model of sediment processes, and then 3) develop one or more sediment transport models and analyze transport processes to develop sediment management recommendations at a basin-wide scale. $2.5 - 5 million for Phase 1, assuming a 5-year monitoring effort and analysis of monitoring conducted in Years 1 and 5.	$ 5,000,000	$ 5,000,000	$ 255,096	Ongoing	Rural - Studies and analysis	Watershed and Floodplain Management
241	RFMP	River Partners and San Joaquin Parkway, Conservation Trust	San Joaquin River Invasive Species Management	Map, treat, and monitor populations of invasive weeds within the channel and floodplain of the San Joaquin River between Friant Dam and the Merced River confluence.	$ 2,800,000	$ 2,800,000	$ 142,854	Ongoing	Rural - Risk awareness, floodproofing and land use planning	Watershed and Floodplain Management
242	RFMP	City of Firebaugh	San Joaquin River Levee at Firebaugh Rodeo Grounds	One of Firebaugh's water treatment plants is located south of the 13th Street (Firebaugh Blvd.) bridge that crosses the San Joaquin River. The City's rodeo grounds and a park area are located north of the bridge. Flood flows in the river have inundated the rodeo grounds and threatened the treatment plant in recent years. Constructing an earthen levee between the river and the facilities would protect them from future flooding. Undeveloped space along the upper flood plain of the river is available for the proposed levee. This project could include recreation and environmental enhancement components.	$ 1,450,000	$ -	$ -	Capital	Small Community - Levee repair and infrastructure improvements	Operation and Maintenance
243	RFMP	City of Firebaugh	San Joaquin River Levee at Firebaugh Waste Water Treatment Plant	The City of Firebaugh's waste water treatment plant is located near the west bank of the San Joaquin River at the south end of Firebaugh. Flood flows in the river have threatened the treatment plant in recent years. Constructing an earthen levee between the river and the treatment plant would protect it against future flooding. Undeveloped space along the upper flood plain of the river is available for the proposed levee. Untreated effluents from the City of Firebaugh's waste water treatment plant would threaten the water quality of the San Joaquin River in case of catastrophic flooding in the area. This project could include recreation and environmental enhancement components.	$ 1,280,000	$ -	$ -	Capital	Small Community - Levee repair and infrastructure improvements	Operation and Maintenance
244	RFMP	San Joaquin River National Wildlife Refuge	San Joaquin River National Wildlife Refuge - Proposed Expansion	The United States Fish and Wildlife Service (USFWS) is considering expanding the San Joaquin River National Wildlife Refuge in two sections to restore and enhance habitat to benefit birds migrating along the Pacific Flyway and many other wildlife species that may be compatible or complementary with flood conveyance and transient floodwater storage on floodplains in the Mid San Joaquin River region.	$ -	$ -	$ -	Capital	Rural - Habitat restoration/reconnection	Natural Floodplain and Ecosystem Functions
245	RFMP	San Luis National Wildlife Refuge	San Luis NWR East Bear Creek Unit - Enhance existing wetland depth and configuration to provide additional habitat and flood water storage on approximately 500 acres of wetland basins	A portion of the existing restored wetlands in the East Bear Creek Unit, which currently comprise some 1000 acres, could be enhanced by deepening, expanding, and reconfiguring the current wetland acreage. This work would increase the capability of the unit for transitory floodwater storage while improving the wetlands for wildlife. This project would identify several options to achieve these objectives and fully develop and implement those options most feasible and efficient to meet the desired objectives.	$ 1,150,000	$ 1,150,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Flood Infrastructure

Table B-5. San Joaquin Basin Management Actions Included within the 2017 Refined SSIA Portfolio

#	Data Set Source	Lead Agency	Project Name	Project Description	Estimated Cost - Provided by Source	Adjusted Estimated Cost - Present Value ($)	Adjusted Estimated Cost - Annualized ($/year)	Investment Type	Area of Interest and Management Action Category	Management Action Type
246	RFMP	San Luis National Wildlife Refuge	San Luis NWR East Bear Creek Unit - Install lift pumps to divert water onto 1000 acres of wetland basins during flood flows	The East Bear Creek Unit has a pumping plant on Bear Creek that is used to flood approximately 1000 acres of managed wetlands when the water level elevation of Bear Creek is between 66 feet and 83 feet. The pumping plant is equipped with four 125 horse power lift pumps and until water level elevation 83 is reached the pumping plant can divert up to 120-acre feet per day of floodwater into managed wetlands and floodplain. When water level elevation exceeds 83 feet (a common condition during flood events) the pumping plant intake alarm goes off and the pumping plant is shut down and becomes inoperable. Once water level elevation 83 is exceeded the following options could be implemented to divert water onto the unit (which is bounded by levees on all sides but does have frequent intake/discharge points). a) Install a lift pump (125 hp pump capable of diverting 30 ac/ft. per day) just northeast of the pumping plant on Bear Creek and build a short pipeline to connect with the existing two mile long pipeline utilized by the pumping plant. This would enable refuge staff to continue diversions into the East Bear Creek Unit throughout a flood event regardless of water level elevation. Electrical power is available at the site. b) Install a lift pump (125 hp pump capable of diverting 30 ac/ft. per day) at an existing but now defunct diversion point on the San Joaquin River and build a short pipeline to connect with the terminus of the existing two mile pipeline. The station could also divert water into an existing 0.8-mile long canal running parallel to the River which delivers water to a series of riparian wetlands currently cutoff from the River by the flood control levee. The improvements would restore floodplain channel and basins that extend across the length of the unit.	$ 1,260,000	$ 1,260,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Flood Infrastructure
247	RFMP	San Luis National Wildlife Refuge	San Luis NWR East Bear Creek Unit - Restore a wetland swale to divert floodwaters onto 1000 acres of wetland basins during flood flows	Utilize an existing pipe and screw-gate on the flood control levee east of the Fish and Wildlife Service (FWS) pumping station to divert floodwaters. Construct a wide swale leading from the levee to an existing refuge ditch to convey water to the restored floodplain swales and basins extending across the East Bear Creek Unit.	$ 340,000	$ 340,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Flood Infrastructure
248	RFMP	San Luis National Wildlife Refuge	San Luis NWR Freitas Unit – restore anabranches of Salt Slough	During flood events, water from the San Joaquin River backs up into and raises the level of Salt Slough. Numerous anabranches extend out of Salt Slough and have potential to spread water westward out into the Freitas floodplain. However the capacity for this is limited because most of the anabranches are silted in at their confluences with Salt Slough. Silt removal could be implemented to lower the channel grades back to level that would more readily accept high water from Salt Slough. Floodwaters would be spread out into floodplain basins and swales west of Hwy 165. The large double and triple box culvert crossings under the highway should readily accommodate any flows through the anabranch channels. Hwy 165 built before flood control levee constructed. Restoring the channel grades may protect Hwy 165 better than the existing condition because floodwaters would be conveyed west of the highway as waters were rising rather than waiting until the floodwaters overtopped the Salt Slough main channel and caused much higher water levels to advance upon the highway.	$ 50,000	$ 50,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Flood Infrastructure
249	RFMP	San Luis National Wildlife Refuge	San Luis NWR West Bear Creek Unit - Restore wetland slough channel connectivity with the San Joaquin River to accommodate flood flows	This project seeks to enhance an existing location where a pipe and screwgate already permit the diversion of flood flows from the San Joaquin River into a water delivery canal that provides water to some 3,500 acres of wetlands. This project would enhance the size of the structures both leading into and exiting this canal at a location that would allow the diversion of water into a naturally existing floodwater basin that is currently cutoff from the San Joaquin River. This project likely would require increasing the size and armoring some four existing water control structures to accommodate the increased water capacity at these four locations.	$ 354,000	$ 354,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Flood Infrastructure
250	RFMP	Lower San Joaquin Levee District	Sand Slough Control Structure Removal	Removal of the Sand Slough Control Structure to improve fish passage and increase flow capacity.	$ 290,000	$ 290,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Flood Infrastructure
251	RFMP	River Partners	Sediment Management Investigation	Complete a study that identifies sediment-induced chokepoints along the San Joaquin River in the planning area, the dynamics that create them, and potential actions to improve flood conveyance in those areas.	$ 250,000	$ 250,000	$ 12,755	Ongoing	Rural - Studies and analysis	Watershed and Floodplain Management
252	RFMP	Lower San Joaquin Levee District	Sediment Removal Chowchilla Canal Bypass Control Structure	Remove sediment upstream from the Chowchilla Canal Bypass Control Structure. As part of this project, opportunities for riparian and wetland habitat enhancements will be considered.	$ 175,000	$ -	$ -	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
253	RFMP	San Joaquin River Restoration Program	Sediment Removal in Reach 4A and Eastside Bypass	Reclamation is pursuing sand removal on the Merced National Wildlife Refuge to improve conveyance capacity in the Eastside Bypass at and downstream of El Nido Road. Permitting is underway and sand is expected to be removed by 2015.	$ -	$ -	$ -	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
254	BWFS	California Department of Water Resources	Sediment Removal in Subsidence Area	Sediment deposition would continue to reduce capacity in the Middle Eastside Bypass. Sediment transport analysis conducted under the SJRRP indicated that the Upper Eastside Bypass and Reach 4A contributed almost 2,000,000 and 540,000 tons in 1983 and 1997, respectively, to the upper two-thirds of the Middle Eastside Bypass. Based on sediment transport analysis, it is currently estimated that 120,000 cubic yards (89,000 tons) of sediment will be deposited in the upper two-thirds of the reach annually (assuming no future subsidence). Annual sediment removal is estimated at $0.6 million per year assuming a cost of $5 per cubic yard. Future subsidence would likely exacerbate sediment deposition in the reach, due to decreasing channel slopes, and make these costs greater. Initial grading and sediment removal costs would be covered by a potential SJRRP Reach 4B Alternative 2 project, which would be in addition to the annual sediment removal cost. DWR would consider sediment management along with levee improvements and flowage easements to address subsidence in the vicinity of the Eastside Bypass.	$ 18,000,000	$ -	$ -	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
255	RFMP	Lower San Joaquin Levee District	Sediment Removal in the Eastside Bypass	Sediment removal in the Eastside Bypass to restore channel design capacity .	$ 12,850,000	$ -	$ -	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
256	RFMP	Lone Tree Mutual Water Company	Siphon Extension near Chamberlain Road	Lone Tree Mutual Water Company has an existing irrigation ditch that crosses the East Side Bypass 1/2-mile south of Chamberlain Road. There are existing culverts under the Eastside Bypass levees and an existing siphon under the pilot channel of the Bypass, but there is open ditch within the Bypass channel between the levees and the pilot channel. High flows in the Bypass are impeded by the ditch banks and the ditch must be cleaned and maintained following flood flows. Extending the siphon so it is continuous across the entire Bypass channel would improve flood operations, reduce maintenance and bring the siphon up to current flood system standards.	$ 700,000	$ 700,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Flood Infrastructure

Table B-5. San Joaquin Basin Management Actions Included within the 2017 Refined SSIA Portfolio

#	Data Set Source	Lead Agency	Project Name	Project Description	Estimated Cost - Provided by Source	Adjusted Estimated Cost - Present Value ($)	Adjusted Estimated Cost - Annualized ($/year)	Investment Type	Area of Interest and Management Action Category	Management Action Type
257	RFMP	San Joaquin River Restoration Program	SJRRP Seepage Management Projects	Existing SJRRP seepage management options include actions that could benefit flood management in the region, including levee improvements, drainage improvements, conveyance improvements, and property acquisition. These actions are being evaluated throughout the San Joaquin River and Eastside Bypass. Continuing coordination with Reclamation on seepage management strategies may result in identification of potentially-compatible flood projects that can be coordinated with the USJR RFMP (such as the Firebaugh Flood Protection / Habitat Project).	$ 185,000,000	$ -	$ -	Capital	Rural - Levee repair and infrastructure improvements	Operation and Maintenance
258	USACE	City of Stockton	Smith Canal Gate	The proposed project will construct a gate structure at the mouth of Smith Canal along the San Joaquin River/Stockton Ship Channel in Stockton. The gate structure will be operated to control back-flooding from the San Joaquin River and Delta during winter months (November 1st to April 30th) when high river flows and stages typically occur in the Smith Canal area.	$ 36,000,000	$ -	$ -	Capital	Urban - Other infrastructure and multi-benefit improvements	Flood Infrastructure
259	Other	California Department of Water Resources	State Operation in Support of 30-year Implementation	Activities and costs associated with State Operations for implementation of a 30 year program.	$ -	$ 180,000,000	$ 9,183,467	Ongoing	Systemwide - State operations, planning and performance tracking	Policy and Regulations
260	Other	California Department of Water Resources	State Policy, Planning, and Performance Tracking	Activities and costs associated with State Policy, Planning and Performance tracking.	$ 250,000,000	$ 250,000,000	$ 12,754,815	Ongoing	Systemwide - State operations, planning and performance tracking	Policy and Regulations
261	USACE	California Department of Water Resources	Stockton Levee Improvements (BWFS Option C)	Levee improvements and floodwalls would be included in the Stockton urban area for a 200 year event that accounts for future climate change and sea-level rise. Closure structures in Stockton at the mouth of Smith Canal, 14 Mile Slough, and Mosher Slough are also included to prevent Delta backwater flooding. These improvements are included in the State Recommended Plan because they are very effective at reducing flood damages and life loss for large flood events in a major urban area that has the highest flood risk in the San Joaquin River Basin. These improvements also would not induce future growth because much of Stockton already has been developed.	$ 252,000,000	$ -	$ -	Capital	Urban - Levee improvements	Flood Infrastructure
262	RFMP	Stanislaus County	Stokman Multi-benefit Floodplain Project	This property would provide wildlife habitat enhancement and restoration, improved flood management for the adjacent community of Grayson, improved groundwater recharge potential, and improved water quality in the Mid San Joaquin River. In February, 2016, River Partners received funding from the Wildlife Conservation Board (WCB) to purchase this 285-acre property within the San Joaquin River floodplain from a private seller. Acquisition is expected to be complete by the end of Summer 2016. This project is unique in that it has been specifically identified by Stanislaus County as a prime location for groundwater recharge potential. Following restoration of this property, 5-acre feet of groundwater will be returned to the San Joaquin River Watershed, as it will no longer be pumped for irrigation purposes. Additional groundwater recharge from floodwater inundation may also result from the project. Additionally, this project is located within a disadvantaged community block group and disadvantaged community tract as identified by DWR in coordination with Proposition 1 and Proposition 84. Project benefits will enhance this area ecologically, recreationally, and in terms of flood safety and groundwater recharge.	$ 2,000,000	$ 2,000,000	$ -	Capital	Small Community - Levee setbacks, land acquisitions and habitat restoration	Natural Floodplain and Ecosystem Functions
263	USACE	San Joaquin County, City of Stockton	Study of Bear Creek aand portions of Calaveras River System, including Stockton Diverting Canal 200-year protection	The purpose of this addendum is to add a potential project that was not identified in Appendix C of the Lower San Joaquin River and Delta South Regional Flood Management Plan (LSJR-DS RFMP) dated November 2014. This addendum seeks to address an area of concern involving the Bear Creek levee system and portions of Calaveras River levee system, including Stockton Diverting Canal, which provide flood protection for the City of Stockton. Substantial time has passed since the publication of the LSJR-DS RFMP. Due to the fact that the levee systems of concern were removed from the Lower San Joaquin River Feasibility Study by the U.S. Army Corps of Engineers, for a number of Corps policy reasons, a study is necessary to determine the level of improvement needed to reach ULDC and SB5 requirements because these systems are critical to providing flood protection for the City of Stockton.	$ 400,000	$ 400,000	$ 20,408	Ongoing	Urban - Studies and analysis	Watershed and Floodplain Management
264	RFMP	Lower San Joaquin River LMAs	Study Reservoir Storage Improvements	One possible measure to reduce peak flows in the lower San Joaquin River would be to increase physical storage in upstream reservoirs. This could be coupled with coordinated- and forecast-based operation of flood control reservoirs. DWR's Enhance Flood System Capacity approach in the CVFPP estimated that about 400,000 acre-feet of new flood storage would be required to effectively manage the 100-year (1% annual chance) flood. Investigations should evaluate smaller and larger storage volumes with an eye to increasing flood system resiliency to better accommodate climate change.	$ 2,000,000	$ 2,000,000	$ 102,039	Ongoing	Systemwide - State operations, planning and performance tracking	Watershed and Floodplain Management
265	RFMP	3F Group (Trout Unlimited, Ducks Unlimited, and American Rivers)	Sunrise Ranch Study	Owned and operated by Grissom Family Land & Cattle, the Ranch is situated on 1,750 acres with the East Side Canal passing through on the westerly portion. Currently, the entire property is managed for cattle grazing and waterfowl habitat, including seasonal and semi-permanent wetlands and grassland uplands. The landowner maintains a low-pressure grazing program to promote excellent grass growth in future years. Ducks Unlimited is currently working on a wetland restoration project with the landowner to restore wetland topography and hydrology. The system improvement consists of improvements to the connection of the wetlands to the adjacent waterways for the purpose of providing flood attenuation, juvenile salmonid rearing, groundwater recharge, more stable wetlands, and recreation.	$ 100,000	$ 100,000	$ 5,102	Ongoing	Rural - Studies and analysis	Watershed and Floodplain Management
266	RFMP	San Joaquin River National Wildlife Refuge	Three Amigos (also known as the Non-structural Alternative at the San Joaquin River National Wildlife Refuge)	Project to restore flooding and transient floodwater storage to more than 3,100 acres of historic floodplain, restore riparian habitats, and promote river physical processes of scour and deposition along 3 miles of the San Joaquin River. While the lands have been purchased, additional investment is needed to implement flood risk reduction goals consistent with the Refuge's habitat management goals. Needed efforts include planning and design of the Refuge for flood management as well as removal of levees from the federal project.	$ 5,500,000	$ -	$ -	Capital	Systemwide - Reservoir and floodplain storage	Reservoir and Floodplain Storage and Operation
267	BWFS	California Department of Water Resources	Three Amigos Transitory Storage	Project to restore flooding and transient floodwater storage to more than 3,100 acres of historic floodplain, restore riparian habitats, and promote river physical processes of scour and deposition along 3 miles of the San Joaquin River. BWFS analysis showed this does not have system-scale hydraulic effects but provides significant ecosystem restoration benefit. The levee breaching option of Three Amigos transitory storage was included in the State Recommended Plan because this element would enhance more than 2,000 acres of habitat and provide more than 150 additional acres of riparian and marsh habitat in the San Joaquin National Wildlife Refuge at low cost.	$ 5,700,000	$ 2,800,000	$ -	Capital	Systemwide - Reservoir and floodplain storage	Reservoir and Floodplain Storage and Operation

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268	RFMP	3F Group (Trout Unlimited, Ducks Unlimited, and American Rivers)	Three Rivers Ranch Study	The Ranch is situated on 205 acres directly adjacent to the Eastside bypass on the west side, Owen's Creek on the north, and the East Side Canal on the other. Currently, the entire property is managed for waterfowl habitat and includes seasonal and semi-permanent wetlands, riparian habitat and grassland, and shrub/scrub uplands. Water is supplied to the wetlands either from the East Side Canal, which then must be lifted, or from a deep well that flows approximately 2,000 gallons per minute (GPM). The landowner is continually working to restore native habitats on the property and allows limited waterfowl hunting during the hunting season. The system improvement consists of improvements to the connection of the wetlands to the adjacent waterways for the purpose of providing flood attenuation, juvenile salmonid rearing, groundwater recharge, more stable wetlands, and recreation.	$ 100,000	$ 100,000	$ 5,102	Ongoing	Rural - Studies and analysis	Watershed and Floodplain Management
269	RFMP	Lower San Joaquin Levee District	Update San Joaquin River Flood Control Project Operations and Maintenance Manual	Update the existing San Joaquin River Flood Control Project Operations and Maintenance Manual for Levees, Irrigation and Drainage Structures, Channels, and Miscellaneous Facilities that was prepared in 1967. This update will require hydraulic modeling and will include significant USACE, Central Valley Flood Protection Board, and Department of Water Resources coordination.	$ 500,000	$ 500,000	$ 25,510	Ongoing	Rural - Studies and analysis	Watershed and Floodplain Management
270	Other	California Department of Water Resources	Upper San Joaquin River - Small Community Levee O&M	Levee O&M costs were separated between urban and rural LMAs to capture the additional costs associated with urban area LMAs. Levee O&M included the following activities: vegetation maintenance, rodent control, encroachment and pipe maintenance, minor repairs (erosion, levee crown repairs etc.)	$ 873,200	$ 873,200	$ 44,550	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
271	Other	California Department of Water Resources	Upper San Joaquin River - Channel RR&R - Arrundo Removal	Regional input indicated giant reed removal cost at $25,000/acre.	$ 8,820,199	$ 8,820,199	$ 450,000	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
272	Other	California Department of Water Resources	Upper San Joaquin River - Channel Sediment Removal	Channel maintenance activities including sediment, vegetation, and debris removal are conducted by DWR with respect to the Sacramento River Flood Control Project and generally by LMAs in the San Joaquin Valley. Estimated costs for the Sacramento Basin were developed by using historical projects overseen by DWR, which have occurred as funding has been available, as well as input from regional experts. Estimated costs for the San Joaquin Basin were based on direct interviews with LMAs and staff.	$ 3,062,569	$ 3,062,569	$ 156,250	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
273	Other	California Department of Water Resources	Upper San Joaquin River - Channel Vegetation and Debris Removal	Channel maintenance activities including sediment, vegetation, and debris removal are conducted by DWR with respect to the Sacramento River Flood Control Project and generally by LMAs in the San Joaquin Valley. Estimated costs for the Sacramento Basin were developed by using historical projects overseen by DWR, which have occurred as funding has been available, as well as input from regional experts. Estimated costs for the San Joaquin Basin were based on direct interviews with LMAs and staff.	$ 5,880,132	$ 5,880,132	$ 300,000	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
274	Other	California Department of Water Resources	Upper San Joaquin River - Large Structure O&M	Major structures involve those facilities described in CWC Section 8361 and administered by DWR, and include weirs, bypass outflow control structures, outfall gate facilities, and large regional pumping plants.	$ 1,001,583	$ 1,001,583	$ 51,100	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
275	Other	California Department of Water Resources	Upper San Joaquin River - Large Structures RR&R	Based on discussions with DWR and LMA staff, major structures have historically been repaired and well maintained, and there is not an immediate need to repair, replace, or rehabilitate these facilities. As such, RR&R costs were not identified for this TM given major structures were assumed not to require significant repairs over the next 50 years. However, it is recommended that funding reserves be established to ensure adequate funding is available in the future to continue needed repairs or to replace aged facilities.	$ -	$ -	$ -	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
276	Other	California Department of Water Resources	Upper San Joaquin River - Non-urban Levee O&M (Rural)	Levee O&M costs were separated between urban and rural LMAs to capture the additional costs associated with urban area LMAs. Levee O&M included the following activities: vegetation maintenance, rodent control, encroachment and pipe maintenance, minor repairs (erosion, levee crown repairs etc.)	$ 236,960,516	$ 236,960,516	$ 12,089,550	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
277	Other	California Department of Water Resources	Upper San Joaquin River - Non-urban Levee RR&R (Rural)	Levee-related RR&R costs have generally been driven by necessary flood-event repairs and known erosion or levee stability issues. The OMRR&R Work Group determined the Delta Subventions Program data set is the most robust data set for estimating RR&R cost on SPFC levees because the existence of the funding program has encouraged more regular analysis and repair of levees. Although urban levees are being improved to a higher standard to meet urban level of protection standards, the OMRR&R Work Group determined that repair and rehabilitation costs for urban and non-urban levees would not differ substantially, and the cost for ULDC compliance would be the only significant differentiating factor for RR&R of urban SPFC levees.	$ 93,348,082	$ 93,348,082	$ 4,762,550	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
278	Other	California Department of Water Resources	Upper San Joaquin River - Small Community Levee RR&R	Levee-related RR&R costs have generally been driven by necessary flood-event repairs and known erosion or levee stability issues. The OMRR&R Work Group determined the Delta Subventions Program data set is the most robust data set for estimating RR&R cost on SPFC levees because the existence of the funding program has encouraged more regular analysis and repair of levees. Although urban levees are being improved to a higher standard to meet urban level of protection standards, the OMRR&R Work Group determined that repair and rehabilitation costs for urban and non-urban levees would not differ substantially, and the cost for ULDC compliance would be the only significant differentiating factor for RR&R of urban SPFC levees.	$ 343,988	$ 343,988	$ 17,550	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
279	Other	California Department of Water Resources	Upper San Joaquin River - Small Structures O&M	Minor structures include stop log or gated closure structures, pumping plants, monitoring wells and piezometers, retaining walls and floodwalls, pipe penetrations, and encroachments. Routine O&M of these types of structures is critical, but often overlooked for budgeting purposes. As became evident in the LMA data received, LMAs typically only account for routine power costs for pumping plants and do not separately account for other activities associated with minor structures such as video inspections of pipes, lubrication and minor repairs of pipe closure valves, routine inspection and maintenance of closure structure gates or stop logs, and inspection and minor repairs of floodwalls. The OMRR&R Work Group determined that costs for minor-structure O&M are likely included in the general overhead expenses for the LMAs who have structures, and no further estimates were developed. However, it is anticipated that video inspections of pipes will be required in the future (once every 5 years) for pipes crossing SPFC levees and as such these projected costs were included in the overall estimates.	$ 2,555,898	$ 2,555,898	$ 130,400	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
280	Other	California Department of Water Resources	Upper San Joaquin River - Small Structures RR&R	Small structures such as stop logs or gated closure structures, monitoring wells and piezometers, retaining walls and floodwalls, pipes, and encroachments are typically accounted for in levee RR&R costs, except for pipes. Many of these pipes were installed before or during original project construction prior to the 1950s, but no plans were implemented to assure these facilities could be replaced when they exceed their useful life. As a result, many pipes have reached their useful life with many of these structures in need of repair, replacement, or proper pipe abandonment.	$ 55,665,253	$ 55,665,253	$ 2,840,000	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance

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281	Other	California Department of Water Resources	Upper San Joaquin River - Urban Levee O&M	Levee O&M costs were separated between urban and rural LMAs to capture the additional costs associated with urban area LMAs. Levee O&M included the following activities: vegetation maintenance, rodent control, encroachment and pipe maintenance, minor repairs (erosion, levee crown repairs etc.)	$ 1,666,038	$ 1,666,038	$ 85,000	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
282	Other	California Department of Water Resources	Upper San Joaquin River - Urban Levee RR&R	Levee-related RR&R costs have generally been driven by necessary flood-event repairs and known erosion or levee stability issues. The OMRR&R Work Group determined the Delta Subventions Program data set is the most robust data set for estimating RR&R cost on SPFC levees because the existence of the funding program has encouraged more regular analysis and repair of levees. Although urban levees are being improved to a higher standard to meet urban level of protection standards, the OMRR&R Work Group determined that repair and rehabilitation costs for urban and non-urban levees would not differ substantially, and the cost for ULDC compliance would be the only significant differentiating factor for RR&R of urban SPFC levees.	$ 599,774	$ 599,774	$ 30,600	Ongoing	Systemwide - Routine maintenance	Operation and Maintenance
283	RFMP	Lower San Joaquin Levee District	Upper San Joaquin Sediment Study	Develop a sediment study in USJR region that identifies upstream sources of sediment as well as regional mitigation efforts.	$ 100,000	$ 100,000	$ 5,102	Ongoing	Rural - Studies and analysis	Watershed and Floodplain Management
284	USACE	California Department of Water Resources	Urban Levee Improvements	All urban levee improvements and associated cost estimates provided by USACE.	$ -	$ 1,000,000,000	$ -	Capital	Urban - Levee improvements	Flood Infrastructure
285	BWFS	California Department of Water Resources	Western Madera and Merced County Subsidence Solution	This element of the San Joaquin BWFS includes a groundwater banking project in the Red Top/El Nido areas east of the San Joaquin River and along the Eastside Bypass. This element would reduce groundwater overdraft, and help reduce subsidence in the region by developing 720 acres of recharge ponds that could absorb about 180 cfs of flows diverted from the flood system. Potential rehabilitation of existing turnouts from the San Joaquin River flood system would be considered along with direct pipelines to the recharge ponds. Flood flow diversions could potentially be from existing local river systems, and other sources could be San Joaquin and Kings rivers flood flows in wet years. The project could include the acquisition of additional surface water supplies to reduce the imbalance between supplies and demands in the region. Diverted surface water could be made directly available to growers as an alternative to pumping groundwater, which would in turn help reduce subsidence through in-lieu recharge (i.e., the use of surface water instead of groundwater ensures that less groundwater is pumped from the aquifer and promotes a healthier groundwater system).	$ 19,700,000	$ 20,000,000	$ -	Capital	Systemwide - Reservoir and floodplain storage	Reservoir and Floodplain Storage and Operation
286	RFMP	Red Top and Washington Ave Area Growers	Western Madera and Merced County Subsidence Solution	The Red Top Area Joint Banking project would consist of a combined banking and overdraft correction program in the Red Top/El Nido (Washington Avenue) areas east of the San Joaquin River in an effort to reduce pumping groundwater from below the Corcoran Clay. Significant subsidence has been observed lately in this area. Red Top area growers are planning to develop 720 acres of recharge ponds, 30 new shallow water wells, and surface water distribution to 26,000 acres of lands currently irrigated with well water. The recharge areas could be expanded and if flood flows occur before vine or tree budding, larger cropped areas could be flooded. Based on current projections the 720 acres of ponds can provide capacity to absorb about 180 cfs off the flood system. Over three months that adds up to 32,400 AF. Potential rehabilitation of existing and construction of new turnouts from the San Joaquin River flood system will be considered along with direct pipelines to the recharge sites. The water source could be from the Fresno and Chowchilla River systems, SJR flood flows, Kings River flood flows, which are limited to a few months in wet years. Also, the SJRECWA and/or Friant. Contractors could sell water to the growers directly. For the El Nido/Washington Ave. area, the projects would consist of detention reservoirs scattered throughout the area north of Highway 152 to enable transitory storage, thereby extending the availability of surface water by a month for use by growers. This reduces groundwater pumping which will help reduce subsidence. Additional turnouts from the Eastside By-pass and potential extensions of local irrigation systems to the area are under evaluation. Adding tile drains to the reservoirs with connections to the aquifer below the Corcoran clay would also be evaluated.	$ 19,600,000	$ 19,600,000	$ -	Capital	Rural - Levee repair and infrastructure improvements	Flood Infrastructure

Appendix C: State Flood Insurance Program

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Appendix C: State Flood Insurance Program

California is in the early stages of evaluating the viability and effectiveness of establishing a State-sponsored flood insurance program that could replace or augment the National Flood Insurance Program (NFIP). If a cost savings could be achieved by a State-sponsored program, the State may then consider using a portion of what it now pays in premiums to purchase private insurance and another portion of insurance premiums to implement risk reduction measures. These risk reduction measures have the potential to decrease damage in the event of a flood and may reduce the amount of mitigation funding needed from other sources.

C.1 Flood Insurance Models

Before evaluating the viability and effectiveness of establishing a State-sponsored flood insurance program, it is necessary to understand the types of flood insurance programs currently in use. Most of these flood insurance programs fall into one of four categories, defined by whether the program is privately-backed vs. government-backed, and whether the flood insurance is bundled vs. offered as an add-on. Each of these programs has its own pros and cons, and typically only one program exists in any particular country (Maddox, 2014).

The United Kingdom's (UK's) flood insurance program is backed by private financial markets and is mandatory; it is bundled into a property owner's insurance policy whether the property-owner wants it or not. Since all property owners are covered, this allows for the insurance providers to spread the risk over a larger pool, which makes the premiums more affordable. This system, which is also used in China and Hungary, safeguards the insurance industry by improving its solvency and profitability.

Germany's flood insurance model is also backed by private financial markets; however, it is optional for property owners. Since the decision to purchase flood insurance rests with a property owner, the markets are characterized by concentration of high-risk properties, which results in high premiums. In the insurance business, this is known as adverse selection. Only those facing the highest risk tend to buy insurance, and moderate- or low-risk properties are priced out of the market. The underlying philosophy in countries that have adopted this model (which includes Austria, Japan and South Africa) is that the cost of insuring against flood damage should only be borne by property owners at risk; therefore, the program should focus on high-risk properties that pay high premiums.

Flood insurance models backed by national governments fall into two categories: bundled and add-on. The French and Spanish models are both backed by the government and are bundled into property insurance that also covers other natural hazards. Policies are still written by private insurers, but the state ensures the solvency of the insurance industry by retaining a portion of the premiums, which it uses to underwrite claims. Since the state is responsible for any claims, it has an interest in minimizing flood risk by either regulating development in floodplains or by funding/implementing flood risk reduction projects.

The NFIP is an example of an optional flood insurance model backed by the United States (U.S.) government. This model is similar to the German model (i.e., optional but privately-backed) with a high concentration of policies in high-risk areas. However, unlike the German model, the NFIP is subject to political pressure to keep premiums lower than the flood risk involved would indicate. This has resulted in the NFIP using borrowing capacity from the U.S. Department of the Treasury (Treasury) and, in some cases, direct appropriations from Congress to make up the shortfall in funding, as the premiums paid into the system have not been able to keep up with payouts. The optional nature of the program results in only 1 percent of properties outside designated high-risk areas purchasing flood insurance, even though about half of all flood damages occur in these properties (Lamond and Penning-Rowsell, 2014).

C.2 History of NFIP

Congress established the NFIP with the passage of the National Flood Insurance Act of 1968. NFIP enables property owners in participating communities to purchase insurance as a protection against flood losses in exchange for State and community floodplain management regulations that reduce future flood damages. Participation in the NFIP is based on agreements between communities and the federal government. For example, if a community adopts and enforces a floodplain management ordinance to reduce future flood risk to new construction in floodplains, the federal government will make flood insurance available in the community as a financial protection against flood losses. This insurance is designed as an alternative to disaster assistance, and is designed to reduce the escalating costs of repairing flood damage (NFIP, 2002).

On April 1, 1979, President Jimmy Carter signed the executive order that created the Federal Emergency Management Agency (FEMA). FEMA is responsible for coordinating federal response to floods, earthquakes, hurricanes, and other natural or man-made disasters. FEMA provides disaster assistance to states, communities, and individuals. The Federal Insurance and Mitigation Administration within FEMA is responsible for administering the NFIP. Before the inception of FEMA, the NFIP was administered by the Department of Housing and Urban Development.

When the long-term average payouts from the NFIP matched the long-term average revenues generated from premiums, the NFIP was financially sound (i.e., self-funding). Additionally, the NFIP was set up with borrowing capacity from the Treasury to help it meet claims in years when payouts exceeded revenues generated from premiums; presently, the NFIP has $30.4 billion in borrowing authority. These borrowed funds are intended to be paid back with interest. Up until 2001, the NFIP could pay back funds it borrowed from the Treasury. In June 2001, the NFIP paid off its debt to the Treasury from a high of $922 million in 1999 (NFIP, 2002). Unfortunately for the NFIP, FEMA had to borrow money later that year to address more than 30,000 claims related to flooding from Tropical Storm Allison. More recently, payouts including those made for Hurricane Katrina in 2005 and Superstorm Sandy in 2012 have left the NFIP indebted to the Treasury by more than $24 billion. In October 2017, after hurricanes Harvey, Irma, and Maria, the President signed a disaster relief bill that included $16 billion in debt forgiveness for the NFIP. This restored borrowing capacity that would have otherwise been exhausted by payouts coming from the 2017 hurricanes.

Even before the 2017 hurricanes, it was generally understood that the NFIP was no longer financially sound. A U.S. Government Accountability Office (GAO) 2015 report titled Report to the Congressional Committees: High Risk Series—An Update identified the NFIP as being at high risk for "not generating sufficient revenues to repay the billions of dollars borrowed from Treasury to cover claims from the 2005 and 2012 hurricanes or potential claims related to future catastrophic losses" (GAO, 2015).

C.2.1 Biggert-Waters Flood Insurance Reform Act of 2012

To help strengthen the NFIP's financial solvency, the Biggert-Waters Flood Insurance Reform Act (BW12) was passed in July 2012. BW12 extended the NFIP's authority through September 30, 2017, while requiring significant reform. These requirements included changes to major components of the program, including flood insurance, flood hazard mapping, grants, and floodplain management. In addition to provisions intended to make the NFIP more financially stable, changes required under BW12 were designed to ensure that flood insurance rates more accurately reflect the real risk of flooding (BW12, 2013).

Provisions of BW12 require the NFIP to raise insurance rates for some older properties in high-risk areas to reflect true flood risk. The affected properties are among those built before their communities joined the NFIP and adopted their first flood insurance rate map (FIRM). Communities began joining the NFIP in the late 1960s. Many of the pre-FIRM properties in high-risk areas do not meet current standards for construction and elevation, and they have received subsidized rates that do not reflect their actual risk. Approximately 20 percent of NFIP policyholders are pre-FIRM; these policyholders qualified for and received subsidized rates prior to BW12 (BW12, 2013).

The proposed changes to discounted premiums for pre-FIRM properties were to be phased over time beginning January 1, 2013, for "homeowners with subsidized insurance rates on non-primary residences and pre-FIRM structures that had not been substantially damaged or improved" (BW12, 2013). For other discounted premium recipients, such as owners of business or residential properties that had either experienced repetitive losses or whose cumulative flood-related damage claims exceeded the fair market value of their properties, the change would go into effect on October 1, 2013. The rates for these discounted premiums were scheduled to increase by 25 percent each year until premiums reflected full-risk rates. Full-risk rates would apply to owners of property who were not insured as of BW12 enactment, those who had lapsed NFIP policies, and those who purchased after the BW12 enactment date (BW12, 2013). Although FEMA started to implement changes required by BW12, there was an immediate public outcry about the affordability of the new flood insurance premiums.

C.2.2 Homeowner Flood Insurance Affordability Act of 2014

In response to this public outcry, Congress enacted the Homeowner Flood Insurance Affordability Act of 2014 (HFIAA). HFIAA "reinstated certain premium subsidies and slowed down certain premium rate increases that had been included in the Biggert-Waters Act" (GAO, 2015). Premium subsidies were reinstated for properties purchased after July 6, 2016 (the date of HFIAA enactment) and properties whose NFIP insurance had lapsed as of that date (GAO, 2016).

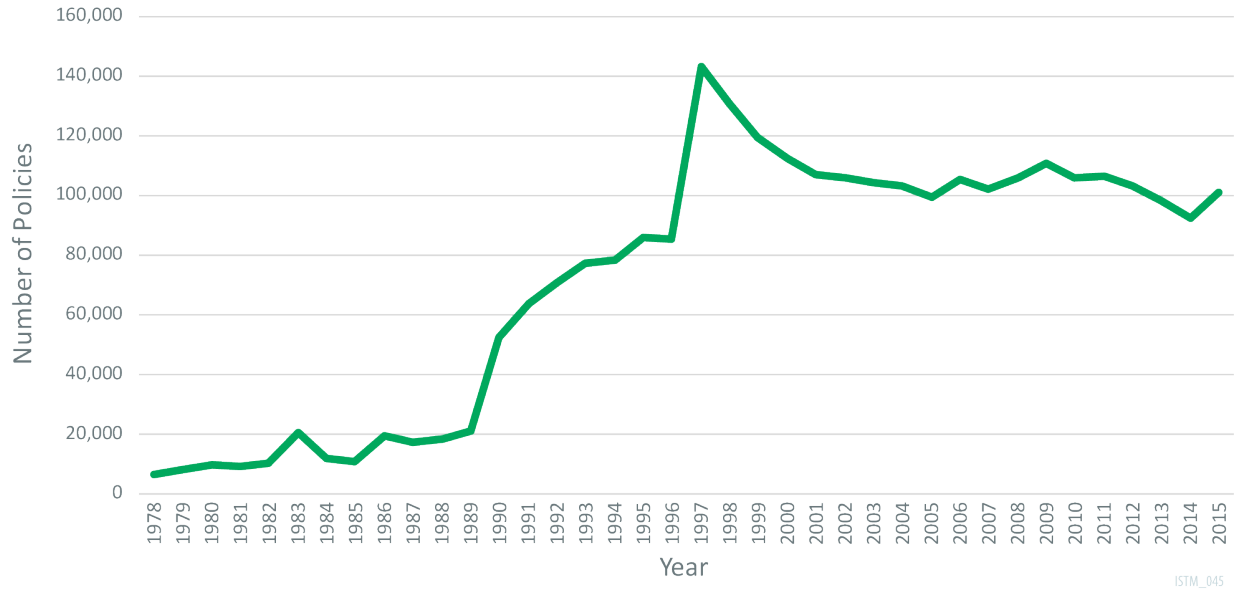
C.2.3 NFIP Reauthorization

The NFIP's most recent authorization coming from BW12 was set to expire on September 30, 2017. It has been extended as part of continuing resolutions funding the government on a temporary basis. Recognizing the challenges faced by the NFIP, it is expected that NFIP reauthorization will be accompanied by significant fiscal and structural reforms.

C.3 NFIP Policies

Figure C-1 shows the total NFIP flood insurance policies between 1978 and 2015 relevant to the State Plan of Flood Control (SPFC) Planning Area (geographic and hydrologic scope of the CVFPP). This figure demonstrates that policy purchasing follows individuals' perceptions of their risk, which typically rises following a major flood and declines over time as the flood event recedes from memory. The number of purchased NFIP policies rose steadily from about 6,500 in 1978 to a peak of about 148,000 in 1997 following a number of significant floods in California. Between 1998 and 2004, the number of policies declined by about a quarter with most (about 90 percent) of the observed decline in policies occurring in the counties of Sacramento, San Joaquin, and Sutter. In Sacramento County, the drop in purchased policies was about 50 percent; in San Joaquin and Sutter counties, the drop was about 20 percent in each county.

Figure C-1. Annual NFIP Policies, SPFC Planning Area, 1978-2015



Source: Clark, 2013; Lohmann, 2014; Lohmann 2016

C.4 NFIP Expenditures

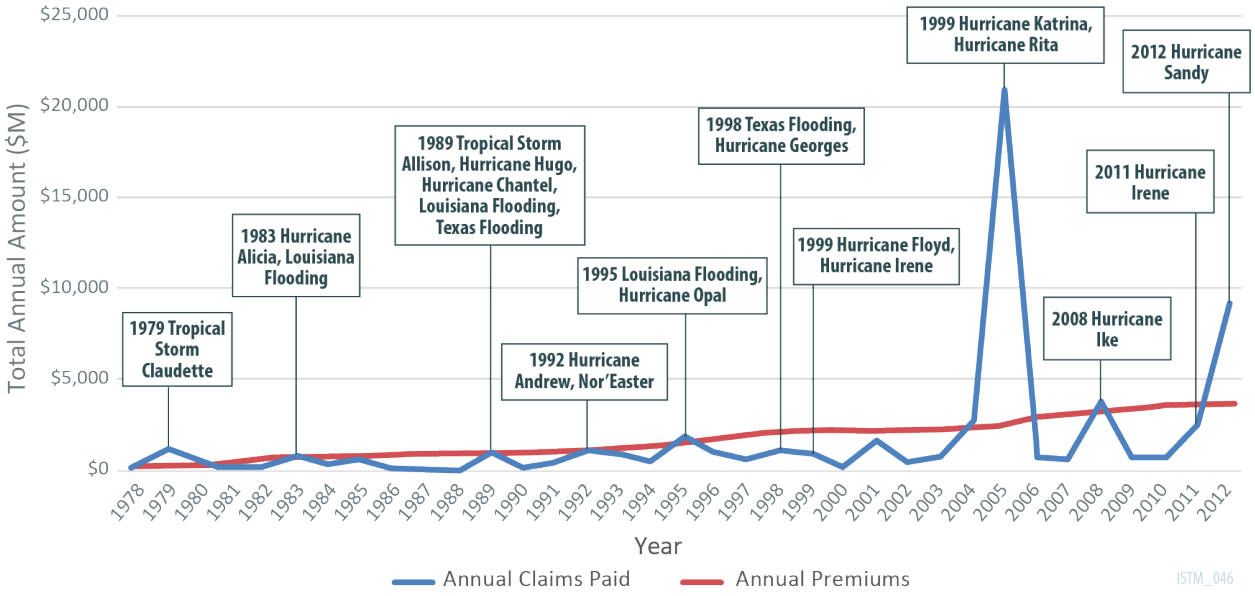
FEMA maintains an NFIP database that includes information about annual claims and annual premiums organized by state and by counties within states. Figure C-2 shows the total premiums collected and total claims paid out by the NFIP between 1978 and 2012. Prior to 2005, the NFIP was financially sound, with annual premiums collected exceeding annual claims paid. Hurricane

Katrina in 2005 overwhelmed the NFIP's ability to repay the Treasury, and since that time premiums have not kept up with the claims paid out.

Figure C-2 also shows that a few states have consistently been among the top recipients of NFIP payouts. Between 1978 and 1989, Louisiana and Texas were the top recipients of annual NFIP payouts. Payouts to these two states combined accounted for 63 percent and 65 percent of total NFIP payouts in 1980 and 1983, respectively. From 1990 through 1999, Florida was the top recipient of NFIP payouts. Florida and Louisiana received approximately 80 percent of all NFIP payouts in 1995. Texas alone received about 79 percent of all payouts in 2001, while more than 90 percent of the 2005 payouts went to Louisiana and Mississippi. During the period shown, California was the leading recipient of NFIP payouts only once—in 1986 when the payout accounted for approximately 29 percent of all payouts that year.

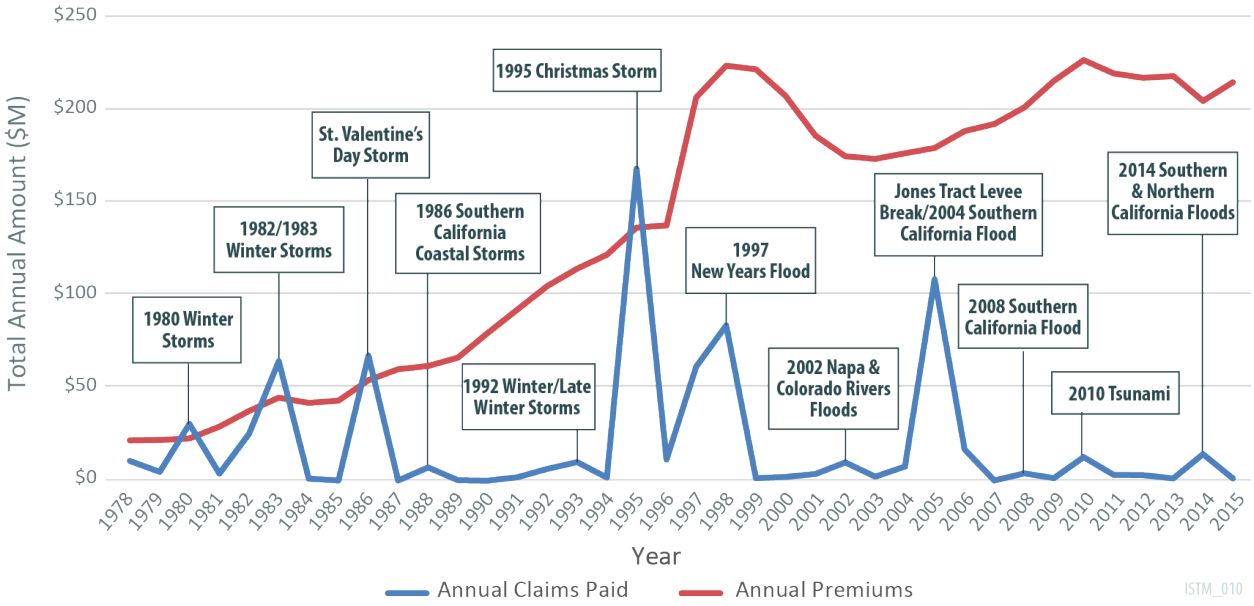
Analysis of NFIP data (from 1978 to 2008) by the Wharton Center for Risk Management and Decision Processes (WCRMDP) showed that premiums paid over time by California policy holders totaled five times more than the payouts (WCRMDP, 2011). Figure C-3 shows the total annual premiums and total annual payouts between 1978 and 2015 in California (in 2015 dollars). This figure shows that the State of California has paid more into NFIP in the form of annual premiums than it has received as payout from the program in all years except in 1983, 1986 and 1995. The 1983 payouts correspond to the floods following the 1982-83 winter storms in Northern California while the 1986 and 1995 figures correspond to the St. Valentine/Winter storm in 1986 and the major floods across the state in January and March 1995, respectively.

Figure C-2. Total Annual Premiums and Payouts, NFIP, Nationwide, 1978-2012



Source: Clark, 2013; Lohmann, 2014; Lohmann 2016

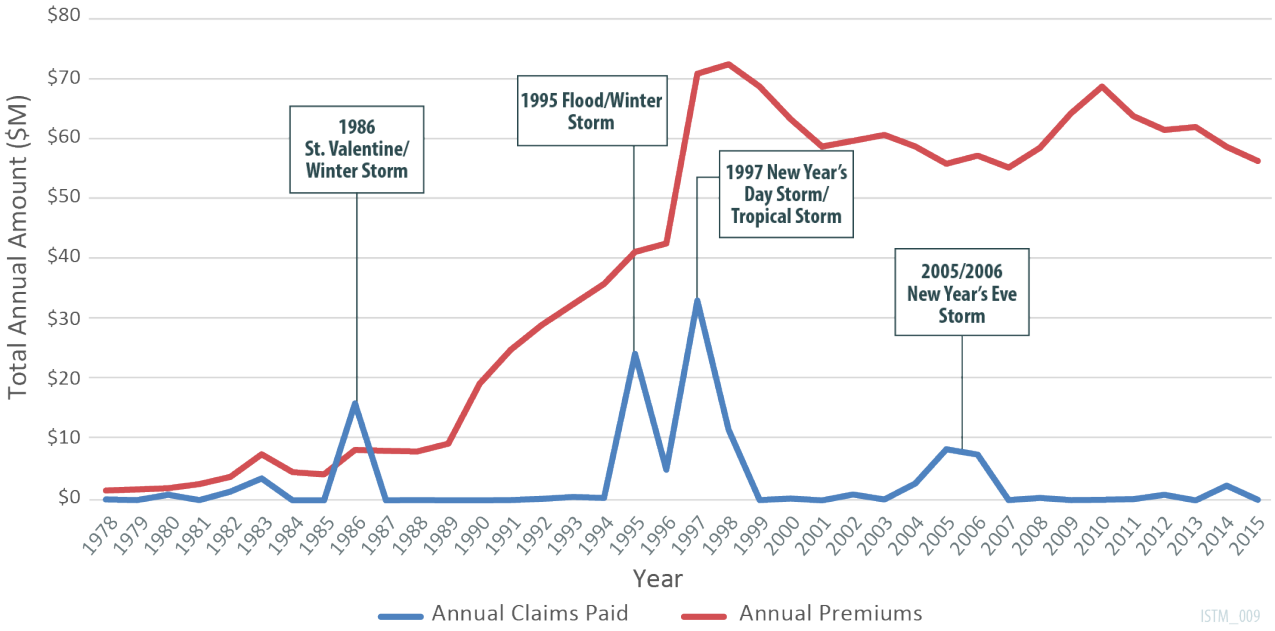
Figure C-3. Annual Premiums and Claims, NFIP, California, 1978-2015



Source: Clark, 2013; Lohmann, 2014; Lohmann 2016

Figure C-4 shows the total annual premiums and total annual claims paid between 1978 and 2015 relevant to the SPFC Planning Area (in 2015 dollars). The trend in the SPFC Planning Area mirrors that seen in the State, with annual premiums exceeding annual claims paid in most years except in 1986 following the floods associated with the St. Valentine/Winter storms in February of that year. Figure C-4 also the shows that annual claims paid were relatively higher in 1986, 1995, 1997, 2005 and 2006, corresponding to flood events in those years. The largest claims paid during these years were to recipients in Sacramento County ($2.7 million in 1986, $8.3 million in 1995, and $5.8 million in 1997) and Solano County ($3.7 million in 2005). All payments are in 2015 dollars.

Figure C-4. Annual Premiums and Claims, NFIP, SPFC Planning Area, 1978-2015



Source: Clark, 2013; Lohmann, 2014; Lohmann 2016

C.5 NFIP Coverage

Flood insurance through the NFIP is available to homeowners, renters, condo owners/renters and commercial owners/renters. In addition to residential and commercial properties, insurance offered through the NFIP also covers public property. Flood insurance is specifically required for all buildings in mapped Special Flood Hazard Areas (SFHAs) shown on FEMA's maps if they are financed by federally-backed loans or mortgages (FEMA, 2015). FEMA also encourages owners of homes and businesses in moderate- to low-risk areas and those whose properties have previously been flooded to purchase insurance even if their mortgage company doesn't require it. Homeowners outside the SFHAs may be eligible for a lower-risk policy called a Preferred Risk Policy (PRP). Properties that have been newly mapped into a high-risk flood zone may also qualify for an equivalent PRP rate.

Flood insurance costs vary depending on how much insurance is purchased, what it covers and the property's flood risk. Coverage is available for buildings and contents, though coverage for contents is optional. Coverage of property is limited to specific parts of the property (e.g., building and foundation, electrical and plumbing systems, HVAC, built-in appliances, permanently installed parts such as bookcases and cabinets). A separate property policy is required for detached structures other than detached garages. Coverage of contents excludes certain valuables (e.g., currency, precious metals, stock certificates, etc.) and financial losses resulting from business closures or from the loss of the use of insured property.

For communities participating in the NFIP Regular Program[1] or Emergency Program[2] the dwelling policy under the Standard Flood Insurance Policy (SFIP[3]) provides building and/or contents coverage. Coverage offered in the Dwelling Form[4] includes the building property up to $250,000, and personal property (or contents) up to $100,000. The personal property coverage applies to both homeowners and renters. The General Property Policy Form is issued to owners or lessees of non-residential buildings or units, or residential condominium buildings insurable under the Residential Condominium Building Association. Non-residential property owners can insure a building and its contents for up to $0.5 million each (FEMA, 2015).

Nationally, as of April 2016, the maximum annual premium (including a basement/enclosure) was $474 under the residential PRP (FloodSmart, 2017a). Based on the 1978 through 2015 NFIP data on premiums, the average flood insurance premium in California was about $600 (in 2015 dollars). This figure includes both PRP and non-PRP rates. The average flood insurance premium relevant to the SPFC Planning Area during this period (i.e., from 1978 through 2015) was about $480 per year (in 2015 dollars), and includes both PRP and non-PRP rates. Following Hurricane Katrina in 2005, average flood insurance premiums have been trending upward for the State and in the SPFC Planning Area.

Based on 2006 through 2015 NFIP premiums, the average cost of flood insurance in California was $820 per year (in 2015 dollars). Relevant to the SPFC Planning Area, and during the same time period, the average flood insurance premium was about $590 per year (in 2015 dollars). These averages are higher than the average pre-Hurricane Katrina flood insurance premiums (i.e., from 1978 through 2005). Average cost in the state was about $520, and in the SPFC Planning Area the cost was about $440 (both in 2015 dollars).

C.6 Possible State Flood Insurance Program

C.6.1 State-Led Alternatives to NFIP

With passage of HFIAA in 2014 and the subsequent losses due to the 2017 hurricanes, the NFIP is at greater risk for financial insolvency. Since Hurricane Katrina in 2005 and Superstorm Sandy in 2012, several states, including Louisiana and New York, have considered opting out of the NFIP and establishing a state insurance program funded through premiums paid by state residents. Their rationale is that these state-run programs would more readily meet the needs of the individual state's residents.

[1] The NFIP Regular Program is the final phase of a community's participation in the NFIP when a FIRM is in effect and full limits of coverage are available.
[2] The NFIP Emergency Program applies during the initial phase of a community's participation in the NFIP, when only limited amounts are available.
[3] The SFIP consists of the Dwelling Form, the General Property Policy Form, and the Residential Condominium Building Association Policy Form.
[4] The SFIP Dwelling Policy Form is used to insure homeowners, renters and condominium unit-owners and owners of residential buildings containing two to four units.

The state program proposed by Louisiana, which was put forth before HFIAA was enacted, would have required property owners to purchase an additional state insurance policy. This state program would have been run by companies set up like corporations that handle property insurance and worker's compensation coverage for those who cannot get it in on the private market (Deslatte, 2013). However, some in Louisiana government, including the Governor, felt the proposed program would not succeed, because property owners would not be willing to pay for two programs (i.e., the new state program and the NFIP). Additionally, opponents pointed out that underwriters who are part of the proposed state corporation would expect the state to act as a backstop. Thus, costs currently born by the NFIP, and by extension all federal taxpayers, would shift to state taxpayers. This state-led proposal has not advanced.

New York State also considered a proposal to establish a state-run flood insurance program. According to the proposal, the state program, called the New York Flood Insurance Association, would have provided an alternative to the rising NFIP premiums to New York residents living in flood-prone areas who may not have access to affordable flood insurance. However, like the Louisiana proposal, the proposed New York program may not be attractive enough to insurance companies due to the state's lack of financial clout in ensuring that insurers are protected from financial liability through limits on their financial exposure (Vagus, 2015).

The State of Florida also considered establishing a program run by private insurance companies (Klas, 2013) after passage of BW12 but prior to the enactment of HFIAA in 2014. However, the program was not initiated because the state could not meet the private insurers' requirement for "extraordinary regulatory flexibility." Private insurers requested extraordinary regulatory flexibility because NFIP could not give them adequate data to assess risks and hence, determine rates.

Several states are also looking to reduce the risk on their state budgets from "repeated flood insurance claims, emergency response, seawall repair, and other public expenses" that are associated with coastal properties (Pillion, 2015). For example, both New York and New Jersey have implemented state programs to buy distressed properties in the aftermath of Hurricane Sandy (Kaplan, 2013; Nutt, 2013). In Massachusetts, the legislature set aside $20 million in a bond bill for a voluntary buyout program for repeatedly damaged coastal homes (Daley and Wang, 2015). The purchased land would be converted to recreational or wildlife refuges. Of particular concern to the Massachusetts legislature is the coastal town of Scituate, which accounts for nearly 40 percent of Massachusetts' "severe repetitive loss" properties. These properties have received at least four payments from NFIP in the past (Daley and Wang, 2015). The rationale for these programs is that a buyout is cheaper for state and federal taxpayers in the long run than paying for repeated flood damage claims.

C.6.2 State Flood Insurance Program

As stated earlier, prior to Hurricane Katrina, the NFIP was able to pay back its debt to the Treasury. However, since Hurricane Katrina, the program has not been financially sound. Additionally, attempts by the federal government to restructure the program to make it more financially sound have not been successful (see Sections C.2.1 and C.2.2). A state flood

insurance program may likely face the same financial constraints as the NFIP unless certain issues are addressed. Some of these issues are related to the following:

- Accuracy of flood maps
- Public awareness about the flood risk
- Voluntary nature of flood insurance
- Linkage of flood insurance to federally-backed mortgages
- Treatment of repetitive loss property
- Affordability
- Financial solvency (i.e., spreading risk over the financial markets)

Accuracy of Flood Maps

Whether the flood insurance is provided through a state-backed program or a private one, there must be an understanding of the level of risk associated with insuring properties in a floodplain. Under the current FEMA mapping system, areas with moderate to low flood risk are included in the Non-Special Flood Hazard Area (NSFHA), which includes flood zones B, C, X, Pre-, and Post-FIRM, as designated by FEMA. Unlike properties in the SFHA that are required to purchase flood insurance if they are financed by federally-backed loans or mortgages, properties in the NSFHA are not required to purchase flood insurance. This is despite the fact that "more than 20 percent of all flood insurance claims" are from properties in the NSFHA areas (FloodSmart, 2017b).

To avoid having a mismatch between flood insurance coverage and flood insurance claims (and/or damages), the State would have to ensure that flood maps used to support the State flood insurance program properly account for actuarial risk. That is, the State would have to ensure that the maps are based on structure-specific flood elevation and frequency determinations, and that they consider future flood risks associated with climate change. In addition to showing the risks associated with flood, the maps would also need to show existing land uses in the area. These maps would need to be updated frequently to capture any changes in an area's flood risk following land use changes or implementation of flood risk reduction projects.

Public Awareness about Flood Risk

Funding a state insurance program would require that property owners living within the floodplain purchase insurance annually. However, property owners tend to underrate their risk and drop their flood insurance within a few years of buying. An analysis of policy tenure under the NFIP showed that 73 percent of new policies entering the NFIP in 2001 renewed their policy in 2002 (Michel-Kerjan et al., 2012). After 2 years, renewal rates declined to 49.5 percent of the original policies, and by 2009 (8 years later), only 19.6 percent of the policies were still in place. This trend was also observed for policies that went into effect in 2002, 2003, and 2004. The study found the median tenure of policies to be 2 years. However, following FEMA's FloodSmart public awareness campaign, the average tenure of policies issued between 2003 and 2006 increased to 4 years. This study also showed that that policy holders in California had shorter tenure than residents of a group of states in the northeastern U.S. (Michel-Kerjan et al., 2012).

The purchasing and renewal of insurance policies are based on many factors, including economic and financial conditions, perceptions of risk, and personal experiences with a disaster, though

this has been shown to not always be the case. In 2014, the WCRMDP published the results of a survey of New York City homeowners who owned a home with a ground flood in a flood-prone area. The purpose of the study was to understand individual flood risk perceptions. The survey was conducted 6 months after Hurricane Sandy and showed that, of the over 1,000 survey participants, only 44 percent purchased flood insurance because it was mandatory while 21 percent bought flood insurance voluntarily and another 33 percent did not have coverage at all. About 2 percent did not know whether they had flood insurance coverage (WCRMDP, 2014). The study also found that most of the respondents (86 percent) believed that they lived in a flood-prone area. The fact that most of the homeowners without flood insurance were nevertheless aware of the flood risk, survey results show the need for improved public understanding of the potential for flood damage and the role of flood insurance.

Outreach and education about flood risks and the potential for flood damage must be an important component of any state flood insurance program. California could model its outreach program on FEMA's FloodSmart program as a start. Flood maps used to communicate flood risks need to include information about potential damage. Additionally, the state can ensure that information about flood risk is expressed in a form that is easily understandable to residents (for example, by communicating the chance for a flood as greater than 20 percent in the next 25 years instead of the typical 1-in-100). The California program would also need to emphasize that large storm events are mostly independent; for example, the fact that Hurricane Sandy struck recently does not mean that the affected area is safe for the next 50 or 100 years.

Voluntary Nature of Flood Insurance Requirement

Flood insurance is mandatory only in properties located in SFHAs that are financed by federally-backed loans or mortgages. Properties outside the SFHA, such as those in the NSFHA are not required to have flood insurance but, as previously stated, about half of all flood damages occur on these properties nationally (Lamond and Penning-Rowsell, 2014). One way to ensure that all property in flood-prone areas are covered by flood insurance is to make flood insurance mandatory on all these properties. An exception would be properties shown to be higher than the base flood elevation for the area.

When setting up a state flood insurance program, California could ensure compliance with its mandatory flood insurance program by requiring that banks and mortgage lenders require flood insurance policies for all property in flood-prone areas. Another option to ensure compliance would be to link flood insurance premiums to annual property tax bills. A third option would be to offer multi-year contracts through the state flood insurance program and write-your-own programs offered through private insurers. These multi-year contracts could stay with the property even if the property changes hands, thus ensuring coverage for properties at risk. Incorporating these types of safeguards may ensure the success of California's program.

Linkage of Flood Insurance to Federally-backed Mortgages

By establishing its own flood insurance program, California would be losing the safeguards provided by NFIP's requirement that properties financed by federally-backed loans or mortgages in SFHAs have flood insurance. To avoid this, the State would need to pass legislation requiring lending institutions doing business in California require flood insurance as a condition of a loan on a property located in areas identified by the State flood map as a flood-prone area.

Treatment of Repetitive Loss Properties

Before the passage of the Bunning-Bereuter-Blumenauer Flood Insurance Reform Act in 2004, the NFIP was paying out multiple flood insurance claims for damages to the same properties in some areas. The cumulative payouts on some of these properties exceeded their fair market value. The 2004 act amended Section 1323 of the National Flood Insurance Act of 1968 to provide funding to reduce or eliminate the long-term risk of flood damage to structures insured under NFIP for properties that had one or more claim payment(s) for flood damages.

The State may choose to identify repetitive loss properties and institute a voluntary buyout program that would eliminate the risks that these properties pose to a State flood insurance program. The legislature could set up a program that funds this buyout program, or a bond measure could provide the required capital. The purchased at-risk property could be converted to open spaces and flood buffer zones and, where applicable, to recreational or wildlife refuges. A State flood insurance program could ensure participation in the voluntary buyout program by stipulating that these properties would no longer be eligible for flood protection through the program.

Affordability of Flood Insurance

Affordability of flood insurance was one of the main reasons Congress passed the HFIAA in 2014. It essentially rolled back the BW12 provision requiring the NFIP to raise insurance rates for some older pre-FIRM properties. The subsidized rates offered to these pre-FIRM properties did not reflect the true cost of their actual flood risk. A California flood insurance program is likely to face the same pressures currently faced by NFIP: keeping flood insurance rates affordable. One option is to offer means-test affordability assistance in the form of a subsidy. A surcharge on non-income based flood insurance premiums could be used to offset the subsidies.

Basing the subsidy level on income is one of the options that the GAO (2016) proposed to make the NFIP more solvent. The GAO proposal called for institution of a means-tested assistance program that targets assistance based on individual policyholders' financial need or the financial characteristics of a local geographic area. The subsidy could also be linked to the cost of mitigating the risk.

Currently, NFIP flood insurance rates for properties on agricultural lands are the same as those for commercial properties. This rate assumes that floodplains and the associated flood risk in these floodplains are the same across the country. It also assumes that farming practices are similar across the country. But there are major differences in the type of floodplain and types of farming practices on floodplains in California and particularly within the Central Valley. In other parts of the country, designation of land as an SFHA would typically render such land inappropriate for agriculture; in California, deeper floodplains are particularly well-suited for agriculture.

FEMA's proposed updates to the NFIP floodplain maps in the Central Valley has resulted in agricultural lands being inside newly designated SFHAs. Once in the SFHA, all agricultural property is subject to NFIP flood insurance requirements, especially if the property is financed with a federally-backed loan or mortgage. Because these flood insurance requirements have the potential to affect the sustainability of agriculture in the Sacramento Valley, the State convened the Agricultural Floodplain Ordinance Task Force (AFOTF) in 2015 to identify and recommend

changes that FEMA could administratively implement. The AFOTF developed many recommendations that would modify FEMA's rules on elevation and floodproofing (by either reducing them or removing them) and reduce the cost of flood insurance for agricultural structures (AFOTF, 2016). These recommendations could be incorporated into a State flood insurance program.

Financial Solvency

Both the BW12 and HFIAA authorized FEMA to secure reinsurance from private reinsurance and capital markets to shore up the NFIP's future finances and reduce the accumulation of future debt to the Treasury. FEMA began its exploration of the reinsurance market by initiating a small reinsurance program for about $1 million in September 2016. In January 2017, FEMA expanded this program by securing about $1 billion in reinsurance from 25 reinsurers to help it cover claims between January 1, 2017 and January 1, 2018 (FEMA, 2017a). Although this reinsurance program has already realized benefits to the NFIP coming from its financial exposure as a result of Hurricane Harvey, it does not help eliminate the accumulated debt of the NFIP (FEMA, 2017b). FEMA plans to expand this reinsurance program into a multi-year program.

While the State currently pays more in premiums than it receives in claims from the NFIP, implementing this type of program at the State level would shift the risk of keeping the flood insurance program solvent from the federal government (and by extension all federal taxpayers) to the State government (and by extension all State taxpayers). It would also shift the responsibility for disaster payments to the State.

One way to shift some of this risk would be to couple the State flood insurance program with traditional reinsurance backed by the State, like the program recently implemented by FEMA. However, this would still expose the State to financial risks that it could avoid if it modeled the State flood insurance program on the UK program (i.e., a government-mandated private insurance program). The UK's program, which has a 95 percent flood insurance penetration, bundles flood insurance with other property insurance. The UK government does not subsidize premiums; nor does it offer a state-backed reinsurance program. However, it does partner with private insurers to guarantee the provision of insurance to high-risk households, conditional on the government implementing a 5-year plan to reduce flood vulnerability. The insurers transfer risk to the international reinsurance market (White, 2011).

Another way to shift or spread this risk would be to couple the State flood insurance program with private investments in the form of resilience bonds. Resilience bonds are a type of catastrophe bond. Catastrophe bonds (or cat bonds) are high-yield debt instruments that are usually insurance-linked and designed to help manage the financial risks associated with natural disasters. They were first created in the mid-1990s, in the aftermath of Hurricane Andrew and the Northridge earthquake in Southern California. Since then, the market share of cat bonds has continued to grow. Over the last decade, the cat bond market has grown 25 percent per year while the rest of the insurance sector has grown by 10 percent. In the first quarter of 2015, the cat bond market was worth approximately $25 billion (Vajjhala and Rhodes, 2015). The growth in the cat bond market can partially be explained by its structure. If a disaster (also called a triggering event) covered by the cat bond occurs during the term of the bond (i.e., usually 3 to 5 years), the bond sponsors (or insurance purchaser) keep a portion of the bond value to pay off losses, and investors lose some (or sometimes all) of their principal invested. However, if the

triggering event does not occur, the bond investors keep all the bond value. Common types of triggers are loss-and-damage based triggers. Cat bonds allow insurers to transfer risk outside the reinsurance market. The California Earthquake Insurance Program is an example of a program based on cat bonds.

Resilience bonds have three building blocks: insurance, resilience projects and rebates. Not only do the sponsors of resilience bonds purchase insurance, they have an interest in reducing physical damages from disasters. Resilience bond sponsors are only responsible for premium payments, and they benefit in the form of resilience rebates realized from the insurance value created by the resilience project. A resilience bond can have multiple sponsors who have a shared interest, and can be tailored to complement existing insurance and risk management programs (Vajjhala and Rhodes, 2015). Like cat bonds, resilience bonds have a fixed timeline; however, unlike cat bonds, resilience bonds identify and are linked to specific resilience projects.

C.6.3 Steps to Creating State Flood Insurance Program

The State legislature would have to pass a law creating a State flood insurance program that would specify how it would be implemented and funded. The State would need to develop a source of funds to cover emergencies that result in payouts exceeding program capacity. As shown above, NFIP policy holders in California have, on average, paid more in premiums into the NFIP than they have received as payouts. However, this has not always been the case in every year. Following the 1980, 1983, 1985 and 1995 floods, California policy holders received more in payouts than they paid as premiums. The NFIP had access to funds from the U.S. Treasury during years when it took in less in premiums than it had to pay out. A State flood insurance program would need to access a source of funding if premiums could not cover payouts over some period; this is where resilience or cat bonds could be used. Opting out of the NFIP may mean that California loses access to other funds available from FEMA, especially funding typically made available upon a presidential declaration of emergency.

C.6.4 State Flood Insurance Program – Example Templates

Possible templates for how a State flood insurance program might be established include the State's Division of Workers' Compensation insurance program and the Earthquake Insurance Program, which are described below. Additionally, the State could establish a private flood insurance program like the UK program.

- **State Division of Workers' Compensation Insurance Program:** In California, all employers are required to participate in the State workers' compensation insurance program. The program, through its Workers' Compensation Rating Bureau, establishes insurance premiums based on risk, number of workers, occupations, wages, and claims history. Risk is determined by occupations represented in the employer's staff (e.g., a roofer's insurance cost is higher than that of an office worker). Some of the risk levels associated with occupations have been developed over 100 years (Clark, 2013). Assessments on insurance companies fund the State Administrative Court, which is charged with resolving disputes that arise because of claims. Insurance for the program is provided in one of three ways: 1) employer self-insurance whereby employers underwrite their own insurance; 2) general liability insurance typically purchased through any insurance underwriter; and 3) through the State

Compensation Insurance Fund. Of these three, the State Compensation Insurance Fund is the insurer of last resort (Clark, 2013).

- **Earthquake Insurance Program:** A state flood insurance program could also be modeled on the existing earthquake insurance program managed by the California Earthquake Authority (CEA). The CEA, created in 1996, is a not-for-profit, publicly managed, privately funded provider of catastrophic residential earthquake insurance. Insurance companies, through the CEA or directly, are mandated to offer minimum levels of earthquake coverage and must contribute upon joining the CEA. The State imposed three requirements on the CEA: 70 percent of insurers in the state had to participate, the CEA must be exempt from federal income taxes, and reinsurance must be purchased at twice the level of contributions from insurance companies. By law, the CEA cannot access State general funds to meet claims. In the event of a catastrophic event, payments are first made from CEA capital followed by reinsurance; if both are inadequate, the CEA can issue bonds to raise the necessary funds. If additional funds from bonds are inadequate to meet claims, the CEA can assess insurers up to $2.8 billion (Kousky, 2010). Instead of issuing bonds to meet shortfalls, additional funding could be generated by imposing a surcharge/assessment on all property insurance premiums in California. This method is used by North Carolina and Georgia in their Fair Access to Insurance Requirements programs.

C.6.5 Revenue Generating Potential

Between 1978 and 2015, the number of annual NFIP policies in effect in the State and relevant to the SPFC Planning Area averaged about 210,000 and 72,000, respectively. Assuming the number of policies remain at the same average annual levels they have been since 2006 (i.e., about 254,000 in the State and about 103,000 in the SPFC Planning Area), and assuming these policy holders are charged at the average state rate ($820 per year), the State would realize about $208 million annually from premiums to fund a State flood insurance program. If only 10 percent of these funds are available for flood risk reduction projects, the State flood insurance program could provide about $20 million per year for these projects. Using the relevant SPFC Planning Area average annual rate of $590 per year, and average annual policies of 103,000, the SPFC Planning Area would generate about $60 million annually for the State flood insurance program, and could provide about $6 million (assuming 10 percent) annually in funding for flood risk reduction projects in the SPFC Planning Area. These estimates assume that the number of policies and the premiums remain at the average annual levels for the period 2006 through 2015. The average annual premium amounts used in estimating revenue generating potential include both PRP and non-PRP rates.

Using the average number of policies for the post-Katrina period does not adequately capture the potential funding for a State flood insurance program; using the higher number of policies from the historical NFIP database does. The NFIP data show that there were about 374,000 policies in California in 1998, the highest number of flood insurance policies purchased in the years between 1978 and 2015. If State flood insurance is a mandatory program and that its implementation results in annual state flood insurance policies of 374,000 to 400,000 (an increase of only 7 percent from the high in 1998), the State could potentially realize between $307 million and $328 million annually in premiums (in 2015 dollars). This is based on the average annual state-level premium of $820 per year. If only 10 percent of these funds are

available for flood risk reduction projects, the State flood insurance program could provide $30 to $33 million annually in funding for flood risk reduction projects.

The implementation of a mandatory flood insurance program would result in increased participation in the flood insurance program and could lead to lower premium rates. Assuming annual premiums of $400 (in 2015 dollars) instead of the 2006 through 2015 average of $820, and assuming the number of policies (374,000 to 400,000) remains the same, the State flood insurance program could generate between $150 and $160 million annually, and would provide between $15 and $16 million annually in funding for flood risk reduction projects.

C.6.6 Forming an NFIP Alternatives Task Force

Before opting out of the NFIP and establishing its own program, the State would need to assess the benefits and costs of participating in the NFIP. The assessment should evaluate potential options and the cost effectiveness of a State flood insurance program in comparison to the NFIP. The comparison should also include an assessment of the relative ability to mitigate losses associated with flooding through flood insurance. That is, the upfront investment in mitigation can reduce costs associated with future damages from floods, and result in a net savings overall. This initial assessment should also include an evaluation of changing risks and damages due to climate change, population growth, and economic growth.

An NFIP Alternatives Task Force should work with the AFOTF and incorporate recommendations from the AFOTF on policies and actions that minimize impacts and preserve agriculture while facilitating wise use of floodplains. Another important consideration is whether and how withdrawal from the NFIP could affect the State's access and participation in other FEMA programs, including those that support flood mitigation programs.

C.7 References

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Appendix D: Additional Cost Estimation Support

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Attachment D.1
State Operations/Planning Cost Estimate

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D.1 State Operations/Planning Cost Estimation

Chapter 2 of the Draft CVFPP Investment Strategy describes the importance of enabling conditions that support effective implementation of the Central Valley Flood Protection Plan (CVFPP) over 30 years. State operations, planning, and performance tracking activities represent some of the State's contributions toward creating those enabling conditions.

To support the wide variety of investments that make up the 2017 refined State Systemwide Investment Approach (SSIA) portfolio, the State requires adequate capacity to administer program activities, continue planning and coordinating with federal agencies, and develop an initial performance tracking system for assessing the effectiveness of these flood management system investments.

This cost estimation effort was assembled to estimate how much it would cost to support activities related to State operation, planning, and performance tracking over a 30-year implementation period.

The cost for State activities related to the State Plan of Flood Control (SPFC) can be estimated in a variety of ways depending on the type of information needed and how an estimate may best to inform the Draft CVFPP Investment Strategy. State operations and planning estimates could be reported through areas of interest, through California Department of Water Resources (DWR) programs, through DWR offices themselves, or through an alignment with the eight flood management policy issues, as listed below:

- Four areas of interest: systemwide, urban, rural, and small community
- Five flood management programs: Flood Management Planning, Floodplain Risk Management, Flood Risk Reduction Projects, Flood System Operations and Maintenance, and Flood Emergency Response
- Eight flood management policy issues: Land Use and Floodplain Management, Residual Risk Management, Hydraulic and Ecosystem Baselines and Program Phasing, Operations and Maintenance of the Flood System, Development of Multi-benefit Projects, Effective Governance and Institutional Support, Coordination with Federal Agencies, and Funding
- Six Division of Flood Management (DFM) offices that oversee the flood management programs: Administrative Services Office, Hydrology and Flood Operations Office, Delta Levees Office, Floodway Ecosystem Sustainability Office, Flood Projects Office, Flood Maintenance Office, and Flood Planning Office

For the purposes of this cost estimation effort, State operation, planning, and performance tracking costs were organized and evaluated by a staff-based approach for the six DFM offices.

D.1.1 Staffing-Based Cost Estimate by DFM Office

The staff-based cost estimates associated with State operations, planning and performance tracking assumed that the current level of existing SPFC staff will carry out all future necessary activities in support of the CVFPP. This approach rendered a staff-based cost estimate and considers only whether the activity is SPFC-related or not.

Currently DFM spends an estimated $58 million per year on SPFC-related staff, as shown in Table D.1-1. SPFC-related staff work on a range of activities and management actions across all areas of interest. Therefore, staff costs may be incorporated into ongoing or capital management action categories other than a State operations, planning and performance tracking line item. Estimates here are for staff resources and management activities only. For example, estimates for the Flood Maintenance Office include only cost estimates of staff resources and management activities. Activities associated with the actual work of maintaining facilities is included in the ongoing routine maintenance estimate included in the overall ongoing investment for the 2017 refined SSIA portfolio (Table 5-2, Chapter 5 of the Draft CVFPP Investment Strategy, Table 4-3 of the 2017 CVFPP Update [DWR, 2017]).

Table D.1-1. Cost Estimates for DFM Staff for SPFC Operations and Planning

Item	State Role	Number of SPFC Staff Needed per Year (PY)[2]	Total Annual State Cost ($M/year)[5,6]
Delta Levee Office[1]	Planning and Operation Support	9	$2.22
Hydrology and Flood Operations Office	Operation Support	80	$19.95
Flood Projects Office	Operation Support	44	$11.00
Flood Maintenance Office[4]	Operation Support	47	$11.75
Flood Planning Office	Planning Support	35	$8.79
Floodway Ecosystem Sustainability Office[1]	Planning Support	15	$3.80
Total		230	$57.5[3]

Notes:
1. Office has been reorganized under the Flood Planning Office.
2. Non-SPFC staff time and resources not included in PY total for each office.
3. Currently, DFM spends approximately $58 million per year on SPFC-related staff. SPFC-related staff work on a range of activities and management actions across all areas of interest. Therefore, staff costs may be incorporated into other ongoing management action categories other than the State operations, planning and performance tracking line item.
4. Maintenance yard PYs (i.e., 34 PY for Sutter Yard and 28 PY for Sacramento Yard) have been deducted from the Flood Maintenance Office PY total. Maintenance yard staff time is covered under current ongoing routine maintenance estimates because the maintenance yards are considered an LMA. See Appendix A of the Draft CVFPP Investment Strategy for an estimate.
5. A fully-burdened PY estimated amount was used to calculate annual State cost. The fully-burdened PY amount accounts for variability among staff level and expertise, staff overhead and administration, and staff management.
6. Estimated costs are in 2016 dollars and indicate annual investments made over 30 years. They have not been discounted to present value nor escalated for inflation.

Table D.1-2 below presents the costs for coordination with other support staff needed to implement the CVFPP (e.g., the Central Valley Flood Protection Board [CVFPB], the California Department of Fish and Wildlife [CDFW], the U.S. Fish and Wildlife Service [USFWS] staff, Regional Flood Management Planning [RFMP] participation etc.). This estimate includes costs associated with federal or local agency operations, planning, or performance tracking where

support is provided specifically for regulatory and coordination activities. This estimate also considers development of models, support tools, and a performance tracking database totaling approximately $17.25 million per year.

Table D.1-2. Cost Estimates for Other Support Staff for SPFC Activities

Item	State Role	Number of SPFC Staff Needed per Year (PY)[2]	Total Annual State Cost ($M/year)[1,3]	Notes
CVFPB	Operations	36	$9.00	
Resource Agency Coordination (CDFW, USFWS, National Marine Fisheries Service [NMFS])	Coordination	12	$3.00	Estimate provided includes an estimate for USFWS, NMFS, and CDFW support.
Federal Partnership Coordination	Coordination	6	$1.50	Estimate provided includes an estimate for USACE, FEMA, U.S. Department of Agriculture (USDA), and U.S. Geological Survey (USGS) support.
External Tool and Model Development and Support	Development and Support	11	$2.75	Estimate for external coordination for tool and model development. DWR staff time covered under appropriate office staffing (Hydrology and Flood Operations Office, Flood Planning Office, etc.) Includes numerical modelling support from UC Davis.
Performance Tracking Database Creation, Data Collection, and Database Maintenance	Development	8	$0	Assumed 2 PYs per societal value. PYs accounted for under appropriate office staffing. Positions may be shifted to cover this work. Assumed DFM will not grow beyond 359 PYs total, with roughly 260 PYs specific to SPFC work.
Regional Flood Management Planning	Planning Support	N/A	$1.0	
Total		**55**	**$17.25**	

Notes:
1. Estimated costs are in 2016 dollars and indicate annual investments made over 30 years. They have not been discounted to present value, nor have they been escalated for inflation.
2 Non-SPFC staff time and resources not included in PY total for each item.
3. A fully-burdened PY estimated amount is used to calculate the annual State cost. The fully-burdened PY amount accounts for variability among staff level and expertise, staff overhead and administration, and staff management.

D.1.2 Refining Cost Estimates

Taken together, estimates for State operations, planning and performance tracking costs organized by DFM office is the summation of Table D.1-1 and Table D.1-2, approximately $75 million per year. The staff-based estimate may over-estimate for specific activities included in the State operations, planning and performance tracking line item. This is because SPFC-related staff work on a range of activities and management actions, and the cost for this staff may be incorporated into other ongoing or capital management action categories. Therefore, this cost estimate is not a direct comparison to the State operations, planning and performance tracking line item included in the overall ongoing investment for the 2017 refined SSIA portfolio

(Table 5-2, Chapter 5 of the Draft CVFPP Investment Strategy; Table 4-3 of the 2017 CVFPP Update [DWR, 2017]).

Without detailed analysis of specific activities performed by individual DFM staff and given the amount of activities paid for by GO bonds and overlapping program activities within DWR, it was difficult to approximate an estimate for the purposes of the Draft CVFPP Investment Strategy. As a result, a smaller more conservative estimate was used for the State operation, planning, and performance tracking line item, an estimated range from $41 to $50 million per year, in the 2017 refined SSIA portfolio (Table 5-2 of the Draft CVFPP Investment Strategy).

In future updates of the CVFPP, it may make sense to estimate the State operation, planning, and performance tracking line item from an activity-based approach versus a staff-based approach. One option may be to understand what kinds of activities, number of staff, and what kinds of tools, equipment, or materials would be needed to implement recommendations related to the eight flood management policy issues. This way a State operation, planning, and performance tracking line item could be more inclusive of the activities needed to specifically implement the CVFPP instead of an estimate of DFM staff related to the SPFC.

D.1.3 References

California Department of Water Resources (DWR). 2017. 2017 Central Valley Flood Protection Plan Update. August. http://www.water.ca.gov/cvfmp/2017-cvfpp-docs.cfm

Attachment D.2
Emergency Management Cost Estimation

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D.2 Emergency Management Cost Estimation

This section documents the process of preparing an emergency management cost estimate for the 2017 CVFPP Update (DWR, 2017). Activities related to emergency management are estimated to cost between $32 and $40 million per year as shown in the overall ongoing investment for the 2017 refined SSIA portfolio (Table 5-2 of the Draft CVFPP Investment Strategy, and Table 4-3 of the 2017 CVFPP Update). The following describes how these estimates compare to 2012 CVFPP estimates, how these estimates were developed, and how these estimates were detailed by activity.

D.2.1 2012 Flood Emergency Response Cost Estimate

Table D.2-1 lists the 2012 CVFPP emergency response cost estimate (for comparison, the 2017 cost estimate for emergency response is $700.2 million).

Table D.2-1. 2012 CVFPP Enhanced Flood Emergency Response Cost Estimate

Emergency Activity	Cost Estimate ($M)2
All-weather roads on levee crowns	$60
Additional flood information collection and sharing	$135
Local flood emergency response planning (221 levee flood protection zones)[1]	$198-221
Additional forecasting and notification	$90
Total	**$483-506**

Source: 2012 CVFPP, Attachment 8J–Cost Estimates, and Appendix A–Cost Estimate Methodology

Notes:
1. Includes a one-time cost of $85 million for floodfight materials and communications equipment.
2. Estimated values are in 2011 dollars.

D.2.2 2017 Flood Emergency Management Cost Estimate

Moving toward the 2017 CVFPP Update, the 2012 CVFPP enhanced flood emergency response cost estimate was refined based on the six regional flood management plans (RFMPs)[1] and the progress of DWR emergency response programs. These refinements allowed a more detailed breakdown of potential emergency management actions and their associated costs. As well as, incorporating other elements of emergency management such as emergency preparedness and emergency recovery, instead of just emergency response actions completing a more comprehensive 2017 refined SSIA portfolio.

Table D.2-2 summarizes the cost estimate for emergency management as approximately $36 million per year. This cost estimate informs the emergency management action category range of $32 to $40 million per year in the overall ongoing investment for the 2017 refined SSIA portfolio (Table 5-2 in the Draft CVFPP Investment Strategy; Table 4-3 of the 2017 CVFPP Update [DWR, 2017]).

[1] Feather River Partners, 2014; FloodProtect, 2014; Mid and Upper Sacramento River Regional Flood Management Plan Partners, 2014; Reclamation District 2092, 2014; San Joaquin Area Flood Control Agency, 2014; San Joaquin River Flood Control Project Agency, 2015

Table D.2-2. 2017 CVFPP Update Cost Estimate Summary – Flood Emergency Management

Emergency Management Activity	Total Estimate ($M)[1]	Annual ($M/year)[2]
Flood Emergency Response Planning – Local and Operational Area	$139.8	$7.1
Flood Emergency Response Preparedness – Local and Operational Area	$123.7	$6.3
Subtotal – Local and Operational Area	**$263.5**	**$13.4**
Flood Emergency Response Planning – State Level	$285.2	$14.5
Flood Emergency Response Preparedness – State Level	$151.5	$7.7
Subtotal – State Level	**$436.7**	**$22.2**
Total	**$700.2**	**$35.6**

Notes:
1. Estimated costs are in present value (2016 dollars) terms.
2. Estimated costs are in 2016 dollars and indicate annual investments made over 30 years. They have not been discounted to present value nor escalated for inflation.

Cost estimates for the local and operational area level categories shown above, were derived from projects proposed in the six RFMPs[2], and through an analysis of the 2013 and 2015 DWR flood emergency grant programs. It was assumed there will be a continuing need for the same level of funding during the 30-planning horizon used for the 2017 CVFPP Update.

Emergency management cost estimates for State level categories are based partly on current and planned DWR programs. Program managers in the Hydrology and Flood Operations Office and the Flood System Repair Program provided cost estimates for their respective programs. Estimates for future training and exercising are based on the following:

- Prior costs for functional and full-scale flood emergency response exercises that occurred in 2001 and 2011
- Cost of the series of forecast-coordinated operations (F-CO) exercises that have occurred since 2008
- Cost of tabletop exercises conducted since 2012

Flood Emergency Response Planning – Local and Operational Area Level Cost Estimate

The flood emergency response planning cost estimate is based on the cost estimates contained in the six RFMPs and from projected costs of continuing the current DWR Flood Emergency Response Grant Program for the next 30 years. The latter cost estimate was developed based on the actual grants made in 2013 and 2015 for the Sacramento and San Joaquin river basins.

[2] Feather River Partners, 2014; FloodProtect, 2014; Mid and Upper Sacramento River Regional Flood Management Plan Partners, 2014; Reclamation District 2092, 2014; San Joaquin Area Flood Control Agency, 2014; San Joaquin River Flood Control Project Agency, 2015

A total of $139.8 million is estimated for this category. The activities included in this category are as follows:

- **Local Flood Information and Flood Risk Mapping:** This activity occurs primarily in the Lower San Joaquin and Delta South regions. This estimate includes the cost of identifying flood hazards, developing flood risk information and mapping to inform flood emergency response planning.

- **Local Flood Forecasting and Early Warning:** This activity occurs primarily in the Lower San Joaquin and Delta South regions. This estimate includes the cost of flood forecasting and dissemination, stream gage network enhancement, and developing early warning systems and providing flood emergency information to local areas.

- **Local Flood Emergency Response Plans:** This activity includes flood evacuation maps and levee safety plans and occurs throughout the Sacramento and San Joaquin river basins. This activity's estimate is based on the cost of the 2013 and 2015 DWR grant programs for new flood emergency response plans and periodic updates to those plans over the 30-year period.

Flood Emergency Response Preparedness - Local and Operational Area Level Cost Estimates

The flood emergency response preparedness cost estimate is based on cost estimates contained in the six RFMPs and the projected costs of continuing the current DWR Flood Emergency Response Grant Program for the next 30 years. The Flood Emergency Response Grant Program cost estimate was developed based on the cost of actual grants made in 2013 and 2015 and the assumed continuation of DWR funding improvements to all-weather roads on levee crowns. The Flood Emergency Response Grant Program estimate is also based on an estimate from the 2012 CVFPP adjusted for actual Flood System Repair Program expenditures, which is administered by DWR.

A total of $123.7 million is estimated for this category. Activities included in this category are as follows:

- **Local Flood Emergency Response Training and Exercising:** This activity includes training and drills in the Standardized Emergency Management System, the Incident Command System, on flood fight methods, levee patrolling, and on conducting flood emergency response exercises. The estimate for this activity is based primarily on the cost of maintaining the 2013 and 2015 DWR grant program levels of funding through the 30-year cost estimate period.

- **Local Flood Emergency Response Materials, Equipment, and Facilities:** This activity includes stockpiled flood fight materials and equipment such as sand bags, riprap rock, and heavy operating equipment, and facilities that store these materials and equipment in the field. The cost estimate for this activity is based primarily on an assumed continuation of funding provided during the 2013 and 2015 DWR grant programs, primarily in the Sacramento River Basin.

- **Flood Emergency Response All-Weather Roads on Levee Crowns:** This activity includes regrading and resurfacing roads located on levee crowns to ensure access during flood fight inspections and emergency response activities during all types of weather. The cost estimates for this activity were derived from the 2012 CVFPP cost estimate, and were adjusted to reflect 2012-15 actual costs from the Flood System Repair Project, projecting forward to completion of the project.

Flood Emergency Response Planning – State Level Cost Estimate

The flood emergency planning cost estimate at the State level was developed based on cost estimates from the branches of the DWR Hydrology and Flood Operations Office (i.e., the Flood Operations, Hydrology, and Flood Project Inspection and Integrity branches).

A total of $285.2 million is estimated for this category. Activities in this category include the following:

- **State Flood Emergency Response Plans:** This activity includes updating DWR's emergency response plans across the state with new information and data. The cost estimate for this activity is based on the cost of completing the Delta Flood Emergency Management Plan, and the cost of updating it on an ongoing basis.

- **State Flood Information and Flood Risk Mapping:** This activity includes developing Statewide flood risk information and mapping to inform flood emergency response planning. The cost estimate for this activity is based on the cost of periodic updates to light and detection and ranging (LiDAR) mapping in the Central Valley Floodplain Evaluation and Delineation (CVFED) Program area every 20 years, and on the cost of making updates to LiDAR mapping regarding levee subsidence surveys every 5 years. These cost estimates were developed by the Flood Project Inspection and Integrity Branch.

- **State Flood Forecasting and Early Warning:** This activity includes developing early State warning systems and the Flood Operations Office and Flood Operations Center disseminating flood emergency information to local areas. The cost estimate for this activity is based on completing and updating the F-CO decision support system now in operation, on the cost of installing and maintaining additional forecast points, and on installing more stream gaging above reservoirs to improve forecasting and runoff estimates.

- **State Levee Advanced Warning Systems**: This activity includes development, installation, and maintenance instrumentation in levees to provide data and levee status and advanced warning of levee failure. This estimate was prepared by the Flood Projects Inspection and Integrity Branch.

- **State Flood Emergency Response Information Management Systems**: This activity includes updating and maintaining DWR's flood emergency response management information systems. This cost estimate was developed by the Hydrology Branch.

Flood Emergency Response Preparedness – State Level Cost Estimate

The Flood Emergency Preparedness cost estimate for the State level was developed based on cost estimates from the DWR Flood Operations Branch.

A total of $151.5 million is estimated for this category. Activities in this category include the following:

- **State Flood Emergency Response Training and Exercises:** This activity includes emergency response training and exercising needs that will maintain skills necessary for flood emergency response. The cost estimate also includes costs for maintaining routine training in Standardized Emergency Management System (SEMS) and the Incident Command System (ICS), costs for augmenting floodfight methods training in the State, costs for conducting DWR and multi-agency annual tabletop and functional exercises, and the costs of multi-day full scale field exercises at 10-year intervals.

- **State Flood Emergency Response Materials, Equipment, and Facilities:** This activity includes maintaining and enhancing floodfight material and storage facilities in the Central Valley. The cost estimate also includes the following:

  - Costs for traditional floodfight materials such as sand bags, low-density polyethylene sheeting (Visqueen), and similar

  - Costs for new types of floodfight materials such Muscle Wall flood containment products and others

  - Costs for facilities to store, load, and transfer materials

  - Cost to enhance and upgrade systems in a new Flood Operations Center facility (capital funds already available)

D.2.3 2017 Cost Estimates and Assumptions Summary

This section provides a more detailed breakdown of flood emergency response cost estimates and the assumptions used to develop those cost estimates. Table D.2-3 expands on Table D.2-2 and is organized by the four areas of flood emergency activities as follows:

- Flood Emergency Response Planning – Local and Operational Area
- Flood Emergency Response Preparedness – Local and Operational Area
- Flood Emergency Response Planning – State Level
- Flood Emergency Response Preparedness – State Level

Table D.2-3 – Emergency Management Cost Estimates

Management Action	Sacramento Basin ($M)	San Joaquin Basin ($M)	Total ($M)[1]	Annual ($M/yr.)[2]
Flood Emergency Response Planning – Local and Operational Area Level				
Flood Information and Flood Risk Mapping	$-	$26.4	$26.4	$1.3
Flood Forecasting and Early Warning	$20.3	$23.5	$43.7	$2.2
Flood Emergency Response Plans	$29.5	$40.2	$69.7	$3.6
Subtotal:	**$49.8**	**$90.1**	**$139.8**	**$7.1**
Flood Emergency Response Preparedness – Local and Operational Area Level				
Flood Emergency Response Training and Exercising	$22.8	$3.6	$26.4	$1.3
Flood Emergency Response Materials, Equipment, and Facilities	$28.5	$6.7	$35.2	$1.8
Flood Emergency Response All-Weather Roads on Levee Crowns	$28.3	$33.8	$62.1	$3.2
Subtotal:	**$79.6**	**$44.1**	**$123.7**	**$6.3**
Flood Emergency Response Planning – State Level				
Flood Emergency Response Plans	$1.0	$1.0	$2.0	$0.1
Flood Information and Flood Risk Mapping	$56.9	$56.9	$113.7	$5.8
Flood Forecasting and Dissemination	$41.3	$41.3	$82.5	$4.2
Levee Advanced Warning Systems	$32.3	$32.3	$64.5	$3.3
Flood Emergency Response Information Management Systems	$11.3	$11.3	$22.5	$1.1
Subtotal:	**$142.8**	**$142.8**	**$285.2**	**$14.5**
Flood Emergency Response Preparedness – State Level				
Flood Emergency Response Training and Exercises	$19.1	$19.1	$38.1	$1.9
State Flood Emergency Response Materials, Equipment, and Facilities	$56.7	$56.7	$113.4	$5.8
Subtotal:	**$75.8**	**$75.8**	**$151.5**	**$7.7**
Emergency Management Total:	**$348.0**	**$352.8**	**$700.2**	**$35.6**

Source: Feather River Partners, 2014; FloodProtect, 2014; Mid and Upper Sacramento River Regional Flood Management Plan Partners, 2014; Reclamation District 2092, 2014; San Joaquin Area Flood Control Agency, 2014; San Joaquin River Flood Control Project Agency, 2015

Notes:
1. Estimated costs are in 2016 dollars.
2. Estimated costs indicate annual investments made over 30 years. They have not been discounted to present value, nor have they been escalated for inflation.

Table D.2-4 is also organized by these four categories, and states the assumptions used to develop each of the estimates for these categories.

Table D.2-4 – Emergency Management Cost Estimates

Management Action	Cost Estimate Assumptions
Flood Emergency Response Planning – Local and Operational Area Level	
Flood Information and Flood Risk Mapping	This is based on cost estimates from the six RFMPs, and assumes a one-time expenditure during the 30-year planning horizon.
Flood Forecasting and Early Warning	This is based on cost estimates from the six RFMPs plus an additional cost estimate from the Flood Emergency Response Grant Program for grants awarded since 2012.
Flood Emergency Response Plans	This is based on cost estimates from the six RFMPs plus additional estimates based on the Flood Emergency Response Grant Program. The estimate assumes an annual update cycle for the RFMPs.
Flood Emergency Response Preparedness – Local and Operational Area Level	
Flood Emergency Response Training and Exercising	This is based on cost estimates from the six RFMPs plus additional estimates based on Flood Emergency Response Grant Program and needs estimated by the Flood Operations Branch.
Flood Emergency Response Materials, Equipment, and Storage Facilities	This is based on cost estimates from the six RFMPs plus additional estimates from the DWR Flood Operations Branch based on grants and an estimate for material turnover.
Flood Emergency Response All-Weather Roads on Levee Crowns	This is based on the estimate from the 2012 CVFPP adjusted for expenditures for this ongoing project.
Flood Emergency Response Planning - State Level	
Flood Emergency Response Plans	This is based on the estimated cost to complete the Delta Flood Emergency Management Plan, and update it on an ongoing basis.
Flood Information and Flood Risk Mapping	This is based on the cost of updating the large-scale LIDAR survey of the Central Valley and on the cost specific LIDAR surveys of SPFC levees on a 5-year cycle to monitor subsidence.
Flood Forecasting and Dissemination	This is based on cost estimates to develop, maintain, and expand the F-CO project to cover the Central Valley, the costs of installing and maintaining additional forecast points and stream gages, and adding additional upper watershed stream gages to improve reservoir inflow forecasts.
Levee Advanced Warning Systems	This is based on a cost estimate for developing, testing, and installing warning systems in levees to provide early warning of a levee failure.
Flood Emergency Response Information Management Systems	This is based on a cost estimate to maintain DWR's flood information management system, which is used by flood responders, agencies, and the public at all levels of the flood response structure in California.
Flood Emergency Response Preparedness – State Level	
Flood Emergency Response Training and Exercises	This estimate considers the planning period and is based on actual costs of conducting training and exercises. It assumes tabletop and functional exercises will be conducted annually (for both DWR internally and for multiple agencies) and full scale (i.e., field) exercises approximately every 5 years.
State Flood ER Materials, Equipment, and Facilities	This is based on cost estimates for maintaining and expanding the current inventory of floodfight materials at a 5-year turnover rate, one-time expenses for additional storage facilities, and on estimated costs for equipping and maintaining/updating a new Flood Operations Center (funding previously approved for procurement).

Source: Feather River Partners, 2014; FloodProtect, 2014; Mid and Upper Sacramento River Regional Flood Management Plan Partners, 2014; Reclamation District 2092, 2014; San Joaquin Area Flood Control Agency, 2014; San Joaquin River Flood Control Project Agency, 2015

D.2.4 References

California Department of Water Resources (DWR). 2017. 2017 Central Valley Flood Protection Plan Update. August. http://www.water.ca.gov/cvfmp/2017-cvfpp-docs.cfm

Feather River Regional Partners. 2014. Feather River Regional Flood Management Plan. Administrative Draft. July. http://frrfmp.com/documents/

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

Mid and Upper Sacramento River Regional Flood Management Plan Partners, 2014. Mid and Upper Sacramento River Regional Flood Management Plan. November. http://musacrfmp.com/

Reclamation District 2092. 2014. Regional Flood Management Plan for the Mid-San Joaquin River Region. October. http://www.midsjrfloodplan.org/2014-rfmp

San Joaquin Area Flood Control Agency. 2014. Lower San Joaquin River and Delta South Regional Flood Management Plan. November. http://sjafca.com/lsjrdsrfmp.php

San Joaquin River Flood Control Project Agency. 2015. Upper San Joaquin River Regional Flood Management Plan. Final. February. http://usjrflood.org/2015/03/09/final-rfmp/

Attachment D.3
Floodplain Management Cost Estimation

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D.3 Floodplain Management Cost Estimation

The 2017 CVFPP Update (DWR, 2017) is focused on enhancing resilience and supporting sustainability in the SPFC. Urban and nonurban areas across California's Central Valley are in need of flood risk and residual risk management. Despite the protection provided by the current flood management system, residual flood risk in California's Central Valley is among the highest in the country.

Residual risk is defined as the risk remaining after all flood risk management actions have performed as planned and intended with the understanding that unanticipated facility failures or extreme flood events may cause flooding. Another component of residual risk is that the nature of flood risk can be changed because of major physical improvements. For example, the presence of a levee system can result in a more sudden inundation of a floodplain location if the levee system breaches, thereby increasing the vulnerability of exposed population and assets in that location. Or, a levee system may improve flood protection such that formerly rural-agricultural land uses can be converted to urban land uses, exposing new development and population to flood risk.

Some nonstructural flood risk mitigation actions (such as floodproofing, conservation easements, flood risk awareness campaigns etc.) are very effective at addressing flood risk and residual risk; they can be more cost efficient and sustainable than alternative structural investments. Additionally, nonstructural flood risk mitigation actions can be implemented by local agencies and can be supported by State and federal partners; they can have their risk reduction modeled, and they can have their costs reasonably developed. These nonstructural actions are the focus of this analysis below.

D.3.1 Purpose

This cost estimating analysis was initiated to better understand how the application of certain nonstructural actions could ideally be applied in high-residual risk areas of the Central Valley, what some basic benefits might be, and what the associated planning-level costs would be. The primary purpose of this cost estimating analysis was to document the cost estimation of applying several nonstructural actions to theoretical use in nonurban areas of the Central Valley for flood damage reduction and for reducing life loss. Additionally, DWR is considering establishing a flood easement program for agricultural-oriented land parcels around Central Valley communities. This effort quantified acreages of irrigated crops and agriculture-related parcels that might be eligible for such a program; estimated costs for these parcels were also developed. These planning-level costs provided an estimate of the upper bookend of cost for these types of nonstructural actions that could be considered within the SPFC in the next 30 years. Developed costs were based on analysis concluded in August 2016 and data available at that time.

However, to include the nonstructural actions into the 2017 refined SSIA portfolio, a more modest cost estimate was used. The costs reported in the 2017 refined SSIA portfolio and in the Draft CVFPP Investment Strategy are a significantly smaller percentage than was included in the following sections. Footnotes denote what costs estimates were scaled back and which ones directly informed the 2017 refined SSIA portfolio. Nonstructural action cost estimates inform the

overall ongoing investment for the 2017 refined SSIA portfolio (Table 5-2 in the Draft CVFPP Investment Strategy; Table 4-3 of the 2017 CVFPP Update [DWR, 2017]).

D.3.2 Results Summary and Findings

Analysis results from nonstructural actions applied to flood-prone structures and analysis results from quantified acreages of crops the State might consider for agricultural easements. For this cost estimation analysis, the results have three components:

- Nonstructural mitigation applied to flood-prone building stock
- Agricultural conservation easements
- Flood risk mapping, risk awareness and land use planning

Nonstructural Mitigation

Table D.3-1 summarizes the calculated total costs associated with the five nonstructural mitigation measures as applied to the non-urban Central Valley building stock in the Sacramento and San Joaquin river basins. Estimated costs have been segregated into the six RFMP regions to aid the State and its regional partners in planning future expenditures.

There are approximately14,241 nonurban buildings in the Sacramento and San Joaquin river basins that may be suited to receive non-structural flood mitigation actions, should funding be available. The structures found with sufficient flood risk that were potentially suitable to warrant mitigation were analyzed from a set of just over 30,000 nonurban parcels with buildings in the Central Valley. Estimated cost for all nonurban properties suited to receive non-structural flood risk reduction actions under the conditions of this analysis, in both the Sacramento and San Joaquin river basins, ranges between $4.39 and $4.94 billion dollars (with construction indirect costs and contingency ranges in effect). Approximately 20 percent of these costs were used to inform the 2017 refined SSIA portfolio and contingency costs were not included. Nonstructural action cost estimates related to floodplain management are reported in the risk awareness, floodproofing, and land use planning management action category in the overall ongoing investment for the 2017 refined SSIA portfolio (Table 5-2 in the Draft CVFPP Investment Strategy; Table 4-3 of the 2017 CVFPP Update [DWR, 2017]). The risk awareness, floodproofing, and land use planning management action category appears in the urban, rural, and small community area of interest.

Table D.3-1. Summary Costs per RFMP Region for Recommended Nonstructural Mitigation Actions

Nonstructural Actions	Sacramento Basin			San Joaquin Basin			Totals
	Upper Sacramento/ Mid-Sacramento River	Feather River	Lower Sacramento/ Delta North	Upper San Joaquin River	Mid San Joaquin River	Upper Sacramento/ Mid-Sacramento River	
Construction-Related Costs							
Acquisition							
Traditional	$165,375,000	$896,994,000	$529,641,000	$223,146,000	$1,764,000	$44,982,000	*$1,861,902,00*
Farmhouse	$5,213,000	$20,272,000	$70,663,000	$86,012,000	$1,738,000	$66,029,000	*$249,927,000*
Elevation	$36,380,000	$354,827,000	$55,141,000	$284,695,000	$9,416,000	$9,575,000	*$750,034,00*
Floodproofing							
Dry	$12,772,000	$56,959,000	$8,755,000	$105,369,000	$2,575,000	$3,296,000	*$189,726,000*
Wet	$-	$-	$-	$1,350,000	$45,000	$225,000	*$1,620,000*
Nonstructural Berm	$26,393,000	$160,739,000	$122,433,000	$127,565,000	$6,599,000	$35,007,000	*$478,736,000*
Subtotals	*$246,133,000*	*$1,489,791,000*	*$786,633,000*	*$828,137,000*	*$22,137,000*	*$159,114,000*	*$3,531,945,000*
Mobilization and Demobilization (5%)	$3,778,000	$28,627,000	$9,317,000	$25,949,000	$932,000	$2,406,000	$71,006,000
Environmental Mitigation Costs (5%)	$3,778,000	$28,627,000	$9,317,000	$25,949,000	$932,000	$2,406,000	$71,006,000
Construction Subtotals:	$253,689,000	$1,547,045,000	$805,267,000	$880,035,000	$24,001,000	$163,926,00	$3,673,957,00
Construction Subtotals - Less Acquisition:	$83,101,000	$629,779,000	$204,963,000	$570,877,000	$20,499,000	$52,915,000	$1,562,128,000
Pre-Construction Services and Project Contingency Costs ($millions)							
Engineering during Construction (2%)	$1.66	$12.60	$4.10	$11.42	$0.41	$1.06	$31.2
Design and Engineering (15%)	$12.47	$94.47	$30.75	$85.63	$3.08	$7.94	$234.32
Permitting and Legal Costs (5%)	$4.16	$31.49	$10.25	$28.54	$1.03	$2.65	$78.11
Contingency (10-25%)	$25.37 $63.42	$54.71 $386.76	$80.53 $201.32	$88.00 $220.01	$2.40 $6.00	$16.39 $40.98	$367.40 $918.49
Pre-Construction Services and Project Contingency Subtotals:	**$43.65 $81.71**	**$293.26 $525.31**	**$125.62 $246.41**	**$213.60 $345.60**	**$6.91 $10.51**	**$28.04 $52.63**	**$711.07 $1,262.16**
Averages	**Low High**	**Low High**	**Low High**	**Low High**	**Low High**	**Low High**	**Low High**
Total (Range) ($millions):	**$297.3 $335.4**	**$1,840.3 $2,072.4**	**$930.9 $1,051.7**	**$1,093.6 $1,225.6**	**$30.9 $34.5**	**$192.0 $216.6**	**$4,385 $4,936**

Notes:

All costs are in June 2014 dollars.

Mobilization and demobilization costs, environmental mitigation costs, and pre-construction services and project contingency costs are not applied to acquisition (i.e, traditional, farmhouse, and/or demolition and disposal) as these additional costs are properly captured within those line items already.

These costs are feasibility-study level estimates with an overall accuracy range estimated at 10 to 25 percent. Some mitigation measures (e.g., elevation) have a greater degree of accuracy than others. Although many building factors of the overall building stock are known to a high degree, there are building types and some building factors lacking accurate, field-verified data. Use this cost estimations accordingly.

The total number of buildings with recommended mitigation measures do not include a demolition/disposal count.

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In the Sacramento River basin, there are approximately 9,129 nonurban buildings within the CVFPP impact areas recommended to receive flood mitigation. By comparison, the 2012 CVFPP estimated 3,180 homes in the Sacramento River basin could potentially have their flood risk reduced or removed with nonstructural measures (i.e., elevation, waterproofing, nonstructural berms, acquisition, and/or relocation) (DWR, 2012 in Attachment 8J: Cost Estimates, Appendix A). The approximate 9,129 buildings found with sufficient flood risk to warrant mitigation were analyzed from over 17,600 non-urban parcels with buildings in the Sacramento River basin. With preconstruction services and construction-related services accounted for and a contingency range of 10 to 25 percent, the total Sacramento River basin cost is estimated between $3.07 and $3.46 billion dollars. Again, approximately 20 percent of these costs were used to inform the 2017 refined SSIA portfolio. The average cost of mitigation across the six mitigative actions in the Sacramento River basin, reflective of the 10 to 25 percent contingency, ranges between $336,000 (low) and $379,000 (high). This is relatively high and significantly influenced by the 43 percent of total actions being acquisition. Contingency costs were not included in the 2017 refined SSIA portfolio.

In the San Joaquin River basin, there are approximately 5,085 nonurban buildings in the CVFPP impact areas recommended to receive flood mitigation. By comparison, the 2012 CVFPP estimated 2,820 homes in the San Joaquin River basin could potentially have their flood risk reduced or removed with nonstructural measures (elevation, waterproofing, nonstructural berms, acquisition, and/or relocation). The 2012 CVFPP does not report the number of at-risk buildings in each San Joaquin River basin impact area and did not have the benefit of this study to support its estimate of homes and buildings with flood risk. The approximate 5,085 structures found with sufficient flood risk to warrant mitigation were analyzed from over 12,400 non-urban parcels with buildings in the basin. With preconstruction services and construction-related services accounted for and a contingency range of 10 to 25 percent, the total San Joaquin River basin cost is estimated between $1.32 and $1.48 billion dollars. Again, approximately 20 percent of these costs were used to inform the 2017 refined SSIA portfolio. The average cost of mitigation across the six mitigative actions in the San Joaquin River basin, reflective of the 10 to 25 percent contingency, ranges between $259,000 (low) and $290,000 (high). This cost range is moderated by the 22 percent of total actions being acquisition, which is the most costly alternative. Contingency costs were not included in the 2017 refined SSIA portfolio.

Agricultural Conservation Easements

This portion of the analysis examined the following:

- How many flood-prone acres of agricultural lands were within a ½-mile buffer zone outside of an urban community's sphere of influence
- How many flood-prone acres of agricultural lands were outside a small community's developed area

Then, using an estimate of $10,000/acre to establish an agricultural easement, analysis sought the total estimated cost.

Agricultural conservation easement cost estimates related to floodplain management are reported in the land acquisitions and easement management action category. The land acquisitions and easement management action category appears in the rural area of interest and is estimated to cost between $770 and $930 million as shown in the overall capital investment for the 2017 refined SSIA portfolio (Table 5-2 in the Draft CVFPP Investment Strategy; Table 4-3 of the 2017 CVFPP Update [DWR, 2017]). The majority of that reported range is informed by the agricultural conservation easement cost estimate listed below in Table D.3-2, in conjunction with some estimates provided by the RFMPs[3].

Table D.3-2. Agricultural Conservation Easement Cost Summary

Ag Easements Categories	Acreage (1,000 acres)	Dollars ($M)
Urban 1/2-mile Buffer, Both Basins	42.6	$426
Small Community ½-mile Buffer, Both Basins	41.4	$414
Total	**84.0**	**$840**

Note:
Estimated costs are in 2016 dollars.

Flood Risk Mapping, Risk Awareness and Land Use Planning

This portion of the study estimated costs associated with activities provided by the State's floodplain risk management programs and information management systems. These activities include flood risk mapping, risk awareness campaigns and public awareness events, channel capacity updates, land use planning, and mitigation planning, and similar. Flood risk mapping, risk awareness and land use planning cost estimates related to floodplain management are reported in the risk awareness, floodproofing, and land use planning management action category in the overall ongoing investment for the 2017 refined SSIA portfolio (Table 5-2 in the Draft CVFPP Investment Strategy; Table 4-3 of the 2017 CVFPP Update [DWR, 2017]). The risk awareness, floodproofing, and land use planning management action category appears in the urban, rural, and small community area of interest. The majority of these costs are informed by the cost estimate listed below in Table D.3-3, in conjunction with some estimates provided by the RFMPs.

[3]Feather River Partners, 2014; FloodProtect, 2014; Mid and Upper Sacramento River Regional Flood Management Plan Partners, 2014; Reclamation District 2092, 2014; San Joaquin Area Flood Control Agency, 2014; San Joaquin River Flood Control Project Agency, 2015

Table D.3-3. Flood Risk Mapping, Risk Awareness and Land Use Planning Cost Summary

Management Action	Sacramento		San Joaquin	
	Low ($M/year)	High ($M/year)	Low ($M/year)	High ($M/year)
Urban Flood Risk Mapping, Risk Awareness and Land Use Planning	$3.5	$4.3	$3.5	$4.3
Rural Flood Risk Mapping, Risk Awareness and Land Use Planning	$0.7	$0.9	$0.7	$0.9
Small Community Flood Risk Mapping, Risk Awareness and Land Use Planning	$2.8	$3.5	$2.8	$3.5
Total	**$7.1**	**$8.7**	**$7.1**	**$8.7**

Note:
Estimated costs are in 2016 dollars and indicate annual investments made over 30 years. They have not been discounted to present value nor escalated for inflation.

D.3.3 References

California Department of Water Resources (DWR). 2012. 2012 Central Valley Flood Protection Plan. Final. June. http://www.water.ca.gov/cvfmp/2012-cvfpp-docs.cfm

California Department of Water Resources (DWR). 2017. 2017 Central Valley Flood Protection Plan Update. August. http://www.water.ca.gov/cvfmp/2017-cvfpp-docs.cfm

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Appendix E: Funding Scenario Support

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Appendix E: Funding Scenario Support

E.1 Central Valley Flood Protection Plan Financial Model

The Central Valley Flood Protection Plan (CVFPP) financial model was developed in Microsoft Excel to support the recommended CVFPP funding plan over the 30-year implementation timeframe. Variables in the CVFPP financial model include annual capacity limits for each funding mechanism, applicability of funding mechanisms to each management action, and the State, federal, and local cost share percentages for each management action.

The CVFPP financial model uses a linear-programming solver to calculate the dollar contribution of each funding mechanism to each management action in Phases 1, 2, and 3. The objective function maximizes the applicability of each funding mechanism's annual capacity. Applicability is based on two criteria: the nature of the funding mechanism and how well a source of funding connects to the benefits received from the management action. The model uses available funds from the most applicable funding mechanisms for each management action to fund Phase 1 investments. Phase 1 is solved independently before Phase 2 and Phase 3. Unfunded capital management actions in a phase roll over to the next phase. Unfunded ongoing management actions do not role over to the next phase. The CVFPP financial model analyzes five different scenarios with varying levels of investment; these five scenarios are described in following section.

E.2 Scenario Support

To better understand the role of State, federal, and local funding mechanisms, this section provides contribution levels and overall cost shares. This appendix contains rounded values of direct model output. This rounding may cause totals to report small mathematical errors. This variation may also cause differences in reporting across scenarios and between this appendix and the Draft CVFPP Investment Strategy Chapter 7. Furthermore, results listed in this appendix were a basis for analysis, and differ slightly from the CVFPP funding plan recommendations. The reported cost shares for Scenario 5 in this appendix vary from the cost shares of the recommended CVFPP funding plan. Present value calculations of ongoing management actions are used in the recommended CVFPP funding plan.

E.2.1 Scenario 1: Decrease Current Investment Levels

This scenario provides one bookend to the analysis, and demonstrates the implications of continued current levels of investment from the State General Fund, local, and federal funding mechanisms, but without any further general obligation (GO) bonds passed. This represents a significant hurdle to all of the proposed capital management actions in the 2017 refined SSIA portfolio, and does not allow for much of an increase in spending on ongoing management actions. Tables E-1 through E-4 describe analysis results.

Table E-1. Scenario 1 Capital Investment by Phase

Management Action Category and Area of Interest	Phase 1 ($M)	Phase 2 ($M)	Phase 3 ($M)
Systemwide			
Yolo Bypass multi-benefit improvements	State GO Bonds: $100 USACE: $100	$0	$0
Feather River-Sutter Bypass multi-benefit improvements	$0	$0	$0
Paradise Cut multi-benefit improvements	$0	$0	$0
Reservoir and floodplain storage	$0	$0	$0
Urban			
Levee improvements	State GF: $13 State GO Bonds: $100 USACE: $357 Local: $80	State GF: $155 USACE: $559 Local: $146	State GF: $147 USACE: $590 Local: $170
Other Infrastructure and multi-benefit improvements	USACE: $38 Local: $20	State GF: $7 USACE: $12	State GF: $32 USACE: $59
Rural			
Levee repair and infrastructure improvements	$0	$0	$0
Small-scale levee setbacks and floodplain storage	$0	$0	$0
Land acquisitions and easements	$0	$0	$0
Habitat restoration/reconnection	$0	$0	$0
Small Community			
Levee repair and infrastructure improvements	$0	$0	$0
Levee setbacks, land acquisitions and habitat restoration	$0	$0	$0
Total Capital Investment	State GF: $13 State GO Bonds: $200 USACE: $495 Local: $100 **Total: $808**	State GF: $162 USACE: $571 Local: $146 **Total: $879**	State GF: $179 USACE: $649 Local: $170 **Total: $998**

Notes:
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$M = million dollars
FEMA = Federal Emergency Management Agency
Sac/SJ Drainage District = Sacramento and San Joaquin Drainage District
State GF = State General Fund
State GO Bonds = State General Obligation Bonds
State Insurance Program = State Flood Insurance Program
State River Basin Assess = State River Basin Assessment or tax
USACE = U.S. Army Corps of Engineers

Table E-2. Scenario 1 Ongoing Investment by Phase

Management Action Category and Area of Interest	Phase 1 ($M/yr)	Phase 2 ($M/yr)	Phase 3 ($M/yr)
Systemwide			
State operations, planning, and performance tracking	State GF: $14.7	State GF: $1.7	State GF: $2.3
Emergency management	State GF: $20	State GF: $20	State GF: $20
Reservoir operations	State GF: $3.9 USACE: $0.8 Local: $0.6	State GF: $4.6 USACE: $0.8	State GF: $4.6 USACE: $0.8
Routine maintenance	State GF: $20 Local: $20	State GF: $16 Local: $16	State GF: $13 Local: $13
Urban			
Risk awareness, floodproofing and land use planning	FEMA: $0.2 Local: $0.2	USACE: $0.3 Local: $0.3	USACE: $0.3 Local: $0.3
Studies and analysis	USACE: $0.7 Local: $0.4	USACE: $1.1 Local: $0.6	USACE: $1.4 Local: $0.8
Rural			
Risk awareness, floodproofing and land use planning	State GF: $0.1 FEMA: $1.6 Local: $0.4	State GF: $0.4 USACE: $2.6 Local: $0.5	State GF: $0.7 USACE: $3.7 Local: $0.5
Studies and analysis	FEMA: $0.4 Local: $0.2	USACE: $0.1 Local: $0.1	USACE: $0.1 Local: $0.1
Small Community			
Risk awareness, floodproofing and land use planning	FEMA: $4.9 Local: $1.6	State GF: $0.1 FEMA: $8.1 Local: $2.6	State GF: $0.5 FEMA: $10 Local: $2.9
Studies and analysis	FEMA: $2.9 Local: $1.6	State GF: $1 USACE: $0.9 FEMA: $1.9 Local: $0.5	State GF: $1 USACE: $2.8 Local: $0.5
Total Ongoing Investment	State GF: $59 USACE: $1 FEMA: $10 Local: $25 **Total: $95**	State GF: $44 USACE: $6 FEMA: $10 Local: $20 **Total: $80**	State GF: $42 USACE: $9 FEMA: $10 Local: $18 **Total: $79**

Notes:

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$M/yr = million dollars per year
FEMA = Federal Emergency Management Agency
Sac/SJ Drainage District = Sacramento and San Joaquin Drainage District
State GF = State General Fund
State Insurance Program = State Flood Insurance Program
State River Basin Assess = State River Basin Assessment or tax
USACE = U.S. Army Corps of Engineers

Table E-3. Scenario 1 Capital Investment Cost Shares

Management Action Category and Area of Interest	State	Federal	Local
Systemwide			
Yolo Bypass multi-benefit improvements	50%	50%	0%
Feather River–Sutter Bypass multi-benefit improvements	0%	0%	0%
Paradise Cut multi-benefit improvements	0%	0%	0%
Reservoir and floodplain storage	0%	0%	0%
Urban			
Levee improvements	18%	65%	17%
Other infrastructure and multi-benefit improvements	23%	65%	12%
Rural			
Levee repair and infrastructure improvements	0%	0%	0%
Small-scale levee setbacks and floodplain storage	0%	0%	0%
Land acquisitions and easements	0%	0%	0%
Habitat restoration/reconnection	0%	0%	0%
Small Community			
Levee repair and infrastructure improvements	0%	0%	0%
Levee setbacks, land acquisitions, and habitat restoration	0%	0%	0%
Capital Cost Share Total	**21%**	**64%**	**15%**
30-year Capital and Ongoing Cost Share Total	**38%**	**42%**	**20%**

Table E-4. Scenario 1 Ongoing Investment Cost Shares

Management Action Category and Area of Interest	State	Federal	Local
Systemwide			
State operations, planning and performance tracking	100%	0%	0%
Emergency management	100%	0%	0%
Reservoir operations	81%	15%	4%
Routine maintenance	50%	0%	50%
Urban			
Risk awareness, floodproofing and land use planning	0%	50%	50%
Studies and analysis	0%	65%	35%
Rural			
Risk awareness, floodproofing and land use planning	12%	75%	13%
Studies and analysis	0%	65%	35%
Small Community			
Risk awareness, floodproofing and land use planning	2%	75%	23%
Studies and analysis	15%	65%	20%
Ongoing Cost Share Total	**57%**	**18%**	**25%**
30-year Capital and Ongoing Cost Share Total	**38%**	**42%**	**20%**

E.2.2 Scenario 2: Continue Current Investment Levels

This scenario identifies the management actions in the 2017 refined SSIA portfolio that can be implemented if future investment levels match the current level of investment. This scenario does not include any new funding mechanisms, but it does assume the continued passage of GO bonds with historical levels of funds for flood management. Tables E-5 through E-8 describe analysis results.

Table E-5. Scenario 2 Capital Investment by Phase

Management Action Category and Area of Interest	Phase 1 ($M)	Phase 2 ($M)	Phase 3 ($M)
Systemwide			
Yolo Bypass multi-benefit improvements	State GO Bonds: $511 USACE: $511	State GO Bonds: $511 USACE: $511	State GO Bonds: $114 USACE: $114
Feather River-Sutter Bypass multi-benefit improvements	$0	$0	$0
Paradise Cut multi-benefit improvements	State GO Bonds: $85 USACE: $21	State GO Bonds: $162 USACE: $41	$0
Reservoir and floodplain storage	State GO Bonds: $138 USACE: $138	State GO Bonds: $72 USACE: $72	State GO Bonds: $203 USACE: $203
Urban			
Levee improvements	State GO Bonds: $77 USACE: $192 Local: $40	State GO Bonds: $101 USACE: $236 Local: $68	State GO Bonds: $168 USACE: $436 Local: $67
Other Infrastructure and multi-benefit improvements	State GO Bonds: $44 USACE: $14 Local: $1	State GO Bonds: $0.1 USACE: $0.1 Local: $0.1	State GO Bonds: $38 USACE: $71
Rural			
Levee repair and infrastructure improvements	State GO Bonds: $365 Local: $41	State GO Bonds: $158 Local: $18	State GO Bonds: $307 USACE: $9 Local: $25
Small-scale levee setbacks and floodplain storage	State GO Bonds: $54 USACE: $6 Local: $0.1	State GO Bonds: $38 USACE: $3 Local: $2	State GO Bonds: $29 USACE: $3
Land acquisitions and easements	State GO Bonds: $107 Local: $12	State GO Bonds: $177 FEMA: $8 Local: $12	State GO Bonds: $169 FEMA: $11 Local: $8
Habitat restoration/reconnection	State GO Bonds: $62 USACE: $7	State GO Bonds: $46 USACE: $5	State GO Bonds: $51 USACE: $6
Small Community			
Levee repair and infrastructure improvements	State GO Bonds: $44 USACE: $3 Local: $2	State GO Bonds: $174 USACE: $19 Local: $0.1	State GO Bonds: $225 USACE: $25
Levee setbacks, land acquisitions and habitat restoration	State GO Bonds: $14 USACE: $0.1 Local: $1	State GO Bonds: $60 USACE: $5 Local: $1	State GO Bonds: $197 USACE: $22

Table E-5. Scenario 2 Capital Investment by Phase

Management Action Category and Area of Interest	Phase 1 ($M)	Phase 2 ($M)	Phase 3 ($M)
Total Capital Investment	State GO Bonds: $1,500 USACE: $892 Local: $96 **Total: $2,488**	State GO Bonds: $1,500 USACE: $892 FEMA: $8 Local: $100 **Total: $2,500**	State GO Bonds: $1,500 USACE: $889 FEMA: $11 Local: $100 **Total: $2,500**

Notes:
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$M = million dollars
FEMA = Federal Emergency Management Agency
Sac/SJ Drainage District = Sacramento and San Joaquin Drainage District
State GF = State General Fund
State GO Bonds = State General Obligation Bonds
State Insurance Program = State Flood Insurance Program
State River Basin Assess = State River Basin Assessment or tax
USACE = U.S. Army Corps of Engineers

Table E-6. Scenario 2 Ongoing Investment by Phase

Management Action Category and Area of Interest	Phase 1 ($M/yr)	Phase 2 ($M/yr)	Phase 3 ($M/yr)
Systemwide			
State operations, planning, and performance tracking	State GF: $14.8	State GF: $13.9	State GF: $13.8
Emergency management	State GF: $20	State GF: $20	State GF: $20
Reservoir operations	State GF: $4.4 USACE: $0.8 Local: $0.1	State GF: $4.6 USACE: $0.8	State GF: $4.6 USACE: $0.8
Routine maintenance	State GF: $20 Local: $20	State GF: $20 Local: $20	State GF: $20 Local: $20
Urban			
Risk awareness, floodproofing and land use planning	FEMA: $3.8 Local: $3.8	FEMA: $3.9 Local: $3.9	FEMA: $4 Local: $4
Studies and analysis	State GF: $0.1 FEMA: $0.7 Local: $0.3	FEMA: $1.1 Local: $0.6	State GF: $0.2 USACE: $0.3 FEMA: $1.1 Local: $0.5
Rural			
Risk awareness, floodproofing and land use planning	State GF: $0.4 FEMA: $1.6 Local: $0.2	State GF: $0.3 FEMA: $0.8	State GF: $0.1 FEMA: $0.4
Studies and analysis	State GF: $0.1 FEMA: $0.1 Local: $0.1	State GF: $0.1 FEMA: $0.1	State GF: $0.1 FEMA: $0.1
Small Community			
Risk awareness, floodproofing and land use planning	State GF: $0.2 FEMA: $3.7 Local: $1	State GF: $0.2 FEMA: $0.6	State GF: $0.2 FEMA: $0.6
Studies and analysis	State GF: $0.1 FEMA: $0.2 Local: $0.1	State GF: $1 FEMA: $2.8 Local: $0.5	State GF: $1 FEMA: $2.8 Local: $0.5
Total Ongoing Investment	State GF: $60 USACE: $1 FEMA: $9 Local: $25 **Total: $96**	State GF: $60 USACE: $1 FEMA: $9 Local: $25 **Total: $95**	State GF: $60 USACE: $1 FEMA: $9 Local: $25 **Total: $95**

Notes:

1. Estimated costs are in 2016 dollars and indicate annual investments made over 30 years; they have not been discounted to present value nor have they been escalated for inflation.
2. Estimated costs contain rounded values of direct model output. This rounding may cause numbers to report summation errors or slight variations in totals across scenarios, and between this appendix and Chapter 7 of the Draft CVFPP Investment Strategy.

$M/yr = million dollars per year
FEMA = Federal Emergency Management Agency
Sac/SJ Drainage District = Sacramento and San Joaquin Drainage District
State GF = State General Fund
State Insurance Program = State Flood Insurance Program
State River Basin Assess = State River Basin Assessment or tax
USACE = U.S. Army Corps of Engineers

Table E-7. Scenario 2 Capital Investment Cost Shares

Management Action Category and Area of Interest	State	Federal	Local
Systemwide			
Yolo Bypass multi-benefit improvements	50%	50%	0%
Feather River–Sutter Bypass multi-benefit improvements	0%	0%	0%
Paradise Cut multi-benefit improvements	80%	20%	0%
Reservoir and floodplain storage	50%	50%	0%
Urban			
Levee improvements	25%	62%	13%
Other infrastructure and multi-benefit improvements	49%	51%	1%
Rural			
Levee repair and infrastructure improvements	90%	1%	9%
Small-scale levee setbacks and floodplain storage	90%	9%	1%
Land acquisitions and easements	90%	4%	6%
Habitat restoration/reconnection	90%	10%	0%
Small Community			
Levee repair and infrastructure improvements	90%	10%	0%
Levee setbacks, land acquisitions, and habitat restoration	90%	9%	1%
Capital Cost Share Total	**60%**	**36%**	**4%**
30-year Capital and Ongoing Cost Share Total	**61%**	**29%**	**10%**

Table E-8. Scenario 2 Ongoing Investment Cost Shares

Management Action Category and Area of Interest	State	Federal	Local
Systemwide			
State operations, planning and performance tracking	100%	0%	0%
Emergency management	100%	0%	0%
Reservoir operations	84%	15%	1%
Routine maintenance	50%	0%	50%
Urban			
Risk awareness, floodproofing and land use planning	0%	50%	50%
Studies and analysis	7%	65%	28%
Rural			
Risk awareness, floodproofing and land use planning	20%	75%	5%
Studies and analysis	32%	65%	3%
Small Community			
Risk awareness, floodproofing and land use planning	10%	75%	15%
Studies and analysis	24%	65%	11%
Ongoing Cost Share Total	**63%**	**11%**	**26%**
30-year Capital and Ongoing Cost Share Total	**61%**	**29%**	**10%**

E.2.3 Scenario 3: Fund All Ongoing Investments

Investment in ongoing management actions is critical to maintaining an effective system and proactively managing risk intensification and residual risk on floodplains. Scenario 3 consists of two sub-scenarios, 3a and 3b, that fully fund ongoing investments with both existing and new mechanisms. Both sub-scenarios require significant increases in revenue from the State General Fund. Capital investments are not included in either of these sub-scenarios. Tables E-9 through E-16 describe analysis results.

Sub-scenario 3a: Maintaining the System with Existing Mechanisms

Sub-scenario 3a fully funds the entire ongoing investment with existing State, federal, and local funding mechanisms. No capital investments are funded in Sub-scenario 3a.

Table E-9. Sub-scenario 3a Capital Investment by Phase

Management Action Category and Area of Interest	Phase 1 ($M)	Phase 2 ($M)	Phase 3 ($M)
Systemwide			
Yolo Bypass multi-benefit improvements	$0	$0	$0
Feather River-Sutter Bypass multi-benefit improvements	$0	$0	$0
Paradise Cut multi-benefit improvements	$0	$0	$0
Reservoir and floodplain storage	$0	$0	$0
Urban			
Levee improvements	$0	$0	$0
Other Infrastructure and multi-benefit improvements	$0	$0	$0
Rural			
Levee repair and infrastructure improvements	$0	$0	$0
Small-scale levee setbacks and floodplain storage	$0	$0	$0
Land acquisitions and easements	$0	$0	$0
Habitat restoration/reconnection	$0	$0	$0
Small Community			
Levee repair and infrastructure improvements	$0	$0	$0
Levee setbacks, land acquisitions and habitat restoration	$0	$0	$0
Total Capital Investment	$0	$0	$0

Note:
$M = million dollars

Table E-10. Sub-scenario 3a Ongoing Investment by Phase

Management Action Category and Area of Interest	Phase 1 ($M/yr)	Phase 2 ($M/yr)	Phase 3 ($M/yr)
Systemwide			
State operations, planning, and performance tracking	State GF: $21.5	State GF: $34.2	State GF: $46.1
Emergency management	State GF: $21.6 Local: $5.4	State GF: $28.9 Local: $7.2	State GF: $28.9 Local: $7.2
Reservoir operations	State GF: $8 USACE: $1.4 Local: $1.3	State GF: $9.6 USACE: $2 Local: $2.7	State GF: $9.3 USACE: $2.1 Local: $2.9
Routine maintenance	State GF: $77.7 Local: $20	State GF: $107.9 Local: $22.7	State GF: $104 Local: $27.2
Urban			
Risk awareness, floodproofing and land use planning	State GF: $2.1 USACE: $3.3 Local: $2.2	USACE: $4.4 FEMA: $0.1 Local: $6.3	USACE: $2.3 FEMA: $2.8 Local: $7.6
Studies and analysis	State GF: $0.1 USACE: $0.7 Local: $0.3	State GF: $0.2 USACE: $1 Local: $0.5	State GF: $0.2 USACE: $1.4 Local: $0.5
Rural			
Risk awareness, floodproofing and land use planning	State GF: $0.4 USACE: $1.3 FEMA: $0.4 Local: $0.1	State GF: $0.2 USACE: $2.5 FEMA: $0.1 Local: $0.6	State GF: $0.7 USACE: $2.5 FEMA: $1.2 Local: $0.5
Studies and analysis	State GF: $0.2 USACE: $0.4 Local: $0	State GF: $0.4 USACE: $0.8 FEMA: $0.2 Local: $0.2	State GF: $0.7 USACE: $0.1 FEMA: $1.8 Local: $0.3
Small Community			
Risk awareness, floodproofing and land use planning	State GF: $1.5 FEMA: $4.8 Local: $0.3	State GF: $1 FEMA: $7.8 Local: $2.1	State GF: $2 FEMA: $11.5 Local: $1.8
Studies and analysis	State GF: $1.8 USACE: $1.6 FEMA: $1.8	State GF: $0.1 USACE: $1.3 FEMA: $3.9 Local: $2.7	State GF: $1.4 USACE: $6.8 FEMA: $0.1 Local: $2.3
Total Ongoing Investment	State GF: $135 USACE: $10 FEMA: $7 Local: $28 **Total: $180**	State GF: $181 USACE: $12 FEMA: $12 Local: $45 **Total: $250**	State GF: $193 USACE: $15 FEMA: $17 Local: $50 **Total: $275**

Notes:

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Sac/SJ Drainage District = Sacramento and San Joaquin Drainage District
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State Insurance Program = State Flood Insurance Program
State River Basin Assess = State River Basin Assessment or tax
USACE = U.S. Army Corps of Engineers

Table E-11. Sub-scenario 3a Capital Investment Cost Shares

Management Action Category and Area of Interest	State	Federal	Local
Systemwide			
Yolo Bypass multi-benefit improvements	0%	0%	0%
Feather River–Sutter Bypass multi-benefit improvements	0%	0%	0%
Paradise Cut multi-benefit improvements	0%	0%	0%
Reservoir and floodplain storage	0%	0%	0%
Urban			
Levee improvements	0%	0%	0%
Other infrastructure and multi-benefit improvements	0%	0%	0%
Rural			
Levee repair and infrastructure improvements	0%	0%	0%
Small-scale levee setbacks and floodplain storage	0%	0%	0%
Land acquisitions and easements	0%	0%	0%
Habitat restoration/reconnection	0%	0%	0%
Small Community			
Levee repair and infrastructure improvements	0%	0%	0%
Levee setbacks, land acquisitions, and habitat restoration	0%	0%	0%
Capital Cost Share Total	**0%**	**0%**	**0%**
30-year Capital and Ongoing Cost Share Total	**72%**	**10%**	**18%**

Table E-12. Sub-scenario 3a Ongoing Investment Cost Shares

Management Action Category and Area of Interest	State	Federal	Local
Systemwide			
State operations, planning and performance tracking	100%	0%	0%
Emergency management	80%	0%	20%
Reservoir operations	68%	14%	17%
Routine maintenance	80%	0%	20%
Urban			
Risk awareness, floodproofing and land use planning	7%	42%	52%
Studies and analysis	10%	64%	26%
Rural			
Risk awareness, floodproofing and land use planning	13%	75%	12%
Studies and analysis	26%	65%	10%
Small Community			
Risk awareness, floodproofing and land use planning	14%	74%	13%
Studies and analysis	14%	65%	21%
Ongoing Cost Share Total	**72%**	**10%**	**18%**
30-year Capital and Ongoing Cost Share Total	**72%**	**10%**	**18%**

Sub-scenario 3b: Maintaining the System with New and Existing Mechanisms

Scenario 3b funds the entire ongoing investment with new and existing State, federal, and local mechanisms. Realistic constraints are placed on the new funding mechanisms based on revenue generation capacity and timing of new mechanism implementation. No capital investments are funded in Scenario 3b.

Table E-13. Sub-scenario 3b Capital Investment by Phase

Management Action Category and Area of Interest	Phase 1 ($M)	Phase 2 ($M)	Phase 3 ($M)
Systemwide			
Yolo Bypass multi-benefit improvements	$0	$0	$0
Feather River-Sutter Bypass multi-benefit improvements	$0	$0	$0
Paradise Cut multi-benefit improvements	$0	$0	$0
Reservoir and floodplain storage	$0	$0	$0
Urban			
Levee improvements	$0	$0	$0
Other Infrastructure and multi-benefit improvements	$0	$0	$0
Rural			
Levee repair and infrastructure improvements	$0	$0	$0
Small-scale levee setbacks and floodplain storage	$0	$0	$0
Land acquisitions and easements	$0	$0	$0
Habitat restoration/reconnection	$0	$0	$0
Small Community			
Levee repair and infrastructure improvements	$0	$0	$0
Levee setbacks, land acquisitions and habitat restoration	$0	$0	$0
Total Capital Investment	$0	$0	$0

Note:
$M = million dollars

Table E-14. Sub-scenario 3b Ongoing Investment by Phase

Management Action Category and Area of Interest	Phase 1 ($M/yr)	Phase 2 ($M/yr)	Phase 3 ($M/yr)
Systemwide			
State operations, planning, and performance tracking	State GF: $21.5	State GF: $34.2	State GF: $46.1
Emergency management	State GF: $21.6 Local: $5.4	State GF: $28.9 Local: $7.2	State GF: $28.9 Local: $7.2
Reservoir operations	State GF: $9.1 USACE: $1.6	State GF: $1.7 State River Basin Assess: $10.4 USACE: $2.1	State GF: $1.7 State River Basin Assess: $10.4 USACE: $2.1
Routine maintenance	State GF: $77.7 Local: $18 Sac/SJ Drainage District: $2	State GF: $104.6 Local: $20 Sac/SJ Drainage District: $6	State GF: $104.7 Local: $20 Sac/SJ Drainage District: $6.4
Urban			
Risk awareness, floodproofing and land use planning	State GF: $2.3 USACE: $3.8 Local: $1.4	USACE: $4.7 Local: $6	USACE: $2.3 FEMA: $3 Local: $7.6
Studies and analysis	State GF: $0.1 USACE: $0.7 Local: $0.3	State GF: $0.2 USACE: $1.1 Local: $0.4	State GF: $0.2 USACE: $1.4 Local: $0.5
Rural			
Risk awareness, floodproofing and land use planning	State GF: $0.4 USACE: $1.2 FEMA: $0.4 Local: $0.1	State Insurance Program: $0.2 USACE: $2.6 Local: $0.7	State GF: $0.8 State Insurance Program: $0.2 USACE: $2.6 FEMA: $1 Local: $0.3
Studies and analysis	State GF: $0.2 USACE: $0.4 Local: $0.1 Sac/SJ Drainage District: $0.1	State GF: $0.4 USACE: $0.9 FEMA: $0.1 Local: $0.1 Sac/SJ Drainage District: $0.1	State GF: $0.8 USACE: $0.1 FEMA: $1.8 Local: $0.3
Small Community			
Risk awareness, floodproofing and land use planning	State GF: $1.6 FEMA: $4.9	State Insurance Program: $1 FEMA: $8.1 Local: $1.7	State GF: $2.2 State Insurance Program: $1.2 FEMA: $11.5 Local: $0.5
Studies and analysis	State GF: $1.8 USACE: $1.4 FEMA: $2	State GF: $0.1 USACE: $1 FEMA: $4.2 Local: $2.4 Sac/SJ Drainage District: $0.3	State GF: $1.5 USACE: $6.8 FEMA: $0.1 Local: $2.2
Total Ongoing Investment	State GF: $135 USACE: $10 FEMA: $7 Local: $26 Sac/SJ Drainage District: $2 **Total: $180**	State GF: $170 State Insurance Program: $1 State River Basin Assess: $10 USACE: $12 FEMA: $12 Local: $39 Sac/SJ Drainage District: $6 **Total: $250**	State GF: $187 State Insurance Program: $1 State River Basin Assess: $10 USACE: $15 FEMA: $17 Local: $39 Sac/SJ Drainage District: $6 **Total: $275**

Table E-14. Sub-scenario 3b Ongoing Investment by Phase

Management Action Category and Area of Interest	Phase 1 ($M/yr)	Phase 2 ($M/yr)	Phase 3 ($M/yr)

Notes:

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Sac/SJ Drainage District = Sacramento and San Joaquin Drainage District
State GF = State General Fund
State Insurance Program = State Flood Insurance Program
State River Basin Assess = State River Basin Assessment or tax
USACE = U.S. Army Corps of Engineers

Table E-15. Sub-scenario 3b Capital Investment Cost Shares

Management Action Category and Area of Interest	State	Federal	Local
Systemwide			
Yolo Bypass multi-benefit improvements	0%	0%	0%
Feather River–Sutter Bypass multi-benefit improvements	0%	0%	0%
Paradise Cut multi-benefit improvements	0%	0%	0%
Reservoir and floodplain storage	0%	0%	0%
Urban			
Levee improvements	0%	0%	0%
Other infrastructure and multi-benefit improvements	0%	0%	0%
Rural			
Levee repair and infrastructure improvements	0%	0%	0%
Small-scale levee setbacks and floodplain storage	0%	0%	0%
Land acquisitions and easements	0%	0%	0%
Habitat restoration/reconnection	0%	0%	0%
Small Community			
Levee repair and infrastructure improvements	0%	0%	0%
Levee setbacks, land acquisitions, and habitat restoration	0%	0%	0%
Capital Cost Share Total	**0%**	**0%**	**0%**
30-year Capital and Ongoing Cost Share Total	**73%**	**10%**	**17%**

Table E-16. Sub-scenario 3b Ongoing Investment Cost Shares

Management Action Category and Area of Interest	State	Federal	Local
Systemwide			
State operations, planning and performance tracking	100%	0%	0%
Emergency management	80%	0%	20%
Reservoir operations	85%	15%	0%
Routine maintenance	80%	0%	20%
Urban			
Risk awareness, floodproofing and land use planning	8%	44%	48%
Studies and analysis	10%	65%	25%
Rural			
Risk awareness, floodproofing and land use planning	15%	75%	10%
Studies and analysis	27%	65%	8%
Small Community			
Risk awareness, floodproofing and land use planning	19%	75%	6%
Studies and analysis	14%	65%	21%
Ongoing Cost Share Total	**73%**	**10%**	**17%**
30-year Capital and Ongoing Cost Share Total	**73%**	**10%**	**17%**

E.2.4 Scenario 4: Fund All Ongoing Investments, Partially Fund Capital Investments

Scenario 4 consists of two sub-scenarios, 4a and 4b, to demonstrate the contributions required to fully invest in the ongoing management actions and partial levels of capital management actions. This build-up is based on leveraging the maximum annual potential from new mechanisms. Additional contributions from existing State, federal, and local funding mechanisms is required. Tables E-17 through E-24 describe analysis results.

Sub-scenario 4a: Fund All Ongoing Investments Plus Continue Current Levels of Capital Investment

Sub-scenario 4a funds all ongoing investments with existing mechanisms. Capital investments are funded with continued current levels of funding from GO bonds, U.S. Army Corps of Engineers (USACE), and local funding mechanisms.

Table E-17. Sub-scenario 4a Capital Investment by Phase

Management Action Category and Area of Interest	Phase 1 ($M)	Phase 2 ($M)	Phase 3 ($M)
Systemwide			
Yolo Bypass multi-benefit improvements	State GO Bonds: $511 USACE: $511	State GO Bonds: $511 USACE: $511	State GO Bonds: $114 USACE: $114
Feather River-Sutter Bypass multi-benefit improvements	$0	$0	$0
Paradise Cut multi-benefit improvements	State GO Bonds: $25 USACE: $6	State GO Bonds: $222 USACE: $56	$0
Reservoir and floodplain storage	State GO Bonds: $138 USACE: $138	State GO Bonds: $3 USACE: $3	State GO Bonds: $227 USACE: $234
Urban			
Levee improvements	State GO Bonds: $77 USACE: $148 Local: $84	State GO Bonds: $101 USACE: $199 Local: $107	State GO Bonds: $117 USACE: $379 Local: $87
Other Infrastructure and multi-benefit improvements	State GO Bonds: $44 USACE: $1 Local: $14	State GO Bonds: $0 USACE: $0 Local: $0	State GO Bonds: $1 USACE: $2
Rural			
Levee repair and infrastructure improvements	State GO Bonds: $202 Local: $22	State GO Bonds: $37 Local: $4	State GO Bonds: $60 Local: $7
Small-scale levee setbacks and floodplain storage	State GO Bonds: $92 USACE: $3 Local: $7	State GO Bonds: $4 USACE: $0	State GO Bonds: $48 USACE: $5 Local: $0
Land acquisitions and easements	State GO Bonds: $194 FEMA: $10	State GO Bonds: $269 FEMA: $17	State GO Bonds: $204 FEMA: $13
Habitat restoration/reconnection	State GO Bonds: $112 USACE: $6	State GO Bonds: $56 USACE: $3	State GO Bonds: $60 USACE: $3

Table E-17. Sub-scenario 4a Capital Investment by Phase

Management Action Category and Area of Interest	Phase 1 ($M)	Phase 2 ($M)	Phase 3 ($M)
Small Community			
Levee repair and infrastructure improvements	State GO Bonds: $79 USACE: $1 Local: $3	State GO Bonds: $194 USACE: $8 Local: $2	State GO Bonds: $380 USACE: $18 Local: $2
Levee setbacks, land acquisitions and habitat restoration	State GO Bonds: $26 Local: $1	State GO Bonds: $102 USACE: $4 Local: $1	State GO Bonds: $290 USACE: $1 Local: $15
Total Capital Investment	State GO Bonds: $1,500 USACE: $814 FEMA: $10 Local: $132 **Total: $2,456**	State GO Bonds: $1,500 USACE: $785 FEMA: $17 Local: $115 **Total: $2,417**	State GO Bonds: $1,500 USACE: $755 FEMA: $13 Local: $111 **Total: $2,379**

Notes:
1. Estimated costs are in 2016 dollars.
2. Estimated costs contain rounded values of direct model output. This rounding may cause numbers to report summation errors or slight variations in totals across scenarios, and between this appendix and Chapter 7 of the Draft CVFPP Investment Strategy.

$M = million dollars
FEMA = Federal Emergency Management Agency
Sac/SJ Drainage District = Sacramento and San Joaquin Drainage District
State GF = State General Fund
State GO Bond = State General Obligation Bond
State Insurance Program = State Flood Insurance Program
State River Basin Assess = State River Basin Assessment or tax
USACE = U.S. Army Corps of Engineers

Table E-18. Sub-scenario 4a Ongoing Investment by Phase

Management Action Category and Area of Interest	Phase 1 ($M/yr)	Phase 2 ($M/yr)	Phase 3 ($M/yr)
Systemwide			
State operations, planning, and performance tracking	State GF: $21.5	State GF: $34.2	State GF: $46.1
Emergency management	State GF: $21.6 Local: $5.4	State GF: $28.9 Local: $7.2	State GF: $28.9 Local: $7.2
Reservoir operations	State GF: $9.1 USACE: $1.6	State GF: $1.7 State River Basin Assess: $10.4 USACE: $2.1	State GF: $1.7 State River Basin Assess: $10.4 USACE: $2.1
Routine maintenance	State GF: $77.7 Local: $18 Sac/SJ Drainage District: $2	State GF: $104.6 Local: $20 Sac/SJ Drainage District: $6	State GF: $104.7 Local: $20 Sac/SJ Drainage District: $6.4
Urban			
Risk awareness, floodproofing and land use planning	State GF: $2.3 USACE: $3.8 Local: $1.4	USACE: $4.7 Local: $6	USACE: $2.3 FEMA: $3 Local: $7.6
Studies and analysis	State GF: $0.1 USACE: $0.7 Local: $0.3	State GF: $0.2 USACE: $1.1 Local: $0.4	State GF: $0.2 USACE: $1.4 Local: $0.5
Rural			
Risk awareness, floodproofing and land use planning	State GF: $0.4 USACE: $1.2 FEMA: $0.4 Local: $0.1	State Insurance Program: $0.2 USACE: $2.6 Local: $0.7	State GF: $0.8 State Insurance Program: $0.2 USACE: $2.6 FEMA: $1 Local: $0.3
Studies and analysis	State GF: $0.2 USACE: $0.4 Local: $0.1 Sac/SJ Drainage District: $0.1	State GF: $0.4 USACE: $0.9 FEMA: $0.1 Local: $0.1 Sac/SJ Drainage District: $0.1	State GF: $0.8 USACE: $0.1 FEMA: $1.8 Local: $0.3
Small Community			
Risk awareness, floodproofing and land use planning	State GF: $1.6 FEMA: $4.9	State Insurance Program: $1 FEMA: $8.1 Local: $1.7	State GF: $2.2 State Insurance Program: $1.2 FEMA: $11.5 Local: $0.5
Studies and analysis	State GF: $1.8 USACE: $1.4 FEMA: $2	State GF: $0.1 USACE: $1 FEMA: $4.2 Local: $2.4 Sac/SJ Drainage District: $0.3	State GF: $1.5 USACE: $6.8 FEMA: $0.1 Local: $2.2
Total Ongoing Investment	State GF: $135 USACE: $10 FEMA: $7 Local: $26 Sac/SJ Drainage District: $2 **Total: $180**	State GF: $170 State Insurance Program: $1 State River Basin Assess: $10 USACE: $12 FEMA: $12 Local: $39 Sac/SJ Drainage District: $6 **Total: $250**	State GF: $187 State Insurance Program: $1 State River Basin Assess: $10 USACE: $15 FEMA: $17 Local: $39 Sac/SJ Drainage District: $6 **Total: $275**

Table E-18. Sub-scenario 4a Ongoing Investment by Phase

Management Action Category and Area of Interest	Phase 1 ($M/yr)	Phase 2 ($M/yr)	Phase 3 ($M/yr)

Notes:

1. Estimated costs are in 2016 dollars and indicate annual investments made over 30 years; they have not been discounted to present value nor have they been escalated for inflation.
2. Estimated costs contain rounded values of direct model output. This rounding may cause numbers to report summation errors or slight variations in totals across scenarios, and between this appendix and Chapter 7 of the Draft CVFPP Investment Strategy.

$M/yr = million dollars per year
FEMA = Federal Emergency Management Agency
Sac/SJ Drainage District = Sacramento and San Joaquin Drainage District
State GF = State General Fund
State Insurance Program = State Flood Insurance Program
State River Basin Assess = State River Basin Assessment or tax
USACE = U.S. Army Corps of Engineers

Table E-19. Sub-scenario 4a Capital Investment Cost Shares

Management Action Category and Area of Interest	State	Federal	Local
Systemwide			
Yolo Bypass multi-benefit improvements	50%	50%	0%
Feather River–Sutter Bypass multi-benefit improvements	0%	0%	0%
Paradise Cut multi-benefit improvements	80%	20%	0%
Reservoir and floodplain storage	50%	50%	0%
Urban			
Levee improvements	23%	56%	21%
Other infrastructure and multi-benefit improvements	73%	5%	22%
Rural			
Levee repair and infrastructure improvements	90%	0%	10%
Small-scale levee setbacks and floodplain storage	90%	6%	4%
Land acquisitions and easements	94%	6%	0%
Habitat restoration/reconnection	95%	5%	0%
Small Community			
Levee repair and infrastructure improvements	95%	4%	1%
Levee setbacks, land acquisitions, and habitat restoration	95%	1%	4%
Capital Cost Share Total	**62%**	**33%**	**5%**
30-year Capital and Ongoing Cost Share Total	**67%**	**22%**	**11%**

Table E-20. Sub-scenario 4a Ongoing Investment Cost Shares

Management Action Category and Area of Interest	State	Federal	Local
Systemwide			
State operations, planning and performance tracking	100%	0%	0%
Emergency management	80%	0%	20%
Reservoir operations	85%	15%	0%
Routine maintenance	80%	0%	20%
Urban			
Risk awareness, floodproofing and land use planning	8%	44%	48%
Studies and analysis	10%	65%	25%
Rural			
Risk awareness, floodproofing and land use planning	15%	75%	10%
Studies and analysis	27%	65%	8%
Small Community			
Risk awareness, floodproofing and land use planning	19%	75%	6%
Studies and analysis	14%	65%	21%
Ongoing Cost Share Total	**73%**	**10%**	**17%**
30-year Capital and Ongoing Cost Share Total	**67%**	**22%**	**11%**

Sub-scenario 4b: Full 2017 Refined SSIA Portfolio without Feather River–Sutter Bypass Multi-Benefit Improvements

Sub-scenario 4b funds all ongoing investments with existing and new mechanisms. Capital investments are funded with increased current levels of funding from existing mechanisms and new mechanisms are used. The only capital investment not funded in Sub-scenario 4b is the Feather River–Sutter Bypass multi-benefit improvements.

Table E-21. Sub-scenario 4b Capital Investment by Phase

Management Action Category and Area of Interest	Phase 1 ($M)	Phase 2 ($M)	Phase 3 ($M)
Systemwide			
Yolo Bypass multi-benefit improvements	State GO Bonds: $511 USACE: $511	State GO Bonds: $511 USACE: $511	State GO Bonds: $114 USACE: $114
Feather River-Sutter Bypass multi-benefit improvements	$0	$0	$0
Paradise Cut multi-benefit improvements	State GO Bonds: $15 USACE: $15 Sac/SJ Drainage District: $1	State GO Bonds: $209 USACE: $64 Sac/SJ Drainage District: $6	$0
Reservoir and floodplain storage	State GO Bonds: $124 USACE: $138 Sac/SJ Drainage District: $14	State GO Bonds: $63 USACE: $199 Sac/SJ Drainage District: $14	State GO Bonds: $23 State River Basin Assess: $46 USACE: $192 Sac/SJ Drainage District: $14
Urban			
Levee improvements	State GO Bonds: $442 USACE: $1,196 Local: $94 Sac/SJ Drainage District: $108	State GO Bonds: $407 State Insurance Program: $34 USACE: $1,196 Local: $152 Sac/SJ Drainage District: $51	State GO Bonds: $174 State Insurance Program: $18 USACE: $598 Local: $108 Sac/SJ Drainage District: $22
Other Infrastructure and multi-benefit improvements	State GO Bonds: $16 USACE: $38 Local: $5	State GO Bonds: $5 USACE: $12 Local: $1	State GO Bonds: $25 USACE: $59 Local: $7
Rural			
Levee repair and infrastructure improvements	State GO Bonds: $285 USACE: $5 Local: $32	State GO Bonds: $440 State Insurance Program: $45 State River Basin Assess: $13 USACE: $72 Local: $8 Sac/SJ Drainage District: $62	State GO Bonds: $258 State Insurance Program: $10 USACE: $58 Local: $43 Sac/SJ Drainage District: $142
Small-scale levee setbacks and floodplain storage	State GO Bonds: $119 USACE: $43 Local: $4 Sac/SJ Drainage District: $5	State GO Bonds: $8 USACE: $0.1 Sac/SJ Drainage District: $0	State GO Bonds: $1 State Insurance Program: $10 USACE: $5 Sac/SJ Drainage District: $1
Land acquisitions and easements	State GO Bonds: $306 FEMA: $14 Local: $13 Sac/SJ Drainage District: $7	State GO Bonds: $278 State Insurance Program: $29 FEMA: $26 Local: $5 Sac/SJ Drainage District: $4	State GO Bonds: $153 FEMA: $4 Local: $6 Sac/SJ Drainage District: $7
Habitat restoration/reconnection	State GO Bonds: $165 USACE: $31	State GO Bonds: $14 USACE: $6	State GO Bonds: $59 USACE: $7

Table E-21. Sub-scenario 4b Capital Investment by Phase

Management Action Category and Area of Interest	Phase 1 ($M)	Phase 2 ($M)	Phase 3 ($M)
Small Community			
Levee repair and infrastructure improvements	State GO Bonds: $111 USACE: $28	State GO Bonds: $336 State River Basin Assess: $33 USACE: $92	State GO Bonds: $193 State River Basin Assess: $92 USACE: $70
Levee setbacks, land acquisitions and habitat restoration	State GO Bonds: $41 USACE: $5	State GO Bonds: $141 USACE: $20	State GO Bonds: $360 State Insurance Program: $69 State River Basin Assess: $9 USACE: $62
Total Capital Investment	State GO Bonds: $2,134 USACE: $2,010 FEMA: $14 Local: $148 Sac/SJ Drainage District: $135 **Total: $4,441**	State GO Bonds: $2,411 State Insurance Program: $108 State River Basin Assess: $46 USACE: $2,173 FEMA: $26 Local: $165 Sac/SJ Drainage District: $136 **Total: $5,065**	State GO Bonds: $1,360 State Insurance Program: $106 State River Basin Assess: $146 USACE: $1,166 FEMA: $4 Local: $164 Sac/SJ Drainage District: $186 **Total: $3,132**

Notes:
1. Estimated costs are in 2016 dollars.
2. Estimated costs contain rounded values of direct model output. This rounding may cause numbers to report summation errors or slight variations in totals across scenarios, and between this appendix and Chapter 7 of the Draft CVFPP Investment Strategy.

$M = million dollars
FEMA = Federal Emergency Management Agency
Sac/SJ Drainage District = Sacramento and San Joaquin Drainage District
State GF = State General Fund
State GO Bonds = State General Obligation Bonds
State Insurance Program = State Flood Insurance Program
State River Basin Assess = State River Basin Assessment or tax
USACE = U.S. Army Corps of Engineers

Table E-22. Sub-scenario 4b Ongoing Investment by Phase

Management Action Category and Area of Interest	Phase 1 ($M/yr)	Phase 2 ($M/yr)	Phase 3 ($M/yr)
Systemwide			
State operations, planning, and performance tracking	State GF: $21.5	State GF: $34.2	State GF: $46.1
Emergency management	State GF: $21.6 Local: $5.4	State GF: $28.9 Local: $7.2	State GF: $28.9 Local: $7.2
Reservoir operations	State GF: $9.1 USACE: $1.6	State GF: $1.7 State River Basin Assess: $10.4 USACE: $2.1	State GF: $1.7 State River Basin Assess: $10.4 USACE: $2.1
Routine maintenance	State GF: $77.7 Local: $18 Sac/SJ Drainage District: $2	State GF: $104.6 Local: $20 Sac/SJ Drainage District: $6	State GF: $104.7 Local: $20 Sac/SJ Drainage District: $6.4
Urban			
Risk awareness, floodproofing and land use planning	State GF: $2.3 USACE: $3.8 Local: $1.4	USACE: $4.7 Local: $6	USACE: $2.3 FEMA: $3 Local: $7.6
Studies and analysis	State GF: $0.1 USACE: $0.7 Local: $0.3	State GF: $0.2 USACE: $1.1 Local: $0.4	State GF: $0.2 USACE: $1.4 Local: $0.5
Rural			
Risk awareness, floodproofing and land use planning	State GF: $0.4 USACE: $1.2 FEMA: $0.4 Local: $0.1	State Insurance Program: $0.2 USACE: $2.6 Local: $0.7	State GF: $0.8 State Insurance Program: $0.2 USACE: $2.6 FEMA: $1 Local: $0.3
Studies and analysis	State GF: $0.2 USACE: $0.4 Local: $0.1 Sac/SJ Drainage District: $0.1	State GF: $0.4 USACE: $0.9 FEMA: $0.1 Local: $0.1 Sac/SJ Drainage District: $0.1	State GF: $0.8 USACE: $0.1 FEMA: $1.8 Local: $0.3
Small Community			
Risk awareness, floodproofing and land use planning	State GF: $1.6 FEMA: $4.9	State Insurance Program: $1 FEMA: $8.1 Local: $1.7	State GF: $2.2 State Insurance Program: $1.2 FEMA: $11.5 Local: $0.5
Studies and analysis	State GF: $1.8 USACE: $1.4 FEMA: $2	State GF: $0.1 USACE: $1 FEMA: $4.2 Local: $2.4 Sac/SJ Drainage District: $0.3	State GF: $1.5 USACE: $6.8 FEMA: $0.1 Local: $2.2
Total Ongoing Investment	State GF: $135 USACE: $10 FEMA: $7 Local: $26 Sac/SJ Drainage District: $2 **Total: $180**	State GF: $170 State Insurance Program: $1 State River Basin Assess: $10 USACE: $12 FEMA: $12 Local: $39 Sac/SJ Drainage District: $6 **Total: $250**	State GF: $187 State Insurance Program: $1 State River Basin Assess: $10 USACE: $15 FEMA: $17 Local: $39 Sac/SJ Drainage District: $6 **Total: $275**

Table E-22. Sub-scenario 4b Ongoing Investment by Phase

Management Action Category and Area of Interest	Phase 1 ($M/yr)	Phase 2 ($M/yr)	Phase 3 ($M/yr)

Notes:

1. Estimated costs are in 2016 dollars and indicate annual investments made over 30 years; they have not been discounted to present value nor have they been escalated for inflation.
2. Estimated costs contain rounded values of direct model output. This rounding may cause numbers to report summation errors or slight variations in totals across scenarios, and between this appendix and Chapter 7 of the Draft CVFPP Investment Strategy.

$M/yr = million dollars per year
FEMA = Federal Emergency Management Agency
Sac/SJ Drainage District = Sacramento and San Joaquin Drainage District
State GF = State General Fund
State Insurance Program = State Flood Insurance Program
State River Basin Assess = State River Basin Assessment or tax
USACE = U.S. Army Corps of Engineers

Table E-23. Sub-scenario 4b Capital Investment Cost Shares

Management Action Category and Area of Interest	State	Federal	Local
Systemwide			
Yolo Bypass multi-benefit improvements	50%	50%	0%
Feather River–Sutter Bypass multi-benefit improvements	0%	0%	0%
Paradise Cut multi-benefit improvements	72%	26%	2%
Reservoir and floodplain storage	31%	64%	5%
Urban			
Levee improvements	23%	65%	12%
Other infrastructure and multi-benefit improvements	27%	65%	8%
Rural			
Levee repair and infrastructure improvements	71%	9%	20%
Small-scale levee setbacks and floodplain storage	71%	24%	5%
Land acquisitions and easements	90%	5%	5%
Habitat restoration/reconnection	84%	16%	0%
Small Community			
Levee repair and infrastructure improvements	80%	20%	0%
Levee setbacks, land acquisitions, and habitat restoration	88%	12%	0%
Capital Cost Share Total	**50%**	**43%**	**7%**
30-year Capital and Ongoing Cost Share Total	**58%**	**31%**	**11%**

Table E-24. Sub-scenario 4b Ongoing Investment Cost Shares

Management Action Category and Area of Interest	State	Federal	Local
Systemwide			
State operations, planning and performance tracking	100%	0%	0%
Emergency management	80%	0%	20%
Reservoir operations	85%	15%	0%
Routine maintenance	80%	0%	20%
Urban			
Risk awareness, floodproofing and land use planning	8%	44%	48%
Studies and analysis	10%	65%	25%
Rural			
Risk awareness, floodproofing and land use planning	15%	75%	10%
Studies and analysis	27%	65%	8%
Small Community			
Risk awareness, floodproofing and land use planning	19%	75%	6%
Studies and analysis	14%	65%	21%
Ongoing Cost Share Total	**73%**	**10%**	**17%**
30-year Capital and Ongoing Cost Share Total	**58%**	**31%**	**11%**

E.2.5 Scenario 5: Fund Full Investment Portfolio

Significant increases in State, federal, and local contribution is necessary for full implementation of the 2017 refined SSIA portfolio. Scenario 5 provides the contribution required for each new and existing funding mechanism. Tables E-25 through E-28 describe analysis results.

Table E-25. Scenario 5 Capital Investment by Phase

Management Action Category and Area of Interest	Phase 1 ($M)	Phase 2 ($M)	Phase 3 ($M)
Systemwide			
Yolo Bypass multi-benefit improvements	State GO Bonds: $511 USACE: $511	State GO Bonds: $511 USACE: $511	State GO Bonds: $114 USACE: $114
Feather River-Sutter Bypass multi-benefit improvements	$0	$0	State GO Bonds: $1,150 USACE: $1,150
Paradise Cut multi-benefit improvements	State GO Bonds: $15 USACE: $15 Sac/SJ Drainage District: $1	State GO Bonds: $209 USACE: $64 Sac/SJ Drainage District: $6	$0
Reservoir and floodplain storage	State GO Bonds: $124 USACE: $138 Sac/SJ Drainage District: $14	State GO Bonds: $63 USACE: $199 Sac/SJ Drainage District: $14	State GO Bonds: $23 State River Basin Assess: $46 USACE: $192 Sac/SJ Drainage District: $14
Urban			
Levee improvements	State GO Bonds: $442 USACE: $1,196 Local: $94 Sac/SJ Drainage District: $108	State GO Bonds: $407 State Insurance Program: $34 USACE: $1,196 Local: $152 Sac/SJ Drainage District: $51	State GO Bonds: $174 State Insurance Program: $18 USACE: $598 Local: $108 Sac/SJ Drainage District: $22
Other Infrastructure and multi-benefit improvements	State GO Bonds: $16 USACE: $38 Local: $5	State GO Bonds: $5 USACE: $12 Local: $1	State GO Bonds: $25 USACE: $59 Local: $7
Rural			
Levee repair and infrastructure improvements	State GO Bonds: $285 USACE: $5 Local: $32	State GO Bonds: $440 State Insurance Program: $45 State River Basin Assess: $13 USACE: $72 Local: $8 Sac/SJ Drainage District: $62	State GO Bonds: $258 State Insurance Program: $10 USACE: $58 Local: $43 Sac/SJ Drainage District: $142
Small-scale levee setbacks and floodplain storage	State GO Bonds: $119 USACE: $43 Local: $4 Sac/SJ Drainage District: $5	State GO Bonds: $8 USACE: $0.1 Sac/SJ Drainage District: $0	State GO Bonds: $1 State Insurance Program: $10 USACE: $5 Sac/SJ Drainage District: $1
Land acquisitions and easements	State GO Bonds: $306 FEMA: $14 Local: $13 Sac/SJ Drainage District: $7	State GO Bonds: $278 State Insurance Program: $29 FEMA: $26 Local: $5 Sac/SJ Drainage District: $4	State GO Bonds: $153 FEMA: $4 Local: $6 Sac/SJ Drainage District: $7
Habitat restoration/reconnection	State GO Bonds: $165 USACE: $31	State GO Bonds: $14 USACE: $6	State GO Bonds: $59 USACE: $7
Small Community			
Levee repair and infrastructure improvements	State GO Bonds: $111 USACE: $28	State GO Bonds: $336 State River Basin Assess: $33 USACE: $92	State GO Bonds: $193 State River Basin Assess: $92 USACE: $70

Table E-25. Scenario 5 Capital Investment by Phase

Management Action Category and Area of Interest	Phase 1 ($M)	Phase 2 ($M)	Phase 3 ($M)
Levee setbacks, land acquisitions and habitat restoration	State GO Bonds: $41 USACE: $5	State GO Bonds: $141 USACE: $20	State GO Bonds: $360 State Insurance Program: $69 State River Basin Assess: $9 USACE: $62
Total Capital Investment	State GO Bonds: $2,134 USACE: $2,010 FEMA: $14 Local: $148 Sac/SJ Drainage District: $135 **Total: $4,441**	State GO Bonds: $2,411 State Insurance Program: $108 State River Basin Assess: $46 USACE: $2,173 FEMA: $26 Local: $165 Sac/SJ Drainage District: $136 **Total: $5,065**	State GO Bonds: $2,510 State Insurance Program: $106 State River Basin Assess: $146 USACE: $2,316 FEMA: $4 Local: $164 Sac/SJ Drainage District: $186 **Total: $5,432**

Notes:

1. Estimated costs are in 2016 dollars.
2. Estimated costs contain rounded values of direct model output. This rounding may cause numbers to report summation errors or slight variations in totals across scenarios, and between this appendix and Chapter 7 of the Draft CVFPP Investment Strategy. Furthermore, this appendix's results were a basis for analysis and differ slightly from the recommended CVFPP funding plan. Estimated costs do not use present value calculations of ongoing management actions as were used in the recommended CVFPP funding plan.

$M = million dollars
FEMA = Federal Emergency Management Agency
Sac/SJ Drainage District = Sacramento and San Joaquin Drainage District
State GF = State General Fund
State GO Bonds = State General Obligation Bonds
State Insurance Program = State Flood Insurance Program
State River Basin Assess = State River Basin Assessment or tax
USACE = U.S. Army Corps of Engineers

Table E-26. Scenario 5 Ongoing Investment by Phase

Management Action Category and Area of Interest	Phase 1 ($M/yr)	Phase 2 ($M/yr)	Phase 3 ($M/yr)
Systemwide			
State operations, planning, and performance tracking	State GF: $21.5	State GF: $34.2	State GF: $46.1
Emergency management	State GF: $21.6 Local: $5.4	State GF: $28.9 Local: $7.2	State GF: $28.9 Local: $7.2
Reservoir operations	State GF: $9.1 USACE: $1.6	State GF: $1.7 State River Basin Assess: $10.4 USACE: $2.1	State GF: $1.7 State River Basin Assess: $10.4 USACE: $2.1
Routine maintenance	State GF: $77.7 Local: $18 Sac/SJ Drainage District: $2	State GF: $104.6 Local: $20 Sac/SJ Drainage District: $6	State GF: $104.7 Local: $20 Sac/SJ Drainage District: $6.4
Urban			
Risk awareness, floodproofing and land use planning	State GF: $2.3 USACE: $3.8 Local: $1.4	USACE: $4.7 Local: $6	USACE: $2.3 FEMA: $3 Local: $7.6
Studies and analysis	State GF: $0.1 USACE: $0.7 Local: $0.3	State GF: $0.2 USACE: $1.1 Local: $0.4	State GF: $0.2 USACE: $1.4 Local: $0.5
Rural			
Risk awareness, floodproofing and land use planning	State GF: $0.4 USACE: $1.2 FEMA: $0.4 Local: $0.1	State Insurance Program: $0.2 USACE: $2.6 Local: $0.7	State GF: $0.8 State Insurance Program: $0.2 USACE: $2.6 FEMA: $1 Local: $0.3
Studies and analysis	State GF: $0.2 USACE: $0.4 Local: $0.1 Sac/SJ Drainage District: $0.1	State GF: $0.4 USACE: $0.9 FEMA: $0.1 Local: $0.1 Sac/SJ Drainage District: $0.1	State GF: $0.8 USACE: $0.1 FEMA: $1.8 Local: $0.3
Small Community			
Risk awareness, floodproofing and land use planning	State GF: $1.6 FEMA: $4.9	State Insurance Program: $1 FEMA: $8.1 Local: $1.7	State GF: $2.2 State Insurance Program: $1.2 FEMA: $11.5 Local: $0.5
Studies and analysis	State GF: $1.8 USACE: $1.4 FEMA: $2	State GF: $0.1 USACE: $1 FEMA: $4.2 Local: $2.4 Sac/SJ Drainage District: $0.3	State GF: $1.5 USACE: $6.8 FEMA: $0.1 Local: $2.2
Total Ongoing Investment	State GF: $135 USACE: $10 FEMA: $7 Local: $26 Sac/SJ Drainage District: $2 **Total: $180**	State GF: $170 State Insurance Program: $1 State River Basin Assess: $10 USACE: $12 FEMA: $12 Local: $39 Sac/SJ Drainage District: $6 **Total: $250**	State GF: $187 State Insurance Program: $1 State River Basin Assess: $10 USACE: $15 FEMA: $17 Local: $39 Sac/SJ Drainage District: $6 **Total: $275**

Table E-26. Scenario 5 Ongoing Investment by Phase

Management Action Category and Area of Interest	Phase 1 ($M/yr)	Phase 2 ($M/yr)	Phase 3 ($M/yr)

Notes:

1. Estimated costs are in 2016 dollars and indicate annual investments made over 30 years; they have not been discounted to present value nor have they been escalated for inflation.
2. Estimated costs contain rounded values of direct model output. This rounding may cause numbers to report summation errors or slight variations in totals across scenarios, and between this appendix and Chapter 7 of the Draft CVFPP Investment Strategy. Furthermore, this appendix's results were a basis for analysis and differ slightly from the recommended CVFPP funding plan. Estimated costs do not use present value calculations of ongoing management actions as were used in the recommended CVFPP funding plan.

$M/yr = million dollars per year
FEMA = Federal Emergency Management Agency
Sac/SJ Drainage District = Sacramento and San Joaquin Drainage District
State GF = State General Fund
State Insurance Program = State Flood Insurance Program
State River Basin Assess = State River Basin Assessment or tax
USACE = U.S. Army Corps of Engineers

Table E-27. Scenario 5 Capital Investment Cost Shares

Management Action Category and Area of Interest	State	Federal	Local
Systemwide			
Yolo Bypass multi-benefit improvements	50%	50%	0%
Feather River–Sutter Bypass multi-benefit improvements	50%	50%	0%
Paradise Cut multi-benefit improvements	72%	26%	2%
Reservoir and floodplain storage	31%	64%	5%
Urban			
Levee improvements	23%	65%	12%
Other infrastructure and multi-benefit improvements	18%	65%	17%
Rural			
Levee repair and infrastructure improvements	72%	8%	20%
Small-scale levee setbacks and floodplain storage	73%	22%	5%
Land acquisitions and easements	90%	5%	5%
Habitat restoration/reconnection	84%	16%	0%
Small Community			
Levee repair and infrastructure improvements	80%	20%	0%
Levee setbacks, land acquisitions, and habitat restoration	88%	12%	0%
Capital Cost Share Total	**50%**	**44%**	**6%**
30-year Capital and Ongoing Cost Share Total	**57%**	**33%**	**10%**

Note:
1. The reported cost shares for Scenario 5 vary from the cost shares of the recommended CVFPP funding plan. Present value calculations of ongoing management actions are used in the recommended CVFPP funding plan.

Table E-28. Scenario 5 Ongoing Investment Cost Shares

Management Action Category and Area of Interest	State	Federal	Local
Systemwide			
State operations, planning and performance tracking	100%	0%	0%
Emergency management	80%	0%	20%
Reservoir operations	85%	15%	0%
Routine maintenance	80%	0%	20%
Urban			
Risk awareness, floodproofing and land use planning	8%	44%	48%
Studies and analysis	10%	65%	25%
Rural			
Risk awareness, floodproofing and land use planning	15%	75%	10%
Studies and analysis	27%	65%	8%
Small Community			
Risk awareness, floodproofing and land use planning	19%	75%	6%
Studies and analysis	14%	65%	21%
Ongoing Cost Share Total	**73%**	**10%**	**17%**
30-year Capital and Ongoing Cost Share Total	**57%**	**33%**	**10%**

Note:
1. The reported cost shares for Scenario 5 vary from the cost shares of the recommended CVFPP funding plan. Present value calculations of ongoing management actions are used in the recommended CVFPP funding plan.

Appendix F: Defining the Levels of Outcome

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Appendix F: Defining the Levels of Outcome

State participation and investment in water resources management in California is driven largely by societal values for the people of California, including public health and safety, a stable economy, sustainable vital ecosystems, and opportunities for enriching experiences, in alignment with the California Water Action Plan (California Department of Water Resources [DWR], 2014), the California Water Plan (California Natural Resources Agency [CNRS], 2016), and California's Flood Future (DWR, 2013). All DWR water management programs—the Central Valley Flood Protection Plan (CVFPP) included—play specific roles in helping the State support these societal values. Central Valley flood management is primarily intended to contribute to these values by helping to minimize lives lost from flooding and contribute to the economic stability of local communities, the region, and the State.

Describing and justifying investments that will achieve CVFPP goals depends on applying an outcome-driven planning approach, which focuses on the outcome of an action versus the action itself. Such an approach guides the CVFPP investment strategy, and has guided the types of management actions included in the 2017 CVFPP Update (DWR, 2017) and its refined SSIA portfolio.

Four levels of outcomes (described below) are defined in this outcome-driven planning approach, and they offer useful distinctions for flood management. Outcomes (both intended and actual) can be sorted into these levels based on sequential dependencies. Outcomes can take different shapes, are interdependent, and can build upon one another to contribute toward broader societal values. The higher-level outcomes (i.e., Levels 3 and 4, with Level 4 being the highest level) represent outcomes that provide the most tangible value to society. These higher-level outcomes are more complex to measure and more challenging to achieve than lower level outcomes (i.e., Levels 1 and 2). However, outcomes at Levels 1 and 2 are crucial to the overall effectiveness of a flood management system because they are necessary to achieve the intended higher levels of outcome (DWR, 2016a).

The following discussion outlines the hierarchy and description of these levels of outcome for flood management. Many of the concepts and the interconnectivity of the outcomes discussed here are associated with overall prioritization of the 2017 refined SSIA portfolio, and have influenced the recommended investments. The prioritization of the 2017 refined SSIA portfolio is directly discussed in Section 3 of the Draft CVFPP Investment Strategy.

- **Higher-level intended outcomes: the "why" of Central Valley flood management**
  - **Level 4: Sustainability.** Sustainability is defined here as a resilient, dynamic balance between the societal values of public health and safety, ecosystem vitality, economic stability and opportunities for enriching experiences. This balance is contributed to in part by flood-specific outcomes, but also by other resource management efforts across the State.

  - **Level 3: Flood-specific resource and societal benefits.** These outcomes are those specific to flood management (such as economic damages from flooding or floodplain ecosystem productivity) that contribute to societal values. Therefore, they are referred to as flood-specific outcomes in the CVFPP. These outcomes depend on the lower level outcomes discussed below.

- **Lower-level outcomes: the "what" and "how" of Central Valley flood management**
  - **Level 2: Physical Assets and Behaviors.** These outcomes form the "what" of Central Valley flood management. Changes to physical assets and behaviors such as floodplain land uses, flood infrastructure, or human responses to floods come about as a result of management action implementation. Therefore, these outcomes are referred to as management actions.
  - **Level 1: Enabling Conditions.** This is the "how" of flood management. Enabling conditions like funding mechanisms, programs, authorities, and other foundational features are needed to support successful CVFPP implementation and associated changes to physical assets and behaviors.

The actions that are recommended for producing the "how" and "what" of Central Valley flood management are ultimately driven by assumptions about management actions that will affect flood-specific outcomes, and by the ultimate desire to meaningfully contribute to societal values. Success is measured by the degree to which actions taken help bring about their related intended outcomes. Actual outcomes are tracked over time for the purpose of demonstrating the value and improve the effectiveness of investment with each planning cycle.

- **The why:** flood-specific outcomes that most effectively and resiliently contribute to societal values
- **The what:** changes to physical assets and behaviors through management actions that are needed to bring about those outcomes
- **The how:** establishing enabling conditions that can make those changes possible

F.1 The Why: Defining Flood-Specific Outcomes

As a DWR water management program, the CVFPP most directly contributes to flood-specific outcomes for which flood management has a unique or shared responsibility. These flood-specific outcomes represent the reason why management actions are needed to be implemented to improve the flood management system, and their relation to societal values is the reason why some degree of public funding for such management actions is justified. This is why the Draft CVFPP Investment Strategy focuses on flood-specific outcomes and uses these outcomes to prioritize its investments. For example, minimizing additional lives exposed and reducing human vulnerability to floodwaters contributes to the societal value of public safety by reducing lives lost or injured from flooding. The management actions most effective at minimizing lives exposed or reducing human vulnerability, therefore, have their investments justified by contributing to public safety. All investments included in the 2017 refined SSIA portfolio were prioritized using this flood-specific outcome pattern as a basis. Section 3 of the Draft CVFPP Investment Strategy expands on this prioritization process. Table F-1 defines the flood-specific outcomes associated with each societal value. CVFPP goals also closely relate to flood-specific outcomes and are shown for reference in Table F-1.

Table F-1. Flood-Specific Outcomes and Related CVFPP Goals

Outcomes that Contribute to Societal Values			Related CVFPP Goals
Public Health and Safety		**Minimize number of people within the floodplain.** Reduce or minimize the current and/or additional number of people who live or work within the floodplain and could be exposed to potential flooding (a floodplain is defined as the area that could potentially flood in a very large, but reasonably foreseeable flood event).	**Improve Flood Risk Management:** Improve public safety, preparedness, and emergency response.
		Reduce human vulnerability when flooding occurs. Reduce the extent to which people located within floodplains are harmed or are unable to evacuate in the case of a flood when faced with oncoming floodwaters.	**Improve Flood Risk Management:** Improve public safety, preparedness, and emergency response.
		Increase system performance in populous areas. Reduce the extent to which river flows from storm events and runoff are capable of or likely to cause flooding in populated areas.	**Improve Flood Risk Management:** Reduce the chance of flooding.
Ecosystem Vitality		**Reduce stressors on riverine and floodplain ecosystems.** Reduce the number of stressors to priority riverine and floodplain species and ecosystems.	Promote Ecosystem Functions
		Improve the riverine and floodplain habitats and ecosystems. Increase the amount (acreage, channel miles, etc.) and variety of available floodplain-related habitats that are wetted and/or connected at the appropriate times, are subject to more natural hydrologic and/or geomorphic processes, and are of otherwise high enough quality to meaningfully function as beneficial habitat for a variety of floodplain-dependent species.	Promote Ecosystem Functions
		Increase and maintain the abundance and diversity of floodplain dependent native species. Increase the number of native species that have access to, benefit from and can use floodplain and associated habitats, and which benefit from those habitats in ways that makes them more likely to survive.	Promote Ecosystem Functions

Table F-1. Flood-Specific Outcomes and Related CVFPP Goals

Outcomes that Contribute to Societal Values			Related CVFPP Goals
Economic Stability		**Minimize property and assets within the floodplain.** Reduce or minimize the value of assets currently within or added to the floodplain and could be exposed to potential flooding (a floodplain is defined as the area that could potentially flood in a very large, but reasonably foreseeable flood event).	**Improve Flood Risk Management:** Reduce damages once flooding occurs.
		Reduce economic vulnerability when flooding occurs. Reduce the extent to which property or other floodplain assets are damaged when faced with oncoming flood waters.	**Improve Flood Risk Management:** Reduce damages once flooding occurs.
		Increase system performance for economically developed areas. Reduce the extent to which river flows from storm events and runoff are likely to cause flooding in already established areas of economic development.	**Improve Flood Risk Management:** Reduce the chance of flooding.
		Produce or maintain economic benefits on floodplains. Maintain agricultural or industrial productivity, increase fisheries production, provide water supply or quality benefits, or reduce transactional costs (usually related to O&M and permitting) on floodplains.	Promote Multi-Benefit Projects, and Improve Operations & Maintenance
Enriching Experiences		**Provide recreational benefits.** Increase the number of floodplain-related recreational opportunities or access points.	Promote Multi-Benefit Projects
		Support societal/aesthetic values. Increase flood protection or visitation opportunities for areas or sites of cultural, social or aesthetic value.	Promote Multi-Benefit Projects
		Provide education and public awareness. Increase access to and the number of floodplain or flood risk-related educational opportunities.	Promote Multi-Benefit Projects
		Protect significant farmland. Maintain acreage of culturally significant farmland.	Promote Multi-Benefit Projects

F.2 The What and How: Defining Lower-Level Outcomes

The intended outcomes of 2017 refined SSIA portfolio are diverse, as is the landscape within which those outcomes are to be achieved. As such, the SSIA approach and any refinements to it developed in each 5-year update must include a broad mix of management action types. The following provides some introductory discussion on the types of management actions, in various areas of interest, which typically have the greatest potential for achieving CVFPP goals and related societal values. This discussion will help to inform the types of management actions from within the broader CVFPP portfolio that will be prioritized for investment.

F.2.1 Providing for Public Health and Safety and Supporting a Stable Economy

> **Resiliency**
> Resiliency is the ability of the system to respond to and recover from stressful events directly related to the outcomes (or services) for which investments are being made (such as public safety, the economy, or the environment).

The CVFPP's primary goal, improve flood risk management, implies the need for actions that resiliently reduce and limit risks to lives and economic assets across the Sacramento and San Joaquin river basins. The term "resiliently" emphasizes that the goal is not just to reduce and limit risk in the short term, but to reliably achieve those outcomes for future generations. This requires that the floodplain management system have the strength and adaptability to sustain new stressors (such as population growth and changing hydrology with climate change). The 2012 CVFPP (DWR, 2012) endorsed the concepts of flood risk, floodplain development, and flood risk management. To follow on and refine those concepts, flood-specific outcomes have described six other concepts that are affected by flood management decisions: life exposure, economic exposure, human vulnerability, economic vulnerability, system performance in populated areas, and system performance in economically valuable areas. Resilient, long-lasting reductions to life and economic risks require that a diverse mix of these outcomes be managed for and addressed across the Central Valley—a focus on minimized or reduced exposure in some places, increased system performance for others, and reduced vulnerability valley-wide. The most resilient and effective management actions will differ greatly depending on the scale, area of interest (systemwide, urban, rural, or small community), and site-specific circumstances. The following reviews each of these approaches to floodplain management, and discusses the contexts in which they are most appropriate and effective.

Managing Life and Economic Risk by Minimizing the Number of People and Economic Assets within the Floodplain

Actions that minimize the number of people and economic assets within the floodplain ultimately reduce exposure. Exposure reduction is one of the most *resilient* ways to manage life and economic risk for the following reasons:

- The types of actions that reduce life or economic exposure (e.g., easements, flood risk awareness campaigns) typically do not preclude other flood management actions from being taken later, thereby preserving adaptive capacity within the system.

- Minimizing exposure limits risk regardless of the system's ability to maintain infrastructure as it ages, which itself depends on outside economic and political pressures that compete with or otherwise affect flood system O&M funding.

- Minimizing exposure limits risk regardless of how accurate our current understanding is of the likelihood of various flood scenarios—an understanding that has changed considerably over the last 50 years, and will likely continue to do so as additional years of data become available. Generally speaking, fewer people or economic assets in a given floodplain will result in fewer lives lost or economic damages when that area floods. This is in stark contrast to something like a new levee or levee upgrade in a currently unpopulated area, which can

actually increase risk over time (Intergovernmental Panel on Climate Change [IPCC], 1994; California Floodplain Management Task Force Independent Panel, 2007) and is typically built based on a given design flow or level of protection.

However, resiliency is meaningless without efficacy. Investments are only worthwhile if they noticeably reduce or limit risk. A focus on exposure is generally most effective at reducing lives lost or economic damages over time in rural areas and small communities located in higher-risk portions of the floodplain, where there is still a danger of significant risk intensification in the future.

Managing Life and Economic Risk by Reducing Vulnerability When Flooding Occurs

Even with the realization of major physical improvements to the flood management system, the risk of flooding can never be completely eliminated. There is a risk that floods can exceed the design capacity of the flood protection system, or that its elements, such as levees or drainage facilities, can fail. This risk is called residual flood risk. When levees fail or overtop, the consequence to safety and property may be much higher than in an unprotected floodplain, because such failures can occur suddenly, quickly, and without adequate warning. Even the best flood-control systems or structures cannot completely eliminate the risk of flooding from all flood events.

The 2017 CVFPP Update recognizes the necessity of residual risk management measures. There is always a chance that flooding will occur in areas with the potential for life or economic losses, so actions that reduce human or economic vulnerability to impending floodwaters are a necessary component of any management action portfolio, regardless of geographic context.

Many of the management actions that focus on reduced vulnerability are also very effective at bolstering system resilience in terms of limiting risk to lives and/or property over long time periods. For instance, emergency response plans and training can be updated as circumstances change or new knowledge becomes available, and flood-proofing actions improve floodplain properties' ability to withstand floodwaters while not precluding other types of risk reduction actions in the future.

Managing Residual Risk

"While managing residual risk in fully-developed urban areas would likely emphasize such things as evacuation plans and emergency warnings… residual risk management and recovery in rural areas is directly tied to prevention of risk intensification and to establishment of new rural programs within California (including structure elevation on earthen pads or by physical raises; ring levees around small communities and farmsteads; and non-structural land use considerations)."

—Mark Cowin, former DWR Director (DWR, 2016a)

Managing Life and Economic Risk by Increasing System Performance in Populous Areas

Risk is already considerably high in some areas, and a focus on reducing current risk levels is needed. Increasing system performance or improving the ability to convey larger flows past these high-risk areas is the most effective means of managing risk. This is especially true for already densely populated urban areas or small communities, in which opportunities for reducing or minimizing exposure are much more limited.

Some management actions that improve system performance are more resilient than others. For example, an increase in designated floodplain area up or downstream of urban areas that can absorb and mitigate high flows is preferable to infrastructure hardening because it reduces pressure on other parts of the system, adds flexibility, and is usually less expensive to maintain over time. However, such expansions are often infeasible or cost prohibitive within the urban footprint where development is already densely concentrated behind existing levees.

Managing Economic Risk by Balancing Risk and Rewards on Floodplains

Central Valley flood management contributes to the societal value of a stable economy by helping to balance economic productivity and risk on floodplains. An important implication of this concept of economic balance is that occasional damages may be tolerable to the extent that they are balanced by economic revenue from floodplain productivity over time. This productivity can come either from industrial or agricultural use of floodplain lands, or from ecosystem and other floodplain services like fisheries production and groundwater recharge. Many of the CVFPP supporting goals address this productivity side of the economic balance. This is especially true for the goal of promoting multi-benefit projects; not only are they often a more cost-effective means of reducing risk while achieving other outcomes like ecosystem functionality and/or recreational benefits, but many of these other benefits often provide a positive impact on California's economy. A good example of this is the potential for transitory storage or habitat restoration projects that also provide groundwater recharge services. Also critically important to the economic balance on floodplains are routine operations and maintenance actions that help to maintain system performance over time, so that risk-based land use decisions remain economically viable over long periods.

F.2.2 Sustaining Vital Ecosystems

Although the primary focus of flood management is typically on outcomes that contribute toward the societal values of public safety and economic stability, flood management decisions also have important implications for the vitality of the State's ecosystems. Flood corridors and systems are often located collocated within extremely valuable wetland and riparian ecosystems with high levels of biodiversity. These ecosystems also provide critical habitats for many endangered and threatened species. As such, one of the CVFPP's supporting goals is to promote ecosystem functions. The CVFPP does this by finding ways to increase the amount and functionality of floodplain and related habitats, and by increasing access and reducing stressors for a diversity of native species that use and benefit from those habitats.

There are generally two approaches to promoting ecosystem functions:

- Traditional restoration relies on restoring natural hydrologic and geomorphic processes to the landscape, with the idea being that these processes then do the work of forming, re-forming, connecting, and maintaining dynamic and functional habitats that serve native species.

- Habitats must often function within less naturally dynamic landscapes that also serve multiple human uses. Therefore, some degree of ongoing management in such areas may be necessary to reconcile human uses with ecosystem functionality in a beneficial way to native species.

In general, restoration actions that make room for and re-introduce natural hydrologic and geomorphic processes to the channel or floodplain are more resilient than those that require vigilant management. When feasible, the traditional restoration approach is usually more effective. However, opportunities for more traditional habitat restoration are limited, and will have to be mixed with reconciliation approaches if ecosystem vitality is to be maintained at the basin scale.

The CVFPP Conservation Strategy (DWR, 2016b) explores many different types of improvements that could be made to Central Valley river corridors and floodplain-related landscapes to support the native species and natural habitats. The recommended management actions that result from this effort represent a combination of the restoration and reconciliation actions. Based on these recommendations, the following types of flood management actions have the greatest potential for resiliently increasing functional habitat, contributing to the recovery of native species, and maintaining native species diversity and abundance over time:

- Habitat restoration projects in rural areas aimed at increased acreage of marsh or riparian habitat
- Habitat reconnection through removal of fish barriers or other means
- Levee setbacks, bypasses, and some types of transitory floodplain storage that do one or more of the following:
  - Increase natural bank and/or river meander potential
  - Improve floodplain connectivity
  - Increase length of shaded riverine habitat
  - Increase acreage of riparian and marsh habitats
  - Reduce levee revetment
  - Increase fish passage or mitigate fish stranding
- Performance-based O&M activities that incorporate ecosystem functions and critical habitats, including management of restored areas and removal of invasive vegetation
- Improved reservoir operations that allow for or mimic more natural downstream flow regimes
- Acquiring easements and/or other property interests that allow for increased habitat acreage, improved habitat quality (through more active management), or increased floodplain connectivity

F.2.3 Providing Opportunities for Enriching Experiences

As with sustaining vital ecosystems, providing opportunities for enriching experiences has not been the primary focus of flood management. However, flood management decisions also have important implications for the State's ability to provide opportunities for enriching experiences in the flood management system for all Californians. Many flood corridors with extremely valuable wetland and riparian ecosystems and riverine accessibility provide Californians an outlet to nature for enjoyment and educational purposes. The broad public benefit gained from

these types of experiences should not be discounted. Moreover, they should be leveraged, because Californians who understand, respect, and enjoy the flood system are more likely to financially and politically support it, and appropriately respond to flood crises when they occur.

Actions that provide opportunities for enriching experiences include:

- **Provide recreational benefits:** increase the number of floodplain-related recreational opportunities or access points. For example, provide a bike path along a levee access road or levee crown.

- **Support societal/aesthetic values:** increase flood protection or visitation opportunities for areas or sites of cultural, social, or aesthetic value. For example, protect the historical community of Locke in the Sacramento–San Joaquin Delta for future generations.

- **Provide education and public awareness:** increase access to, and the number of, floodplain or flood risk-related educational opportunities. For example, provide information plaques about flooding at wetland viewing areas.

- **Protect significant farmland:** Maintain acreage of culturally significant farmland. For example, protect farmland that creates a community and way of life centered on historical significance.

Identifying flood-specific outcomes associated with enriching experiences provides a more perceptible understanding of this intangible societal value. Furthermore, providing a framework that illustrates the contribution that flood management can have to these types of outcomes is helpful in demonstrating the benefits and value. This is important when investments are needed to the flood system and diverse funding avenues are opened because multiple benefits will be provided to a community or group of stakeholders that were not previously realizing the benefits of the investments.

Describing and justifying investments that will achieve CVFPP goals depends on applying the outcome-driven planning approach, which focuses on the outcome of an action versus the action itself as described above. Closely tied to this outcome-driven approach are the four levels of outcome and the societal values. It is important to understand how the concepts and the interconnectivity of the outcomes discussed here are associated with overall prioritization of the 2017 refined SSIA portfolio, and influenced the recommended investments. For a direct discussion on the prioritization of the 2017 refined SSIA portfolio, please refer to Section 3 of the Draft CVFPP Investment Strategy.

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